

# **PHILIPPINE BIDDING DOCUMENTS**

(As Harmonized with Development Partners)

## **CONSTRUCTION OF COAST GUARD STATION NORTHERN SAMAR BUILDING AND FACILITIES**

Government of the Republic of the Philippines

**Sixth Edition  
29 October 2024**

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# ***Glossary of Terms, Abbreviations, and Acronyms***

**ABC** – Approved Budget for the Contract.

**ARCC** – Allowable Range of Contract Cost.

**BAC** – Bids and Awards Committee.

**Bid** – A signed offer or proposal to undertake a contract submitted by a bidder in response to and in consonance with the requirements of the bidding documents. Also referred to as *Proposal* and *Tender*. (2016 revised IRR, Section 5[c])

**Bidder** – Refers to a contractor, manufacturer, supplier, distributor and/or consultant who submits a bid in response to the requirements of the Bidding Documents. (2016 revised IRR, Section 5[d])

**Bidding Documents** – The documents issued by the Procuring Entity as the bases for bids, furnishing all information necessary for a prospective bidder to prepare a bid for the Goods, Infrastructure Projects, and/or Consulting Services required by the Procuring Entity. (2016 revised IRR, Section 5[e])

**BIR** – Bureau of Internal Revenue.

**BSP** – Bangko Sentral ng Pilipinas.

**CDA** – Cooperative Development Authority.

**Consulting Services** – Refer to services for Infrastructure Projects and other types of projects or activities of the GOP requiring adequate external technical and professional expertise that are beyond the capability and/or capacity of the GOP to undertake such as, but not limited to: (i) advisory and review services; (ii) pre-investment or feasibility studies; (iii) design; (iv) construction supervision; (v) management and related services; and (vi) other technical services or special studies. (2016 revised IRR, Section 5[i])

**Contract** – Refers to the agreement entered into between the Procuring Entity and the Supplier or Manufacturer or Distributor or Service Provider for procurement of Goods and Services; Contractor for Procurement of Infrastructure Projects; or Consultant or Consulting Firm for Procurement of Consulting Services; as the case may be, as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.

**Contractor** – is a natural or juridical entity whose proposal was accepted by the Procuring Entity and to whom the Contract to execute the Work was awarded. Contractor as used in these Bidding Documents may likewise refer to a supplier, distributor, manufacturer, or consultant.

**CPI** – Consumer Price Index.

**DOLE** – Department of Labor and Employment.



**DTI** – Department of Trade and Industry.

**Foreign-funded Procurement or Foreign-Assisted Project** – Refers to procurement whose funding source is from a foreign government, foreign or international financing institution as specified in the Treaty or International or Executive Agreement. (2016 revised IRR, Section 5[b]).

**GFI** – Government Financial Institution.

**GOCC** – Government-owned and/or –controlled corporation.

**Goods** – Refer to all items, supplies, materials and general support services, except Consulting Services and Infrastructure Projects, which may be needed in the transaction of public businesses or in the pursuit of any government undertaking, project or activity, whether in the nature of equipment, furniture, stationery, materials for construction, or personal property of any kind, including non-personal or contractual services such as the repair and maintenance of equipment and furniture, as well as trucking, hauling, janitorial, security, and related or analogous services, as well as procurement of materials and supplies provided by the Procuring Entity for such services. The term “related” or “analogous services” shall include, but is not limited to, lease or purchase of office space, media advertisements, health maintenance services, and other services essential to the operation of the Procuring Entity. (2016 revised IRR, Section 5[r])

**GOP** – Government of the Philippines.

**Infrastructure Projects** – Include the construction, improvement, rehabilitation, demolition, repair, restoration or maintenance of roads and bridges, railways, airports, seaports, communication facilities, civil works components of information technology projects, irrigation, flood control and drainage, water supply, sanitation, sewerage and solid waste management systems, shore protection, energy/power and electrification facilities, national buildings, school buildings, hospital buildings, and other related construction projects of the government. Also referred to as *civil works or works*. (2016 revised IRR, Section 5[u])

**LGUs** – Local Government Units.

**NFCC** – Net Financial Contracting Capacity.

**NGA** – National Government Agency.

**PCAB** – Philippine Contractors Accreditation Board.

**PhilGEPS** - Philippine Government Electronic Procurement System.

**Procurement Project** – refers to a specific or identified procurement covering goods, infrastructure project or consulting services. A Procurement Project shall be described, detailed, and scheduled in the Project Procurement Management Plan prepared by the agency which shall be consolidated in the procuring entity's Annual Procurement Plan. (GPPB Circular No. 06-2019 dated 17 July 2019)

**PSA** – Philippine Statistics Authority.

**SEC** – Securities and Exchange Commission.

**SLCC** – Single Largest Completed Contract.

**UN** – United Nations.



## *Section I. Invitation to Bid*

1. The **Philippine Coast Guard**, through the General Appropriations Act for FY 2024 under **Capital Outlay** intends to apply the sum of **Fourteen Million One Hundred Thirty-Three Thousand Two Hundred Thirty-Four Pesos and 61/100 (₱14,133,234.61)** being the Approved Budget for the Contract (ABC) to payments under the contract for **Construction of Coast Guard Station Northern Samar Building and Facilities**. Bids received in excess of the ABC shall be automatically rejected at bid opening.
2. The **Philippine Coast Guard** now invites bids for the above Procurement Project. Completion of the Work is required within **Two Hundred Three (203) calendar days** from the date of receipt of the Notice to Proceed. Bidders should have completed a contract similar to the Project. The description of an eligible bidder is contained in the Bidding Documents, particularly, in Section II (Instructions to Bidders).
3. Bidding will be conducted through open competitive bidding procedures using non-discretionary “*pass/fail*” criterion as specified in the 2016 revised Implementing Rules and Regulations (IRR) of Republic Act (RA) No. 9184.
4. Interested bidders may obtain further information from Philippine Coast Guard and inspect the Bidding Documents at the address given below from Mondays to Fridays during office hours from 8:00 AM – 5:00 PM except non-working days (i.e. Saturday and Sunday), legal holiday, or special non-working holiday, or other nonworking days duly declared by the President, Governor, Mayor or other Government Official authorized to make such declaration.
5. A complete set of Bidding Documents may be acquired by interested bidders on 29 October 2024 – 19 November 2024 from given address and website/s below and upon payment of the applicable fee for the Bidding Documents, pursuant to the latest Guidelines issued by the GPPB, in the amount of Twenty-Five Thousand Pesos (PhP25,000.00). The Procuring Entity shall allow the bidder to present its proof of payment for the fees in person, or through electronic means.
6. The **Philippine Coast Guard** will hold a Pre-Bid Conference on **06 November 2024, 9:00 a.m. onwards** at the Conference Room, Second (2<sup>nd</sup>) Floor, Administrative Building, Philippine Coast Guard National Headquarters, 139 25<sup>th</sup> Street, Port Area, 1018 Manila and on-line using the videoconferencing platform and details described below, which shall be open to prospective bidders.
7. Bids must be duly received by the BAC Secretariat through *manual submission* at the address as indicated below on or before 19 November 2024 at 9:00 AM. Late bids shall not be accepted.
8. All bids must be accompanied by a bid security in any of the acceptable forms and in the amount stated in **ITB** Clause 16.

9. Bid opening shall be on **19 November 2024** at 10:00 AM onwards at the Conference Room, National Headquarters Philippine Coast Guard, 139 25<sup>th</sup> Street Port Area, Manila. Bids will be opened in the presence of the bidders' representatives who choose to attend the activity.
10. The Bids and Awards Committee (BAC) shall use a non-discretionary and non-discriminatory measure based on sheer luck or chance, which is "DRAW LOTS," in the event that two or more bidders have been post-qualified and determined as the bidder having the Lowest Calculated Responsive Bid (LCRB) to determine the final LCRB, based on the following procedures:
  - a. In alphabetical order, the bidders shall pick one rolled paper.
  - b. The lucky bidder who would pick the paper with a "CONGRATULATIONS" remark shall be declared as the final bidder having the LCRB and recommended for award of the contract.
11. The Philippine Coast Guard reserves the right to reject any and all bids, declare a failure of bidding, or not award the contract at any time prior to contract award in accordance with Sections 35.6 and 41 of the 2016 revised Implementing Rules and Regulations (IRR) of RA No. 9184, without thereby incurring any liability to the affected bidder or bidders.
12. For further information, please refer to:

**CAPT BENEDICTO C BARTOLOME PCG**  
Commander, Coast Guard Procurement Service  
Coast Guard Procurement Service  
Second (2<sup>nd</sup>) Floor, Bachrach Building 1  
23rd St. Cor A.C Delgado St. Port Area, 1018 Manila  
Email Address: [procurement@coastguard.gov.ph](mailto:procurement@coastguard.gov.ph)  
Contact Number: 09565787067
13. You may visit the following websites:

For downloading of Bidding Documents: [www.philgeps.gov.ph](http://www.philgeps.gov.ph) and [www.coastguard.gov.ph](http://www.coastguard.gov.ph)

**RADM HOSTILLO ARTURO E CORNELIO PCG**  
Chairperson, NHQ-PCG BAC



## *Section II. Instructions to Bidders*

## 1. Scope of Bid

The Procuring Entity, **Philippine Coast Guard** invites Bids for the **Construction of Coast Guard Station Northern Samar Building and Facilities**, with Project Identification Number IB No. 2024-029.

The Procurement Project (referred to herein as “Project”) is for the construction of Works, as described in Section VI (Specifications).

## 2. Funding Information

2.1. The GOP through the source of funding as indicated below for Capital Outlay Continuing Fund in the amount of **Fourteen Million One Hundred Thirty-Three Thousand Two Hundred Thirty-Four Pesos and 61/100 (₱14,133,234.61)**

2.2. The source of funding is General Appropriations Act (Continuing Budget) with Special Allotment Release Order No. SARO-BMB-A-24-0007013 dated 19 August 2024.

## 3. Bidding Requirements

The Bidding for the Project shall be governed by all the provisions of RA No. 9184 and its 2016 revised IRR, including its Generic Procurement Manual and associated policies, rules and regulations as the primary source thereof, while the herein clauses shall serve as the secondary source thereof.

Any amendments made to the IRR and other GPPB issuances shall be applicable only to the ongoing posting, advertisement, or invitation to bid by the BAC through the issuance of a supplemental or bid bulletin.

The Bidder, by the act of submitting its Bid, shall be deemed to have inspected the site, determined the general characteristics of the contracted Works and the conditions for this Project, such as the location and the nature of the work; (b) climatic conditions; (c) transportation facilities; (c) nature and condition of the terrain, geological conditions at the site communication facilities, requirements, location and availability of construction aggregates and other materials, labor, water, electric power and access roads; and (d) other factors that may affect the cost, duration and execution or implementation of the contract, project, or work and examine all instructions, forms, terms, and project requirements in the Bidding Documents.

## 4. Corrupt, Fraudulent, Collusive, Coercive, and Obstructive Practices

The Procuring Entity, as well as the Bidders and Contractors, shall observe the highest standard of ethics during the procurement and execution of the contract. They or through an agent shall not engage in corrupt, fraudulent, collusive, coercive, and obstructive practices defined under Annex “I” of the 2016 revised IRR of RA No. 9184 or other integrity violations in competing for the Project.

## **5. Eligible Bidders**

- 5.1. Only Bids of Bidders found to be legally, technically, and financially capable will be evaluated.
- 5.2. The Bidder must have an experience of having completed a Single Largest Completed Contract (SLCC) that is similar to this Project, equivalent to at least fifty percent (50%) of the ABC adjusted, if necessary, by the Bidder to current prices using the PSA's CPI, except under conditions provided for in Section 23.4.2.4 of the 2016 revised IRR of RA No. 9184.

A contract is considered to be "similar" to the contract to be bid if it has the major categories of work stated in the **BDS**.

- 5.3. For Foreign-funded Procurement, the Procuring Entity and the foreign government/foreign or international financing institution may agree on another track record requirement, as specified in the Bidding Document prepared for this purpose.
- 5.4. The Bidders shall comply with the eligibility criteria under Section 23.4.2 of the 2016 IRR of RA No. 9184.

## **6. Origin of Associated Goods**

There is no restriction on the origin of Goods other than those prohibited by a decision of the UN Security Council taken under Chapter VII of the Charter of the UN.

## **7. Subcontracts**

- 7.1. The Bidder may subcontract portions of the Project to the extent allowed by the Procuring Entity as stated herein, but in no case more than fifty percent (50%) of the Project.

The Procuring Entity has prescribed that Subcontracting is not allowed.

## **8. Pre-Bid Conference**

The Procuring Entity will hold a pre-bid conference for this Project on the specified details indicated in paragraph 6 of the **IB**.

## **9. Clarification and Amendment of Bidding Documents**

Prospective bidders may request for clarification on and/or interpretation of any part of the Bidding Documents. Such requests must be in writing and received by the Procuring Entity, either at its given address or through electronic mail indicated in the **IB**, at least ten (10) calendar days before the deadline set for the submission and receipt of Bids.

## **10. Documents Comprising the Bid: Eligibility and Technical Components**



- 10.1. The first envelope shall contain the eligibility and technical documents of the Bid as specified in **Section IX. Checklist of Technical and Financial Documents**.
- 10.2. If the eligibility requirements or statements, the bids, and all other documents for submission to the BAC are in foreign language other than English, it must be accompanied by a translation in English, which shall be authenticated by the appropriate Philippine foreign service establishment, post, or the equivalent office having jurisdiction over the foreign bidder's affairs in the Philippines. For Contracting Parties to the Apostille Convention, only the translated documents shall be authenticated through an apostille pursuant to GPPB Resolution No. 13-2019 dated 23 May 2019. The English translation shall govern, for purposes of interpretation of the bid.
- 10.3. A valid PCAB License is required, and in case of joint ventures, a valid special PCAB License, and registration for the type and cost of the contract for this Project. Any additional type of Contractor license or permit shall be indicated in the **BDS**.
- 10.4. A List of Contractor's key personnel (e.g., Project Manager, Project Engineers, Materials Engineers, and Foremen) assigned to the contract to be bid, with their complete qualification and experience data shall be provided. These key personnel must meet the required minimum years of experience set in the **BDS**.
- 10.5. A List of Contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of ownership, certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be, must meet the minimum requirements for the contract set in the **BDS**.

## **11. Documents Comprising the Bid: Financial Component**

- 11.1. The second bid envelope shall contain the financial documents for the Bid as specified in **Section IX. Checklist of Technical and Financial Documents**.
- 11.2. Any bid exceeding the ABC indicated in paragraph 1 of the **IB** shall not be accepted.
- 11.3. For Foreign-funded procurement, a ceiling may be applied to bid prices provided the conditions are met under Section 31.2 of the 2016 revised IRR of RA No. 9184.

## **12. Alternative Bids**

Bidders shall submit offers that comply with the requirements of the Bidding Documents, including the basic technical design as indicated in the drawings and specifications. Unless there is a value engineering clause in the **BDS**, alternative Bids shall not be accepted.

### **13. Bid Prices**

All bid prices for the given scope of work in the Project as awarded shall be considered as fixed prices, and therefore not subject to price escalation during contract implementation, except under extraordinary circumstances as determined by the NEDA and approved by the GPPB pursuant to the revised Guidelines for Contract Price Escalation guidelines.

### **14. Bid and Payment Currencies**

14.1. Bid prices may be quoted in the local currency or tradeable currency accepted by the BSP at the discretion of the Bidder. However, for purposes of bid evaluation, Bids denominated in foreign currencies shall be converted to Philippine currency based on the exchange rate as published in the BSP reference rate bulletin on the day of the bid opening.

14.2. Payment of the contract price shall be made in Philippine Pesos.

### **15. Bid Security**

15.1. The Bidder shall submit a Bid Securing Declaration or any form of Bid Security in the amount indicated in the **BDS**, which shall be not less than the percentage of the ABC in accordance with the schedule in the **BDS**.

15.2. The Bid and bid security shall be valid for a period of One Hundred twenty (120) calendar days from the Date of Bid Opening. Any bid not accompanied by an acceptable bid security shall be rejected by the Procuring Entity as non-responsive.

### **16. Sealing and Marking of Bids**

Each Bidder shall submit one copy of the first and second components of its Bid.

The Procuring Entity may request additional hard copies and/or electronic copies of the Bid. However, failure of the Bidders to comply with the said request shall not be a ground for disqualification.

If the Procuring Entity allows the submission of bids through online submission to the given website or any other electronic means, the Bidder shall submit an electronic copy of its Bid, which must be digitally signed. An electronic copy that cannot be opened or is corrupted shall be considered non-responsive and, thus, automatically disqualified.

### **17. Deadline for Submission of Bids**

The Bidders shall submit on the specified date and time and either at its physical address or through online submission as indicated in paragraph 7 of the **IB**.

## **18. Opening and Preliminary Examination of Bids**

- 18.1. The BAC shall open the Bids in public at the time, on the date, and at the place specified in paragraph 9 of the **IB**. The Bidders' representatives who are present shall sign a register evidencing their attendance. In case videoconferencing, webcasting or other similar technologies will be used, attendance of participants shall likewise be recorded by the BAC Secretariat.

In case the Bids cannot be opened as scheduled due to justifiable reasons, the rescheduling requirements under Section 29 of the 2016 revised IRR of RA No. 9184 shall prevail.

- 18.2. The preliminary examination of Bids shall be governed by Section 30 of the 2016 revised IRR of RA No. 9184.

## **19. Detailed Evaluation and Comparison of Bids**

- 19.1. The Procuring Entity's BAC shall immediately conduct a detailed evaluation of all Bids rated "*passed*" using non-discretionary pass/fail criteria. The BAC shall consider the conditions in the evaluation of Bids under Section 32.2 of 2016 revised IRR of RA No. 9184.

- 19.2. If the Project allows partial bids, all Bids and combinations of Bids as indicated in the **BDS** shall be received by the same deadline and opened and evaluated simultaneously so as to determine the Bid or combination of Bids offering the lowest calculated cost to the Procuring Entity. Bid Security as required by **ITB** Clause 16 shall be submitted for each contract (lot) separately.

- 19.3. In all cases, the NFCC computation pursuant to Section 23.4.2.6 of the 2016 revised IRR of RA No. 9184 must be sufficient for the total of the ABCs for all the lots participated in by the prospective Bidder.

## **20. Post Qualification**

Within a non-extendible period of five (5) calendar days from receipt by the Bidder of the notice from the BAC that it submitted the Lowest Calculated Bid, the Bidder shall submit its latest income and business tax returns filed and paid through the BIR Electronic Filing and Payment System (eFPS), and other appropriate licenses and permits required by law and stated in the **BDS**.

## **21. Signing of the Contract**

The documents required in Section 37.2 of the 2016 revised IRR of RA No. 9184 shall form part of the Contract. Additional Contract documents are indicated in the **BDS**.



### *Section III. Bid Data Sheet*

# Bid Data Sheet

ITB Clause																								
5.2	For this purpose, contracts similar to the Project refer to contracts which have the same major categories of work, which shall be <b>General Building Projects</b>																							
7.1	No portion of the project shall be subcontracted.																							
10.3	A valid Philippine Contractors Accreditation Board (PCAB) license with the following particulars: <table><tr><td>Classification</td><td>License Category</td></tr><tr><td>General Building</td><td>C &amp; D</td></tr></table>				Classification	License Category	General Building	C & D																
Classification	License Category																							
General Building	C & D																							
10.4	The key personnel must meet the required minimum years of experience set below: <table><tr><th colspan="2">Key Personnel</th><th>Minimum Years of Experience</th><th>General Experience</th><th>Relevant Experience</th></tr><tr><td>1</td><td>Project Manager</td><td>7</td><td>-Licensed architect or engineer. - Experience in managing construction projects of similar scale and complexity.</td><td>-Experience in managing lighthouse construction projects or similar marine structures would be advantageous.</td></tr><tr><td>2</td><td>Project Engineer/ Architect</td><td>5</td><td>-Licensed architect or engineer. -Experience in civil engineering / architectural design and construction project management.</td><td>-Experience in overseeing construction projects involving structural engineering and site management.</td></tr><tr><td>3</td><td>Materials Engineer</td><td>5</td><td>-Materials Engineer I accredited by DPWH. - Experience in materials testing.</td><td>- Experience in construction projects involving specialized materials for maritime environments.</td></tr></table>				Key Personnel		Minimum Years of Experience	General Experience	Relevant Experience	1	Project Manager	7	-Licensed architect or engineer. - Experience in managing construction projects of similar scale and complexity.	-Experience in managing lighthouse construction projects or similar marine structures would be advantageous.	2	Project Engineer/ Architect	5	-Licensed architect or engineer. -Experience in civil engineering / architectural design and construction project management.	-Experience in overseeing construction projects involving structural engineering and site management.	3	Materials Engineer	5	-Materials Engineer I accredited by DPWH. - Experience in materials testing.	- Experience in construction projects involving specialized materials for maritime environments.
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			selection, and quality control.	
4	Electrical Engineer	5	-Licensed electrical engineer. - Experience in electrical engineering and construction.	-Experience in designing and installing electrical systems for buildings and structures, including maritime applications.
5	Mechanical Engineer	5	-Licensed mechanical engineer. -Experience in mechanical engineering and construction.	-Experience in HVAC, plumbing, and mechanical systems for buildings, including those in coastal environments.
6	Sanitary Engineer / Master Plumber	5	-Licensed sanitary engineer / master plumber. -Experience in sanitary engineering and construction and/or plumbing installation and maintenance.	-Experience in designing and implementing sanitary systems for buildings, including those in coastal areas and/or plumbing systems for buildings.
7	Foreman	5	-Experience in construction supervision and management.	-Experience in overseeing construction crews for building projects, preferably in maritime environments.
8	Safety and Health Officer	5	-Experience in occupational health and safety management.	-Experience in implementing safety protocols and regulations on construction sites, including those in maritime environments.
9	AutoCAD Operator	5	-Proficiency in AutoCAD software and	-Experience in preparing detailed architectural,

				drafting techniques.	structural, and electrical drawings for construction projects, preferably including experience in maritime or coastal structures.																											
10.5	The minimum major equipment requirements are the following: <table><tr><td>Plant/Equipment</td><td>Capacity</td><td>Number of Units</td></tr><tr><td>Backhoe</td><td>At least 0.80 cu.m.</td><td>1</td></tr><tr><td>Dump Truck</td><td>At least 10 cubic yards</td><td>1</td></tr><tr><td>Vibratory Roller</td><td>At least 10 MT</td><td>1</td></tr><tr><td>Water Truck</td><td>At least 16000 liters</td><td>1</td></tr><tr><td>Plate Compactor</td><td>At least 2 tons</td><td>1</td></tr><tr><td>Concrete Vibrator</td><td>At least 3600 RPM</td><td>1</td></tr><tr><td>Concrete Mixer</td><td>At least 7 cu.ft.</td><td>1</td></tr><tr><td>Service Vehicle</td><td>At least five-seater</td><td>1</td></tr></table>					Plant/Equipment	Capacity	Number of Units	Backhoe	At least 0.80 cu.m.	1	Dump Truck	At least 10 cubic yards	1	Vibratory Roller	At least 10 MT	1	Water Truck	At least 16000 liters	1	Plate Compactor	At least 2 tons	1	Concrete Vibrator	At least 3600 RPM	1	Concrete Mixer	At least 7 cu.ft.	1	Service Vehicle	At least five-seater	1
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Concrete Mixer	At least 7 cu.ft.	1																														
Service Vehicle	At least five-seater	1																														
12	Implementation of Value Engineering activities shall not be applicable.																															
15.1	The bid security shall be in the form of a Bid Securing Declaration or any of the following forms and amounts: <p>a. The amount of not less than <i>two percent (2%) of the ABC or at least <b>Two Hundred Eighty-Two Thousand Six Hundred Sixty-Four Pesos and 69/100 (PhP282,664.69)</b></i>, if bid security is in cash, cashier's/manager's check, bank draft/guarantee or irrevocable letter of credit;</p> <p>b. The amount of not less than <i>five percent (5%) of the ABC or at least <b>Seven Hundred Six Thousand Six Hundred Sixty-One Pesos and 73/100 (PhP706,661.73)</b></i> if bid security is in Surety Bond.</p>																															
19.2	Partial bid is not allowed.  The infrastructure project is packaged in a single lot and the lot shall not be divided into sub-lots for the purpose of bidding, evaluation, and contract award.																															
20	Additional license and/or permits required: <p>1. Building Permit</p> <p>2. Zoning Clearance</p> <p>3. Occupancy Permit</p>																															

	<p>The bidder having the Lowest Calculated Bid (LCB) or Single Calculated Bid (SCB) shall submit within a non-extendible period of five (5) calendar days from the BAC Notice as the LCB/SCB, the following:</p> <ol style="list-style-type: none"> <li>1. In case the bidder has just submitted the Class “A” Legal eligibility requirements and Audited Financial Statement (AFS), a valid PhilGEPS Registration Certificate;</li> <li>2. Latest income and business tax returns filed and paid through the BIR Electronic Filing and Payment System (eFPS);</li> </ol> <p>In accordance with Executive Order (E.O.) No. 398, Revenue Regulation (R.R.) No. 03-2005 and Revenue Memorandum Circular (RMC) 16 – 2005, the above-mentioned tax returns shall refer to the following:</p> <ol style="list-style-type: none"> <li>2.1. Latest Income Tax Return (ITR) shall be the ITR for the preceding year, whether calendar or fiscal, and</li> <li>2.2. Latest Business Tax Returns shall refer to the Value Added Tax (VAT) or Percentage Tax filed and paid covering the previous six (6) months before the date of Submission, Receipt, Opening &amp; Preliminary Examination of Bids.</li> </ol>
21	<p>The following shall form part of the Contract Agreement which shall be submitted by the winning contractor within ten (10) calendar days from the date of receipt of the Notice of Award (NOA) prior to contract signing:</p> <ol style="list-style-type: none"> <li>1. Manpower Schedule</li> <li>2. Equipment Utilization Schedule</li> <li>3. Construction Schedule and S-Curve</li> <li>4. PERT/CPM</li> <li>5. Construction Methods, and</li> <li>6. Construction Safety and Health Program duly approved by the Department of Labor and Employment</li> </ol> <p>In addition to the submission of any of the allowable forms of Performance Security provided under Section 39.2 of the 2016 Revised Implementing Rules and Regulations (IRR) of Republic Act (R.A.) No. 9184 and above-stated contract documents, the bidder having the Lowest/Single Calculated Responsive Bid shall submit a Certificate of No Pending Case within ten (10) calendar days from receipt of the NOA.</p>





## *Section IV. General Conditions of Contract*

## 1. Scope of Contract

This Contract shall include all such items, although not specifically mentioned, that can be reasonably inferred as being required for its completion as if such items were expressly mentioned herein. All the provisions of RA No. 9184 and its 2016 revised IRR, including the Generic Procurement Manual, and associated issuances, constitute the primary source for the terms and conditions of the Contract, and thus, applicable in contract implementation. Herein clauses shall serve as the secondary source for the terms and conditions of the Contract.

This is without prejudice to Sections 74.1 and 74.2 of the 2016 revised IRR of RA No. 9184 allowing the GPPB to amend the IRR, which shall be applied to all procurement activities, the advertisement, posting, or invitation of which were issued after the effectivity of the said amendment.

## 2. Sectional Completion of Works

If sectional completion is specified in the **Special Conditions of Contract (SCC)**, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date shall apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

## 3. Possession of Site

4.1. The Procuring Entity shall give possession of all or parts of the Site to the Contractor based on the schedule of delivery indicated in the **SCC**, which corresponds to the execution of the Works. If the Contractor suffers delay or incurs cost from failure on the part of the Procuring Entity to give possession in accordance with the terms of this clause, the Procuring Entity's Representative shall give the Contractor a Contract Time Extension and certify such sum as fair to cover the cost incurred, which sum shall be paid by Procuring Entity.

4.2. If possession of a portion is not given by the above date, the Procuring Entity will be deemed to have delayed the start of the relevant activities. The resulting adjustments in contract time to address such delay may be addressed through contract extension provided under Annex "E" of the 2016 revised IRR of RA No. 9184.

## 4. The Contractor's Obligations

The Contractor shall employ the key personnel named in the Schedule of Key Personnel indicating their designation, in accordance with **ITB** Clause 10.3 and specified in the **BDS**, to carry out the supervision of the Works.

The Procuring Entity will approve any proposed replacement of key personnel only if their relevant qualifications and abilities are equal to or better than those of the personnel listed in the Schedule.

## **5. Performance Security**

- 5.1. Within ten (10) calendar days from receipt of the Notice of Award from the Procuring Entity but in no case later than the signing of the contract by both parties, the successful Bidder shall furnish the performance security in any of the forms prescribed in Section 39 of the 2016 revised IRR.
- 5.2. The Contractor, by entering into the Contract with the Procuring Entity, acknowledges the right of the Procuring Entity to institute action pursuant to RA No. 3688 against any subcontractor be they an individual, firm, partnership, corporation, or association supplying the Contractor with labor, materials and/or equipment for the performance of this Contract.

## **6. Site Investigation Reports**

The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the **SCC** supplemented by any information obtained by the Contractor.

## **7. Warranty**

- 7.1. In case the Contractor fails to undertake the repair works under Section 62.2.2 of the 2016 revised IRR, the Procuring Entity shall forfeit its performance security, subject its property(ies) to attachment or garnishment proceedings, and perpetually disqualify it from participating in any public bidding. All payables of the GOP in his favor shall be offset to recover the costs.
- 7.2. The warranty against Structural Defects/Failures, except that occasioned-on force majeure, shall cover the period from the date of issuance of the Certificate of Final Acceptance by the Procuring Entity. Specific duration of the warranty is found in the **SCC**.

## **8. Liability of the Contractor**

Subject to additional provisions, if any, set forth in the **SCC**, the Contractor's liability under this Contract shall be as provided by the laws of the Republic of the Philippines.

If the Contractor is a joint venture, all partners to the joint venture shall be jointly and severally liable to the Procuring Entity.

## **9. Termination for Other Causes**

Contract termination shall be initiated in case it is determined *prima facie* by the Procuring Entity that the Contractor has engaged, before, or during the implementation of the contract, in unlawful deeds and behaviors relative to contract acquisition and implementation, such as, but not limited to corrupt, fraudulent, collusive, coercive, and obstructive practices as stated in **ITB** Clause 4.

## **10. Dayworks**

Subject to the guidelines on Variation Order in Annex “E” of the 2016 revised IRR of RA No. 9184, and if applicable as indicated in the **SCC**, the Dayworks rates in the Contractor’s Bid shall be used for small additional amounts of work only when the Procuring Entity’s Representative has given written instructions in advance for additional work to be paid for in that way.

## **11. Program of Work**

11.1. The Contractor shall submit to the Procuring Entity’s Representative for approval the said Program of Work showing the general methods, arrangements, order, and timing for all the activities in the Works. The submissions of the Program of Work are indicated in the **SCC**.

11.2. The Contractor shall submit to the Procuring Entity’s Representative for approval an updated Program of Work at intervals no longer than the period stated in the **SCC**. If the Contractor does not submit an updated Program of Work within this period, the Procuring Entity’s Representative may withhold the amount stated in the **SCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program of Work has been submitted.

## **12. Instructions, Inspections and Audits**

The Contractor shall permit the GOP or the Procuring Entity to inspect the Contractor’s accounts and records relating to the performance of the Contractor and to have them audited by auditors of the GOP or the Procuring Entity, as may be required.

## **13. Advance Payment**

The Procuring Entity shall, upon a written request of the Contractor which shall be submitted as a Contract document, make an advance payment to the Contractor in an amount not exceeding fifteen percent (15%) of the total contract price, to be made in lump sum, or at the most two installments according to a schedule specified in the **SCC**, subject to the requirements in Annex “E” of the 2016 revised IRR of RA No. 9184.

## **14. Progress Payments**

The Contractor may submit a request for payment for Work accomplished. Such requests for payment shall be verified and certified by the Procuring Entity’s Representative/Project Engineer. Except as otherwise stipulated in the **SCC**, materials and equipment delivered on the site but not completely put in place shall not be included for payment.

## **15. Operating and Maintenance Manuals**

15.1. If required, the Contractor will provide “as built” Drawings and/or operating and maintenance manuals as specified in the **SCC**.

- 15.2. If the Contractor does not provide the Drawings and/or manuals by the dates stated above, or they do not receive the Procuring Entity's Representative's approval, the Procuring Entity's Representative may withhold the amount stated in the **SCC** from payments due to the Contractor.



## *Section V. Special Conditions of Contract*

# Special Conditions of Contract

<b>GCC Clause</b>	
2	No sectional completion.
4.1	The Procuring Entity shall give possession of all parts of the site to the contractor upon receipt of Notice to Proceed (NTP) until the date of its termination and/or project completion.
6	The site investigation report is Soil Foundation Investigation Report.
7.2	Fifteen (15) years starting from the date of issuance of the Certificate of Final Acceptance.
10	Day works are applicable at the rate shown in the Contractor's original Bid.
11.1	The Contractor shall submit the Program of Work to the Procuring Entity's Representative within fourteen (14) calendar days of delivery of the Notice of Award.
11.2	The amount to be withheld for late submission of an updated Program of Work is equivalent to one tenth of one percent (1/10 of 1%) of the total contract price for every day of delay.
13	No advance payment is allowed.
14	Materials and equipment delivered on the site but not completely put in place shall not be included for payment.
15.1	<p>The date by which operating and maintenance manuals are required is on final billing.</p> <p>The date by which "as built" drawings are required is on final billing. The Contractor is required to submit five (5) sets of "as built" drawings in blue/white print (20" x 30" size) duly signed and sealed by the supervising professionals, and electronic copy in CAD and pdf file format (electronically signed).</p>
15.2	The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required is equivalent to the amount of the final payment to be released.



## ***Section VI. Specifications***

***(See Annex A – Specifications)***





***Section VII. Drawings***  
**(See Annex B – Drawings)**



***Section VIII. Bill of Quantities***  
**(See Annex C – Bill of Quantities)**



## ***Section IX. Checklist of Technical and Financial Documents***

# Checklist of Technical and Financial Documents

Each Bidder shall submit one (1) original and six (6) copies of the first and second components of its bid through their duly authorized representatives.

All envelopes shall:

- a. contain the name of the contract to be bid in capital letters;
- b. bear the name and address of the Bidder in capital letters;
- c. be addressed to the BAC with the following details:

BIDS AND AWARDS COMMITTEE (BAC)  
PHILIPPINE COAST GUARD – NATIONAL HEADQUARTERS

- d. bear the specific identification of this bidding process; and
- e. bear a warning “DO NOT OPEN BEFORE...” the date and time for the opening of bids.

## I. TECHNICAL COMPONENT ENVELOPE

### *Class “A” Documents*

#### Legal Documents

- ☐ (a) Valid PhilGEPS Registration Certificate (Platinum Membership) (all pages) in accordance with Section 8.5.2 of the IRR;

The PhilGEPS Certificate of Platinum Registration and Membership in accordance with Section 8.5.2 of the 2016 revised IRR of RA 9184 contains the following caveat to reflect that through the submission of said Certificate, the Bidder certifies:

- a) the authenticity, genuineness, validity, and completeness of the copy of the original eligibility documents submitted;
- b) the veracity of the statements and information contained therein;
- c) that the Certificate is not a guaranty that the named registrant will be declared eligible without first being determined to be such for that particular bidding nor is it evidence that the same has passed the post-qualification stage; and
- d) that any finding of concealment, falsification, or misrepresentation of any of the eligibility documents submitted, or the contents thereof shall be a ground for disqualification of the Bidder from further participation in the bidding process, without prejudice to the imposition of appropriate administrative, civil and criminal penalty in accordance with the laws.

It shall likewise state that for the purpose of updating the said Certificate, all Class “A” Eligibility Documents covered by Section 8.5.2 of the 2016 revised IRR of RA 9184 supporting the veracity, authenticity and validity of the Certificate shall remain current and updated, and that failure by the prospective bidder to update its Certificate with the current and updated Class “A” Eligibility Documents covered by the afore-cited Section of the same IRR shall result in the automatic suspension of the validity of its Certificate until such time that all of the expired Class “A” Eligibility Documents has been updated.

**During the conduct of post-qualification**, bidders are likewise requested to submit copies of the following:

1. Securities and Exchange Commission (SEC) Registration Certificate for corporations, partnerships and/or joint ventures, Department of Trade and Industry (DTI) Registration Certificate for sole proprietorship, or Cooperative Development Authority (CDA) Registration Certificate for cooperatives;
2. Valid Mayor’s or Business Permit issued by the city or municipality where the principal place of business of the prospective bidder is located, or the equivalent document for Exclusive Economic Zones or Areas.
3. Valid Tax Clearance Certificate per Executive Order (E.O.) No. 398, series of 2005, as finally reviewed and approved by the Bureau of Internal Revenue (BIR); **AND**
4. Latest AFS stamped “received” by the BIR or its duly accredited and authorized institutions, for the preceding calendar year. In case the AFS for the preceding calendar year is not yet available, said AFS should not be earlier than two (2) years from the deadline for the Submission and Receipt of Bids.

Technical Documents

- ☐ (b) Statement of the prospective bidder of all its ongoing government and private contracts, including contracts awarded but not yet started, if any, whether similar or not similar in nature and complexity to the contract to be bid; **and**

The Statement of all On-going Government and Private Contracts shall indicate for each contract, the following:

- name of contract, location, project/contract cost;
- owner name, address, telephone numbers;
- nature of work;
- contractor’s role;
- contract duration, date started, date of completion;
- percent accomplishment; and

- value of outstanding works;

For purposes of post-qualification, the bidders are required to submit copies of the Notices of Award (NOA), Contract/Purchase Order and Notice to Proceed (NTP) for all on-going government contracts. On the other hand, for on-going private contracts, bidders shall submit a copy of its contract and/or other equivalent documents of the NOA and NTP, if any.

Non-submission of copies of the NOA, Contract/Purchase Order and NTP on the deadline for the Submission and Receipt of Bids shall not be a ground for the bidder's disqualification. However, the bidder having the Lowest/Single Calculated Bid shall be requested by the Technical Working Group (TWG) to provide copies of the aforesaid documents as part of the verification and validation process during post-qualification.

- ☐ (c) Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid, except under conditions provided under the rules; **and**

The statement identifying the Single Largest Completed Contract (SLCC) shall indicate the following:

- (a) name of the contract;
- (b) date of the contract;
- (c) contract duration;
- (d) owner's name and address;
- (e) contact person and contact details;
- (f) nature of work;
- (g) amount of completed contracts, adjusted by the bidder to current prices using PSA's consumer price index, if necessary for purposes of meeting the SLCC requirement;
- (h) date of completion; and
- (i) Owner's Certificate of Final Acceptance or Contractor's Performance Evaluation System Rating (CPES) with a "Satisfactory" rating, which should be attached as an integral part of the SLCC. In case of contracts with the private sector, an equivalent document shall be submitted.

- ☐ (d) Philippine Contractors Accreditation Board (PCAB) License; **or** Special PCAB License in case of Joint Ventures **and** registration for the type and cost of the contract to be bid; **and**

- ☐ (e) Original copy of Bid Security. If in the form of a Surety Bond, submit also a certification issued by the Insurance Commission **or** original copy of Notarized Bid Securing Declaration with the following details: **and**

- (f) Project Requirements, which shall include the following:
- ☐ f.1. Organizational chart for the contract to be bid;
  - ☐ f.2. List of contractor's key personnel (*e.g.*, Project Manager, Project Engineers, Materials Engineers, and Foremen), to be assigned to the contract to be bid, with their complete qualification and experience data;

- ☐ f.3. List of contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of ownership or certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be; **and**
- ☐ (g) Original duly signed Omnibus Sworn Statement (OSS) **and** if applicable, Original Notarized Secretary's Certificate in case of a corporation, partnership, or cooperative; or Original Special Power of Attorney of all members of the joint venture giving full power and authority to its officer to sign the OSS and do acts to represent the Bidder.

Reminder: If the prospective bidder's representative who will attend the Submission, Receipt, Opening and Preliminary Examination of Bids is different from the authorized representative to do, execute and perform any and all acts necessary and/or to represent the prospective bidder in the bidding, then the prospective bidder can include the name/s of said representative in the above-mentioned proofs of authorization (e.g., original copy of the duly notarized Secretary's Certificate for corporations, Board/Partnership Resolution for partnerships, corporations, and/or joint ventures or an original copy of the Special Power of Attorney for sole proprietorships, whichever is applicable).

#### Financial Documents

- ☐ (h) The prospective bidder's computation of Net Financial Contracting Capacity (NFCC).

Bidders must submit a computation of its NFCC, which must be at least equal to the ABC to be bid.

The minimum amount of the NFCC computation is Fourteen Million One Hundred Thirty-Three Thousand Two Hundred Thirty-Four Pesos and 61/100 (₱14,133,234.61)

NFCC = [(Current assets minus current liabilities) (15)] minus the value of all outstanding or uncompleted portions of the projects under ongoing contracts, including awarded contracts yet to be started, coinciding with the contract to be bid.

The values of the domestic bidder's current assets and current liabilities shall be based on the latest Audited Financial Statements submitted to the BIR.

#### ***Class "B" Documents***

- ☐ (i) If applicable, duly signed joint venture agreement (JVA) in accordance with RA No. 4566 and its IRR in case the joint venture is already in existence **or** duly notarized statements from all the potential joint venture partners stating that they will enter into and abide by the provisions of the JVA in the instance that the bid is successful.

Each partner of the joint venture shall submit their respective valid and updated PhilGEPS Certificates of Registration in accordance with Section 8.5.2 of the 2016 Revised IRR of R.A. 9184.

For purposes of post-qualification, all partners of the joint venture shall be requested to submit all of the following valid/updated Class “A” Eligibility Documents:

1. SEC Registration Certificate for corporations, partnerships and/or joint ventures; DTI Registration Certificate for sole proprietorship; or CDA Registration Certificate for cooperatives;
2. Valid Mayor’s Permit issued by the city or municipality where the principal place of business of the prospective bidder is located, or the equivalent document for Exclusive Economic Zones or Areas;
3. Valid Tax Clearance Certificate;
4. PCAB License and Registration; and
4. Latest AFS, stamped “received” by the BIR or its duly accredited and authorized institutions, for the preceding calendar year.

The submission of technical and financial eligibility documents by any of the joint venture partners constitutes compliance: *Provided*, That the partner responsible to submit the NFCC shall likewise submit the Statement of all of its ongoing contracts and Audited Financial Statements.

## II. FINANCIAL COMPONENT OF THE BID

- ☐ (j) Original of duly signed and accomplished Financial Bid Form; **and**

### Other documentary requirements under RA No. 9184

- ☐ (k) Original of duly signed Bid Prices in the Bill of Quantities; **and**
- ☐ (l) Duly accomplished Detailed Estimates Form, including a summary sheet indicating the unit prices of construction materials, labor rates, and equipment rentals used in coming up with the Bid; **and**
- ☐ (m) Cash Flow by Quarter.





## ***Section IX. Bidding Forms***

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## Bid Form for the Procurement of Infrastructure Projects

*[shall be submitted with the Bid]*

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### BID FORM

Date : \_\_\_\_\_

Project Identification No. : \_\_\_\_\_

To: *[name and address of Procuring Entity]*

Having examined the Philippine Bidding Documents (PBDs) including the Supplemental or Bid Bulletin Numbers *[insert numbers]*, the receipt of which is hereby duly acknowledged, we, the undersigned, declare that:

- a. We have no reservation to the PBDs, including the Supplemental or Bid Bulletins, for the Procurement Project: *[insert name of contract]*;
- b. We offer to execute the Works for this Contract in accordance with the PBDs;
- c. The total price of our Bid in words and figures, excluding any discounts offered below is: *[insert information]*;
- d. The discounts offered and the methodology for their application are: *[insert information]*;
- e. The total bid price includes the cost of all taxes, such as, but not limited to: *[specify the applicable taxes, e.g. (i) value added tax (VAT), (ii) income tax, (iii) local taxes, and (iv) other fiscal levies and duties]*, which are itemized herein and reflected in the detailed estimates,
- f. Our Bid shall be valid within the a period stated in the PBDs, and it shall remain binding upon us at any time before the expiration of that period;
- g. If our Bid is accepted, we commit to obtain a Performance Security in the amount of *[insert percentage amount]* percent of the Contract Price for the due performance of the Contract, or a Performance Securing Declaration in lieu of the the allowable forms of Performance Security, subject to the terms and conditions of issued GPPB guidelines<sup>1</sup> for this purpose;

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<sup>1</sup> currently based on GPPB Resolution No. 09-2020

- h. We are not participating, as Bidders, in more than one Bid in this bidding process, other than alternative offers in accordance with the Bidding Documents;
- i. We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal Contract is prepared and executed; and
- j. We understand that you are not bound to accept the Lowest Calculated Bid or any other Bid that you may receive.
- k. We likewise certify/confirm that the undersigned, is the duly authorized representative of the bidder, and granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for the [Name of Project] of the [Name of the Procuring Entity].
- l. We acknowledge that failure to sign each and every page of this Bid Form, including the Bill of Quantities, shall be a ground for the rejection of our bid.

Name: \_\_\_\_\_

Legal Capacity: \_\_\_\_\_

Signature: \_\_\_\_\_

Duly authorized to sign the Bid for and behalf of: \_\_\_\_\_

Date: \_\_\_\_\_

## **Contract Agreement Form for the Procurement of Infrastructure Projects (Revised)**

*[not required to be submitted with the Bid, but it shall be submitted within ten (10) days after receiving the  
Notice of Award]*

---

### **CONTRACT AGREEMENT**

THIS AGREEMENT, made this *[insert date]* day of *[insert month]*, *[insert year]* between *[name and address of PROCURING ENTITY]* (hereinafter called the “Entity”) and *[name and address of Contractor]* (hereinafter called the “Contractor”).

WHEREAS, the Entity is desirous that the Contractor execute *[name and identification number of contract]* (hereinafter called “the Works”) and the Entity has accepted the Bid for *[contract price in words and figures in specified currency]* by the Contractor for the execution and completion of such Works and the remedying of any defects therein.

#### **NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:**

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents as required by the 2016 revised Implementing Rules and Regulations of Republic Act No. 9184 shall be deemed to form and be read and construed as part of this Agreement, *viz.*:
  - a. Philippine Bidding Documents (PBDs);
    - i. Drawings/Plans;
    - ii. Specifications;
    - iii. Bill of Quantities;
    - iv. General and Special Conditions of Contract;
    - v. Supplemental or Bid Bulletins, if any;
  - b. Winning bidder’s bid, including the Eligibility requirements, Technical and Financial Proposals, and all other documents or statements submitted;

Bid form, including all the documents/statements contained in the Bidder’s bidding envelopes, as annexes, and all other documents submitted (*e.g.*, Bidder’s response to request for clarifications on the bid), including corrections to the bid, if any, resulting from the Procuring Entity’s bid evaluation;

- c. Performance Security;

- d. Notice of Award of Contract and the Bidder's conforme thereto; and
  - e. Other contract documents that may be required by existing laws and/or the Procuring Entity concerned in the PBDs. **Winning bidder agrees that additional contract documents or information prescribed by the GPPB that are subsequently required for submission after the contract execution, such as the Notice to Proceed, Variation Orders, and Warranty Security, shall likewise form part of the Contract.**
3. In consideration for the sum of *[total contract price in words and figures]* or such other sums as may be ascertained, *[Named of the bidder]* agrees to *[state the object of the contract]* in accordance with his/her/its Bid.
  4. The *[Name of the procuring entity]* agrees to pay the above-mentioned sum in accordance with the terms of the Bidding.

IN WITNESS whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

*[Insert Name and Signature]*  
*[Insert Signatory's Legal Capacity]*

for:  
*[Insert Procuring Entity]*

*[Insert Name and Signature]*  
*[Insert Signatory's Legal Capacity]*

for:  
*[Insert Name of Supplier]*

### ACKNOWLEDGEMENT

REPUBLIC OF THE PHILIPPINES)  
 \_\_\_\_\_) S.S.

BEFORE ME, a Notary Public for and in City of \_\_\_\_\_, Philippines, this  
 \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared:

**NAME**

**ID ISSUED AT/ON**

\_\_\_\_\_

\_\_\_\_\_

known to me and known to be the same person who execute the foregoing instrument consisting of \_\_\_\_\_ (\_\_) pages, including the page whereon the acknowledgments is written and acknowledged before me that the same is his/her free and voluntary act and deed and that of the Corporation/Sole Proprietorship he/she represents.

WITNESS MY HAND AND NOTARIAL SEAL, at the place and on the date first above written.

Doc No. \_\_\_\_\_;  
Page No. \_\_\_\_\_;  
Book No. \_\_\_\_\_;  
Series of 20\_\_\_\_.

## Omnibus Sworn Statement

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REPUBLIC OF THE PHILIPPINES \_\_\_\_\_ )  
CITY/MUNICIPALITY OF \_\_\_\_\_ ) S.S.

### AFFIDAVIT

I, [Name of Affiant], of legal age, [Civil Status], [Nationality], and residing at [Address of Affiant], after having been duly sworn in accordance with law, do hereby depose and state that:

**1. Select one, delete the other:**

*If a sole proprietorship:* I am the sole proprietor or authorized representative of [Name of Bidder] with office address at [address of Bidder];

*If a partnership, corporation, cooperative, or joint venture:* I am the duly authorized and designated representative of [Name of Bidder] with office address at [address of Bidder];

**2. Select one, delete the other:**

*If a sole proprietorship:* As the owner and sole proprietor, or authorized representative of [Name of Bidder], I have full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached duly notarized Special Power of Attorney;

*If a partnership, corporation, cooperative, or joint venture:* I am granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached [state title of attached document showing proof of authorization (e.g., duly notarized Secretary's Certificate, Board/Partnership Resolution, or Special Power of Attorney, whichever is applicable;)];

**3. [Name of Bidder] is not "blacklisted" or barred from bidding by the Government of the Philippines or any of its agencies, offices, corporations, or Local Government Units, foreign government/foreign or international financing**

institution whose blacklisting rules have been recognized by the Government Procurement Policy Board, **by itself or by relation, membership, association, affiliation, or controlling interest with another blacklisted person or entity as defined and provided for in the Uniform Guidelines on Blacklisting;**

4. Each of the documents submitted in satisfaction of the bidding requirements is an authentic copy of the original, complete, and all statements and information provided therein are true and correct;
5. *[Name of Bidder]* is authorizing the Head of the Procuring Entity or its duly authorized representative(s) to verify all the documents submitted;
6. **Select one, delete the rest:**

*If a sole proprietorship:* The owner or sole proprietor is not related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

*If a partnership or cooperative:* None of the officers and members of *[Name of Bidder]* is related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

*If a corporation or joint venture:* None of the officers, directors, and controlling stockholders of *[Name of Bidder]* is related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

7. *[Name of Bidder]* complies with existing labor laws and standards; and
8. *[Name of Bidder]* is aware of and has undertaken the following responsibilities as a Bidder:
  - a) Carefully examine all of the Bidding Documents;
  - b) Acknowledge all conditions, local or otherwise, affecting the implementation of the Contract;
  - c) Made an estimate of the facilities available and needed for the contract to be bid, if any; and
  - d) Inquire or secure Supplemental/Bid Bulletin(s) issued for the *[Name of the Project]*.

9. *[Name of Bidder]* did not give or pay directly or indirectly, any commission, amount, fee, or any form of consideration, pecuniary or otherwise, to any person or official, personnel or representative of the government in relation to any procurement project or activity.
10. In case advance payment was made or given, failure to perform or deliver any of the obligations and undertakings in the contract shall be sufficient grounds to constitute criminal liability for Swindling (Estafa) or the commission of fraud with unfaithfulness or abuse of confidence through misappropriating or converting any payment received by a person or entity under an obligation involving the duty to deliver certain goods or services, to the prejudice of the public and the government of the Philippines pursuant to Article 315 of Act No. 3815 s. 1930, as amended, or the Revised Penal Code.

IN WITNESS WHEREOF, I have hereunto set my hand this \_\_\_\_ day of \_\_\_\_, 20\_\_ at \_\_\_\_\_, Philippines.

\_\_\_\_\_  
Bidder's Representative/Authorized Signatory

**SUBSCRIBED AND SWORN** to before me this \_\_\_\_ day of *[month]* *[year]* at *[place of execution]*, Philippines. Affiant/s is/are personally known to me and was/were identified by me through competent evidence of identity as defined in the 2004 Rules on Notarial Practice (A.M. No. 02-8-13-SC). Affiant/s exhibited to me his/her *[insert type of government identification card used]*, with his/her photograph and signature appearing thereon with no. \_\_\_\_\_ issued on \_\_\_\_ at \_\_\_\_.

Witness my hand and seal this \_\_\_\_ day of *[month]* *[year]*.

**NAME OF NOTARY PUBLIC**

Serial          No.          of          Commission

\_\_\_\_\_

Notary Public for \_\_\_\_\_ until \_\_\_\_\_

Roll of Attorneys No. \_\_\_\_\_

PTR No. \_\_\_\_\_ *[date issued]*, *[place issued]*

IBP No. \_\_\_\_\_ *[date issued]*, *[place issued]*

Doc. No. \_\_\_\_\_

Page No. \_\_\_\_\_

Book No. \_\_\_\_\_

Series of \_\_\_\_\_



## BID SECURING DECLARATION FORM

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REPUBLIC OF THE PHILIPPINES)  
CITY OF \_\_\_\_\_) S.S.

### **BID SECURING DECLARATION** **Project Identification No.: *[Insert number]***

To: *[Insert name and address of the Procuring Entity]*

I/We, the undersigned, declare that:

1. I/We understand that, according to your conditions, bids must be supported by a Bid Security, which may be in the form of a Bid Securing Declaration.
2. I/We accept that: (a) I/we will be automatically disqualified from bidding for any procurement contract with any procuring entity for a period of two (2) years upon receipt of your Blacklisting Order; and, (b) I/we will pay the applicable fine provided under Section 6 of the Guidelines on the Use of Bid Securing Declaration, within fifteen (15) days from receipt of the written demand by the procuring entity for the commission of acts resulting to the enforcement of the bid securing declaration under Sections 23.1(b), 34.2, 40.1 and 69.1, except 69.1(f), of the IRR of RA No. 9184; without prejudice to other legal action the government may undertake.
3. I/We understand that this Bid Securing Declaration shall cease to be valid on the following circumstances:
  - a. Upon expiration of the bid validity period, or any extension thereof pursuant to your request;
  - b. I am/we are declared ineligible or post-disqualified upon receipt of your notice to such effect, and (i) I/we failed to timely file a request for reconsideration or (ii) I/we filed a waiver to avail of said right; and
  - c. I am/we are declared the bidder with the Lowest Calculated Responsive Bid, and I/we have furnished the performance security and signed the Contract.

IN WITNESS WHEREOF, I/We have hereunto set my/our hand/s this \_\_\_\_ day of *[month]* *[year]* at *[place of execution]*.

*[Insert NAME OF BIDDER OR ITS  
AUTHORIZED REPRESENTATIVE]  
[Insert signatory's legal capacity]  
Affiant*

**SUBSCRIBED AND SWORN** to before me this \_\_\_\_ day of *[month]* *[year]* at *[place of execution]*, Philippines. Affiant/s is/are personally known to me and was/were identified by me through competent evidence of identity as defined in the 2004 Rules on Notarial Practice (A.M. No. 02-8-13-SC). Affiant/s exhibited to me his/her *[insert type of government identification card used]*, with his/her photograph and signature appearing thereon, with no. \_\_\_\_\_ issued on \_\_\_\_ at \_\_\_\_\_.

Witness my hand and seal this \_\_\_\_ day of *[month]* *[year]*.

**NAME OF NOTARY PUBLIC**

Serial No. of Commission \_\_\_\_\_

Notary Public for \_\_\_\_\_ until \_\_\_\_\_

Roll of Attorneys No. \_\_\_\_\_

PTR No. \_\_\_\_\_ *[date issued]*, *[place issued]*

IBP No. \_\_\_\_\_ *[date issued]*, *[place issued]*

Doc. No. \_\_\_\_\_

Page No. \_\_\_\_\_

Book No. \_\_\_\_\_

Series of \_\_\_\_\_



## STATEMENT OF ALL ON-GOING GOVERNMENT AND PRIVATE CONTRACTS

**Kindly supply the required information in the spaces provided.**

Name of Bidder \_\_\_\_\_. Invitation to Bid Number \_\_\_\_\_. Page \_\_\_\_ of \_\_\_\_.

Name of Contract/Location/Project/Contract Cost	a. Owner Name b. Address c. Telephone Nos.	Nature of work	Contractor's Role		a. Contract Duration b. Date Started c. Date of Completion	% of Accomplishment		Value of Outstanding Works
			Description	%		Planned	Actual	
<b><u>Government:</u></b>								
<b><u>Private:</u></b>								
Total Cost:								

\_\_\_\_\_  
[Printed Name & Signature of the Authorized Rep.]

\_\_\_\_\_  
[in the capacity of] (Please indicate position of Authorized Rep.)]

Duly authorized to sign Bid for and on behalf of \_\_\_\_\_

Date: \_\_\_\_\_

*(Please indicate name of company)*

**NOTE:**

*The aforesaid statement should include those contracts awarded but not yet started.*

*Further, bidders should indicate “None” or “No On-going Government and/or Private Contracts” if they do not have any on-ongoing government and/or private contracts in the corresponding rows and/or column, including contracts awarded but not yet started, whether similar or not similar in nature and complexity to the contract to be bid.*

## STATEMENT OF THE SINGLE LARGEST COMPLETED CONTRACT

**Kindly supply the required information in the spaces provided.**

Name of Bidder \_\_\_\_\_. Invitation to Bid Number \_\_\_\_\_. Page \_\_ of \_\_\_\_\_.

Name of the Contract	Date of the Contract	Contract Duration	Owner's Name and Address	Contact Person and Contact Details (Tel./Cell No. and/or Email Address)	Nature of Work	Amount of Contract adjusted by the bidder to current prices using PSA's consumer price index, if necessary for purposes of meeting the SLCC requirement;	Date of Completion

\_\_\_\_\_  
*[Printed Name & Signature of the Authorized Rep.]*

\_\_\_\_\_  
*[in the capacity of] (Please indicate position of Authorized Rep.)*

Duly authorized to sign Bid for and on behalf of \_\_\_\_\_

Date: \_\_\_\_\_

*(Please indicate name of company)*

### **NOTE:**

***Bidders shall submit and attach a copy of the end-user's acceptance or official receipt(s) or sales invoice.***

## NFCC COMPUTATION

**Kindly supply the required information in the spaces provided.**

Name of Bidder \_\_\_\_\_. Invitation to Bid Number \_\_. Page of \_\_\_\_.

LOT No.	DESCRIPTION	ABC
1	Construction of Coast Guard Station Northern Samar	<b>Fourteen Million One Hundred Thirty-Three Thousand Two Hundred Thirty-Four Pesos and 61/100 (₱14,133,234.61)</b>

DETAILS	AMOUNT
Current Assets	
Minus	
Current Liabilities	
Difference of Current Assets and Current Liabilities	
Multiplied by	
K	15
Total (Product)	
Minus	
Total value of all outstanding contracts, including those awarded but not yet started	
Total NFCC Computation	

\_\_\_\_\_  
*[Signature of the Authorized Rep.] [in the capacity of] (Please indicate position of Authorized Rep.)]*

*Duly authorized to sign Bid for and on behalf of* \_\_\_\_\_  
*(Please indicate name of company)*

**Kindly supply the required information in the spaces provided.**

[illegible]

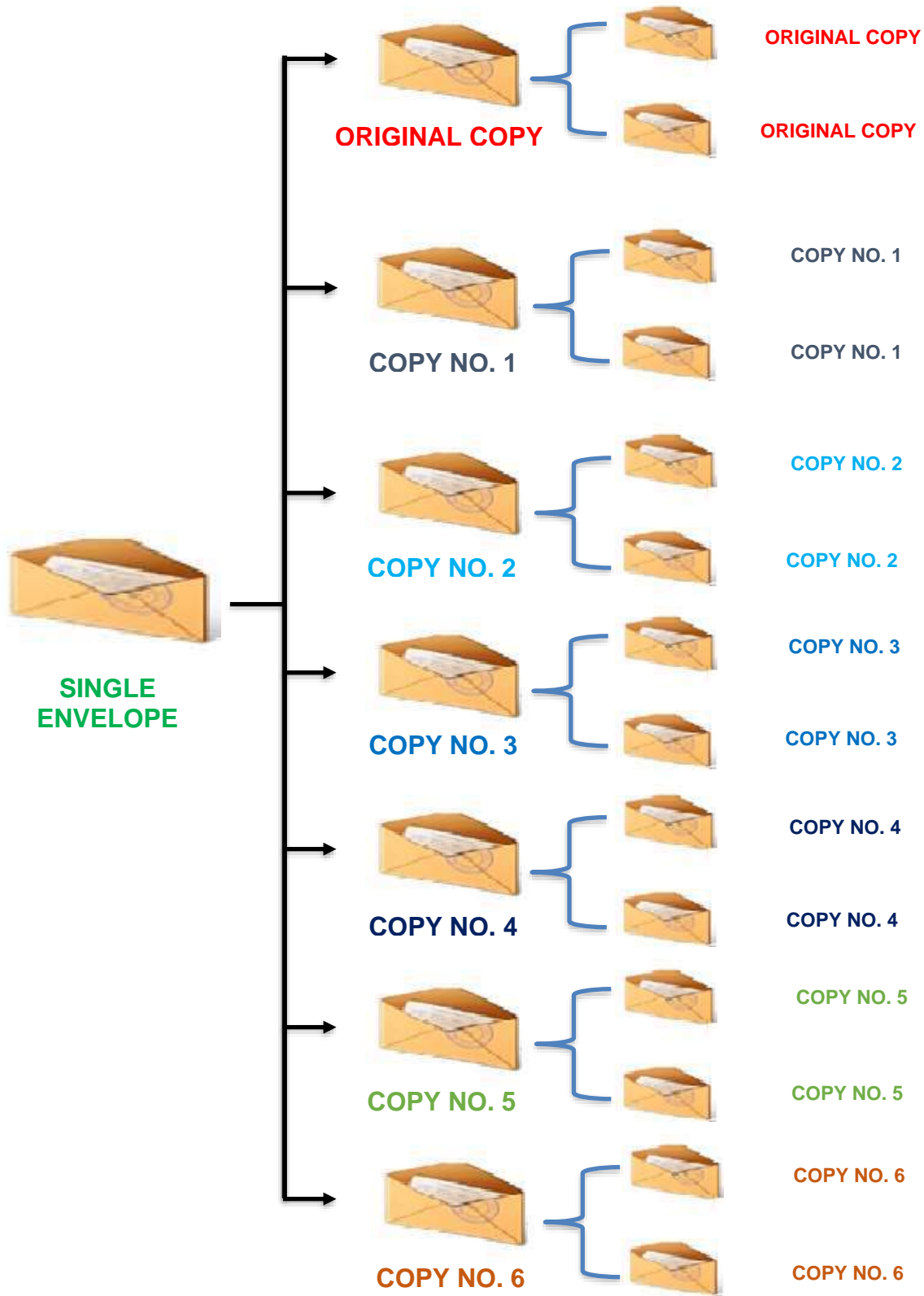
*[in the capacity of] (Please indicate position of Authorized Rep.)*

Date: \_\_\_\_\_

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DIAGRAM FOR THE SEALING AND MARKING OF BIDS







Philippine Coast Guard  
**HEADQUARTERS COAST GUARD LOGISTICS SYSTEM COMMAND**  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CBGF, Muelle Dela Industria Compound, Binondo  
1006 Manila



# **SCOPE OF WORKS & TECHNICAL SPECIFICATIONS**

**CONSTRUCTION OF COAST GUARD STATION NORTHERN SAMAR  
BUILDING AND FACILITIES**  
BRGY. SABANG ZONE 2, ALLEN, NORTHERN SAMAR



# **CONSTRUCTION OF COAST GUARD STATION SOUTHERN LEYTE BUILDING AND FACILITIES**

BRGY. COMBADO, MAASIN CITY, SOUTHERN LEYTE

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02302 Excavation, Backfilling, and Compacting for Utilities

#### **DIVISION 16 – ELECTRICAL**

16301 Underground Electrical Work  
(Refer to same Section under Division 16 of IV. Building Works)

*Note: For Non-Potable Water Tank:  
Refer to Appropriate Sections of the Specifications for Building Works*

## **III. BUILDING WORKS**

#### **DIVISION 2 – SITE CONSTRUCTION**

02217 Building Layout  
02302 Excavation, Backfilling, and compacting for utilities  
02360 Soil Treatment for Subterranean Termite Control

*Note: For Structure Excavation, Soil Disposal and Subgrade Preparation:  
Refer to Appropriate Sections of the Specifications for Civil Works*

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03300 Cast in Place Concrete

#### **DIVISION 4 - MASONRY**

04800 Reinforced Masonry

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05120 Structural Steel  
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06400 Finish Carpentry

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07102 Elastomeric Waterproofing System, Fluid- applied  
07103 Elastomeric Acrylic Waterproofing System  
07150 Polyurethane Based Applied Waterproofing System  
07160 Cementitious Waterproofing System  
07410 Prepainted Horizontal Roofing Sheet  
07412 Roof Insulation  
07900 Sealants and Caulking

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09910	Painting Works

## **DIVISION 10 - SPECIALTIES**

10165	Toilet Compartments
10810	Toilet Accessories

## **DIVISION 12 – FURNISHING**

12600	Furniture and Accessories
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## **DIVISION 15 – MECHANICAL (PLUMBING)**

15400	Plumbing Works
15440	Plumbing Fixtures

## **DIVISION 15 – MECHANICAL (FIRE PROTECTION SYSTEM)**

150401	Fire Protection General Provision
150402	Basic Materials
152003	Execution

## **DIVISION 16 – ELECTRICAL**

160401	General Provision
160402	Basic Materials
162003	Execution

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## GENERAL REQUIREMENTS

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PART A - FACILITIES FOR THE PCG  
ENGINEER  
(INCLUDING PCG  
ENGINEER'S  
REPRESENTATIVE)

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## **PART A - FACILITIES FOR THE PCG ENGINEER (INCLUDING PCG ENGINEER'S REPRESENTATIVE)**

### **1.1 SCOPE OF WORK**

This section shall include the mobilization and demobilization of Contractor's plant, equipment, materials and employee to the site; construction and maintenance of PCG Engineer's (including PCG Engineer's Representative) staff house, maintenance of existing field office and facilities; compliance with the contract requirements, and provision for the health/safety and environmental protection during the entire project duration.

This section shall include the furnishing of labor, materials, transportation, tools, supplies, plant, equipment and appurtenances to complete satisfactorily the construction of the proposed project.

### **1.2 MOBILIZATION AND DEMOBILIZATION**

The Contractor upon receipt of the Notice-to-Proceed shall immediately mobilize and transport his plant, equipment, materials and labor forces to the site and demobilize or remove the same at the completion of project and level/ clear the site acceptable to the PCG Engineer and the Owner.

Mobilization and Demobilization are incidental to other items of work and will not be measured for payment.

### **1.3 FACILITIES FOR THE PCG ENGINEER AND PCG ENGINEER'S REPRESENTATIVE**

#### **1.3.1 Office and Staff House for the PCG Engineer**

During the performance of the contract, the Contractor shall construct and maintain an office for the PCG Engineer and PCG Engineer's representative within the site of the work at designated location indicated on the Drawings while the work is in progress.

The Contractor shall also maintain the existing field office at Site, existing staff house for the PCG Engineer.

The field office at the Site and Office for the PCG Engineer's representative shall have a 24-hour security services and shall strictly comply with the provisions of Batas Pambansa 344 (Accessibility Law) and the Building National Code.

All facilities to be provided by the Contractor shall conform to the best standard for the required types. The facilities provided by the Contractor including utilities and communication facilities shall revert to the Government including office equipment, apparatus, and furniture's upon completion of the Project, unless otherwise specified in the Contract Documents.

The Contractor shall be responsible for the maintenance and protection of all facilities to be provided during the entire duration of the Contract including provision of adequate stock of all expendable items, such as light bulbs, light tubes, equipment and supplies, at all times to ensure proper and continuous functioning of all the PCG Engineer's facilities.

It shall be understood that if the Contractor cannot provide the articles as described or intends to supply equivalent substitutes, the PCG Engineer may execute their availability and the Contractor shall pay therefore as certified by the PCG Engineer or the PCG Engineer shall have the right to deduct the sums from any money which is due or which will become due to the Contractor.

Construction shanties, sheds and temporary facilities provided as required for the Contractor's convenience shall be maintained in good condition and neat appearance including finishes as required by the PCG Engineer.

#### 1.3.2 Temporary Light and Power

The Contractor shall provide and maintain temporary electrical service including installation of temporary power and lighting within the construction site and facilities constructed thereat. The electrical services shall be adequate in capacity to supply power to construction tools and equipment without over-loading the temporary facilities and shall be made available to supply power, lighting and construction operations of all trades. All temporary equipment and wiring for power and lighting shall be in accordance with the applicable provisions of the local governing codes. At the completion of the construction work, all temporary wiring, lighting, equipment and devices shall be removed.

#### 1.3.3 Temporary Toilets

The Contractor shall provide and maintain in sanitary condition enclosed toilets for the use of all construction personnel located within the contract limits, complete with fixtures, water and sewer connections and all appurtenances. Installation shall be in accordance with all applicable codes and regulations of the local authorities having jurisdiction thereof. Upon completion of the work, temporary toilet and their appurtenances shall be removed.

#### 1.3.4 Temporary Water Service

The Contractor shall provide and maintain temporary water supply service, complete with necessary connections and appurtenances. Installed water supply lines shall be used as a source of water for construction purposes subject to the approval of the PCG Engineer. The Contractor shall pay the cost of operation, maintenance and restoration of the water system. All temporary water service including equipment and piping shall be removed upon completion of the work and all worn out and damaged parts of the permanent system shall be replaced and restored in first class condition equal to new.

#### Security

The Contractor shall provide sufficient security in the construction site to prevent illegal entry or work damaged during nights; holidays and other period when work is not executed; and during working hours. The Contractor shall take ample precautions against fire by keeping away flammable materials, and ensure that such materials are properly handled and stored. Fires shall not be allowed within the area of construction, except when permitted by the PCG Engineer.

#### 1.3.5 Disposal Area

The proposed location of disposal area shall be at the site designated by the PCG Engineer. It is the responsibility of the Contractor to disposed off-site all construction debris and be considered in the preparation of his proposal.

#### 1.3.6 Contractor's Key Personnel and Maintenance Staff to be assigned to the Project:

##### **SCHEDULE A.1 - MAINTENANCE OF OFFICE FOR THE PCG ENGINEER'S REPRESENTATIVE**

REF. NO.	DESCRIPTION	Qty	Unit
I.	<b>Operation/Maintenance Staff for the PCG Engineer's Representative (Monthly)</b>		

Part A – Facilities for the PCG Engineer (including  
PCG Engineer's Representative)

a.	Clerk/Encoder	1	no.
b.	Utility	1	no.
c.	Security Guard	1	no.
<b>II</b>	<b>Key Personnel (on-full time basis) / Monthly</b>	<b>Qty</b>	<b>Unit</b>
d.	Project Manager (Licensed Civil Engineer / Architect)	1	no.
e.	Project Engineer / Architect (Licensed Civil Engineer / Architect)	1	no.
f.	Materials Engineer (Accredited Materials Engineer)	1	no.
g.	Mechanical Engineer (Licensed)	1	no.
h.	Electrical Engineer (Licensed)	1	no.
i.	Plumbing/Sanitary Engineer (Licensed)	1	no.
j.	AutoCAD Operator	1	no.
k.	Foreman	1	no.
l.	Safety PCG Engineer (Certified by the Bureau of Working Conditions of DOLE or with Certificate of Training in Occupational Safety and Health)	1	no.
Note: Payment for the above key personnel (d) to (l) are incidental to items of the permanent works, hence, will not be measured and paid separately. However, Safety Officer is included under Pay-item No. B.2 (Construction Health and Safety) of the Bill of Quantities.			
<b>III.</b>	<b>Miscellaneous (Monthly)</b>	<b>Qty</b>	<b>Unit</b>
a.	Water Bill	8	mos.
b.	Electric Bill	8	mos.

**SCHEDULE A.2 - MAINTENANCE OF STAFF HOUSE FOR THE PCG ENGINEER**

REF. NO.	DESCRIPTION	Qty	Unit
<b>I.</b>	<b>Miscellaneous (Monthly)</b>		
a.	Water Bill	8	mos.
b.	Electric Bill (including replacement of defective lighting fixtures)	8	mos.

**SCHEDULE A.3 - MAINTENANCE OF FIELD OFFICE FOR THE PCG ENGINEER AND PCG ENGINEER'S REPRESENTATIVE**

REF. NO.	DESCRIPTION	Qty	Unit
<b>I.</b>	<b>Miscellaneous (Monthly)</b>		
a.	Water Bill	8	mos.
b.	Electric Bill (including replacement of defective lighting fixtures)	8	mos.

1.4 ITEMS TO BE CONSIDERED FOR THE FACILITIES FOR THE PCG ENGINEER (INCLUDING PCG ENGINEER'S REPRESENTATIVE)

The Contractor shall provide and maintain the field office, office (satellite) and staff house for the PCG Engineer and PCG Engineer's representative but not limited to the items specified below.

1.4.1 Site Office, Office (Satellite) and Staff House for the PCG Engineer and PCG Engineer's Representative

By way of maintenance, the Contractor shall provide the necessary personnel specified under **Schedule A.1** to maintain all of the facilities in good operating condition and adequately safeguard and secure the building, equipment and property day and night, regularly and properly cleaned, and to take care household helps, all as directed and approved by the PCG Engineer. The Contractor, if requested by the PCG Engineer, shall immediately replace assigned personnel for reasons arising from misconduct and/or unsatisfactory performance.

All test and quality control works shall be done by the Contractor's Materials Testing and Laboratory Staff under the direct supervision of the PCG Engineer/PCG Engineer's representative. The Contractor shall make all necessary arrangements for the supply and delivery of samples to, and collection of samples from such laboratory. He shall arrange for one copy of the independent testing laboratory's test certificate to be delivered to the PCG Engineer not less than three days before the materials covered by the relevant test certificate are incorporated into the works, and the test certificate shall be related to the materials from which the samples were taken. It shall be reiterated that all test and quality control works shall be the responsibility of the Contractor. The PCG Engineer shall define from the beginning of the works, and in accordance with the Specifications, all tests to be performed for each kind of materials and/or works, together with the corresponding frequencies to be used and amend such statement from time to time during the progress of work if deemed necessary. The Contractor shall be responsible for all the laboratory material testing necessary in the project implementation. Expenses shall be incorporated in the contractor's overhead cost and shall not be considered as pay-item.

If the Contractor cannot provide the articles on time, the PCG Engineer shall secure the items and the Contractor shall immediately reimburse the PCG Engineer for the cost thereof.

During the period of maintenance of all the buildings, the Contractor shall provide with a 24-hour supply of potable water, electricity and other services. The Contractor shall pay all bills for water, electricity, and other services.

The Contractor shall be responsible for replacing and/or restoring, as directed, any facility or parts thereof which become damaged from any cause, or become worn out, lost, misplaced or stolen. The Contractor shall also provide stocks of expendable items such as light bulbs and tubes, insecticides, fuel, lubricants and the like.

The site office, office and staff house, furniture's and fixtures, office equipment like air-con units and temporary power, equipment, and computer system shall become the property of the Procuring Entity upon their payment.

1.4.2 Maintenance of Communication Facilities for the PCG Engineer and PCG Engineer's Representative

The Contractor shall maintain the existing communication facilities for the exclusive use of the PCG Engineer and PCG Engineer's Representative as listed in **Schedule C** within the required number of months during the Project implementation as specified in the Bill of Quantities. Should the specified number of months be insufficient to cover the period until Project completion, said period of maintenance of said communication facilities shall be extended upon approval of the PCG Engineer.

In order to have continuous operation and efficient maintenance of the equipment, the Contractor shall provide monthly operating expenses including cost for servicing and minor repairs.

1.4.3 Vehicle for the PCG Engineer and PCG Engineer's Representative

The Contractor shall provide within thirty (30) calendar days after notice to commence work, the service vehicle listed in the Bid Data Sheet for the exclusive use of the PCG Engineer and PCG Engineer's Representative.

The vehicle shall comply in all respects with all relevant Philippine national or local laws, statutes and regulations. All vehicle shall carry or be fitted with the accessories as may be prescribed by laws and have comprehensive insurance. The vehicle shall be driven by a competent qualified and experienced driver who shall be under the direct order of the PCG Engineer.

The Contractor shall maintain the vehicle in good condition and shall be supplied with appropriate fuel, lubricants and servicing driver at all times as well as minor repair at all times at his own expense. Provide a minimum of 30 liters of fuel per day and spare tires.

He shall provide equivalent substitute vehicle when taken out of service for maintenance, repair or any other reason.

In addition to the maintenance of the service vehicle, the Contractor shall also maintain the vehicle within the required number of months during the Project implementation as specified in the Bill of Quantities. Should the specified number of months be insufficient to cover the period until Project completion, said period of maintenance of said vehicle shall be extended upon approval of the PCG Engineer.

#### 1.4.4 Photographs

The Contractor shall provide record progress photographs (120 photographs per month) taken as, when and where directed by the PCG Engineer at intervals of not more than one month. The photographs shall be sufficient in number and location to record the exact progress of the works. The Contractor shall provide photographs in electronic files to the PCG Engineer. The photographs retained by the PCG Engineer will become the property of the Procuring Entity.

#### 1.4.5 As-Built Drawings

The contractor shall prepare and submit as-built plans duly signed and sealed by appropriate PCG Engineer in the same sheet size and scale as the original drawings in five (5) reproducible copies. Electronic copies of the as-built contract drawings shall also be submitted in native files for use with the Autodesk software AutoCAD and Revit. The \*.PDF format files shall be delivered with the CAD or BIM files.

No separate payment for the as-built drawings as this is deemed to be included as incidental to other items of work.

### 1.5 MEASUREMENT AND PAYMENT

#### 1.5.1 Measurement

##### a) Office for the PCG Engineer

##### (1) Maintenance of Office for the PCG Engineer's

The maintenance of office for the PCG Engineer's shall include monthly salaries and wages of the maintenance personnel, assistance to the PCG Engineer's representative including provision of security, water and electricity 24 hours daily, repair of office and shall be paid the date the PCG Engineer's representative's occupancy reckoned from the commencement of the works until completion of the contract. Refer to **Schedule A.1**. Unit of measurement and payment is "lump sum".

- (2) Furnish Equipment, Furniture, Fixtures, Office Equipment and Appliances for the PCG Engineer and PCG Engineer's Representative

The quantities for the provision of equipment, furniture/fixtures, office equipment and appliances for the PCG Engineer & PCG Engineer's representative, shall be the number of each type of equipment, furniture/fixtures, office equipment and appliances supplied and as listed in **Schedule B**. This item shall be paid at the "Lump Sum" price upon delivery of equipment, furniture/fixtures, and appliances and upon its approval/acceptance by the PCG Engineer.

- b) Operate and Maintain Communication Equipment for the PCG Engineer

This item consists of the maintenance of existing communication equipment as specified in Subsection 1.4.2 which includes provision and maintenance of (a) monthly fee for telephone landline with internet and (b) cellular phone prepaid cards worth Php500.00 each per month. Refer to **Schedule C**. The unit of measurement and payment is at the "per Month", until completion of the Project.

- c) Vehicle for PCG Engineer and PCG Engineer's Representative

- (1) Provide Service Vehicle for the PCG Engineers and PCG Engineer's Representative

The quantity for the provision of service vehicle for the PCG Engineer and PCG Engineer's Representative shall be the type of vehicle supplied as mentioned in Subsection 1.4.3, including registration and comprehensive insurance of the vehicle.

Payment of which shall be on a rental basis ("Vehicle-Month") from the date the Contractor has supplied with the type of vehicle until the completion of the Project.

- (2) Operate and Maintain Service Vehicle for the PCG Engineers

Quantities for operation and maintenance of the service vehicle as mentioned in Subsection 1.4.3 including driver, renewal of registration and comprehensive insurance of the vehicle for the PCG Engineer and PCG Engineer's Representative shall be measured in "Vehicle-Month". The maintenance of the service vehicle provided for this Contract shall be maintained from the date the Contractor is supplied with the type of vehicle until completion of the project.

The existing vehicle procured under Separate Contract shall be maintained as mentioned in Subsection 1.4.3 in the number of months specified in the Bill of Quantities.

### 1.5.3 Payment

Payment shall be made under the following pay items included in the Bill of Quantities. Such payments shall be full compensation for furnishing, maintaining and insuring against loss of the facilities and equipment specified including removal and restoration of the site(s). The requirement that ownership of facilities shall revert to the government shall not apply if such facilities are provided on rental basis under terms approved by the Procuring Entity.

**SCHEDULE B - EQUIPMENT, FURNITURES, FIXTURES, OFFICE EQUIPMENT AND APPLIANCES  
FOR THE LABORATORY BUILDING FOR THE PCG ENGINEER AND PCG ENGINEER'S  
REPRESENTATIVE (ALL ITEMS SHALL BE APPROVED BY THE PCG ENGINEER)**

I. Description	Qty	Unit
<b>FURNITURE (Office, Receiving/Lobby/Conference, Laboratory and Front Desk)</b>		
Office Desk, standard, 70 cm x 120 cm, with 3 drawers on each side and center drawer provided with locks and keys	3	each
Standard revolving chairs, screw type with pneumatic height adjustment	3	each
Mobile steel cabinet, 3 layer	3	each

I. Description	Qty	Unit
<b>OFFICE EQUIPMENT AND SUPPLIES</b>		
Electric fans, 16" blade, free standing human height/Ceiling Fan	2	each
Air conditioners, window mounted type, 1.0 HP (for office)	1	set
Photo copier A3 & A4 sizes, 50% - 200% reducer/enlarger capability, with complete standard provided accessories	1	set
Laptop computer, Windows 11 Home; Intel® Core™ i7-14650HX processor Hexadeca-core; NVIDIA® GeForce RTX™ 4060 with 8 GB dedicated memory; 16" WUXGA (1920 x 1200) 16:10 IPS 165 Hz; 16 GB, DDR5 SDRAM; 1 TB SSD	2	set
Portable Printer Deskjet or equivalent compatible with the personal computer, for both manual A4 and A3 paper	1	set
<b>PANTRY/TOILET</b>		
Refrigerator, 10 cu. Ft.	1	each
Microwave oven (800 watts)	1	each
Hot and Cold Water Dispenser (5 gallons)	1	each
Electric Kettles, Aluminum (Commercial Type)	1	set
Set of kitchenware for at least 5 persons consisting of the following: spoons, forks, knives, drinking glass, cup and saucers, serving plates, placemats, table cloths, rice plates, pitchers. Canisters, serving bowls, bolos, dust pans, waste baskets and others	1	set
Doormat, rugs, brooms, dust pan, garbage cans, gloves	1	Lump Sum



**SCHEDULE C – MAINTENANCE OF COMMUNICATION EQUIPMENT FOR THE PCG  
ENGINEER AND PCG ENGINEER'S REPRESENTATIVE  
(ALL ITEMS SHALL BE APPROVED BY THE PCG ENGINEER)**

DESCRIPTION	QTY.	UNIT
<b>Equipment</b>		
<b>A. Telephone Landline with internet</b> (Subscription and Installation Fee inclusive)	8	Month
<b>B. Cellular Phone</b>		
Prepaid card for 2 cellular phones worth Php2000 each	8	month

**SCHEDULE D - PROVISION OF SUPPLIES AND CONSUMABLE STORES  
FOR THE PCG ENGINEER**

REF NO.	DESCRIPTION	QTY.	UNIT
<b>a)</b>	<b>OFFICE SUPPLIES (to be supplied during the first month only)</b>		
1.	Desk Paper Organizer Trays	2	each
2.	First Aid Kit	1	each
3.	Heavy Duty Flashlights	2	each
4.	Heavy Duty Cutter	1	each
5.	Mechanical Pencil	5	each
6.	Pencil Sharpener (Table Mounted)	1	each
7.	Puncher	4	each
8.	Record Book, 100 pages	3	each
9.	Scissor	1	each
10.	Stainless Erasing Shield	2	each
11.	Stamp Pad with Ink	2	each
12.	Staple Wire Remover, Special	2	each
13.	Stapler, Max HD 12N/70, Cap. 30 to 170 sheets	2	each
14.	Stapler, Max HD 50, standard #35 staple wire	2	each
15.	Steel Ruler, 12inch	1	each
16.	Tape Dispenser	2	each

Part A – Facilities for the PCG Engineer (including PCG  
Engineer's Representative)

REF NO.	DESCRIPTION	QTY.	UNIT
17.	Waste Paper Bins	1	each
18.	Whiteboard, 1200 mm x 1200 mm	1	each
<b>b)</b>	<b>OFFICE SUPPLIES (Monthly)</b>		
19.	Ballpen (Black, Red, Blue)	2	each
20.	Bond Paper Long	1	ream
21.	Bond Paper, A3 size	1	ream
22.	Bond Paper, A4 size	2	ream
23.	Brown Envelope, Long	2	each
24.	Brown Envelope, Short	2	each
25.	Expanded Envelope, Long	2	each
26.	Fastener	2	box
27.	Folder, Long	2	each
28.	Folder, Short	2	each
29.	Glue Stick, 20 grams	1	each
30.	Ink Eraser	1	each
31.	Inkjet Cartridge, Black	1	each
32.	Inkjet Cartridge, Tri-colour	1	each
33.	Letter Envelope, brown	0.50	box
34.	Letter Envelope, white	0.50	box
35.	Magic Tape (18mm x 50mm)	1	roll
36.	Marker, Stabilo (assorted colors)	1	box
37.	Masking Tape	1	roll
38.	Mini Correction Roller, 6m	1	each
39.	Paper Clip	1	box
40.	Scotch Tape (3/4")	1	roll
41.	Sign pen (Black, Red, Blue)	2	each

Part A – Facilities for the PCG Engineer (including PCG  
Engineer's Representative)

REF NO.	DESCRIPTION	QTY.	UNIT
42.	Staple wire Special	0.1	box
43.	Staple Wire, normal size #35	1	box
44.	Technical Pen Ink	1	bottle
45.	Toner Replacement for the photocopier		
	capable : Toner	1.0	each
	Developer	1.0	each
	Drum kit	0.300	each
46.	Whiteboard Eraser	1	each
47.	Whiteboard Marker, assorted colors	1	each
48.	Yellow Paper, Rule	1	pad
<b>c)</b>	<b>CONSUMABLE STORES (Monthly)</b>		
49.	Battery	1	each
50.	Broom	1	each
51.	Dust Pan	1	each
52.	Floor Mop (Set Handle with Mophead)	1	set
53.	Fluorescent Tube 20-40 watts	1	each
54.	Insect spray	1	each
55.	Toilet Deodorant	1	each
56.	Toilet Paper	3	each
57.	Toilet Soap	1	Each

## 1.1 COMPLIANCE WITH CONTRACT REQUIREMENTS

### 1.1.1 Control of on Site Construction

Prior to the start of any definable feature of the work, the Contractor must perform the necessary inspection to include as follows:

- a) Review of Contract Documents to make sure that materials, equipment and products have been tested, submitted and approved.
- b) Physical examination of materials and equipment to assure its conformity to the specifications, plans, shop drawings and other data.
- c) As soon as the work has been started the Contractor shall conduct initial inspection to check and review the workmanship in compliance with the contract requirements for a particular item of work.
- d) The Contractor shall perform these inspections on a regular basis to assure continuing compliance with the contract requirements until completion of a particular type of work.

### 1.1.2 Preconstruction Meetings

Prior to the start of construction, Contractor's material men or vendors whose presence are required, must attend preconstruction meetings as directed for the purpose of discussing the execution of work.

### 1.1.3 Progress Meetings

Progress meetings shall be called upon by the following for the purpose of discussing the implementation of the work:

When called upon by the PCG Engineer or the PCG Engineer's representative for the purpose of discussing the execution of work. Contractor's material men or vendors whose presence is necessary or requested must attend progress meetings. Each of such meeting shall be held at the time and place designated by the PCG Engineer or his representative. Decisions and instructions agreed on these meetings shall be binding and conclusive on the contract. Minutes of this meeting shall be recorded and reasonable number of copies shall be furnished to the Contractor for distribution to various materials men and vendors involved.

The Contractor may also call for a progress meeting for the purpose of coordinating, expediting and scheduling the work. In such meeting Contractor's material men or vendors, whose presence is necessary or requested are required to attend.

### 1.1.4 Progress Reports

The Contractor shall faithfully prepare and submit progress reports to the PCG Engineer every 30 days after the start of the project up to its completion, showing the work completed, work remaining to be done, the status of construction equipment and materials at the site.

### 1.1.5 Survey Data

The Contractor shall layout his work from established based lines and bench mark indicated in the drawing and shall be responsible for all measurement in connection therewith. The Contractor shall furnish, at his own expense, all stakes, templates, platforms, equipment, tools, materials and labor as may be required in laying out any part of the work, out of established base lines and bench mark. It shall be the responsibility of the Contractor to maintain and preserve all stakes and other marks until he is authorized to remove them. If such marks are destroyed by the Contractor through his negligence prior to the authorized removal, they shall be replaced at the expense of the Contractor.

#### 1.1.6 Shop Drawings

The Contractor shall submit and furnish shop drawings and samples accompanied with transmittal forms in accordance with the provision of the Conditions of Contract. The term "Shop Drawings" as used herein shall be understood to include detailed design calculations, construction drawings, lists, graphs, and others.

- a) Transmittal forms shall be filled out in type-written or ink with no alterations or interlineations unless initialed and dated before submittal. Shop drawings shall be submitted the same size as the contract drawings when practicable, but in no case it shall exceed dimension of the contract drawings. The Contractor shall make preliminary check of all shop drawings for compliance with the contract documents and he shall stamp each print with statement of compliance with the requirements. The Contractor may authorize his supplier to deal directly with the PCG Engineer/PCG Engineer's representative with regard to shop drawings, however, ultimate responsibility for accuracy and completeness in the submittal shall remain with the Contractor.
- b) The said shop drawing and transmittal shall be submitted at a time sufficiently early, to allow review of the same by the PCG Engineer/PCG Engineer's representative and to accommodate the rate of construction progress required under the contract. The contractor shall submit print copies of shop drawings with transmittal forms, and copies of brochures with transmittal forms, as required by the PCG Engineer.
- c) Any shop drawings and samples, submitted not accompanied by transmittal forms or where all applicable items on the forms are not completed will be returned for re-submittal. The PCG Engineer's representative will examine/evaluate and recommend approval of the mentioned shop drawing and endorsed it to the PCG Engineer for its approval. The PCG Engineer will retain print copy for his file and return the rest to the Contractor with notation. Returned shop drawings marked "No Exceptions Taken" or "Make Corrections Noted", means formal revision of said drawings will not be required. If it is marked "Amend-Resubmit" or "Rejected-Resubmit", the Contractor shall revise said drawing and shall submit revised drawing to the PCG Engineer.
- d) The PCG Engineer shall process the submission and indicate the appropriate action on the shop drawings and transmittal forms. Construction of an item shall not commenced before the PCG Engineer has reviewed the pertinent shop drawing and returned it to the Contractor, marked as mentioned above. Revisions indicated on shop drawing shall be considered as changes necessary to meet the requirements of the contract drawings and specifications, and shall not be taken as the basis of claims for extra work. The Contractor shall have no claim for damages or extension of time due to any delay, resulting from having Contractors make the required revisions, unless reviewed by the PCG Engineer was delayed beyond reasonable period of time and unless the Contractor can establish that such delay in revision resulted in delay of the project.

Re-submittal procedure shall follow the same procedure as the initial submittal.

#### 1.1.7 Construction Photographs

The Contractor shall take photographs during the progress of the work once a month, all taken where directed by the PCG Engineer. At the completion of the project final photographs shall be taken by the Contractor as directed by the PCG Engineer. Photograph shall be sent to the PCG Engineer or to the PCG Engineer's Representative. The photographs shall be neatly labeled, dated, and identified, showing the date of exposure, project name, location and direction of view.

1.1.8 Cleaning-up

The Contractor shall at all times keep the construction area including storage area used by him free from accumulations of waste material or rubbish. Upon completion of construction, the Contractor shall leave the work and premises in a clean, neat and workmanlike conditions satisfactory to the PCG Engineer.

1.1.9 Provisional Facilities

In the period of two (2) months between the start of contract time and the construction until the occupancy of the of the combined site office and testing laboratory to the PCG Engineer's representative, the Contractor shall provide provisional substitute facilities. During the said period, he shall lease spaces acceptable to the PCG Engineer's representative, for use as laboratory building in the immediate vicinity of the project. He shall provide provisional vehicle acceptable to the PCG Engineer until the specified vehicle are delivered. For the quality control of materials and the Works, testing shall be undertaken at the laboratory of the Bureau of Research and Standards of the respective DPWH Region, or at another laboratory accredited by DOST/BRS with the cost thereof for the account of the Contractor.

If the provisional facilities are not provided by the Contractor, the PCG Engineer may lease or rent such facilities and the cost thereof shall be immediately reimbursed to the PCG Engineer by the Contractor. In the event that the Contractor fails to provide the specified facilities within the specified period, the Contractor shall continue to lease or rent and maintain the provisional facilities at his expense until the specified facilities are made fully available to the satisfaction of the PCG Engineer.

The Contractor shall make all necessary arrangements for the supply and delivery of samples to, and collection of samples from such laboratory. He shall arrange for one copy of the independent testing laboratory's test certificate to be delivered to the PCG Engineer not less than three days before the materials covered by the relevant test certificate are incorporated into the works, and the test certificate shall be related to the materials from which the samples was taken. It shall be reiterated that all test and quality control works shall be the responsibility of the Contractor. The PCG Engineer shall define from the beginning of the works, and in accordance with the Specifications, all test to be performed for each kind of materials and/or works, together with the corresponding frequencies to be used and amend such statement from time to time during the progress of work if deemed necessary.

1.1.10 Documents to be Submitted

The following documents shall be submitted by the Contractor to the PCG Engineer prior to final payment and before issuance of final certificate of payment in accordance with the provisions of the conditions of contract.

- a) The guarantee required by the Conditions of Contract and any other extended guarantees stated in the technical sections of the specifications.
- b) A set of As-Built drawings shall be submitted showing accurate record of changes or deviations from the contract documents and the shop drawings indicating the work as actually installed. Records shall be arranged in order, in accordance with the various sections of the specifications and properly indexed with certifications of endorsement thereof, that each of the revised print of the drawings and specifications are complete and accurate. Prior to the application for final payment, and as a condition to its approval by the PCG Engineer, the Contractor shall deliver the records, drawings, and specifications arranged in proper order, indexed and endorsed as herein specified.

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## PART B – OTHER REQUIREMENTS

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## **PART B - OTHER REQUIREMENTS**

### **1.1 BILLBOARDS**

The Contractor shall install one (1) Billboard measuring 1200 mm x 2400 mm (4ft x 8ft) using 12mm (1/2 inch) marine plywood or tarpaulin posted on 5mm (3/16 inch) marine plywood, in front of the Project site. Project Billboard shall be installed for government information projects to inform the public of the implementation of the project and to advise the road users of the on-going construction. See attached drawing **(Annex A)**.

The Contractor shall also install one (1) Billboard per attached COA Circular No 2013-004 **(Annex B)**.

Upon completion of the work, all signs installed shall be removed from the site.

### **1.2 OFFICE, SHOPS, STORES AND WORKMENS ACCOMMODATION FOR CONTRACTOR**

The Contractor shall provide and maintain such offices stores, workshops, latrines, housing and messing accommodations as are necessary. These shall be located in the Contractor's compound, distinct and separate from the PCG Engineer's compound. The Contractor shall not be permitted to erect temporary buildings or structures on the site without the specific permission in writing of the PCG Engineer including approval of the dimensions of such buildings or structures.

The selection of the site shall be the responsibility of the Contractor and shall be approved by the PCG Engineer. It is entirely up to the Contractor to make whatever arrangements he deems necessary with landowners regarding use of land for the purpose of erecting camps, workshops, garages, stockpiling of materials, location of plants, housing of labor and staff, welfare facilities, and all costs incurred in connection with rental or lease of such land shall be at the Contractor's expense.

The Contractor shall be solely responsible for the erection, maintenance and subsequent disposal of whatever facilities he deems necessary to execute the work.

The Contractor shall not erect temporary buildings or structures within the road right-of-way without the prior written approval of the PCG Engineer.

### **1.3 CONSTRUCTION HEALTH AND SAFETY**

#### **a) Health and Safety Plan**

Within one month of his arrival on the project site, the Contractor shall submit a Health and Safety Plan/Program with operational details of his proposals to the PCG Engineer for prior approval.

#### **b) Accident Prevention Officer; Accidents**

Due precautions shall be taken by the Contractor, at his own cost, to ensure the safety and protection against accidents of all staff and labor engaged on the Works, local residents in the vicinity of the Works, and the public traveling through the Works.

The Contractor shall have on his staff on Site a designated Safety Officer qualified to promote and maintain safe working practices. This Safety Officer shall have authority to issue instructions and shall take protective measures to prevent accidents, including but not limited to, the establishment of safe working practices and the training of staff and labor in their implementation.



The Contractor shall be responsible for all costs including medical treatment, transport, and accommodation incurred by any member of the public or his labor force whether on direct contract or sub-contract as a result of injuries or illness arising from the execution of the Works.

c) Protective Clothing and Safety Equipment

The Contractor shall, at his own expense, provide protective clothing and safety equipment to all staff and labor engaged on the Works to the satisfaction of the PCG Engineer. Such clothing and equipment shall include, at a minimum, high visibility vests for workers directing traffic, protective footwear for workmen undertaking concrete mixing work, protective footwear and gloves for workmen performing paving works, dust masks, rubber boots, rain coats and otherwise as appropriate to the job on hand and to the PCG Engineer's satisfaction.

Refer to **Schedule E** below, after Sub-item d), "Medical and First Aid Facilities) for the breakdown of protective clothing and safety equipment as well as Staff to be supplied by the Contractor for the entire duration of the Project.

d) Medical and First-Aid Facilities

The Contractor shall provide and maintain throughout the duration of the Contract, a medical examining room and sickbay together with all necessary supplies and equipment to be sited in the Contractor's main camp. The rooms shall be used exclusively for medical purposes and shall be of good quality construction with electric lighting and otherwise suitable for their purpose. The sickbay shall have at least one bed, and shall be provided with adjacent washing and sanitation facilities.

The Contractor shall employ permanently on site at least one fully trained medical aide, nurse or paramedic who shall be engaged solely for medical duties.

The Contractor shall, at his own expense, provide first aid equipment at all camps and work sites to the satisfaction of the PCG Engineer, and shall ensure that at all camps and works sites where 20 or more persons are engaged on the Works there shall at all times be a person qualified in first-aid with access to appropriate first-aid equipment.

The location of the medical room and other medical and first-aid arrangements shall be made known to all employees by posting suitable notices at prominent locations around the site and by verbal instruction upon recruitment.

The Contractor's arrangements for complying with this Sub-Section shall be subject to the prior approval of the PCG Engineer and also to the approval of any qualified Medical Officer designated by the Employer to inspect or supervise medical arrangements on the Site.

**SCHEDULE E –CONSTRUCTION HEALTH AND SAFETY  
INCLUDING MEDICAL AND FIRST AIDE FACILITIES**

<b>Description</b>	<b>Quantity</b>	<b>Unit</b>
<b>Labor</b>		
Safety Officer	8	month
Safety Aide	8	month
<b>Materials</b> (Quantities shown below shall be supplied for the entire contract duration of 8 months)		
(a) Medical and First Aid Facilities	1	set
(b) Protective Clothing and Safety Equipment		
Protective Footwear	5	each
Hard Hats	5	each
Reflectorized Vests	5	each
Safety Glasses	5	each

e) Supply of Drinking Water, Sanitation

The Contractor shall provide on the Site at his expense, an adequate supply of drinking water for all staff and labor engaged on the Works, together with sanitary facilities (portable toilets or latrines), to the satisfaction of the PCG Engineer. The Contractor shall thoroughly disinfect and fill all latrine pits, sumps and trenches when no longer required.

Payment of the provision of construction safety and health shall be full compensation for fully satisfying the requirement of this Item to the approval of the PCG Engineer.

1.3.1 Environmental Control Provisions

The required project specific EMP shall consider amongst others, the following Environmental Provisions:

a) Environmental Protection during Construction

- (1) During excavation works, the Contractor shall take all steps necessary to complete drainage and slope protection works in advance of each rainy season. Erosion or instability or sediment deposition arising from operation not in accordance with the Specification shall be made good immediately by the Contractor at his expense.
- (2) Notwithstanding approval of the intended method of working, the Contractor shall at all times be responsible for constructing the earthworks in accordance with the Specifications and Drawings.
- (3) The project area can experience inclement weather – fog, heavy rainfall, monsoons and earthquakes. It will be deemed that the Contractors is familiar with these conditions and has formulated his Works Program considering possible loss of time due to these causes, and it shall be the obligation of the Contractor to revise his program and enhance his construction efforts as necessary to ensure timely completion of the work schedule for each working season.

## b) Revegetation of Disturbed Ground.

Where directed by the PCG Engineer, the Contractor shall establish vegetation on fill slopes, out slopes of IV: 1H or less, worked out borrow pits, and other areas which may include roadway shoulders and verges, spoil disposal areas, stockpile areas, quarries, access tracks, plant sites, camp, landslide scars, gullies and stream and river banks. Prior to placing topsoil and/or establishing vegetation on embankments, all fill material not compacted to the required standards shall be removed from the side slopes.

The Contractor shall be responsible for supplying sufficient planting material to carry out all revegetation works, and shall establish and operate plant nurseries as necessary and shall make his own arrangements for procuring cutting, slips and seed for growing.

## Prevention of Air and Water Pollution

The Contractor shall ensure that his activities do not result in any contamination of land or water by polluting substances. He shall implement physical and operational measures such as earth bunds of adequate capacity around fuel, oil and solvent storage tanks and stores, oil and greases traps in drainage systems from workshops, vehicle and plant washing facilities and service and fuelling areas and kitchens, the establishment of sanitary solid and liquid waste disposal systems, the maintenance in effective condition of these measures, the establishment of emergency response procedures for pollution, events, and dust suppressions, all in accordance with normal good practice and to the satisfaction of the PCG Engineer.

To prevent water pollution caused by disposal of domestic sewage from the worker's camp, temporary toilet facilities shall be installed within the construction area to provide the sanitation requirements of workers. These units shall be kept clean and sanitary at all times.

Should any pollution arise from the Contractor's activities including the improper deposition of sediment he shall clean up the affected area immediately at his own cost and to the satisfaction of the PCG Engineer, and shall pay full compensation to any affected parties.

Air pollution will be mitigated through dust control on the street and at the stock pile of aggregates. This shall be implemented through regular water sprinkling of the stockpile of aggregates and soil.

Maintenance of equipment, scheduled calibration of fuel injection pumps and the use of emission control devices are expected to help reduce the volume of exhaust emissions.

The stand-by diesel engine generator set of the project will be regularly maintained to prevent emission of air pollutants. The said generator set should have a Permit to Operate from the DENR-EMB in accordance with the requirements of the Philippine Clean Air Act.

## c) Protection of Trees and Vegetation

Unless otherwise provided in the Specifications, the Contractor shall ensure that no trees or shrubs or are felled or harmed except for those required to be cleared for execution of the Works. The Contractor shall protect trees and vegetation from damage to the satisfaction of the PCG Engineer. The Contractor shall be responsible for obtaining any necessary felling permits and for ensuring the disposal of felled trees in accordance with prevailing regulations. Endangered species shall be identified, and the Contractor will follow any special provisions in the EMP or DENR permits regarding the potential removal of endangered species. No trees shall be removed without the prior approval of the PCG Engineer and any competent authorities. Should the Contractor become aware during the period of the Contract that any tree or trees designated for

clearance have cultural or religious significance he shall immediately inform the PCG Engineer and await his instruction before proceeding with clearance.

In the event that trees or other vegetation not designated for clearance are damaged or destroyed, they shall be repaired or replaced to the satisfaction of the PCG Engineer.

d) Noise Level and Vibration Control

In general, all construction activities will be limited during daytime hours only (7:00 AM – 5:00 PM). Should there be a need to extend construction hours, proper coordination by the Project Contractor with the LGU and affected communities should be undertaken.

Regular check up and maintenance of heavy equipment will be conducted to control the generation of noise during project construction.

The Contractor shall control noise level from his construction operations to satisfy the Noise Standards of the “Rules and Regulations of the National Pollution Control Commission” (1978) for general areas as shown:

Noise standards in general areas are shown in the table:

**MAXIMUM VALUES OF AIR POLLUTANTS**

Category of Area <sup>1</sup>	Daytime <sup>2</sup>	Morning <sup>3</sup> and Evening <sup>4</sup>	Night Time <sup>5</sup>
AA	50dB	45dB	40dB
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

Legend:

- AA - A section or contiguous area which requires quietness, such as an area within 100 meters from school sites, hospitals, and special homes for the aged.
- B - A section or contiguous area which is primarily used for residential purposes.
- C - A section primarily reserved as a light industrial area.
- D - A section which is primarily reserved as a heavy industrial area

Daytime <sub>2</sub>	-	9:00 A.M. to 6:00 P.M.
Morning <sub>3</sub>	-	5:00 A.M. to 9:00 P.M.
Evening <sub>4</sub>	-	6:00 A.M. to 10:00 P.M.
Night Time	-	10:00 P.M. to 5:00 A.M.

Noise control measures shall include:

- (1) Selecting construction equipment used or the modes of operation adopted that produce less noise. For instance, rotating or impacting machines can be based on anti-vibration mountings. Noisy construction equipment or internal combustion engines must be fitted with silencers.
- (2) Measures such as installation of road/noise barriers must be undertaken to minimize excessive generation of noise and vibrations brought about by earthwork activities and heavy equipment during construction especially along portions of the route close to noise-sensitive areas, such as hospitals, schools and churches.
- (3) Proper scheduling so that noisy construction activities will be done at daytime.

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- (4) Providing earmuffs to construction workers exposed to noise.
  - (5) Monitoring noise levels during construction.
  - (6) Management of traffic during construction to produce a smooth flow instead of a noisier stop-and-start flow.
  - (7) The source can be enclosed to insulate or absorb the sound.
- e) Disposal of all Rubbish, and Demolition Waste
- The Contractor shall be entirely responsible for and ensure the safe and hygienic collection, transportation and disposal of all rubbish, tires, liquid/solid waste material off-site arising from construction activities and from site offices, canteen and for disposal of demolition waste that cannot be recycled. Fires and burning of rubbish and waste on the Site will not be permitted, nor the burying of rubbish and waste. Particular care shall be taken in identification and safe disposal of hazardous materials (if any).
- f) Use of Wood and Fuel
- The Contractor shall not use, or permit to be used, wood as fuel for the execution of any part of the Works and to the extent practicable shall ensure that fuels other than wood are used for cooking, space and water heating in all camps and living accommodations. Any wood so used must be harvested legally, and the Contractor shall provide the PCG Engineer with copies of the relevant permits if required.
- g) Fire Prevention
- In addition to the provision of adequate fire-fighting equipment at this base camp and other facilities to the satisfaction of the PCG Engineer, the Contractor shall take all precautions necessary to ensure that no vegetation along the line of the area of the permanent works is affected by fires arising from the execution of the Works. These precautions shall include the prevention of fires for any purposes in the vicinity of the Works except where expressly permitted by the PCG Engineer.
- In the event of any other fire emergency in the vicinity of the Works, the Contractor shall render assistance to the civil authorities to the best of his ability.
- h) Relationships with Local Communities and Authorities
- In siting and operating his facilities and in executing the Works, the Contractor shall, at all times, and to the extent possible, minimize the impact of his activities on existing communities. Where communities are likely to be affected by major activities such as the establishment of a camp or extensive road closure or bypassing, he shall liaise closely with the concerned communities and their representatives and, if so directed, shall attend additional meetings arranged by the PCG Engineer to resolve issues and claims and minimize impacts on local communities.
- Any problems arising from his operations and which cannot be resolved by the Contractor shall be referred to the PCG Engineer. The Contractor shall be responsible for any compensation due to reinstatements necessary with respect to any damage caused by him to areas outside the Site and no separate payment will be made in this regard.
- i) Privately or Community-Owned Services and Structures
- The Contractor shall take all necessary precautions to ensure that no public or private services, utilities or similar facilities are damaged or interrupted by the Works. These precautions shall include but not be limited to liaison with public and private service providers, local government units, and private owners; a condition survey of all affected services; provision of a satisfactory alternative service while the works are carried out; and reinstatement of a satisfactory permanent facility after completion of the Works in

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each area.

No service or utilities shall be disturbed or cut before arrangements have been made for a satisfactory alternative service, or the Contractor has obtained agreement in writing from the service provider or owner to a temporary cessation of service.

Not less than 14 days before commencing site clearance on any particular section of the Project in accordance with his agreed Program of Work, the Contractor shall supply to the PCG Engineer for his prior approval, a copy of his condition survey of all utilities and services to be affected, copies of any agreements with service providers and owners, his plans for providing temporary service, and his plans for reinstating permanent service following construction of the Works.

Provision of temporary and permanent services shall be to at least the pre-existing level of service and to the satisfaction of the PCG Engineer.

j) Water Supply for Construction

The Contractor shall make the necessary arrangements, at his own expense, for water supply for construction and other purposes. Only clean water, free from deleterious materials and appropriate quality for its intended use, shall be used. In providing water, the Contractor shall ensure that the rights of and supply to existing users are not affected either in quality or timing.

In the event of a dispute over the effect of the Contractor's arrangement on the water supply of others, the PCG Engineer shall be informed immediately and shall instruct the Contractor as to appropriate remedial actions to be undertaken at his expense.

k) Construction and Management of Work Camp

The location of the work camp shall be far from residential areas. The Contractor shall provide adequate fuel or LPG gas for both cooking and other needs. The collection and treatment of solid wastes shall be maintained during construction. The Contractor shall prohibit illegal fishing and hunting in the vicinity of the camp. Cutting of trees shall be avoided to the extent possible and removal of vegetation shall be minimized. Water and pit latrine facilities shall be provided for the employees. At completion of the project, all wreckage, rubbish or temporary works that are no longer required shall be removed or given to local residents. All temporary structures including office building, shelters and latrines shall be removed to prevent encroachment within the road right-of-way. The site shall be restored to near natural or stable conditions. The PCG Engineer shall report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of the works.

## 1.4 TESTS ON COMPLETION

### a. General

- (1) Where the Works or parts thereof are required to perform or function in a particular manner, then before the Contractor requests that they be taken over by the Employer they shall have been tested, commissioned and passed all performance verification checks to ensure that they perform or function in the particular manner specified. Such tests shall include the operation of a system under the conditions expected to prevail during its normal operations. Where testing is required which exceeds normal operating conditions, or where particular testing is required, then this will be described in the appropriate parts of the Specifications.
- (2) The sequence for testing which shall be complete prior to and as a prerequisite to the PCG Engineer issuing the Taking Over Certificate shall be :
  - ☐ Testing : proof of operation in (generally) static conditions
  - ☐ Commissioning : setting to work and adjusting as necessary in dynamic conditions
  - ☐ Performance Verification : measurement of controlled outputs against design outputs
  - ☐ Demonstration testing : equipment or system operation in differing modes
- (3) Testing shall be undertaken using temporary power supplies and the like reticulated by the Contractor. Commissioning, Performance verification and Demonstration Testing shall be undertaken using mains utilities, upgraded and expanded as required by the Contract.

### b. Testing

- (1) Testing shall mean the proof of operation (generally) in static conditions of all Plant, mechanical equipment, materials and installed systems to the design requirements specified for tests and or the manufacturers test ratings. Where tests or specific test requirements are not shown in the Specification for particular elements of the Works the tests to be undertaken shall be those shown in the standards, codes of practice and the like, applicable to those elements of the Works.
- (2) The Contractor shall submit to the PCG Engineer for his approval a complete programme for testing all Plant, mechanical and electrical equipment, materials and installed systems. Separate attachments to this programme shall be provided in a standard format identifying as a minimum requirement :
  - ☐ Plant, mechanical and electrical equipment, materials or installed systems to be tested
  - ☐ standard(s) applicable to the test to be undertaken
  - ☐ design test requirement
  - ☐ methods, equipment and personnel to be used for the test
  - ☐ appropriate notices issued to local and or airport authorities
  - ☐ proposed test date and time.

Space shall be available on the form to record the test date, the results of the test and any comments, consumables used for the test, the PCG Engineer's staff witnessing the test and the PCG Engineers approval. Two copies of the completed and signed test record shall be issued to the PCG Engineer within 5 days of completing the test. The original shall be retained by the Contractor for incorporation to the Operation and Maintenance Manuals.

a. Commissioning

- (1) Commissioning shall mean the setting to work calibrating, balancing, adjusting and measuring outputs of all plant, mechanical and electrical equipment and installed systems against the designed performance outputs. Commissioning shall be carried out for all Mechanical and Electrical equipment/system in accordance with the internationally recognized standards or codes as approved by the PCG Engineer. All automatic controls, refrigeration, conveying, hoisting, and other specialist systems shall be commissioned by, or with, the relevant manufacturer in attendance.
- (2) The Contractor shall submit to the PCG Engineer for his approval a complete programme for commissioning all Plant, mechanical and electrical equipment and installed systems. Separate attachments to this programme shall be provided in a standard format to the requirement of 1.8.b.(2) above, suitably amended for commissioning purposes.

b. Performance Verification

- (3) Performance Verification shall mean the measurement of speeds, flows, volumes, noise, outputs and the like to verify the performance of all Plant, mechanical and electrical equipment and installed systems against the specified performance during the specified range of conditions and over specified durations in each operating mode. Performance verification shall be undertaken following the guidelines given in 1.8.a.(1) or as determined by the PCG Engineer.
- (4) The Contractor shall submit to the PCG Engineer for his approval a complete programme for performance verification of all Plant, mechanical and electrical equipment and installed systems. Separate attachments to this programme shall be provided in a standard format to the requirements of 1.8.b.(2) above, suitably amended for performance verification purposes.

c. Demonstration Testing

Demonstration testing shall be undertaken as performance verification with additionally the Employers staff in attendance as part of the Contractors training obligation. All Plant, mechanical and electrical equipment and installed systems shall be operated over limited durations to demonstrate, fault finding techniques, emergency stop, start up procedures and normal operating modes in varying conditions. A record of all tests, procedures and the like demonstrated together with a record of the Employers staff in attendance shall be submitted to the PCG Engineer.

d. Water Retaining and Conveying Structures

- (1) Structures such as tanks, channels and pipelines intended for the storage or conveyance of water or aqueous liquids shall be tested for water tightness and pressure, as may be necessary, once they have been completed. Such tests shall be required to demonstrate that the individual structures do not leak and that the system formed by the interlinking or connection of the structures also does not leak. Water testing, except where otherwise stated in the Specifications, shall consist of:

- ☐ filling the structures to be tested with water;
- ☐ leaving the water-filled structures to stand for 24 hours;
- ☐ topping the water level up to a set mark;
- ☐ leaving the water-filled structures to stand for a further 24 hours;
- ☐ undertaking pressure test on water pipelines as required by the Specifications; and



② measuring the reduction in level and calculating the loss of water.

- (2) The structures shall be considered to be watertight if the loss of water is less than 2% of the total volume of water required to fill the structures to the set mark.

## 1.5 PUBLICITY

The Contractor shall not, by means of advertising, writings to and for publications, photographs, notices, boards or any other means, use the Works for publicity except with the expressed permission of the PCG Engineer in writing.

## 1.6 INSURANCES

### a. General

In order to permit preliminary works to commence, the Contractor shall, upon receipt of the PCG Engineer's Notice to Proceed, immediately arrange suitable insurances and shall submit to the PCG Engineer cover notes showing that the appropriate insurances are in force. The Contractor shall submit, at the same time as the cover notes, statement(s) from the insurer(s) to the effect that the cover notes are, and the policies to be issued will be in accordance with the Contract and that all the requirements of the Contract are covered.

### b. Approval

As the policies of insurance are issued the Contractor shall submit them to the PCG Engineer for scrutiny prior to approval by the Employer.

### c. Responsibility for Maintaining Insurance Cover

The Contractor shall be wholly and solely responsible for keeping all policies in force and for paying all premiums and other charges necessary for effecting the insurance cover to the full extent required under the Contract.

## 1.7 OWNERSHIP OF SOFTWARE PROGRAMMES

The Contractor is to ensure that the ownership of all programmes for operation of any equipment is vested in the Employer.

## 1.8 INCOME TAX AND OTHER TAXES

The Contractor and his employees shall be liable for income tax and such other taxes, duties, contributions and other charges levied on all payments made to them as shall be payable in accordance with any National or Local Statute, Ordinance, Decree or other Law of the Republic of the Philippines. The Contractor shall ascertain for himself all such liabilities and shall make due allowance in his rates which will be deemed to cover all such costs.

## 1.9 INTERFERENCE WITH WORKS

The Contractor shall not interfere in any way with any existing works, whether the property of the Employer or of a third party and whether the position of such works is indicated to the Contractor by the PCG Engineer or not, except where such interference is specifically described as part of the Works, either in the Contract or in the PCG Engineer's instructions.

**1.10 RATES AND PRICES**

In addition to the detailed breakdown of unit prices submitted by the Contractor prior to award of Contract, the Contractor shall also provide legitimate invoices or quotations, of any rate or price contained in the Contract Documents when required by the PCG Engineer to do so. Said documents will be for the purpose of this contract and shall not be made public.

**1.11 PERMITS AND LICENSES**

The Contractor shall ensure all permits and licenses, and pay all charges, taxes and fees and shall give all notices necessary and incident to the due and lawful execution of the Works.

The Contractor shall also pay all tonnage and other royalties, rent and other payments or compensation, if any for getting stone, sand, gravel or other materials required for the Temporary Works or any of them.

The Contractor shall make application and be entirely responsible for obtaining the Occupancy Permit, and pay at his own expense for all processing fees and the like.

The requirements under this Section are incidental to other items of work and will not be paid separately unless otherwise specified in the Bill of Quantities.

**1.12 OTHER REQUIREMENTS**

The procuring entity reserves the right to conduct background investigation and security clearance to all prospective bidders. Proponents / bidders who are found to have connection, relation, or affiliation to any prescribed, designated terrorist organizations and personalities, those countries whose policies that are contrary, adverse and inconsistent with existing law of the Government of the Philippines, either during eligibility check, post-qualification, or during the implementation stage, whether locally, by the United Nation or other supranational or foreign jurisdiction shall automatically be disqualified/terminated. Further, any bidder or proponent and its personnel who is found to endanger or breach security shall constitute a ground for cancellation of contract.

## Annex A of Part B – Other Requirements

# CONSTRUCTION OF CG STATION SOUTHERN LEYTE BUILDING BRGY. COMBADO, MAASIN CITY, SOUTHERN LEYTE

NOTE: THE EXPENSES INCURRED IN THE INSTALLATION OF BILLBOARD IS INCLUDED IN THE OCM PER DO. 12, SERIES 2011

**CONSTRUCTION OF (Name of Project and Location)**

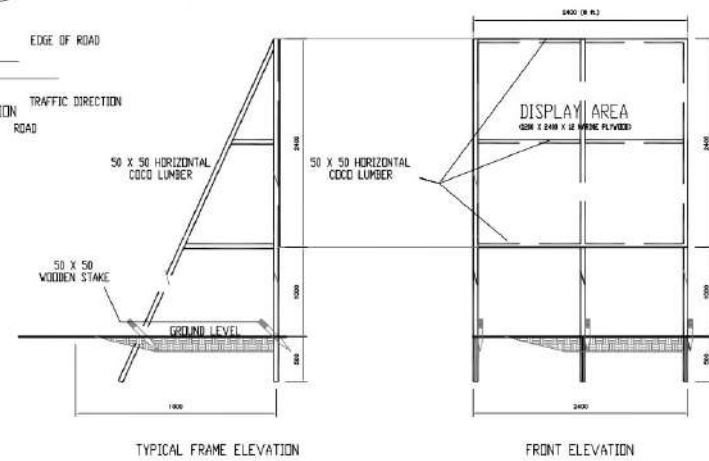
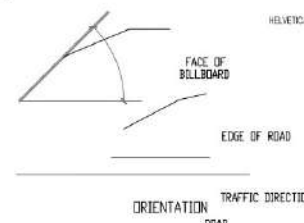
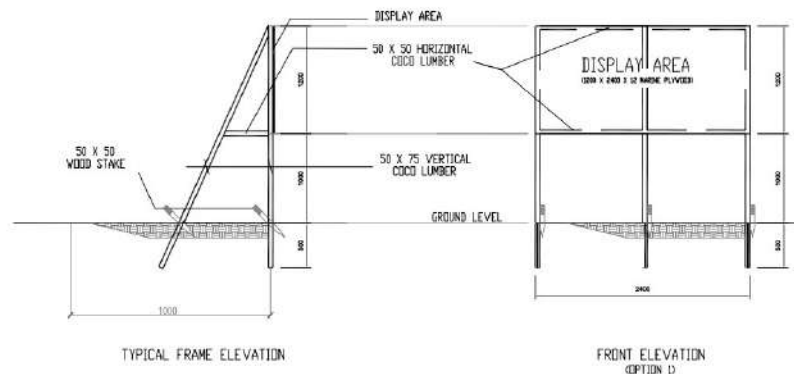
CONTRACTOR :  
DATE STARTED :  
CONTRACT COMPLETION DATE :  
CONTRACT COST :  
CONSTRUCTION CONSULTANT :  
IMPLEMENTING OFFICE :  
SOURCE OF FUND :

**PHILIPPINE COASTGUARD**

Text \_\_\_\_\_ or call (02) \_\_\_\_\_ for any concern on this project  
www. \_\_\_\_\_ gov.ph

SCALE 1:10 M

NOTE 1  
For Source of Fund, \_\_\_\_\_



SCALE 1: 25 M.

## STANDARD PROJECT BILLBOARD (PHILIPPINE COASTGUARD)

**COMMISSION ON AUDIT**  
(PREVISED AND LIT)

Project: \_\_\_\_\_ Cost: \_\_\_\_\_  
Location: \_\_\_\_\_ Fundurce: \_\_\_\_\_  
Implementing Agency: \_\_\_\_\_  
Development Partner: \_\_\_\_\_  
Contractor Supplier: \_\_\_\_\_  
Brief Description of Project: \_\_\_\_\_  
Project Details: \_\_\_\_\_

Project Date			Project Status				Remarks
Duration	Started	Target Date of Completion	Percentage of Completion	As of (Date)	Cost Incurred to Date	Date Completed	

For Particulars or comments about this project, please contact the Regional Office or Cluster which has jurisdiction on this project.  
CGA Regional Office No. / Cluster: \_\_\_\_\_  
Address: \_\_\_\_\_ or Text CGA Cluster Desk at: \_\_\_\_\_  
Contact: \_\_\_\_\_

WHITE/GROUND BLACK/ST

**Annex B**  
**of Part B – Other Requirements**  
(see attached COA Circular No. 2013-004)

## II. CIVIL WORKS (SITE DEVELOPMENT WORKS)

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## PART C – EARTHWORKS

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## **ITEM 100 – CUTTING OF TREES/ CLEARING AND GRUBBING**

### **100.1 DESCRIPTION**

This Item shall consist of clearing, grubbing, removing and disposing all vegetation and debris as designated in the Contract, except those objects that are designated to remain in place or are to be removed in consonance with other provisions of this Specification. The work shall also include the preservation from injury or defacement of all objects designated to remain.

### **100.2 CONSTRUCTION REQUIREMENTS**

#### **100.2.1 General**

The PCG Engineer will establish the limits of work and designate all tree~ shrubs, plants and other things to remain. The Contractor shall preserve all objects designated to remain. Paint required for cut or scarred surface of trees or shrubs selected for retention shall be an approved asphaltum base paint prepared especially for tree surgery.

Clearing shall extend one (1) meter beyond the toe of the fill slopes or beyond rounding of cut slopes, as the case maybe, for the entire length of the project unless otherwise shown on the plans or a directed by the PCG Engineer and provided it is within the right of way limits of the project, with the exception of trees under the jurisdiction of the Forest Management Bureau (FMB).

#### **100.2.2 Clearing and Grubbing**

All surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared and/or grubbed, including mowing as required, except as provided below:

1. Removal of undisturbed stumps and roots and nonperishable solid objects with a minimum depth of 1 meter below subgrade or slope of embankments will not be required.
2. In areas outside of the grading limits of cut and embankment areas, stumps and nonperishable solid objects shall be cut off not more than 150 mm (6 inches) above the ground line or low water level.
3. In areas to be rounded at the top of cut slopes, stumps shall be cut off flush with or below the surface of the final slope line.
4. Grubbing of pits, channel changes and ditches will be required only to the depth necessitated by the proposed excavation within such areas.
5. In areas covered by cogon / talahib, wild grass and other vegetations, top soil shall be cut to a maximum depth of 150 mm below the original ground surface or as designated by the PCG Engineer, and disposed outside the clearing and grubbing limits as indicated in the typical roadway section.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted to the required density.

If perishable material is burned, it shall be burned under the constant care of competent watchmen at such times and in such a manner that the surrounding vegetation, other adjacent property, or anything designated to remain on the right of way will not be jeopardized. If permitted, burning shall be done in accordance with applicable laws, ordinances, and regulations.



The Contractor shall use high intensity burning procedures. (i.e. incinerators, high stacking or pit and ditch burning with forced air supplements) that produce intense burning with little or no visible smoke emission during the burning process. At the conclusion of each burning session, the fire shall be completely extinguished so that no smoldering debris remains.

In the event that the Contractor is directed by the PCG Engineer not to start burning operations or to suspend such operations because of hazardous weather conditions, material to be burned which interferes with subsequent construction operations shall be moved by the Contractor to temporary locations clear of construction operations and later, if directed by the PCG Engineer, shall be placed on a designated spot and burned.

Materials and debris which cannot be burned and perishable materials may be disposed off by methods and at locations approved by the PCG Engineer, on or off the project. If disposal is by burying, the debris shall be placed in layers with the material so disturbed to avoid nesting. Each layer shall be covered or mixed with earth material by the land-fill method to fill all voids. The top layer of material buried shall be covered with at least 300 mm (12 inches) of earth or other approved material and shall be graded, shaped and compacted to present a pleasing appearance. If the disposal location is off the project, the Contractor shall make all necessary arrangements with property owners in writing for obtaining suitable disposal locations which are outside the limits of view from the project. The cost involved shall be included in the unit bid price. A copy of such agreement shall be furnished to the PCG Engineer. The disposal areas shall be seeded, fertilized and mulched at the Contractor's expense.

Woody material may be disposed off by chipping. The wood chips may be used for mulch, slope erosion control or may be uniformly spread over selected areas as directed by the PCG Engineer. Wood chips used as mulch for slope erosion control shall have a maximum thickness of 12 mm (1/2 inch) and faces not exceeding 3900 mm<sup>2</sup> (6 square inches) on any individual surface area. Wood chips not designated for use under other sections shall be spread over the designated areas in layers not to exceed 75 mm (3 inches) loose thickness. Diseased trees shall be buried or disposed off as directed by the PCG Engineer.

All merchantable timber in the clearing area which has not been removed from the right of way prior to the beginning of construction, shall become the property of the Contractor, unless otherwise provided.

Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be trimmed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 6 m (20 feet) above the roadbed surface. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

Timber cut inside the area staked for clearing shall be felled within the area to be cleared.

#### 100.2.3 Individual Removal of Trees or Stumps

Individual trees or stumps designated by the PCG Engineer for removal and located in areas other than those established for clearing and grubbing and roadside cleanup shall be removed and disposed off as specified under Subsection 100.2.2 except trees removed shall be cut as nearly flush with the ground as practicable without removing stumps.

### 100.3 METHOD OF MEASUREMENT

Measurement will be by one or more of the following alternate methods:

1. Area Basis. The work to be paid for shall be the number of hectare and fractions thereof acceptably cleared and grubbed within the limit indicated on the Plans or as may be adjusted in field staking by the PCG Engineer. Areas not within the clearing and grubbing limits shown on the plans or not staked for clearing and grubbing will not be measured for payment.

2. Lump-Sum Basis. When the Bill of Quantities contains a Clearing and Grubbing lump-sum item, no measurement of area will be made for such item.
3. Individual Unit Basis (Selective Clearing). The diameter of tree will be measured at a height of 1.4m (54 inches) above the ground. Tree less than 150 mm (6 inches) in diameter will not be measured for payment.
4. When Bill of Quantities indicates measurement of trees by individual unit basis, the units will be designated and measured in accordance with the following schedule of sizes:

<u>Diameter at height of 1.4 m</u>	<u>Pay Item Designation</u>
Over 150 mm to 900 mm	Small
Over 900 mm	Large

#### **100.4 BASIS OF PAYMENT**

The accepted quantities, measured as prescribed in Section 100.3, shall be paid for at the Contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities, which price and payment shall be full compensation for furnishing all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

## **ITEM 101 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS**

### **101.1 DESCRIPTION**

This Item shall consist of the removal wholly or in part, and satisfactory disposal of all obstructions which are not designated or permitted to remain, except for the obstructions to be removed and disposed off under other items in the Contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits.

### **101.2 CONSTRUCTION REQUIREMENTS**

#### **101.2.1 General**

The Contractor shall perform the work described above, within and adjacent to the roadway and runway, on Government land or easement, as shown on the Plans or as directed by the PCG Engineer. All designated salvable material shall be removed, without unnecessary damage, in sections or pieces which may be readily transported, and shall be stored by the Contractor at specified places on the project. Perishable material shall be handled as designated in Subsection 100.2.2. Nonperishable material may be disposed off outside the limits of view from the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished to the PCG Engineer. Basements or cavities left by the structure removal shall be filled with acceptable material to the level of the surrounding ground and, if within the prism of construction, shall be compacted to the required density.

#### **101.2.2 Removal of Existing Pavement**

All concrete pavement designated for removal shall be broken into pieces and used for riprap on the project, or broken into pieces, the size of which shall not exceed 300 mm in any dimension and stockpiled at designated locations on the project.

### **101.3 METHOD OF MEASUREMENT**

When the Contract stipulates that payment will be made for removal of obstructions on lump-sum basis, the pay item will include all structures and obstructions encountered within the roadway. Where the contract stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the Contract.

Whenever the Bill of Quantities does not contain an item for any aforementioned removals, the work will not be paid for directly, but will be considered as a subsidiary obligation of the Contractor under other Contract Items.

### **101.4 BASIS OF PAYMENT**

The accepted quantities, measured as prescribed in Section 101.3 shall be paid for at the Contract unit price or lump sum price bid for each of the Pay Items listed below that is included in the Bill of Quantities which price and payment shall be full compensation for removing and disposing of obstructions, including materials, labor, equipments, tools and incidentals necessary to complete the work prescribed in this Item. The price shall also include backfilling, salvage of materials removed, their custody, preservation, storage on the right-of-way and disposal as provided herein.

Payment will be made in accordance with the Bill of Quantities.

## **ITEM 102 - EXCAVATION OF UNSUITABLE MATERIALS AND DISPOSAL**

### **102.1 DESCRIPTION**

This Item shall consist of runway/roadway and drainage and borrow excavation and the disposal of material in accordance with this Specification and in conformity with the lines, grades and dimensions shown on the Plans or established by the PCG Engineer.

#### **102.1.1 Roadway and Runway Excavation**

Excavation will include excavation and grading for roadway, runways, parking areas, intersections, approaches, slope rounding, benching, waterways and ditches; removal of unsuitable material from the runway and beneath embankment areas; and excavating selected material found in the runways as ordered by the PCG Engineer for specific use in the improvement. Runway excavation will be classified as "unclassified excavation", "rock excavation", common excavation", or "muck excavation," as indicated in the Bill of Quantities and hereinafter described.

1. **Unclassified Excavation.** Unclassified excavation shall consist of the excavation and disposal of all materials regardless of its nature, not-classified and included in the Bill of Quantities under other pay items.
2. **Rock Excavation.** Rock excavation shall consist of igneous, sedimentary and metamorphic rock which cannot be excavated without blasting or the use of rippers, and all boulders or other detached stones each having a volume of 1 cubic meter or more as determined by physical measurements or visually by the PCG Engineer.
3. **Common Excavation.** Common excavations shall consist of all excavation not included in the Bill of Quantities under "rock excavation" or other pay items.
4. **Muck Excavation.** Muck excavation shall consist of the removal and disposal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for foundation material regardless of moisture content.

#### **102.1.2 Borrow Excavation**

Borrow excavation shall consist of the excavation and utilization of approved material required for the construction of embankments or for other portions of the work, and shall be obtained from approved sources, in accordance with the following:

1. **Borrow, Case 1.** Borrow Case 1 will consist of material obtained from sources designated on the Plans..
2. **Borrow, Case 2.** Borrow, Case 2 will consist of material obtained from sources provided by the Contractor.

The material shall meet the quality requirements determined by the PCG Engineer unless otherwise provided in the Contract.

### **102.2 CONSTRUCTION REQUIREMENTS**

#### **102.2.1 General**

When there is evidence of discrepancies on the actual elevations and that shown on the Plans, a pre-construction survey referred to the datum plane used in the approved Plan shall be undertaken by the Contractor under the control of the PCG Engineer to serve as basis for the computation of the actual volume of the excavated materials.

All excavations shall be finished to reasonably smooth and uniform surfaces. No materials shall be wasted without authority of the PCG Engineer. Excavation operations shall be conducted

so that material outside of the limits of slopes will not be disturbed. Prior to excavation, all necessary clearing and grubbing in that area shall have been performed in accordance with Item 100, Clearing and Grubbing.

#### **102.2.2 Conservation of Topsoil**

Where provided for on the Plans, suitable topsoil encountered in excavation and on areas where embankment is to be placed shall be removed to such extent and to such depth as the PCG Engineer may direct. The removed topsoil shall be transported and deposited in storage piles at locations approved by the PCG Engineer. The topsoil shall be completely removed to the required depth from any designated area prior to the beginning of regular excavation or embankment work in the area and shall be kept separate from other excavated materials for later use.

#### **102.2.3 Utilization of Excavated Materials**

All suitable material removed from the excavation shall be used in the formation of the embankment, subgrade, shoulders, slopes, bedding and backfill for structures, and for other purposes shown on the Plans or as directed.

The PCG Engineer will designate as unsuitable those soils that cannot be properly compacted in embankments. All unsuitable material shall be disposed off as shown on the Plans or as directed without delay to the Contractor.

Only approved materials shall be used in the construction of embankments and backfills.

All excess material, including rock and boulders that cannot be used in embankments shall be disposed off as directed.

Material encountered in the excavation and determined by the PCG Engineer as suitable for topping, road finishing, slope protection, or other purposes shall be conserved and utilized as directed by the PCG Engineer.

Borrow material shall not be placed until after the readily accessible roadway excavation has been placed in the fill, unless otherwise permitted or directed by the PCG Engineer. If the Contractor places more borrow than is required and thereby causes a waste of excavation, the amount of such waste will be deducted from the borrow volume.

#### **102.2.4 Prewatering**

Excavation areas and borrow pits may be prewatered before excavating the material. When prewatering is used, the areas to be excavated shall be moistened to the full depth, from the surface to the bottom of the excavation. The water shall be controlled so that the excavated material will contain the proper moisture to permit compaction to the specified density with the use of standard compacting equipment. Prewatering shall be supplemented where necessary, by truck watering units, to ensure that the embankment material contains the proper moisture at the time of compaction.

The Contractor shall provide drilling equipment capable of suitably checking the moisture penetration to the full depth of the excavation.

#### **102.2.5 Presplitting**

Unless otherwise provided in the Contract, rock excavation which requires drilling and shooting shall be presplit.

Presplitting to obtain faces in the rock and shale formations shall be performed by: (1) drilling holes at uniform intervals along the slope lines, (2) loading and stemming the holes with appropriate explosives and stemming material, and (3) detonating the holes simultaneously.

Prior to starting drilling operations for presplitting, the Contractor shall furnish the PCG Engineer a plan outlining the position of all drill holes, depth of drilling, type of explosives to be used, loading pattern and sequence of firing. The drilling and blasting plan is for record purposes only and will not absolve the Contractor of his responsibility for using proper drilling and blasting procedures. Controlled blasting shall begin with a short test section of a length approved by the PCG Engineer. The test section shall be presplit, production drilled and blasted and sufficient material excavated whereby the PCG Engineer can determine if the Contractor's methods are satisfactory. The PCG Engineer may order discontinuance of the presplitting when he determines that the materials encountered have become unsuitable for being presplit.

The holes shall be charged with explosives of the size, kind, strength, and at the spacing suitable for the formations being presplit, and with stemming material which passes a 9.5 mm (3/8 inch) standard sieve and which has the qualities for proper confinement of the explosives.

The finished presplit slope shall be reasonably uniform and free of loose rock. Variance from the true plane of the excavated back slope shall not exceed 300 mm (12 inches); however, localized irregularities or surface variations that do not constitute a safety hazard or an impairment to drainage courses or facilities will be permitted.

A maximum offset of 600 mm (24 inches) will be permitted for a construction working bench at the bottom of each lift for use in drilling the next lower presplitting pattern.

#### **102.2.6 Excavation of Ditches, and Gutters**

All materials excavated from side ditches and gutters, channel changes, irrigation ditches, inlet and outlet ditches, toe ditches, furrow ditches, and such other ditches as may be designated on the Plans staked by the PCG Engineer, shall be utilized as provided in Subsection 102.2.3.

Ditches shall conform to the slope, grade, and shape of the required cross-section, with no projections of roots, stumps, rock, or similar matter. The Contractor shall maintain and keep open and free from leaves, stick and other debris all ditches dug by him until final acceptance of the work.

Furrow ditches shall be formed by plowing a continuous furrow along the line staked by the PCG Engineer. Methods other than plowing may be used if acceptable to the PCG Engineer. The ditches shall be cleaned out by hand shovel work, by ditcher, or by some other suitable method, throwing all loose materials on the downhill side so that the bottom of the finished ditch shall be approximately 450 mm (18 inches) below the crest of the loose material piled on the downhill side. Hand finish will not be required, but the flow lines shall be in satisfactory shape to provide drainage without overflow.

#### **102.2.7 Excavation of Roadbed and Runway bed Level**

Rock shall be excavated to a depth of 150 mm (6 inches) below subgrade within the limits of the roadbed and runway bed, and the excavation backfilled with material designated on the Plans or approved by the PCG Engineer and compacted to the required density.

When excavation methods employed by the Contractor leave undrained pockets in the rock surface, the Contractor shall at his own expense, properly drain such depressions or when permitted by the PCG Engineer fill the depressions with approved impermeable material.

Material below subgrade, other than solid rock shall be thorough scarified to a depth of 150 mm (6 inches) and the moisture content increased or reduced, as necessary, to bring the material throughout the 150 mm layer to the moisture content suitable for maximum compaction. This layer shall then be compacted in accordance with Subsection 104.3.3.

### **102.2.8 Borrow Areas**

The Contractor shall notify the PCG Engineer sufficiently in advance of opening any borrow areas so that cross-section elevations and measurements of the ground surface after stripping may be taken, and the borrow material can be tested before being used. Sufficient time for testing the borrow material shall be allowed.

All borrow areas shall be bladed and left in such shape as to permit accurate measurements after excavation has been completed. The Contractor shall not excavate beyond the dimensions and elevations established, and no material shall be removed prior to the staking out and cross-sectioning of the site. The finished borrow areas shall be approximately true to line and grade established and specified and shall be finished, as prescribed in Clause 61. When necessary to remove fencing, the fencing shall be replaced in at least as good condition as it was originally. The Contractor shall be responsible for the confinement of livestock when a portion of the fence is removed.

### **102.2.9 Removal of Unsuitable Material**

Where the Plans show the top portion of the runway-bed to be selected topping, all unsuitable materials shall be excavated to the depth necessary for replacement of the selected topping to the required compacted thickness.

Where excavation to the finished graded section results in a subgrade or slopes of unsuitable soil, the PCG Engineer may require the Contractor to remove the unsuitable material and backfill to the finished graded section with approved material. The Contractor shall conduct his operations in such a way that the PCG Engineer can take the necessary cross-sectional measurements before the backfill is placed.

The excavation of muck shall be handled in a manner that will not permit the entrapment of muck within the backfill. The material used for backfilling up to the ground line or water level, whichever is higher, shall be rock or other suitable granular material selected from the roadway excavation, if available. If not available, suitable material shall be obtained from other approved sources. Unsuitable material removed shall be disposed off in designated areas shown on the Plans or approved by the PCG Engineer.

### **102.3 METHOD OF MEASUREMENT**

The cost of excavation of material which is incorporated in the Works or in other areas of fill shall be deemed to be included in the Items of Work where the material is used.

Measurement of Unsuitable or Surplus Material shall be the net volume in its original position. For measurement purposes, surplus suitable material shall be calculated as the difference between the net volume of suitable material required to be used in embankment corrected by applying a shrinkage factor or a swell factor in case of rock excavation, determined by laboratory tests to get its original volume measurement, and the net volume of suitable material from excavation in the original position. Separate pay items shall be provided for surplus common, unclassified and rock material.

The Contractor shall be deemed to have included in the contract unit prices all costs of obtaining land for the disposal of unsuitable or surplus material.

### **102.4 BASIS OF PAYMENT**

The accepted quantities, measured as prescribed in Section 102.3, shall be paid for at the contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities which price and payment shall be full compensation for the removal and disposal of excavated materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

## ITEM 103 - STRUCTURE EXCAVATION

### 103.1 DESCRIPTION

This Item shall consist of the necessary excavation for culverts and other structures not otherwise provided for in the Specifications. Except as otherwise provided for pipe culvert, the backfilling of completed structures and the disposal of all excavated materials, shall be in accordance with these Specifications and reasonably close conformity with the Plans or as established by the PCG Engineer.

It shall also include the furnishing and placing of approved foundation fill material to replace unsuitable material encountered below the foundation elevation of structures.

No allowance will be made for classification of different types material encountered.

### 103.2 CONSTRUCTION REQUIREMENTS

#### 103.2.1 Clearing and Grubbing

Prior to starting excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Item 100, Clearing and Grubbing.

#### 103.2.2 Excavation

(1) General, all structures. The Contractor shall notify the PCG Engineer sufficiently in advance of the beginning of any excavation so that cross-sectional elevations and measurements may be taken on the undisturbed ground. The natural ground adjacent to the structure shall not be disturbed without permission of the PCG Engineer.

(2) Trenches or foundation pits for structures shall be excavated to the lines and grades or elevations shown on the Plans or as staked by the PCG Engineer. They shall be of sufficient size to permit placing of structures of the full width and length shown.

Boulders, logs, and other objectionable materials encountered excavation shall be removed.

After each excavation is completed, the Contractor shall notify the PCG Engineer to that effect and no bedding material shall be placed until the PCG Engineer has approved the depth of excavation and the character of the foundation material.

(3) Structures other than pipe culverts. All rock or other hard foundation materials shall be cleaned all loose materials, and cut to a firm surface, either level, stepped, or serrated as directed by the PCG Engineer. All seams or crevices shall be cleaned and grouted. All loose and disintegrated rocks and thin strata shall be removed. When the foundation material is soft or mucky or otherwise unsuitable, as determined by the PCG Engineer, the Contractor shall remove the unsuitable material and backfill with approved granular material. This foundation fill shall be placed and compacted in 150 mm (6 inches) layers up to the foundation elevation.

(4) **Pipe Culverts.** The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe.

Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least 300 mm or 4 mm for each 100 mm of fill over the top of pipe, whichever is greater, but not to exceed three-quarters of the vertical inside diameter of the pipe. The width of the excavation shall be at least 300 mm (12 inches) greater than the horizontal outside diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material,



such as silty clay or loam, and lightly compacted in layers not over 150 mm (6 inches) in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, such unstable soil under the pipe and for a width of at least one diameter on each side of the pipe shall be removed to the depth directed by the PCG Engineer and replaced with approved granular foundation fill material properly compacted to provide adequate support for the pipe, unless other special construction methods are called for on the Plans.

The foundation surface shall provide a firm foundation of uniform density throughout the length of the culvert and, if directed by the PCG Engineer, shall be cambered in the direction parallel to the pipe centerline.

Where pipe culverts are to be placed in trenches excavated in embankments, the excavation of each trench shall be performed after the embankment has been constructed to a plane parallel to the proposed profile grade and to such height above the bottom of the pipe as shown on the Plans or directed by the PCG Engineer.

### **103.2.3 Utilization of Excavated Materials**

All excavated materials, so far as suitable, shall be utilized as backfill or embankment. The surplus materials shall be disposed off in such manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure. No excavated materials shall be deposited at any time so as to endanger the partly finished structure.

### **103.2.4 Backfill and Embankment for Structures Other Than Pipe Culverts**

Excavated areas around structures shall be backfilled with free draining granular material approved by the PCG Engineer and placed in horizontal layers not over 150 mm (6 inches) in thickness, to the level of the original ground surface. Each layer shall be moistened or dried as required and thoroughly compacted with mechanical tampers.

In placing backfills or embankment, the material shall be placed simultaneously in so far as possible to approximately the same elevation on both sides of the structure. If conditions require placing backfill or embankment appreciably higher on one side than on the opposite side, the additional material on the higher side shall not be placed until the masonry has been in place for 14 days, or until tests made by the laboratory under the supervision of the PCG Engineer establishes that the masonry has attained sufficient strength to withstand any pressure created by the methods used and materials placed without damage or strain beyond a safe factor.

Backfill or embankment shall not be placed behind the walls of concrete culverts or rigid frame structures until the top slab is placed and cured.

All embankments adjacent to structures shall be constructed in horizontal layers and compacted as prescribed in Subsection 104.3.3 except that mechanical tampers may be used for the required compaction. Special care shall be taken to prevent any wedging action against the structure and slopes bounding or within the areas to be filled shall be benched or serrated to prevent wedge action. The placing of embankment and the benching of slopes shall continue in such a manner that at all times there will be horizontal berm of thoroughly compacted material for a distance at least equal to the height of the abutment or wall to the backfilled against except insofar as undisturbed material obtrudes upon the area.

Broken rock or coarse sand and gravel shall be provided for a drainage filter at weep holes as shown on the Plans.

### **103.2.5 Bedding, Backfill, and Embankment for Pipe Culverts**

Bedding, Backfill, and Embankment for pipe culverts shall be done in accordance with Item 500, Pipe Culverts and Storm Drains.

## **103.3 METHOD OF MEASUREMENT**

### **103.3.1 Structure Excavation**

The volume of excavation to be paid for will be the number of cubic metres measured in original position of material acceptably excavated in conformity with the Plans or as directed by the PCG Engineer, but in no case except as noted, will any of the following volumes be included in the measurement for payment:

1. The volume outside of vertical planes of 450 mm (15 inches) outside of and parallel to the neat line of the structures
2. The volume of excavation for culvert and sections outside the vertical plane for culverts stipulated in (1) above.
3. The volume of any excavation performed prior to the taking elevations and measurements of the undisturbed ground.
4. The volume of any material rehandled, except that where the plans indicate or the PCG Engineer directs the excavation after embankment has been placed and except that when installation of pipe culverts by the imperfect trench method specified in Item 500 is required, the volume of material re-excavated as directed will be included.

The volume of structural backfill to be paid for will be the number of cubic meters of granular materials actually provided and placed within the limit of excavation.

### **103.3.2 Foundation Fill**

The volume of foundation fill to be paid for will be the number cubic meters measures in final position of the special granular material or lean concrete actually provided and placed below the foundation elevation of structures as specified, complete in place and accepted.

### **103.3.3 BASIS OF PAYMENT**

The accepted quantities measure as prescribed in Section 103 shall be paid for at the contract unit price for each of the particular pay item listed below that is included in the Bill of Quantities. The payment shall constitute full compensation for the removal and disposal of excavated materials including all labor, equipment, tools and incidentals to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

## **ITEM 104 - EMBANKMENT FROM SITE/FROM SOURCE**

### **104.1 DESCRIPTION**

This Item shall consist of the construction of embankment from site and from source, in accordance with this Specification and in conformity with the lines, grades and dimensions shown on the Plans or established by the PCG Engineer.

### **104.2 MATERIAL REQUIREMENTS**

Embankments shall be constructed of suitable materials, in consonance with the following definitions:

1. Suitable Material -Material which is acceptable in accordance with the Contract and which can be compacted in the manner specified in this Item. It can be common material or rock.

Selected Borrow, for topping -soil of such gradation that all particles will pass a sieve with 75 mm (3 inches) square openings and not more than 15 mass percent will pass the 0.075 mm (No. 200) sieve, as determined by AASHTO T 11. The material shall have a plasticity index of not more than 6 as determined by ASSHTO T 90 and a liquid limit of not more than 30 as determined by AASHTO T 89.

2. Unsuitable Material -Material other than suitable materials such as:
  - a. Materials containing detrimental quantities of organic material, such as grass, roots and sewerage.
  - b. Highly organic soils such as peat and muck.
  - c. Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.
  - d. Soils with a natural water content exceeding 100%.
  - e. Soils with very low natural density, 800 kg/m<sup>3</sup> or lower.
  - f. Soils that cannot be properly compacted as determined by the PCG Engineer.

### **104.3 CONSTRUCTION REQUIREMENTS**

#### **104.3.1 General**

Prior to construction of embankment, all necessary clearing and grubbing in that area shall have been performed in conformity with item 100, Clearing and Grubbing.

Embankment construction shall consist of constructing roadway, runway and parking areas embankments, including preparation of areas upon which they are to be placed; the placing and compacting of approved material with in roadway, runway and parking areas where unsuitable has been removed, and the placing and compacting of embankment material in holes, pits and other depression within the roadway, runway and parking areas.

Embankments and backfill shall contain no muck, peat, sod, root or other deleterious matter.

When shown on the plan or as directed by the PCG Engineer, the surface of the existing ground shall be compacted to a depth of 150 mm (6 inches) and to the specified requirements of this item.

Where provided in the Bill of Quantities, the top portions of the roadbed in both cuts and embankments, as indicated, shall consist of selected borrow for topping from excavations.

### 104.3.2 Methods of Construction

When there is evidence of discrepancies on the actual elevations and that shown on the Plans, a preconstruction survey referred to the datum plane used in the approved Plan shall be undertaken by the Contractor under the control of the PCG Engineer to serve as basis for the computation of the actual volume of the embankment materials.

When embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when embankment is built one-half width at a time, the existing slopes that are steeper than 3:1 when measured at right angles to the roadway, runway and parking shall be continuously benched over those areas as the work is brought up in layers. Benching will be subject to the PCG Engineer's approval and shall be of sufficient width to permit operation of placement and compaction equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus excavated shall be placed and compacted along with the embankment material in accordance with the procedure described in this Section.

Unless shown otherwise on the Plans, where an embankment of less than 1.2 m (4 feet) below subgrade is to be made, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up by plowing, scarifying, or steeping to a minimum depth of 150 mm except as provided in Subsection 102.2.2. This area shall then be compacted as provided in Subsection 104.3.3. Sod not required to be removed shall be thoroughly disc, harrowed or scarified before construction of embankment. Wherever a compacted road surface containing granular materials lies within 900 mm (36 inches) of the subgrade, such old road surface shall be scarified to a depth of at least 150 mm (6 inches) whenever directed by the PCG Engineer. This scarified material shall then be compacted as provided in Subsection 104.3.3.

When shoulder excavation is specified, the roadway shoulders shall be excavated to the depth and width shown on the Plans. The shoulder material shall be removed without disturbing the adjacent existing base course material, and all excess excavated materials shall be disposed off as provided in Subsection 102.2.3. If necessary, the areas shall be compacted before being backfilled.

Roadway and runway embankment shall be formed on successive horizontal layers of not more than 200mm (8") loose measurement for the full width of the cross section, unless otherwise approved by the PCG Engineer and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assume uniform density. Water shall be added or removed if necessary, in order to obtain the required density. Removal of water shall be accomplished through aeration by plowing, blading, dicing, or other methods satisfactory to the PCG Engineer.

Where embankment is to be constructed across low swampy ground that will not support the mass of trucks or other hauling equipment, the lower part of the fill may be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers.

When excavated material contains more than 25 mass percent of rock larger than 150 mm in greatest diameter and cannot be placed in layers of the thickness prescribed without crushing, pulverizing or further breaking down the pieces resulting from excavation methods, such materials may be placed on the embankment in layers not exceeding in thickness the approximate average size of the larger rocks, but not greater than 600 mm (24 inches).

Even though the thickness of layers is limited as provided above the placing of individual rocks and boulders greater than 600 mm in diameter will be permitted provided that when placed, they do not exceed 1200 mm (48 inches) in height and provided they are carefully distributed with the interstices filled with finer material to form a dense and compact mass.

Each layer shall be levelled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of earth. Lifts of material containing more than 25 mass percent of rock larger than 150 mm in greatest dimension shall not be constructed above an elevation 300 mm (12 inches) below the finished subgrade. The balance of the embankment shall be composed of suitable material smoothed and placed in layers not exceeding 200 mm (8 inches) in loose thickness and compacted as specified for embankments. When rock and other materials are excavated approximately the same time, the rock shall be incorporated into the outer portion of the embankment and other materials shall be incorporated under the future paved areas. Stones or fragmentary rock larger than 100mm (4") in their greatest dimension will not be allowed in the top 150mm (6") of the subgrade. Rockfill shall be brought up in layers as specified or as directed and every effort shall be exerted to fill the voids with the finer materials forming a dense, compact mass.

Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until compaction complies with the requirements of Subsection 104.3.3.

Hauling and leveling equipment shall be so routed and distributed over each layer of the fill in such a manner as to make use of compaction effort afforded thereby and to minimize rutting and uneven compaction.

### **104.3.3 Compaction**

#### Compaction Trials

Before commencing the formation of embankments, the Contractor shall submit in writing to the PCG Engineer for approval his proposals for the compaction of each type of fill material to be used in the Works. The proposals shall include the relationship between the types of compaction equipment, and the number of passes required and the method of adjusting moisture content. The Contractor shall carry out full scale compaction trials on areas not less than 10 m wide and 50 m long as required by the PCG Engineer and using his proposed procedures or such amendments thereto as may be found necessary to satisfy the PCG Engineer that all the specified requirements regarding compaction can be consistently achieved. Compaction trials with the main types of fill material to be used in the Works shall be completed before work with the corresponding materials will be allowed to commence.

Throughout the periods when compaction of earthwork is in progress, the Contractor shall adhere to the compaction procedures found from compaction trials for each type of material being compacted, each type of compaction equipment employed and each degree of compaction specified.

#### Earth

The Contractor shall compact the material placed in all embankment layers and the material scarified to the designated depth below subgrade in cut sections, until a uniform density of not less than 95 mass percent of the maximum determined by AASHTO T 180 Method D, is attained, at a moisture content determined by the PCG Engineer to be suitable for such density. Acceptance of compaction may be based on adherence to an approved roller pattern developed as set forth in Item 106, Compaction Equipment and Density Control Strips.

The PCG Engineer shall during progress of the Work, make density tests of compacted material in accordance with AASHTO T 191, T 205, or other approved field density tests, including the use of properly calibrated nuclear testing devices. A correction for coarse particles may be made in accordance with AASHTO T 224. If, by such tests, the PCG Engineer determines that the specified density and moisture conditions have not been attained, the Contractor shall perform additional work as may be necessary to attain the specified conditions.

At least one group of three in-situ density tests shall be carried out for each 500 m<sup>2</sup> of each layer of compacted fill.

Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with approved methods.

Embankment materials classified as rock shall be deposited, spread and levelled the full width of the fill with sufficient earth or other fine material so deposited to fill the interstices to produce a dense compact embankment. In addition, one of the rollers, vibrators, or compactors meeting the requirements set forth in Subsection 106.2.1, Compaction Equipment, shall compact the embankment full width with a minimum of three complete passes for each layer of embankment.

#### **104.3.4 Protection of Roadbed and Runway Bed During Construction**

During the construction of the roadbed runway and parking area, they shall be maintained in such condition that they will be well drained at all times. Side ditches or gutters emptying from cuts to embankments or otherwise shall be so construed as to avoid damage to embankments by erosion.

#### **104.3.5 Protection of Structure**

If embankment can be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of, or excessive pressure against the structure. When noted on the Plans, the fill adjacent to the end bent of a bridge shall not be placed higher than the bottom of the backfill of the bent until the superstructure is in place. When embankment is to be placed on both sides of a concrete wall or box type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure.

#### **104.3.6 Rounding and Warping Slopes**

Rounding - Except in solid rock, the tops and bottoms of all slopes, including the slopes of drainage ditches, shall be rounded as indicated on the Plans. A layer of earth overlaying rock shall be rounded above the rock as done in earth slopes.

Warping-adjustments in slopes shall be made to avoid injury in standing trees or marring of weathered rock, or to harmonize with existing landscape features, and the transition to such adjusted slopes shall be gradual. At intersections of cuts and fills, slopes shall be adjusted and warped to flow into each other or into the natural ground surfaces without noticeable break.

#### **104.3.7 Finishing Roadbed and Runway Bed and Slopes**

After the roadbed, Runway Bed have been substantially completed, the full width shall be conditioned by removing any soft or other unstable material that will not compact properly or serve the intended purpose. The resulting areas and all other low sections, holes or depressions shall be brought to grade with suitable selected material. Scarifying, blading, dragging, rolling or other methods of work shall be performed or used as necessary to provide a thoroughly compacted roadbed shaped to the grades and cross-sections shown on the Plans or as staked by the PCG Engineer.

All earth slopes shall be left with roughened surfaces but shall be reasonably uniform, without any noticeable break, and in reasonably close conformity with the Plans or other surfaces indicated on the Plans or staked by the PCG Engineer, with no variations therefrom readily discernible as viewed from the road.

#### **104.3.8 Serrated Slopes**

Cut slopes in rippable material (soft rock) having slope ratios between 0.75:1 and 2:1 shall be constructed so that the final slope line shall consist of a series of small horizontal steps. The step rise and tread dimensions shall be shown on the Plans. No scaling shall be performed on

the step slopes except for removal of large rocks which will obviously be a safety hazard if they fall into the ditch line or roadway.

#### **104.3.9 Earth Beams**

When called for in the Contract, permanent earth beams shall be constructed of well graded materials with no rocks having a diameter greater than 0.25 the height of the beam. When local material is not acceptable, acceptable material shall be imported, as directed by the PCG Engineer.

##### Compacted Beams

Compacted beam construction shall consist of moistening or drying and placing material as necessary in locations shown on the drawings or as established by the PCG Engineer. Material shall contain no frozen material, roots, sod, or other deleterious materials. Contractor shall take precaution to prevent material from escaping over the embankment slope. Shoulder surface beneath beam will be roughened to provide a bond between the beam and shoulder when completed. The Contractor shall compact the material placed until at least 90 mass percent of the maximum density is obtained as determined by AASHTO T 99. Method C. The cross-section of the finished compacted beam shall reasonably conform to the typical cross- section as shown on the Plans.

##### Uncompacted Beams

Uncompacted beam construction shall consist of drying, if necessary, and placing material in locations shown on the Plans or as established by the PCG Engineer. Material shall contain no frozen material, roots, sod or other deleterious materials. Contractor shall take precautions to prevent material from escaping over the embankment slope.

#### **104.4 METHOD OF MEASUREMENT**

The quantity of embankment to be paid for shall be the volume of material compacted in place, accepted by the PCG Engineer and formed with material obtained from any source.

Material from excavation per Item 102 which is used in embankment and accepted by the PCG Engineer will be paid under Embankment and such payment will be deemed to include the cost of excavating, hauling, stockpiling and all other costs incidental to the work.

Material for Selected Borrow topping will be measured and paid for under the same conditions specified in the preceding paragraph.

#### **104.5 BASIS OF PAYMENT**

The accepted quantities, measured as prescribed in Section 104.4, shall be paid for at the Contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities. The payment shall constitute full compensation for placing and compacting all materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

#### **104.6 QUALITY STANDARD**

Refer to Annex 1 (Quality Standards).

## **ITEM 105 - SUBGRADE PREPARATION**

### **105.1 DESCRIPTION**

This item shall consist of the preparation of the subgrade for the support of overlying structural layers. It shall extend to full width of the roadway/runway. Unless authorized by the PCG Engineer, subgrade preparation shall not be done unless the Contractor is able to start immediately the construction of the pavement structure.

### **105.2 MATERIAL REQUIREMENTS**

Unless otherwise stated in the Contract and except when the subgrade is in rock cut, all materials below subgrade level to a depth 150 mm or to such greater depth as may be specified shall meet the requirements of Section 104.2, Materials Requirements.

### **105.3 CONSTRUCTION REQUIREMENTS**

#### **105.3.1 Prior Works**

Prior to commencing preparation of the subgrade, all culverts, cross drains, ducts and the like (including their fully compacted backfill), ditches, drains and drainage outlets shall be completed. Any work on the preparation of the subgrade shall not be started unless prior work herein described shall have been approved by the PCG Engineer. Subgrade surface level (Cut, Fill and existing) shall be subjected to proof rolling test by using a Dump truck with minimum load of 30 metric tons to check the displacement and rutting. Acceptance of the surface movement will be at PCG Engineers discretion.

#### **105.3.2 Subgrade Level Tolerances**

The finished compacted surface of the subgrade shall conform the allowable tolerances as specified hereunder:

Permitted variation from	+ 10 mm
Design LEVEL OF SURFACE	-30 mm
Permitted SURFACE IRREGULARITY MEASURED BY 3-m STRAIGHT EDGE	20mm
Permitted variation from DESIGN CROSSFALL OR CAMBER	±0.5%
Permitted variation from DESIGN LONGITUDINAL GRADE over 25 m length	±0.1 %

#### **105.3.3 Subgrade in Common Excavation**

Unless otherwise specified, all materials below subgrade level in earth cuts to a depth 150 mm or other depth shown on the Plans or as directed by the PCG Engineer shall be excavated. The material, if suitable, shall be set aside for future use or, if unsuitable, shall be disposed off in accordance with the requirements of Subsection 102.2.9.

Where material has been removed from below subgrade level, the resulting surface shall be compacted to a depth of 150 mm and in accordance with other requirements of Subsection 104.3.3.



All materials immediately below subgrade level in earth cuts to a depth of 150 mm, or to such greater depth as may be specified, shall be compacted in accordance with the requirements of Subsection 104.3.3.

#### **105.3.4 Subgrade in Rock Excavation**

Surface irregularities under the subgrade level remaining after trimming of the rock excavation shall be levelled by placing specified material and compacted to the requirements of Subsection 104.3.3.

#### **105.3.5 Subgrade on Embankment**

After the embankment has been completed, the full width shall be conditioned by removing any soft or other unstable material that will not be compacted properly. The resulting areas and all other low sections, holes, or depressions shall be brought to grade with suitable material. The entire roadbed shall be shaped and compacted to the requirements of Subsection 104.3.3. Scarifying, blading, dragging, rolling, or other methods of work shall be performed or used as necessary to provide a thoroughly compacted roadbed shaped to the cross-sections shown on the Plans.

#### **105.3.6 Subgrade on Existing Pavement**

Where the new pavement is to be constructed immediately over an existing Portland Cement concrete pavement and if so specified in the Contract the slab shall be broken into pieces with greatest dimension of not more than 500 mm and the existing pavement material compacted as specified in Subsection 104.3.3, as directed by the PCG Engineer. The resulting subgrade level shall, as part of pavement construction be shaped to conform to the allowable tolerances of Subsection 105.3.2 by placing and compacting where necessary a levelling course comprising the material of the pavement course to be placed immediately above.

Where the new pavement is to be constructed immediately over an existing asphalt concrete pavement or gravel surface pavement and if so specified in the Contract the pavement shall be scarified, thoroughly loosened, reshaped and recompactd in accordance with Subsection 104.3.3. The resulting subgrade level shall conform to the allowable tolerances of Subsection 105.3.2.

#### **105.3.7 Protection of Completed Work**

The Contractor shall be required to protect and maintain at his own expense the entire work within the limits of his Contract in good condition satisfactory to the PCG Engineer from the time he first started work until all work shall have been completed. Maintenance shall include repairing and recompactd ruts, ridges, soft spots and deteriorated sections of the subgrade caused by the traffic of the Contractor's vehicle/equipment or that of the public.

#### **105.3.8 Templates and Straight-edges**

The Contractor shall provide for use of the PCG Engineer, approved templates and straight-edges in sufficient number to check the accuracy of the work, as provided in this Specification.

### **105.4 METHOD OF MEASUREMENT**

#### **105.4.1 Measurement of Items for payment shall be provided only for:**

- I. The compaction of existing ground below subgrade level in cuts of common material as specified in Subsection 105.3.3.
- II. The breaking up or scarifying, loosening, reshaping and re-compacting of existing pavement as specified in Subsection 105.3.6. The quantity to be paid for shall be the area of the work specified to be carried out and accepted by the PCG Engineer.

**105.4.2** Payment for all work for the preparation of the subgrade, including shaping to the required levels and tolerances, other than as specified above shall be deemed to be included in the Pay Item for Embankment.

**105.5 BASIS OF PAYMENT**

The accepted quantities, measured as prescribed in Section 105.4 shall be paid for at the appropriate contract unit price for Pay Item listed below that is included in the Bill of Quantities which price and payment shall be full compensation for the placing or removal and disposal of all materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

## **ITEM 106 - COMPACTION EQUIPMENT AND DENSITY CONTROL STRIPS**

### **106.1 DESCRIPTION**

When specified, this procedure will be used to determine density requirements of selected embankments, subgrade, bases, and bituminous concrete. The procedure will consist of control strip construction to establish target densities for the specified course plus use of sand-cone method of density testing equipment to determine in place densities obtained during the construction process.

### **106.2 – CONSTRUCTION REQUIREMENTS**

#### **106.2.1 Compaction Equipment**

Compaction equipment shall be capable of obtaining compaction requirements without detrimentally affecting the compacted material. The equipment shall be modern, efficient compacting units approved by the PCG Engineer. The compacting units may be of any type, provided they are capable of compacting each lift of material as specified and meet the minimum requirements as contained herein. Minimum requirements for rollers are as follows:

- a. Sheepfoot, tamping or grid rollers shall be capable of exerting a force of 45 Newton per millimeter (250 pounds per inch) of length of roller drum.
- b. Steel-wheel rollers other than vibratory shall be capable of exerting a force of not less than 45 Newton per millimeter of width of the compression roll or rolls.
- c. Vibratory steel-wheel rollers shall have a minimum mass of 6 tonnes. The compactor shall be equipped with amplitude and frequency controls and specifically designed to compact the material on which it is used.
- d. Pneumatic-tire rollers shall have smooth tread of equal size that will provide a uniform compacting pressure for the full width of the roller and capable of exerting a ground pressure of at least 550 kPa (80 pounds per square inch).
- e. Heavier compacting units may be required to achieve the specified density of the embankment.

#### **106.2.2 Construction of Control Strips and Determination of Target Density**

To determine target density, a control strip shall be compacted at the beginning of work on each course of material to be compacted. Each control strip, constructed to acceptable density and surface tolerances shall remain in place and become a section of the completed roadway. Unacceptable control strip shall be corrected or removed and replaced at the Contractor's expense. A control strip shall have an area of approximately 335 square meters and shall be of the same depth specified for the construction of the course which it represents.

The materials used in the construction of the control strip shall conform to the specification requirements. They shall be furnished from the same source and shall be on the same type to be used in the remainder of the course represented by the control strip. The underlying grade or pavement structure upon which a control strip is to be constructed shall have the prior approval of the PCG Engineer.

The equipment used in the construction of the control strip shall be approved by the PCG Engineer and shall be of the same type and mass to be used on the remainder of the course represented by the control strip.

Compaction of controls strips shall commence immediately after the course has been placed to

the specified thickness, and shall be continuous and uniform over the entire surface. Compaction of the control strip shall be continued until no discernible increase in density can be obtained by additional compactive effort.

Upon completion of the compaction, the mean density of the control strip will be determined by averaging the results of ten in place density tests taken at randomly selected sites within the control strip. The mean density of the control strip shall be the target density for the remainder of the course which it represents.

If the mean density of the control strip is less than 98 percent of the density of laboratory compacted specimens as determined by testing procedures appropriate for the material being placed, the PCG Engineer may order the construction of another control strip.

A new control strip may also be ordered by the PCG Engineer or requested by the Contractor when:

- a. A change in the material or job-mix formula is made.
- b. Ten days of production have been accepted without construction of a new control strip.
- c. There is reason to believe that a control strip density is not representative of the material being placed.

#### **106.3 METHOD OF MEASUREMENT**

No measurement for payment will be made for this item.

#### **106.4 BASIS OF PAYMENT**

Unless otherwise provided, the cost of constructing the control strip will be considered incidental to the cost of the work item for which a control strip is required. Payment for the work item shall be deemed to include compensation for performing the work therein specified and the furnishing of all materials, labors, tools, equipment and incidentals necessary to construct the density control strip. No payment will be made for any material used in the construction of unacceptable control strip.

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## PART D – SUBBASE AND BASE COURSE

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## **ITEM 200 - AGGREGATE SUBBASE COURSE**

### **200.1 DESCRIPTION**

The Item shall consist of furnishing, placing and compacting an aggregate subbase course on a prepared subgrade in accordance with this Specification and the lines, grades and cross sections shown on the Plans, or as directed by the PCG Engineer.

### **200.2 MATERIAL REQUIREMENTS**

Aggregate for Subbase shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable Subbase.

The Subbase material shall conform to Table 200.1 Grading requirement.

**Table 200.1 -Grading Requirements**

<b>Sieve Designation</b>		<b>Mass Percent Passing</b>
<b>Standard mm</b>	<b>Alternate US Standard</b>	
50	2"	100
25	1"	55-85
9.5	3/8"	40-75
0.075	No. 200	0-12

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and plasticity index not greater than 12 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve, shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion Tests as determined by AASHTO T 96.

The material shall have a soaked CBR value of not less than 25% as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density and determined by AASHTO T 180, Method D.

### **200.3 CONSTRUCTION REQUIREMENTS**

#### **200.3.1 Preparation of Existing Surface**

The existing surface shall be graded and finished as provided under Item 105 - Subgrade Preparation, before placing the Subbase material.

#### **200.3.2 Placing**

The aggregate subbase material shall be placed at a uniform mixture on a prepared subgrade in a quantity which will provide the required compacted thickness. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed. The placing of material shall begin at the point designated by the PCG Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or

windrow. The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans. When hauling is done over previously placed material, hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer, to minimize rutting or uneven compaction.

### **200.3.3 Spreading and Compacting**

When uniformly mixed, the mixture shall be spread to the plan thickness, for compaction.

Where the required thickness is 150 mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate Subbase shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of anyone layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of Subbase material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothening, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until the surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the Subbase material shall be compacted thoroughly with approved tampers or compactors.

If the layer of Subbase material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a field density of at least 100 percent of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191.

### **200.3.4 Trial Sections**

Before Subbase construction is started, the Contractor shall spread and compact trial sections as directed by the PCG Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and construction method which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m<sup>2</sup> shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such proof rolling test, field density tests and other tests required as directed by the PCG Engineer.

If a trial section shows that the proposed materials, equipment or procedures in the PCG Engineer's opinion are not suitable for Subbase, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.

If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

### 200.3.5 Tolerances

Aggregate Subbase shall be spread with equipment that will provide a uniform layer which when compacted will conform to the designed level and transverse slopes as shown on the Plans. The allowable tolerances shall be as specified hereunder:

Permitted Variation from Design

THICKNESS OF LAYER	±10mm
Permitted variation from design	±10mm
LEVEL OF SURFACE	-10mm
Permitted SURFACE IRREGULARITY MEASURED by 3-m straight-edge	20mm
Permitted variation from design CROSS FALL or CAMBER	±0.3%
Permitted variation from design LONGITUDINAL GRADE over 25 m length	±0.1%

### 200.4 METHOD OF MEASUREMENT

Aggregate Subbase Course will be measured by the cubic meter (m<sup>3</sup>). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed course. No allowance will be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of Subbase herein measured. Side waste shall not include in the measurement.

### 200.5 BASIS OF PAYMENT

The accepted quantities, measured as prescribed in Section 200.4, shall be paid for at the contract unit price for Aggregate Subbase Course which price and payment shall be full compensation for furnishings and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

### 200.6 QUALITY STANDARD

Refer to Annex 1 (Quality Standards).



## ITEM 201- AGGREGATE BASE COURSE

### 201.1 DESCRIPTION

This item shall consist of furnishing, placing and compacting an aggregate base course on a prepared subgrade/subbase in accordance with this Specification and the lines, grades, thickness and typical cross-sections shown on the Plans, or as established by the PCG Engineer.

### 201.2 MATERIAL REQUIREMENTS

Aggregate for base course shall consist of hard, durable particles or fragments of crushed stone, crushed slag or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable base.

In some areas where the conventional base course materials are scarce or non-available, the use of 40% weathered limestone blended with 60% crushed stones or gravel shall be allowed, provided that the blended materials meet the requirements of this Item.

The base course material shall conform to the grading requirements of "Grading A" specified in Table 201.1.

**Table 201.1 Grading Requirements**

Sieve Designation		Mass Percent Passing	
Standard, mm	Alternate US Standard	Grading A	Grading B
50	2"	100	
37.5	1-1/2"	-	100
25.0	1"	60-85	-
19.0	3/4"	-	60-85
12.5	1/2"	35-65	-
4.75	No. 4	20-50	30-55
0.425	No. 40	5-20	8-25
0.075	No. 200	0-12	2-14

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No. 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 25 and plasticity index not greater than 6 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion test determined by AASHTO T 96.

The material passing the 19 mm (3/4 inch) sieve shall have a soaked CBR value of not less than 80% as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density (MDD) as determined by AASHTO T 180, Method D.

If filler, in addition to that naturally present, is necessary for meeting the grading requirements or for satisfactory bonding, it shall be uniformly blended with the base course material on the road or in a pugmill unless otherwise specified or approved. Filler shall be taken from sources approved by the PCG Engineer, shall be free from hard lumps and shall not contain more than 15 percent of material retained on the 4.75 mm (No. 4) sieve.

### **201.3 CONSTRUCTION REQUIREMENTS**

#### **201.3.1 Preparation of Existing Surface**

The existing surface shall be graded and finished as provided under Item 105, Subgrade preparation, before placing the base material.

#### **201.3.2 Placing**

It shall be in accordance with all the requirements of Subsection 200.3.2, Placing.

#### **201.3.3 Spreading and Compacting**

It shall be in accordance with all the requirements of Subsection 200.3.3, Spreading and Compacting.

#### **201.3.4 Trial Sections**

Trial sections shall conform in all respects to the requirements specified in Subsection 200.3.4.

#### **201.3.5 Tolerances**

The aggregate base course shall be laid to the designated level and transverse slopes shown on the Plans. The allowable tolerances shall be in accordance with following:

Permitted variation from design THICKNESS OF LAYER	+ 10 mm
Permitted variation from design LEVEL OF SURFACE	+ 5 mm - 10 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	5 mm
Permitted variation from design CROSSFALL OR CAMBER	+ 0.2%
Permitted variation from design LONGITUDINAL GRADE over 25 m length	+ 0.1%

### **201.4 METHOD OF MEASUREMENT**

Aggregate Base Course will be measured by the cubic meter (m<sup>3</sup>). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed base course. No allowance shall be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of aggregate base course.

### **201.5 BASIS OF PAYMENT**

The accepted quantities, measured as prescribed in Section 201.4 shall be paid for at the contract unit price for Aggregate Base Course which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

## ITEM 202 - CRUSHED AGGREGATE BASE COURSE

### 202.1 DESCRIPTION

This Item shall consist of furnishing, placing and compacting crushed gravel, crushed stone or crushed rock on a prepared subgrade/subbase in one or more layers in accordance with this Specification and lines, grades, thickness and typical cross-sections shown on the Plans or as established by the PCG Engineer.

### 202.2 MATERIAL REQUIREMENTS

#### 202.2.1 Crushed Aggregate

It shall consist of hard, durable particles or fragments of stone or gravel crushed to the size and of the quality requirements of this Item. It shall be clean and free from vegetable matters, lumps or balls of clay and other deleterious substances. The material shall be of such nature that can be compacted readily to form a firm, stable base.

The base material shall conform to the grading requirements of Table 202.1, whichever is called for in the Bill of Quantities.

**Table 202.1 -Grading Requirements**

Sieve Designation		Mass Percent Passing	
Standard mm	Alternate US Standard	Grading A	Grading B
37.5	1 1/2"	100	
25	1"	-	100
19	3/4"	60-85	-
12.5	1/2"	-	60-90
4.75	No. 4	30-55	35-65
0.425	No. 40	8-25	10-30
0.075	No. 200	2-14	5-15

The portion of the material passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing 0.425 mm (No. 40) sieve.

The portion of the material passing the 0.425 mm (No. 40) sieve shall have a liquid limit of not more than 25 and a plasticity index of more than 6 as determined by AASHTO T 89 and 90, respectively.

The coarse aggregate retained on a 2.00 mm (No.10) sieve shall have a mass percent of wear not exceeding 45 by the Los Angeles Abrasion Test as determined by AASHTO T 96, and not less than 50 mass percent shall have at least one (1) fractured face.

The material passing the 19 mm (3/4 inch) sieve shall have a minimum soaked CBR-value of 80% tested according to AASHTO T 193. The CBR-value shall be obtained at the maximum dry density determined according to AASHTO T 180, Method D.

If filler, in addition to that naturally present, is necessary for meeting the grading requirements or for satisfactory bonding, it shall be uniformly blended with the crushed base course material on the road or in a pugmill unless otherwise specified or approved. Filler shall be obtained from sources approved by the PCG Engineer, free from hard lumps and not contain more than 15 percent of material retained on the 4.75 mm (No.4) sieve.

**202.3 CONSTRUCTION REQUIREMENTS SAME AS SUBSECTIONS 201.3.1 THROUGH 201.3.5.**

**202.4 METHOD OF MEASUREMENT**

Crushed Aggregate Base Course will be measured by the cubic meter (m<sup>3</sup>). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed course. No allowance shall be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of crushed aggregate base course. Side waste shall not include in the measurement.

**202.5 BASIS OF PAYMENT**

The accepted quantities, measured as prescribed in Section 202.4, shall be paid for at the contract unit price for Crushed Aggregate Base Course which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

**202.6 QUALITY STANDARD**

Refer to Annex 1 (Quality Standards)

## PART E – SURFACE COURSE

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## ITEM 311 - PORTLAND CEMENT CONCRETE PAVEMENT

### 311.1 DESCRIPTION

This Item shall consist of pavement of Portland Cement Concrete, with or without reinforcement, constructed on the prepared base in accordance with this Specification and in conformity with lines, grades, thickness and typical cross-section shown on the Plans.

### 311.2 MATERIAL REQUIREMENTS

#### 311.2.1 Portland Cement

It shall conform to the applicable requirements of AASHTO M85 (ASTM C150). Only Type I Portland Cement shall be used unless otherwise provided for in the Special Provisions. Different brands or the same brands from different mills shall not be mixed nor shall they be used alternately unless the mix is approved by the PCG Engineer. However, the use of Portland Pozzolan Cement Type IP meeting the requirements of AASHTO M 240/ASTM C 595, Specifications for Blended Hydraulic Cement shall be allowed, provided that trial mixes shall be done and that the mixes meet the concrete strength requirements, the AASHTO/ ASTM provisions pertinent to the use of Portland Pozzolan Type IP shall be adopted.

Cement which for any reason, has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used. Samples of Cement shall be obtained in accordance with AASHTO T 127.

#### 311.2.2 Fine Aggregate

It shall consist of natural sand, stone screenings or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles. Fine aggregate from different sources of supply shall not be mixed or stored in the same pile nor used alternately in the same class of concrete without the approval of the PCG Engineer.

It shall not contain more than three (3) mass percent of material passing the 0.075 mm (No. 200 sieve) by washing nor more than one (1) mass percent each of clay lumps or shale. The use of beach sand will not be allowed without the approval of the PCG Engineer.

If the fine aggregate is subjected to five (5) cycles of the sodium sulfate soundness test, the weighted loss shall not exceed 10 mass percent.

The fine aggregate shall be free from injurious amounts of organic impurities. If subjected to the colorimetric test for organic impurities and a color darker than the standard is produced, it shall be rejected. However, when tested for the effect of organic impurities of strength of mortar by AASHTO T 71, the fine aggregate may be used if the relative strength at 7 and 28 days is not less than 95 mass percent.

The fine aggregate shall be well-graded from coarse to fine and shall conform to Table 311.1

**Table 311.1 - Grading Requirements for Fine Aggregate**

Sieve Designation	Mass Percent Passing
9.5 mm (3/8 in)	100
4.75 mm (No. 4)	95 – 100
2.36 mm (No. 8)	-
1.18mm (No. 16)	45 – 80
0.600 mm (No. 30)	-
0.300 mm (No. 50)	5 – 30
0.150 mm (No. 100)	0 – 10

### 311.2.3 Coarse Aggregate

It shall consist of crushed stone, gravel, blast furnace slag, or other approved inert materials of similar characteristics, or combinations thereof, having hard, strong, durable pieces and free from any adherent coatings.

It shall contain not more than one (1) mass percent of material passing the 0.075 mm (No. 200) sieve, not more than 0.25 mass percent of clay lumps, nor more than 3.5 mass percent of soft fragments.

If the coarse aggregate is subjected to five (5) cycles of the sodium sulfate soundness test, the weighted loss shall not exceed 12 mass percent.

It shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96.

If the slag is used, its density shall not be less than 1120 kg/m<sup>3</sup> (70 lb./cu. ft.). The gradation of the coarse aggregate shall conform to Table 311.2. Only one grading specification shall be used from any one source.

**Table 311.2 -Grading Requirement for Coarse Aggregate**

Sieve Designation		Mass Percent Passing		
Standard Mm	Alternate U.S. Standard	Grading A	Grading B	Grading C
75.0	3 in.	100	-	-
63.0	2-1/2 in.	90-100	100	100
50.0	2 in.	-	90-100	95-100
37.5	1-1/2 in.	25-60	35-70	-
25.0	1 in.	-	0-15	35-70
19.0	3/4 in.	0-10	-	-
12.5	1/2 in.	0-5	0-5	10-30
4.75	No. 4	-	-	0-5

### 311.2.4 Water

Water used in mixing, curing or other designated application shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product. Water will be tested in accordance with and shall meet the requirements of Item 714, Water. Water which is drinkable may be used without test. Where the source of water is shallow, the intake shall be so enclosed as to exclude silt, mud, grass or other foreign materials.

### 311.2.5 Reinforcing Steel

It shall conform to the requirements of Item 404, Reinforcing Steel. Dowels and tie bars shall conform to the requirements of AASHTO M 31 or M 42, except that rail steel shall not be used for tie bars that are to be bent and re-straightened during construction. Tie bars shall be deformed bars. Dowels shall be plain round bars. Before delivery to the site of work, one-half of the length of each dowel shall be painted with one coat of approved lead or tar paint.

The sleeves for dowel bars shall be metal of approved design to cover 50 mm (2 inches), plus or minus 5 mm (1/4 inch) of the dowel, with a closed end, and with a suitable stop to hold the end of the sleeve at least 25 mm (1 inch) from the end of the dowel. Sleeves shall be of such design that they do not collapse during construction.

### **311.2.6 Joint Fillers**

Poured joint fillers shall be mixed asphalt and mineral or rubber filler conforming to the applicable requirements of Item 705, Joint Materials.

Preformed joint filler shall conform to the applicable requirements of Item 705. It shall be punched to admit the dowels where called for in the Plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint.

### **311.2.7 Admixtures**

Air-entraining admixture shall conform to the requirements of AASHTO M 154.

Chemical admixtures, if specified or permitted, shall conform to the requirements of AASHTO M 194.

Fly Ash, if specified or permitted as a mineral admixture and as 20% partial replacement of Portland Cement in concrete mix shall conform to the requirements of ASTM C 618.

Admixture should be added only to the concrete mix to produce some desired modifications to the properties of concrete where necessary, but not as partial replacement of cement.

### **311.2.8 Curing Materials**

Curing materials shall conform to the following requirements as specified:

- |                                      |   |              |
|--------------------------------------|---|--------------|
| a) Burlap cloth                      | - | AASHTO M 182 |
| b) Liquid membrane forming compounds | - | AASHTO M 148 |
| c) Sheeting (film) materials         | - | AASHTO M 171 |

Cotton mats and water-proof paper can be used.

### **311.2.9 Calcium Chloride/Calcium Nitrate**

It shall conform to AASHTO M 144, if specified or permitted by the PCG Engineer, as accelerator.

### **311.2.10 Storage of Cement and Aggregate**

All cement shall be stored, immediately upon delivery at the Site, in weatherproof building which will protect the cement from dampness. The floor shall be raised from the ground. The buildings shall be placed in locations approved by the PCG Engineer. Provisions for storage shall be ample, and the shipments of cement as received shall be separately stored in such a manner as to allow the earliest deliveries to be used first and to provide easy access for identification and inspection of each shipment. Storage buildings shall have capacity for storage of a sufficient quantity of cement to allow sampling at least twelve (12) days before the cement is to be used. Bulk cement, if used, shall be transferred to elevated air tight and weatherproof bins. Stored cement shall meet the test requirements at any time after storage when retest is ordered by the PCG Engineer. At the time of use, all cement shall be free-flowing and free of lumps.

The handling and storing of concrete aggregates shall be such as to prevent segregation or the inclusion of foreign materials. The PCG Engineer may require that aggregates be stored on separate platforms at satisfactory locations.

In order to secure greater uniformity of concrete mix, the PCG Engineer may require that the coarse aggregate be separated into two or more sizes. Different sizes of aggregate shall be stored in separate bins or in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed.



### **311.2.11 Proportioning, Consistency and Strength of Concrete**

The Contractor shall prepare the design mix based on the absolute volume method as outlined in the American Concrete Institute (ACI) Standard 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete".

It is the intent of this Specification to require at least 364 kg of cement per cubic meter of concrete to meet the minimum strength requirements. The PCG Engineer shall determine from laboratory tests of the materials to be used, the cement content and the proportions of aggregate and water that will produce workable concrete having a slump of between 40 and 75 mm (1-1/2 and 3 inches) if not vibrated or between 10 and 40 mm (1/2 and 1-1/2 inches) if vibrated, and a flexural strength of not less than (550 psi and 700 psi) when tested by the third-point method at fourteen (14) days and 28 days respectively in accordance with AASHTO T97. Slump shall be determined using AASHTO T 119.

The designer shall consider the use of lean concrete (econocrete) mixtures using local materials or specifically modified conventional concrete mixes in base course and in the lower course composite, monolithic concrete pavements using a minimum of 75 mm (3 inches) of conventional concrete as the surface course.

The mix design shall be submitted to the PCG Engineer for approval and shall be accompanied with certified test data from an approved laboratory demonstrating the adequacy of the mix design. A change in the source of materials during the progress of work may necessitate a new design mix.

## **311.3 CONSTRUCTION REQUIREMENTS**

### **311.3.1 Quality Control of Concrete**

#### **1. General**

The Contractor shall be responsible for the quality control of all materials during the handling, blending, and mixing and placement operations.

#### **2. Quality Control Plan**

The Contractor shall furnish the PCG Engineer a Quality Control Plan detailing his production control procedures and the type and frequency of sampling and testing to insure that the concrete produces complies with the Specifications. The PCG Engineer shall be provided free access to recent plant production records, and if requested, informational copies of mix design, materials certifications and sampling and testing reports.

#### **3. Qualification of Workmen**

Experienced and qualified personnel shall perform all batching or mixing operation for the concrete mix, and shall be present at the plant and job site to control the concrete productions whenever the plant is in operation. They shall be identified and duties defined as follows:

- a. **Concrete Batcher.** The person performing the batching or mixing operation shall be capable of accurately conducting aggregate surface moisture determination and establishing correct scale weights for concrete materials. He shall be capable of assuring that the proportioned batch weights of materials are in accordance with the mix design.
- b. **Concrete Technician.** The person responsible for concrete production control and sampling and testing for quality control shall be proficient in concrete technology and shall have a sound knowledge of the Specifications as they relate to concrete production. He shall be capable of conducting tests on concrete and concrete materials in accordance with these Specifications. He

shall be capable of adjusting concrete mix designs for improving workability and Specification compliance and preparing trial mix designs. He shall be qualified to act as the concrete batcher in the batcher's absence.

4. Quality Control Testing

The Contractor shall perform all sampling, testing and inspection necessary to assure quality control of the component materials and the concrete.

The Contractor shall be responsible for determining the gradation of fine and coarse aggregates and for testing the concrete mixture for slump, air content, water-cement ratio and temperature. He shall conduct his operations so as to produce a mix conforming to the approved mix design.

5. Documentation

The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and nature of any corrective action taken.

The PCG Engineer may take independent assurance samples at random location for acceptance purposes as he deems necessary.

### 311.3.2 Equipment

Equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the PCG Engineer as to design, capacity and mechanical condition. The equipment shall be at the jobsite sufficiently ahead of the start of construction operations to be examined thoroughly and approved.

1. Batching Plant and Equipment

- a. General. The batching shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, a hopper, and separate scale for cement shall be included. The weighing hopper shall be properly sealed and vented to preclude dusting operation. The batch plant shall be equipped with a suitable non-resettable batch counter which will correctly indicate the number of batches proportioned.
- b. Bins and Hoppers. Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.
- c. Scales. Scales for weighing aggregates and cement shall be of either the beam type or the springless-dial type. They shall be accurate within one-half percent (0.5%) throughout the range of use. Poises shall be designed to be locked in any position and to prevent unauthorized change.  
Scales shall be inspected and sealed as often as the PCG Engineer may deem necessary to assure their continued accuracy.
- d. Automatic Weighing Devices. Unless otherwise allowed on the Contract, batching plants shall be equipped with automatic weighing devices of an approved type to proportion aggregates and bulk cement.

2. Mixers

- a. General. Concrete may be mixed at the Site of construction or at a central plant, or wholly or in part in truck mixers. Each mixer shall have a manufacturer's plate attached in a prominent place showing the capacity of the

drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

- b. Mixers at Site of Construction. Mixing shall be done in an approved mixer capable of combining the aggregates, cement and water into a thoroughly mixed and uniform mass within the specified mixing period and discharging and distributing the mixture without segregation on the prepared grade. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and released it at the end of the mixing period. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, provided that each batch is mixed 90 seconds. The mixer shall be equipped with a suitable nonresettable batch counter which shall correctly indicate the number of the batches mixed.
- c. Truck Mixer and Truck Agitators. Truck mixers used for mixing and hauling concrete, and truck, agitators used for hauling central-mixed concrete, shall conform to the requirements of AASHTO M 157.
- d. Non-Agitator Truck. Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation.

3. Paving and Finishing Equipment

The concrete shall be placed with an approved paver designed to spread, consolidate, screed and float finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement in conformance with the Plans and Specifications. The finishing machine shall be equipped with at least two (2) oscillating type transverse screed.

Vibrators shall operate at a frequency of 8,300 to 9,600 impulses per minute under load at a maximum spacing of 60 cm.

4. Concrete Saw

The Contractor shall provide sawing equipment in adequate number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel to the required dimensions and at the required rate. He shall provide at least one (1) stand-by saw in good working condition and with an ample supply of saw blades.

5. Forms

Forms shall be of steel, of an approved section, and of depth equal to the thickness of the pavement at the edge. The base of the forms shall be of sufficient width to provide necessary stability in all directions. The flange braces must extend outward on the base to not less than  $\frac{2}{3}$  the height of the form.

All forms shall be rigidly supported on bed of thoroughly compacted material during the entire operation of placing and finishing the concrete. Forms shall be provided with adequate devices for secure setting so that when in place, they will withstand, without visible spring or settlement, the impact and vibration of the consolidation and finishing or paving equipment.

### 311.3.3 Preparation of Grade

After the subgrade of base has been placed and compacted to the required density, the areas which will support the paving machine and the grade on which the pavement is to be constructed shall be trimmed to the proper elevation by means of a properly designed

machine extending the prepared work areas compacted at least 60 cm beyond each edge of the proposed concrete pavement. If loss of density results from the trimming operations, it shall be restored by additional compaction before concrete is placed. If any traffic is allowed to use the prepared subgrade or base, the surface shall be checked and corrected immediately ahead of the placing concrete.

The subgrade or base shall be uniformly moist when the concrete is placed.

#### **311.3.4 Setting Forms**

1. Base Support

The foundation under the forms shall be hard and true to grade so that the form when set will be firmly in contact for its whole length and at the specified grade. (Any roadbed, which at the form line is found below established grade, shall be filled with approved granular materials to grade in lifts of three (3) cm or less, and thoroughly rerolled or tamped.) Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary.

2. Form Setting

Forms shall be set sufficiently in advance of the point where concrete is being placed. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. The forms shall not deviate from true line by more than one (1) cm at any point.

3. Grade and Alignment

The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. Testing as to crown and elevation, prior to placing of concrete can be made by means of holding an approved template in a vertical position and moved backward and forward on the forms.

When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

#### **311.3.5 Conditioning of Subgrade or Base Course**

When side forms have been securely set to grade, the subgrade or base course shall be brought to proper cross-section. High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed. Unless waterproof subgrade or base course cover material is specified, the subgrade or base course shall be uniformly moist when the concrete is placed. If it subsequently becomes too dry, the subgrade or base course shall be sprinkled, but the method of sprinkling shall not be such as to form mud or pools of water.

#### **311.3.6 Handling, Measuring and Batching Materials**

The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the work. Stockpiles shall be built up in layers of not more than one (1) meter in thickness. Each layer shall be completely in place before beginning the next which shall not be allowed to "cone" down over the next lower layer. Aggregates from different sources and of different grading shall not be stockpiled together. All washed aggregates and aggregates produced or handled by hydraulic methods, shall be stockpiled or binned for draining at least twelve (12) hours before being batched.

When mixing is done at the side of the work, aggregates shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies, or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, with chute, boot or other approved device, to prevent loss of cement, and to provide positive assurance of the actual presence in each batch of the entire cement content specified.

Bulk cement shall be transported to the mixer in tight compartments carrying the full amount of cement required for the batch. However, if allowed in the Special Provisions, it may be transported between the fine and coarse aggregate. When cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1-1/2 hours of such contact. Cement in original shipping packages may be transported on top of the aggregates, each batch containing the number of sacks required by the job mix.

The mixer shall be charged without loss of cement. Batching shall be so conducted as to result in the weight to each material required within a tolerance of one (1) percent for the cement and two (2) percent for aggregates.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over than one (1) percent. Unless the water is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be equipped with an outside tap and valve to provide checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

### **311.3.7 Mixing Concrete**

The concrete may be mixed at the site of the work in a central-mix plant, or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time will be measured from the time all materials, except water, are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of AASHTO M 157, except that the minimum required revolutions at the mixing speed for transit-mixed concrete may be reduced to not less than that recommended by the mixer manufacturer. The number of revolutions recommended by the mixer manufacturer shall be indicated on the manufacturer's serial plate attached to the mixer. The Contractor shall furnish test data acceptable to the PCG Engineer verifying that the make and model of the mixer will produce uniform concrete conforming to the provision of AASHTO M 157 at the reduced number of revolutions shown on the serial plate.

When mixed at the site or in a central mixing plant, the mixing time shall not be less than fifty (50) seconds nor more than ninety (90) seconds, unless mixer performance tests prove adequate mixing of the concrete is a shorter time period.

Four (4) seconds shall be added to the specified mixing time if timing starts at the instant the skip reaches its maximum raised positions. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

The mixer shall be operated at the drum speed as shown on the manufacturer's name plate attached on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed off by the Contractor at his expense. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic meter, as shown on the manufacturer's standard rating plate on the mixer, except that an overload up to ten (10) percent above the mixer's nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

The batches shall be so charged into the drum that a portion of the mixing water shall be entered in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first fifteen (15) seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators or non-agitating truck specified in Subsection 311.3.2, Equipment. The time elapsed from the time water is added to the mix until the concrete is deposited in place at the Site shall not exceed forty five (45) minutes when the concrete is hauled in non-agitating trucks, nor ninety (90) minutes when hauled in truck mixers or truck agitators, except that in hot weather or under other conditions contributing to quick hardening of the concrete, the maximum allowable time may be reduced by the PCG Engineer.

In exceptional cases and when volumetric measurements are authorized for small project requiring less than 75 cu.m. of concrete per day of pouring, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate. Batching and mixing shall be in accordance with ASTM C 685, Section 6 through 9.

Concrete mixing by chute is allowed provided that a weighing scales for determining the batch weight will be used.

Re-tempering concrete by adding water or by other means shall not be permitted, except that when concrete is delivered in truck mixers, additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements, if permitted by the PCG Engineer, provided all these operations are performed within forty-five (45) minutes after the initial mixing operation and the water-cement ratio is not exceeded. Concrete that is not within the specified slump limits at the time of placement shall not be used. Admixtures for increasing the workability or for accelerating the setting of the concrete will be permitted only when specifically approved by the PCG Engineer.

#### **311.3.8 Limitation of Mixing**

No concrete shall be mixed, placed or finished when natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

During hot weather, the PCG Engineer shall require that steps be taken to prevent the temperature of mixed concrete from exceeding a maximum temperature of 90°F (32°C).

Concrete not in place within ninety (90) minutes from the time the ingredients were charged into the mixing drum or that has developed initial set shall not be used. Re-tempering of concrete or mortar which has partially hardened, that is remixing with or without additional cement, aggregate, or water, shall not be permitted.

In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete

#### **311.3.9 Placing Concrete**

Concrete shall be deposited in such a manner to require minimal re-handling. Unless truck mixers or non-agitating hauling equipment are equipped with means to discharge concrete without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade in such a manner as to prevent segregation. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

When concrete is to be placed adjoining a previously constructed lane and mechanical equipment will be operated upon the existing lane, that previously constructed lane shall have attained the strength for fourteen (14) day concrete. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after three (3) days.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than fifteen (15) seconds in any one location.

Concrete shall be deposited as near as possible to the expansion and contraction joints without disturbing them, but shall not be dumped from the discharge bucket or hopper into a joint assembly unless the hopper is well centered on the joint assembly. Should any concrete material fall on or be worked into the surface of a complete slab, it shall be removed immediately.

#### **311.3.10 Test Specimens**

As work progresses, at least one (1) set consisting of three (3) concrete beam test specimens, 150 mm x 150 mm x 525 mm or 900 mm shall be taken from each 330 m<sup>2</sup> of pavement, 230 mm depth, or fraction thereof placed each day. Test specimens shall be made under the supervision of the PCG Engineer, and the Contractor shall provide all concrete and other facilities necessary in making the test specimens and shall protect them from damage by construction operations. Cylinder samples shall not be used as substitute for determining the adequacy of the strength of concrete.

The beams shall be made, cured, and tested in accordance with AASHTO T 23 and T 97.

#### **311.3.11 Strike-off of Concrete and Placement of Reinforcement**

Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the Plans. When reinforced concrete pavement is placed in two (2) layers, the bottom layer shall be struck off and consolidated to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be firmly positioned in advance of concrete placement or it may be placed at the depth shown on the Plans in plastic concrete, after spreading by mechanical or vibratory means.

Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale and loose or thick rust which could impair bond of the steel with the concrete.

#### **311.3.12 Joints**

Joints shall be constructed of the type and dimensions, and at the locations required by the Plans or Special Provisions. All joints shall be protected from the intrusion of injurious foreign material until sealed.

##### **1. Longitudinal Joint**

Deformed steel tie bars of specified length, size, spacing and materials shall be placed perpendicular to the longitudinal joints, they shall be placed by approved mechanical equipment or rigidly secured by chair or other approved supports to

prevent displacement. Tie bars shall not be painted or coated with asphalt or other materials or enclosed in tubes or sleeves. When shown on the Plans and when adjacent lanes of pavement are constructed separately, steel side forms shall be used which will form a keyway along the construction joint. Tie bars, except those made of rail steel, may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed, or in lieu of bent tie bars, approved two-piece connectors may be used.

Longitudinal formed joints shall consist of a groove or cleft, extending downward from and normal to, the surface of the pavement. These joints shall be effected or formed by an approved mechanically or manually operated device to the dimensions and line indicated on the Plans and while the concrete is in a plastic state. The groove or cleft shall be filled with either a pre-molded strip or poured material as required.

The longitudinal joints shall be continuous, there shall be no gaps in either transverse or longitudinal joints at the intersection of the joints.

Longitudinal sawed joints shall be cut by means of approved concrete saws to the depth, width and line shown on the Plans. Suitable guide lines or devices shall be used to assure cutting the longitudinal joint on the true line. The longitudinal joint shall be sawed before the end of the curing period or shortly thereafter and before any equipment or vehicles are allowed on the pavement. The sawed area shall be thoroughly cleaned and, if required, the joint shall immediately be filled with sealer. Longitudinal pavement insert type joints shall be formed by placing a continuous strip of plastic materials which will not react adversely with the chemical constituent of the concrete.

2. Transverse Expansion Joint

The expansion joint filler shall be continuous from form to form, shaped to subgrade and to the keyway along the form. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used.

The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joint shall not deviate more than 6 mm from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

3. Transverse Contraction Joint/Weakened Joint

When shown on the Plans, it shall consist of planes of weakness created by forming or cutting grooves in the surface of the pavement and shall include load transfer assemblies. The depth of the weakened plane joint should at all times not be less than 50 mm, while the width should not be more than 6 mm.

- a. Transverse Strip Contraction Joint. It shall be formed by installing a parting strip to be left in place as shown on the Plans.
- b. Formed Groove. It shall be made by depressing an approved tool or device into the plastic concrete. The tool or device shall remain in place at least until the concrete has attained its initial set and shall then be removed without disturbing the adjacent concrete, unless the device is designed to remain in the joint.
- c. Sawed Contraction Joint. It shall be created by sawing grooves in the surface of the pavement of the width not more than 6 mm, depth should at all times



not be less than 50 mm, and at the spacing and lines shown on the Plans, with an approved concrete saw. After each joint is sawed, it shall be thoroughly cleaned including the adjacent concrete surface.

Sawing of the joint shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive ravelling, usually 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on during the day or night, regardless of weather conditions. The sawing of any joint shall be omitted if crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discounted when a crack develops ahead of the saw. In general all joints should be sawed in sequence. If extreme condition exist which make it impractical to prevent erratic cracking by early sawing, the contraction joint groove shall be formed prior to initial set of concrete as provided above.

4. Transverse Construction Joint

It shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 1.50 m of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has been mixed at the time of interruption to form a slab of at least 1.5 m long, the excess concrete from the last preceding joint shall be removed and disposed off as directed.

5. Load Transfer Device

Dowel, when used, shall be held in position parallel to the surface and center line of the slab by a metal device that is left in the pavement.

The portion of each dowel painted with one coat of lead or tar, in conformance with the requirements of Item 404, Reinforcing Steel, shall be thoroughly coated with approved bituminous materials, e.g., MC-70, or an approved lubricant, to prevent the concrete from binding to that portion of the dowel. The sleeves for dowels shall be metal designed to cover 50 mm plus or minus 5 mm (1/4 inch), of the dowel, with a watertight closed end and with a suitable stop to hold the end of the sleeves at least 25 mm (1 inch) from the end of the dowel.

In lieu of using dowel assemblies at contraction joints, dowel may be placed in the full thickness of pavement by a mechanical device approved by the PCG Engineer.

**311.3.13 Final Strike-off (Consolidation and Finishing)**

1. Sequence

The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging and final surface finish. Work bridges or other devices necessary to provide access to the pavement surface for the purpose of finishing straight-edging, and make corrections as hereinafter specified, shall be provided by the Contractor.

In general, the addition of water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as fog spray by means of an approved spray equipment.

2. Finishing Joints

The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material assembly, also under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in Subsection 311.3.9, Placing Concrete.

After the concrete has been placed and vibrated adjacent to the joints as required in Subsection 311.3.9, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to over and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 20 cm (8 inches) from the joint. Segregated concrete shall be removed from in front of and off the joint. The front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

3. Machine Finishing

- a. Non-vibratory Method. The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been placed, it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without wobbling or other variation tending to affect the precision finish.
- b. During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed in its entire length.
- c. Vibratory Method. When vibration is specified, vibrators for full width vibration of concrete paving slabs, shall meet the requirements in Subsection 311.3.2, Equipment. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and method which will produce pavement conforming to the Specifications. All provisions in item (a) above not in conflict with the provisions for the vibratory method shall govern.

4. Hand Finishing

Hand finishing methods may only be used under the following conditions:

- a. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade.
- b. In narrow widths or areas of irregular dimensions where operations of the mechanical equipment is impractical, hand methods may be used.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used.

The screed for the surface shall be at least 60 cm (2 feet) longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and constructed either of metal or other suitable material shod with metal.

Consolidation shall be attained by the use of suitable vibrator or other approved equipment.

In operation, the screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the striking off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

5. Floating

After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, either by hand or mechanical method.

- a. Hand Method. The hand-operated longitudinal float shall be not less than 365 cm (12 feet) in length and 15 cm (6 inches) in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete, shall be worked with a sawing motion while held in a floating position parallel to the road center line, and moving gradually from one side of the pavement to the other. Movement ahead along the center line of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or soupy material shall be wasted over the side forms on each pass.
- b. Mechanical Method. The mechanical longitudinal float shall be of a design approved by the PCG Engineer, and shall be in good working condition. The tracks from which the float operates shall be accurately adjusted to the required crown. The float shall be accurately adjusted and coordinated with the adjustment of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward screed shall be adjusted so that the float will lap the distance specified by the PCG Engineer on each transverse trip. The float shall pass over each areas of pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.
- c. Alternative Mechanical Method. As an alternative, the Contractor may use a machine composed of a cutting and smoothing float or floats suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on, and constantly in contact with the side forms. If necessary, following one of the preceding method of floating, long handled floats having blades not less than 150 cm (5 feet) in length and 15 cm (6 inches) in width may be used to smooth and fill in open-textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of, or supplementing, one of the preceding methods of floating. When strike off and consolidations are done by the hand method and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a 3-m straight-edge or more in length. Successive drags shall be lapped one-half the length of the blade.

6. Straight-edge Testing and Surface Correction

After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 300 cm long straight-edge. For this purpose, the Contractor shall furnish and use an

accurate 300-cm straight-edge swung from handles 100 cm (3 feet) longer than one-half the width of the slab. The straight-edge shall be held in contact with the surface in successive positions parallel to the road center line and the whole area gone over from one side of the slab to the other as necessary. Advances along the road shall be in successive stages of not more than one-half the length of the straight-edge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straight-edge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross-section.

7. Final Finish

If the surface texture is broom finished, it shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operation should be so executed that the corrugations produced in the surface shall be uniform in appearance and not more than 1.5 mm in depth. Brooming shall be completed before the concrete is in such condition that the surface will be unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom. Brooms shall be of the quality size and construction and be operated so as to produce a surface finish meeting the approval of the PCG Engineer. Subject to satisfactory results being obtained and approval of the PCG Engineer, the Contractor will be permitted to substitute mechanical brooming in lieu of the manual brooming herein described.

If the surface texture is belt finished, when straight-edging is complete and water sheen has practically disappeared and just before the concrete becomes non-plastic, the surface shall be belted with 2-ply canvass belt not less than 20 cm wide and at least 100 cm longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the center line and with a rapid advances parallel to the center line.

If the surface texture is drag finished, a drag shall be used which consists of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform of gritty texture after dragging it longitudinally along the full width of pavement. For pavement 5 m or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 100 cm wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 15 cm wider than the layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1.5 mm in depth. Drag shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags be substituted.

Regardless of the method used for final finish, the hardened surface of pavement shall have a coefficient of friction of 0.25 or more. Completed pavement that is found to have a coefficient of friction less than 0.25 shall be ground or scored by the Contractor at his expense to provide the required coefficient of friction.

8. Edging at Forms and Joints

After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints, shall be worked with an approved tool and rounded to the radius required by the Plans. A well - defined and continuous radius shall be produced and a smooth,

dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting the tool during the use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a straight-edge before the concrete has set and correction made if one edge of the joint is higher than the other.

#### **311.3.14 Surface Test**

As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 3-m straight-edge or other specified device. Areas showing high spots of more than 3 mm but not exceeding 12 mm in 3 m shall be marked and immediately ground down with an approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of 3 mm when tested with 3 m straight-edge. Where the departure from correct cross-section exceeds 12 mm, the pavement shall be removed and replaced by and at the expense of the Contractor.

Any area or section so removed shall be not less than 1.5 m in length and not less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 1.5 m in length, shall also be removed and replaced.

#### **311.3.15 Curing**

Immediately after the finishing operations have been completed and the concrete has sufficiently set, the entire surface of the newly placed concrete shall be cured in accordance with either one of the methods described herein. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or the lack of water to adequately take care of both curing and other requirements, shall be a cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than ½ hour between stages of curing or during the curing period.

In all congested places, concrete works should be designed so that the designed strength is attained.

##### **1. Cotton of Burlap Mats**

The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that as laid they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mat shall be placed so that the entire surface and the edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mat shall be so placed and weighted down so as to cause them to remain in intimate contact with the covered surface. The mat shall be maintained fully wetted and in position for 72 hours after the concrete has been placed unless otherwise specified.

##### **2. Waterproof Paper**

The top surface and sides of the pavement shall be entirely covered with waterproof paper, the units shall be lapped at least 45 cm. The paper shall be so placed and weighted down so as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimension but each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement, or at pavement width and 60 cm strips of paper for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do

not open up or separate during the curing period. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed. The surface of the pavement shall be thoroughly wetted prior to the placing of the paper.

3. Straw Curing

When this type of curing is used, the pavement shall be cured initially with burlap or cotton mats, until after final set of the concrete or, in any case, for 12 hours after placing the concrete. As soon as the mats are removed, the surface and sides of the pavement shall be thoroughly wetted and covered with at least 20 cm of straw or hay, thickness of which is to be measured after wetting. If the straw or hay covering becomes displaced during the curing period, it shall be replaced to the original depth and saturated. It shall be kept thoroughly saturated with water for 72 hours and thoroughly wetted down during the morning of the fourth day, and the cover shall remain in place until the concrete has attained the required strength.

4. Impervious Membrane Method

The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with jute or cotton mats, it may be applied upon removal of the mass. The curing compound shall not be applied during rain.

Curing compound shall be applied under pressure at the rate 4 L to not more than 14 m<sup>2</sup> by mechanical sprayers. The spraying equipment shall be equipped with a wind guard. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surface exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed, but approved means shall be used to insure proper curing at least 72 hours and to prevent the intrusion of foreign material into the joint before sealing has been completed. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film be damaged from any cause within the 72 hour curing period, the damaged portions shall be repaired immediately with additional compound.

5. White Polyethylene Sheet

The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 45 cm. The sheeting shall be so placed and weighted down so as to cause it to remain intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed.

### 311.3.16 Removal of Forms

After forms for concrete remained in place undisturbed for not less than twenty four (24) hours after concrete pouring. In the removal of forms, crowbars should be used in pulling out nails and pins. Care should be taken so as not to break the edges of the pavement. In case portions of the concrete are spalled, they shall be immediately repaired with fresh mortar mixed in the proportion of one part of Portland Cement and two parts fine aggregates. Major honeycomb areas will be considered as defective work and shall be removed and replaced at the expense of the Contractor. Any area or section so removed shall not be less than the distance between weakened plane joint nor less than the full width of the lane involved.

### **311.3.17 Sealing Joints**

Joints shall be sealed with asphalt sealant soon after completion of the curing period and before the pavement is opened to traffic, including the Contractor's equipment. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign materials including membrane curing compound and the joint faces shall be clean and surface dry when the seal is applied.

The sealing material shall be applied to each joint opening to conform to the details shown on the Plans or as directed by the PCG Engineer. Material for seal applied hot shall be stirred during heating so that localized overheating does not occur. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. The use of sand or similar material as a cover for the seal will not be permitted.

Preformed elastomeric gaskets for sealing joints shall be of the cross-sectional dimensions shown on the Plans. Seals shall be installed by suitable tools, without elongation and secured in place with an approved lubricant adhesive which shall cover both sides of the concrete joints. The seals shall be installed in a compressive condition and shall at time of placement be below the level of the pavement surface by approximately 6 mm.

The seals shall be in one piece for the full width of each transverse joint.

### **311.3.18 Protection of Pavement**

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection of and maintenance of warning signs, lights, pavement bridges or crossovers. The Plans or Special Provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic.

All boreholes after thickness and/or strength determinations of newly constructed asphalt and concrete pavements shall be immediately filled/restored with the prescribed concrete/asphalt mix after completion of the drilling works.

Any damage to the pavement, occurring prior to final acceptance, shall be repaired or the pavement be replaced.

### **311.3.19 Concrete Pavement-Slip Form Method**

If the Contract calls for the construction of pavement without the use of fixed forms, the following provisions shall apply:

#### **1. Grade**

After the grade or base has been placed and compacted to the required density, the areas which will support the paving machine shall be cut to the proper elevation by means of a properly designed machine. The grade on which the pavement is to be constructed shall then be brought to the proper profile by means of properly designed machine. If the density of the base is disturbed by the grading operation, it shall be corrected by additional compaction before concrete is placed. The grade should be constructed sufficiently in advance of the placing of the concrete. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately before the placing of concrete.

#### **2. Placing Concrete**

The concrete shall be placed with an approved slip-form paver designed to spread, consolidate, screed and float-finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finish will be necessary to

provide a dense and homogenous pavement in conformance with the Plans and Specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accompanied with vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur, and that necessary final finishing can be accomplished while the concrete is still within the forms. Any edge slump of the pavement, exclusive of edge rounding, in excess of 6 mm shall be corrected before the concrete has hardened.

The concrete shall be held at a uniform consistency, having a slump of not more than 40 mm (1-12/ inches). The slip form paver shall be operated with as nearly as possible a continuous forward movement and that all operations of mixing, delivering and spreading concrete shall be coordinated so as to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

3. Finishing

The surface smoothness and texture shall meet the requirements of Subsections 311.3.13 and 311.3.14.

4. Curing

Unless otherwise specified, curing shall be done in accordance with one of the methods included in Subsection 311.3.15. The curing media shall be applied at the appropriate time and shall be applied uniformly and completely to all surfaces and edges of the pavement.

5. Joints

All joints shall be constructed in accordance with Subsection 311.3.12.

6. Protection Against Rain

In order that the concrete may be properly protected against rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times, materials for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of standard metal forms or wood planks having a nominal thickness of not less than 50 mm (2 inches) and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper or plastic sheeting materials for the protection of the surface of the pavement. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

### **311.3.20 Acceptance of Concrete**

The strength level of the concrete will be considered satisfactory if the averages of all sets of three (3) consecutive strength test results equal or exceed the specified strength,  $f_c'$  and no individual strength test result is deficient by more than 15% of the specified strength,  $f_c'$ . Concrete deemed to be not acceptable using the above criteria may be rejected unless the Contractor can provide evidence, by means of core tests, that the quality of concrete represented by failed test results is acceptable in place. At least three (3) representative cores shall be taken from each member or area of concrete in place that is considered deficient. The location of cores shall be determined by the PCG Engineer so that there will be at



least impairment of strength of the structure. The obtaining and testing of drilled cores shall be in accordance with AASHTO T 24.

Concrete in the area represented by the cores will be considered adequate if the average strength of the cores is equal to at least 85% of, and if no single core is less than 75% of, the specified strength,  $f_c'$ .

If the strength of control specimens does not meet the requirements of this Subsection, and it is not feasible or not advisable to obtain cores from the structure due to structural considerations, payment of the concrete will be made at an adjusted price due to strength deficiency of concrete specimens as specified hereunder:

Deficiency in Strength of Concrete Specimens, Percent (%)	Percent (%) of Contract Price Allowed
Less than 5	100
5 to less than 10	80
10 to less than 15	70
15 to less than 20	60
20 to less than 25	50
25 or more	0

#### 311.3.21 Opening to Traffic

The PCG Engineer will decide when the pavement may be opened to traffic. The road will not be opened to traffic until test specimens molded and cured in accordance with AASHTO T 23 have attained the minimum strength requirements in Subsection 311.2.11. If such tests are not conducted prior to the specified age the pavement shall not be operated to traffic until 14 days after the concrete was placed. Before opening to traffic, the pavement shall be cleaned and joint sealing completed.

#### 311.3.22 Tolerance and Pavement thickness

##### 1. General

The thickness of the pavement will be determined by measurement of cores from the completed pavement in accordance with AASHTO T 148.

The completed pavement shall be accepted on a lot basis. A lot shall be considered as 1000 linear meters of pavement when a single traffic lane is poured or 500 linear meters when two lanes are poured concurrently. The last unit in each slab constitutes a lot in itself when its length is at least  $\frac{1}{2}$  of the normal lot length. If the length of the last unit is shorter than  $\frac{1}{2}$  of the normal lot length, it shall be included in the previous lot.

Other areas such as intersections, entrances, crossovers, and ramp will be grouped together to form a lot. Small irregular areas may be included with other unit areas to form a lot.

Each lot will be divided into five (5) equal segments and one core will be obtained from each segment in accordance with AASHTO T 24.

## 2. Pavement Thickness

It is the intent of this Specification that the pavement has a uniform thickness as called for on the Plans for the average of each lot as defined. After the pavement has met all surface smoothness requirements, cores for thickness measurements will be taken.

In calculating the average thickness of the pavement, individual measurements which are in excess of the specified thickness by more than 5 mm will be considered as the specified thickness plus 5 mm and measurement which are less than the specified thickness by more than 25 mm shall not be included in the average. When the average thickness for the lot is deficient, the contract unit price will be adjusted for thickness in accordance with paragraph (3 below).

Individual areas within a segment found deficient in thickness by more than 25 mm shall be evaluated by the PCG Engineer, and if in his judgment, the deficient areas warrant removal, they shall be removed and replaced by the Contractor with pavement of the specified thickness at his entire expense. However, if the evaluation of the PCG Engineer is that the deficient area should not be removed and replaced, such area will not be paid.

When the measurement of any core is less than the specified thickness by more than 25 mm, the actual thickness of the pavement in this area will be determined by taking additional cores at no less than 5 m intervals parallel to the center line in each direction from the affected location until a core is found in each direction, which is not deficient in thickness by more than 25 mm. The area of slab for which no payment will be made shall be the product of the paving width multiplied by the distance along the center line of the road between transverse sections found not deficient in thickness by more than 25 mm. The thickness of the remainder of the segment to be used to get the average thickness of each lot shall be determined by taking the average thickness of additional cores which are not deficient by more than 25 mm.

## 3. Adjustment for Thickness

When the average thickness of the pavement per lot is deficient, payment for the lot shall be adjusted as follows:

Deficiency in the Average Thickness per lot (mm)	Percent (%) of Contract Price Per Lot
0-5	100% payment
6-10	95% payment
11-15	85% payment
16-20	70% payment
21-25	50% payment
More than 25	Remove and replace/ No payment

No acceptance and final payment shall be made on completed pavement unless core test for thickness determination is conducted, except for Barangay Roads where the implementing office is allowed to waive such test.

#### **311.4 METHOD OF MEASUREMENT**

The area to be paid for under this Item shall be the number of square meters (m<sup>2</sup>) of concrete pavement placed and accepted in the completed pavement. The width for measurements will be the width from outside edge to outside edge of completed pavement as placed in accordance with the Plans or as otherwise required by the PCG Engineer in writing. The length will be measured horizontally along the center line of each roadway or ramp. Any curb and gutter placed shall not be included in the area of concrete pavement measured.

#### **311.5 BASIS OF PAYMENT**

The accepted quantity, measured as prescribed in Section 311.4, shall be paid for at the contract unit price for Portland Cement Concrete Pavement, which price and payment shall be full compensation for preparation of roadbed and finishing of shoulders, unless otherwise provided by the Special Provisions, furnishing all materials, for mixing, placing, finishing and curing all concrete, for furnishing and placing all joint materials, for sawing weakened plane joints, for fitting the prefabricated center metal joint, for facilitating and controlling traffic, and for furnishing all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made in accordance with the Bill of Quantities.

#### **311.6 QUALITY STANDARD**

Refer to Annex 1 (Quality Standards).

## PART F – STRUCTURAL WORKS

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## **ITEM 404 - REINFORCING STEEL**

### **404.1 DESCRIPTION**

This Item shall consist of furnishing, bending, fabricating and placing of steel reinforcement of the type, size, shape and grade required in accordance with this Specification and in conformity with the requirements shown on the Plans or as directed by the PCG Engineer.

### **404.2 MATERIAL REQUIREMENTS**

Reinforcing shall be deformed and shall meet PNS 49 Weldable/ASTM A 706. The minimum yield strength shall be as follows:

For 12 mm dia. and smaller:

$$f_y = 276 \text{ MPa (40 Ksi)}$$

For 16 mm dia. and larger:

$$f_y = 414 \text{ MPa (60 Ksi)}$$

Modulus of Elasticity,  $E_s = 200,000 \text{ MPa}$

### **404.3 CONSTRUCTION REQUIREMENTS**

#### **404.3.1 Order Lists**

Before materials are ordered, all order lists and bending diagrams shall be furnished by the Contractor, for approval of the PCG Engineer. The approval of order lists and bending diagrams by the PCG Engineer shall in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams. Any expense incident to the revisions of materials furnished in accordance with such lists and diagrams to make them comply with the Plans shall be borne by the Contractor.

#### **404.3.2 Protection of Material**

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, detrimental rust, loose scale, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross-sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel specified.

#### **404.3.3 Bending**

All reinforcing bars requiring bending shall be cold-bent to the shapes shown on the Plans or required by the PCG Engineer. Bars shall be bent around a circular pin having the following diameters (D) in relation to the diameter of the bar (d):

<u>Nominal diameter, d, mm</u>	<u>Pin diameter (D)</u>
10 to 20	6d
25 to 28	8d
32 and greater	10d

Bends and hooks in stirrups or ties may be bent to the diameter of the principal bar enclosed therein.

#### 404.3.4 Placing and Fastening

All steel reinforcement shall be accurately placed in the position shown on the Plans or required by the PCG Engineer and firmly held there during the placing and setting of the concrete. Bars shall be tied at all intersections except where spacing is less than 300 mm in each direction, in which case, alternate intersections shall be tied. Ties shall be fastened on the inside.

Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports, so that it does not vary from the position indicated on the Plans by more than 6 mm. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shapes and dimensions. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks shall not be permitted. Unless otherwise shown on the Plans or required by the PCG Engineer, the minimum distance between bars shall be 40 mm. Reinforcement in any member shall be placed and then inspected and approved by the PCG Engineer before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal may be required. If fabric reinforcement is shipped in rolls, it shall be straightened before being placed. Bundled bars shall be tied together at not more than 1.8 m intervals.

#### 404.3.5 Splicing

All reinforcement shall be furnished in the full lengths indicated on the Plans. Splicing of bars, except where shown on the Plans, will not be permitted without the written approval of the PCG Engineer. Splices shall be staggered as far as possible and with a minimum separation of not less than 40 bar diameters. Not more than one-third of the bars may be spliced in the same cross-section, except where shown on the Plans.

Unless otherwise shown on the Plans, bars shall be lapped a minimum distance of:

Splice Type	Grade 40	Grade 60	But not less than
Tension	24 bar dia	36 bar dia	300 mm
Compression	20 bar dia	24 bar dia	300 mm

In lapped splices, the bars shall be placed in contact and wired together. Lapped splices will not be permitted at locations where the concrete sections is insufficient to provide minimum clear distance of one and one-third the maximum size of coarse aggregate between the splice and the nearest adjacent bar. Welding of reinforcing steel shall be done only if detailed on the Plans or if authorized by the PCG Engineer in writing. Spiral reinforcement shall be spliced by lapping at least one and a half turns or by butt welding unless otherwise shown on the Plans.

#### 404.3.6 Lapping of Bar Mat

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The overlap shall not be less than one mesh in width.

### 404.4 METHOD OF MEASUREMENT

The quantity of reinforcing steel to be paid for will be the final quantity placed and accepted in the completed structure.

No allowance will be made for tie-wires, separators, wire chairs and other material used in fastening the reinforcing steel in place. If bars are substituted upon the Contractor's request and

approved by the PCG Engineer and as a result thereof more steel is used than specified, only the mass specified shall be measured for payment.

No measurement or payment will be made for splices added by the Contractor unless directed or approved by the PCG Engineer.

When there is no item for reinforcing steel in the Bill of Quantities, costs will be considered as incidental to the other items in the Bill of Quantities.

#### **404.5 BASIS OF PAYMENT**

The accepted quantity, measured as prescribed in Section 404.4, shall be paid for at the contract unit price for Reinforcing Steel which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

## **ITEM 405 - STRUCTURAL CONCRETE**

### **405.1 DESCRIPTION**

#### **405.1.1 Scope**

This Item shall consist of furnishing, placing and finishing concrete in all structures except pavements in accordance with this Specification and conforming to the lines, grades, and dimensions shown on the Plans. Concrete shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, admixtures when specified, and water mixed in the proportions specified or approved by the PCG Engineer.

#### **405.1.2 Classes and Uses of Concrete**

Five classes of concrete are provided for in this Item, namely: A, B, C, P and Seal. Each class shall be used in that part of the structure as called for on the Plans.

The classes of concrete will generally be used as follows:

Class A - All superstructures and heavily reinforced substructures. The important parts of the structure included are slabs, beams, girders, columns, arch ribs, box culverts, reinforced abutments, retaining walls, and reinforced footings.

Class B - Footings, pedestals, massive pier shafts, pipe bedding, and gravity walls, unreinforced or with only a small amount of reinforcement.

Class C - Thin reinforced sections, railings, precast R. C. piles and cribbing and for filler in steel grid floors.

Class P - Prestressed concrete structures and members

Seal - Concrete deposited in water.

### **405.2 MATERIAL REQUIREMENTS**

#### **405.2.1 Portland Cement**

It shall conform to all the requirements of Subsection 311.2.1 .

#### **405.2.2 Fine Aggregate**

It shall conform to all the requirements of Subsection 311.2.2

#### **405.2.3 Coarse Aggregate**

It shall conform to all the requirements of Subsection 311.2.3 except that gradation shall conform to Table 405.1.



**Table 405.1 .Grading Requirements for Coarse Aggregate**

Sieve Designation		Mass Percent Passing				
Standard mm	Alternate US Standard	Class A	Class B	Class C	Class P	Class Seal
63	2- 1/2 "		100			
50	2"	100	95-100			
37.5	1- 1/2 "	95-100	-			100
25	1"	-	35-70		100	95-100
19.0	3/4"	35-70	-	100	95-100	-
12.5	1/2"	-	10-30	90-100	-	25-60
9.5	3/8"	10-30	-	40-70	20-55	-
4.75	No. 4	0-5	0-5	0-15*	0-10*	0-10*

\* The measured cement content shall be within plus (+) or minus (-)2 mass percent of the design cement content.

#### **405.2.4 Water**

It shall conform to the requirements of Subsection 311.2.4.

#### **405.2.5 Reinforcing Steel**

It shall conform to the requirements of Item 404, reinforcing Steel.

#### **405.2.6 Admixtures**

Admixtures shall conform to the requirements of Subsection 311.2.7.

#### **405.2.7 Curing Materials**

Curing materials shall conform to the requirements of Subsection 311.2.8.

#### **405.2.8 Expansion Joint Materials**

Expansion joint materials shall be:

1. Preformed Sponge Rubber and Cork, conforming to AASHTO M 153.
2. Hot-Poured Elastic Type, conforming to AASHTO M 173.
3. Preformed Fillers, conforming to AASHTO M 213.

#### **405.2.9 Elastomeric Compression Joint Seals**

These shall conform to AASHTO M 220.

#### **405.2.10 Elastomeric Bearing Pads**

These shall conform to AASHTO M 251 or Item 412 – Elastomeric Bearing Pads

#### **405.2.11 Storage of Cement and Aggregates**

Storage of cement and aggregates shall conform to all the requirements of Subsection 311.2.10.

### 405.3 Sampling and Testing of Structural Concrete

As work progresses, at least one (1) sample consisting of three (3) concrete cylinder test specimens, 150 x 300 mm (6 x 12 inches), shall be taken from each seventy five (75) cubic metres of each class of concrete or fraction thereof placed each day.

Compliance with the requirements of this Section shall be determined in accordance with the following standard methods of AASHTO:

Sampling of fresh concrete	T 141
Weight per cubic meter and air content (Gravi-Metric) of concrete	T 121
Sieve analysis of fine and coarse aggregates	T 27
Slump of Portland Cement concrete	T 119
Specific gravity and absorption of fine aggregate	T 84
Tests for strength shall be made in accordance with the following: Making and curing concrete compressive and flexural tests specimens in the field	T 23
Compressive strength of molded concrete cylinders	T 22

### 405.4 Production Requirements

#### 405.4.1 Proportioning and Strength of Structural Concrete

The concrete materials shall be proportioned in accordance with the requirements for each class of concrete as specified in Table 405.2, using the absolute volume method as outlined in the American Concrete Institute (ACI) Standard 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete". Other methods of proportioning may be employed in the mix design with prior approval of the PCG Engineer. The mix shall either be designed or approved by the PCG Engineer. A change in the source of materials during the progress of work may necessitate a new mix design.

The strength requirements for each class of concrete shall be as specified in Table 405.2.

**Table 405.2 -Composition and Strength of Concrete for use in Structures**

<b>Class of Concrete</b>	<b>Minimum Cement Content per m<sup>3</sup> kg (bag<sup>**</sup>)</b>	<b>Maximum Water/ Cement Ratio kg/kg</b>	<b>Consistency Range in Slump mm (inch)</b>	<b>Designated Size of Coarse Aggregate Square Opening Std. mm</b>	<b>Minimum Compressive Strength of 150x 300 mm Concrete Cylinder Specimen at 28 days, MN/m<sup>2</sup>(psi)</b>
A	360 (9 bags)	0.53	50 – 100 (2-4)	37.5 - 4.75 (1 ½"-No. 4)	20.7 (3000)
B	320 (8 bags)	0.58	50 – 100 (2-4)	50 - 4.75 (2" - No. 4)	16.5 (2400)
C	380 (9.5 bags)	0.55	50 – 100 (2-4)	12.5 - 4.75 (½" - No. 4)	20.7 (3000)
P	440 (11 bags)	0.49	100 max. (4 max.)	19 - 4.75 (¾" - No. 4)	37.7 (5000)
Seal	380 (9.5 bags)	0.58	100 – 200 (4-8)	25 - 4.75 (1"- No. 4)	20.7 (3000)

\* The measured cement content shall be within plus or minus 2 mass percent of the design cement content.

\*\* Based on 40 kg/bag

#### 405.4.2 Consistency

Concrete shall have a consistency such that it will be workable in the required position. It shall be of such a consistency that it will flow around reinforcing steel but individual particles of the coarse aggregate when isolated shall show a coating of mortar containing its proportionate amount of sand. The consistency of concrete shall be gauged by the ability of the equipment to properly place it and not by the difficulty in mixing and transporting. The quantity of mixing water shall be determined by the PCG Engineer and shall not be varied without his consent. Concrete as dry as it is practical to place with the equipment specified shall be used.

#### 405.4.3 Batching

Measuring and batching of materials shall be done at a batching plant.

1. Portland Cement

Either sacked or bulk cement may be used. No fraction of a sack of cement shall be used in a batch of concrete unless the cement is weighed. All bulk cement shall be weighed on an approved weighing device. The bulk cement weighing hopper shall be properly sealed and vented to preclude dusting operation. The discharge chute shall not be suspended from the weighing hopper and shall be so arranged that cement will neither be lodged in it nor leak from it.

Accuracy of batching shall be within plus (+) or minus (-) 1 mass percent.

2. Water

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not more than 1 percent.

3. Aggregates

Stockpiling of aggregates shall be in accordance with Subsection 311.2.10. All aggregates whether produced or handled by hydraulic methods or washed, shall be stockpiled or binned for draining for at least 12 hours prior to batching. Rail shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. If the aggregates contain high or non-uniform moisture content, storage or stockpile period in excess of 12 hours may be required by the PCG Engineer.

Batching shall be conducted as to result in a 2 mass percent maximum tolerance for the required materials.

4. Bins and Scales

The batching plant shall include separate bins for bulk cement, fine aggregate and for each size of coarse aggregate, a weighing hopper, and scales capable of determining accurately the mass of each component of the batch.

Scales shall be accurate to one-half (0.5) percent throughout the range used.

5. Batching

When batches are hauled to the mixer, bulk cement shall be transported either in waterproof compartments or between the fine and coarse aggregate. When cement is placed in contact with moist aggregates, batches will be rejected unless mixed within 1-1/2 hours of such contact. Sacked cement may be transported on top of the aggregates.

Batches shall be delivered to the mixer separate and intact. Each batch shall be dumped cleanly into the mixer without loss, and, when more than one batch is carried on the truck, without spilling of material from one batch compartment into another.

6.     Admixtures

The Contractor shall follow an approved procedure for adding the specified amount of admixture to each batch and will be responsible for its uniform operation during the progress of the work. He shall provide separate scales for the admixtures which are to be proportioned by weight, and accurate measures for those to be proportioned by volume. Admixtures shall be measured into the mixer with an accuracy of plus or minus three (3) percent.

The use of Calcium Chloride as an admixture will not be permitted.

**405.4.4 Mixing and Delivery**

Concrete may be mixed at the site of construction, at a central point or by a combination of central point and truck mixing or by a combination of central point mixing and truck agitating. Mixing and delivery of concrete shall be in accordance with the appropriate requirements of AASHTO M 157 except as modified in the following paragraphs of this section, for truck mixing or a combination of central point and truck mixing or truck agitating. Delivery of concrete shall be regulated so that placing is at a continuous rate unless delayed by the placing operations. The intervals between delivery of batches shall not be so great as to allow the concrete in place to harden partially, and in no case shall such an interval exceed 30 minutes.

In exceptional cases and when volumetric measurements are authorized, for small project requiring less than 75 cu.m. per day of pouring, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate. Batching and mixing shall be in accordance with ASTM C 685, Section 6 through 9.

Concrete mixing, by chute is allowed provided that a weighing scales for determining the batch weight will be used.

For batch mixing at the site of construction or at a central point, a batch mixer of an approved type shall be used. Mixer having a rated capacity of less than a one-bag batch shall not be used. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity as shown on the manufacturer's standard rating plate on the mixer except that an overload up to 10percent above the mixer's nominal capacity may be permitted, provided concrete test data for strength, segregation, and uniform consistency are satisfactory and provided no spillage of concrete takes place. The batch shall be so charge into the drum that a portion of the water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. Mixing time shall be measured from the time all materials, except water, are in the drum. Mixing time shall not be less than 60 seconds for mixers having a capacity of 1.5m<sup>3</sup> or less. For mixers having a capacity greater than 1.5 m<sup>3</sup>, the mixing time shall not be less than 90 seconds. If timing starts, the instant the skip reaches its maximum raised position, 4 seconds shall be added to the specified mixing time. Mixing time ends when the discharge chute opens.

The mixer shall be operated at the drum speed as shown on the manufacturer's name plate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed off by the Contractor at his own expenses.

The timing device on stationary mixers shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the Contractor will be permitted to continue operations while it is being repaired, provided he furnishes an approved timepiece equipped with minute and second hands. If the timing device is not placed in good working order within 24 hours, further use of the mixer will be prohibited until repairs are made.

Retempering concrete will not be permitted. Admixtures for increasing the workability, for retarding the set, or for accelerating the set or improving the pumping characteristics of the concrete will be permitted only when specifically provided for in the Contract, or authorized in writing by the PCG Engineer.

1.      Mixing Concrete: General

Concrete shall be thoroughly mixed in a mixer of an approved size and type that will insure a uniform distribution of the materials throughout the mass.

All concrete shall be mixed in mechanically operated mixers. Mixing plant and equipment for transporting and placing concrete shall be arranged with an ample auxiliary installation to provide a minimum supply of concrete in case of breakdown of machinery or in case the normal supply of concrete is disrupted. The auxiliary supply of concrete shall be sufficient to complete the casting of a section up to a construction joint that will meet the approval of the PCG Engineer.

Equipment having components made of aluminum or magnesium alloys, which would have contact with plastic concrete during mixing, transporting or pumping of Portland Cement concrete, shall not be used.

Concrete mixers shall be equipped with adequate water storage and a device of accurately measuring and automatically controlling the amount of water used.

Materials shall be measured by weighing. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. The accuracy of all weighing devices except that for water shall be such that successive quantities can be measured to within one percent of the desired amounts. The water measuring device shall be accurate to plus or minus 0.5 mass percent. All measuring devices shall be subject to the approval of the PCG Engineer. Scales and measuring devices shall be tested at the expense of the Contractor as frequently as the PCG Engineer may deem necessary to insure their accuracy.

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cut-off shall not vary from the weight designated by the PCG Engineer more than one mass percent for cement, 1- 1/2 mass percent for any size of aggregate, or one (1) mass percent for the total aggregate in any batch.

2.      Mixing Concrete at Site

Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. The pick-up and throw-over blades of mixers shall be restored or replaced when any part or section is worn 20 mm or more below the original height of the manufacturer's design. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used.

When bulk cement is used and volume of the batch is 0.5 m<sup>3</sup> or more, the scale and weigh hopper for Portland Cement shall be separate and distinct from the aggregate hopper or hoppers. The discharge mechanism of the bulk cement weigh hopper shall be interlocked against opening before the full amount of cement is in the hopper. The

discharging mechanism shall also be interlocked against opening when the amount of cement in the hopper is underweight by more than one (1) mass percent or overweight by more than 3 mass percent of the amount specified.

When the aggregate contains more water than the quantity necessary to produce a saturated surface dry condition, representative samples shall be taken and the moisture content determined for each kind of aggregate.

The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate. All water shall be in the drum by the end of the first quarter of the specified mixing time.

Cement shall be batched and charged into the mixer so that it will not result in loss of cement due to the effect of wind, or in accumulation of cement on surface of conveyors or hoppers, or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

The entire content of a batch mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch except water shall be deposited simultaneously into the mixer.

All concrete shall be mixed for a period of not less than 1-1/2 minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed.

Mixers shall be operated with an automatic timing device that can be locked by the PCG Engineer. The time device and discharge mechanics shall be so interlocked that during normal operation no part of the batch will be charged until the specified mixing time has elapsed.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand, and water to coat the inside of the drum without reducing the required mortar content of the mix. When mixing is to cease for a period of one hour or more, the mixer shall be thoroughly cleaned.

### 3. Mixing Concrete at Central Plant

Mixing at central plant shall conform to the requirements for mixing at the site.

### 4. Mixing Concrete in Truck

Truck mixers, unless otherwise authorized by the PCG Engineer, shall be of the revolving drum type, water-tight, and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in which case a tank is not required. Truck mixers may be required to be provided with a means of which the mixing time can be readily verified by the PCG Engineer.

The maximum size of batch in truck mixers shall not exceed the minimum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing, shall, unless otherwise directed be continued for not less than 100 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.

Mixing shall begin within 30 minutes after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water

or surface wet aggregate and when the temperature is above 32°C, this limit shall be reduced to 15 minutes. The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the judgment of the PCG Engineer, the aggregate is sufficiently free from moisture, so that there will be no harmful effects on the cement.

When a truck mixer is used for transportation, the mixing time specified in Subsection 405.4.4 (3) at a stationary mixer may be reduced to 30 seconds and the mixing completed in a truck mixer. The mixing time in the truck mixer shall be as specified for truck mixing.

5. Transporting Mixed Concrete

Mixed concrete may only be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturers of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place.

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point.

The rate of discharge of mixed concrete from truck mixers or agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within one hour, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under, conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 30°C, or above, a time less than one hour will be required.

6. Delivery of Mixed Concrete

The Contractor shall have sufficient plant capacity and transportation apparatus to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The methods of delivering and handling the concrete shall be such as will facilitate placing of the minimum handling.

#### **405.5 METHODS OF MEASUREMENT**

The quantity of structural concrete to be paid for will be the final quantity placed and accepted in the completed structures. No deduction will be made for the volume occupied by pipe less than 100 mm (4 inches) in diameter or by reinforcing steel, anchors, conduits, weep holes or expansion joint materials.

#### **405.6 BASIS OF PAYMENT**

The accepted quantities, measured as prescribed in Section 405.5, shall be paid for at the contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities.



Payment shall constitute full compensation for furnishing, placing and finishing concrete including all labor, equipment, tools and incidentals necessary to complete the work prescribed in the item.

Payment will be made in accordance with the Bill of Quantities.

## ITEM 407 - CONCRETE STRUCTURE

### 407.1 DESCRIPTION

This Item shall consist of the general description of the materials, equipment, workmanship and construction requirements of concrete structures and the concrete portions of composite structures conforming to the alignment, grades, design, dimensions and details shown on the Plans and in accordance with the Specifications for piles, reinforcing steel, structural steel, structural concrete and other items which constitute the completed structure, The class of concrete to be used in the structure or part of the structure shall be as specified in Item 405, Structural Concrete.

### 407.2 MATERIAL REQUIREMENTS

#### 1. Concrete and Concrete Ingredients

Concrete and concrete materials shall conform to the requirements in Item 405, Structural Concrete. Unless otherwise shown on the Plan, concrete shall be of Class A.

#### 2. Reinforcing Steel

Reinforcing Steel shall conform to the requirements in Item 404, Reinforcing Steel.

#### 3. Structural Steel

Carbon Steel. Unless otherwise specified, structural carbon steel for riveted, bolted or welded construction shall conform to Structural Steel, AASHTO M 183.

#### 4. Paints

Paints shall conform to the following requirements:

Ready Mixed Red Lead Paint	AASHTO M 72 and PNS Type I, II, III & IV
Aluminum Paint	AASHTO M 69 and PNS Type I & II
White & Tinted Ready Mixed Paint	AASHTO M 70
Foliage Green Bridge Paint	AASHTO M 67
Black Paint for Bridges And Timber Structures	AASHTO M 68
Basic Lead-Silico-Chromate Ready Mixed Primer	AASHTO M 229
Ready Mixed Aluminum Paint	AASHTO M 260 and PNS

5. Waterproofing and Dampproofing

Unless otherwise shown on the Plans or indicated in Special Provisions, materials for waterproofing and dampproofing shall conform to the requirements of the following specifications:

- a. AASHTO M 115 Asphalt for dampproofing and waterproofing
- b. AASHTO M 116 Primer for the use with Asphalt in dampproofing and waterproofing.
- c. AASHTO M 117 Woven cotton fabrics saturated with bituminous substances for use in waterproofing.
- d. AASHTO M 118 Coal-Tar pitch for roofing, dampproofing and waterproofing.
- e. AASHTO M 121 Creosote for priming coat with coal-tar pitch dampproofing and waterproofing.
- f. AASHTO M 159 Woven burlap fabric saturated with bituminous substances for use in waterproofing.
- g. AASHTO M 166 Numbered cotton duck and array duck.
- h. AASHTO M 239 Asphalt for use in waterproofing membrane construction.

6. Concrete Curing Compound

Curing compound shall conform to the requirements of AASHTO M 148 Liquid membrane-forming compound for curing concrete.

7. Joint Filler

Unless otherwise shown on the Plans or in Special provisions, materials for expansion joint filler shall conform to the requirements of the following specifications:

- a. AASHTO M 33 Preformed expansion joint filler for concrete.
- b. AASHTO M 153 Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction.
- c. AASHTO M 173 Concrete joint sealer hot poured elastic type.
- d. AASHTO M 213 Preformed expansion joint filler for concrete paving and structural construction-non-extruding and resilient bituminous types.
- e. AASHTO M 220 Preformed elastomeric compression joint seals for concrete.

**407.2.1 Proportioning and Strength of Structural Concrete**

This shall be in accordance with Item 405, Structural Concrete.

**407.2.2 Sampling and Testing**

This shall be in accordance with Item 405, Structural Concrete.

### **407.3 CONSTRUCTION AND REQUIREMENTS**

#### **407.3.1 Handling and Placing Concrete: General**

Concrete shall not be placed until forms and reinforcing steel have been checked and approved by the PCG Engineer.

If lean concrete is required in the Plan or as directed by the PCG Engineer prior to placing of reinforcing steel bar, the lean concrete should have a maximum compressive strength of 13.8 MPa (2000 psi).

In preparation for the placing of concrete all sawdust, chips and other construction debris and extraneous matter shall be removed from inside the formwork, struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

No concrete shall be used which does not reach its final position in the forms within the time stipulated under "Time of Hauling and Placing Mixed Concrete".

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes, and pipes for conveying concrete to the forms shall be permitted only on written authorization of the PCG Engineer. The PCG Engineer shall reject the use of the equipment for concrete transportation that will allow segregation, loss of fine materials, or in any other way will have a deteriorating effect on the concrete quality.

Open troughs and chutes shall be of metal lined: where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement to avoid segregation.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure.

When placing operations would involve dropping the concrete more than 1.5m, concrete shall be conveyed through sheet metal or approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower end shall be kept buried in the newly placed concrete. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement bars.

The concrete shall be placed as nearly as possible to its final position and the use of vibrators for moving of the mass of fresh concrete shall not be permitted.

##### **407.3.1.1 Placing Concrete by Pneumatic Means**

Pneumatic placing of concrete will be permitted only if specified in the Special Provisions or authorized by the PCG Engineer. The equipment shall be so arranged that vibration will not damage freshly placed concrete.

Where concrete is conveyed and placed by pneumatic means, the equipment shall be suitable in kind and adequate in capacity for the work. The machine shall be located as close as practicable to the work. The discharge lines shall be horizontal or inclined upwards from the machine. The discharge end of the line shall not be more than 3 m from the point of deposit.

At the conclusion of placing the concrete, the entire equipment shall be thoroughly cleaned.

#### **407.3.1.2 Placing of concrete by pumping**

The placing of concrete by pumping will be permitted only if specified or if authorized by the PCG Engineer. The equipment shall be so arranged that vibration will not damage freshly placed concrete.

Where concrete is conveyed and placed by mechanically applied pressure the equipment shall be suitable in kind and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. After this operation, the entire equipments shall be thoroughly cleaned.

#### **407.3.1.3 Placing Concrete in Water**

Concrete shall not be placed in water except with approval of the PCG Engineer and under his immediate supervision. In this case the method of placing shall be hereinafter specified.

Concrete deposited in water shall be Class A concrete with a minimum cement content of 400 kg/m<sup>3</sup> of concrete. The slump of the concrete shall be maintained between 10 and 20 cm. To prevent segregation, concrete shall be carefully placed in a compact mass, in its final position, by means of a tremie, a bottom-dump bucket, or other approved means, and shall not be disturbed after being placed.

A tremie shall consist of a tube having a diameter of not less than 250 mm constructed in sections having flanged couplings fitted with gaskets with a hopper at the top. The tremie shall be supported so as to permit free movement of the discharge and over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of work so as to prevent water entering the tube and shall be completely submerged in concrete at all times; the tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by lightly raising the discharge end, but always keeping it in the placed concrete. The flow shall be continuous until the work is completed.

When the concrete is placed with a bottom-dump bucket, the top of the bucket shall be open. The bottom doors shall open freely downward and outward when tripped. The buckets shall be completely filled and slowly lowered to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited and when discharged shall be withdrawn slowly until well above the concrete.

#### **407.3.2 Compaction of Concrete**

Concrete during and immediately after placing shall be thoroughly compacted. The concrete in walls, beams, columns and the like shall be placed in horizontal layers not more than 30 cm thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding layer has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the layers. Each layer shall be compacted so as to avoid the formation of a construction joint with a preceding layer.

The compaction shall be done by mechanical vibration. The concrete shall be vibrated internally unless special authorization of other methods is given by the PCG Engineer or is provided herein. Vibrators shall be of a type, design, and frequency approved by the PCG Engineer. The intensity of vibration shall be such as to visibly affect a mass of concrete with a 3 cm slump over a radius of at least 50 cm. A sufficient number of vibrator shall be provided to properly compact each batch immediately after it is placed in the forms. Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms and shall be applied at the point of placing and in the area of freshly placed concrete. The vibrators shall be inserted into and

withdrawn from the concrete slowly. The vibration shall be of sufficient duration and intensity to compact the concrete thoroughly but shall not be continued so as to cause segregation and at any one point to the extent that localized areas of grout are formed. Application of vibrators shall be at points uniformly spaced, and not farther apart than twice the radius over which the vibration is visibly effective. Vibration shall not be applied directly or thru the reinforcement to sections or layers of concrete that have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms of troughs or chutes.

#### **407.3.3 Casting Sections and Construction Joints**

The concrete in each form shall be placed continuously. Placing of concrete in any such form shall not be allowed to commence unless sufficiently inspected and approved materials for the concrete is at hand, and labor and equipment are sufficient to complete the pour without interruption.

Joints in the concrete due to stopping work shall be avoided as much as possible. Such joints, when necessary, shall be constructed to meet the approval of the PCG Engineer.

When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its shape, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. Where a "faster edge" might be produced at a construction joint, as in the sloped top surface of a wingwall, an inset formwork shall be used to produce an edge thickness of not less than 15 cm in the succeeding layer. Work shall not be discontinued within 50 cm of the top of any face, unless provision has been made for a coping less than 50 cm thick, in which case if permitted by the PCG Engineer, the construction joint may be made at the underside of coping.

Immediately following the discontinuance of placing concrete, all accumulations of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. Care shall be exercised, during the cleaning of the reinforcing steel, not to injure or break the concrete- steel bond at and near the surface of the concrete.

#### **407.3.4 Casting Box Culverts**

In general, the base slab of box culverts shall be placed and allowed to set before the remainder of the culvert is constructed. In the construction of box culverts the sidewalls and top slab may be constructed as a monolith.

If the concrete in the walls and top slab is placed in two separate operations, special care shall be exercised in order to secure bonding in the construction joint and appropriate keys shall be left in the sidewalls for anchoring the top slab. Each wingwall shall be constructed, if possible, as a monolith. Construction joints where unavoidable, shall be horizontal and so located that no joints will be visible in the exposed face of the wingwall above the ground line.

Vertical construction joints shall be at right angles to the axis of the culverts.

#### **407.3.5 Casting Columns, Slabs and Girders**

Concrete in columns shall be placed in one continuous operation, unless otherwise directed. The concrete shall be allowed to set for at least 20 hours before the caps are placed.

Unless otherwise permitted by the PCG Engineer, no concrete shall be placed in the superstructure until the column forms have been stripped sufficiently to determine the condition of the concrete in the column. The load of the superstructure shall not be allowed to come upon the bents until they have been in place at least 14 days, unless otherwise permitted by the PCG Engineer.

Concrete in slab spans shall be placed in one continuous operation for each span unless otherwise provided.

Concrete in T-beam or deck girder spans shall be placed in one continuous operation unless otherwise directed. If it is permitted to place the concrete in two separate operations, each of the operations, shall be continuous: first, to the top of the girder stems, and second, to completion. In the latter case, the bond between stem and slab shall be secured by means of suitable shear keys which may be formed by the use of timber blocks approximately 50 mm x 100 mm in cross-section having a length of 100 mm less than the width of the girder stem. These key blocks shall be placed along the girder stems as required, but the spacing shall not be greater than 300 mm center to center. The blocks shall be bevelled and oiled in such a manner as to insure their ready removal, and they shall be removed as soon as the concrete has set sufficiently to retain its shape. If the Contractor wishes to place the concrete in two separate operations, he shall, with his request for permission to do so, submit plans and proposals of the required changes to the reinforcement, which plans and proposals shall be subject to the approval of the PCG Engineer.

In box girders, the concrete in the bottom slab be poured first, as a separate operation. The concrete in the webs and the top slab shall be placed in one continuous operation unless otherwise specified. If it is permitted to place the concrete in more than one operation, the requirements for T-beam shall apply.

#### **407.3.6 Construction Joints**

Construction joints shall be made only where shown on the Plans or called for in the pouring schedule, unless otherwise approved by the PCG Engineer. Shear keys or reinforcement shall be used, unless otherwise specified, to transmit shear or to bond the two sections together. Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened. The surface of the hardened concrete shall be roughened as required by the PCG Engineer, in a manner that will not leave loose particles of aggregate or damage concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance. When directed by the PCG Engineer the surface of the hardened concrete which will be in contact with new concrete shall be washed with water to his satisfaction, and to insure an excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces shall first be thoroughly covered with a coating of mortar of the same proportion of sand and cement as the class of concrete used against which the new concrete shall be placed before the grout or mortar has attained its initial set.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints which are exposed to view shall be carefully finished true to line and elevation.

#### **407.3.7 Concrete Surface Finishing**

Surface finishing shall be classified as follows:

- Class 1. Ordinary Finish
- Class 2. Rubbed Finish
- Class 3. Floated Finish

All concrete shall be given Class 1, Ordinary Finish and additionally any further finish as specified.

Unless otherwise specified, the following surfaces shall be given Class 2, Rubbed Finish.

1. The exposed faces of piers, abutments, wingwalls, and retaining walls.
2. The outside faces of girders, T-beams, slabs, columns, bracket curbs, headwalls, railings, arch rings, spandrel walls and parapets.

Excluded, however, are the tops and bottoms of floor slabs and sidewalks, bottoms of beams and girders, sides of interior beams and girders, backwalls above bridge seats or the underside of copings. The surface finish on piers and abutments shall include all exposed surface below the bridge seats to 20 cm below low water elevation or 50 cm below finished ground level when such ground level is above the water surface. Wingwalls shall be finished from the top to 50 cm below the finished slope lines on the outside face and shall be finished on top and for a depth of 20 cm below the top on the back sides.

Unless otherwise specified, the surface of the travelled way shall be Class 3, Floated Finish.

#### *Class 1, Concrete Ordinary Finish*

Immediately following the removal of forms, all fins and irregular projections shall be removed from all surface except from those which are not to be exposed or are not to be waterproofed. On all surfaces the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned, and after having been kept saturated with water for a period of not less than three hours shall be carefully pointed and made true with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall not be more than one hour old. The mortar patches shall be cured as specified under Subsection 407.3.8. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with a clean and true edges.

The resulting surface shall be true and uniform. All repaired surfaces the appearance of which is not satisfactory to the PCG Engineer, shall be "rubbed" as specified below.

#### *Class 2. Concrete Rubbed Finish*

After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work the concrete shall be kept thoroughly saturated with water for a minimum period of three hours. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of pot holes and defects to thoroughly set. Surfaces to be finished shall be rubbed with a minimum coarse carborundum stone using a small amount of mortar on each face. The mortar shall be composed of cement and fine sand mixed in the proportions used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids have been filled, and a uniform surface has been obtained. The face produced by this rubbing shall be left in place at this time.

After all concrete above the surface being created has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it should be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

#### *Class 3, Concrete Floated Finish*

After the concrete is compacted as specified in Subsection 407.3.2, Compaction of Concrete, the surface shall be carefully struck off with a strike board to conform to the cross-section and grade shown on the Plans. Proper allowance shall be made for camber if required. The strike board may be operated longitudinally or transversely



and shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither is raised from the side forms during the process. A slight excess of concrete shall be kept in front of the cutting edge at all times.

After striking off and consolidating as specified above, the surface shall be made uniform by longitudinal or transverse floating or both. Longitudinal floating will be required except in places where this method is not feasible.

The longitudinal float, operated from foot bridges, shall be worked with a sawing motion while held in a floating position parallel to the road centerline and passing gradually from one side of the pavement to the other. The float shall then be moved forward one-half of each length and the above operation repeated. Machine floating which produces an equivalent result may be substituted for the above manual method.

The transverse float shall be operated across the pavement by starting at the edge and slowly moving to the center and back again to the edge. The float shall then be moved forward one-half of each length and the above operation repeated. Care shall be taken to preserve the crown and cross-section of the pavement.

After the longitudinal floating has been completed and the excess water removed, but while the concrete is still plastic, the slab surface shall be tested for trueness with a straight-edge. For this purpose, the Contractor shall furnish and use an accurate 3m straight-edge swing handless 1m longer than one-half the width of the slab.

The straight-edge shall be held in successive positions parallel to the road centerline and in contact with the surface and the whole area gone over from one side of the slab to the other as necessary advancement along the deck shall be in successive stages of not more than one-half the length of the straight-edge. Any depression found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. The straight-edge testing and refloating shall continue until the entire surface is found to be free from observable departure from the straight-edge and the slabs has the required grade and contour until there are no deviations of more than 3 mm under the 3 m straight-edge.

When the concrete has hardened sufficiently, the surface shall be given a broom finish. The broom shall be an approved type. The stroke shall be square across the slabs from edge to edge, with adjacent stroke slightly overlapped, and shall be made by drawing the broom without tearing the concrete, but so as to produce regular corrugations not over 3 mm in depth. The surface as thus finished shall be free from porous spots, irregularities, depressions and small pockets or rough spots such as may be caused by accidental disturbing, during the final brooming of particles of coarse aggregate embedded near the surface.

#### *Concrete Surface Finish for Sidewalk*

After the concrete has been deposited in place, it shall be compacted and the surface shall be struck off by means of strike board and floated with a wooden or cork float. An edging tool shall be used on all edges and at all expansion joints. The surface shall not vary more than 3mm under a 3m straight-edge. The surface shall have a granular or matted texture which will not slick when wet.

### **407.3.8 Curing Concrete**

All newly placed concrete shall be cured in accordance with the Specification, unless otherwise directed by the PCG Engineer. The curing method shall be one or more of the following:

1. Water Method

The concrete shall be kept continuously wet by the application of water for a minimum period of 7 days after the concrete has been placed.

The entire surface of the concrete shall be kept damp by applying water with an atomizing nozzle. Cotton mats, rugs, carpets, or earth or sand blankets may be used to retain the moisture. At the expiration of the curing period the concrete surface shall be cleared of the curing medium.

2. Curing Compound

Surfaces exposed to the air may be cured by the application of an impervious membrane if approved by the PCG Engineer.

The membrane forming compound used shall be practically colorless liquid. The use of any membrane-forming compound that will alter the natural color of the concrete or impart a slippery surface to any wearing surface shall be prohibited. The compound shall be applied with a pressure spray in such a manner as to cover the entire concrete surface with a uniform film and shall be of such character that it will harden within 30 minutes after application. The amount of compound applied shall be ample to seal the surface of the concrete thoroughly. Power-operated spraying equipment shall be equipped with an operational pressure gauge and means of controlling the pressure.

The curing compound shall be applied to the concrete following the surface finishing operation immediately after the moisture sheen begins to disappear from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any delay, in the application of the curing compound, which results in any drying or cracking of the surface, application of water with an atomizing nozzle as specified under "Water Method" shall be started immediately and shall be continued until the application of the compound is resumed or started, however, the compound shall not be applied over any resulting free standing water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures, the damaged portion shall be repaired immediately with additional compound.

Curing compound shall not be diluted or altered in any manner after manufacture. At the time of use, the compound shall be in a thoroughly mixed condition. If the compound has not been used within 120 days after the date of manufacture, the PCG Engineer may require additional testing before the use to determine compliance to requirements.

An anti-setting agent or a combination of anti-setting agents shall be incorporated in the curing compound to prevent caking.

The curing compound shall be packaged in clean barrels or steel containers or shall be supplied from a suitable storage tank located on the Site. Storage tanks shall have a permanent system designed to completely redisperse any settled material without introducing air or any other foreign substance. Containers shall be well-sealed with ring seals and lug type crimp lids. The linings of the containers shall be of a character that will resist the solvent of the curing compound. Each container shall be labelled with a manufacturer's name, specification number, batch number, capacity and date of manufacture, and shall have label warning concerning flammability. The label shall also warn that the curing compound shall be well-stirred before use. When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.

Curing compound may be sampled by the PCG Engineer at the source of supply and on the Site.

3. Waterproof Membrane Method

The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed until the concrete has set, after which a curing membrane of waterproof paper or plastic sheeting shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.

Waterproof paper and plastic sheeting shall conform to the specification of AASHTO M 171.

The waterproof paper or plastic sheeting shall be formed into sheets of such width as to cover completely the entire concrete surface.

All joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 100 mm.

The sheets shall be securely weighed down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the PCG Engineer.

Should any portion of the sheets be broken or damaged within 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

Sections of membrane which have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used.

4. Forms-in-Place Method

Formed surfaces of concrete may be cured by retaining the form- in-place. The forms shall remain in place for a minimum period of 7 day after the concrete has been placed, except that for members over 50 cm in least dimensions, the forms shall remain in place for a minimum period of 5 days. Wooden forms shall be kept wet by watering during the curing period.

5. Curing Cast-in-Situ Concrete

All newly placed concrete for cast-in-situ structures, other than highway bridge deck, shall be cured by the water method, the forms-in-place method, or as permitted herein, by the curing compound method, all in accordance with the requirements of Subsection, 407.3.8 Curing Concrete.

The curing compound method may be used on concrete surfaces which are to be buried under ground and surfaces where only Ordinal Surface Finish is to be applied and on which a uniform color is not required and which will not be visible from public view.

The top surface of highway bridge decks shall be cured by either the curing compound method or the water method. The curing compound shall be applied progressively during the deck finishing operations. The water cure shall be applied not later than 4 hours after completion of the deck finishing.

When deemed necessary by the PCG Engineer during periods of hot weather, water shall be applied to concrete surface being cured by the curing compound method or by the forms-in-place method until the PCG Engineer determine that a cooling effect is no longer required.

6. Curing Pre-Cast Concrete (except piles)

Pre-cast concrete members shall be cured for not less than 7 days by the water method or by steam curing. Steam curing for pre-cast members shall conform to the following provisions:

- a. After placement of the concrete, members shall be held for minimum 4-hour pre-steaming period.
- b. To prevent moisture loss on exposed surfaces during the pre-steaming period, members shall be covered immediately after casting or the exposed surface shall be kept wet by fog spray or wet blankets.
- c. Enclosures for steam curing shall allow free circulation steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar, flexible covers will be permitted, provided they are kept in good condition and secured in such a manner to prevent the loss of steam and moisture.
- d. Steam at jets shall be low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 20°C per hour. The curing temperature throughout the enclosure shall not exceed 65°C and shall be maintained at a constant level for a sufficient time necessary to develop the required compressive strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature of the enclosure will be the same as that of the concrete.
- e. Temperature recording devices that will provide an accurate continuous permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per 50 m of continuous bed length will be required for checking temperature.
- f. Curing of pre-cast concrete will be considered completed after the termination of the steam curing cycle.

7. Curing Pre-cast Concrete Piles

All newly placed concrete for pre-cast concrete piles, conventionally reinforced or prestressed shall be cured by the "Water Method" as described in Subsection 407.3.8, Curing Concrete, except that the concrete shall be kept under moisture for at least 14 days. At the option of the Contractor, steam curing may be used in which case the steam curing provisions of Subsection 407.3.8 (6), Curing Pre-Cast Concrete (except piles) shall apply except that the concrete shall be kept wet for at least 7 days including the holding and steaming period.

**407.3.9 Falsework Design and Drawings**

Detailed working drawings and supporting calculations of the falsework shall be furnished by the Contractor to the PCG Engineer. No falsework construction shall start until the PCG Engineer has reviewed and approved the design. The Contractor shall provide sufficient time for the PCG Engineer to complete this review. Such time shall be proportionate to the complexity of the falsework design and in no case be less than two weeks.

The Contractor may review the falsework drawings at any time provided sufficient time is allowed for the PCG Engineer's review before construction is started on the revised portion.

Assumptions used in design of the falsework shall include but not be limited to the following:

1. The entire superstructure cross-section, except for the railing, shall be considered to be placed at one time, except when in the opinion of the PCG Engineer, a portion of the load is carried by members previously cast and having attained a specified strength.
2. The loading used on timber piles shall not exceed the bearing value for the pile and shall in no case exceed 20 tonne per pile.
3. Soil bearing values and soil condition (wet and dry) shall be designated by the Contractor on the falsework drawings. Falsework footings shall be designed to carry the loads imposed upon them without exceeding estimated soil bearing values or allowable settlements.
4. The maximum loadings and deflections used on jacks, brackets, columns and other manufactured devices shall not exceed the manufacture's recommendations. If requested by the PCG Engineer, the Contractor shall furnish catalogue or other data verifying these recommendations.
5. If the concrete is to be prestressed, the falsework shall be designed to support any increased or readjusted loads caused by the prestressing forces.
6. Joints supporting slabs and overhangs shall be considered as falsework and designed as such.

For the construction of falsework over and adjacent to roadways where falsework openings are required for maintaining traffic, the Contractor shall provide any additional features for the work needed to insure that the falsework will be stable if subjected to impact by vehicles.

The falsework design at the locations where said openings are required shall include but not be limited to the following minimum provisions:

- a. Each exterior stringer in a span shall be securely anchored to the following cap or framing.
- b. Adequate bracing shall be used during all stages of falsework construction and removal over or adjacent to public traffic.
- c. Falsework members shall be at least 300mm clear of temporary protective railing members.

The falsework drawings shall include a superstructure placing diagram showing proposed concrete placing sequence and construction joint locations, except that where a schedule for placing concrete is shown on the Contract Plans, no deviation will be permitted there from unless approved in writing by the PCG Engineer.

The falsework drawings shall show pedestrian openings which are required through the falsework.

Anticipated total settlements of falsework and forms shall be indicated by the Contractor on the falsework drawings. These should include falsework footing settlements over 20 mm will not be allowed unless otherwise permitted by the PCG Engineer. Deck slab forms between girders shall be constructed with no allowance for settlement relative to the girders.

Detailed calculations by the Contractor showing the stresses deflections, and camber necessary to compensate for said deflections in all load supporting members shall be supplied.

After approving the Contractor's falsework deflection camber, the PCG Engineer will furnish to the Contractor the amounts of camber necessary to compensate for vertical alignment or

anticipated structure deflection, if these are not shown on the drawings. The total camber used in constructing falsework shall be the sum of the aforementioned cambers.

#### **407.3.10 Falsework Construction**

The falsework shall be constructed to conform to the falsework drawings. The materials used in the falsework construction shall be of the quantity and quality necessary to withstand the stresses imposed. The workmanship used in falsework shall be of such quality that the falsework will support the loads imposed on it without excessive settlement or take-up beyond that shown on the falsework drawings.

When falsework is supported on piles, the piles shall be driven to a bearing value equal to the total calculated pile loading as shown on the falsework drawings.

Suitable jacks or wedges shall be used in connection with falsework to set the forms to their required grade and to take up any excessive settlement in the falsework either before or during the placing of concrete.

The Contractor shall provide tell-tales attached to the soffit forms easily readable and in enough systematically-placed locations to determine the total settlement of the entire portion of the structure where concrete is being placed.

Should unanticipated events occur, including settlements that deviate more than  $\pm 20$  mm from those indicated on the falsework drawings, which in the opinion of the PCG Engineer would prevent obtaining a structure conforming to the requirement of the Specification, the placing of concrete shall be discontinued until corrective measures satisfactory to the PCG Engineer are provided. In the event satisfactory measures are not provided prior to initial set of the concrete in the affected area, the placing of concrete shall be discontinued at a location determined by the PCG Engineer. All unacceptable concrete shall be removed.

#### **407.3.11 Removing Falsework**

Unless otherwise shown on the drawings, or permitted by the PCG Engineer, falsework supporting any span of a supported bridge shall not be released before 14 days after the last concrete, excluding concrete above the bridge deck, has been placed. Falsework supporting any span of a continuous or rigid frame bridge shall not be released before 14 days after the last concrete excluding concrete above the bridge deck, has been placed in that span and in the adjacent portions of each adjoining span for a length equal to at least half the length of the span where falsework is to be released.

Falsework supporting deck overhangs and deck slabs between girders shall not be released until 7 days after the deck concrete has been placed.

In addition to the above requirements, no falsework for bridges shall be released until the supported concrete has attained a compressive strength of at least 80% of the required 28-day strength. Falsework for cast-in place prestressed portion of structure shall not be released until after the prestressing steel has been tensioned.

All falsework materials shall be completely removed. Falsework piling shall be removed at least 50 cm below the surface of the original ground or stream bed. When falsework piling is driven within the limits of ditch or channel excavation areas, the falsework piling within such areas shall be removed to at least 50 cm below the bottom and side slopes of said excavated areas.

All debris and refuse resulting from work shall be removed and the site left in a neat and presentable condition.

#### **407.3.12 Formwork Design and Drawings**

The Contractor shall prepare drawings and materials data for the form work and shutters to be submitted to the PCG Engineer for approval unless otherwise directed.

The requirements for design of formwork are the same as described under Section 407.3.9.

#### **407.3.13 Formwork Construction**

Concrete forms shall be mortar-tight, true to the dimensions, lines and grades of the structure and with the sufficient strength, rigidity, shape and surface smoothness as to leave the finished works true to the dimensions shown on the Plans or required by the PCG Engineer and with the surface finish as specified.

Formwork and shutters are to be constructed in accordance with the approved Plans.

The inside surfaces of forms shall be cleaned of all dirt, mortar and foreign material. Forms which will later be removed shall be thoroughly coated with form oil prior to use. The form oil shall be of commercial quality form oil or other approved coating which will permit the ready release of the forms and will not discolor the concrete.

Concrete shall not be deposited in the forms until all work in connection with constructing the forms has been completed, all materials required for the unit to be poured, and the PCG Engineer has inspected and approved said forms and materials. Such work shall include the removal of all dirt, chips, sawdust and other foreign material from the forms.

The rate of depositing concrete in forms shall be such to prevent bulging of the forms or form panels in excess of the deflections permitted by the Specification.

Forms for all concrete surfaces which will not be completely enclosed or hidden below the permanent ground surface shall conform to the requirements herein for forms for exposed surfaces. Interior surfaces of underground drainage structures shall be completely enclosed surfaces.

Formwork for concrete placed under water shall be watertight. When lumber is used, this shall be planed, tongued and grooved.

Forms for exposed concrete surfaces shall be designed and constructed so that the formed surface of the concrete does not undulate excessively in any direction between studs, joists, form stiffeners, form fasteners, or walls. Undulations exceeding either 2 mm or 1/270 of the center to center distance between studs, joists, form stiffeners, form fasteners, or walls will be considered to be excessive. Should any form of forming system, even though previously approved for use, produce a concrete surface with excessive undulations, its use shall be discontinued until modifications satisfactory to the PCG Engineer have been made. Portions of concrete structures with surface undulations in excess of the limits herein specified may be rejected by the PCG Engineer.

All exposed surfaces of similar portions of a concrete structure shall be formed with the same forming material or with materials which produce similar concrete surface textures, color and appearance.

Forms for exposed surfaces shall be made of form materials of even thickness and width and with uniform texture. The materials shall have sharp edges and be mortar-tight.

Forms for exposed surfaces shall be constructed with triangular fillets at least 20 mm wide attached so as to prevent mortar runs and to produce smooth straight chamfers at all sharp edges of the concrete.

Form fasteners consisting of form bolts, clamps or other devices shall be used as necessary to prevent spreading of the forms during concrete placement. The use of ties consisting of twisted wire loops to hold forms in position will not be permitted.

Anchor devices may be cast into the concrete for later use in supporting forms or for lifting precast members. The use of driven types of anchorage for fastening forms or form supports to concrete will not be permitted.

#### 407.3.14 Removal of Forms and Falsework

Forms and falsework shall not be removed without the consent of the PCG Engineer. The PCG Engineer's consent shall not relieve the Contractor of responsibility for the safety of the work. Blocks and bracing shall be removed at the time the forms are removed and in no case shall any portion of the wood forms be left in the concrete.

Falsework removal for continuous or cantilevered structures shall be as directed by the PCG Engineer or shall be such that the structure is gradually subjected to its working stress. When concrete strength tests are used for removal of forms and supports, such removal should not begin until the concrete has attained the percentage of the specified design strength shown in the table below.

	Minimum Time	Minimum Percentage Design Strength
Centering under girders, beams frames or arches	14 days	80%
Floor slabs	14 days	70%
Walls	1 day	70%
Columns	2 days	70%
Sides of beams and all other vertical surfaces	1 day	70%

In continuous structures, falsework shall not be released in any span until the first and second adjoining spans on each side have reached the strength specified herein, or in the Special Specifications. When cast-in-place post tensioned bridges are constructed, falsework shall remain in place until all post tensioning has been accomplished.

Falsework under all spans of continuous structures shall be completely released before concrete is placed in railings and parapets. In order to determine the condition of column concrete, forms shall be removed from columns before releasing supports from beneath beams and girders.

Forms and falsework shall not be released from under concrete without first determining if the concrete has gained adequate strength without regard to the time element. In the absence of strength determination, the forms and falsework are to remain in place until removal is permitted by the PCG Engineer.

The forms for footings constructed within cofferdams or cribs may be left in place when, in the opinion of the PCG Engineer, their removal would endanger the safety of the cofferdam or crib, and when the forms so left intact will not be exposed to view in the finished structure. All other forms shall be removed whether above or below the ground line or water level.



All forms shall be removed from the cells of concrete box girders in which utilities are present and all formwork except that necessary to support the deck slab shall be removed from the remaining cells of the box girder.

To facilitate finishing, forms used on ornamental work, railing, parapets and exposed vertical surfaces shall be removed in not less than 12 nor more than 48 hours, depending upon weather conditions. In order to determine the condition of concrete in columns, forms shall always be removed from them before the removal of shoring from beneath beams and girders.

Falsework and centering for spandrel-filled arches not be struck until filling at the back of abutments has been placed up to the spring line. Falsework supporting the deck of rigid frame structures shall not be removed until fills have been placed back to the vertical legs.

#### **407.4 METHOD OF MEASUREMENT**

The quantity of structural steel, structural concrete, reinforcing steel or other Contract Pay Items shall constitute the completed and accepted structure which shall be measured for payment in the manner prescribed in the several items involved.

#### **407.5 BASIS OF PAYMENT**

The quantities measured as provided in Section 407.4. Method of Measurement shall be paid for at the contract price for the several pay items which price and payment shall be full compensation for furnishing, preparing, fabricating, placing, curing and for all labor, equipment, tools and incidentals necessary to complete the Item. Such payment shall constitute full payment for the completed structure ready for use.

Payment will be made in accordance with the Bill of Quantities.

## PART G – DRAINAGE AND SLOPE PROTECTION STRUCTURES

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## ITEM 500 - PILE CULVERTS AND STORM DRAINS

### 500.1 DESCRIPTION

This Item shall consist of the construction or reconstruction of pipe culverts and storm drains, hereinafter referred to as “conduit” in accordance with this Specification and in conformity with the lines and grades shown on the Plans or as established by the PCG Engineer.

### 500.2 MATERIALS REQUIREMENTS

Materials shall meet the requirements specified in the following specifications:

Zinc coated (galvanized) corrugated iron or steel culverts and underdrains	AASHTO M36
Cast iron culvert pipe	AASHTO M 64
Concrete sewer, storm drain and culvert pipe	AASHTO M 86
Reinforced concrete culvert, storm drainage and sewer pipe	AASHTO M 170
Bituminous coated corrugated metal culvert pipe and pipe arches	AASHTO M 190
Reinforced concrete arch culvert, storm drain and sewer pipe	AASHTO M 206
Asbestos cement pipe for culverts and storm drains	AASHTO M 217

Joint Mortar – Joint mortar for concrete pipes shall consist of 1 part, by volume of Portland Cement and two (2) parts of approved sand with water as necessary to obtain the required consistency.

Portland Cement and sand shall conform to the requirements of Item 405, Structural Concrete. Mortar shall be used within 30 minutes after its preparation.

Rubber gaskets	AASHTO M 173
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Oakum – Oakum for joints in bell and spigot pipes shall be made from hemp (*Cannabis Sativa*) line or Benares Sunn fiber or from a combination of these fibers. The oakum shall be thoroughly corded and finished and practically free from lumps, dirt and extraneous matter.

Hot poured joint sealing compound	AASHTO M 173
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Bedding material shall conform to the requirements of Subsection

#### 500.3.2 Bedding

Backfill material shall conform to the requirements of Subsection 500.

#### 500.3.6 Backfilling

When the location of manufacturing plants allows, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for

laboratory testing for compliance with materials quality requirements. This shall be the basis for acceptance of manufacturing lots as to quality.

Prior to and during incorporation of materials in the work, these materials will be subject to the latest inspection and approval of the PCG Engineer.

### **500.3 CONSTRUCTION REQUIREMENTS**

#### **500.3.1 Excavation**

Trenches shall be excavated in accordance with the requirements of Item 103, Structure Excavation, to a width sufficient to allow for proper jointing of the conduit and thorough compaction of the bedding and backfill materials under and around the conduit. Where feasible, trench walls shall be vertical.

The completed trench bottom shall be firm for its full length and width. Where required, in the case of crop drains, the trench shall have a longitudinal camber of the magnitude specified.

When so specified on the Plans, the excavation for conduits placed in embankment fill, shall be made after the embankment has been completed to the specified or directed height above the designed grade of the conduit.

#### **500.3.2 Bedding**

The conduit shall conform to one of the classes specified. When no bedding class is specified, the requirements for Class C bedding shall apply.

Class A bedding shall consist of a continuous concrete cradle conforming to the plan details.

Class B bedding shall consist of bedding the conduit to a depth of not less than 30 percent of the vertical outside diameter of the conduit. The minimum thickness of bedding material beneath the pipe shall be 100 mm. The bedding material shall be sand or selected sandy soil all of which passes a 9.5 mm sieve and not more than 10 percent of which passes a 0.075 mm sieve. The layer of bedding material shall be shaped to fit the conduit for at least 15 percent of its total height. Recesses in the trench bottom shall be shaped to accommodate the bell when bell and spigot type conduit is used.

Class C bedding shall consist of bedding the conduit to a depth of not less than 10 percent of its total height. The foundation surface, completed in accordance with Item 103, Structure Excavation, shall be shaped to fit the conduit and shall have recesses shaped to receive the bells, if any.

For flexible pipe, the bed shall be roughly shaped and a bedding blanket of sand or fine granular material as specified above shall be provided as follows:

<u>Pipe Corrugation Depth</u>	<u>Minimum Bedding Depth</u>
10 mm	25 mm
25 mm	50 mm
50 mm	75 mm

For large diameter structural plate pipes the shaped bed need not exceed the width of bottom plate.

### 500.3.3 Laying Conduit

The conduit laying shall begin at the downstream end of the conduit line. The lower segment of the conduit shall be in contact with the shaped bedding throughout its full length. Bell or groove ends of rigid conduits and outside circumferential laps of flexible conduits shall be placed facing upstream. Flexible conduit shall be placed with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the conduit.

Paved or partially-lined conduit shall be laid such that the longitudinal center line of the paved segment coincides with the floor line. Elliptical and elliptically reinforced conduits shall be placed with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the conduit.

### 500.3.4 Jointing Conduit

Rigid conduits may either be of bell and spigot or tongue and groove design unless another type is specified. The method of joining conduit sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush even.

Joints shall be made with (a) Portland Cement mortar, (b) Portland Cement grout, (c) rubber gaskets, (d) oakum mortar, (e) oakum and joint compound (f) plastic sealing compound, or by a combination of these types, or any other type, as may be specified. Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the conduit and finished smooth on the inside. For grouted joints, molds or runners shall be used to retain the poured grout. Rubber ring gaskets shall be installed so as to form flexible water-tight seal. Where oakum is used, the joint shall be called with this material and then sealed with the specified material.

When Portland Cement mixtures are used, the completed joints shall be protected against rapid drying by any suitable covering material.

Flexible conduits shall be firmly joined by coupling bands.

Conduits shall be inspected before any backfill is placed. Any pipe found to be out of alignment, unduly settled, or damaged shall be taken up and relaid or replaced.

### 500.3.5 Field Strutting

When required by the Plans, vertical diameter of round flexible conduit shall be increased 5 percent by shop elongation or by means of jacks applied after the entire line of conduit has been installed on the bending but before backfilling. The vertical elongation shall be maintained by means of sills and struts or by horizontal ties when so specified. Only horizontal ties shall be used on paved invert pipe.

Ties and struts shall be 300 mm in place until the embankment is completed and compacted, unless otherwise shown on the Plans.

These construction specifications shall also apply in the case of relaid conduits. In addition, all conduits salvaged for relaying shall be cleaned of all foreign materials prior to reinstallation.

### 500.3.6 Backfilling

Materials for backfilling on each side of the conduit for the full trench width to an elevation of 300 mm above the top of the conduit shall be fine, readily compactible soil or granular material selected from excavation or from a source of the Contractor's choice, and shall not contain stones that would be retained on a 50 mm sieve, chunks of highly plastic clay, or other objectionable material. Granular backfill material shall have not less than 95 percent

passing a 12.5 mm sieve and not less than 95 percent retained on a 4.75 mm sieve. Oversized material, if present, shall be removed at the source of the material, except as directed by the PCG Engineer.

When the top of the conduit is flushed with or below the top of the trench, backfill material shall be placed at or near optimum moisture content and compacted in layers not exceeding 150 mm (compacted) on both sides to an elevation 300 mm above the top of the conduit. Care shall be exercised to thoroughly compact the backfill under the haunches of the conduit. The backfill shall be brought up evenly on both sides of the conduit for the full required length. Except where negative projecting embankment-type installation is specified, the backfill material shall be placed and compacted for the full depth of the trench.

When the top of the conduit is above the top of the trench, backfill shall be placed at or near optimum moisture content and compacted in layers not exceeding 300 mm (compacted) and shall be brought up to evenly on both sides of the conduit for its full length to an elevation 300 mm above the top of the conduit. The width of the backfill on each side of the conduit for the portion above the top of the trench shall be equal to twice the diameter of the conduit or 3.5 m, whichever is less. The backfill material used in the trench section and the portion above the top of the trench for a distance on each side of the conduit equal to the horizontal inside the diameter and to 300 mm above the top of the conduit shall conform to the requirements for backfill materials in this Subsection. The remainder of the backfill shall consist of materials from excavation and borrow that is suitable for embankment construction.

Compaction to the density specified in Item 104, Embankment, shall be achieved by use of mechanical tampers or by rolling.

All conduits after being bedded and backfill as specified in this Subsection shall be protected by one metre cover of fill before heavy equipment is permitted to cross during construction of the roadway.

#### **500.3.7 Imperfect Trench**

Under this method, for rigid conduit, the embankment shall be completed as described in Subsection 500.3.6, Backfilling, to a height above the conduit equal to the vertical outside diameter of the conduit plus 300 mm. A trench equal to the outside horizontal diameter of the conduit and to the length shown on the Plans or as directed by the PCG Engineer shall then be excavated to within 300 mm of the top of the conduit, trench walls being as nearly vertical as possible. The trench shall be loosely filled with highly compressible soil. Straw, hay, corn stalks, leaves brush or sawdust maybe used to fill the lower one-fourth to one-third of the trench. Construction of embankment above shall then proceed in a normal manner.

#### **500.4 METHOD OF MEASUREMENT**

Conduit of the different types and sizes, both new and relaid, will be measured by the linear metre in place. Conduit with sloped or skewed ends will be measured along the invert.

Each section will be measured by the number of units installed.

Branch connection and elbows will be included in the length measurement for conduit, or they may be measured by the number of units installed.

Class B bedding material placed and approved shall be measured by the cubic meter in place.

When the Bid Schedule contains an estimated quantity for "Furnishing and Placing Backfill Material, Pipe Culverts", the quantity to be paid for will be the number of cubic meter complete in place and accepted, measured in final position between limits as follows:

1. Measurement shall include backfill material in the trench up to the top of the original ground line but will not include any material placed outside of vertical planes 450 mm up to outside of and parallel to the inside wall of pipe at its widest horizontal dimension.
2. When the original ground lines is less than 300 mm above the top of the pipe, the measurement will also include the placing of all backfill materials, above the original ground line adjacent to the pipe for a height of 300 mm above the top of pipe and for a distance on each side of the pipe not greater than the widest horizontal dimension of the pipe.
3. The measurement shall include the placing of backfill material in all trenches of the imperfect trench method. Materials re-excavated for imperfect trench construction will be measured for payment under Item 102, Excavation.

#### **500.5 BASIS OF PAYMENT**

The accepted quantities of conduit, determined as provided in Section 500.4, Method of Measurement, shall be paid for at the contract unit price per linear metre for the conduit of the types and sizes specified complete in place. End sections and, when so specified, branch connections and elbows, shall be paid for the contract unit price per piece for the kind and size specified completed in place.

Excavation for culverts and storm drains, including excavation below flow line grade and for imperfect trench, shall be measured and paid for as provided in Item 103, Structure Excavation.

Concrete for Class A bedding will be paid for under Item 405, Structural Concrete.

When the Bid Schedule does not contain an estimated quantity for "Furnishing and Placing Backfill Material, Pipe Culvert", payment for placing backfill material around pipe culverts will be considered as included in the payment for excavation of the backfill material.

Payment will be made in accordance with the Bill of Quantities.

## ITEM 502 - MANHOLES, INLETS AND CATCH BASINS

### 502.1 DESCRIPTION

This Item shall consist of the construction, reconstruction or adjustment of manholes, inlets and catch basins in accordance with this Specification and in conformity with the lines and grades shown on the approved Plans and Drawings.

### 502.2 MATERIAL REQUIREMENTS

Concrete for these structures shall meet the requirements of Item 405, Structural Concrete (DPWH Standard Specification). Other materials shall meet the following specifications:

#### Concrete Masonry Units (Concrete Hollow Blocks)

The units shall conform to the approved Plans and Drawings, dimension and to the ASTM C129-11 Non-load bearing Concrete Masonry Units.

Compressive Strength  $fc' = 600\text{psi}$  (minimum) average of three units, computed to minimum net area.

Absorption =  $18\text{ lbs/ft}^3$  average of three units.

Corrugated Metal Units -The units shall conform to Plan dimensions and the metal to AASHTO M 36. Bituminous coating, when specified, shall conform to ASTM D 1187, Asphalt- base Emulsion for use as Protective Coating for Metal.

Sewer and manhole brick (Made from clay or shale)	AASHTO M 91
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Building brick (Solid masonry Units made from clay or shale)	AASHTO M 114
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Joint Mortar -Unless otherwise indicated on the Plans, joints mortar shall be composed of one part Portland Cement and two parts fine aggregate by volume to which hydrated lime has been added in an amount equal to 10 percent of the cement by weight. All materials for mortar shall meet the requirements of Item 405, Structural Concrete.

Frames, Gratings, Covers and Ladder Rungs -Metal units shall conform to the plan dimensions and to the following specification requirements for the designated materials.

Metal gratings and covers which are to rest on frames shall bear on them evenly. They shall be assembled before shipment and so marked that the same pieces may be reassembled readily in the same position when installed. Inaccuracy of bearings shall be corrected by machining if necessary. A frame and a grating or cover to be used with it shall constitute one pair.

All castings shall be uniformly coated with asphalt-base emulsion meeting the requirements of ASTM D 1187, Asphalt-base Emulsion for use as Protective Coating for Metal.

Samples of the material in casting shall be taken during the casting of the units and shall be separate casting poured from the same material as the casting they represent.

Gray iron casting	AASHTO M 105
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Mild to medium-strength carbon steel castings for general application	AASHTO M 103
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Structural steel AASHTO M 183

Galvanizing, where specified  
for these units, shall conform  
to the requirements of AASHTO M 111

Reinforcing Steel AASHTO M 31

Pre-cast Concrete Units - These units shall be cast in substantial permanent steel forms. Structural concrete used shall attain a minimum 28-day compressive strength of 20.682 MPa (3,000 psi). The pre-cast units shall be cured in accordance with AASHTO M 171. Water absorption of individual cores taken from such units shall not exceed 7 percent. Additional reinforcement shall be provided as necessary to provide for handling of the pre-cast units.

A sufficient number of cylinders shall be cast from the concrete for each unit to permit compression tests at 7, 14 and 28 days, and to allow for at least 3 cylinders for each test. If the strength requirement is met at 7 or 14 days, the units shall be certified for use 14 days from the date of casting. If the strength is not met for 28 days, all units made from that batch or load will be rejected.

Cracks in units, honeycombed or patched areas in excess of 2,000 square millimetres, excessive water absorption and failure to meet strength requirements shall be the causes for rejection. Pre-cast reinforced concrete manhole risers and tops shall conform to the requirements of AASHTO M 199.

The plants will be inspected periodically for compliance with specified manufacturing methods, and material samples, will be obtained for laboratory testing for compliance with material quality requirements. This may be the basis for acceptance of manufacturing lots as the quality.

All materials shall be subject to inspection for acceptance as to condition at the latest practicable time the PCG Engineer has the opportunity to check for compliance prior to or during incorporation of materials into the work.

### **502.3 CONSTRUCTION REQUIREMENTS**

Concrete construction shall conform to the requirements for Item 405, Structural Concrete of DPWH standard.

Metal frames shall be set in full mortar bed. Pipe sections shall be flushed on the inside of the structure wall and projected outside sufficiently for proper connection with next pipe section. Masonry shall fit neatly and tightly around the pipe.

When grade adjustment on existing structures is specified, the frames, covers and gratings shall be removed and the walls reconstructed as required. The cleaned frames shall be reset at the required elevation. Upon completion, each structure shall be cleaned of any accumulations of silt, debris, or foreign matter of any kind and shall be kept clear of such accumulation until final acceptance of the work.

Excavation and backfill shall be done in accordance with Item 103, Structure Excavation.

### **502.4 METHOD OF MEASUREMENT**

Standard manholes, inlets and catch basins, both new and reconstructed as applicable, will be measured by the unit. Any additional concrete, reinforcing steel, or masonry required for authorized increases in heights of structures paid of under this Item and in excess of the standard height shown on the Plans will be measured and paid for under Item 405, Structural Concrete and Item 404. Reinforcing Steel, as applicable, Structures noted on the Plans as "junction boxes" will be measured for payment as manholes.

The number of concrete covers, pairs of metal frames and gratings, and pairs of metal frames and covers will be measured as acceptably completed.

The number of existing manholes, inlets and catch basins adjusted as directed will be measured as acceptably completed.

#### **502.5 BASIS OF PAYMENT**

The accepted quantities, determined as provided in Section 502.4, Method of Measurement of the Pay Items in the Bill of Quantities will be paid for at the contract unit prices, which shall constitute full compensation for furnishing and placing all materials and for all labor, equipment tools and incidentals necessary to complete the Item.

Excavation and backfill will be measured and paid for as provided in Item 103, Structure Excavation.

Payment will be made in accordance with the Bill of Quantities

## PART H – MISCELLANEOUS STRUCTURES

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## **ITEM 600 - CURB AND/OR GUTTER**

### **600.1 DESCRIPTION**

This item shall consist of the construction of curb and gutter either Cast in place, made of concrete in accordance with this Specification at the location, and in conformity with the lines, grades, dimensions and design, shown on the Plans or as required by the PCG Engineer.

### **600.2 MATERIAL REQUIREMENTS**

#### **600.2.1 Material for Bed Course**

Bed course materials as shown on the Plans shall consist of cinders, sand, slag, gravel, crushed stone, or other approved porous material of such grading that all particles will pass through 12.5 mm (1/2") sieve.

#### **600.2.2 Concrete**

Concrete shall be of the class indicated on the Plans and shall conform to the requirements of Item 405, Structural Concrete.

#### **600.2.3 Expansion Joint Filler**

Expansion joint filler shall conform to the requirements of AASHTO M 153.

#### **600.2.4 Cement Mortar**

Cement mortar shall consist of one part of Portland cement and two parts of fine aggregates with water added as necessary to obtain the required consistency. The mortar shall be used within 30 minutes of preparation.

#### **600.2.5 Bonding Compound**

Where bonding compound is used, it shall conform to AASHTO M 200.

### **600.3 CONSTRUCTION REQUIREMENTS**

#### **600.3.1 Bedding**

Excavation shall be made to the required depth and the base upon which the curb and/or gutter is to be set shall be compacted to a firm and even surface. All soft and unsuitable material shall be removed and replaced with suitable material.

Bed course material shall be placed and compacted to form a bed of the required thickness as shown on the Plans.

#### **600.3.2 Cast in Place Curb and Gutter**

##### **600.3.2.1 Placing**

Forms shall conform to the requirements of Item 407, Concrete Structures. Metal forms shall be of an approved section.

Forms to hold the concrete shall be built and set-in-place as described in Item 407, Concrete Structures. Forms for at least 50 m of curb and gutter shall be in-placed and checked for alignment and grade before concrete is placed. Curbs and gutter constructed on curves shall be accurately shaped to the curvature shown on the Plans.

Mixing, placing, finishing and curing of concrete shall conform to the requirements of Item 405, Structural Concrete, as modified by the requirements below.

The concrete shall be placed in the forms in layers of 100 or 125 mm each, and to the depth required. It shall be tamped and spaded until mortar entirely covers the top and surfaces of the forms. The top of the concrete shall be finished to a smooth and even surface and the edges rounded to the radii shown on the Plans. Before the concrete is given the final finishing, the surface of the gutter shall be tested with a 3-m straight-edge and any irregularities of more than 10 mm in 3 m shall be corrected.

The curb and gutter shall be constructed in uniform sections of not more than 50 m in length except where shorter sections are required to coincide with the location of weakened planes or construction joints of the concrete pavement, or for closures, but no section shall be less than 2 m long. The sections shall be separated by sheet templates set perpendicular to the face and top of the curb and gutter. The templates shall be approximately 5 mm in thickness and of the same width as that of the curb and/or gutter and not less than 50 mm deeper than the depth of the curb and/or gutter. Templates shall be set carefully and held firmly during the placing of the concrete and shall remain in place until the concrete has set sufficiently to hold its shape but shall be removed while the forms are still in place. A preformed joint filler approved by the PCG Engineer may be used in lieu of the sheet template mentioned above. In this event the fiber board shall be pre-cut to the shape of the curb so that its outer edge will be flushed with the abutting curb and/or gutter.

Expansion joints shall be formed at intervals shown on the Plans. Where a curb is placed next to a concrete pavement, expansion joints in the curb shall be located opposite expansion joints in the pavement.

The form shall be removed within 24 hours after the concrete has been placed. Minor defects shall be repaired with mortar containing one part of Portland Cement and two parts of fine aggregate. Plastering shall not be permitted and all rejected portions shall be removed and replaced at the Contractor's expense. The exposed surface shall be finished while the concrete is still fresh by rubbing the surfaces with a wetted soft brick or wood until they are smooth. The surfaces shall be wetted thoroughly, either by dipping the brick or wood in water, or by throwing water on the surfaces with a brush. After the concrete has been rubbed smooth using water, it shall then be rubbed with a thin grout containing one part of Portland Cement and one part of fine aggregates. Rubbing with grout shall continue until uniform color is produced. When completed, the concrete shall be covered with suitable material and kept moist for a period of 3 days, or a membrane forming material may be applied as provided in Item 405, Structural Concrete. The concrete shall be suitably protected from the weather until thoroughly hardened.

After the concrete has set sufficiently, the spaces on the back of the curb which were excavated for placing the curb shall be refilled to the required elevation with suitable material which shall be tamped in layers of not more than 150 mm until consolidated.

### 600.3.3 Precast Curb and Gutter

#### 600.3.3.1 Placing

The precast concrete curb and gutter shall be set in 20 mm of cement mortar as specified in 600.2.4 to the line level and grade as shown on the approved Plans.

The precast curb shall not be more than 20 cm in width at the top portion and not be more than 25 cm at the base. The precast curb and gutter shall be 1.0 m in length and shall be put side by side consecutively with joint in between.

Joints between consecutive curb and gutter shall be filled with mortar to the full section of curb and gutter. Expansion joints shall be formed at intervals shown on the Plans. Where a

curb and gutter is placed next to a concrete pavement, expansion joints in the curb and gutter shall be located opposite expansion joints in the pavement.

Minor defects shall be repaired with mortar containing one part of Portland Cement and two parts of fine aggregates. Plastering shall not be permitted and all rejected portions shall be removed and replaced at the Contractor's expense. The exposed surface shall be finished by rubbing the surfaces with a wetted soft brick or wood until they are smooth. The surfaces shall be wetted thoroughly, either by dipping the brick or wood in water, or by throwing water on the surfaces with a brush. After the concrete has been rubbed smooth using water, it shall then be rubbed with a thin grout containing one part of Portland Cement and one part of the aggregate. Rubbing with grout shall continue until uniform color is produced.

#### 600.3.3.2 Handling Precast Curb and Gutter

- a. In preparation for the handling of precast curb and gutter, all fabricated curb and gutter of one (1) meter in length shall be provided or inserted with 2-1"Ø PVC pipes for fitting at their required locations. The PVC pipes shall be placed 25 mm from both edge during the fresh concrete is in plastic state.
- b. Precast curb and gutter shall be lifted on upright position and not at the points of support and shall be the same during transporting and storage.
- c. Extreme care shall be exercised in handling and moving precast curb and gutter to avoid cracking.
- d. No precast curb and gutter shall be used that does not reach its final position in the forms with the required time stipulated prior to installation.
- e. Precast curb and gutter shall be transferred to the construction site. Fresh curb and gutter shall not be placed against in-situ concrete which has been in a position for more than 30 minutes.
- f. Precast curb and gutter may only be transported to the delivery point in truck agitators or truck mixer operating at the speed designated by the manufacturer of the equipment, provided that the consistency and workability of the mix concrete upon discharge at the delivery point is suitable for adequate placement.

#### 600.4 METHOD OF MEASUREMENT

The length of curb and gutter to be paid for shall be the number of linear meters of curb and gutter (cast in place) or the number of pieces of precast curb and gutter of the required dimensions shown on the Plans measured along its front face in-place, completed and accepted. No deductions shall be made for flattening of curbs at entrances and no additional allowances shall be made for curbs and gutters constructed on curves.

#### 600.5 BASIS OF PAYMENT

The length of curb and gutter determined in part 4, Method of Measurement, shall be paid for at the contract unit price per linear meter for Curb and Gutter which price and payment shall constitute full compensation for furnishing and placing all materials for concrete, reinforcing steel if required on the Plans, expansion joint materials, forms for drainage openings, excavation for curb and gutter, backfilling, dumping and disposal of surplus materials, and for all labor equipment, tools and incidentals necessary to complete the Item.

Payment will be made in accordance with the Bill of Quantities.

## **ITEM 601 - SIDEWALK**

### **601.1 DESCRIPTION**

This Item shall consist of the construction of Portland cement concrete sidewalk in accordance with this Specification and to the lines, grades, levels and dimensions shown on the Plans, or as required by the PCG Engineer.

### **601.2 MATERIAL REQUIREMENTS**

#### **601.2.1 Portland Cement Concrete**

The cement concrete shall be Class A as specified in Item 405, Structural Concrete.

#### **601.2.2 Expansion Joint Filler**

Unless otherwise ordered, the preformed joint filler shall have a thickness of 5 mm and shall conform to the requirements of Item 311, Portland Cement Concrete Pavement.

#### **601.2.3 Forms**

Forms shall be of wood or metal as approved by the PCG Engineer and shall extend to the full depth of the concrete. All forms shall be straight, free from warps and of adequate strength to resist distortion.

#### **601.2.4 Bed Course Material**

Bed course material consists of cinders, sand, slag, gravel, crushed stone or other approved permeable granular material of such grading that all particles shall pass a 12.5 mm (1/2 inch) sieve.

### **601.3 CONSTRUCTION REQUIREMENTS**

#### **601.3.1 Cement Concrete Sidewalk**

Excavation shall be as specified above. The bed course material shall be placed in accordance with the Item 200, Aggregate Subbase Course.

All forms shall be staked securely in position at the correct line and level. Preformed joint filler shall be set in position shown on the Plans before placing of the concrete is started. The top of the joint filler shall be placed 5 mm below the top surface of the finished sidewalk.

The mixing, placing, finishing and curing of concrete shall be as specified in Item 405, Structural Concrete. The Portland Cement concrete shall be placed to the total depth shown on the plans.

The surface shall be cut through to a depth of 10 mm with a trowel at intervals of 1 m or, were required, in straight lines perpendicular to the edge of sidewalk. The surface shall then be brushed. The edges of the sidewalk and the transverse cuts shall be shaped with a suitable tool so formed as to round the edges to a radius of 15 mm

### **601.4 METHOD OF MEASUREMENT**

The area to be paid for shall be the number of square meters of sidewalk measured, completed in-place and accepted.

#### **601.5 BASIS OF PAYMENT**

The quantity as determined in Subsection 601.4, Method of Measurement, shall be paid for all the contract unit price per square meter for Sidewalk which price and payment shall constitute full compensation for furnishing and placing all materials for concrete sidewalk, expansion joint material, for excavating and compacting the foundation bed, for furnishing and placing gravel or other permeable bed course material, for forms, and for all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made in accordance with the Bill of Quantities.



## **ITEM 608 - TOPSOIL**

### **608.1 DESCRIPTION**

This Item shall consist of topsoil furnished, transported and spread, or topsoil removed from designated areas, hauled and spread, in accordance with this Specification at the location shown on the Plans or as required by the PCG Engineer.

### **608.2 MATERIAL REQUIREMENTS**

Topsoil furnished shall consist of fertile friable soil of loamy character without admixture of undesirable subsoil, refuse or foreign materials. It shall be obtained from well-drained arable land and shall be reasonably free from roots, hard clay, coarse gravel, stones larger than 50 mm in size, coarse sand, noxious seeds, sticks, brush, litter and other deleterious substances. Topsoil shall be capable of sustaining healthy plant life and shall be subject to the approval of the PCG Engineer.

Topsoil shall contain not less than five (5) percent organic matter as determined by loss on ignition of samples oven-dried to constant weight.

### **608.3 CONSTRUCTION REQUIREMENTS**

#### **608.3.1 Sources of Material**

Topsoil shall be obtained as specified in Item 102, Excavation, or from other approved sources. The Contractor shall notify the PCG Engineer at least five days before he intends to start topsoil stripping operations. After inspection and approval by the PCG Engineer and prior to stripping any topsoil, the Contractor shall remove noxious weeds and tall grass, brush roots and stones larger than 50 mm in diameter.

#### **608.3.2 Placing**

The topsoil shall be evenly spread on the areas and to the line and level shown on the Plans and compacted with a light roller to a depth of not less than 100 mm. Spreading shall not be done when the ground topsoil is excessively wet or otherwise in a condition detrimental to such work. The roadway surfaces shall be kept clean during hauling and spreading operations.

After spreading has been completed, large clods, stones, roots stumps and other loose-lying materials shall be raked up and removed. Any erosion, irregularities of grade or other incidental damage to the surface of the topsoil shall be repaired and/or restored to the PCG Engineer's satisfaction.

### **608.4 METHOD OF MEASUREMENT**

The quantities to be paid for shall be the number of cubic meter of Topsoil removed, furnished and hauled complete in place and accepted.

### **608.5 BASIS OF PAYMENT**

The quantities, as determined in Section 608.4, Method of Measurement, shall be paid for at the contract unit price respectively, for each of the particular Pay Items listed below that is shown on the Bid Schedule, which price and payment shall be full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made in accordance with the Bill of Quantities.

## **ITEM 610 - SODDING**

### **610.1 DESCRIPTION**

This item shall consist of furnishing, hauling, and placing approved live sod on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the PCG Engineer.

### **610.2 MATERIALS**

#### **610.2.1 Sod**

Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials that might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod shall be composed of the species stated in the special provisions, and any vegetation more than 150 mm (6 inches) in height shall be mowed to a height of 75 mm (3 inches) or less before sod is lifted. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than that stated in the special provisions.

#### **610.2.2 Lime**

- (1) Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through No. 100 mesh sieve.
- (2) Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. This shall be applied at the rate of 120 g/m<sup>2</sup> to areas of Type 1 and Type 2 sodding.

#### **610.2.3 Fertilizer**

- (1) The fertilizer shall be of standard commercial fertilizer supplied separately or in mixtures containing nitrogen, phosphoric acid, and water-soluble potash.
- (2) Fertilizer shall be applied at the rate of 120 g/m<sup>2</sup> and to depth of 50 mm to 100 mm to areas of Type 1 and Type 2 sodding.
- (3) It shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamid compounds or hydrated lime shall be permitted in mixed fertilizers.
- (4) The fertilizer may be supplied in one of the following forms:
  - (a) A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
  - (b) A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
  - (c) A granular or pellet form suitable for application by blower equipment.

#### **610.2.4 Water**

The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass. It shall be subject to the approval of the PCG Engineer prior to use.

#### **610.2.5 Soil For Repairs**

The soil for fill and topsoiling of areas to be repaired must be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil should be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and must be approved by the PCG Engineer before being placed

### **610.3 CONSTRUCTION METHODS**

#### **610.3.1 General**

Areas to be solid, strip, or spot sodded shall be shown on the plans. Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition that are to remain undisturbed shall also be shown on the plans.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the PCG Engineer before the various operations are started. The Contractor shall demonstrate to the PCG Engineer before starting the various operations that the application of required materials will be made at the specified rates.

#### **610.3.2 Preparing the Ground Surface**

After grading of areas has been completed and before applying fertilizer and limestone, areas to be sodded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

#### **610.3.3 Applying Fertilizer and Ground Limestone**

Following ground surface preparation, fertilizer shall be uniformly spread at a rate which will provide not less than the minimum quantity of each fertilizer ingredient, as stated in the special provisions. If use of ground limestone is required, it shall then be spread at a rate that will provide not less than the minimum quantity stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than 2 inches (50 mm) by disking, raking, or other methods acceptable to the PCG Engineer. Any stones larger than 2 inches (50 mm) in any diameter, large clods, roots, and other litter brought to the surface by this operation shall be removed.

#### **610.3.4 Obtaining and Delivering Sod**

After inspection and approval of the source of sod by the PCG Engineer, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 50 mm (2 inches). Sod sections or strips shall be cut in uniform widths, not less than 250 mm (10 inches), and in lengths of not less than 45 cm (18 inches), but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are

required, the sod must be rolled without damage with the grass folded inside. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, permission to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

#### **610.3.5 Laying Sod**

Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the PCG Engineer, provided the sod bed is watered to moisten the soil to a depth of at least 100 mm (4 inches) immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and insure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen when replacing it shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately (25 mm) 1 inch below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

On slopes steeper than 1 vertical to 2-1/2 horizontal and in v-shaped or flat-bottom ditches or gutters, the sod shall be pegged with wooden pegs not less than 300 mm (12 inches) in length and have a cross-sectional area of not less than 18 square millimeter (3/4 square inch). The pegs shall be driven flush with the surface of the sod.

#### **610.3.6 Watering**

Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner that will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

#### **610.3.7 Establishing Turf**

##### **(1) General**

The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work.

##### **(2) Protection**

All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the PCG Engineer.

(3) Mowing

The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. In the event that weeds or other undesirable vegetation are permitted to grow to such an extent that, either cut or uncut, they threaten to smother the sodded species, they shall be

**610.3.8 Repairing**

When the surface has become bullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the PCG Engineer, and shall then be sodded as specified in 904-3.5.

**610.4 METHODS OF MEASUREMENT**

This item shall be measured on the basis of the area in square meters of the surface covered with sod and accepted.

**610.5 BASIS OF PAYMENT**

This item will be paid for on the basis of the contract unit price per square meter for sodding, which price shall be full compensation for all labor, equipment, material, staking, and incidentals necessary to satisfactorily complete the items as specified.

Payment will be made in accordance with the Bill of Quantities.

## **ITEM 611 - TREE PLANTING**

### **611.1 DESCRIPTION**

The scope under this section shall include all labor, materials, equipment and services necessary for the completion of the planting. Included in this scope are the finished grading, soil preparation, lawn installation, planting of trees, shrubs and ground cover; guarantee and replacement of lawns and plants; maintenance services; and all related items required to complete work as per drawings and specifications.

This item shall consist of furnishing, hauling, and placing approved live sod on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the PCG Engineer.

### **611.2 SUPERVISION AND INTERPRETATION OF PLANS AND SPECIFICATIONS**

- a. The work will be under the general supervision and direction of the Owner's Representative who will interpret and enforce strict compliance with plans and specifications.
- b. At all times when work is in progress there must be a competent foreman at the site of work with the authority to act for the Contractor. Instructions given to such Foreman shall be considered given to the Contractor.

### **611.3 CHANGES IN THE WORK**

When the Owner orders changes in the work, the sum shall be adjusted accordingly. All such orders and adjustments shall be made in writing. Claims by the Contractor for extra cost must be made in writing before executing the work involved.

### **611.4 MATERIALS**

- a. Topsoil – The Contractor shall furnish sufficient topsoil to properly install all work specified.

For Lawn	152 mm
For Ground Cover	203 mm
For Shrubs	305 mm
For Trees & Palms	305 mm

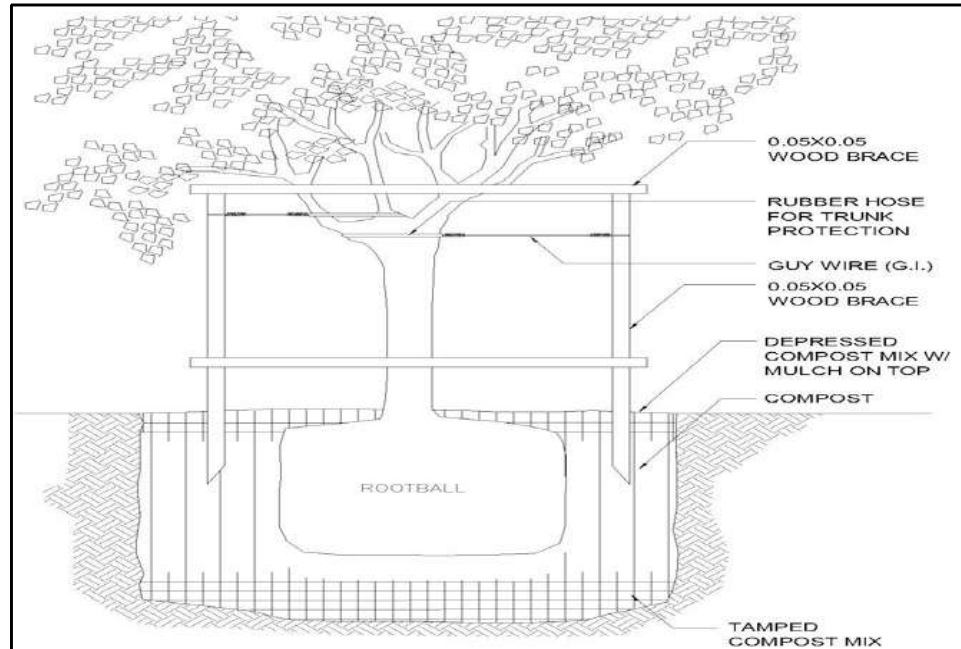
- b. Manure – shall be well-rooted animal manure free from wood shaving, sawdust, or other litter and containing no chemicals harmful to plant growth.
- c. Commercial Fertilizer - shall be approved by the Architect and shall be brought to the site in its original unopened container.

Water – shall be made available at the site before any planting is started. The Contractor shall furnish all necessary hose, equipment attachments for the adequate irrigation of all lawns and planting.

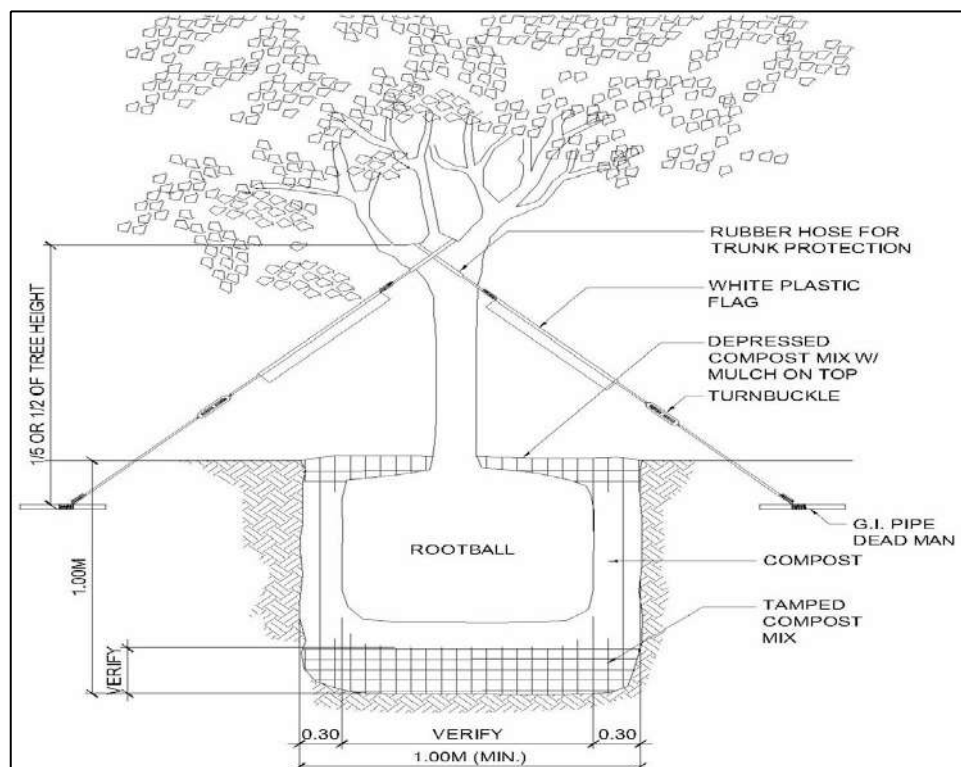
- d. Water shall be free from oil, acid, alkali, salt, and other substances harmful to growth of plants. The source shall be subject to approval.

e. Staking and Guying

- (1) Stakes for trees over 122 cm in height shall be 50 mm x 50 mm x 244 cm sound wood treated for ½ length with creosote or other wood preservative.



- (2) For fastening trees to stakes, use 50 mm tire strips tie with No. 16 gauge, pliable galvanized wire.



f. Lawn Materials

All planting of lawns and grass shall be made by blocks and shall be healthy, freshly dug, free of weeds and shall be properly protected until planting.

g. Plant Materials

- (1) A plant list specifying quantities, types and conditions accompanies the planting plan.
- (2) Nomenclature – The names of plants conform to those given in the following:
  - (a) Co's Digital Flora of the Philippines ([www.philippineplants.org](http://www.philippineplants.org))
  - (b) Rainforestation Information Portal
  - (c) ([www.reforestation.ph](http://www.reforestation.ph))
  - (d) Ramon Aboitiz Foundation Inc. [RAFI]
  - (e) ([www.rafi.org.ph](http://www.rafi.org.ph)) <http://www.energy.com.ph/>
  - (f) Haribon Foundation
  - (g) Directory of Native Tree (Beach Forest) Nurseries
  - (h) Phil. Tropical Forest Conservation Foundation
  - (i) Energy Development Corporation Binhi database
- (3) Quantities – In case of discrepancy between quantities shown in the plan and those actually required to complete the job as per spacing specified, the latter shall prevail, therefore, the Contractor should compute and verify the necessary quantities.
- (4) Quality and size – Plants shall have normal growth for its particular species and shall be free from injury, plant diseases or insect pests. All Plants shall equal or exceed the measurements specified.

#### **611.6 START AND COMPLETION OF LANDSCAPE WORK AT THE JOBSITE**

The Contractor shall be notified by the Owner when the site is ready for him to commence work on the lawns and planting. The site shall be turned over to the Contractor free of all debris and obstructions, and shall be reasonably leveled to the required sub-grade specified by the Landscape Planting Plan. Thereafter, planting shall be conducted only under favorable weather conditions to avoid compacting soil.

#### **611.7 OBSTRUCTIONS BELOW GROUND**

Before any site preparation work, the contractor shall verify the existence of underground facilities, obstructions and hazards that may be encountered.

Utilities damaged by the operation shall be repaired or replaced without extra cost by the Contractor. When an obstruction is encountered in a place where a plant is specified, another location may be designated by the Architect.

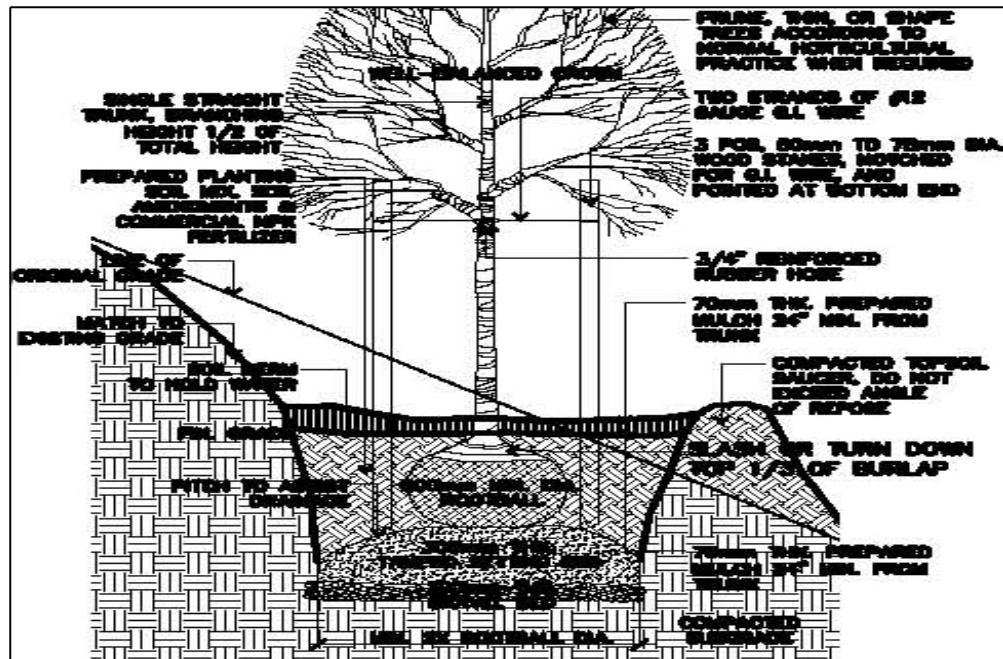
#### **611.8 TREE AND SHRUB PLANTING**

- a. Planting Pits – Reasonable care shall be exercised to have pits dug and soil dug and soil prepared prior to moving plants to their respective locations for planting to insure that they shall not be exposed to drying elements or physical damages. Diameter of pits for shrubs and trees shall be at least 61 cm greater than the diameter of the ball or the spread of roots. The depth of plant pits shall be enough to accommodate the



ball of roots flush to finish grade with 152 mm of prepared topsoil at the bottom of the pit.

- b. Backfill – Prepare by using 5 parts topsoil, 1 part manure, 1 part organic compost (leaf mold or mulch).
- c. Slope Planting – For trees and shrubs planted on slopes, provide a shallow saucer around each plant with well tamped ridge of topsoil around the edge **of the pit**.



- d. Guying and Staking – Trees shall be supported immediately after planting.
- e. Staking – Shall be equally spaced around each tree driven vertically in the ground to a depth of 91 cm avoiding injury to root ball. Provide at least 2 stakes per tree.

## 611.9 LAWN INSTALLATION

- a. Subsoil shall be graded and uniformly compacted so that it will be parallel to the proposed finish grade. The sub-grade shall be raked to a depth of 50 mm and all stones and debris shall be removed. No heavy objects except lawn rollers shall be moved over prepared lawn areas.
- b. Finished Grading. Topsoil shall be spread evenly to a minimum depth of 100 mm, lightly compacted by means of approved rolling equipment weighing 60 to 90 pounds per linear foot or roller. No soil shall be spread or handled in a muddy condition.
- c. Fertilizer shall be spread as per manufacturer's specifications or upon instructions of the Architect.
- d. Guying and Staking – Trees shall be supported immediately after

## 611.10 CLEAN – UP

- a. The Contractor shall dispose of all waste material and rubbish properly. At the completion of the work, he shall remove from the premises all rubbish, implements and surplus materials that belong to him and shall leave the ground uncluttered and all the paved areas affected by his scope of work broom-cleaned.

#### 611.11 MAINTENANCE SERVICES

Maintenance Services shall be performed by the Contractor for a period of 12 months from the date of Certification by the Landscape Architect that the work performed is satisfactory and in accordance with the requirements of the plans and specifications. Work to be performed by the Contractor during this period of maintenance shall be as follows:

- a. Watering – Newly planted lawns must be kept in moist condition at all times. Watering shall be done with a fine spray nozzle. Except for rainy days, when watering may be eliminated, the following schedule is suggested:

First 3 weeks..... 2 to 3 times a day

3rd to 6th week.....2 times a day after

6th week..... Once a day

As the number of watering decreases, the lengths of watering shall be increased proportionately. Avoid any excess puddles as this may wash away topsoil and expose the roots. Topsoil washed away or settled shall be replaced immediately to restore specified finish grade.

- b. Ground Cover Areas – Plants should be kept in a continually dampened condition for at least 4 weeks. Water with fine spray to avoid washing away any soil over the roots. Special care should be taken on slope areas to prevent excessive erosion.
- c. Tree and Shrub Areas – Because the roots of the shrubs will not take up much water until they become fully established in their respective locations, irrigate for long periods each time to allow water to soak down through the full depth of the plant hole to the roots. Do not water again until the feeder roots have had sufficient time to take up most of the moisture. Plants native to the area will probably require less water for establishment, therefore, after 4 months limit the watering to once every other day.
- d. Fertilizing – If any deficiency of nutrients appear during the maintenance period, consult Architect for proper fertilizer to be applied to correct deficiency.
- e. Pruning – Thinning of plants will be necessary if they become too dense. Pruning should be handled only by an expert with instructions from the Architect.
- f. Control of Pests and Diseases – Careful observation should be made to see to it that no serious pest or diseases gain a foothold among the materials. In the event any pest or diseases occur, consult the Architect immediately for proper treatment.
- g. Cultivation and weeding – If any weeds should appear, such weeds should be removed immediately, before serious consequences occur. By keeping all exposed soil cultivated to a depth of 50mm to 75mm, weeds will be discouraged and the soil will benefit from watering because of easy penetration.

#### 611.12 PLANT GUARANTEES AND REPLACEMENT CLAUSE

- a. Guarantee of grass, shrubs and ground cover shall be until the end of the maintenance period.
- b. Guarantee of all trees shall be for a period of six (6) months after the date of final acceptance. Dead or unhealthy trees shall be replaced soon after this condition has

been established, with the same guarantee of six (6) months from the time of planting.

- c. Replacement of all dead, diseased or unhealthy looking plants as noted at the end of the maintenance period, shall be done immediately.
- d. Plants used for replacement shall be of the same kind and size as per plans and subject to the same conditions stated in the herein specifications.

#### 611.13 FINAL ACCEPTANCE

The work shall be inspected and approved by the Owner and Architect upon termination of the period of maintenance (1 year). Only after the work has proven satisfactory shall final acceptance of the work be granted.

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## ITEM 612 - PAVEMENT MARKINGS

### 612.1 DESCRIPTION

This Item shall consist of placing markings on the finished pavement. The work shall include the furnishing of pre-mixed reflectorized thermoplastic stripping material conforming to the requirement of AASHTO M 249 that is applied to the road surface in a molten state by mechanical means with surface application of glass beads at a rate of not less than 350 g/L of glass beads having a size range of drop-in type and will produce an adherent reflectorized stripe of specified thickness and width capable of resisting deformation by traffic.

### 612.2 MATERIALS REQUIREMENTS

1. Reflectorized Thermoplastic Pavement Material shall be homogeneously composed of pigment, filler, resins and glass reflectorizing spheres.

The thermoplastic material shall be available to both white and yellow.

2. Glass Beads (Pre-Mix) shall be uncoated and shall comply with the following requirements:

Refractive Index, min. – 1.50  
Spheres, Percent, min. - 90

Gradation:

Sieve	Mass Percent Passing
mm	
0.850	100
0.600	75-95
0.425	-
0.300	15-35
0.180	-
0.150	0-5

### 612.3 GENERAL REQUIREMENTS

#### 612.3.1 Composition

The pigment, beads and filler shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with the requirements as specified in Table 612.1.

**Table 612.1 – Composition Requirements**

Component	White	Yellow
Binder, min.	18.0	18.0
Glass Beads:		
min.	30	30
max.	30	30
Titanium Dioxide, min.	10	
Chrome Yellow, Medium, min.		10
Calcium Carbonate And Inert Fillers, max.	42.0	42.0

### 612.3.2 Qualitative

The material shall conform to the qualitative requirements as specified in Table 612.2

**Table 612.2 – Qualitative Requirements**

Property	Requirements	
	White	Yellow
Specific Gravity, max.	2.15	
Drying Time, mixtures, max.	10.0	
Bond Strength to Portland Cement Concrete after Heating for four (4) hours $\pm 5$ min. @ $218^{\circ}\text{C}$ , MPa, max.	1.24	
Cracking Resistance @ low temp. after heating for four (4) hours $\pm 5$ min. @ $218 \pm 2^{\circ}\text{C}$ .	No cracks	
Impact Resistance after heating for four (4) hours $\pm 5$ min. @ $218 \pm 2^{\circ}\text{C}$ and forming test specimens, mm/kg, min.	115	
Softening Point after heating for four (4) hours $\pm 5$ min. @ $218 \pm 2^{\circ}\text{C}$ .	102.5 $\pm$ 9.5 $^{\circ}\text{C}$	
Daylight reflectant @ 45 Degree $-0$ degree, %, min.	75	45

### 612.4 APPLICATION PROPERTIES

The material shall readily extrude at a temperature of  $211 \pm 7^{\circ}\text{C}$ , from approved equipment to produce a line 3.2 to 4.8 mm thick which shall be continuous and uniform in shape having clear and sharp dimensions.

The material shall not exude fumes which are toxic, obnoxious or injurious to persons or property when heated during applications.

The application of additional glass beads by drop-in methods shall be at a rate of not less than 350 g/L of glass beads having a size range for drop-in type. The typical size range of spheres of a drop-in type paints is as follows:

Passing 850  $\mu\text{m}$  (#20) sieve and

Retained on 250  $\mu\text{m}$  (#60) sieve, %                      80 – 100

- a) Preparation of Pavement Surface – the materials should be applied only on the surface which is clean and dry. It shall not be laid into loose detritus, mud or similar

extraneous matter, or over an old paint markings, or over an old thermoplastic marking which is faulty. In the case of smooth, polished surface stones such as smooth concrete, old asphalt surfacing with smooth polished surface stones and/or where the method of application of the manufacturer of the thermoplastic materials shall be recommended, and with the approval of the PCG Engineer.

- b) Preparation of Thermoplastic Materials – The materials shall be melted in accordance with the manufacturer's instruction in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic and such the local overheating shall be avoided. The temperature of the mass shall be within the range specified by the manufacturer and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material shall be used as expeditiously as possible and for thermoplastics which have natural resin binders or otherwise sensitive to prolong heating the materials shall not be maintained in a molten condition for more than 4 hours.
- c) Laying – Center lines, lane lines and edges lines shall be applied by approved mechanical means and shall be laid in regular alignment. Other markings may be applied by hand – screed, hand propelled machine or by self-propelled machine approved or directed by the PCG Engineer. After transfer to the laying apparatus the materials shall be maintained within the temperature range specified by the manufacturer and stirred to maintain the right consistency for laying.

In the case of screen application, the material shall be laid to a thickness of not less than 3 mm or more than 6 mm unless authorized by the PCG Engineer when laid over an existing markings. In the case of sprayed application the material shall be laid to thickness of not less than 1.5 mm unless authorized by the PCG Engineer. In all cases the surface produced shall be uniform and appreciably free from bubbles and steaks. Where the Contractor Documents require or the PCG Engineer direct that ballotini shall be applied to the surface of the markings, these shall be applied uniformly to the surface of hot thermoplastic immediately after laying such that the quality of ballotini firmly embedded and retained in the surface after completion complies with the requirements of Sub-section 606.2.2, Material Requirements.

Road markings of a repetitive nature, other center lines, and lane lines shall unless otherwise directed by the PCG Engineer be set out with stencils which comply with the size and spacing requirements shown on the Plans.

- d) Re-use of Thermoplastic Materials – At the end of day's as much as possible the material remaining in the heater and/or laying apparatus shall be removed. This may be broken and used again provided that the maximum heating temperature has not been exceeded and that the total time during which it is a molten condition does not exceed the requirements of Sub-section 606.2.3, Construction Requirements.

#### **612.4.1 Defective Materials or Workmanship**

Materials which are defective or have been applied in an unsatisfactory manner or to incorrect dimensions or in a wrong location shall be removed, the road pavement shall be made good and materials replaced, reconstructed and/or properly located, all at the Contractor's expenses and to the satisfaction of the PCG Engineer.

#### **612.4.2 Protection of the Traffic**

The Contractor shall protect pedestrians, vehicles and other traffic adjacent to the working area against damage or disfigurement by construction equipment, tools and materials or by spatters, splashes and smirches or paint or other construction materials and during the course of the work, provide and maintain adequate signs and signals for the warning and guidance of traffic.

#### **612.5 SAMPLING**

A minimum weight of 10 kg. of Reflectorized Thermoplastic paint shall be taken for every 100 bags or fraction thereof.

#### **612.6 TESTING**

The material shall be tested in accordance with AASHTO T 250 or with the appropriate method in ASTM designation.

#### **612.7 PACKING AND MARKING**

The material shall be packaged in a suitable containers to which it will not adhere during shipment and storage. The blocks of cast thermoplastic material shall be approximately 300 x 915 by 51 mm and shall weigh approximately 23 kg. Each container label shall designate the color, manufacturer's name, batch number and date of manufacture. Each batch manufactured shall have its own separate number. The label shall warn the user that the material shall be heated to  $211 \pm 7^{\circ}\text{C}$  during application.

#### **612.8 METHOD OF MEASUREMENT**

The quantity of pavement markings to be paid for shall be the area as shown on the Plans of painted traffic line of the stated width and the area as shown on the plans of symbols, lettering, hatching and the like, completed and accepted.

The quantity shown in the Bill of Quantities represents the approximate quantity in square meter of pavement markings, with width as shown applied at the centerline of the road pavements to which may be increased or decreased depending on the PCG Engineer's decision whether to require additional markings or delete parts of it. Other markings representing symbols, lettering, hatching and others in locations where they maybe required by the PCG Engineer shall, likewise, be implemented by the Contractor using reflectorized thermoplastic pavement markings as approved and directed.

#### **612.9 BASIS OF PAYMENT**

The quantities measured as determined in Section 612.8, Method of Measurement, shall be paid for at the appropriate contract unit price for the Pay Items shown in the Bid Schedule which price and payment shall constitute full compensation for furnishing and placing all materials, sampling and packing, for the preparation of the surface, and for all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made in accordance with the Bill of Quantities.

## ITEM SPL 623 - AUXILIARY SYSTEM

### SPL 623.1 DESCRIPTION

This item consists of the provision of Auxiliary System in accordance with this Specification and in conformity with the lines, grade, dimensions and backfilling of suitable materials on the ducts trench as shown on the approved plans and drawings. It shall consist of approved auxiliary pipes or ducts laid in appropriate trench with concrete encasement from Manhole to Manhole with the provision of warning tape at least 300 mm above the PVC pipes ducting.

### SPL 623.2 MATERIAL REQUIREMENTS

Auxiliary System shall be constructed of appropriate materials in consonance with the following definitions:

1. PVC Conduit Pipe – Terminology used in this specification is in accordance with the definitions of ASTM D 883 and ASTM F 412, unless otherwise specified. Ducts shall be 110mm $\phi$  PVC pipes with a nominal thickness of 4.2mm and a hub length of 70mm. The product shall be tested in accordance with the following requirements for physical and performance properties:
  - a. Resistance to burning
  - b. Flattening
  - c. Water absorption
  - d. Tensile strength at 28 °C
  - e. Elongation at break
  - f. Heat reversion
  - g. Resistance to external blows
2. Concrete spacer – It is made up of concrete with at least compressive strength of 20.7 MPa (3000 psi) molded with the size of the duct pipes as per the requirement of the PCG Engineer. The concrete spacer has a sleeve at the bottom to accommodate 2- 10mm $\phi$  bars for the concrete encasement. Concrete encasement shall meet 20.7 MPa (3000 psi) compressive strength at 28 days for Class A concrete mix.
3. Reinforcement – The reinforcing bars shall be 12mm $\phi$  Grade 40 with stirrups of 10mm $\phi$  spaced according to plans or determined by the PCG Engineer. Quality of reinforcement shall be in accordance with AASHTO M 31.
4. Tie Wire – This specification covers 45 Mg cold drawn galvanized steel wire to be used as such or in fabricated form for the reinforcement of concrete in sizes not less than 2.03 mm (0.080") nominal diameter or size no. W5 in 225kg secured coils in accordance with M 32 or approved equal.
5. Portland Cement – It shall conform to the requirements of ASTM C150, Type 1.
6. Top Soil Materials - Topsoil furnished shall consist of fertile friable soil of loamy character without admixture of undesirable subsoil, refuse or foreign materials. It shall be obtained from well-drained arable land and shall be reasonably free from roots, hard clay, coarse gravel, stones larger than 50 mm in size, coarse sand, noxious seeds, sticks, brush, litter and other deleterious substances. Topsoil shall be capable of sustaining healthy plant life and shall be subject to the approval of the PCG Engineer.

Topsoil shall contain not less than five (5) percent organic matter as determined by loss on ignition of samples oven-dried to constant weight.



### SPL 623.3 CONSTRUCTION REQUIREMENTS

#### SPL 623.3.1 Excavation

Borrow excavation shall consist of the excavation and utilization of approved material required for the construction of Auxiliary System or the excavated suitable materials along the runway where its embankment that has earlier been approved. Additional of the following:

- a. **Borrow, Case 1.** Borrow Case 1 will consist of material obtained from sources designated on the Plans or in the Special Provisions.
- b. **Borrow, Case 2.** Borrow, Case 2 will consist of material obtained from sources provided by the Contractor.

The material shall meet the quality requirements determined by the PCG Engineer unless otherwise provided in the Contract.

When there is evidence of discrepancies on the actual elevations of the trench and that shown on the Plans or as directed by the PCG Engineer's Representative, the Contractor shall correct the elevation in accordance with the 5-meter stake interval reading points. True elevation shall be based on the Benchmark determined in the pre-construction survey.

#### 1. Forms

Form setting shall be in accordance with the drawings or as directed by the PCG Engineer's Representative. All excavations shall be thoroughly examined by the Contractor. Forms for the concrete encasement shall also be used to achieve the uniform size of the structure and the concrete cover.

#### 2. Filling Materials and Restoration

All suitable materials removed from the excavation shall be used in the formation of the embankment or backfill for structure, and for other purposes as shown on the Plans or as directed by the PCG Engineer or PCG Engineer's Representative.

Filling materials shall be used in the trench after pipe laying. The top of the finished grade line of the trench shall have at least 5 mm for settlement allowance for the wheel moving loads or compactor. Restoration shall be the same as the feature of original plane and level.

#### a. Top Soil

All suitable material removed from the excavation shall be used in the formation of the embankment or backfill for structure, and for other purposes as shown on the Plans or as directed.

The topsoil shall be evenly spread on the area of the excavated Trench and to the level as shown on the Plans and compacted with a light roller to a depth of not more than 200 mm layer by layer. Spreading of the next layer shall not be permitted unless the previous layer satisfied the minimum required specification.

#### b. Sand Fill

Sand fill shall be placed on top of the concrete encasement of at least 200 mm thick as a cautioned of succeeding backfill soil materials. Sand shall be well graded and pass through sieve #

3. Warning Tape

Warning tape shall be 150 mm wide subject to approval by the PCG Engineer's Representative.

4. Compaction

Appropriate compaction shall be used for the Sand Bedding and Top Soil backfill.

- a. Water Compaction
- b. Field Density Test

**SPL 623.3.2 Pipe Laying**

Pipe Laying shall be in accordance with the approved construction or shop drawings and submitted approved work methodology.

**SPL 623.3.3 Steel Reinforcement**

1. Protection of Material

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, detrimental rust, loose scale, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be the cause for rejection, provided the minimum dimensions, cross-sectional area and tensile properties of a hand wire brushed specimen meets the physical requirement for the size and grade of steel specified.

2. Bending

All reinforcing bars requiring bending shall be cold-bent to the shapes shown on the Plans or required by the PCG Engineer. Bars shall be bent around a circular pin having the following diameters (D) in relation to the diameter of the bar (d):

<u>Nominal diameter, d, mm</u>	<u>Pin diameter (D)</u>
10 to 20	6d

Bends and hooks in stirrups or ties may be bent to the diameter of the principal bar enclosed therein.

3. Placing and Fastening

All steel reinforcements shall be accurately placed in the position shown on the Plans or as required by the PCG Engineer and firmly held there during the placing and setting of the concrete. Bars shall be tied at all intersections except where spacing is less than 300 mm in each direction, in which case, alternate intersections shall be tied. Ties shall be fastened on the inside.

Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports, so that it does not vary from the position indicated on the Plans by more than 6 mm. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shapes and dimensions. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks shall not be permitted. Unless otherwise shown on the Plans or required by the PCG Engineer, the minimum distance between bars shall be 30 mm.

#### 4. Splicing

All reinforcement shall be furnished in the full lengths indicated on the Plans. Splicing of bars, except where shown on the Plans, will not be permitted without the written approval of the PCG Engineer. Splices shall be staggered as far as possible and with a minimum separation of not less than 40 bar diameters. Not more than one-third of the bars may be spliced in the same cross-section, except where shown on the Plans.

Unless otherwise shown on the Plans, bars shall be lapped a minimum distance of:

Splice Type	Grade 40	Grade 60	But not less than
Tension	24 bar dia	36 bar dia	300 mm
Compression	20 bar dia	24 bar dia	

#### **SPL 623.4 METHODS OF MEASUREMENT**

The cost of excavation of Ducting Trench which is incorporated in the Works shall be deemed to be included in this Item of Work where the material is used such as pipe laying, concrete encasement and backfilling materials.

#### **SPL 623.5 BASIS OF PAYMENT**

This contract item shall be paid in linear meter that includes excavation, pipe laying, backfilling materials, concrete encasement, Steel Reinforcement, forms, equipment, warning tape and all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

## PART I – MATERIAL DETAILS

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## **ITEM 702 - BITUMINOUS MATERIALS**

### **702.1 ASPHALT CEMENTS**

Asphalt cement shall conform to the requirements of the AASHTO M 226.

### **702.2 LIQUID ASPHALTS**

Liquid asphalt shall conform to the requirements of the following specifications:

Rapid Curing Liquid Asphalts - AASHTO M 81

Medium Curing Liquid Asphalts - AASHTO M 82

### **702.3 EMULSIFIED ASPHALTS**

Emulsified asphalts shall conform to the requirements of the following specifications:

Emulsified Asphalt (Anionic) - AASHTO M 140  
(ASTM D 977)

Emulsified Asphalt (Cationic) - AASHTO M 208

### **702.4 Acceptance of Procedures for Bituminous Materials**

#### **702.4.1 General**

Bituminous materials will be accepted at the source of shipment subject to the following conditions:

- a. The supplier shall conduct laboratory tests of all materials intended for shipment to the Government and certify that the materials meet the Contract Specifications.
- b. Before loading, the producer shall examine the shipping container, remove all remnants of previous cargoes which might contaminate the material to be loaded and certify that it was clean and free of contaminating material loaded.
- c. The Contractor shall furnish with each shipment two copies of the delivery ticket. The delivery tickets shall contain the following information:

Consignees \_\_\_\_\_ Destination \_\_\_\_\_

Project Number \_\_\_\_\_ Date \_\_\_\_\_

Grade \_\_\_\_\_ Loading Temp. \_\_\_\_\_

Net Liters \_\_\_\_\_ Specific Gravity \_\_\_\_\_  
At 15.5°C (60°F)

Net Weight \_\_\_\_\_

Identification No. (Truck, Car, Tank) \_\_\_\_\_

- d. The Contractor or the supplier as his agent, shall deliver to the PCG Engineer or his representative a certification signed by an authorized representatives of the supplier to cover the quality and quantity of material and the condition of container for each

shipment. The certification shall be essentially in the following form and be stamped, written or printed on the delivery tickets.

“This is to certify that this shipment of \_\_\_\_\_ (tones/litres) or \_\_\_\_\_ of asphalt meets all Contract Specification requirements of the DPWH, and the shipping container was clean and free from contaminating material when loaded

Producer \_\_\_\_\_

Signed \_\_\_\_\_

Failure to sign the certification will be a cause to withhold use of the material until it can be sampled, tested and approved.

#### **702.4.2 Quality Control Reviews**

Quality control review will be conducted by the Government, or an authorized representative at the point of production, at frequencies prescribed by the DPWH, to determine the reliability of the producer's certifications.

If this review indicates that the certifications are not reliable, the acceptance of bituminous materials by certification will be discontinued and the contents of each shipping container will be sampled at point of delivery, tested and accepted prior to incorporation into the work. This procedure will be followed until the PCG Engineering determination is made that the supplier's quality control and testing procedures are such that material meeting Contract Specifications is being consistently produced.

#### **702.4.3 Alternate Acceptance Procedures for Asphalt Materials**

Where required by the Special Provisions, the following alternate acceptance plan for asphalt material will apply in lieu of (a) and (b) above. The Contractor shall provide deliver tickets and certifications as set out in (a), above.

Acceptance samples of bituminous materials shall be obtained in accordance with AASHTO T 40, Sampling Bituminous Materials, at the applicable point of acceptance as defined herein:

- a. Bituminous materials used in direct application on the road. Acceptance samples shall be obtained under the supervision of the PCG Engineer from the conveyances containing the bituminous material at the point of delivery. Single samples shall be taken of each separate tank load of bituminous material delivered, at the time of discharged, into distributors or other conveyances on the project.
- b. Bituminous materials initially discharged into storage tanks on the project. Acceptance samples shall be obtained from the line between the storage tank and distributor of the bituminous mixing plant after each delivery. A single acceptance shall be taken after sufficient period of circulation of such bituminous material has taken place to insure samples representative of the total materials then in the storage tank.
- c. As soon as after sampling as practicable, the acceptance sample shall be delivered by the PCG Engineer to the nearest authorized laboratory for tests to determine compliance.

#### **702.4.4 Requirements for Bituminous Materials containing Anti-stripping Additives**

- a. All the foregoing requirements of Item 702 shall apply for the type of bituminous material involved.

- b. Additionally, the Contractor or the supplier as his agent, shall furnish the PCG Engineer or his representative along with and the time of delivery of the initial shipment for fortified bituminous material to the project, and thereafter with the subsequent shipments when ordered by the PCG Engineer, 1 liter (1 quart) sealed sample of the bituminous material taken at the time of loading of the refinery and prior to introduction of the additive, along with a separated 0.5 liter (1 pint) sample of the anti- stripping additive involved.

## 702.5 Application Temperatures

Bituminous materials for the several applications indicated in the Specifications shall be applied within the temperature ranges indicated in Table 702.1

**Table 702.1 - Application Temperature**

Type and Grade of Material	Application Spray (Min./Max.)	Temp. Range (°C) Mix (Min./Max.)
RT 1-2-2	15.5 - 54	15.5 - 54
RT 4-5-6	29 - 65.5	29 - 65.5
RT 7-8-9	65.5 - 107	65.5 - 107
RT 10-11-12	79 - 121	79 - 121
RTCB 5-6.....30	15.5 - 48.9	15.5 - 48.9
MC .....30	21 - 62.8	15.5 - 40.5
RC-MC .....70	40.5 - 85	32 - 68
RC-MC. ....250	60 - 107	51.7 - 93
RC-MC.....800	79 - 129	71 - 107
RC-MC.....3000	106.7 - 143	93 - 126.7
All emulsions	10 - 71	10 - 71
Asphalt Cement (All Grades)	204 Max.	As required to achieve viscosity of 75-150 seconds to achieve a Kinematic Viscosity of 150-300 mm <sup>2</sup> /s (150-300) centi-strokes

Table 702.1 shall apply unless temperatures ranges applicable to specific lots of material delivered to the job are supplied by the producer.

## 702.6 Material for Damproofing and Waterproofing Concrete and Masonry Surfaces

Material shall conform to the requirements of the following specifications:

- |    |                               |                             |
|----|-------------------------------|-----------------------------|
| a. | Primer for use with asphalt   | AASHTO M 116                |
| b. | Primer for use with tar<br>Or | AASHTO M 121<br>(ASTM D 43) |

it may be a liquid water-gas tar conforming to the following requirements:

Specific gravity, 25°/25°C	1.030 – 1.100
Specific viscosity at 40°C	
(Engler), not more than	3.0
Total distillate, mass percent	
300°, not more than	50.0

Bitumen (soluble in carbon

- |    |  |   |
|----|--|---|
|    | Disulphide), not less than<br>Water not more than  | 98.0 percent                              |
| c. | Tar for mop or seal coats:<br>Coal tar pitch (heated to free<br>flowing but not to exceed<br>149°C (300°F)   | AASHTO M 118,<br>Type B (ASTM D<br>450)   |
|    | or   |   |
|    | Tar applied at about 27°C (80°F)<br>Rubberized tar (heated to free<br>Flowing but not to exceed 121°C<br>(205°F)   | AAHTO M 52,<br>RTCB 5 or 6<br>ASTM D 2993 |
| d. | Asphalt for mop coat   | AASHTO M 115                              |
| e. | Water proofing fabric  | AASHTO M 117                              |
|    | Fabric shall be waterproofed with tar or<br>asphalt in agreement with the material<br>specified for prime and mop coats.   |   |
| f. | Mortar materials shall conform to Section 705.5 except that the<br>mortar shall be uniformly mixed to spreading consistency in the<br>proportion of 1 part Portland Cement to 3 parts fine aggregate.  |   |
| g. | Asphalt plank  | AASHTO M 46<br>(ASTM D 517)               |
|    | Unless otherwise shown on the plants, planks, shall be 30 mm thick<br>may be from 150 to 300 mm in width but all pieces for one structure<br>shall be of the same width except such "closers" as may be<br>necessary. The lengths shall be such as to permit the laying of the<br>planks to the best advantage on the surface to be covered but shall<br>not be less than 0.9 nor more than 2.5 m. |   |
| h. | Asphalt roll roofing   | ASTM D 224,<br>65 pound                   |

#### 702.7 Membrane Material for Waterproofing Bridge Decks.

Bridge deck waterproofing membrane shall be mesh-reinforced self-sealing rubberized asphalt preformed membrane and shall have the following properties:

Thickness	1.65 mm (655 mils)	ASTM E 96
Permeance-Perms KgPa.s.m <sup>2</sup> Kg/Pa s.m <sup>2</sup> (grains/sq.ft./hr./in./Hg)	57.213 x 10 <sup>-11</sup> (0.10)	Method B
Tensile strength	344.5 kPa (50 lb/in)	ASTM D 882 Modified for 25.4 mm (1 inch) opening
Puncture resistance (mesh)	90.8 kg (200 lb)	ASTM E 154



Pliability – 6.35 mm  
(1/4") mandrel 180°  
bend at –8.3°C (-15°F)

No cracks in rubberized  
asphalt

ASTM D 146

Primer and mastic shall be as recommended by the manufacturer and shall be compatible with the membrane.

## 702.8 Tars

Tars shall conform to the requirements of AASHTO M 52.

## 702.9 Dust Oils

Dust oils and clarified dust oil shall conform to the following requirements:

General Requirements	ASTM METHOD	Light	Dust Oil Medium	Heavy	Clarified Dust Oil
Flash Point, °C (Open tag), min.	D 1310	51.6	51.6	51.6	93.3
Viscosity at 38°C (100°F) Kinematic, CS	D 2170	40-70	90-135	145-200	20-100
Water, % maximum	D 95	2.0	2.0	2.0	2.0
Asphaltiness %	*D2006	3.0-6.0	4.0-7.0	5.0-8.0	0-5.0
Saturates % minimum	*D2006	25	25	25	10
Distillation					
Total Distillate to 288°C (550°F), Max. %	**D402	35	30	30	5
Test on residue from Distillation to 288°C (550°F)					
Viscosity at 100°C Kinematic, CS	D 2170	72-250	200-360	540-1500	20-150
Solubility in Trichloroethylene, % Min.	***2042	97.0	97.0	97.0	97.0

\* As modified in procedure as "Test Method for Determination of Asphaltene and Saturate Content of Dust Oils" by Material Testing and Laboratory, Region I, USDA Forest Service, Missoula, MT dated November 1970. Copies of the procedure available from the Regional Materials PCG Engineer, Region I, USDSA Forest Service, Missoula, MT 598011.

\*\* Except that the residue remaining after a temperature of 288°C (instead of 360°C) shall be used for further testing. As modified in procedure identified as "Standard Method of Test for Distillation of Forest Service Dust Oil" dated July 1972. Copies of the procedure are available from the Regional Materials PCG Engineer, Region I USDA Forest Service, Missoula, MT 59801.

\*\*\* Trichloroethylene shall be used as a solvent instead of carbon disulphide

## **ITEM 703 - AGGREGATES**

### **703.1 FINE AGGREGATE FOR CONCRETE AND INCIDENTALS**

#### **703.1.1 Concrete**

Fine Aggregate for concrete shall conform to the requirements of AASHTO M 6, with no deleterious substances in excess of the following percentages:

Clay lumps	3.0
Coal and lignite	1.0
Material passing 0.075 mm sieve	4.0

Other substances - as shown in the Special Provisions Lightweight aggregate, if required or permitted by the Special Provisions, shall meet the pertinent requirements of AASHTO M 195.

703.1.2 Granular backfill filter material for underdrains and filler for paved waterways shall be permeable and shall meet the requirements of AASHTO M 6, except that soundness tests will not be required and minor variations in grading and content of deleterious substances may be approved by the PCG Engineer.

703.1.3 Aggregate for minor concrete structures shall be clean, durable, uniformly graded sand and gravel, crushed slag or crushed stone, 100 percent of which will pass a 37.5 mm (1-1/2 inches) sieve and containing not more than 5 percent passing the 0.075 mm (No. 200) sieve.

### **703.2 COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE**

Coarse aggregate for concrete shall meet the requirements of AASHTO M 80. Lightweight aggregate, if required or permitted by the Special Provisions, shall conform to the requirements of AASHTO M 195, for the grading specified.

### **703.3 AGGREGATE FOR PORTLAND CEMENT TREATED AND STABILIZED BASE COURSE**

The crushed and uncrushed granular material shall consist of hard durable stones and rocks of accepted quality, free from an excess of flat, elongated, soft or disintegrated pieces or other objectionable matter. The method used in obtaining the aggregate shall be such that the finished product shall be as consistent as practical.

All materials passing the 4.75 mm (No. 4) mesh produced in the crushing operation of either the stone or gravel shall be incorporated in the base material to the extent permitted by the gradation requirements. The plasticity index shall not be less 4 nor more than 10.

### **703.4 AGGREGATE FOR UNTREATED SUBBASE, BASE OR SURFACE COURSES**

Aggregate shall consist of hard, durable particles or fragments of crushed stone, crushed slag or crushed or natural gravel. Materials that break up when alternately wetted and dried shall not be used.

Coarse aggregate is the material retained on the 2.00 mm (No. 10) sieve and shall have a percentage of wear of not more than 50 for subbase and not more than 45 for Base and Surface Courses as determine by AASHTO Method T 96.

Fine aggregate is the material passing the 2.00 mm (No. 10) sieve and shall consist of natural or crushed sand and fine mineral particles. The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two-thirds) of the fraction passing the 0.425 mm (No. 40) sieve. For base courses, the fraction passing the 0.425 mm (No. 40) sieve shall have a liquid

limit not greater than 25 and a plasticity index not greater than 6, while for subbase course, the liquid limit shall not be greater than 35 plasticity index not greater than 12.

For surface courses, the fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and a plasticity index not less than 4 or greater than 9.

All materials shall be free from vegetable matter and lumps or balls of clay.

When crushed aggregate is specified, not less than 50 mass percent of the particles retained on the 4.75 mm (No. 4) sieve shall have at least one fractured face.

Gradation of each designated size of aggregate shall be obtained by crushing, screening and blending processes as may be necessary. Materials otherwise meeting the requirements of this Section will be acceptable whenever such materials produce a compacted course meeting applicable density requirements as specified in Subsections 200.3.3, 201.3.3, 202.3.3 and 203.3.6.

### **703.5 AGGREGATE FOR BITUMINOUS CONCRETE**

#### **703.5.1 Coarse Aggregate**

Coarse aggregate retained on the 2.36 mm (No. 8) sieve shall be crushed stone, crushed slag or crushed or natural gravel and unless otherwise stipulated, shall conform to the quality requirements of AASHTO M 79 - 74.

When crushed gravel is used, it shall meet the pertinent requirements of Section 2.1 and 3.1 of AASHTO M 62 - 74 and not less than 50 mass percent of the particles retained on the 4.75 mm (No. 4) sieve shall have at least one fractured face. The coarse aggregate shall be of such gradation that when combined with other required aggregate fractions in proper proportion, the resultant mixture will meet the gradation required under the composition of mixture for the specific type under contract. Only one kind shall be used on the project except by permission of the PCG Engineer.

#### **703.5.2 Fine Aggregate**

Fine aggregate passing the 2.36 mm (No. 8) sieve shall consist of natural sand, stone, stone screenings or slag screenings or a combination thereof and unless otherwise stipulated shall conform to the quality requirements of AASHTO M 29 (ASTM D 1073). Fine aggregate shall be of such gradation that when combined with other required aggregate fractions in proper proportion, the resultant mixture will meet the gradation required under the composition of mixture for the specific type under contract.

#### **703.5.3 Open-Graded Asphalt Concrete Friction Course**

Aggregate shall conform to Subsections 703.5.1 and 703.5.2 above and the following requirements. Relatively pure carbonate aggregates or any aggregates known to polish shall not be used for the coarse aggregate fraction (material retained on the 2.36 mm (No 8) sieve. In addition, the coarse aggregate fraction shall have at least 75 mass percent of weight of particles with at least two fractured faces and 90 mass percent with one or more fractured faces, except that lightweight aggregates need not meet this requirement. The abrasion loss (AASHTO T 96) shall not exceed 40 mass percent.

#### **703.5.4 Lightweight Aggregate (except slag)**

Lightweight aggregate (except slag), if required or permitted by a Special Provisions, shall be manufactured by the rotary kiln process. The material shall consist of angular-fragments uniform in density and reasonably free from flat, elongated or other deleterious substances. The material shall show an abrasion loss of less than 45 mass percent when tested in accordance with AASHTO T 96. The dry mass per cubic metre shall not exceed 1080 kg (67

pcf). After testing through five cycles of the magnesium sulfate soundness test, the loss shall not exceed ten (10) mass percent.

#### 703.6 Aggregate for Bituminous Plant Mix Surfacing

Aggregate shall be uniformly graded from coarse to fine. Target values for the intermediate sieve sizes shall be established within the limits shown in Table 703.1.

The Contractor shall submit the proposed target values in writing to the PCG Engineer for approval. The target gradation is subject to confirmation testing in accordance with Section 307.2 before approval by the PCG Engineer. Any changes in the target gradation are subject to confirmation testing in accordance with Section 307.2, unless otherwise approved in writing by the PCG Engineer. No target gradation adjustment will be permitted during the span of a lot.

**Table 703.1 Range of Gradation Target Values**

<b>Sieve Designation, mm</b>	<b>Mass percent passing square mesh sieves, AASHTO T 11 and T 27, exclusive of mineral filler</b>
	Range
25 (1 inch)	100
19 (3/4 inch)	100
4.75 (No. 4)	50 – 60
2.36 (No. 8)	38 – 48
0.075 (No. 200)	3 – 7
	The minimum for Sand Equivalent is 35

No intermediate sizes of aggregate shall be removed for other purposes without written consent of the PCG Engineer.

If crushed gravel is used, not less than 50 mass percent of the material retained on the 4.75 mm (No. 4) sieve shall be particles having at least one fractured face.  
That portion of the composite material passing a 4.75 mm (No. 4) sieve shall have a sand equivalent of not less than 35, as determined by AASHTO T 176, Alternate Method No. 2.  
The aggregate shall show a durability index not less than 35 (coarse and fine) as determined by AASHTO T 210.

The material shall be free of clay balls and adherent films of clay or other matter that would prevent thorough coating with the bituminous material.

#### 703.7 AGGREGATE FOR HOT PLANT-MIX BITUMINOUS PAVEMENT

The provisions of Subsections 703.5.1, 703.5.2 and 703.5.3 shall apply. The several aggregate fraction for the mixture shall be sized, graded and combined in such proportions that the resulting composite blend meets one of the grading requirements of Table 703.2 as specified in the Schedule.

The gradings to be used will be shown in the Special Provisions, adjusted to reflect variations in aggregate densities.

The ranges apply to aggregates with bulk specific gravity values that are relatively constant throughout a grading band. When such values vary from sieve to sieve, such as with lightweight aggregates, the ranges for each sieve size shall be adjusted to reflect the variations.

#### 703.8 AGGREGATE FOR COLD PLANT-MIX BITUMINOUS PAVEMENT

The provisions of Subsections 703.5.1 and 703.5.2 shall apply.

### 703.8.1 Aggregate for Pavement

The several aggregate fractions for the mixture shall be sized graded and combined in such proportions that the resulting composite blends meet the respective grading requirements of Table 703.3 adjusted to reflect variation in aggregate densities.

### 703.8.2 Aggregate for Top Dressing

The material for the top dressing shall consist of dry sand, stone screenings or slag screenings so graded that at least 95 mass percent shall pass the 4.75 mm (No. 4) sieve and not more than 40 percent shall pass the 0.300 mm (No. 50) sieve.

**Table 703.2**

#### **Gradation Ranges - Hot Plant Mix Bituminous Pavements**

**(Mass percent passing square sieves, AASHTO T 11 and T 27)**

Sieve Designation, mm	GRADING						
	A	B	C	D	E	F	G
37.5 (1-1/2 inch)	100	-	.	—	—	.	—
25 ( 1 inch)	95-100	100	100	-	.	-	.
19 (3/4 inch)	75-95	95-100	95-100	100	-	100	-
12.5 (1/2 inch)	-	68-86	68-86	95-100	100	-	100
9.5 (3/8 inch)	54-75	56-78	56-78	74-92	95-100	-	95-100
4.75 (No. 4)	36-58	38-60	38-60	48-70	75-90	45-65	30-50
2.36 (No. 8)	25-45	27-47	27-47	33-53	62-82	33-53	5-15
1.18 (No. 16)	-	18-37	18-37	22-40	38-58	-	-
0.600 (No. 30)	11-28	11-28	13-28	15-30	22-42	-	-
0.300 (No. 50)	-	6-20	9-20	10-20	11-28	10-20	-
0.075 (No. 200)	0-8	0-8	4-8	4-9	2-10	3-8	2-5

### 703.9 AGGREGATE FOR ROAD MIX BITUMINOUS PAVEMENT

Aggregates for road mix bituminous pavement construction shall be crushed stone, crushed slag, or crushed or natural gravel which meet the quality requirements of AASHTO M 62-74 or M 63-74 for the specified gradation, except that the sodium sulfate soundness loss shall not exceed 12 mass percent.

When crushed gravel is used, at least 50 mass percent of the particles retained on the 2.00 mm (No. 10) sieve shall have at least one fractured face. Gradation shall conform to Grading F of Table 703.2.

### 703.10 AGGREGATE FOR COVER COATS, SURFACE TREATMENTS AND BITUMINOUS PRESERVATIVE TREATMENT

Cover aggregate for type 2 seal coat (Item 303) shall consist of sand or fine screenings, reasonably free from dirt or organic matter.

Aggregates for type 3 seal coat (Item 303) surface treatments or bituminous preservative treatment shall be crushed stone, crushed slag or crushed or natural gravel. Only one type of aggregate shall be used on the project unless alternative types are approved. Aggregates shall meet the quality requirements of AASHTO M 78-74.

When tested in accordance with AASHTO T 182, (ASTM D 1664) aggregate shall have a retained bituminous film above 95 mass percent.

Aggregates which do not meet this requirement may be used for bituminous surface treatments and seal coats provided a water resistant film.

Lightweight aggregate, if required or permitted by the Special Provisions, shall meet the pertinent requirements of Subsection 703.5.4.

When crushed gravel is used, not less than 50 mass percent of the particles retained on the 4.75 mm (No. 4) sieve shall have at least one fractured face. Aggregates shall meet the gradation requirements called for in the Bid Schedule.

**Table 703.3**  
**Gradation Requirements - Cold Plant Mix Bituminous Pavement**  
**(Mass percent passing square mesh sieves, AASHTO T 27)**

Sieve Designation		Bottom (Binder) Course	Wearing (Surface) Course
Standard, mm	Alternate US Standard		
37.5	1-1/2"	100	-
25	1"	85-100	-
19	3/4"	40-70	100
12.5	1/2"	10-35	95-100
4.75	No. 4	4-16	15-40
2.36	No. 8	0-5	10-25
0.600	No. 30	-	4-13
0.300	No. 50	-	0-5

**Table 703.4**  
**Gradation Requirements for Cover Coats**  
**(Mass percent passing square mesh sieves, AASHTO T 27)**

Sieve Designation		Grading designation with corresponding size No. from MSHTO M 43 (ASTM D 448) modified					
Std. mm	Alt US Std	A (No.5)	B (No.6)	C (No.7)	D (No.8)	E (No.9)	F (No.10)
37.5	1-1/2"	100	-	-	-	-	-
25	1"	90-100	100	-	-	-	-
19	3/4"	-	90-100	100	-	-	-
12.5	1/2"	0-10	-	90-100	100	-	-

Sieve Designation		Grading designation with corresponding size No. from MSHTO M 43 (ASTM D 448) modified					
Std. mm	Alt US Std	A (No.5)	B (No.6)	C (No.7)	D (No.8)	E (No.9)	F (No.10)
9.5	3/8"	-	0-15	-	85-100	100	100
4.75	No. 4	-	-	0-15	-	85-100	85-100
2.36	No. 8	-	-	-	0-10	-	-
0.075	No. 200	0-2	0-2	0-2	0-2	0-2	0-10

#### 703.11 BLOTTER

Aggregate for blotter material shall conform to the gradation requirements of AASHTO M 43 (ASTM D 448), size 2.00 mm (No. 10). The aggregate shall be free from vegetable or other deleterious materials.

**Table 703.5**  
**Gradation Requirements for Bituminous Surface Treatments**  
**(Mass percent passing square mesh sieves, AASHTO T 27)**

Sieve Designation		Grading designation with corresponding size No. from MSHTO M 43 (ASTM D 448) modified					
Std. mm	Alt US Std	A (No.5)	B (No.6)	C (No.7)	D (No.8)	E (No.9)	F (No.10)
37.5	1-1/2"	100	-	-	-	-	-
25	1"	90-100	100	-	-	-	-
19	3/4"	20-25	90-100	100	-	-	-
12.5	1/2"	0-10	20-55	90-100	100	-	-
9.5	3/8"	0-5	0-15	40-70	85-100	100	100
4.75	No. 4	-	0-5	0-15	10-30	85-100	85-100
2.36	No. 8	-	-	0-5	0-10	10-40	60-100
0.075	No. 100	-	-	-	-	-	0-10

**Table 703.6**  
**Gradation Requirements for Bituminous Preservative Treatment**

Sieve Designation		Mass percent passing square mesh Sieves, AASHTO T 27	
Standard, mm	Alternate US Standard	Grading A	Grading B
19	3/4"	-	100
9.5	3/8"	100	-
4.75	No. 4	45-80	45-80
2.36	No. 8	28-64	28-64
0.075	No. 200	0-12	0-12

### 703.12 BED COURSE MATERIAL

Bed course material for sidewalks, paved waterways and curbing shall consist of cinders, sand, slag, gravel, crushed stone or other approved material of such gradation that all particles will pass through a sieve having 37.5 mm (1-1/2 inches) square openings.

Bed course material for slope protection shall be a porous, free-draining material consisting of sand, gravel, cinders, slag, crushed stone or other approved free-draining material. This material shall be uniformly graded and of such size that 100 percent of the material will pass through a sieve having 37.5 mm (1-1/2 inches) square opening.

### 703.13 SHEATHING MATERIAL

Sheathing material shall conform to either (a) or (b) below:

- a. Sound, durable particles of gravel, slag or crushed stone meeting the following gradation:

<u>Sieve</u>	<u>Mass percent passing</u>
75 mm (3")	100
4.75 mm (No. 4)	0 - 10
0.075 mm (No. 200)	0 - 2

- b. Clean noncementitious sand meeting the requirements of Subsection 703.1.2.

### 703.14 AGGREGATES FOR SUBGRADE MODIFICATION

The material shall consist of hard, durable particles or fragments of slag, stone or gravel, screened or crushed to the required size and grading. The material shall be visually free from vegetable matter and lumps or balls of clay and shall meet the requirements for one of the gradings given in Table 703.7 whichever is called for in the Bid Schedule.

That portion of the material passing a 0.425 mm (No. 40) sieve shall have a plasticity index of not over 6, as determined by AASHTO T 90.



**Table 703.7**  
**Grading Requirements - Aggregates for Subgrade Modification**

Sieve Designation		Mass percent passing square mesh sieves using AASHTO T 27		
Standard, mm	Alternate US Standard	Grading A	Grading B	Grading C
75	3"	100	-	-
37.5	1-1/2"	-	100	-
25	1"	-	-	100
4.75	No. 4	30-70	30-70	40-80
0.075	No. 200	0-15	0-15	5-20

Crushed slag shall consist of clean, tough, durable pieces of blast furnace slag, reasonably uniform in density and quality and reasonably free from glassy pieces.

#### 703.15 AGGREGATES FOR SALT STABILIZATION

Aggregates for salt stabilized base course shall consist of hard durable particles or fragments of slag, stone or gravel, screened or crushed to the required size and grading.

That portion of the material passing a 0.425 mm (No. 40) sieve shall have a plasticity index of not over 6, as determined by AASHTO T 90.

The material shall be visually free from vegetable matter or lumps or balls of clay and shall meet the requirements for one of the gradings given in Table 703.8 as called for in the Bid Schedule.

**Table 703.8**  
**Gradation Requirements for Aggregates for Salt Stabilized Base Course**

Sieve Designation		Mass percent passing square mesh sieves, AASHTO T 11 and T 27	
Standard, mm	Alternate US Standard	Grading A	Grading B
75	3"	-	-
50	2"	-	100
37.5	1-1/2"	-	70-100
25	1"	100	-
19	3/4"	70-100	50-80
9.5	3/8"	50-80	40-70
4.75	No. 4	35-45	30-60
2.00	No. 10	25-50	20-50
0.425	No. 40	15-30	10-30
0.075	No. 200	7-15	7-15

- \* Gradation varies with top size of material and should be based on size of largest material used. For instance, if largest size is 50 mm (2 inches), gradation should be under heading B; if 25 mm (1 inch), under A.

### 703.16 AGGREGATES FOR EMULSIFIED ASPHALT TREATED BASE COURSE

Aggregate shall consist of coarse aggregate of crushed gravel, crushed slag or crushed stone, composed of hard, durable particles or fragments and a filler of finely crushed stone, sand, slag or other finely divided mineral matter. The portion of the material retained on a 4.75 mm (No. 4) sieve shall be known as coarse aggregate and that portion passing a 4.75 mm (No. 4) sieve shall be known as fine aggregate. The material shall meet one of the grading requirements of Table 703.9.

**Table 703.9**  
**Grading Requirements for Aggregates for**  
**Emulsified Asphalt Treated Base**

Sieve Designation		Mass percent passing square mesh Sieves, AASHTO T 11 and T 27		
Standard, mm	Alternate US Standard	Grading A	Grading B	Grading C
37.5	1-1/2"	100	100	-
25	1"	95-100	95-100	-
19	3/4"	-	50-85	100
12.5	1/2"	-	-	95-100
4.75	No. 4	-	26-59	65-100
2.00	No. 10	0-9	17-48	-
0.300	No. 50	-	-	12-35
0.075	No. 200	0-2	2-10	3-12

If crushed gravel is used, not less than 65 mass percent of the coarse aggregate particles retained on a 4.75 mm (No. 4) sieve shall be particles having at least one fractured face.

Coarse aggregate shall have a percent of wear of not more than 35 at 500 revolution, as determined by AASHTO T 96.

The aggregate shall show a durability factor not less than 35 (coarse and fine) as determined by AASHTO T 210 (Production of Plastic Fines in Aggregates).

The material shall be free of clay balls and adherent films of clay or other matter that would prevent thorough coating with bituminous material.

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## **ITEM 703A - MINERAL FILLER**

### **703A.1 DESCRIPTION**

Mineral filler shall consist of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, fly ash or other suitable mineral matter. It shall be free from organic impurities and at the time of use, shall be sufficiently dry to flow freely and shall be essentially free from agglomerations.

### **703A.2 GENERAL REQUIREMENTS**

**703A.2.1** Filler material for bituminous bases or pavements shall meet the requirements of AASHTO M 17, Mineral Filler for Bituminous Paving Mixtures.

#### **703A.2.2 Physical Requirements**

Mineral filler shall be graded within the following limits:

Sieve	Maximum Percent Passing
0.600 mm (No. 30)	100
0.300 mm (No. 50)	95 - 100
0.075 mm (No. 200)	70 – 100

The mineral filler shall have a plasticity index not greater than 4. Plasticity index limits are not appropriate for hydraulic lime and cement.

### **703A.3 METHODS OF SAMPLING**

#### **703A.3.1 Materials in Bulk**

Sampling from bins, piles or cars - A sampling tube that takes a core not less than 25 mm (1 inch) in diameter may be used to obtain sample portions from one or more location as required to obtain a field sample of at least 5 kg (10 lb). Sample portions may be taken from holes dug into the material at 5 or more locations to provide a field sample of at least 5 kg (10 lb).

Sampling from conveyors - Sample portions shall be taken at regular intervals during the time of movement of the materials in the unit being sampled to provide a field sample of at least 5 kg (10 lb).

#### **703A.3.2 Materials in Packages**

From the unit to be sampled, select at least one percent of the packages at random for sampling, but in no case shall fewer than 5 packages be selected. Take a sample portion from a hole dug into the top of each package selected for sampling. A sampling tube may be used that takes a core not less than 25 mm (1 inch) diameter. Insert the tube into the package to substantially sample the entire length of the package. Combine the sample portions taken to obtain a field sample of at least 5 kg (10 lb).

### **703A.4 SHIPPING SAMPLES**

Mineral filler shall be shipped in a clean, moisture-proof container and packaged securely to prevent the loss of material during handling. Reduce the field sample to a minimum size of 2.5 kg (5 lb) to submit for testing, using the method of quartering.

### 703A.5 METHODS OF TEST

The properties enumerated in this Specification shall be determined in accordance with the following AASHTO Method of Test:

Gradation	T 37
Plasticity Index	T 90

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## **ITEM 705 - JOINT MATERIALS**

### **705.1 JOINT FILLERS**

Poured filler for joints shall conform to the requirements of AASHTO M173.

Preformed fillers for joints shall conform to the requirements of AASHTO M 33 (ASTM D 994), AASHTO M 153, AASHTO M 213, AASHTO M 220, as specified, and shall be punched to admit the dowels where called for on the Plans. The filler for each joint shall be furnished in a single piece for the depth and width required for the joint unless otherwise authorized by the PCG Engineer. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened securely and held accurately to shape, by stapling or other positive fastening satisfactory to the PCG Engineer.

### **705.2 JOINT MORTAR**

Pipe joint mortar shall consist of one part Portland Cement and two parts approved sand with water as necessary to obtain the required consistency. Portland Cement and sand shall conform respectively to Section 700.1 and 703.1. If shown in the Special Provisions, air entrainment conforming to Section 708.3 shall be provided. Mortar shall be used within 30 minutes after its preparation.

### **705.3 RUBBER GASKETS**

Ring gaskets for rigid pipe shall conform to the requirements of AASHTO M 198. Continuous flat gaskets for flexible metal pipe shall conform to the requirements of ASTM D 1056 with grade SCE 41 used for bands with projections or flat bands and grade SCE 43 for corrugated bands. Gaskets thickness for bands with projections or flat bands shall be 12.5 mm (1/2 inch) greater than the nominal depth of the corrugation and shall be 9.5 mm (3/8 inch) for corrugated bands.

### **705.4 OAKUM**

Oakum for joints in bell and spigot pipe shall be made from hemp (*Cannabis Sativa*) line, or Benares Sunn fiber, or from a combination of these fibers. The oakum shall be thoroughly corded and finished and practically free from lumps, dirt and extraneous matter.

### **705.5 MORTAR FOR MASONRY BEDS AND JOINTS**

#### **705.5.1 Composition**

Unless otherwise indicated on the Plans, masonry mortar shall be composed of one part Portland Cement or air-entraining Portland Cement and two parts fine aggregate by volume to which hydrated lime has been added in an amount equal to ten (10) mass percent of the cement. In lieu of air-entraining cement, Portland Cement may be used with an air-entraining admixture in accordance with the applicable provisions of Item 405.

For masonry walls not exceeding 1.8 m (6 feet) in height, a mortar composed of one part masonry cement and two parts fine aggregate by volume maybe substituted for the above mixture of Portland Cement, lime and fine aggregate. For other construction, masonry cement may be used if and as shown on the Plans.

#### **705.5.2 Materials**

Either Type I or Type IA air-entraining Portland Cement, conforming to AASHTO M 85 may be used, except that when the contract contains an item for concrete under Item 405, the Contractor may use the same type as is used for that work.

Masonry cement shall conform to the requirements of AASHTO M 150 - 74 (ASTM C 91).

Fine aggregate shall conform to the requirements of AASHTO M 45 (ASTM C 144).

Hydrated lime shall meet the requirements for Residue, Popping and Pitting, and Water retention shown for Type N lime in Section 701.3 (ASTM C 207).

Water shall conform to the requirements of Item 714, Water. Air-entraining agents shall conform to the requirements of Section 708.2 AASHTO M 154 (ASTM C 260).

#### 705.6 COPPER WATER STOPS OR FLASHINGS

Sheet copper for water stops of flashings shall meet the requirements of AASHTO M 138 (ASTM B 152) for Type ETP, light cold-rolled, soft anneal, unless otherwise specified in the Special Provisions.

#### 705.7 RUBBER WATER STOPS

Rubber water stops may be molded or extruded and have a uniform cross-section, free from porosity or other defects, conforming to the nominal dimensions shown on the Plans. An equivalent standard shape may be furnished, if approved by the PCG Engineer.

The water stop may be compounded from natural rubber, synthetic rubber or a blend of the two, together with other compatible materials which will produce a finished water stop meeting the requirements of Table 705.1. No reclaimed material shall be used. The Contractor shall furnish a certificate from the producer to show the general compositions of the material and values for the designated properties. The Contractors shall also furnish samples, in length adequate for making designated tests, as ordered by the PCG Engineer.

#### 705.8 PLASTIC WATER STOPS

Plastic water stops shall be fabricated with a uniform cross-section, free from porosity or other defects, to the nominal dimensions shown on the Plans. An equivalent standard shape may be furnished, if approved by the PCG Engineer.

The material from which the water stop is fabricated shall be a homogenous,, elastomeric, plastic compound of basic polyvinyl chloride and other material which, after fabrication, will meet the requirements tabulated herein. No reclaimed material shall be used. The Contractor shall furnish a certificate from the producer, showing values for the designated properties in Table 705.2. The Contractor shall furnish samples, in lengths adequate for making designated tests, as ordered by the PCG Engineer.

**Table 705.1**  
**Required Properties and Test Methods-Finished**  
**Rubber Water Stop**

Property	Federal Test Method Standard No. 601	Requirement
Hardness (by shore durometer)	3021	60 – 70
Compression set	3311	Maximum 30 percent
Tensile strength	4111	Minimum 17.23 MPa (2,500 psi)
Elongation at Breaking	ASTM D 412	Minimum 450 percent
Tensile stress at 300 percent Elongation	4131	Minimum 6.20 MPa (900 psi)
Water absorption by mass	6631	Minimum 5 percent
Tensile strength after aging	7111	Minimum 80 percent original

**Table 705.2**  
**Required Properties and Test Methods-Finished Plastic Water Stop**

Property	ASTM	
	Method	Requirements
Tensile strength	D 638	Minimum 9.646 MPa (1,400 psi)
Elongation at breaking	D 638	Minimum 260 percent
Hardness (shore)	D 2240	60 – 75
Specific gravity	(Federal test Method No. 406-5011)	Maximum – 0.02 from manufacturer's value
Resistance to alkali	D 543	Maximum weight change: -0.10 percent to + 0.25 percent
Water absorption (48 hrs.)	D 570	No cracking Not more than manufacturer's value
Cold bending	(1)	
Volatile loss	D 1203	
7 days using 10% NaOH	-	Maximum hardness change <u>+5</u> (shore), Maximum tensile strength decrease: 15%

- (1) The cold bend test will be made by subjecting a 25 x 150 x 3mm (1 x 6 x 1/8 inch) strip of plastic water stop to a temperature of -28.8°C (-20°F) for 2 hours. The strip will immediately thereafter be bent 180 degrees around a rod of 6.35 mm (1/4 inch) diameter by applying sufficient force to hold the sample in intimate contact with the rod. The sample will then be examined for evidence of cracking. At least three individual samples from each lot will be tested and the result reported.

#### **705.9 HOT POURED PIPE-JOINT SEALING COMPOUND**

It shall meet the requirements of Federal Specification SS-S-169 for the type and class specified.

#### **705.10 PIPE-JOINT PACKING COMPOUND**

Packaging compounds for use with sealing compounds specified in Section 705.9 shall be of appropriate sizes and shall meet the requirements of Federal Specification HH-P-117.

#### **705.11 PREFORMED PLASTIC SEALING COMPOUND**

For concrete pipe joints, it shall meet the requirements of Federal Specification SS-S-210.

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## ANNEX 1 – QUALITY STANDARDS

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## ANNEX 1 – QUALITY STANDARDS

WORK ITEM	WORK DESCRIPTION	KINDS OF TEST	TEST METHOD	TEST FREQUENCY	STANDARD VALUE	NOTES
104	Embankment from Site Excavation / from Source	Moisture Content	ASTM D-2216	For every 1500 cu.m.or fraction thereof	As per results	
		Sieve Analysis Test	AASHTO T-11 and T- 27	- ditto -	Passing 75mm (3 inches) sieve = 100 % Passing 0.075mm (No. 200) sieve = 15 % maximum	
		Liquid Limit Test	AASHTO T-89	- ditto –	Not more than 30%	
		Plasticity Index	AASHTO T-90	- ditto –	Not more than 6%	
		Moisture - Density Relations	AASHTO T-99 Method C	- ditto -	As per results	
		Density of Soil in place by Sand-Cone Method	AASHTO T-191	For every 500 sq. m. or fraction thereof	Not less than 95%	
200	Aggregate Subbase Course (0.15m thick)	Moisture Content	ASTM D-2216	For every 300 cu.m.or fraction thereof	As per results	
		Sieve Analysis Test	AASHTO T-11 and T- 27	- ditto -	Within the gradation range of Table 200.1	
		Percentage by the weight passing sieve 0.075 mm (No. 200) and 0.425mm (No. 40)	AASHTO T-11 and T- 27	- ditto -	The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No 40) sieve.	
		Liquid Limit Test	AASHTO T-89	- ditto –	Not more than 35%	
		Plasticity Index	AASHTO T-90	- ditto –	Not more than 12%	

WORK ITEM	WORK DESCRIPTION	KINDS OF TEST	TEST METHOD	TEST FREQUENCY	STANDARD VALUE	NOTES
		Moisture - Density Relations	AASHTO T-180 Method D	For every 1500 cu.m.or fraction thereof	As per results	
		Los Angeles Abrasion Test	AASHTO T-96	- ditto -	Not more than 50%	
		California Bearing Ratio (CBR) Test	AASHTO T-193	For every 2500 cu.m.or fraction thereof	Not less than 25%	
		Density of Soil in place by Sand-Cone Method	AASHTO T-191	For every 500 sq. m. or fraction thereof	Not less than 100%	
202	Crushed Aggregate Base Course	Moisture content	ASTM D-2216	For every 300 cu.m.or fraction thereof	As per results	
		Sieve Analysis Test	AASHTO T-11 and T- 27	- ditto -	Within the gradation range of Table 202.1	
		Percentage by the weight passing sieve 0.075 mm (No. 200) and 0.425mm (No. 40)	AASHTO T-11 and T- 27	- ditto -	The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No 40) sieve.	
		Liquid Limit Test	AASHTO T-89	- ditto -	Not more than 25%	
		Plasticity Index	AASHTO T-90	- ditto -	Not more than 6%	
		Moisture - Density Relations	AASHTO T-180 Method D	For every 1500 cu.m.or fraction thereof	As per results	
		Los Angeles Abrasion Test	AASHTO T-96	- ditto -	Not more than 45%	

WORK ITEM	WORK DESCRIPTION	KINDS OF TEST	TEST METHOD	TEST FREQUENCY	STANDARD VALUE	NOTES
		One (1) Fractured Face	ASTM D 5821	- ditto -	Not less than 50%	
		California Bearing Ratio (CBR) Test	AASHTO T-193	For every 2500 cu.m.or fraction thereof	Not less than 80%	
		Density of Soil in place by Sand-Cone Method	AASHTO T-191	For every 500 sq. m.or fraction thereof	Not less than 100%	
301	Bituminous Prime Coat	Sampling	As approved by the PCG Engineer	At every receiving	To meet the requirement of Table 6.1 of Item 301	
		Quality Test	As approved by the PCG Engineer	As designated by the PCG Engineer	0.7 liter/m <sup>2</sup> to 1.2 liters/m <sup>2</sup>	
310	Bituminous Concrete Surface Course					
A.	Bituminous Materials	Quality Test	AASHTO M 20	For every 40 T or 200 drums	Within the requirements of Table 1	
B.	Aggregates	Sieve Analysis Test	AASHTO T-11 and T- 27	For every 75 cu.m/200 T or fraction thereof	Within the requirements of Table 703.5	
		Liquid Limit Test	AASHTO T-89	- ditto -	- ditto -	
		Plasticity Index	AASHTO T-90	- ditto -	- ditto -	
		Los Angeles Abrasion Test	AASHTO T-96	For every 1500 cu.m or fraction thereof	Not more than 40%	
		Bulk Specific Gravity	AASHTO T-85	- ditto -	As per results	
		One (1) Fractured Face	ASTM D 5821	- ditto -	Not less than 50%	
C.	Bituminous Mix	Extraction Test	AASHTO T 164	For every 75 cu.m/130 T or fraction thereof	Within the requirements of Table 703.2	
		Stability	AASHTO T 167	- ditto -	Within the requirements of 307.2.1	
		Laboratory Compaction	AASHTO T 166	- ditto -	- ditto -	
D.	Mineral Filler	Sieve Analysis Test	AASHTO T-11 and T- 27	For every 75 cu.m. or fraction thereof	Within the requirements of Table 703 A	

WORK ITEM	WORK DESCRIPTION	KINDS OF TEST	TEST METHOD	TEST FREQUENCY	STANDARD VALUE	NOTES
E.	Compacted Pavement	Coring Test	ASTM D 3549	For each full day's operation: Density & Thickness (At least 1 but not more than 3 core samples)	At point designated by the PCG Engineer	
SPL 312	EconocreteSubbaseCourse					
A.	Cement	Quality Test	ASTM C150	For every 2000 bags or fraction thereof	Within the requirements of Table 1 & 2	
B.	Aggregates	Sieve Analysis Test	ASTM C 136	For every 75 cu.m. or fraction thereof	Within the requirements of Table 1	
		Flatness of Particles		For every 1500 cu.m or fraction thereof	Width : Thickness > 5	
		Elongated Particles		- ditto –	Length : Width > 5	
		Los Angeles Abrasion Test	AASHTO T-96	For every 1500 cu.m or fraction thereof	Not more than 50%	
C.	Water	Quality Test	AASHTO T 26	For every source	PCG Engineer's Certificate	
D.	Admixtures	Quality Test	ASTM C 494	For each shipment	Standard values specified in this Specification	Manufacturer's test data may be substituted as directed by the PCG Engineer's Representative
E.	EconocreteMix	Sampling	ASTM C 192	For every 75 cu.m. or fraction thereof	At point designated by the PCG Engineer's Representative	
		Compressive Test	ASTM C 39	For every 75 cu.m. or fraction thereof	Not less than 500 psi (3.45 MPa) at 7 days and 750 psi (5.17 MPa) at 28 days but not	

WORK ITEM	WORK DESCRIPTION	KINDS OF TEST	TEST METHOD	TEST FREQUENCY	STANDARD VALUE	NOTES
					to exceed 1,200 psi (8.27 MPa)	
F.	Curing Compound	Quality Test	ASTM C 309	For each shipment	Standard values specified in this Specification	Manufacturer's test data may be substituted as directed by the PCG Engineer's Representative
G.	Completed Pavement	Coring Test	AASHTO T 24	One (1) core for 3,350 sq. m. or fraction thereof	At point designated by the PCG Engineer	
311	PCCP					
A.	Cement	Quality Test	ASTM C150	For every 2000 bags or fraction thereof	Within the requirements of Table 1 & 2	
B.	Fine Aggregates	Sieve Analysis Test	ASTM C 27	For every 75 cu.m. or fraction thereof	Within the requirements of Table 311.1	
		Material passing the 0.075 mm (No. 200 sieve)	AASHTO T-11	For every 1500 cu.m or fraction thereof	Not more than 3%	
		Clay lumps or shale	AASHTO T-112	- ditto -	Not more than 1%	
		Soundness	AASHTO T-104	- ditto -	Not more than 10%	
		Bulk Specific Gravity	AASHTO T 95	- ditto -	As per results	
C.	Coarse Aggregates	Sieve Analysis Test	ASTM C 27	For every 75 cu.m. or fraction thereof	Within the requirements of Table 311.2	
		Material passing the 0.075 mm (No. 200 sieve)	AASHTO T-11	For every 1500 cu.m or fraction thereof	Not more than 1%	

WORK ITEM	WORK DESCRIPTION	KINDS OF TEST	TEST METHOD	TEST FREQUENCY	STANDARD VALUE	NOTES
		Material passing the 0.075 mm (No. 200 sieve)	AASHTO T-11	For every 1500 cu.m or fraction thereof	Not more than 1%	
		Clay lumps or shale	AASHTO T-112	- ditto –	Not more than 0.25%	
		Soundness	AASHTO T-104	- ditto –	Not more than 12%	
		Bulk Specific Gravity	AASHTO T-85	- ditto -	As per results	
		Los Angeles Abrasion Test	AASHTO T-96	- ditto -	Not more than 40%	
D.	Water	Quality Test	AASHTO T 26	For every source	PCG Engineer's Certificate	
E.	Admixtures	Quality Test	AASHTO M 194	For each shipment	Standard values specified in this Specification	Manufacturer's test data may be substituted as directed by the PCG Engineer's Representative
F.	Dowel & Tie Bar	Quality Test	AASHTO M 31 or M 42	For every 10,000 kgs. or fraction thereof	Within the requirements of Item 404	
G.	Joint Fillers	Quality Test	AASHTO T 42	For each shipment	Within the requirements of Item 705	
H.	Curing Compound	Quality Test	ASTM C 309	For each shipment	Standard values specified in this Specification	Manufacturer's test data may be substituted as directed by the PCG Engineer's Representative
I.	Concrete Mix	Flexural Test	AASHTO T 97	For every 330 sq.m. or fraction thereof	Not less than (550 psi and 700 psi) 14 days and 28 days, respectively	
J.	Completed Pavement	Coring Test	AASHTO T 24	5 holes/km/lane or 5 holes/500m if 2 lanes	At point designated by the PCG Engineer	

WORK ITEM	WORK DESCRIPTION	KINDS OF TEST	TEST METHOD	TEST FREQUENCY	STANDARD VALUE	NOTES
				poured concurrently		
505	Grouted Riprap					
A.	Cement	Quality Test	ASTM C150	For every 2000 bags or fraction thereof	Within the requirements of Table 1 & 2	
B.	Fine Aggregates	Sieve Analysis Test	ASTM C 27	For every 75 cu.m. or fraction thereof	Within the requirements of Table 311.1	
C.	Water	Quality Test	AASHTO T 26	For every source	PCG Engineer's Certificate	
D.	Boulders	Weight	As determined by the PCG Engineer's Representative	For every source	Within the requirements of 505.2.1	
Masonry Works						
A.	Cement	Quality Test	ASTM C150	For every 2000 bags or fraction thereof	Within the requirements of Table 1 & 2	
B.	Fine Aggregates	Sieve Analysis Test	ASTM C 27	For every 75 cu.m. or fraction thereof	Within the requirements of Table 311.1	
C.	CHB 6"	Compressive Test	ASTM C140	For every 10,000 units: at least 3 pcs.	Within the requirements of ASTM C 90	
D.	Steel Bars	Quality Test	AASHTO M 31 or M 42	For every 10,000 kgs. or fraction thereof	Within the requirements of Item 404	
612	Pavement Markings	Quality Test	AASHTO M 249	1- 20 liter can for every 100 cans or 1 - 4 liter for every 100 cans or fraction thereof	Within the requirement of Table 612.1 & Table 2.3.2	

## EXTERIOR UTILITIES AND STRUCTURES

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## DIVISION 2 – SITE CONSTRUCTION

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## **SECTION 02302 - EXCAVATION, BACKFILLING, AND COMPACTING FOR UTILITIES**

### **PART 1 - GENERAL**

#### **1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

##### **1.1.1 American Society for Testing and Materials (ASTM)**

- |            |   |
|------------|---|
| ASTM D422  | Particle-Size Analysis of Soils   |
| ASTM D698  | Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))   |
| ASTM D1140 | Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve                              |
| ASTM D1556 | Density and Unit Weight of Soil in Place by the Sand-Cone Method                                      |
| ASTM D1557 | Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m)) |
| ASTM D2487 | Classification of Soils for PCG Engineering Purposes (Unified Soil Classification System)             |
| ASTM D2922 | Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)                        |
| ASTM D3017 | Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)                            |
| ASTM D4318 | Liquid Limit, Plastic Limit, and Plasticity Index of Soils  |

##### **1.1.2 U.S. Department of Agriculture (USDA)**

- |          |  |
|----------|--|
| DOA SSIR | Soil Survey Investigation Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil Conservation Service |
|----------|--|

#### **1.2 DEFINITIONS**

##### **1.2.1 Backfill**

Material used in refilling a cut, trench or other excavation.

##### **1.2.2 Cohesive Materials**

Soils classified by ASTM D2487 as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when fines have a plasticity index greater than zero.

##### **1.2.3 Cohesionless Materials**

Soils classified by ASTM D2487 as GW, GP, SW, and SP. Materials classified, as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

#### 1.2.4 Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D698 or ASTM D155 for general soil types.

#### 1.2.5 Granular Pipe Bedding

A dense, well-graded aggregate mixture of sand, gravel, or crushed stone (mixed individually, in combination with each other, or with suitable binder soil) placed on a subgrade to provide a suitable foundation for pipe. Granular bedding material may also consist of poorly graded sands or gravels where fast draining soil characteristics are desired.

#### 1.2.6 In-Situ Soil

Existing in place soil.

#### 1.2.7 Lift

A layer or course of soil placed on top of subgrade or a previously prepared or placed soil in a fill or backfill.

#### 1.2.8 Refill

Material placed in excavation to correct overcut in depth.

#### 1.2.9 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling, drilling and the use of expansion jacks, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 0.76 cubic meter (1 cubic yard) in volume. Material identified in the soil boring logs as having a standard penetration resistance as determined by ASTM D1586 greater than 1968 blows per meter (600 blows per foot) is arbitrarily defined herein as "Rock."

##### a. Topsoil

In natural or undisturbed soil formations, the fine-grained, weathered material on the surface or directly below any loose or partially decomposed organic matter. Topsoil may be a dark-colored, fine, silty, or sandy material with a high content of well-decomposed organic matter, often containing traces of the parent rock material. Gradation and material requirements specified herein apply to all topsoil references in this contract. The material shall be representative of productive soils in the vicinity.

##### b. Unyielding Material

Rock rib, ridge, rock protrusion, or soil with cobbles in the trench bottom requiring a covering of finer grain material or special bedding to avoid bridging in the pipe or conduit.

##### c. Unsatisfactory Material

In-Situ soil or other material, which can be identified as having insufficient strength characteristics or stability to carry intended loads in the trench without excessive consolidation or loss of stability. Also backfill material, which contains refuse, large rocks, debris, soluble particles, and other material, which could damage the pipe or

cause the backfill not to compact. Materials classified as PT, OH, or OL by ASTM D2487 are unsatisfactory.

d. Unstable Material

Material in the trench bottom which lacks firmness to maintain alignment and prevent joints from separating in the pipe, conduit, or appurtenance structure during backfilling. This may be material otherwise identified as satisfactory which has been disturbed or saturated.

1.3 SUBMITTALS

- a. Test Reports
- b. Trench backfill material tests
- c. Pipe bedding material tests

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials in a manner to prevent contamination, segregation, and other damage.

1.5 PROTECTION

1.5.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within 600 mm (two feet) of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand or light equipment. Start hand light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until the PCG Engineer grants approval for backfill. Report damage to utility lines or subsurface construction immediately to the PCG Engineer.

**PART 2 - PRODUCTS**

2.1 SOIL MATERIALS

Provide soil materials as specified below free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, or other deleterious and objectionable materials.

2.1.1 Backfill

Bring trenches to grade indicated on the drawings using material excavated on the site of this project. This material will be considered unclassified and no testing other than for compaction will be required before use as backfill, classified as GM, SM, SC by ASTM 2487 with a maximum particle size of 75 mm (3 inches).

2.1.2 Special Backfill for Roads and Paved Areas

Backfill trenches under roads, structures, and paved areas as specified in Section 02300, "Earthwork for Structures and Pavements", with material conforming to the requirements stated above except that the liquid limit of the material cannot exceed 35 percent when tested in accordance with ASTM D4318, the plasticity index cannot exceed 12 percent

when tested in accordance with ASTM D4318, and not more than 35 percent by weight can be finer than the 75 micrometers No. 200 sieve when tested in accordance with ASTM D1140.

2.1.3 Sand

Clean, coarse-grained sand classified as SW or SP by ASTM D2487 for bedding and backfill as indicated.

2.1.4 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof having a classification of GW GP in accordance with ASTM D2487 for bedding and backfill as indicated. Maximum particle size shall not be more than 25mm per 300mm (one inch per foot) of pipe diameter or 75mm (3 inches) maximum.

2.1.5 Topsoil Material

Salvaged topsoil from stockpile. Topsoil should be free of subsoil, stumps, rocks larger than 19 mm (3/4 inch) in diameter with maximum 3 percent retained on 6 mm (1/4 inch) sieve, brush, weeds, toxic substances, and other material or substance detrimental to plant growth. Topsoil shall be a natural, friable soil representative of productive soils in the vicinity. Modify the topsoil provided if necessary to meet the requirements specified in Table 2. Furnish additional topsoil from approved sources off the Site meeting requirements specified in Table 2 if stockpiled material is insufficient to complete work indicated.

TABLE 2

DOA SSIR Soil Survey Investigation Report No. 1, Laboratory Test for:	Acceptable Limits
Sand Content	20 - 45 percent by weight
Silt Content	25 - 50 percent by weight
Clay Content	10 - 30 percent by weight
Organic Material (Walkley-Block)	5 percent

TABLE 2

DOA SSIR Soil Survey Investigation Report No. 1, Laboratory Test for:	Acceptable Limits
pH	5.0 to 7.6
Soluble Salts	600-ppm maximum
Absorption Rate minimum	0.21 mm per second

2.1.6 Borrow

Provide materials meeting requirement for general site fill, backfill, granular fill, and topsoil. Obtain borrow materials in excess of those furnished from excavations specified herein from sources off the project area.

2.1.7 Pipe Bedding

Provide material for pipe bedding consisting of GW GP GM GC SW SP SM SC sand gravel as classified in accordance with ASTM D2487.

## 2.2 CONCRETE PIPE CRADLES

Concrete pipe cradles where indicated conforming to lines and dimensions indicated. Construct cradles with concrete having a 28 day compressive strength of 20.7 MPa (3000 psi).

## PART 3 - EXECUTION

### 3.1 PROTECTION

#### 3.1.1 Drainage and Dewatering

##### a. Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

#### 3.1.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. Operate the dewatering system until construction work below existing water levels is complete.

#### 3.1.3 Underground Utilities

The Contractor shall physically verify the location and elevation of the existing utilities prior to starting construction. The Contractor shall mark the surface of the ground where existing underground utilities are discovered.

#### 3.1.4 Structures and Surfaces

Protect newly backfilled areas slopes, or grades from traffic, erosion settlement, or any other damage. Repair and reestablish damaged or eroded grades and slopes and restore surface construction prior to acceptance. Protect existing streams, ditches, and storm drain inlets from water-borne soil.

### 3.3 SURFACE PREPARATION

#### 3.3.1 Stockpiling Topsoil

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be wasted. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

#### 3.3.2 Cutting Pavement, Curbs, and Gutters

Saw cut with neat, parallel, straight lines 300 mm (one foot) wider than trench width on each side of trenches and 300 mm (one foot) beyond each edge of pits. When the saw cut is within 300 mm (one foot) of an existing joint, remove pavement to the existing joint.

### 3.4 GENERAL EXCAVATION AND TRENCHING

Keep excavations free from water while construction is in progress. Notify the PCG Engineer immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Make trench sides as nearly vertical as practicable except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. Excavate ledge rock, boulders, and other unyielding material to an over depth at least 150 mm (6 inches) below the bottom of the pipe and appurtenances unless otherwise indicated or specified. Over excavate soft, weak, or wet excavations. Use bedding material placed in 150 mm (6 inch) maximum layers to refill over depths to the proper grade. At the Contractor's option, the excavations may be cut to an overdepth of not less than 100 mm (4 inches) and refilled to required grade as specified. Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe or structure on undisturbed soil, or bedding material as indicated or specified at every point along its entire length except for portions where it is necessary to excavate for bell holes and for making proper joints. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be only 13 mm (½ inch) greater than length, width, and depth of bell as required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation. Trench dimensions shall be as indicated.

### 3.5 BEDDING

Bedding shall be of materials and depths as indicated for utility lines and utility line structures. Place bedding in 150 mm (6 inch) maximum loose lifts. Provide uniform and continuous support for each section of structure except at bell holes or depressions necessary for making proper joints.

#### 3.5.1 Concrete Cradles

Specified in lieu of other types of bedding for a particular type of pipe material, shall be as specified.

### 3.6 BACKFILLING

Construct backfill in two operations (initial and final) as indicated and specified in this section. Place initial backfill in 150 mm (6 inch) maximum loose lifts to 300 mm (one foot) above pipe unless otherwise specified. Ensure that initially placed material is tamped firmly under pipe haunches. Bring up evenly on each side and along the full length of the pipe, or structure. Ensure that no damage is done to the utility or its protective coating. Place the remainder of the backfill (final backfill) in 225 mm (9 inch) maximum loose lifts unless otherwise specified. Compact each loose lift as specified in the paragraph 3.7, "General Compaction" before placing the next lift. Do not backfill where the material in the trench is muddy, except as authorized. Provide a minimum cover from final grade of 600mm (2 feet) for storm drains and 1200 mm (3.9 feet) for sewer mains. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation. Coordinate backfilling with testing of utilities. Testing for the following shall be complete before final backfilling: water distribution, storm drainage and sanitary sewer.

### 3.7 COMPACTION

Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings. Compact material in accordance with the following unless otherwise specified. If necessary, alter, change, or modify selected equipment or compaction methods to meet specified compaction requirements.

### 3.7.1 Compaction of Material in Subcuts or Over excavations

In rock, compact to 95 percent of ASTM D1557 maximum density. In soft, weak, or wet soils, tamp refill material to consolidate to density of adjacent material in trench wall. In stable soils, compact to 90 percent of ASTM D1557 maximum density.

### 3.7.2 Compaction of Pipe and Conduit Bedding

In rock, compact to 95 percent and in soil, compact to 90 percent of ASTM D1557 maximum density.

### 3.7.3 Compaction of Backfill

Compact initial backfill material surrounding pipes, or conduits, to 90 percent of ASTM D1557 maximum density except where bedding and backfill are the same material. Where bedding and backfill are the same material, compact initial backfill to the density of the bedding. Under areas to be seeded or sodded, compact succeeding layers of final backfill to 85 percent of ASTM D1557 maximum density. For utilities under road or highway right-of-way, structures and pavements compact layers of final backfill as specified under paragraph 3.8, "Special Earthwork Installation Requirements."

## 3.8 SPECIAL EARTHWORK INSTALLATION REQUIREMENTS

### 3.8.1 Concrete Culvert Piping Under Embankment

Construct the embankment to 150 mm (6 inches) above elevation of top of pipe for 600 mm (24 inch) size pipe and to 750 mm (30 inches) above elevation of top of pipe where the pipe diameter is larger than 600mm (24 inches). After pipe installation, backfill and compact in accordance with requirements stated in paragraphs 3.6, "Backfilling and 3.7, "Compaction."

### 3.8.2 Manholes and Other Appurtenances

Provide at least 300 mm (12 inches) clear from outer surfaces to the embankment or shoring. Remove rock as specified herein. Remove unstable soil that is incapable of supporting the structure to an overdepth of 300 mm (one foot) and refill with gravel or sand to the proper elevation. Stabilize soft, weak, or wet excavations as indicated. Refill over depths with gravel or sand to the required grade and compact to 90 percent of ASTM D1557 maximum density.

### 3.8.3 Compaction under Roads, Streets, and other Areas to be paved

Place final backfill in 150 mm (6 inch) maximum loose lifts. If a vibratory roller is used for compaction of final backfill, the lift thickness can be increased to 225 mm (9 inches). Compact all backfill surrounding pipes, conduits, and other structures to 90 percent of ASTM D1557 maximum density except compact the top 300 mm (12 inches) of subgrade to 95 percent of ASTM D1557 maximum density. Backfill to permit the rolling and compacting of the completed excavation with the adjoining material, providing the specified density necessary to enable paving of the area immediately after backfilling has been completed. Compaction requirements for materials in pavement sections above the subgrade level shall be as specified in Section 02300, "Earthwork for Structures and Pavement."

## 3.9 FINISH OPERATIONS

### 3.9.1 Grading

Finish to grades indicated within 30 mm (one-tenth of a foot). Grade areas to drain water away from structures. Grade existing grades that are to remain but have been disturbed by the Contractor's operations.



### 3.9.2 Spreading Topsoil

Clear areas to receive topsoil for the finished surface of materials that would interfere with planting and maintenance operations. Scarify subgrade to a depth of 50 mm (2 inches). Do not place topsoil when the subgrade is extremely wet or dry, or in other conditions detrimental to seeding, planting, or grading. Spread topsoil to a uniform depth of 100 mm (4 inches) over the designated areas.

### 3.9.3 Disposition of Surplus Material

Surplus or other soil material not required or suitable for filling, backfilling, or grading shall be wasted by disposition off the work site.

### 3.9.4 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

## 3.10 FIELD QUALITY CONTROL

Test sand, gravel, bedding, backfill and topsoil for conformance to specified requirements. Test backfill to be used under roads and paved areas for conformance to special requirements. Test bedding and backfill for moisture-density relations in accordance with ASTM D1557 and as specified herein. Perform at least one of each of the required tests for each material provided. Perform sufficiently in advance of construction so as not to delay work. Provide additional tests as specified above for each change of source. Perform final tests on topsoil to ensure adjustment of parameters into the ranges specified. Perform density and moisture tests in randomly selected locations and in accordance with ASTM D1556, ASTM D2922 and ASTM D3017 as follows:

- a. Bedding and backfill in trenches: One test per 15 meters

(50 linear feet) in each lift.

- b. Appurtenance structures: One test per 9 square meters

(100 square feet) or fractions thereof in each lift.

Where ASTM D2922 and ASTM D3017 are used to test field compaction densities, verify test results by performing at least one test per day using ASTM D1556 at a location already tested in accordance with ASTM D2922. Perform at least one additional test using ASTM D1556 for every ten tests performed with a nuclear device, at locations checked in accordance with ASTM D2922.

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## **SECTION 02510 - EXTERIOR WATER SUPPLY AND DISTRIBUTION AND FIRE PROTECTION SYSTEMS**

### **Part 1 - GENERAL**

#### **1.1 Applicable Publications**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

##### **1.1.1 American Society for Testing and Materials (ASTM) Publications:**

A48	Standard Specification for Gray Iron Castings
A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A120	Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses
A139	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A234	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
A283	Low and Intermediate Tensile Strength Carbon Steel Plates
A325	Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength
A536	Ductile Iron Castings
A570	Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
A572	High Strength, Low-Alloy Columbium-Vanadium Steels of Structural Quality
B62	Composition Bronze or Ounce Metal Castings
B584	Copper Alloy Sand Castings for General Application
C33	Concrete Aggregates
C94	Ready-Mixed Concrete
C109	Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50 mm Cube Specimens)
C150	Portland Cement
D1248	Polyethylene Plastic Moldings and Extrusion Material
D1785	Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120
D2122	Standard Test Method for Determining Dimension of Thermoplastic Pipe and Fittings
D2241	Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
D2466	Socket Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings Schedule 40

	D2666	Polybutylene (PB) Plastic Tubing
	D2737	Polyethylene (PE) Plastic Tubing
	D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
	F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
1.1.2	American Water Works Association (AWWA) Publications:	
	C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
	C106	Cast Iron Pipe Centrifugally Cast in Metal Molds for Water or Other Liquids
	C108	Cast Iron Pipe Centrifugally Cast in Sand-Lined Molds for Water and Other Liquids
	C110	Ductile-Iron and Cast-Iron Fittings, 3 in. through 48 in. for Water and Other Liquids
	C111	Rubber Gasket Joints for Ductile-Iron and Cast-Iron Pressure Pipe and Fittings
	C200	Steel Water Pipe- 6 in. (150mm) and Larger
	C207	Steel Pipe Flanges for Waterworks Service, Sizes 4-inches through 144-inches (100 mm through 3,600 mm)
	C208	Dimension for Fabricated Steel Water Pipe Fittings
	C500	Gate Valves, 3 in. through 48 in. NPS, for Water and Sewage System
	C508	Swing-check Valves for Waterworks Service 2 in. through 24 in. NPS
	C601	Disinfecting Water Mains
	C800	Underground Service Line Valves and Fittings
	C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in. for Water
1.1.3	Underwriter's Laboratories, Inc. (UL) Publications:	
	UL246	Hydrants for Fire Protection Service
	UL262	Gate Valves for Fire Protection Service
	UL312	Check Valves for Fire Protection Service
1.1.4	Uni-Bell Plastic Pipe Association (UNI) Publication:	
	UNI-B-3	Installation of Polyvinyl Chloride (PVC) Pressure Pipe Complying with AWWA Standard C-900
1.1.5	National Fire Protection Association (NFPA) Publication:	
	NFPA 24	National Fire Code, Vol. I, Installation of Private Fire Service Mains and their Appurtenances

1.1.6 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publications

SP-58 Pipe Hangers and Supports-Materials, Design and Manufacture

SP 70 Cast Iron Gate Valves, Flanged and Threaded Ends

SP 80 Bronze Gate, Globe, Angle and Check Valves

1.1.7 American Association of Plumbing and Mechanical Officials (IAPMO) Publications

B 16.1 Cast Iron Pipe Flanges and Flanged Fitting Class 25, 125, 250 and 300

1.1.8 International Association of Plumbing and Mechanical Officials (IAPMO) Publications

UPC 2006 Uniform Plumbing Code

1.2 General Requirements

Section 15011, "General Requirements, Mechanical," also applies to this Section except as specified otherwise. This Section applies to the water distribution system and appurtenances.

1.2.1 Water Service Line

Provide water service lines from watermain to a point approximately 1.0 meter inside the lot fence line. Water service lines shall be Polyethylene or Polybutylene plastic pipe. Pipe sizes are as shown on the drawings. Provide water service line appurtenances where specified and where indicated.

1.2.2 Samples:

Submit samples of the following materials and have them approved before work is started:

- a. Pipe and Fittings
- b. Joint Materials

1.2.3 Manufacturer's Data

Submit manufacturer's standard drawings or catalog cuts of the following items:

- a. Pipe and Fittings
- b. Joints and Couplings, including gaskets for joints (submit both drawings and catalog for push-on joints)
- c. Valves
- d. Corporation Stops
- e. Installation Procedures

1.2.4 Standards Compliance

Submit manufacturer's certificates of conformance or compliance for each of the following materials which are specified to conform to publications referenced under Part 2, "Products" in this Section:

- a. Pipe and Fittings
- b. Pipe Joint Materials
- c. Valves

All tests required by the applicable referenced publication shall have been performed, whether specified in that publication to be mandatory or otherwise. For tests which are not specified in the referenced publication to be mandatory or otherwise. For tests which are not specified in the referenced publication to be performed at definite intervals during manufacture, the tests

shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as being provided for the project.

### 1.3 Delivery, Storage and Handling of Materials

#### 1.3.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store materials on site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

#### 1.3.2 Handling

Handle pipe, fittings, valves, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coating or linings are damaged. Carry pipe to the trench; do not drag it. Do not leave rubber gaskets and plastic piping that are not to be installed immediately out in the sunlight, but store under cover out of direct sunlight.

## PART 2 - PRODUCTS

### 2.1 Materials

#### 2.1.1 Exterior Underground Fire Water Lines

##### a. General

Black and hot-dipped cement-coated/cement-lined steel pipes, equivalent to ERW or spiral welded black iron pipe shall conform to AWWA C200, Grade B, subject to the exceptions and supplemental requirements contained in the following subsections. The pipe, of the diameter and class shown, shall be furnished complete with rubber gaskets if required and specials and bends shall be provided as shown.

##### b. Cement

Cement shall conform with ASTM C150 and shall be Type 1 for Pipe linings and coatings.

##### c. Aggregate

Aggregate shall conform to ASTM C33.

##### d. Mortar

The cement mortar used for the lining and coating shall be composed of mixtures of Portland cement, aggregate and water, well mixed and of the proper consistency to produce dense, homogenous lining and coating that will adhere firmly to the steel cylinder. The cement mortar shall develop compressive strength of not less than 18 MPa (2,600 psi) at twenty-eight(28) days.

##### e. Cylinder Material

Cylinders shall be fabricated from hot rolled carbon steel sheets or plates conforming with ASTM A-570 Grades C,D or E, ASTM A-283 Grade D; steel pipe conforming to ASTM A-139 Grade B; or, if approved by the PCG Engineer, high strength low-alloy steel conforming with ASTM A-572 Grade 42.

f. Rubber Gasket

The rubber gasket shall be the continuous ring type, made of special composition rubber. The compound shall be of first grade natural crude, synthetic rubber, or a suitable combination thereof. The gasket shall be so formed and cured as to be dense, homogenous, and have a smooth surface free of blisters, pits, and other imperfections. The gaskets shall be of sufficient volume to fill substantially the recess provided when the joint is assembled and shall be the sole element depended upon to make the joint watertight. Gaskets shall be furnished with the pipe. The compound shall conform with the physical requirements listed below.

<u>Physical Requirement</u>	<u>Value</u>
Tensile strength, min. Natural rubber	15.85 MPa (2,300psi)
Synthetic rubber and combination	14.47 MPa (2,100 psi)
Ultimate elongation, percent minimum	500%
Natural Synthetic and combination	425%
Shore durometer, Type A	40-65%
Compression set, percent of original	20%
Deflection, maximum Tensile strength after Aging, percent of original tensile strength, min. (oxygen pressure test or air heat test)	80%

g. Welded Joints:

Where welded joints are provided, well bell type joints may be used, or the bell may be cut back, or a filler rod added so as to permit a field weld between the bell and spigot joint rings.

h. Lining

The mortar for pipe lining shall consist of one part cement to not more than three (3) parts sand by weight. The cement mortar lining shall be applied by the centrifugal method or by a method obtaining equivalent results. The process used in the application of the lining shall produce a smooth dense durable surface, free from pockets, voids, over sanded areas, blisters and excessively cracked areas. Except where otherwise specified or shown, lining thickness shall be as follows, with a tolerance of plus or minus twenty-five percent ( $\pm 25\%$ ):

<u>Nominal Pipe Diameter</u>	<u>Lining Thickness</u>
350 mm and smaller	8 mm

i. Cement Mortar Coating

The steel reinforcement in the mortar coating shall consist of: (a) Helically wound cold drawn steel wire or, (b) a cage of self-furring welded steel wire fabric of 50 mm x 50 mm No. 14 gage fabric or 50 mm x 100 mm No.13 gage fabric, or (c) 25 mm No. 18 gage or 37 mm hexagonal No.17 gage ribbon mesh, twisted wire fabric, salvaged both edges using steel wire. Helically wound steel wire shall be not less than the

thickness of No. 14 gage and shall be embedded at the approximate center of the cement mortar coating.

Mortar for pipe coating shall consist of one (1) part cement to not more than three (3) parts sand by weight. The cement mortar coating shall be applied by pneumatic placement or by a method producing equivalent results. Except as otherwise specified or shown, coating shall be 25 mm for all sizes.

j. Curing

The pipe shall be water or steam cured, or a combination of both, or the coating may be cured by covering with a plastic membrane.

Water curing and steam curing may be used interchangeably on a time ratio basis of four (4) hours water curing to one (1) hour steam curing.

(1) Steam Curing- Where steam curing is used, the pipe shall be kept in steam maintained at a temperature of 55°C, for the specified period. The pipe ends shall be tightly capped with waterproofed cover whenever the steam curing is interrupted or completed. The water proof covers shall be kept throughout and beyond the curing period. The covers shall be kept throughout and beyond the curing period. The covers shall not be removed until the pipes are to be laid. The Contractor shall furnish the PCG Engineer copies of recorded charts showing temperature and duration of curing period.

(2) Water Curing- Where the water curing is used, the pipe shall be kept continually moist by spraying or other means for seven (7) days before moved to the trench side. The pipe shall not be allowed to dry either on the inside or outside surfaces during the curing period. The pipe shall be tightly capped with a waterproof cover immediately upon completion of the lining of each section to prevent the escape of moisture from the interior of the pipe. When additional moisture is required to maintain a moist condition, water shall be introduced inside the pipe after the mortar has attained sufficient set so that the introduction of water will not damage the mortar. The pipes shall be water-cured for a minimum of twenty-four (24) hours before application of the coating.

k. Compressive Strength for Mortar:

Test cylinder shall be cast samples of the mortar used in lining and coating the pipe. The curing of test cylinders shall be in conformity with the curing of the pipe. Cylinders shall be molded and tested in accordance with ASTM 39 or C109.

l. Hydrostatic Pressure Test:

All steel cylinders shall be subjected to a hydrostatic pressure test, which stresses the steel to 172.36 MPa. While under pressure test, all welds shall be thoroughly inspected and all parts showing leakage shall be marked. Cylinders, which show any leakage under test, shall be re-welded at the point of leakage and subjected to another hydrostatic test.

m. Specials:

(1) Definition: Specials are defined as bends, reducers, wyes, tees, crosses, outlets, and manifolds, wherever located and all piping above ground or in structures.

- (2) Design: Except as otherwise provided herein, materials, fabrication, and shop testing of straight pipe shall conform with AWWA C 200. Minimum plate thickness of specials shall be computed using the following formula:

$$T = \frac{DP}{2(Y/S)}$$

Where:

T= plate thickness in inches  
D=outside diameter  
P=design pressure, psi  
S=factor of safety, 2.50  
Y= specified yield point in steel in psi

But in no case shall the design stress (Y/S) exceed 91 MPa (13,200 psi) nor shall plate thickness be less than 4.7 mm.

- (3) Outlets, Tees, Wyes and Crosses: Outlets shall be welded to the steel cylinder of the pipe following application of mortar coating to the cylinder. Following this, all outlets larger than 50 mm in diameter shall be provided with steel reinforcing saddles, wrapper plates having a thickness equal to the sum of the required thickness of the saddle or wrapper plate, plus the cylinder to which they are attached.

Such saddles or wrapper plates shall be steel plate at least 1.25 times the thickness of the pipe cylinder to which the outlet is attached. The total cross-sectional area of the saddle or wrapper plate thickness of the pipe, as determined by the equation in Clause (m) (2). The overall width of the saddle or wrapper plate shall not be more than 2 times, and not less than 1.67 times, the maximum dimension of the cut-out. Outlets may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameter.

Tees, wyes, and crosses shall either be fabricated of steel plate or provided with wrapper plates. The thickness of the plate or plates, exclusive of crotch plates, being such that when multiplied by the diameter of the opening, will be not less than 1.25 times the cross-sectional area of the cutout. Where tees, wyes, or crosses are fabricated from steel plate without wrapper plates, the thickness of the plate shall be not less than 2.5 times the required 4.70 mm plate thickness, Clause (m) (2).

- (4) Dimensions: Unless otherwise shown, dimensions of specials shall conform to AWWA C 208.
- (5) Steel Welding Fittings: Steel welding fittings shall conform with ASTM A 234.
- (6) Ends of Mechanical- Type Couplings: Except as otherwise provided herein, where mechanical – type couplings are indicated, the ends of the pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 300 mm and smaller is furnished in standard schedule thickness, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.
- (7) Flanges: Where the design pressure is 1.2 MPa (175 psi) or less, flanges shall conform with either AWWA C-207 Class D, or E, or ANSI B16.5 1.0 MPa (150 psi) Class. Where the design pressure is greater than 1.2 MPa (175 psi), flanges shall conform with ANSI B16.5 2.0 MPa (300 psi) Class. Flanges shall have flat or raised faces. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe.



- (8) Shop Testing: Upon completion of welding, but before lining and coating, each special shall be bulk-headed and tested under a hydrostatic pressure of not less than one and tested under a hydrostatic pressure of not less than one and one-half (1-1/2) times the pressure for which the pipe has been designed; provided, however, that if straight pipe used in fabricating the special has been previously tested in accordance with Clause (m) (2) herein, the circumferential welds may be tested by a dye penetrant process using Turco Dy-Check or approved equal, with no further hydrostatic test. Any pinholes or porous welds, which may be revealed by the test, shall be chipped out and re-welded and the special re-tested.
- (9) Lining: all requirements, pertaining to thickness, application, and curing of lining specified for straight pipe shall apply to specials, with the following provision. If the special cannot be centrifugally lined, it shall be lined by hand. In such case, the lining shall be reinforced with 50 mm x 100 mm No. 12 welded wire fabric positioned approximately in the center of the lining. The wire spaced 50 mm on centers shall extend circumferentially around the pipe with the fabric securely fastened to the pipe. Splices shall be lapped 100 mm and free ends tied or looped to assure continuity.
- (10) Coating: All requirements pertaining to thickness, application, and curing of coating specified for straight pipe shall apply to specials. Unless otherwise shown, the coating on the buried portion of a pipe section passing through a structure wall shall extend 50 mm inside the outer surface of the wall, or to the wall flange, if one is indicated.
- (11) Marking: a mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

## 2.1.2 Exterior Underground Water Transmission and Distribution Lines

### a. Materials

- (1) PVC (Polyvinyl Chloride) Pipe shall conform to the requirements of AWWA C900 and shall be pressure Class 150. The pipe shall have steel pipe equivalent or cast iron equivalent outside dimensions and furnished with rubber ring gasket joints.

Outside diameters and wall thickness are shown below for pressure Class 150.

Nominal Pipe Size (mm)	Outside Diameter (mm)	Nominal Wall Thickness (mm) <u>Class 150</u>
50	63	3.6
75	90	5.2
100	110	6.3

The ISO Short Term Hydrostatic Pressure Test may be used in lieu of the 5 second AWWA Hydrostatic Proof Test providing the following criteria is used. A short term hydrostatic pressure test shall be performed on a specimen produced from each extrusion outlet at the beginning of production of each specific material, style or size and thereafter once every two hours and upon start up following any planned or unplanned interruption of production. The bell, including any reinforcement sleeve, shall be included as part of at least 50 percent of the test specimens. One short term hydrostatic pressure test failure from a production run requiring four or less test shall cause the rejection of all pipe from production run. Pipe from production runs requiring five or more tests shall be rejected upon the second test specimen failure. A

production run to be rejected per set of specimens tested shall in no case exceed 8 hours production. An affidavit of compliance to these specifications shall be provided to the Owner.

- (2) Fittings shall be polyvinyl chloride (PVC). PVC fittings shall in general conform to ASTM D 2466, Type 1 (normal impact). The inside diameter of fittings shall be suitable for making a water tight joint with the pipe furnished. Joints for pipe and fittings shall be especially constructed for joining with neoprene ring gaskets. A sufficient number of ring gaskets and lubricant shall be furnished to provide for a two percent (2%) overrun. Pipe and fittings shall be labeled by the manufacturer to indicate class rating, type of material, manufacturer's trade name and production code. The minimum thickness for PVC flanges shall be as follows:

<b><u>Nominal Pipe Size</u></b>	<b><u>Minimum Plate Thickness</u></b>
75 mm (3-in)	25 mm (1-in)
100 mm (4-in)	28 mm (1-1/8-in)

b. Installation

After a section of pipe has been lowered into the prepared trench and immediately before joining the pipe, the ends of the pipe to be joined shall be cleaned, and the rubber gasket lubricated, with a vegetable compound soap all in accordance with the pipe manufacturer's instructions. Assembly of the pipe lengths shall be in accordance with the recommendations of the manufacturer of the type of joint used. All special tools and appliance required for joining the pipe shall be provided by the Contractor. When cutting or machining of the pipe is necessary, only tools and methods recommended by the pipe manufacturer and approved by the PCG Engineer shall be employed.

1.1.3 Water Service Lines

2.1.3.1 PE (Polyethylene) Plastic Tubing

a. Materials

The extrusion compound shall be either Grade P33, Class C or Grade P34, Class C (PE3306 or PE3406) as defined by ASTM D 1248. All compounds used shall be virgin plastic except that clean rework material from the manufacturer's own pipe production may be used so long as the original was virgin material. The pipe shall meet the requirements of the National Sanitation Foundation (NSF) for potable water use as tested by the National Institute of Science and Technology or other approved testing laboratories and shall be made from non-toxic, non-lead based plastic.

b. Dimensions

The Standard Dimensional Ratio (SDR) shall be 9 with nominal dimensions as follows (in English units):

<b><u>Nominal (mm)</u></b>	<b><u>Size (in)</u></b>	<b><u>Average O.D. (mm)</u></b>
20	3/4	26.68
32	1-1/4	42.16
40	1-1/2	48.26
50	2	60.32

c. Rating

All service tubing shall be rated for use with water at 23.0°C (73.40°F) and at a minimum working pressure of 1.1 MPa (160 psi). Other requirements shall be in accordance with ASTM D2737.

d. Marking

All tubing shall be clearly marked at intervals of not more than 0.6M with nominal size, type of material (PE 3306, or PE 3406). Standard Dimensional Ratio (SDR 9), manufacturer's trade name and production code, and the seal of approval from an accredited testing laboratory.

e. Installation

The installation and method of end connections of PE plastic tubing shall be as shown on the drawings. All procedures and tools used shall comply with the recommendations of the Manufacturer and be approved by the PCG Engineer.

### 2.1.3.2 PB (Polybutylene Plastic) Tubing

a. Materials

The extrusion compound shall be Type II, Class C, Grade 1 polybutylene resin (PB2110) as defined by ASTM D 2581. All compounds used shall be virgin plastic except that clean rework material from the manufacturer's own pipe production may be used so long as the original was virgin material. The tubing shall meet the requirement of the National Sanitation Foundation (NSF) for potable water use as tested by the National Institute of Science and Technology or other approved testing laboratories and shall be made from non-toxic, non-lead based plasticizer approved by the PCG Engineer.

b. Dimensions

The Standard Dimensional Ratio (SDR) shall be a maximum of 13.5 with average diameter, wall thickness and tolerance as herein specified, when measured in accordance with ASTM D 2122.

The dimensional criteria of all polybutylene water service tubing shall conform to ASTM D2666 as follows (in English units):

<b>Nominal (mm)</b>	<b>Size (in)</b>	<b>Average O.D.</b>	<b>O.D. Tolerances</b>	<b>Min. Wall Thickness</b>	<b>Wall Tolerance</b>
20	3/4	0.875"	+0.008/-0.000	0.065"	+0.010"
32	1	1.25"	+0.010/-0.000	0.120"	+0.010"
40	1-1/2	1.625"	+0.012/-0.000	0.120"	+0.012"
50	2	2.125"	+0.012/-0.000	0.157"	+0.015"

c. Rating

All service tubing shall be rated for use with water at 23.0°C (73.40°F) at minimum hydrostatic design stress of 6.9 MPa (1000 psi) and minimum working pressure of 1.1 MPa (160 psi).

d. Marking

All tubing shall be clearly marked at intervals of not more than 0.60M with nominal size, type of material (PB2110), Standard Dimension Ratio (SDR 13.5), pressure rating (1.1 MPa or 160 psi), ASTM designation (ASTM D 2666), manufacturer's trade name and production code, and the seal of approval from an accredited testing laboratory.

e. Installation

The installation and method of end connections of PB plastic tubing shall be as shown on the drawings. All procedures and tools used shall comply with the recommendations of the manufacturer and be approved by the PCG Engineer.

### 2.1.3.3 Service Lines

a. Materials

The service line piping 50 mm (2-in) and smaller shall be polyethylene or polybutylene tubing as specified herein and in the sizes shown on the drawings. Service piping having diameter larger than 50 mm (2-in) shall be constructed of the same materials approved for water mains of similar sizes. Small tubing-size service lines shall have brass fittings as shown on the drawings using cold flare method of connection or compression type connections and stainless steel inserts as shown. The brass fittings shall be manufactured according to AWWA C 800. Welded outlets on steel pipe shall be insulated from brass fittings with nylon bushings approved by the PCG Engineer.

b. Installation

All workmanship shall be in accordance with the manufacturer's recommendations and approved by the PCG Engineer. Service taps for plastic service lines shall be made between 45 degrees to 90 degrees from the top of the pipe and the tubing shall be laid in a serpentine fashion along the service trench bottom to resist pull-out. Galvanized steel pipe for service lines shall be installed only where specifically shown on the standard drawings.

Unless otherwise directed, all service lines shall be installed prior to the hydrostatic test of the water main, and they shall be tested with pressure test of the water main. Each stop-cock valve shall be operated to thoroughly flush the service and remove any accumulated air present prior to the hydrostatic test.

### 2.1.3.4 Service Saddle

a. Materials

Where saddles are required as shown on the drawings, they shall be constructed of one or a combination of the following materials and complying with the requirements as hereunder indicated.

1. Brass – Leaded red brass, copper alloy with commercial designation 85-5-5 in accordance with ASTM B584, UNS No. 83000.
2. Bronze – Silicon bronze in accordance with ASTM B584, UNS No. 87200.
3. Ductile iron – Grade 60-40-18 in accordance with ASTM A536.
4. Cast iron – Grey iron in accordance with ASTM A48, Class 30.

b. **Manufacture**

Service saddles shall be supplied either with:

1. Clamp at least 50 mm (2-in) wide, bolted on each side or bolted on one side and hinged on the other side.
2. Double or single strap, as shown on the drawings, each with a width not less than 20 mm (3/4-in).
3. Straps or clamps shall be made of any of the materials listed above or of steel hot dipped galvanized in accordance with ASTM A153 or 18-8 stainless steel.

All parts of the service saddle including the clamp or strap shall comply with the following minimum thickness requirements:

<u>Pipe Nominal Diameter</u>	<u>Thickness</u>
75 mm	8 mm
100 mm	8 mm
150 mm	10 mm
200 mm	12 mm

Saddles shall be shaped to the various outside pipe diameter to which they are to be fitted and shall be provided with an approved resilient neoprene rubber gasket with a minimum bearing width of 12 mm (1/2-in). The tapping thread shall be at least 30 mm deep and drilled in accordance with iron pipe (I.P.) thread dimensions.

2.1.4 **Exposed Water Lines**

2.1.4.1 **Galvanized Steel Pipe:** Unless otherwise shown, galvanized steel pipe in sizes 400 mm (16 in.) in diameter and smaller, shall conform to the requirements of the ASTM A120, and shall be Schedule 40. Zinc coating shall conform to the requirements of ASTM A53 Specification for Hot Dip Process. Galvanized steel pipe shall not be cement mortar-lined unless otherwise shown. Fittings for galvanized steel pipe shall be of galvanized malleable iron.

2.1.5 **Valves and Other Water Main Accessories**

2.1.5.1 **Gate Valves**

a. **Valves**

This Section applies to gate valves 75 mm (3-in) through 300 mm (12-in) in size. All valves shall conform to AWWA C500. Gate valves where the pipeline design pressure is 1.0 MPa (150 psi) or less shall be designed for a minimum water working pressure of 1.0 MPa (150 psi) and shall be cast iron bodied, bottom-wedging, double disc with parallel seats. Discs shall be cast iron with bronze disc rings and the seat ring shall be bronze and replaceable. The valve shall be non-rising stem with a minimum of two "O" rings seals (at least one above the stem collar). The valves shall have a 50 mm (2-in) square operating nut with a cast arrow showing direction in which the nut is to be turned to open the valve. Valves shall be constructed to permit the replacement of the "O" rings above the stem collar under full working water pressure with the valves in the full open position. The valves shall be coated with coal tar epoxy with minimum dry film thickness of 15 mils.

b. **Reliability Testing**

Whenever condition warrants, the PCG Engineer may require a reliability test to be conducted in the following manner:

1. For every size and type of wedging mechanism, two sample gate valves representing each lot of one hundred (100) pieces or less shall be tested for reliability of operation. This test is in addition to those required under AWWA C500.
2. After gate valves have passed the required tests under the aforementioned standard, sample gate valves shall be subjected to fatigue stresses by unbalanced working water pressure. At an initial fully open position, pressure at 1.0 Mpa (150 psi) minimum shall be introduced at one end of the valve. At the same pressure the valve shall be slowly closed and held in that position for twenty (20) seconds after which it is again opened fully. Opening and closing of the valve shall be repeated fifty (50) times on each end, the pressure of 1.0 Mpa (150 psi) maintained at all times.
3. Subsequent examination of the operating parts, i.e., body seat rings, disc rings, stem, stem threads, stem nuts and stem packing must show no indication of failure or other defects that adversely affect the proper functioning of parts and operation of the valve.
4. After this test, the stuffing box shall be removed from the bonnet and the o-rings above the stem collar shall be replaced under full working water pressure with the valve in the fully open position.
5. In the event that any of the first two samples tested fail to pass the test, a second sample of four shall be tested. Failure of any of one in the second sample will be grounds for rejection of the whole lot. If all four in the second sample pass, the lot will be accepted.

#### 2.1.5.2 Check Valves

Check valves 100 mm (4-in) and larger shall have flanged connections and be of the swing type with outside lever and weight. The valves shall be designed for a minimum water working pressure of 1.0 MPa (150 psi) and shall have 125 lb American Standard Flanges. Valve bodies shall be cast iron or steel. The valves shall have bronze gate rings and seat rings and type 18-8 stainless steel hinge pins. The check valves shall be designed so that disc and body seat may be easily removed without removing valve from the line.

#### 2.1.5.3 Corporation Stops

Corporation stops shall be as shown on the plans.

#### 2.1.5.4 Miscellaneous Small Valves

Valves 50 mm (2-in) and smaller unless otherwise shown, shall be all bronze or brass with screwed connections designed for a water working pressure not less than 1.0 MPa (150 psi). Gate valves shall be non-rising stems with double disc and parallel seats.

#### 2.1.5.5 Combination Air Release and Vacuum Valve

The combination air valve shall combine the operating features of both an air and vacuum valve and an air release valve in one housing. The air and vacuum valve portion shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allow air to re-enter the pipeline when the internal pressure of the pipeline approaches a negative value due to column separation, draining of the pipeline or other emergency. The air release valve portion shall automatically release small amounts of air from the pipeline while it is under pressure.

The valve shall have a maximum pressure rating of 2.0 MPa (300 psi) and shall be capable

of withstanding a water temperature up to 82.22°C (180°F). It shall have a 1" NPT fitting size. The equipment shall be of the following materials:

- a. Body and Cover: Cast Iron ASTM A-48, Class 304
- b. Float: Stainless Steel 304

The inlet and outlet of the valve shall have the same cross-section area. The float shall be guided by a stainless steel guide shaft and seat drip tight against a synthetic rubber seal. The float shall be of stainless steel construction and capable of withstanding maximum system surge pressure without failure. The body and cover shall be concentrically located and of cast-iron and the valve internal parts shall be of stainless steel or Buna-N rubber.

#### 2.1.5.6 Pressure Relief Valve

The pressure relief valve shall be of the diaphragm type equipped with a pilot valve spring. The valve shall provide a range of pressure relief settings. The valve shall be designed for a water working pressure not less than 1.0 MPa (150 psi) and shall be factory tested under a hydrostatic pressure of at least 2.0 MPa (300 psi). The valves shall have flanged ends, the disc shall be non-metallic and renewable, and the valve seat shall be replaceable. The main valve trim shall be of bronze conforming to ASTM Specification B62. The pilot control shall be fully supported by the valve body. The valve shall have a globe pattern.

#### 2.1.5.7 Flap Valves

Flap valves shall be of cast iron, having bronze seating faces and stainless steel or low-zinc bronze hinge pins. The flap valves shall have flanged or spigot frames as shown on the drawings.

#### 2.1.5.8 Valve Boxes

Each embedded valve shall be provided with an adjustable PVC pipe valve box of a size suitable for the valve on which it is to be used. The head shall be round and the lid shall have the letter "W" cast on it. The least diameter of the shaft of the box shall be 13.34 cm.

#### 2.1.5.9 Sleeve-Type Couplings

Sleeve-type couplings shall be provided where shown. Coupling shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fitting shown. The middle ring shall be not less than 6 mm (1/4-in) in thickness and shall be 300 mm long for standard steel couplings, and 400 mm long for long-sleeved couplings. Bolts for exposed coupling shall be hot-dip galvanized. Buried bolts and sleeve-type couplings shall be coated with coal tar epoxy with minimum dry film thickness of 15 mils.

#### 2.1.5.10 Gasket and Bolts

- a. Except as otherwise provided, gaskets for flanged joints shall be 3mm thick Buna-N rubber gaskets.
- b. Wherever blind flanges are shown, the gaskets shall consist of 3 mm thick cloth-inserted rubber sheet which shall be cemented to the surface of the blind flange.
- c. Except as otherwise provided, galvanized carbon steel bolts shall conform to the requirements of ASTM A 325.

#### 2.1.5.11 Pressure Gauges

The pressure element of the gauge shall be protected against excessive pulsations and surges by an external pressure snubber.

- a. Suction Gauge – A compound pressure and vacuum gauge not less than 89mm (3-1/2 in.) in diameter is to be connected to the suction pipe near the pump. The dial reads in inches of mercury on vacuum and in pounds per square inch on pressure. It shall have a pressure range of at least twice the maximum suction pressure of the pump but not less than 100 psi.
- b. Discharge Gauge – A pressure gauge not less than 89mm (3-1/2 in.) in diameter is to be connected to the discharge pipe near the pump. The dial reads in pounds per square inch. It shall have a pressure range of at least twice the maximum working pressure of the pump but in no case less than 200 psi.

### **PART 3 - EXECUTION**

#### **3.1 Installation of Pipelines**

##### **3.1.1 General Requirements**

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements for Installation of PVC plastic water service main pipe and associated fittings" paragraph hereunder.

Location of Water Lines: The work covered by this section shall terminate at a point approximately 0.10 meter outside the fence line unless otherwise indicated on the drawings. Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 3 meters from any sewer line. Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 3 meters on each side of the crossing and no joint is located within 1 meter horizontally of the crossing. Do not lay water lines in the same trench with electric wiring.

##### **3.1.2 Earthwork**

Do earthwork in accordance with Section 02302, "Excavation, Backfilling, and Compacting for Utilities".

##### **3.1.3 Pipe Laying and Jointing**

Pipe, fittings, valves and accessories will be carefully inspected by the Owner's Representative before and after installation and those found defective will be rejected. Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe accurately to measurements established at the site and work into place without springing or forcing. Replace by one of the proper dimensions any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines, taking care to avoid the formation of any dips or low points. Support pipe at its proper elevation and grade, taking care to secure firm and uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each day's work, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather are unsuitable.



#### 3.1.4 Pipe Anchorage:

Provide concrete thrust blocks for pipe anchorage. Thrust blocks shall be in accordance with the requirements of UNI-B-3 for reaction or thrust blocking. Use concrete conforming to ASTM C 94 having a minimum compressive strength of 17.23 MPa at 28 days; or use concrete of mix not leaner than one part cement, 2-1/2 sand having the same minimum compressive strength.

#### 3.1.5 Installation of Valves:

Install gate valves in accordance with the requirements of AWWA C500 for valve and fitting installation. Make and assemble joints to valve as previously specified for making and assembling the same type of joints between pipe and fittings.

### 3.2 Testing and Disinfecting

#### 3.2.1 General

The Contractor shall furnish all equipment, labor and materials, including taps, valves and bulkheads as required and exclusive of water and water meter for testing and proper disinfection of the pipelines. The water and any water meter used for testing shall be furnished by the Contractor and shall provide the facilities necessary to convey the water from the Owner- designated source to the points of use. All testing and chlorinating operations shall be done in the presence of the PCG Engineer.

#### 3.2.2 Pipeline Testing

All pipelines shall be thoroughly flushed out with water prior to testing. The Contractor shall test the pipeline in sections prior to permanent resurfacing after the trench is backfilled, but with joints exposed for examination except in heavily traveled roadways. Maximum length of test sections shall be 500 meters for distribution mains and 1,000 meters for transmission mains unless otherwise approved. Where test sections are approved which exceed the above maximum lengths the allowable leakage for the lengths in excess of the maximum allowable shall be reduced by fifty percent (50%). The pipeline shall not be filled with water until the following curing periods have elapsed.

<u>Description</u>		<u>Minimum Allowable Time</u>
1.	Cement Mortar Linings	14 days
2.	Cement Mortar at Joints	8 hours
3.	Concrete Thrust Block	
a.	Standard Cement	7 days
b.	High early strength cement	36 hours

The pipeline shall be prepared for testing by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. During the filling of the pipe and before the application of the specified test pressure, all air shall be expelled from the pipeline. To accomplish this, taps shall be made if necessary, at points of highest elevation and after completion of the test taps shall be tightly plugged unless otherwise specified. After the line or section thereof has been completely filled, it shall be allowed to stand under a slight pressure for a minimum of forty-eight (48) hours to allow the escape of air from any air pockets and to allow the pipe or mortar lining to absorb as much water as possible.

During this period, all exposed pipes, fittings, valves, hydrants, joints and coupling shall be examined for leaks. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound material at his own expense. The pipeline shall then be refilled and all bulkheads, joints and connections shall be examined for leaks. If any are found,

these shall be stopped. The test shall consist of holding the test pressure on each section of the line for a period of two (2) hours. The test pressure at the lowest point shall be 1.0 MPa (150 psi) according to the class of pipe installed, and as approved by the PCG Engineer. Pressure gauges shall also be provided at all ends of the section tested. The water necessary to maintain the pressure shall be measured through a meter or by other means satisfactory to the PCG Engineer. The leakage shall be considered the amount of water entering the pipeline during the two-hour test period. The allowable leakage for cast iron pipe or ductile iron pipe shall not exceed the values listed in Table 3 of the AWWA C 600. All other types of pipes shall have an allowable leakage not exceeding 1.85 L/mm (20 gal/in) of diameter of pipe per kilometer (mile) per day. Should any test of a section of pipeline disclose joint leakage greater than that permitted, the Contractor shall, at his own expense, locate and repair or replace the defective pipe, fitting, joint, coupling or other appurtenances. The test shall then be repeated until the leakage is within the permitted allowance.

### 3.2.3 Pipeline Disinfecting

Before being placed in service, and before certification of completion by the PCG Engineer, all water mains shall be disinfected with chlorine in accordance with AWWA C 601. Disinfection shall be completed not more than three (3) days prior to placing the pipeline into service unless otherwise approved by the PCG Engineer and care shall be taken to prevent recontamination of the pipeline. A bacteriological test shall be taken, at the expense of the Owner, prior to acceptance of the pipeline disinfected.

### 3.3 Method of Measurement

Measurement for payment of fittings, valves, hose bibb, fire hydrant, service connections shall be the actual number furnished, placed and accepted.

Measurement for payment of fire hose and coupling shall be the actual number of sets furnished, placed and accepted.

Measurement for payment of pipes of the type and size specified including trenching, bedding and backfill shall be the linear meter installed and accepted.

### 3.4 Basis of Payment

The quantities measured as provided in Method of Measurement, shall be paid for at the contract unit price, respectively, for each of the Pay Item listed below and shown in the Bill of Quantities, which price and payment shall be full compensation for trenching, bedding and backfilling for pipelines, for furnishing and placing all materials including labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

## **SECTION 02530 - EXTERIOR SANITARY SEWER SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 APPLICABLE PUBLICATIONS**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by their basic designation only, and the most recent edition at the time of tender shall be used.

##### **1.1.1 American Society for Testing and Materials (ASTM) Publications:**

ASTM A 48	Standard Specification for Gray Iron Castings
ASTM D 3033-85	Type PSP Polyvinyl Chloride (PVC) Sewer Pipes and Fittings
ASTM D 3034-85	Type PSM Polyvinyl Chloride (PVC) Sewer Pipes and Fittings
ASTM D 3212	Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals
ASTM F 477-76	Elastomeric Seals (Gaskets) for Jointing Plastic Pipes
ASTM C 94-86	Ready mixed Concrete
ASTM C 270	Type M with Type II Cement Mortar for Unit Masonry
ASTM C 478	Precast Reinforced Concrete Manhole Sections
ASTM C 150	Portland Cement

##### **1.1.2 Uni-Bell Plastic Pipe Association (UNI) Publications:**

UNI B5-78	Installation of Polyvinyl Chloride (PVC) Sewer Pipe
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#### **1.2 GENERAL REQUIREMENTS:**

##### **1.2.1 Sanitary Sewer System**

The system shall include pipelines, manholes, and other appurtenances.

###### **1.2.1.1 Buried Pipelines**

Provide gravity sewers of Polyvinyl Chloride (PVC) Pipe for pipe sizes 250mm Ø and smaller.

###### **1.2.1.2 Exposed Gravity and Pressurized Sewer Lines: Shall be Cast Iron Pipe and Fittings with cement-mortar lining conforming to AWWA C108/C110, pressure class 150.**

###### **1.2.1.3 Manholes: Provide reinforced concrete manholes with pre-cast concrete chamber rings at the locations indicated.**

##### **1.2.2 Samples**

Submit samples of the following materials and have them approved before work is started:

- a. Pipes and Fittings

#### 1.2.3 Manufacturer's Data

Submit manufacturer's standard drawings or catalog cuts of the following items:

- a. Pipes and fittings
- b. Pipe joint materials
- c. Manhole frames & covers
- d. Installation Procedures

#### 1.2.4 Standards Compliance

Submit manufacturer's certificates of conformance or compliance for each of the following materials which are specified to conform to publications referenced under Part 2, "Products" in this Section:

- a. Pipe and fittings
- b. Pipe joint materials
- c. Manhole frames & covers

All tests required by the applicable referenced publication shall have been performed, whether specified in that publication to be mandatory or otherwise. For tests which are not specified in the referenced publication to be performed at definite intervals during manufacture, the tests shall have been performed within three years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

### 1.3 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

#### 1.3.1 Delivery and Storage:

##### 1.3.1.1 Piping

Inspect materials delivered to site for damage: store with minimum of handling. Store materials on site in enclosures or under protective cover, in accordance with the manufacturer's instructions. Store plastic piping, fittings, and gaskets under cover and out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

#### 1.3.2 Handling

Handle pipes, fittings, and other accessories in such manner as to ensure delivery to the trench in a sound undamaged condition. Do not leave plastic pipes and gaskets that are not to be installed in direct sunlight. Pipes should be handled with all necessary care to avoid damage and transported to the trench in accordance with the manufacturer's instructions. Pipes should not be transported along the ground.

## PART 2 - PRODUCTS

### 2.1 PIPES AND FITTINGS

#### 2.1.1 Gravity Sewer (Non-Pressure Pipelines):

- 2.1.1.1 Polyvinyl Chloride (PVC) Pipes: Unless otherwise indicated on the drawings, sewer pipes shall be Polyvinyl Chloride (PVC) Pipes and Fittings and shall be in accordance with

ASTM D 3034, Type PSM, with a maximum SDR of 34. The size shall be as indicated on the drawings, with flexible elastomeric gasket joint in accordance with ASTM D 3212.

- a. Branch Connections: Branch Connections shall be made by use of regular fittings with elastomeric gasket joint. Saddles for polyvinyl chloride (PVC) pipe shall comply with Table 4 of ASTM D 3034.
- b. Fittings: Fittings shall be in accordance with ASTM D 3034 and shall be compatible with the pipe supplied. Fittings shall have a strength not less than that of the pipe.
- c. Joints:

Elastomeric Gaskets: Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477. Joints installation shall comply with the manufacturer's instructions.

#### 2.1.1.2 Exposed Gravity and Pressurized Sewer Lines:

Bell and spigot cast iron pipe shall conform to the requirements of the following:

- a. "Cast Iron Pipe Centrifugally Cast in Metal Moulds for Water or Other Liquids" (AWWA C-106) or "Cast Iron Pipe Centrifugally Cast in Sand Lined Moulds for Water or Other Liquids" (AWWA C-108) shall be Class 100 or Class 150 where shown on the Drawings and as indicated in the Bid Schedule; or
- b. "ISO Recommendation R-13; Cast Iron Pipes, Special Casings and Cast Iron Parts for Pressure Main Lines". The pipe shall be Class LA; however the hydrostatic test pressure shall be 2.45 MPa (355 psi) for all sizes.

Standard flanged cast iron pipe fittings shall conform with the requirements of the "American Standard for Cast Iron Pipe Flanges and Flanged Fittings" (ANSI B16.1), Class 125.

Short body cast iron pipe fittings shall conform with the "American Standard for Cast Iron and Ductile Iron Fittings, 2 in. through 48 in., for Water and Other Liquids" (AWWA C110) or "Cast Iron Pipes, Special castings and cast iron parts for Pressure Main Lines", ISO R13. Fittings shall have a wall thickness of not less than that of the pipe with which they are used and the ends shall have inside diameters suitable for making a watertight joint with cast iron pipe furnished.

Cast iron pipe shall be furnished with bell and spigot ends with rubber "push on" joints, flanged joints, or flexible couplings as shown. At the option of the Contractor, a mechanical joint may be substituted on all cast iron pipe and fittings for which a bell and spigot is called for. The mechanical joint shall conform with the requirements of the "American Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings" (AWWA C111), Class 150, except that inside diameters shall be suitable for making watertight joints with the cast iron pipe furnished.

Cement Mortar Lining – Cast iron pipe and fitting shall be lined with cement mortar in accordance with the requirements of the "American Standard for Cement Mortar Lining for Cast Iron Pipe and Ductile Iron Pipe and Fittings for Water" (AWWA C104).

Installation – Cast iron pipe and fitting shall be installed with the requirements of the "Standard for Installation of Cast Iron Water Mains" (AWWA C600).

## 2.2 PORTLAND CEMENT AND CONCRETE

### 2.2.1 Portland Cement

Portland cement shall conform to the ASTM C 150, Type V, for concrete used in concrete protection and manholes and be optional with the Contractor for cement used in concrete

cradles, encasement, and thrust blocks.

#### 2.2.2 Concrete

Portland Cement Concrete shall conform to ASTM C 94, with a minimum compressive strength of 3500 psi (24MPa) at 28 days, except for concrete thrust blocking, cradles and encasements, or for concrete blocks for manholes. Concrete used for thrust blocking and cradle and encasement shall have a minimum compressive strength of 2500 psi (17.25MPa) at 28 days.

#### 2.3 CEMENT MORTAR

Cement Mortar shall conform to ASTM C 270, Type M with Type II cement.

#### 2.4 FRAMES AND COVERS

Frames and covers shall be cast iron as indicated on the drawings. The type shall be suitable for the application, circular without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds (181 kg) and shall conform to ASTM A 48, Class 20B. The letter "S", at least 100 mm high, shall be stamped or cast into all covers so as to be plainly visible.

#### 2.5 PRECAST REINFORCED CONCRETE PRODUCTS

Precast reinforced concrete manhole components shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure.

#### 2.6 LADDER RUNGS

Ladders and step irons shall be fabricated in Grade 316 stainless steel. Step irons shall be provided where the depth of the manhole exceeds 1.20m. The size and location of the step irons shall be as indicated on the drawings. They shall be cast into the concrete with a minimum embedment of 125mm and a maximum distance of 150mm from the wall to the rung.

### **PART 3 - EXECUTION**

#### 3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

##### 3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made on the drawings.

##### 3.1.1.1 Location

The work covered by this Section shall terminate at a point approximately 1.0 meter inside the lot fence line, unless otherwise indicated on the drawings. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 1 meter, horizontal distance, to the water line.

##### 3.1.1.2 Earthwork

Carry out earthworks in accordance with Section 02302 "Excavation, Backfilling, and Compacting for Utilities."

##### 3.1.1.3 Pipe Laying and Jointing

Each pipe and fitting will be inspected before and after installation and those found defective will be rejected. Provide proper facilities for lowering sections of pipe into trenches. Lay non-

pressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform joint gap all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimension any pipe or fitting that does not allow sufficient space for installation of joint material. At the end of each day's work, close open ends of pipe temporarily with wood blocks or bulkheads.

#### 3.1.1.4 Cut Pipes

Where pipes are required to be cut for closures or for negotiating bends, the cutting shall be done by the Contractor with a pipe cutting machine supplied by him in a manner approved so as not to damage the pipe, its lining or sheathing. The Contractor shall be responsible for the accuracy of the measurement of the cut pipe required, all such cutting required, cutting back the sheathing and subsequently making good.

#### 3.1.1.5 Trench Widths

Widths of trenches for pipe laying shall be such that the pipes can be laid and jointed properly, and backfill placed and compacted properly. Trench walls shall be vertical to 300mm above the top of the pipe or to the maximum permitted by safety requirements, its width at this location shall not exceed the maximum. The maximum width of the trench shall be the outside diameter of the pipe plus 600mm.

#### 3.1.1.6 Tolerances

The centreline of gravity pipelines shall be within 20mm of the specified line. The invert level of gravity pipelines shall be within 6mm of the specified invert level and shall be such that there is no backfill at any point.

#### 3.1.1.7 Thrust and Anchor Blocks

Construct thrust and anchor blocks at all changes in direction along pressure pipelines, to the dimensions indicated on the drawings. Internal pressure shall not be applied to the pipeline until the thrust and anchor blocks have developed the specified grade strength.

3.1.1.8 Connections to Structures: The joints between pipes and structures into which the pipes are built shall be watertight. Two flexible joints shall be provided in pipelines adjacent to the outside faces of structures into which pipes will be built. The distances from the outside face of the structure to the first joint and from the first joint to the second joint shall be as follows:

Diameter of Pipe	Position of First Flexible Joint from Structure		Distance of Second Flexible Joint from First
	Minimum	Maximum	
up to 500 mm	300 mm	600 mm	600 to 1000 mm

3.2.2 Concrete Work: Cast-in-place concrete is included in Section 03300, "Cast- in-Place Concrete".

### 3.3 FIELD TESTS AND INSPECTIONS

#### 3.3.1 General

The PCG Engineer will conduct field inspections and witness all field tests specified in this Section. The Contractor shall perform all field tests and provide all labor, equipment, and incidents required for testing at his cost. The Contractor shall be able to produce evidence, when required, that any item of work has been constructed properly in accordance with the drawings and specifications.

### 3.3.2 Tests and Inspections:

#### 3.3.2.1 Non-Pressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the next manhole.

##### a. Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration test, as specified in this paragraph. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When the water table is 600 mm or more above top of pipe at upper end of pipeline section to be tested, measure infiltration using a suitable weir or other acceptable device. When the water table is less than 600 mm above top of pipe at upper end of pipeline section to be tested, make exfiltration test by filling the line to be tested with water so that the head will be at least 1.2 meters above top of pipe at upper end of pipeline section being tested.

Allow filled pipeline to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, re-establish the head and measure amount of water needed to maintain this water level during a two-hour test period. Amount of leakage, as measured by either infiltration or exfiltration test shall not exceed 230 liters per cm of diameter per day per km of pipeline. When leakage exceeds the amount specified, make satisfactory correction and retest pipeline section in the same manner as previously specified. Correct all visible leakage regardless of test results.

##### b. Deflection Testing

Make a deflection test on the entire length of installed plastic pipeline on completion of all work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under all external loads shall not exceed 4.5 percent of the normal inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of (a) a pull-through device, or (b) a deflection measuring device.

#### (1) Testing Devices:

##### (i) Pull-through Device

This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, or 95 percent of the normal inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted. Ball, cylinder, or circular sections shall be of homogenous material throughout, shall have a density greater than 1.0 as related to water at 4 degrees C, and shall have a surface Brinell hardness of not less than 150. Ball, cylinder, or circular sections shall be center bored and through bolted with a 5/8-inch minimum diameter steel shaft having a yield strength of not less than 483 MPa (70,000 psi) with eyes or loops at each end for attaching pulling cables. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end of ball, cylinder, or circular sections. Circular sections shall be so spaced on the shaft that distance from external faces of front and



back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device.

(ii) Deflection Measuring Device

This device shall be sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to its use.

(2) Testing Procedures

(i) Pull-Through Device

Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water, if the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in the same manner and under same conditions as previously specified.

(ii) Deflection Measuring Device

Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of normal inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of normal diameter of pipe, replace pipe which has excessive deflection and completely re-test in same manner and under same conditions as previously specified.

(3) Warranty Period Test

Pipe found to have a deflection, of greater than 5 percent when deflection test is performed just prior to end of one-year warranty period shall be replaced and tested as previously specified for leakage and deflection.

3.4 METHOD OF MEASUREMENT

The quantities to be paid for shall be the number of lineal meters of pipe actually installed, complete in place and accepted. No deductions in length will be made for fittings.

For service connections and sewer manholes, the quantities to be paid for shall be each actually installed, completed in place and accepted.

3.5 BASIS OF PAYMENT

The quantities determined in Method of Measurement shall be paid for at the contract price per unit of measurement respectively, for each of the particular Pay Item listed below and as shown in the Bill of Quantities, which price and payment shall constitute full compensating for trenching, bedding, backfilling for furnishing as placing all materials, including all labor, equipment, tools and incidentals, necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

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### III. BUILDING WORKS (Station Building)

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## DIVISION 2 – SITE CONSTRUCTION

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## **SECTION 02217 - BUILDING LAYOUT**

### **PART 1- GENERAL**

#### **1.1 SCOPE**

Furnish material and equipment and perform labor required to establish lines, grades and reference marks for the accurate layout of the building and other construction. See drawings for location and extent of work required.

#### **1.2 VERIFICATION OF EXISTING CONDITIONS**

Verify and examine the site to familiarize with the existing conditions affecting the work.

### **PART 2 – PRODUCTS**

#### **2.1 BUILDING LAYOUT MATERIALS**

- a. Form Lumber; good lumber
- b. Ga. 16 G.I tie Wire
- c. CW nail

### **PART 3 - EXECUTION**

#### **3.1 STAKES AND BATTERBOARDS**

- a. Stake out building accurately and establish grades.
- b. Batter boards and reference marks shall be erected at locations where they will not be disturbed during the construction.
- c. Construct two permanent benchmarks of previously known elevations near the site of construction.

#### **3.2 METHOD OF MEASUREMENT**

Building layout shall be measured by square meters performed and accepted.

#### **3.3 BASIS OF PAYMENT**

The accepted quantity measured as prescribed in Method of Measurement shall be paid for at the contract unit price for building layout which price and payment shall be full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 02302 - EXCAVATION, BACKFILLING, AND COMPACTING FOR UTILITIES**

### **PART 1 - GENERAL**

#### **1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

##### **1.1.1 American Society for Testing and Materials (ASTM)**

ASTM D422	Particle-Size Analysis of Soils
ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D1140	Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3017	Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils

##### **1.1.2 U.S. Department of Agriculture (USDA)**

DOA SSIR	Soil Survey Investigation Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil Conservation Service
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#### **1.2 DEFINITIONS**

##### **1.2.1 Backfill**

Material used in refilling a cut, trench or other excavation.

##### **1.2.2 Cohesive Materials**

Soils classified by ASTM D2487 as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when fines have a plasticity index greater than zero.

##### **1.2.3 Cohesionless Materials**

Soils classified by ASTM D2487 as GW, GP, SW, and SP. Materials classified, as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

#### 1.2.4 Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D698 or ASTM D155 for general soil types.

#### 1.2.5 Granular Pipe Bedding

A dense, well-graded aggregate mixture of sand, gravel, or crushed stone (mixed individually, in combination with each other, or with suitable binder soil) placed on a subgrade to provide a suitable foundation for pipe. Granular bedding material may also consist of poorly graded sands or gravels where fast draining soil characteristics are desired.

#### 1.2.6 In-Situ Soil

Existing in place soil.

#### 1.2.7 Lift

A layer or course of soil placed on top of subgrade or a previously prepared or placed soil in a fill or backfill.

#### 1.2.8 Refill

Material placed in excavation to correct overcut in depth.

#### 1.2.9 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling, drilling and the use of expansion jacks, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 0.76 cubic meter (1 cubic yard) in volume. Material identified in the soil boring logs as having a standard penetration resistance as determined by ASTM D1586 greater than 1968 blows per meter (600 blows per foot) is arbitrarily defined herein as "Rock."

##### a. Topsoil

In natural or undisturbed soil formations, the fine-grained, weathered material on the surface or directly below any loose or partially decomposed organic matter. Topsoil may be a dark-colored, fine, silty, or sandy material with a high content of well-decomposed organic matter, often containing traces of the parent rock material. Gradation and material requirements specified herein apply to all topsoil references in this contract. The material shall be representative of productive soils in the vicinity.

##### b. Unyielding Material

Rock rib, ridge, rock protrusion, or soil with cobbles in the trench bottom requiring a covering of finer grain material or special bedding to avoid bridging in the pipe or conduit.

##### c. Unsatisfactory Material

In-Situ soil or other material, which can be identified as having insufficient strength characteristics or stability to carry intended loads in the trench without excessive consolidation or loss of stability. Also backfill material, which contains refuse, large rocks, debris, soluble particles, and other material, which could damage the pipe or

cause the backfill not to compact. Materials classified as PT, OH, or OL by ASTM D2487 are unsatisfactory.

d. Unstable Material

Material in the trench bottom which lacks firmness to maintain alignment and prevent joints from separating in the pipe, conduit, or appurtenance structure during backfilling. This may be material otherwise identified as satisfactory which has been disturbed or saturated.

1.3 SUBMITTALS

- a. Test Reports
- b. Trench backfill material tests
- c. Pipe bedding material tests

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials in a manner to prevent contamination, segregation, and other damage.

1.5 PROTECTION

1.5.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within 600 mm (two feet) of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand or light equipment. Start hand light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until the Engineer grants approval for backfill. Report damage to utility lines or subsurface construction immediately to the Engineer.

**PART 2 - PRODUCTS**

2.1 SOIL MATERIALS

Provide soil materials as specified below free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, or other deleterious and objectionable materials.

2.1.1 Backfill

Bring trenches to grade indicated on the drawings using material excavated on the site of this project. This material will be considered unclassified and no testing other than for compaction will be required before use as backfill, classified as GM, SM, SC by ASTM 2487 with a maximum particle size of 75 mm (3 inches).

2.1.2 Special Backfill for Roads and Paved Areas

Backfill trenches under roads, structures, and paved areas as specified in Section 02300, "Earthwork for Structures and Pavements", with material conforming to the requirements stated above except that the liquid limit of the material cannot exceed 35 percent when tested in accordance with ASTM D4318, the plasticity index cannot exceed 12 percent

when tested in accordance with ASTM D4318, and not more than 35 percent by weight can be finer than the 75 micrometers No. 200 sieve when tested in accordance with ASTM D1140.

2.1.3 Sand

Clean, coarse-grained sand classified as SW or SP by ASTM D2487 for bedding and backfill as indicated.

2.1.4 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof having a classification of GW GP in accordance with ASTM D2487 for bedding and backfill as indicated. Maximum particle size shall not be more than 25mm per 300mm (one inch per foot) of pipe diameter or 75mm (3 inches) maximum.

2.1.5 Topsoil Material

Salvaged topsoil from stockpile. Topsoil should be free of subsoil, stumps, rocks larger than 19 mm (3/4 inch) in diameter with maximum 3 percent retained on 6 mm (1/4 inch) sieve, brush, weeds, toxic substances, and other material or substance detrimental to plant growth. Topsoil shall be a natural, friable soil representative of productive soils in the vicinity. Modify the topsoil provided if necessary to meet the requirements specified in Table 2. Furnish additional topsoil from approved sources off the Site meeting requirements specified in Table 2 if stockpiled material is insufficient to complete work indicated.

TABLE 2

DOA SSIR Soil Survey Investigation Report No. 1, Laboratory Test for:	Acceptable Limits
Sand Content	20 - 45 percent by weight
Silt Content	25 - 50 percent by weight
Clay Content	10 - 30 percent by weight
Organic Material (Walkley-Block)	5 percent

TABLE 2

DOA SSIR Soil Survey Investigation Report No. 1, Laboratory Test for:	Acceptable Limits
pH	5.0 to 7.6
Soluble Salts	600-ppm maximum
Absorption Rate minimum	0.21 mm per second

2.1.6 Borrow

Provide materials meeting requirement for general site fill, backfill, granular fill, and topsoil. Obtain borrow materials in excess of those furnished from excavations specified herein from sources off the project area.

2.1.7 Pipe Bedding

Provide material for pipe bedding consisting of GW GP GM GC SW SP SM SC sand gravel as classified in accordance with ASTM D2487.



## 2.2 CONCRETE PIPE CRADLES

Concrete pipe cradles where indicated conforming to lines and dimensions indicated. Construct cradles with concrete having a 28 day compressive strength of 20.7 MPa (3000 psi).

## PART 3 - EXECUTION

### 3.1 PROTECTION

#### 3.1.1 Drainage and Dewatering

##### a. Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

#### 3.1.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. Operate the dewatering system until construction work below existing water levels is complete.

#### 3.1.3 Underground Utilities

The Contractor shall physically verify the location and elevation of the existing utilities prior to starting construction. The Contractor shall mark the surface of the ground where existing underground utilities are discovered.

#### 3.1.4 Structures and Surfaces

Protect newly backfilled areas slopes, or grades from traffic, erosion settlement, or any other damage. Repair and reestablish damaged or eroded grades and slopes and restore surface construction prior to acceptance. Protect existing streams, ditches, and storm drain inlets from water-borne soil.

### 3.3 SURFACE PREPARATION

#### 3.3.1 Stockpiling Topsoil

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be wasted. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

#### 3.3.2 Cutting Pavement, Curbs, and Gutters

Saw cut with neat, parallel, straight lines 300 mm (one foot) wider than trench width on each side of trenches and 300 mm (one foot) beyond each edge of pits. When the saw cut is within 300 mm (one foot) of an existing joint, remove pavement to the existing joint.

### 3.4 GENERAL EXCAVATION AND TRENCHING

Keep excavations free from water while construction is in progress. Notify the Engineer immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Make trench sides as nearly vertical as practicable except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. Excavate ledge rock, boulders, and other unyielding material to an over depth at least 150 mm (6 inches) below the bottom of the pipe and appurtenances unless otherwise indicated or specified. Over excavate soft, weak, or wet excavations. Use bedding material placed in 150 mm (6 inch) maximum layers to refill over depths to the proper grade. At the Contractor's option, the excavations may be cut to an overdepth of not less than 100 mm (4 inches) and refilled to required grade as specified. Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe or structure on undisturbed soil, or bedding material as indicated or specified at every point along its entire length except for portions where it is necessary to excavate for bell holes and for making proper joints. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be only 13 mm (½ inch) greater than length, width, and depth of bell as required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation. Trench dimensions shall be as indicated.

### 3.5 BEDDING

Bedding shall be of materials and depths as indicated for utility lines and utility line structures. Place bedding in 150 mm (6 inch) maximum loose lifts. Provide uniform and continuous support for each section of structure except at bell holes or depressions necessary for making proper joints.

#### 3.5.1 Concrete Cradles

Specified in lieu of other types of bedding for a particular type of pipe material, shall be as specified.

### 3.6 BACKFILLING

Construct backfill in two operations (initial and final) as indicated and specified in this section. Place initial backfill in 150 mm (6 inch) maximum loose lifts to 300 mm (one foot) above pipe unless otherwise specified. Ensure that initially placed material is tamped firmly under pipe haunches. Bring up evenly on each side and along the full length of the pipe, or structure. Ensure that no damage is done to the utility or its protective coating. Place the remainder of the backfill (final backfill) in 225 mm (9 inch) maximum loose lifts unless otherwise specified. Compact each loose lift as specified in the paragraph 3.7, "General Compaction" before placing the next lift. Do not backfill where the material in the trench is muddy, except as authorized. Provide a minimum cover from final grade of 600mm (2 feet) for storm drains and 1200 mm (3.9 feet) for sewer mains. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation. Coordinate backfilling with testing of utilities. Testing for the following shall be complete before final backfilling: water distribution, storm drainage and sanitary sewer.

### 3.7 COMPACTION

Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings. Compact material in accordance with the following unless otherwise specified. If necessary, alter, change, or modify selected equipment or compaction methods to meet specified compaction requirements.

### 3.7.1 Compaction of Material in Subcuts or Over excavations

In rock, compact to 95 percent of ASTM D1557 maximum density. In soft, weak, or wet soils, tamp refill material to consolidate to density of adjacent material in trench wall. In stable soils, compact to 90 percent of ASTM D1557 maximum density.

### 3.7.2 Compaction of Pipe and Conduit Bedding

In rock, compact to 95 percent and in soil, compact to 90 percent of ASTM D1557 maximum density.

### 3.7.3 Compaction of Backfill

Compact initial backfill material surrounding pipes, or conduits, to 90 percent of ASTM D1557 maximum density except where bedding and backfill are the same material. Where bedding and backfill are the same material, compact initial backfill to the density of the bedding. Under areas to be seeded or sodded, compact succeeding layers of final backfill to 85 percent of ASTM D1557 maximum density. For utilities under road or highway right-of-way, structures and pavements compact layers of final backfill as specified under paragraph 3.8, "Special Earthwork Installation Requirements."

## 3.8 SPECIAL EARTHWORK INSTALLATION REQUIREMENTS

### 3.8.1 Concrete Culvert Piping Under Embankment

Construct the embankment to 150 mm (6 inches) above elevation of top of pipe for 600 mm (24 inch) size pipe and to 750 mm (30 inches) above elevation of top of pipe where the pipe diameter is larger than 600mm (24 inches). After pipe installation, backfill and compact in accordance with requirements stated in paragraphs 3.6, "Backfilling and 3.7, "Compaction."

### 3.8.2 Manholes and Other Appurtenances

Provide at least 300 mm (12 inches) clear from outer surfaces to the embankment or shoring. Remove rock as specified herein. Remove unstable soil that is incapable of supporting the structure to an overdepth of 300 mm (one foot) and refill with gravel or sand to the proper elevation. Stabilize soft, weak, or wet excavations as indicated. Refill over depths with gravel or sand to the required grade and compact to 90 percent of ASTM D1557 maximum density.

### 3.8.3 Compaction under Roads, Streets, and other Areas to be paved

Place final backfill in 150 mm (6 inch) maximum loose lifts. If a vibratory roller is used for compaction of final backfill, the lift thickness can be increased to 225 mm (9 inches). Compact all backfill surrounding pipes, conduits, and other structures to 90 percent of ASTM D1557 maximum density except compact the top 300 mm (12 inches) of subgrade to 95 percent of ASTM D1557 maximum density. Backfill to permit the rolling and compacting of the completed excavation with the adjoining material, providing the specified density necessary to enable paving of the area immediately after backfilling has been completed. Compaction requirements for materials in pavement sections above the subgrade level shall be as specified in Section 02300, "Earthwork for Structures and Pavement."

## 3.9 FINISH OPERATIONS

### 3.9.1 Grading

Finish to grades indicated within 30 mm (one-tenth of a foot). Grade areas to drain water away from structures. Grade existing grades that are to remain but have been disturbed by the Contractor's operations.

### 3.9.2 Spreading Topsoil

Clear areas to receive topsoil for the finished surface of materials that would interfere with planting and maintenance operations. Scarify subgrade to a depth of 50 mm (2 inches). Do not place topsoil when the subgrade is extremely wet or dry, or in other conditions detrimental to seeding, planting, or grading. Spread topsoil to a uniform depth of 100 mm (4 inches) over the designated areas.

### 3.9.3 Disposition of Surplus Material

Surplus or other soil material not required or suitable for filling, backfilling, or grading shall be wasted by disposition off the work site.

### 3.9.4 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

## 3.10 FIELD QUALITY CONTROL

Test sand, gravel, bedding, backfill and topsoil for conformance to specified requirements. Test backfill to be used under roads and paved areas for conformance to special requirements. Test bedding and backfill for moisture-density relations in accordance with ASTM D1557 and as specified herein. Perform at least one of each of the required tests for each material provided. Perform sufficiently in advance of construction so as not to delay work. Provide additional tests as specified above for each change of source. Perform final tests on topsoil to ensure adjustment of parameters into the ranges specified. Perform density and moisture tests in randomly selected locations and in accordance with ASTM D1556, ASTM D2922 and ASTM D3017 as follows:

- a. Bedding and backfill in trenches: One test per 15 meters

(50 linear feet) in each lift.

- b. Appurtenance structures: One test per 9 square meters

(100 square feet) or fractions thereof in each lift.

Where ASTM D2922 and ASTM D3017 are used to test field compaction densities, verify test results by performing at least one test per day using ASTM D1556 at a location already tested in accordance with ASTM D2922. Perform at least one additional test using ASTM D1556 for every ten tests performed with a nuclear device, at locations checked in accordance with ASTM D2922.

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## **SECTION 02360 - SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL**

### **PART 1 - GENERAL**

#### **1.1 SUBMITTALS**

##### **a. Samples**

Pesticides: Submit on request, or may draw at any time and without prior notice, from stocks at the job site, samples of the pesticides used in this work. Should analysis, indicate such samples to contain less than the amount of active ingredient specified on the label, work performed with such products shall be repeated, with pesticides conforming to this specifications, at no additional cost to the Owner.

##### **b. Qualifications of pesticides applicators: Submit data as required in the paragraph 1.2, "Qualifications of Pesticide Applicators", prior to commencement of work.**

##### **c. Manufacturer's Instructions**

Pesticides: Submit a copy of manufacturer's label.

##### **d. Closeout Submittals**

(1) Warranty

(2) Application report

(3) Submit documents signed and sealed by an officer of the Contractor

#### **1.2 QUALIFICATIONS OF PESTICIDE APPLICATORS**

The pesticide applicator's principal business shall be pest control and the pesticide applicator shall be certified pesticide applicator.

#### **1.3 DELIVERY, STORAGE AND HANDLING**

Deliver pesticides to the project site in sealed and labeled containers in good condition as supplied by the manufacturer or formulator. Store, handle and use pesticides in accordance with manufacturer's labels. Labels shall bear evidence of registration.

#### **1.4 SAFETY REQUIREMENTS**

Formulate, treat and dispose of termiticides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Owner's representative and fit the filling hose with backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of a Contractor's Representative to prevent overflow. Secure pesticides and related materials under lock and key when unattended. Ensure that proper protective clothing and equipment are worn and used during all phases of termiticide operation. Dispose of used pesticide containers off the project site.

#### **1.5 WARRANTY**

Furnish a three year written warranty against infections or reinfestations by subterranean termite of the building constructed under this contract. Perform annual inspections of the building. If live subterranean termite infestation or subterranean termite damage is discovered

during the warranty period, and the soil and building conditions have not been altered in the interim, the Contractor shall:

- a. Retreat the soil and perform other treatment as may be necessary for the elimination of subterranean termite infestation.
- b. Repair damage caused by termite infestation; and
- c. Re-inspect the building approximately 180 days after the re-treatment.

#### 1.6 QUALITY ASSURANCE

Application Report: Upon completion of this work, submit report identifying the type of operation, brand name and manufacturer of pesticide, formulation, concentration or rate of application used. Maintain daily records and submit copies of records when requested by the Owner's Representative.

### PART 2 - PRODUCTS

#### 2.1 PESTICIDES

Termiticides bearing currently approved for such use by the appropriate agency.

### PART 3 - EXECUTION

#### 3.1 VERIFICATION OF CONDITIONS

At the time of application, the soil shall have a sufficiently low moisture content to allow uniform distribution of the treatment solution throughout the soil. Do not make applications during or immediately following heavy rains or when conditions may cause runoff and create an environment hazard.

#### 3.2 APPLICATION

- a. Treatment Area: Apply termiticide to soil material which will be covered by or lie immediately adjacent to the buildings and structures so as to provide a protective barrier against subterranean termites.
- b. Treatment Application: Apply termiticide as a coarse spray and in such manner as to provide uniform distribution onto the soil surface. Apply treatment prior to placement of a vapor barrier or waterproof membrane and at least 12 hours prior to concrete pouring. Where treated soil or fill material is not to be covered with a vapor barrier or waterproof membrane, exercise adequate precautions to prevent its disturbance. If soil or fill material has been disturbed after treatment, retreat as specified above before placement of slab or other covering structure. Coordinate treatment of the soil on the exterior sides of foundation walls, grade beams and similar structure with final grading and planting operations so as to avoid disturbance of the treated barriers by such operations. Observe manufacturer's warnings and precautions in the handling and use of such materials. Exercise precaution that these chemicals do not enter water supply systems or potable water supplies or aquifers, and that they do not endanger plants as well.

Notify the Owner's Representative at least 48 hours prior to beginning of treatment and perform formulating, mixing and application in the presence of Owner's Representative.

- c. Rates and Methods of Application: Apply in accordance with the pesticide label. Provide maximum application or dosage rates. Resolve conflict between this specification and the label direction in favor of the label.

### 3.3 METHOD OF MEASUREMENT

Soil Treatment or Termite Control shall be measured by the number of square meters applied and accepted.

### 3.4 BASIS OF PAYMENT

The accepted quantity measured as prescribed in Method of Measurement shall be paid for at the contract unit price for Soil Treatment or Termite Control which price and payment shall be full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## DIVISION 3 – CONCRETE

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## **SECTION 03300 - CAST-IN-PLACE CONCRETE**

### **PART 1 - GENERAL**

#### **1.1 Applicable Publications**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless specified, all publications below shall be of the latest edition.

##### **1.1.1 American Concrete Institute (ACI) Publications:**

ACI 224 R	Control of Cracking in Concrete Structures
ACI 301	Specifications for Structural Concrete for Buildings
ACI 302.1 R	Guide for Concrete Floor and Slab Construction
ACI 304	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
ACI-305R	Hot-Weather Concreting
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318R	Building Code Requirements for Reinforced Concrete
ACI 347-R	Recommended Practice for Concrete Formwork
ACI 350R	Environmental Engineering Concrete Structures

##### **1.1.2 American Society for Testing and Materials (ASTM) Publications:**

C 39	Compressive Strength of Cylindrical Concrete Specimens
C 94	Ready-Mixed Concrete
C920	Elastomeric Joint Sealants
C 138	Test Methods for Unit Weight, Yield and Air Content (Gravimetric) or Concrete
C 231	Standard Test Method for Air Content of Freshly-Mixed Concrete by the Pressure Method
C 173	Standard Test Method for Air Content of Freshly-Mixed Concrete by the Volumetric Method
D 1751	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

##### **1.1.3 American Welding Society (AWS) Publication:**

D1.4	Structural Welding Code-Reinforcing Steel
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1.1.4 Product Standards Agency (PSA) Publications:

a. Philippine National Standards:

PNS 07 Specifications for Portland Cement

PNS 18 Specifications for Concrete Aggregates

PNS 49 Specifications for Steel Bars for Concrete Reinforcement

b. Standards Administrative Order (SAO)

SAO-6 Philippine Plywood

**1.2 Description of Work**

The work includes the provision of cast-in-place concrete. In the ACI publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears.

**1.3 Submittals:**

1.3.1 Shop Drawings

Reproductions of contract drawings are unacceptable.

- a. Shop Drawings for Reinforcing Steel: ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover.

Do not scale dimensions from structural drawings to determine lengths of reinforcing rods.

- b. Shop Drawings for Formwork: ACI 347. Include design calculations indicating arrangement of forms, sizes and grade of supports (lumber), panels, and related components. Indicate placement schedule, construction, and location and method of forming control joints. Include locations of inserts, pipework, conduit, sleeves, and other embedded items. Furnish drawings and descriptions of shoring and reshoring methods, proposed for suspended slab, spandrel beams, and other horizontal concrete members. Furnish schedule of form removal of structures not included in paragraph 3.5.5 "Removal of Forms".

- c. Shop Drawings for Construction Joints: ACI 318. Drawings shall clearly indicate sequence of pouring for all footings, columns, beams and slabs.

- 1.3.2 Contractor Mix Design: Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Furnish a complete list of materials including type; brand; source and amount of cement and admixtures; applicable reference specifications; and copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Submit additional data regarding concrete aggregates if the source of aggregate changes.

- 1.3.3 Certified Laboratory Test Reports: Before delivery of materials, certified copies in 5 copies of the reports of all tests required in referenced publications or otherwise specified herein shall be submitted to and approved by the Owner's Representative. The testing shall have been performed within one year of submittal of the test reports for approval by an independent laboratory approved by the Owner's Representative. Test reports on a previously tested

materials shall be accompanied by notarized certificates from the manufacturer certifying that the previously tested material is of the same type, quality, manufacture, and make as that proposed for use in this project. Certified test reports are required for the following:

- a. Aggregates
- b. Reinforcement
- c. Cement

1.3.4 Certificates of Compliance:

- a. Materials for Curing Concrete
- b. Joint filler
- c. Vapor barrier
- d. Admixtures

1.3.5 Catalog Data:

- a. Materials for curing concrete
- b. Joint filler
- c. Vapor barrier
- d. Admixtures

**1.4 DELIVERY AND STORAGE:**

1.4.1 Cement

Cement in bags shall be stored in a suitable weatherproof structure which shall be as airtight as practicable; floors shall be elevated above the ground a distance sufficient to prevent the absorption of moisture. Bags shall be stacked close together to reduce circulation of air but shall not be stacked against outside walls; the manner of storage shall permit easy access for inspection and identification of each shipment. Bulk cement shall be transferred to elevated airtight and weatherproof bins. At the time of use all cement shall be free-flowing and free of lumps. Cement that has been in storage longer than 6 months will be tested by standard mortar tests or other tests as deemed necessary by the Owner's Representative to determine its suitability for use and such cement shall not be used without approval of the Owner's Representative.

1.4.2 Aggregates

Aggregates shall be stored on areas covered with tightly laid wood planks, sheet metal, or other hard and clean surface, and in a manner that will preclude the inclusion of foreign material. Aggregates of different sizes shall be stored in separate piles. Stock piles of coarse aggregate shall be built in horizontal layers not exceeding 1.20 meters in depth to minimize segregation. Should the coarse aggregate become segregated it shall be remixing to conform to the grading requirements.

1.4.3 Reinforcement

Store reinforcement of different sizes in racks raised above the ground with accurate identification. Protect reinforcing steel from contaminants such as grease, oil, and dirt.

1.4.4 Admixtures

Admixtures shall be stored in a manner that will not damage the containers.

## PART 2 - PRODUCTS

### 2.1 CONCRETE

#### 2.1.1 Contractor-Furnished Mix Design

ACI 211.1 and ACI 301. Unless indicated otherwise on the drawings, the following shall apply:

Location	28 Day Compressive Strength		Maximum Aggregate Size (mm)	Slump (max)
	MPa	psi		
Suspended Slabs, Beams and Girders	28	4,000	20	100mm
Columns and Pedestal	28	4,000	20	100mm
Footings and Footing Tie Beams	28	4,000	20	100mm
Slab on Grade	21	3,000	20	100mm
Retaining Walls	28	4,000	20	100mm
Stairs and Parapet (if any)	28	4,000	20	100mm
Other not indicated	28	4,000	20	100mm

### 2.2 MATERIALS

#### 2.2.1 Cement

Cement shall conform to ASTM C150, Type I Portland Cement

#### 2.2.2 Water

Water shall be fresh, clean, and potable.

#### 2.2.3 Aggregates

Aggregate shall conform to ASTM C33, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

#### 2.2.4 Non-shrink Grout

Non-shrink grout shall be non-metallic conforming to ASTM C 827.

#### 2.2.5 Admixtures

- a. Accelerating: ASTM C 494, Type C.
- b. Retarding: ASTM C 494, Type B or D.
- c. Water Reducing: ASTM C 494, Type A or E.
- d. Air entraining, ASTM C 260

Percentage of air content shall be as required in ACI 318, ACI 201.2R and ASTM C 1116, as applicable.

e. Materials for Forms

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Plywood shall conform with SAO 6, Type I, Grade A or better surfaces. Steel form surfaces shall not contain irregularities, dents, or sags.

2.2.7 Reinforcement

a. Reinforcing Bars

Reinforcing bars shall conform to ASTM A 615 (Weldable). All reinforcing steel shall be deformed. Reinforcing steel shall have a minimum yield strength of 275 MPa (Grade 40) for bars dia. 12mm and smaller, and 414 MPa (Grade 60) for bars dia. 16 and larger.

2.2.8 Vapor Barrier

Vapor barrier shall be made of polyethylene sheet, minimum 6 mil thickness conforming to ASTM C 171.

2.2.9 Materials for Curing Concrete

- a. Impervious Sheeting: ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.
- b. Pervious Sheeting: AASHTO M 182.
- c. Liquid Membrane-Forming Compound: ASTM C 309, white-pigmented, Type 2, Class B, free of paraffin or petroleum.
- d. Liquid Chemical Sealer-Hardener Compound: Compound shall not contain petroleum resins or waxes. Compound shall not reduce the adhesion of resilient flooring, tile, paint, waterproofing, or other material applied to concrete.
- e. Expansion/Contraction Joint Filler: ASTM D 1751 or ASTM D 1752.
- f. Joint Sealants
- g. Horizontal Surfaces (3 percent slope, maximum):
  - (1) Outside Buildings: ASTM D 1190.
  - (2) Inside Buildings: ASTM D 1190 or ASTM D 1850.
  - (3) Vertical Surfaces (greater than 3 percent slope): ASTM C 920, Type M, Grade NS, Class 25, Use T.
  - (4) Forms: ACI 301
  - (5) General Requirements

Forms shall be provided for all concrete not indicated or specified otherwise. Forms shall be set true to line and grade and maintained so as to insure

completed work within the allowable tolerance specified, and shall be mortar-tight. The Contractor shall be responsible for the adequacy of forms and form supports. Bolts and rods used for internal ties shall be arranged so that when the forms are removed, all metals will have concrete cover not less than that indicated in the drawings. Bolts or rod type form ties that must be removed when forms are removed shall not be used for watertight forms. Wire tire shall not be used where the concrete surface will be exposed to weathering and where discoloration will be exposed. All form work shall be provided with adequate clean-out openings to permit inspection and easy cleaning after all reinforcement has been placed. Where forms for continuous surfaces are placed in successive units, the forms shall be fitted over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Panel forms shall be constructed to provide tight joints between panels. All forms shall be constructed so that they can be removed without damaging the concrete. All exposed joints, edges, and external corners shall be chamfered a minimum of 20 mm unless specified otherwise herein. Forms for heavy girders and similar members shall be constructed with a proper camber as indicated.

f. Materials for Forms

Forms shall be of wood, plywood, or steel. Wood forms for surfaces exposed to view in the finished structure and requiring a smooth form finish, shall be plywood. For unexposed surfaces, undressed square-edge lumber may be used. Forms for surfaces requiring special finishes shall be plywood, or shall be lined with plywood, a non-absorptive, hard-pressed fiberboard, absorptive-type lining or other suitable material. Plywood, other than for lining, shall be concrete-form plywood not less than 16 mm thick free of raised grain, torn surfaces, worn edges, patches, or other surface defects which would impair the texture of the concrete surface. Surfaces of steel forms shall be free from irregularities, dents, and sags.

g. Coating

Before placing the concrete, the contact surfaces of forms shall be coated with a non-staining mineral oil or suitable non-staining form coating compound or shall be given two coats of nitrocellulose lacquer, except as specified otherwise. Mineral oil shall not be used on forms for surfaces which are to be painted. For surfaces not exposed to view in the finished structure, sheathing may be wetted thoroughly with clean water. All excess coating shall be removed by wiping with cloths. Reused forms shall have the contact surfaces cleaned thoroughly; those which have been coated shall be given an additional application of the coating. Plaster waste molds shall be sized with two coats of thin shellac or lacquer and coated with soft or thinned non-staining grease.

h. Tolerance and Variations

The Contractor shall set and maintain concrete forms to ensure that, after removal of the forms and prior to patching and finishing, no portion of the concrete work will exceed any of the tolerances specified. Variations in floor levels shall be measured before removal of supporting shores. The Contractor shall be responsible for variations due to deflection, when the latter results from concrete quality or curing other than that which has been specified. The tolerances specified shall not be exceeded by any portion of any concrete surfaces; the specified variation for one element of the

structure will not be applicable when it will permit another element of the structure to exceed its allowable variations except as otherwise specified herein, tolerances shall conform to ACI 347.

### **PART 3 - EXECUTION**

#### **3.1 PROPORTIONING, MEASUREMENT AND MIXING**

ASTM, C94, ACI 301, ACI 302.1R, and ACI 304, except as modified herein.

##### **3.1.1 Proportioning of Materials**

Proportioning of materials shall be accomplished by weighing, except as otherwise provided herein. In urgent situations, volumetric proportioning may be used temporarily, if permitted by the Owner's Representative, who will stipulate the length of the period during which volumetric proportioning may be used. The Contractor shall furnish the necessary equipment and shall establish accurate procedures for determining the quantities of free moisture in the aggregates, the true volume of the fine aggregate if volumetric proportioning is used, and the air content of the freshly mixed concrete if air-entrained concrete is used. Moisture, volumetric, and air determinations shall be made at intervals as directed by the Owner's Representative as specified herein under Sampling and testing requirements. Allowable tolerances for measuring cement and water shall be one percent; for aggregates 2 percent and for admixtures 3 percent.

##### **a. Weight Measurement**

The fine aggregate and each size of coarse aggregate shall be weighed separately. Cement in standard packages shall be weighed on a scale separate from that used for weighing the other materials.

##### **b. Volumetric Measurement**

The weight proportions shall be transposed into equivalent volumetric proportions by weighing representative samples of the aggregates in the condition in which they will be measured and in accordance with ASTM C 29. In determining the true volume of the fine aggregate, allowance shall be made for the bulking effect from the moisture contained therein. Suitable allowances shall also be made for variations in the moisture conditions of the aggregates.

##### **3.1.2 Mixing**

All concrete shall be machine mixed. In emergencies, the mixing may be done by hand if so authorized by the Owner's Representative. Mixing shall begin within 30 minutes after the cement has been added to the aggregates. The time of mixing after all cement and aggregates are in the mixer drum shall be not less than one minute for mixers having a capacity of one cubic yard or less; for mixers of larger capacities, the minimum time shall be increased 15 seconds for each additional cubic yard or fraction thereof of additional capacity. A reduction in the aforementioned mixing time shall be permitted in accordance with ASTM C 94 if mixer performance tests made at the Contractor's option and at his expense, indicate adequate mixing with the reduced time. All mixing water shall be introduced in the drum before one-fourth of the mixing time has elapsed. The entire contents of the mixer drum shall be discharged before recharging. The time elapsing between the introduction of the mixing water to the cement and aggregates or the cement to the aggregates and placing of the concrete in final position in the forms shall not exceed 60 minutes if the air temperature is less than 30 degrees C and 45 minutes if the air temperature is equal or greater than 30 degrees C. The retempering of concrete, i.e., remixing with or without additional cement, aggregate, or water, is not permitted.

### 3.1.3 Ready Mixed Concrete

Ready-mixed concrete shall conform to ASTM C 94 as modified herein. Ready-mixed concrete is defined in this specification as concrete produced regularly by a commercial establishment and delivered to the purchaser in the plastic state. Ready-mixed concrete may be used provided that (a) the plant has sufficient capacity and transportation equipment to deliver the concrete at the rate desired, and (b) the plant meets the requirements specified herein for equipment, measurement of materials, and mixing, except as modified herein. The cement, aggregates, water and admixtures shall conform to all applicable requirements of this specification. Ready-mixed concrete not specified otherwise herein shall be mixed and delivered by one of the following methods.

a. Truck Mixing

Concrete shall be mixed and delivered in a truck mixer. Mixers shall be charged with a ribbon fed mixture of aggregates and cement, or in the absence of facilities for ribbon feeding, the aggregates shall be charged before the cement. When mixing is begun during or immediately after charging a portion of the mixing water not in excess of that required to produce the minimum acceptable slump, shall be added ahead of or with, the other ingredients. Total mixing shall be for not less than 50 nor more than 100 revolutions of the drum at the manufacturer's rated mixing speed after all ingredients including water are in the drum except as follows: After 30 to 75 revolutions of the drum the slump shall be tested and additional water shall be added if necessary to produce the required slump; if additional water is necessary, mixing shall be continued for at least 20 revolutions after the water is added. Mixing speed shall be not less than 16 rpm for open-top mixers, and not less than 4 rpm nor more than 16 rpm for open-top mixers. Any turning of the drum during transportation shall be at the speed designated by the manufacturer of the equipment, as agitating speed. Each batch of concrete delivered at the job site shall be accompanied by a time slip issued at the batching plant, bearing the time of departure therefrom and the signature of the inspector. Discharge of concrete from the drum shall be completed within one hour or before the drum completes 250 revolutions after the introduction of water to the cement and the aggregates.

b. Combination Central Plant and Truck Mixing (Shrink Mixing)

Concrete shall be partially mixed in a central plant mixer and the mixing completed in a truck mixer. The mixing time in a central-plant mixer shall be the minimum required to intermingle the ingredients and shall not exceed 30 minutes. The mixing shall be completed in a truck mixer as specified herein under truck mixing.

c. Central-Plant Mixing

Concrete shall be mixed completely in a stationary mixer at a plant and transported to the site of the work in a truck agitator or a truck mixer operating at a speed of rotation designated by the manufacturer as agitating speed. Mixing shall begin within 30 minutes after cement has been added to aggregates. When authorized in writing by the Owner's Representative, non-agitation equipment approved by him may be used for transporting concrete. The time lapse between the introduction of the mixing water to the cement and aggregates and the placing of concrete in final position in the forms, shall not exceed: (a) for agitating equipment - 60 minutes, air temperature less than 30 degrees C; (b) for non-agitating equipment - 30 minutes.

d. Consistency of Concrete

Slump shall be determined in accordance with ASTM C 143. Samples for slump determination shall be taken from the concrete during placing in the forms.



### **3.2 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS: ACI 301**

#### **3.2.1 General Requirements**

All reinforcement bars, stirrups, hanger bars, wire fabric, spirals and other reinforcing materials shall be provided as indicated in the drawing or required by this specification, together with all necessary wire ties, chairs, spacers, supports and other devices necessary to install and secure the reinforcement properly. All reinforcement, when placed, shall be free from rust, scale, oil, grease, clay, and other coatings, and foreign substances that would reduce or destroy the bond. Rusting of reinforcement shall not reduce the effective cross sectional area of the reinforcement to the extent that the strength is reduced beyond specified values. Heavy, thick rust or loose, flaky rust shall be removed by rubbing with burlap or other approved method, prior to placing. Reinforcement which has bends not shown on the project drawings or on approved shop drawings, or is reduced in section by rusting such that its weight is not within permissible ASTM tolerances, shall not be used. All reinforcement shall be supported and wired together to prevent displacement by construction loads or by the placing of concrete. Unless directed otherwise by the Engineer, reinforcement shall not be bent after being partially embedded in hardened concrete. Detailing of reinforcing shall conform to ACI 315. Where cover over reinforcing steel is not specified or indicated it shall be in accordance with ACI 318.

#### **3.2.2 Placing**

Reinforcement shall be placed accurately and secured. It shall be supported by suitable chairs and spacers or by metal hangers. On the ground, and where otherwise subject to corrosion, concrete or other suitable non-corrodible material shall be used for supporting reinforcement. Where the concrete surface will be exposed to the weather in the finished structure or where rust would impair the appearance or finish of the structure, all reinforcement supports, within specified concrete cover, shall be galvanized or made of a suitable non-corrodible material.

#### **3.2.3 Splicing of Reinforcement**

Splicing of reinforcement shall be in accordance with ACI 318, except as indicated otherwise or modified herein. Where splices in addition to those indicated on the drawings are necessary, they shall be approved by the Owner's Representative prior to their use. Splices shall not be made in beams, girders, and slabs at points of maximum stress. Butt splicing shall preferably be used over lapping for bar sizes larger than 32 mm<sup>2</sup>. Splices to be welded shall conform to AWS D 1.4; certification of weld ability of the reinforcement by the manufacturer, shall be submitted to the Owner's Representative. If the Contractor elects to use butt splicing of reinforcing, he shall submit complete details of the process to be used to the Owner's Representative. If butt splices are used the Contractor shall ensure that the splice meets the requirements specified herein by performing at least three splices which shall be submitted for tests to a testing laboratory that has been approved for such testing by the Owner's Representative. The cost of these shall be borne by the Contractor.

#### **3.2.4 Moving Reinforcing Steel**

All placement or movement of reinforcing steel after placement, to positions other than indicated or specified, shall be subject to the approval of the Owner's Representative.

#### **3.2.5 Concrete Protection for Reinforcement**

Concrete protection for reinforcement shall be as indicated; or if not indicated, in accordance with ACI 318.

### 3.2.6 Tolerances and Variations

The minimum concrete cover for reinforcement specified in the contract documents takes precedence over all permissible reinforcement-placement variations; nothing in the variations listed below is to be construed as permitting violation or compromise thereof:

- |    |                         |   |
|----|-------------------------|---|
| a. | Height of bottom bars   | plus or minus 6 mm. above form              |
| b. | Lengthwise positioning  | plus or minus 50 mm. of bars                |
| c. | Spacing bars in walls   | plus or minus 25 mm. and solid slabs        |
| d. | Spacing bars in         | minus 0 mm plus 6 mm.<br>beams and footings |
| e. | Height of top bars      | minus 0 mm plus 6 mm.                       |
| f. | Stirrup spacing         |   |
|    | (1) For any one stirrup | plus or minus 25 mm.                        |
|    | (2) For over-all group  | plus or minus 25 mm. of stirrups            |

3.2.7 Vapor Barrier: Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 300 mm. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement shall not damage vapor barrier material.

3.2.8 Setting Miscellaneous Material: Anchors and bolts, including but not limited to those for machine and equipment bases; frames or edgings, hangers and inserts, door bucks, pipe supports, pipe sleeves, pipes passing through walls, metal ties, conduits, flashing reglets, drains and all other materials in connection with concrete construction shall, where practicable be placed and secured in position when the concrete is placed. Anchor bolts for machines shall be set to templates, shall be plumbed carefully and checked for location and elevation with an instrument, and shall be held in position rigidly to prevent displacement while concrete is being placed.

### 3.3 CONVEYING AND PLACING CONCRETE

ACI 301 and ACI 304, except as modified herein.

3.3.1 Conveying: Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by proper methods which will not cause segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position in the forms. At any point in the conveying, the free vertical drop of the concrete shall not exceed 1 m. Conveying equipment shall be cleaned thoroughly before each run. All concrete shall be deposited as soon as practicable after the forms and the reinforcement have been inspected and approved by the Owner's Representative. Concrete which has segregated in conveying shall be removed and disposed of as directed by the Owner's Representative.

3.3.2 Placing Concrete: No concrete shall be placed after there is evidence of initial set. Concrete placement will not be permitted when weather conditions prevent proper placement and consolidation. The placement of concrete in uncovered areas during periods of precipitation will not be allowed except for covered areas. Subgrades of earth or other material shall be properly prepared and, if necessary, covered with heavy building paper or other suitable

material to prevent the concrete from becoming contaminated. Before placing concrete on porous subgrades, they shall be dampened. Forms shall be clean of dirt, construction debris and water. Fresh concrete shall not be placed on vertical supporting members such as columns and walls without approval of the Owner's Representative. Concrete shall be deposited in approximately horizontal layers, 300 mm to 500 mm deep in a manner to preclude the formation of cold joints between successive layers.

3.3.3 Vibration: All concrete shall be compacted with high frequency, internal mechanical vibrating equipment supplemented by hand spading and tamping. Concrete slabs 100 mm or less in depth shall be consolidated by wood tampers, spading and settling with a heavy leveling straight edge. Vibrators shall be designed to operate with vibratory element submerged in the concrete, and shall have a frequency of not less than 6,000 impulses per minute when submerged. The vibrating equipment shall be adequate at all times in number of units and power of each unit to consolidate the concrete properly. Vibration of forms and reinforcement shall not be employed except when authorized specifically by the Owner's Representative. Vibrators shall not be used to transport the concrete in the forms. Vibration shall be discontinued when the concrete has been compacted thoroughly and ceases to decrease in volume.

3.3.4 Construction Joints: Joints not shown on the drawings shall be made and located so as to least impair the strength of the structure and shall be subject to approval of the Owner's Representative. In general, they shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joints in the girders shall be offset a distance equal to twice the width of the beam. Horizontal joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the top of footings or grade slabs. Beams, girders, brackets, column capitals, haunches and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

a. Reinforcement in Construction Joints

All reinforcing steel shall be continued across joints. Keys and inclined dowels shall be provided as indicated. Longitudinal keys at least 38 mm deep shall be provided in all joints in walls.

b. Preparation of Surface

The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed.

c. Bonding

When a bonded construction joint is required, bond shall be obtained by one of the following methods:

- (i) The use of suitable chemical retardant which delays but does not prevent setting of the surface mortar. Retarded mortar shall be removed within 24 hours after placing to produce a clean exposed aggregate bonding surface.
- (2) By roughening the surface of the concrete in proper manner, which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate, or damaged concrete at the surface.

### 3.3.5 Embedded Items

#### a. Other Embedded Items

All sleeves, inserts, anchors and embedded items required for adjoining work or for its support shall be placed prior to concreting. All sub-contractors, whose work is related to the concrete or must be supported by it, shall be given ample notice and opportunity to introduce or furnish embedded items before the concrete is placed. All ferrous metal sleeves, inserts, anchors and other embedded ferrous items exposed to the weather or where rust would impair the appearance or finish of the structure shall be galvanized.

#### b. Placing Embedded Items: Expansion joint material, and embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids. Aluminum shall not be embedded in concrete except where aluminum is protected from direct contact with the concrete.

#### c. Reinforcing Bars: Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items, but not so as to impair design strengths of the members. If bars are moved more than one bar diameter, the resulting arrangement of bars shall be subject to the approval of the Owner's Representative.

### 3.3.6 Placing Concrete in Hot Weather

Placing concrete in hot weather shall be in accordance with ACI 305 except as modified herein. In hot weather, extra care should be made to prevent rapid drying of newly placed concrete. When the outdoor ambient temperature is more than 32 degrees C; the temperature of the concrete as placed shall not exceed 32 degrees C; the fresh concrete shall be shaded as soon as possible after placing; and curing shall be started as soon as the surface of the fresh concrete is sufficiently hard to permit it without damage.

## 3.4 SURFACE FINISHES (EXCEPT FLOOR AND SLAB ON GRADE)

### 3.4.1 Repair of Surface Defects

All surface defects including tie holes, minor honeycombing, and other defective concrete shall be repaired with cement mortar with the approval of the Owner's Representative. Cement mortar for patching shall be the same composition as that used in the concrete, except that for exposed surfaces part of the cement shall be white portland cement to provide a finish color matching the surrounding concrete. Patching shall be done as soon as the forms are removed; areas of surfaces, which are to be cured with a curing compound, shall be covered during the application of the compound. All areas to be patched shall be cleaned thoroughly. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of not less than 25 mm. The edges of the cut shall be perpendicular to the surface of the concrete. The area to be patched and at least 150 mm adjacent thereto shall be saturated with water before placing the mortar. The mortar shall be mixed approximately one hour before placing and shall be remixed occasionally during this period with a trowel without the addition of water. A grout of cement and water mixed to the consistency of paint shall then be brushed onto the surfaces to which the mortar is to be bonded. The mortar shall be compacted into place and screened slightly higher than the surrounding surface. Patches shall be cured as specified for the concrete. Holes extending through the concrete shall be filled by means of a plunger type gun or other suitable device from the unexposed face. The excess mortar shall be wiped off the exposed face with a cloth. Finished surfaces shall be protected from stains and abrasions as cast finish against

steel, plywood, forms, and rubbed finish shall be equal in workmanship, texture, and general appearance to that of sample panels specified herein. Concrete with excessive honeycombing, which exposes the reinforcing steel or other defects which affect the structural strength of the member, shall be rejected or the defects corrected as directed by the Owner's Representative, and at the expense of the Contractor.

#### 3.4.2 Finishing of Formed Surfaces

Finishing of formed surfaces shall be accomplished as soon as practicable after form removal and repair of surface defects. Finishing shall be accomplished and specified herein where indicated.

- a. As Cast Finishes
- b. Smooth Form Finish: The form facing material shall produce a smooth, hard, uniform texture on the concrete. Tie holes and defects shall be patched. All fins shall be completely removed.
- c. Rough Form Finish: No selected form facing materials are required for rough form finish surfaces. Tie holes and defects shall be patched. Fins exceeding 6 mm in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

#### 3.4.3 Unindicated Finish

Finishes not indicated on the drawings shall be as follows.

- a. Smooth Form Finish  
For all concrete surfaces exposed to public view.
- b. Rough Form Finish  
For all concrete surfaces not exposed to public view.

#### 3.4.4 Unformed Surfaces

- a. Related Unformed Surfaces  
Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the adjacent formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

### 3.5 CURING AND PROTECTION (Except Floors)

ACI 301 unless otherwise specified.

#### 3.5.1 General Requirements

Concrete shall be protected adequately from injurious action by sun, rain, flowing water, and mechanical injury, and shall not be allowed to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Curing shall be accomplished by moist curing, or by application of liquid chemical or liquid membrane forming compound, except as specified otherwise herein. Membrane forming compound shall not be used on surfaces for which special finish is specified, on any surface to be painted, waterproofed,

tilled, roofed, or where coverings are to be bonded. Completion of curing shall be initiated immediately following the removal of forms.

### 3.5.2 Moist Curing

#### a. Mats

The entire surface of the concrete shall be covered with two thicknesses of wet burlap weighing not less than 250 gram per square meter, dry weight, mats, or other suitable material having high absorptive quality. The material shall be thoroughly wet when applied and shall be kept continuously wet during the time it remains on the slab. Mats shall be made of clean material which is free from any substance which will have a deleterious effect on the concrete; they shall be at least as long as the width of the concrete under construction. During application, the mats shall not be dragged over the finished concrete nor over mats already placed; shall they be placed to provide complete coverage of surface and edges of the pavement with a slight overlap over adjacent mats. These mats shall be left in place not less than 7 days during which time they shall be kept wet continuously.

- b. Impervious-Sheeting Curing: The entire exposed surface shall be wetted thoroughly with a fine spray of water and then covered with (a) waterproofed paper, (b) polyethylene-bonded water-proof paper sheeting, (c) polyethylene-coated burlap sheeting, or (d) polyethylene sheeting, as specified elsewhere herein. Sheets shall be laid directly on the concrete surface and overlapped 300 mm when a continuous sheet is not used. The curing medium shall be not less than 450 mm wider than the concrete surface to be cured, and shall be weighed down by placing a bank of moist earth on the edges just outside the forms and over the transverse laps to form closed joints. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

### 3.5.3 Liquid Membrane-Forming Compound Curing

Liquid membrane-forming compound curing shall be accomplished by applying a white-pigmented liquid compound, free of paraffin or petroleum, over the concrete surface to restrict evaporation of the mixing water. All joint openings except sawed joints shall be sealed at the top by inserting moistened paper or fiber rope, or covering with strips of waterproof material, prior to application of the curing compound, in a manner to prevent the curing compound from entering the joint. Seven days following the placing of the liquid membrane forming compound shall be considered as the end of the curing period and the basis for determining when joint sealing material will be placed in joints.

#### a. Application of Curing Compound

The compound shall be applied immediately after the surface loses its water sheen and has a dull appearance and before joints are sawed. Curing compound shall be agitated thoroughly by mechanical means during use and shall be applied uniformly in a 2-coat continuous operation by suitable power-spraying equipment. The total coverage for the two coats shall be between 4 to 5 square meter per liter of undiluted compound. The compound shall form a uniform, continuous, coherent film that will not check, crack or peel and shall be free from pinholes or other imperfections. An additional coat of the compound shall be applied immediately to areas where the film is defective. Suitable covering other than liquid curing compound, shall be kept readily available for use to protect the freshly placed concrete in the event conditions occur which prevent correct application of the compound at the proper time. Concrete surfaces that are subject to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed with

two coats of curing compound by the method and at the foregoing coverage rate specified, at no additional cost to the Owner.

b. Protection of Treated Surfaces

Concrete surfaces to which liquid membrane-forming compounds have been applied shall be kept free from all foot and vehicular traffic and all other sources of abrasion for not less than 72 hours. Continuity of the coating shall be maintained for the entire curing period and any damage to the coating during this period shall be repaired immediately.

c. Liquid Chemical Sealer-Hardener Curing

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and opening in which joint sealant is to be applied as required by the joint sealant manufacturer. The sealer-hardener shall not be applied until the concrete has cured for a minimum of 30 days. Apply a minimum of 2 coats of sealer-hardener.

3.5.4 Curing Periods

When the 7-day compression-test-cylinders, representative of parts of a structure already placed, indicate that the 28-day strengths may be less than 90 percent of the design strengths, those parts of the structure shall be given additional curing, as directed by the Owner. Cast-in-place parts of a structure which will be permanently submerged in fresh water may be cured for not less than 12 hours, provided they are submerged immediately thereafter. Curing, except steam curing, shall be as follows:

<u>Time (minimum)</u>	<u>Concrete Element</u>
7 days	All concrete not specified otherwise

3.5.5 Removal of Forms and Protection: Forms shall be removed in a manner, which will prevent damage to the concrete. Forms shall not be removed without approval of the Engineer, or before the expiration of the minimum periods specified herein:

	<u>Days After Placing</u>
Side forms on beams, girders and columns	1
Forms for columns	7
	<u>Days After Placing</u>
Supporting forms for slabs, beams, girders	14

Sufficient shoring members to support dead load plus construction loads on beams, girders and slabs shall be provided for a period of 7 days in addition to the 14 days specified herein.

3.5.6 Special Requirements for High-Early-Strength Portland Cement Concrete: The curing periods, minimum periods during which supporting forms and shores shall be left in place, and minimum periods for maintaining curing temperatures shall be not less than one-quarter

of those specified herein for Portland cement concrete, but in no case less than 48 hours.

### **3.6 SAMPLING AND TESTING:**

#### **3.6.1 Sampling**

a. **Aggregates**

Prior to production and delivery of aggregates, at least one initial sample shall be taken at the source. Each sample shall be collected by taking three incremental samples at random from the source material to make a composite sample of not less than 20 kilograms. Three random samples shall then be taken from each 270 metric tons of material, or a day's run, whichever is the least amount, during the course of the project. Three increments shall be taken from the same vehicle at the central plant during unloading. The above sampling shall be repeated when the source of material is changed or when unacceptable deficiencies or variations from the specified grading of materials are found in testing.

- b. **Coarse Aggregates:** A 20 kilograms or larger sample for analysis as specified herein shall be taken 2 times daily with a sampling device approved by the Owner's Representative. The samples shall be taken from the conveyor belt. The plant shall be brought up to full operation before samples are taken. The samples shall be taken so that a uniform cross-section, accurately representing the materials on the belt or in the bins, is obtained. Random checks of the sampling may be made by the Owner's Representative. Additional sampling is required when analyses show deficiencies or unacceptable variances or deviation from the specified requirements.

- c. **Fine Aggregates:** A 20 kilogram-sample shall be taken as specified herein for sampling of fine aggregate. The sample shall be taken at least 2 times daily for sieve analysis of fine aggregate sand and specific gravity tests. Additional samples may be required when analyses show deficiencies, unacceptable variances, or deviations. Sampling can be reduced to 1 time daily when test results show that the fine aggregates consistency meet specified requirements. Samples of sand shall be taken when the sand is moist.

- d. **Sample Identification:** Each sample shall be contained in a clean container which shall be securely fastened to prevent loss of material. It shall be tagged for identification. The tag shall contain the following information:

Contract No. \_\_\_\_\_

Sample No. \_\_\_\_\_ Quantity \_\_\_\_\_

Date of Sample \_\_\_\_\_

Sampler \_\_\_\_\_

Source \_\_\_\_\_

Intended Use \_\_\_\_\_

For Testing \_\_\_\_\_

- e. **Concrete:** ASTM C 172. Samples for strength tests of concrete placed each day shall be taken not less than once a day, nor less than once for each 50 cubic meters of concrete, nor less than once for each 400 sq.m. of surface area for slabs or walls.



Nine (9) cylinders shall be molded from each day sample.

### 3.6.2 Testing

- a. Aggregate Testing: Gradation tests shall be made on each sample without delay. All other aggregate tests required by this specification shall be made on the initial source samples, and shall be repeated whenever there is a change of source. The tests shall include an analysis of each grade of material and an analysis of the combined material representing the aggregate part of the mix.
- b. Cement:
- c. The Contractor's inspection shall be performed in accordance with PNS 07. The Contractor's certification shall include:
  - (1) A report of the mill test results signed by the laboratory chemist;
  - (2) At the time of shipment from the mill or other storage point, a manufacturer's certificate that the cement was tested in accordance with the specified requirements.
  - (3) A statement that the concrete for the project will contain cement conforming to the specified requirements.

The Contractor shall make all necessary arrangement with the cement supplier and carrier for the identification and transportation of the certified cement from the manufacturer to the concrete batch plant.

- d. At any time the cement stored at the concrete plant or other storage area is not certified by the cement manufacturer for use in the project, or if the Contractor desires to use cement of a different brand or type which is not certified by the cement mill, the Contractor shall, before using the cement, secure three random samples of the cement in storage, and arrange for complete chemical and physical tests by an Owner approved cement testing laboratory to provide information as to the properties of the cement. Test results of each individual sample shall be reported; acceptance will be determined on the average test result of the three samples for the selected lot size. Cement not meeting the specified requirements shall not be used in the concrete. Each shipment of acceptable cement as determined by field tests shall be sampled, the samples identified and stored for not less than 42 days. A random sample shall be tested for conformance at least once each month. The sampling and testing shall continue until subsequent shipments of cement are certified by the cement producer.
- e. The Owner reserves the right to inspect and sample at the source or at the site of work all cement to be used on the project.
- f. Concrete Testing:
  - . Testing consistency of concrete slumps shall be determined in accordance with ASTM C 143. Consistency may be determined in the field by means of the ball-penetration method in accordance with ASTM C 360 after a correlation between slump and ball-penetration is determined. Tests to verify the ratio will be made at least once each working day. Samples for slump determination will be taken from the concrete during placing in the forms; samples for ball-penetration shall be taken as specified in ASTM C 360. Tests shall be made as follows:
    - 1. At the beginning of a concrete placement operation and at subsequent

intervals to insure that the specification requirements are met.

2. Whenever test cylinders are made.

Compressive Tests: Testing of specimen for compressive strength shall be in accordance with ASTM C 39. Test two (2) cylinders at seven (7) days, six (6) cylinders at twenty eight (28) days and hold one (1) cylinder in reserve. When a satisfactory relationship between 7-day and 28-day strength has been established, the 7-day test results may be used as an indicator of the 28-day strength. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of the three strength test result is less than  $f'_c$  or if any strength test result falls below  $f'_c$  by more than 3.5 MPa (500 psi), take a minimum of three ASTM C42 core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core tests shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of  $f'_c$  and if no single core is less than 75 percent of  $f'_c$ . Locations represented by erratic core strength shall be retested. Demolition and concrete replacement if recommended shall be borne by the Contractor.

Air Content Tests: Test methods for air content of concrete shall comply with ASTM C-138, C 173 and C 231 as applicable.

### **3.7 METHOD OF MEASUREMENT**

The quantity of structural concrete, reinforcing steel or other Contract Pay Items shall constitute the completed and accepted structure which shall be measured for payment in the manner prescribed in the several items involved.

### **3.8 BASIS OF PAYMENT**

The quantities measured as provided in the Method of Measurement shall be paid for at the contract price for the several pay items which price and payment shall be full compensation for furnishing, preparing, fabricating, placing, curing and for all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section. Such payment shall constitute full payment for the completed structure ready for use.

Payment will be made in accordance with the Bill of Quantities.

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## DIVISION 4 – MASONRY

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## **SECTION 04800 - REINFORCED MASONRY (CHB)**

### **PART 1 - GENERAL**

#### **1.1 Applicable Publications**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless specified, all publications below shall be of the latest edition.

##### **1.1.1 American Concrete Institute (ACI) Publication:**

Manual of Standard Practice for Detailing Reinforced Concrete Structures

##### **1.1.2 American Society for Testing and Materials (ASTM) Publications:**

C 39	Compressive Strength of Cylindrical Concrete Specimens
C 91	Masonry Cement
C 144	Aggregate for Masonry Mortar
C 270	Mortar for Unit Masonry
C 404	Aggregates for Masonry Grout
C 426	Drying Shrinkage of Concrete Block
D 1056	Flexible Cellular Materials-Sponge or Expanded Rubber
D 1667	Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Sponge)
E 447	Compressive Strength of Masonry Prisms

##### **1.1.3 Product Standards Agency (PSA) Publications (Philippines):**

PNS 07	Specifications for Portland Cement
PNS 16	Specifications for Concrete Hollow Blocks
PNS 18	Specifications for Concrete Aggregate
PNS 49	Specifications for Steel Bars for Concrete Reinforcement
SAO 181	Industrial Quicklime and Hydrated Lime

#### **1.2 Definitions**

##### **1.2.1 Concealed Masonry Surfaces:**

- a. Surfaces of foundation walls against which backfill is placed.
- b. Surfaces covered by furring and wallboard plaster, stucco, or masonry facings.
- c. Surfaces above suspended ceilings.
- d. Surfaces within attic spaces, crawl spaces, pipe or duct chases and elevator shafts.

### 1.2.2 Exposed Masonry Surfaces

Masonry surfaces other than those listed above including those to be painted.

### 1.2.3 Grout Lift and Grout Pour

A grout lift is the layer of grout placed in a single continuous operation. A grout pour is the entire height of grout fill placed in one day and is composed of a number of successively placed grout lifts.

### 1.2.4 Reinforced Hollow Unit Masonry

Hollow concrete masonry units reinforced vertically and horizontally with steel bars located within cells or kerfs in the units and with cells containing reinforcing bars filled solidly with grout.

### 1.2.5 Additional Definitions:

- a. Back-Up: That part of masonry walls which is behind the exterior facing.
- b. Bed Joint: The horizontal layer of mortar on which a masonry unit is laid.
- c. Head Joint: The vertical mortar joint between ends of masonry units. Sometimes
- d. Kerf: A cut or notch made with a saw, or with a cutter, part way through a portion of a unit.
- e. Low Lift Grouting: The technique of grouting masonry in 0.20 to 1.8 meters lifts as the wall is being laid.
- f. Reinforced Masonry: Masonry in which reinforcement is embedded in such a manner that the component act together to resist lateral forces.

## 1.3 Delivery, Storage and Handling

Handle, store and protect masonry units to avoid chipping, breakage or contact with the soil. Keep steel reinforcing bars free of rust and loose scale. Reject rusted steel reinforcing bars. Deliver cement and lime in unbroken bags, barrels, or other sealed containers. Keep cementitious materials dry. Store and handle cement to prevent the inclusion of foreign materials. Store aggregates in a manner to avoid contamination or segregation. Plainly mark and label containers with the manufacturer's names and brands.

## PART 2- PRODUCTS

### 2.1 Masonry Units

#### 2.1.1 Concrete Masonry Units (CHB):

- a. Aggregates: ASTM C33
- b. Linear Drying Shrinkage: Not to exceed 0.065 percent when tested in accordance with ASTM 426.
- c. Kinds and Shapes: In addition to the requirements specified, concrete masonry units of the various kinds shall conform to PNS 16, Type II for 150 mm thick ( $f'_m = 7 \text{ MPa} / 5 \text{ MPa}$ ) and for 100 mm thick ( $f'_m = 2.5 \text{ MPa}$ ). Include closer, jamb, lintel and bond beam units and special shapes and sizes to complete the work as indicated.

## **2.2 Centering Device**

Provide centering clips that prevent displacement of reinforcing bars during the course of construction.

## **2.3 Deformed Reinforcing Bars**

ASTM A615, Grade 275 (40,000 psi).

## **2.4 Materials for Mortar and Grout**

### **2.4.1 Admixtures**

- a. Admixtures: May be used in mortar or grout provided that the admixture does not adversely affect bond or compressive strength of mortar or grout.
- b. Prohibited Ingredients: Do not use air entraining compounds, calcium chloride salts or other chemicals that will adversely affect metals or the coatings of metals embedded in the mortar or grout.

### **2.4.2 Aggregate for Mortar**

ASTM C 144, except that not less than 3 percent nor more than 15 percent shall pass the No. 100 sieve. Aggregate used in mortar for joint 6 mm or less shall have 100 percent passing the No. 8 sieve with 10 percent being retained on the No. 16 sieve.

### **2.4.3 Aggregate for Grout:**

- a. Fine Aggregate: ASTM C 404, Size No. 2 or ASTM C 144.
- b. Pea Gravel: ASTM C 404, except that 100 percent shall pass the 9 mm screen and not more than 5 percent shall pass the No. 8 sieve.
- c. Coarse Aggregate: ASTM C 404, size No. 8.

### **2.4.4 Portland Cement**

ASTM C150, Type I.

### **2.4.5 Lime Putty**

Slaked according to manufacturer's instructions.

- a. Hydrated Lime: SAO 181.
- b. Pulverized Quicklime: SAO 181 except 100 percent shall pass the No. 20 sieve and 90 percent shall pass the No. 50 sieve.
- c. Lime Paste: Lime paste shall be made with pulverized quicklime or hydrated lime. Hydrated lime processed by the steam method shall be allowed to soak not less than 24 hours. Quicklime and other hydrated lime shall be allowed to soak not less than 72 hours. In lieu of hydrated lime paste for use in mortar, the hydrated lime may be added in the dry form.

### **2.4.6 Water: Potable.**

## **2.5 Mortar Mixes**

### **2.5.1 Proportions**

Type M in accordance with the proportion specifications of ASTM C 270. The mortar shall have a flow, after 11 minutes, of 75 percent or more when tested for water retention in accordance with ASTM C 91 except mortar shall be mixed to an initial flow of 105 to 115 percent.

## **2.6 Grout Mixtures**

### **2.6.1 Proportions**

Mix in laboratory established proportions to in a compressive strength at 28 days of not less than 13.80 MPa (2,000 psi) when tested in accordance with ASTM C 91 for fine aggregate and ASTM C 39 for grout containing coarse aggregate. Grout shall be classified as fine and low lift types as specified below.

- a. Fine Grout: Portland cement, fine aggregate, and sufficient water to obtain a pouring consistency without segregation of the constituents. Slump shall be approximately 125 mm.
- b. Low Lift Grout: Portland cement, lime paste or hydrated lime, fine aggregate and coarse aggregate, and sufficient water to obtain a pouring consistency without segregation of the constituents. Slump between 200 and 250 mm.

## **2.7 Source Quality Control**

Prior to delivery of masonry units to the site, select by random sampling nine individual whole units from the units proposed for use. Select units free from cracks or other structural defects. Test in accordance with PNS 16.

## **PART 3 - EXECUTION**

### **3.1 Preparation**

#### **3.1.1 Protection**

- a. Forms and Shores: Where required, construct forms to the shapes, lines, and dimensions of the members indicated. Construct forms sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support its weight and construction loads to which it may be subjected. In no case shall supporting forms or shores be removed in less than 10 days. Wait at least 16 hours after grouting masonry walls after applying uniform loads and wait an additional 48 hours before applying concentrated loads.
- b. Wall Bracing: Brace walls against wind and other forces during construction. Allow sufficient time between lifts to prevent cracking of face shells of hollow masonry units. If blowouts, misalignment, or cracking of face-shells should occur during construction, tear down and rebuild the wall at no additional cost to the Owner.

#### **3.1.2 Surface Preparation**

Clean laitance, dust, dirt, oil, organic matter or foreign materials from concrete surface upon which reinforced masonry is to be placed. Use sandblasting, if necessary, to remove laitance

from pores and expose to the aggregate.

### **3.2 Laying Masonry Units**

#### **3.2.1 Wet Masonry Units**

Do not wet concrete masonry units. Do not lay units having a film of water on the surface.

#### **3.2.2 Embedded Items**

Build in wall plugs, accessories, flashings pipe sleeves and other items required being built-in as the masonry works progresses. Fill cells receiving anchor bolts and cells of the first course below bearing plates with mortar or grout. Fill spaces around metal doorframes and other built-in items with mortar. Point openings around flush-mounted electrical outlet boxes in wet locations, including the flush joint above the box with mortar. Do not embed aluminum items.

**3.2.3 Bond Beams and Lintels:** Install bond units, reinforced as indicated, filled with grout. Install open bottom type bond beam units over cells to be filled. Place wire mesh or small mesh metal lath under open bond beam units if used over cells not to be filled.

**3.2.4 Unfinished Work:** Step back-unfinished work for joining with new work. Do not use toothing without the written approval of the Owner's Representative. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

**3.2.5 Placing Units:** Lay hollow masonry units so as to preserve the vertical continuity of cells filled with grout. The minimum clear horizontal dimensions of vertical cores shall be 50 mm by 75 mm. Masonry bond units at corners. Anchor intersections by reinforcing bars as indicated. Adjust each unit to its final position while mortar is still soft and plastic. If any unit is disturbed after mortar has stiffened, remove and relay in fresh mortar. Keep chases, raked out joints, and spaces to be grouted, free from mortar and other debris.

**3.2.6 Bond Pattern:** Lay masonry units in running bond.

**3.2.7 Cutting and Fitting:** Wherever possible, use full units of the proper size in lieu of cut units. Use power masonry saws for cutting and fitting. Concrete -masonry units shall be wet cut. Make cut edges clean, true and sharp. Make openings carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will be aligned at the bottom with the masonry joints. Cut webs of hollow masonry units to the minimum required for proper installation. Provide reinforced masonry lintels, above openings over 300 mm wide for pipes, ducts and cables trays unless steel sleeves are used.

**3.2.8 Mortar Joints:** Spread bed joints with mortar for the full thickness of the face shells. Where only cells containing reinforcement are to be grouted, spread cross webs around such cell with mortar to prevent leakage of grout. Butter head joints for full thickness of the face shell and place the units. Avoid fins of mortar that protrude into cells to be grouted.

**3.2.9 Jointing:** Tool joints when the mortar is thumbprint hard. Tool horizontal joints first. Brush joints to remove loose and excess mortar. Mortar joints shall be finished as follows:

- a. **Flush Joints:** Flush cut joints in concealed masonry surfaces and joints above electrical outlet boxes in wet areas. Make flush cut joints by cutting off the mortar flush with the face of the wall.
- b. **Tooled Joints:** Tool joints in exposed exterior and interior masonry surfaces slightly concave. Use a jointer of sufficient length to obtain a straight and true mortar joints.
- c. **Joint Width:** 9 mm wide.



### **3.3 Placing Reinforcing Steel**

Prior to placing grout, clean, reinforcement of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond with the grout. Details of reinforcement shall be in conformance with ACI 315. Do not bend or straighten reinforcing in a manner injurious to the steel. Do not use bars with kinks or bends not shown on the drawings. Placement of reinforcement shall be inspected and approved prior to placing grout.

- 3.3.1 **Positioning Bars:** Position vertical bars accurately at the centerline of the wall. Maintain a minimum clearance between the bars and masonry units of 12 mm and between parallel bars of one diameter of the reinforcement. Hold vertical reinforcing in place using metal support, centering clips, spacers, ties or caging devices located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement.
- 3.3.2 **Splices:** Locate splices only as indicated. Stagger splices in adjacent bars at least 600 mm. Lap bars a minimum of 40 diameters of the reinforcement or 600 mm, whichever is greater. Welded or mechanical connections shall develop the full strength of the reinforcement.

### **3.4 Placing Grout**

Use a hand bucket, concrete hopper or grout pump. Place grout in final position within 1-½ hours after mixing. Where grouting is discontinued for more than one hour, stop the grout 25-mm below the top of a course to form a key at pour points. Place grout to completely fill the grout spaces without segregation of the aggregates.

#### **3.4.1 Low Lift Grout Method**

Place grout as masonry is erected at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. If mortar has been allowed to set prior to grouting, remove fins protruding more than 12 mm into the grout space. Rod or puddle grout during placement using a long 25-mm by 50-mm wood stick or a mechanical vibrator.

### **3.5 Tolerance**

Lay masonry plumb, true to line, with course level. Keep bond patterns plumb throughout.

### **3.6 Field Quantity Control**

#### **3.6.1 Grout**

Employ a qualified testing laboratory to proportion and test grout. Do not change laboratory established proportions or use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

### **3.7 Cleaning**

After mortar joints have attained their initial set but prior to hardening, completely remove mortar and grout daubs or splashing from exposed masonry surfaces. Before completion of the work, make out defects in joints in exposed masonry surfaces fill with mortar and tool to match existing joints. Immediately after grout work is completed remove scum and stains which have percolated through the masonry using a high pressure steam of water and a stiff fiber bristled brush. Do not use metal tools or metal brushes for cleaning. Dry brush exposed concrete masonry unit surfaces at the end of work each day.

**3.8 Method Of Measurement**

The quantity to be paid for shall be the number of square meters of reinforced concrete masonry completed in place and accepted. Projections extending beyond the faces of the walls shall not be included. In computing the quantity of payment, the dimensions used shall be those shown on the Plans. No deductions shall be made for weepholes, drainpipes or other openings of less than one square meter in area.

**3.9 Basis Of Payment**

The quantity of masonry, determined as provided in the Methods of Measurement, shall be paid for at the contract unit price per square meter of masonry, which price and payment shall be full compensation for furnishing and placing all materials, including mortar for masonry, for all necessary excavations, and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## DIVISION 5 – METAL

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## **SECTION 05120 -STRUCTURAL STEEL**

### **PART 1 - GENERAL**

#### **1.1 Applicable Publications**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless specified, all publications below shall be of the latest edition.

##### **1.1.1 American Institute of Steel Construction (AISC) Publications:**

Manual of Steel Construction, 13<sup>TH</sup> Edition

Detailing for Steel Construction

Engineering for Steel Construction

##### **1.1.2 American National Standards Institute (ANSI) Publications:**

B18.22.1 Plane Washers

##### **1.1.3 American Society for Testing and Materials (ASTM) Publications:**

A 36 Structural Steel

A 53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

A 108 Steel Bars, Carbon, Cold-Finished, Standard Quality

A 307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

A 325 High-Strength Bolts for Structural Steel Joints

A 370 Mechanical Testing of Steel Products

A 563 Carbon and Alloy Steel Nuts

C 827 Early Volume Change of Cementitious Mixtures

##### **1.1.4 American Welding Society (AWS) Publications**

D 1.1 Structural Welding Code, Steel

##### **1.1.5 Steel Structures Painting Council (SSPC) Publications:**

SSPC SP1 Surface Preparation Specification No. 1, Solvent Cleaning

SSPC SP3 Surface Preparation Specification No. 3, Power Tool Cleaning.

SSPC SP10-91 Surface Preparation Specification No. 10, Near White Blast

## **1.2 Description of Work**

The work includes the fabrication, erection, and shop painting of structural steel in accordance with the AISC "Manual of Steel Construction" referred to herein. In the AISC "Manual of Steel Construction" referred to herein, the Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and the "Code of Standard Practice for Steel Buildings and Bridges", and "structural Joints using A325 or A490 Bolts" shall be considered a part thereto.

## **1.3 Submittals**

1.3.1 Shop Drawings: Submit shop drawings of all structural steel in 5 copies for approval prior to fabrication of structural steel. Include complete information necessary for the fabrication and erection of the component parts of the structure including the location, type and size of all bolts and welds, members sizes and length, camber & connector details, blocks, copes, and cuts. Include all welds by standard welding symbols of the AWS.

1.3.2 Erection Plan: Submit descriptive data to illustrate the structural steel erection procedure including the sequence of erection and temporary shoring and bracing, and written description of the detailed sequence of all welding, including each welding procedure to be performed.

1.3.3 Certificates of Conformance: Submit certificates of conformance for the following:

- a. Steel
- b. Bolts, Nuts and Washers
- c. Welding Electrodes and Rods
- d. Shop Painting Materials
- e. Nonshrink Grout

1.3.4 Certified Test Reports:

- a. Structural Steel: Chemical analysis and tensile strength test required by ASTM A36.
- b. High Strength Bolts and Nuts: Chemical analysis, tensile strength and hardness test required by ASTM A325.
- c. Anchor Bolts: Chemical Analysis Tensile Strength and Hardness Test required by ASTM A 307.

## **1.4 Delivery and Storage**

Handle, ship, and store material in a manner that will prevent distortion or other damage. Store material in a clean, properly drained location out of contact with the ground. Replace all damaged material with new material or repair damaged material in an approved manner at no additional cost to the owner.

## **PART 2 - PRODUCTS**

### **2.1 Steel**

2.1.1 Structural Steel: Shall conform to ASTM A 36.

2.1.2 Steel Pipe: Shall conform to ASTM A 53, Type E or S, Grade B, ASTM A 501.

## **2.2 Bolts, Nuts, and Washers**

- 2.2.1 High Strength bolts for structural steel joints shall conform to ASTM A 325.
- 2.2.2 Anchor bolts shall conform to ASTM A 307.
- 2.2.3 Nuts: ASTM A 563, Grade A, heavy hex style, except nuts under 38 mm may be provided in hex style or equal.
- 2.2.3 Washers: ANSI B18.22.1, Type B or equal.

## **2.3 Accessories**

- 2.3.1 Welding Electrodes and Rods: Steel structural members (built up columns, built up beams, beam to beam, beam to column, and base plate connections, trusses) shall use E70XX electrodes.
- 2.3.2 Non-shrink Grout: ASTM C 827; non-metallic.

## **PART 3 - EXECUTION**

- 3.1 Fabrication: Fabricate in accordance with the applicable provisions of the Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings as set forth in Part 5 of the AISC "Manual of Steel Construction".
  - 3.1.1 Welding of Structural Steelwork: Provide AWS D1.1 qualified welders, welding operators and tackers.
  - 3.1.2 Shop Painting: Except as otherwise specified, shop paint surfaces of all structural steel, except steel to be embedded in concrete or mortar and bearing surfaces. Surfaces to be welded shall not be coated within 12 mm from the specified top of the weld prior to welding (except surfaces on which sheer studs are to be welded. Do not apply paint to steel which is at a temperature that will cause blistering or porosity or will otherwise be detrimental to the life of the paint. Apply paint in a workmanlike manner, and coat all joints and crevices thoroughly. Prior to assembly, paint all surfaces which will be concealed or inaccessible after assembly.
    - a. Cleaning: Wash clean surfaces which become contaminated with rust, dirt, oil, grease or other contaminants with solvents until thoroughly clean. Insure that steel to be embedded in concrete and surfaces when assembled, are free from rust, grease, dirt and other foreign matter.
    - b. Priming: Shop prime coat surfaces as soon as possible after cleaning. Apply two coats of epoxy red lead primer to a minimum dry film thickness of 2.0 mils.
  - 3.1.3 Field Painting: When the erection work is complete, the heads of field bolts, all welds and any surface from which the shop coat of paint has become worn off or has otherwise become defective, shall be cleaned and thoroughly covered with two coats of shop coat paint. When the paint applied for touching up bolt heads and abraded surfaces has become thoroughly dry, apply two field coats of finishing paint to a minimum dry film thickness of 2.0 mils.
  - 3.1.4 Marking: Prior to erection, members shall be provided with a painted erection mark. In addition, connecting parts assembled in the shop for remaining holes in field connections shall be matched marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

### **3.2 Erection**

Except as modified herein, erect steel in accordance with the AISC "Manual of Steel Construction". Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report such condition immediately to the Owner's Representative and obtain approval therefrom for the methods of correction before proceeding with making any corrections. Do not heat-treat parts for straightening. Drain steel work properly; fill pockets in structures exposed to the weather with an approved waterproof material. Provide safety belts and lines for workmen aloft on high structures unless safe working platforms or safety nets are provided. When calibrated wrenches are used for tightening bolts, calibrate them at least once each working day using not less than three typical bolts of each diameter. Do not use impact torque wrenches to tighten anchor bolts set in concrete.

- 3.2.1 Connections: Connections not detailed shall be designed in accordance with AISC "Manual of Steel Construction". Build connections into existing work. Punch, subpunch and ream, or drill bolt holes.
- 3.2.2 Base Plates and Bearing Plates: After final positioning of steel members, provide full bearing under plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.
- 3.2.3 Tolerances: In accordance with the "Code of Standard Practice" of the AISC "Manual of Steel Construction".
- 3.2.4 Temporary Welds and Run-Off Plates and Backing Strips: Need not be removed.

### **3.3 Tests and Inspections**

- 3.3.1 Visual Inspection of Welding: After the welding is completed, hand or power wire brush welds, and thoroughly clean them before the inspector makes the check inspection. Inspect welds with magnifiers under strong, adequate light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size and insufficient throat and concavity. Inspect the preparation of groove welds for adequate throat opening and for snug positioning of backup bars.
- 3.3.2 Nondestructive Testing: AWS D1.1. Twenty five percent of the total number of joints as selected by the Owner's Representative shall be tested. If more than 20 percent of welds contain defects identified by testing, then all welds shall be tested by radiographic or ultrasonic testing, as approved by the Owner's Representative. When all welds made are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

### **3.4 Method Of Measurement**

The quantity of structural metal framing to be paid for shall be the number of kilograms complete in place and accepted.

### **3.5 Basis Of Payment**

The quantities, measured as prescribed in the Method of Measurement, shall be paid for at the contract unit price for the several Pay Items which price and payments shall be full compensation for furnishing, preparing, fabricating, transporting, placing and erecting all structural steel and all other materials for the complete structure; for all shop work, painting and field work; for all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section. Such payment shall constitute full payment for the completed structure ready for use, and no allowance shall be made for cofferdam construction, false

work, or other erection expenses that shall be needed for the correction of misfits and errors in the fabrication.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 05510 - MISCELLANEOUS METALS**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

Furnish materials and equipment and perform all work necessary to complete:

All miscellaneous metal work as shown and as hereinafter specified.

The work includes but is not necessarily limited to the following:

Stainless Steel Ladder Rung  
Manhole Cover including frame and handle  
Anchors  
Checkered plate manhole cover  
and miscellaneous metals

See drawings for sizes, details and location of work required.

#### **1.2 SUBMITTAL**

- a. Shop Drawings: Submit detailed shop drawings for approval prior to ordering materials or fabrication. Show complete information concerning fabrication installation, insert location, joint details, fastenings and other information requested by the Engineer. Shop drawings shall be submitted in accordance with the requirements of the General Conditions.

Minor variation in details for the purpose of improving fabrication and installation procedures, but not affecting the exterior design concept or structural stability will be given consideration if submitted.

#### **1.3 MEASUREMENT AND COORDINATIONS**

Obtain measurements for all work required to be accurately fitted at the job and not from the drawings. The Contractor will be responsible for the accuracy of all such measurements and the precise fitting and assembly of the finish products. Coordinate the work with that of all other trades to prevent interference. Verify conditions at the job before fabrication.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- a. Miscellaneous: Miscellaneous materials or accessories not listed above shall be provided as specified hereinafter the various items of work and/or indicated on the drawings, or in accordance with manufacturer's specifications.

### **PART 3 - EXECUTION**

#### **3.1 WORKMANSHIP**

- a. Make all works well formed to shape and size shown and assemble as detailed.

All items shall be of the materials, design, shape, sizes and thickness shown or called for on the drawings and herein specified. Methods of fabrication and assembly however, unless otherwise specifically stated, shall be of first quality craftsmanship and at the discretion of the Contractors whose responsibility shall be to guarantee satisfactory performance as herein specified.

- b. Cut, shear and punch to produce clean, true lines and surfaces with burrs removed.
- c. Weld or bolt connections as indicated. Use countersunk screws in recessed work where possible. Make all details of assembly strong with sufficient stiffness. Form joints exposed to weather in a manner to exclude water.
- d. Provide all work proper clearances. Fabricate and install in a manner to provide for expansion and contraction but will insure rigidity and provide close fitting of sections.
- e. Fabricate and install as directed by the Manufacturer.
- f. Provide a protective clear coating which is resistant to alkaline, mortar and plaster to be applied to aluminum sections after fabrication.

### 3.2 PROTECTION

Protect all finished work until turnover to the Owner.

### 3.3 METHOD OF MEASUREMENT

The quantity to be paid for shall be the number of set of specified item actually completed and accepted.

### 3.4 BASIS OF PAYMENT

The quantities determined as provided in Method of Measurement shall be paid for at the contract price per unit of measurement, respectively, for each of the particular Pay Item listed on the Bill of Quantities, which price and payment shall constitute full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

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## **SECTION 05520 – HANDRAILS, RAILINGS AND GUARDRAILS**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing of materials and labor including equipment necessary to complete the installation of handrails, railings and guardrails as shown on the drawings and as specified herein.

#### **1.2 SUBMITTAL**

##### **1.2.1 Product Data**

Manufacturer's technical data for products and processed used in handrails, railing, guardrails system, including finishes and grout.

##### **1.2.2 Shop Drawings**

Show details of fabrication and installation for each type and material of handrail, railing, and guardrails required including plans, elevations, sections, profiles of rails, fittings, connections, and anchors.

##### **1.2.3 Samples**

Prepare samples of each type of metal handrails & railings stainless steel hairline finish and automotive paint finish as required on GIP metal. Where finish involves normal color and texture variations, include sample sets composed of two or more units showing limits of such variations expected in completed works.

- a. Include 6" long samples of each distinctly different railing member including guardrails, handrails, top rails, posts, and balusters. Include samples of fittings and brackets if requested by Architect.
- b. Include sample of typical welded connection.

#### **1.3 QUALITY ASSURANCE**

##### **1.3.1 Single Source Responsibility**

Obtain handrails, guardrail and railing systems of each type and material from a single manufacturer.

#### **1.4 STORAGE**

##### **1.4.1 Store handrails, guardrail and railing systems in clean, dry location, away from uncured concrete and masonry, protected against damage of any kind. Cover with waterproof paper, tarpaulin, or polyethylene sheeting; allow for air circulation inside the covering.**

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

##### **2.1.1 General**

Comply with standards indicated for forms and types of metals indicated or required for handrail and railing system components.

- a. Stair Railings: 50 x 8mm thk GI pipe, or as indicated on plans.
- b. Stair Handrail: 50 x 10mm thk pipe, Stainless steel or as indicated on plans.

- c. Guardrail: 50mm x 10mm thick stainless steel pipe or as indicated on plans.
- d. Steel Railings: refer to plans for the required dimension of various types of stainless steel railings and location.

Stair Tread: 6mm thk bended checkered plate.

Fastenings: commercial types, except where special types are shown or required. Fastenings for all exterior work shall be non-ferrous, unless otherwise shown. Fastenings for steel and aluminum and for all other interior work, where exposed, shall match the fastened metal.

Miscellaneous: miscellaneous materials or accessories not listed above shall be provided as specified hereinafter the various items of work and/or indicated on the drawings, or in accordance with manufacturer's specifications.

## 2.2 MISCELLANEOUS MATERIALS

- a. Non-shrink Nonmetallic Epoxy Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, nongaseous grout complying with CE CRD C621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.
- b. Welding Electrodes as recommended by producer of metal to be welded, complying with applicable AWS Specifications, and as required for color match, strength, and compatibility in fabricated items.

- c. Fasteners

Use fasteners of same basic metal as the fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnection of handrail and railing components and for their attachment to other work, except where otherwise indicated.
2. Provide Philips flat head machine screws for exposed fasteners, unless otherwise indicated.

## 2.3 FABRICATION

### 2.3.1 General

Fabricate handrails and railing systems to design, dimensions and details shown. Provide handrail and railing members in sizes and profiles indicated, with supporting posts and brackets or size and spacing shown, but not less than required to comply with requirements indicated for structural performance.

### 2.3.2 Shop Assembly

Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

### 2.3.3 Welded Connections

Fabricate handrails, guardrail and railing systems of materials indicated below for interconnections of members of welding. Use welding method, which is appropriate for metal and finish, indicated and develops strength required to comply with structural

- performance criteria. Finish exposed welds and surfaces smooth, flush, and blended to match adjoining surfaces.
- 2.3.4 Form changes in direction of railing members by bending members by metering, or as indicated on the drawing, as approved by the Architect.
- 2.3.5 Furnish inserts and other anchorage devices for connecting handrails, guarail and railing systems to concrete or masonry work. Fabricate anchorage devices, which are capable of withstanding loading imposed by handrails, guardrails and railing systems. Coordinate anchorage devices with supporting structure.
- a. For railing, and guardrail posts set in concrete provide pre-chiseled openings and insert posts as indicated on drawings. Fill opening with non-shrink, non-metallic grout.

## 2.4 METAL FINISHES, GENERAL

Comply with NAAMM "Metal Finishes Manual" for recommendations and designations of finishes, except as otherwise indicated.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- a. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete and masonry construction. Coordinate delivery of such items to project site.
- b. Field Measurements
- Take field measurements prior to fabrication.

### 3.2 INSTALLATION, GENERAL

- a. Fit exposed connections accurately together to form tight, hairline joints.
- b. Perform cutting, drilling, and fitting required for installation of handrails, guardrail and railing systems. Set work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.
- c. Field Welding
- Comply with applicable AWS specification for procedures of manual shielded metal-arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent rail surfaces.
- d. Prior to anchoring, adjust handrails and railing systems to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loading.

### 3.3 ANCHORING POSTS

- a. Concrete-Anchored Posts: Provide chiseled opening on concrete base as indicated on the drawings to receive railing posts and required anchoring system. Clean holes of all loose material, insert posts, and fill annular space between post and concrete with non-shrink, non-metallic epoxy grout, mixed and placed to comply with grout manufacturer's directions.

### 3.4 RAILING CONNECTIONS

- a. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact or use manufacturer's standard fittings designed for this purpose.

### 3.5 ANCHORING RAILING ENDS

- a. Anchor railing ends to metal surfaces with manufacturer's standard fittings using concealed fasteners, unless otherwise indicated.
- b. Anchor Railing Ends to Concrete or Masonry, use drilled-in expansion shields and concealed hanger bolts, unless otherwise indicated.

### 3.6 PROTECTION

- a. Protect finishes of railing, handrails and guardrails system from damage during construction period by use of temporary protective coverings approved by railing manufacturer. Remove protective covering at time of Substantial Completion.
- b. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items which cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units as required.

### 3.7 METHOD OF MEASUREMENT

The quantity to be paid for shall be the number of linear meters of specified railing actually completed and accepted.

### 3.8 BASIS OF PAYMENT

The quantities determined as provided in Method of Measurement shall be paid for at the contract price per unit of measurement, respectively, for each of the particular Pay Item listed below and shown on the Bill of Quantities, which price and payment shall constitute full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

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## DIVISION 6 – WOODS AND PLASTICS

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## **SECTION 06400- FINISH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the supply and furnishing of materials including equipment and performing labor necessary to complete the installation of all finish carpentry works as shown on drawings and specified herein.

#### **1.2 SUBMITTALS**

Submit to the Architect and Owner the following for approval.

##### **1.2.1 Shop Drawings**

Show all prefabricated millwork. Include details and erection data associated with the work of other trades; materials and species; arrangements; profiles of moldings; thickness; sizes of parts; construction; fastenings; and clearances.

##### **1.2.2 Certificates of Grade:**

Submit certificates from the grading agency on graded but unmarked lumber of plywood attesting that materials meet the grade requirements specified herein.

##### **1.2.3 Samples:**

Interior trim and moldings: One linear foot of each kind.

#### **1.3 DELIVERY AND STORAGE**

Deliver lumber, plywood, trim, and mill work to the jobsite in an undamaged condition. Stack materials to ensure ventilation and drainage and protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in the building until wet trade materials are dry.

#### **1.4 GRADE AND QUALITY MARKING**

##### **1.4.1 Lumber**

The trademark of a recognized association shall identify each piece or each bundle of lumber, millwork, and trim.

##### **1.4.2 Plywood**

Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, and shall show exposure durability classification, grade, and compliance with PTS 631-02.

#### **1.5 SIZES AND PATTERNS OF WOOD PRODUCTS**

Yard and board lumber sizes shall conform to PTS 20. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the applicable standard.



## 1.6 MOISTURE CONTENT OF WOOD PRODUCTS

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. The maximum moisture content of wood products at time of delivery to the job site shall be 17 percent.

## 1.7 LUMBER GRADE AND SPECIES

- a. All lumber shall be grade "Clear".
- b. Clear shall be sound lumber and free of rot, unsound knots, shake, splits, dry-rot or other defects impairing the strength of the piece.

# PART 2 - PRODUCTS

## 2.1 MATERIALS

Expansion Shield shall be of high quality, heavy duty, with size, group, type, class, and style best suited for the purpose. Shield shall be accurately recessed and shall be not less than 63 mm into concrete or masonry.

- a. Nails and Staples shall be of best quality with type and size best suited for the purpose. Nails may be of the annular ring or the screw type, with mechanically deformed shanks.
- b. Lumber for interior millwork, shelves, wardrobes, wood base, finish and trim shall be Tanguile, grade "Clear".
- c. Plywood shall conform to PTS 631-02.
- d. Plastic Laminate Sheet:

High pressure laminate shall meet minimum standards for decorative laminate by National Electric Manufacturer's Association (NEMA) Publication No. LD3. The sheets shall be not less than 1.6 mm (1/16") thick, color as selected from manufacturer's standard. The sheets shall be furnished in units as large as practicable, ready for bonding with backing material. Adhesive for bonding with backing material shall be as specified herein.

- e. Adhesives:

For Interior Millwork and Woodwork: Shall be of best quality, water and mold resistant.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- a. Requirements: Lumber and woodwork shall be covered and protected from the elements until used. All lumber shall be surfaced-four side. All materials for millwork shall be kiln-dried. Where practicable, shop assemblies and finishes items of built-up millwork. Material shall show no warp after installation. Fasten finish work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping. All lumber surfaces in contact with concrete and masonry shall receive one brush coat of bituminous paint.

## 3.2 METHOD OF MEASUREMENT

Single check-in counter and ticketing counter shall be measured by will be measured by the number of set installed and accepted.

### 3.3 BASIS OF PAYMENT

The quantities determined as provided in Method of Measurement shall be paid for at the contract price per unit of measurement, respectively, for each of the particular Pay Item listed below and shown on the Bill of Quantities, which price and payment shall constitute full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made in accordance with the Bill of Quantities.

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## **DIVISION 7 – THERMAL AND MOISTURE**

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## **SECTION 07102 - ELASTOMERIC WATERPROOFING SYSTEM, FLUID-APPLIED**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing and supply of materials including equipment, and performing labor necessary to complete the installation of fluid applied elastomeric waterproofing system for escalator and elevator pits and as shown on plans and specified herein.

#### **1.2 SUBMITTALS:**

Submit the following for approval:

##### **1.2.1 Certificates of Compliance**

Manufacturer's certificates of compliance attesting that fluid membrane materials are physically and chemically compatible with each other.

##### **1.2.2 Manufacturer's Data**

Includes material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity. Submit for:

- a. Fluid-applied membrane component, including primers
- b. Elastomeric sheets
- c. Cleaner, activating solvent

##### **1.2.3 Samples**

Submit mock-up samples for each waterproofing type.

#### **1.3 DELIVERY AND STORAGE**

Deliver manufactured waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by referenced specification number shall bear the specification number, type, and class of the contents. Store and protect materials in accordance with the manufacturer's instructions, and use within their indicated shelf life. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture. Use pallets and canvas tarpaulins to cover stored materials top to bottom.

#### **1.4 ENVIRONMENTAL CONDITIONS**

Apply materials when there is no surface moisture, or visible dampness on the substrate surface. Ensure the air temperature remains above the temperature recommended by the manufacturer. Moisture test for substrate is specified under Item 3.4, "Field Tests". Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum temperature recommended by the manufacturer, for 24 hours prior to the application of the waterproofing, and remains above that the temperature during the cure period recommended by the manufacturer.

#### **1.5 WATERPROOFING CONFERENCE**

Prior to starting application of the waterproofing system arrange a pre-waterproofing

conference to ensure a clear understanding of drawings and specifications. Give the Owner 7 days advance written notice of the time and place of meeting. The contractor, mechanical and electrical sub-contractor, flashing sheets metal sub-contractor, and other trades that may do other types of work on or over the membrane after installation shall attend this conference.

## **PART 2 - PRODUCTS**

### **2.1 FLUID-APPLIED MEMBRANE ASTM C 836**

#### **2.1.1 Membrane Primer**

Primers, unless specifically prohibited by the manufacturer of the fluid-applied membrane, are required and shall be as recommended by the fluid-applied membrane.

### **2.2 SEALANT**

As specified in Section 07900, "Sealant and Caulking".

### **2.3 SEALANT PRIMER**

As specified in Section 07900, "Sealant and Caulking"

### **2.4 JOINT FILLER**

Joint filler shall conform to ASTM D1751 or D1752.

### **2.5 BOND BREAKER**

Bond breaker shall be as recommended by the manufacturer of the fluid-applied membrane. The bond breaker shall not interfere with the curing process or other performance properties of the fluid-applied membrane.

### **2.6 ELASTOMERIC SHEET**

Elastomeric sheet shall be preformed sheet as recommended by the fluid-applied membrane manufacturer. The bond strength between the fluid-applied membrane and the preformed elastomeric sheet shall be not less than 6.9 MPa when tested in accordance with ASTM C836.

### **2.7 ELASTOMERIC SHEET ADHESIVE**

Elastomeric sheet adhesive shall be as recommended by the elastomeric sheet manufacturer.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

Coordinate the work with that of other trades to assure that components to be incorporated into the waterproofing system are available when needed. Inspect and approve surfaces immediately before the application of the waterproofing materials. Free concrete surfaces of laitance, loose aggregate, sharp projections, grease, oil, dirt, curing compounds, and other contaminants that could adversely affect the complete bonding of the fluid-applied membrane to the concrete surface.

#### **3.1.1 Flashings**

Do not begin application until penetrations through the structural slab are in place, and until

sleeves are placed through the slab and are made watertight.

#### 3.1.1.1 Drains

Drain flanges shall be flush with the surface of the structural slab. Apply a full elastomeric sheet around the drain, with edges fully adhered to the drain flange and to the structural slab. Do not adhere the elastomeric sheet over the joint between the drain and the concrete slab. Take care not to plug any drainage or weep holes. Cover the elastomeric sheet with fluid-applied waterproofing during waterproofing application. The elastomeric sheet shall be adhered a minimum of 100 mm (4") into the horizontal deck. Cover this portion of the elastomeric during waterproofing application.

#### 3.1.1.2 Other Penetration and Projections

Flash penetrations and projections, including vents and service pipes, through the structural slab with an elastomeric sheet adhered to the concrete slab and the penetration. Leave the elastomeric sheet unadhered for 25 mm (1") over the joint between the penetration and the concrete slab. The elastomeric sheet shall be adhered a minimum of 100 mm (4") onto the horizontal deck. Cover the elastomeric sheet with fluid-applied waterproofing during the waterproofing application.

#### 3.1.1.3 Walls and Vertical Surfaces

Flash wall intersections which are not of monolithic pour or constructed with reinforced concrete joints with an elastomeric sheet adhered to both the vertical wall surface and the concrete slab. Intersections that are monolithic pour or constructed with reinforced concrete joints with an elastomeric sheet adhered to both the vertical wall surface and the concrete slab can be flashed with a vertical grade of fluid-applied waterproofing membrane. Leave the sheet unadhered for a distance of 300 mm (12") from the corner on both the vertical and horizontal surfaces. Cover the elastomeric sheet with fluid-applied waterproofing during waterproofing application.

#### 3.1.2 Cracks and Joints

Prepare visible cracks and joints in the substrate to receive application of the waterproofing membrane by separating these joints from the waterproofing membrane by placing bond breaker and an elastomeric slip between the membrane and the substrate. Cracks that show movement shall receive a 50 mm (2") bond breaker followed by an elastomeric sheet adhered to the deck. Nonmoving cracks shall be double coated with the fluid-applied waterproofing.

#### 3.1.3 Priming

Prime surfaces to receive the fluid-applied waterproofing membrane. Apply the primer as required by the membrane manufacturer's printed instructions.

### 3.2 SPECIAL PRECAUTIONS

Protect components during transport and application of waterproofing materials. Do not dilute primers and other materials, unless specifically recommended by the materials manufacturer. Keep containers closed except when removing the contents. Do not allow contact of various materials through mixing of remains and dual use of application equipment for mixing and transporting materials. Do not permit equipment on the project site that has residue of materials on previous projects. Use cleaners for cleaning, not for thinning primers of membrane materials. Ensure that workers and other who walk on the cured membrane wear clean, soft-soled shoes to avoid damaging the waterproofing materials.

### 3.3 APPLICATION

Over the primed surfaces, provide a uniform, monolithic coating of fluid-applied membrane, 60 mils thick, plus or minus 5 mils thick, by following the manufacturer's printed instructions. Apply material by trowel, squeegee, roller, brush, spray apparatus, or other method acceptable to the membrane manufacturer. Check wet film thickness as specified under Item 3.4, "Field Tests", and adjust application rate as necessary to provide a uniform coating of the thickness specified. Where possible, mark off the surface to be coated in even units to facilitate proper coverage. At expansion joints, control joints, prepared cracks, and termination, carry the membrane over the preformed elastomeric sheet in a uniform 60 mils thick, plus or minus 5 mils, wet thickness to provide a monolithic coating. When work has stopped long enough for the membrane to cure, begin the next application by wiping the previously applied materials with a solvent so that accumulated dirt and dust, which could inhibit adhesion of the overlapping membrane coat, is removed. Use solvent recommended by the membrane manufacturer, as approved.

### 3.3.1 Work Sequence

Perform the work so that protection board is installed prior to using the waterproofed surface. Do not permanently install protection board until the membrane has passed the flood test specified under Item 3.4, "Field Tests". Move material storage areas as work progresses to prevent abuse of the membrane and overloading the structural deck.

### 3.3.2 Protection Board

Protect the fluid-applied membrane by placing protection board over the membrane. Timing of placement shall fall within the parameters established by the fluid-applied membrane manufacturer. Protect membrane application if the protection board is not placed immediately. Butt protection boards together and do not overlap.

## 3.4 FIELD TESTS

### 3.4.1 Moisture Test

Prior to application of the waterproofing, check moisture content of substrate with moisture meter. An acceptable device is the Delmhorst Moisture Meter, Model BD7/2E/CS, Type 21 E. Similar meters by other manufacturers, which are suitable for the purpose, may be used as approved. Do not begin application until the meter reading indicates "dry" range or similar reading indicating that substrate is suitably dry.

### 3.4.2 Film Thickness

Check wet film thickness every 10 square meters during application by placing flat metal plates on the substrate or using a mil-thickness gauge especially manufactured for the purpose.

### 3.4.3 Flood Test

After application and curing is complete, plug drains and fill the waterproofed area with water to a depth of 50 mm (2"). A minimum 48-hour cure time shall be required prior to flood testing in order to ensure full cure of the membrane and adhesive prior to subjecting them to full flood test of water. Allow water to stand 24 hours. Test water tightness by carefully measuring the water level at the beginning and end of the 24-hour period. In the event that the water level falls drain the water, allow the installation to dry, and inspect. Make repairs or replace as required and repeat the test. Work shall not proceed before approval of repairs or replacement.

## 3.5 AREAS OF APPLICATION

- a. 5 Ply Elastomeric Membrane Waterproofing or approved equal, buried type waterproofing.

3.6 METHOD OF MEASUREMENT

Elastomeric waterproofing shall be measured by actual area in square meter installed and accepted.

3.7 BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price for Elastomeric Waterproofing which price and payment shall constitute full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals, necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 07103 - ELASTOMERIC ACRYLIC WATERPROOFING SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing and supply of materials including equipment, and performing labor necessary to complete the installation of elastomeric acrylic waterproofing system applied as coating for roof, as shown on plans and specified herein.

#### **1.2 SUBMITTALS:**

Submit the following for approval:

##### **1.2.1 Manufacturer's Data**

Includes material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

##### **1.2.3 Samples**

Submit mock-up samples for each waterproofing type.

#### **1.3 DELIVERY AND STORAGE**

Deliver manufactured waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by referenced specification number shall bear the specification number, type, and class of the contents. Store and protect materials in accordance with the manufacturer's instructions, and use within their indicated shelf life. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture. Use pallets and canvas tarpaulins to cover stored materials top to bottom.

#### **1.4 ENVIRONMENTAL CONDITIONS**

Apply materials when there is no surface moisture, or visible dampness on the substrate surface. Ensure the air temperature remains above the temperature recommended by the manufacturer. Moisture test for substrate is specified under Item 3.4, "Field Tests". Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum temperature recommended by the manufacturer, for 24 hours prior to the application of the waterproofing, and remains above that the temperature during the cure period recommended by the manufacturer.

#### **1.5 WATERPROOFING CONFERENCE**

Prior to starting application of the waterproofing system arrange a pre-waterproofing conference to ensure a clear understanding of drawings and specifications. Give the Owner 7 days advance written notice of the time and place of meeting. The contractor, mechanical and electrical sub-contractor, flashing sheets metal sub-contractor, and other trades that may do other types of work on or over the membrane after installation shall attend this conference.

### **PART 2 - PRODUCTS**

#### **2.1 ELASTOMERIC ACRYLIC WATERPROOFING**

This waterproofing is made of water-based acrylic resin system which is filled with minute heat shield cells which act as a thermally resistant blanket covering the whole treated

structure. When applied, the Ultraviolet and heat rays are reflected and emitted from the surface, reducing the thermal conductivity between the substrate and the coating. Hence, roof surfaces treated with elastomeric acrylic membrane can experience interior temperature reduction up to 10 degree Celsius. This roof coat also has excellent dirt pick-up resistance and is able to retain elasticity even after aging.

### **PART 3 - EXECUTION**

#### **3.1 SURFACE PREPARATION**

All surfaces must be clean & free from laitance, dust, dirt, oil & grease. Surfaces should be power washed prior to coating without damaging the roof or cause leaks. Clean the area & apply primer to the unpainted surfaces. Let the primer dry thoroughly before applying the color coat. For painted surfaces, it is required to remove all flakes paints & apply one coat of primer.

#### **3.2 Application**

Elastomeric acrylic membrane can be applied by roller, brush or airless spray & should be applied on touch dry between coats.

- a. For roller, use a roller to larger areas & use the largest one that fits in the areas to be covered.
- b. For brush, use on small or narrow areas & cross brush 3 coats or as per manufacturer's instruction for adequate protection.
- c. For airless spray, tip orifice: 0.031"/ atomizing pressure: 2200-2500 psi. For Pump : 3 liters per minute at 2500 psi prime pump with water before using elastomeric acrylic membrane coating. Filter: Remove filters & screens.

#### **d. Cleaning Equipment**

Clean equipment with soapy water followed by rinsing with clean water. Flush mineral spirits through spray equipment to prevent rust.

#### **e. Curing**

Curing shall be 45 minutes.

#### **3.3 METHOD OF MEASUREMENT**

Elastomeric acrylic waterproofing shall be measured by actual area in square meter installed and accepted.

#### **3.4 BASIS OF PAYMENT**

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price for Elastomeric Acrylic Waterproofing which price and payment shall constitute full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals, necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 07150 - POLYURETHANE BASED APPLIED WATERPROOFING SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing and supply of materials including equipment, and performing labor necessary to complete the installation of polyurethane based applied waterproofing system for canopy, suspended slab deck, toilets and as shown on plans and specified herein.

#### **1.2 SUBMITTALS:**

Submit the following for approval:

##### **1.2.1 Manufacturer's Data**

Includes material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

##### **1.2.3 Samples**

Submit mock-up samples for each waterproofing type.

#### **1.3 DELIVERY AND STORAGE**

Deliver manufactured waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by referenced specification number shall bear the specification number, type, and class of the contents. Store and protect materials in accordance with the manufacturer's instructions, and use within their indicated shelf life. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture. Use pallets and canvas tarpaulins to cover stored materials top to bottom.

#### **1.4 ENVIRONMENTAL CONDITIONS**

Apply materials when there is no surface moisture, or visible dampness on the substrate surface. Ensure the air temperature remains above the temperature recommended by the manufacturer. Moisture test for substrate is specified under Item 3.4, "Field Tests". Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum temperature recommended by the manufacturer, for 24 hours prior to the application of the waterproofing, and remains above that the temperature during the cure period recommended by the manufacturer.

#### **1.5 WATERPROOFING CONFERENCE**

Prior to starting application of the waterproofing system arrange a pre-waterproofing conference to ensure a clear understanding of drawings and specifications. Give the Owner 7 days advance written notice of the time and place of meeting.

### **PART 2 - PRODUCTS**

#### **2.1 Exposed Type Trafficable Polyurethane Waterproofing**

The polyurethane based liquid applied waterproofing is a single component, ready to use, highly elastic, cold applied polyurethane waterproofing which cures into a membrane with excellent abrasion, mechanical, chemical, thermal, and UV resistance.

## 2.2 Bitumen Modified Polyurethane Liquid Membrane

Liquid Applied Polyurethane waterproofing shall be one part coal-tar-free bitumen modified, moisture curing polyurethane coating. After curing it provides tough highly elastomeric membrane, impervious barrier to moisture.

### **PART 3 - EXECUTION**

## 3.1 EXPOSED TYPE TRAFFICABLE POLYURETHANE WATERPROOFING

### 3.1.1 Surface Preparation

Substrate moisture should not exceed 5% (use moisture meter or polyethylene test in accordance with ASTM D 4263). New concrete structures need to dry until the required strength is acquired.

The substrate must be clean and free from all traces of loose materials, old coatings, curing compounds, release agents, laitance, and oil grease. It should be saturated surface dry (SSD) condition.

Structurally unsound layers or surface contaminants must be mechanically removed by abrasive blast tracking, shot blasting, scarifying, or grinding. Substrates heavily impregnated with oil must be cleaned by torching, using suitable solvent or degreaser substance.

Weak concrete must be removed and surface defects such as blow holes and voids must be fully exposed.

All ducts, loose and friable material must be completely removed from all surfaces before application of product, preferably brush and/or vacuum.

### 3.1.2 For new Construction: (exposed-type roof deck application)

- a. For a well prepared and mechanically sound concrete slab, apply waterproofing screed to attain desired slope-to-drain surface level.
- b. Anticipate cold joints during Screed pouring. With these joints, create a V-cut profile using concrete grinder or router with the size of approximately 2 inches on both edge diagonally.
- c. Apply polyurethane sealant to fill completely the V-cut profile, about 1.5 inches in depth. Once the sealant is cured, create a strip of 25 wet mils waterproofing, 3 inches on each side.

### 3.1.3 For pipe vent or penetration:

- a. Seal the gap between pipe and slab using polyurethane sealant for about 2 inches in diameter.
- b. Apply a strip of 25 wet mils waterproofing, 3 inches each side of the sealant around the pipe.

### 3.1.4 For flashing and wall application:

Apply polyurethane sealant with approximate 20mm width and 20mm height in all corners where the floor meets the wall.

After the sealant has cured, create a strip of 25 wet mils waterproofing measuring 3 inches

on each side.

### 3.1.5 Priming

For porous substrates like concrete, cement mortar, or wood, use primer, then apply waterproofing within 2-3 hours (not later than 4 hours) when the primer is still a little bit tacky.

For non-porous substrates like metals, ceramic tiles, use primer, then apply waterproofing within 6-12 hours (not later than 24 hours) when the primer is still a little bit tacky.

### 3.1.6 Mixing

Stir the material well by means of an electric stirrer (approx. 500 rpm). Mixing time at least 2-3 minutes until homogenous mixture is achieved.

### 3.1.7 Application

- a. After application of appropriate primer and observing its curing time, using brush or roller consistently cover the whole area with waterproofing coating system as per manufacturer's recommendation.
- b. Second coat has to be applied within 18 hours (not later than 48 hours), if necessary.
- c. Ensure that the waterproofing coating layers overlap by at least 3 inches beyond previously applied detailing strip.

## 3.2 BITUMEN MODIFIED POLYURETHANE LIQUID MEMBRANE

### 3.2.1 Surface Preparation

To ensure optimum results, the surface must be clean, dry and structurally sound, free from contaminants, including but not limited to dust, dirt, loose particles, rust, and oil. before application of waterproofing. New concrete must have cured for 28 days.

### 3.2.2 Application

- a. Liquid Applied Polyurethane (PU) Waterproofing can be applied by brush, roller or squeegee.
- b. Seal all cracks or joints of up to 20 mm in width with polyurethane sealant before the application of liquid applied waterproofing.
- c. Waterproofing can be applied immediately over the polyurethane sealant and seal after initial set of approximately 60 minutes at 25°C.
- d. Waterproofing shall be applied to achieve a dry film thickness between 1.0 to 1.2 mm minimum for optimum performance. To achieve this dry film thickness apply waterproofing at 1.2m/liter/coat. Extremely porous surfaces should be filled prior to coating and a second coat of waterproofing shall be applied.
- e. Apply waterproofing evenly to avoid thin spots, air entrapment or pin holes. Any defects can be repaired by over coating and a second coat of waterproofing may be applied as needed.
- f. For applications where two coats of waterproofing are required, allow 24 hours between coats. Protection board must be used to protect the membrane before back

filling or concreting. If applied waterproofing is damaged, it can be repaired by cleaning the surface and recoating with the said type of waterproofing.

### 3.3 METHOD OF MEASUREMENT

Polyurethane based waterproofing system shall be measured by actual area in square meter applied and accepted.

### 3.4 BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price for the polyurethane based waterproofing system which price and payment shall constitute full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals, necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 07160 – CEMENTITIOUS WATERPROOFING SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing and supply of materials including equipment, and performing labor necessary to complete the application of cementitious waterproofing system as shown on plans and specified herein.

#### **1.2 SUBMITTALS:**

Submit the following for approval:

##### **1.2.1 Manufacturer's Instruction**

Submit to the Engineer the manufacturer's complete printed instructions for the application of the material.

##### **1.2.2 Samples**

Submit mock-up samples for each waterproofing type.

#### **1.3 DELIVERY AND STORAGE**

Deliver manufactured waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by referenced specification number shall bear the specification number, type, and class of the contents. Store and protect materials in accordance with the manufacturer's instructions, and use within their indicated shelf life. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture. Use pallets and canvas tarpaulins to cover stored materials top to bottom.

#### **1.4 ENVIRONMENTAL CONDITIONS**

Apply materials when there is no surface moisture, or visible dampness on the substrate surface. Ensure the air temperature remains above the temperature recommended by the manufacturer. Moisture test for substrate is specified under Item 3.4, "Field Tests". Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum temperature recommended by the manufacturer, for 24 hours prior to the application of the waterproofing, and remains above that the temperature during the cure period recommended by the manufacturer.

### **PART 2 - PRODUCTS**

#### **2.1 CEMENTITIOUS WATERPROOFING**

Cementitious waterproofing material is a special formulated acrylic polymer designed for compounding with Portland cement. The resulting mixture possesses excellent adhesion, water resistance and flexibility even on thin section. It has also excellent sunlight exposure resistance.

When mixed with cement, the waterproofing material forms a seamless, non-porous impenetrable layer that disperses any liquid upon contact, preventing any seepage when applied on both vertical and horizontal surfaces.

### **PART 3 - EXECUTION**

#### **3.1 SURFACE PREPARATION**

New masonry surfaces should be allowed to cure at least 14 to 28 days. Surface should be clean, free from oil, grease, dirt, and loose grit or mortar. Wet masonry surfaces first with water before applying the mixture to avoid abrupt drying and cracking of the applied modified cement, under hot and sunny condition.

#### **3.2 APPLICATION**

- a. Add cement to the waterproofing material slowly while stirring to prevent lumping. Pass mixture through a fine strainer to sift out lumpy materials. Ensure intimate mixing, stirring as often as possible to avoid settling. Keep mixture proportion constant for a uniform texture. Mix enough material to prevent waste. Workability of the waterproofing mixture is 30 minutes, while potlife is 2 hours.
- b. For vertical surface such as firewalls, apply 2 coats of the mixture by textured roller or 3 coats by brush.
- c. For mortar patching, apply the waterproofing mixture using applicable trowels.
- d. For maximum durability, topcoat application is recommended. Allow the waterproofing material to dry at least one day before paint application.

#### **3.3 METHOD OF MEASUREMENT**

Cementitious waterproofing shall be measured by actual area in square meter installed and accepted.

#### **3.4 BASIS OF PAYMENT**

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price for Cementitious Waterproofing which price and payment shall constitute full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals, necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.



## **SECTION 07410 - PREPAINTED HORIZONTAL ROOFING SHEET**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing and supply of materials including equipment, and performing labor necessary to complete the installation of all prepainted horizontal roofing sheet as shown on drawings and as specified herein. The works shall include flashings, trims, accessories and other supplementary materials required for a complete watertight and weather-tight installation.

#### **1.2 SUBMITTALS:**

##### **1.2.1 Descriptive Data**

Submit descriptive data on materials to be provided. Data shall be sufficient to indicate conformance to specified requirements.

##### **1.2.2 Shop Drawings**

Submit shop drawings showing erection and installation details, indicating type, elevations, gauges, fastening and anchoring systems, and other construction details for the following:

- a. Roof
- b. Flashings and Trims
- c. Joint sealing
- d. Fastener layouts and sizes
- e. Corners
- f. Supports
- g. Anchorage
- h. Closure and special details

##### **1.2.3 Manufacturer's Certificates of Conformance**

Submit certificates for all materials to be provided under this section.

##### **1.2.4 Color Sample**

Submit two (2) samples of each color indicated or specified.

#### **1.3 DELIVERY AND STORAGE**

Deliver, store, and handle panels and other manufactured products to prevent damage. Stack materials stored on the site on platform or pallets and cover with tarpaulins or other suitable weather-tight covering. Store panels so that water, which might have accumulated during transit or storage, will drain off; do not store the panels in contact with materials that might cause staining. Inspect the panels upon arrival to the job site; if wet, remove the moisture and restack and protect the panels until used.

#### **1.4 FACTORY TESTS**

The manufacturer shall have conducted tests on previously manufactured sheets of the same type and finish as proposed for the project to assure conformance with quality requirements.

#### 1.5 GUARANTEE

Submit a five (5) year paint warranty that the finished paint coating shall be free of defects, fading color, cracking, flaking or any failure of color finish quality.

### **PART 2 - PRODUCTS**

#### 2.1 GALVANIZED PRE-PAINTED HORIZONTAL ROOFING SHEETS

The prepainted horizontal roofing sheet, shall be 6mm thick x 305mm galvanized cold rolled steel-complying to JIS G 3141 SPCC coated with the eutectic mixture of zinc and aluminum (95/5), complying to ISO 14788, commercial quality.

### **PART 3 – EXECUTION**

#### 3.1 ROOF FRAMING

Roof frames should be well-anchored. Rafters and trusses should be straight, level and parallel to each other. Regular spacing between rafters and trusses should be based on 0.6mm metal thickness and profile of roof to be installed as per manufacturer's recommendation. Provide top grid along ridge line and bridging at mid-span between rafters parallel to top grid.

Double rafters should be provided with 0.10 meter (4 in.) clear space between rafters along valley gutter line. Gutters should be installed before any roofing is laid. Insufficient roof framing anchorage brings about the danger of wind and storm pressure lifting off the whole roof including the roof framing system.

#### 3.2 ROOF CARE DURING INSTALLATION

If possible, carry out all panel cutting on a flat surface. Use a straight edge as a guide and mark off the length where the cut is to be made. Roof panels must be free from concreting works cement, water-proofing compounds, chemical solutions, paint, welding sparks, nails, or iron tools. Removal or scraping of such may cause damage to the roof panels.

Scaffoldings should have protective caps on the points of contact with the roof and should be rested with care on roof edges, gutters and end-flushing to prevent dents and scratches. Roof traffic should be minimized. When crossing the roof area, walking should be conducted along roof frame locations, along overlaps or on wooden planks laid over the roof panels. Walking on the ridges or valleys between the purlins may dent the roofing.

#### 3.3 PAINT COATING SYSTEM

Standard Coating shall be factory applied. The paint is oil free polyester, over baked to achieve full curing to satisfy the requirements of both PNS and JIS Standards. Coating shall have a top coat of 15-18 microns for exterior surfaces. Primer and service coat with 5-7 microns. Exterior color as selected and approved by the Owner and Architect/Engineer.

#### 3.4 CLEANING UP

Pick up all discarded scrap materials, especially ferrous metals such as nails and wires. Immediately wash all plastering site with water. Clean all gutters of leaves and other waste refuse to prevent clogging at downspout areas and allow the continuous flow of water.

To attain its original bright luster finish, wipe the panel with a wet rag and follow up with a clean rag.

### 3.5 STORAGE REMINDER

Panels should be stacked neatly in a dry and covered areas to prevent capillary action which could cause rainwater or condensation to be drawn between the sheets. If it is necessary to store the panels in the open, cover completely with loose tarpaulin or similar material and stack with one end slightly elevated. Remember that permanent damage may result if the panels remain wet and clustered together for a long period of time.

### 3.6 METHOD OF MEASUREMENT

The galvanized pre-painted horizontal roofing sheets shall be measured by the number of square meters installed and accepted.

### 3.7 BASIS OF PAYMENT

The quantity measured as provided above shall be paid for at the contract unit price for galvanized pre-painted horizontal roofing sheets, which price and payment shall be full compensation for furnishing and placing all materials including roof insulation, sheet metal accessories and gutter, and all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 07412 - ROOF INSULATION**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing of materials including equipment and performing labor necessary to complete the installation of interior roof insulation as shown on drawings and as specified herein.

#### **1.2 APPLICABLE PUBLICATIONS**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

##### **1.2.1 American Society for Testing and Materials (ASTM) Publications:**

D4397-84 Polyethylene Sheet for Construction, Industrial and Agricultural Applications.E84-

84 Surface Burning Characteristics of Building Materials

#### **1.3 SUBMITTALS**

##### **1.3.1 Manufacturer's Instruction**

Submit manufacturer's complete printed instructions for the installation of materials.

##### **1.3.2 Samples**

Submit samples of materials to be used and secure approval prior to installation.

#### **1.4 DELIVERY AND STORAGE**

Deliver materials to the site in the original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect materials from damage. Do not allow insulation materials to become wet or soiled. Comply with manufacturer's recommendation for handling, storage, and protection during insulation.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIAL**

The roof insulation shall be double bubble/double foil with minimum thickness of 7.5mm and R value = 19. It consists of air bubble pockets made of high density polyethylene, thermally bonded and sandwiched by layer of pure aluminum foil. Provide chicken wire mesh prior to the laying of bubble insulation. Provide chicken wire mesh prior to the laying of bubble insulation.

### **PART 3 – EXECUTION**

#### **3.1 INSTALLATION**

- a. Before installing insulation, ensure that the areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation. If moisture or other conditions are found that do not allow the workmanlike

installation of the insulation, do not proceed but notify the Engineer of such conditions.

- b. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used. As required observe safe work practices.
- c. Install insulation material according to the direction and procedure of the manufacturer.

### 3.2 METHOD OF MEASUREMENT

The Blanket insulation shall be measured by actual area in square meters installed and accepted.

### 3.3 BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price for roof insulation which price and payment shall constitute full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals, necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 07900 - SEALANTS AND CAULKING**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing and supply of materials including equipment and performing labor necessary to complete installation of all sealants and caulking work as shown on drawings and specified herein.

#### **1.2 APPLICABLE PUBLICATIONS**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

##### **1.2.1 American Society for Testing and Materials (ASTM) Publications:**

C 834-76          Latex Sealing Compounds  
(Rev.86)

C 920-86          Elastomeric Joint Sealants

#### **1.3 SUBMITTALS**

##### **1.3.1 Certificates of Conformance**

Submit certificates from the manufacturers attesting that materials meet the specified requirements.

##### **1.3.2 Manufacturers' Data**

Clearly mark data to identify material type provided. Submit complete descriptive data for:

###### **a. Sealants**

Data for sealant and caulking shall include application instructions and precautions, self life, mixing instructions for multi-component sealants and recommended cleaning solvent. Silicone sealant should not be used in all the buildings.

###### **b. Primers**

###### **c. Backstop Materials**

##### **1.3.3 Colors**

Submit one sample of each color for each sealant type to verify that products match the colors indicated. Where colors are not indicated, submit not less than 3 different samples of manufacturer's standard colors.

##### **1.3.4 Manufacturer's Test Report**

Indicate sealant compatibility with commonly used substrates.

#### **1.4 SAMPLE JOINTS**

Before sealant work is started, provide a sample of each type of finished joint where directed. Sample shall show the workmanship, bond, and color of sealant. The workmanship, bond, and color of sealant work throughout the project shall match the approved sample joints.

## 1.5 ENVIRONMENTAL CONDITIONS

The ambient temperature shall be within the limits of 40 and 100 degrees F when the sealant is applied.

## 1.6 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturer's external shipping containers, unopened, with brand names, date of manufacture and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled as to type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 37.8 degrees or less than 4.5 degrees C.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

Products shall conform to the reference documents listed for each use. Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

#### 2.1.1 Interior Sealant: ASTM C 834, Type S or M, Grade NS, Class 12.5, Use NT. Locations and colors of sealant shall be as follows:

	<u>Location</u>	<u>Color</u>
a.	Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixture, and similar items.	As selected
b.	Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	As selected
c.	Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	As selected
d.	Joints between edge members for acoustical tile and adjoining vertical surfaces.	As selected
e.	Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected

#### 2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT.

For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T.

Locations and colors of sealant shall be as follows:

	<u>Location</u>	<u>Color</u>
a.	Joints and recesses formed where frames and	Match adjacent

	subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	surface color
b.	Masonry Joint where shelf angles occur.	Match adjacent surface color
c.	Expansion and control joints	Match adjacent surface color
d.	Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Match adjacent surface color
e.	Voids where items pass through exterior walls	Match adjacent surface color
f.	Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match adjacent surface color
g.	Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color
h.	Joints between ends of facias, copings, and adjacent walls.	Match adjacent surface color

### 2.1.3 Floor Joint Sealant

Floor joint sealant shall conform to ASTM C 920, Type S or M, Grade P, Class 25, Use T. Locations and colors of sealant shall be as follows:

	<u>Location</u>	<u>Color</u>
a.	Seats of metal thresholds for exterior doors.	Match adjacent surface color
b.	Control and expansion joints in floors, slabs, ceramic tile, and walkways.	Match adjacent surface color

## 2.2 FIRE RATED SEALANT

Fire rated sealant shall be one part in tumescent elastomer. Under normal environment conditions the material shall be non-corrosive to metal.

## 2.3 PRIMER FOR SEALANT

Provide a non-staining, quick-drying type of consistency recommended by the sealant manufacturer for the particular application.

## 2.4 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer for the particular application.

## 2.5 BACKSTOPS



Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

## 2.6 CLEANING SOLVENTS

Provide types recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

## PART 3 - EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces shall be clean, dry to the touch, and free from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant.

#### 3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent.

#### 3.1.2 Aluminum Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

### 3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multi-component elastomeric sealants in accordance with manufacturer's instructions.

### 3.3 APPLICATION

#### 3.3.1 Joint Width-To-Depth Ratios

##### a. Acceptable Ratios

<u>JOINT WIDTH</u>	<u>JOINT DEPTH</u>	
	<u>Minimum</u>	<u>Maximum</u>
For metal, glass, or other nonporous surfaces:		
6 mm (minimum)	6 mm	6 mm
Over 6 mm	12 mm width	Equal to width
For wood, concrete, masonry, stone:		
6 mm (minimum)	6 mm	6 mm
Over 6 mm	6 mm	Equal to width
Over 12 mm to 50 mm	12 mm	16 mm
Over 50 mm	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios

Where joints of acceptable width-to- depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated

b. Where backstops are not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

3.3.3 Primer

Immediately prior to application of the sealant, clean out all loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.4 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.5 Sealants

Provide a sealant compatible with the materials to which it is applied. Do not use a sealant that has exceeded shelf life or has become too jelled to be discharge in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joint, apply sealant, and tool smooth as specified.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if remove 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces

Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hours then remove by wire brushing or sanding.

### 3.5 MEASUREMENT AND PAYMENT

Sealant and Caulking shall not be measured and paid for separately, but the cost thereof shall be considered as included in the contract unit price of the Items where called for.

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## DIVISION 8 – DOORS AND WINDOWS

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## **SECTION 08110 - STEEL DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing and supply of materials including equipment, and performing labor necessary to complete the installation of all steel doors and frames as shown on drawings and schedule, and as specified herein.

#### **1.2 APPLICABLE PUBLICATIONS**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

##### **1.2.1 American National Standards Institute, Inc. (ANSI) Publications:**

- |            |  |
|------------|--|
| A 115.1-82 | Preparation for Mortise Locks for 1-3/8 Inch and 1-3/4 Inch Doors                                      |
| A 115.2-80 | Preparation for Bored Locks for 1-3/4 Inch and 1-3/8 Inch Doors  |
| A 115.4-82 | Preparation for Lever Extension Flush Bolts  |
| A 151.1-80 | Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing |

##### **1.2.2 Steel Door Institute (SDI) Publications**

- |        |   |
|--------|---|
| 100-85 | Recommended Specifications-Standard Steel Doors and Frames                |
| 105-82 | Recommended Erection Instructions for Steel Frames                        |
| 107-84 | Hardware on Steel Doors (Reinforcement Application)                       |
| 111-F  | Recommended Completed Opening Anchors for Standard Steel Doors and Frames |

##### **1.2.3 Underwriters Laboratories, Inc. (UL) Publications**

- |        |                              |
|--------|------------------------------|
| 10B-79 | Fire Test of Door Assemblies |
|--------|------------------------------|

#### **1.3 SUBMITTALS**

##### **1.3.1 Catalog Data**

Manufacturer's descriptive literature for steel doors and frames. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction.

##### **1.3.2 Shop Drawings**

Submit drawings for steel doors showing types, sizes, location, elevations, construction details, metal gauges, hardware provisions, installation details and other details of construction.

1.3.3 Certificates of Conformance

Attest that doors, frames, and accessories meet the requirements specified herein. Include the grade and model of each door.

1.3.4 Samples

Two samples of each color for pre-finished doors. Where colors are not indicated, submit manufacturer's standard colors and patterns to the Owner/Engineer for selection.

1.4 DELIVERY AND STORAGE

Deliver doors, frames and accessories undamaged and with protective wrappings or packaging. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 6 mm airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new ones.

**PART 2 - PRODUCTS**

2.1 STANDARD STEEL DOORS

Standard Steel doors shall conform to SDI 100, except as specified otherwise. Doors shall be either hollow steel construction or composite construction, fabricated from minimum Gauge 18 steel face sheets for exterior doors and Gauge 20 steel face sheets for interior doors. Prepare doors to receive hardware specified in Section 08710, "Finish Hardware." Exterior doors shall have top edge closed flush. Doors shall be 44 mm (1-3/4") thick, unless otherwise indicated. Exterior doors shall be provided with weather-stripping and thresholds.

Metal flush doors using # 18 G.I. panel, 4mm thk., with Honeycomb / Rockwool insulation on # 16 G.I. frame (150mm), single rabbet jamb with SS butt 4.5" x 4" x 3.5 mm thk. (4BB) hinges (4 pcs / panel) with epoxy primer gray. Door sizes & swing as shown on plans.

2.1.1 Door Grades

a. Standard Duty Doors

Standard duty doors shall conform to SDI 100, Model 3 of size and design indicated. Provide where shown on drawings.

b. Heavy Duty doors

Heavy duty doors shall conform to SDI 100, Grade II, Model 3 or 4 of sizes and designs indicated.

2.2 LOUVERS

Door shall be provided with louver section. Louvers shall be sight-proof type, inserted into the doors. Inserted louvers shall be stationary as shown, and formed of not less than Gauge 20 steel. Blades of inserted louvers shall be securely installed into the frame, and the entire assembly shall be fastened to the door to present a neat appearance and to be non-removable from the outside of the door. Insect screens shall be removable type with 18 x 16 mesh stainless steel, aluminum or bronze cloth.

## 2.3 ASTRAGALS

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08710, "Finish Hardware," provide overlapping steel astragals with the doors.

## 2.4 STANDARD STEEL FRAMES

Standard steel frame shall conform to SDI 100, except as otherwise specified. Fabricate frames from minimum Gauge 16 commercial grade cold-rolled steel for all exterior and interior steel doors. Form frames to sizes and shapes indicated, welded corners. Provide steel frames for steel doors, unless otherwise indicated.

### 2.4.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind weld smooth.

### 2.4.2 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than Gauge 18.

#### a. Wall Anchor

Provide a minimum of three anchors for each jamb. Locate anchors opposite top and bottom hinges and midway between.

#### b. Masonry

Provide anchors of corrugated or perforated steel straps or 5 mm (3/16") diameter steel wire, adjustable or T-shaped.

## 2.5 WEATHERSTRIPPING

As specified in Section 08710, "Finish Hardware".

## 2.6 HARDWARE PREPARATION

Reinforce, drill, and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI 107, ANSI A 115.1, ANSI A 115.2, and ANSI A 115.4. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI 100, as applicable.

## 2.7 FINISHES

### 2.7.1 Factory-Primed Finish

Unless specified otherwise, phosphate treat and factory prime metal doors and frames as specified in SDI 100.

### 2.7.2 Factory-Applied Enamel Finish

After factory priming, apply two coats of low-gloss enamel to exposed surfaces. Separately bake or oven dry each coat. Drying time and temperature requirements shall be in

accordance with the coating manufacturer's recommendations. Color(s) of finish coat shall be as indicated and shall match approved color sample(s).

## 2.8 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

#### 3.1.2 Doors

Hang doors in accordance with clearances specified in SDI 100. After erection clean and adjust.

### 3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until all rust is removed, clean thoroughly, and apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

### 3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

### 3.4 METHOD OF MEASUREMENT

Steel doors of the type specified shall be measured by the number of set installed and accepted. A set shall consist of metal door, jambs, anchors and hardware except locksets.

### 3.5 BASIS OF PAYMENT

The accepted quantity, measured as prescribed in Method of Measurement shall be paid for at the contract unit price for Steel Door, which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 08210 - WOOD DOORS**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing and supply of materials, including equipment and performing labor necessary to complete the installation of all wood doors as shown on drawings and schedule and as specified herein.

#### **1.2 SUBMITTALS**

##### **1.2.1 Shop Drawings**

Shop drawings shall be submitted for approval. Shop drawings shall indicate the location of each door, elevation of each type of door, details of construction, marks to be used to identify the doors, and location and extent of hardware blocking.

##### **1.2.2 Samples**

Prior to the delivery of wood doors, a sample section of each type of door which shows the stile, rail, veneer and core construction shall be submitted.

#### **1.3 DELIVERY AND STORAGE**

Doors shall be delivered to the site in an undamaged condition and shall be protected against damage and dampness. They shall be stored under cover in a well-ventilated building and shall not be exposed to extreme changes of temperature and humidity. They shall not be stored in a building under construction until concrete and masonry works are dry. Defective or damaged doors shall be replaced.

#### **1.4 FACTORY SEALING**

Before shipment, the top and bottom edges of doors shall be sealed with approved manufacturer's standard water resistant sealer.

#### **1.5 SIZES AND DESIGNS**

Doors shall be of the type, size, and design indicated on the drawings.

### **PART 2 - PRODUCTS**

#### **2.1 PLYWOOD**

Local plywood used for fabrication of wood doors shall conform to PTS 631-02, Class 1, preservative treated, and the adhesive used for plywood manufacture shall be water-proofing grade. The Contractor shall submit compliance certificates for plywood and adhesive for approval prior to fabrication of doors.

#### **2.2 LUMBER**

Local lumber used for fabrication of wood doors shall conform to PTS 20. Lumber used shall be of premium select grade and in no case contain any defects or damage. Lumber shall be Tanguile or a higher class hardwood specie. Wood blocking for specified hardware shall be provided in all hollow core and mineral core doors.

#### **2.3 ADHESIVE AND BONDS**

Adhesive and bonds shall be in accordance with NWMA Standard I.S.I. using requirements for interior doors. Adhesives shall be waterproof type.

## 2.4 GLAZING

Glazing shall conform to Section 08800, "Glazing"

## **PART 3 - EXECUTION**

### 3.1 PREFITTING AND FACTORY-PRIMING OR FACTORY-FINISHING

Doors shall be furnished prefit, in accordance with the standard under which they are produced. Doors with surfaces to receive paint finish shall be furnished with these surfaces factory primed.

### 3.2 INTERIOR FLUSH DOORS

Interior flush doors shall be hollow core flush doors conforming to NWMA I.S.I. Doors shall have waterproof plywood veneered faces. Waterproof plywood veneered doors shall have premium grade 6 mm. minimum face veneers. Finger jointed edge bands will not be permitted.

#### 3.2.1 Glazing

Where shown, doors shall be prepared for the reception of glass. Glass requirements are specified in Section 08800, "Glazing".

#### 3.2.2 Insert Louvers

Where indicated, doors shall be provided with sight-proof insert louvers. Louvers shall be stationary. Blades shall be tenoned to the frame and the entire assembly fastened to the door with metal mounding on both sides. The frame shall be non-removable from the outside of the door.

### 3.3 DOOR FRAMES

Door frames shall be of the sizes and profile shown. Doorstops shall be provided. Frames and trims shall be constructed of the species of hardwood specified in Section 06200 Finish Carpentry. Frames shall be set plumb and square, double-wedged, and secured with proper size finishing nails. Solid blocking shall be provided back of jambs at butts and lock strikes. Blocking shall be placed at a maximum of 400 mm. on centers.

### 3.4 INSTALLATION

Doors shall be fit, hung and trimmed as required. The lock edge of doors shall be beveled at the rate of 3 mm in 50 mm. Cuts made on the door shall be sealed immediately after cutting, using a clear varnish or sealer.

### 3.5 HARDWARE

Specified in Section 08710, "Finish Hardware", shall be carefully fitted, securely attached, and demonstrated to work freely. Care shall be exercised not to mar or injure the work.

### 3.6 PRIMING

Doors and door frames shall be primed as specified in Section 09900, "Painting of Buildings (Field Painting)". In addition, before installation, all side and edges of door frames that will be in contact with concrete, masonry or mortar shall be given a primecoat.

### 3.7 METHOD OF MEASUREMENT

Wood doors, of the type specified shall be measured by the number of sets installed and accepted.

### 3.8 BASIS OF PAYMENT

The accepted quantity, measured as prescribed in Method of Measurement, shall be paid for at the contract unit price for Wood Doors which price and payment shall be full compensation for furnishing and placing all materials inclusive of door frame and all required hardware and for all labor, equipment, tools and incidentals necessary to complete the prescribed work in this Section. Locks shall be paid under Section 08710, "Finish Hardware".

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 08420 - ALUMINUM DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

The work includes the supply and furnishings of materials including equipment, and performing labor necessary to complete the installation of all aluminum doors and frames as specified and as show on drawings and schedules.

#### **1.2 APPLICABLE PUBLICATIONS**

The publication listed below form a part of this specification to the extent referenced. The publication is referred to in the text by the basic designation only.

##### **1.2.1 Aluminum Association (AA) Publication:**

(6th Edition)                      Designation System for Aluminum Finishes

#### **1.3 SUBMITTALS**

##### **1.3.1 Shop Drawings**

Shall indicate elevations of aluminum doors and frames, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring frames, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, method and materials for weather-stripping, installation details and other related items.

##### **1.3.2 Sample**

Submit one full size corner showing construction, color and finish.

##### **1.3.3 Door Schedule**

Submit schedule with erection drawings indicating location of each door unit.

#### **1.4 DELIVERY AND STORAGE**

Deliver aluminum doors and frames to project site in an undamaged condition. Use care in handling and hoisting aluminum doors and frames during transportation and at the job site. Store aluminum doors and components out of contact with the ground, under a weather-tight covering, so as to prevent bending, warping, or otherwise damaging the aluminum doors. Damaged doors shall be repaired to an "as new" condition as approved. If doors cannot be repaired, a new unit shall be provided.

#### **1.5 PROTECTION**

Finish surfaces shall be protected during delivery and handling using the Manufacturer's Standard Method, except that no coatings or lacquers shall be applied to surfaces to which caulking and glazing compounds must adhere.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

Aluminum doors and frames shall be designed and constructed with swinging panels and

fixed side panels in the sizes and arrangements indicated. All door and framing sections shall be extruded from AA-6063-T5 aluminum alloy 44mm (1 3/4") thick, to size and shape as shown in drawing and details. Sections shall conform to details, 3 mm (1/8 inch) minimum thickness, and shall present straight, sharply defined lines, and shall be free from defects impairing strength or durability. All fasteners shall be of aluminum, stainless steel, cadmium plate or other corrosion resistant materials.

## 2.2 FABRICATION

### 2.2.1 Construction and Design

Aluminum doors except for all glass entrance doors shall have narrow stile design unless otherwise shown or specified. Door stiles and rails shall be securely joined and reinforced by means of structural corner block assemblies. Welded corners without structural corner block assembly will not be permitted. Lock and hinge stiles on all double acting doors, and the lock stile of a pair of doors shall incorporate two woven pile weather-strips from top to bottom. Doors shall be adjustable vertically and front to back. Cut-out operations for hardware shall be accurately made and reinforced, as required. Glass stops shall be the snap-on type with non-stretch vinyl beads. Screw fastened stops will not be permitted. Push-pull bars shall have a formed, comfortable grip and concealed mechanical fasteners. All vertical and horizontal door sections shall be installed so as to receive infill thickness as specified in the glazing section of the specifications.

### 2.2.2 Finishes

All exposed surfaces shall be smooth and free of distracting scratches and blemishes. Interior door frames shall have anodized clean finish. Exterior door frames shall have anodized finish conforming to Aluminum Standards of Architectural Class 1 anodic coding. Color shall be anodized bronze.

### 2.2.3 Hardware

All doors shall have maximum security deadbolt lock for single doors and maximum security hook bolt lock and 460 mm (18 inches) lever type flush bolts for double doors. Operating hardware shall be offset pivots or center pivots as recommended and supplied by door manufacturer. All push and pull hardware shall be of size and type furnished by door manufacturer.

### 2.2.4 Weatherstripping

All four sides of each door shall be provided with weather-stripping which shall provide maximum protection against the elements and designed so it may easily be replaced. Provide continuous wool pile, silicone treated or type recommended by door manufacturer.

### 2.2.5 Glass and Glazing - shall be as specified under Section 08800, "Glazing"

### 2.2.6 Caulking and Sealing - shall be as specified under Section 07900, "Sealants and Caulking".

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Method of Installation

Plumb, square, level, and align frames and framing members to receive doors and transoms. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions.

### 3.1.2 Protection

Protect doors and frames from damage. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

### 3.1.3 Cleaning

Upon completion of installation, thoroughly clean door and frame surfaces in accordance with door manufacturer's recommended procedure. Do not use abrasive caustic, or acid cleaning agents.

## 3.2 METHOD OF MEASUREMENT

Aluminum glass door, fully equipped with fixing accessories and locking devices shall be measured by the number of set installed as shown on the Plans and accepted.

## 3.3 BASIS OF PAYMENT

The accepted quantity, measured as prescribed in Method of Measurement shall be paid for at the contract unit price for Aluminum Glass Doors, which price and payment shall be full compensation for furnishing and placing all materials including fixing accessories and locking devices and for all labor, equipment and incidentals to complete the prescribed work in this Section.

Payment will be made in accordance with the Bill of Quantities

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## **SECTION 08520 - ALUMINUM WINDOWS**

### **PART 1 GENERAL**

#### **1.1 SCOPE**

The work includes the supply and furnishing of materials, including equipment, and performing labor necessary to complete the installation of all aluminum windows as specified and as shown on drawings and schedules.

#### **1.2 APPLICABLE PUBLICATIONS**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

##### **1.2.1 Aluminum Association (AA) Publication:**

(6<sup>th</sup> Edition)                      Designation System for Aluminum Finishes

##### **1.2.2 American National Standards Institute (ANSI) Publication:**

ANSI/AAMA                      Aluminum prime Windows  
302.9-197

#### **1.3 SUBMITTALS**

##### **1.3.1 Shop Drawings**

Shop drawings shall indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, and proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, method and materials for weather-stripping, installation details and other related items.

##### **1.3.2 Sample**

Submit one full size corner showing construction, color and finish.

##### **1.3.3 Manufacturer's Certificate of Conformance**

Submit certificates that identical windows have been tested and meet the requirements specified herein for air infiltration and water penetration.

##### **1.3.4 Window Schedule**

Submit schedule with erection drawings indicating location of each window unit.

#### **1.4 DELIVERY AND STORAGE**

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the job site. Store windows and components at the site on edge, out of contact with the ground, under a weathertight covering, so as to prevent bending, warping or otherwise damaging the windows. Damaged window shall be repaired to an "as new" condition as approved. If windows cannot be repaired, a new unit shall be provided.

#### **1.5 PROTECTION**

Finished surfaces shall be protected during delivery and handling using the manufacturer's standard method, except that no coating or lacquers shall be applied to surfaces to which caulking and glazing compounds must adhere.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

Aluminum windows shall conform to the requirements of ANSI/AAMA 302.9, ANSI/AAMA A 134.1 and the specifications listed below. Provide windows of combinations, types and sizes indicated or specified. Each window shall consist of a unit including frame, sash, mullions, trim, and anchors, complete. All frame and sash extruded members shall be constructed from 6063-T5 aluminum alloy with a nominal depth of 38 mm (1-1/2") and wall thickness of 3 mm (1/8 inch) for principal members of all solid and tubular shapes. Window unit shall be prime windows of the types specified. Dimensions shown are minimum.

#### **2.1.1 Fixed Windows**

Type P-A2.5 of AMMA Specifications.

#### **2.1.2 Awning Windows**

Provide each side hinged ventilator with one pair of non-friction-type extension hinges, one sash operator designed to hold ventilator open firmly at any angle up to 90° and one locking handle. Hinges shall have the strength necessary to permanently support the glazed ventilator without twist or sag.

#### **2.1.3 Glass Glazing**

Materials are specified under Section 08800, "Glazing".

#### **2.1.4 Caulking and Sealing**

Caulking and Sealing shall be specified under Section 07900, "Sealants and Caulking".

### **2.2 FABRICATION**

Window units shall conform to the requirements of Master Specification, Part A, "Architectural" of ANSI/AAMA 302.9.

#### **2.2.1 Drips and Weep Holes**

Provide as required to return water to outside.

#### **2.2.2 Glazing Thickness**

Design glazed windows and rabbets suitable for glass thickness shown on drawings.

#### **2.2.3 Fasteners**

Use flathead, cross-recessed type, exposed head screws and bolts with standard threads on windows, trim and accessories. Screw heads shall be finished flush with adjoining surfaces. Self-tapping sheet metal screws are not acceptable for material more than 1.5 mm (1/16 inch) in thickness.

#### **2.2.4 Provisions for Glazing**

Design sash for inside glazing and for securing glass with glazing channels and glazing compound.

#### **2.2.5 Mullions**

Provide mullions between multiple windows units designed to withstand the wind load requirements specified. Secure mullions to adjoining construction and window units in such a manner as to permit expansion and contraction and to form a weather-tight joint. Provide mullion covers on the interior and exterior to completely close exposed joints and recesses between window units and to present a neat appearance.



#### 2.2.6 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads and other appurtenances necessary for complete installation and proper operation.

#### 2.2.7 Anchors

Build into, bolt to, or otherwise secure anchors and fastenings to the heads, jambs and sills of openings and fasten securely to the windows or frames. Use concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Use fasteners compatible with the fastened materials. Anchor each frame at jambs with a minimum of three adjustable anchors. Provide perforated anchor stems for mortar keying with anchor flanges of sufficient width to provide a sliding friction fit inside frames. Extend perforated stems in less than 100 mm (4 inches) into masonry.

#### 2.2.8 Protective Coating

Clean all surfaces and apply a protective coating of clear, water-white methacrylate-type lacquer, resistant to alkaline mortar and plaster immediately after fabrication. Covering shall not chip, peel or flake due to temperature or weather, and shall protect against discoloration and surface damage from transportation, storage, and construction activities. Covering shall be readily removable without affecting the finish. Covering shall either be adhesive paper, waterproof tape, or strippable plastic and may not be removed even after completion of installation.

#### 2.2.9 Finishes

Exposed aluminum surfaces shall be powdercoated finished. All windows shall have the same finish.

### **PART 3 - EXECUTION**

#### 3.1 INSTALLATION

##### 3.1.1 Method of Installation

Install in strict accordance with the window manufacturer's printed instructions and details, except as specified otherwise herein. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location and reveal; plumb, square level and in alignment; and brace, strut and stay properly to prevent distortion and misalignment. Bed screws or bolts in sill members, joint at mullions, contacts of windows with sill and built-in fins, in mastic sealant of a type recommended by the window manufacturer. Install windows in a manner that will prevent entrance of water.

##### 3.1.2 Anchors and Fastenings

Make ample provisions for securing units to each other, to masonry, and to other adjoining construction. Windows installed in direct contact with masonry wall shall have head and jamb members designed to recess into masonry wall not less than 11 mm (7/16 inch).

##### 3.1.3 Protection

Where aluminum surfaces are in contact with, or fastened to masonry, wood or dissimilar metals, except stainless steel or zinc, the aluminum surface shall be protected from dissimilar materials as recommended in the Appendix to ANSI/AAMA 302.9.

#### 3.2 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint, spattering spots and other foreign matter to present a neat appearance and to prevent fouling of weathering surfaces and weather-tripping, and to prevent interference with the operation of hardware.

Replace with new windows all stained, discolored or abraded windows that cannot be restored to their original condition.

3.3 METHOD OF MEASUREMENT

Aluminum windows of the design / style and type of operation specified shall be measured by the number of set installed and accepted.

3.4 BASIS OF PAYMENT

The quantity measured as determined in Method of Measurement shall be paid for at the contract unit price per set of Aluminum Window which price and payment shall constitute full compensation for furnishing and placing all materials inclusive of glazing and accessories and for all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## SECTION 08710 - FINISH HARDWARE

### PART 1- GENERAL

#### 1.1 SCOPE

This specification covers the furnishing of materials including equipment and performing labor necessary to complete the installation of all finish hardware as shown on drawings and schedule, and as specified herein.

#### 1.2 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

##### 1.2.1 American National Standards Institute (ANSI/BHMA) Publications:

A156.1-81	Butts and Hinges
A156.2-83	Bored and Preassembled Locks and Latches
A156.4-80	Door Controls - Closers
A156.6-79	Architectural Door Trim
A156.7-81	Template Hinge Dimensions
A156.13-80	Mortise Locks and Latches
A156.16-81	Auxiliary Hardware
A156.18-84	Materials and Finishes

##### 1.2.2 Door and Hardware Institute (DHI) Publications

Keying – Procedures, System and Nomenclature (Jan. 1978). Recommended Location for Builder's Hardware for Standard Steel door and Frames (1975).

#### 1.3 SUBMITTALS

##### 1.3.1 Hardware List and Catalog Cuts

Submit for approval by the Engineer a listing of each item of finish hardware and a manufacturers' catalog cut for each different item of hardware. Submit hardware list in the following form:

<u>Hardware</u>	<u>Ref. Publication Type No.</u>	<u>Manufacturer's Name And Catalog No.</u>	<u>UL Mark (if fire) Rate and Listed</u>	<u>BHMA Finish Designation</u>
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##### 1.3.2 Hardware Schedule

Submit for approval by the Architect / Engineer. Include for each item the quantity, manufacturer's catalog number, corresponding reference publication type number, size, finish, and key control symbols.

### 1.3.3 Certified Test Reports

Indicate that each item listed under Hardware Items meets the standard listed for that item. A copy of the listing of proposed hardware items in the current applicable BHMA directories of certified products may be submitted in lieu of test reports.

### 1.3.4 Keying System

Submit for approval by the Architect / Engineer a keying and master keying system. Also submit key bitting charts to the Architect / Engineer prior to completion of the contract.

### 1.3.5 Project Reference Samples

Upon delivery of finish hardware to the site, select and tag one item of each different type. Identify each item by reference publication type number and manufacturer's catalog number. Items shall remain on file until similar items have been installed, at which time items on file shall be installed in predetermined locations.

## 1.4 TEMPLATES

The Contractor shall furnish templates or information otherwise necessary to enable the door and frame manufacturer to make proper provision in his work to receive the specified hardware. Where two or more articles of hardware are to be mounted on the same door, the Contractor shall effect proper coordination between the manufacturers of the different articles. Templates of hinges shall conform to ANSI Standard A156.7.

## 1.5 DELIVERY AND MARKING

Deliver hardware in original individual containers, complete with necessary appurtenance including fasteners and instructions. Mark each individual container with manufacturer's name and catalog number. Deliver permanent keys to the Architect / Engineer.

## PART 2 - PRODUCTS

### 2.1 HARDWARE MANUFACTURES AND MODIFICATIONS

Provide, as far as practicable, locks, hinges, and closers of one lock hinge, pivot, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

### 2.2 HARDWARE DESIGNATIONS

Hardware items covered by ANSI/BHMA standards are specified by BHMA designations.

### 2.3 TEMPLATE HARDWARE

Hardware to be applied to metal shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to ANSI/BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

### 2.4 HARDWARE ITEMS

Conform to the respective standards listed and to requirements specified herein. Hinges, pivots, locks, latches, exit devices, bolts, and closers shall bear the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the

name or trademark may be beneath the cover. Provide hardware items as specified below and as listed under “Hardware Schedule” indicated on the drawings.

#### 2.4.1 Hinges

ANSI/BHMA A156.1, 113 mm x 113 mm (4-1/2 by 4-1/2 inches) unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be non-removable when door is closed. Other anti-friction bearing hinges may be provided in lieu of ball-bearing hinges.

#### 2.4.2 Locks and Latches

ANSI/BHMA A156.2 and ANSI 156.13, Series 4000, Grade 1. Provide trim of wrought construction and commercial plain design. Locks for exterior doors shall have threaded roses or concealed machine screws.

#### 2.4.3 Lock Cylinders

Provide cylinders for new locks including locks provided under other sections of these specifications. Cylinders shall have six pin tumblers and shall be products of the same manufacturer. Provide a master keying system.

#### 2.4.4 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system; furnish one additional working key for each lock of each keyed-alike group. Stamp each key with appropriate key control symbol. Do not place room number on keys.

#### 2.4.5 Closers

ANSI/BHMA A156.4, Series CO2021, and Grade 1. Provide closers complete with brackets, arms, mounting devices, fasteners, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations and list sizes in the Hardware Schedule.

##### a. Identification Marking

In addition to the manufacturer's name or trademark, each closer shall bear the manufacturer's size designation where it will be visible after installation.

##### b. Special Tools

Provide special tools for adjustment of door closing devices, such as spanner and socket wrenches.

#### 2.4.6 Thresholds

In accordance with type indicated on the drawings with vinyl or silicone rubber insert in face of stop and ANSI/BHMA A156.6.

#### 2.4.7 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

### 2.5 FASTENERS

Furnish fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Use fasteners of type necessary to accomplish a permanent installation.

## 2.6 FINISHES

ANSI/BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paint finish, and except steel hinges which shall have BHMA finish. Exposed parts of concealed closers shall be finished to match the doors. Hardware for aluminum doors shall be finished to match the doors.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF HARDWARE

Install hardware following manufacturers' instructions. Except as indicated or specified otherwise, use fasteners furnished with hardware to fasten hardware in place. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Use machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Use toggle bolts where required for fastening to hollow core construction. Use through bolts where indicated or specified and where necessary for satisfactory installation.

### 3.2 ACCEPTANCE

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of operation testing 10 days before schedules, so that the testing can be witnessed. Hinges, locks, latches, bolts, holders, closers, and other items shall be adjusted to operate properly. Also demonstrate that tagged keys operate respective locks. After hardware is checked, deliver tagged keys to the Engineer. Correct, repair, and finish as directed errors in cutting and fitting and damage to adjoining work.

### 3.3 LABELED DOORS

Install hardware for fire doors in accordance with NFPA requirements.

### 3.4 LOCATION OF HARDWARE ON HINGED DOORS

Locate as follows, unless indicated or specified otherwise herein:

#### 3.4.1 Locks

Locate knobs so that center line of strike is 1.023 meters (40-5/16 inches nominal) above bottom of door frame.

#### 3.4.2 Hinges

Locate as follows:

- |                 |   |
|-----------------|---|
| a. Top Hinge    | Not over 285 mm (11-1/4 inches) from inside of frame rabbet at head to center line of hinge |
| b. Bottom Hinge | Not over 330 mm (13 inches) above bottom of door frame to center line of hinge              |
| c. Center Hinge | Midway between top and bottom hinges  |

d. Intermediate Hinges Equally spaced between top and bottom hinges

#### 3.4.3 Door Closing Devices

Shall be installed and adjusted in strict accordance with the templates and printed instructions.

#### 3.5 KEY CABINET

Locate where directed. Key as directed by the Architect / Engineer.

#### 3.6 METHOD OF MEASUREMENT

Center pivot, threshold, dead locks, door sets, closets, push / pull bars and panic device shall be measured by the number of sets installed and accepted.

Flush bolts and hinges shall be measured by the number of pairs installed and accepted.

#### 3.7 BASIS OF PAYMENT

The quantities accepted, measured as provided in Method of Measurement, shall be paid for at the contract unit price for the several Pay Items listed below and shown in the Bill of Quantities which price and payment shall be full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## DIVISION 9 – FINISHES

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## **SECTION 09601 - EPOXY COATING**

### **PART 1- GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing of materials including equipment and performing labor necessary to complete the installation of epoxy flooring as shown on the drawings and as specified herein.

#### **1.2 SUBMITTALS**

##### **1.2.1 Product Data**

Submit manufacturer's technical information including basic materials analysis and application instructions for each coating material specified.

##### **1.2.2 Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate. Resubmit samples as requested by the Architect / Engineer until the required sheen, color and texture is achieved.**

#### **1.3 QUALITY ASSURANCE**

##### **1.3.1 Single Source Responsibility**

Obtain primary chemical-resistant seamless, epoxy coating materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than 3 years of successful experience in supplying principal materials for work of type described in this section. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

##### **1.3.2 Prime Coat**

Apply primer over prepared substrate at manufacturer's recommended spreading rate. Coordinate timing of primer application with application of topping mix to insure optimum adhesion between chemical-resistant epoxy coating materials and substrate.

##### **1.3.3 Finish or Sealing Coat**

After topping mix has cured sufficiently, apply finish or sealing coat of type required by the manufacturer to produce required finish indicated and in number of coats and spreading rates recommended by manufacturer.

#### **1.4 FIELD QUALITY CONTROL**

a. The Owner reserves the right to invoke the following material testing procedure at any time, and any number of times during period of epoxy application.

1. The Owner will engage service of an independent testing laboratory to sample materials being used. Samples of material will be taken, identified and sealed, and certified in the presence of Contractor.

### **PART 2 - PRODUCTS**

## 2.1 MATERIALS

Epoxy coating shall conform to the respective specification and standards and to the requirements specified herein.

- a. Epoxy coating shall be two component epoxy resins and polyamide curing agent and shall be used as follows:
- b. Epoxy coating shall be solvent-free two components colored epoxy for self-smoothing screeds.

1. Self-smoothing floor: (2-3mm layer thickness)

- Primer
- Self-smoothing floor

Color and texture shall be as approved by the Architect / Engineer and Owner.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

Comply with epoxy coating manufacturer's written instructions for installation of epoxy coating system, including surface preparation, joint treatment, flashing, reinforcement, accessory items and surfacing. Apply materials by methods as instructed by epoxy manufacturer to provide uniform thickness.

#### 3.1.1 Coordination

Proceed with epoxy work only after substrate construction, including curbs; spill dams and equipment pads, and penetrating work through substrate have been completed. Nophased construction will be permitted.

### 3.2 ADJUSTING, CLEANING AND PROTECTION

- a. Upon completion of the work, repair surfaces that have been permanently stained, marred, or otherwise damaged. Replace work that is damaged or cannot be adequately cleaned as directed.
- b. Upon completion of the work, remove unused materials, debris, containers and equipment from the project site. In addition to the initial cleaning procedure required, clean the work before acceptance by the Owner.
- c. Protect the work during the construction period so that it will be without any indication of use or damage at the time of acceptance.
  1. Until the epoxy coating is fully cured and protected with a temporary covering during the construction period, keep the coating areas free from traffic and other trades. Construction Manager shall provide necessary temporary protection to prevent damage, such as caused by traffic, gouging, scraping, spillage of deleterious substances, excessive heat, or other manner.

### 3.3 METHOD OF MEASUREMENT

Epoxy coating shall be measured by the number of square meters installed and accepted.

#### 3.4 BASIS OF PAYMENT

The quantity as determined in Method of Measurement, shall be paid for at the contract unit price per square meter for Epoxy Coating which price and payment shall constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete the prescribed work in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 09602 - GRANITE TILES**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing of materials, equipment and performing labor necessary to complete the installation of granite tiles.

#### **1.2 SUBMITTALS**

Submit samples of granite suitable for flooring, countertop and other accessories for approval.

### **PART 2- PRODUCTS**

#### **2.1 MATERIALS**

- a. Granite tiles and baseboards shall be the best obtainable under its respective classification and shall be natural, hard, durable, resistant to acids, free from stains, porous streaks, and other defects and shall contain nothing which would cause discoloration. Veins shall be tight and sound.

Polished granite floor tiles -      Nano Technology - Location & Pattern as shown on plans

For Flooring:

Light yellow & Dark yellow -      600mm x 600mm x 19mm thick  
600mm x 298mm x 19mm thick  
600mm x 198mm x 19mm thick

For Wall:

Light yellow & Dark yellow -      600mm x 198mm x 19mm thick  
600mm x 600 mm x 19mm thick

Granite Countertop      width 600 mm

- b. Cement for mortar setting bed shall be Portland cement.
- c. Grout shall be the best quality and shall be as recommended by granite supplier
- d. Sand shall be natural, clean, and free from soluble salts and organic matter, fine grade.
- e. Portland cement, gray or natural color for mortar setting beds and scratch coat shall conform to the requirements of PNS 07, Type 1.
- f. Sand for mortar setting beds shall conform to the requirement of PNS 18, Type 1.
- g. Water shall be potable.

### **PART 3 - EXECUTION**

#### **3.1 MIXING**

Mortar shall be mixed in the proportions specified by the manufacturer.

### 3.2 INSTALLATION OF GRANITE TILES AND COUNTERTOP

- a. Preparation of surfaces: Surfaces to receive the granite tiles countertop shall be clean, free of dust, dirt, oil grease, and other deleterious substances before laying of the setting bed.
- b. Setting bed shall be a minimum thickness of 25 mm thick. The grout shall be spread until its surface is true and even thoroughly compacted. A setting bed, as large as can be covered with marble slab before the grout has reached its initial set, shall be placed in one operation but in the event that more setting bed has been placed that can be covered, the unfinished portion shall be removed and cut back on a clean leveled edge.
- c. Laying of Granite Tiles and Countertops: All exposed edges shall be accurately gauged to a uniform thickness. Cutting and fitting shall be done in workmanlike manner as required to accommodate the work of others. Joints between the granite tiles shall show an even width when laid and finished. The method of fully buttering edges of the tile as it is laid equally approved. Surplus grout shall be cleaned from face of the tile immediately.

### 3.3 FINISH AND QUALITY

All exposed granite surfaces shall be even level with all edges clean cut sharp. All exposed granite surfaces shall be polished smooth.

### 3.4 PROTECTION

It shall be the responsibility of the Contractor to fully protect the granite from damage by others before, during and after its installation until the final acceptance of the work.

- a. The cut granite shall be carefully packed for transportation with the exercise of all customer practical and reasonable precautions against damage in transit.
- b. All granite shall be unloaded and delivered to the site, with all necessary care in handling being maintained to avoid soiling or damaging. When stored, marble shall be clear of the ground and adequately protected from all elements.

### 3.5 CLEANING

Upon completion of various portions of the granite work, the contractor shall remove all unused surplus materials, rubbish, and debris, in connection with this contract and shall give marble surface a thorough cleaning to the satisfaction and approval of the Owner. No acid or harsh abrasive cleaners or steel wire brushes shall be used. Scrub with fiber brush and clean water to clean marble.

### 3.6 METHOD OF MEASUREMENT

Granite tiles shall be measured by the number of square meters laid and accepted.

### 3.7 BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price, respectively for each of the Pay Items listed below and shown in the Bill of Quantities, which price and payment shall constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 09604 - CERAMIC TILE**

### **PART 1 GENERAL**

#### **1.1 SCOPE**

The work includes the supply and furnishing of materials and performing labor necessary for the complete installation of all ceramic tile work as shown or indicated on drawings and as specified herein.

#### **1.2 SUBMITTALS**

##### **1.2.1 Samples**

Submit samples of each type of floor and wall tiles including all required bead, moulding, and trim units.

#### **1.3 DELIVERY AND STORAGE**

- a. Deliver materials (except bulk materials) in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.
- b. Store materials in unopened containers off ground and under cover, protected from damage.

#### **1.4 EXTRA STOCK**

Supply an extra two percent of each type of tile used in clean, marked cartons for emergency use.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

the All materials shall be of the best of their respective kinds, in sizes and colors as shown on plans, details and finish schedules or otherwise specified herein or as will be approved by the Architect / Engineer upon submission of samples. Samples of all tiles shall be submitted to the Architect / Engineer for approval before placing orders. All tiles shall be delivered to the jobsite in unopened grade-sealed containers.

##### **2.1.1 Color and Patterns**

Tile Colors and patterns shall be selected. Colors and patterns by reference to manufacturer's name and designations are for color and pattern identification only and are not intended to limit selection of other manufacturer's products with similar color and patterns.

##### **2.1.2 Stairs**

- a. Unglazed Ceramic Tile with non-skid nosing

For stairs, shall be vitrified tiles, porcelain or natural clay with cushioned edges. Sizes and colors shall be as indicated on drawings.

#### **2.2 HYDRATED LIME**

ASTM C206, Type S; or ASTM C207, Type S.

#### **2.3 SAND**

ASTM C144, for mortar setting beds, grouting and pointing.

## 2.4 WATER

Clean, potable.

## 2.5 PORTLAND CEMENT

ASTM C150, Type I, white for grout, gray for other uses.

# PART 3 - EXECUTION

## 3. L INSTALLATION

Do not start tile work until roughing-in for plumbing and electrical work has been completed and tested. All surfaces to receive tile-work shall be cleaned of loose materials and given proper surface preparation prior to ceramic tile-work. Prepare and install in accordance with ANSI A108.1 and ANSI A108.5.

### 3.1.1 Application of Scratch Coat

- a. Thoroughly dampen, but not saturate, surfaces of masonry or concrete walls before applying the scratch coat. Make surface areas appear slightly damp. Allow no free water on the surface.
- b. On masonry, first apply a thin coat with great pressure, then bring it out sufficiently to compensate for the major irregularities on the masonry surfaces to a thickness of not less than 6 mm at any point.
- c. Evenly rake scratch coats, but not dash coats, to provide good mechanical key for subsequent course before the mortar has fully hardened.
- d. On surfaces not sufficiently rough to provide good mechanical key, dash on the first coat with a whisk by broom or fiber brush using a strong whipping motion. Do not trowel or otherwise disturb mortar applied by dashing until it is hardened.

### 3.1.2 Floor Tile Installation on Mortar Bed

- a. Before spreading the setting bed, establish lines of borders and center the fieldwork in both directions to permit the pattern to be laid with a minimum of cut tiles.
- b. Clean concrete sub-floor then moisture but not soak. Afterwards sprinkle dry cement over the surface and spread the mortar on the setting bed.
- c. Mix mortar 1 part Portland cement to 2 parts sand. Tamp to assure good bond over the entire area and screed to provide a smooth and level bed at proper height and slope.
- d. Pitch floor to drains as required.
- e. After setting bed has set sufficiently to be worked over sprinkle dry cement over surface and lay tile.
- f. Keep the joints parallel and straight over the entire area by using straight edges.
- g. Tamp the tile solidly onto the bed, using wood blocks of size to ensure solid bedding free from depressions.
- h. Lay tiles from center outward and make adjustments at walls.



### 3.1.3 Wall Tile Installation on Mortar Bed

- a. Before application of mortar bed, dampen the surface of the scratch coat evenly to obtain uniform section.
- b. Use temporary or spot grounds to control the thickness of the mortar bed. Fill out the mortar bed even with the grounds and rod it to a true plane.
- c. Apply the mortar bed over an area no greater than can be covered with tile while the coat is still plastic.
- d. Allow no single applications of mortar to 19 mm thick.
- e. Completely immerse wall tile in clean water and soak it at least ½ hour. After removal, stack tile on edge long enough to drain off excess water. Re-soak and drain individual tiles then dry along edges. Allow no moisture to remain on the back of tile during setting.
- f. Apply a bond coat 0.8 mm thick to the plastic setting bed or to the back of each sheet or tile.
- g. Press tile firmly into the bed and beat into place within 1 hour.
- h. Lay tile field in rectangular block areas not exceeding 600 mm x 600 mm. cut the setting bed through its entire depth along the edges of each block area after placement and before subsequent blocks are installed.
- i. Within 1 hour after installation of tile, remove strings from string-set tile and wet the faces of face-mounted tile and remove the paper and glue. Avoid using excess water. Adjust any tile that is out of alignment.

### 3.1.4 Grouting

- a. After tile has sufficiently set, force a maximum of grout into joints by trowel, brush or finger application.
- b. Before grout sets, strike or tool the joints of cushion-edge tile to the depth of the cushion.
- c. Fill all joints of square-edged tile flush with the surface of the tile. Fill all gaps or sips.
- d. During grouting clean all excess grout off with clean burlap, other cloth or sponges.

### 3.2 CLEANING

Sponge and wash tile thoroughly with clean water after the grout has stiffened. Then clean by rubbing with damp cloth or sponges and polish clean with dry cloth.

### 3.3 PROTECTION

Cover finished tile floors with clean 13.6 kg. Natural Kraft paper before permitting foot traffic. Place board walkways on floors that are to be continuously used as passageways by workers. Protect tiled corners external angles, with board corner strips in areas used as passageways by workers.

### 3.4 METHOD OF MEASUREMENT

Ceramic tiles of the type and size specified shall be measured by the numbers of square meters laid and accepted.

### 3.5 BASIS OF PAYMENT

The quantities measured as determined in Method of Measurement shall be paid for at the contract unit price, respectively for each of the Pay Items listed below and shown in the Bill of Quantities which price and payment shall be full compensation for furnishing and placing all materials including all labor, equipment, tools and incidentals necessary to complete the prescribe work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 09614 - FLOOR HARDENER**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

Furnish all labor and materials to complete finish work indicated, as specified herein.

#### **1.2 GENERAL REQUIREMENTS**

Deliver hardener in bags or bulks for the building site with the label intact and seals unbroken, subject to inspection by the Owner's Representative before being opened.

#### **1.3 SUBMITTALS**

1.3.1 Catalog cuts

1.3.2 Samples: 300 mm square panel of each type of finish

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

Provide materials conforming to specifications and the requirement specified.

##### **2.1.1 Portland Cement**

Available brand in the local market in conformity with ASTM requirements.

##### **2.1.2 Heavy Traffic Floor Hardener**

Powder composed of Non-Metallic aggregate, permanent coloring media, dispersing agents, and binding elements.

2.1.3 Hardener finish color shall be 'Natural Gray', or as selected by the Owner or Architect / Engineer.

### **PART 3 - EXECUTION**

#### **3.1 APPLICATION**

Monolithic Method: The hardener shall be applied into the fresh concrete hardener substrate. The surface is finished the same day slab is poured in place.

#### **3.2 METHOD OF MEASUREMENT AND PAYMENT**

Floor hardener shall be measured by actual area installed in square meters and accepted to the satisfaction of the Architect / Engineer.

No separate payment for the application of floor hardener since it will be included under payment for the epoxy floor system.

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## **SECTION 09703 - PLASTERING**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

The work under this section of the specification covers the furnishing of materials including equipment and performing labor necessary for the complete installation of plastering work as shown on drawings and as specified herein.

#### **1.2 GENERAL REQUIREMENTS**

Portland-cement plaster as included herein shall be applied as specified hereinafter to those areas indicated in the finish schedule. Plaster may be applied directly to interior masonry walls.

#### **1.3 DELIVERY AND STORAGE**

Deliver manufactured materials in the manufacturer's original unbroken packages or containers that are labeled plainly with the manufacturer's names and brands. Keep cementitious materials dry and stored off the ground, under cover, and away from sweating walls and other damp surfaces until ready to be used.

#### **1.4 ENVIRONMENTAL CONDITIONS**

##### **1.4.1 Portland Cement Plaster**

Maintain an ambient temperature of not less than 27 degrees C continuously where plastering work will be done. Maintain this temperature for not less than 48 hours prior to the application of plaster while the plastering is being done and during the curing operation.

##### **1.4.2 Protection from Sun and Dry Winds**

During the application of the finish coat, and for a period of 48 hours following the completion of finish coat application for any given area, the surface of the plaster shall be protected from direct sunlight and direct winds. Use of tarpaulins or other temporary means may be acceptable. Moist curing shall be provided in accordance with paragraph 3.3, Portland Cement-Lime Plaster.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

Provide materials conforming to specifications and the requirements specified.

##### **2.1.1 Portland Cement**

ASTM C 150, gray Portland cement Type I.

##### **2.1.2 Hydrated Lime**

ASTM C206, Type S

##### **2.1.3 Aggregates**

Sand for Portland Cement Lime Plaster shall be ASTM C 144, except gradation of sand shall conform to the following requirements.

### 2.1.3.1 Sand Gradation for Basecoats:

Percentage Retained by weight (plus or minus 2 percent) on each sieve

<u>Sieve</u>	<u>Min</u>	<u>Max</u>
No. 4		0
No. 8	0	10
No. 16	10	40
No. 30	30	65
No. 50	70	90
No. 100	95	100

### 2.1.3.2 Sand for Finish Coats

Sand for finish coat shall be near white and shall be graded within the limits shown above for basecoats, except that the sand shall pass the No. 8 sieve, and for smooth finish the sand shall pass the No. 30 sieve.

### 2.1.3.3 Water

Clean, fresh, suitable for domestic consumption, and free of mineral and organic substances that affect the hardening or durability of the plaster.

## 2.2 PROPORTIONING AND MIXING

Except where specified otherwise, materials are specified on a volume basis and shall be measured in approved containers, which will ensure that the specified proportions will be controlled and accurately maintained during the progress of the work. Measuring materials with shovels "shovel count" will not be permitted. Ready-mix plasters shall be prepared for use by the addition of water only.

### 2.2.1 Basecoat Proportions

#### 2.2.1.1 Portland Cement-Lime Plaster Basecoats

Mix scratch coat in the proportion of one part by volume of Portland cement to not more than 3/4 part by volume of hydrated lime and not less than 2-1/2 nor more than 4 parts by volume of damp loose sand. Mix brown coat in the proportion of one part by volume of Portland cement to not more than 1/2 part by volume hydrated lime and not less than 3 nor more than 5 parts by volume of damp loose sand. Workability shall govern the actual amount of lime and sand used in the scratch and brown coats.

### 2.2.2 Finish Coat Proportions

#### 2.2.2.1 Portland Cement-Lime Plaster Finish Coat

Mix finish in the proportion of one part by volume of Portland cement to not more than one part by volume of hydrated lime, and not more than 4 parts by volume of damp loose sand. Workability shall govern the actual amount of lime and sand used in the finish coat, within the limits specified herein. Where smooth troweled finish is indicated, allow plaster to set up to the extent that it does not flow ahead or under the trowel, yet has not solidified, then trowel the face lightly to embed the granules. Do not over-trowel or burnish the surface.

## 2.3 MIXING

Mix materials in approved mechanical mixers of the type in which the quantity of water can be controlled accurately and uniformly, except that finish coats containing lime may be hand mixed. While the mixer is in continuous operation, add approximately 90 percent of the estimated quantity of water, half of the sand, all of the cementitious materials, and introduce the other one-half of the sand into the mixer in that sequence and mix thoroughly with the remainder of the water until the mixture is uniform in color and consistency. Avoid excessive mixing or agitation. Discard plaster which has begun to set before it is used; re-tempering will not be permitted. Do not use caked, or lumped materials. Empty mixers and mixing boxes after each batch is mixed, and keep free of old plaster.

## PART 3 - EXECUTION

### 3.1 PREPARATION OF SURFACES

Clean surfaces to which plaster is to be applied of all projections, dust, loose particles, grease, bond breakers, and foreign matter. Do not apply plaster directly to (1) surfaces of masonry or concrete that has been coated with bituminous compound or other waterproofing agents, or (2) to surfaces that have been painted. Before plaster work is started, wet masonry and concrete surfaces thoroughly with a fine fog spray of clean water to produce a uniformly moist condition. Check metal grounds, corner beads, screeds, and other accessories carefully for alignment before the work is started. Check expansion and control joints and supporting metal structures to ensure that expansion and control joints can move unrestrained.

### 3.2 APPLICATION OF PLASTER

#### 3.2.1 General

Plaster may be applied by hand or by machine. When a plastering machine is used the fluidity of Portland cement-lime plaster shall be controlled to have a slump of not more than 63 mm when tested using a 50 by 100 by 150 mm high slump cone. Subsequent to determining water content to meet this slump, do not add additional water to the mix. Conduct the slump test according to the following procedure:

- a. Place cone on level, dry, non-absorptive base plate.
- b. While holding cone firmly against base plate, fill cone with plaster taken directly from the hose or nozzle of the plastering machine, tamping with metal rod during filling to release air bubbles.
- c. Screed off plaster level with top of cone. Remove cone by lifting it straight up with a slow and smooth motion.
- d. Place cone in a vertical position adjacent to freed plaster sample, using care not to jiggle base plate.
- e. Lay a straight edge across top of cone, again being careful not to vibrate cone. Measure slump in inches from the bottom edge of the straightedge to the top of the slumped plaster sample.

#### 3.2.2 Workmanship

Apply plaster in three coats, except as follows:

- a. Provide scratch coat. Apply base coats with sufficient pressure and plaster shall be sufficiently plastic to provide a good bond to bases. Work base coats into screed at

intervals of from 1.50 to 2.40 meters. Plaster shall not be continuous across expansion and control joints occurring in walls, and partitions. Finish plasterwork level, plumb, square, and true, within a tolerance of 3 mm in 2.40 meters, without waves, cracks, blisters, pits, crazing, discoloration, projections, or other imperfections. Form plasterwork carefully around angles and contours, and well up to screeds. Special care shall be taken to prevent sagging and consequent dropping of applications. There shall be no visible junction marks in finish coat where one day's work adjoins another.

### 3.3 PORTLAND CEMENT – LIME PLASTER

Apply base coats with sufficient pressure to curl the keys around the back of metal lath or wire fabric and to provide good bond on masonry or concrete bases.

#### 3.3.1 Plaster except Scratch Coat for Ceramic Tile Backing

Apply in three coats to a thickness of not less than 16 mm. Apply the scratch coat not less than 6 mm thick, lightly score horizontally, and moist cure for not less than 24 hours. Apply the brown coat after the scratch coat has been aged at least 24 hours in addition to the moist curing period. Apply the brown coat to bring the base coat out to the screeds, compact and straighten to a true surface with rod and Darby, and float to receive the finish coat. After the brown coat has been moist cured for not less than 24 hours and aged at least an additional 5 days, apply the finish coat to a thickness of not less than 3 mm. Where any previous coat has become dry, dampen the surface evenly with water, prior to the application of the next coat. The finish coat for plaster shall have a troweled finish. Moist cure plaster for 24 hours using a fine fog spray of water and apply to the finish coat as frequently as required to prevent dry-out of the plaster. Do not saturate the plaster to the point where free water stands on the surface. Prevent staining of the finish coat. Provide moist curing.

#### 3.3.2 Scratch Coat for Ceramic Tile and Marble Backing

Apply scratch coat and keep continuously damp for not less than 24 hours before tile is to be set. Apply scratch coat in thickness indicated or as necessary to bring the face of the tile and marble to the required plane, but not less than 6 mm from the face of the material it is being applied to and with a level surface within a tolerance of 6 mm in 2.40 meters. Apply scratch coat after substantial grounds, plugs, hangers and other electrical outlets, and other fixtures and fittings have been installed that are to be secured to tiled and marbled surfaces. Apply scratch coat with sufficient pressure to ensure a proper bond and key with the base and a proper base for the setting bed. While the mortar is still plastic, cut the scratch coat with a trowel at internal vertical angles to the depth of the coat and for the full height of the tile bed, score horizontally or cross-scratch coats within one hour after mixing, and at no time shall the mortar be re-tempered. Protect scratch coat and keep moist during curing period. A leveling coat of the same mix specified for the scratch coat shall be applied over the scratch coat when the surface of the scratch coat is not level within the specified tolerance or when a base coat thickness of more than 19 mm is required. Scratch leveling coat and cure for not less than 24 hours.

### 3.4 PATCHING AND POINTING

Upon completion of the building, cut out and patch loose, cracked, damaged, or defective plaster. Patching shall match existing work in texture, color and shall be finished flush with plaster previously applied. Do pointing and patching of plaster work abutting or adjoining any other finish work in a neat and workmanlike manner. Remove plaster droppings or spattering from surfaces, in condition ready to receive paint or other finish. Remove protective covering from floors and other surfaces, and rubbish and debris from the building.



3.5 METHOD OF MEASUREMENT

All cement plaster finish shall be measured in square meters or part thereof for work actually completed and accepted.

3.6 BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price per square meter of Cement Plaster Finish which price and payment shall constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 09705 - FIBER CEMENT BOARD**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing of materials and labor including equipment necessary to complete the installation of fiber cement board panels/ceiling as shown on the drawings and as specified herein.

#### **1.2 SUBMITTALS**

- a. Product data: Submit manufacturer's product data for each type of product specified.
- b. Samples:
  - (1) Submit 300 mm x 300 mm for each board required, 2 sets of required mock up.
  - (2) Submit miscellaneous product samples such as joint tapes and compounds.

#### **1.3 QUALITY ASSURANCE**

- a. Single Source Responsibility: Obtain each type of fiber cement panels and related treatment materials from a single manufacturer.

#### **1.4 DELIVERY, HANDLING AND STORAGE**

- a. Delivery: Deliver materials in original-packages containers or bundles bearing brand name and identification of manufacturer or supplier.
- b. Handling: Handle fiber cement boards to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner boards and trim.
- c. Storage: Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack fiber cement panels flat to prevent sagging.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

Shall be Fiber Cement Sheets, Auto-cleaved, single faced sheets containing Portland cement, ground sand, cellulose fiber and water. Fiber Cement sheets shall be manufactured from asbestos-free materials.

- a. 3.5 mm thick for internal wall and ceiling  
6 mm thick cove light housing
- b. Composition: Fiber cement board shall be asbestos free, fiber-reinforced cement sheets.
- c. Density: 1380 kg/m<sup>3</sup> minimum

## 2.2 STEEL FRAMING

- a. Steel Studs and Runner: Ga. 25 minimum thickness of uncoated metal galvanized C-shaped or as otherwise indicated.

## 2.3 FASTENERS

- a. Provide fasteners of type, material size, corrosion resistance, holding power and other properties required for fastening furring and framing members to substrates indicated.
- b. Trim Accessories: Provide metal trims accessories of profile and materials as shown on the drawings, or as otherwise required by the Architect/manufacturer.

## 2.4 MISCELLANEOUS FRAMING AND SUPPORTS

- a. General: Provide steel framing and supports for applications indicated.
- b. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
  - (1) Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish insert, if units must be installed after concrete is placed.
  - (2) Except as otherwise indicated, space anchors at 600 mm O.C. and provides minimum anchor units in the form of steel straps 32 mm wide by 6 mm by 200 mm long.

## 2.5 MISCELLANEOUS MATERIALS

- a. General: Provide auxiliary materials for fiber cement board construction, which comply with reference standards and the recommendations of the manufacturer of the fiber cement board.
- b. Fastening Adhesive for Metal: Special adhesive recommended by manufacturer.
- c. Screws: As per recommendation by manufacturer.
- d. Bedding and Topping Cement: As per recommendation by manufacturer.
- e. Perforated Paper Reinforcing Tape: As per recommendation by manufacturer.
- f. Trim Accessories: Provide galvanized steel edge corner and joint trims as shown or otherwise required by the Architect/manufacturer as standard details.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- a. Examine substrates to which fiber cement panel construction attaches or abuts, preset hollow metal frames, cast-in anchors, and structural framing, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fiber cement panel construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- a. General: Follow specifications of manufacturer.

### 3.3 INSTALLATION OF STEEL FRAMING GENERAL

- a. General: Follow specification by manufacturer.
- b. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixture, equipment services, heavy trim, furnishings, and similar construction to comply with details indicated and with recommendations of fiber cement board manufacturer.
- c. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at locations indicated below to comply with details shown on drawings.
- d. Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

### 3.4 INSTALLATION OF STEEL FRAMING

- a. Installation Tolerances: Install each steel furring members so that fastening surface do not vary more than 3 mm from plane of faces of adjacent framing.
- b. Extend steel furring full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for fibercement board.

### 3.5 APPLICATION AND FINISHING OF FIBER CEMENT PANELS GENERAL

- a. Apply and finish fiber cement panels as per specifications by manufacturer for flush-jointed applications.
- b. Install fiber cement panels in manner which minimizes the number of end-butt joints or avoids them entirely where possible.
- c. Install exposed fiber cement panel with face side out. Do not install imperfect, damages or damp boards. Bat boards together for slight contact at edges and ends with not more than 1.5 mm open space between boards. Do not force into place.
- d. Locate either edge or end joints over supports, except in horizontal applications where intermediate support is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.
- e. Attach fiber cement panel for supplementary framing and blocking provided for additional support at openings and cutouts.
- f. Space fasteners in fiber cement boards in accordance with referenced application and finishing standard and manufacturer specifications.

### 3.6 METHODS OF FIBER CEMENT PANEL APPLICATION

- a. General: Follow specifications by manufacturer.
- b. Single-layer Application: Install fiber cement panel as follows, and as indicated on the drawings.

- c. Single-layer fastening Methods: Apply fiber cement panels to supports as follows:
  - (1) Fasten to steel framing with adhesive and supplementary screws as per recommendation by manufacturer.

### 3.7 INSTALLATION OF TRIM ACCESSORIES

- a. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten fiber cement board to the supports. Otherwise, fasten flanges to comply with specification by the manufacturer.
- b. Install corner boards at external corners.
- c. Install metal edge trim whenever edge of fiber cement board would otherwise be exposed or semi-exposed.
  - (1) Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled.

### 3.8 FINISHING OF FIBER CEMENT BOARDS

- a. General: Apply to joint treatment at fiber cement panels joints (both directions); penetrations; fasteners head, surface defects and elsewhere as required to prepare works for decoration.
- b. Finish fiber cement panels as per recommendation by manufacturer.

### 3.9 PROTECTION

- a. Provide final protection and maintain conditions, in a manner suitable to installer that ensures, fiber cement panel construction being without damage or deterioration at time of substantial completion.

### 3.10 METHOD OF MEASUREMENT

Fiber cement board shall be measured by actual area in square meters installed and accepted to the satisfaction of the Architect / Engineer.

### 3.11 BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price per square meter of Fiber Cement Board which price and payment shall constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 09800 - CEILING SUSPENSION SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

The work under this section of the specification covers the furnishing and supply of materials including equipment and performing labor necessary for the complete installation of ceiling suspension system for the attachment of board as shown on the drawing, and as specified herein.

#### **1.2 APPLICABLE PUBLICATIONS**

The publications listed below form part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A 463-77 Steel Sheet, Cold-Rolled, Aluminum-Coated Type I

A 525-81 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process

C 754-82 Installation of Steel Framing Members to Receive Screw Attached Plaster Wallboard, Backing Board, or Water Resistant Backing Board.

#### **1.3 SUBMITTALS**

##### **1.3.1 Certificates of Compliance**

Manufacturer's certificates attesting that materials meet the requirements specified herein in referenced publications.

##### **1.3.2 Manufacturer's Erection Instructions**

Printed instructions for the erection of metal suspension systems.

#### **1.4 DELIVERY AND STORAGE**

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If it is necessary to store materials outdoors, stack materials off the ground, properly supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items that cannot be restored to like-new conditions.

### **PART 2 - PRODUCTS**

#### **2.1 STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS**

- a. Furring Channels: ASTM C 645 gauge 25 standard channels
- b. Accessories : Hangers and inserts
- c. Installation Standard : ASTM C 754

##### **2.1.1 Water-resistant plasterboard**

Water-resistant plasterboard shall conform to ASTM C630, regular & 12mm thickness.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

Examine substrates and adjoining construction and conditions under which work is to be installed. Do not proceed with work until satisfactory conditions are corrected.

### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- a. Install in accordance with reference standards and manufacturer's instructions (and as required to comply with seismic requirements).
- b. Tolerances:
  - 1. Do not exceed 1/8 inch in 8'-0" variation from plumb or level in exposed lines of surface, except at joints between plaster board units.
  - 2. Do not exceed 1/16" inch variation between planes of abutting edges or ends.
  - 3. Shim as required to comply with specified tolerances.
- c. Install framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation.
- d. Install supplementary framing, blocking and bracing at terminations in plasterboard assemblies to support fixtures, equipment, and heavy trim, grab, bars, toilet accessories, furnishings or similar construction.

### **3.3 METAL SUPPORT INSTALLATION**

#### **3.3.1 Ceiling and Soffit Support Systems**

- a. Secure hangers or rods to structural support by connecting directly to structure where possible; otherwise connect to inserts, clips or other anchorage devices or fasteners indicated.
- b. Space main runners, hangers and furring according to requirements of ASTM C754, except as otherwise indicated.
- c. Where spacing of structural members, or width of ducts or other equipment, prevents regular spacing of hangers, provide supplemental hangers and suspension members and reinforce nearest affected hangers to span extra distance.
- d. Attach directly to structural elements only; do not attaché to metal deck. Loop hangers and wire-tie directly or provide anchors or inserts.
- e. Install compression posts, splay wires and other accessories as required to comply with seismic requirements.
- f. Extend runners to within 6 inches of walls.
- g. Wire-tie or clip furring members to main runners and to other structural supports indicated. In fire resistance rated assemblies, wire-tie furring members, do not clip.
- h. Do not permit furring or runners to contact masonry or concrete walls.

- i. Provide 1 inch clearance between furring or runners and abutting walls and partitions.
- j. For proprietary framing system, comply with manufacturer's instructions.

### 3.4 BOARD INSTALLATION

#### 3.4.1 Ceilings

- a. Install plaster base sheets with long direction at right angles to furring channels with end joints occurring over channels.
- b. Stagger and joints.
- c. Install ceiling boards prior to adjoining partition boards where feasible.
- d. Fasten at not less than 12 inches on center at furring channels.
- e. Double layer applications:
  - 1. Apply base layer prior to base layer application on adjoining partitions; apply face layers in same sequence.
  - 2. Apply plaster base layer and face layer with long dimension parallel to supports. Offset joints of face at least 16 inches from base layer joints.
  - 3. Fasten both base and face layers separately to supports.
  - 4. Stagger and space fasteners in accordance with plaster base manufacturer's instructions.
- f. Vaulted (curved) applications:
  - 1. Provide sheet length such that one single sheet covers curved surface. Provide sheet thickness as recommended by manufacturer for minimum boarding radius.
  - 2. Install sheets perpendicular to furring channels.
  - 3. Start fastening sheets at center of curve and work onwards to ends of sheets.
  - 4. Do not cut openings for ceiling penetrations until sheets are installed and thoroughly dry.

### 3.5 SOUND RATED CONSTRUCTION

- a. Insulation
  - 1. Install sound attenuation blankets in sound-rated partitions and ceilings where indicated.
  - 2. Completely fill space between studs and framing to full height of partition wall or full area of ceiling.
  - 3. Fit carefully behind electrical outlets and other work penetrating sound-rated construction.



- b. Plaster Board
  - 1. Install plaster board same as for interior partitions and ceilings.
  - 2. Coordinate with installation of perimeter sealants.
- c. Acoustical Sealant:
  - 1. At partition walls, provide continuous beads of acoustic sealant at juncture of both faces of runners with floor and ceiling construction, and wherever plaster board abuts dissimilar materials, prior to installation of plaster board.
  - 2. At ceilings, provide continuous beads of sealant wherever plaster board abuts dissimilar materials.
  - 3. Provide continuous bead of sealant behind faces of control joints prior to installation of control joint accessories.
  - 4. After installation of plaster board base layers, cut face layer sheets  $\frac{1}{2}$  inch less than floor-to-ceiling height and position with  $\frac{1}{4}$  inch open space between plaster board and floor, ceiling and dissimilar vertical construction. Fill  $\frac{1}{4}$  inch open space with continuous sealant beads after installation of face layer.
  - 5. At openings and cutouts, fill open spaces between plaster board and fixtures, cabinets, ducts and other flush or penetrating items, with continuous bead of sealant.
  - 6. Seal sides and backs of electrical boxes to completely close off openings and joints.
- d. Sound Flanking Paths
  - 1. Where sound-rated partition walls intersect non-rated plaster board partition walls, extend sound-rated construction to completely close sound flanking paths through non-rated construction.
  - 2. Seal joints between face layers at vertical interior angles of intersecting partitions.

### 3.6 ACCESSORY INSTALLATION

- a. Trim:
  - 1. Use same fasteners to anchor trim accessory flanges as required to fasten plaster board to supports, unless otherwise recommended by trim manufacturer.
  - 2. Install metal corner beads at external corners.
  - 3. Install metal casing bead trim whenever edge of plaster board would otherwise be exposed or semi-exposed.
- b. Control Joints:
  - 1. Install control joints at junction of plaster board partitions with walls or

partitions of other finish material.

2. Install control within long runs of partitions, ceilings or soffits at approximately 30'-0" on center or as indicated.
3. Where plaster board is vertically continuous, as at stairwells, provide horizontal control joints at each floor level.

- c. Special Trim: Install as indicated on drawings and in accordance with manufacturer's instructions.

### 3.7 ADJUSTING

- a. Correct damage and defects which may telegraph through finish work.
- b. Leave work smooth and uniform.

### 3.8 Method of Measurement

Aluminum spandrel ceiling inclusive of ceiling suspension system shall be measured by the number of square meters installed and accepted.

### 3.9 Basis of Payment

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price per square meter of Aluminum Spandrel Ceiling which price and payment shall constitute full compensation for furnishing and placing all materials including ceiling suspension system and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 09801- ALUMINUM SPANDREL CEILING SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

The work includes the supply and furnishing of materials, including equipment, and performing labor necessary to complete the installation of all aluminum ceiling system as specified and as shown on the drawings and schedules.

#### **1.2 SUBMITTALS**

##### **1.2.1 Shop Drawings**

Submit along with catalog cuts, templates, and erection and installation details, indicating thickness, type, grade, class and dimensions.

##### **1.2.2 Samples**

Submit the following samples for approval:

- a. Aluminum finishes
- b. Supports
- c. Fasteners

##### **1.2.3 Delivery Storage and Handling**

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area from contact with soil and weather. The Contractor shall replace all damage items.

### **PART 2 - PRODUCTS**

#### **2.1 CEILING PANELS**

The ceiling panel is 84 mm wide, 16 mm deep and 0.5 mm thick made of stove enameled aluminum panels, which are clipped on to specific carrier profiles in simple manner. The panels can be easily removed and replaced without special tools.

#### **2.2 PANEL CARRIERS**

The panel carrier is 62 mm wide, 29 mm deep made of 0.95 mm thick enameled aluminum or 0.5 mm thick enameled steel. Color satin black. The flanges have prongs to hold the panels.

#### **2.3 PANEL CLIPS**

The panel clip is made of enameled aluminum, color satin black. The clips are independent from the prong; allow variable fixing of the panels to the carriers. With this clip panels can be fixed to an angle of 50 deviating from the normal position to the carrier 90.

#### **2.4 FLUSH JOIN PROFILES**

Flush join is made of un-perforated enameled aluminum.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

##### **3.1.1 Carriers**

Space carriers 1500 mm o.c. overhead or directly to structural supports. Utilize expansion carriers to compensate for ceiling areas that are out of square, out of parallel or where ceiling size does not conform to the standard 101 mm increment. Install carrier splices at abutting ends of carrier for rigidity, and align holes of splices with carriers.

##### **3.1.2 Filler Strips**

Insert filler strip in carriers where required. Use strip in color as selected where directional or aesthetic features are required.

##### **3.1.3 Ceiling Panels**

Snap ceiling panels over protruding ears of carrier. Stagger joints in panels between adjoining carriers, using an interior splice of color similar to ceiling panel to stiffen the joint. Where panel ends are visible install end plug or panels. At angular walls and turn, trim panels to the correct angle and join ends along top inconspicuously with a stock angle for rigidity.

#### **3.2 CLEANING**

Upon completion of installation, thoroughly clean surfaces in accordance with recommended procedure of manufacturer. Do not use abrasive, caustic or acid cleaning agents.

#### **3.3 METHOD OF MEASUREMENT**

Aluminum spandrel ceiling inclusive of ceiling suspension system shall be measured by the number of square meters installed and accepted.

#### **3.4 BASIS OF PAYMENT**

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price per square meter of Aluminum Spandrel Ceiling which price and payment shall constitute full compensation for furnishing and placing all materials including ceiling suspension system and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## **SECTION 09910 – PAINTING WORKS**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing of materials, equipment and labor necessary to complete all field painting works on buildings as shown and indicated on the drawings and schedule of finishes as well as specified herein.

#### **1.2 DELIVERY AND STORAGE**

Deliver coatings and coating materials in unopened original container bearing the manufacturer's name and brand designation, specification number, batch number, color, date of manufacture, and manufacturer's instruction for application. Restrict storage of coatings and coating materials and the mixing of coatings to the locations directed.

#### **1.3 SELECTION OF COLORS**

Colors of finish coats shall be as approved by the Architect / Engineer. Manufacturer's name and color designation, if indicated, are used for the purpose of color designations only and are acceptable for use on this project only if they conform to all specified requirements. Products of other manufacturers are acceptable if the color closely approximate the colors indicated and the product conforms to all specified requirements.

#### **1.4 DESCRIPTION OF WORK**

Surfaces concealed by portable objects and by surface mounted articles readily detachable by removal of fasteners such as screws and bolts are included in the work. Surfaces concealed and made inaccessible by panel boards, fixed ductwork, machinery, and equipment fixed in place are not included. Remove articles obstructing access to those surfaces specified to be included in the work and restore to their original position on completion. Do not coat surfaces in concealed spaces unless specifically so stated. Do not coat surfaces of steel to be embedded in concrete. Do not coat copper, stainless steel, and aluminum except where specifically so stated and except where surfaces have existing coatings. Do not coat new factory finished material except those that require identification or color coding and those factory-finished surfaces which are damaged during installation. Restore damaged factory-finished surfaces to their original condition. Do not paint zinc-coated ducts, zinc-coated pipe, or copper pipe in concealed spaces.

##### **1.4.1 Exterior Painting**

Includes new surfaces, including items on or a part of the roof which are not factory-finished.

##### **1.4.2 Interior Painting**

Includes new surfaces, and appurtenances of the types listed. Where a space or surface, supports, hangers, and miscellaneous metalwork, except as specified otherwise herein.

##### **1.4.3 Mechanical and Electrical Painting**

Includes the field coating as required of interior and exterior piping, conduit, ductwork, supports, hangers, air grilles, registers, miscellaneous, and coverings where required, except as specified otherwise herein.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

Paints enamels, coating, primers and stains shall be "best-in-line" product.

#### **2.1.1 Lead Content**

Do not use coatings having a lead content of over 0.06 percent by weight of nonvolatile content.

## **PART 3 - EXECUTION**

### **3.1 PROTECTION OF AREAS AND SPACES**

Remove, mask, or otherwise protect prior to surface preparation and painting operations such items as hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixture, and similar items in contact with coated surfaces. Following completion of painting, reinstall removed items utilizing workmen skilled in the trades involved for such removal and reinstallation. Protect from contamination by coating materials all surfaces not to be coated. Restore surfaces that are contaminated by painting materials to original condition.

### **3.2 PREPARATION OF SURFACES**

Remove all dirt, rust, scale, splinters, loose particles, grease, oil and other deleterious substance from all surfaces which are to be coated or otherwise finished. Allow putty to set one week before coating. Caulking and glazing compounds shall be allowed to cure for times stated in manufacturer's literature prior to being coated. Sandpaper entire surface of existing enamel and other glossy surfaces before application of any coatings. Inspect surfaces after preparation and receive approval before application of any coatings. On surface to be coated with water thinned coatings, spot prime with a brush all exposed nails and other ferrous metal with zinc chromate primer.

#### **3.2.1 Wood Surfaces**

Surfaces shall be free from dust and in an approved condition to receive the paint or other finish. Do not use water on uncoated wood. Prior to application of paint, treat knots and resinous wood with an application of knot sealer. Putty cracks and nail-holes after the priming coat has been applied and has dried properly. Prime coat wood doors, frames and trim immediately following delivery to the job site. Sandpaper the entire area previously painted interior wood surfaces; scrape as necessary to remove loose coatings. Set and putty stop all nail heads. Where checking of the wood is present, sand the surface down smooth, wipe and apply a coat of pigmented orange shellac and allow to dry before additional paint is applied. Fill open joints and all other openings whitening putty.

#### **3.2.2 Concrete and Masonry**

Remove dirt, fungus, grease, and oil prior to application of coatings. Wash new surfaces with a solution composed of from 14 to 56 grams of tri-sodium phosphate per 1 liter of hot water and rinse thoroughly with fresh water. Wash previously coated surfaces with a suitable detergent and rinse thoroughly. Remove glaze, all loose particles, and scale by wirebrushing. Remove efflorescence by scraping, wire brushing, and washing with 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid and then wash thoroughly with fresh water, removing all traces of the acid. Give all new surfaces to be painted with other than cement-water paint a neutralizing treatment consisting of 0.23 kg. of zinc sulphate in 1 liter of warm water. Apply the neutralizer liberally and allow to dry, then rinse the surfaces thoroughly with clean water and allow to dry for not less than 48 hours before paint is applied.

### 3.2.3 Plaster

Prior to painting, repair all joints, cracks, holes, and other surface defects with patching plaster or spackling compound and sand out smooth. New plaster to be coated shall have an instrument-measured moisture content of not more than 8 percent. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before application of coating.

### 3.2.4 New Unprimed Metal Surfaces

Solvent clean zinc-coated surfaces with mineral spirits and wipe dry with clean, dry cloths. Immediately after cleaning and treating, apply pretreatment wash primer, to a dry film thickness of 0.2 to 0.5 mil on zinc-coated, and ferrous surfaces. Apply primer as soon as practicable after pretreatment has dried. Surface preparation shall be in strict compliance with Steel Structure Painting Council, SSPC SP-10, Near White Blast Cleaning also known as through blast cleaning using dry abrasive.

### 3.2.5 New Hot Metal Surfaces

Clean new surfaces down to clean bare metal free of mill scale, rust, oil, oxides, dust, coatings and contaminants. Apply new coatings before any new oxidation or contamination begins. Surface preparation shall be in strict compliance with steel structures. Painting SSPC-SP-10 near white metal blast cleaning also known as thorough blast cleaning using dry abrasive.

## 3.3 APPLICATION

Provide finished surfaces free from burns, drops, ridges, waves, laps, brush marks, and variations in colors. Avoid contamination of other surfaces and repair all damage thereto. Allow sufficient time between coats to permit thorough drying and provide each coat in proper condition to receive the next coat. Each coat shall cover the surface of the preceding coat or surface completely; there shall be an easily perceptible difference in shades of successive coats. Thoroughly clean dust-free before and during the application of coating material. Prior to erection, used two coats of the designated primer to treat and prime wood and metal surfaces, which will be inaccessible after erection. Thoroughly work painting materials into all joints, crevices, and open spaces. Finished surfaces shall be smooth, even and free of defects. Retouch damaged painting before applying succeeding coats of paint. Spray painting operations shall comply with the best procedural trade practice. Procure and utilize the engineering controls and/or personal protective equipment necessary for safe and effective application of specified paint systems. Apply strains in accordance with the manufacturer's printed instruction.

Storing, thinning, mixing, handling and applications of painting materials shall be in strict compliance with the manufacturer's recommendation and instruction. Unless otherwise recommended by the paint manufacturer, painting shall be done when:

- a. Metal surface temperature is at least 3°C more than dew point temperature
- b. Ambient temperature is above 10°C
- c. Relative humidity is less than 85%
- d. Application of paints shall be done by Airless Spray Equipment. Pigmented and catalyzed materials shall be thoroughly mixed and strained before applying. Materials that have not been applied within the pot life period specified by manufacturer shall be discarded and properly disposed of.

### 3.3.1 Equipment

Apply coatings carefully with good, clean brushes or approved spray equipment, except as specified otherwise. Spray areas made inaccessible to brushing by ducts and other equipment. Use airless type spray equipment. Use approved rollers for the application of flat latex coatings to interior walls and ceilings.

### 3.3.2 Thinning of Paints

Reduce to proper brushing consistency by adding fresh paint, except that when thinning is not mandatory for the type of paint being used.

### 3.3.3 Environmental Conditions

Do not apply exterior coatings in rainy weather or when the temperature of the air at the surface is over 35 degrees C. Apply interior coatings when the surfaces to be painted are dry and the temperature can be kept below 95 degrees F during the applications of ordinary paints, between 65 degrees F and 95 degrees F during the application of enamels and varnishes.

### 3.3.4 Special Requirements for Coating Concrete Masonry Surfaces with Acrylic Emulsion Paint

Requires containers be marked for the formulation and mixing of fill coat. The fill coat shall conform to these markings except as specified herein.

#### a. Mixing of Fill Coat

The formula given in Acrylic Emulsion Paint for the content of the fill coat requires a definite amount of water to be added in preparation of the mixture. This requirement shall not apply. Deliver the sand, cement, and mixing liquids pre-proportioned and packaged so that field proportioning will not be required. Field mix the mixing liquid with the sand and cement; after this mixture is thoroughly blended, add water as necessary to produce a rich, creamy mixture of proper brushing consistency. Mix the fill coat materials by hand but do not vigorously agitate. After mixing, allow to set for 10 minutes to permit air to escape before applying. The fill coat mixture will gradually thicken with time; add small amounts of water, when necessary, to keep the mixture a rich brushing consistency. Do not begin mixing more than one hour before application.

#### b. Wetting of Surface

Before applying filler coat, thoroughly wet the masonry and concrete to control surface suction and provide a reserve of moisture to aid in curing the paint. A garden hose nozzle adjusted to a fine spray is adequate for the purpose. Do not dampen with a brush dipped in water. Dampen the masonry and concrete in one operation not more than one hour nor less than 30 minutes before painting. Apply the spray in such manner that each part is sprayed three or four times for about 10 seconds. Allow time between applications for the water to soak into the surface. If the surface tends to dry rapidly, as in hot weather, re--dampen slightly just in advance of painting. The surface shall be moist but without free water when paint is applied.

#### c. Application

Do not paint when the paint may be exposed to temperatures below 40 degrees F within 48 hours after application or when the temperature is over 95 degrees F. Rub the filler coat into the surface in such a manner as to fill all depressions, holes, voids, joints, and hollows. Apply the filler coat with stiff fiber bristle brushes with bristles not longer than 2-1/2 inches, using a circular motion. Give the surface a final stroke parallel to the course of block. Provide uniform coverage and laps well brushed out. Apply the first finish coat at a rate of not less than one gallon per 250 square feet; apply the second finish coat at the rate of not less than one gallon per 300 square feet. Brush apply finish coats, except that behind large ducts and similar locations



inaccessible to a brush they may be applied by rollers. Spray application will not be permitted. Deliver all paint to the job site prior to application. Compute the amount of finish coat paint required and submit calculations for approval. Do not begin painting until this amount has been approved and delivered to the job site. Apply all delivered paint. Keep paint in tightly covered containers when not in use; keep stirred to maintain uniform color and consistency during application. At least 24 hours shall lapse between coats; do not start another coat until the preceding coat has become so hard that it cannot be marked with the brushes used. In hot weather, slightly moisten the prior coat before applying the succeeding coat. Covering is not necessary.

### 3.3.5 Paint Systems

New surfaces made by cleaning operations, shall receive the following coatings. Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a dry film thickness of not less than 1.0 mil. each coat except as specified otherwise. Where coating thickness is specified, it is the minimum dry film thickness.

#### a. Exterior and Interior Surfaces

##### (1) Exterior Concrete / Masonry and Plaster Surfaces

Primer:	Acrylic solvent base coating primer
Putty:	Acrylic solvent base putty
Two coats of 100% acrylic latex paint	

##### (2) Metal Surfaces

1 <sup>st</sup> Coat:	Red Oxide Primer
2 <sup>nd</sup> and Third Coat:	Quick Dry Enamel

##### (3) Interior Concrete / Masonry and Plaster Surfaces

First Coat:	Flat Latex
Putty:	Masonry Putty
2 <sup>nd</sup> and Third Coat:	Odorless Water Base Interior Paint

##### (4) Interior/ Exterior Masonry

1 <sup>st</sup> Coat:	100% Acrylic Water Based
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Putty:	<input type="checkbox"/> Acrylic Solvent Water Based Putty for Interior <input type="checkbox"/> Masonry Water Base Putty for Exterior
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2<sup>nd</sup> and Third Coat:

100% Acrylic Latex Paint

#### b. Interior Surfaces Not Specified Otherwise

##### (1) Wood Surfaces

1 <sup>st</sup> Coat:	Flat Alkyd Type Paint
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Putty:	Alkyd Type Putty
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2 <sup>nd</sup> and Third Coat:	Alky Type Enamel Paint
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- c. Oil Wood Stain Lacquer Varnish Products that highlights wood grains, adds freshness and color and protect interior paneling, furniture, doors, cabinets and other woodworks.

1<sup>st</sup> Coat: Oil Wood Stain (any desired color)

2<sup>nd</sup> and Third Coat: Lacquer Sanding Sealer (Commercial Grade Nitro-cellulose based sealer)

4<sup>th</sup> and 5<sup>th</sup> Coat: Clear glass Lacquer (nitro cellulose solvent based high gloss lacquer varnish finished)

- d. Coat other surfaces for which the type of coating has not been specified herein as specified for surfaces having similar conditions of exposure.

- e. Mechanical, Electrical and Miscellaneous Metal Items, Except Hot metal Surfaces and New Pre-finished Equipment

Pre-finishing of new mechanical and electrical equipment is specified in the section covering the particular item.

#### 3.4 METHOD OF MEASUREMENT

Painting of concrete, wood and metal surfaces shall be measured by the number of square meters applied and accepted.

#### 3.5 BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price, respectively for each of the Pay Items listed below and shown in the Bill of Quantities, which price and payment shall constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## DIVISION 10 – SPECIALTIES

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## **SECTION 10165 - TOILET COMPARTMENTS**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

Furnish and install toilet partitions as shown on drawings and as specified herein.

#### **1.2 SUBMITTALS**

##### **1.2.1 Shop Drawings**

Submit shop drawings indicating elevations of partitions, full scale sections, thickness and gauges of metal, fastenings, proposed method of anchoring, the size and spacing of anchors, details of construction, hardware, fittings, mountings, and other related items and installation details.

##### **1.2.2 Samples**

Submit one of each item of hardware, fittings, fastening, and each type of panel. The panel sample shall be cross-sectioned not less than 150 mm by 150 mm in size and shall show finish on base material and core of the panel.

##### **1.2.3 Manufacturer's Data**

Submit literature for each item of hardware, fitting, fastening and each type of panel, complete with description of materials, finishes, and anchoring devices, and appurtenances.

##### **1.2.4 COLORS**

Submit one sample of each color of partition for verification that products match the color indicated. Where colors are not indicated, submit the manufacturer's standard color samples for selection by the Owner and/or Architect / Engineer.

#### **1.3 DELIVERY AND STORAGE**

Deliver materials to the site in original sealed containers or packages, bearing the manufacturer's name, brand designation, specification number, type, style and finish as applicable. Store and handle materials in a manner to protect them from damage.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

Toilet compartments/cubicles - comprising 12mm thk intermediate panels, doors, and partitions/compartments (compact laminated phenolic board) including door frame system urinal divider, cubicle divider, hardware and accessories in nylon finish and all other incidentals to complete. Sizes, dimensions of doors, cubicles and dividers as shown on plans. Color shall be as selected by Architect / Engineer and / or Owner.

#### **2.2 DOOR HARDWARE AND FIXING**

All pilaster shall rest on polyamide adjustable foot and anchored to the divisional walls by black anodized "U" channel. The pilasters shall be finished with black anodized heavy duty channel at the top rail. Fixing of the pilaster to the wall shall be done with black anodized heavy duty channel.

Each cubicle shall be equipped with nylon steel privacy thumb turn, nylon door knob, nylon coat hook, steel hinges with polyamide cover. All the accessories shall be of heat chemical and bacteria resistance nylon.

2.3 FINISH

All edges of doors and pilasters are chamfered and finish without any metal trimming.

**PART 3 - EXECUTION**

3.1 INSTALLATION

Installation of toilet partitions and urinal screens shall be in accordance with approved shop drawings and manufacturer's installation and directions.

3.2 METHOD OF MEASUREMENT

Toilet compartment shall be measured by one (1) lot installed and accepted.

3.3 BASIS OF PAYMENT

The accepted quantity measured as provided in Method of Measurement shall be paid for at the contract unit price for Toilet Compartment, which price and payment shall be full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## SECTION 10810 - TOILET ACCESSORIES

### PART 1- GENERAL

#### 1.1 SCOPE

This specification covers the furnishing of materials and labor necessary to complete the installation of all toilet accessories as shown on drawings and as specified herein.

#### 1.2 SUBMITTALS

##### 1.2.1 Manufacturer's Catalog Data

Submit for each type of accessories specified. Include descriptions of materials, finishes, fastenings and anchoring devices, and appurtenances.

##### 1.2.2 Samples

Submit one of each type of accessory complete with appurtenances and finished as specified. Approved samples may be installed in the work provided each sample labeled for identification and location recorded.

#### 1.3 DELIVERY AND STORAGE

Deliver materials to the site in unopened containers, labeled with the manufacturer's names and brands, ready for installation. Store accessories in safe, dry locations until needed for installation.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS AND FABRICATION

Fabricate accessories in accordance with commercial practice, with welds ground smooth. Bend, flange, draw, form, and perform similar operations in a manner to ensure no defects. Flanges of recessed accessories to return to walls to provide a continuous, tight-against the wall installation.

- a. Corrosion-resistant steel shall conform to AISI, Type 304. The exposed surfaces shall have a No. 4 finish, unless otherwise specified.
- b. Brass shall be cast/ forged in accordance with ANSI A112.18.1M. Steel sheet shall conform to ASTM A 366/A 366M and ASTM A 568/A 568M. Surface preparation and pretreatment shall be provided as required for the subsequent finish.
- c. Galvanized-steel sheet shall be hot-dipped, minimum spangle, conforming to ASTM A 526/A 526M, with not less than a 35 gram (1.25-ounce) zinc coating in accordance with ASTM A 525. ASTM A 525M. The surface preparation for painting shall conform to ASTM D 2092, Method A.

#### 2.2 FINISHES

Finishes on metals not specified otherwise shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Corrosion-resisting steel (Stainless Steel)	General-purpose polished

Aluminum	Satin Anodic, Clear
Carbon Steel	Bright Chromium Plate
Copper Alloy (Brass)	Bright Chromium Plate
Zinc Alloy	Bright Chromium Plate

## 2.3 TOILET ACCESSORIES

### 2.3.1 Tissue Paper Holder

Tissue paper holder with cover shall be stainless steel.

### 2.3.2 Soap Dispenser

- a. Sensor type soap dispenser with brass finish stainless casing (AC 22V/60 Hz, output DC 6V).
- b. Stainless steel vertical type wall mounted liquid soap dispenser.

### 2.3.3 Baby Changing Station

Baby changing station shall be a compact wall mounted infant changing station that includes safety straps and an integral liner dispenser. It is easy to maintain and can be cleaned with any general purpose cleaner. It is made of high density polyethylene plastic which makes it impervious to odors, mildew. It is equipped with pneumatic air pump for controlled lowering and automatic retraction of the changing bed. It is designed to withstand over 400 lbs of static weight which provides the highest safety standards and vandalism protection.

The hardware and brackets shall be of high quality that they would not break with hard or continual use.

The mechanisms that raise and lower the table should be as hidden as possible to prevent injury to hands or fingers. There should also be appropriate straps present to hold infants on the table so that they cannot roll or otherwise get off the table while being changed.

The baby changing station shall comply with the following reference standard:

ANSI A117.1	Accessible and usable Building and Facilities.
ANSI Z535.4	Product Safety Signs and Labels
ASTM F 2285	Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use.
ASTM G 21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

### 2.3.3 Hand Dryer

- a. Sensorized hand dryer (AC220V/60Hz).
- b. Automatic hand dryer (AC220V/60Hz).

### 2.3.4 Grab Bar

L-type anti-bacterial ABS grab bar (600 mm x 600 mm).

2.3.5 Mirrors

Provide 6mm thick Facial mirror on 6mm thick marine plywood backing inclusive all incidentals to complete. Glass for mirrors is specified under Section 8800 "Glazing".

**PART 3 - EXECUTION**

3.1 INSTALLATION

Field measurements shall be taken prior to the preparation of drawings and fabrication to ensure proper fits. Surfaces of fastening devices exposed after installation shall have the same finish as the attached fixtures. Exposed screw heads shall be oval. Install fixtures at the location and height as shown on the drawings. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. Coordinate fixture manufacturer's mounting details with other trades as their work progresses. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Set anchors in mortar in masonry construction or fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mounting on concealed back-plates shall have concealed fasteners. Unless indicated or specified otherwise, install fixtures with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shield, or other approved fasteners as required by the construction. Install back-plates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction.

3.2 METHOD OF MEASUREMENT

Toilet accessories of the type specified shall be measured by the actual number installed and accepted.

3.3 BASIS OF PAYMENT

The quantities measured as provided in Method of Measurement, shall be paid for at the contract unit price for the several Pay Items listed below and shown in the Bill of Quantities which price and payment shall be full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## DIVISION 12 – FURNISHING

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## **SECTION 12600 – FURNITURE AND ACCESSORIES**

### **PART 1 – GENERAL**

#### **1.1 Scope of Work**

The Contractor shall provide and install all furnishing, complete with all upholstery, surface veneers, glass covers, framing, supports, fixings and paintings, varnishing or polishing as appropriate for this Contract and all to the approval of the Architect/Engineer.

The work shall consists of furnishing all labor, materials, equipment and other incidentals necessary to complete the work as shown on the Drawings or as maybe directed by the Architect/ Engineer.

#### **1.2 Submittals**

Shop drawings and catalogs shall be submitted for approval before ordering.

Comprehensive material list for all furniture and fittings, for the approval of the Architect/Engineer.

### **PART 2 - PRODUCTS**

- 2.1 Products shall be supplied by an approved manufacturer. They shall be made to shapes and sizes shown in the Drawings and shall be of sufficient rigidity and stability to suit their intended purpose. Colors shall be as selected by the Architect and Engineer.

#### **Zone Four-Seater Airport Seating**

##### **a. Dimensions**

- (1) Overall seat depth ( single unit ) = 626 mm
- (2) Seat width = 514 mm
- (3) Seat height = 390 mm
- (4) Seat depth = 453 mm
- (5) Overall Height = 789 mm
- (6) Overall height = Overall length = 2,368 mm

##### **b. Upholstery Cover**

- (1) PVC Leather of U.S. origin, finished with polyurethane pigments totally waterproof, oil proof & fire resistant.

##### **c. Base**

- (1) Die cast aluminum base, powder varnished or chromed, nylon glided, black color, with anti-slipper rubber cap assuring floor adjustable height & shock absorber, stainless steel fixation screws.

d.     **Seat Support**

- (1) Die cast aluminum supports, powder varnished.
- (2) High resistance extruded aluminum suitable for fixation.

e.     **Metal Finishes**

- (1) Powder varnishing, finishing obtained with epoxy polyester resins base applied with film from 80-100 micron thickness & stoved.

f.     **Armrest**

Die cast aluminum armrest, powder varnished stainless steel fixation screws with option of site fitting.

**PART 3 – Execution**

3.1     **INSTALLATION**

- a.     Furnitures and fittings shall be fabricated and installed in accordance with acceptable standards for high quality work, details as indicated in the drawings, all to the approval of the Architect/Engineer.
- b.     Each unit shall be assembled tightly and rigidly secured in place free from any damage or defects.
- c.     Exposed surfaces shall be clean, free from scratches, dents, warping, waviness, buckling, misalignment or improper fitted joints.

3.2     **METHOD OF MEASUREMENT**

Furnitures as specified in these Specification and Bill of Quantities shall be measured by the actual number of each type of furnitures installed and accepted.

5.0     **BASIS OF PAYMENT**

The quantities measured as provided in Method of Measurement, shall be paid for at the contract unit price for the several Pay Items listed below and shown in the Bill of Quantities which price and payment shall be full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

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## DIVISION 15 – MECHANICAL (PLUMBING)

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## **SECTION 15400 - PLUMBING WORKS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

The General Conditions apply to all work under this section of the Specifications.

##### **1.1.1 Scope of Work:**

Unless otherwise specified, the Contractor or his subcontractor shall furnish all materials, tools, equipment, apparatus, appliances, accessories, transportation, labor and supervision required for the complete installation and testing of the Plumbing System ready for use in accordance with the best practice of the Plumbing trade as listed herein but not limited to the following:

- a. The Plumbing Contractor is required to refer to all architectural, structural, mechanical, fire protection, and electrical plans and investigate all possible interference and conditions affecting his work.
- b. All work shall comply with the pertinent provisions of the Plumbing Code of the concerned city or town, the Code on Sanitation of the Philippines, and/or the National Plumbing Code of the Philippines.
- c. Domestic water supply and distribution system (potable and non-potable) including supply pipes to the equipment, fixtures and hose bibbs inclusive of all valves, fittings, and other accessories to complete the system.
- d. All building sanitary drains, waste and venting systems including floor drains.
- e. Building storm drainage system including collection system from roof drains, and storm drainage catch basins up to the street drainage system.
- f. Supply and installation of all plumbing fixtures, fittings, trims and accessories.
- g. Supply and installation of a duplex-type booster system and a 4.76gallons capacity bladder tank, to include concrete base, controls, valves, pipes, fittings, liquid level control, and other accessories for complete installation.
- h. Testing for leakage of all water supply and distribution system, drains, waste, sewer and venting system plus pressure testing and disinfection of the water supply and distribution system.
- i. Test run of all pumps and other equipment under Plumbing Works.
- j. Securing of all permits and licenses as required.

- k. Excavation and backfilling in connection with the work shall be included.
- l. Preparation and submittal of two (2) sets of as-built plans.
- m. Furnishing of written one (1) year warranty on the plumbing system.

#### 1.2 NOTES ON DRAWINGS

- a. The Drawings show the general arrangements of all pipings. However, where local and/or actual conditions at the job site necessitate a deviation or re-arrangement, the Contractor shall prepare and submit the new arrangement for the Engineer's approval.
- b. Small scale Drawings do not possibly indicate all offsets, fittings and other parts of the system required. The Contractor shall arrange such work accordingly, furnishing such fittings, traps, valves and accessories as may be required to meet such conditions.

#### 1.3 QUALITY ASSURANCE

- a. The work covered in this contract is to be installed according to the specifications, codes, ordinances and requirements of the following:
  - (1) National Plumbing Code of the Philippines
  - (2) The Code on Sanitation of the Philippines
  - (3) Environmental Management Bureau, DENR
  - (4) Ordinance of the Municipality of BAIS
- b. All construction permits and fees required for the work shall be obtained by and at the expense of the Contractor. The Contractor shall furnish the Owner final certificates of inspection and approval from the proper government authorities after the completion of the Work.

#### 1.4 WORKMANSHIP AND COORDINATION WITH OTHER TRADES

- a. All work shall be performed in first class and neat workmanship by plumber skilled in their trades and such plumber mechanics and their work shall be satisfactory to the Engineer.
- b. The Plumbing Contractor is required to refer to the General Conditions and to all architectural, structural, electrical, mechanical and fire protection plans and Specifications and shall investigate all possible interferences and conditions affecting his work.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

#### **2.1.1 General**

- a. Except as specified, the Contractor shall submit for the Engineer's approval, four (4) copies of a complete list of manufacturer's names of all equipment and materials he proposes to use, within thirty (30) days after award of contract.
- b. The Contractor shall assume the cost of materials and the entire responsibility for any change in the work as shown on contract drawings which may be occasioned by approval of materials other than those specified.

#### **2.1.2 Pipes and Fittings Schedule**

- a. Potable Water Lines – for risers, downfeeds & distribution lines shall be Polypropylene (PP-R) pipe and fittings PN 20 conforming to DIN specifications DIN 8077 and DIN 8078 or ASTM 2389, forming polyfusion homogeneous joint. All threaded inserts should be made of nickel-plated brass conforming to DIN 2999.
- b. Soil, Waste and Vent Pipes - shall be Polyvinyl Chloride (PVC) pipes conforming to ASTM D2729, Series 1000.
- c. Downspouts/Collector Pipes - shall be Polyvinyl Chloride (PVC) pipes conforming to ASTM D2729, Series 1000.
- d. Storm Drainage Lines – shall be Polyvinyl Chloride (PVC) pipes series 1000 conforming to ASTM D2729 for sizes 100mm to 250mm diameter. Use reinforced concrete drain pipes (RCP), tongue and groove, mortar joints for sizes 300 mm diameter and larger conforming to ASTM C-76 Class IV Wall B.

#### **2.1.3 Valves**

- a. Gate Valve - 75 mm & larger, shall be double disc type, iron body with bronze trim, flanged connection, rated 150 psig working pressure. Gate valves installed in vertical piping shall be of solid wedge type. Gate valves installed inside structures shall be of rising stem type with stuffing box stem seals. Gate valves, which are buried or submerged, shall be non-rising stem types with O-ring stem seals.

For 65 mm and smaller, shall be solid wedge type, rated 150 psig working pressure. Valves shall be of bronze construction with screwed bonnet, rising stem, and teflon impregnated packing. PPR gate valves may be used at above ground interior installations.

- b. Check Valve - Check valves 50 mm and smaller shall be rated 150 psig, of cast bronze body, Y-pattern, regrinding, horizontal swing check type, with threaded

ends conforming to ASTM-B-62 or approved equal. Check valve larger than 65 mm shall be rated at 150 psig, of cast iron body, swing check type conforming to ASTM-A-216 or approved equal.

- c. Float Valve - shall be hydraulically operated, diaphragm actuated valve with the pilot control and float mechanism mounted on the cover of the main valve. The float positions the pilot control to close the valve when float contacts the upper stop and to open the valve when the float contacts the lower stop.
- d. Angle Valve - Angle valves 50 mm and smaller for water service shall be rated 125 psig with bronze body, seat and disc; screwed bonnet; rising stem; teflon impregnated packing; and threaded ends.
- e. Flap Valve - cast iron body, minimum 150 psig working pressure.

#### 2.1.4 Other Materials

- a. Drains – shall have cast iron body with integral trap and socketed end, brass strainer.
  - (1) Floor/Shower Drains – similar to METMA M200-D
- b. Roof Strainers - Sanitary basket strainers shall be of brass wires constructed on slotted holes on brass ring with secondary strainer to insure continuous flow of water, similar to METMA M-319-58.
- c. Cleanout
  - (1) Floor Level Cleanout: Shall be of cast bronze or brass with countersunk thread and screwed plug, all items chromium plated.
  - (2) Above Ceiling Cleanout: Shall be of cast bronze or brass with screwed plug and square head.
- d. Hose Bibbs – 20 mm standard hose connection, 15mm male tapered threads, polished chrome plated, angle type with lock shield and hardwell.
- e. Water Hammer Arrestors - shall be of stainless steel construction, with heavy duty balanced expansion bellows. Water hammer arrestors shall be provided in potable water.
- f. Unions - unions for water piping 15 mm and larger in diameter shall be flange pattern of galvanized wrought iron. Gasket for flanged unions shall be of the best quality fiber, plastic or leather.

#### 2.1.5 Outdoor Pipe Lines and Appurtenances

- a. Drainage Junction Boxes/ Catch Basins and Area Drains - shall be cast-in-place 140 kg/cm<sup>2</sup> (13.73 MPa) reinforced concrete sections with pre-cast reinforced concrete cover and steel gratings, respectively.
- b. Thrust Blocks - 140 kg/cm<sup>2</sup> (13.73 MPa) plain concrete.



### 2.1.6 Jointing

- a. Flanged Joint Gasket – “GARLOCK” or approved equal.
- b. Screwed Joints – U.S. Federal Specifications GG-P-251.
- c. PVC Pipes and Fittings – socket type with PVC solvent cement, elastomeric rubber O-ring gasket, or as per the Manufacturer’s recommendations.
- d. Polypropylene - High density pipes and brass fittings and joints shall be used.
- e. G.I. Pipes and Fittings - Carefully reamed threaded joints. Apply seal tape, or paint with red lead paint at all joints lengths.
- f. Dissimilar Pipes - Adaptor fittings shall be used.
- g. Concrete Drain Pipe – Bell and spigot or tongue and groove with cement mortar.

### 2.2 IDENTIFICATION AND APPROVAL OF MATERIALS

- a. Each length of pipe, fittings, traps, fixtures, and device used in the Plumbing System shall have cast, stamped or marked on it, the manufacturer's trademark or name, the weight, type and class of products when so required by the Standards.
- b. Within thirty (30) days after award of the Contract, the Contractor shall submit for the Engineer’s approval, the names of suppliers and materials proposed including trade names and/or samples of the materials if deemed necessary.

### 2.3 SUBSTITUTION AND TESTING OF MATERIALS

- a. Materials intended to be substituted for those originally specified shall be accepted only after a formal request for substitution, accompanied by:
  - (1) Reasons for substitutions;
  - (2) Certificate of test indicating quality, compared to those originally specified.
  - (3) Cost comparisons with material originally specified. Request shall be submitted to the Engineer for evaluation at least 15 working days before installation of subject material is due, or at least 7 days before opening of bids.
- b. Cost of testing of materials, whether on originally specified items or on substitutions, shall be to the account of the Contractor.
- c. Results of tests shall be submitted to the Engineer for evaluation at least 15 days before the material is due for installation on the job.

## 2.4 SOIL, WASTE, DRAIN AND VENT PIPES

### a. Installation

- (1) All sewer lines shall be pitched 6 mm per 300 mm (1/4" per foot) for soil pipes and no case flatter than 3 mm per 300 mm (1/8" per foot) for waste pipes.
- (2) All sanitary waste piping buried beneath floors shall be encased in concrete at least 150 mm thick.
- (3) All changes in pipe sizes on soil, waste and drain lines shall be made with reducing fittings or reducers. All changes in direction shall be made by the appropriated use of forty five degree (45°) wyes, or long sweep bends, except that sanitary tees may be used on vertical stacks. Short quarter bends or elbows may be used in soil and waste lines where the change in direction is from the horizontal to the vertical and on the discharge from the water closet.
- (4) Roughing-in for pipes and fixtures shall be carried along with the building construction. Correctly located openings of proper sizes shall be provided where required in the walls and floors for the passage of pipes all items to be embedded in concrete shall be thoroughly clean and free from all rust, scale and paint.

### b. Traps

- (1) Every plumbing fixture shall be separately trapped by a vented water sealed trap as close to the fixture outlets as the conditions allow, but in no case at a distance greater than 600 millimeters. In case of the upper or the only fixture on a soil pipe extended full size through the roof, a vent shall not be required when said fixture has its center stack. Traps shall be of the same diameter as the waste pipes from the fixtures which they shall serve, all traps shall have a water seal of at least 32 millimeters with a brass thumb screw clean out at the bottom of the seal.

### c. Vent

- (1) Vents shall be taken from the crown of the fixtures, except for water closet traps, in which case, the branch line shall be vented below trap and above all small waste line inlets, so connected as to prevent obstructions. Each vent pipe shall be run separately above the fixtures into the adjacent soil pipes, a distance not more than 1.50 meters. If more than this distance, the vent shall run independently through the roof.
- (2) A vent line shall be wherever practicable, direct extension of a soil or waste line.
- (3) Main vent risers at 4.5 meters long or more shall be connected at the foot with the main water or soil pipes below the lowest vent outlet with a forty five degree connection.
- (4) All vertical soil or vent pipes shall be carried up at least 600mm above the roof of the building and the open side ends are to be entirely and securely covered with a Ga. 16 mesh copper cloth.

- (5) Vent pipes in roof spaces shall be run as close as possible to the underside of roof with horizontal piping pitched down to stacks without forming traps.
- (6) Where an end or circuit vent pipe from fixtures it shall be connected into the main vent or vent stack.
- d. Joints and Connections - All joints shall be air and water tight. For jointing pipes, see Item 2.1.6.

## 2.5 WATER DISTRIBUTION SYSTEM

### a. Installation

- (1) The pipings shall be extended to all fixtures, outlets and equipment from the gate valves installed in the branch near the riser.
- (2) The water supply piping at each fixture shall be provided with a shutoff valve and union, whether indicated on the drawings or not, which will permit isolation and disconnection of each item without disturbing the remainder of the system.
- (3) An union shall be provided within 600 mm of each threaded end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping at locations adjacent to devices or equipment which may require removal in the future and at locations required by the drawings or specifications.
- (4) All necessary provisions shall be taken in laying out piping to provide throughout for expansion and contraction. Piping shall be held free of contact with building construction so as not to transmit noise resulting from expansion.
- (5) All pipes shall be cut accurately to measurement and shall be worked into place without springing or facing. Care shall be taken so as not to weaken the structural portions of the building.
- (6) All service pipes, valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 15mm from such work or from finished covering on the different service.
- (7) Changes in sizes shall be made with reducing fittings.
- (8) Accessible Contraction - Expansion joint shall be made where necessary. Horizontal runs of pipes over 15 m in length shall be anchored to wall or the supporting structure about midway on the run to force expansion and contraction equally towards the ends.
- (9) Polypropylene (PP-R) Random (Type 3) PP-R pipes and fittings must be installed in accordance with the manufacturer's installation recommendation. The maximum permissible support for (PP-R) spacing shall be as follows:

d (mm)	Distance between two brackets (cm)					
	20°C	30°C	40°C	50°C	60°C	70°C
20	75	75	70	65	60	50
25	85	85	85	80	75	65
32	100	100	95	90	85	80
40	110	110	105	100	95	90
50	130	125	115	110	105	100
63	150	145	140	125	120	110
75	170	165	160	150	145	120
90	180	175	170	165	160	130
110	190	185	175	170	165	140

## 2.6 EXCAVATING, PIPELAYING AND BACKFILLING

- a. Trenches for all underground pipe lines shall be excavated to the required depths and grades. Bell holes shall be provided so that pipe will rest on well-tamped solid ground for its entire length. Where rock is encountered, excavation shall extend to a depth 150 mm below the pipe bottom and other approved filling materials.
- b. All pipes except concrete pipes and cast iron soil pipes that will run across the road shall be protected with Class B concrete casing, a minimum of 100 mm around the pipe perimeter and 250 mm below the finish grade.
- c. Materials for backfilling shall be free of debris or big rocks. Backfill shall be placed in horizontal layers, properly moistened and compacted to an optimum density that will prevent excessive settlement and shrinkage.

## 2.7 MISCELLANEOUS

- a. Cleanout shall be gas and watertight, and shall be provided with quick and easy plug removal to allow ample space for cleansing tools.

Cleanout shall be of the same size as the pipe up to and including 100mm, the location of which is extended to an easily accessible place.

- b. Traps
  1. Every plumbing fixture or equipment requiring connections to the drainage system shall be equipped with a trap.
  2. Each trap shall be placed as near as possible to fixture. No fixture shall be double-trapped.
- c. Valves
  1. Valves shall be provided on all water supplies to fixtures as specified.
- d. Pipe Hangers, Inserts and Supports
  1. Horizontal runs of pipe shall be hung with adjustable wrought iron and malleable iron pipe hangers spaced not over 3 m apart, except hub and spigot soil pipes which shall have hangers spaced not over 1.52 m apart and located near the hub.
  2. Hangers shall have short turn buckles or other approved means of

adjustment.

3. Insert shall be of cast steel and shall be of type to receive a machine bolt or nut after installation.
4. Vertical runs of pipe shall be supported by wrought iron clamps or collars spaced not more than 9 m. apart.
5. Water and Vent Pipes - 65 mm and larger, band type 6.4 mm x 25 mm flat mild steel or black iron with 15 mm round rod with plates and nuts; 50 mm and smaller split ring type with 10 mm iron rods with insert plates; toggle bolts, clamps or expansion shield.

e. Pipe Sleeves

1. Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through masonry or concrete.
2. Pipe sleeves shall be of sufficient diameter to provide approximately 6.4 mm clearance around the pipe or insulation.
3. Pipe sleeves in walls and partitions shall be of cast iron, wrought iron or steel pipe. Pipe sleeves in concrete beams or concrete slabs shall be wrought iron or steel pipe.
4. Pipe sleeves on footings shall be cast iron or steel and shall be not less than 100mm larger in diameter than the pipe to be installed.
5. Where pipes pass through waterproofing membrane, the sleeves shall be provided with an integral flange or clamping device to which a flashing shield can be soldered.
6. The space between the pipes and sleeves shall be made water tight by inserting a picked oakum gasket and filling the remaining space with poured lead caulking thoroughly.

f. Fixture and Equipment Supports and Fastenings

1. Where secured to concrete or filled hollow block walls, fastenings shall be brass and at least 76mm into solid concrete.
2. Inserts shall be securely anchored and the anchor shall be properly flushed with mortar.

g. Floor, Walls and Ceilings Plates:

Plates shall be large enough to completely close the hole around the pipes and shall be round with the least dimension hole 30mm larger than the diameter of the pipe.

h. Drains

All drains installed in connection with waterproofing of floors shall be equipped with a clamping device.

2.8 PLUMBING FIXTURES, FITTINGS AND ACCESSORIES

- a. Materials and schedule of plumbing fixtures, fittings and accessories shall be as specified under Section 10810 (Toilet Accessories) and Section 15440 (Plumbing Fixtures) of these Specifications.

2.9 PUMPS

2.9.1 General

- a. All equipment shall be supplied from reputable firms engaged in the manufacture of each particular item. The entire assembly as installed shall be given a start-up and test run to prove that all the Specifications have been met before acceptance by the Owner. The test duration shall be 24 hours. Submittal of the Certificate of Test to the Owner shall be a condition of final payment.
- b. The Specifications stated herein are basic guides only. Other items not so indicated but which are obviously necessary for the proper operation of system as intended shall be supplied in accordance with accepted engineering standards.
- c. The equipment shall be guaranteed for a period of at least one year of trouble free operation. The supplier of equipment shall certify to the availability of spare parts locally and service in case of system breakdowns within a period of at least three years. Manuals of operation and maintenance and lists of spare parts shall be supplied together with the equipment. Submittal of Warranty Certificate shall be a condition for final payment.
- d. The supplier shall submit at least two copies of pump performance curves showing, among others, the pump rating and pump efficiency properly marked thereon.
- e. Accessories to be supplied for each pump shall include one non-slam type check valve and two (2) gate valves, of size equal to the size of pump discharge and suction, rated 150 psi. Also, one pressure gauge for each set of pumps and pipe fittings necessary for complete installation shall be provided. The pressure gauge shall be 100 mm face diameter and shall be reading from 0 psi (or 0 kg/cm<sup>2</sup>) to 100 psi (or 7 kg/cm<sup>2</sup>).
- f. Price quoted shall include cost of delivery of all quoted items to the jobsite. Pump and motor installation dimension drawings shall be submitted together with the quotation.
- g. The brands, names and place of manufacture of pump, motor, valves, controls and all accessories where applicable shall be indicated in the quotation. Also, a description of pump impellers being offered shall be included.
- h. A metal nameplate indicating in indelible letters the correct Specifications of the pump and motor shall be properly attached to the assembly at a location such that the information written thereon can be conveniently read by all concerned.
- i. Separate price shall be quoted for installation work, preparation and submittal of as-installed Drawings.

2.9.2 Variable Speed Booster System

- a. Scope

Supply and installation of a pre-fabricated and tested variable speed packaged system to maintain constant water delivery pressure.

b. Pumps

The pumps shall be in-line vertical multi-stage centrifugal pumps with one external frequency converter. The unit shall be rated for a total system capacity of 250 GPM at a discharge head of 100 feet when supplied with a working suction head of 1 foot. Each pump shall be sized as indicated:

Triplex System

Pump P1 = 50 GPM (33% of Total System Flow)  
Pump P2 = 100 GPM (67% of Total System Flow)  
Pump P3 = 100 GPM (Stand-by Unit)

The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

The pumps shall have the following features:

- (1) The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
- (2) The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.
- (3) Pump Construction
  - ☐ Suction/discharge base, pump head, motor stool: Cast iron (Class 30)
  - ☐ Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel
  - ☐ Shaft: 316 or 431 Stainless Steel
  - ☐ Impeller wear rings: 304 Stainless Steel
  - ☐ Shaft journals and chamber bearings: Silicon Carbide
  - ☐ O-rings: EPDM

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).

- (4) The shaft seal shall be a balanced o-ring cartridge type with the following features:
  - ☐ Collar, Drivers, Spring: 316 Stainless Steel
  - ☐ Shaft Sleeve, Gland Plate: 316 Stainless Steel
  - ☐ Stationary Ring: Silicon Carbide
  - ☐ Rotating Ring: Silicon Carbide
  - ☐ O-rings: EPDM

The Silicon Carbide shall be imbedded with graphite.

- (5) Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall

have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

c. Variable Frequency Drive

- (1) The VFD shall convert incoming fixed frequency single-phase or three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full wave diode bridge; VFD's utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.
- (2) The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load.
- (3) The VFD shall produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping or derating.
- (4) The VFD shall utilize an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. VFD's that utilize Sine-Coded PWM or Look-up tables shall not be acceptable.
- (5) VFD shall automatically boost power factor at lower speeds.
- (6) The VFD shall be able to provide its full rated output current continuously at 110% of rated current for 60 seconds.
- (7) An empty pipe fill mode shall be available to fill an empty pipe in a short period of time, and then revert to the PID controller for stable operation.
- (8) Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.
- (9) Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.
- (10) The VFD shall have temperature controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.
- (11) VFD shall provide full torque to the motor given input voltage fluctuations of up to +10% to -15% of the rated input voltage.
- (12) The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. VFD's without a DC link reactor shall provide a 5% impedance line side reactor.
- (13) VFD to be provided with the following protective features:
  - ☐ VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.



- ☐ VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
  - ☐ VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
  - ☐ VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.
  - ☐ VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed can be reduced, but not stopped.
  - ☐ The VFD shall have the option of an integral RFI filter. VFD enclosures shall be made of metal to minimize RFI and provide immunity.
- (14) VFD to be provided with the following interface features:
- ☐ VFD shall provide an alphanumeric backlit display keypad, which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.
  - ☐ VFD shall display all faults in plain text; VFD's, which can display only fault codes, are not acceptable.
  - ☐ All VFD's shall be of the same series, and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable through the entire range of drives used on the project.
  - ☐ VFD keypad shall be capable of storing drive parameter values in non-volatile RAM uploaded to it from the VFD, and shall be capable of downloading stored values to the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up the programmed parameters.
  - ☐ A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
  - ☐ A start guide menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning.
  - ☐ VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLC's and other connected equipment from power surges and spikes.

- ☐ All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
  - ☐ There shall be three programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. An additional digital input is preprogrammed for start/stop.
  - ☐ The VFD shall have two analog signal inputs. One dedicated for sensor input and one for external set point input.
  - ☐ One programmable analog output shall be provided for indication of a drive status.
  - ☐ The VFD shall provide two user programmable relays with selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.
  - ☐ The VFD shall store in memory the last 5 faults with time stamp and recorded data.
  - ☐ The VFD shall be equipped with a standard RS-485 serial communications port for communication to the multi-pump controller. The bus communication protocol for the VFD shall be the same as the controller protocol.
- (15) VFD service conditions:
- ☐ Ambient temperature operating range, -10 to 45°C (14 to 113°F).
  - ☐ 0 to 95% relative humidity, non-condensing.
  - ☐ Elevation to 1000 meters (3,300 feet) without derating.
  - ☐ VFD's shall be rated for line voltage of 380 to 480VAC; with +10% to -15% variations. Line frequency variation of  $\pm 2\%$  shall be acceptable.
  - ☐ No side clearance shall be required for cooling of the units.

d. Fixed Speed Motors

- (1) Fixed Speed Motors are to be provided with the following basic features:
- (2) Designed for continuous duty operation, NEMA design B with a 1.15 service factor.
- (3) Totally Enclosed Fan Cooled or Open Drip Proof with Class F insulation.
- (4) Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.
- (5) Motors shall have a NEMA C-Flange for vertical mounting.
- (6) Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

e. Pump System Controller

- (1) The pump system controller shall be a standard product developed and supported by the pump manufacturer.
- (2) The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a VGA display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.
- (3) The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.
- (4) The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
  - ? Current value of the control parameter, (typically discharge pressure)
  - ? Most recent existing alarm (if any)
  - ? System status with current operating mode
  - ? Status of each pump with current operating mode and rotational speed as a percentage (%)
- (5) The controller shall have as a minimum the following hardware inputs and outputs:
  - ? Three analog inputs (4-20mA or 0-10VDC)
  - ? Three digital inputs
  - ? Two digital outputs
  - ? Ethernet connection
  - ? Field Service connection to PC for advanced programming and data logging
- (6) Pump system programming (field adjustable) shall include as a minimum the following:
  - ? Water shortage protection (analog or digital)
  - ? Transducer Settings (Suction and Discharge Analog supply/range)
  - ? PI Controller (Proportional gain and Integral time) settings
  - ? High system pressure indication and shut-down
  - ? Low system pressure indication and shut-down
  - ? Low suction pressure/level shutdown (via digital contact)
  - ? Low suction pressure/level warning (via analog signal)
  - ? Low suction pressure/level shutdown (via analog signal)
  - ? Flow meter settings (if used, analog signal)
- (7) The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).
- (8) The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level

is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).

- (9) The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).
- (10) The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.
- (11) The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:

High System Pressure	Low system pressure
Low suction pressure (warning and/or alarm)	Individual pump failure
VFD trip/failure	Loss of sensor signal (4-20 mA)
Loss of remote set-point signal (4-20mA)	System power loss

- (12) The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.

Control panel options shall include, but not be limited to:

Pump Run Lights	Pump Alarm Lights
System Fault Light	Audible Alarm (80 db[A])
Surge Arrestor	Control Panel Internal Illumination
Emergency/Normal Operation Switches Service	Disconnect Switches

- (13) The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).
- (14) The controller shall have a pump "Test Run" feature such that pumps are switched on during periods of inactivity (system is switched to the "off" position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (2-3) seconds every 24 hours, 48 hours or once per week (user selectable).
- (15) The actual pump performance curves (5<sup>th</sup> order polynomial) shall be loaded (software) into the pump system controller.

f. Hydropneumatic Pressure Tank

A 34 gallon nominal (or as recommended by pump manufacturer) bladder- type

(“bag type”) carbon steel hydropneumatic pressure tank, designed to ASME Code and stamped 200 psi working pressure shall be furnished mounted and piped at the factory. The bladder shall be made of heavy duty butyl rubber and FDA approved for potable water applications.

g. Sequence of Operation

The system controller shall operate from one to two pumps and one Variable Frequency Drive (VFD) to maintain a constant discharge pressure (system set-point). The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. When a flow demand is detected (drop in system pressure) the VFD controlled pump shall start first. As flow demand increases, the speed of the VFD controlled pump shall be increased to maintain the system set- point pressure. When the VFD controlled pump cannot maintain the system set- point as flow increases (pressure starts to drop below system set-point), an additional pump will be started Direct-On-Line (DOL). The VFD controlled pump shall immediately adjust speed to maintain the system set-point. Additional DOL pumps shall be started as flow demand increases. As flow demand decreases, the pump speed shall be reduced while system set-point pressure is maintained. The system controller shall switch off DOL operated pumps as required with decreasing flow.

The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

h. Low Flow Stop Function

The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut-down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable.

Standard Low Flow Stop and Energy Saving Mode

If a low or no flow shut-down is required (periods of low or zero demand) a bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band). Upon low flow shut-down a pump shall be restarted in one of the following two ways:

- (1) Low Flow Restart: If the drop in pressure is slow when the start pressure is reached (indicating the flow is still low), the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.
- (2) Normal Flow Restart: If the drop in pressure is fast (indicating the flow is greater than 10% of pump nominal flow) the pump shall start and the speed shall be increased until the system pressure reaches the system

set-point.

It shall be possible to change from the standard low flow stop to the optional low flow stop (and vice-versa) via the user interface.

i. System Construction

- (1) The suction and discharge manifolds shall be constructed of 316 stainless steel. Manifold connection sizes shall be as follows:  

3 inch and smaller:	Male NPT threaded
4 inch through 8 inch:	ANSI Class 150 rotating flanges
10 inch and larger:	ANSI Class 150 flanges
- (2) Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.
- (3) A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2" and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2" and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.
- (4) For systems that require a diaphragm tank, a minimum diaphragm tank connection size of 3/4" shall be provided on the discharge manifold.
- (5) A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.
- (6) A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless steel case. Gauge accuracy shall be 2 1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.
- (7) Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.
- (8) The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pump and

Base frame to minimize vibration.

- (9) The control panel shall be mounted on a 304 stainless steel fabricated control cabinet stand attached to the system skid.

### **PART 3 - EXECUTION**

#### **3.1 DRAINAGE SYSTEM TESTS**

- a. The entire drainage and venting system shall have all necessary openings which can be plugged to permit the entire system to be filled with water to the level of the highest stack vent and/or vent stack above the roof.
- b. The system shall hold this water for a full thirty (30) minutes during which time there shall be no drop more than 100 mm.
- c. If and when the Engineer decides that additional test is needed, such as an air or smoke test on the drainage system, the Contractor shall perform such test without additional cost.

#### **3.2 PRESSURE TESTS FOR WATER LINES**

- a. After the pipe have been installed, the joints completed and with joints exposed for examination, all newly installed pipe or any valve section, thereof, shall be subjected to hydrostatic pressure one and one half (1½) the designed working pressure of the system or as specified by the Engineer.
- b. The duration of each pressure test shall be at least 10 minutes unless otherwise specified by the Engineer.
- c. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. During the filling of the pipe and before applying the test pressure, all air shall be expelled from the pipeline. To accomplish this, tap shall be made if necessary, at the highest point of the pipe under test and after completion of the test, the taps shall be tightly plugged unless otherwise specified. During the test, all exposed pipes, fittings, valves, joint and couplings will be carefully examined. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound materials at his expense. The test shall then be repeated until satisfactory results are obtained.

#### **3.3 LEAKAGE TESTS FOR WATER LINES**

- a. Leakage test shall be conducted after satisfactory completion of the pressure test and shall consist of an examination of all exposed joints for leakage as well as an overall leakage test of the completed pipeline.

- b. The pressure to be maintained during the test shall be the designed working pressure of the system.
- c. Leakage test shall be made only after a minimum of 24 hours after the pipe to be tested has been filled with water.
- d. The duration of each leakage test shall be two hours unless otherwise specified by the Engineer.
- e. Each section of pipe line shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation shall be applied by means of a positive displacement type pump and reservoir connected to the pipe in a manner satisfactory to the Engineer.
- f. Before starting the leakage test, all air shall be expelled from the pipe. All exposed pipes, fittings, valves and joints shall be examined for leakage during the test.
- g. Allowable leakage rate per 100 joints per inch of Pipe Diameter at Pressure Stipulated.

PRESSURE		LEAKAGE RATE	
PSI	KG/CM <sup>2</sup>	LITERS/HR	LITERS/2 HRS.
50	3.5	1.45	2.90
75	5.3	1.75	3.50
100	7.0	2.05	4.10
125	8.8	2.30	4.60
150	10.5	2.50	5.00
200	14.0	2.90	5.80

### 3.4 DEFECTIVE WORK

- a. If the inspection or test shows any defect, such defective work or material shall be replaced and the test shall be repeated until satisfactory to the Engineer.
- b. All repairs to piping shall be made with new materials at the expense of the Contractor.
- c. No caulking of screwed joints or holes will be accepted.

### 3.5 TEST CERTIFICATE

Test Certificate shall be filled up and signed by the Owner's representative.

### 3.6 DISINFECTION OF WATER DISTRIBUTION SYSTEM

- a. The entire water system shall be thoroughly flushed and disinfected with chlorine before it is placed on operation.
- b. Chlorination materials shall be liquid chlorine or hypochlorite, as specified and shall be introduced into the water lines in a manner approved by the Engineer.
- c. The chlorine dosage shall be such as to provide not less than fifty parts per million (50 ppm) available chlorine.



- d. Following a contact period of not less than sixteen (16) hours, the heavily chlorinated water shall be flushed from the system with clean water until the residual chlorine content is not greater than two tenth parts per million (0.20 ppm). All valves in water lines being sterilized shall be opened and closed several times during the 16-hour chlorinating period.

### 3.7 CLEANING

- a. All exposed metal surfaces shall be free of grease, dirt or other foreign materials.
- b. Chrome or nickel plated pipings, fittings and trimmings shall be polished upon completion.
- c. All plumbing fixtures shall be properly protected from use and damage during the construction stage. The fixtures shall be cleaned to the satisfaction of the Engineer upon completion and prior to acceptance of work.
- d. All equipment, pipes, valves and fittings shall be cleaned of grease and sludge which may have accumulated. Any clogging, discoloration or damage to other parts of the building due to the system shall be repaired by the Contractor.

### 3.8 PAINTING AND PROTECTION

- a. All exterior of pipings to be installed in or through concrete floor fill or fill floors and underground shall be given one coat of acid resisting paint having a bituminous base.
- b. Pipe hanger supports and all other iron work in concealed spaces shall be painted with one coat of asphalt.

### 3.9 COLOR CODE FOR EXPOSED PIPES

- a. All exposed pipings shall be adequately and durably identified by distinctive colored paints as follows:

<u>Item</u>	<u>Color Code</u>
Water line	blue
storm water pipe	orange (with tag)
sewage pipe	orange (with tag)
waste pipe	orange (with tag)
vent pipe	orange (with tag)

### 3.10 WARRANTY AND "AS - BUILT" PLANS

- a. All works, equipment and fixtures shall be guaranteed by the Contractor for satisfactory service for a minimum period of one (1) year.
- b. The Contractor shall submit to the Owner, in reproducible form plus three (3) sets of white prints, the complete plans of the entire system as actually built. The cost of those shall be borne by the Contractor. Submittal of "AS BUILT" Plans shall be a condition to final payment.

### 3.11 RESPONSIBILITY

The general Contractor shall be responsible for the coordination among the different trades on the job in order to finish the work in the least possible time, in strict accordance with the Plans and Specifications.

- a. Throughout the construction period open ends of all installed pipe lines shall be kept closed by temporary plugs.
- b. Drainage lines shall not be used to conduct dirty construction washed water especially those with cement mixes to avoid possible clogging.
- c. A temporary fire protection system shall be provided by the Contractor during the construction period. This shall be of sufficient capacity to put out any fire that may break out at any floors due to construction operations. This is in addition to temporary fire extinguisher required.
- d. A temporary potable water supply shall be made available to construction workers as construction progresses.
- e. A temporary human excreta disposal system shall be provided by the Contractor to serve the workers during the construction period.

### 3.12 METHOD OF MEASUREMENT

Measurement for payment of pipe fittings, valves, hose bibbs, drains, clean-outs, p-traps, and other accessories shall be the actual number furnished, placed and accepted.

Measurement for payment of variable speed booster system and elevator pit pumps shall be the actual number of sets furnished, placed and accepted.

Measurement for payment of pipes of the type and size specified including trenching, bedding and backfill, as required, shall be the linear meter installed and accepted.

### 3.13 BASIS OF PAYMENT

The quantities measured as provided in Method of Measurement, shall be paid for at the contract unit price, respectively, for each of the Pay Item shown in the Bill of Quantities, which price and payment shall be full compensation for trenching, bedding and backfilling for pipelines, for furnishing and placing all materials including labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

\* \* \* \* \*

## **SECTION 15440 - PLUMBING FIXTURES**

### **PART 1- GENERAL**

#### **1.1 SCOPE**

This specification covers the furnishing of materials and labor necessary to complete the installation of all toilet and bath fixtures as shown on drawings and as specified herein.

#### **1.2 SUBMITTALS**

##### **1.2.1 Manufacturer's Catalog Data**

Submit for each type of fixture specified. Include descriptions of materials, finishes, fastenings and anchoring devices, and appurtenances.

##### **1.2.2 Samples**

Submit one of each type of accessory complete with appurtenances and finished as specified. Approved samples may be installed in the work provided each sample labeled for identification and location recorded.

#### **1.3 DELIVERY AND STORAGE**

Deliver materials to the site in unopened containers, labeled with the manufacturer's names and brands, ready for installation. Store accessories in safe, dry locations until needed for installation.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS AND FINISHES**

This specifications covers all plumbing fixtures made from a mixture of white burning clays and finely ground minerals, the wares are subjected to a high temperature rendering them incapable of adsorbing liquid, when unglazed, does not have a mean value of water absorption greater than a 5% of the dry weight making it sanitary and odorless. It is then coated on all exposed surfaces with an impervious non-crazing vitreous glaze giving it a permanent colored finish and retains high quality gloss resistant to acids and alkalis making it easy to maintain.

#### **2.2 MANUFACTURED UNITS**

##### **2.2.1 Water Closets**

- a. Water Closets shall be elongated 4.8 LPF top-inlet flush valve type water closet with seat and cover and floor flange.

Provide 6 LPF flush valve fitting for water closet with 1-1/4" diameter vacuum breaker with brass spud.

- b. Water Closets shall be elongated 4.8 LPF top-inlet flush valve type water closet with seat and cover and floor flange.

Provide exposed sensor type flushometer for 1-1/2" top spud flush valve water closet with adjustable flush volume, DC type power supply with brass inlet spud.

### 2.2.2 Urinals

- a. Urinals shall be wall-hung urinal supplied with spreader.  
  
Provide 3.8 LPF flush valve fitting for urinal with 3/4" Ø vacuum breaker with bushing reducer.
- b. Urinals shall be wall-hung urinal supplied with spreader.  
  
Provide exposed sensor type flushometer for 3/4" top spud urinal, with adjustable flush volume, DC type power supply with bushing reducer.

### 2.2.3 Lavatory

- a. Lavatory shall be under-the-counter wash basin with single-lever hole basin mixing faucet supplied with angle valve, flexible hose and p-trap.
- b. Lavatory shall be under the counter wash basin with sensor faucet (AC 220V/60 Hz), output DC 6V. For single-hole wash basin (35-40mm diameter) supplied with complete fittings.
- c. Lavatory shall be wall hung lavatory with single-lever 6" wall mounted basin mixing faucet with hand shower.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

Surfaces of fastening devices exposed after installation shall have the same finish as the attached fixtures. Exposed screw heads shall be oval. Install fixtures at the location and height as shown in the drawings. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. Coordinate fixture manufacturer's mounting details with other trades as their work progress. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

#### 3.1.2 Surface Mounted Accessories

Mounting on concealed back-plates shall have concealed fasteners. Unless indicated or specified otherwise, install fixtures with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shield, or other approved fasteners as required by the construction. Install back-plates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction.

### 3.2 METHOD OF MEASUREMENT

The quantities to be paid for shall be the number of sets plumbing fixtures, whichever is called for in the contract, installed, complete and accepted.

### 3.3 BASIS OF PAYMENT

The quantities determined as provided in Method of Measurement, shall be paid for at the contract unit price, respectively for each of the Pay Items listed below and shown in the Bill of Quantities, which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to

complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

DIVISION 15 – MECHANICAL  
(FIRE PROTECTION SYSTEM)

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## **SECTION 150401 FIRE PROTECTION GENERAL PROVISION**

### **PART 1.0 - GENERAL DESCRIPTION**

- 1.0 Water Based Fire Protection Systems include, but are not limited to, manual - wet standpipes, fire water mains and fire protection water sources.
  - 1.1 The Point of Service for the fire protection water supply.
  - 1.2 Applicable NFPA standard and requirements of authority having jurisdiction, to be applied, or in the case where no such standard exists, the engineering study, judgments, and/or performance based analysis and conclusions.
  - 1.3 Classification of hazard occupancy for each room or area.
  - 1.4 Design approach, which includes system type, densities, device temperature rating, and spacing for each separate hazard occupancy.
  - 1.5 Characteristics of water supply to be used, such as main size and location, whether it is dead-end or circulating; and if dead-end, the distance to the nearest circulating main, as well as its minimum duration and reliability for the most hydraulically demanding design area.
  - 1.6 When private or public water supplies are used, the flow test data, including date and time of test, who conducted test or supplied information, test elevation, static gauge pressure at no flow rate with residual gauge pressure, hydrant butt coefficient, and location of test in relation to the hydraulic point of service.
  - 1.7 Valving and alarm requirements to minimize potential for impairments and unrecognized flow of water.
  - 1.8 Microbial Induced Corrosion (MIC). The Records Engineer shall make reasonable efforts to identify water supplies that could lead to Microbial Induced Corrosion (MIC). Such efforts may consist of discussions with the local water purveyor and/or fire official, familiarity with conditions of the fire protection piping, the engineer shall design corrective measures.
  - 1.9 Backflow prevention and metering specifications and details to meet local water purveyor requirements including maximum allowable pressure drop.
  - 1.10 Quality and performance specifications of all yard and interior fire protection components.
- 2.0 To ensure minimum design quality in Fire Protection System Engineering Documents, said documents shall include as a minimum the following information when applicable.
- 3.0 Contractor submittals which deviate from the above minimum design parameters shall be considered material deviations and require supplemental engineering approval and documentation.
- 4.0 In the event the Records Engineer provides more information and direction than is established above, he or she and the company he or she represents shall be held responsible for the technical accuracy of the work in accordance with applicable codes, standards, and sound engineering principles.

### **PART 2.0 - GENERAL SCOPE**

Under this section of the specifications, the contractor shall be responsible for the design and installation of the fire protection system, including seismic supports. The contractor shall coordinate with architectural, civil, mechanical, and electrical, design and construction documents, to ascertain the required information, to effect a properly designed fire protection system for the building construction and occupancy classification.

- 1.0 The design of fire protection systems shall be complete with all necessary accessories for proper operation. System design and installation shall reflect high quality professional work that properly accounts for practical maintenance concerns and aesthetic concerns, as well as meets the design density requirements. Departures from this standard of professionals including inefficient designs, unnecessary materials, and special system modifications to meet design density (e.g., reduced spacing the hydraulically remote areas) shall be avoided.
- 2.0 The fire protection water supply lines, controlling devices, protective devices, alarm systems, supervisory devices, and related equipment shall be compatible so that all equipment will function together as specified. Switching operations of the fire protection system shall be integrated with the fire alarm system.
- 3.0 The design shall comply with all mandatory, advisory interpretations, and recommended applicable rules of the latest editions of the referenced codes and standards, except where otherwise noted on the drawings or specified.
- 4.0 Design calculations and data used shall be provided in both electronic and hard copies, including the methodology used in the calculations.
- 5.0 The contractor shall produce design drawings (design files) that indicate the extent and arrangement of the fire protection systems.
- 6.0 Unless indicated in the contract, drawing(s) refers to the plotted hard copy document or print and the electronic computer aided drafting design (CADD) file.

### **PART 3.0 - PERMITS AND FEES, CODES AND REGULATIONS, INSPECTION**

- 1.0 All construction permits and fees including construction plans and specifications required for this work shall be obtained and at the expense of the Contractor. The Contractor shall furnish Philippine Coast Guard final certificates of inspection and approval from the government authorities after the completion of work. The Contractor shall prepare all the shop and working drawings, as-built plans and all other paper works required by the approving authorities.
- 2.0 All work under this contract is to be installed in accordance to the latest requirements of the following:
  - Philippine National Building Code
  - Philippine Electrical Code
  - Fire Code of the Philippines
  - Regulations of City of Taguig
  - Manila Electric Company
  - Philippine Long Distance Telephone Company
  - All requirements of Authority Having Jurisdiction (AHJ)and, their counterparts to where it is applicable as follows:

National Fire Protection Association (NFPA)  
UL Fire Protection Equipment Directory

### **3.0 SUBMITTALS**



- 3.1 Shop Drawings on Items Specified:
- a. Pipe and Fittings.
  - b. Valves.
  - c. Exterior Weatherproof Waterflow Alarm.
  - d. Wet Pipe Valve and Accessories.
  - e. Hanger Assemblies.
  - f. Pressure Gauges.
  - g. Fire Department Connection (FDC).
  - h. Double Check Backflow Prevention assembly (DCBP).
  - i. Reduced Pressure Zone Backflow Prevention Assembly.
  - j. Hydraulic Calculations.
  - k. Drawings.
  - l. Seismic Restraint Detailing.
  - m. Fire Department Valve Cabinets (FVC).
  - n. Fire Department Valves (FDV).
- 3.2 Include items listed in product section and additional items required to provide complete installation.
- 3.3 Indicate by red marking or arrow, items to be used where more than 1 item appears on manufacturer's catalog sheet.
- 3.4 Submit shop drawings, equipment submittals, and hydraulic calculations to CGIDS prior to installation or fabrication of system components.
- 3.5 Submit shop drawings, product data sheets and hydraulic calculations to Bureau of Fire Protection prior to installation or fabrication of system components.
- 3.6 Include copy of Bureau of Fire Protection plan review letter in submission to CGIDS.
- 3.7 Review of submittals does not relieve Contractor from coordinating installation of work with other trades, or from compliance with Codes and Standards.
- 3.8 At completion of acceptance tests:
- a. Send copy of test log to CGIDS.
  - b. Send copy of Contractor's Material and Test Certificates and fire pump test results to:
    - 1. CGIDS
    - 2. Authority Having Jurisdiction
  - c. Provide PCG (CGIDS) with following:
    - 1. Manufacturer's literature and instructions describing operation and maintenance of equipment and devices installed.
    - 2. Current copy of NFPA or equivalent local counterpart, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

#### **4.0 COORDINATION**

- 4.1 Coordinate timing of installation with work of the other trades.

- 4.2 Systems provided shall be complete and operable, and shall include required accessories, fastenings, and support.
- 4.3 Determine required location, arrangement, and quantities of equipment and materials from drawings, schedules and specifications.
- 4.4 All equipment shall be installed in strict accordance with manufacturer's recommendations.

## **5.0 GUARANTEE**

- 5.1 All works performed and all materials and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least two (2) years reckoned from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one-year period shall be provided at the expense of the Contractor.
- 5.2 The Contractor shall indemnify and save harmless Philippine Coast Guard and/or PCG representative from and against all liability for damages arising from injuries or disabilities to persons or damage arising from injuries or disabilities to person or damage to property occasioned by any act or omissions of the Contractor, including any and all expenses, legal or otherwise which may be incurred by Philippine Coast Guard and/or PCG representative, in the defense of any claim, action or suit.

## **6.0 WORKMANSHIP**

- 6.1 The Contractor shall assume unit responsibility and shall provide the service of a qualified engineer to supervise the complete installation of equipment and systems and who shall be available for conducting the final acceptance.  
The work throughout shall be executed in the best and most thorough manner.

## **7.0 INSTALLATION PROGRAM**

- 1. Licensed persons employed by Fire Protection Contractor shall perform planning, calculations, layout, and installation. Certified fire protection specialist, or licensed Professional Engineer for planning and calculations, and journeyman standpipe fitters for installation foreman and supervisory personnel.
- 2. Journeyman fire protection fitter(s) shall supervise field installation.
- 3. Contractor shall submit pre-qualification evidence of at least 3 projects of comparable size successfully completed with their Bid.
- 4. Distortion or misrepresentation of qualification evidence may result in Contract cessation.

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## **SECTION 150402 BASIC MATERIALS**

### **PART 1.0 - REFERENCE**

Requirement of Section 15 04 02 apply to all works under this Section

### **PART 2.0 - GENERAL SCOPE**

The Contractor in conjunction with the contract documents and drawings shall provide the materials and operations required for the design and installation of fire protection systems. Requirements are included for the design and installation of fire protection systems, shop drawings, equipment, pipe, pipe fittings, valves, check valves, backflow prevention devices, alarm initiation and supervisory devices, fire department connections, operating instructions, identification, tests, and disinfecting of piping.

All items mentioned in the general provision, applies to all fire protection piping downstream of the flanged & spigot piece at the base of the sprinkler riser, unless otherwise noted on the contract drawings.

### **PART 3.0 - MATERIALS**

1. Materials and Equipment
  - a. Materials and equipment in system shall be new and current products of manufacturer regularly engaged in production of such materials and equipment.
  - b. Where 2 or more pieces of equipment are required to perform interrelated functions, they shall be products of 1 manufacturer.
  - c. Clean and cap pipe after fabrication and prior to placing pipe in building.
  - d. Mark pipe with tags that can be removed during installation so no permanent markings remain on unpainted pipe located in exposed areas.
  - e. Couplings shall be tees with capped outlets.
2. Approval Guides:
  - a. Unless otherwise shown, products shall be UL Listed in the latest publication of the UL Fire Protection Equipment Directory or Approved in the latest Factory Mutual Approval Guide for service intended.

### **PART 4.0 - PIPE**

1. Above Ground:
  - a. Carbon steel pipe, Schedule 10, ASTM A795, ASTM A53 or A135, roll-grooved

for mechanical fittings.

- b. Carbon steel pipe, Schedule 40, ASTM A795, ASTM A53 or A135, cut-grooved for mechanical fittings.
- c. In areas such as tight ceiling spaces or where exact center-of-tile placement is critical, only flexible sprinkler pipe shall be permitted. Each flexible ceiling sprinkler system shall include multi-port ceiling mounting bracket and a 1-piece tested sprinkler drop including adjustable flange and hardware. No other flexible sprinkler pipe is allowed for this project unless it is both UL Listed and Factory Mutual Approved. Alternates to flexible sprinkler pipe must also be acceptable to CGIDS.
- d. Provide metal pipe's exposed threads with corrosion inhibitive paint.

## **PART 5.0 - FITTINGS**

### **1. Above Ground:**

- a. Cast iron threaded, Class 125, 175 psi WOG pressure rating, ANSI B16.4.
- b. Cast iron flanged, Class 125, 175 psi WOG pressure rating, ANSI B16.1.
- c. Grooved:
  - 1. Ductile iron or malleable iron, grooved for mechanical coupling, 175 psi WOG pressure rating, malleable iron conforming to ASTM A536 for ductile iron and ASTM A47 for malleable iron.
  - 2. Fitting, gasket and coupling shall be furnished by same manufacturer.
- d. Fitting, gasket and coupling shall be furnished by same manufacturer.
- e. Wrought copper fittings, pressure rated, solder type, ANSI B16.22.
- f. Galvanized, cast iron, threaded fittings, 175 psi WOG pressure rating, ANSI B16.4.
- g. Fittings shall be galvanized when installed on galvanized piping.
- h. Pipe-o-lets or similar clamp on or saddle type fittings are not allowed as fittings.
- i. Weld-o-lets welded to piping in fabrication shops are permitted. No welding allowed at project site.
- j. Saddle type devices that strap or clamp onto piping are not allowed.

## **PART 6.0 - JOINTS:**

### **1. Above Ground:**

- a. Threaded joints:
  - 1. Tapered pipe threads, ANSI B1.20.1.
- b. Flanged:
  - 1. Cast iron, 175 psi WOG pressure rating, ANSI B16.1.
  - 2. Square head machine bolts with semi-finished hexagon nuts, ASTM A183.
  - 3. Neoprene gasket.

- c. Mechanical coupling:
  - 1. Grooved couplings shall be of same manufacturer as used for grooved fittings.
  - 2. Malleable iron, ASTM A47, equal to Victaulic No. 75.
  - 3. Rigid mechanical, ASTM A536, equal to Victaulic No. 005.
  - 4. Gaskets: Grade E EPDM gasket per UL 157 and UL 213.
  - 5. Rigid or zero flex type couplings shall be used when operating pressures may cause piping to move out of place or sway on hangers. Flexible couplings may be used where piping is securely braced or clamped into rigid position.
  - 6. Plain end couplings are not allowed on either new or existing sprinkler systems.
- d. Shop welded joints.
  - 1. Welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.

## **PART 7.0 - VALVES**

- 1. Gate Valve:
  - a. Outside screw and yoke (OS&Y), gate valve, bronze body and trim or cast iron body bronze mounted, non-shock cold water working pressure.
- 2. Check Valve:
  - a. Iron body, bronze seat, stainless steel clapper with a replaceable rubber seal, nonshock cold water working pressure.
- 3. Ball Valve:
- 4. Butterfly Valve:
- 5. Double Check Backflow Prevention Assembly (DCBP):
  - a. Weighted clapper double check valve assembly including 2 OS&Y gate valves.
  - b. Assembly shall be double check valve assembly for cross connection devices.
  - c. Certified in accordance with ASSE 1015 and AWWA C510-97.
  - d. Double check valve shall be selected based on minimal pressure drop to allow maximum available pressure to sprinkler system.
- 6. Reduced Pressure Zone Backflow Prevention Assembly (RPZ):
  - a. Assembly shall consist of 2 independently operating, spring loaded cam-check valves and include 2 OS&Y gate valves.
  - b. Assembly shall have a hydraulically operated differential pressure relief valve located between and below cam-checks.
  - c. Certified in accordance with ASSE 1013 and AWWA C511-97.
  - e. Assembly shall be selected based on minimal pressure drop to allow maximum available pressure to sprinkler system.
- 7. Test and Drain Valves:
  - a. AGF TEST and DRAIN Victaulic Style 720 TestMaster II or equal may be installed.
- 8. Drain Valves:
  - a. Thread-in bonnet bronze globe valves, rated to 175 psi non-shock cold water working pressure.

- b. Low point drain valves shall have, 3/4" brass nipple with 3/4" male hose threads and cap.
- 9. Pressure Regulating Valves:
  - a. Valve shall be able to regulate inlet pressure up to 400 psi, brass body with brass and stainless steel internal parts, field adjustable indicating scale, non-rising stem, red handwheel, tamperproof monitor switch adapter.
- 10. Fire Department Valve (FDV):
  - a. Fire Department valve shall be 2-1/2" angle valve, cast brass body, [polished brass] [rough brass] [polished chrome plated] finish. Valve cap for 2- 1/2" valve shall be [2-1/2" x 1-1/2" hose adapter reducer with 1-1/2" cap with chain. Cap and chain finish shall match finish of valve body. Threads shall match Fire Department Standards.
- 11. Provide identification sign (enamel on metal) for valves per NFPA requirements (Mechanical Systems Identification).
- 12. Valves in galvanized piping shall be bronze.

#### **PART 11.0 - FIRE DEPARTMENT VALVE CABINETS (FVC)**

- 1. Fire Department Valve Cabinets:
  - a. FVC-1:
    - 1. Cabinet: recessed.
    - 2. Door Style: [Full Glass] [Break Glass] [Solid Metal], white polyester coating with identifying decal.
  - 3. Angle Valve: Female x Male, 2-1/2" cast brass, [polished brass] [rough chrome plated] [polished chrome plated] finish with threads to match local Fire Department Standards.
- b. FVC-2:
  - 1. Cabinet: surface mounted.
  - 2. Door Style: [Full Glass] [Break Glass] [Solid Metal], white polyester coating with identifying decal.
  - 3. Angle Valve: Female x Male, 2-1/2" cast brass, [polished brass] [rough chrome plated] [polished chrome plated] finish with threads to match local fire department standards.

#### **PART 12.0 - FIRE DEPARTMENT CONNECTION (FDC)**

- 1. Fire Department Connection:
  - a. Flush type, cast brass body with drop clappers, [polished brass] [rough chrome plated] [polished chrome plated] finish, with lettering reading AUTOSPKR STANDPIPE.

- b. Unit shall include four 2-1/2" chrome plated brass snoots with rigid end threading to match local fire department standards by pin-lug hose thread swivels, pin-lug plugs and chains.

#### **PART 13.0 - BALL DRIP**

- 1. Provide bronze ball drip for Fire Department connection inside of building and pipe to nearest floor drain, or discharge to exterior.
- 2. Exterior discharge must be coordinated with CGIDS.

#### **PART 18.0 - HANGERS**

- 1. Provide hangers to support piping: in perfect alignment without sagging or interference, to permit free expansion and contraction, and meet requirements of NFPA 13.
- 2. Riser clamps shall not protrude more than 2" beyond edge of hole.
- 3. Concrete expansion anchors are to be Hilti, Rawl, or Phillips concrete fasteners.

#### **PART 19.0 - EARTHQUAKE BRACING**

- 1. Standpipe system shall be protected from earthquake influence in accordance with requirements of NFPA 13 and as outlined in Section 20 0549 - Seismic Anchorage and Restraints.
- 2. Provide flexible couplings, bracing, and other components required, compatible with piping material and jointing system used.
- 3. Seismic detailing shall be included on Fire Protection System layout shop drawings.

#### **PART 20.0 - PRESSURE GAUGES**

- 1. Pressure gauges shall be 3-1/2", corrosion resistant moving parts, polycarbonate window, and provided with connection not smaller than 1/4" NPT.
- 2. Include shutoff valve with provisions for draining on each pressure gauge.

#### **PART 21.0 - DIELECTRIC FITTINGS**

- 1. Insulating nipple, metal casing, inert thermoplastic lining, Clearflow dielectric fitting by Perfection Corporation.
- 2. Dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psig at 180°F.

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## **SECTION 150403 EXECUTION**

### **PART 1.0 - REFERENCE**

Requirement of Section 15 04 01 apply to all works under this Section

### **PART 2.0 - GENERAL SCOPE**

1. The Contractor is responsible for the installation of the manual wet standpipe system in accordance with these specifications and the contract drawings. The Contractor shall coordinate with architectural, mechanical, and electrical, design and construction documents, to ascertain the required information, to effect a properly designed and installed sprinkler system for the building construction and occupancy classification. The installation shall reflect high quality professional work that properly accounts for practical maintenance concerns and aesthetics.
2. The installation of the manual wet standpipe system shall be complete with all necessary accessories for proper operation and shall be accomplished by a licensed fire protection contractor or licensed company regularly engaged in this type of work, and in accordance with requirements of the National Fire Protection Association Standards (NFPA) and local Authorities Having Jurisdiction (AHJ).
3. The fire protection system installation shall be coordinated with the other trades (mechanical, electrical and structural).
4. The installation shall comply with all mandatory, advisory interpretations, and recommended applicable rules of the latest editions of the standards listed, except where otherwise noted on the drawings or specified herein.

### **PART 3.0 - DESIGN CRITERIA**

1. Flow Test:
  - a. Static Pressure: XXX psig.
  - b. Residual Pressure: XXX psig with XXX gallons flowing per minute.
  - c. Flowing hydrant is located at XXX and pressure-test hydrant is located at XXX.
  - d. Test Date: XXX
  - e. Test Time: XXX
  - f. Elevation of pressure-test hydrant: XXX.
  - g. Test conducted by or information supplied by: XXX.
2. This flow test data will be used as basis for Contract Documents. Fire Protection Contractor, prior to preparation of installation design calculations, shall validate this flow data.
3. Send current hydrant flow test data to Engineer.



4. Pump source shall be meet the Fire Protection System demand.
5. Hydraulically calculated system shall be designed to a minimum of 10% below available water flow curve.
6. Systems that are hydraulically calculated must include 1.2 factor for design area.
7. Basis of Design:
  - a. Office areas and general building spaces shall be hydraulically designed to provide minimum density of 0.10 gpm per sq ft over most hydraulically remote 1500 sq ft. Maximum spacing shall not exceed 225 sq ft per head.
  - b. Laboratory areas including corridors between labs separated from office areas by doors and firewalls shall be hydraulically designed to provide minimum density of 0.15 gpm per sq ft over most hydraulically remote 2000 sq ft. Maximum spacing shall not exceed 130 sq ft per head.
  - c. Penthouse and other mechanical equipment areas shall be hydraulically designed to provide minimum density of 0.15 gpm per sq ft for most remote 2000 sq ft. Maximum spacing shall not exceed 130 sq ft per head.
  - d. General storage areas and chemical transfer area shall be hydraulically designed to provide minimum density of 0.20 gpm per sq ft over most hydraulically remote 2000 sq ft. Maximum spacing shall not exceed 100 sq ft per head.
8. Hose Streams:
  1. Add 250 gpm hose stream to sprinkler zone hydraulic calculations.
9. Fire Protection System Layout and Shop Drawings:
  1. Contractor shall review Design Drawings and Specifications, and shall produce Shop Drawings, calculations, and product data sheets.
  2. Conceal sprinkler piping above ceilings where possible.
  2. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.
  3. Submit shop drawings, calculations and product data sheets for coordination review to: CGIDS and authorities having jurisdiction over this project prior to installation (see submittals).
  5. Contractor shall be held to have examined "Reflected Ceiling" drawings as well as Mechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
  6. Contractor shall coordinate routing of piping with other trades and CGIDS.
  7. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.

## **PART 4.0 - SITE INSPECTION**

Investigate site conditions; verify utility locations and elevations before start of excavation. Discrepancies will be forwarded to CGIDS before proceeding with construction.

## **PART 5.0 - INSTALLATION**

1. Install hydraulically designed standpipe system and associated accessories according to requirements of NFPA 14 and as shown on drawings.
2. Install pipe and fittings according to recommendations of pipe manufacturer.
3. Keep materials within listed temperature range to assure jointing in accordance with manufacturer's requirements.
4. Pipe and fittings shall be of corresponding materials when assembled.
5. For underground pipe, in lieu of thrust blocks; anchors and tie rods can be provided. Tie rods shall be 3/4" diameter steel rod. Clamps shall be 3/8" thick by 2" wide steel. Each clamp shall be secured with four 5/8" diameter bolts.
6. Apply asphaltum or corrosion inhibitive paint to tie rods, clamps and bolts of underground pipe.
7. Provide readily removable fittings at end of cross-mains. Minimum size of flushing connection shall be 2".
8. Provide test connection for each flow switch.
9. Discharge test connections inside building to receptacles provided as part of plumbing system or to drain standpipe.
10. Drain line detailed adjacent to standpipe/sprinkler risers shall be considered as part of Sprinkler System from combination test/auxiliary drain valve for each zone or sub-zone shown on plans to plumbing receptacle.
11. Provide auxiliary drains at low points of systems. Where trapped section of pipe exceeds 5 gallons, drain shall consist of, as a minimum: valve, 3/4" brass nipple with 3/4" male hose threads, and cap.
12. Identify valve with brass tag denoting which flow switch is being tested, when test valves are located remote from flow switch.
13. Clamp-on or saddle type fittings are not allowed. Outlet fittings inserted into holes drilled into piping or pipe-o-lets are not allowed.
14. Provide reducing fittings or provide shop fabricated weld-o-lets to change pipe sizes in sprinkler/standpipe systems. No bushings or grooved reducing couplings are allowed.
15. Feed sprinkler heads, installed in finished ceilings, with swing joint or return bend arrangement for final positioning in ceiling grid pattern during construction phases. Sprinklers are required to be installed in the center of ceiling tiles.

16. Provide minimum 1" outlets with sprigs or drops for sprinklers located in shelled spaces.
17. Install locking device with each shutoff valve to prevent inadvertent closing of valve. Keys shall be indexed to identify valve location.
18. Make joints of threaded pipe by cutting pipe square and reaming inside.
19. Coat exposed threads with corrosion inhibitive paint. Use joint compound sparingly.
20. Install joints for mechanical coupled pipe according to manufacturer's recommendations. Use manufacturer's gasket lubricant sparingly.
21. Pipe shall be cut grooved for Schedule 40 steel pipe or roll grooved for Schedule 10 steel pipe as specified by coupling manufacturer.
22. Welded joints shall be made in fabrication shop. No welding allowed at project site.
23. Hang pipe from building members using concrete inserts or beam clamps. Expansion type inserts may be used for branch piping.
24. Support piping in accordance with NFPA 13 and Section 15025 - Seismic Anchorage and Restraints, and in accordance with State and Local seismic restraint requirements.
25. Include seismic restraint details with standpipe shop drawings.
26. Install pressure gauges as required in manufacturer's installation instructions, and as required per NFPA.
27. Generally, install capped tees in lieu of couplings for future connections.

#### **PART 6.0 - BONDING**

1. Provide underground cast iron and underground ductile iron pipe with metallic bond at each joint.
2. Bond wire shall be type RHW-USE size 1/0 neoprene-jacketed copper conductor shaped to stand clear of joint.

#### **PART 8.0 - CLEANING**

1. Ensure underground feed pipe has been flushed, to clear out construction debris, prior to connecting aboveground fire protection system to it.

#### **PART 9.0 - TESTING**

1. Perform all NFPA required acceptance tests.
2. Joints allowed. Re-test system after defective joints is replaced, until satisfactory results are obtained.
3. Hydrostatically test piping between the exterior fire department connection (FDC) and the

- check valve in the fire department inlet pipe in the same manner as the balance of the system.
4. Pipe shall not be concealed until satisfactorily pressure tested.
  5. CGIDS may witness tests. Contractor shall notify CGIDS a minimum of 3 days in advance to allow for participation.
  6. Log of tests shall be kept at job site and shall identify:
    - a. Who performed test.
    - b. Time of test.
    - c. Date of test.
    - d. Section of system tested.
    - e. Results of test.
    - f. Along with completed Contractor's Material and Test Certification form(s) from NFPA 14.
  7. Operate flow switches to test that signal are transmitted to Fire Alarm Control Panel.

## DIVISION 16 – ELECTRICAL

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## **PART 1.0 - GENERAL PROVISIONS**

### **1.0 GENERAL DESCRIPTION**

- 1.1 The work to be done under this article of the specifications shall consist of supply of labor and materials, fabrication and installation, complete in all details of the electrical works at the subject premises, and all incidentals necessary for the proper completion of the project, except those portions of the work which are expressly stated to be done by others.

All works shall be done in accordance with the governing Codes and Regulations and with the Specifications, except whenever there are conflicts between Codes and Specifications, the former shall govern.

The requirements with regards to materials and workmanship specify the required standards for the furnishing of labor, materials and appliances necessary for the complete installation of the work specified therein and indicated on the drawings. These specifications are intended to provide a broad outline of the required installation, but are not intended to include all details of design and construction.

- 1.2 The Contractor, before submitting his proposal, shall examine all drawings relating to his work and verify all prevailing conditions at site and shall become fully aware as to the extent and nature of the work required. Considerations will not be entertained for any alleged misunderstanding of the work to be done and materials to be furnished. It is being understood that the submission of proposal is an agreement to all conditions referred to herein and to all items or indicated on the drawings and actual site conditions.
- 1.3 It is the purpose of these specifications and drawings to call for furnished work tested and ready for operation. Minor details not usually specified but essential for the proper installation and operation, shall be included in the work, the same as herein specified/shown.
- 1.4 The Contractor, before the start of the work, shall examine all adjoining areas on which this work is in anyway dependent for perfect workmanship in accordance to the intent of this specification. No waiver of responsibility for defective work will be considered unless notice has been filed at the time the Contractor submits his proposal.
- 1.5 The Contractor before the start of the work shall submit a coordinated program of works with corresponding charts and tables, including schedule of deliveries.

### **2.0 GENERAL SCOPE**

Under this article of the specifications, provide all materials and equipment and perform all the works necessary for the complete execution of all electrical works as shown on the drawings, and on the general construction drawings, as herein specified, or both, except otherwise excluded, and which without excluding the generality of the foregoing, shall include but not limited to the following principal items of work:

- 2.1 Incoming power and auxiliary service including concrete pedestal, manholes and duct bank from pedestal to MDP, inclusive of cable trench and laddered tray.
- 2.2 Power Distribution equipment including lighting and power distribution panelboards.
- 2.3 A system of lighting and power wiring including all feeders, sub-feeders, branch circuits and connection to all lighting and power outlets.
- 2.4 Connection to all power equipment including wires and conduits necessary for remote controls, and motor interlocks.
- 2.5 Supply and installation of power wiring from panelboard to motor starters and from motor starters to motor.
- 2.6 All general lighting fixtures and lamps, inclusive of emergency lighting system.
- 2.7 Control and monitoring panel, bells and station, monitoring devices, wires and conduits, and all necessary incidentals for fire detection and alarm system.
- 2.8 Conduits and wires, faceplates/devices and all necessary incidentals for a complete LAN/WAN system.
- 2.9 Complete grounding system of equipment/electrical enclosures and inclusive of all the necessary incidentals.
- 2.10 Complete testing of electrical system and all other system installed.
- 2.11 Painting of electrical work and equipment with proper tagging.
- 2.12 Grouting of openings in floors and walls after all conduits or ducts are in place and sealing of all such openings including roof openings, if not in used.
- 2.13 Anything that has been omitted in any item of work or materials usually furnished which are necessary for the completion of the electrical work.

### 3.0 PERMITS and FEES, CODES and REGULATIONS, INSPECTION

- 3.1 All construction permits and fees including construction plans and specifications required for this work shall be obtained and at the expense of the Contractor. The Contractor shall furnish Philippine Coast Guard final certificates of inspection and approval from the government authorities after the completion of work. The Contractor shall prepare all the shop and working drawings, as-built plans and all other paper works required by the approving authorities.
- 3.2 All work under this contract is to be installed in accordance to the latest requirements of the following:

Philippine National Building Code  
Philippine Electrical Code  
Fire Code of the Philippines  
Regulations of Bais City  
Negros Oriental Electric Cooperative  
Local Internet Provider  
All requirements of Authority Having Jurisdiction (AHJ)

Nothing contained in these specifications or shown on the drawings shall be construed as to conflict with the National and Local Ordinances or Laws governing the installation of electrical works, all such laws and ordinances are hereby made part of these specifications. The Contractor

is required to meet the requirements thereof.

- 3.3 Approval from authorities of all plans for construction shall be secured by the Contractor.

#### 4.0 SUBMITTALS

##### 4.1 General

- 4.1.1 The location of equipment, devices, panelboards, and lighting fixtures, are approximate and shall be adjusted on site to suit site conditions and subject to CGIDS approval. No claim for extra cost will be allowed for such adjustments.
- 4.1.2 The Contractor shall keep a record of all deviations of the actual installations from that shown on the contract drawings, during the progress of the work. Copies of sepia prints the size of A3, indicating such changes and revision, complete with all the details, shall be submitted to CGIDS.
- 4.1.3 The Contractor shall submit to CGIDS six (6) copies of the as-built drawings, indicating the work as actually and finally installed, including new information not originally shown in the contract drawing, upon completion of the work.

##### 4.2 Shop Drawings

- 4.2.1 The Contractor shall prepare and submit to Philippine Coast Guard dimensional layout and assembly drawings, which shall contain sizes, spacing, and arrangement.
- 4.2.2 Detailed shop drawings for the following installations:
  - 1. Lighting Fixtures
  - 2. Main Feeder and Sub-Feeders
  - 3. Cable Trays and Wireways
  - 4. Mounting details of panelboards, pullboxes and gutters
  - 5. Mounting details of air-conditioning units, as required
- 4.2.3 All other shop drawings as indicated on the plans or as CGIDS may require. All drawings shall be signed and dry sealed by the Contractor's Professional Electrical Engineer.

##### 4.3 Manuals

- 4.3.1 Sample's and/or manufacturer's catalog sheets with complete technical data marked as necessary to indicate materials, devices and equipment being furnished.
- 4.3.2 List of proposed miscellaneous materials, including conduits, conductors, and accessories, identifying manufacturer and type.
- 4.3.3 Operation and maintenance manuals of equipment or devices installed showing all instructional and troubleshooting details.
- 4.3.4 All submittals shall be complete and shall contain all required and detailed information.

#### 5.0 COORDINATION

- 5.1 Coordinate timing of installation with work of the other trades
- 5.2 Systems provided shall be complete and operable, and shall include required accessories, fastenings, and support



- 5.3 Determine required location, arrangement, and quantities of equipment and materials from drawings, schedules and specifications
- 5.4 All equipment shall be installed in strict accordance with manufacturer's recommendations.
- 5.5 Certain items of equipment specified in other contracts require electrical connections. Contractor shall provide such connections as required.

#### 6.0 MINOR MODIFICATIONS

The plans as drawn are based upon architectural plans and details and show conditions as accurately as it is possible to indicate them on scale. The plans are diagrammatical and do not necessarily show all fittings necessary to fit the building conditions. The location of outlets, apparatus and equipment shown on the plans are approximate. The Contractor shall be responsible for the proper location in order to make them fit with architectural details.

#### 7.0 GUARANTEE

- 7.1 All works performed and all materials and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year reckoned from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one-year period shall be provided at the expense of the Contractor.
- 7.2 The Contractor shall indemnify and save harmless Philippine Coast Guard and/or PCG representative from and against all liability for damages arising from injuries or disabilities to persons or damage arising from injuries or disabilities to person or damage to property occasioned by any act or omissions of the Contractor, including any and all expenses, legal or otherwise which may be incurred by Philippine Coast Guard and/or PCG representative, in the defense of any claim, action or suit

#### 8.0 WORKMANSHIP

- 8.1 The Contractor shall assume unit responsibility and shall provide the service of a qualified engineer to supervise the complete installation of equipment and systems and who shall be available for conducting the final acceptance.

The work throughout shall be executed in the best and most thorough manner.

### **PART 2.0 – BASIC MATERIALS AND METHODS**

#### 1.0 REFERENCE

Requirement of Section 01310 apply to all works under this Section

#### 2.0 GENERAL SCOPE

2.1. Furnish and install all conduits, cable troughs, wireways, joint and outlet boxes, conductor and miscellaneous materials required for wiring, as specified herein and shown on drawings.

2.2. Furnish and install all power and control wiring to all equipment, except as otherwise specified. Equipment includes motor, motor starters, and miscellaneous devices.

### 3.0 INSTALLATION

#### 3.1. Services

Service voltage inside the building shall be 230-Volts, Single-Phase, 2-Wires, 60 Hertz. Grounding wire shall be provided, sizes and color as per indicated in the plan.

#### 3.2. Wiring Methods

- a. Primary service conduit shall be PVC (Polyvinyl Chloride) thick walled run exposed or surface mounted at concrete pedestal, which shall be embedded concrete encased. A two percent (2%) conduit slope towards each manhole shall be provided, details as provided in the plans.
- b. MDS, MTS and DP shall be surface mounting. See details as provided in the working plans.
- c. All others shall be done in the following manner or as indicated in the plan:
  1. PVC (Polyvinyl Chloride) - for exposed power service entrance and for feeder raceways and all exposed feeders
  2. EMT (Electrical Metallic Tubing) - for all exposed power and lighting branch circuit and for LAN/WAN conduit. Compression type adaptors and coupling shall be used.
  3. PVC (Polyvinyl Chloride), Thick-Walled - for all power and lighting branch circuit raceways running embedded in concrete slab and partitions or above ceiling.
  4. FMC (Flexible Metallic Conduit)/Royal Cord - for all connection between fixtures/equipment and junction boxes/pullboxes.
  5. LQT (Liquid-Tight) Flexible Conduit - for all exposed connections from conduit to motors or electrical devices/equipment to where vibrations are eminent and to all wet/damped locations.

#### 3.3. Grounding

The following shall be grounded in accordance with the drawings and the requirements of the latest edition of the Philippine Electrical Code and Standard Grounding Practices.

- a. All metal frames, cabinets, structures and other metal masses.

- b. All metallic conduits and raceway system including boxes.
- c. All systems, distribution, power, lighting fixtures, outlets (Convenience Outlets and Switches) and all auxiliary system. Sizes as indicated in the plans and drawings.
- d. Provide grounding bond on all metal conduit connections, joints and coupling for effective grounding continuity.
- e. Ground wire shall be green in color for the entire installations, except for the main service feeder and equipment grounding of the MDS (Main Disconnect Switch), which are white and orange, respectively.
- f. Bare Copper Wire shall be installed in a continuous manner all through-out the system; from the service entrance to the manholes and concrete encasements and to the individual panel enclosures and/or equipment to be installed as provided in the drawing plans, which shall be properly bonded using exothermic welding process for every point of connections and splices as required.

#### 3.4. Distribution Feeders

Feeder conductors and raceways shall be installed underground from MDP to Distribution Panels and no changes in size shall be made without written consent of the Design Engineer/CGIDS. Unless otherwise indicated, feeder conductor shall be continuous without splices between terminals as possible.

#### 3.5. Branch Circuits

The plans indicate the general methods of the installation of all circuit wiring and the outlet which are to be supplied from these circuits. Branch circuits shall be run from outlets to panelboards as direct as the building conditions will allow, no wire of different circuit shall be inserted in one conduit. Exact location of lighting and power outlet shall be properly identified on site.

#### 3.6. Panelboards

Main Disconnect Switch (MDS), Manual Transfer Switch (MTS), and Main Distribution Panel (DP) shall be surface mounting fabricated from 1.9mm thick galvanized steel plate/sheet powder coated and bake enameled, beige/gray, paint finished. Door shall be hinged with allen screw lock from top to bottom. Dead front type cover shall be provided with appropriate labels, and can only be removed after the front cover has been opened or detached. Power, lighting and control panelboards shall be surface mounted fabricated from 1.5mm thick galvanized steel plate/sheet powder coated and bake enamel, beige/gray paint finished. Front cover shall have stainless push to open lock type with master key. Plastic made lock is not acceptable.

Bus bar shall be made from solid copper with silver plating on connection points. All exposed parts of bus bars shall be PVC/plastic laminated.

All main CB of each panelboard shall be vertically mounted and located above center of branch CB.

Panelboards front cover shall be provided with nameplate and back of the front cover shall have a directory which will indicate the location of the outlets or load served and its actual phase connection to panelboard.

The word “space” as indicated in the panelboard schedule shall mean that complete bus and insulators shall be included and ready to accept future circuit breaker of the same frame and size as the largest branch circuit breaker or as indicated in the load schedule.

The word “spare” as indicated in the panelboard schedule shall mean that complete bus and insulators is included, installed and ready to accept load of the same frame and size as the largest branch circuit breaker or as indicated in the load schedule.

Panelboards shall be provided with grounding kit/bus terminals with number of lugs equal to the number of branch circuit plus three spares. Splicing of ground wire within the panelboards shall not be accepted.

### 3.7. Wire/Cable Gutters/Tray and Pullboxes

Wire gutters, cable trays, cabinets and common pullboxes shall be fabricated from 1.9mm thick galvanized steel plate/sheet powder coated and bake enamel, gray paint finished. Details as provided in the working plans.

Junction, utility, and splice boxes embedded in concrete slabs and partitions shall be Ga.#14, deep type made of GI materials to be coated with primer paint before installation. PVC boxes are not accepted. All outlet boxes shall have ground terminal for bonding of ground wires.

### 3.8. Raceways

Conduits and tubing shall be as specified in the Material Specifications. No more than three (3) 90 degrees bends shall occur in any run. When it becomes necessary to have more than three (3) 90 degrees or a total of 270 degrees offsets and bends in any run, an intermediate pullbox shall be provided to facilitate wire/cable pulling. Methods of installation shall be as stated in Article 2.

Exposed conduits shall be run in parallel to or perpendicular with building lines and shall be secured fastened in place by means of approved supports and fastenings. Conduit supports shall be fastened to wall by means of screw or bolts with expansion sleeves or directly welded on steel building frames. The use of wooden or lead plugs is not permitted. All ends shall be firmly attached to cabinets or boxes by means of locknut and bushings.

Metal conduit bushing shall be a grounding type. Field bends shall not be allowed for rigid steel conduit larger than 20mm in diameter. Threadless couplings and connections used with tubing shall be of concrete-tight type. Fields bends in tubing shall have a radius of curvature not less than those specified in the latest edition of Philippine Electrical Code. No tubing smaller than 15mm in diameter shall be used.

For more than one exposed conduit a unistrut type channel shall be used with an angular steel hanger attached on concrete slab by means of expansion bolt. Hangers shall be two (2) at every length of conduit. Conduit or tubing shall be attached on the unistrut channel by means of u-clamp/bolt on both ends.

Exposed conduits shall be treated with red lead primer and finished with gray color paint. All field cut threads shall be painted with galvanizing paint.

#### 4.0 PERFORMANCE TEST AND RESULTS

##### 4.1 Installation Test

Test shall be carried out in order that the Electrical Contractor can guarantee the security of the wiring connections, tightness of terminals, the insulation and ground continuity of the system.

##### 4.2. Test and Test Sequence

For all power circuits the following tests shall be carried out in the order specified and the results recorded on the test sheet. Each circuit test sheet shall be signed off by the Field Work Engineer and Philippine Coast Guard Electrical Engineer before the circuit may be energized.

The Electrical Contractor shall ensure that test engineers are suitably qualified, trained and provided with appropriate test equipment. Test engineers shall not be taken from installation teams but shall be brought into site as independent individuals. They will not, therefore be influenced by the Contractor people.

##### 4.3. Field Test Report shall be as follows:

- a. Insulation Resistance Test
- b. Voltage Level Test
- c. Continuity Test
- d. Phase Relationship
- e. Earth Resistance Test

#### 5.0 MATERIAL SPECIFICATIONS

##### 5.1. Conformity to the standard specification

Materials to be used shall conform to the standard and specifications set by the following, in addition to Section 00010, where such standard and specifications have been established for particular type of materials or equipment in question.

- a. BUREAU OF PRODUCT STANDARD PHILIPPINES
- b. US UNDERWRITER'S LABORATORIES
- c. US NATIONAL BOARD OF FIRE UNDERWRITER'S
- d. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION
- e. INSULATED POWER CABLE
- f. AMERICAN STANDARD ASSOCIATION

##### 5.2. Wires and Cables

Wires shall be recent manufacture and in no case be more than one year old. Any conductor whose insulation shows sign of deterioration within one year from final acceptance of work shall be replaced by the Contractor at his own expense. Sufficient length of slack shall be left inside boxes, hand holes/manholes and for

splicing and/or connecting to apparatus without straining the cable. Wires and cables shall be copper, soft drawn and annealed, of 98% conductivity with insulation rated at 600 Volts.

Feeders and Sub-feeders	-	use type THW only
Branch Circuits	-	use type THHN/THWN-2 only
Ground Wires	-	use type TW only
Earthing	-	use Bare Copper Wire

Wire/Cable insulation shall be color coded as follows:

- a. Live 1 – Red/Black
- b. Ground Wires -Green on sub-feeders and branch circuits
  - White from entrance to MDS, ATS, MDP
  - Orange from MDS to Grounding Rod
- c. Control/Traveller Wires (lighting) – Yellow

All joint or splice for 8.0 mm<sup>2</sup> or larger shall be made with a double indent mechanical compression connector. After the conductor have been made mechanically and electrically secured, the entire joint shall be covered with rubber and plastic tape to make the insulation of the joint/splice equal to the insulation of the conductors and all the connectors shall be UL approved. All feeders shall be properly marked as to number of phase, wire size, and feeder designation and voltage capacity.

### 5.3. Conduits

#### a. RIGID STEEL CONDUIT (RSC)

Shall be hot-dipped galvanized steel pipe made on standard weight with smooth circular bore and shall conform to local and US specifications. Conduit shall be in standard length of 3.05 meters including coupling reamed and threaded on each end, to be used on sub-feeder raceways.

#### b. INTERMEDIATE METAL CONDUIT (IMC)

Shall be hot-dipped galvanized standard weight pipes, made of mild steel with smooth circular bore and shall conform to local and US specifications. Standard length of 3.05 meters including coupling reamed and threaded on each end, to be used on feeders.

#### c. ELECTRICAL METTALIC TUBING (EMT)

Shall be made of mild steel pipe, lead tin coated and hot-dipped galvanized finished with smooth circular bore standard weight pipe. Standard length of 3.00 meters, to be used on all exposed lighting and power circuit, and to all fire alarm installations whether exposed or embedded in concrete.

#### d. NON-METALLIC CONDUIT (PVC)

CS40 smooth wall rigid non-metallic conduit conforming to Philippine National Standard No.14 for PVC pipes. Conduit shall be in standard length 3.05 meter with bell end on one side. To be use on embedded installations and running in concrete slab/walls of lighting and power

branch circuit raceways and all other auxiliary system raceways and power feeder, except as stated in 3c.

e. LIQUID TIGHT (LQT) FLEXIBLE METALLIC CONDUIT

Shall be manufactured from an electro-galvanised steel flexible inner core which is pressure coated with an oil resistant, high temperature grade of plasticized PVC. The PVC is keyed into the corrugations of the inner steel flexible core, preventing the PVC from wrinkling when the conduit is bent to its minimum bend radius.

5.4. Panelboards and Circuit Breakers

a. Circuit Breakers

Used only one brand of circuit breaker for the entire project, catalogs must be submitted and approved by CGIDS before ordering has to be made.

b. Panelboard Enclosures

Panelboard enclosures shall be locally manufactured as per standard set in the latest edition of the Philippine Electrical Code as for size, gauge, and finish, or as provided in the plans. They shall be made of galvanized sheet powder coated gray and baked enamel finish.

5.5. Lighting Fixtures

Lighting fixtures shall be as describe or detailed in the plans. Samples of fixtures shall be submitted for approval of CGIDS prior to fabrication or installations.

5.6. Wiring Devices

Convenience Outlets – Universal Type rated at 10 Amperes, 250-Volts, with grounding terminal for all general purpose outlets, duplex or one-gang.

5.7. Others

All other materials to be used not mentioned herewith shall be approved by CGIDS, for both location and purpose intended, and shall be brand new.

## **PART 3.0 – LOCAL AREA NETWORK/WIRELESS AREA NETWORK SYSTEM**

### **1.0 REFERENCE**

Requirement of Part 1.0 and 2.0 apply to all works under this Section

### **2.0 GENERAL SCOPE**

The Contractor shall furnish all labor, supervision, tooling, miscellaneous mounting hardware, consumables, and documentation for all systems furnished and/or installed. It is the Contractor's responsibility to propose any and all items required for a complete and operational system of LAN.

### **3.0 BASIC CONCEPT**

The LAN SYSTEM will be a 1 Gigabit per Second (Mbps) copper based switched Ethernet LAN systems. The system will consist of local area network and wide area network connectivity equipment and UTP providing connectivity for local data ports. Connected to the cabling system, through various network interface cards, will be Windows, and other computers and printers, servers, and copiers.

### **4.0 WORKS INCLUDED**

Provide all materials and perform all works necessary for the complete execution of works as shown on the plans, which shall include but not limited to the following:

1. Design service and drafting of plan indicating all the necessary equipment, functionality, connectivity, interoperability and performance of a complete LAN/WAN system.
2. Document all LAN/WAN system equipment hardware, firmware, and software necessary to connect each workstation, server, router, and other end devices.
3. A system of conduit including all the necessary boxes, cover plates, and other incidentals to layout a complete groundwork for future installation of LAN/WAN cabling, equipment mounting and operations.

### **5.0 WORKS NOT INCLUDED**

Supply and installation of LAN/WAN equipment hardware, firmware, software, workstations, server, router, and other end devices, inclusive of, cabling works.

### **6.0 SUBMITTALS**

1. General



- for
- a. Two copies of all submittals shall be submitted to the CGIDS review.
  - b. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent equipment (compatible UL-Listed) from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
  - c. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

## 2. Shop Drawings

Prepare and submit complete and detailed drawings for the LAN/WAN system with reference to the plans provided. The bill of quantity of materials/equipment to be used for the system shall be included in the above drawings.

## 3. Manuals

Shall include an equipment list, data sheets, system description, and block diagrams on equipment to be furnished, with all data necessary to evaluate design, function, quality, and configuration of proposed equipment and system(s). Technical manual(s) relevant to the installed equipment and user manual(s) related to the use of functions in the LAN/WAN system.

# 7.0 MATERIAL SPECIFICATIONS

## 1. Conformity to the Standard Specifications

Materials to be used shall conform to the standard and specifications set by the following, in addition to Section 00010, where such standard and specifications have been established for particular type of materials and equipment

- a. BUREAU OF PRODUCT STANDARD PHILIPPINES
- b. US UNDERWRITER'S LABORATORIES
- c. US NATIONAL FIRE PROTECTION ASSOCIATION
- d. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION
- e. All requirements of Authority Having Jurisdiction (AHJ) and the Local Utility Company.

## 2. Conduit

- a. Conduit shall be in accordance with the latest edition of the Philippine Electrical Code requirements.
- b. Conduit fill shall not exceed 40 percent of interior cross

sectional area where three or more cables are contained within a single conduit.

- c. Conduit shall be 1/2-inchØ (20mmØ, minimum). Use “Polyvinyl Chloride (PVC)” only for all installations. All connection between pipes to boxes/cabinets/panels shall be joined using adaptor.

3. Terminal Boxes, Junction Boxes and Cabinets

- a. All terminal boxes, junction boxes, cabinets shall be UL Listed for their use and purpose.
- b. Terminal, junction and other boxes shall be Ga.#14, deep type made of GI materials to be coated with primer paint before installation. PVC boxes are not accepted. All outlet boxes shall have ground terminal for bonding of ground wires.



Philippine Coast Guard  
**HEADQUARTERS COAST GUARD LOGISTICS SYSTEM COMMAND**  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CBGF, Muelle Dela Industria Compound, Binondo  
1006 Manila



PROJECT TITLE : CONSTRUCTION OF COAST GUARD STATION NORTHERN  
SAMAR BUILDING AND FACILITIES  
LOCATION : BRGY. SABANG ZONE 2, ALLEN, NORTHERN SAMAR  
OWNER : PHILIPPINE COAST GUARD  
SUBJECT : SCOPE OF WORKS (SUMMARY) and GENERAL NOTES

---

## **SCOPE OF WORKS:**

### **A. GENERAL REQUIREMENTS**

1. The Contractor shall conduct through site inspection of the existing job site conditions.
2. The Contractor shall conduct soil bearing test with at least 1 borehole for the Coast Guard Station Northern Samar Building.
3. The Contractor shall secure documents needed for processing to obtain building permit. Also, the contractor should shoulder all government fees for this project.
4. The Contractor shall construct and place a project billboard / signage in front of the project site.
5. The Contractor shall implement Occupational Health and Safety Requirements of the project.
6. Clearing and cleaning of all areas affected during the implementations of the project.
7. Furnish pictures to Coast Guard Infrastructure Development Service (CGIDS) or email at [cgids.operations@gmail.com](mailto:cgids.operations@gmail.com) for the pre/post construction of the project for monitoring purpose of the National Headquarters Philippine Coast Guard (NHPCG).

### **B. LAND DEVELOPMENT**

#### **B.I DRAINAGE SYSTEM**

1. Supply of labor, tools and equipment for the excavation in preparation for installation of concrete culvert, sizes, depths and location as indicated in the plan. Excavation shall be to the depths indicated reckoned either from the natural grade line (NGL) or finish grade whichever is lower.

2. Supply of, labor, materials; tools and equipment for gravel bedding and compaction location as indicated in the plan. Gravel fill materials shall consist of approved site materials and shall be free from brush, roots and other unsuitable materials which would be detrimental to compaction requirements.
3. Supply of materials, labor, tools and equipment for embankment and compaction of the excavated materials location as indicated in the plan. Backfill materials shall consist of approved site excavated materials and shall be free from brush, roots and other unsuitable materials which would be detrimental to compaction requirements.
4. Supply of materials, labor, tools and equipment for the fabrication and installation of reinforcing bars including tie wires, usage of tools and equipment to complete the work.
5. Supply of materials, labor, tools and equipment for the fabrication, installation, stripping and/or leaving of formworks with the actual surface in contact with the concrete, including provision of block-outs, chamfered edges, notching, and overlaps, necessary greasing and/or coating with form oil, all necessary hardware, fixing accessories, scaffolding, shoring, and staging.
6. Supply of materials labor tools and equipment for the placing of concrete including necessary grouting, vibrating, hammering, tamping, consolidating, curing, hardening, wetting, sealing, brooming and scratching, protecting, sampling, provision of necessary extended chutes, and mixing boards usage of equipment and tools.
7. Supply of labor, materials, and tools for installation of PVC Pipe with catch basin including all necessary hardware and fixing accessories to complete the works.
8. Supply of materials, labor, tools and equipment for the fabrication and installation of steel gratings its accessories and usage of tools and equipment to complete the work, location as described on plans and specifications.

## **B.II PERIMETER FENCE AND GATE**

1. Supply of labor, tools and equipment for the excavation in preparation for concreting of footing and column footing, wall footing sizes, depths and location as indicated in the plan. Excavation shall be to the depths indicated reckoned either from the natural grade line (NGL) or finish grade whichever is lower.
2. Supply of materials, labor, tools and equipment for backfilling and compaction location as indicated in the plan. Backfill materials shall consist of approved site excavated materials and shall be free from brush, roots and

other unsuitable materials which would be detrimental to compaction requirements.

3. Supply of materials, labor, tools and equipment for the fabrication and installation of reinforcing bars including tie wires, usage of tools and equipment to complete the work.
4. Supply of materials, labor, tools and equipment for the fabrication, installation, stripping and/or leaving of formworks with the actual surface in contact with the concrete, including provision of block-outs, chamfered edges, notching, and overlaps, necessary greasing and/or coating with form oil, all necessary hardware, fixing accessories, scaffolding, shoring, and staging.
5. Supply of materials labor tools and equipment for the placing of concrete including necessary grouting, vibrating, hammering, tamping, consolidating, curing, hardening, wetting, sealing, brooming and scratching, protecting, sampling, provision of necessary extended chutes, and mixing boards usage of equipment and tools.
6. Supply of labor, materials, tools and equipment for the construction of masonry walls for walls and plastering of masonry walls, blocks including lintel beams, stiffeners and sundry items such as tie wires, sealants, mortar and joint filler and other necessary materials to complete the works, location as described on plans and specifications.
7. Supply of labor, materials, and tools for General (3-coats) painting on all surfaces i.e. masonry and concrete surfaces, ceilings, baseboards, casing including metal / steel surfaces, including surface preparation, primer tools and its use and all necessary accessories to complete the work.
8. Supply of materials, labor, tools and equipment for the fabrication and installation of steel attachment using angle bar and its accessories and usage of tools and equipment to complete the work, location as described on plans and specifications.

### **B.III FLAGPOLE**

1. Supply of labor, tools and equipment for the excavation in preparation for concreting of footing and column footing, wall footing sizes, depths and location as indicated in the plan. Excavation shall be to the depths indicated reckoned either from the natural grade line (NGL) or finish grade whichever is lower.

2. Supply of labor, tools and equipment for the excavation in preparation for concreting of footing and column footing, wall footing sizes, depths and location as indicated in the plan. Excavation shall be to the depths indicated reckoned either from the natural grade line (NGL) or finish grade whichever is lower.
3. Supply of materials, labor, tools and equipment for backfilling and compaction location as indicated in the plan. Backfill materials shall consist of approved site excavated materials and shall be free from brush, roots and other unsuitable materials which would be detrimental to compaction requirements.
4. Supply of materials, labor, tools and equipment for the fabrication and installation of reinforcing bars including tie wires, usage of tools and equipment to complete the work.
5. Supply of materials, labor, tools and equipment for the fabrication, installation, stripping and/or leaving of formworks with the actual surface in contact with the concrete, including provision of block-outs, chamfered edges, notching, and overlaps, necessary greasing and/or coating with form oil, all necessary hardware, fixing accessories, scaffolding, shoring, and staging.
6. Supply of materials labor tools and equipment for the placing of concrete including necessary grouting, vibrating, hammering, tamping, consolidating, curing, hardening, wetting, sealing, brooming and scratching, protecting, sampling, provision of necessary extended chutes, and mixing boards usage of equipment and tools.
7. Supply of labor, materials, and tools for General (3-coats) painting on all surfaces i.e. masonry and concrete surfaces, ceilings, baseboards, casing including metal / steel surfaces, including surface preparation, primer tools and its use and all necessary accessories to complete the work.
8. Supply of materials, labor, tools and equipment for the fabrication and installation of GI pipe pole and its accessories and usage of tools and equipment to complete the work, location as described on plans and specifications.

#### **B.IV EMBANKMENT**

1. Supply of labor, tools, materials and equipment for the site preparations, clearing of site of all obstruction from the general area of the WORKSITE shall be done.

2. Supply of, labor, materials; tools and equipment for excavation, backfilling and compaction location as indicated in the plan. Earth fill materials shall consist of approved site excavated materials and shall be free from brush, roots and other unsuitable materials which would be detrimental to compaction requirements.
- 

### **C. SUB STATION BUILDING**

1. The Contractor shall conduct through site inspection of the existing job site condition.
2. The Contractor shall construct all Architectural, Structural, Electrical, Sanitary / Plumbing, and Fire Protection Works in accordance with the plans and specification. All items shown on the plans but not mentioned in the specification shall be included.
3. Supply of labor, tools and equipment for the excavation in preparation for concreting of footing and column footing, wall footing sizes, depths and location as indicated in the plan. Excavation shall be to the depths indicated reckoned either from the natural grade line (NGL) or finish grade whichever is lower.
4. Supply of materials, labor, tools and equipment for backfilling and compaction location as indicated in the plan. Backfill materials shall consist of approved site excavated materials and shall be free from brush, roots and other unsuitable materials which would be detrimental to compaction requirements.
5. Supply of materials, labor, tools and equipment for the fabrication and installation of reinforcing bars including tie wires, usage of tools and equipment to complete the work.
6. Supply of materials, labor, tools and equipment for the fabrication, installation, stripping and/or leaving of formworks with the actual surface in contact with the concrete, including provision of block-outs, chamfered edges, notching, and overlaps, necessary greasing and/or coating with form oil, all necessary hardware, fixing accessories, scaffolding, shoring, and staging.
7. Supply of materials labor tools and equipment for the placing of concrete including necessary grouting, vibrating, hammering, tamping, consolidating, curing, hardening, wetting, sealing, brooming and scratching, protecting, sampling, provision of necessary extended chutes, and mixing boards usage of equipment and tools.
8. Supply of materials, labor, tools and equipment for the construction of masonry walls for exterior walls / parapet and interior partition and plastering of masonry walls, blocks including lintel beams, stiffeners and

sundry items such as tie wires, sealants, mortar and joint filler and other necessary materials to complete the works, location as described on plans and specifications.

9. Supply of labor, materials, tools and equipment for the installation of Tiles including cement mortar, tile setting epoxy, grout seller, tile cleaner trim and all necessary including all necessary fixing accessories and usage of tools and equipment to complete the work, location as described on plans and specifications.
10. Supply of materials, labor, tools and equipment for the fabrication and installation of Logo and stainless cut out names (build-up letters) including all fixing accessories and hardware, usage of tools and equipment to complete the work, location as described on plans and specifications.
11. Supply of labor, materials, tools and equipment for the installation of solid panel, hollow flush doors, steel door, powder coated aluminum frame glass doors and awning window in powder coated aluminum framing with tempered glass panels including all fixing accessories and hardware, usage of tools and equipment to complete the work, location as described on plans and specifications.
12. Supply of materials, labor, tools and equipment for the installation of complete ceiling system including all necessary fixing accessories and usage of tools and equipment to complete the work, location as described on plans and specifications.
13. Supply of materials, labor, tools and equipment for the fabrication and installation of Free-Standing Cabinet, Kitchen Counter Cabinet, Hanging and Lavatory Cabinet and Working Station (Cubicle) using Laminated and Marine plywood including all fixing accessories and hardware, usage of tools and equipment to complete the work, location as described on plans and specifications.
14. Supply of materials, labor, tools and equipment for the fabrication and installation of Stainless-steel Fire Exit Ladder, Stainless Aluminum Railings at Main Stairs, Front and Fire Exit Stairs on fill, Ladder Rung and PWD Ramp using stainless pipe/steel top rail, intermediate horizontal rail and vertical post rail fully welded including all fixing accessories and hardware, usage of tools and equipment to complete the work, location as described on plans and specifications.
15. Supply of labor, materials, tools and equipment for the installation/application of Waterproofing at Toilet and Bath and Deck including all other materials accessories necessary to complete the works, location as described on plans and specifications.
16. Supply of materials, labor, tools and equipment for the fabrication and installation of Roofing system including all necessary fixing accessories



and usage of tools and equipment to complete the work, location as described on plans and specifications.

17. Supply of labor, materials, and tools for General (3-coats) painting on all surfaces i.e. masonry and concrete surfaces, ceilings, baseboards, casing including metal / steel, and wood surfaces, including surface preparation, primer tools and its use and all necessary accessories to complete the work.
18. Supply of materials, labor, tools and equipment for the production and installation of Facade cladding including all fixing accessories and hardware, usage of tools and equipment to complete the work, location as described on plans and specifications.
19. Supply of labor, materials, tools and equipment for the installation of sanitary and plumbing system complete with all the necessary accessories as provided for in the plan this section of that specifications consisting of, but not necessarily limited to the following:
  - a. Soil, waste and vents pipe system, within the building up to sewer line.
  - b. Water service connection from main building distribution system.
  - c. Roughing-ins, installation and testing of plumbing fixtures including controls & piping works.
  - d. Roughing-ins, installation and testing of all plumbing pipes, fittings, trims and accessories.
  - e. Installation of Septic Tank and Cistern Tank, including all necessary fittings and accessories to complete the works.
21. Supply of labor, materials, tools and equipment for the new installation of fire protection system with all the necessary accessories as provided for in the plan consisting of, but not necessarily limited to the following:
  - a. Valves, control devices, and accessories;
  - b. Fire Department Connection and accessories;
  - c. Fire Extinguishers including installation of steel plates, bracketing supports and expansion bolts;
  - d. Fire Hose Cabinets with accessories.
22. Supply of labor, materials, tools and equipment for the installation of Lighting System complete with all the necessary accessories as provided for in the plan.
23. Supply of labor, materials, tools and equipment for the installation of Receptacle Outlets complete with all the necessary accessories as provided for in the plan.
24. Supply of labor, materials, tools and equipment for the installation of Special Purpose Outlets complete with all the necessary accessories as provided for in the plan.

25. Supply of labor, materials, tools and equipment for the installation of Air-conditioning unit outlets complete with all the necessary accessories as provided for in the plan.
26. Supply of labor, materials, tools and equipment for the installation of Grounding System complete with all the necessary accessories as provided for in the plan.
27. Supply of labor, materials, tools and equipment for the installation of Panel Boards and Circuit Breakers complete with all the necessary accessories as provided for in the plan.
28. Supply of labor, materials, tools and equipment for the new installation of Local Area Network (LAN) complete with all the necessary accessories as provided for in the plan.
29. Clearing and cleaning of all areas affected during the implementations of the project.
30. Furnish pictures to Coast Guard Infrastructure Development Service (CGIDS) or email at [cgids.operations@gmail.com](mailto:cgids.operations@gmail.com) for the pre/post repair of the project for monitoring purpose of the National Headquarters Philippine Coast Guard (NHPCG).

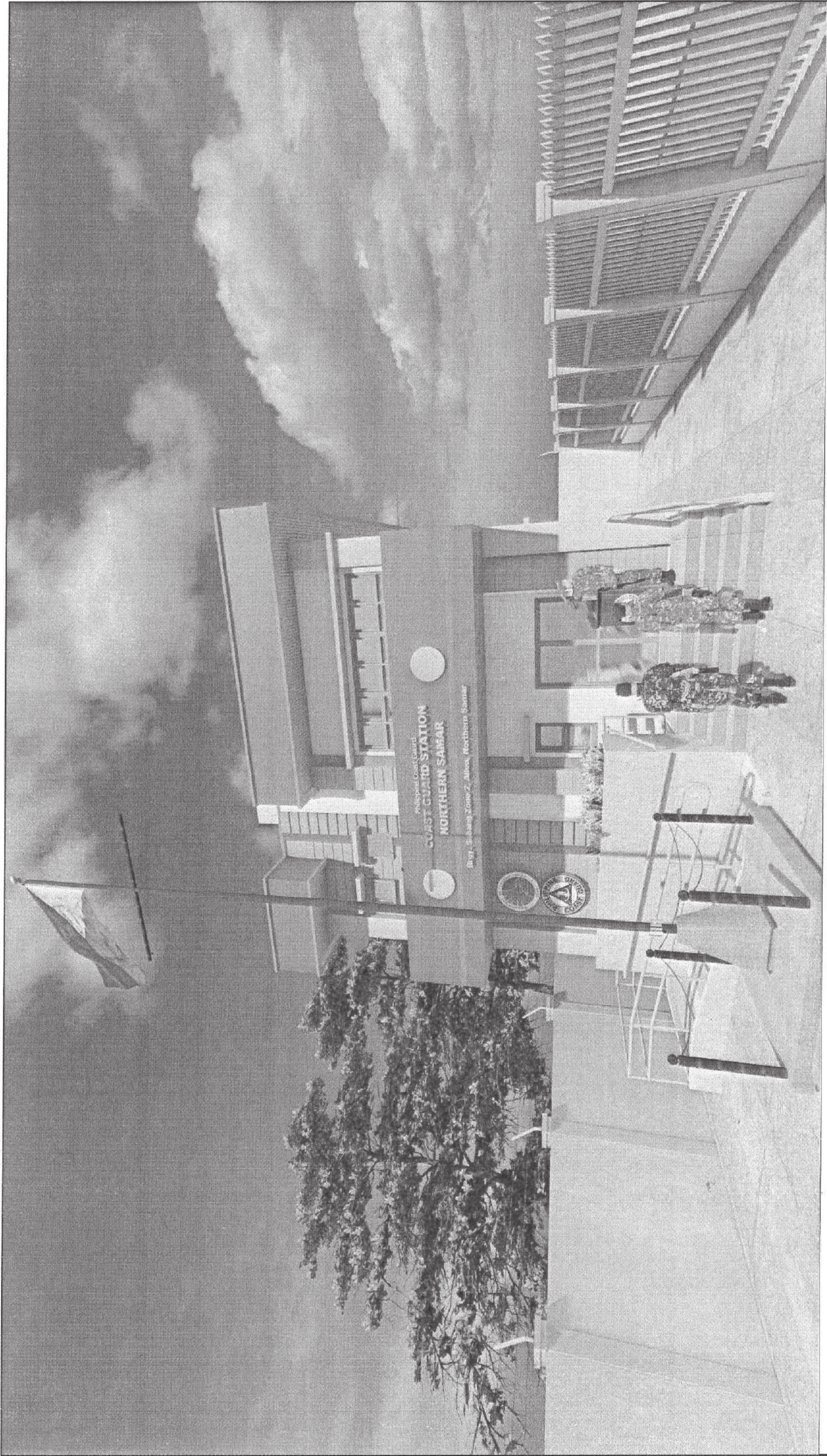
#### **GENERAL NOTES:**

1. This simplified scope of works and the specifications are prepared in a concise manner which intention is to save time and to simplify specifications elaborateness. All work covered in the contract shall be executed in the highest form of workmanship and quality.
2. The drawings and specifications are intended to explain each mutually, and anything shown or called for in one and not the other shall be executed as part of the contract as though both are shown and specified.
3. The contractor shall take all the precautionary measures for the protection of adjacent properties from injury, damage or loss arising in connection with this contract. He shall be responsible for all damages to person and property, which may occur with the prosecution of work.
4. The contractor shall be in close coordination with the Philippine Coast Guard Technical Representatives (Coast Guard Infrastructure Development Service) on matters pertaining to engineering works. Any changes in work and materials shall be approved by the authorized representative and shall be to the advantage of the Philippine Coast Guard.
5. All works, materials and undertakings found necessary during the course of the construction shall be executed for the satisfactorily completion of the project,





and shall be subject to general conditions and inspection before proper installation.

6. All permits, fees, inspections, material testing, and commissioning necessary for the satisfactory completion of the project shall be done at the expense of the contractor.
  7. Submission of complete five (5) sets of as-built plans of the project, signed and sealed, indicating all measurements and details. Warranties and test results shall also be submitted in five (5) copies for all installed materials. Liability period (2-years) shall take effect upon actual acceptance of the completed project.
  8. The contractor shall undertake/furnish all the necessary items, materials, tools, equipment, labor, plants, appliances, methods and all operations that may be needed and other incidentals for the satisfactory completion of the **CONSTRUCTION OF COAST GUARD STATION NORTHERN SAMAR BUILDING AND FACILITIES.**
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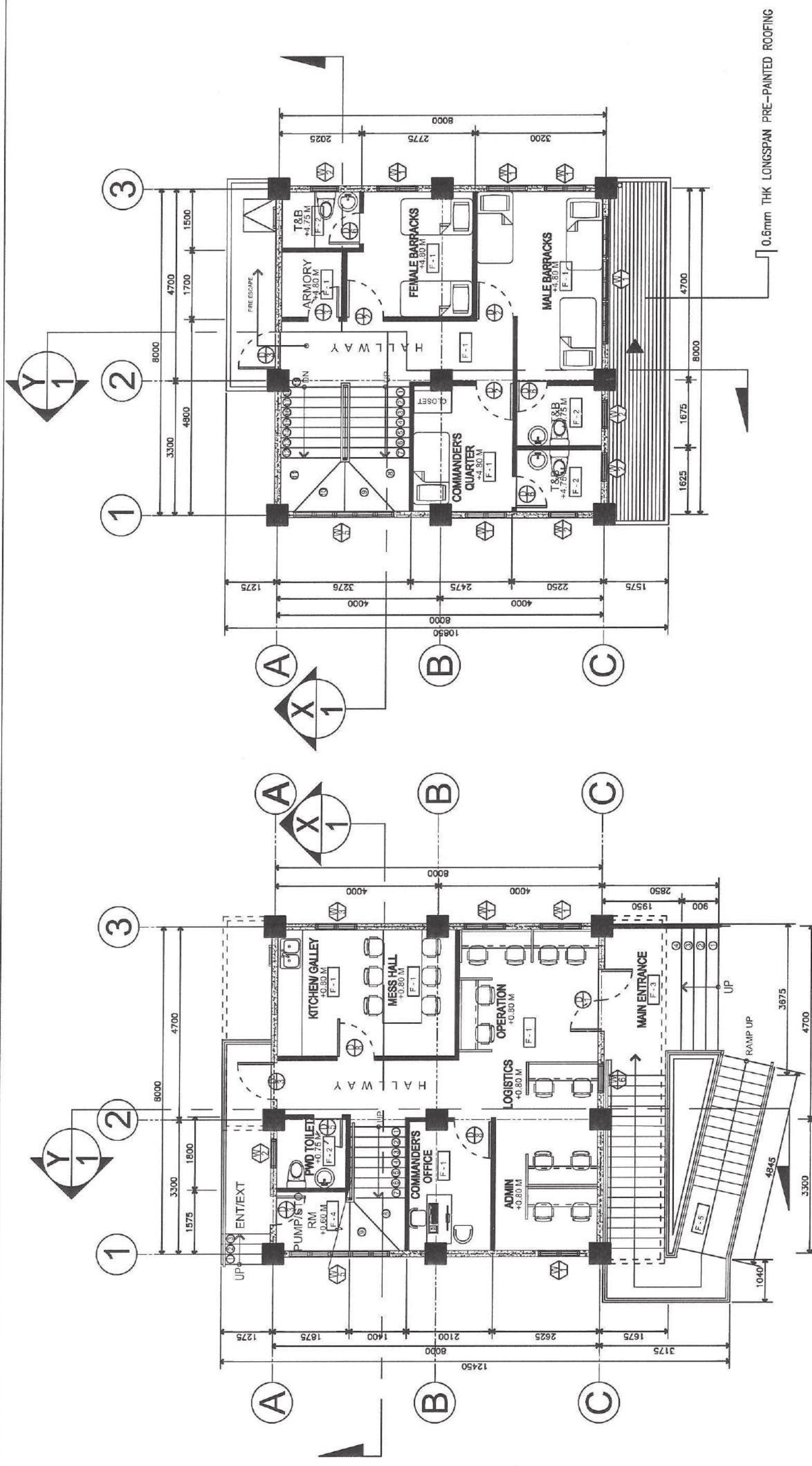




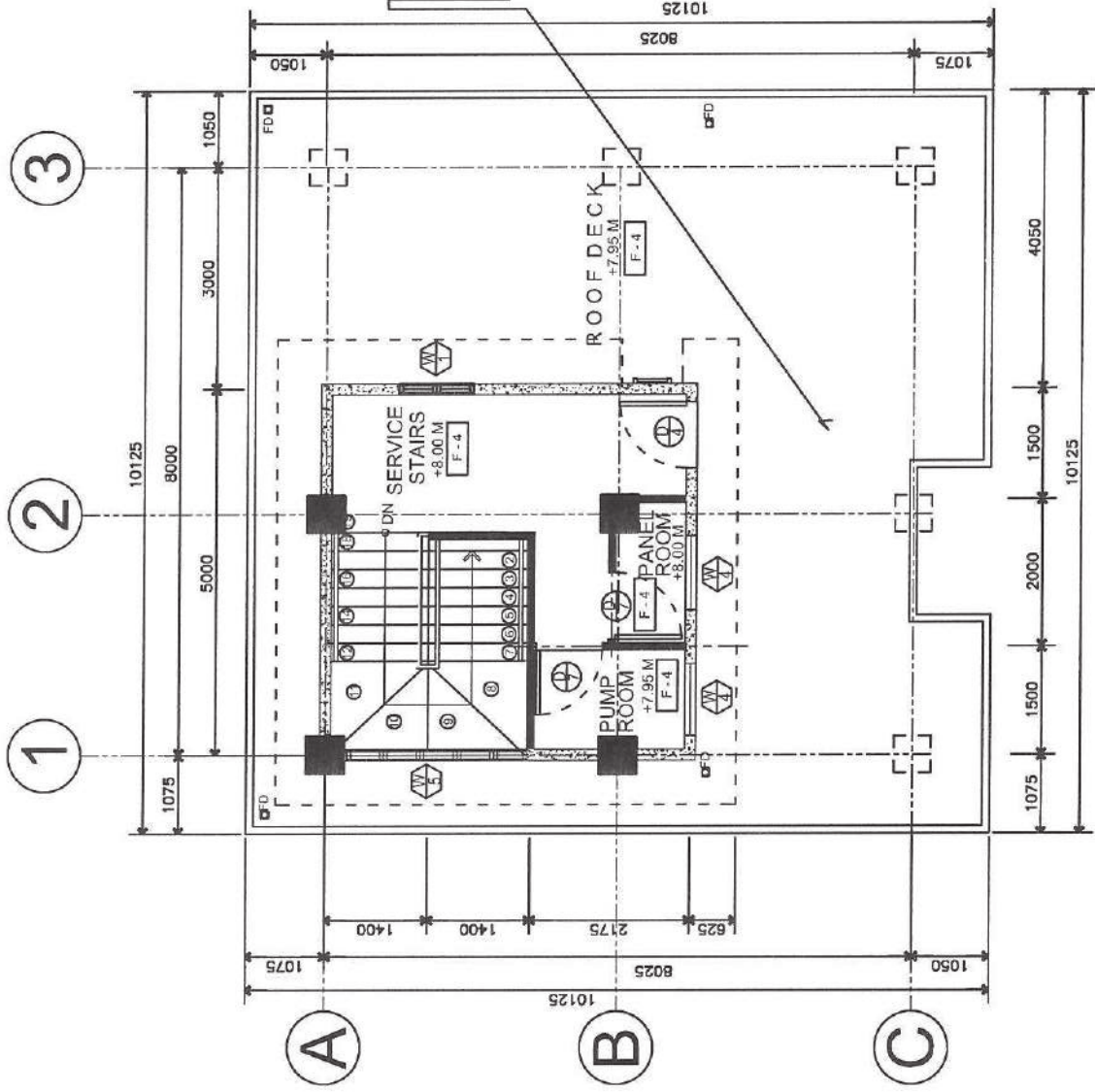
PERSPECTIVE

	<b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST. PORT AREA MANILA <b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGBF, Muella dela Industria, Exola Compound Binondo, Manila 1006	<b>PROJECT AND LOCATION</b>  CONSTRUCTION OF STATION NORTHERN SAMAR Brgy. Sibang Zone 2, Alim, Northern Samar PHILIPPINE COAST GUARD	<b>SHEET CONTENT</b>  PERSPECTIVE	<b>BRANCH</b> Architectural Branch <b>PREPARED BY</b> CG ASN T. Carlos L. Piedad Member Architectural Branch, CGAS <b>CHECKED BY</b> CG PERS LUISIE DOOLA CRUZ Member Architectural Branch, CGAS	<b>SUBMITTED BY</b>  CG LT REXNER JAM P. DAGOHOY Member Engineering Branch, CGAS	<b>RECOMMENDING APPROVAL</b>  CG CDR JAURINCE IVAN N. FELIZARTE Member Engineering Branch, CGAS	<b>APPROVED BY</b>  CG COMMO PRUDENCIO C. PATRICIO JR. Commander, CGAS	<b>SHEET NO</b> A-1 01 51
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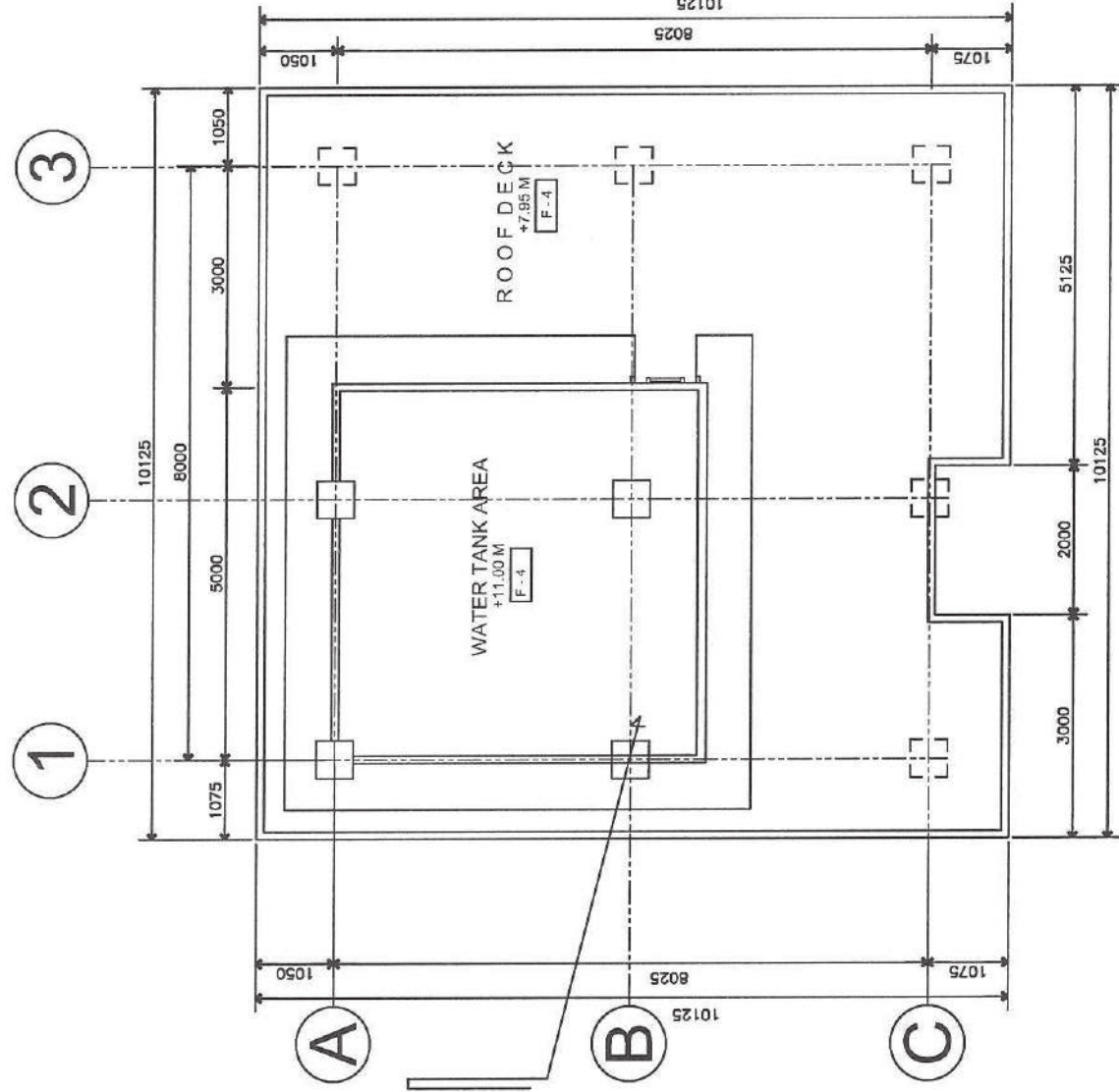








CGS NORTHERN SAMAR  
1 LOWER ROOF DECK PLAN  
SCALE 1:100M



CGS NORTHERN SAMAR  
2 UPPER ROOF DECK PLAN  
SCALE 1:100M

LEGEND

WALL	
	6" (150MM) CHB WALL - PLASTERED, PAINTED (ELASTOMERIC PAINT)
	4" (100MM) CHB WALL - PLASTERED, PAINTED (LATEX PAINT)
FLOOR	
	60 CM X 60 CM HOMOGENEOUS PORCELAIN TILES
	30 CM X 30 CM HOMOGENEOUS CERAMIC TILES (NON-SLIP)
	60 CM X 60 CM HOMOGENEOUS CERAMIC TILES (NON-SLIP)
	INDUSTRIAL RUBBERIZED FLOOR PAINT



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE**  
DEVELOPMENT SERVICE  
CGBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

CONSTRUCTION OF  
**STATION NORTHERN SAMAR**  
Brgy. Sabang Zone 2, Alen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
LOWER ROOF DECK PLAN  
UPPER ROOF DECK PLAN

BRANCH  
Architectural Branch  
PREPARED BY  
CG ASN Terrence L. Piedad  
Checked by  
CG PLENIS LUCIE D. DELA CRUZ  
CGS

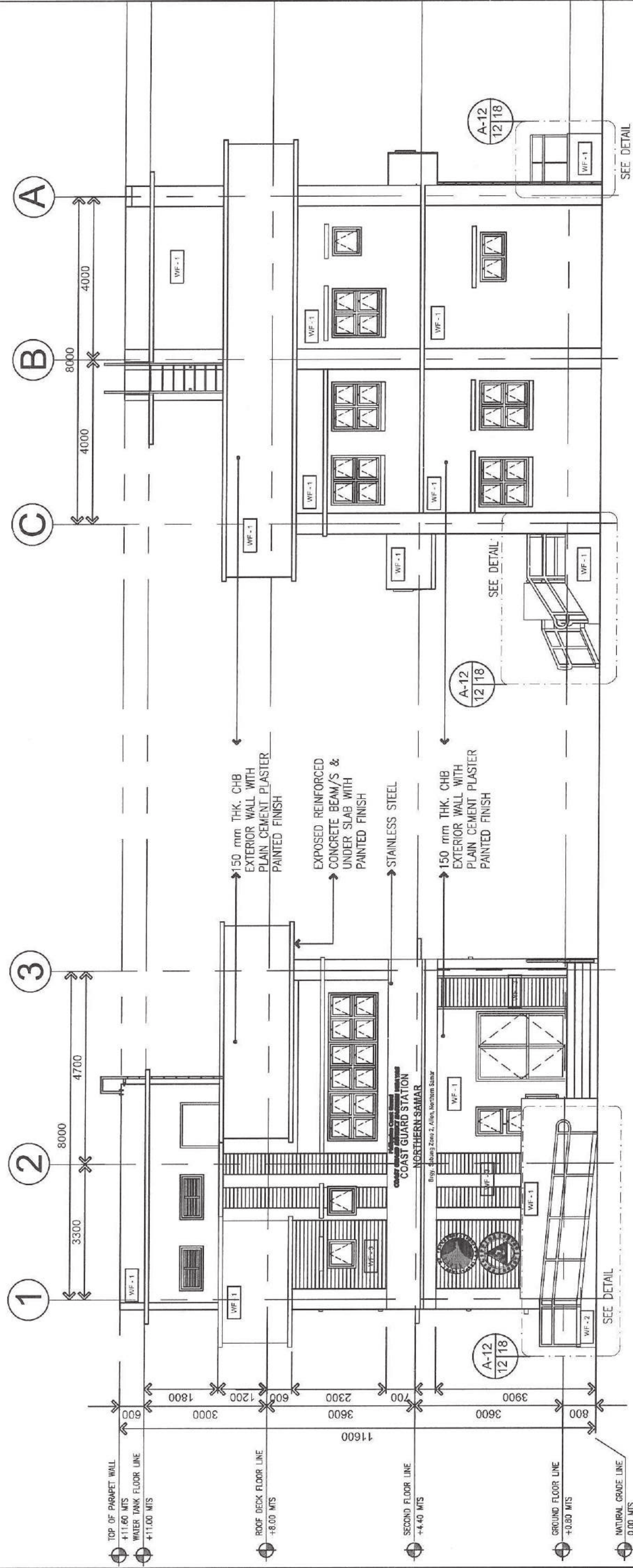
SUBMITTED BY  
CG LT REYMER J. P. DAGOHY  
Head, Engineering Department, CGS

RECOMMENDING APPROVAL  
CG CDR LARINCE VAN N. FELIZARTE  
Big Design Commander, CGS


APPROVED BY  
CG COMMO PRUDENCIO Q. PATRICIO JR.  
Commander, CGS

SHEET NO  
A-3  
03 51

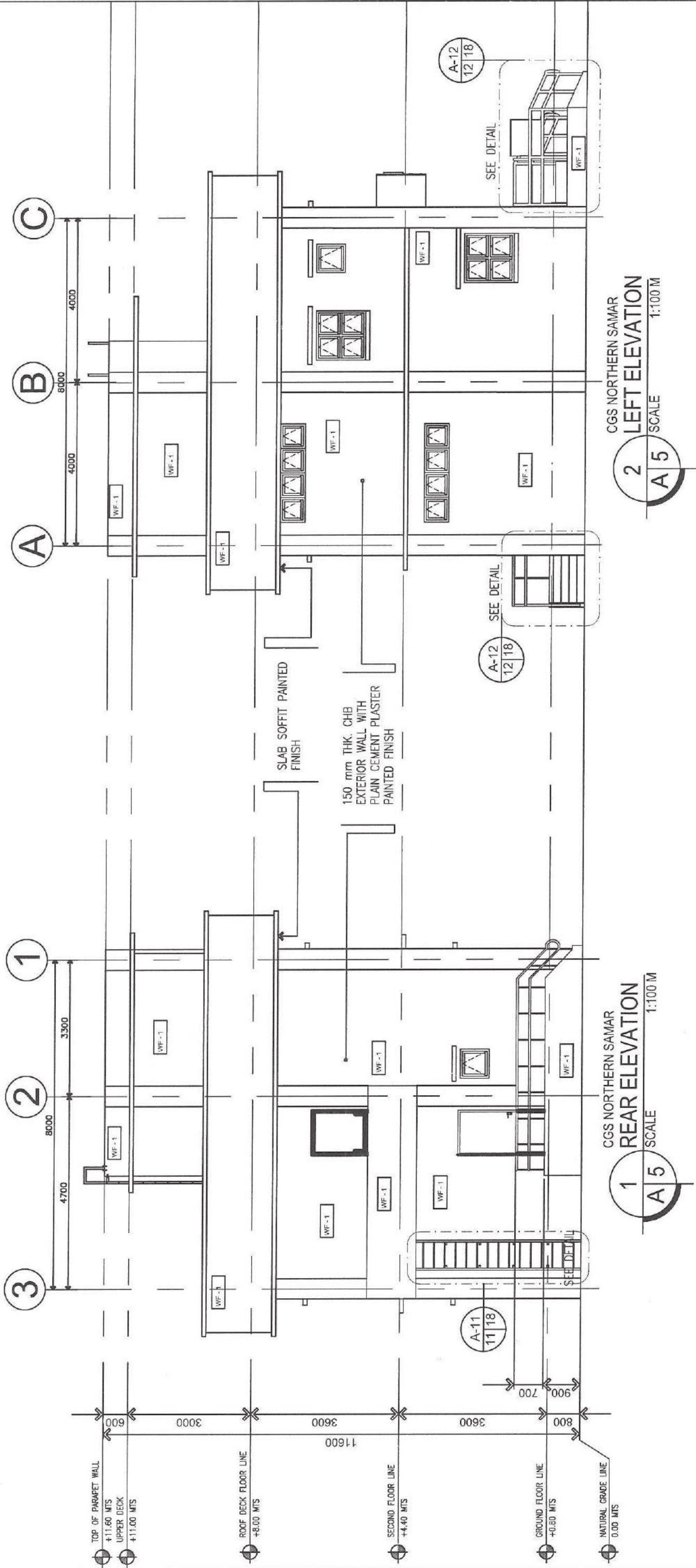




LEGEND	
WALL FINISHES	
WF - 1	ELASTOMERIC SEMI-GLOSS PAINT (FOR EXTERIOR WALLS)
WF - 2	SEMI-GLOSS LATEX PAINT (FOR INTERIOR WALLS) COLOR: WHITE
WF - 3	CONCRETE CLADDING

 <p><b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST., PORT AREA MANILA</p> <p><b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGBF, Muelle de la Industria, Farola Compound Binondo, Manila 1006</p>	<p><b>PROJECT AND LOCATION</b></p> <p>CONSTRUCTION OF STATION NORTHERN SAMAR Brgy. Sabang Zone 2, Allen, Northern Samar</p> <p>PHILIPPINE COAST GUARD</p>	<p><b>SHEET CONTENT</b></p> <p>FRONT ELEVATION RIGHT ELEVATION</p>	<p><b>BRANCH</b></p> <p>Architectural Branch</p>	<p><b>SUBMITTED BY</b></p> <p><i>[Signature]</i> CG LT REYNER JAN P. DAGOHOY Head, Engineering Department, CGAS</p>	<p><b>RECOMMENDING APPROVAL</b></p> <p><i>[Signature]</i> CG ODR LAURINCE IVAN N. FELIZARTE CGAS Deputy Commander, CGAS</p>	<p><b>APPROVED BY</b></p> <p><i>[Signature]</i> CG COMMO PRUDENCIO PATRICIO JR. Commander, CGAS</p>	<p><b>SHEET NO.</b></p>
							<p><b>PREPARED BY</b></p> <p>CG ASN TERRY M. PLEASID Member Architectural Branch, CGAS</p>
							<p><b>CHECKED BY</b></p> <p><i>[Signature]</i> CG PIENS LUIS B. DELA CRUZ Member Architectural Branch, CGAS</p>





LEGEND

WALL FINISHES

WF-1	ELASTOMERIC SEMI-GLOSS PAINT (FOR EXTERIOR WALLS)
WF-2	SEMI-GLOSS LATEX PAINT (FOR INTERIOR WALLS) COLOR: WHITE
WF-3	CONCRETE CLADDING



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST., PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE**  
DEVELOPMENT SERVICE  
CGBF, Muelle de la Industria, Fabela Compound  
Binondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Eng'g. Subing Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
REAR ELEVATION  
LEFT ELEVATION

**BRANCH**  
Architectural Branch  
**PREPARED BY**  
CG ASN TAYLOR, Piedad U. Piedad  
Senior Architect & Surveyor  
**CHECKED BY**  
CG PIENS JUNG, D. BETA A. CRUZ  
Senior Architect & Surveyor

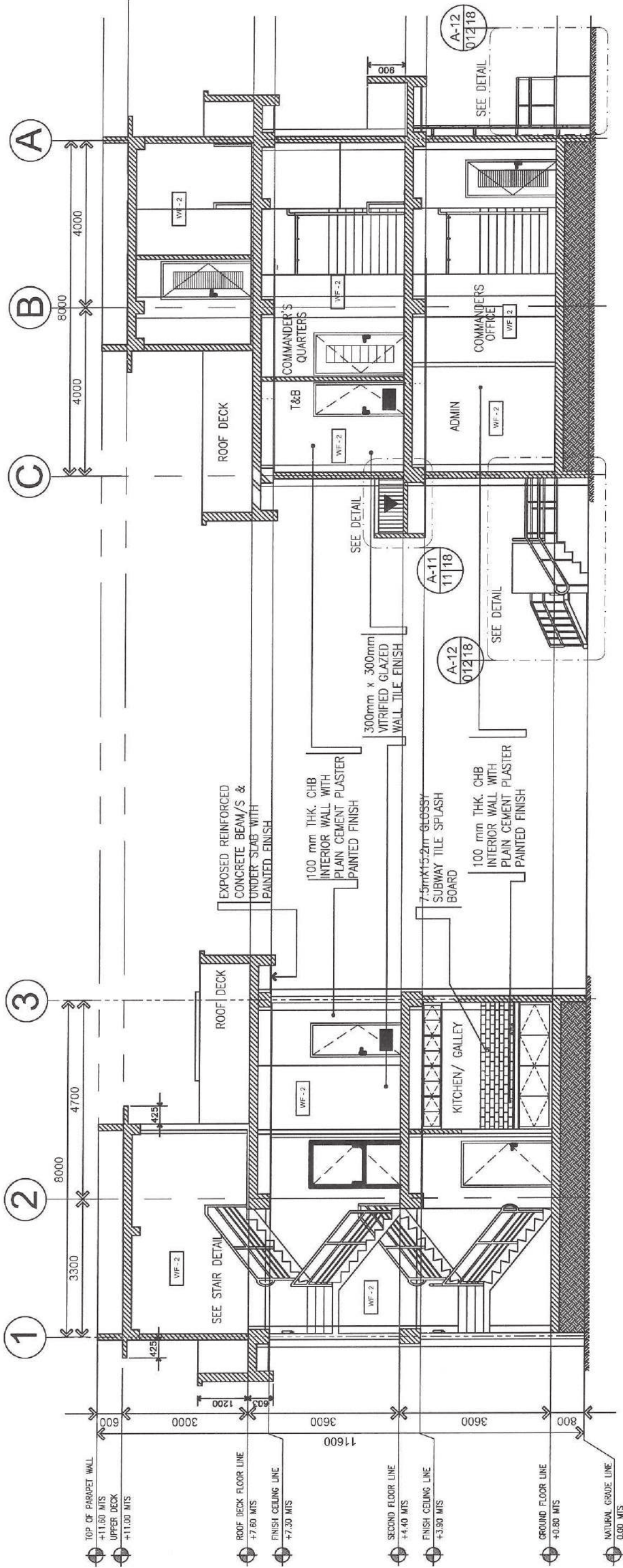
**SUBMITTED BY**  
CG LT REYNER JAN P. DAGOHAN  
Head of Engineering Department, CGS

**RECOMMENDING APPROVAL**  
CG CDR LAURINCE V. N. FELIZARTE  
Engineering Department, CGS

**APPROVED BY**  
CG COMMO PRUDENCIO Q. PATRICIO JR.  
Commander, CGS

**SHEET NO**  
A-5  
05 51





CGS NORTHERN SAMAR  
SECTION THRU X-1  
SCALE 1:100 M

CGS NORTHERN SAMAR  
SECTION THRU Y-1  
SCALE 1:100 M

LEGEND

WALL FINISHES

- WF-1 ELASTOMERIC SEMI-GLOSS PAINT (FOR EXTERIOR WALLS)
- WF-2 SEMI-GLOSS LATEX PAINT (FOR INTERIOR WALLS) COLOR: WHITE
- WF-3 CONCRETE CLADDING



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA, MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle de la Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Saling Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
SECTION THRU X-1  
SECTION THRU Y-1

BRANCH  
Architectural Branch  
PREPARED BY  
CG ASN Terny, Marial L. Piedad  
Checked By  
CG PENS YUGIE DELA CRUZ  
Headquarters, Architectural Unit-05, CGAS

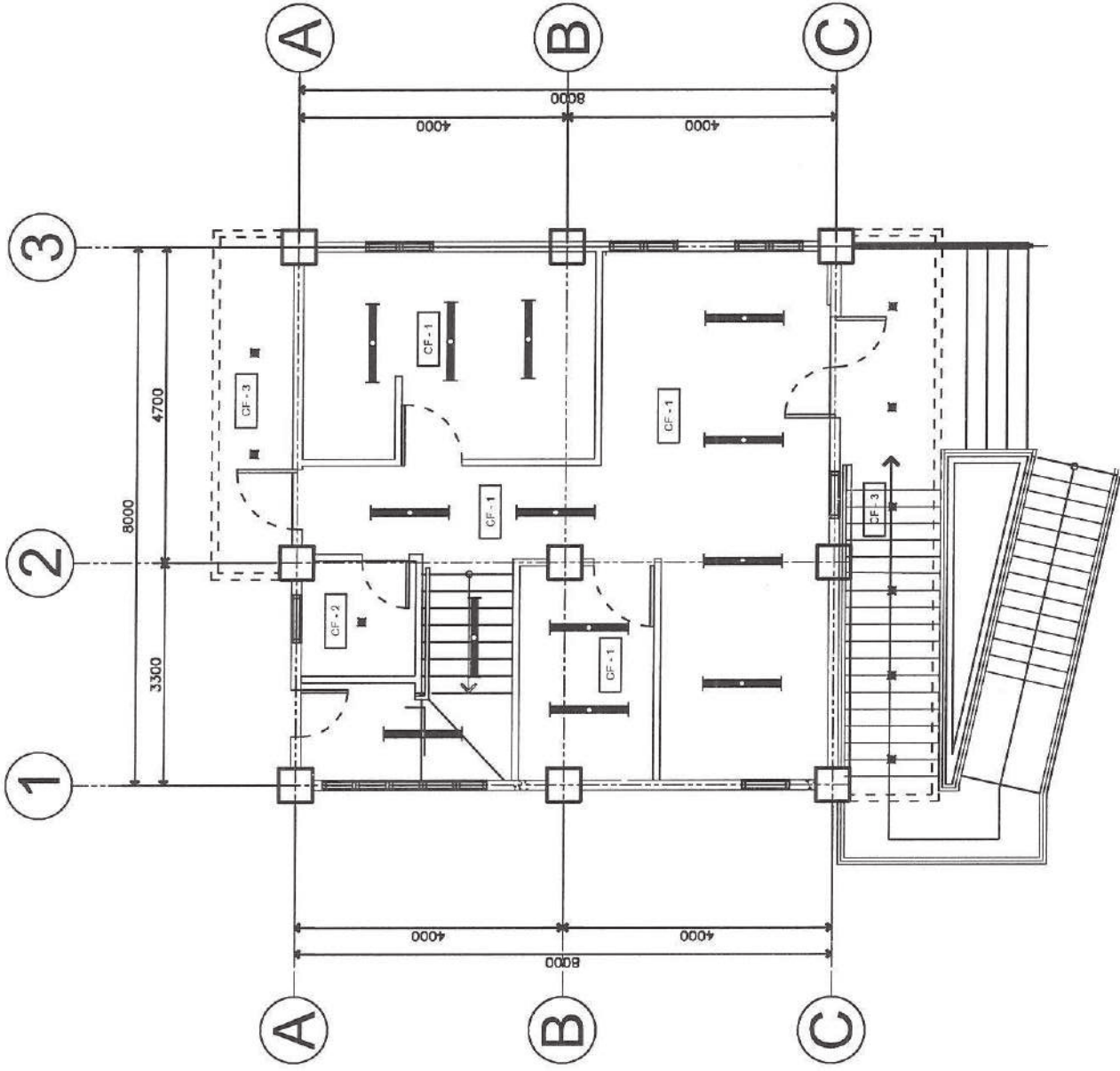
SUBMITTED BY  
CG LT REYNER JAN P. DAGOHAY  
Headquarters, Engineering Department, CGAS

RECOMMENDING APPROVAL  
CG CTR JAURINCE IVAN N. FELIZARTE  
Long Deploy, Command, CGAS

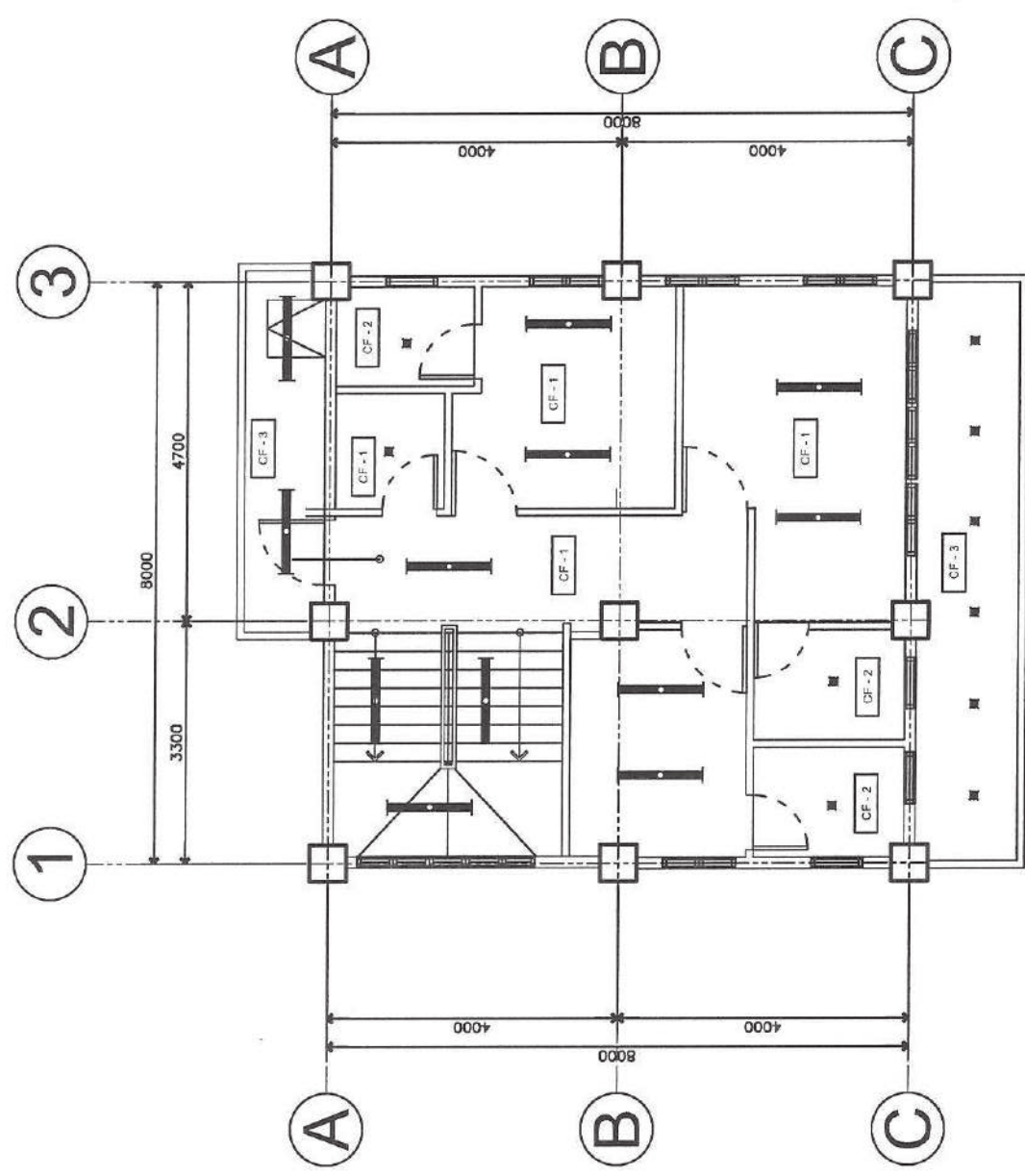
APPROVED BY

SHEET NO  
A-6  
06 51





CGS NORTHERN SAMAR  
1  
GROUND FLOOR REFLECTED CEILING PLAN  
A7 SCALE  
1:100M



CGS NORTHERN SAMAR  
2  
SECOND FLOOR REFLECTED CEILING PLAN  
A7 SCALE  
1:100M

LEGEND	
CEILING FINISHES	
CF-1	3.5 THK FICEM BOARD ON METAL FURRING; PAINTED FINISH
CF-2	3.5mm THK WATER RESISTANT FIBER CEMENT BOARD ON METAL FURRING; PAINTED FINISH
CF-3	BARE CEILING
	12W LIGHT BULB WITH RECEPTACLE; DAYLIGHT
	2ft x 4ft FLOURESCENT TROFFER LIGHT; DAYLIGHT



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zonia 2, Alon, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
GROUND FLOOR REFLECTED  
CEILING PLAN  
SECOND FLOOR REFLECTED  
CEILING PLAN

BRANCH  
Architectural Branch  
PREPARED BY  
CG ASST. Engr. L. Pladad  
Checked by  
CG PIENS ZOLAIE E. LA CRUZ  
Junior, Army, Civil Service, CGS

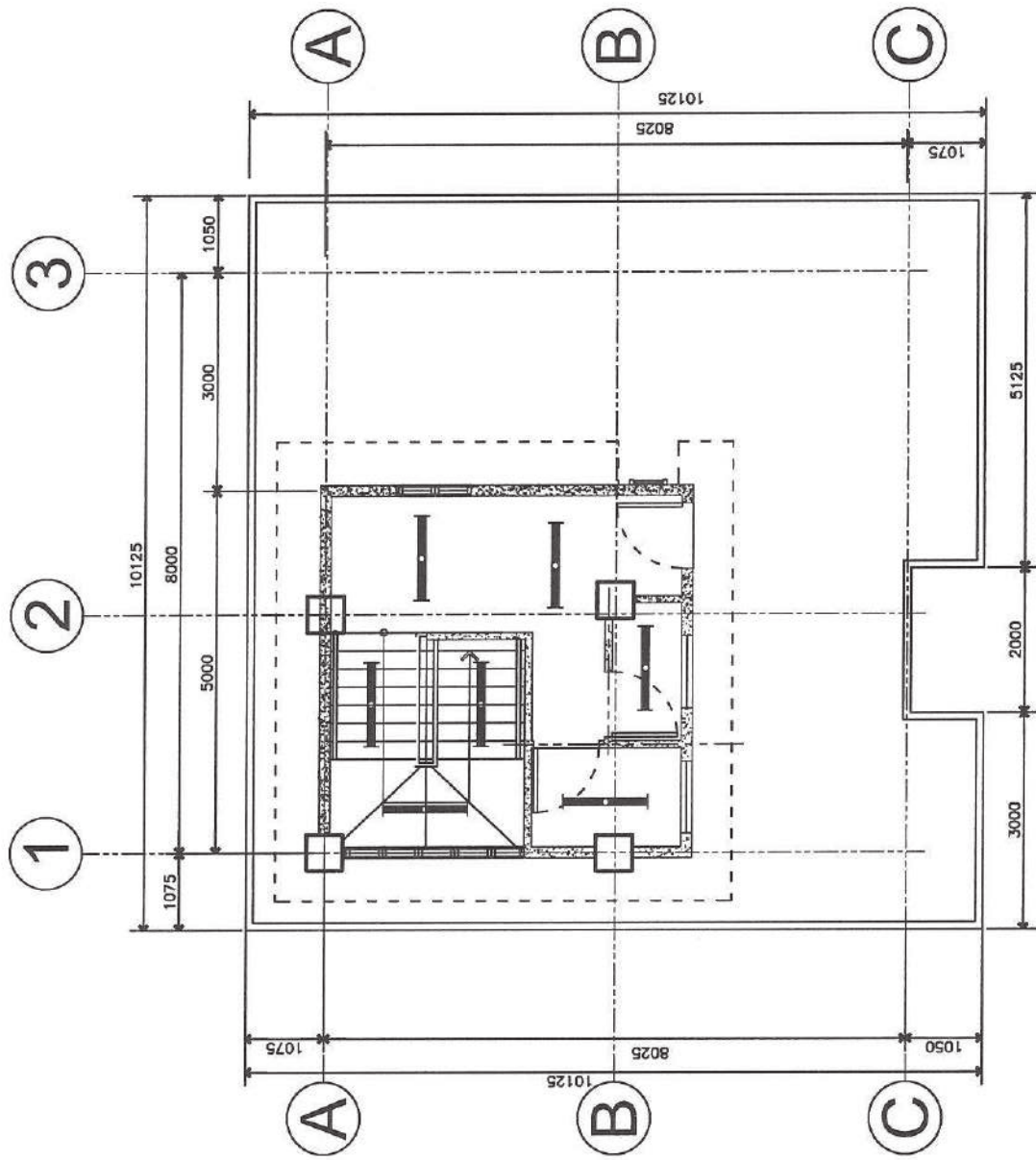
SUBMITTED BY  
CG LT REYNER JAN P. DAGORROY  
Head, Planning Department, CGS

RECOMMENDING APPROVAL  
CG CDK LAURINOB MAN N. FELIZARTE  
Chief Deputy Commander, CGS

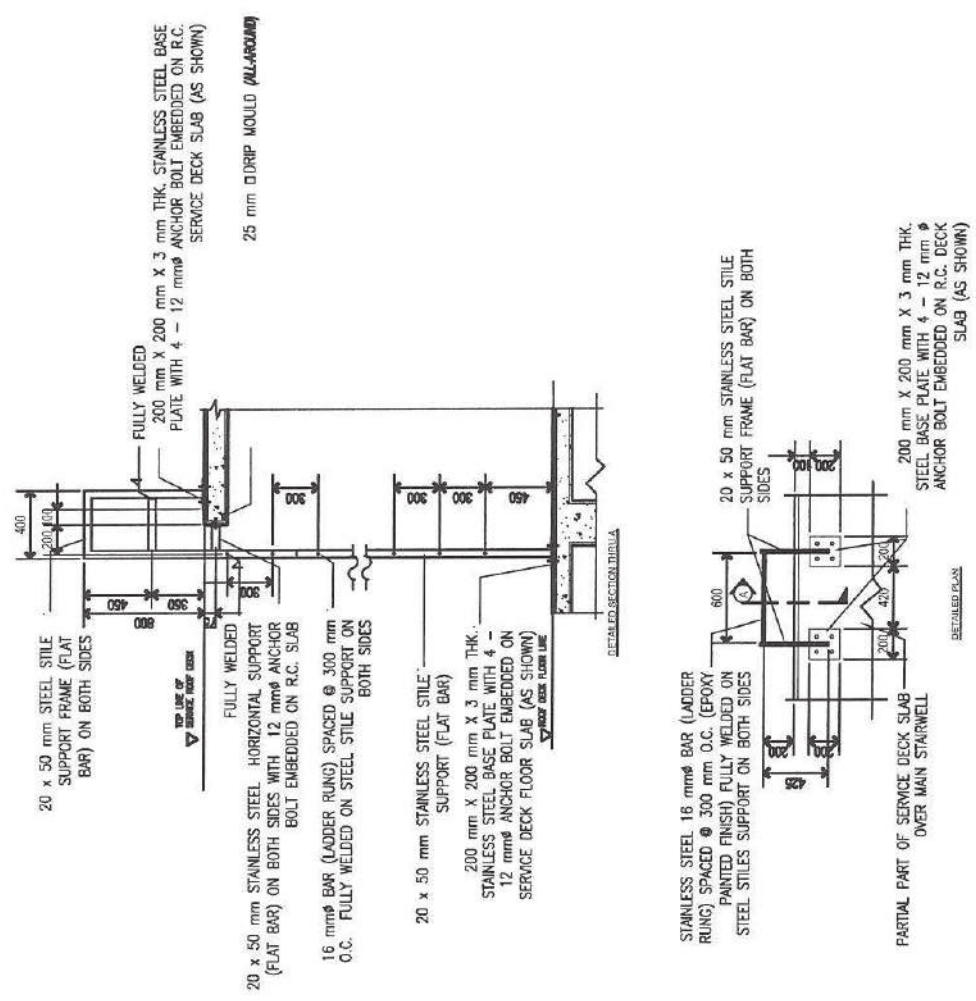
APPROVED BY  
CG COMMO PRUDENCIO PATRICIO JR.  
Commander, CGS

SHEET NO  
A-7  
07  
51





CGS NORTHERN SAMAR  
1 ROOF DECK REFLECTED CEILING PLAN  
SCALE 1:100M



CGS NORTHERN SAMAR  
2 LADDER DETAIL  
SCALE 1:25M

LEGEND	
CEILING FINISHES	
CF - 1	3.5 THK FICEM BOARD ON METAL FURRING; PAINTED FINISH
CF - 2	3.5mm THK WATER RESISTANT FIBER CEMENT BOARD ON METAL FURRING; PAINTED FINISH
CF - 3	BARE CEILING
	12W LIGHT BULB WITH RECEPTACLE; DAYLIGHT
	2ft x 4ft FLOURESCENT TROFFER LIGHT; DAYLIGHT



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGSDF, Muelle de Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Subang Zone 2, Alon, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
ROOF DECK REFLECTED CEILING PLAN  
LADDER DETAIL

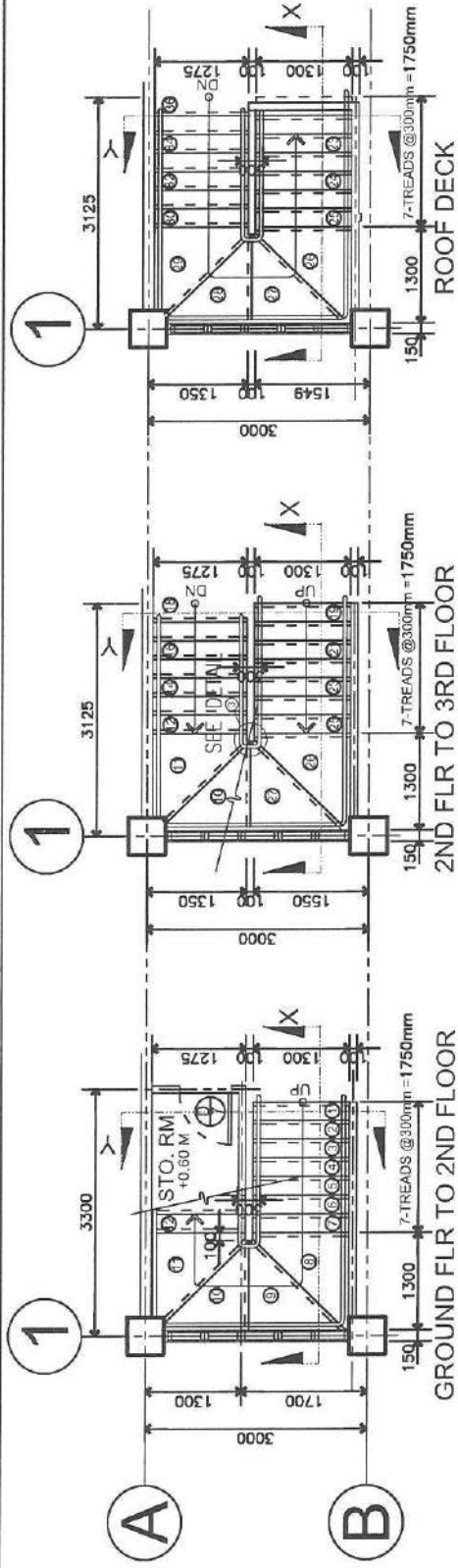
BRANCH Architectural Branch  
PREPARED BY CG ASN Terny Chaitou L. Piedad  
Checked By CG PERS YOLIE D. DE LA CRUZ  
CGSDF, Muelle de Industria, Farola Compound, Binondo, Manila 1006

SUBMITTED BY  
CG LT REYNIER JAN P. DAGOHY  
Head, Planning Department, CGSDF  
CG OFR LAURINCE IVAN N. FELIZARTE  
Acting Deputy Commander, CGSDF

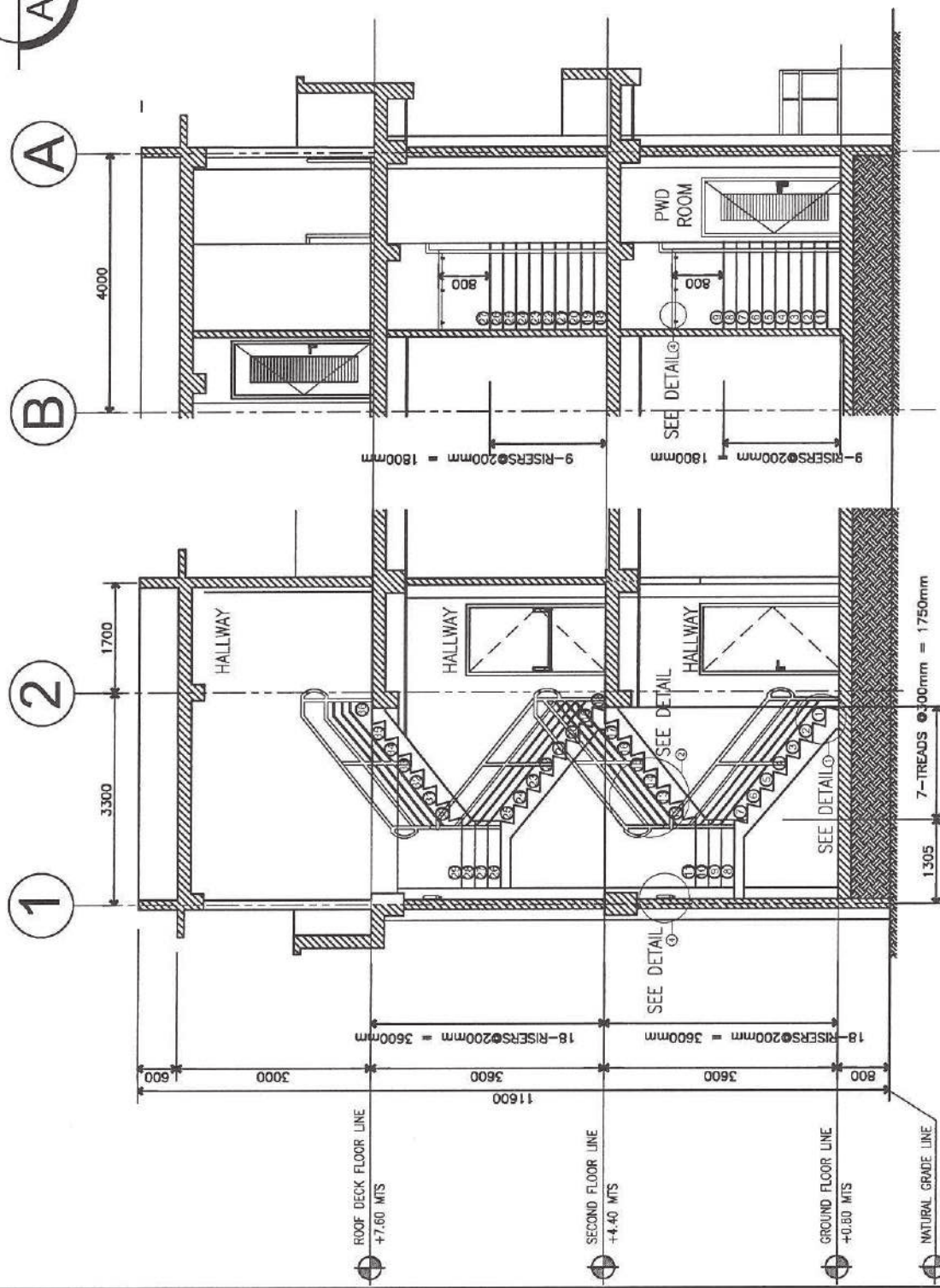
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Commander, CGSDF

SHEET NO  
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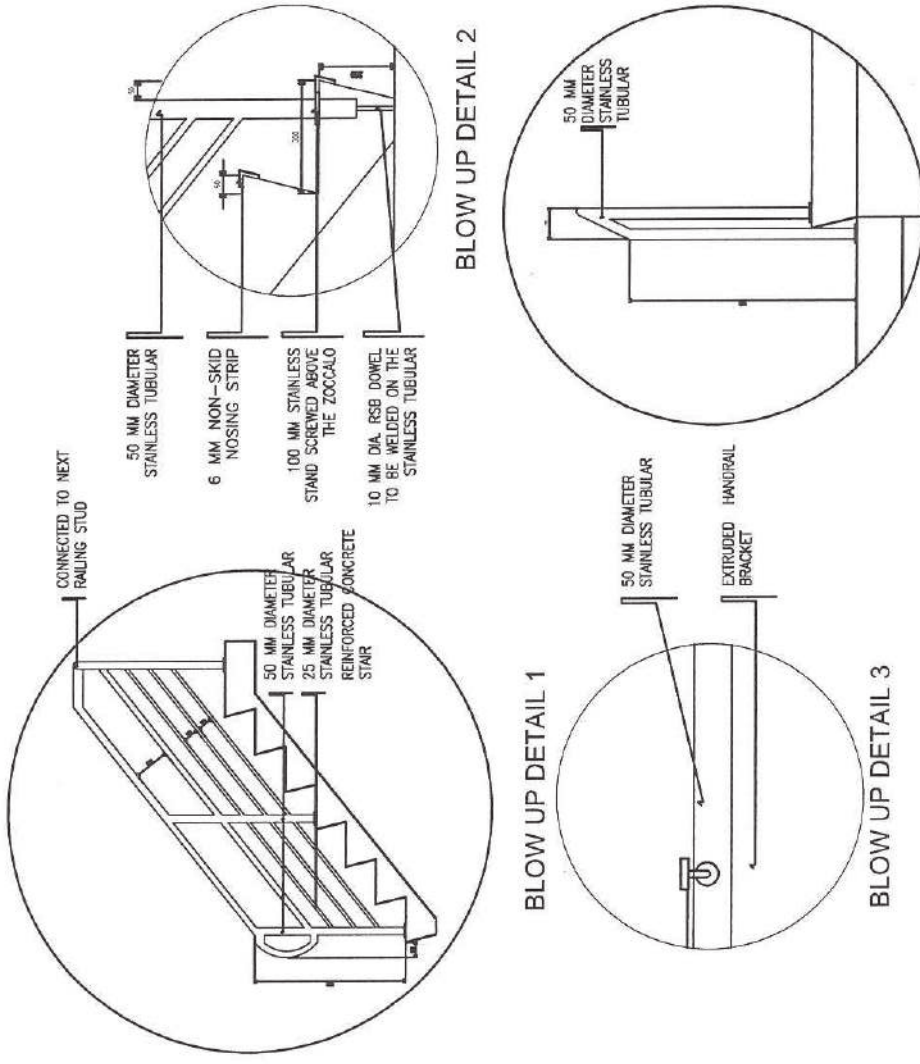




1 STAIR CASE PLAN  
SCALE 1:100M  
A 9



2 STAIR CASE  
SECTION DETAIL  
SCALE 1:100M  
A 9



3 STAIR CASE  
BLOW-UP DETAILS  
SCALE 1:100M  
A 9



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA, MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle de la Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brig. Subang Zone 2, Alon, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
STAIR CASE PLAN  
SECTION DETAIL  
STAIR CASE BLOW UP DETAIL

BRANCH  
Architectural Branch  
PREPARED BY  
CG ASN Terry L. Piedad  
Checked By  
CG PIENS LIGIE DELA CRUZ  
Head of Architectural Branch, CGPS

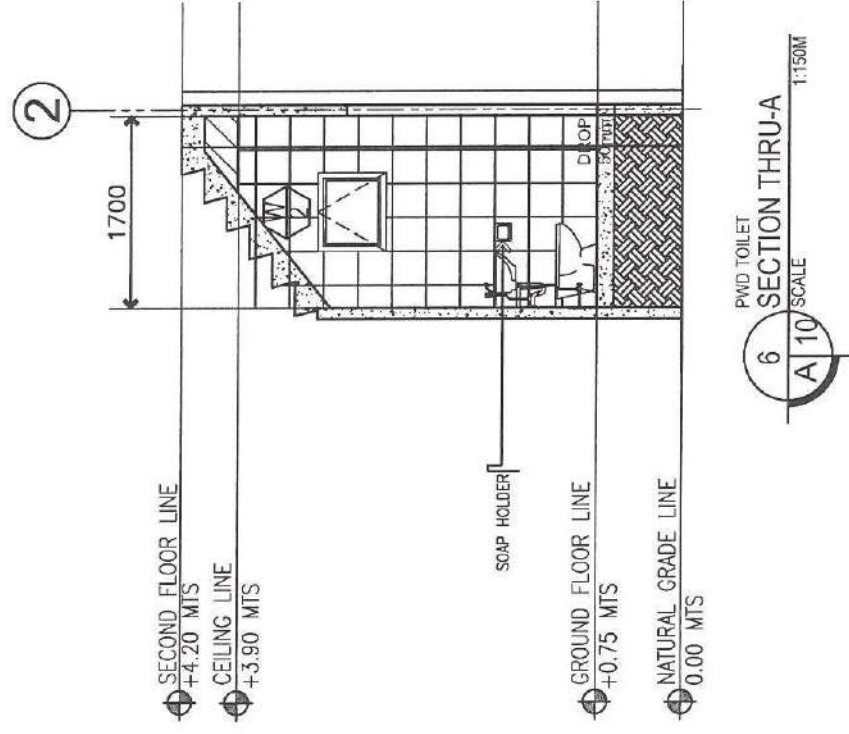
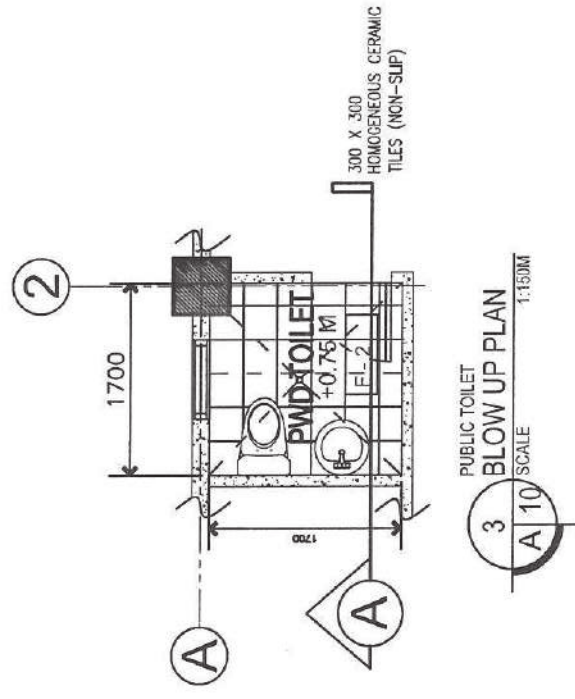
SUBMITTED BY  
CG LT REYNER JAN P. DAGOMOY  
Head of Planning Department, CGPS

RECOMMENDING APPROVAL  
CG CDRA RINCE MARTELIZARTE  
Asst. Deputy Commander, CGPS

APPROVED BY  
CG COMMO PRUDENCIO PATRICIO JR.  
Commander, CGPS

SHEET NO  
A-9  
09 51





**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle de la Industria, Farola Compound  
Binondo, Manila 1006

BRANCH	Architectural Branch
PREPARED BY	CG ASNT Terry M. Norio L. Piedad Member, Architectural Branch, CGAS
CHECKED BY	<i>[Signature]</i> CG PIENS LUCIO DE LA CRUZ Member, Architectural Branch, CGAS

PROJECT AND LOCATION

SHEET CONTENT	BLOW UP DETAILS
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Architectural Branch

CG LT REYMER JAN P DAGCHOY  
Head, Engineering Department, CGMS

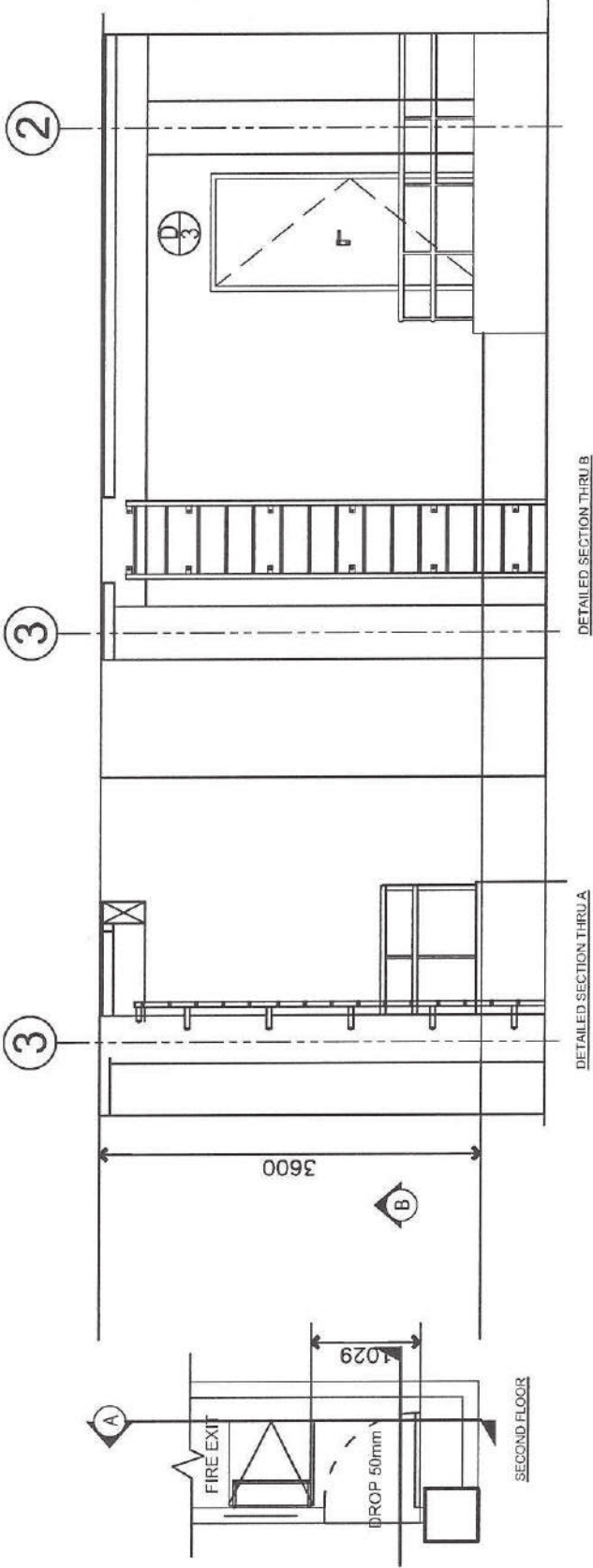
CG CDR LAURINDE WANN FELIZARTE  
Acting Deputy Commander, CDRUS

APPROVED BY

SHEET NO. 10

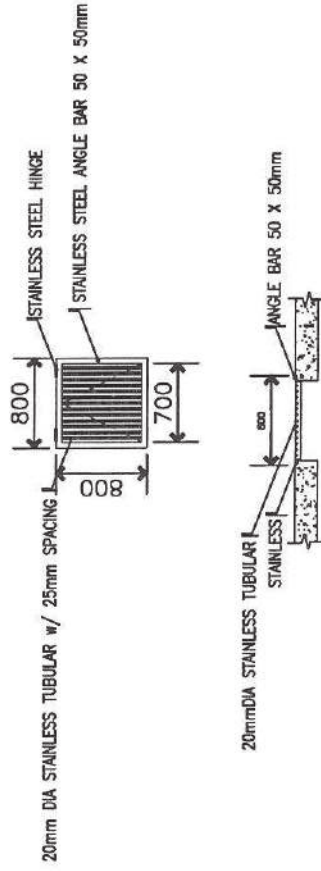
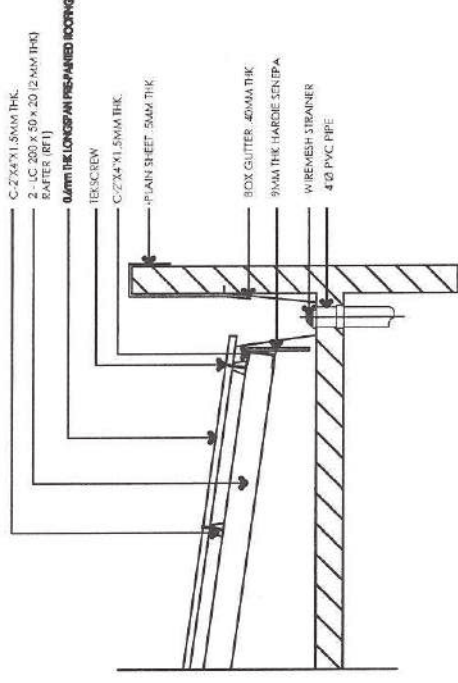
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Comandante, CG105



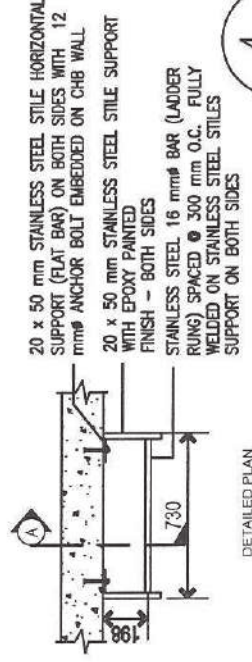


1  
A 9  
SCALE  
1:25M  
FIRE EXIT  
DETAIL OF FIRE EXIT

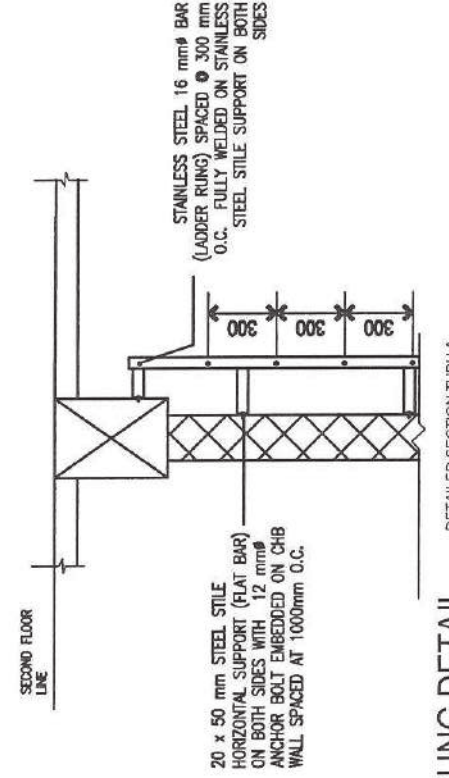
2  
A 9  
SCALE  
NTS  
FIRE EXIT  
GUTTER DETAIL



3  
A 9  
SCALE  
1:150 M  
FIRE EXIT  
OPERABLE FIRE ESCAPE COVER DETAIL



4  
A 9  
SCALE  
1:25M  
FIRE EXIT  
LADDER RUNG DETAIL



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CDSF, Muelle de la Industria, Parola Compound  
Binondo, Manila 1000

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Subang Zone 2, Alim, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
FIRE EXIT DETAIL  
GUTTER DETAIL  
OPERABLE FIRE ESCAPE COVER DETAIL  
LADDER RUNG DETAIL

**BRANCH**  
Architectural Branch  
**PREPARED BY**  
CG ASN TONY CHIRIO L Piedad  
Branch Architectural Branch CDSF  
**CHECKED BY**  
CG PIENS LAGID D DELA CRUZ  
Branch Architectural Branch CDSF

**SUBMITTED BY**  
CG LT REYER JAN P DAGOHAY  
Head of Station Department CDSF

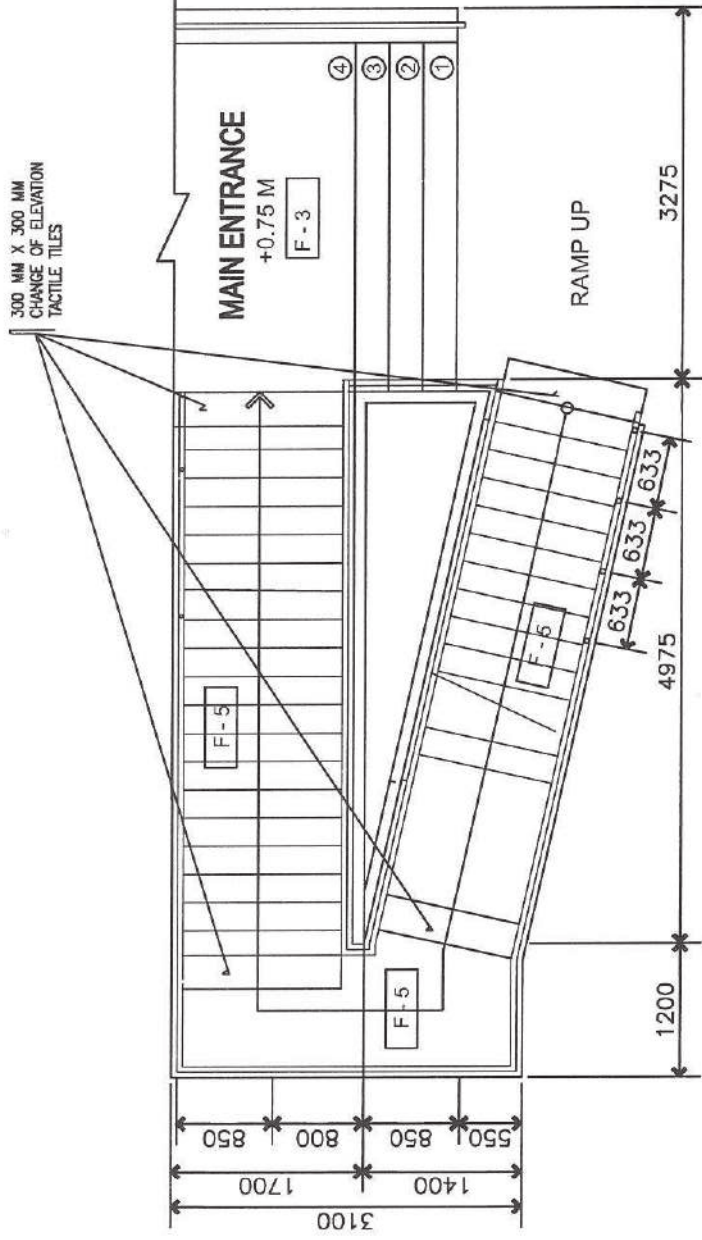
**RECOMMENDING APPROVAL**  
CG CAPT LAURINE IVAN N FELIZARTE  
Branch Deputy Commander CDSF

**APPROVED BY**

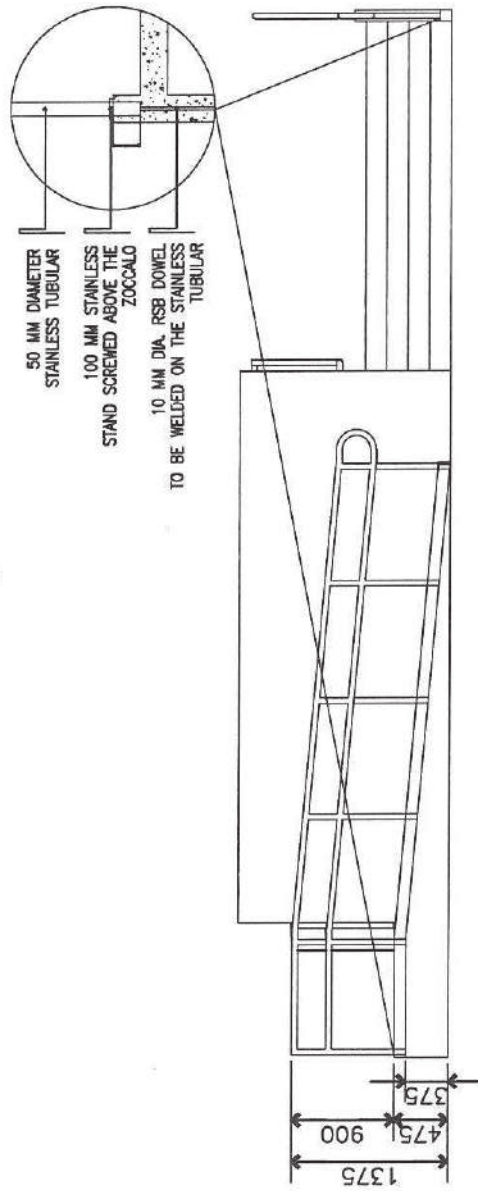
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CG COMMO PRUDENCIO PATRICIO JR  
Commander CDSF

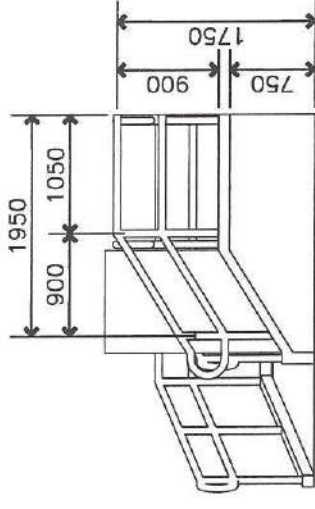




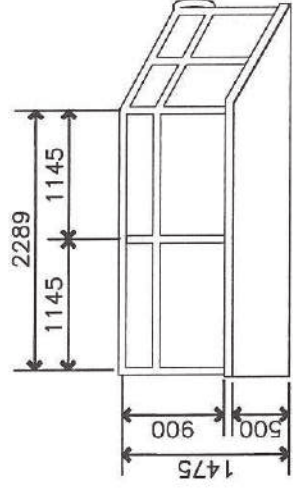
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1 BLOW-UP PLAN  
SCALE 1:150



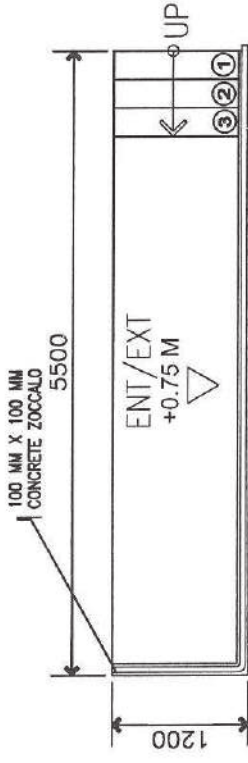
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2 BLOW-UP ELEVATION  
SCALE 1:150



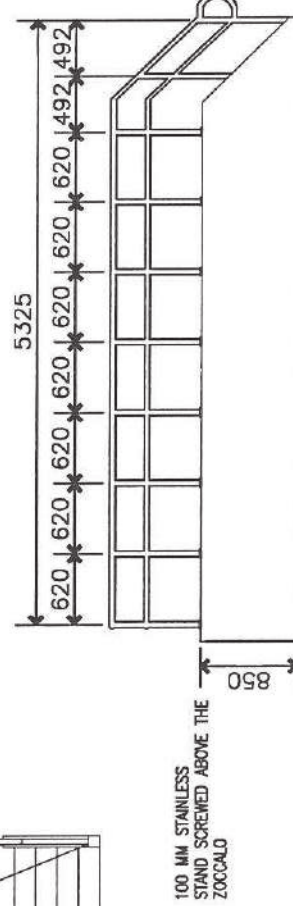
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4 BLOW-UP ELEVATION  
SCALE 1:150



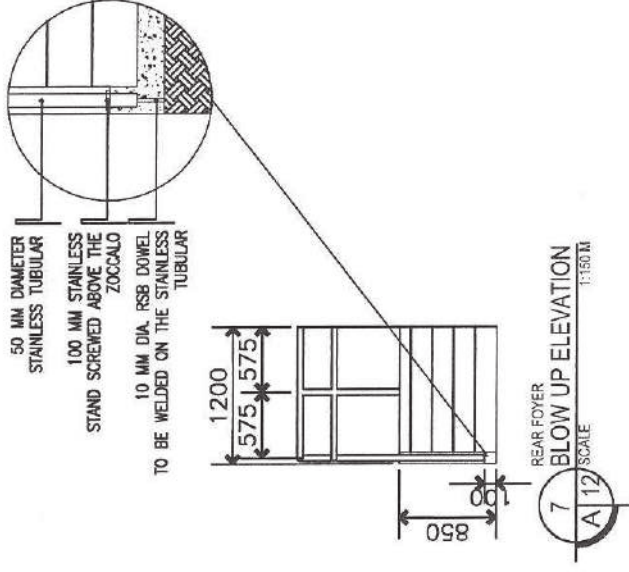
PWD RAMP DETAIL  
3 BLOW-UP ELEVATION  
SCALE 1:150



REAR FOYER  
5 FLOOR PLAN  
SCALE 1:150



REAR FOYER  
6 BLOW-UP ELEVATION  
SCALE 1:150



REAR FOYER  
7 BLOW-UP ELEVATION  
SCALE 1:150



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA, MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Farola Compound  
Bhondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
PWD RAMP DETAIL

**BRANCH**  
Architectural Branch  
**PREPARED BY**  
CG ASN Teryn L. Piedad  
Junior Architect  
**CHECKED BY**  
CG P/ENS MIGUEL D. CRUZ  
Senior Architect

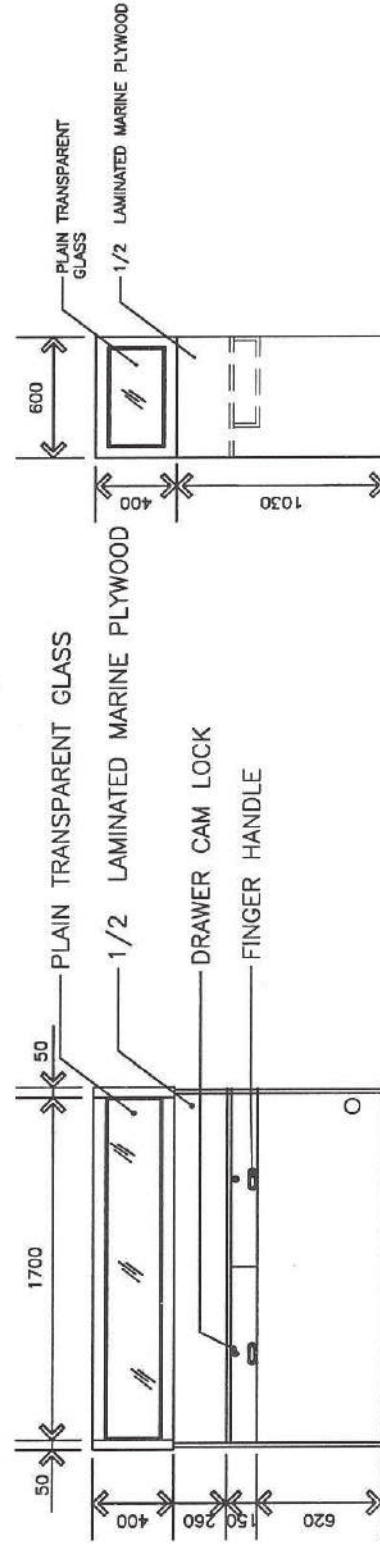
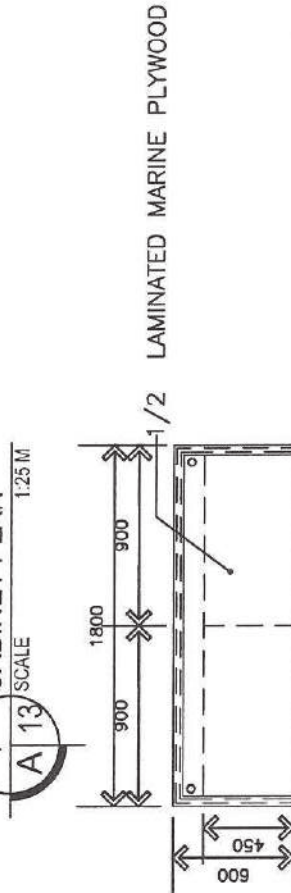
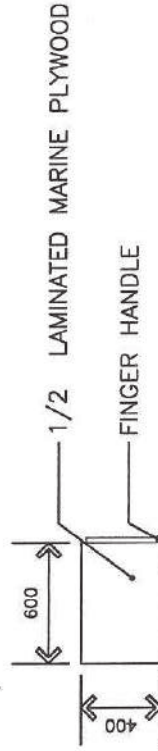
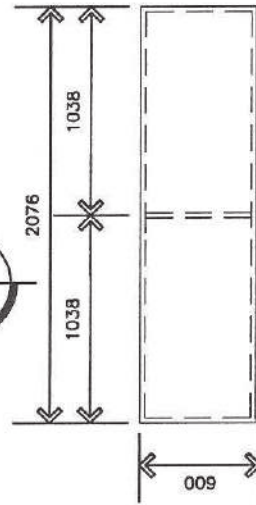
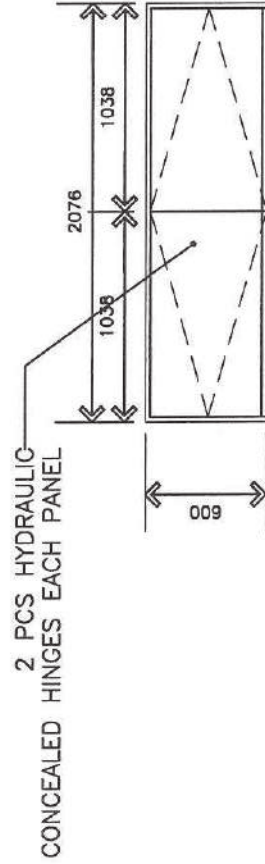
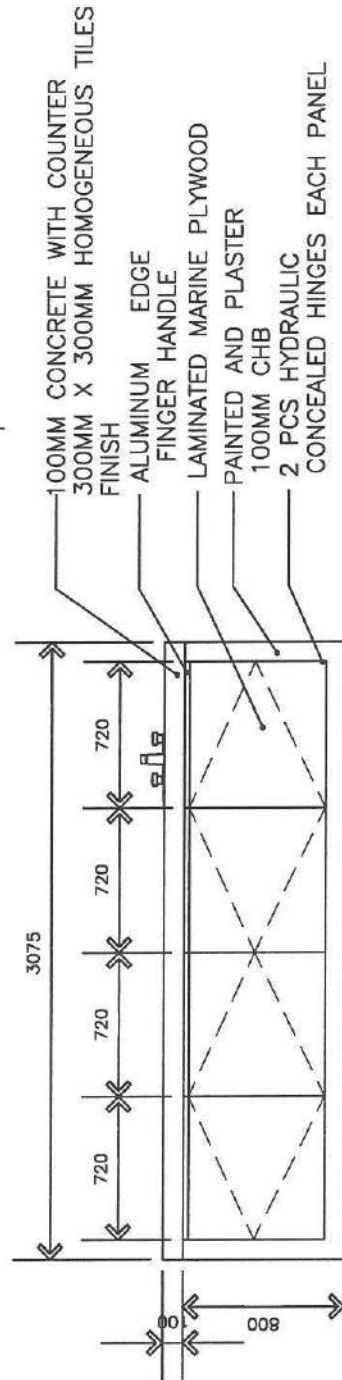
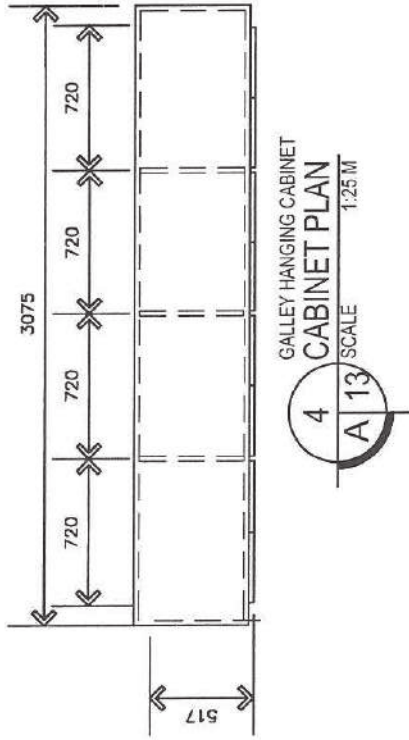
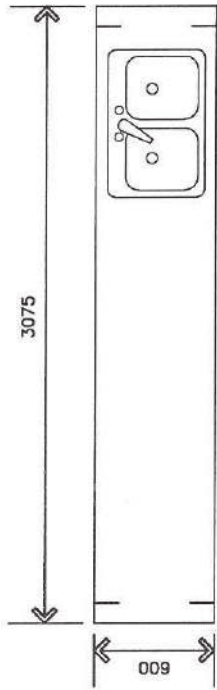
**SUBMITTED BY**  
CG LT REYNER JAN P. DAGOHOY  
Head Engineering Department (CECS)

**RECOMMENDING APPROVAL**  
CG CDR LAURINCE IVAN N. FELIZARTE  
Acting Deputy Commander (CECS)

**APPROVED BY**  
CG COMMO PRUDENCIO PATRICIO JR.  
Commander (CECS)

**SHEET NO**  
A-12  
12 51





**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle de la Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
KITCHEN COUNTER TOP DETAIL  
KITCHEN FRONT ELEVATION  
CABINET PLAN  
CABINET FRONT ELEVATION  
CABINET SIDE ELEVATION

BRANCH  
Architectural Branch  
PREPARED BY  
CG ASN Nery M. Piedad L. Piedad  
Senior Architectural Engineer, CGBF  
CHECKED BY  
CG PENS JUDGE D. A. CRUZ  
Senior Architectural Engineer, CGBF

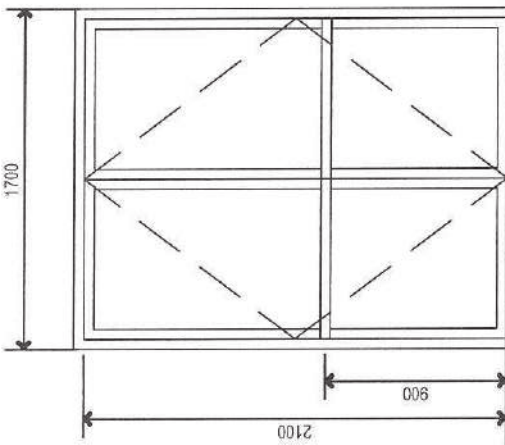
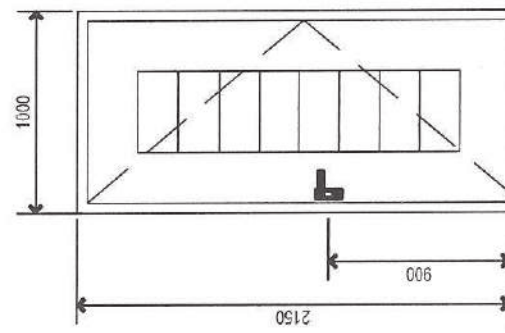
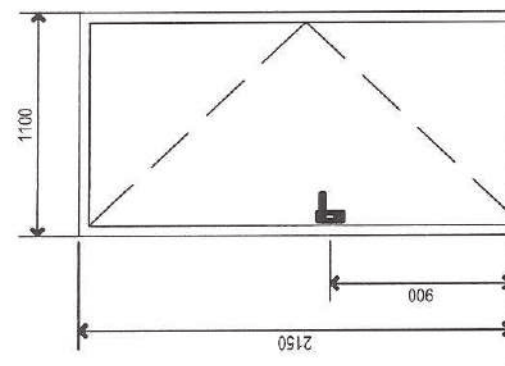
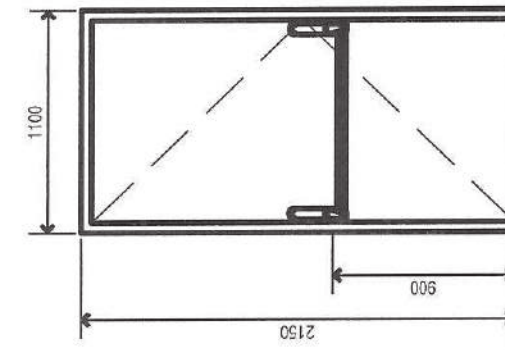
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CG LT REYNER JAN P. DABOHOY  
Head, Engineering Department, CGBF

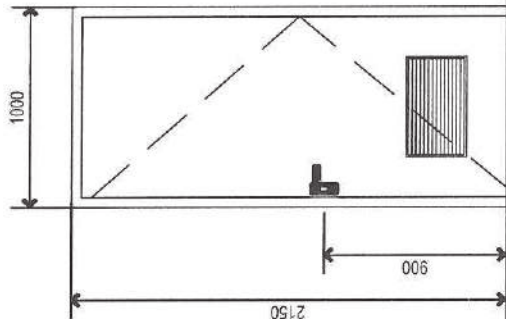
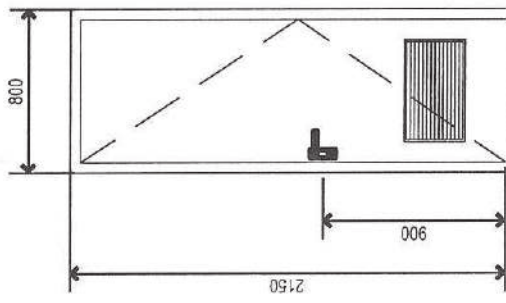
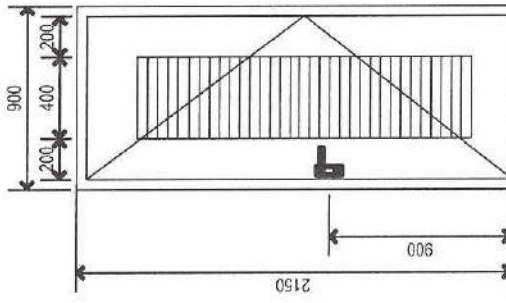
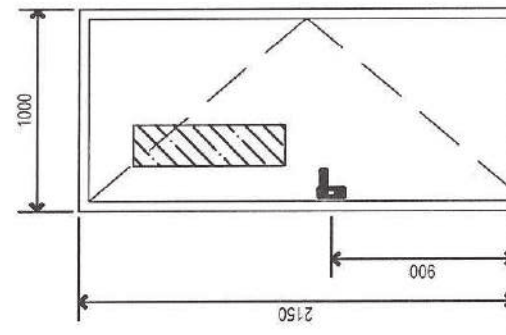
RECOMMENDING APPROVAL  
CG CDR LAURINCE IVAN N. FELIZARTE  
Acting Deputy Commander, CGBF





APPROVED BY  
CG COMMO PRUDENCIO PATRICIO JR.  
Commander, CGBF

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A-13  
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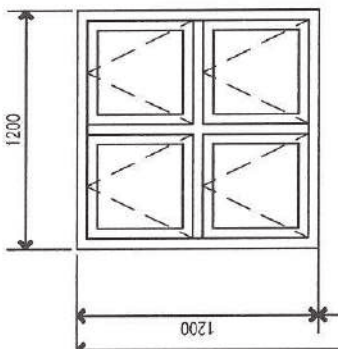
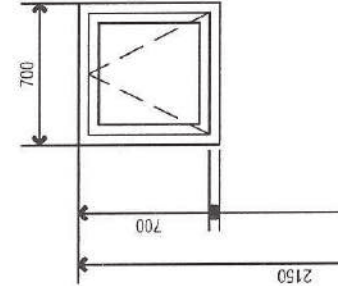
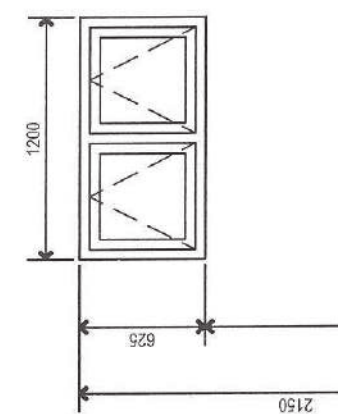
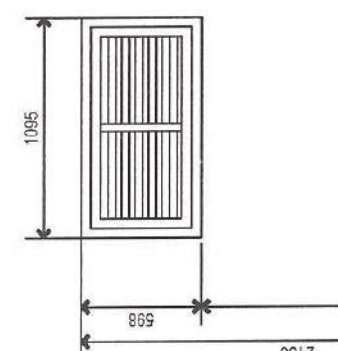


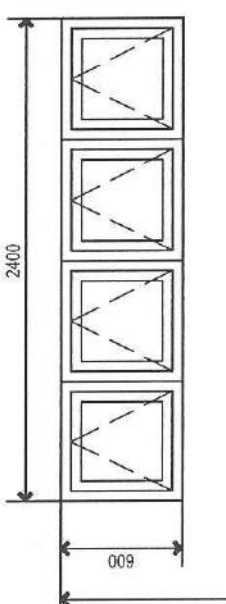
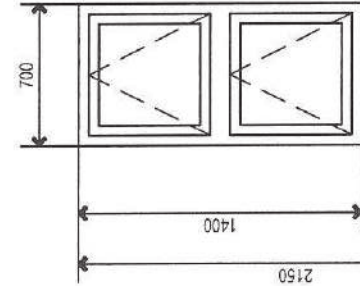
			
DOOR NO.: D-1	DOOR NO.: D-2	DOOR NO.: D-3	DOOR NO.: D-4
TYPE: DOUBLE SWING DOUBLE LEAF DOOR DOW	TYPE: SWING DOOR	TYPE: SWING DOOR	TYPE: FIRE EXIT SWING DOOR
FINISH: POWDER COATED ALUMINUM FRAME	FINISH: SOLID WOOD DOOR	FINISH: STAINLESS STEEL DOOR W/ SECURITY GRADE LOCK LEVER TYPE DOOR KNOB	FINISH: STAINLESS STEEL DOOR W/ FIRE EXIT DOOR ACCESSORIES
SET: 1 SET	SET: 3 SETS	SET: 4 SETS	SET: 1 SET
LOCATION: ENTRANCE	LOCATION: FEMALES BARRACKS, MALE BARRACKS, COMMANDERS QUARTER	LOCATION: SERVICE ENTRANCE, ARMORY, ROOF DECK, PUMP ROOM	LOCATION: 2ND FLOOR FIRE EXIT
GLASS: 12mm THICK TEMPERED GLASS	GLASS: N/A	GLASS: N/A	GLASS: N/A


			
DOOR NO.: D-5	DOOR NO.: D-6	DOOR NO.: D-7	DOOR NO.: D-8
TYPE: SWING DOOR W/ LOUVER	TYPE: SWING DOOR	TYPE: SWING DOOR W/ LOUVER	TYPE: SWING DOOR
FINISH: SOLID LOUVERED WOOD DOOR	FINISH: PVC LOUVERED DOOR	FINISH: STEEL LOUVERED DOOR	FINISH: SOLID WOOD DOOR W/ 6MM THK VIEWING GLASS PANEL
SET: 1 SET	SET: 3 SETS	SET: 2 SETS	SET: 2 SET
LOCATION: PWD TOILET	LOCATION: T&B	LOCATION: AS SHOWN	LOCATION: COMMANDER'S OFFICE, MESS HALL
GLASS: N/A	GLASS: N/A	GLASS: N/A	GLASS: N/A

	<b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST. PORT AREA MANILA <b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGBF, Muelle de la Industria, Farola Compound Binondo, Manila 1006	CONSTRUCTION OF STATION NORTHERN SAMAR Brgy. Sabang Zone 2, Allen, Northern Samar PHILIPPINE COAST GUARD	BRANCH Architectural Branch PREPARED BY CG ASN TARY J. BAYO, L. Piedad Assistant Architect IV (2014-2015) CHECKED BY CG PIENAST, MIGUEL D. DEACRUZ Assistant Architect IV (2014-2015)	SUBMITTED BY  CG LT REYNALDO P. DAQUHOY Head of Engineering Department, CGBF	RECOMMENDING APPROVAL  CG CDR LAURINDE VAN N. FELIZARTE Acting Deputy Commander, CGBF	APPROVED BY  CG COMMO PRUDENCIO J. PATRICIO JR. Commander, CGBF	SHEET NO. A-14 14 51
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FEL			
WINDOW NO. : W-1	WINDOW NO. : W-2	WINDOW NO. : W-3	WINDOW NO. : W-4
TYPE : AWNING WINDOW	TYPE : AWNING WINDOW	TYPE : AWNING WINDOW	TYPE : FIXED WINDOW
FINISH : POWDER COATED ALUMINUM FRAME	FINISH : POWDER COATED ALUMINUM FRAME	FINISH : POWDER COATED ALUMINUM FRAME	FINISH : STEEL LOUVERED WINDOW
SET : 10 SETS	SET : 5 SETS	SET : 1 SET	SET : 3 SETS
LOCATION : AS SHOWN	LOCATION : HEAD	LOCATION : GALLEY	LOCATION : UTILITIES
GLASS : 10mm THICK TEMPERED GLASS	GLASS : 10mm THICK TEMPERED GLASS	GLASS : 10mm THICK TEMPERED GLASS	GLASS : N/A

	
FEL	
WINDOW NO. : W-5	WINDOW NO. : W-6
TYPE : FIXED WINDOW	TYPE : AWNING WINDOW
FINISH : POWDER COATED ALUMINUM FRAME	FINISH : POWDER COATED ALUMINUM FRAME
SET : 2 SETS	SET : 1 SET
LOCATION : STAIRCASE	LOCATION : LOBBY
GLASS : 10mm THICK TEMPERED GLASS	GLASS : 10mm THICK TEMPERED GLASS

	<b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST. PORT AREA MANILA	<b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CG8F, Muelle de la Industria, Ferrol Compound Binondo, Manila 1006	CONSTRUCTION OF STATION NORTHERN SAMAR Brgy. Sibang Zone 2, Allen, Northern Samar PHILIPPINE COAST GUARD	SHEET CONTENT SCHEDULE OF WINDOWS	BRANCH Architectural Branch	PREPARED BY CG ASN Ternang, L. Piedad Head, Architectural Branch, CGAS	CHECKED BY CG PIENS YUGIE D DELA CRUZ Head, Architectural Branch, CGAS	CG LT REYNIER JAN P DAGOHY Head, Engineering Department, CGAS	CG CDK LAURINCE VAN RIZELIZARTE Head, Supply Department, CGAS	CG COMMO PRUDENCIO C PATRICIO JR Commander, CGAS	APPROVED BY	SHEET NO A-15 15 51
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DOTR LOGO COLORS

- 1) D0TR RED (Global Red or Cyan=0%, Magenta=100%, Yellow=100%, Black=0%)
- 2) D0TR BLUE ( Pantone Blue 072 or Cyan=100%, Magenta=88%, Yellow=0%, Black=5%)

DOTR LOGO FONT

- 1) Circular Emblem Text "DEPARTMENT OF TRANSPORTATION 1899" – Frutiger 55 Roman (Uppercase)
- 2) Republic of the Philippines – Frutiger 65 Bold ( Upper and Lower Case)
- 3) DEPARTMENT OF TRANSPORTATION – Frutiger 75 Black Italic (Uppercase)

**DIMENSION**

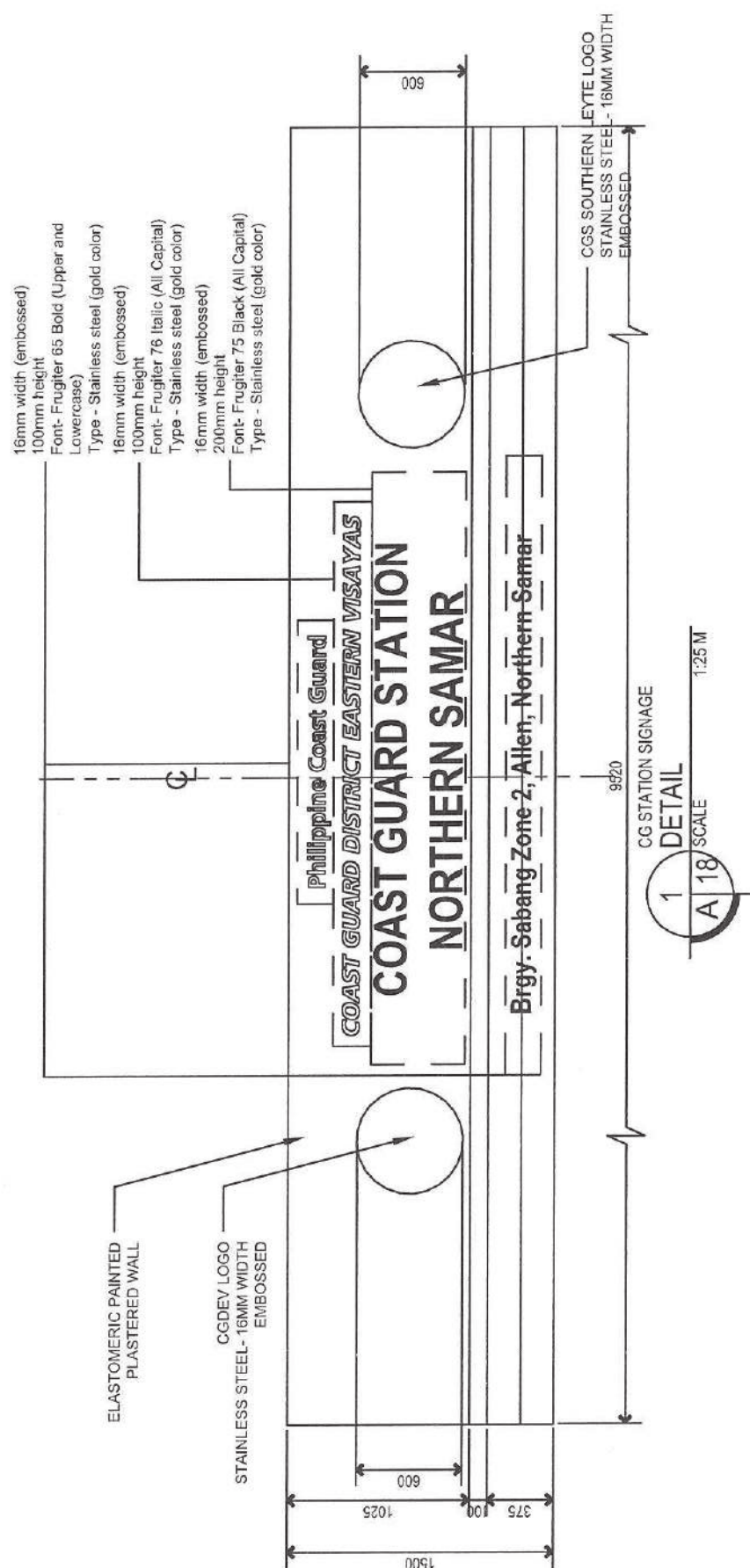
50mm LOGO width  
1000mm LOGO diameter







PCC LOGO COLORS  
VERIFY PCC LOGO DESIGN

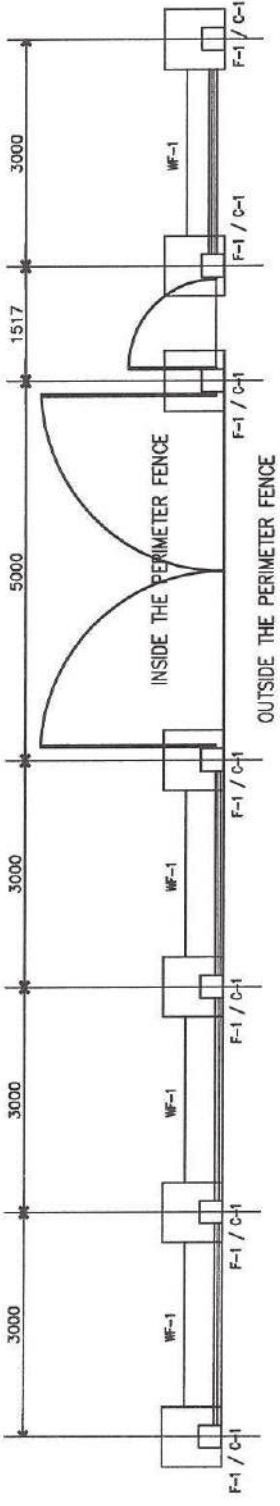
**DIMENSION**  
50mm LOGO width  
1000mm LOGO diameter

DOTR &amp; PCG LOGO

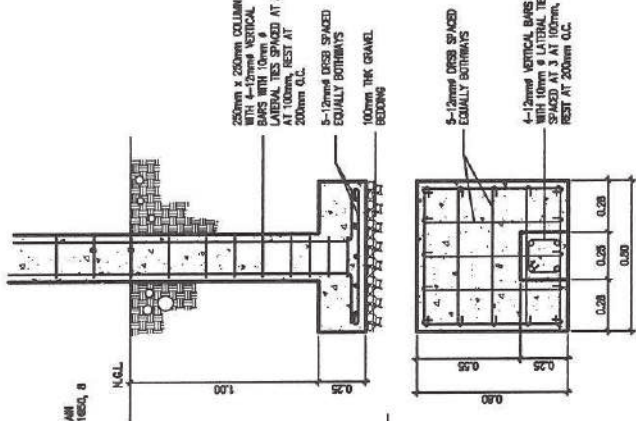


 <b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST., PORT AREA MANILA  <b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGBF, Muelle dels Industriales, Farola Compound Binondo, Manila 1006	<b>PROJECT AND LOCATION</b>  CONSTRUCTION OF STATION NORTHERN SAMAR Brgy. Sinasag Zone 2, Allen, Northern Samar  PHILIPPINE COAST GUARD		<b>SHEET CONTENT</b>  SIGNAGE DETAIL LOGO DETAILS	<b>BRANCH</b>  Architectural Branch	<b>SUBMITTED BY:</b>   CG LT REWIER JAN P. DASOHOY	<b>RECOMMENDING APPROVAL</b>   CG CDR JAUPING MAN N. FELIZARTE CG COMMO PRUDENCIO Q. PATRICIO JR.	<b>APPROVED BY</b>  	<b>SHEET NO</b> <div>A-1616 51</div>
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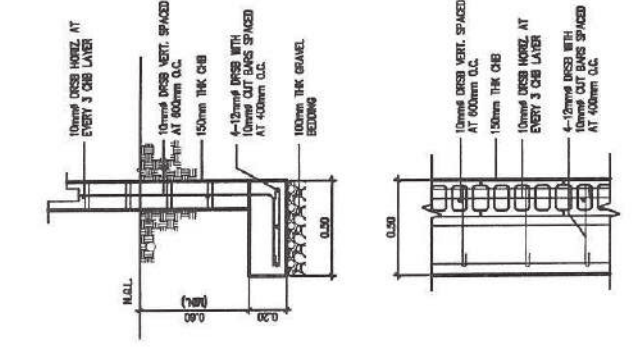




1 FRONT FENCE & GATE LAYOUT  
1:150 M  
A 18 SCALE

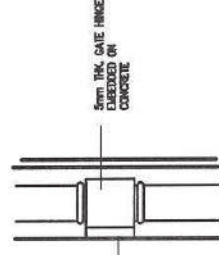


2 PERIMETER BEAM DETAIL  
A 18 SCALE



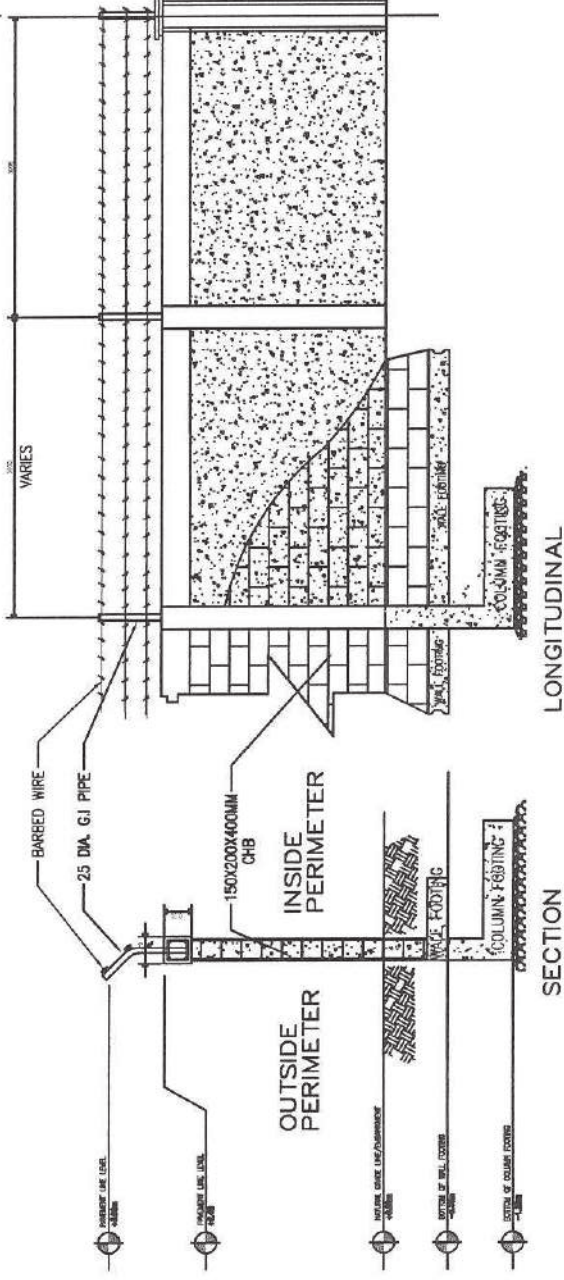
3 F-1 / C-1 DETAIL  
A 18 SCALE

4 WF-1 DETAIL  
A 18 SCALE

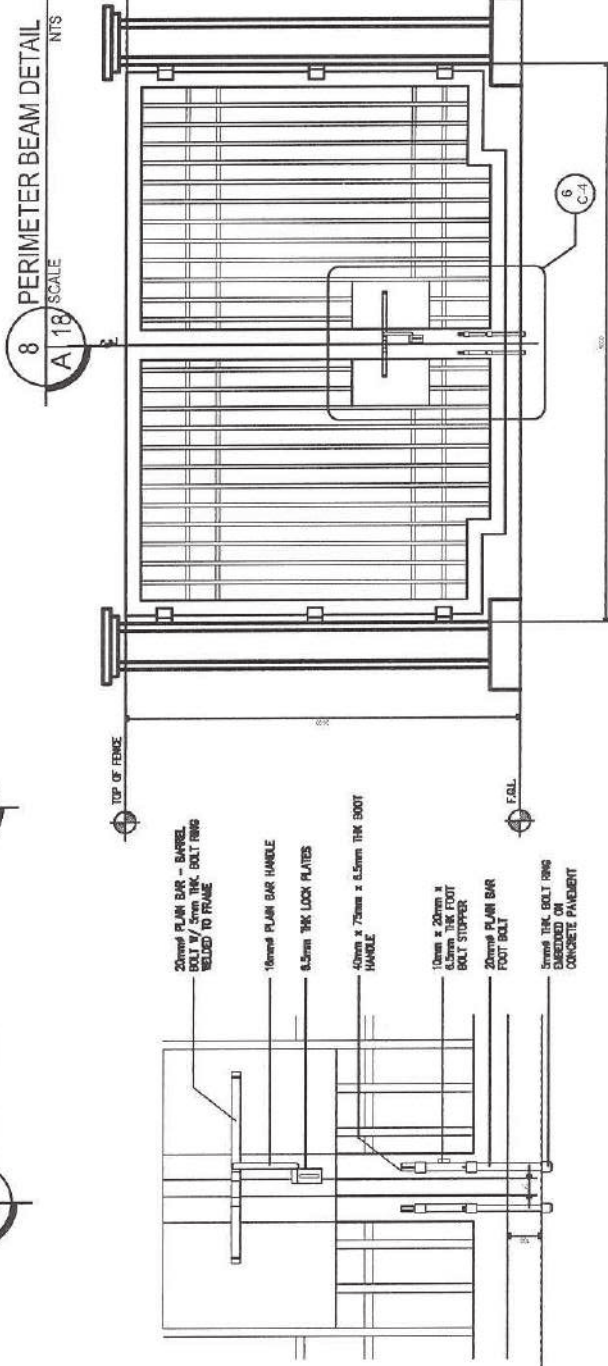


6 GATE HINGE  
A 18 SCALE

7 PERIMETER BEAM DETAIL  
A 18 SCALE



9 REAR GATE AND PERIMETER FENCE ELEVATION  
1:150 M  
A 18 SCALE



10 SPOT DETAIL  
A 18 SCALE

11 GATE ELEVATION  
1:25 M  
A 18 SCALE



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Parola Compound  
Binondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Subang Zone 2, Alipin, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
FENCE AND GATE LAYOUT  
PERIMETER BEAM DETAIL  
WF-1 DETAIL  
F-1 / C-1 DETAIL  
SPOT DETAIL  
GATE ELEVATION  
GATE ELEVATION

**BRANCH** Architectural Branch  
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**SUBMITTED BY**  
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**APPROVED BY**  
CG COMMO PRUDENCIO PATRICIO JR.  
Commander, CGBF

**SHEET NO**  
A-17  
17 51



GENERAL NOTES

1.0 STANDARD AND REFERENCE  
THE FOLLOWING SHALL GOVERN THE DESIGN, FABRICATION AND CONSTRUCTION OF THE PROJECT.  
1.1 NATIONAL STRUCTURAL CODE OF THE PHILIPPINES (NSCP), VOL. 1, 7TH EDITION 2015  
2.0 DESIGN CRITERIA

2.1 LOADINGS  
A. DEAD LOAD:  
CONCRETE  
STEEL  
150mm THK CHB WALL  
100mm THK CHB WALL

B. LIVE LOAD  
ROOF  
OFFICE  
BALCONY  
MULTIPURPOSE AREA /  
CONFERENCE HALL / ROOM  
LOBBY / CORRIDORS

C. WIND LOAD (NSCP 2015)  
BASIC WIND VELOCITY, V = 250 KPH  
DESIGN WIND PRESSURE  
P = qh [GCF] - (GCp) [GCF] (DESIGN WIND PRESSURE)  
WHERE: qh = WIND VELOCITY PRESSURE, KPa  
GCp = EXTERNAL PRESSURE COEFFICIENT  
GCF = INTERNAL PRESSURE COEFFICIENT

D. SEISMIC LOAD (NSCP 2015)  
V =  $\frac{C_u}{RT} W$  (DESIGN BASE SHEAR)  
Vmax =  $\frac{0.80 C_u}{RT} W$  (ZONE 4)  
Vmin = 0.11C<sub>u</sub>W  
WHERE: W = TOTAL DEAD LOAD  
T = NATURAL PERIOD =  $C_u (h/3)^{0.9}$   
WHERE: C = NUMERICAL COEFFICIENT  
h = BUILDING HEIGHT

I = IMPORTANCE FACTOR = 1.50  
R = NUMERICAL FACTOR = 8.40  
SEISMIC COEFFICIENT C<sub>s</sub> = 0.44 I<sub>v</sub>  
C<sub>v</sub> = 0.64 I<sub>u</sub>  
NEAR SOURCE FACTOR (2km) N<sub>v</sub> = 2.0  
Z = SEISMIC ZONE = 0.40 (ZONE 4)  
S = SOIL TYPE = D

2.2 DESIGN STRESSES  
A. CONCRETE FOR FOOTING, COLUMNS, BEAMS, SLAB AND SLAB ON FILL (COMPRESSIVE STRENGTH @ 28 DAYS)  
B. REINFORCING STEEL BARS  
a. FOR BARS 16mmØ AND GREATER  
b. FOR BARS LESS THAN 16mmØ  
C. STRUCTURAL STEEL, ASTM-A36  
FOR TRUSSES, BRACINGS & STRUTS  
D. PURLINS  
E. MASONRY UNIT (CHB)  
F. WELDS - USED E-70XX ELECTRODE  
G. STRUCTURAL BOLTS, ASTM-A307  
a. F<sub>t</sub> = 96.60 MPa (14,000 psi)  
b. F<sub>y</sub> = 69 MPa (10,000 psi)

3.0 IN THE INTERPRETATION OF THE DRAWING, INDICATED DIMENSIONS SHALL GOVERN AND DISTANCES AND SIZES SHALL NOT BE SCALED FOR CONSTRUCTION PURPOSES.  
4.0 IN REFERENCE TO OTHER DRAWINGS, SEE ARCHITECTURAL DRAWINGS FOR DEPRESSIONS IN FLOOR SLABS, OPENINGS IN THE WALLS AND SLABS, INTERIOR PARTITIONS, LOCATION OF DRAINS, ETC.  
5.0 IN CASE OF DISCREPANCIES AS TO THE LAYOUT, DIMENSIONS, AND ELEVATIONS BETWEEN THE STRUCTURAL PLANS, AND ARCHITECTURAL DRAWINGS, THE CONTRACTOR SHALL NOTIFY BOTH THE STRUCTURAL ENGINEER AND THE ARCHITECT.  
6.0 ALL CONCRETE WORK SHALL BE DONE IN ACCORDANCE WITH THE ACI 318-95 BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE AND ALL STRUCTURAL STEEL WORK ACCORDING WITH AISC SPECIFICATION (9th EDITION) IN SO FAR AS THEY DO NOT CONFLICT WITH THE LOCAL BUILDING CODE REQUIREMENT.

PHILIPPINE COAST GUARD  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE  
CGAB, Nueve de la Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sasing Zone 2, Aliran, Northern Samar  
PHILIPPINE COAST GUARD

GENERAL NOTES  
GENERAL NOTES



PHILIPPINE COAST GUARD  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE  
CGAB, Nueve de la Industria, Farola Compound  
Binondo, Manila 1006

CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sasing Zone 2, Aliran, Northern Samar  
PHILIPPINE COAST GUARD

GENERAL NOTES

BRANCH  
Civil and Structural Branch

PREPARED BY  
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SUBMITTED BY

RECOMMENDING APPROVAL

CG COL JUAN RIVERA N. FELIZARTE  
Chief, Civil and Structural Branch, CGAB

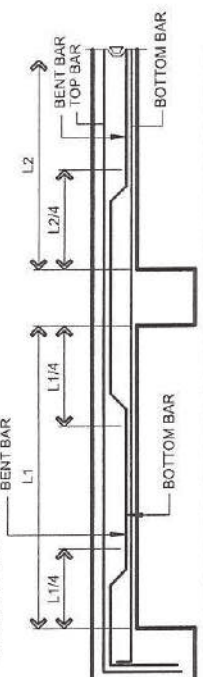
APPROVED BY

SHEET NO  
S-1  
18 51

GENERAL CONSTRUCTION NOTES

NOTES ON CONCRETE SLABS

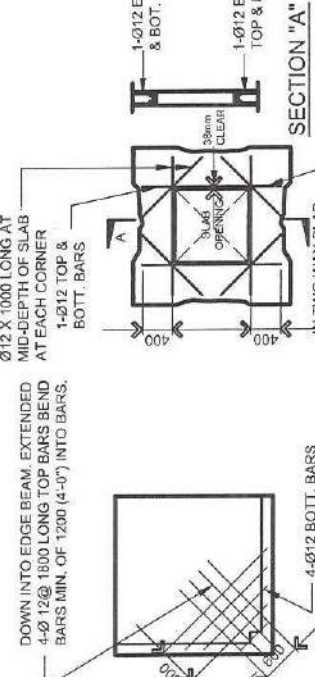
- ALL SLABS REINFORCEMENTS SHALL BE 20mm CLEAR MINIMUM FROM BOTTOM AND FROM THE TOP OF SLAB.
- UNLESS OTHERWISE SHOWN, REINFORCEMENT IN CONTINUOUS ELEVATED SLAB SHALL BE CUT AS FOLLOWS:



- IF SLABS ARE REINFORCED BOTHWAYS BARS ALONG THE SHORTER SPAN SHALL BE PLACED BELOW THOSE ALONG THE LONG SPAN AT THE CENTER AND OVER THE LONGER SPAN FOR REINFORCING BARS NEAR THE SUPPORTS. THE SPACING OF THE BARS AT THE COLUMN STRIPS SHALL BE NOT MORE THAN ONE AND A HALF (1-1/2) SLAB THICKNESS. TEMPERATURE BARS FOR SLAB SHALL BE GENERALLY PLACED NEAR THE FACE IN THE TENSION AND SHALL NOT BE LESS THAN 0.0025 X GROSS CROSS-SECTIONAL AREA (A<sub>g</sub>) OF THE SLAB. (SEE SCHEDULE BELOW)

THICKNESS	MINIMUM TEMPERATURE BARS
100 mm	10 mmØ @ 250mm EACH WAY
125 mm	10 mmØ @ 225mm EACH WAY
150 mm	10 mmØ @ 185mm EACH WAY
175 mm	10 mmØ @ 150mm EACH WAY
200 mm	10 mmØ @ 140mm EACH WAY

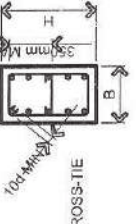
- UNLESS OTHERWISE NOTED IN THE PLANS, ALL BEDDED SLABS SHALL BE REINFORCED WITH 10mmØ AT 250mm O.C. EACH WAY TO CENTER OF SLAB AND CONSTRUCTION JOINTS FOR SAME SHALL NOT BE LESS THAN 3.65 METERS APART.
- PROVIDE EXTRA REINFORCEMENTS FOR CORNER SLAB (TWO ADJACENT DISCONTINUOUS EDGES) AS SHOWN BELOW.
- CONCRETE SLAB REINFORCEMENTS SHALL BE PROPERLY SUPPORTED WITH 10mmØ STEEL CHAIR OR APPROVED EQUIVALENT SPACED AT 1.0 METER ON CENTER BOTHWAYS.



TYPICAL CORNER SLAB DETAIL

NOTES ON COLUMNS

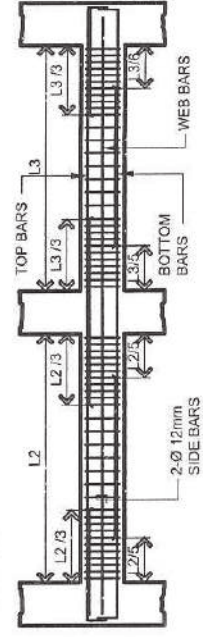
- PROVIDE EXTRA SETS OF TIES AT 100mm O.C. FOR TIED COLUMN REINFORCEMENT ABOVE AND BELOW BEAM-COLUMN CONNECTIONS FOR A DISTANCE FROM FACE OF CONNECTION EQUAL TO THE GREATER OF THE OVERALL THICKNESS OF COLUMN, 1/16 THE CLEAR HEIGHT OF COLUMN OR 450mm.
- COLUMN TIES SHALL BE PROTECTED EVERYWHERE BY A COVERING OF CONCRETE NOT LESS THAN 40 TIMES THE MAXIMUM SIZE OF COARSE AGGREGATE IN MILLIMETERS. WHERE COLUMNS CHANGE IN SIZE, VERTICAL REINFORCEMENTS SHALL BE OFFSET AT A SLOPE OF NOT MORE THAN 1 IN 6 AND EXTRA 10mmØ TIES AT 100mm SHALL BE PROVIDED THRU OUT THE OFFSET REGION.
- UNLESS OTHERWISE NOTED IN THE PLANS, LAP SPICES FOR VERTICAL COLUMN REINFORCEMENTS SHALL BE MADE WITHIN THE CENTER HALF OF COLUMN HEIGHT. AND THE SPICE LENGTH SHALL NOT BE LESS THAN 40 BAR DIAMETERS. WELDING OR APPROVED BARS ARE WELDED OR MECHANICALLY SPICED AT ANY LEVEL AND THE VERTICAL DISTANCES BETWEEN THESE WELDS OR SPICES OF ADJACENT BARS IS NOT LESS THAN 600mm.



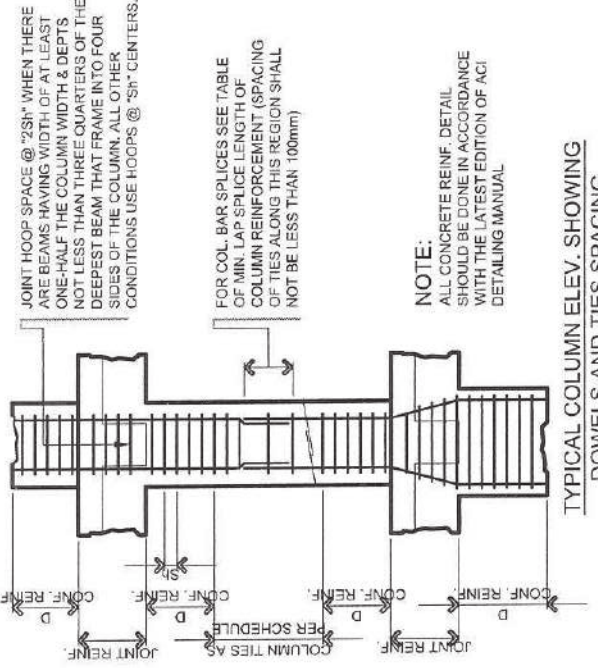
CROSS-TIE

NOTES ON BEAMS AND GIRDERS

- UNLESS OTHERWISE NOTED IN PLANS, CAMBER ALL BEAMS AND GIRDERS AT LEAST 6mmØ FOR EVERY 4.5M OF SPAN. EXCEPT CANTILEVERS FOR WHICH THE CAMBER SHALL BE AS NOTED IN PLANS OR AS ORDERED BY THE ENGINEER BUT IN NO CASE LESS THAN 20mm FOR EVERY 3.0M OF FREE SPAN.
- TYPICAL BARS REINFORCING AND CUTTING DETAILS SHALL BE AS SHOWN IN FIG. B-1.
- TO THE FARTHER FACE OF THE WALL NOT BE LESS THAN 25mm. EMBEDMENT LENGTH SHALL BE AS SHOWN IN A TABLE "A" FOR TENSION BARS AND TABLE "B" FOR COMPRESSION BARS UNLESS SPECIFIED IN PLAN. TOP BAR SHALL NOT BE SPICED WITHIN THE COLUMN OR WITHIN A DISTANCE TWICE THE MEMBER DEPTH FROM THE FACE OF THE COLUMN. AT LEAST TWO STIRRUPS SHALL BE PROVIDED AT ALL SPICES.

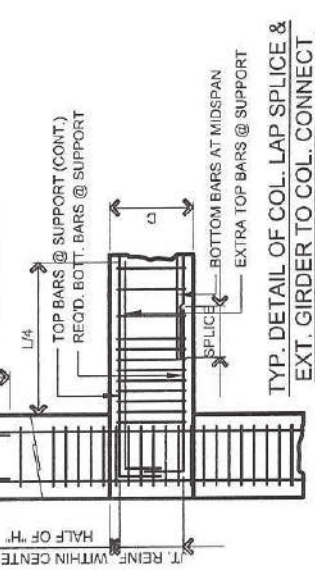


TYP. DETAIL OF COL. LAP SPICE & EXT. GIRDER TO COL. CONNECT



TYPICAL COLUMN ELEV. SHOWING DOWELS AND TIES SPACING

NOTE:  
ALL CONCRETE REINFORCING DETAIL SHOULD BE DONE IN ACCORDANCE WITH THE LATEST EDITION OF ACI DETAILING MANUAL



TYP. DETAIL OF COL. LAP SPICE & EXT. GIRDER TO COL. CONNECT

NOTES ON BEAMS AND GIRDERS

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- TYPICAL BARS REINFORCING AND CUTTING DETAILS SHALL BE AS SHOWN IN FIG. B-1.
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# GENERAL CONSTRUCTION NOTES

FIG. B-1

TABLE 'A' TENSION BARS EMBEDMENT LENGTHS AND LAPPED SPICES IN MILLIMETERS			
BAR SIZE (DEFORMED)	f <sub>c</sub> = 20.7 MPa (3000psi)		f <sub>c</sub> = 27.6 MPa (4000psi)
	EMBEDMENT	LAPPED	LAPPED
10mm Ø	300	300	300
12mm Ø	300	300	300
16mm Ø	300	300	300
20mm Ø	300	300	300
25mm Ø	300	300	300
28mm Ø	300	300	300
32mm Ø	300	300	300

NOTE: TOP PLAIN BARS, MULTIPLY VALUE BY 2

TABLE 'B' COMPRESSION BARS EMBEDMENT LENGTHS AND LAPPED SPICES IN MILLIMETERS			
BAR SIZE (DEFORMED)	f <sub>c</sub> = 20.7 MPa (3000psi)		f <sub>c</sub> = 27.6 MPa (4000psi)
	EMBEDMENT	LAPPED	LAPPED
10mm Ø	225	300	300
12mm Ø	275	300	300
16mm Ø	350	400	400
20mm Ø	450	500	500
25mm Ø	550	625	625
28mm Ø	625	675	675
32mm Ø	700	775	775

NOTE: TOP PLAIN BARS, MULTIPLY VALUE BY 2

- IF THERE ARE TWO OR MORE LAYERS OF REINFORCING BARS, USE 25mm Ø BAR SEPARATORS SPACED AT 1.0m ON CENTERS. IN NO CASE SHALL THERE BE LESS THAN TWO (2) SEPARATORS BETWEEN TWO LAYERS OF BARS.
- MINIMUM CONCRETE PROTECTION FOR REINFORCING BARS OR STEEL SHAPES SHALL BE AS SHOWN IN FIG. B-2 UNLESS SPECIFIED OTHERWISE.

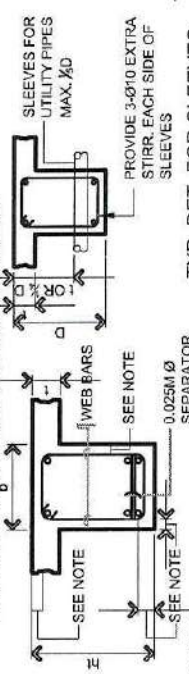


FIG. B-2  
TYP. DET. FOR SLEEVES  
THRU CONCRETE BEAM

FIG. B-3  
TYP. DET. FOR SLEEVES  
THRU CONCRETE BEAM

- WHEN A BEAM CROSSES A GIRDER, REST BEAM ON TOP OF GIRDER BARS. BEAM REINFORCING BAR SHALL BE SYMMETRICAL ABOUT CENTER LINE WHENEVER POSSIBLE.
- GENERALLY NO SPLICES SHALL BE PERMITTED AT POINTS WHERE CRITICAL BENDING STRESSES OCCUR. SPLICES WHERE SO PERMITTED SHALL BE INDICATED IN THE TABLE 'A' AND 'B'. WELDED SPLICES SHALL DEVELOP IN TENSION AT LEAST 125% OF THE SPECIFIED YIELD STRENGTH OF THE BAR. NOT MORE THAN 50% OF THE BARS AT ANY ONE SECTION IS ALLOWED TO BE SPICED THEREIN.

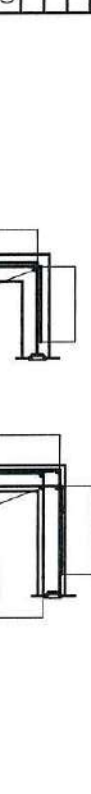
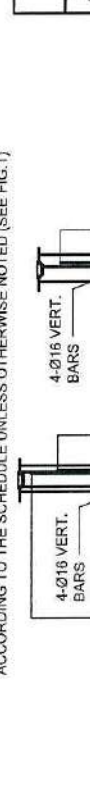
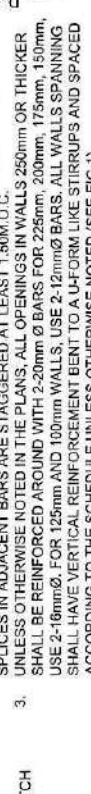
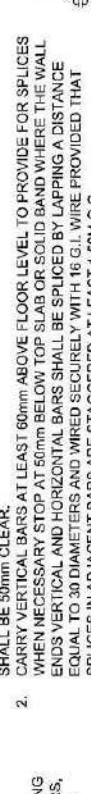
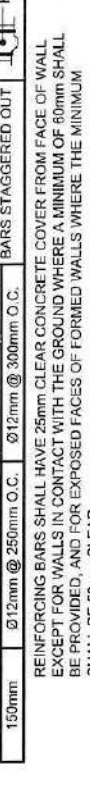
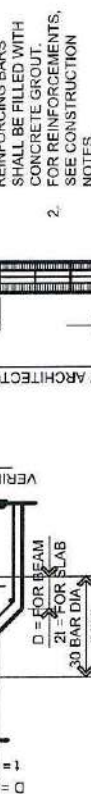
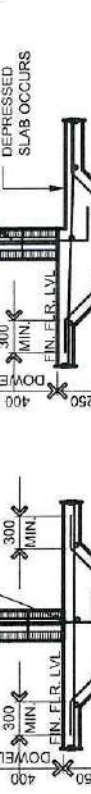
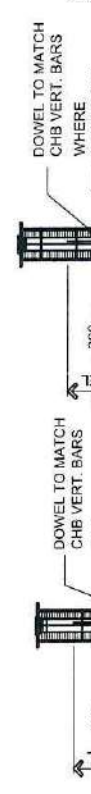
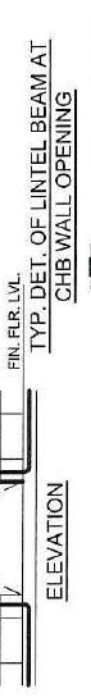
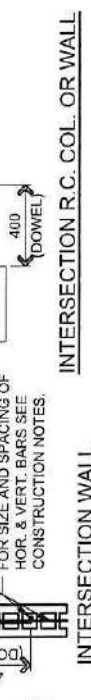
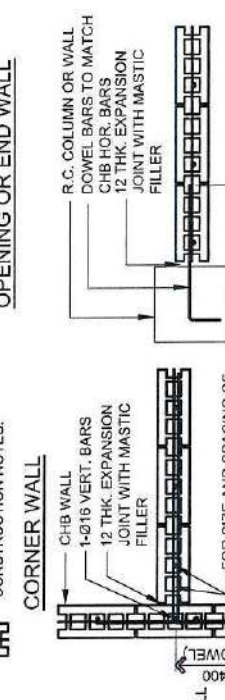
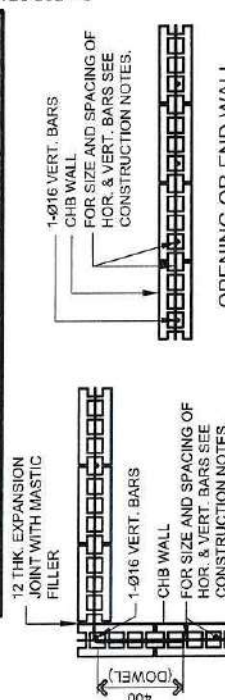
## NOTES ON CONCRETE HOLLOW BLOCK WALLS

- UNLESS OTHERWISE SHOWN IN PLANS ALL CONCRETE HOLLOW BLOCKS AND CERAMIC BLOCKS SHALL BE REINFORCED AS SHOWN IN THE SCHEDULE OF CONCRETE HOLLOW BLOCKS AND CERAMIC BLOCK REINFORCEMENT.
- PROVIDE 150mm x 300mm STIFFENER COLUMN REINFORCED WITH 4-12mm WITH 6mm Ø TIES AT 150mm ON CENTER WHERE CONCRETE HOLLOW BLOCK TERMINATES AND AT EVERY 3.0m LENGTH OF CONCRETE HOLLOW BLOCK WALLS UNLESS NOTED IN STRUCTURAL PLANS.

SCHEDULE OF CONCRETE HOLLOW BLOCK AND CERAMIC BLOCK REINFORCEMENT			
BLOCK THICKNESS	REINFORCEMENT		NOTES
	HORIZONTAL	VERTICAL	
75 mm	10mm Ø @ EVERY 3RD LEVEL	10mm Ø @ 800mm O.C.	A. MINIMUM LAP AT SPICE = 0.25M B. PROVIDE RIGHT ANGLED REINFORCEMENT AT CORNERS 0.92M LONG C. WHERE CHB OR CER. BLK. WALL DOVELS JOIN COL. R.C. BEAMS AND WALL DOVELS WITH THE SAME SIZE AS VERT. OR HOR. REINFORCEMENTS SHALL BE PROVIDED
125 mm	10mm Ø @ EVERY 3RD LEVEL	10mm Ø @ 800mm O.C.	
150 mm	10mm Ø @ EVERY 3RD LEVEL	10mm Ø @ 600mm O.C.	
200 mm	12mm Ø @ EVERY 3RD LEVEL	10mm Ø @ 600mm O.C.	

## REINFORCING CONCRETE LINTEL BEAM IN CONCRETE BLOCK WALLS

LINTELS IN BLOCK WALLS			
CLEAR SPAN (L) (m)	MIN. HEIGHT OF LINTEL (mm)	REINFORCEMENT	
		BOTTOM	TOP
1.20 m	1.60 m	200	1-Ø10
1.50 m	1.80 m	200	1-Ø10
1.80 m	2.20 m	200	1-Ø10
2.10 m	2.50 m	200	1-Ø10
2.40 m	2.80 m	200	1-Ø10
2.70 m	3.10 m	200	1-Ø10
3.00 m	3.40 m	200	1-Ø10
3.30 m	3.70 m	200	1-Ø10
3.60 m	4.00 m	200	1-Ø10



- UNLESS OTHERWISE SPECIFIED ALL WELDING RODS SHALL CONFORM AWS E80 ELECTRODES.
- ALL BOLTS USED UNLESS OTHERWISE SPECIFIED SHALL BE ASTM A307 BOLTS.

## NOTES ON EMBEDDED PIPES

- ALL EMBEDDED PIPES FOR UTILITIES, ETC. THAT PASS THRU BEAMS SHALL NOT EXCEED 100mm IN DIAMETER OR 1/2 BEAM DEPTH WHICHEVER IS LESS, UNLESS OTHERWISE APPROVED BY THE STRUCTURAL ENGINEER.
- NO PIPES SHALL BE ALLOWED TO PASS THRU BEAM VERTICALLY.
- NO PIPES SHALL BE EMBEDDED IN COLUMNS.

## NOTES ON CONSTRUCTION JOINTS IN CONCRETE

- WHERE A CONSTRUCTION JOINT IS TO BE MADE, THE SURFACE OF CONCRETE SHALL BE CLEANED AND ALL LATANCE AND STANDING WATER REMOVED. SHEAR KEY SHALL BE PROVIDED AT THE JOINT.

## MAIN REINFORCEMENTS TO BE CONTINUOUS (TOP & BOTT. BARS)



## POINT OF STRESS, PROVIDE SHEAR RODS WITH APPROVAL



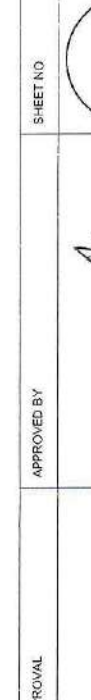
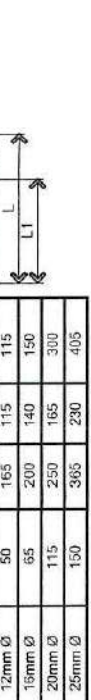
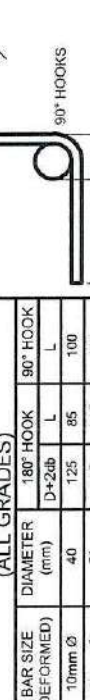
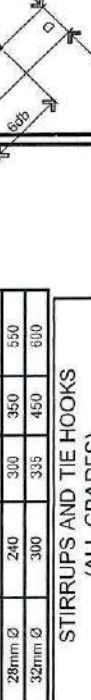
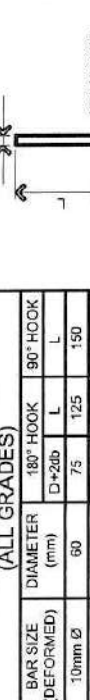
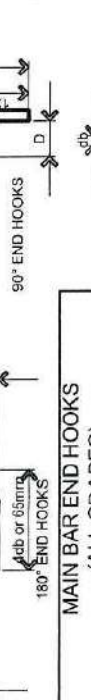
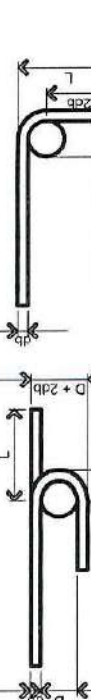
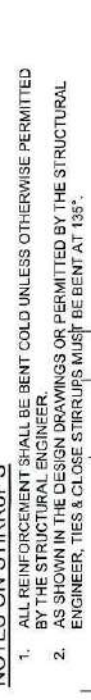
## TYPICAL SLAB & BEAM CONSTRUCTION JOINT DETAIL



## NOTE: PROVIDE THESE ADDITIONAL BARS FOR ALL OPENINGS PLUS BARS (NOT SHOWN) PARALLEL TO SIDE OF OPENING EQUAL TO THE NUMBER OF TERMINATED BARS AT OPENING



## TYP. EXTERIOR WINDOW & DOOR OPENING



## PHILIPPINE COAST GUARD

HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA, MANILA  
COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE  
CGBF, Muella dela Industria, Fola Compound  
Binondo, Manila 1006

CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brig. Subing Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

GENERAL NOTES

BRANCH  
Civil and Structural Branch  
PREPARED BY  
CG ENS KRISTINE KEO Y FENOMENO  
Member, Civil and Structural Branch, CGBF  
CHECKED BY  
CG LT JAC EDGARDO TORTEZ  
Head, Civil and Structural Branch, CGBF

SUBMITTED BY

RECOMMENDING APPROVAL

APPROVED BY

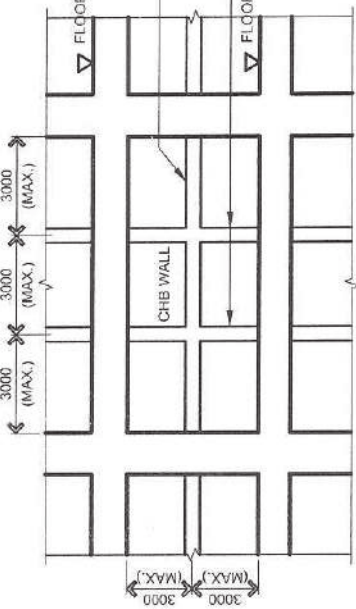
SHEET NO

CG COMMO PRUDENCIO PATRICIO JR.  
Commander, CGBF  
CG CR LAURANCE AN N FELIZARTE  
Acting Deputy Commander, CGBF  
CG LT REYNER JAN P DICOHOY  
Head, Engineering Department, CGBF

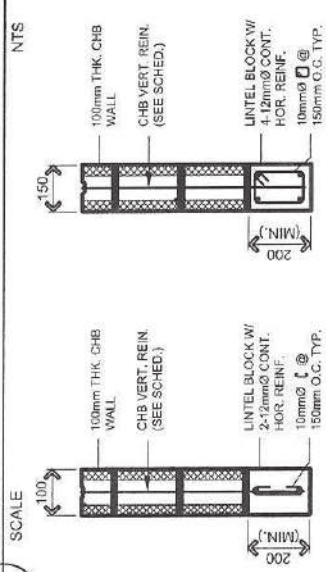
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19 51



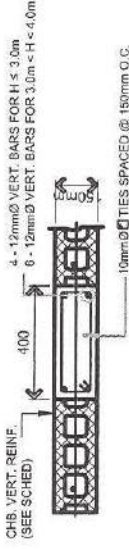
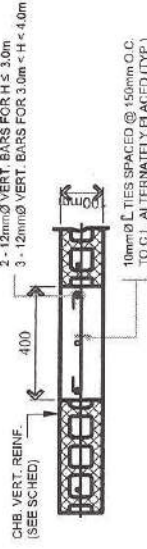
# GENERAL CONSTRUCTION NOTES



TYP. STIFFENER BEAM / COLUMN ELEV.

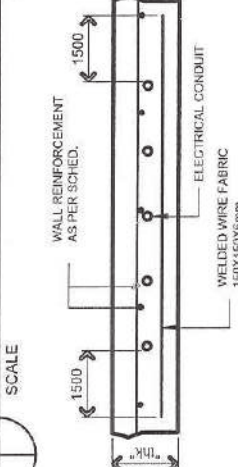


TYP. STIFFENER BEAM SECTION

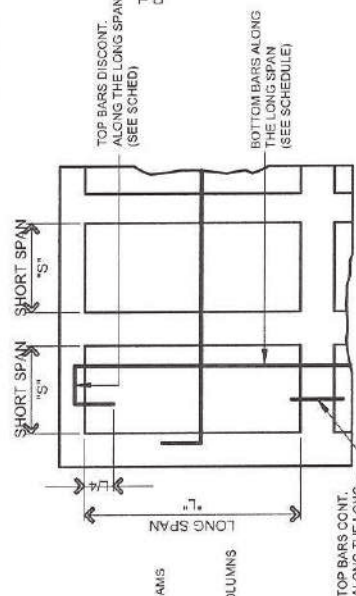


TYP. STIFFENER COLUMNS.

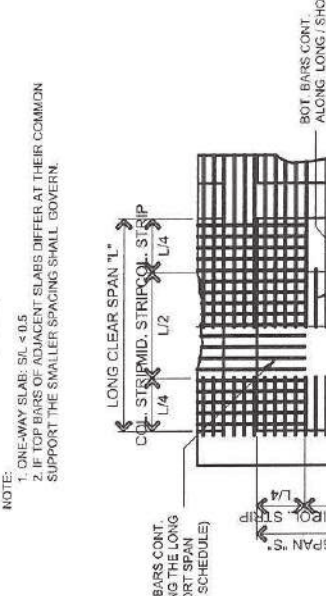
DET. ON CHB WALLS



ADDITIONAL REINF. FOR WALL W/ EMBEDDED CONDUITS



TYPICAL ONE-WAY SLAB DETAILS



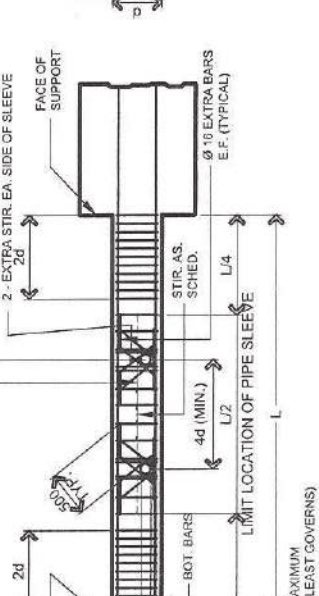
TYPICAL TWO-WAY SLAB DETAILS



TYP. SLAB DETAILS

SCALE

NTS

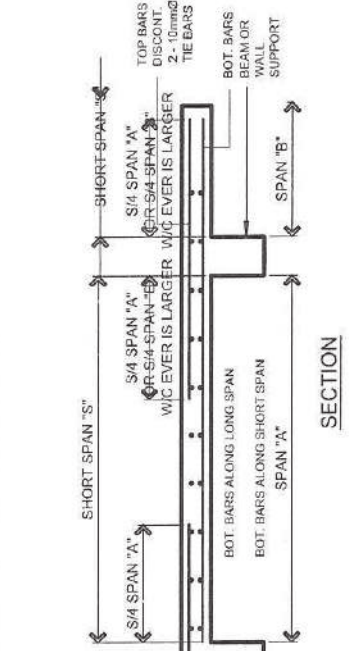


PIPE SLEEVE THRU BEAM DETAIL

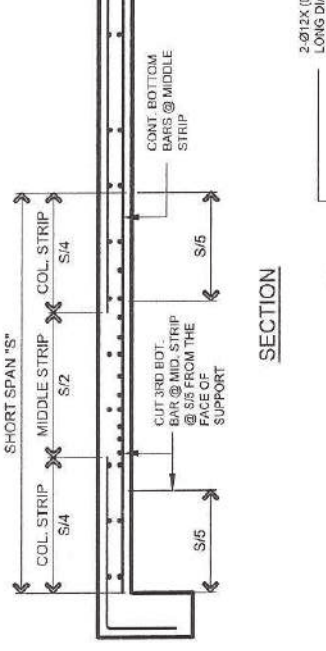


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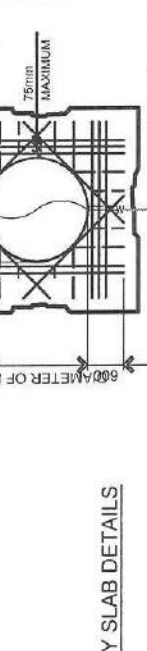
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SECTION



SECTION



PIPE PENETRATION ON R.C. WALL



SCALE

NTS

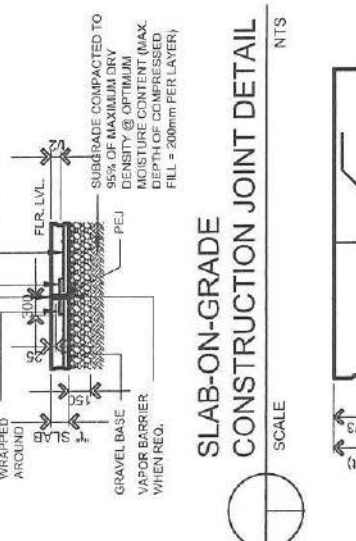


PIPE SLEEVE THRU BEAM DETAIL

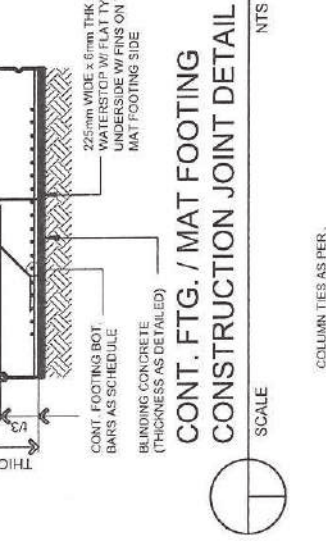


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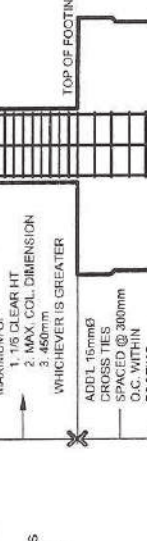
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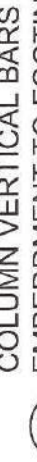
SLAB-ON-GRADE CONSTRUCTION JOINT DETAIL



CONT. FTG. / MAT FOOTING CONSTRUCTION JOINT DETAIL

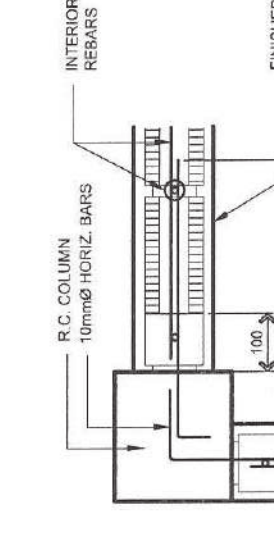


COLUMN VERTICAL BARS EMBEDMENT TO FOOTING DET.



SCALE

NTS



CHB EXTERIOR WALL SIDE ANCHORAGE DETAIL



SCALE

NTS



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle de la Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brig. Subang Zone 2, Alfin, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
GENERAL NOTES

BRANCH  
Civil and Structural Branch  
PREPARED BY  
CG ENS KRIS NINE ALEJO P. FERNANDO  
Checked by  
CG LTJG EDGARDO M. PORTER  
Head, Civil and Structural Branch

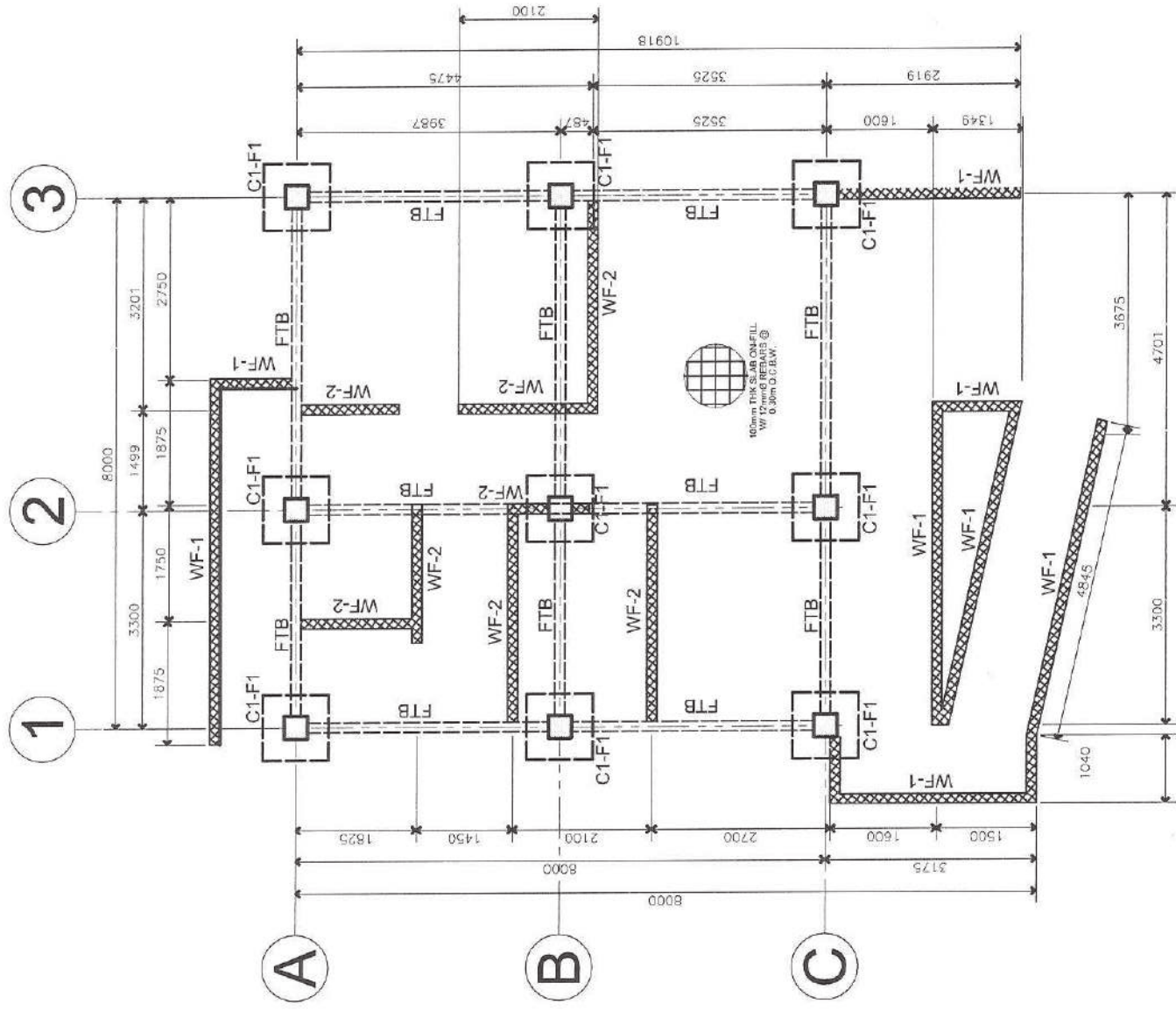
SUBMITTED BY  
CG LT REYMER JAN P. DAGOHY  
Head, Engineering Department, CGBF

RECOMMENDING APPROVAL  
CG CDJ LAURINCE VAN N. FELIZARTE  
Chief Deputy Commander, CGBF

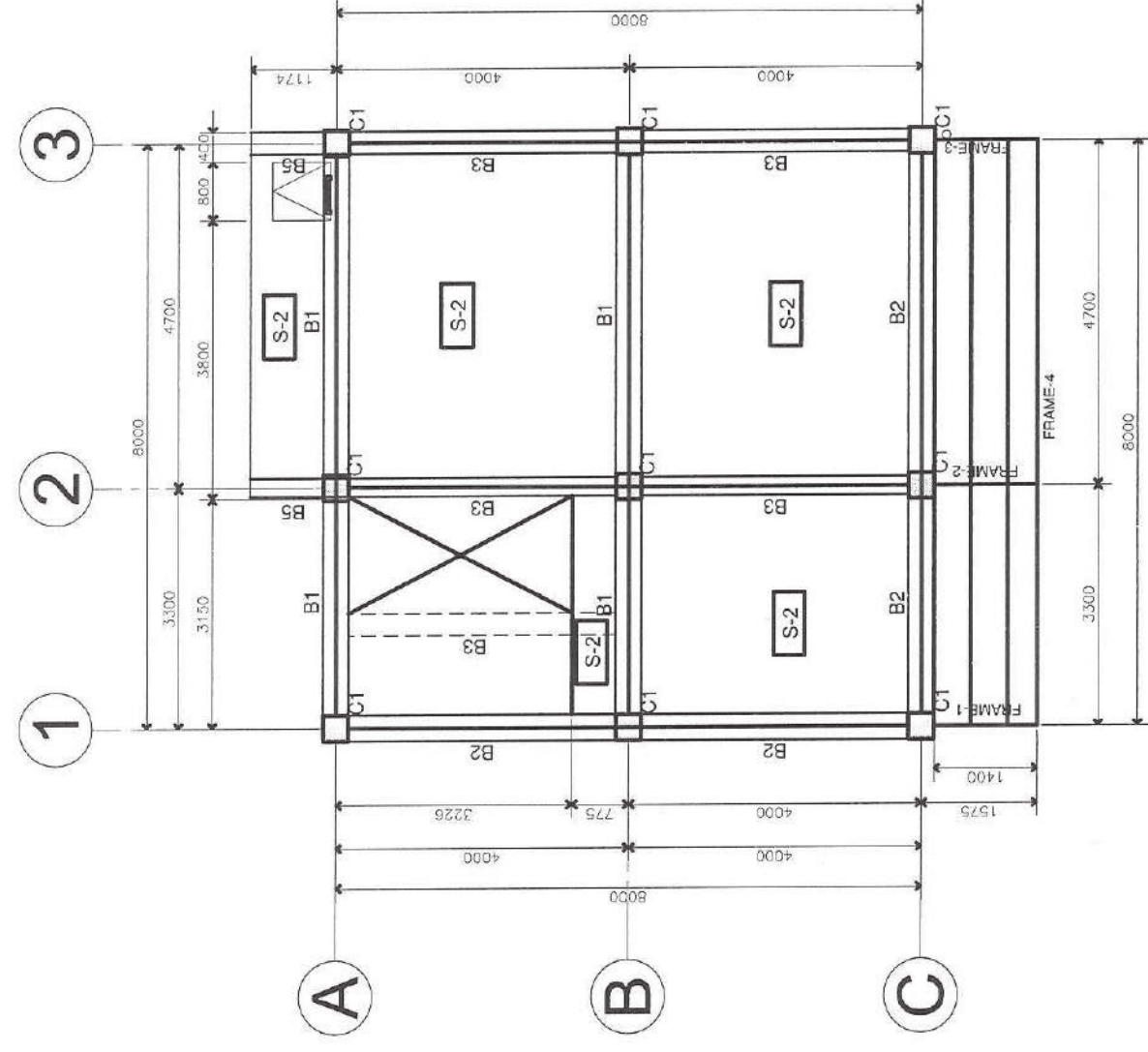
APPROVED BY  
CG COMMO PRUDENCIO CPATRICIO JR.  
Commander, CGBF

SHEET NO  
S-3  
20  
51





CGS NORTHERN SAMAR  
1 FOUNDATION PLAN  
SCALE 1:100M



CGS NORTHERN SAMAR  
2 SECOND FLOOR FRAMING PLAN  
SCALE 1:100M



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Alib, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
FOUNDATION PLAN  
SECOND FLOOR FRAMING PLAN

**BRANCH** Civil and Structural Branch  
**PREPARED BY** CG ENS KRISTINE KUEKO P. FENOMENO  
Northern Coast Guard Branch, CAGPS  
**CHECKED BY** CG LTJG EDUARDO DORTENZ  
Head Office, Civil and Structural Branch, CAGPS

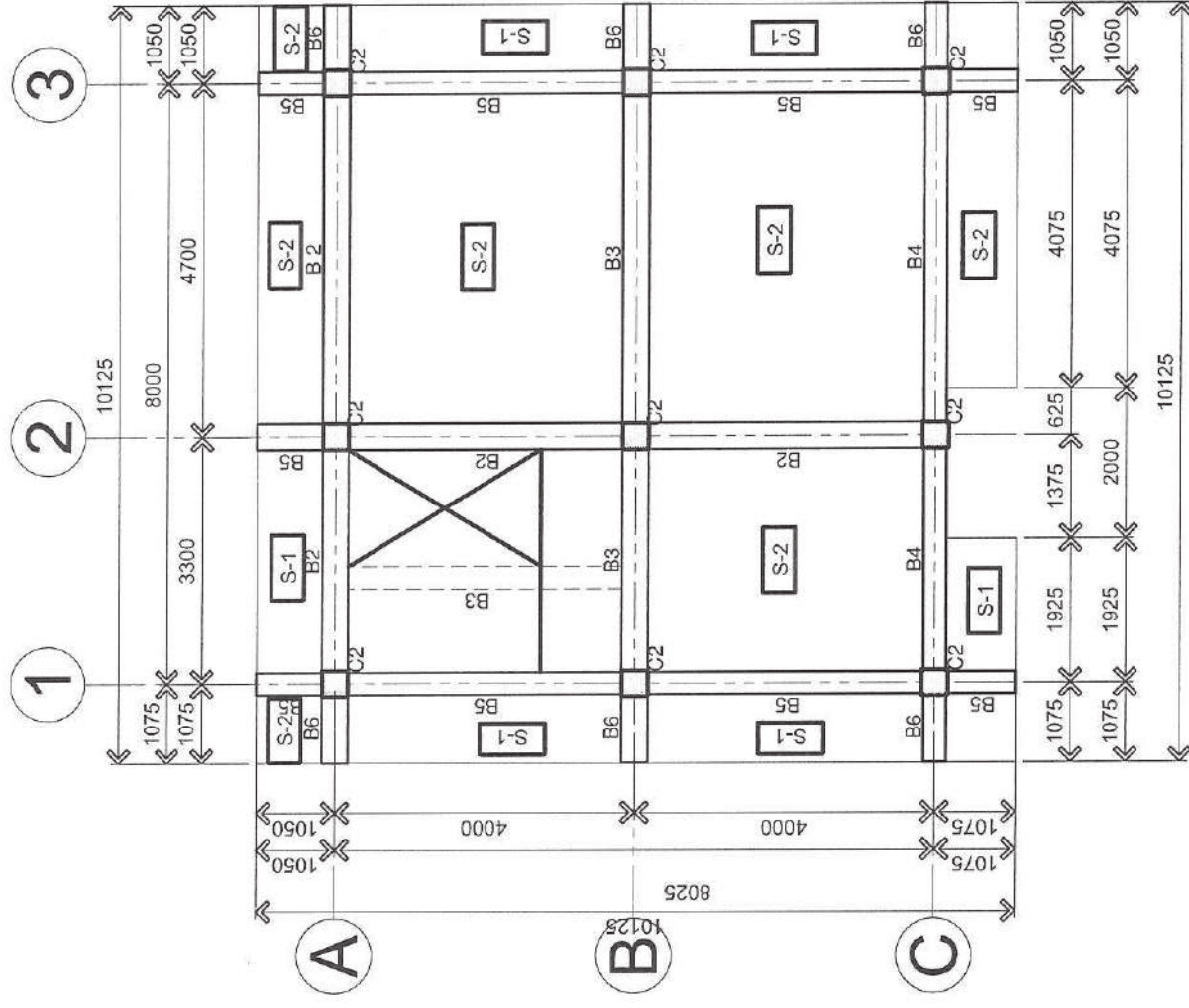
**SUBMITTED BY** CG LT REYNER JAN P. DABOHOY  
Head Office, Engineering Department, CAGPS

**RECOMMENDING APPROVAL** CG CDK LAMIRANCE IVAN N. FELIZARTE  
Head Office, Civil and Structural Branch, CAGPS

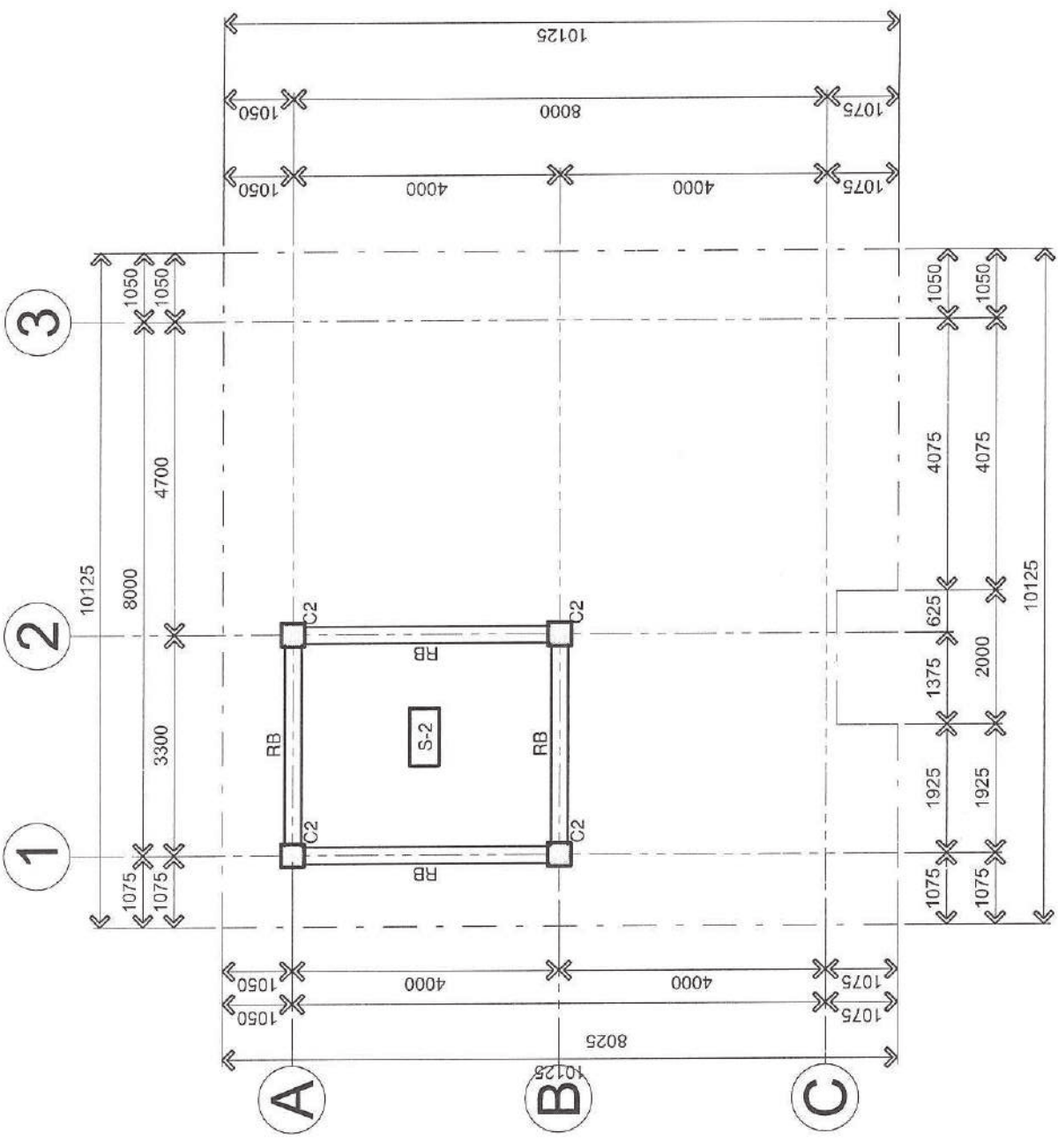
**APPROVED BY** CG COMMO PRUDENCIO PATRICIO JR.  
Commander, CAGPS

**SHEET NO** S-4  
21 51





CGS NORTHERN SAMAR  
1 LOWER ROOF DECK FRAMING PLAN  
SCALE 1:100M



CGS NORTHERN SAMAR  
2 UPPER ROOF DECK FRAMING PLAN  
SCALE 1:100M



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
LOWER ROOF DECK FRAMING PLAN  
UPPER ROOF DECK FRAMING PLAN

**BRANCH**  
Civil and Structural Branch  
**PREPARED BY**  
CG ENS KRIS NNE ALKOP P. FENOMENO  
Number: Civil Engineering Branch, CGOCS  
**CHECKED BY**  
CG LTJG EDUARDO J. ORTIZ  
Head, Civil and Structural Branch, CGOCS

**SUBMITTED BY**  
CG LT REYNER JAN P. DAGOHAY  
Head, Engineering Branch, CGOCS

**RECOMMENDING APPROVAL**  
CG CDR JAVIER N. N. FELIZARTE  
Asst. Deputy Commander, CGOCS

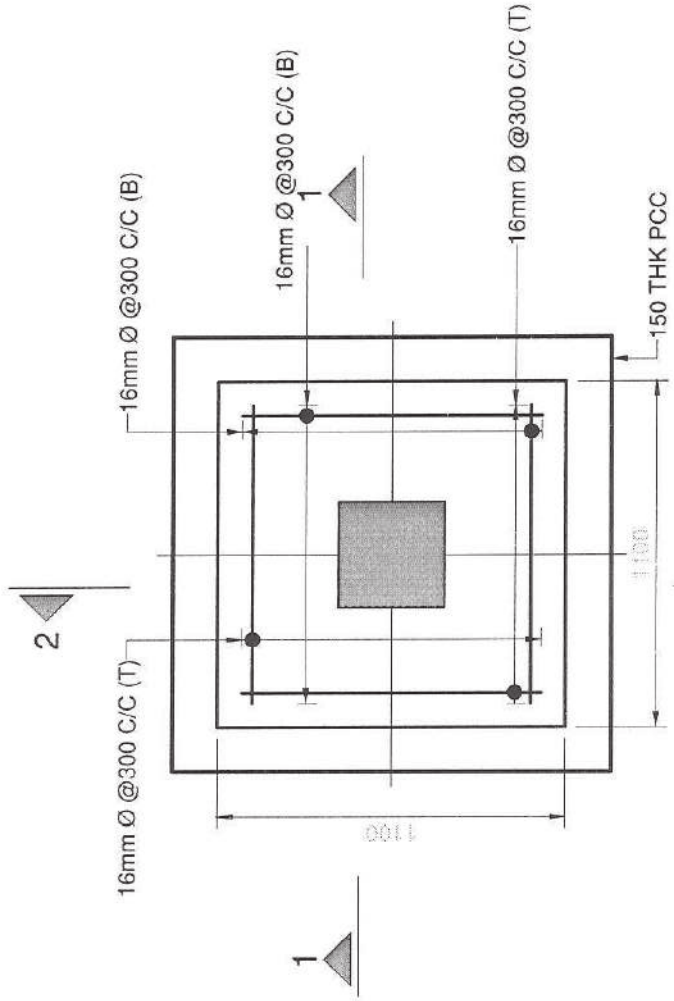
**APPROVED BY**  
CG COMMO PRUDENCIO C. PATRICIO JR.  
Commander, CGOCS

**SHEET NO**  
S-5  
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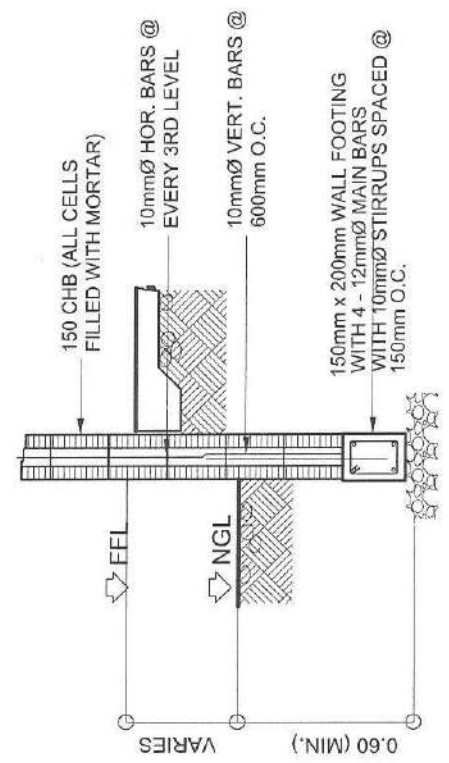


SCHEDULE OF FOOTING

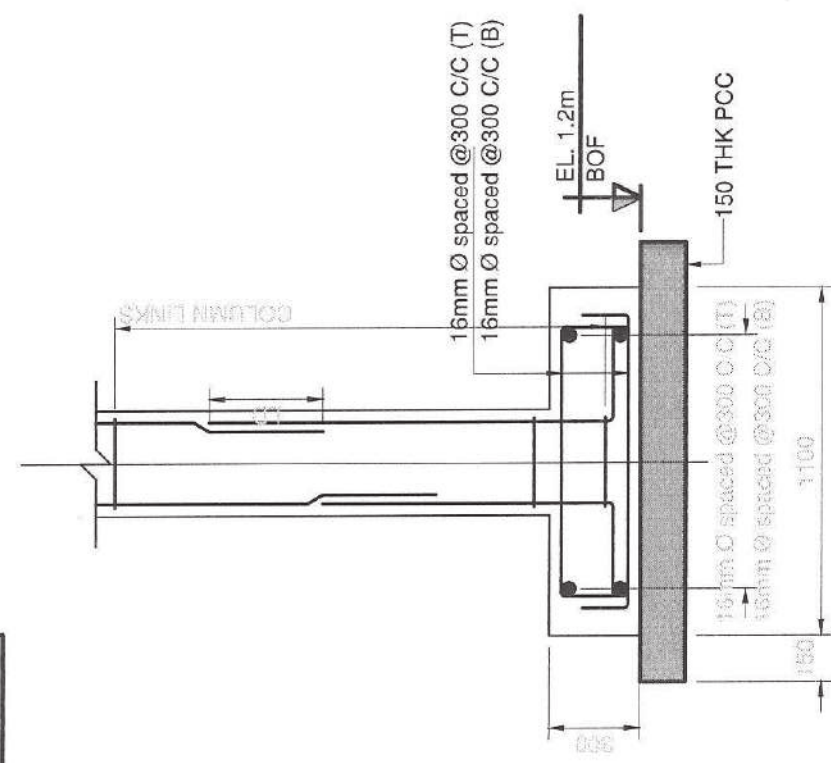
MARK	FOOTING SIZES		DEPTH	REINFORCEMENTS		REMARKS
	WIDTH (mm)	LENGTH (mm)		BOTTOM BARS PARALLEL TO "B"	BOTTOM BARS PARALLEL TO "L"	
F-1	1100	1100	1200	16mm Ø @300 C/C	16mm Ø @300 C/C	ISOLATED



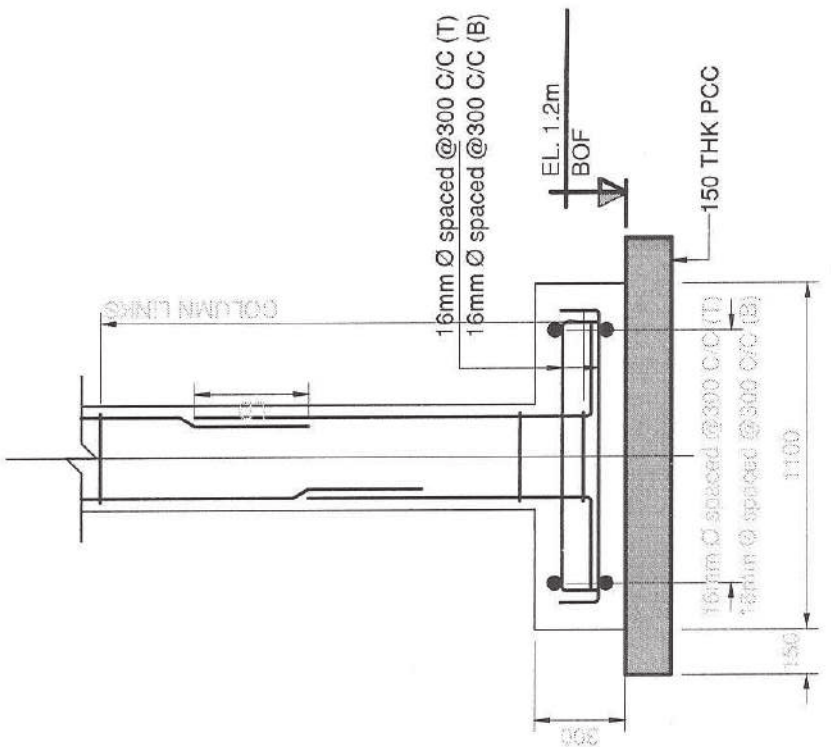
FOOTING FC1- PLAN  
(SCALE 1:25)



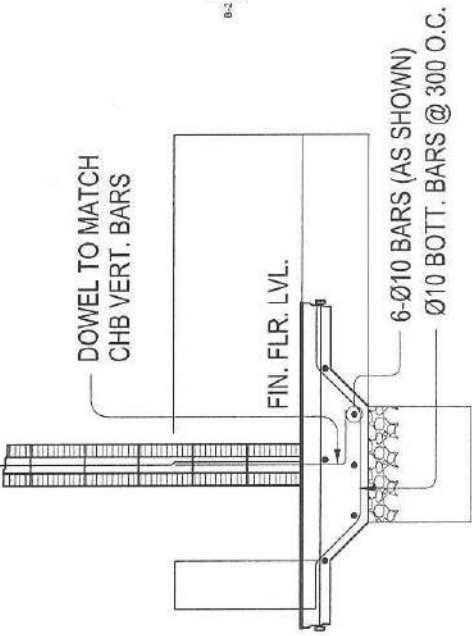
WF1 DETAILS



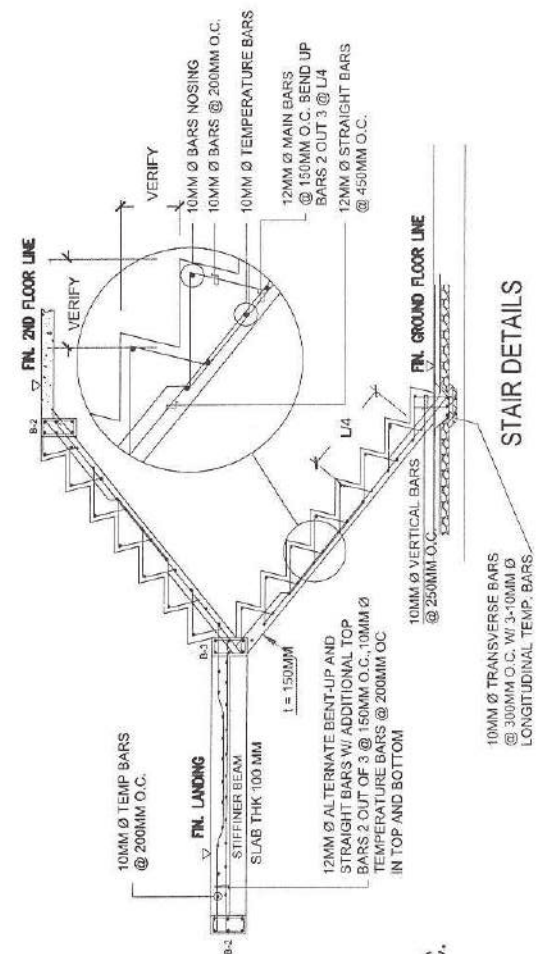
SECTION 1-1  
DETAIL OF FOOTING FC1  
(SCALE 1:25)



SECTION 2-2  
DETAIL OF FOOTING FC1  
(SCALE 1:25)



WF2 DETAILS



STAIR DETAILS



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CCBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Bay, Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
SCHEDULE OF FOOTING

BRANCH  
Civil and Structural Branch  
PREPARED BY  
CG ENS KRISTINE KIERO P. FENOMENO  
Member, Civil Engineering Branch, CCBF  
CHECKED BY  
CG LTJG EDUARDO J. CORTEZ  
Head, Civil and Structural Branch, CCBF

SUBMITTED BY  
CG LT REYNER JAN P. DAGOHY  
Head, Engineering Department, CCBF

RECOMMENDING APPROVAL  
CG CDR LAURINE VAN N. FELIZARTE  
Acting Deputy Commander, CCBF

APPROVED BY  
CG COMMO PRUDENCIO S. PATRICIO JR.  
Commander, CCBF

SHEET NO  
S-6  
23 51

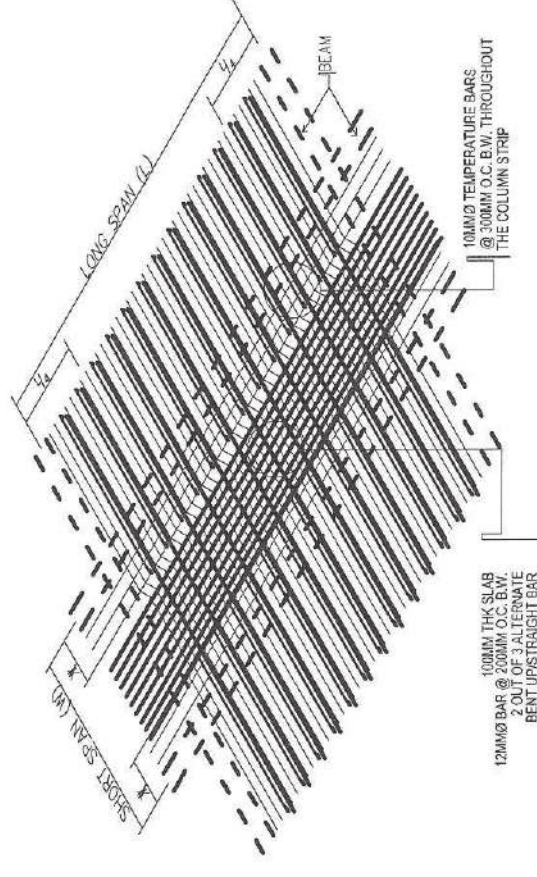


## SCHEDULE OF BEAM

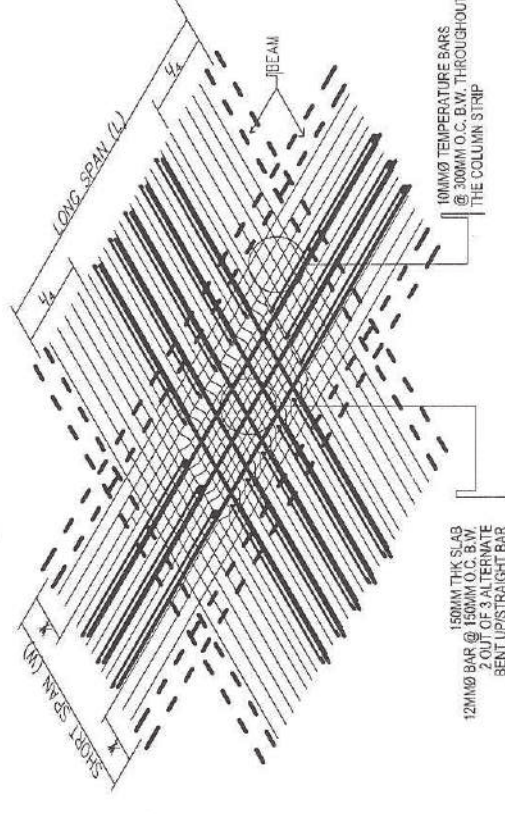
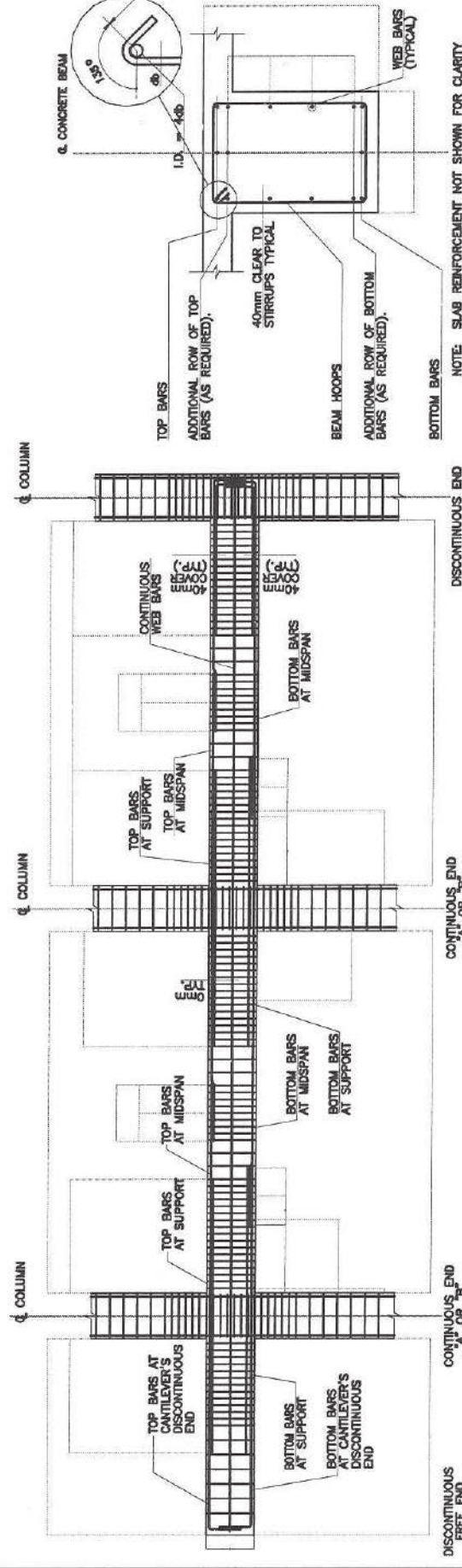
BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT				TOP REINFORCEMENT				BAR ARRANGEMENT			LATERAL TIE SIZES AND SPACING	REMARKS
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	EXTERNAL	MID SPAN	INTERNAL				
B1	350	400	4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 5-12mm	Ø 3-12mm	Ø 5-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	10mmØ 2@50mm, 4@100mm, @150mm, REST @200mm O.C.	
B2	350	350	4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 5-12mm	Ø 3-12mm	Ø 5-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	10mmØ 2@50mm, 4@100mm, @150mm, REST @200mm O.C.	
B3	300	400	4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 3-12mm	Ø 4-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	10mmØ 2@50mm, 4@100mm, @150mm, REST @200mm O.C.	
B4	300	300	4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 3-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	10mmØ 2@50mm, 4@100mm, @150mm, REST @200mm O.C.	
B5	300	350	3-12mm	Ø 3-12mm	Ø 3-12mm	Ø 4-12mm	Ø 3-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 4-12mm	10mmØ, @200mm O.C.	CANTILEVERED
B6	350	350	4-12mm	Ø 4-12mm	Ø 4-12mm	Ø 5-12mm	Ø 3-12mm	Ø 5-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	Ø 2-12mm	10mmØ, @200mm O.C.	CANTILEVERED
RB	250	300	2-#12	2-#12	2-#12	3-#12	3-#12	3-#12	3-#12	3-#12	3-#12	3-#12	3-#12	10mmØ 2@50mm, 4@100mm, @150mm, REST @200mm O.C.	

## SCHEDULE OF SLABS

MARK	THICKNESS (mm)	REINFORCEMENTS		REMARKS
		PARALLEL TO LONG SPAN	PARALLEL TO SHORT SPAN	
S-1	100 + FIN.	12mmØ @ 200mm O.C. BENT UP ALTERNATE @ L/4 FROM FACE OF SUPPORT	10mmØ @ 300mm O.C. TEMP BARS	ONE-WAY REINFORCEMENT
S-2	100 + FIN.	12mmØ @ 100mm O.C. BENT UP ALTERNATE @ L/4 FROM FACE OF SUPPORT	12mmØ @ 100mm O.C. BENT UP ALTERNATE @ L/4 FROM FACE OF SUPPORT	TWO-WAY REINFORCEMENT



CGS NORTHERN SAMAR  
ONE-WAY SLAB DETAIL

CGS NORTHERN SAMAR  
TWO-WAY SLAB DETAIL

CGS NORTHERN SAMAR  
BEAM SECTION DETAIL  
SCALE



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA

**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**

CG9F, 'Muelle delas Industrias', Farola Compound  
Brondo, Manila 1006

CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT	SCHEDULE OF BEAMS BEAM SECTION D ONE-WAY SLAB D TWO-WAY SLAB D
---------------	---

BRANCH: Civil and Structural Branch

PREPARED BY  
CG ENS KRISTINE KIEKO P ENOM

CHECKED BY *[Signature]* CG TJG BOGARD CORTEZ

CG LT REYNER JAN P DACOHAY  
United States Department of Justice  
Criminal Division

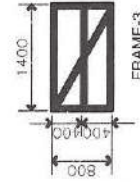
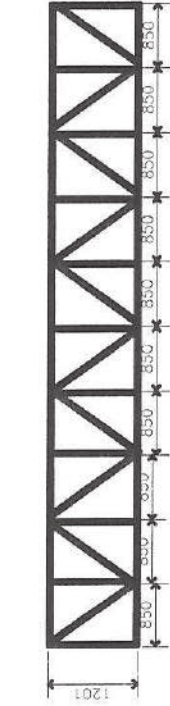
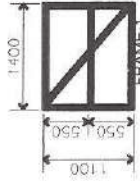
CG CDR LAURINCE IVAN N FELIZARTE  
 1. 1st Deputy Commander, 2005

CG COMMO PRUDENCIO &amp; PATRICIO JF

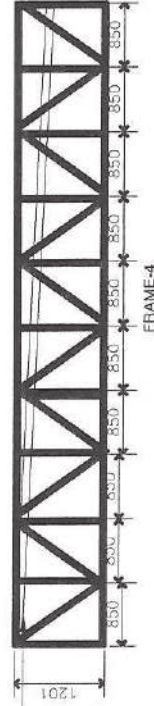
SHEET NO.

S-7	24	5'
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50mm x 100mm x 12.5mm x  
1.5mm Thick C-Purlins  
including fixing accessories

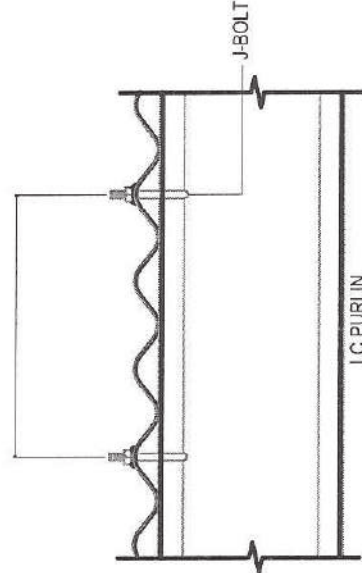
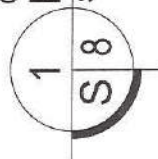


2 1/2" x 2 1/2" x 3/16" Thick  
Angle Bar & 2" x 2" x 1/8"  
Thick Angle Bar including  
fixing accessories

CGS NORTHERN SAMAR

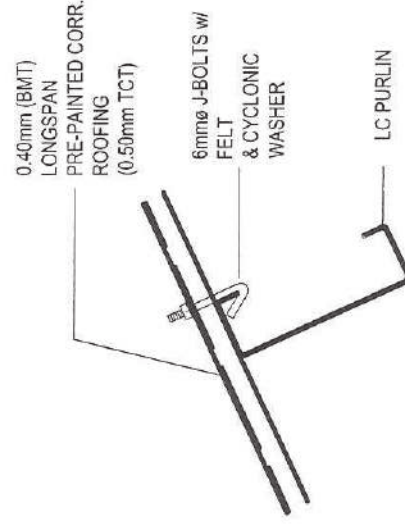
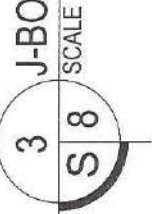
## ROOF FRAMING DETAIL

NTS



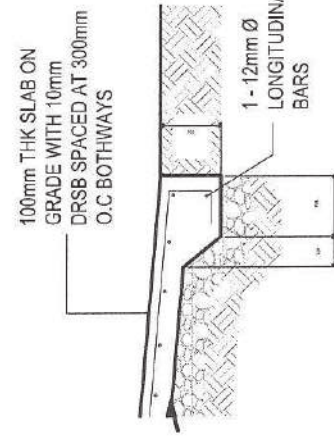
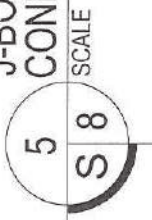
## 3 J-BOLT SPACING DETAIL

NTS



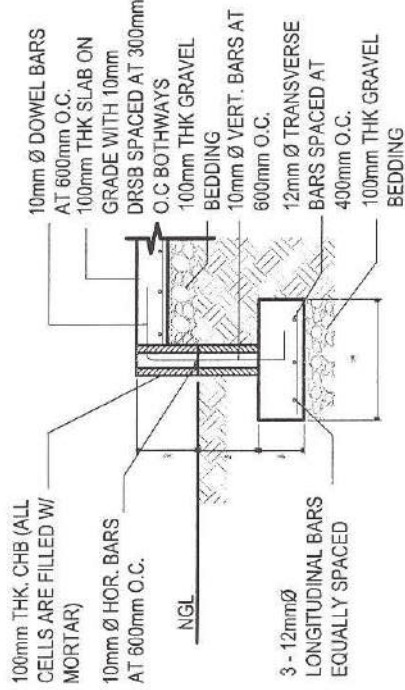
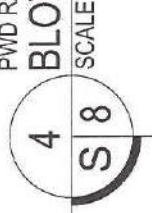
## J-BOLT TOP PURLIN & G.I SHEET CONNECTION DETAIL

NTS



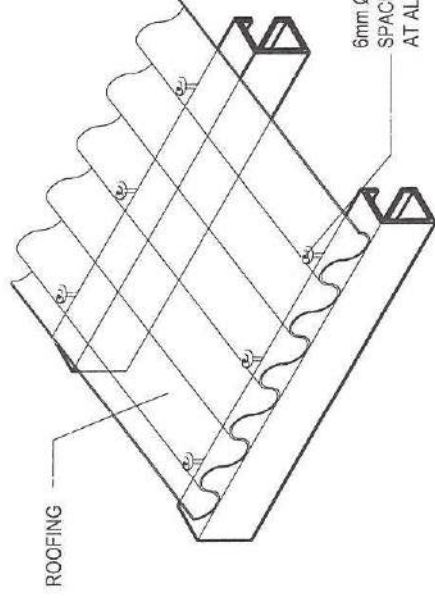
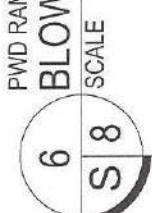
## 4 BLOW UP DETAIL A

1:25M



## 6 BLOW UP DETAIL B

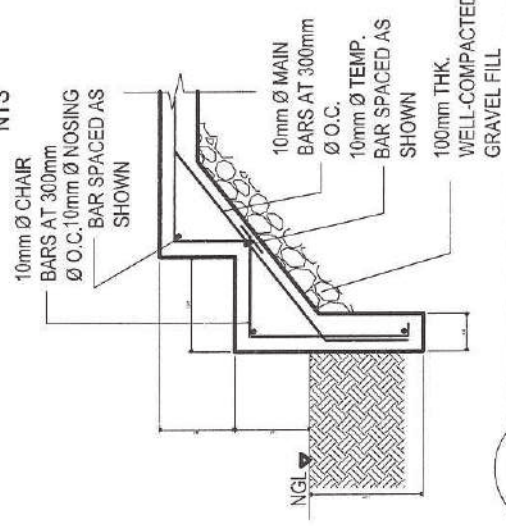
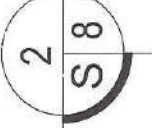
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## ISOMETRIC VIEW OF CONNECTION OF ROOFING TO PURLINS

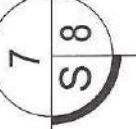
NTS

SCALE



## 7 STAIR ON FILL DETAILS

1:20 M



MARK	FROM FOUNDATION TO GROUND FLOOR	FROM GROUND FLOOR TO SECOND FLOOR	FROM SECOND FLOOR TO ROOF BEAM
C1			
SIZE (mm)	350 x 350	350 x 350	300 x 300
REBARS	8-16mmØ	8-16mmØ	8-16mmØ
TIES	3 SETS 16mmØ SPACED 150mm, 200mm, REST @ 150mm O.C. TO MID-HT.	3 SETS 16mmØ SPACED 150mm, 200mm, REST @ 150mm O.C. TO MID-HT.	3 SETS 16mmØ SPACED 150mm, 200mm, REST @ 150mm O.C. TO MID-HT.
MARK	FROM FOUNDATION TO GROUND FLOOR	FROM GROUND FLOOR TO SECOND FLOOR	FROM SECOND FLOOR TO ROOF BEAM
C2			
SIZE (mm)	350 x 350	350 x 350	300 x 300
REBARS	8-16mmØ	8-16mmØ	8-16mmØ
TIES	3 SETS 16mmØ SPACED 150mm, 200mm, REST @ 150mm O.C. TO MID-HT.	3 SETS 16mmØ SPACED 150mm, 200mm, REST @ 150mm O.C. TO MID-HT.	3 SETS 16mmØ SPACED 150mm, 200mm, REST @ 150mm O.C. TO MID-HT.



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST., PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muella dela Industria, Farola Compound  
Binondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
ROOF FRAMING DETAIL  
ISOMETRIC VIEW OF CONNECTION  
OF ROOFING TO PURLINS  
J-BOLT SPACING DETAIL  
BLOW UP DETAIL A  
STAIR ON FILL DETAILS  
J-BOLT TOP PURLIN & G.I SHEET  
CONNECTION DETAIL  
BLOW UP DETAIL B

**BRANCH**  
Civil and Structural Branch  
**PREPARED BY**  
CG ENS KRISTINE WENDY P. FENOMENO  
Member: Civil Engineering, CEBOS  
**CHECKED BY**  
CG LT LG EDUARDO J. PORTEZ  
Member: Civil Engineering, CEBOS

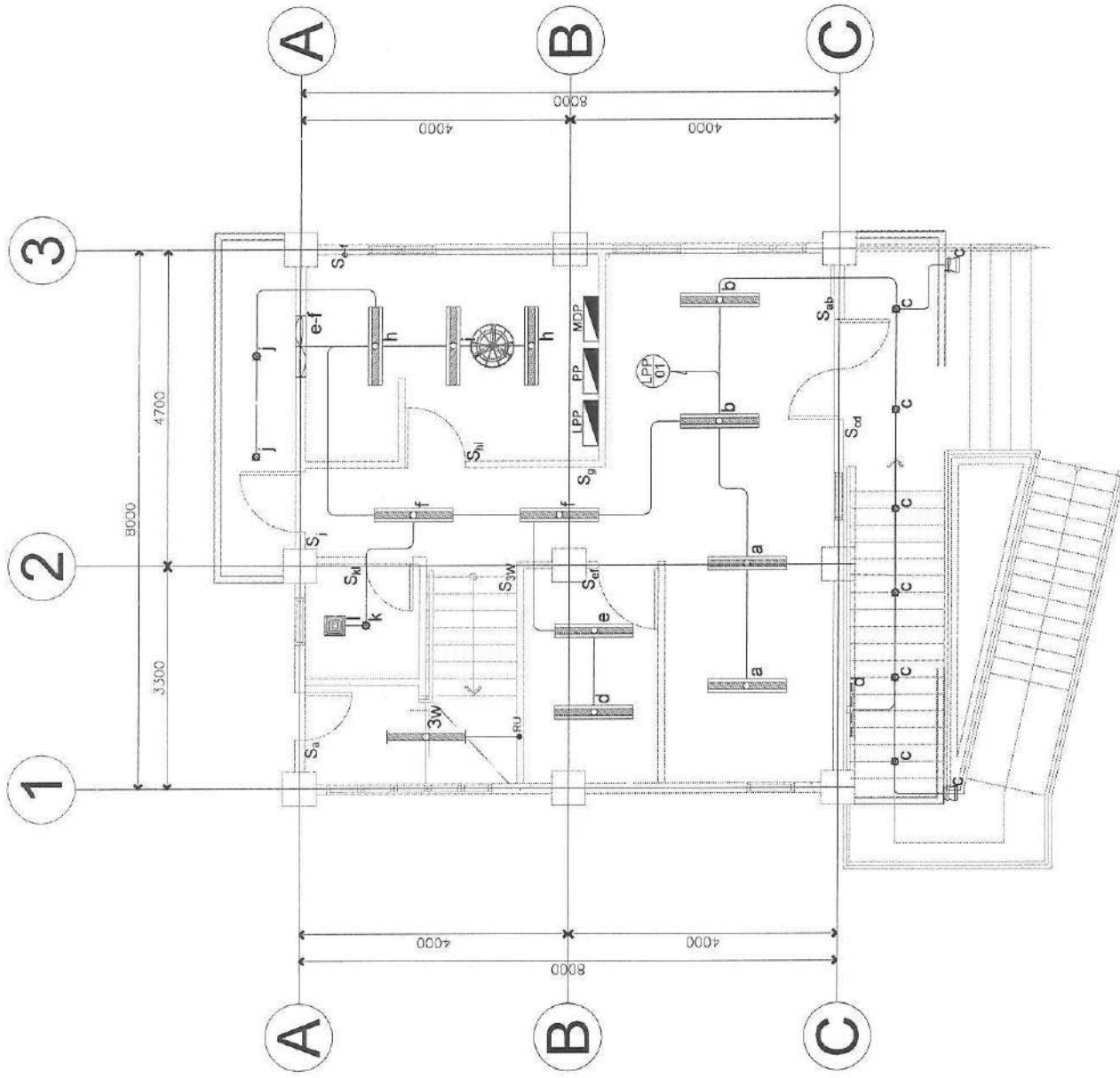
**SUBMITTED BY**  
CG LT REYMER JAN P. DAHOYAY  
Head, Engineering Department, CEBOS

**RECOMMENDING APPROVAL**  
CG COM LAURINCE AN N. FELIZARTE  
Vice Deputy Commander, CEBOS

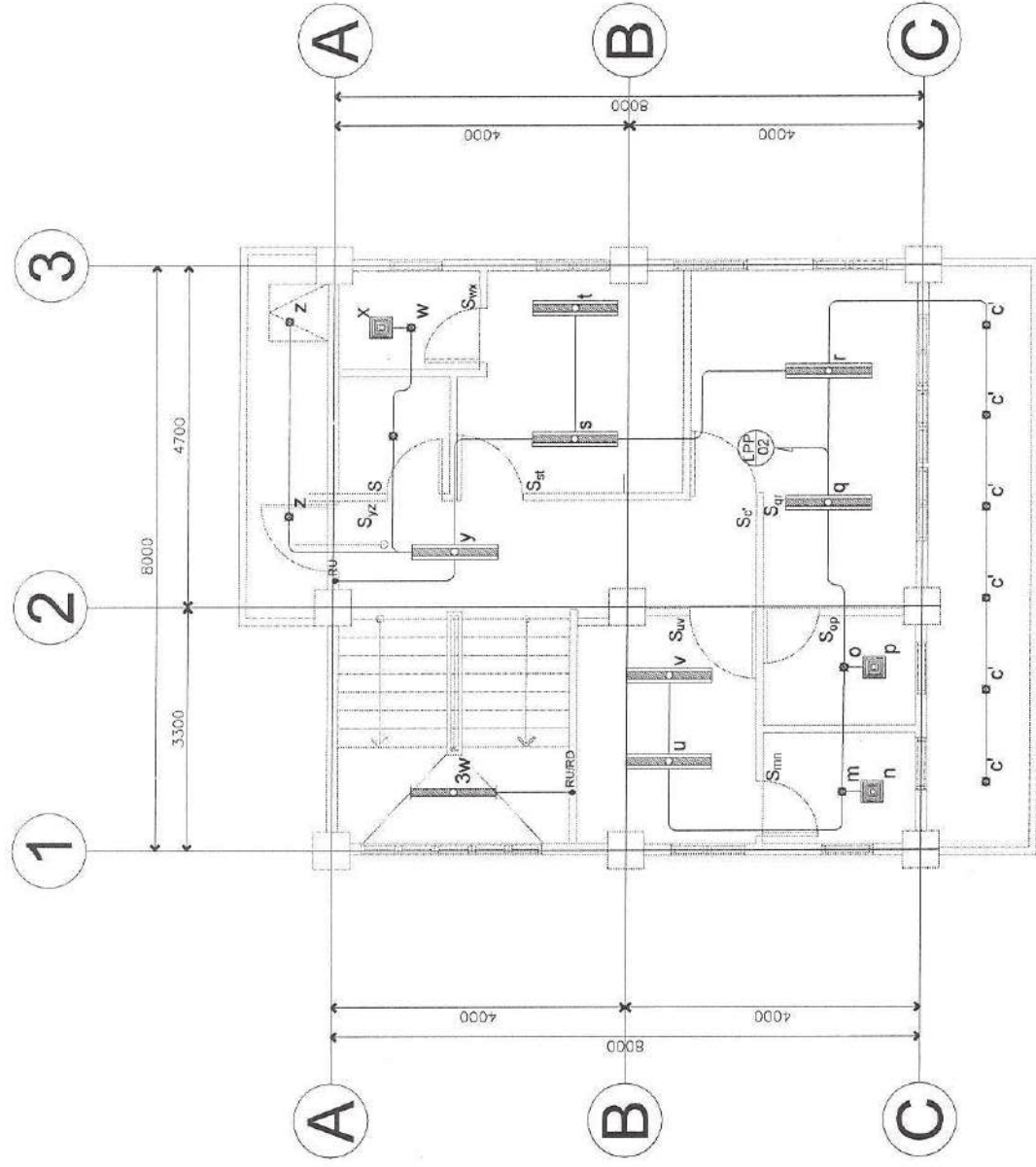
**APPROVED BY**  
CG COMMO PRUDENCIO P. PATRICIO JR.  
Commander, CEBOS

**SHEET NO**  
S-8  
25 51





CGS NORTHERN SAMAR  
1 GROUND FLOOR LIGHTING LAYOUT  
E 1 SCALE  
1:100M



CGS NORTHERN SAMAR  
2 SECOND FLOOR LIGHTING LAYOUT  
E 1 SCALE  
1:100M



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE**  
DEVELOPMENT SERVICE  
CGBF, Muelle de la Industria, Parola Compound  
Binondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brig. Subing Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
GROUND FLOOR  
LIGHTING LAYOUT  
SECOND FLOOR  
LIGHTING LAYOUT

**BRANCH** Electrical and Mechanical Branch  
**PREPARED BY** CGS JAMES C. MATRENAS  
Member, Electrical and Mechanical Branch, CGS  
**CHECKED BY** CGS THOM DAVID Z. AMANTE  
Head, Electrical and Mechanical, CGS

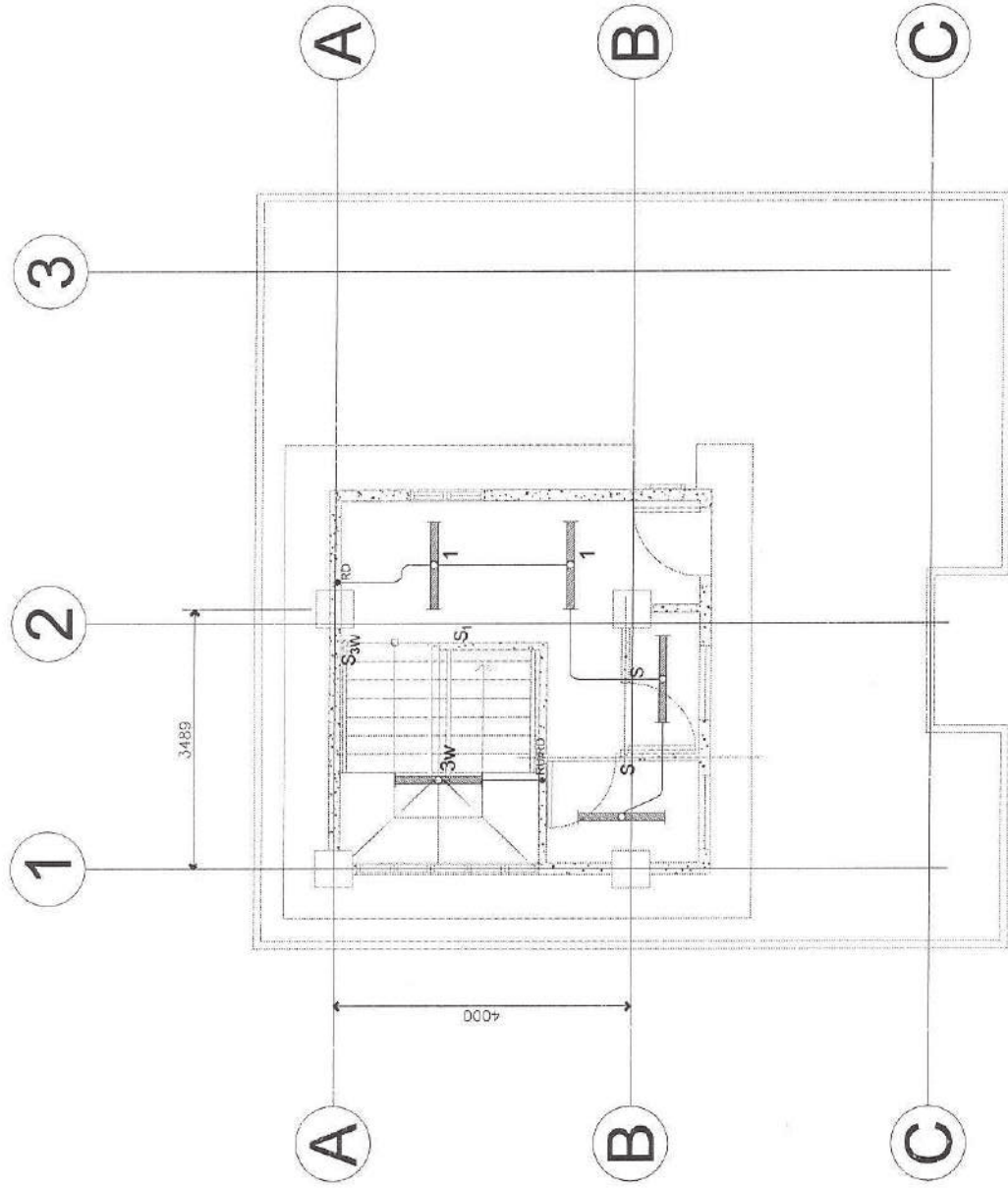
**SUBMITTED BY** CG LT REYNER JAN P. DAZOHO  
Head, Planning Department, CGS

**RECOMMENDING APPROVAL** CG CDR LAURINCE IVAN N. FELIZARTE  
Long Deputy Commander, CGS

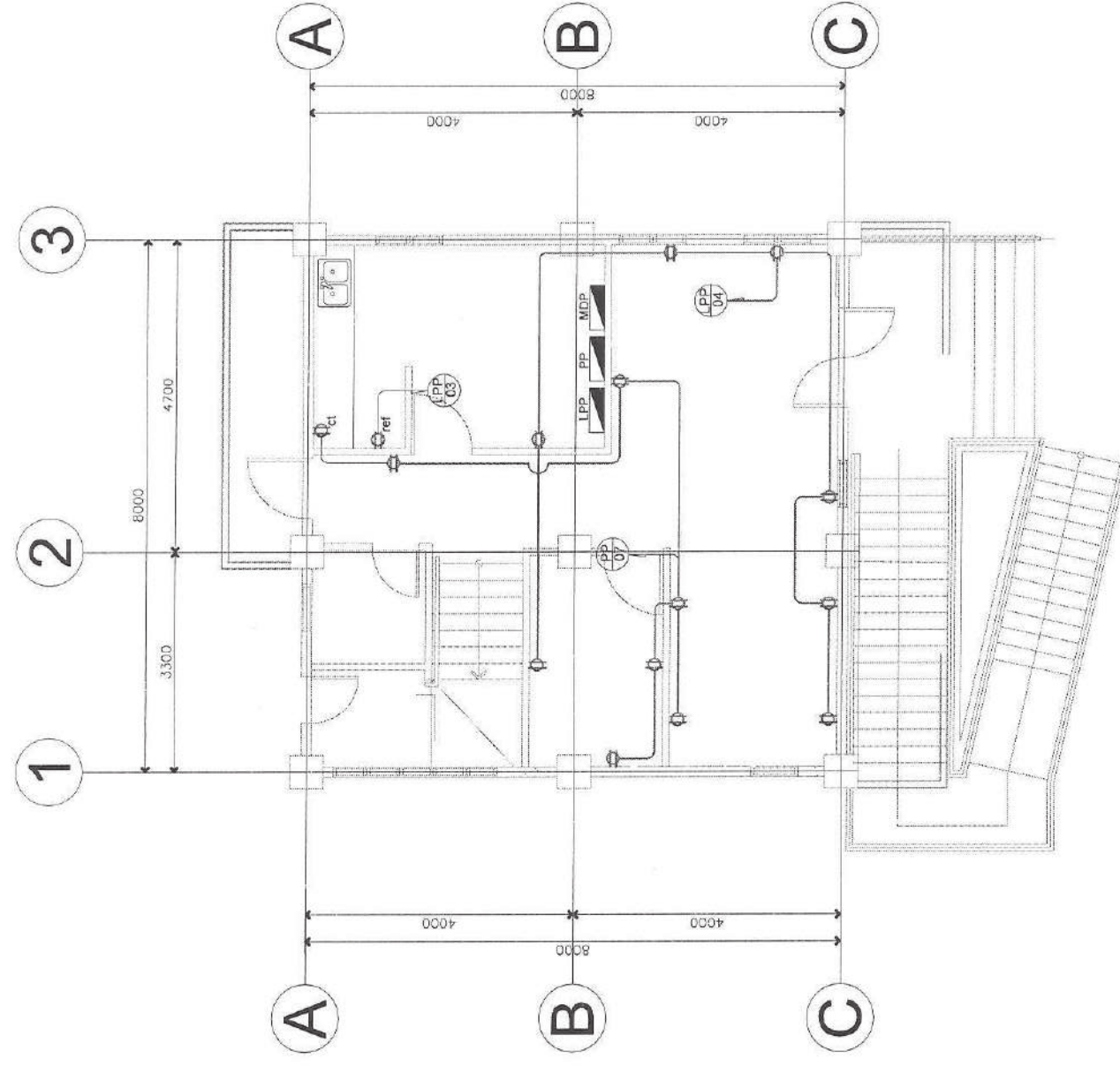
**APPROVED BY** CG COMMO PRUDENCIO Q. PATRICIO JR.  
Commander, CGS

**SHEET NO**  
E-1  
26 51





CGS NORTHERN SAMAR  
**1 ROOF DECK REFLECTED CEILING PLAN**  
 SCALE  
 1:100M



CGS NORTHERN SAMAR  
**2 GROUND FLOOR POWER LAYOUT**  
 SCALE  
 1:100M



**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE**  
**DEVELOPMENT SERVICE**  
 CGBF, Muelle dela Industria, Forota Compound  
 Binondo, Manila 1006

PROJECT AND LOCATION  
 CONSTRUCTION OF  
 STATION NORTHERN SAMAR  
 Brgy. Sabang Zone 2, Allen Northern Samar  
 PHILIPPINE COAST GUARD

SHEET CONTENT  
 ROOF DECK  
 LIGHTING LAYOUT  
 GROUND FLOOR  
 POWER LAYOUT

BRANCH  
 Electrical and Mechanical Branch  
 PREPARED BY  
 C/Sgt. Jones & Matranas  
 Marine Electrical and Mechanical Branch, CGUS  
 CHECKED BY  
 CG ENS THOM DAVID Z AMANTE  
 Head Electrical and Mechanical Branch, CGUS

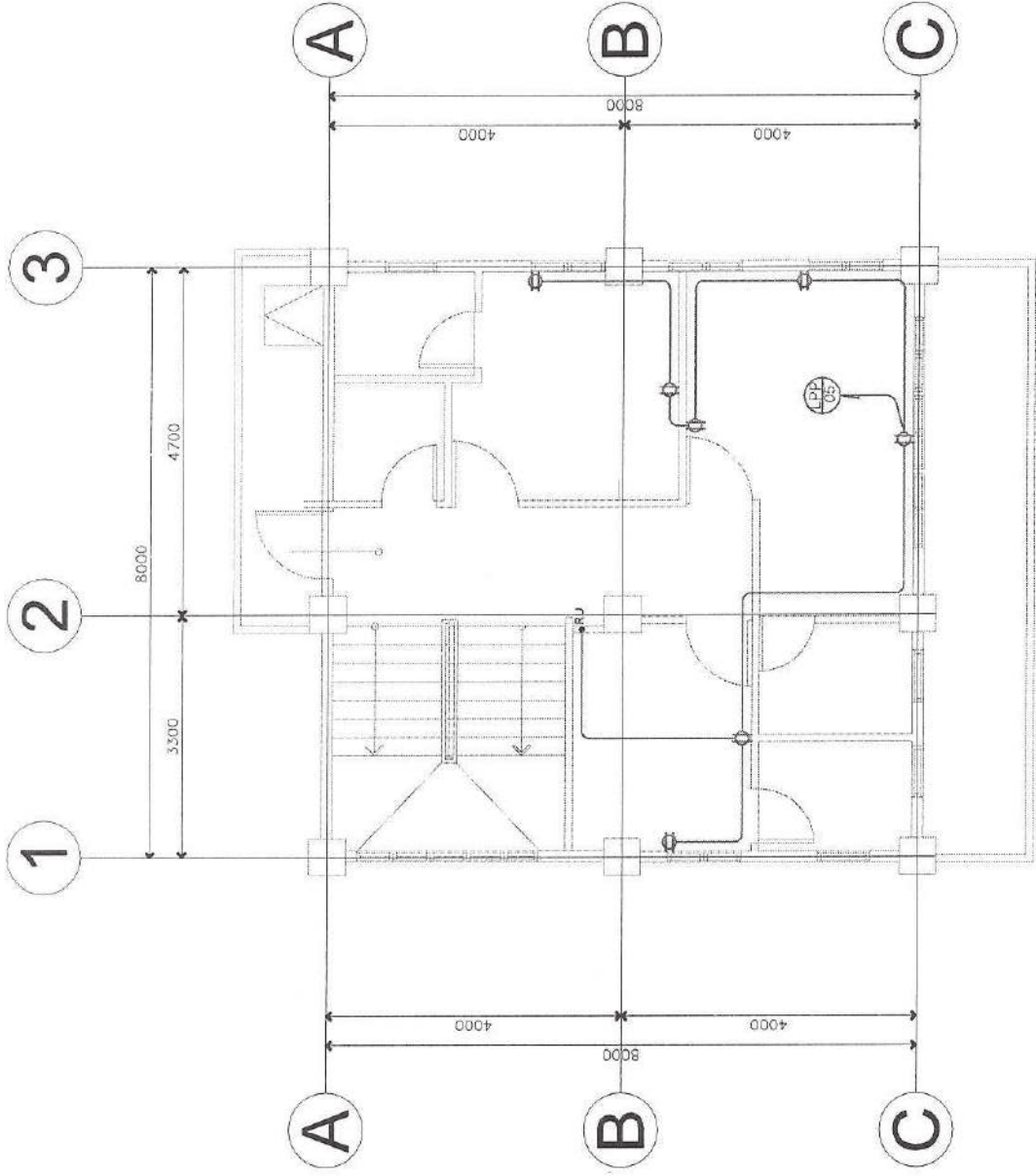
SUBMITTED BY  
 CG LT REYNER JAN P. DABOY  
 Head Engineering Department, CGUS

RECOMMENDING APPROVAL  
 CG QDR LAURINCE IVAN N FELIZARTE  
 Long Beach Command, CGUS

APPROVED BY  
 CG COMMO PRUDENCIO PATRICIO JR  
 Command, CGUS

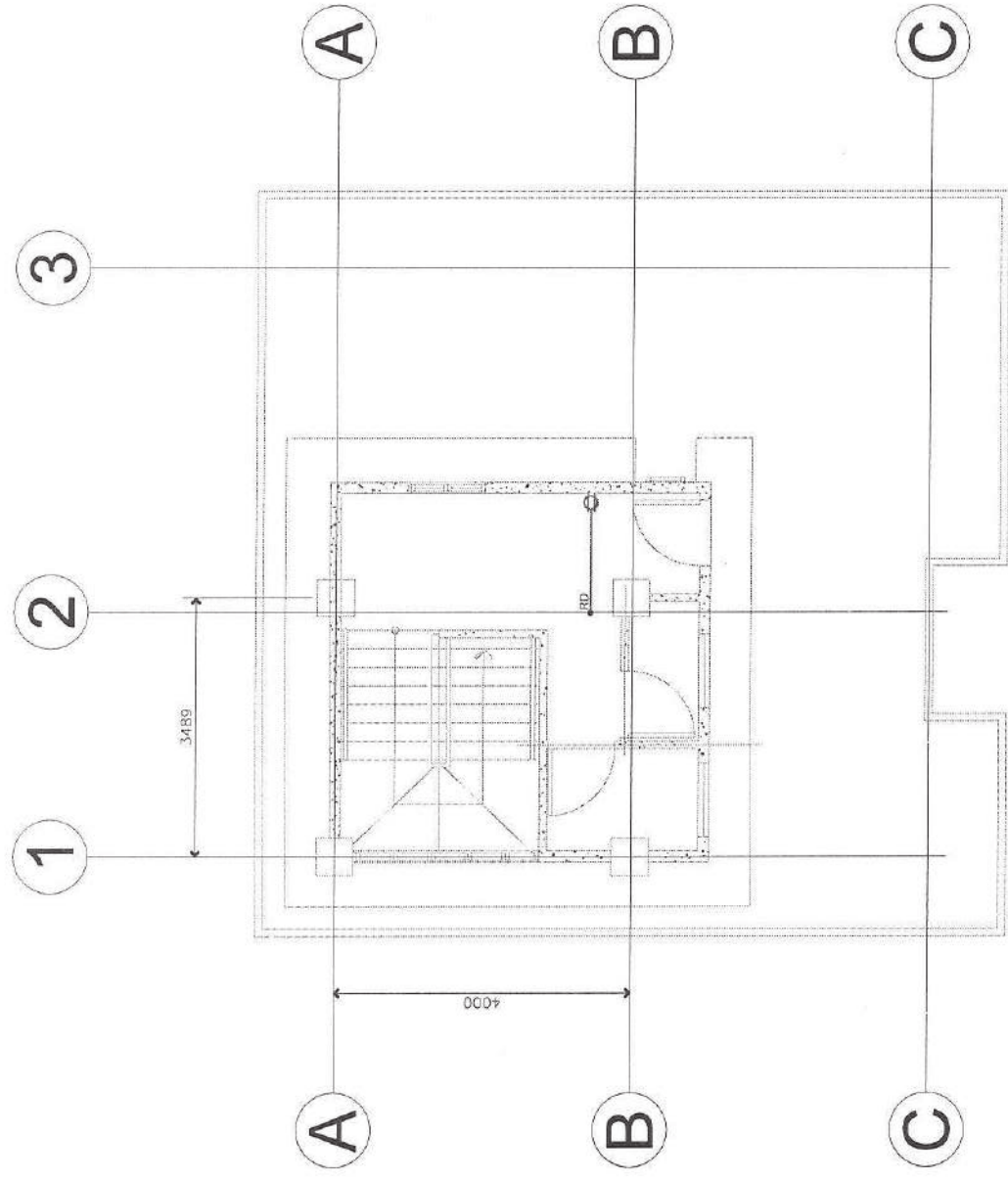
SHEET NO  
 E-2  
 27 51





CGS NORTHERN SAMAR  
1 SECOND FLOOR POWER LAYOUT  
SCALE 1:100M

1  
E 3



CGS NORTHERN SAMAR  
2 ROOF DECK POWER LAYOUT  
SCALE 1:100M

2  
E 3



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
138 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Farola Compound  
Briondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Alen, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
SECOND FLOOR  
POWER LAYOUT  
ROOF DECK  
POWER LAYOUT

**BRANCH**  
Electrical and Mechanical Branch  
**PREPARED BY**  
CGS2 Jerris Calatranes  
Member, Electrical and Mechanical Branch, CGS  
**CHECKED BY**  
CGENS THOM DAVID C. AMANTE  
Head, Electrical and Mechanical Branch, CGS

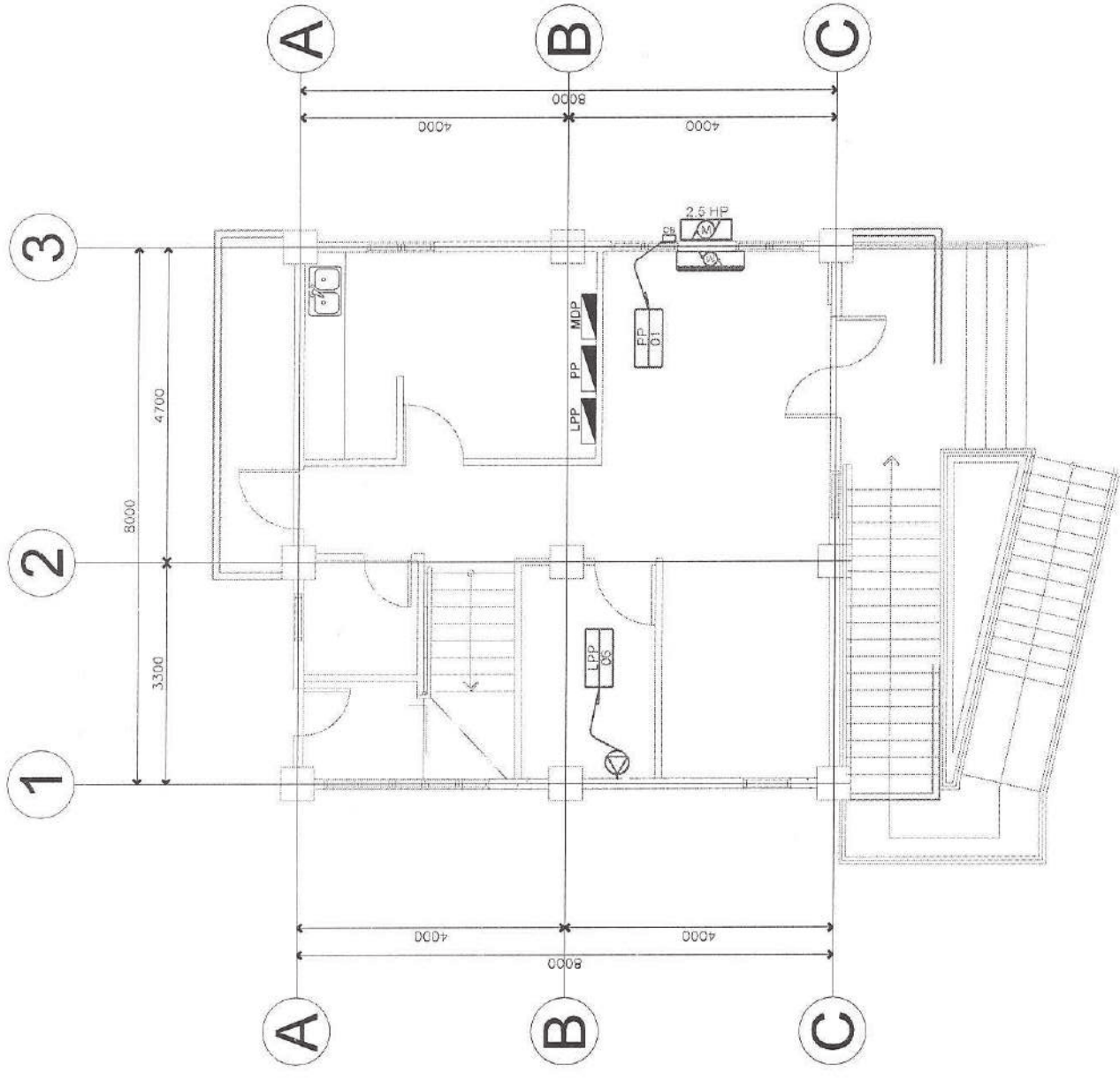
**SUBMITTED BY**  
CG LT REYNER JAN P. DAGORAY  
Head, Engineering Department, CGS

**RECOMMENDING APPROVAL**  
CG CDR LAURINCE VANT FELIZARTE  
Chief Deputy Commander, CGS

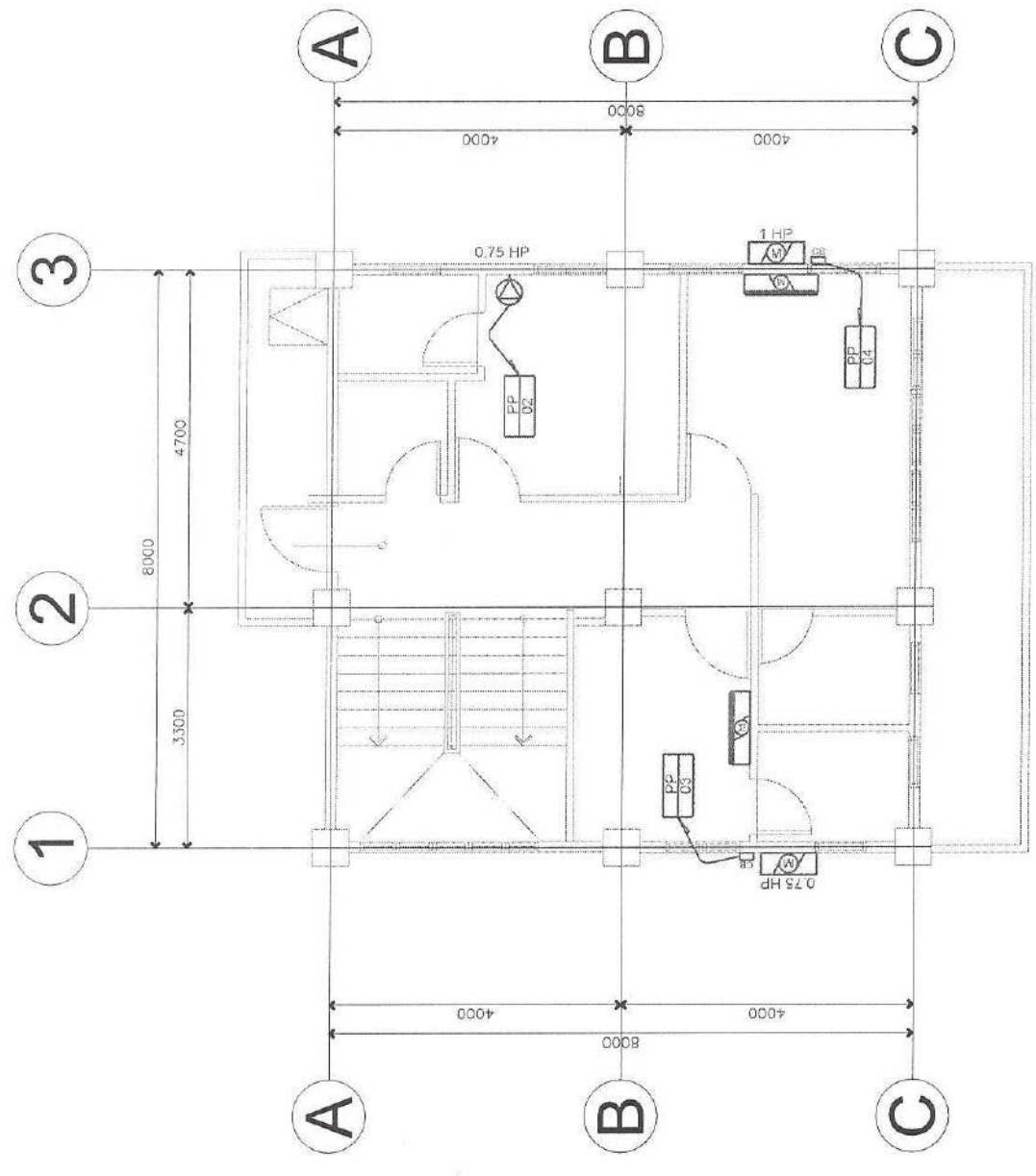
**APPROVED BY**  
CG COMMO PRUDENCIO PATRICIO JR.  
Commander, CGS

**SHEET NO**  
E-3  
28 51





CGS NORTHERN SAMAR  
**1 GROUND FLOOR AIR CONDITIONING UNIT LAYOUT**  
 SCALE **E 4** 1:100M



CGS NORTHERN SAMAR  
**2 SECOND FLOOR AIR CONDITIONING UNIT LAYOUT**  
 SCALE **E 4** 1:100M



**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
 CGBF, Muelle dela Industria, Farola Compound  
 Bironido, Manila 1006

**PROJECT AND LOCATION**  
 CONSTRUCTION OF  
 STATION NORTHERN SAMAR  
 Brgy. Sabang Zone 2, Allen, Northern Samar  
 PHILIPPINE COAST GUARD

**SHEET CONTENT**  
 GROUND FLOOR  
 AIR CONDITIONING UNIT LAYOUT  
 SECOND FLOOR  
 AIR CONDITIONING UNIT LAYOUT

**BRANCH**  
 Electrical and Mechanical Branch  
**PREPARED BY**  
 CGS S. J. M. Matranes  
 Member, Electrical and Mechanical Branch, CGS  
**CHECKED BY**  
 CG ENS THOM DAVID C. ANANTE  
 Head, Electrical and Mechanical Branch, CGS

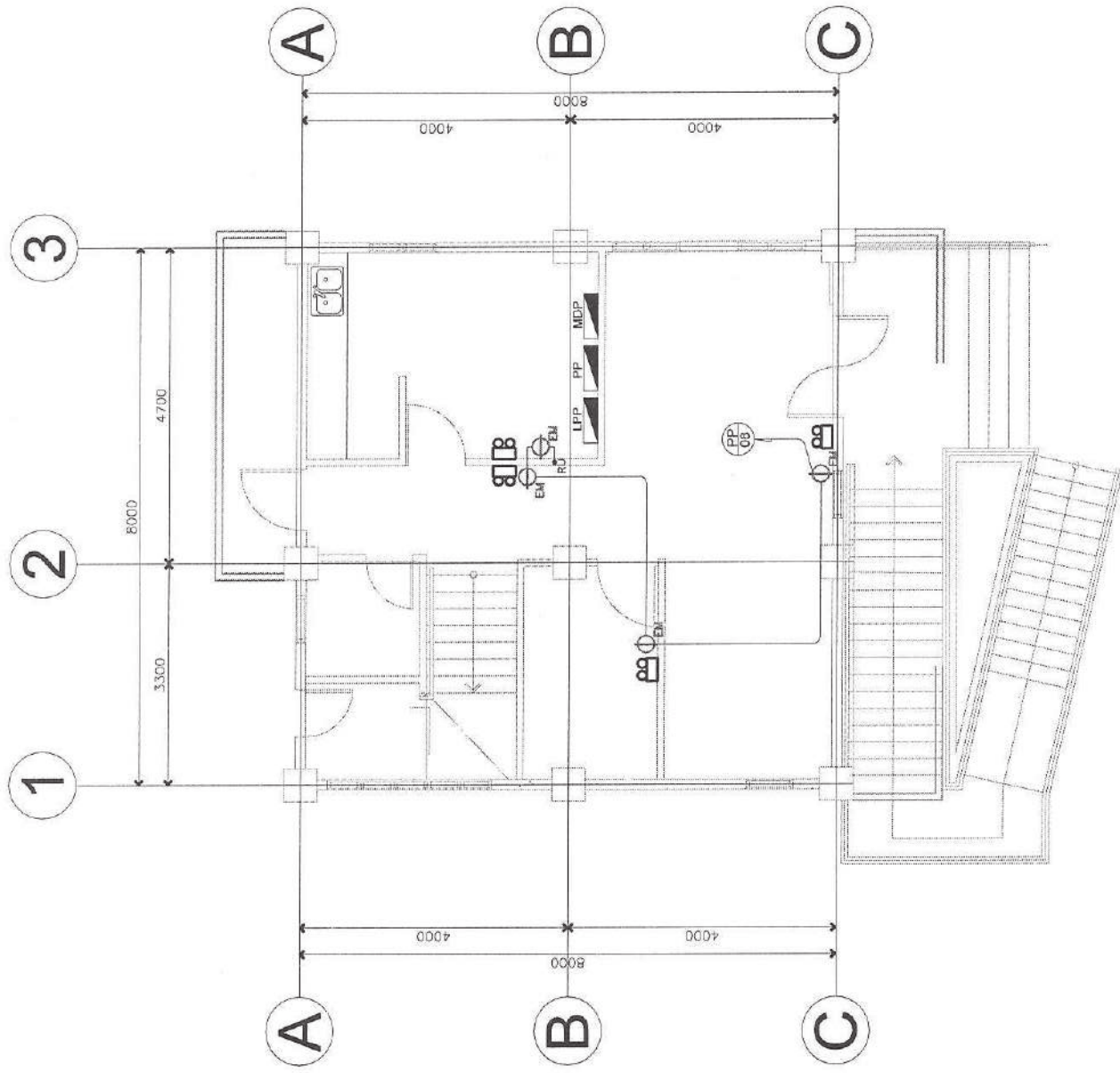
**SUBMITTED BY**  
 CG LT REYNER JAN P. DAGOHAY  
 Head, Engineering Department, CGS

**RECOMMENDING APPROVAL**  
 CG CDR LAURINCE KAYN FELIZARTE  
 Acting Deputy Commander, CGS

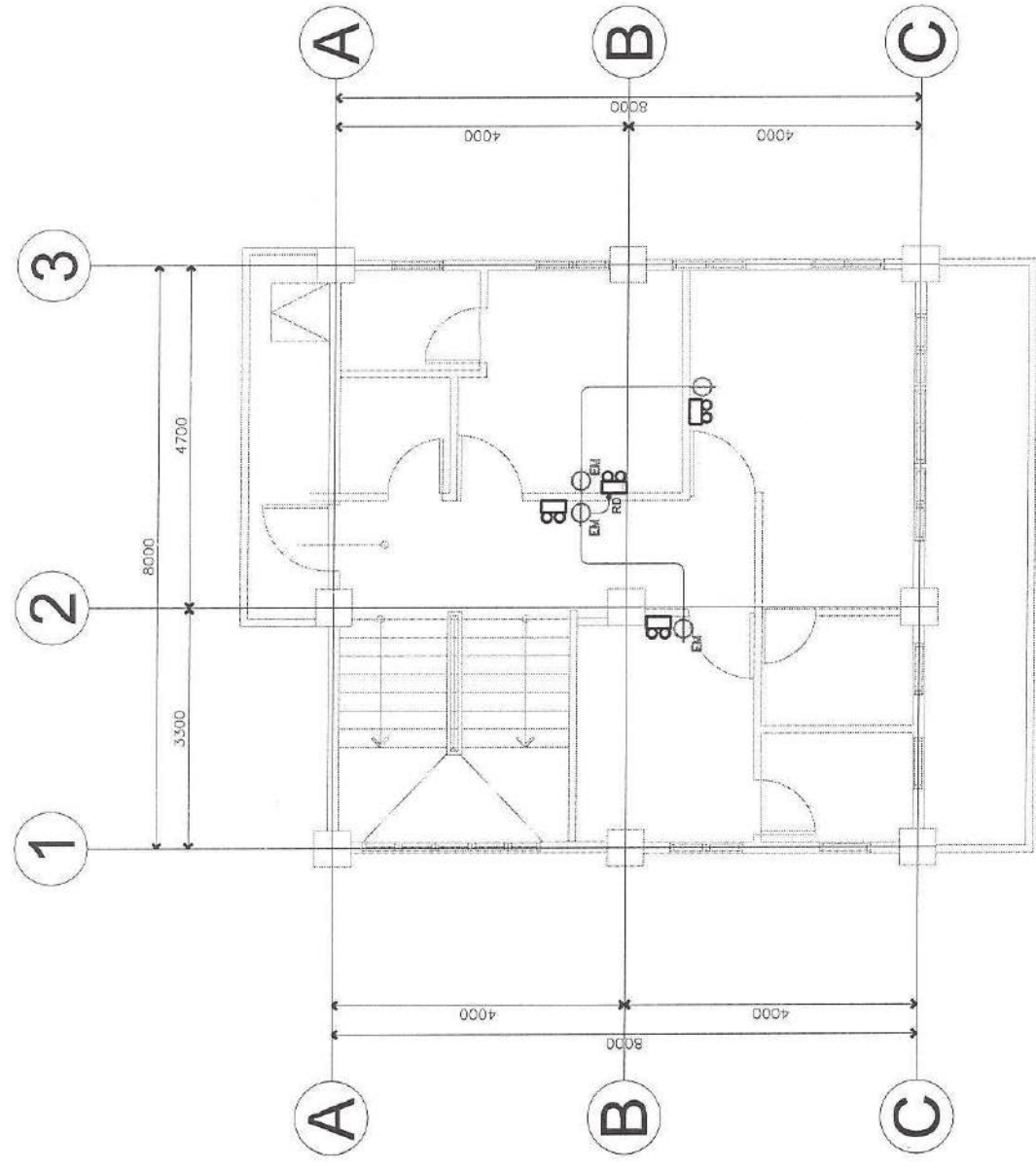
**APPROVED BY**  
 CG COMMO PRUDENCIO PATRICIO JR.  
 Commander, CGS

**SHEET NO**  
 E-4  
 29 51





CGS NORTHERN SAMAR  
**1 GROUND FLOOR EMERGENCY LIGHTING LAYOUT**  
 SCALE 1:100M



CGS NORTHERN SAMAR  
**2 SECOND FLOOR EMERGENCY LIGHTING LAYOUT**  
 SCALE 1:100M



**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 26TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE**  
 DEVELOPMENT SERVICE  
 CGBF, Muelle dela Industria, Farola Compound  
 Binondo, Manila 1006

**PROJECT AND LOCATION**  
 CONSTRUCTION OF  
 STATION NORTHERN SAMAR  
 Brig. Sabong Zone 2, Allen Northern Samar  
 PHILIPPINE COAST GUARD

**SHEET CONTENT**  
 GROUND FLOOR  
 EMERGENCY LIGHTING LAYOUT  
 SECOND FLOOR  
 EMERGENCY LIGHTING LAYOUT

**BRANCH**  
 Electrical and Mechanical Branch  
**PREPARED BY**  
 CGS SMC JAMES C. MATERNES  
 Member, Electrical and Mechanical Branch, CGCS  
**CHECKED BY**  
 CG ENS THOM DAVID C. AMANTE  
 Head, Electrical and Mechanical Branch, CGCS

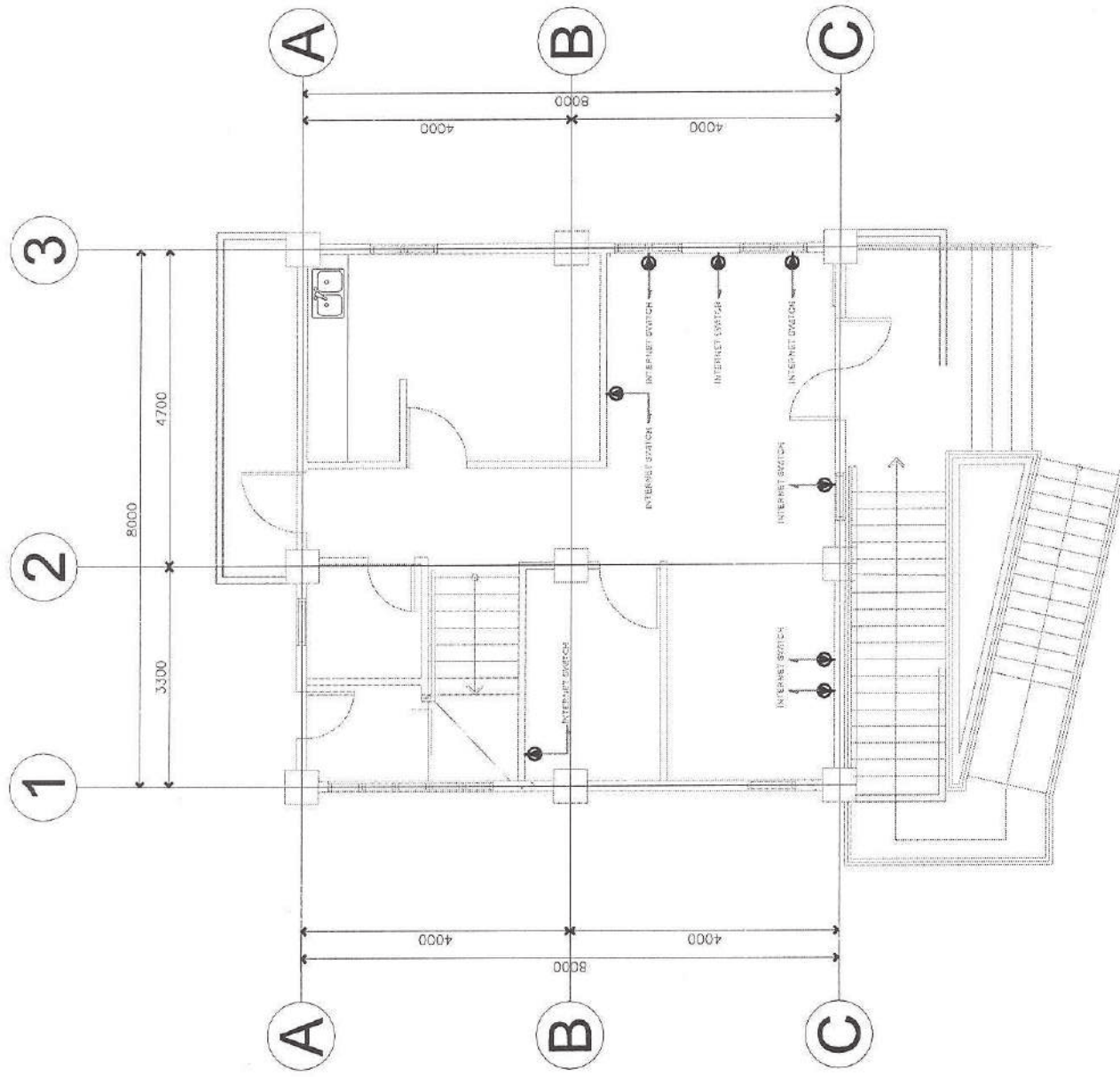
**SUBMITTED BY**  
 CG LT REYNER JAN P. DASOHOY  
 Head, Engineering Department, CGCS

**RECOMMENDING APPROVAL**  
 CG CDR LAURINCE IVAN N. FELIZARTE  
 Acting Deputy Commander, CGCS

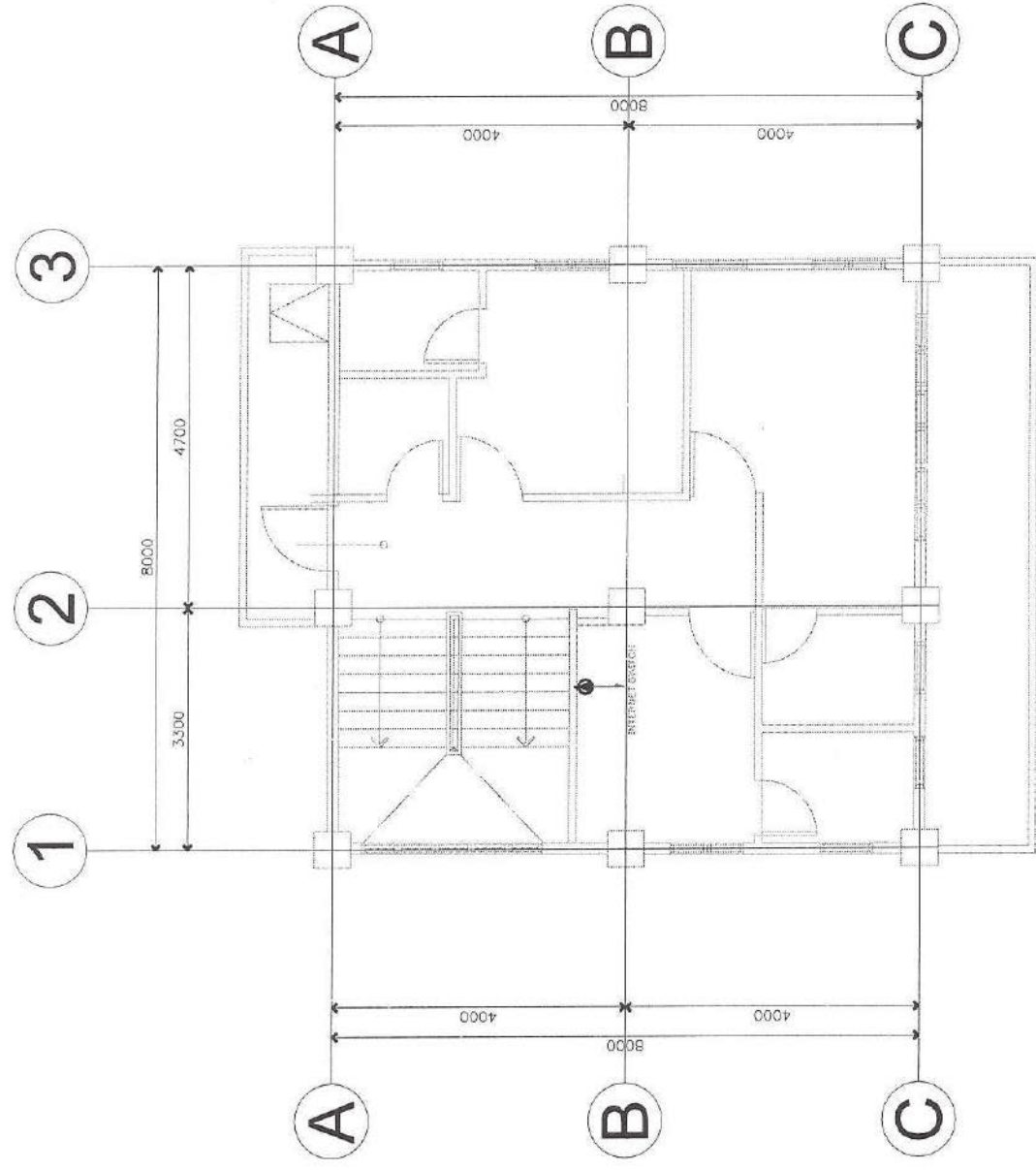
**APPROVED BY**  
 CG COMMO PRUDENCIO C. PATRICIO JR.  
 Commander, CGCS

**SHEET NO**  
 E-5  
 30 51





CGS NORTHERN SAMAR  
**1 GROUND FLOOR LOCAL AREA NETWORK LAYOUT**  
 SCALE **E 6** 1:100M



CGS NORTHERN SAMAR  
**2 SECOND FLOOR LOCAL AREA NETWORK LAYOUT**  
 SCALE **E 6** 1:100M



**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
 DEVELOPMENT SERVICE**  
 CGBF, Muelle de la Industria, Farola Compound  
 Binondo, Manila 1005

**PROJECT AND LOCATION**  
 CONSTRUCTION OF  
**STATION NORTHERN SAMAR**  
 Brgy. Sabang Zone 2, Alvin, Northern Samar  
 PHILIPPINE COAST GUARD

**SHEET CONTENT**  
 GROUND FLOOR  
 LOCAL AREA NETWORK LAYOUT  
 SECOND FLOOR  
 LOCAL AREA NETWORK LAYOUT

**BRANCH** Electrical and Mechanical Branch  
**PREPARED BY** *[Signature]*  
 CGS JR. JONAS M. MANTANAS  
 Member, Electrical and Mechanical Branch, CGDS  
**CHECKED BY** *[Signature]*  
 CGS ENS THOM DAVID C. AMANTE  
 Head, Electrical and Mechanical Branch, CGDS

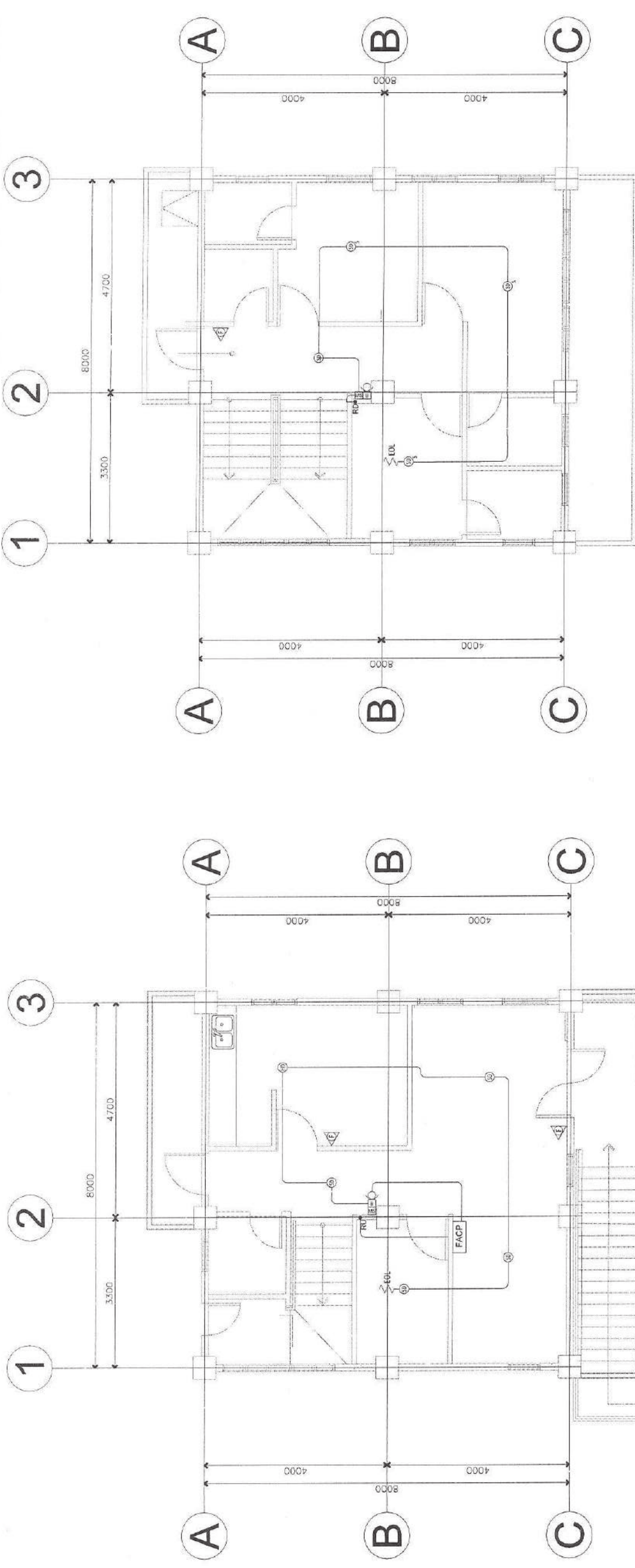
**SUBMITTED BY** *[Signature]*  
 CG LT REYNER JAN P. GONZALEZ  
 Head, Engineering Department, CGDS

**RECOMMENDING APPROVAL** *[Signature]*  
 CG CDR LAURINCE IVAN N. FELIZARTE  
 CGS, CGSAR, CGSAR, CGSAR

**APPROVED BY** *[Signature]*  
 CG COMMO PRUDENCIO J. PATRICIO JR.  
 CGSAR, CGSAR, CGSAR

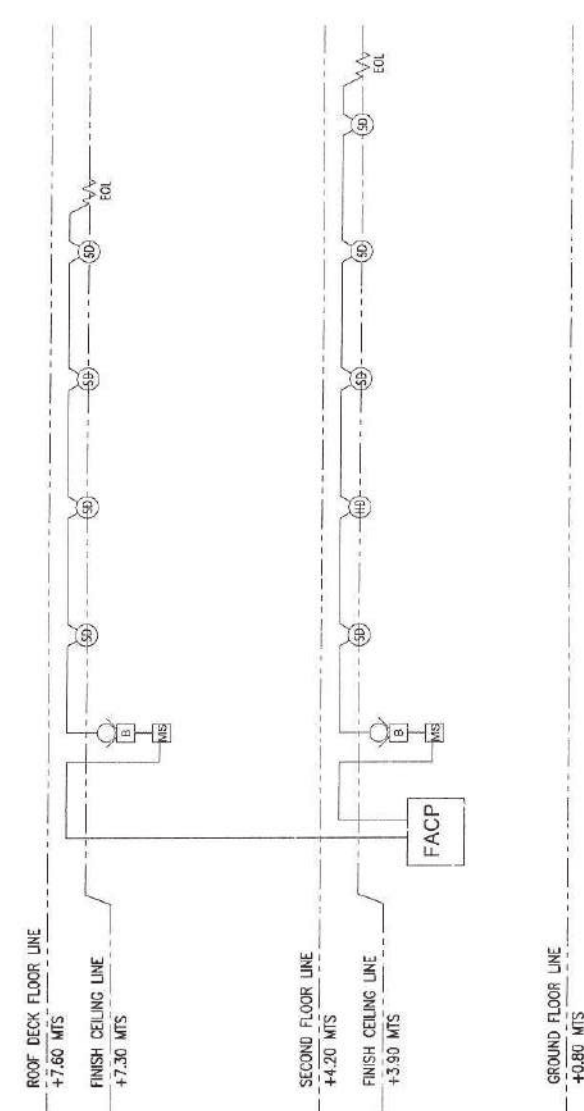
**SHEET NO**  
 E-6  
 31 51






CGS NORTHERN SAMAR  
**2**  
 SECOND FLOOR FDAS & FIRE EXTINGUISHER LAYOUT  
 SCALE  
 E 7  
 1:100M

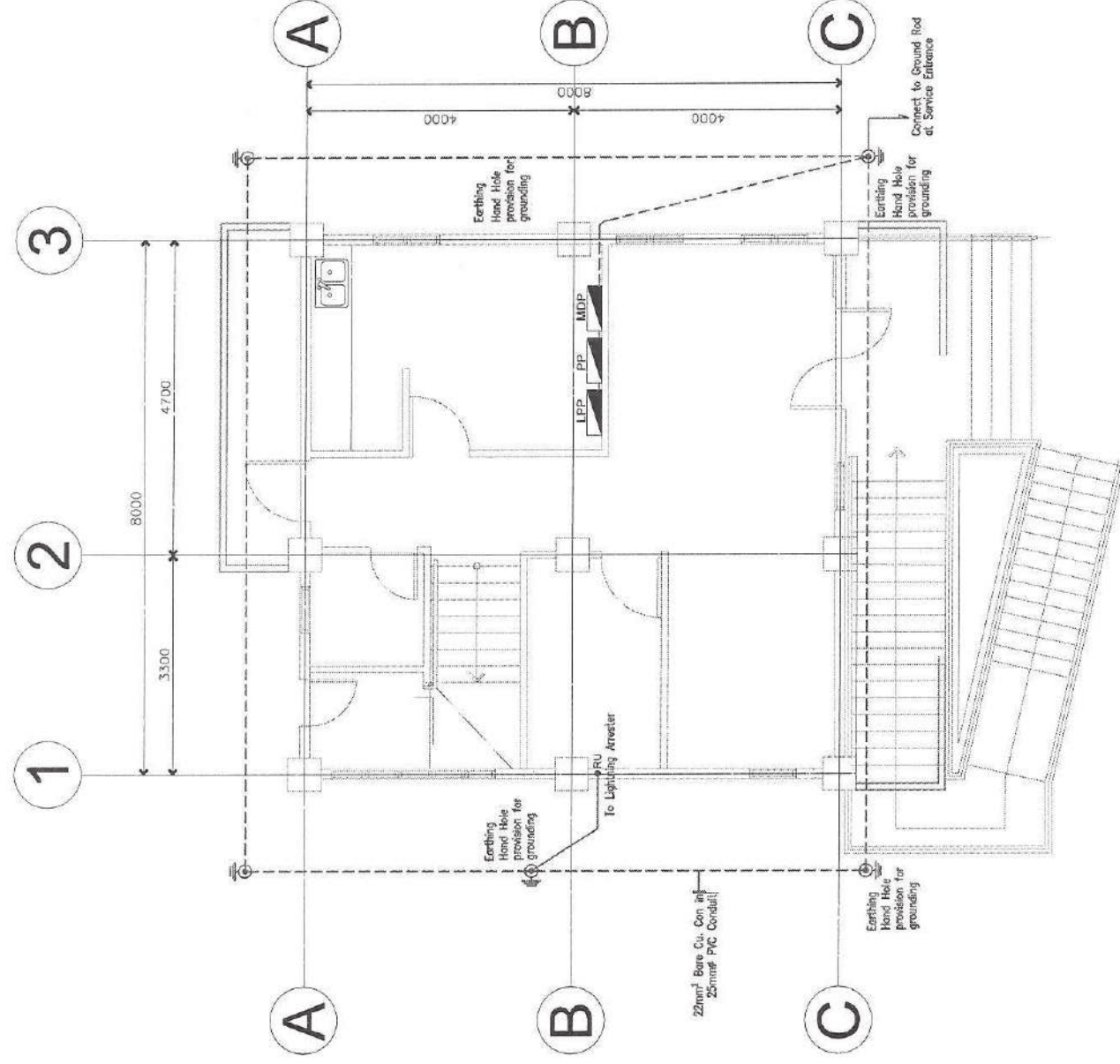
CGS NORTHERN SAMAR  
**1**  
 GROUND FLOOR FDAS & FIRE EXTINGUISHER LAYOUT  
 SCALE  
 E 7  
 1:100M



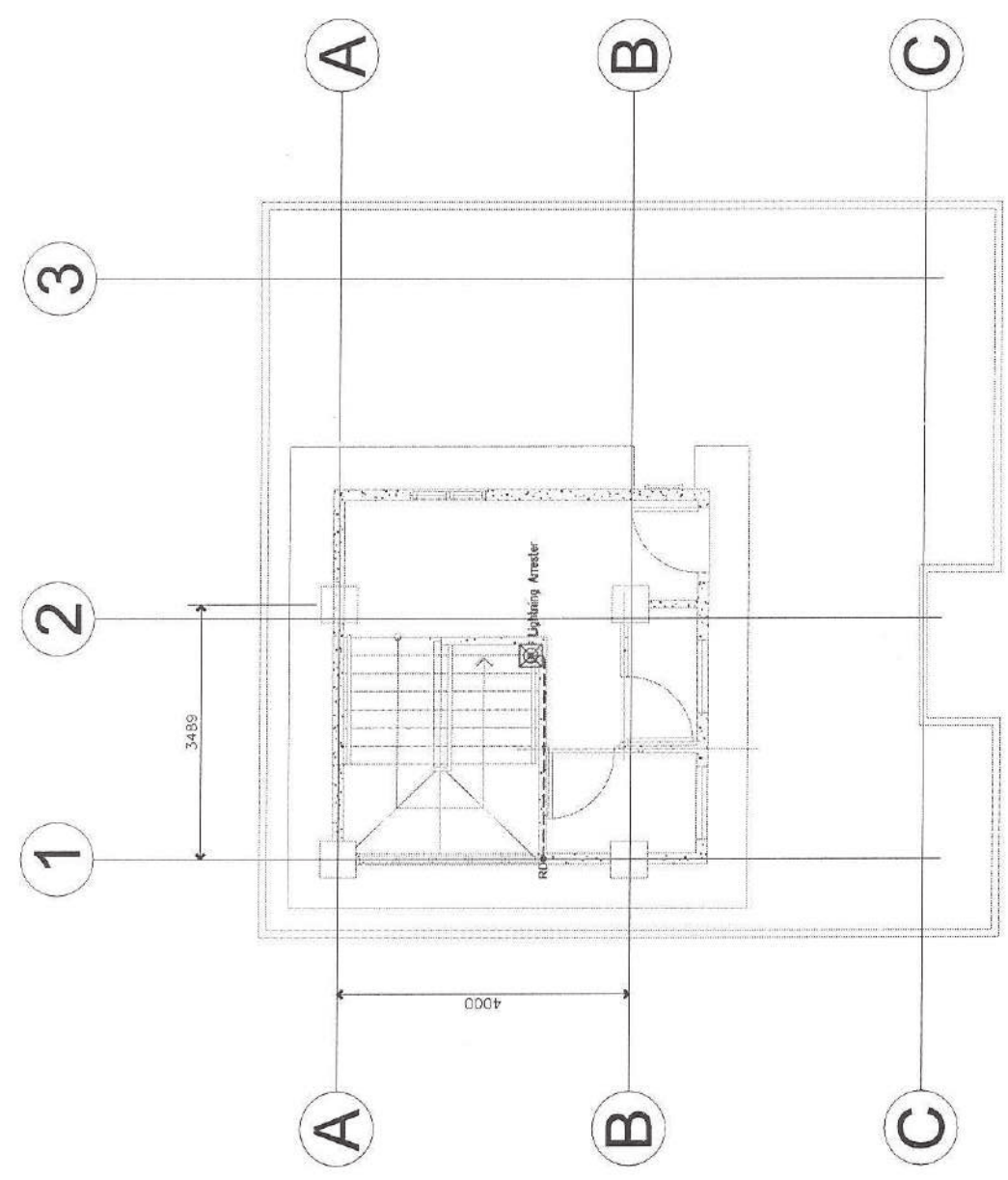
CGS NORTHERN SAMAR  
**3**  
 FDAS RISER DIAGRAM  
 SCALE  
 E 7  
 NTS

	<b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST. PORT AREA MANILA <b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGBF, Muelle dela Industria, Exola Compound Binondo, Manila 1006	PROJECT AND LOCATION <b>CONSTRUCTION OF</b> <b>STATION NORTHERN SAMAR</b> Bgy. Sabang Zone 2, Allen, Northern Samar <b>PHILIPPINE COAST GUARD</b>	SHEET CONTENT GROUND FLOOR FDAS & FIRE EXTINGUISHER LAYOUT SECOND FLOOR FDAS & FIRE EXTINGUISHER LAYOUT FDAS RISER DIAGRAM	BRANCH Electrical and Mechanical Branch PREPARED BY CGS NORTHERN SAMAR CHECKED BY CGS NORTHERN SAMAR	SUBMITTED BY CGS NORTHERN SAMAR RECOMMENDING APPROVAL CGS NORTHERN SAMAR	APPROVED BY CGS NORTHERN SAMAR	SHEET NO E-7 32 51
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CGS NORTHERN SAMAR  
**1 GROUND FLOOR GROUNDING & LIGHTNING PROTECTION**  
 SCALE **E 8** 1:100M



CGS NORTHERN SAMAR  
**2 ROOF DECK GROUNDING & LIGHTNING PROTECTION**  
 SCALE **E 8** 1:100M



**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
 CGDF, Muelle de la Industria, Farola Compound  
 Bironondo, Manila 1006

**PROJECT AND LOCATION**  
 CONSTRUCTION OF  
 STATION NORTHERN SAMAR  
 Brgy. Sabang Zone 2, Allen, Northern Samar  
 PHILIPPINE COAST GUARD

**SHEET CONTENT**  
 GROUND FLOOR  
 GROUNDING & LIGHTNING PROTECTION  
 ROOF DECK  
 GROUNDING & LIGHTNING PROTECTION

**BRANCH**  
 Electrical and Mechanical Branch  
**PREPARED BY**  
 CGS JORLAS O. MATRANAS  
 Marine, Electrical and Mechanical Branch, CGS  
**CHECKED BY**  
 CG ENS THOM DAVID C. AMANTE  
 Head, Electrical and Mechanical Branch, CGS

**SUBMITTED BY**  
 CG LT REYNER JAN P. DAGHON  
 Head, Planning Department, CGS

**RECOMMENDING APPROVAL**  
 CG JDR LAURINCEN IVAN N. FELIZARTE  
 Head, Design Department, CGS

**APPROVED BY**  
 CG COMMO PRUDENCIO PATRICIO JR.  
 Commander, CGS

**SHEET NO**  
 E-8  
 33 51



1. All electrical installations herein shall conform with the provisions of the latest edition of the Philippine Electrical Code, the rules and regulations of the national and local authorities concerned in the enforcement of electrical laws pertaining to the practice of electrical engineering and the requirement of the local utility company.
2. All electrical works herein shall be done under the strict supervision of a duly licensed professional electrical engineer or a registered electrical engineer or a registered master electrician.
3. No revisions shall be done without prior knowledge and approval of the designer/engineer; such revision done without approval shall cause responsibility of the designer/engineer to leave as a whole.
4. Unless otherwise indicated in the plan, the minimum size of conductor and conduit shall be 3.5 mm<sup>2</sup> and 15mm Ø for metallic tubing and 20mm Ø for polyvinyl chloride conduit.
5. All wirings shall be provided with an additional ground wire which shall be continuous throughout the whole system and properly bonded and grounded as provided in the Code.
6. All service/electrical equipment such as: safety switches, panelboards, transformers, metallic boxes and cabinets, raceways, etc., shall be properly grounded as provided in the Code.
7. Service entrance shall be 1Ø, 2-Wire, 230V, 60Hz.
8. All materials to be used shall be brand new and of the approved type for both location and purpose intended to, subject to the approval of the designer/engineer.

CGS NORTHERN SAMAR  
1 GENERAL NOTES  
E 10 SCALE  
NTS

	GROUND		1X15W LED DOWNLIGHT/LED BULB
	CIRCUIT BREAKER		1X20W LED FLUORESCENT LIGHTING FIXTURE
	CIRCUIT BREAKER		2X20W LED FLUORESCENT LIGHTING FIXTURE
	KILOWATT HOUR METER		1X50W LED FLOODLAMP
	RISER DOWN/UP		1X38W CEILING MOUNTED EXHAUST FAN
	LIGHTING AND POWER PANEL		1X55W WALL MOUNTED EXHAUST FAN
	POWER PANEL, MOTOR, AIR-CONDITIONING UNIT		1X65W ORBITAL CEILING FAN
	DISTRIBUTION PANEL		LED EMERGENCY LIGHT DUAL OPTICS
	MAIN DISCONNECT SWITCH		ONE-WAY ONE GANG SWITCH
	MANUAL TRANSFER SWITCH		ONE-WAY TWO GANG SWITCH
	SMOKE DETECTOR / SMOKE DETECTOR W/ SOUNDER		THREE-WAY SWITCH
	HEAT DETECTOR		DUPLEX CONVENIENCE OUTLET
	END OF LINE RESISTOR		ONE GANG CONVENIENCE OUTLET
	MANUAL PULL STATION, DUAL ACTION		REFRIGERATOR OUTLET
	HORN AND LIGHT STROBE		AIR-CONDITIONING OUTLET
	FIRE EXTINGUISHER		SPLIT TYPE ACU, INDOOR UNIT
	GROUND ROD WITH HANDHOLE		LAN OUTLET
	LIGHTNING ARRESTER		SERVICE ENTRANCE

CGS NORTHERN SAMAR  
2 LEGEND AND SYMBOLS  
E 10 SCALE  
NTS



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST., PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle de la Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
GENERAL NOTES  
FLAT AIR SURFACE TERMINAL DETAIL  
DOWNLEAD TO GROUND  
CONNECTION DETAIL  
LED LIGHTING FIXTURE DETAILS  
HAND-HOLE SECTION

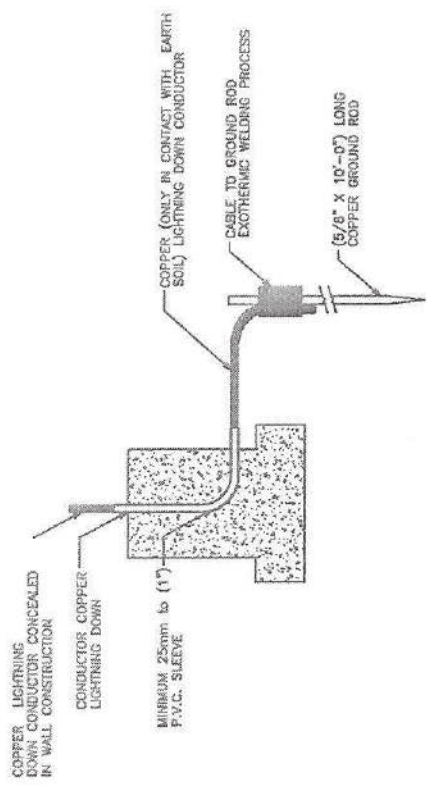
BRANCH  
Electrical and Mechanical Branch  
PREPARED BY  
CGS Northern Samar  
Member, Electrical and Mechanical Branch, CGS  
CHECKED BY  
CG ENSTHOM DAVID CAMANTE  
Head, Electrical and Mechanical Branch, CGS

SUBMITTED BY  
CG LT REYNER JAN P. DIAZ  
Head, Engineering Division, CGS

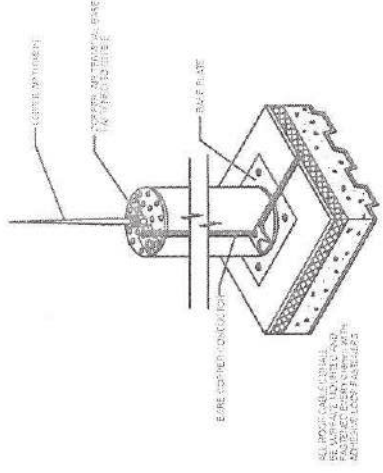
RECOMMENDING APPROVAL  
CG CDR LAURINE VAN FELIZARTE  
Safely Design Commander, CGS

APPROVED BY  
CG COMMO BRUCE VICIO PATRICIO JR.  
Commander, CGS

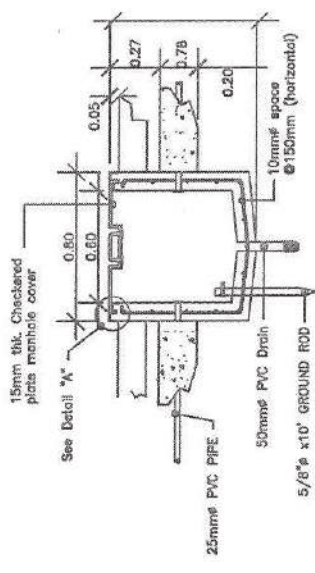
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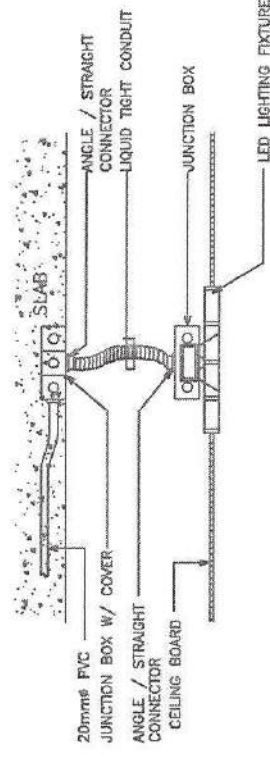
CGS NORTHERN SAMAR  
4 DOWN LEAD TO GROUND CONNECTION DETAIL  
E 10 SCALE  
NTS



CGS NORTHERN SAMAR  
3 FLAT SURFACE AIR TERMINAL MOUNTING DETAIL  
E 10 SCALE  
NTS



CGS NORTHERN SAMAR  
6 HAND HOLE SECTION  
E 10 SCALE  
NTS



CGS NORTHERN SAMAR  
5 LED LIGHTING FIXTURE DETAILS  
E 10 SCALE  
NTS



Main: 125AT, 18kAIC, 125AF, 1-Phase, 2-Pole, 230V, 60HZ Flush Mounting											
CKT	LOADS, NO. OF PANELS - VA RATINGS				VA / CIRCUIT	FRAME (AF)	POLE	TRIP	BRANCH RACEWAY		
									WIRE SIZE	CONDUIT SIZE	
1	LPP	- LIGHTING AND POWER PANEL			6251	60	2	50AT	1 - 8.0 mm <sup>2</sup> THW Cu Con + G 25mm <sup>2</sup> PVC Pipe		
2	PP	- AIR CONDITION UNIT & OTHER MOTOR LOADS			17221	100	2	70AT	1 - 14 mm <sup>2</sup> THHN Cu Con + G 32mm <sup>2</sup> PVC Pipe		
3	SPACE										
4	SPACE										
TOTAL CONNECTED LOAD					23472						
LOAD DESIGN ANALYSIS					COMPUTATIONS						
LOADS		CONN. VA	DF	DEMAND VA	Load Current = (23472 / 230)					=	102.05
1	LIGHTS	1312	100	1312	Load Demand Factor = (23472 / 23472) * 100%					=	100.00%
2	RECEPTACLES	5400	100	5400	Load Demand Current = (102.05 * 100%)					=	90.06 A
3	ACU	11408	100	11408	Total Load Current = (102.05 + 25% Largest Motor)*(1.25Spare)					=	111.67 A
4	OTHERS	5352	100	5352	Conductor Capacity = 111.67/ 140						
MAXIMUM DEMAND VA				23472	Use 1-50mm <sup>2</sup> THW Cu Con. + 14mm <sup>2</sup> G in 50mm <sup>2</sup> IMC						

Main: 40AT, 10kAIC, 60AF, 2P, 230V, 60HZ Flush Mounting Enclosure (BOLT - ON)														
CKT	LOADS NO. OF OUTLETS - VARIATIONS	LIGHTS	SWITCHES			VA / CIRCUIT	CURRENT (A)	FRAME (AF)	POLE	TRIP	TYPE	BRANCH RACEWAY		
			S <sub>L</sub>	S <sub>P</sub>	S <sub>SC</sub>							WIRE SIZE	CONDUIT SIZE	
1	OUTLETS 1 - 30W CEF, 1 - 60W ORBITAL 8 - 120VA LED LF, 1 - 120VA LED BULB, 1 - 55W XAL LED, 7 - 220VA LED FF	11 - 220VA LED FF, 3 - 120VA LED FF, 1 - 120VA LED BULB, 2 - 100VA LED BULB	3	5	0	2	966	50	2	15AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mmØ PVC Pipe	
2	3 - 35W CEF	4 - 120VA LED FF, 12 - 1X15VA LED Light Bulb	5	7	0	0	618	50	2	15AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mmØ PVC Pipe	
3	REF						500	217	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mmØ PVC Pipe
4	7 - 180VA						1260	548	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mmØ PVC Pipe
5	8 - 180VA						1440	626	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mmØ PVC Pipe
6	0.75 HP WINDOW TYPE ACU						1587	690	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mmØ PVC Pipe
TOTAL CONNECTED LOAD														
LOAD DESIGN ANALYSIS														
COMPUTATIONS														
Current = (6371/230)														
Demand Factor = (6371/6371) * 100%														
Demand Current = (27.2 * 100%)														
Feeder Sizing = 27.2 * 1.2 (Spalle)														
Capacity = 33.24/50														
Use: 2x8.0mm <sup>2</sup> THW Cu Con + 1x8.0mm <sup>2</sup> TW Ground in 1.25mmØ Conduit														
MAXIMUM DEMAND VA														
6371														

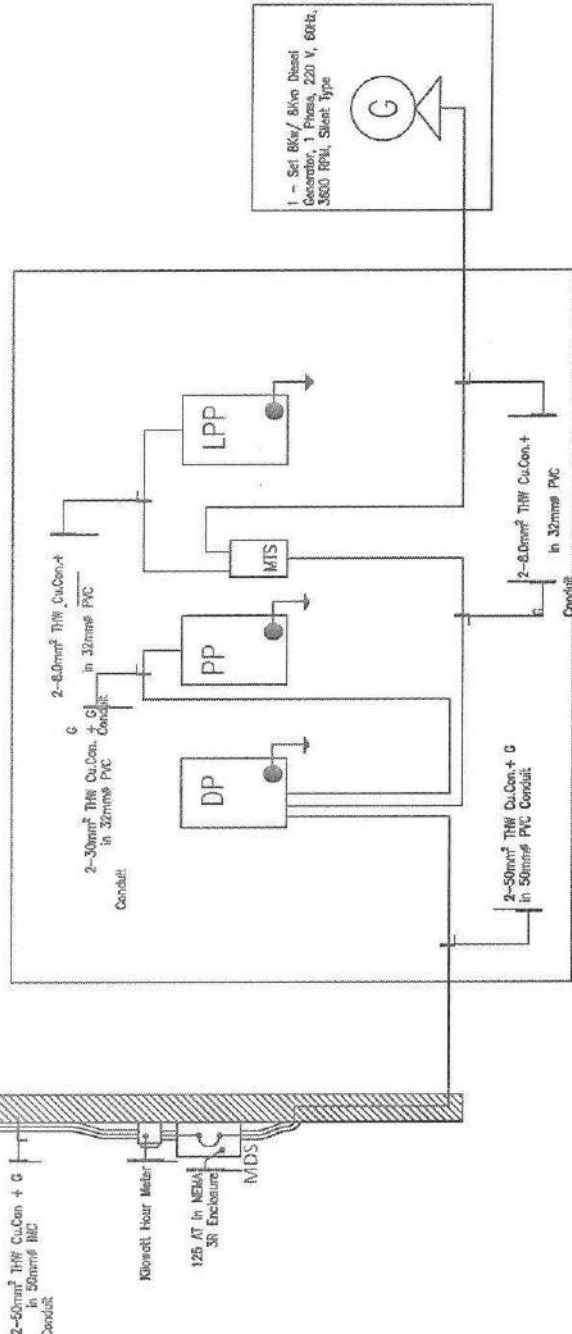
Main: 100AT, 10kAIC, 100AF, 2P, 230V, 60Hz Flush Mounting Enclosure (BOLT - ON)												
CKT	LOADS, NO. OF OUTLETS - VA RATINGS				VA / CIRCUIT	CURRENT (A)	FRAME (AF)	POLE	TRIP	TYPE	BRANCH RACEWAY	
	OUTLETS	OTHERS	ACU	CONDUIT SIZE							WIRE SIZE	
1			2.5 HP SPLIT TYPE ACU		3220	14.00	50	2	30AT	BOLT - ON	5.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
2			0.75 HP WINDOW TYPE ACU		1587	6.90	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
3			0.75 HP SPLIT TYPE ACU		1587	6.90	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
4			1 HP SPLIT TYPE ACU		1840	8.00	50	2	30AT	BOLT - ON	5.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
5			2 HP TRANSFER PUMP		2100	9.13	50	2	30AT	BOLT - ON	5.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
6			2 HP BOOSTER PUMP		2100	9.13	50	2	30AT	BOLT - ON	5.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
7		7 - 180VA			1260	10.13	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
8		8 - 180VA			1440	5.47	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
9			FACP		500	2.17	50	2	20AT	BOLT - ON	3.5 mm <sup>2</sup> THHN Cu Con + G	20mm <sup>2</sup> PVC Pipe
10			SPARE									
TOTAL CONNECTED LOAD					15634	71.8						
LOAD DESIGN ANALYSIS												
LOADS				CONN. VA	DF	DEMAND VA						
1	LIGHTS			100		Current = (15634 / 230)		=		71.8 A		
2	RECEPTACLES			2700	100	Demand Factor = (15634/15634) * 100%		=		100.00%		
3	ACU			8234	100	Demand Current = (71.8 * 100%)		=		78.7 A		
4	OTHERS			4700	100	Feeder Sizing = [(71.8 + 25% Largest Motor) x 1.2 Spare]		=		90.36 A		
MAXIMUM DEMAND VA				15634	Capacity = 90.36 / 100							
Use : 2-30mm <sup>2</sup> THW Cu Con + 14.0mm <sup>2</sup> TW Ground in 1-32mm <sup>2</sup> Conduit												

# 1 E 9 SCALE

CGS NORTHERN SAMAR  
LOAD SCHEDULE  
NTS

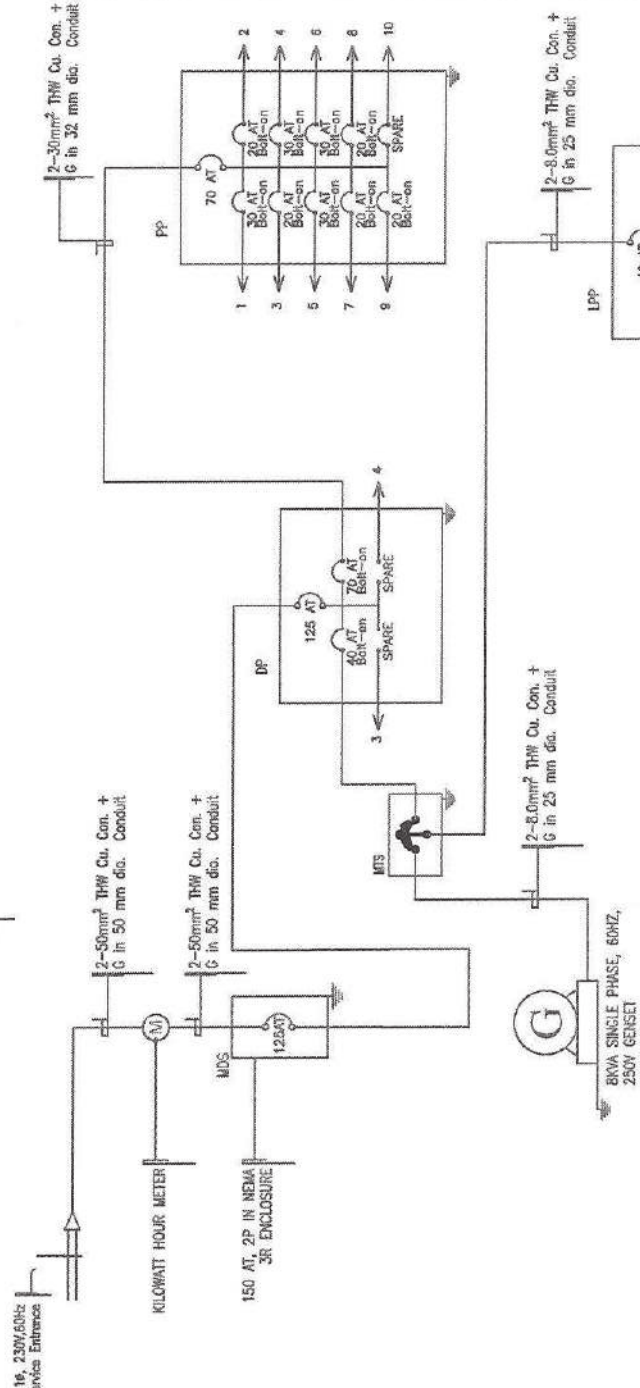
Power Sources : LOCAL UTILITY COMPANY

SINGLE PHASE 230V, 60 HZ LINE SERVICE



## 2 E 9 SCALE

CGS NORTHERN SAMAR  
SINGLE LINE RISER DIAGRAM  
NTS



## 3 E 9 SCALE

CGS NORTHERN SAMAR  
SINGLE LINE PANEL DIAGRAM  
NTS



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle de Industria, Ermita Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Bay, Subic Bay Zone 2, Alen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
LOAD SCHEDULE  
SINGLE LINE PANEL DIAGRAM  
SINGLE LINE RISER DIAGRAM

BRANCH  
Electrical and Mechanical Branch  
PREPARED BY  
CGS ENR, Jorge C. Mairanas  
Member: Electrical Engineering Board, ECE  
CHECKED BY  
CGS ENR, David Camante  
Member: Electrical Engineering Board, ECE

SUBMITTED BY  
CGS ENR, David Camante  
RECOMMENDING APPROVAL  
CGS ENR, David Camante  
APPROVED BY  
CGS ENR, David Camante

SHEET NO  
E-9  
34 51

CGS ENR, David Camante  
CGS ENR, David Camante  
CGS ENR, David Camante  
CGS ENR, David Camante



1. ALL PLUMBING WORKS TO BE DONE AND SIZES OF PIPES TO BE USED SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE NATIONAL PLUMBING CODE OF THE PHILIPPINES AND LOCAL REGULATIONS AND ORDINANCES.

2. ALL PIPES SHALL BE INSTALLED AS INDICATED IN THE WORKING DRAWINGS. ANY RELOCATION REQUIRED FOR PROPER EXECUTION OF OTHER TRADES SHALL BE UPON THE APPROVAL OF THE REGISTERED MASTER PLUMBER OR SANITARY ENGINEER.
3. WRITTEN DIMENSION SHALL TAKE PRECEDENCE OVER SCALED DIMENSIONS.
4. ALL PIPES SHALL BE PROVIDED WITH PROPER HANGER AND SUPPORT.
5. ALL FIXTURES SHALL BE VENTED INDIVIDUALLY AND WATERLINES SHALL BE VALVE BY VALVE.
6. UNLESS OTHERWISE SPECIFIED, ALL PLUMBING FIXTURES SHALL BE PROPERLY VENTED. MAXIMUM DISTANCE OF VENTILATION FROM FIXTURES SHALL BE 1.50m MEASURED ALONG THE LENGTH OF PIPE.
7. ALL PLUMBING FITTINGS SHALL BE ACCESSIBLE FOR MAINTENANCE. PROVIDE MANHOLE IF SUCH INSTALLATIONS ARE INSIDE THE CEILING.
8. ALL CHANGES IN DIRECTIONS SHALL BE MADE BY THE APPROPRIATE USE OF FORTY FIVE (45) WYE LONG SWEEP QUARTER BEND. ONE EIGHT WHEN THE CHANGE OF FLOW IS FROM HORIZONTAL TO VERTICAL. A SINGLE BEND COMBINATION MAY BE USED ONLY ON VENT PIPE.
9. NO DOUBLE HUB OR DOUBLE TEE BRANCH SHALL BE USED ON HORIZONTAL SOIL OR WASTE LINES.
10. PROVIDE PIPE SLEEVES AT WALL, COLUMNS OR SLAB TO PROTECT FROM BRACKAGE.

11. ALL EXPOSED PIPINGS AND FITTINGS IN THE AREAS SHALL BE CHROME PLATED.
12. THE BRAND AND OTHER DETAILED PLUMBING FIXTURES SHALL BE IN ACCORDANCE WITH THE SCHEDULE FURNISHED BY THE ARCHITECT.
13. GATE VALVE SHALL BE BRONZE BODY, SOLID WEDGE TYPE, SCREWED OR FLANGE END.
14. USE P OL'YVINYL CHLORIDE, uPVC (SERIES 1000) FOR WATER PIPING SYSTEM.
15. USE uPVC SANITARY PIPING SYSTEM SERIES 1000 FOR 100mmØ AND SMALLER AND GRAVITY SEWER MAIN uPVC PIPING SYSTEM FOR 150mmØ AND BIGGER.
16. ENGINEER-IN-CHARGE TO VERIFY ACTUAL LOCATION AND ELEVATION OF STREET DRAINAGE, STREET SEWER AND STREET WATER MAINS FOR CONNECTION BEFORE CONSTRUCTION.

1. GRADES OF HORIZONTAL PIPINGS  
RUN ALL HORIZONTAL PIPINGS IN PERFECT ALIGNMENT AND AT FORM GRADE NOT  
LESS THAN TWO PERCENT (2%)

2. CHANGE IN DIRECTION  
ALL CHANGE IN DIRECTION SHALL BE MADE BY APPROPRIATE USE OF FORTY-FIVE DEGREES (45°) WYES, LONG SWEEP QUARTER BEND, SIXTH EIGHT OR SIXTEENTH BEND. WHEN THE CHANGE OF FLOW IS FROM HORIZONTAL TO VERTICAL, A SINGLE 1/8 BEND COMBINATION MAY BE USED ON VERTICAL STACKS, AND SHORT QUARTER BENDS MAY BE USED ON WASTE LINE, TEE AND CROSSES MAYBE USED IN BENT PIPES.
3. PROHIBITED FITTINGS  
NO DOUBLE HUB OR TEE BRANCH SHALL BE USED ON HORIZONTAL SOIL AND WASTE LINES, THE DRILLINGS AND TAPPING OF HOUSE DRAIN, WASTE OR VENT PIPES AND USE OF SADDLE HUB AND BEND ARE PROHIBITED.
4. PIPE CLEAN-OUTS  
CLEAN-OUTS ARE REQUIRED UNDER THE FOLLOWING CONDITIONS:
  - a. EVERY CHANGE OF HORIZONTAL DIRECTION EXCEEDING TWENTY TWO AND ONE-HALF DEGREES (22-1/2°).
  - b. ONE AND ONE-HALF METERS (1.50m) INSIDE THE PROPERTY LINES BEFORE THE HOUSE DRAINAGE CONNECTION.
  - c. EVERY FIFTEEN METERS (15.00m) IN HORIZONTAL RUN OF PIPES.
  - d. AT THE END OF ANY HORIZONTAL PIPE LINES.
5. THE DIGESTION CHAMBER OF SEPTIC VAULT MUST BE WATERPROOFED.
6. NOT LESS THAN 0.30m OF AIR SPACE MUST BE LEFT BETWEEN THE TOP OF THE SEWAGE AND THE UNDER PART OF VAULT ROOF SLAB.
7. NO SEPTIC VAULT SHALL BE CONSTRUCTED UNDER THE BUILDING.
8. ALL PLUMBING WORKS SHALL BE UNDER THE SUPERVISION OF A LICENSED MASTER PLUMBER OR SANITARY ENGINEER AND A LICENSED PLUMBING CONTRACTOR.

COLD WATER LINE SHALL BE POLYPROPYLENE RANDOM (PPR) TYPE 3 PIPE PN20, "WAVIN EKOPLASTIK" BRAND OR APPROVED EQUAL

VENT PIPES SHALL BE POLYVINYL CHLORIDE (PVC) PIPE SERIES 1000, "NELTEX", "ATLANTA" BRAND OR APPROVED EQUAL

**FITTING**  
SHALL BE SOLVENT CEMENT JOINT TO ASTM D2584.

SEWER LINES SHALL BE POLYVINYL CHLORIDE (PVC) PIPE SERIES

SEWER LINES SHALL BE POLYVINYL CHLORIDE (PVC) PIPE SERIES 1000, "NELTEX", "ATLANTA" BRAND OR APPROVED EQUAL. FITTINGS SHALL BE SOLVENT CEMENT JOINT TO ASTM D2564.

STORM DRAINAGE LINES SHALL BE POLYVINYL CHLORIDE (PVC) SERIES 1000 "ATLANTA" BRAND OR APPROVED EQUAL. FITTING SHALL BE SOLVENT CEMENT JOINT TO ASTM D 2564. 250mmØ & ABOVE. MATERIAL SHALL BE CONCRETE DRAIN PIPE (CDP) TONGUE & GROOVE. MORTAR JOINTS, REINFORCED FOR 300mmØ & LARGER.

SHALL BE POLYVINYL CHLORIDE (PVC) PIPE SERIES 600 II, "NELTEX", "ATLANTA"  
 BRAND OR APPROVED EQUAL.

**FITTINGS** SHALL BE SOLVENT CEMENT JOINT TO ASTM D2564.

CHECK VALVES  
"GREAT VOLUME," "CRANE," "KITS," OR APPROVED EQUAL.

GATE VALVES  
"GREAT VOLUME", "CRANE", "KITS", OR APPROVED EQUAL

WATER METER "ARAD" "ASAHI" BRAND OR APPROVED EQUAL.

S/N	EQUIPMENT DESCRIPTION	QTY	LOCATION	FLOWRATE (GPM)	TDR (ft)	Mobile B <sup>2</sup> Power Pack (HP)	Electrical Connections (ft)	Webcam (ft)	TYPE	REMARKS	
1	TRANSFER PUMPS	1 UNIT	GF	50	6.01	55	2	250	3	Vertical, mid-depth camera and pump with 100' and 150' cables. (Pump) (Type computer unit) 200-550-550-550.	Unit shall be Flow, Web, Caudex, 1 unit 4.0g & 1 unit standby
2	BOOSTER PUMPS	1 UNIT	RD	50	62.45	55	2	250	1	Vertical, mid-depth camera and pump with 100' and 150' cables. (Pump) (Type computer unit) 200-550-550-550.	Unit shall be Flow, Web, Caudex, 1 unit 4.0g & 1 unit standby

WATER DISTRIBUTION SYSTEM	
	COLD WATER LINE
	RECYCLE WATER LINE
	HOT WATER LINE
	FIRE LINE
	GV GATE VALVE
	CV CHECK VALVE
	WSP WATER METER
	AC AIR CHAMBER

VENT PIPE SIZES SCHEDULE		
FIXTURE	ABBR.	PIPE SIZES (mm dia.)
FLOOR DRAIN	FD	50
WATER CLOSET	WC	50
WASH BASIN	WB	50
KITCHEN SINK	KS	50

FIXTURE	ABBR.	PIPE SIZES (mm dia.)
WATER CLOSET	WC	100
WASH BASIN	WB	50
FLOOR DRAIN	FD	50
FLOOR TRAP	FT	75
SHOWER DRAIN	SD	50
KITCHEN SINK	KS	50
WASHING MACHINE	WM	50
PARKING DRAIN	PD	75

FIXTURE	ABBR.	PPE SIZES (D (mm dia.))
SHOWER	SHQ	15
WATER CLOSET FV	WC	25
WATER CLOSET FT	WC	15
LAVATORY	LAV	15
URINAL	UR	20

		NOMINAL SIZE										
		1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	6"	8"
POLYPROPYLENE (PPR)	mm dia.	20	25	32	40	50	63	75	90	110		
GALVANIZED IRON (G.I.)	mm dia.	12	19	25	32	40	50	65	80	100	150	200

**SCHEDULE OF PIPE SLEEVE**

PIPE SIZE		25	32	40	50	65	80	100	150	200
SLEEVE SIZE	mm dia.	50	50	65	100	125	125	200	250	300

1. GRADES OF HORIZONTAL PIPINGS  
RUN ALL HORIZONTAL PIPINGS IN PERFECT ALIGNMENT AND AT FORM GRADE NOT  
LESS THAN TWO PERCENT (2%)

2. CHANGE IN DIRECTION  
ALL CHANGE IN DIRECTION SHALL BE MADE BY APPROPRIATE USE OF FORTY-FIVE DEGREES (45°) WYES, LONG SWEEP QUARTER BEND, SIXTH EIGHT OR SIXTEENTH BEND. WHEN THE CHANGE OF FLOW IS FROM HORIZONTAL TO VERTICAL, A SINGLE 1/8 BEND COMBINATION MAY BE USED ON VERTICAL STACKS, AND SHORT QUARTER BENDS MAY BE USED ON WASTE LINE, TEE AND CROSSES MAYBE USED IN BENT PIPES.
3. PROHIBITED FITTINGS  
NO DOUBLE HUB OR TEE BRANCH SHALL BE USED ON HORIZONTAL SOIL AND WASTE LINES, THE DRILLINGS AND TAPPING OF HOUSE DRAIN, WASTE OR VENT PIPES AND USE OF SADDLE HUB AND BEND ARE PROHIBITED.
4. PIPE CLEAN-OUTS  
CLEAN-OUTS ARE REQUIRED UNDER THE FOLLOWING CONDITIONS:
  - a. EVERY CHANGE OF HORIZONTAL DIRECTION EXCEEDING TWENTY TWO AND ONE-HALF DEGREES (22-1/2°).
  - b. ONE AND ONE-HALF METERS (1.50m) INSIDE THE PROPERTY LINES BEFORE THE HOUSE DRAINAGE CONNECTION.
  - c. EVERY FIFTEEN METERS (15.00m) IN HORIZONTAL RUN OF PIPES.
  - d. AT THE END OF ANY HORIZONTAL PIPE LINES.
5. THE DIGESTION CHAMBER OF SEPTIC VAULT MUST BE WATERPROOFED.
6. NOT LESS THAN 0.30m OF AIR SPACE MUST BE LEFT BETWEEN THE TOP OF THE SEWAGE AND THE UNDER PART OF VAULT ROOF SLAB.
7. NO SEPTIC VAULT SHALL BE CONSTRUCTED UNDER THE BUILDING.
8. ALL PLUMBING WORKS SHALL BE UNDER THE SUPERVISION OF A LICENSED MASTER PLUMBER OR SANITARY ENGINEER AND A LICENSED PLUMBING CONTRACTOR.

COLD WATER LINE

VENT PIPES SHALL BE POLYVINYL CHLORIDE (PVC) PIPE SERIES 1000, "NELTEX", "ATLANTA" BRAND OR APPROVED EQUAL

FITTING SHALL BE SOLVENT CEMENT JOINT TO ASTM D2584.

SEWER LINES SHALL BE POLYVINYL CHLORIDE (PVC) PIPE SERIES

SEWER LINES SHALL BE POLYVINYL CHLORIDE (PVC) PIPE SERIES 1000, "NELTEX", "ATLANTA" BRAND OR APPROVED EQUAL. FITTINGS SHALL BE SOLVENT CEMENT JOINT TO ASTM D2564.

STORM DRAINAGE LINES SHALL BE POLYVINYL CHLORIDE (PVC) SERIES 1000 "ATLANTA" BRAND OR APPROVED EQUAL. FITTING SHALL BE SOLVENT CEMENT JOINT TO ASTM D 2564. 250mmØ & ABOVE. MATERIAL SHALL BE CONCRETE DRAIN PIPE (CDP) TONGUE & GROOVE. MORTAR JOINTS, REINFORCED FOR 300mmØ & LARGER.

SHALL BE POLYVINYL CHLORIDE (PVC) PIPE SERIES 600 II, "NELTEX", "ATLANTA"  
 BRAND OR APPROVED EQUAL.

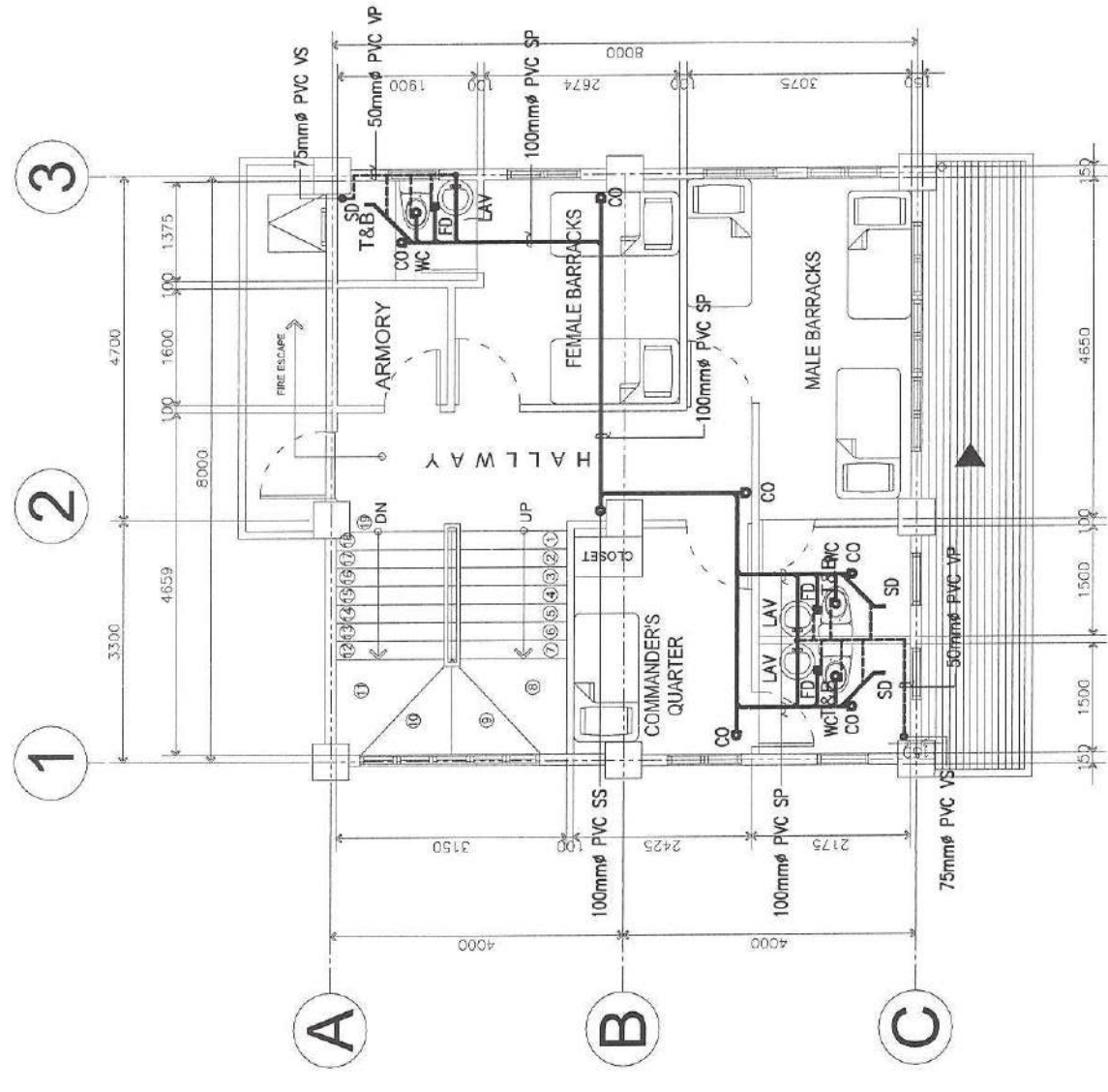
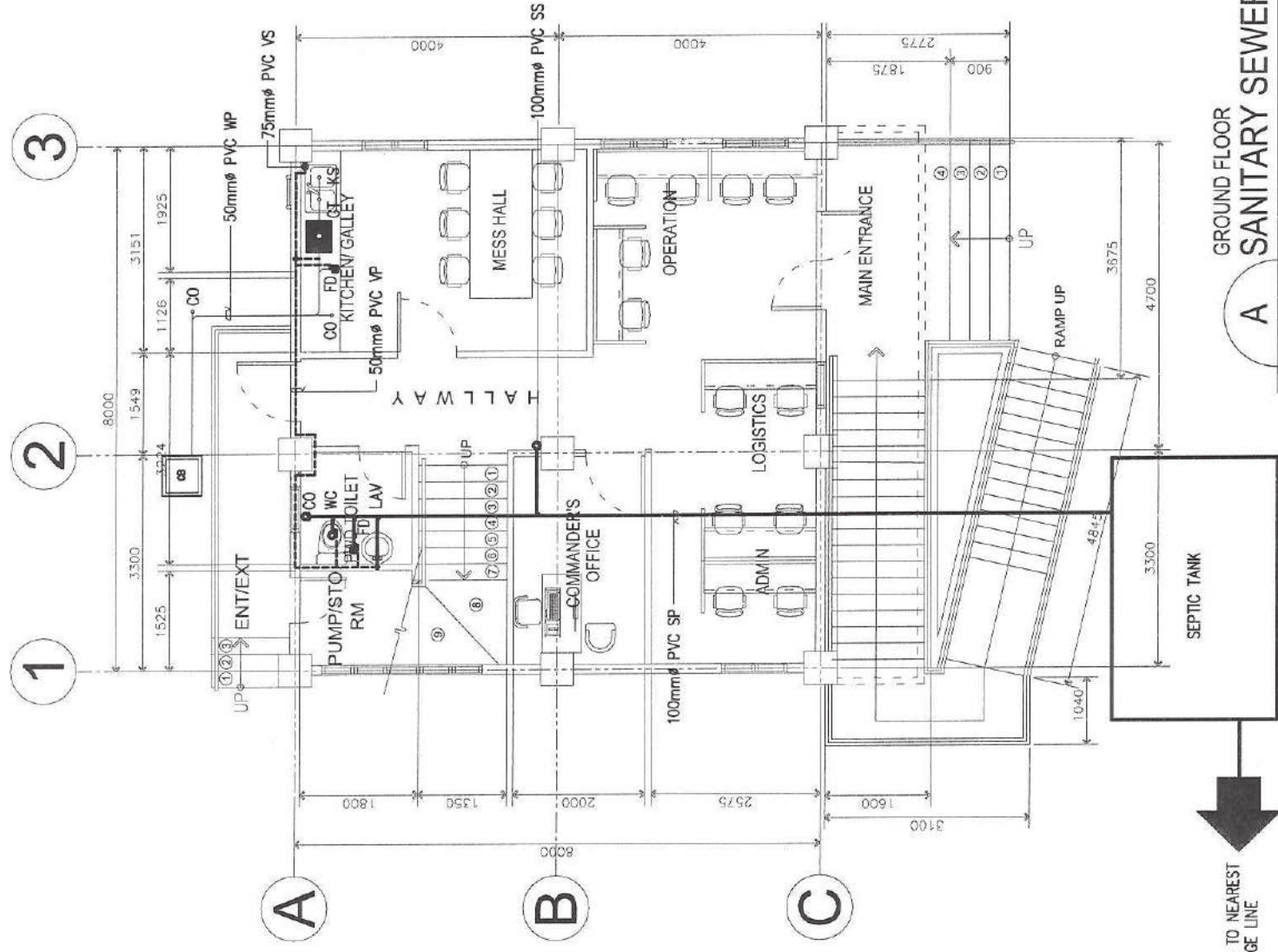
**FITTINGS** SHALL BE SOLVENT CEMENT JOINT TO ASTM D2564.

CHECK VALVES  
"GREAT VOLUME," "CRANE," "KITS," OR APPROVED EQUAL.

GATE VALVES  
"GREAT VOLUME", "CRANE", "KITS", OR APPROVED EQUAL

WATER METER "ARAD" "ASAHI" BRAND OR APPROVED EQUAL.





**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
 CGBF, Muelle dela Industria, Farola Compound  
 Binondo, Manila 1006

**PROJECT AND LOCATION**  
 CONSTRUCTION OF  
 STATION NORTHERN SAMAR  
 Brig. Sabang Zone 2, Alir, Northern Samar  
 PHILIPPINE COAST GUARD

**SHEET CONTENT**  
 SANITARY SEWERLINE LAYOUT

**BRANCH**  
 Plumbing and Sanitary Branch  
**PREPARED BY**  
 CG ENS JESMAR REY A VELASQUEZ  
 Member, Plumbing and Sanitary Branch, CGBF  
**CHECKED BY**  
 CG ENS GEORGE PATRICK R FERNANDEZ  
 Head, Plumbing and Sanitary Branch, CGBF

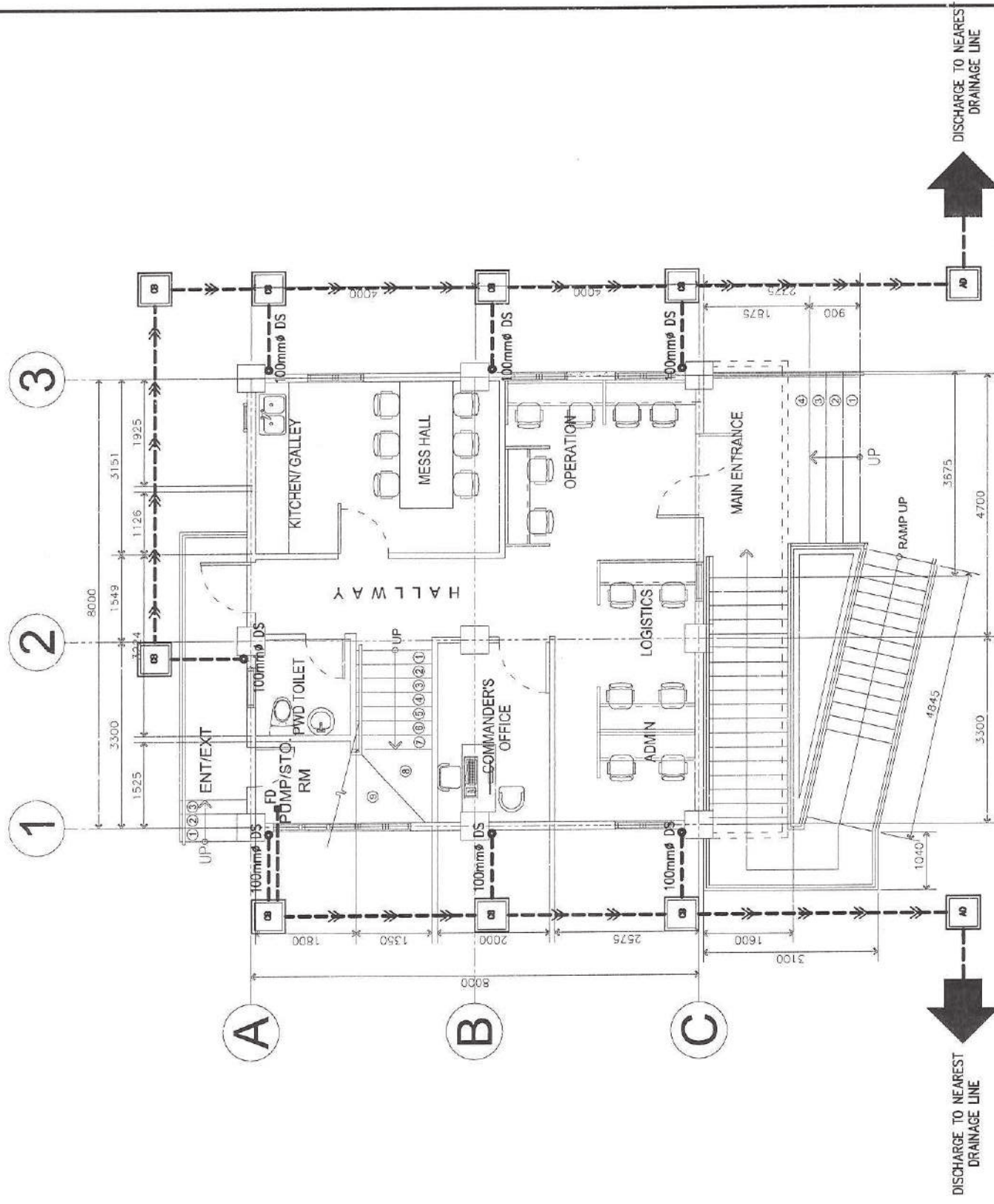
**SUBMITTED BY**  
 CG LT REYMER JAN P DAGORAY  
 Head, Engineering Department, CGBF

**RECOMMENDING APPROVAL**  
 CG CDR LAURINCE KAN FELIZARTE  
 Acting Deputy Commander, CGBF

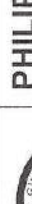



**APPROVED BY**  
 CG COMMO PRUDENCIO PATRICIO JR.  
 Commander, CGBF

**SHEET NO**  
 P-2  
 37 51

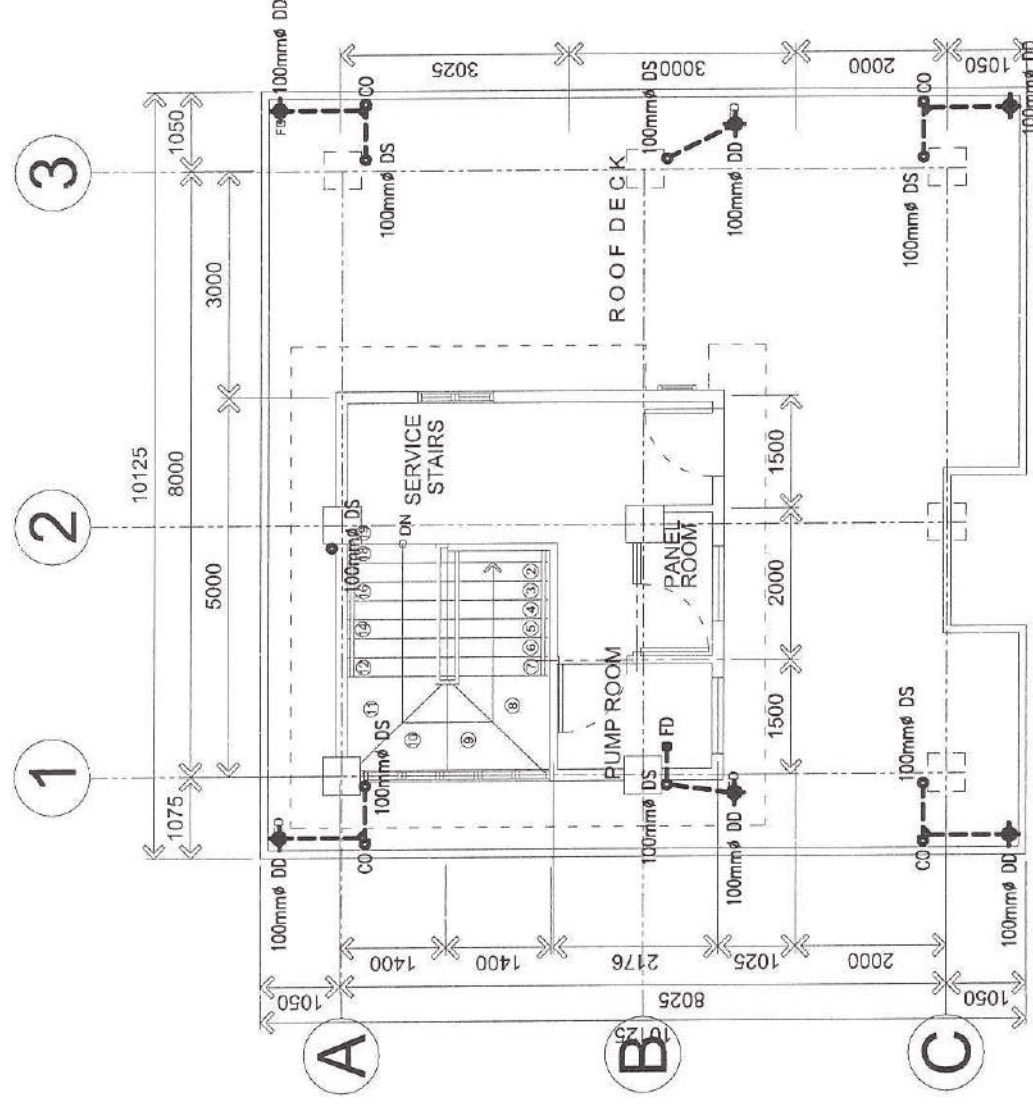
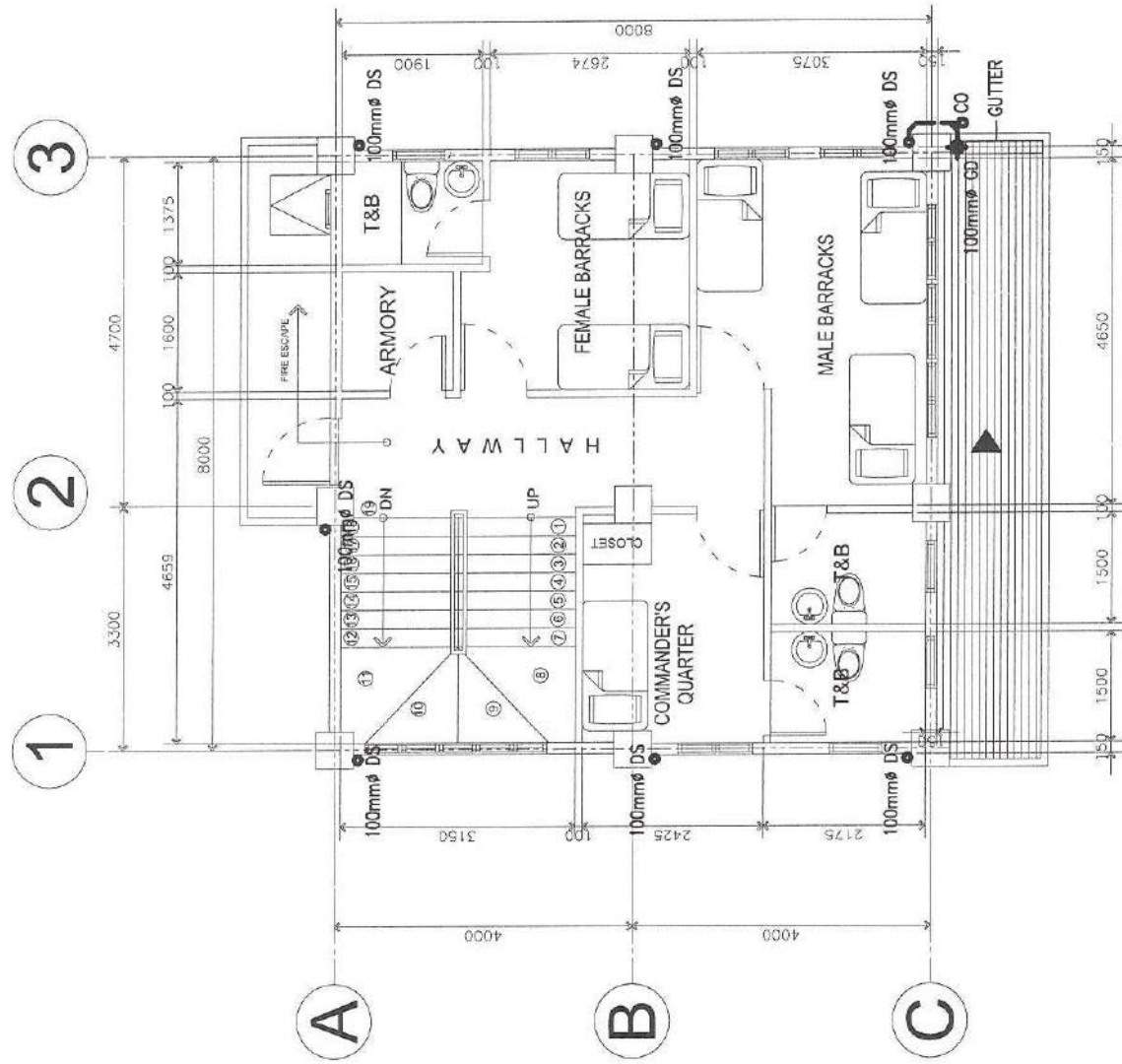




GROUND FLOOR  
B STORM DRAINAGE LAYOUT  
SCALE 1:100M

<div><p><b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST., PORT AREA MANILA</p><p><b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGBF, Muelle dela Industria, Farola Compound Binondo, Manila 1006</p></div>	<div><p><b>PROJECT AND LOCATION</b></p><p>CONSTRUCTION OF STATION NORTHERN SAMAR Bay, Sabang Zone 2, Allen, Northern Samar</p><p>PHILIPPINE COAST GUARD</p></div>	<div><p><b>SHEET CONTENT</b></p><p>SANITARY SEWERLINE LAYOUT STORM DRAINAGE LAYOUT</p></div>	<div><p><b>BRANCH</b></p><p>Plumbing and Sanitary Branch</p></div>	<div><p><b>PREPARED BY</b></p><p>CG ENS. JELONAR REY A. VELASQUEZ Member, Numbering and Sanitary Branch, CGBS</p></div>	<div><p><b>SUBMITTED BY</b></p><p> CG LT REYNER JAN P. DAHOY Head of Engineering Department, CGBS</p></div>	<div><p><b>RECOMMENDING APPROVAL</b></p><p> CG CDR LAURINO IVAN N. FELIZARTE Engineering Deputy Commander, CGBS</p></div>	<div><p><b>APPROVED BY</b></p><p> CG COMMO PRUDENCIO C. PATRICIO, JR. Communications Commander, CGBS</p></div>	<div><p><b>SHEET NO.</b></p><div><div>P-3</div><div>38 51</div></div></div>
				<div><p><b>CHECKED BY</b></p><p>CG ENS. GEORGE PATRICK R. FERNANDEZ Staff Engineer, Numbering and Sanitary Branch, CGBS</p></div>				





**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
 CGBF, Muelle de la Industria, Farola Compound  
 Binondo, Manila 1006

**PROJECT AND LOCATION**  
 CONSTRUCTION OF  
 STATION NORTHERN SAMAR  
 Brgy. Sabang Zone 2, Alim. Northern Samar  
 PHILIPPINE COAST GUARD

**SHEET CONTENT**  
 STORM DRAINAGE LAYOUT

**BRANCH**  
 Plumbing and Sanitary Branch  
**PREPARED BY**  
 CG ENS. JEDUAR REY A VELASQUEZ  
 Member (Plumbing and Sanitary Branch, CGBF)  
**CHECKED BY**  
 CG ENS. GEORGE PATRICK R FERNANDEZ  
 Head, Sanitary and Plumbing Branch, CGBF

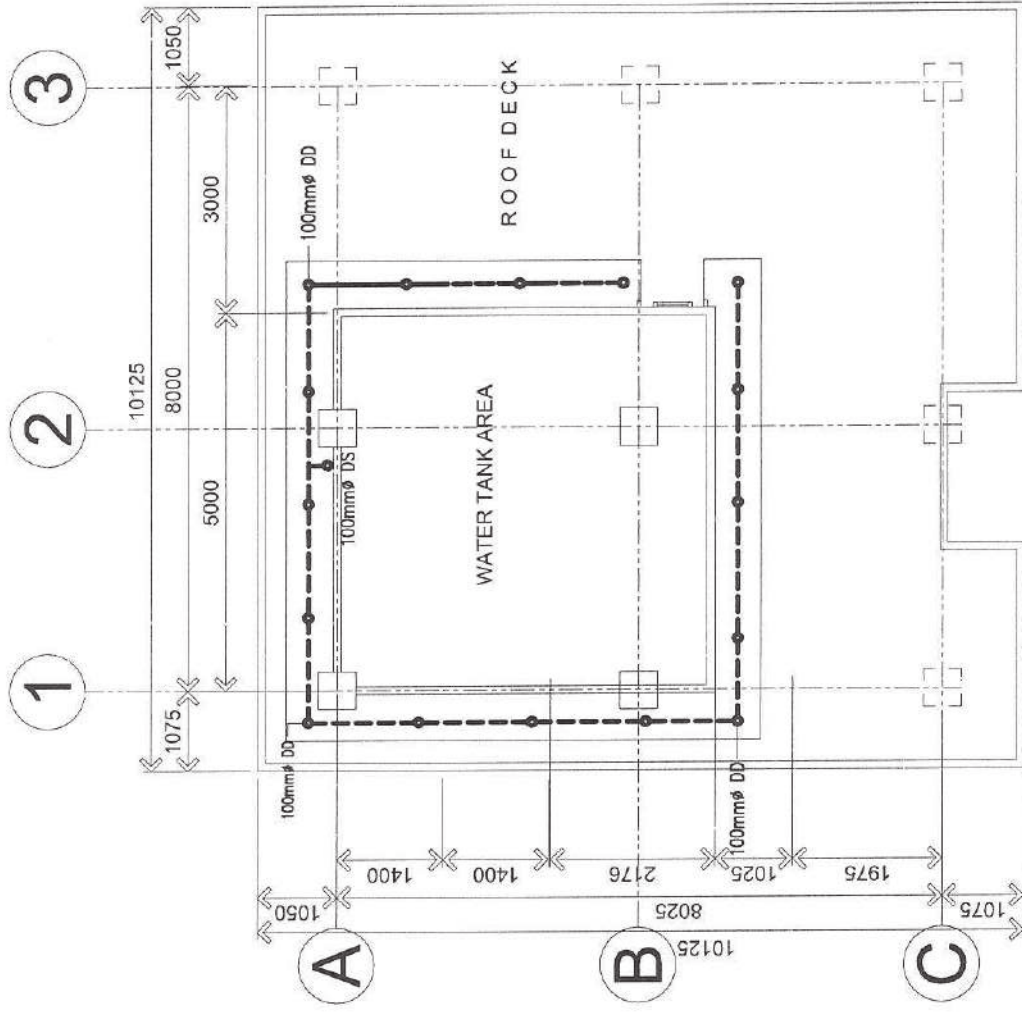
**SUBMITTED BY**  
 CG LT REYNER JAN P DAGOHOY  
 Head, Sanitary and Plumbing Branch, CGBF

**RECOMMENDING APPROVAL**  
 CG CDR LAURINCEWAN N FELIZARTE  
 Captain, Sanitary and Plumbing Branch, CGBF

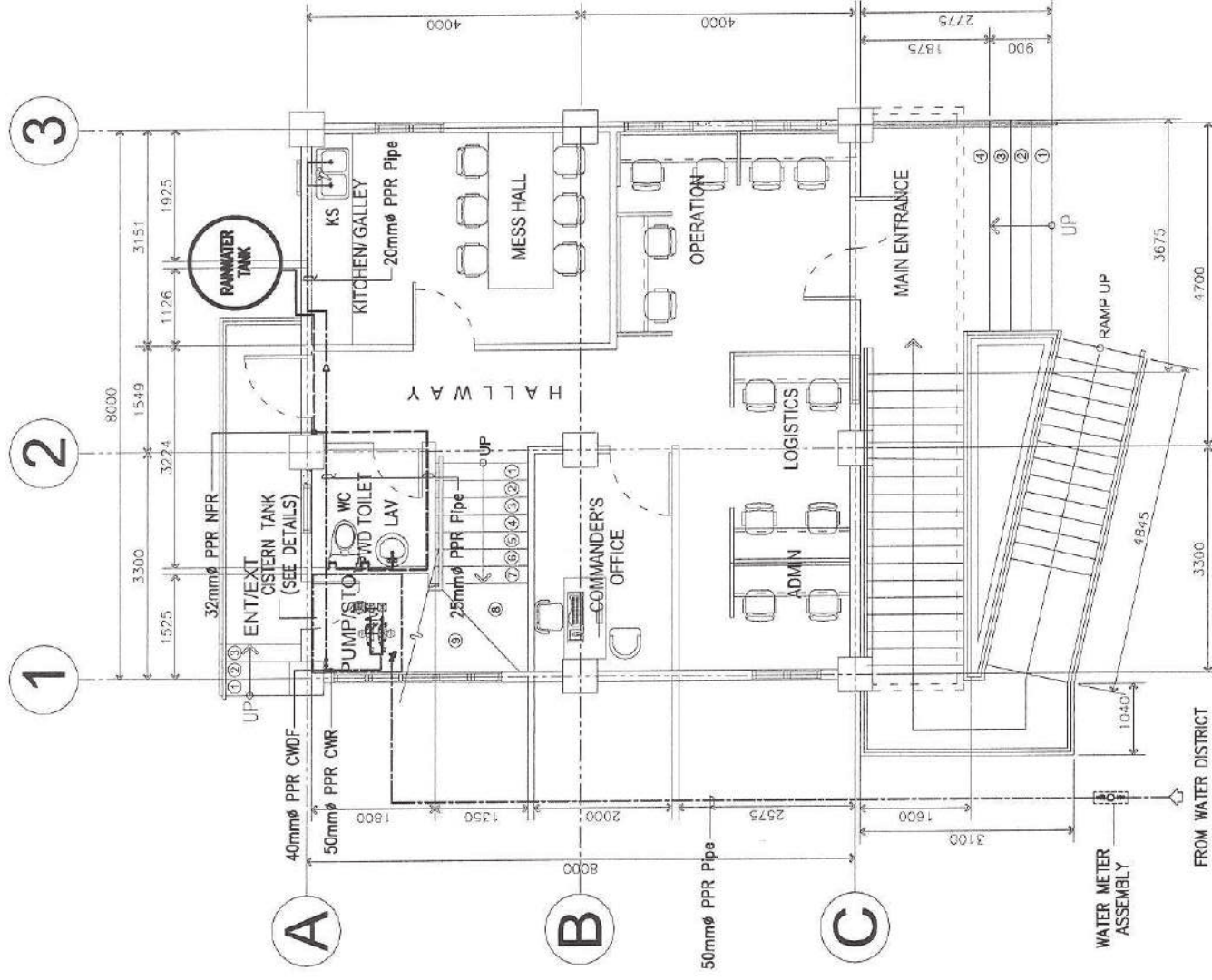
**APPROVED BY**  
 CG COMMO PRUDENTIO Q PATRICIO JR  
 Commander, CGBF

**SHEET NO**  
 P-4  
 39 51





UPPER ROOF DECK  
A STORM DRAINAGE LAYOUT  
P 5 SCALE 1:100M



GROUND FLOOR  
B WATER DISTRIBUTION LAYOUT  
P 5 SCALE 1:100M



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
STORM DRAINAGE LAYOUT  
WATER DISTRIBUTION LAYOUT

BRANCH  
Plumbing and Sanitary Branch  
PREPARED BY  
CG ENS. EJOUR REY A VELASQUEZ  
Head, Plumbing and Sanitary Branch, CGCG  
CHECKED BY  
CG ENS. GEORGE PATRICK R FERNANDEZ  
Head, Plumbing and Sanitary Branch, CGCG

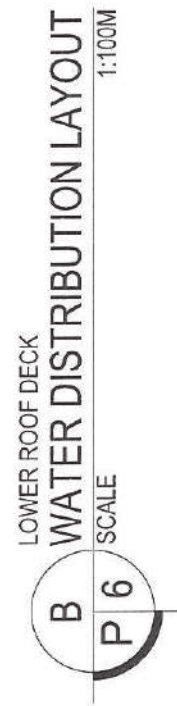
SUBMITTED BY  
CG LT REYNOL JAN P DAGOHY  
Head, Engineering Department, CGCG





RECOMMENDING APPROVAL  
CG CDRLA RINCE WAN N FELIZARTE  
Head, Design Department, CGCG

APPROVED BY  
CG COMMO PRUDENCIO PATRICIO JR  
Commander, CGCG

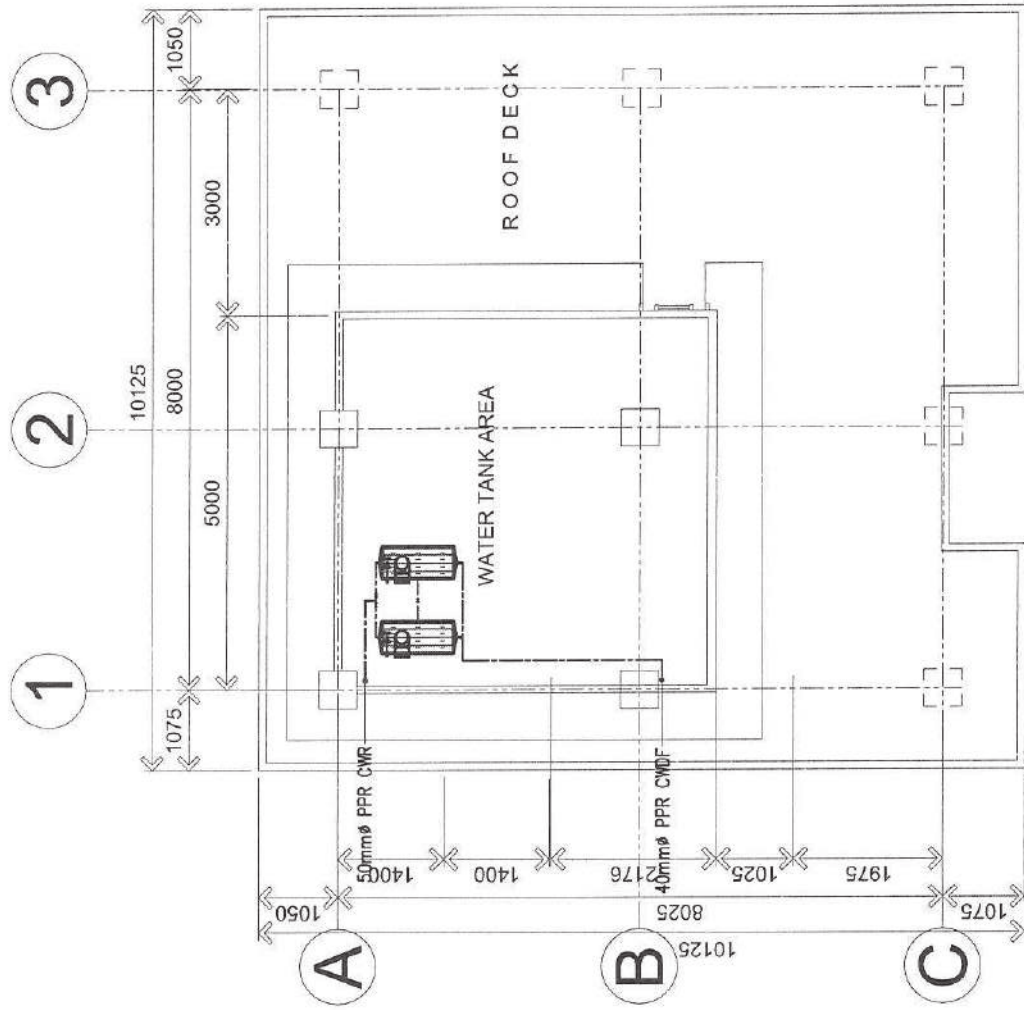
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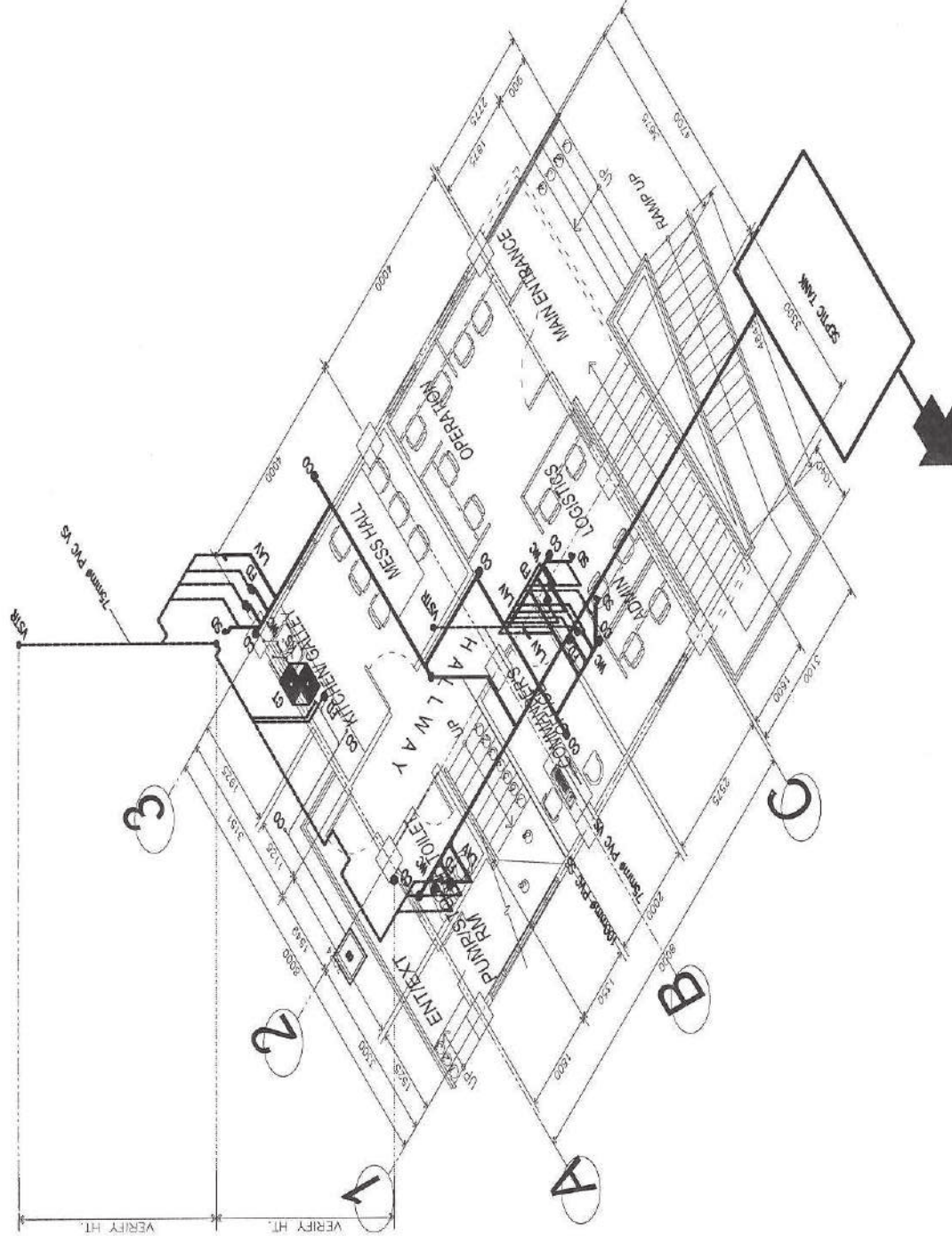


<div><p><b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST. PORT AREA MANILA</p><p><b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGBF, Muelle dela Industria, Farola Compound Binondo, Manila 1006</p></div>	<div><p><b>PROJECT AND LOCATION</b></p><p>CONSTRUCTION OF <b>STATION NORTHERN SAMAR</b> Brgy. Sabing Zone 2, Allen, Northern Samar</p><p>PHILIPPINE COAST GUARD</p></div>	<div><p><b>SHEET CONTENT</b></p><p>WATER DISTRIBUTION LAYOUT</p></div>	<div><p><b>BRANCH</b></p><p>Plumbing and Sanitary Branch</p></div>	<div><p><b>SUBMITTED BY</b></p><p> CG LT REYMER JAN P DAZA/JOY Head, Plumbing and Sanitary Branch, CGDBS</p></div>	<div><p><b>RECOMMENDING APPROVAL</b></p><p> CG CDR LAURINE IVAN N FELIZARTE Acting Deputy Commander, CGDBS</p></div>	<div><p><b>APPROVED BY</b></p><p> CG COMMO PRUDENCIO C PATRICIO JR/JOY Commander, CGDBS</p></div>	<div><div>SHEET NO.</div><div><div>P-6</div><div>4151</div></div></div>





UPPER ROOF DECK  
A WATER DISTRIBUTION LAYOUT  
P 7 SCALE 1:100M



ISOMETRIC DIAGRAM  
B SANITARY SEWERLINE LAYOUT  
P 7 SCALE 1:100M



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle de la Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
WATER DISTRIBUTION LAYOUT  
SANITARY SEWERLINE LAYOUT

BRANCH  
Plumbing and Sanitary Branch  
PREPARED BY  
CG ENS JEDUAR REY A VELASQUEZ  
Member, Philippine Coast Guard Branch, CGBF  
CHECKED BY  
CG ENS GEORGE PATRICK R FERNANDEZ  
Head, Engineering Department, CGBF

SUBMITTED BY  
CG LT REYNER JAN P DAGOHY  
Head, Engineering Department, CGBF

RECOMMENDING APPROVAL  
CG CDR LAYRINCE MAN N FELIZARTE  
Asst. Supply Commander, CGBF

APPROVED BY  
CG COMMO PRUDENCIO C PATRICIO JR  
Commander, CGBF

SHEET NO  
P-7  
42 51





**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA

**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**

CGBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION	CONSTRUCTION OF
	STATION NORTHERN SAMAR
	Brgy. Sabang Zone 2, Alun, Northern Samar
	PHILIPPINE COAST GUARD

SHEET CONTENT

STORM DRAINAGE LAYOUT

Plumbing and Sanitary Branch

**PREPARED BY**

**CG ENS JELONM RY A VELASQUEZ**  
Marine Corps Intelligence Training Center, San Diego, CA 92106

**CHECKED BY**

**CG ENS GEORGE PATRICK R FERNANDEZ**  
Marine Corps Intelligence Training Center, San Diego, CA 92106

SUBMITTED BY

CG LT REYNER JAN P DAGOHY  
Head, Engineering Department, C305

RECOMMENDING APPROVAL

CG CDR LAURINCE IVAN M FELIZARTE  
Acting Deputy Commandant, CG308

APPROVED BY \_\_\_\_\_


CG COMMO PRUDENCIO G PATRICIO JR  
Comandante CMO

SHEET NO. \_\_\_\_\_

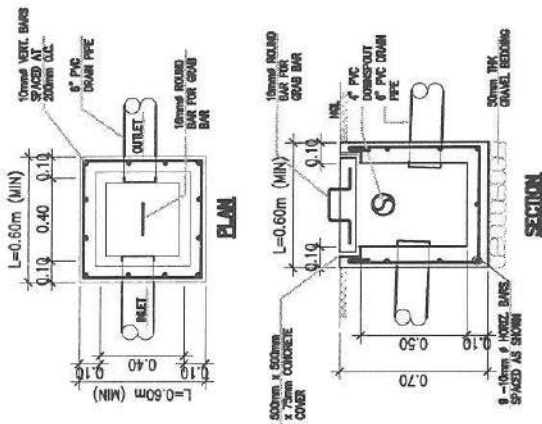
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P-8	43%
P-9	51%



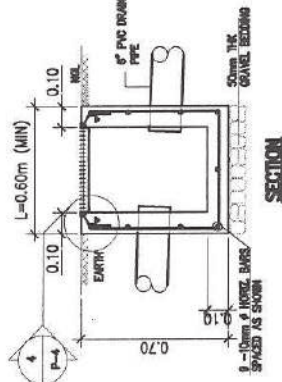
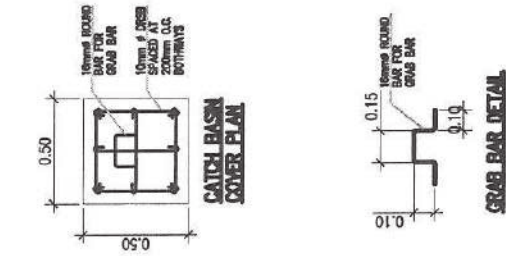


 <p><b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST. PORT AREA MANILA <b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGSF, Muelle dela Industria, Farola Compound Binondo, Manila 1006</p>	<p><b>PROJECT AND LOCATION</b></p> <p>CONSTRUCTION OF <b>STATION NORTHERN SAMAR</b> Bagy Sabang Zone 2, Allen, Northern Samar   <b>PHILIPPINE COAST GUARD</b></p>		<p><b>SHEET CONTENT</b></p> <p>WATER DISTRIBUTION LAYOUT</p>	<p><b>BRANCH</b></p> <p>Plumbing and Sanitary Branch</p>	<p><b>SUBMITTED BY</b></p> <p><i>[Signature]</i> CG LT REYMIER JAN P. DAZAROC Head, Sanitary Unit, Department: CG085</p>	<p><b>RECOMMENDING APPROVAL</b></p> <p><i>[Signature]</i> CG CDR LAURINCE IVAN N. FELIZARTE Unit Deputy Commander: CG085</p>	<p><b>APPROVED BY</b></p> <p><i>[Signature]</i> CG COMMO PRUDENCIO &amp; PATRICIO JR085 Commander: CG085</p>	<p><b>SHEET NO.</b></p> <table border="1"> <tr> <td>P-9</td> </tr> <tr> <td>44 51</td> </tr> </table>	P-9	44 51
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	44 51									

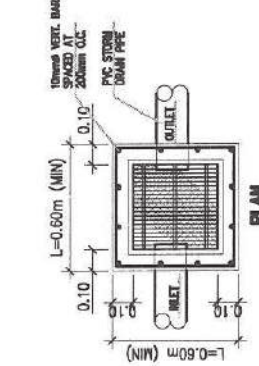




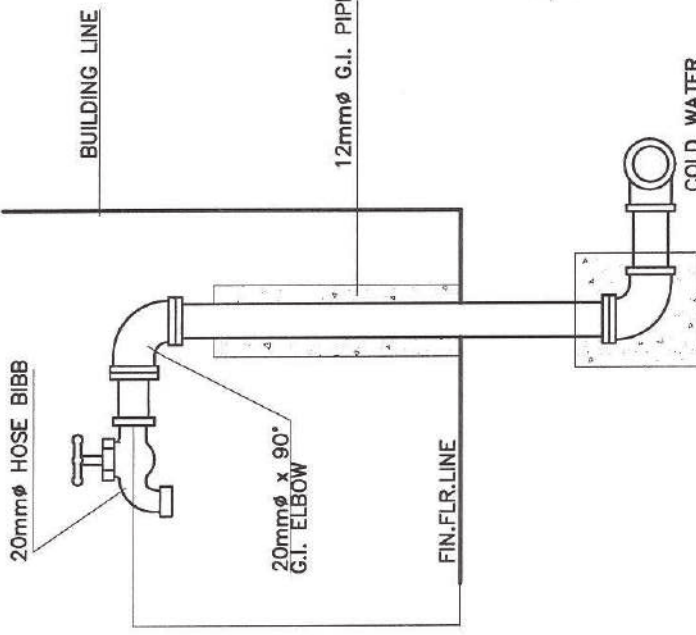
**A CATCH BASIN DETAILS**  
1:20M  
P 10 SCALE



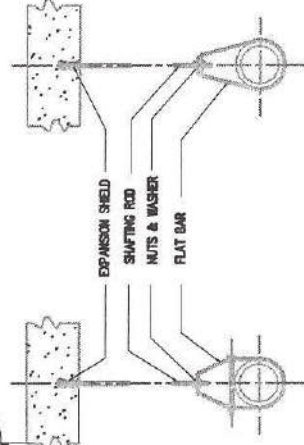
**B AREA DRAIN DETAILS**  
NTS  
P 10 SCALE



**C BLOW-UP DETAIL**  
NTS  
P 10 SCALE



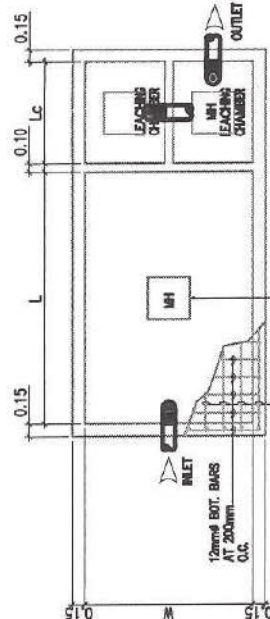
**D AIR CHAMBER DETAIL**  
1:5M  
P 10 SCALE



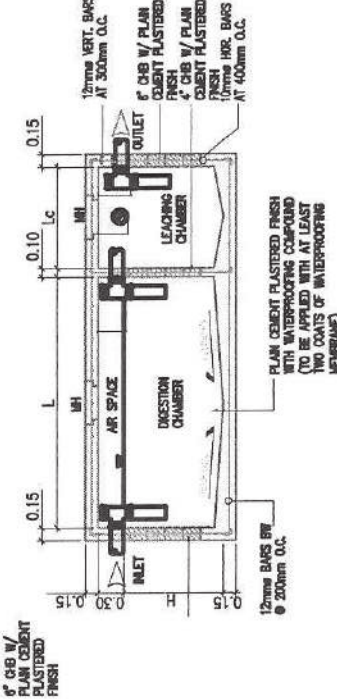
**E HOSE BIBB DETAIL**  
1:5M  
P 10 SCALE

**F PIPE HANGER DETAIL**  
NTS  
P 10 SCALE

SEPTIC TANK SCHEDULE				
SEPTIC TANK	L	W	H	Lc
	4.00 m	2.50 m	1.80 m	1.00 m



**G SEPTIC TANK DETAILS**  
1:50M  
P 10 SCALE



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

CONSTRUCTION OF  
**STATION NORTHERN SAMAR**  
Brgy. Subong Zone 2, Alon, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
CATCH BASIN DETAILS  
AIR CHAMBER DETAIL  
HOSE BIBB DETAIL  
AREA DRAIN DETAILS  
BLOW-UP DETAIL  
SEPTIC TANK DETAILS

BRANCH  
Plumbing and Sanitary Branch  
PREPARED BY  
CG ENS. J. J. VELASQUEZ  
Checked by  
CG ENS. GEORGE PATRICK R. FERNANDEZ

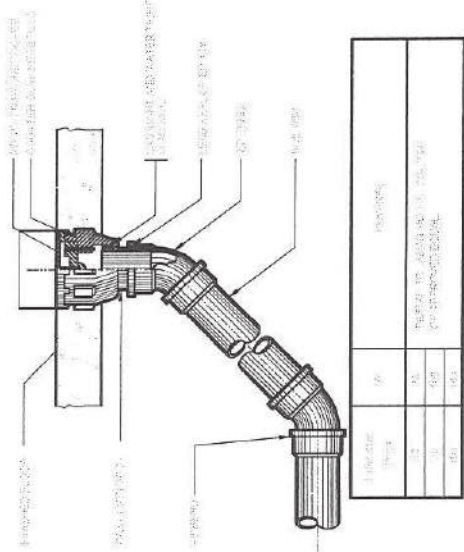
SUBMITTED BY  
CG LT REYER JAN P. DAGHOY  
Head, Engineering Department, CGBF

RECOMMENDING APPROVAL  
CG CDR LAURANCE IVAN FELIZARTE  
Head, Design Department, CGBF

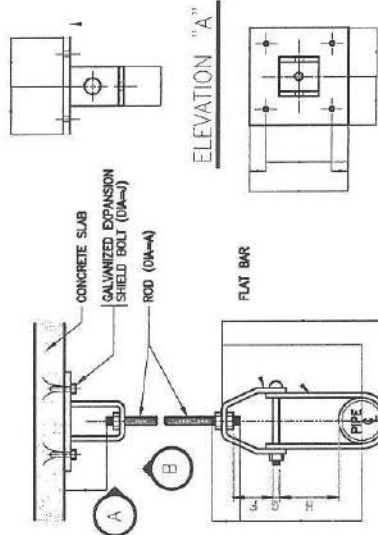
APPROVED BY

SHEET NO  
P-10  
45 51





**A FLOOR CLEANOUT DETAIL**  
P 11 SCALE NTS

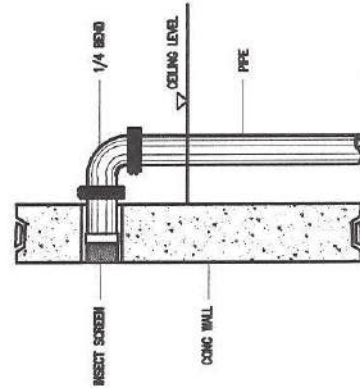


**B GROUND CLEANOUT DETAIL**  
P 11 SCALE NTS

**SCHEDULE OF PIPE HANGER**

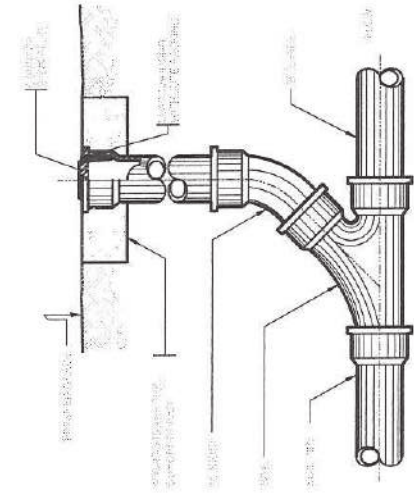
PIPE SIZE (mm)	FLAT BAR SIZE (mm)	DIMENSIONS IN mm										
		A	B	C	D	E	F	G	H	J	T	W
15-25	3x25	10	100	119	65	83	18	6	50	14	10	50
32-40	3x25	10	121	148	65	103	27	6	50	14	10	50
50	3x25	10	169	221	65	165	41	6	100	14	10	50
65-75	5x32	13	219	282	75	192	45	10	100	14	10	50
100	6x32	16	233	295	90	208	48	10	100	14	10	50
150	6x40	19	270	350	100	238	49	13	100	18	13	65

**F PIPE HANGER DETAIL**  
P 11 SCALE NTS

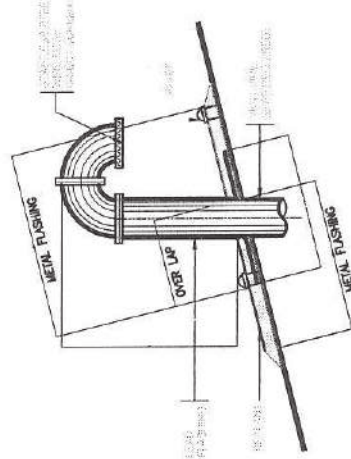


**G VENT THRU ROOF DETAIL**  
P 11 SCALE NTS

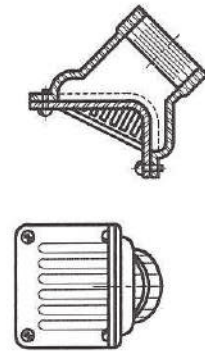
**J VENT THRU WALL DETAIL**  
P 11 SCALE NTS



**H PIPE SLEEVE DETAIL**  
P 11 SCALE NTS



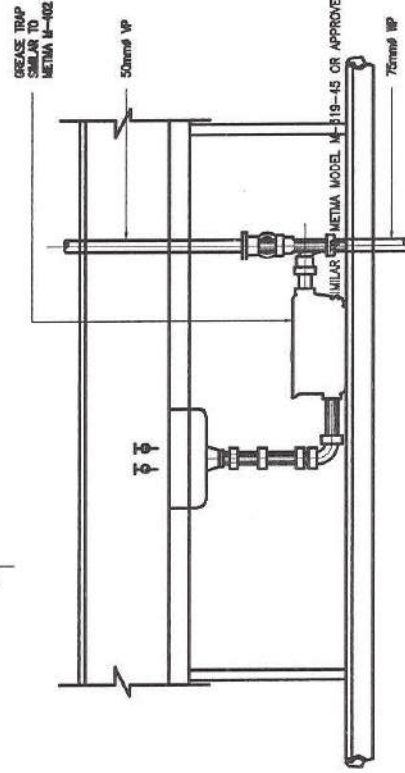
**I COLLAR PLATE DETAIL**  
P 11 SCALE NTS



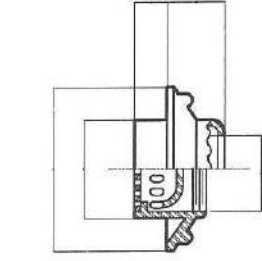
**K SCUPPER DRAIN DETAIL**  
P 11 SCALE NTS

**SCHEDULE OF GREASE TRAP**

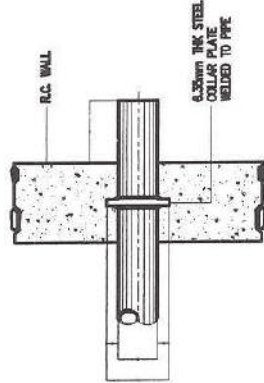
GREASE TRAP NO.	DIMENSIONS IN INCHES					GPM	REMARKS
	E	T	A	R	O		
GT-1	8 1/2	3 5/8	24	20	15	20	SIMILAR TO JIP-102-S APPROVED EQUAL



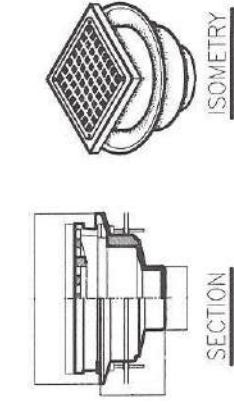
**L GREASE TRAP DETAIL**  
P 11 SCALE NTS



**M DECK DRAIN DETAIL**  
P 11 SCALE NTS



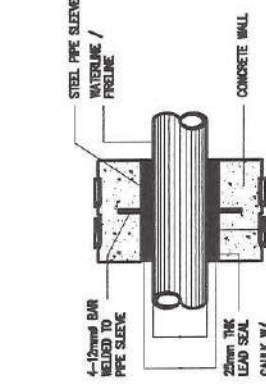
**N FLOOR DRAIN DETAIL**  
P 11 SCALE NTS



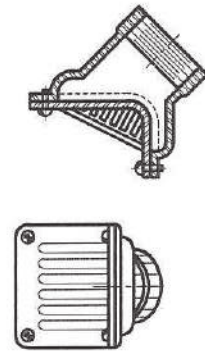
**O ISOMETRY**  
P 11 SCALE NTS

1. 排水口は、排水路の開口部から、排水路の中心線まで、排水路の開口部の中心線から、排水路の中心線まで、排水路
---

**P CEILING CLEANOUT DETAIL**  
P 11 SCALE NTS



**Q PIPE SLEEVE DETAIL**  
P 11 SCALE NTS



**K SCUPPER DRAIN DETAIL**  
P 11 SCALE NTS



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE**  
CGBF, Muelle de la Industria, Fabela Compound  
Brondo, Manila 1005

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Allen, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
FLOOR CLEANOUT DETAIL  
CEILING CLEANOUT DETAIL  
PIPE HANGER DETAIL  
VENT THRU ROOF DETAIL  
COLLAR PLATE DETAIL  
PIPE HANGER DETAIL  
SCUPPER DRAIN DETAIL  
GREASE TRAP DETAIL

**BRANCH**  
Plumbing and Sanitary Branch  
**PREPARED BY**  
CG ENS JERONIMO A VELASQUEZ  
Number 1, Pinaric, San Jose Branch, CGBUS  
**CHECKED BY**  
CG ENS GEORGE PATRICK R FERNANDEZ  
Head, Plumbing and Sanitary Branch, CGBUS

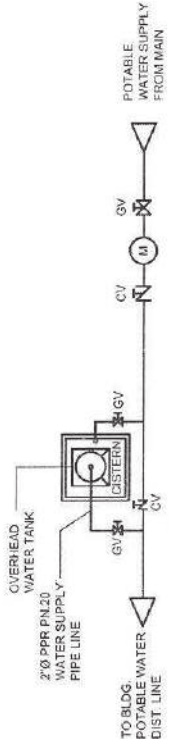
**SUBMITTED BY**  
CG LT REYNER JAN P DABOHOY  
Head, Engineering Department, CGBUS

**RECOMMENDING APPROVAL**  
CG CDR LAURANCE MAN N FELIZARTE  
Staff Officer, Engineering, CGBUS

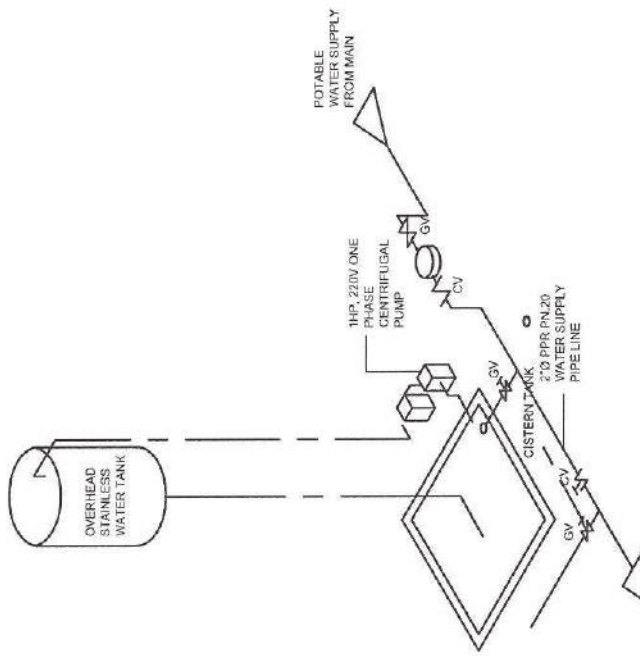
**APPROVED BY**  
CG COMMO PRUDENCIO CPATRICIO JR  
Commander, CGBUS

**SHEET NO**  
P-11  
46 51

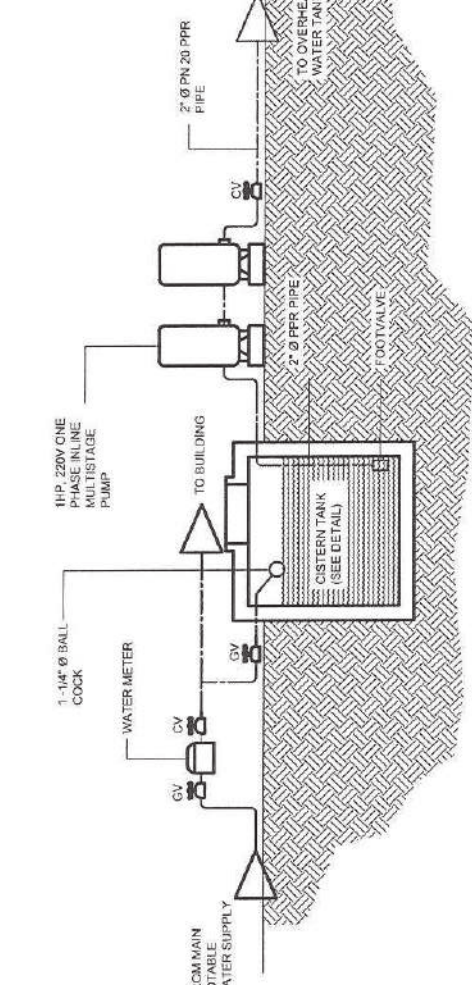




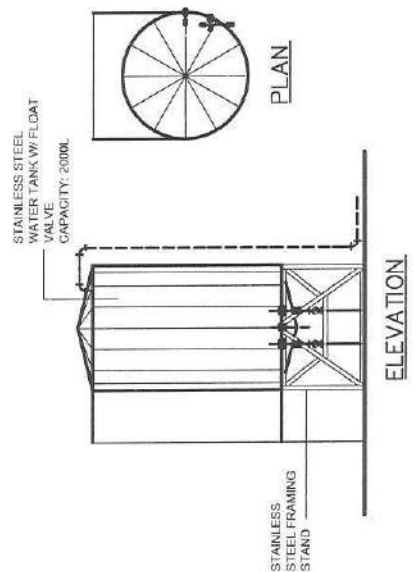
A WATER TANK DIAGRAM  
P 12 SCALE  
NTS



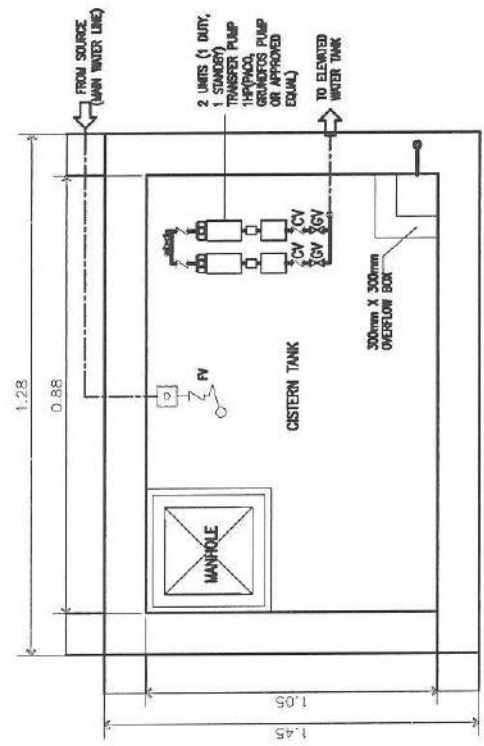
B WATER TANK DIAGRAM  
P 12 SCALE  
NTS



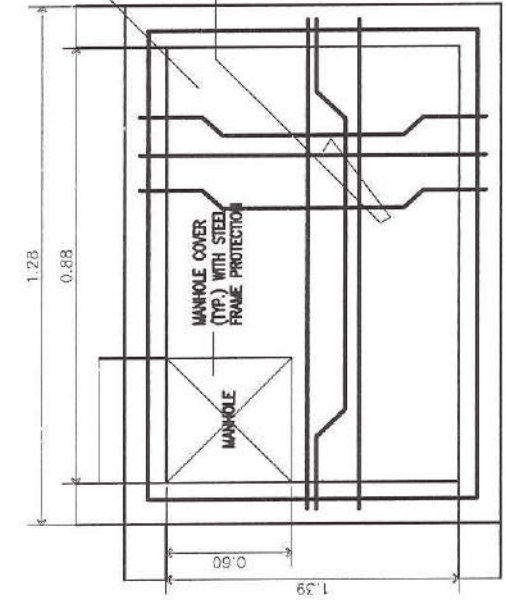
C WATER PUMP DISTRIBUTION LAYOUT SYSTEM  
P 12 SCALE  
NTS



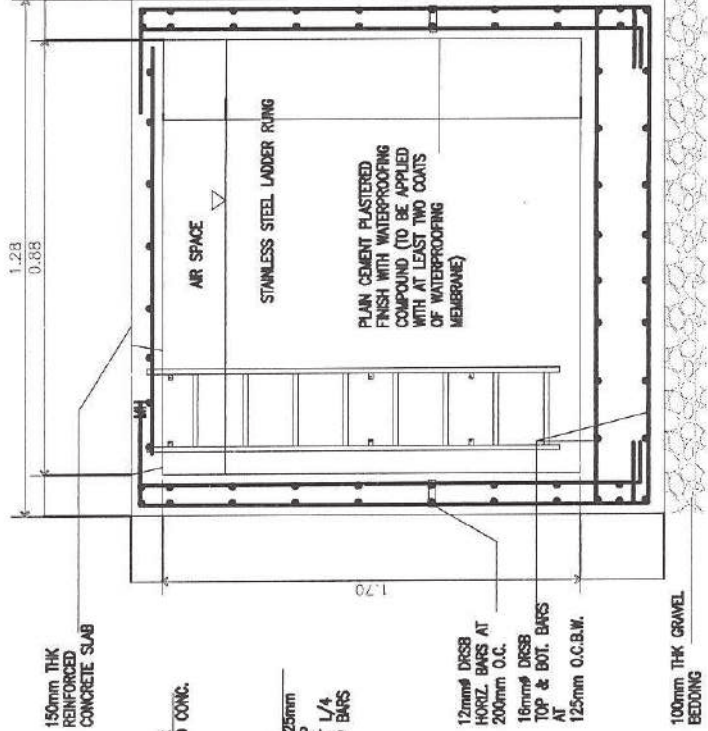
D OVERHEAD WATER TANK DETAIL  
P 12 SCALE  
1:50M



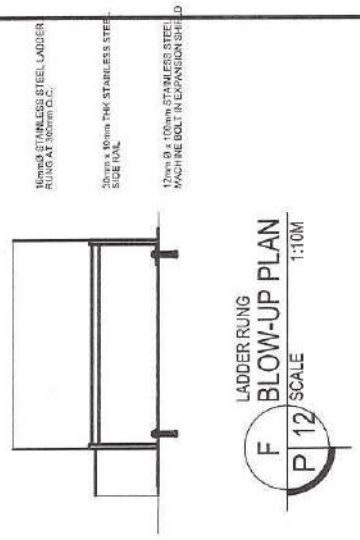
E WATER PUMP LAYOUT  
P 12 SCALE  
1:20M



F WATER TANK DETAIL  
P 12 SCALE  
1:20M



G CISTERNA DETAIL  
P 12 SCALE  
1:20M



H LADDER RING BLOW-UP PLAN  
P 12 SCALE  
1:10M

CROSS SECTION



PHILIPPINE COAST GUARD  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE  
CGBF, Muelle de la Industria, Farola Compound  
Binondo, Manila 1006

PROJECT AND LOCATION  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Bray, Subang Zone 2, Albin, Northern Samar  
PHILIPPINE COAST GUARD

SHEET CONTENT  
WATER TANK DIAGRAM  
WATER TANK DIAGRAM (ISOMETRIC)  
WATER PUMP DISTRIBUTION LAYOUT  
SYSTEM  
OVERHEAD WATER TANK DETAIL  
WATER PUMP LAYOUT  
BLOW-UP PLAN  
STRUCTURAL DETAIL

BRANCH  
Plumbing and Sanitary Branch  
PREPARED BY  
CG ENS JESOMAR REY A VELASQUEZ  
Member of the Philippine Society of Professional Engineers  
CHECKED BY  
CG ENS GEORGE PATRICK R FERNANDEZ  
Head, Plumbing and Sanitary Branch, CGBF

SUBMITTED BY  
CG LT REYNER JAN P DASHOBY  
Head, Plumbing and Sanitary Branch, CGBF

RECOMMENDING APPROVAL  
CG CDR JAIRANCE IVAN N FELIZARTE  
Deputy Commander, CGBF

APPROVED BY  
CG COMMO PRUDENCIO C PATRICIO JR  
Deputy Commander, CGBF

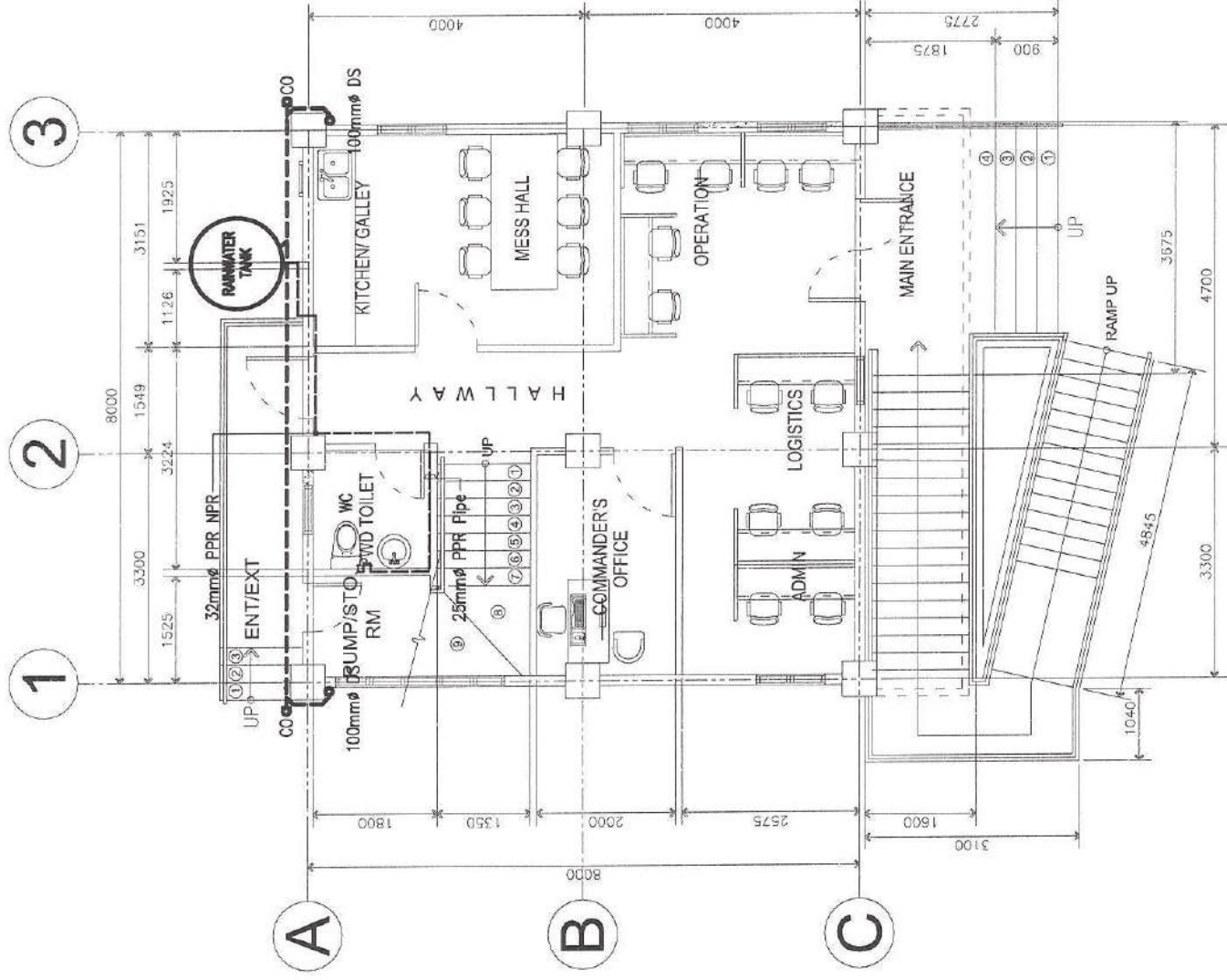
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P-12  
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RAINWATER HARVESTING NOTES:

1. ALL PIPING AND PLUMBING COMPONENT MATERIALS USED IN THE INSTALLATION OF A RAINWATER HARVESTING SYSTEM SHALL BE AS APPROVED FOR THE SPECIFIC USE PER LOCAL PLUMBING CODE, OR BE LISTED BY AN ANSI ACCREDITED PRODUCT CERTIFICATION PROGRAM AS AVAILABLE.
2. FOR NON-POTABLE WATER APPLICATIONS, HARVESTED RAINWATER MUST BE FILTERED OR TREATED TO AN APPROPRIATE QUALITY SUITABLE FOR INTENDED USE. NO TREATMENT IS REQUIRED FOR SUB SURFACE IRRIGATION, AGRICULTURAL, OR GARDEN USE. FOR ABOVE SURFACE IRRIGATION, THE LOCAL AUTHORITY HAVING JURISDICTION SHOULD BE CONSULTED REGARDING REQUIRED WATER QUALITY.
3. WASHERS AND PRE-FILTRATION. ALL COLLECTED RAINWATER, FOR POTABLE WATER APPLICATION, SHALL PASS THROUGH A ROOF WASHER OR PRE-FILTRATION SYSTEM BEFORE THE WATER ENTERS THE CISTERN(S).
4. FILTRATION. FILTRATION SHALL MEET THE FOLLOWING PROVISIONS:  
(A) WHERE RAINWATER IS USED FOR NON-POTABLE USE AND FOR NON CRITICAL OPERATIONS, SUCH AS IRRIGATION, WASH DOWN, ETC., A FINAL STAGE FILTRATION SYSTEM IS NOT REQUIRED.  
WHERE RAINWATER IS USED FOR NON-POTABLE USE, INTERIOR TO AN OCCUPIED FACILITY, FOR MAKEUP FOR LAUNDRY, TOILETS, PROCESS, ETC.; THE WATER IS TO BE FILTERED AS A SAFEGUARD AGAINST SEDIMENT OR DISCOLORATION, AND FOR PROPER OPERATION OF VALVES OR OTHER DEVICES.
5. LABELING. IF A RAINWATER HARVESTING SYSTEM IS APPLIED TO ANY BUILDING, FACILITY OR RESIDENCE, IT SHALL BE SO INDICATED AS FOLLOWS:  
(A) ALL RAINWATER SUPPLIED FIXTURES, NOT SPECIFICALLY TREATED FOR POTABLE WATER USE, SHALL BE PROMINENTLY LABELED  
"NON-POTABLE - DO NOT DRINK"

SUMMARY - RAINWATER SYSTEM EQUIPMENT & ACCESSORIES
ACCESSORIES:
FIRST FLUSH DIVERTER
CYCLONE FILTER
3P COMPACT TANK FILTER
OVERFLOW SIPHON
TRANSFER PUMP, 1.0 HP
WATER TANK, 300 GAL POLYETHYLENE-HORIZONTAL TYPE



GROUND FLOOR  
A RAINWATER HARVESTING SYSTEM LAYOUT  
P 13 SCALE 1:100M



**PHILIPPINE COAST GUARD**  
HEADQUARTERS PHILIPPINE COAST GUARD  
139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
DEVELOPMENT SERVICE**  
CGBF, Muelle dela Industria, Farola Compound  
Binondo, Manila 1006

**PROJECT AND LOCATION**  
CONSTRUCTION OF  
STATION NORTHERN SAMAR  
Brgy. Sabang Zone 2, Alon, Northern Samar  
PHILIPPINE COAST GUARD

**SHEET CONTENT**  
RAINWATER HARVESTING NOTES  
RAINWATER HARVESTING SYSTEM  
LAYOUT

**BRANCH**  
Plumbing and Sanitary Branch  
**PREPARED BY**  
CG ENS JESON M. REY A VELASQUEZ  
Marine Plumbing and Sanitary Branch, CGOBS  
**CHECKED BY**  
CG ENS GEORGE PATRICK R FERNANDEZ  
Marine Plumbing and Sanitary Branch, CGOBS

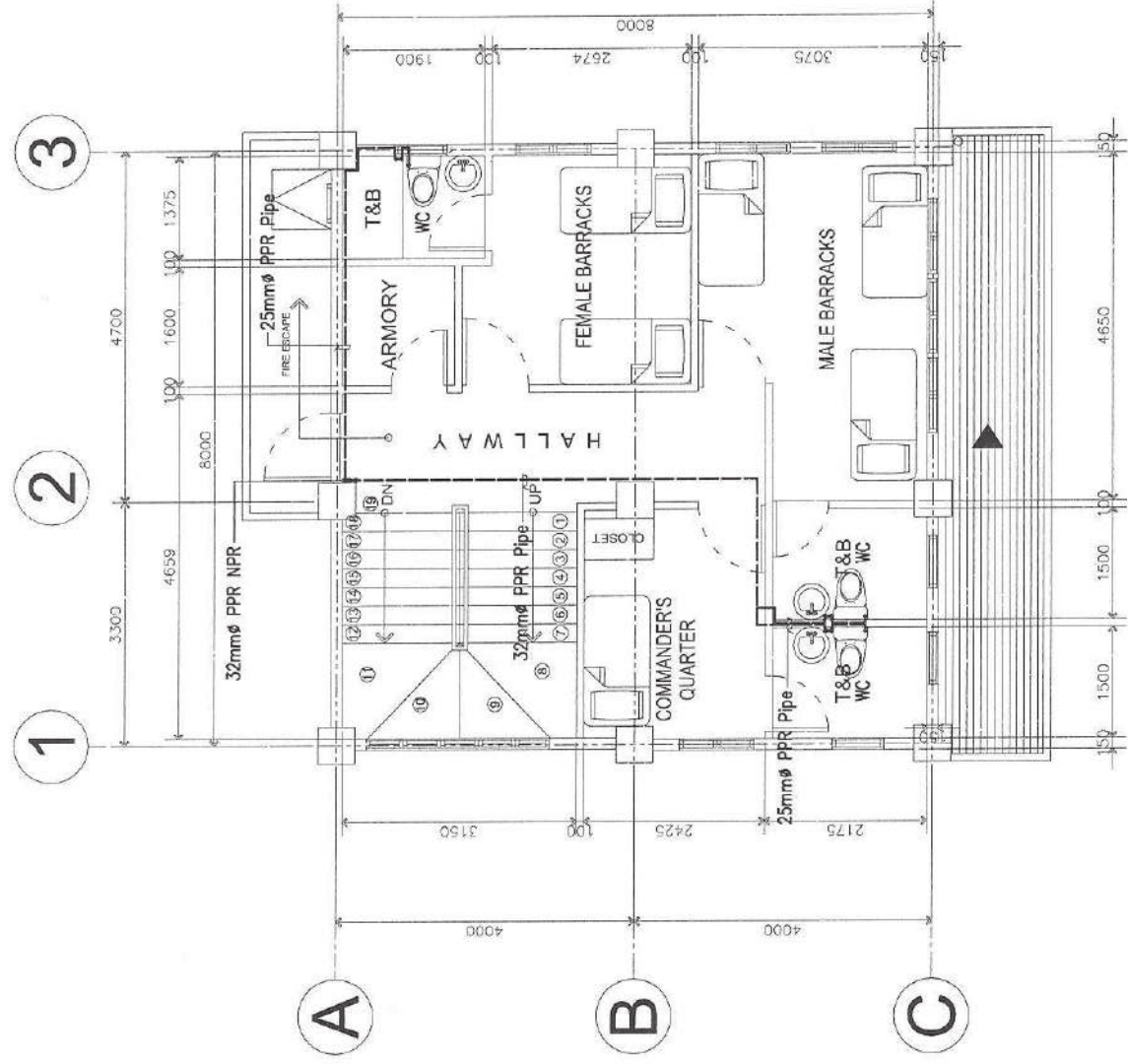
**SUBMITTED BY**  
CG LT REYNER JAN P DAHOAY  
Head, Engineering Department, CGOBS

**RECOMMENDING APPROVAL**  
CG CDR LAURINCE MAN N FELIZARTE  
Engineering Deputy Commander, CGOBS

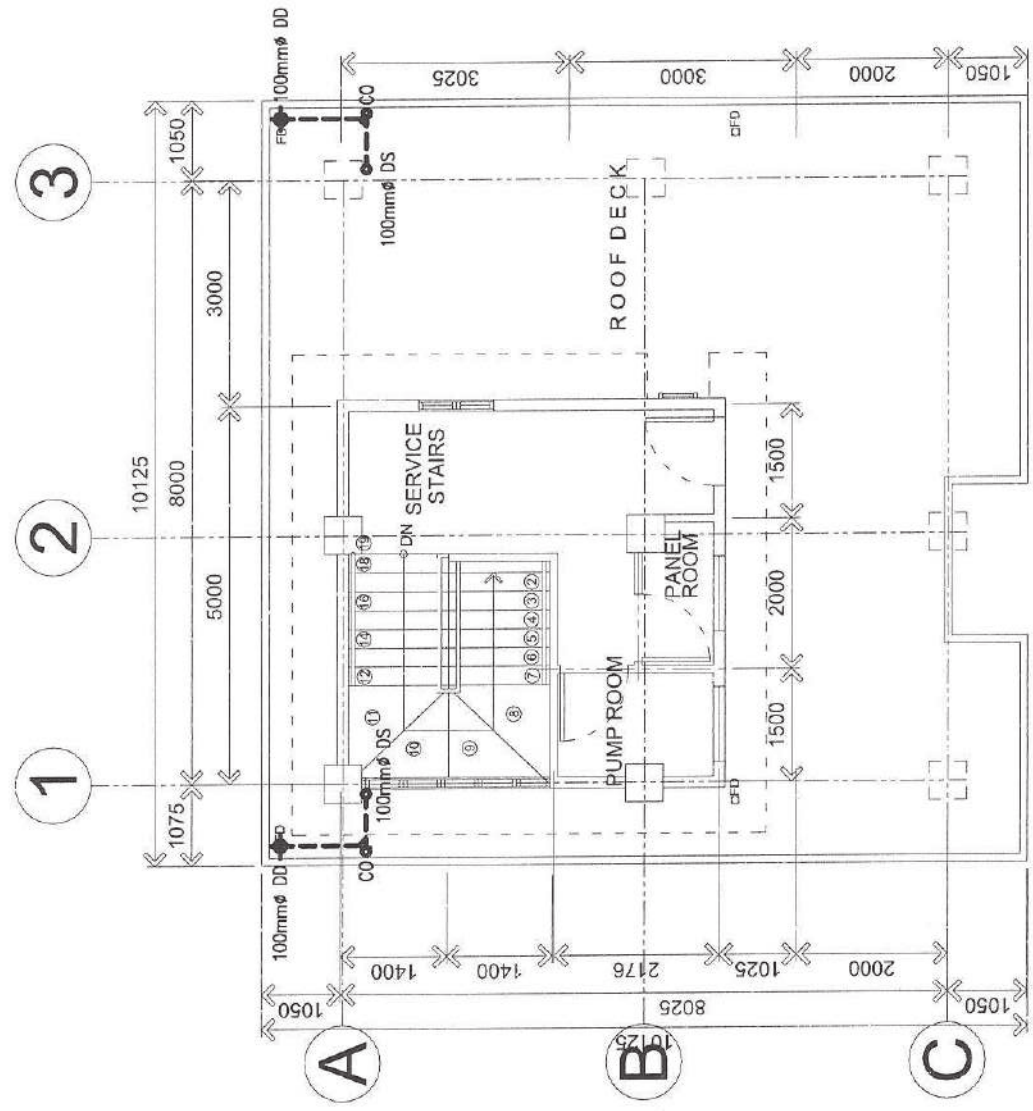
**APPROVED BY**  
CG COMMO PRUDENCIO PATRICIO JR  
Commander, CGOBS

**SHEET NO**  
P-13  
48 51





SECOND FLOOR  
**A** RAINWATER HARVESTING SYSTEM LAYOUT  
 SCALE 1:100M



LOWER ROOF DECK  
**B** RAINWATER HARVESTING SYSTEM LAYOUT  
 SCALE 1:100M



**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE  
 DEVELOPMENT SERVICE**  
 CGBF, Muelle de la Industria, Farola Compound  
 Binondo, Manila 1006

**PROJECT AND LOCATION**  
 CONSTRUCTION OF  
 STATION NORTHERN SAMAR  
 Brgy. Sabang Zone 2, Alifan, Northern Samar  
 PHILIPPINE COAST GUARD

**SHEET CONTENT**  
 RAINWATER HARVESTING SYSTEM  
 LAYOUT

**BRANCH**  
 Plumbing and Sanitary Branch  
**PREPARED BY**  
 CG ENS JECOMAR REY A VELASQUEZ  
 Member, Philippine Institution of Sanitary Branch, COUS  
**CHECKED BY**  
 CG ENS GEORGE PATRICK R FERNANDEZ  
 Head, Plumbing Branch, COUS

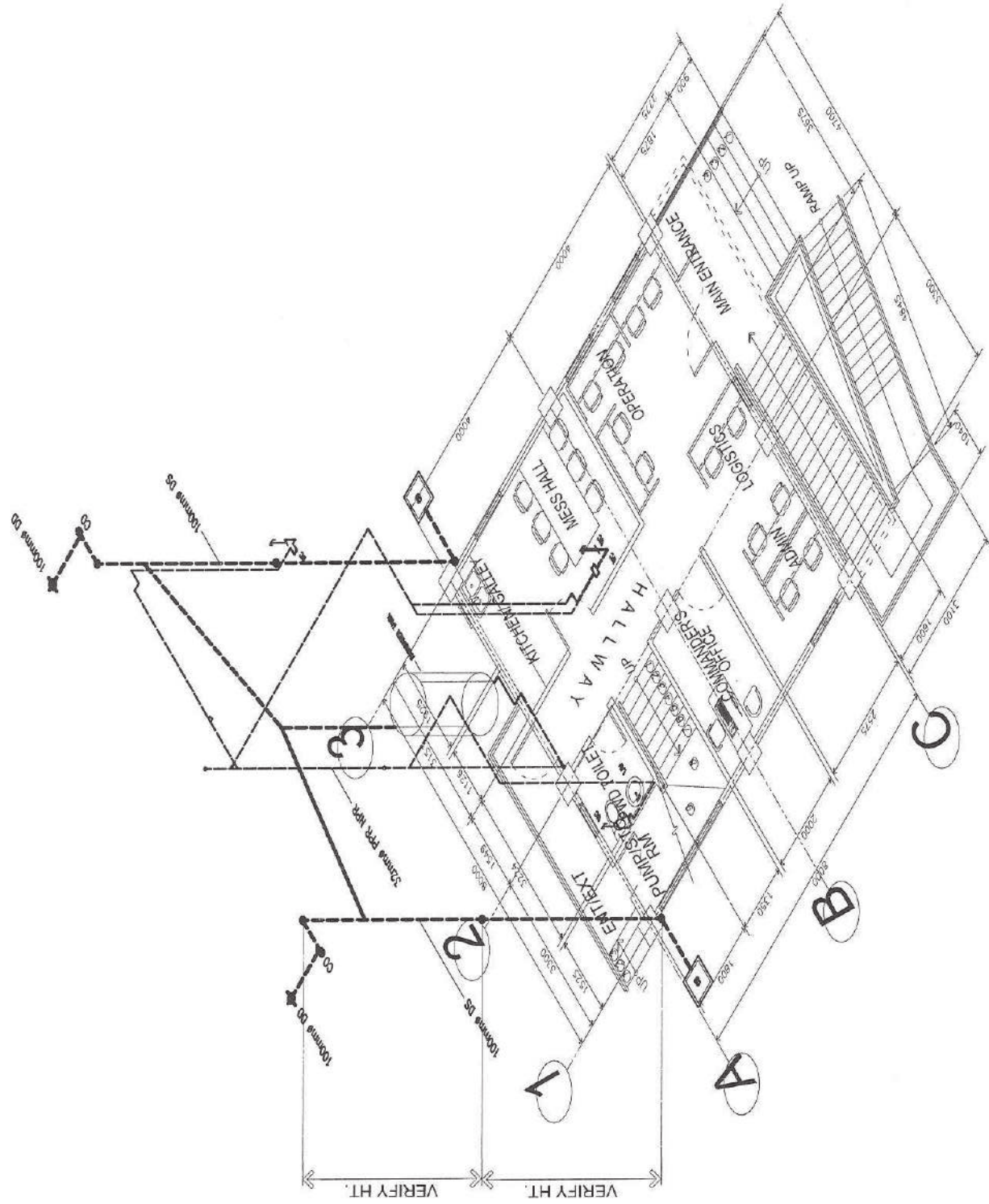
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 Head, Engineering Department, COUS

**RECOMMENDING APPROVAL**  
 CG CDR LAURINCE IVAN N FELIZARTE  
 Deputy Commander, COUS

**APPROVED BY**  
 CG COMMO PRUDENCIO C PATRICIO JR  
 Commander, COUS

**SHEET NO**  
 P-14  
 49 51





ISOMETRIC DIAGRAM  
**A** RAINWATER HARVESTING SYSTEM LAYOUT  
**P 15** SCALE 1:100M



**PHILIPPINE COAST GUARD**  
 HEADQUARTERS PHILIPPINE COAST GUARD  
 139 25TH ST. PORT AREA MANILA  
**COAST GUARD INFRASTRUCTURE**  
**DEVELOPMENT SERVICE**  
 CGBF, Muelle dela Industria, Farola Compound  
 Binondo, Manila 1006

**PROJECT AND LOCATION**  
 CONSTRUCTION OF  
 STATION NORTHERN SAMAR  
 Brgy. Sabang Zone 2, Alisan, Northern Samar  
 PHILIPPINE COAST GUARD

**SHEET CONTENT**  
 RAINWATER HARVESTING SYSTEM  
 LAYOUT

**BRANCH**  
 Plumbing and Sanitary Branch  
**PREPARED BY**  
 CG ENS JESOMAR REY A VELASQUEZ  
 Member/Plumber, Sanitary Branch, CDBS  
**CHECKED BY**  
 CG ENS GEORGE PATRICK R FERNANDEZ  
 Head Plumber, Sanitary Branch, CDBS

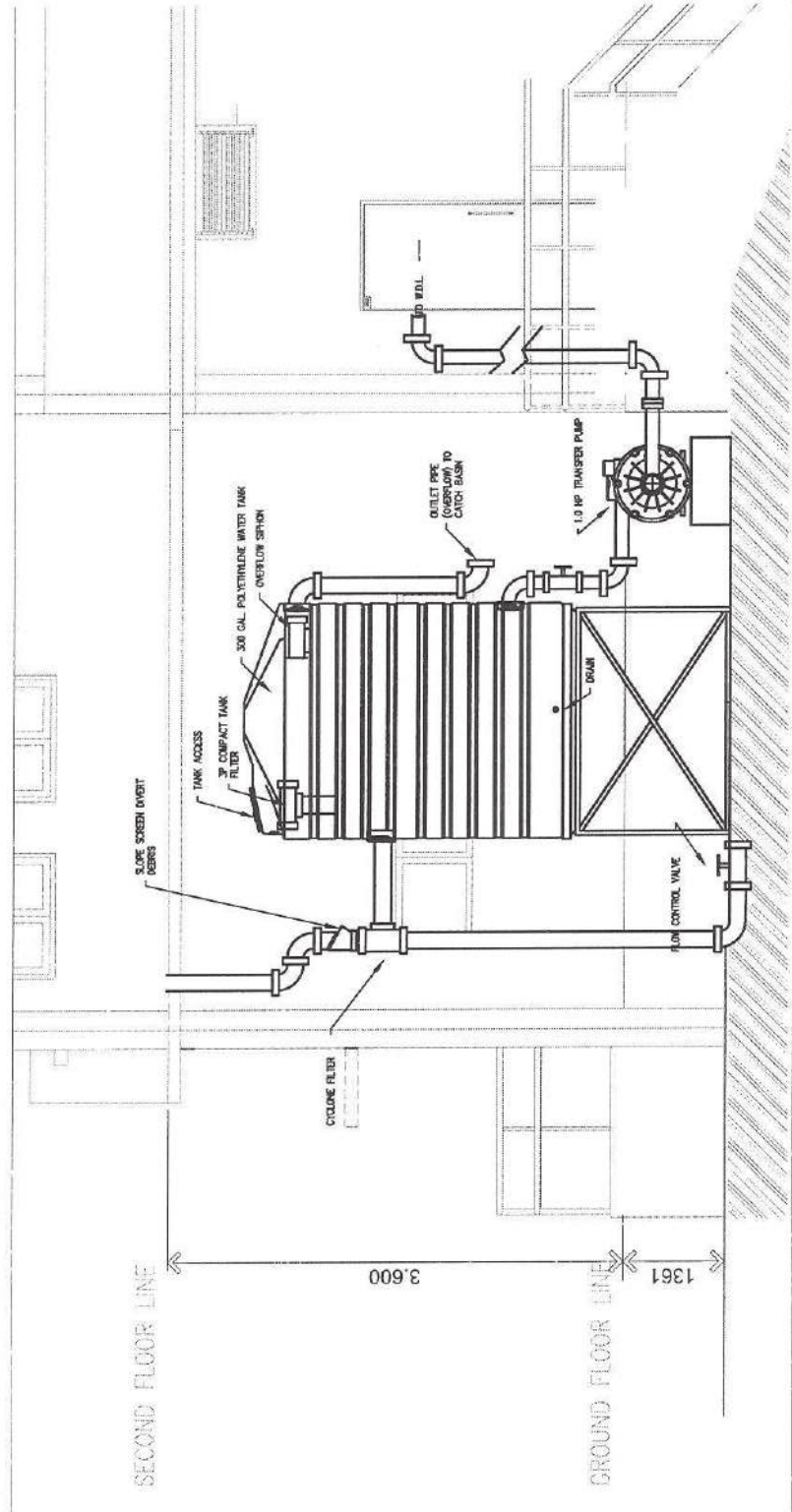
**SUBMITTED BY**  
 CG LT REYNER JAN P DABOHOY  
 Head, Sanitary Department, CDBS

**RECOMMENDING APPROVAL**  
 CG CDR LAURINCE VAN NITELIZARTE  
 CG Deputy Commander, CDBS

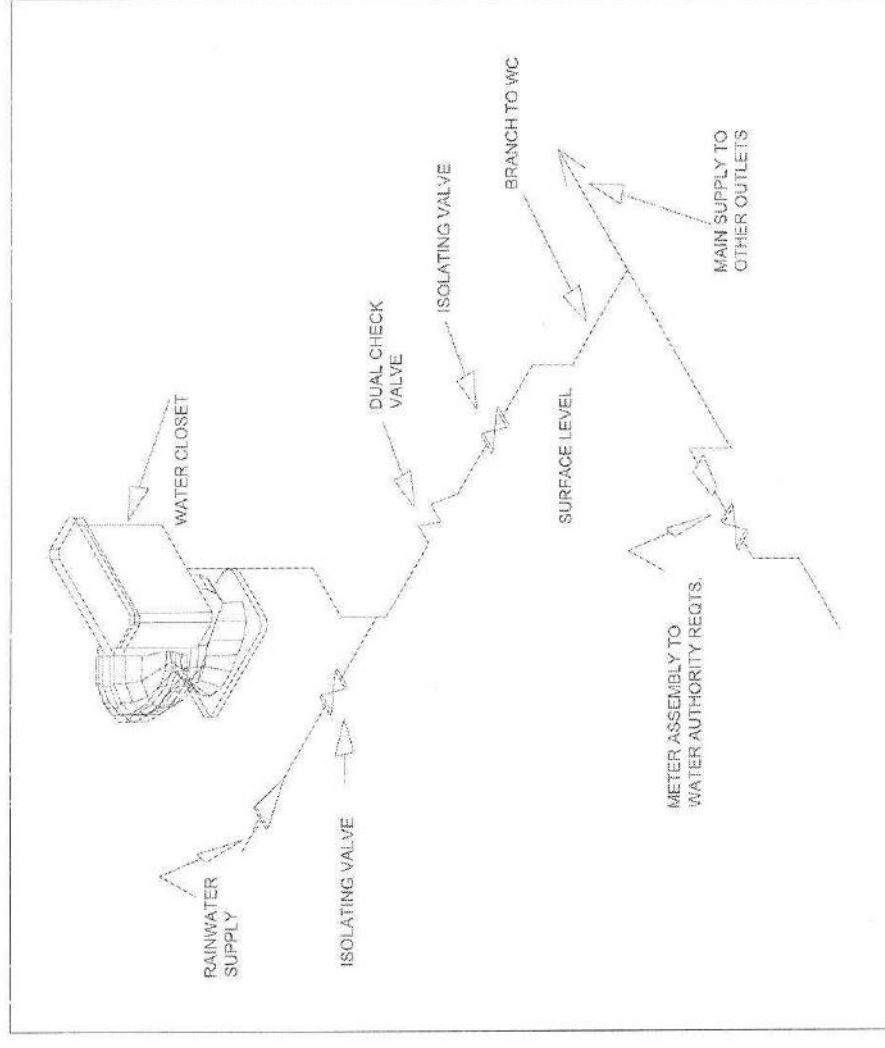
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 CG COMMO PRUDENCIO C PATRICIO JR.  
 Commander, CDBS

**SHEET NO**  
 P-15  
 50 51

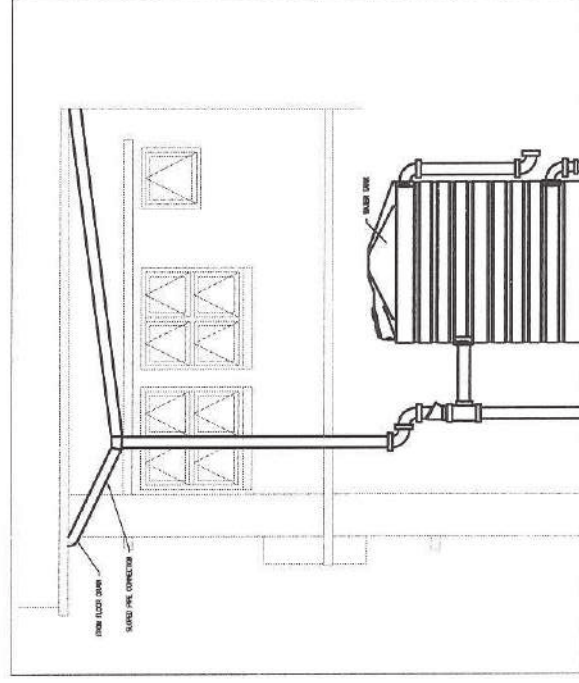




**A** RAINWATER HARVESTING SYSTEM PROCESS FLOW  
NTS  
P 16 SCALE



**B** RAINWATER HARVESTING BRANCHING DETAIL  
NTS  
P 16 SCALE



**C** RAINWATER HARVESTING CATCHMENT DETAIL  
NTS  
P 16 SCALE

	<b>PHILIPPINE COAST GUARD</b> HEADQUARTERS PHILIPPINE COAST GUARD 139 25TH ST. PORT AREA MANILA <b>COAST GUARD INFRASTRUCTURE DEVELOPMENT SERVICE</b> CGBF, Muelle de la Industria, Forola Compound Binondo, Manila 1005	<b>PROJECT AND LOCATION</b>  CONSTRUCTION OF STATION NORTHERN SAMAR Brig. Sabang Zone 2, Allen, Northern Samar PHILIPPINE COAST GUARD	<b>SHEET CONTENT</b> RAINWATER HARVESTING SYSTEM PROCESS FLOW RAINWATER HARVESTING BRANCHING DETAIL RAINWATER HARVESTING CATCHMENT DETAIL	<b>BRANCH</b> Plumbing and Sanitary Branch  PREPARED BY CG ENS/CEJOMAR REY A VELASQUEZ Head, Plumbing and Sanitary Branch, CGBF  CHECKED BY CG ENS/GEORGE PATRICK R FERNANDEZ Head, Plumbing and Sanitary Branch, CGBF	<b>SUBMITTED BY</b>  CG LT REYNER JAN P BALOGHON Head, Engineering Department, CGBF	<b>RECOMMENDING APPROVAL</b>  CG CDR LAURINCE IVAN N FELIZARTE Asst. Deputy Commander, CGBF	<b>APPROVED BY</b>  CG COMMO PRUDENCIO C PATRICIO JR Commander, CGBF	<b>SHEET NO</b> P-16 51 51
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## BILL OF QUANTITIES

**PROJECT TITLE** : CONSTRUCTION OF COAST GUARD STATION NORTHERN SAMAR BUILDING AND FACILITIES  
**LOCATION** : BRGY. SABANG ZONE 2, ALLEN, NORTHERN SAMAR  
**OWNER** : PHILIPPINE COAST GUARD  
**SUBJECT** : BILL OF QUANTITIES

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
<b>A. GENERAL REQUIREMENTS</b>					
01	Occupational Health & Safety Requirements	1	l.s		
02	Soil Foundation Investigation	1	l.s		
03	Temporary Facilities & Utilities	1	l.s		
04	Building Permit and Government Fees	1	l.s		
05	Project Billboard/Signboard	1	e.a		
	<b>Sub - Total A</b>				
<b>B. LAND DEVELOPMENT</b>					
<b>B.I DRAINAGE SYSTEM</b>					
	<b>Drainage Line</b>				
01	Structure Excavation, Common Soil	0.756	cu.m		
02	Embankment from Structure Excavation	0.5	cu.m		
03	Gravel Bedding (G-1)	0.108	cu.m		
	<b>Area Drain Wall and Slab</b>				
04	Structural Concrete Class A-3000 PSI, 28 days	0.576	cu m		
	<b>Rebar Works (Area Drain Wall and Slab)</b>				
05	10mm dia Reinf. Steel Bars (Grade 40)	26.610	kgs		
06	Formworks and Falseworks	2.4	sq.m		
07	Steel Gratings (0.40m x 0.40m) (3 Sets) Including fixing accessories	3	sets		
08	100mm PVC Pipe including sundry items	7	pcs		
	<b>Sub - Total B.I</b>				

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
<b>B.II PERIMETER FENCE</b>					
01	Structure Excavation, Common Soil	25.9	cu.m		
02	Embankment from Structure Excavation	20.72	cu.m		
03	Gravel Bedding (G-1)	3.13	cu.m		
	<b>Column Footing , Column, Beam &amp; Wall Footing</b>				
04	Structural Concrete (Footings) Class A-3000 PSI, 28 days	13.26	cu m		
	<b>Rebar Works</b>				
05	12mm dia Reinf. Steel Bars (Grade 40)	737.43	kgs		
06	10mm dia Reinf. Steel Bars (Grade 40)	436.94	kgs		
07	Formworks and Falseworks	138.45	sq.m		
08	CHB Non-Bearing Masonry Wall (including Reinforcement Steel) 150mm	135.3	sq.m		
09	Cement Plaster Finish/ Plastering	270.6	sq.m		
	<b>Steel Works (Rear and Side Fence)</b>				
10	Supply, fabrication and installation of 25mm dia. Pipe Ga# 40 vertical support with Barbed Wire Galvanize 3 strands Gauge 12.5 fully welded including all fixing accessories.	1	l.s		
	<b>Painting Works</b>				
11	Painting Works, Masonry Concrete	324.72	sq.m		
12	Painting Works, Steel	100	sq.m		
	<b>Sub - Total B.II</b>				
<b>B.III FLAGPOLE</b>					
01	Structure Excavation, Common Soil	1.87	cu.m		
02	Embankment from Structure Excavation	1.44	cu.m		
03	Gravel Bedding (G-1)	0.14	cu.m		
	<b>Column Footing</b>				
04	Structural Concrete (Footings) Class A-3000 PSI, 28 days	0.43	cu m		
	<b>Column</b>				
06	Structural Concrete (Columns) Class A-3000 PSI, 28 days	0.18	cu m		
	<b>Slab on Fill</b>				
07	Structural Concrete (Slab on Fill) Class A-3000 PSI, 28 days	0.8	cu m		



ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
	<b>Rebar Works (Column Footing)</b>				
08	16mm dia Reinf. Steel Bars (Grade 60)	23.67	kgs		
	<b>Rebar Works (Column)</b>				
09	16mm dia Reinf. Steel Bars (Grade 60)	14.83	kgs		
10	10mm dia Reinf. Steel Bars (Grade 60)	14.6	kgs		
	<b>Slab on Fill, Ramp Slab</b>				
11	10mm dia Reinf. Steel Bars (Grade 40)	14.78	kgs		
12	<b>Formworks and Falseworks</b>	3.28	sq.m		
	<b>Steel Pole &amp; Accessories</b>				
13	Supply, fabrication and installation of 100mm Dia. GI Pipe with 75mm & 50mm Dia. GI Pipe reducer, fully welded including all fixing accessories.	1	l.s		
	<b>Painting Works</b>				
14	Painting Works, Masonry Concrete	4.96	sq.m		
15	Painting Works, Steel	4	sq.m		
	<b>Sub - Total B.III</b>				
<b>B.IV EARTHWORKS</b>					
1	Embankment from (Common Borrow) by Equipment	890.334	cu.m		
	<b>Sub - Total B.IV</b>				
<b>C. COAST GUARD STATION BUILDING</b>					
<b>C.I EARTHWORKS</b>					
01	Structure Excavation, Common Soil	30.54	cu.m		
02	Embankment from Structure Excavation	17.9	cu.m		
03	Gravel Bedding (G-1)	10	cu.m		
04	Embankment from (Common Borrow) by Equipment	70.5	cu.m		
05	Damproofing (Polyethylene Sheets 1m x 25m)	52.56	sq.m		
06	Soil Poisoning	15	ltrs		
	<b>Sub - Total C.I</b>				

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
<b>C.II CONCRETE WORKS</b>					
01	<b>Column Footing</b> Structural Concrete (Footings) Class AA-4000 PSI, 28 days	5.92	cu m		
02	<b>Footing Tie Beam</b> Structural Concrete (Footing Tie Beam) Class AA-4000 PSI, 28 days	6.72	cu m		
03	<b>Wall Footing</b> Structural Concrete (Wall Footing) Class AA-4000 PSI, 28 days	1.47	cu m		
04	<b>Column &amp; Planted Column</b> Structural Concrete (Columns) Class AA-4000 PSI, 28 days	12.32	cu m		
05	<b>Girder &amp; Beam, Lintel Beam ( Second Floor )</b> Structural Concrete (Girder, Beams & Lintel Beam) Class AA-4000 PSI, 28 days	6.41	cu m		
06	<b>Girder &amp; Beam, Lintel Beam ( Roof Deck )</b> Structural Concrete (Girder, Beams & Lintel Beam) Class AA-4000 PSI, 28 days	6.551	cu m		
07	<b>Girder &amp; Beam, Lintel Beam ( Service Deck )</b> Structural Concrete (Girder, Beams & Lintel Beam) Class AA-4000 PSI, 28 days	1.7	cu m		
09	<b>Suspended Slab, Roof Deck Slab &amp; Service Deck Slab</b> Structural Concrete (Slab) Class AA-4000 PSI, 28 days	17.22	cu m		
10	<b>Stiffener Column</b> Structural Concrete (Stiffener Column) Class AA-4000 PSI, 28 days	0.65	cu m		
11	<b>Stairs</b> Structural Concrete (Stairs) Class AA-4000 PSI, 28 days	6.63	cu m		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
12	<b>Slab on Fill, Stair on Fill &amp; Ramp Slab &amp; Kitchen Counter</b> Structural Concrete Class A-3000 PSI, 28 days	9.985	cu m		
	<b>Sub - Total C.II</b>				
<b>C.III REBAR WORKS</b>					
	<b>Column Footing</b>				
01	16mm dia Reinf. Steel Bars (Grade 60)	681.84	kgs		
	<b>Footing Tie Beam</b>				
02	12mm dia Reinf. Steel Bars (Grade 40)	703.56	kgs		
03	10mm dia Reinf. Steel Bars (Grade 40)	310.8	kgs		
	<b>Wall Footing</b>				
04	12mm dia Reinf. Steel Bars (Grade 40)	29.44	kgs		
05	10mm dia Reinf. Steel Bars (Grade 40)	4.31	kgs		
	<b>Column</b>				
06	16mm dia Reinf. Steel Bars (Grade 60)	1477.32	kgs		
07	10mm dia Reinf. Steel Bars (Grade 40)	2771.3	kgs		
	<b>Girder and Beam, Lintel Beam (Second Floor)</b>				
08	12mm dia Reinf. Steel Bars (Grade 40)	820.32	kgs		
09	10mm dia Reinf. Steel Bars (Grade 40)	347.8	kgs		
	<b>Girder and Beam, Lintel Beam (Third Floor)</b>				
10	12mm dia Reinf. Steel Bars (Grade 40)	847.47	kgs		
11	10mm dia Reinf. Steel Bars (Grade 40)	425.5	kgs		
	<b>Girder and Beam, Lintel Beam (Roof Deck)</b>				
12	12mm dia Reinf. Steel Bars (Grade 60)	85.28	kgs		
13	10mm dia Reinf. Steel Bars (Grade 40)	96.2	kgs		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
	<b>Suspended Slab, Roof Deck Slab &amp; Service Deck Slab</b>				
14	12mm dia Reinf. Steel Bars (Grade 40)	2563.73	kgs		
	<b>Stiffener Column</b>				
15	12mm dia Reinf. Steel Bars (Grade 40)	198.91	kgs		
16	10mm dia Reinf. Steel Bars (Grade 40)	264.4	kgs		
	<b>Stairs, Stairs on fill</b>				
17	16mm dia Reinf. Steel Bars (Grade 60)	656.37	kgs		
18	12mm dia Reinf. Steel Bars (Grade 40)	313.27	kgs		
19	10mm dia Reinf. Steel Bars (Grade 40)	533.29	kgs		
	<b>Slab on Fill, Ramp Slab</b>				
20	12mm dia Reinf. Steel Bars (Grade 40)	281.2	kgs		
	<b>Sub - Total C.III</b>				
<b>C.IV FORMWORKS &amp; SCAFFOLDING</b>					
01	Formworks and Falseworks	699.28	sq.m		
	<b>Sub - Total C.IV</b>				
<b>C.V MASONRY WORKS</b>					
01	CHB Non-Bearing Masonry Wall (including Reinforcement Steel) 100mm	203.80	sq.m		
02	CHB Non-Bearing Masonry Wall (including Reinforcement Steel) 150mm	225.29	sq.m		
03	Cement Plaster Finish/ Plastering	858.18	sq.m		
	<b>Sub - Total C.V</b>				

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
<b>C.VI FINISHING WORKS</b>					
01	60cm x 60cm Homogeneous Porcelain Floor Tiles (F-1)	100.443	sq.m		
02	30cm x 30cm Homogeneous Ceramic Floor Tiles Non-Skid (F-2)	12.7575	sq.m		
03	60cm x 60cm Homogeneous Ceramic Floor Tiles Non-Skid (F-3)	6.762	sq.m		
04	30cm x 30cm Homogeneous Ceramic Wall Tiles (T&B)	76.39	sq.m		
05	30cm x 30cm Homogeneous Tiles (Counter Top)	2.279	sq.m		
06	Industrial Rubberized Floor Paint (Cholirinated Rubber Base) (2 Coats)(F-4)	118.77	sq.m		
07	300mm X 1200mm Wood Texture Stair Floor Tile	28.5	sq.m		
08	1.5mm X 14.7mm X 33mm X 2.5m Aluminum with Rubber Stair Nosing	36	pcs		
09	Cement Floor Finish	119	sq.m		
10	Stainless Steel PCG and DOTR Logo (1m Diameter)	2	sets		
11	Stainless Steel CGS NORTHERN SAMAR and CGDEV Logo (600mm dia.x 16mm Thick embossed )	2	sets		
12	CGS NORTHERN SAMAR Stainless Steel 3D Build-up Letter (200mm Height x 16mm Thick embossed) (Uppercase) (Frugiter 75 Black) (Gold Color)	30	pcs		
13	CGDEV Stainless Steel 3D Build-up Letter (100mm Height x 16mm thick embossed) (Upper and Lowercase) (Frugiter 65 Bold) (Gold Color)	32	pcs		
14	PCG & ADDRESS of CGS NORTHERN SAMAR Stainless 3D Build-up Letter (100mm Height X 16mm thick embossed) (Upper and Lowercase) (Frugiter 65 Bold)	56	pcs		
15	Aluminum Metal Cladding	13.56	sq.m		
16	Metal Furring	45	pcs		
17	Rivets	1000	pcs		
18	Drill Bit	5	box		
	<b>Sub - Total C.VI</b>				

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
<b>C.VII DOORS &amp; WINDOWS</b>					
01	(1700mm x 2100mm) Double- Leaf 12mm Thick Tempered Swing Glass Door on Powder Coated Aluminum Frame with complete accessories <b>(D-1) (1 set)</b>	3.57	sq.m		
02	(1000mm x 2150mm) Single Leaf Solid Wood Door with Door Jamb and complete accessories <b>(D-2) (3 sets)</b>	6.45	sq.m		
03	(1100mm x 2150mm) Single Leaf Steel Door with Security Grade Lock Lever Type Doorknob with Door Jamb and complete accessories <b>(D-3) ( 4 sets)</b>	9.46	sq.m		
04	(1100mm x 2150mm) Fire Exit Steel Door with Panic Device Emergency Exit with Steel Door Jamb and complete accessories <b>(D-4) (1 set)</b>	2.365	sq.m		
05	(1000mm x 2150mm) Single Leaf Solid Louvered Wood Door with Door Jamb and complete accessories <b>(D-5) ( 1 set)</b>	2.15	sq.m		
06	(800mm x 2150mm) PVC Louvered Door with Door Jamb and complete accessories <b>(D-6) (3 sets)</b>	5.16	sq.m		
04	(900mm x 2150mm) Steel Louvered Door with Door Jamb and complete accessories <b>(D-7) (2 sets)</b>	3.87	sq.m		
05	(1000mm x 2150mm) Single Leaf Solid Wood Door with 6mm Thick Viewing Glass Panel with Door Jamb and complete accessories <b>(D-8) (2 sets)</b>	4.3	sq.m		
06	(1200mm x 1200mm) 10mm Thick Tempered Fixed Glass Window on Powder Coated Aluminum Frame with complete accessories <b>(W-1) (10 sets)</b>	14.4	sq.m		
07	(700mm x 700mm) 10mm Thick Tempered Casement Window on Powder Coated Aluminum Frame with complete accessories <b>(W-2) (5 sets)</b>	2.45	sq.m		
08	(625mm x 1200mm) 10mm Thick Tempered Awning Glass Window on Powder Coated Aluminum Frame with complete accessories <b>(W-3) (1 set)</b>	0.75	sq.m		
09	(600mm x 1095mm) Steel Louvered Fixed Window with complete accessories <b>(W-4) (3 sets)</b>	1.971	sq.m		
10	(600mm x 2400mm) 10mm Thick Tempered Awning Glass Window on Powder Coated Aluminum Frame with complete accessories. <b>(W-5) (2 sets)</b>	2.88	sq.m		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
11	(1400mm x 700mm) 10mm Thick Tempered Awning Glass Window on Powder Coated Aluminum Frame with complete accessories. <b>(W-6) (1 set)</b>	0.98	sq.m		
	<b>Sub - Total C.VII</b>				
<b>C.VIII CEILING WORKS</b>					
01	3.5mm Thick Fiber Cement Board Ceiling on Metal Frame with complete accessories	196.58	sq.m		
	<b>Sub - Total C.VIII</b>				
<b>C.IX CARPENTRY WORKS</b>					
01	<b>Hanging Kitchen Cabinet and Kitchen Counter Cabinet</b> Fabrication and Installation of Counter Top Cabinet and Hanging Cabinet with complete accessories.	1	l.s		
02	<b>Working Station</b> Fabrication and Installation of 6 Units of Work Station (Cubicle)	1	l.s		
	<b>Sub - Total C.X</b>				
<b>C.X STEEL WORKS</b>					
01	<b>Main Stair Railings</b> Supply, fabrication and installation of 50mm diameter S.S pipe handrail and vertical support with 25mm Dia. Stainless Pipe baluster member, fully welded with Stainless Steel Raised Base Flange and Stainless Steel Extruded Bracket including all fixing accessories	1	l.s		
02	<b>PWD Ramp Railings</b> Supply, fabrication and installation of 50mm Dia. S.S pipe handrail baluster with 50mm Dia. Vertical support, fully welded with Stainless Steel Raised Base Flange including all fixing accessories	1	l.s		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
03	<b>Fire Exit Ladder ( Ground Floor to Second Floor)</b> Supply, fabrication and installation of 16mm Dia. Stainless steel Ladder Rung on 20mm x 50mm Stainless Steel Stile (Flat Bar) fully welded including all fixing accessories	1	l.s		
04	<b>Ladder Rung ( Roof Deck to Upper Deck)</b> Supply, fabrication and installation of 16mm Dia. Stainless steel Ladder Rung on 20mm x 50mm Steel Stile (Flat Bar) fully welded including all fixing accessories	1	l.s		
05	<b>Stainless Steel Operable Fire Escape Cover</b> Supply, fabrication and installation of 50mm x 50mm x 6mm Thick Stainless Steel Angle Bar Frame with 20mm Diameter Stainless Steel Round Tube fully welded including all fixing accessories.	1	l.s		
	<b>Sub - Total C.XI</b>				
<b>C.XI WATERPROOFING WORKS</b>					
01	Cementitious Waterproofing ( T&B, Balcony and Deck) (2 Coats)	217.58	sq.m		
	<b>Sub - Total C.XII</b>				
<b>C.XII ROOFING WORKS</b>					
01	0.6mm Thick Pre-painted Roofing Sheets with complete accessories	11.45	sq.m		
02	Pre-painted Gutter with complete accessories	2	l.m		
03	Pre-painted Flashing with complete accessories	18	l.m		
	<b>Trusses</b>				
04	50mm x 100mm x 12.5mm x 1.5mm Thick C-Purlins including fixing accessories	555.12	kgs		
05	2 1/2" x 2 1/2" x 3/16" Thick Angle Bar & 2 " x 2 " x 1/8" Thick Angle Bar including fixing accessories	1386.18	kgs		
06	12mm Dia. Anchor Bolts with Nuts and Washer	30	pcs		
	<b>Sub - Total C.XIII</b>				



ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
<b>C.XIII PAINTING WORKS</b>					
01	Interior Painting Works, Ceiling, Masonry & Concrete	800.76	sq.m		
02	Exterior Painting Works, Masonry & Concrete (Elastomeric Paint)	450.58	sq.m		
	<b>Sub - Total C.XIV</b>				
<b>C.XIV PLUMBING WORKS</b>					
	<b><i>Plumbing Fixtures</i></b>				
01	Water Closet with complete accessories	4	sets		
02	Lavatory with complete accessories	4	sets		
03	Stainless Kitchen Double Sink with complete accessories	1	set		
04	Shower set with complete accessories	3	sets		
05	Tissue Holder with cover, with complete accessories	4	sets		
06	Stainless Faucet	9	set		
07	Grease Trap 20GPM with Complete accessories	1	set		
08	2.0 HP Transfer Pump, with Complete accessories	1	set		
09	2.0 HP Booster Pump, with Complete accessories	1	set		
10	Polyethylene Storage Water Tank, Horizontal Type, with complete accessories and Float Valve - Capacity: 1572 Gallons	2	set		
11	Mirror with Complete Accessories	4	sq.m		
12	Floor Drain, 50mm dia	7	pcs		
13	Shower Drain, 50mm dia	3	pcs		
14	Deck Drain, 100mm dia	10	pcs		
15	Gutter Drain, 100mm dia	2	pcs		
	<b><i>Potable Water Line</i></b>				
16	PPR Pipe, 20mm dia x 4m	20	pcs		
17	PPR Pipe, 25mm dia x 4m	20	pcs		
18	PPR Pipe, 32mm dia x 4m	16	pcs		
19	PPR Pipe, 40mm dia x 4m	12	pcs		
20	PPR Pipe, 50mm dia x 4m	8	pcs		
21	PPR Fittings and Accessories	1	l.s		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
	<b><i>Non- Potable Water Line</i></b>				
22	PPR Pipe, 25mm dia x 4m	20	pcs		
23	PPR Pipe, 32mm dia x 4m	16	pcs		
24	PPR Fittings and Accessories	1	l.s		
	<b><i>Sewage Line / Vent Line</i></b>				
25	PVC Pipe, 50mm dia x 3m	36	pcs		
26	PVC Pipe, 75mm dia x 3m	3	pcs		
27	PVC Pipe, 100mm dia x 3m	18	pcs		
28	PVC Fittings and Accessories	1	l.s		
	<b><i>Drainage Line</i></b>				
29	PVC Pipe, 100mm dia x 3m	50	pcs		
30	PVC Pipe, 150mm dia x 6m	6	pcs		
31	PVC Fittings and Accessories	1	l.s		
	<b><i>Miscellaneous</i></b>				
32	Pipe Hanger / Pipe Support & Solvent Cement (400cc)	1	l.s		
	<b><i>Rain Water Equipment and Accessories</i></b>				
33	Rainwater Hopper Downspout drain adapter collector	1	set		
34	Polyethylene Storage Water Tank, Vertical Type, with complete accessories - Capacity: 300 Gallons	1	set		
35	Rainwater Cyclone Filter Filter 110mm	1	set		
36	3P Compact Tank Filter	1	set		
37	Rainwater Tank Overflow Siphon	1	set		
	<b><i>Catch Basin</i></b>				
38	Structure Excavation, Common Soil	3.53	cu.m		
39	Gravel Bedding (G-1)	0.5	cu.m		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
	<b>Catch Basin Wall, Slab &amp; Cover</b>				
40	Structural Concrete Class AA-4000 PSI, 28 days	2.7	cu m		
	<b>Rebar Works (Wall, Slab &amp; Cover)</b>				
41	16mm dia Reinf. Steel Bars (Grade 60)	11	kgs		
42	10mm dia Reinf. Steel Bars (Grade 40)	124.18	kgs		
43	Formworks and Falseworks	23.52	sq.m		
44	Steel Gratings	1	set		
	<b>CISTERN TANK</b>				
45	Structure Excavation, Common Soil	3.89	cu.m		
46	Gravel Bedding (G-1)	0.2	cu.m		
	<b>Cistern Wall and Slab</b>				
47	Structural Concrete Class AA-3000 PSI, 28 days	3.23	cu m		
	<b>Rebar Works (Cistern Wall and Slab)</b>				
48	16mm dia Reinf. Steel Bars (Grade 60)	66.57	kgs		
49	12mm dia Reinf. Steel Bars (Grade 40)	358.59	kgs		
50	Formworks and Falseworks	13.32	sq.m		
51	Waterproofing	15	sq.m		
	<b>SEPTIC TANK</b>				
52	Structure Excavation, Common Soil	31.7	cu.m		
53	Gravel Bedding (G-1)	1.5	cu.m		
	<b>Septic Wall and Slab</b>				
54	Structural Concrete Class AA-3000 PSI, 28 days	4.53	cu m		
	<b>Rebar Works (Septic Wall and Slab)</b>				
55	12mm dia Reinf. Steel Bars (Grade 40)	226.7	kgs		
56	10mm dia Reinf. Steel Bars (Grade 40)	50.82	kgs		
57	Formworks and Falseworks	15.12	sq.m		
58	CHB Non-Bearing Masonry Wall (including Reinforcement Steel)	32.4	sq.m		
59	Cement Plaster Finish	64.8	sq.m		
	<b>Sub - Total B.XIII</b>				

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
<b>C.XV</b>	<b>ELECTRICAL WORKS</b>				
	<b>WIRES AND CABLES</b>				
	<b>THHN (Branch Circuits)</b>				
01	3.5 mm <sup>2</sup> Cu Cond Strnd	8	rolls		
02	5.5 mm <sup>2</sup> Cu Cond Strnd	2	rolls		
	<b>THW (Feeder/Subfeeder)</b>				
03	8.0 mm <sup>2</sup> Cu Cond Strnd	40	mtrs		
04	30 mm <sup>2</sup> Cu Cond Strnd	20	mtrs		
05	50 mm <sup>2</sup> Cu Cond Strnd	60	mtrs		
	<b>TW (Grounding)</b>				
06	8.0 mm <sup>2</sup> Cu Cond Strnd	30	mtrs		
07	14 mm <sup>2</sup> Cu Cond Strnd	30	mtrs		
	<b>PIPES/CONDUIT AND FITTINGS</b>				
	<b>uPVC CONDUIT</b>				
08	20 mm Ø x 3m	120	lngths		
09	25 mm Ø x 3m	6	lngths		
10	32 mm Ø x 3m	3	lngths		
11	50 mm Ø x 3m	10	lngth		
	<b>uPVC CONDUIT ELBOW</b>				
12	32 mm Ø	3	pcs		
13	50 mm Ø	3	pcs		
	<b>uPVC CONDUIT ENDBELL</b>				
14	20 mm Ø	150	pcs		
15	25 mm Ø	4	pcs		
16	32 mm Ø	4	pcs		
17	50 mm Ø	10	pcs		
	<b>IMC</b>				
18	50 mm Ø x 3m	2	lngths		
	<b>IMC ELBOW</b>				
19	50 mm Ø	1	pc		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
	<b>IMC COUPLING</b>				
20	50 mm Ø	1	pc		
	<b>Flexible Metallic Conduit</b>				
21	Liquid Tight Flexible Metallic Conduit 20 mm Ø x 30m	2	rolls		
	<b>WIRING DEVICES</b>				
22	One-Way, One-Gang Switch, Wide Series	8	sets		
23	One-Way, Two-Gang Switch, Wide Series	13	sets		
24	Three-Way, One-Gang Switch, Wide Series	2	sets		
25	One-Gang Universal Convenience Outlet	8	sets		
26	Two-Gang Universal Convenience Outlet	22	sets		
27	ACU Outlet/ Special Purpose Outlet with Ground	2	sets		
	<b>LIGHTING FIXTURES OTHER DEVICES</b>				
28	1 - 2x 20W LED FF	18	sets		
29	1 - 1x20W LED FF	7	sets		
30	1 - 15W LED Bulb w/ Receptacle	17	sets		
31	1 x50w LED Weatherproof Square Floodlight	2	sets		
32	2 x1w High Power SMT LED Emergency Lights	8	sets		
33	4.0V 4.0Ah Sealed Lead Acid Battery				
34	36W 10" Ceiling Mounted Exhaust Fan	4	sets		
35	55W Wall Mounted Exhaust Fan	1	sets		
36	65W Orbital Ceiling Fan	1	sets		
	<b>BOXES AND CONDULETS</b>				
37	2x4 Junction Box, Guage #14, Galvanized	55	pcs		
38	4x4 Junction Box, Guage #14, Galvanized	50	pcs		
39	Pull box, 6x6 Metal gauge #14	5	pcs		
40	Fabricated Pull Box, 12x12, Gauge #14	2	assy		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
41	<b>PANEL BOARDS AND CIRCUIT BREAKERS</b> <b>LPP</b> Main: 40AT,10Kaic, 60AF 250V,1-Phase, 2-Pole,60HZ, Bolt-on Type Branches: 2 - 15AT, 60AF, 10Kaic, 2P 4 - 20AT, 60AF, 10Kaic, 2P 250V, 60Hz, Bolt-on 2-space NEMA 1 Enclosure, with Circuit and Panel Tagging	1	assy		
42	<b>PP</b> Main: 100AT,10Kaic, 100AF 250V,1-Phase, 2-Pole,60HZ, Bolt-on Type Branches: 5 - 20AT, 60AF, 10Kaic, 2P 4 - 30AT, 60AF, 10Kaic, 2P 250V, 60Hz, Bolt-on, 2-space NEMA 1 Enclosure, with Circuit and Panel Tagging	1	assy		
43	<b>DP</b> Main : 125AT, 125AF, 10Kaic 2-Pole, 1-Phase, 250V, 60Hz, Bolt-On Branches: 1 - 40AT, 10Kaic, 60AF, 2-Pole 1 - 100AT, 10Kaic, 100AF, 2-Pole 2 - Spare NEMA 1 Enclosure, with Circuit and Panel Tagging	1	assy		
44	<b>MDS</b> Main : 125AT, 125AF, 10Kaic 2-Pole, 1-Phase, 250V, 60Hz, Bolt-On NEMA 3R Enclosure	1	assy		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
45	<b>MTS</b> 40 AT, 230V, 1-Phase NEMA 1 Enclosure, with Panel Tagging	1	assy		
46	<b>ACU ECB</b> 30 AT, 60AF, 230V, 1-Phase NEMA 1 Enclosure, with Panel Tagging	3	assy		
47	<b>WATER PUMP ECB</b> 30 AT, 60AF, 230V, 1-Phase NEMA 1 Enclosure, with Panel Tagging	2	assy		
48	<b>GENERATOR SET</b> 8Kw / 8Kva Diesel Generator Set, 1Phase, 220V, 60Hz, p.f. 1.0 3600 RPM, Silent Type, Complete with accessories	1	set		
	<b>GROUNDING SYSTEM</b>				
49	Lighting Arresters	1	assy		
50	25mm Ø uPVC Electrical Pipe	20	lgths		
51	Miscellaneous and Hardwares	1	lot		
	<b>BCW (System Grounding)</b>				
52	22 mm <sup>2</sup> Bare Cu Cond	60	mtrs		
53	25mm Ø Ground Rod	6	pcs		
54	Ground Rod Clamp	6	pcs		
	<b>MISCELLANEOUS AND HARDWARES</b>				
55	50mm Ø Entrance Cap	1	pc		
56	KiloWatt Hour Meter, Single Phase, 2-Wire	1	pc		
57	Meter Base	1	pc		
58	Pipe Hanger w/ Rod	50	sets		
59	Electrical Tape	5	bndls		
60	Rubber Tape	3	rolls		
61	Hacksaw Blade	5	pcs		
62	Blow Torch Gun	2	pcs		
63	Butane Gas	10	pcs		
64	Ga #14 GI Pull Wire	5	kgs		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
65	PVC Cement, 120cc	10	cans		
66	5mm x 300mm Cable Ties	4	pcks		
	<b>Sub - Total C. XVI</b>				
<b>C.XVI</b>	<b>LOCAL AREA NETWORK (LAN) SYSTEM</b>				
	<b>WIRES AND CABLES</b>				
01	LAN Cable Cat6	150	mtrs		
02	RJ45 Ethernet Cable	9	pcs		
	<b>EMT PIPES</b>				
03	EMT 25 mm Ø	25	lngths		
	<b>EMT ELBOW</b>				
04	25 mm Ø	18	pcs		
	<b>WIRING DEVICES</b>				
05	Local Area Network (LAN) Outlet	9	sets		
06	12-Port Gigabit Internet Switch	1	set		
07	Gigabit Router	1	set		
08	UPS	1	set		
	<b>BOXES AND CONDULETS</b>				
09	4x2 Ga#14 Utility Box	9	pcs		
10	4x4 Ga#14 Pull Box	2	pcs		
	<b>AUXILLARY EQUIPMENT</b>				
11	LAN/Internet Terminal Cabinet (L/ITC)	1	assy		
	<b>MISCELLANEOUS AND HARDWARES</b>				
12	R45 Connector	20	pcs		
13	Hacksaw Blade	5	pcs		
14	Ga #14 GI Pull Wire	1	kgs		
	<b>Sub - Total C. XVIII</b>				
<b>C.XVII</b>	<b>FIRE PROTECTION SYSTEM</b>				
	<b>Fire Detection and Alarm System</b>				
	<b>Field Devices</b>				
01	a. Smoke Detector, Conventional,	5	pcs		



ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
	b. Smoke Detector with Base Sounder, Conventional,	3	pcs		
02	Heat Detector, Conventional	1	pcs		
03	Manual Pull Station, Dual Action	2	pcs		
04	Horn and Light Strobe, Conventional	2	pcs		
05	End-Of-Line Resistor	2	pcs		
	<b>Main Equipment</b>				
06	Control Panel, Conventional, 2-Zone Compact with Complete Module	1	pcs		
07	Battery Back-up, 12V, 4Ah	2	pcs		
	<b>Wires and Roughing- ins</b>				
	Includes:				
08	a. TF Wire 1.25mm #16	1	roll		
09	b. Junction Box Type Gauge #16 (101mm x 101mm x 53mm)	14	pcs		
10	c. PVC Conduit Pipe 3/4" (20mm) x 10'	20	pcs		
11	d. PVC Conduit Elbow 3/4" x 10'	16	pcs		
12	e. PVC Coupling (20mm)	30	pcs		
13	f. PVC Clamp 3/4" 100s	1	pack		
	<b>Fire Protection System</b>				
14	<i>Fire Extinguisher</i> 10lb ABC Dry Chemical Fire Extinguisher with complete fixing accessories.	3	set		
	<b>Standpipe System</b>				
15	4" (100mm) Grade B x 6.0M, Sch40 Steel Pipe, ASTM A53	3	pcs		
16	4" (100mm) Check Valve	1	pcs		
17	2 1/2" (65mm) UL FM Approved 2.5" Fire Hose Valve w/ Cap & Chain	3	pcs		
18	4 X 2 1/2" X 2 1/2 inch UL FM 100 x 65mm dia. 2 Way Siamese FDC	1	pcs		
	<b>Pipe Sleeve and Fittings</b>				
19	6" (150mm) Grade B x 6.0M, Sch40 Steel Pipe, ASTM A53	1	pcs		

ITEM NO	DESCRIPTION	QTY	UNIT	MATERIAL COST	AMOUNT
20	20mm x 6.0 M Deformed Bar – Grade 75 Steel Bar	1	pcs		
21	1.2 x 2.4m 12mm Thk Steel plate	1	pcs		
22	100mm Elbow 90° Fixed Table E Flanged SGP Galvanized	1	pcs		
23	Galvanized Iron ( GI ) Round Flange 100mm ( 4" ) (T/E)	4	pcs		
	<b>Sub - Total C. XIX</b>				
	<b>TOTAL COST</b>				

AMOUNT IN WORDS: \_\_\_\_\_

Submitted by:

\_\_\_\_\_  
Name and Signature of Bidder's Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Position

\_\_\_\_\_  
Name of the Company