

**Republic of the Philippines**

Department of Transportation and Communication

Republic of the Philippines

**Detailed Design Study Report  
of  
New Bohol Airport Construction and  
Sustainable Environment Protection  
Project**

**Final Report**

**Appendix-1: Draft Bid Documents**

**Document II : Specifications (Volume-1/4)**

Section 1000 Series - General Requirements

September 2013

Japan International Cooperation Agency (JICA)

Japan Airport Consultants, Inc. (JAC)

Nippon Koei Co., Ltd. (NK)

NJS Consultants Co., Ltd. (NJS)

Joint Venture



Republic of the Philippines  
DEPARTMENT OF TRANSPORTATION  
AND  
COMMUNICATIONS



JAPAN  
INTERNATIONAL  
COOPERATION  
AGENCY

# NEW BOHOL AIRPORT CONSTRUCTION AND SUSTAINABLE ENVIRONMENT PROTECTION PROJECT

(Loan No: PH-P256)

## DRAFT BID DOCUMENT II SPECIFICATIONS (VOL-1/4)

**Section 1000 Series: General Requirements**



August 2013

**JICA Design Consultant Joint Venture**



JAPAN AIRPORT  
CONSULTANTS,  
INC.



NIPPON KOEI  
CO., LTD.



NJS CONSULTANTS  
CO., LTD.

# **New Bohol Airport Construction and Sustainable Environmental Protection Project**

## **Specifications**

### **Section 1000 Series: General Requirements**

## SPECIFICATIONS

### 1000 SERIES: GENERAL REQUIREMENTS

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**ATTACHMENT:**

- A: Project Site
- B: Emplier’s& Engineer’s Office
- C: Laboratory Building
- D: Test Equipment
- E: Environment Management Plan for Construciton Works



## SECTION 1105

### THE WORKS

#### 1.0 GENERAL

- 1.1. New Bohol Airport Construction and Sustainable Environment Protection Project) (hereinafter referred to as the “NBAC-SEP Project” or “Project”) shall comprise all civil works, utility works, building works, together with the supply and installation of radio nav aids, ATS facilities, meteorological facilities, and aeronautical ground lighting.
- 1.2. The specification documents are referred to herein and in other documents comprising the Contract collectively as the “Specification” or “Specifications”. The Specification shall be read in conjunction with all of the remaining documents forming part of the Contract.

#### 2.0 SCOPE OF THE WORKS

- 2.1. The scope of the Project Works shall consist of the execution and completion of the following 6 components:

Component	Work Description
<b>Component-1: General Requirements (G)</b>	As specified in GCC and this Specification 1000 including: <ul style="list-style-type: none"> <li>- Insurances specified</li> <li>- Employer’s and Engineer’s facilities</li> <li>- Environment Management</li> <li>- Project Equipment</li> <li>- Maintenance Equipment</li> </ul>
<b>Component-2: Civil Works (C)</b>	Construction of access road and airport infrastructure of runway strip, runway, taxiways, and apron including earthworks, pavement works, drainage works, landscaping and miscellaneous works
<b>Subcomponent-2-1</b>	(C1) Access Road
<b>Subcomponent-2-2</b>	(C2) Airport Infrastructure
<b>Component-3: Utility Works (U)</b>	Design, supply and installation of the equipment, piping, cabling and associated works for the following facilities:
<b>Subcomponent-3-1</b>	(U1) Water Supply System
<b>Subcomponent-3-2</b>	(U2) Power Supply System
<b>Subcomponent-3-3</b>	(U3) Sewage Treatment System
<b>Component-4: Building Works (B)</b>	Construction of the following buildings including structural works, architectural works, mechanical works, electrical works, IT works and landscaping works, and installation of airport special equipment such as baggage handling system and security check system:
<b>Subcomponent-4-1</b>	(B1) Passenger Terminal Building
<b>Subcomponent-4-2</b>	(Not used)
<b>Subcomponent-4-3</b>	(B3) Control Tower, ATC Operation & Administration Building
<b>Subcomponent-4-4</b>	(B4) Fire Station and Airport Maintenance Building
<b>Subcomponent-4-5</b>	Ancillary Buildings (B51) Driver’s Lounge (B52) Car Parks Toilet (B53) Guard House (B54) Tollbooths

<b>Subcomponent-4-6</b>	Utility Buildings (B61) Water Tank & Pump Station (B62) Power Houses (B63) STP Control Room (B64) Material Recover Facility
<b>Subcomponent-4-7</b>	Nav aids Buildings (B71) LLZ Building (B72) GS Building (B73) VOR Building
<b>Component-5: Air Navigation Facilities (N)</b>	Supply and installation of the following Air navigation Facilities:
<b>Subcomponent-5-1</b>	(N1) ILS
<b>Subcomponent-5-2</b>	(N2) VOR/DME
<b>Subcomponent-5-3</b>	(N3) ATS and Telecommunications
<b>Subcomponent-5-4</b>	(N4) Meteorological Observation System
<b>Component-6: Aeronautical Ground Lighting Works (L)</b>	Supply and installation of the following Aeronautical Ground Lighting:
<b>Subcomponent-6-1</b>	(L1) Approach Lighting Systems
<b>Subcomponent-6-2</b>	(L2) Precision Approach Path Indicator
<b>Subcomponent-6-3</b>	(L3) Runway Lighting System
<b>Subcomponent-6-4</b>	(L4) Taxiway Lighting System
<b>Subcomponent-6-5</b>	(L5) Other Aeronautical Lighting
<b>Subcomponent-6-6</b>	(L6) Apron Floodlighting
<b>Subcomponent-6-7</b>	(L7) Underground Cable Ducts
<b>Subcomponent-6-8</b>	(L8) Control and Monitor System

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2.2. The Specifications applicable to each component shall consist of the following sections:

- (1) Section 1000 Series: General Requirements
- (2) Section 2000 Series: Civil Works
- (3) Section 3000 Series: Utility Works
- (4) Section 4000 Series: Architectural Works
- (5) Section 5000 Series: Mechanical Works
- (6) Section 6000 Series: Electrical Works
- (7) Section 7000 Series: Special Equipment
- (8) Section 8000 Series: Air Navigation Facilities
- (9) Section 9000 Series: Aeronautical Ground Lighting Works

### **3.0 PROCURING ENTITY / EMPLOYER**

3.1. The expressions “Procuring Entity” and “Employer” shall be synonymous and interchangeable.

### **4.0 BID AND CONTRACT DOCUMENTS**

- 4.1. The expressions “Bid Document(s)” and “Contract Document(s),” shall be synonymous and interchangeable according to the context of its use. Reference throughout the Specification, Drawings and Bills of Quantities, to “Bid Document(s)” and “Contract Document(s)” shall in general be understood to be the same, after the Contract Agreement has been executed.

## **SECTION 1110**

### **THE SITE**

#### **1.0 LOCATION AND BOUNDARIES**

- 1.1. The Site for the Works is indicated on the Drawings, with the Site boundaries being clearly defined thereon, and the Contractor shall limit construction activities to within these Site boundaries. The Site shall comprise the following two areas:
  - (1) Access Road
  - (2) Airport
- 1.2. Location of the site and the boundary fencing around the site installed by the Employer is indicated in Attachment-A and the Drawings for Component-2: Civil Works.
- 1.3. The Contractor shall be responsible for controlling security for the site and also of the personnel traversing the Site for the purposes of the other Works appointed by the Employer throughout the duration of the Works.

#### **2.0 AREA FOR CONTRACTOR'S FACILITIES**

- 2.1. Refer to Section 1115.

#### **3.0 TEMPORARY ACCESS ROADS**

- 3.1. Refer to Section 1115.

#### **4.0 EXISTING SERVICES, ETC. WITHIN THE SITE**

- 4.1. The Contractor shall ascertain, the location of the existing fences, ditches, canals and services including power cables and wires, telephone cables, water, and all other like structures and system within the site.
- 4.2. If the Contractor finds such services will interfere with the operation of the works, the Contractor shall notify to the Engineer for further instructions.
- 4.3. If, during the course of the Contract, any services are uncovered, which were not recorded in the Drawings, the Contractor shall notify to the Engineer for further instructions.

#### **5.0 DISPOSAL OF SURFACE WATER AND EFFLUENTS**

- 5.1. The Contractor shall keep the working area free at all times from surface water and effluents, from whatever cause arising.
- 5.2. The Contractor shall provide such temporary drains and ditches as are discharged to the Soaking Yard shown in the Section VI: (4) Supplementary Information of Bidding Documents and Drawings for Component-2:

## SECTION 1115

### CONTRACTOR'S FACILITIES

#### 1.0 PROVISION OF TEMPORARY FACILITIES

1.1. The Contractor shall submit to the Engineer for approval, final detailed proposals of Contractor's temporary facilities including offices, stores, workshops, and the like showing all construction details, components and siting. Location of Temporary Facilities Area

1.2. The area within the Site that is to be made available for the Contractor's temporary facilities is indicated in Attachment-A.

#### 1.3. Temporary Facilities

(1) The Contractor shall provide and maintain all necessary temporary facilities throughout the duration of the Works including for example as follows:

- (a) Office buildings;
- (b) Storage buildings and warehousing;
- (c) Workshops;
- (d) First aid room and medical facilities;
- (e) Canteen

The Contractor shall provide a canteen for his work staff, All health safety and hygiene regulations must be met and maintained in respect of this canteen facility.

- (f) Toilets on the Contractor's facilities areas;
- (g) Mobile toilets on the site;
- (h) Contractor's workforce accommodation, bunk houses, etc.;
- (i) Temporary roads (haul roads and temporary roads), including temporary access road to Site;
- (j) Temporary bridges if required at site;
- (k) Temporary ditches, culverts and pipes for drainage; and
- (l) Temporary fences

(2) The Contractor's office shall include for the provision of a design drawing office, fully equipped with a CAD facility compatible with that of the Engineer's and drawing printing/copying facilities. All CAD software shall be officially licensed with the manufacturer.

(3) The Contractor shall keep on the Site, maintain and regularly re-calibrate, all necessary surveying and measuring equipment.

(4) The Contractor shall ensure that adequate separate facilities are provided for female members of contractor's staff.

(5) The Contractor shall make his own arrangements for the provision to all Temporary Facilities of:

- (a) Electrical power and distribution;
- (b) Water supply, storage and distribution; and
- (c) Storage, treatment and collection of sewage

#### 1.4. Temporary Roads, Bridges, Culverts and Coffering

(1) Within 42 days of the receipt of the Notification on Commencement date, the

Contractor shall submit for the review and approval by the Engineer, layout and details of all required temporary roads, protective crossing points and all temporary culverts that shall be provided by the Contractor, to sustain drainage flow for all canals and ditches, drainage canals and ditches, or bridges/protection of services whether buried or exposed, all of which, in the opinion of the Engineer, are necessary for the proper execution of the Works.

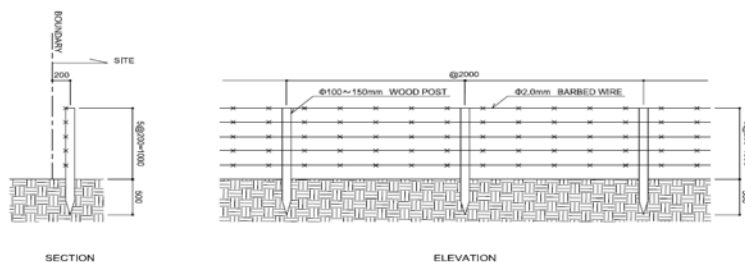
- (2) The Contractor shall be responsible for repairing at his own cost any damaged areas of the Works, any existing canals, ditches and services on the Site or within the Project area, caused by the construction operations including through temporary access operations.
- (3) The Contractor shall be responsible for upholding and protecting all boundaries of the Site against slippage into the area of the Works.
- (4) Temporary Roads shall be maintained in dust free condition by daily watering, rolling and grading all to the approval of the Engineer.
- (5) On completion of the Project, if instructed by the Engineer, the temporary roads shall be demolished and the ground restored, as far as physically possible, to its original condition.
- (6) The Contractor shall provide an approved wheel cleaning facility for trucks and construction equipment, at all exits from the construction site and temporary facilities area where considered necessary by the Engineer, to avoid depositing any dirt or debris on public roads.

## 2.0 RIGHTS OF WAY

- 2.1. Rights of way to the site under GCC 4.13 are shown in Attachment-A.
- 2.2. The Contractor not wish to use the mentioned rights of way as described on para 2.1 above, he shall investigate other routes to the Site and submit them for approval to the Engineer.
- 2.3.

## 3.0 EXISTING BARANGAY ROADS

- 3.1. Three (3) existing roads crossing the site shown in Attachment-A shall be ensured availability for use of the public traffic for 365 days from the Commencement Date of the Works. Three (3) roads may be closed and the fencing shall be removed after the completion of Section A (Access Road under Component-2-C1) as specified in Particular Conditions, Part A.
- 3.2. The Contractor shall provide barbed-wire fences for both sides of the roads as shown below.



- 3.3. The Contractor shall also provide the security personnel at each entrance of the roads and at the contractor's vehicle transverse points of the Barangay Roads to other Zones of the site for 24 hours.

- 3.4. The Contractor shall provide fencing and security personnel for outstanding settlement families as shown in Attachment-A for 365 days from the Commencement Date.

**4.0 CONTRACTOR'S EQUIPMENT**

- 4.1. Fuel and lubricant leakage and dripping on permanent paved areas, bases, sub-bases, grades, sub-grades and formations shall be avoided. If this occurs, the equipment shall be taken off Site, and all affected works and paved areas shall be replaced according to the instructions of the Engineer and at the Contractor's expense.
- 4.2. All lifting and hoisting equipment shall be correctly and regularly certified, and safe working limits must not be exceeded.
- 4.3. Temporary fuel and lubricant storage site shall be properly constructed, secure and well ventilated.

## **SECTION 1120**

### **EMPLOYER'S AND ENGINEER'S FACILITIES**

#### **1.0 PROJECT SIGNBOARD**

- 1.1. The Contractor shall provide Project Site Signboards at the following four (4) locations.
  - (1) Near the approach to the new bridge in Panglao Island;
  - (2) Cross point between airport approach road and Central Highway;
  - (3) Entrance to the Employer's and Engineer's Office; and
  - (4) A point near the existing road along the Central Highway as instructed by the Engineer
- 1.2. The signboard shall include the Project name, contract title, and employer's name, funding agency, consultant's name and contractor's name.
- 1.3. Basic specification of the Signboard shall be as follows:
  - (1) Size: 3m x 5 m;
  - (2) Steel frame and post;
  - (3) Post shall be fixed with concrete base;
  - (4) Silk screen on the board shall be watertight laminated and placed on the watertight painted marine plywood (thickness 1.8 cm).
- 1.4. The Contractor shall submit drawings for the Signboard for approval of the Engineer.

#### **2.0 OFFICES FOR THE EMPLOYER AND THE ENGINEER**

- 2.1. The Contractor shall provide a site office fully equipped and furnished for the exclusive use of both the Employer and Engineer as shown in Attachment-B.
- 2.2. The Contractor shall complete the construction and equipping of the site office within the maximum period of 120 days, counted from receipt of a Notice for the Commencement Date.
- 2.3. Until the Site Office is occupied by the Engineer, suitable temporary office (100 m<sup>2</sup>) with air-conditioning car parks, internet connection, LAN, network copy machine / printers, water dispenser and bottle water including maintenance at Tagbilaran City shall be provided by the Contractor.
- 2.4. Within 28 days from the Commencement date, the Contractor shall submit a detail drawing of the Employer's and Engineer's office for approval of the Engineer with complete lists of utility, finishing, equipment and furniture.
- 2.5. The Site office shall have a floor area 410 m<sup>2</sup> and it shall be located within the Contractor's temporary facilities area.
- 2.6. All areas shall be air-conditioned with split type air-conditioner units.

#### **3.0 FACILITIES FOR THE EMPLOYER AND THE ENGINEER**



- 3.1. The Contractor shall provide and install the following facilities:
- (1) Computer equipment and ancillaries all to be connected through both wired and wireless Local Area Network (LAN)
  - (2) Multi-task Photocopy Machines (A3, color, scanner, Fax)
  - (3) PLDT Telephone System
  - (4) Laser Printers (A3, black and white) -
  - (5) Drawing Printer
  - (6) Projector
  - (7) Refrigerators
  - (8) Other facilities
- 3.2. Local Area Network (LAN)
- (1) Local Area Network shall be installed for both cable connection and wireless connection with more than 60 ports for computers and printers in the Engineer's office and Laboratory Building.
  - (2) LAN shall be connected with internet services of broadband type.
  - (3) The Computer equipment and ancillaries shall be manufactured by Toshiba, Sony or Fujitsu, or equal and approved and comprise the following specifications and accessories:
- 3.3. Office Use Computers with accessories
- (a) CPU: more than 2 GHz
  - (b) 4 GB Memory;
  - (c) More than 1 TB Hard Disk;
  - (d) Network Interface Card and WiFi connector;
  - (e) 19" Wide TFT LCD Monitor;
  - (f) DVD / CD Writer;
  - (g) Mouse and keyboard;
  - (h) MS Windows 8;
  - (i) MS Office 2010 or latest version including Word, Excel and Power Point;
  - (j) Uninterruptible Power Supply (UPS) for 30 minutes
- 3.4. Computers for AutoCAD with accessories:
- (a) CPU: more than 2 GHz
  - (b) 8 GB Memory;
  - (c) More than 1 TB Hard Disk;
  - (d) Network Interface Card and WiFi connector;
  - (e) 21" Wide TFT LCD Monitor;
  - (f) DVD / CD Writer;
  - (g) Mouse and keyboard;
  - (h) Latest OS (e.g. MS Windows 8);
  - (i) MS Office 2010 or latest version including Word, Excel and Power Point;
  - (j) AutoCAD version 2010;
  - (k) Uninterruptible Power Supply (UPS) for 30 minutes
- 3.5. The Multi-task Color Photocopy Machine

- (1) Two (2) Multi-task Color Photocopy Machine, one for the use of the Employer, one for the use of the Engineer
- (2) These machines shall be "Xerox Document Center IV C3375 PFC", or equivalent equipped with WiFi network, Fax, scanner, auto feeder, duplex and sorting tray. Paper tray should have A3 and A4 each independently.
- (3) Leasing of the equipment is acceptable. Leasing charge and other required consumables including replacement print toner, plain papers (A4 & A3) for copying and all maintenance services shall be paid by the Contractor.

3.6. Drawing Plotter

- (1) Drawing Plotter shall be "Canon Image Prograf iPF605L" with stand, network card, or other equal and approved by the Engineer.
- (2) All required consumables including replacement print toner or cartridges, plain paper for copying and all maintenance services.

3.7. Network Laser Printers

- (1) Laser Printer shall be "Canon LBP8630" with 2 trays for A3 and A4, duplex and network card, or other equal and approved by the Engineer.
- (2) All required consumables including replacement print toner, plain papers, A3 and A4 size for copying and all maintenance services.

3.8. The telephone system for the Engineer office and laboratory building shall comprise:

- (1) Nine (9) incoming lines (Multi-task Color Photocopy Machine-2, Administrator-1, Project Manager-1, engineer-2, laboratory-1, Employer-2)
- (2) PABX and fifty (50) extensions with all handsets, cabling and equipment

3.9. Projector and Screen

- (1) Projector shall be "Canon WX6000" or other equal and approved by the Engineer.
- (2) Screen shall be more than 100 inches of hanging roll type from ceiling.
- (3) All required consumables including replacement lumps and all maintenance services.

3.10. The Contractor shall also provide the following facilities:

- (1) Document shredders
- (2) Potable water dispensers shall be provided and bottled potable mineral water shall be supplied on a regular basis for consumption by the Employer's and Engineer's staff
- (3) Refrigerators of 300 liter
- (4) White boards
- (5) Time Recorders
- (6) Full time security services on a 24 hour basis, 7 days a week
- (7) Full time cleaning, waste and garbage removal and maintenance services

(8) Grass cutting and landscape maintenance services.

- 3.11. Concrete or asphalt paved roads to the Office, Laboratory Building and car parking areas, pre-cast concrete block sidewalks, and all landscaping and planting, shall be provided around the offices.
- 3.12. Car park roof shading and lighting shall be provided, comprising galvanized corrugated iron sheeting or galvanized steel frame for 15 cars and 1 microbus and 6 motorbikes.
- 3.13. The buildings, all furniture and equipment shall be insured by the Contractor against loss and damage of any cause and shall be maintained by the Contractor at the Contractor's expense.
- 3.14. The Contractor shall maintain all offices and facilities throughout the contract period.

#### **4.0 CONSTRUCTION LABORATORY**

- 4.1. The Contractor shall provide laboratory facilities for the use of the Employer, Engineer and Contractor. The laboratory facilities shall be completed, including the provision of all testing equipment, within a maximum of 120 days from Commencement Date.
- 4.2. The Laboratory shall be provided internally with a concrete test sample curing pond of approved size.
- 4.3. All areas shall be air-conditioned and provided with all utilities.
- 4.4. Layout of Laboratory Building will be as indicated in Attachment-C.
- 4.5. General test equipment to be provided under the Contract is listed in Attachment-C. All items shall be not necessarily new but of first quality. Consumable items required for testing shall be provided by the Contractor. If any particular item or items of testing equipment are not listed in Attachment C, but which are required for the testing of the Works, such item or items shall be provided free of charge by the Contractor.
- 4.6. The buildings, all furniture and equipment shall be maintained by the Contractor (or by the manufacturer/supplier) at the Contractor's expense. All equipment shall be regularly checked, re-calibrated and re-certified.
- 4.7. The Contractor shall maintain the laboratory and facilities throughout the contract period.
- 4.8. The Contractor shall supervise, coordinate and control the operation of the laboratory to ensure that all such testing is achieved efficiently and without causing any delay.

#### **5.0 UTILITIES**

- 5.1. The Contractor shall provide permanent electric power supply to the Employer's and Engineer's offices and laboratory building.
- 5.2. Standby generators to cover 100% of the load for these facilities shall be provided. The Contractor shall also provide all fuel, lubricants, operation and attendance, servicing and maintenance.
- 5.3. Domestic water supply and storage for the Employer's and Engineer's offices, construction laboratory and accommodation units shall be provided by the Contractor.

#### **6.0 ATTENDANCE UPON THE ENGINEER'S STAFF**

- 6.1. The Contractor shall provide attendance upon the Engineer's staff as detailed below.

6.2. Personnel to be provided are as follows:

<b>Description</b>	<b>Number</b>
<b>(During the Construction Period)</b>	
Survey Assistants	3 persons
Laboratory Assistants	5 persons
Chainman	4 persons
Drivers	10 persons
<b>(During the Defects Notification Period)</b>	
Survey Assistants	1 persons
Laboratory Assistants	1 persons
Chainman	2 persons
Drivers	4 persons

**7.0 PAYMENT BASIS**

- 7.1. Pay items listed in the Bills of Quantities will be paid separately.
- 7.2. The requirements and items specified in this section, but not listed in the Bill of Quantities are deemed to be included in the Contract Price.
- 7.3. These rates for these items shall be deemed to include:
  - (a) Provision of insurance for all of the facilities;
  - (b) Provision, construction and removal and reinstatement of areas to the approval of the Engineer;
  - (c) Maintenance, repairs, renewals and replacements; and
  - (d) Payment of all electric, water, and telephone
- 7.4. Quantities for Attendance upon the Engineer's Staff shall be as the numbers actually assigned to the Engineer's office.
- 7.5. Rates for Attendance upon the Engineer's Staff shall include all compensation, subsistence allowance, and accommodation allowance at the site, transportation cost to/from site based on 6 day working a week, 8 hours a day, together with an allowance for 60 hours (per month) overtime working under the labour law of the Philippines.

## SECTION 1125

### CONTRACTOR'S MANAGEMENT OF THE WORKS

#### 1.0 GENERAL

- 1.1. The Contractor shall provide all management and staff necessary for the execution, completion and maintenance of the Works and the remedying of any defects therein, both on Site and at the head office.
- 1.2. The Contractor shall be entirely responsible for the adequacy of supervision throughout the duration of the Works and shall discharge his duties in this respect in a diligent and professional manner.

#### 2.0 QUALITY ASSURANCE

- 2.1. 28 days prior to commencement of each work, the Contractor shall submit a details of all procedures and compliance documents to the Engineer describing the organization and resources which he proposes and undertakes to provide quality assurance of the Works, including the work of all manufacturers, subcontractors and suppliers. The said documents shall include the number and type of staff responsible for quality control.

#### 3.0 CONTROL OF TIME

- 3.1. As specified in GCC 8.3, the Contractor shall submit his detailed programme for the Works (referred to as the "Programme") to the Engineer within the prescribed time frame.
- 3.2. The Programme shall contain the following minimum information, showing the duration and sequencing of:
  - (1) Activities for which the Contractor and his subcontractors or suppliers are responsible including but not limited to:
    - (a) Preparation of drawings;
    - (b) Fabrication;
    - (c) Delivery;
    - (d) Construction and installation;
    - (e) Inspection, testing and commissioning;
    - (f) Training;
    - (g) Completion activities including "as-built" drawings and Operation Manuals;
    - (h) Other works concurrent with the Contract based on information provided; and
    - (i) Matters for which the Employer or Engineer is responsible to the Contractor, e.g. issue of drawings, other design information or approvals.
- 3.3. The Programme shall be on recognized computer software, which must be approved by the Engineer, presented as bar charts with links to show essential logic. The Contractor shall provide two (2) copies of his programme on disk to the Engineer, and a copy of the necessary software for the Employer.
- 3.4. The Contractor shall constantly monitor progress always using the Programme as a basis.
- 3.5. Progress monitoring and recording shall include the key quantities, on a weekly timescale. Reports of key quantity progress shall be by pro-forma or other suitable format in agreement with the Engineer.

#### **4.0 MEETINGS AND REPORTS**

- 4.1. The Engineer shall hold regular site meetings as are necessary for the proper management and coordination of the Works and the Contractor's official representative shall attend such meetings.
- 4.2. The Contractor will prepare all necessary reports and data for these meetings in a manner and format to be agreed with the Engineer, for each of the following items that will be reviewed at these meetings:
- (1) Progress programmed and progress achieved, if necessary with the Contractor giving reasons for any delay and stating action being taken to reduce or eliminate delays;
  - (2) Status of actual labour and construction plant assigned, against the planned requirement, if necessary with the Contractor stating action being taken;
  - (3) Any difficulties and delays in the execution of the works, if necessary with the Contractor stating proposed actions or solutions;
  - (4) Any outstanding information/actions required from the Employer;
  - (5) Any outstanding information/actions required from the Engineer;
  - (6) Any outstanding information/actions required from the Contractor;
  - (7) The Contractor shall inform Subcontractors when their attendance is required;
  - (8) The Engineer will take and distribute the minutes of these meetings;
  - (9) The discussion of progress at these regular meetings will be at a summary level, with detail by exception only. The detail progress reports against programmes and trend curves should therefore be submitted to the Engineer, discussed and a summary report agreed prior to each meeting;
  - (10) The Contractor shall prepare and submit to the Engineer a weekly report in such format as the Engineer may require, covering the following:
    - (a) List of Works proposed for following week;
    - (b) Anticipated arrival dates of major Plant and material;
    - (c) Records of Contractor's Equipment and labour; and
    - (d) Weather report
- 4.3. The Contractor shall prepare and submit to the Engineer a monthly progress report in such format as the Engineer may require, covering the following, in addition to the items specified in GCC 4.21:
- (1) For the manufacturer of each item of Plant, the name of the manufacturer, manufacturer's location, percentage progress and the actual or anticipated dates of
    - (a) Commissioning and training;
    - (b) Time lost due to any cause, stating reasons for this and measures for improvement;
    - (c) Summary of Contractor's Equipment and labour;
    - (d) Information required by the Contractor;
    - (e) Safety report;
    - (f) Testing report including copies of quality assurance documents, test results and certificates of materials;

- (g) Environmental testing and monitoring report (records and summary);
- (h) Meteorological data; and
- (i) (On a quarterly basis), an updated Cash flow schedule

- 4.4. The Contractor shall prepare and submit to the Engineer a monthly Environment Management and Monitoring Report in such format as the Engineer may require and as specified in Section 1130.
- 4.5. The first monthly progress report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates.
- 4.6. Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate of the Works.

## **5.0 SECURITY**

- 5.1. The Contractor shall be wholly responsible for security and safety on the Site and any other areas being used for the purposes of the Contract or the Project.
- 5.2. The Contractor shall be entirely responsible for the control of visitors to the Site and shall take such precautions as are necessary for their security and safety.
- 5.3. Upon the issue of the Taking-Over Certificate, the airport will become operational and access to the Site and the facilities will be strictly controlled by the Employer.
- 5.4. In order for the Contractor to complete his obligations under the Contract during the Defects Notification Period, it will be necessary for the Contractor to enter restricted areas and he shall therefore comply with all regulations that will be established at the airport in connection therewith.
- 5.5. The Contractor shall submit applications for his personnel to obtain security clearance by the Airport Police and/or other designated security organization after Taking-Over of the Works. The Contractor shall cooperate fully and actively with the respective authorities and develop and submit procedures for this with them, the Employer and the Engineer.
- 5.6. Security clearance shall be evidenced by issue of an airport ID / Temporary Access Permit for all individual personnel and this shall also indicate the individual approved area of working.
- 5.7. The Contractor shall be responsible and shall control his personnel and that of the subcontractors or others associated with the Works, to ensure that the use of the airport Temporary Access Permits is not violated or abused in any way.

## **6.0 SAFETY**

- 6.1. Within 28 days of the Commencement Date of the Works, the Contractor shall submit a Safety Plan in accordance with the procedure prescribed in GCC 4.8, taking into consideration, but not limited to, Labor Code of Philippines and The Occupational Safety and Health Standards (OSHS) of Philippines.
- 6.2. The Safety Plan should contain adequate control measures, in accordance with the relevant local laws and regulations as well as internationally accepted good practice, for the prevention of accidents, fires and public nuisance. The Safety Plan shall be implemented properly and diligently throughout the Time for Completion of the Works.
- 6.3. The Contractor's Safety Plan should make safety provision for, among other things:

- (a) Deep excavations;
  - (b) Scaffolds and overhead working;
  - (c) Working in confined spaces;
  - (d) Contractor's Equipment, especially cranes;
  - (e) Hand held power tools;
  - (f) Air compressor and hoses;
  - (g) Electrical equipment;
  - (h) Hazardous chemicals, gases and fuels;
  - (i) The use of protective clothing, and
  - (j) The provision of first aid facilities
- 6.4. The Contractor shall appoint a Safety Manager for the Works, who shall be responsible for implementing the Safety Plan.
- 6.5. The Contractor shall ensure that his staff and labour and his Subcontractors are all fully trained in and aware of good and safe working practices.
- 6.6. The Contractor shall ensure that all precautions are taken to safeguard the general public and operating staff from any danger.
- 6.7. All temporary and partially completed works shall be protected by way of barriers, lights, notices and the like.
- 6.8. All excavations and the like are to be protected by barriers at all times and adequately illuminated at night.
- 6.9. The Safety Plan shall also consider requirements for warning and protection for other risks including overhead and underground cables, pipes or obstructions, or voids, openings, pits and trenches.
- 6.10. The Contractor shall ensure compliance by all his staff and labor with the "No Smoking Policies" of the Government and Employer, particularly in hazardous locations like fuel storage tanks and flammable material storage areas. Special precautions will need to be observed when executing any remedial work during the Defects Notification Period as the airport will then be operational. Restrictions on working hours and use of vehicles and Contractor's Equipment airside will then apply and the Contractor is deemed to be fully aware of such types of restrictions and to have made allowance for them in his unit rates and prices.

## **7.0 TRAFFIC SAFETY MANAGEMENT**

- 7.1. Within 28 days after the Date of Commencement, taking into consideration Philippines Traffic and Vehicle Law, the Contractor shall submit to the Engineer for approval a Traffic Safety Management Plan for temporary and public roads to be used for the construction works including the following items:
- (1) All public and temporary roads route to be used for construction;
  - (2) Timing of diversions of each route, if necessary;
  - (3) Layout of temporary road lighting, signage and markings;
  - (4) Transport schedule and traffic volume of construction equipment and materials;
  - (5) Placement of traffic controllers;
  - (6) Communication method for emergency;



- 7.2. The Contractor shall liaise closely with the Employer, Engineer and relevant local agencies regarding the transportation of earth and sand, construction materials, and machines by construction vehicle.
- 7.3. When using the public roads for the haul routes for the construction activities, the Contractor shall make efforts not to cause damages to or soil the road surface by the falling of materials and equipment. Damage of the public roads caused by the Contractor shall be repaired by the Contractor with own expense.
- 7.4. Materials or facilities shall not be stored at a place that prevents free and safe traffic of the public. At the end of work every day and when the Contractor discontinues the construction works for any reason, the Contractor shall remove all the facilities and other obstacles from the road surface that is used for general traffic.
- 7.5. During construction, the Contractor shall take necessary safety measures including putting up signs around the work area and informing interested persons.

## **8.0 TEMPORARY WORKS**

### **8.1 Generally**

- (1) Temporary Works including scaffolding, false work, and excavation slope protection shall be designed by the Contractor, and shall be submitted to the Engineer for his consent. Calculations and drawings of the temporary works shall be in accordance with the Specifications, geotechnical conditions of the work area and the following standards:
- (a) National Structural Code of Philippines (NSCP), 6th edition;
  - (b) Building Code Requirements for Reinforced Concrete and Commentary – American Concrete Institute (ACI);
  - (c) Concrete Reinforcing Steel Institute (CRSI)
- 8.2. The Contractor shall obtain the consent of the Engineer before constructing, loading or removing any temporary works. Any consent given by the Engineer shall not relieve the Contractor of any liability or obligations under the Contract.
- 8.3. Where construction works are required to be performed at a height of 2 m or more from the ground or could result in a possible fall by the workmen, the Contractor shall provide a scaffold.
- 8.4. If it is difficult to provide a scaffold, a protective net shall be stretched and each worker shall be instructed to secure himself with a life-line to protect him against an accidental fall.
- 8.5. The Contractor shall check periodically all scaffolds and keep them in perfect service condition at all times.
- 8.6. Tubular Scaffold
- (1) All the tubular scaffolds, prefabricated independent scaffolds and binding fixtures shall satisfy the requirement of JIS A 8951 “Tubular Steel Scaffolds” or equivalent.
  - (2) Sole plates, base plates, base angles and braces shall be used to prevent scaffold from collapse and sinkage.
  - (3) Scaffolds shall be rigidly reinforced with transverse braces to withstand lateral forces imposed by wind and earthquake.
  - (4) Wall ties and braces shall be used to prevent scaffold from falling down.

- (5) When scaffold is erected near overhead electric cables, the Contractor shall shield them with a suitable insulating device or temporarily relocate the cables. The Contractor shall be responsible for all arrangements with responsible third parties

8.7. Ascending Ramp and Staircase

- (1) Ascending ramps and staircases shall be constructed rigidly so as to avoid accidents and to suitable gradient, tread and riser.

8.8. Guard-rail

- (1) Secure guard-rails of at least 75 cm height shall be provided in working places higher than 2 m from the ground.

**9.0 WORK CONSTRAINTS**

9.1. Generally

- (1) The programmes prepared by the Contractor must include allowance for the following work constraints:-
  - (a) Works of other contractors appointed directly by the Employer upon the Works and upon the Project Works
  - (b) Local government restrictions and accessibility limitations around the vicinity of the airport site
  - (c) Environmental restrictions

9.2. Works Executed by Others

- (1) The Contractor shall allow other contractors employed by the Employer in the site in accordance with GCC 4.6, and provide electric power supply to the other contractors at a reasonable price. The following works will be executed by others:
  - (a) Main power line will be installed by Bohol Electric Company 1 to the Power House to be constructed under Component-3: Utility Work.
  - (b) Installation and refurbishment of shops and restaurants will be done by other contractors in the Passenger Terminal Building.

9.3. Environmental Restrictions

- (1) The Contractor will be responsible for complying with all the requirements of the Environmental Compliance Certificate (ECC) and the Environmental Monitoring Programme (EMoP), where they affect the construction operations.
- (2) In particular construction activities shall be programmed by the Contractor so that between the hours of 7:00 pm and 7:00 am noise from such activities and Contractor's Equipment associated with them is kept to an acceptable level within the provision of the Environment Standards of the Philippines.

**10.0 PUBLICITY AND NOTICE**

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

10.2. The Contractor shall erect, to the approval of the Engineer, illuminated notice boards at suitable locations on or near the Site as specified Section 1120.

## **SECTION 1130**

### **ENVIRONMENTAL MANAGEMENT**

#### **1.0 GENERAL**

- 1.1. The Contractor shall carry out the Works in such a manner as to ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the value stated from the Tables 1130.1 to 1130.5.
- 1.2. If the Contractor requires to execute the work before or after the working hours specified in GCC 6.5, the Contractor shall obtain prior approval of the Engineer.
- 1.3. The Contractor shall comply with all applicable the national, provincial and local environmental laws and regulations of the Philippines.
- 1.4. Abbreviation
  - (1) DOTC: Department of Transportations and Communications
  - (2) EMP: Environment Management Plan
  - (3) EMoP: Environment Monitoring Plan for New Bohol Airport Construction and Sustainable Environment Protection Project
  - (4) ECC: Environment Compliance Certificate
  - (5) EMoF: Environment Monitoring Fund
  - (6) DENR: Department of Environment and Natural Resources, Philippines
  - (7) DAO: DENR Administrative Order
  - (8) MMT: Multi-Partite Monitoring Team consisting of LGUs, Stakeholders, NGOs, and PENRO/CENRO.
  - (9) LGU: Local Government Unit
  - (10) NGO: Non-governmental Organization
  - (11) PENRO: Provincial Environment and Natural Resources Officer
  - (12) CENRO: Community Environment and Natural Resources Officer
  - (13) EMB: Environment Management Bureau, DENR

#### **2.0 ENVIRONMENTAL MANAGEMENT PLAN**

- 2.1. Within 28 days after the Commencement Date, the Contractor shall submit a detailed Contractor's Environmental Management Plan (Contractor's EMoP) for the approval of the Engineer based on the Environment Management Plan for Construction Works shown in Attachment-E issued by DOTC.
- 2.2. The EMoP will consist of the following sections
  - (1) Contractor's Organisation: An organisation chart indicating persons with environmental responsibilities, their level of authority, lines of reporting and contact

details. Identify other responsibilities held and the proportion of their time allocated to environmental management. Information shall be provided for the Contractor and any subcontractors appointed by him;

- (2) Company Environmental Policy: A copy of the Company Environmental Policy signed by the CEO / Chairman or other senior staff member of the Contractor confirming commitment to meeting the environmental requirements;
- (3) Staff Awareness: Method of developing environmental awareness within site staff such that the significance of the impact mitigation measures is understood;
- (4) Environmental Compliance: Description of specific procedures to meet environmental performance requirements specified in appropriate legislation;
- (5) Preventive Action and Mitigation Measures: Description of the procedures to be put in place to prevent environmental impacts from occurring or measures that will minimise the extent of impact to levels within the Environmental Standards;
- (6) Contaminated Land Procedures: Description of procedures to be carried out in the event that the Contractor identifies contamination of any contamination in ground within the Contractor's working area;
- (7) Corrective Action Procedures: Description of procedures to be carried out in the event that the Contractor himself identifies the need for corrective action or is informed by the Engineer of the need for corrective action or that the results of the environmental monitoring programme indicate that environmental standards are being breached;
- (8) Communication Pathways: Description of the procedures for third parties to be able to notify the Contractor of environmental concerns and for the Contractor to communicate with third parties with regard to environmental performance;
- (9) Environmental Monitoring: The Contractor will be responsible for carrying out the environmental monitoring associated with the construction phase and Defects Notification Period of the Project as described hereinafter. Prior to the start of construction the Contractor will carry out a programme of environmental monitoring to establish the baseline conditions for air quality, noise, vibration and water quality.

### **3.0 CONTRACTOR'S RESPONSIBILITIES**

- 3.1. The Contractor shall minimize, as far as is practically possible, the effects of all his and his Subcontractor's activities upon the environment and shall implement and monitor measures to prevent:
  - (a) Contamination of surfaces, ground, groundwater, surface water and sea water
  - (b) Emissions to air, including smells, gases or smoke;
  - (c) Unsanitary or unsafe storage or discharge of drain, sewer and surface waters;
  - (d) Unsanitary or unsafe storage or discharge of solid wastes;
  - (e) Noise;
  - (f) Visual intrusion, and
  - (g) Excessive energy and water consumption
- 3.2. These requirements shall be met through the constant and careful attention of the Contractor's management of all Site and off-site activities, and by instruction to all staff and labour in these matters.
- 3.3. The Contractor shall appoint personnel who shall be responsible for preparing an

environmental management and control plan.

- 3.4. The Contractor shall attend the meetings of Multi-Parties Monitoring Team (MMT), and provide a brief of construction activities and environment monitoring conducted by the Contractor under the Specifications.

**4.0 ENVIRONMENT MONITORING**

- 4.1. The Contractor shall conduct the environment monitoring of water quality, air quality, noise and solid / liquid waste around the site periodically at the locations specified hereinafter and during construction period and Defect Notification Period.

- 4.2. Monitoring Reports shall be in writing and submitted on monthly basis. The Report shall include a listing and summary of testing and monitoring results on all aspects.

- 4.3. The Contractor is recommended to employ a company who specializes in the monitoring and measurement of the environment items specified herein and shall obtain the Engineer's approval in accordance with Clause 4.4 of GCC.

4.4. Water Quality

- (1) Sampling and monitoring of Water Quality shall be conducted at four (4) locations shown in the drawing below:
- (2) Sampling and mentoring shall be before commencement of the work and at quarterly basis of the samples taken at the locations shown in the drawings attached hereto.
- (3) Monitoring items and sampling / measurement method are as follows:

**Parameter to be Monitored (Water Quality)**

Parameter to be Monitored	Sampling and Measurement Plan		
	Method	Frequency	Location
<b>Seawater (SW1 &amp; SW2)</b>			
Copper	DAO 34	Monthly	Two (2) Seawater Sampling Stations, SW1 & SW2
Total Coliform	DAO34	Monthly	
Fecal Coliform	DAO34	Monthly	
pH	DAO34	Monthly	
Temperature	DAO34	Monthly	
Color	DAO34	Monthly	
Dissolved Oxygen	DAO34	Monthly	
Biological Oxygen Demand	DAO34	Monthly	
MBAS	DAO34	Monthly	
Phenols	DAO34	Monthly	
Total Suspended Solids	DAO34	Monthly	
Oil and Grease	DAO34	Monthly	
<b>Groundwater</b>			
Iron	DAO34	Monthly	Two (2) Groundwater Sampling Stations GW1 & GW2
Total Coliforms	DAO34	Monthly	
Escherichia Coli	DAO34	Monthly	
Heterotrophic Plate Count	DAO34	Monthly	
pH	DAO34	Monthly	
Temperature	DAO34	Monthly	
Color	DAO34	Monthly	
Settleable Solids	DAO34	Monthly	
Dissolved Oxygen	DAO34	Monthly	
Biological Oxygen Demand	DAO34	Monthly	
Chemical Oxygen Demand	DAO34	Monthly	
Total Dissolved Solids	DAO34	Monthly	

Parameter to be Monitored	Sampling and Measurement Plan		
	Method	Frequency	Location
MBAS (Surfactants)	DAO34	Monthly	
Phenols	DAO34	Monthly	
Total Suspended Solids	DAO34	Monthly	
Oil & Grease	DAO34	Monthly	
Calcium	DAO34	Monthly	
Magnesium	DAO34	Monthly	
Chloride	DAO34	Monthly	
Silica	DAO34	Monthly	
Sulfite	DAO34	Monthly	
Total Hardness	DAO34	Monthly	



Sta. ID No.	GPS Readings		Description of Sampling Stations
	Longitude	Latitude	
GW-1	N 09°35'05.7"	E123°46'14.5"	It is located at Airport Site in Brgy. Tawala, Panglao, Bohol. Owned by deceased Mr. Leoncio Boncaron
GW-2	N 09°33'30.6"	E123°45'28.4"	It is located inside compound of former barangay captain Mr. AvitoArcay which is in front of the Brgy. Hall of Brgy. Danao crossing the municipal road in the municipality of Panglao, Bohol.
SW-1	N 09°32'51.1"	E123°46'22.2"	This is situated about 100 meters away from the seashore which is in front of the Alona Kew Beach in Brgy. Tawala, Panglao, Bohol.
SW-2	N 09°34'05.0"	E123°45'03.1"	This is located inside mangrove trees about 150 meters away from seashore in Brgy. Danao, municipality of Panglao, Bohol.

### Locations of Water Sampling

#### 4.5. Air Quality

- (1) The Contractor shall monitor the air environmental conditions in the vicinity of the Works to ascertain the environmental impacts of the Project, such as effects of vehicular traffic, heavy construction equipment, and fossil fuel burning.
- (2) The air quality shall be monitored in five (5) locations, as shown in the drawing attached hereto before commencement of the work at the site and access road and quarterly during construction period.

- (3) As those locations are outside the Site the Employer will make all arrangements for access and the Contractor shall liaise and inform the Employer, via the Engineer, when such monitoring operations will take place.

**Parameter to be Monitored (Air Quality)**

Potential Impact	Parameter to be Monitored	Sampling and Measurement Plan		
		Method	Frequency	Location
Air Quality (TSP/Dust from Soil excavation/embankment and from heavy equipment/trucks)	SO <sub>2</sub> , NO <sub>2</sub> , Pb, TSP	- Proper maintenance of equipment, sprinkling of water on unpaved grounds and site  - 1-hour ambient sampling (DAO14)	- visual inspection (weekly) - Monthly during dry season	- 5 stations 1) Tawal Elem. School, 2) DanaoBrgy Hall 3) Panglao Mun. Hall, 4) Access Road to Airport and 5) Bolod Elem. School

4.6. Noise

- (1) The Contractor shall monitor the air environmental conditions in the vicinity of the Works to ascertain the environmental impacts of the Project, such as effects of vehicular traffic, heavy construction equipment, and fossil fuel burning. In p
- (2) The noise level shall be monitored in five (5) locations, as shown in the drawing hereto before commencement of the work at the site and access road and weekly during construction period.
- (3) Noise quality on the same sites at daytime (10:00 to 12:00, 14:00 to 16:00) and night time (22:00 to 24:00) should be monitored quarterly and annually. Wind direction at each point is also measured and recorded.

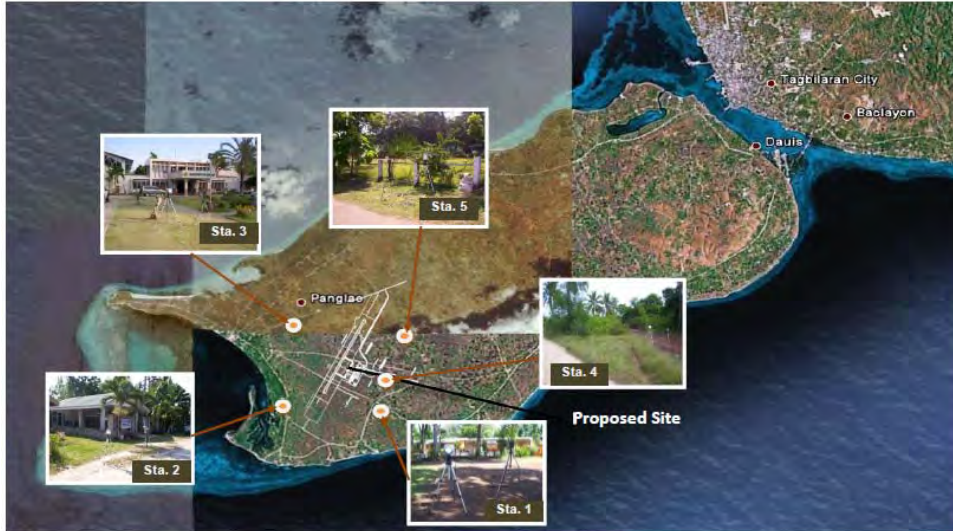
**Parameter to be Monitored (Noise)**

Potential Impact	Parameter to be Monitored	Sampling and Measurement Plan		
		Method	Frequency	Location
Noise (Noise from construction work by heavy equipment/trucks)	Noise, dB(A)	- Proper maintenance of equipment  -10-minute averaging time at seven readings (DAO14)	- monthly measurement, and  - weekly hearing	- 5 stations 1) Tawal Elem. School, 2) DanaoBrgy Hall 3) Panglao Mun. Hall, 4) Access Road to Airport and 5) Bolod Elem. School

**Monitoring Stations of Air & Noise**

Sta. No.	GPS Readings		Description of Sampling Stations
	Longitude	Latitude	
Sta - 1	N 09°33'42.3"	E123°46'40.1"	It is located in front of Tawala Elementary School in BrgyTawala, Panglao, Bohol. It is situated about 10 meters away from center of the municipal road and about 35 meters from the Classrooms.
Sta - 2	N 09°33'32.9"	E123°45'27.0"	It is situated almost in front of the Brgy Hall of BrgyDanao in the municipality of Bohol. It is about 7 meters away from center of the municipal road.
Sta- 3	N 09°34'50.4"	E123°45'08.4"	It is about 30 meters away in front of the municipal hall building of Panglao and about 25 meters from center of the municipal road.

Sta. No.	GPS Readings		Description of Sampling Stations
Sta - 4	N 09°34' 19.9"	E123°46'28.9"	It is located along access road of the proposed new Bohol airport in BrgyTawala in the municipality of Panglao.
Sta - 5	N 09°34' 10.4"	E123°47'14.5"	It is located in front of Bolod Elementary School in BrgyBolod, Panglao. It is about 2 meters away from the perimeter fence of the school and 5 meters away from center of the municipal road.



**Location of Air and Noise Monitoring**

4.7. Solid Waste

- (1) The solid waste from construction work shall be deposited temporarily in the area of the Contractor's yard. After completion of the public disposal area at Albuquerque in Bohol Island, all solid waste shall be removed from the site and disposed to the public disposal area.
- (2) During the construction of the Project, daily monitoring of solid waste at the construction site shall be done to ascertain whether it is disposed of in designated areas or in bin/receptacles if it is collected by the municipal government.
- (3) Industrial waste from the construction activities should be monitored daily to check whether it has accumulated in the designated areas, not contaminating surface water or nearby ground water sources on or off Site, and whether it is regularly removed from the industrial waste disposal areas by the Contractor in order to minimize the environmental impacts of the Project.

**Parameter to be Monitored (Solid Waste)**

Potential Impact	Parameter to be Monitored	Sampling and Measurement Plan		
		Method	Frequency	Location
Waste collection- solid waste collection/ disposal	Solid waste at the airport	<ul style="list-style-type: none"> <li>▪ Provision of coded garbage bins (biodegradable, non-biodegradable and recyclables)</li> </ul>	Daily as necessary as per refuse collection schedule	Airport/At project site

**5.0 MEASUREMENT**

- 5.1. Monitoring i.e. sampling, testing and reporting shall be measured and paid as specified in the Bill of Quantities.



5.2. Rate shall include all cost necessary for the work specified in this section.

## 6.0 ENVIRONMENT STANDARDS

6.1. Standard for National Ambient Air Quality Guidelines for Source Specific Air Pollutants from Industrial Sources/Operations, National Ambient Air Quality Guidelines for Criteria Pollutants, Air Quality Indices, Emission Standards for Noise, Water Quality Criteria for Class D Waters, and Effluent Standards; Pollutants in Class D Water related directly to the Project are shown in the subsequent tables 1 to 5 while Table 6 shows the matrix of the monitoring plan.

**Table 1130.1  
National Ambient Air Quality Guideline for Source Specific  
Air Pollutants from Industrial Sources/Operations**

Pollutant (a)	Concentration		Averaging Time (Minutes)	Method of Analysis / Measurement (b)
	µg/Nm <sup>3</sup>	ppm		
Ammonia	200	0.28	30	Nesslerization
Carbon Disulfide	30	0.01	30	Tischer Method
Cl <sub>2</sub>	100	0.03	5	Methyl Orange
Formaldehyde	50	0.04	30	Chronotropic Acid
Hydrogen Chloride	200	0.13	30	Volhard Titration
Hydrogen Sulfide	100	0.07	30	Methylene Blue
Lead	20		30	AAS
No <sub>2</sub>	375	0.20	30	Griess - Saltzman
	260	0.14	60	
Phenol	100	0.03	30	4-Aminoantipyrine
SO <sub>2</sub>	470	0.18	30	Colorimetric Pararosaniline
	340	0.13	60	
TSP	300	-	60	Gravimetric
PM-10	200	-	60	- do -

- a: Pertinent ambient standards for Antimony, Arsenic, Cadmium, Asbestos, Nitric Acid and Sulfuric Acid Mists in the 1978 NPCC Rules and Regulations may be considered as guides in determining compliance.
- b: Other equivalent methods approved by Department of Environment and Natural Resources may be used.
- c: Ninety-eight percentile (98%) values of 30 minutes sampling measured at 25°C and one atmosphere pressure.
- d: DENR Administrative Order No. 14 Series of 1993: Revising Chapter II, Section 57 to 66 of 1978 Implementing Rules and Regulations of P.D. 984, EMB, DENR

**Table 1130.2  
National Ambient Air Quality Guideline for Criteria Pollutants**

Pollutant	Short Term (a)			Long Term (b)		
	µg/Ncm	PPM	Averaging Time	µg/Ncm	PPM	Averaging Time
TSP (e)	230 (f)		24 hrs	90		1 yr (c)
PM-10	150 (g)		24 hrs	60		1 yr (c)
Sulfur Dioxide (e)	180	0.07	24 hrs	80	0.03	1 yr
Photochemical Oxidants	140	0.07	1 hr	--	--	--
As Ozone	60	0.03	8 hr	--	--	--
Nitrogen Dioxide	150	0.08	24 hrs	--	--	--
Carbon Monoxide	3.5mg/Ncm 10mg/Ncm	30 9	1 hr 8 hrs	-- --	-- --	-- --
Lead (d)	1.5	--	3 month (d)	1	--	1 yr

a:Maximum limits represented by ninety eight percentile (98%) values not to be exceeded more than once a year.

b:Arithmetic mean.

c:Annual Geometric Mean

d:Evaluation of this guideline is carried out for 24-hours averaging time and averaged over three moving calendar months. The monitored average value for any three months shall not exceed the guideline value.

e:SO<sub>2</sub> and Suspended Particulate are sampled once every six days when using the manual method. A minimum number of twelve sampling days per quarter or forty eight sampling days each year is required for these methods. Daily sampling may be done in the future once continuous analyzer equipment is procured and becomes available.

f:Limits for Total Suspended Particulate with mass median diameter less than 25-50 µm.

g:Provisional limits for Suspended Particulate with mass median diameter less than 10 microns until sufficient monitoring data is gathered to base a proper guideline.

Source:DENR Administrative Order No. 14 Series of 1993: Revising Chapter II, Section 57 to 66 of 1978 Implementing Rules and Regulations of P.D. 984, EMB, DENR.

**Table 1130.3 Air Quality Indices**

Indices	Good µg/Ncm	Fair µg/Ncm	Poor µg/Ncm	Serious or Alert Conditions		
				Very Unhealthy (Alert Level) µg/Ncm	Hazardous (Warning Level) µg/Ncm	Extremely Hazardous (Emergency Level) µg/Ncm
Total Suspended Particulate(TSP); 24-hoursaverage	0-80	81-230	231-350	350	600	900
Sulfur Dioxide; SO <sub>2</sub> 24-hoursaverage	0-80	81-180	181-650	650 (0.25 ppm)	1,570 (0.6 ppm)	2,360 (0.9 ppm)
Photochemical Oxidant as Ozone; 1-hour Average	0-80	81-160	161-350	350 (0.18 ppm)	780 (0.4 ppm)	1,180 (0.6 ppm)
Carbon Monoxide; CO, 8-hrs average	0-5 mg/Ncm	5.1-10 mg/Ncm	10.1-17 mg/Ncm	17mg/Ncm (15 ppm)	34mg/Ncm (30 ppm)	46mg/Ncm (40 ppm)

Source: DENR Administrative Order No. 14, Series of 1993: Revising Chapter II, Section 57 to 66 of 1978 Implementing Rules and Regulations of P.D. 984 EMB, DENR.

**Table 1130.4  
DENR Ambient Quality and Emission Standards for Noise (dBA) 1**

TIME	CLASS 2				
	AA	A	B	C	D
Daytime (0800H – 2200H)	50	55	65	70	75
Morning (0500H – 0900H) And Evening (1800H – 2200H)	45	50	60	65	70
Nighttime (2200H – 0500H)	40	45	55	60	65

Source: Rules and Regulations of National Pollution Control Commission (1978), Official Gazette, Professional Regulation Commission, Manila, Phil., Vol. 74 Nov. 23, 1978

Class AA: Institutional, requires quietness e.g. school, hospital, require quietness within 100 meters

Class A: Used for residential purposes

Class B: Used for commercial areas

Class C: Used for light industrial area

Class D: Used for heavy industrial areas

**Table 1130.5  
Water Quality Criteria for Class D Waters**

Parameters	Value
Temperature, °C	3 (max. rise in °C)
Color	No abnormal discoloration from unnatural causes
pH, range	6.0 – 9.0
BOD, 5-day 20 °C, mg/l	10 (15)
Total Suspended Solids, mg/l	Not more than 60 mg/L increase
Total Dissolved Solids, mg/l	1,000 (a)
Oil and Grease, mg/l	2
Total Coliform, MPN/100 ml	--
Fecal Coliform, MPN/100 ml	--

Standard of these substances is not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources.

(a) Does not apply if natural background is higher in concentration. The latter will prevail and will be used as baseline.

**Table 1130.6  
Environmental Monitoring Plan**

Parameter	Station	Frequency	Method	Applicable Standard
<b>Construction Phase</b>				
Air Quality				
TSP, NO <sub>2</sub> , SO <sub>2</sub>	Sampling Stations	Quarterly	Griess Saltzman for NO <sub>2</sub> , Pararosaniline Method for SO <sub>2</sub> , and Gravimetric Method for TSP	DAO 2000-81
Noise	Sampling Stations	Quarterly	Noise meter	NPCC 1978
Water Quality				
pH, Temperature	Sampling Stations	Quarterly	pH meter	DAO 34

TSS, TDS	Sampling Stations	Quarterly	Gravimetric Method	DAO 34
BOD	Sampling Stations	Quarterly	Azide modification	DAO 34
Oil and Grease	Sampling Stations	Quarterly	Gravimetric Method	DAO 34
Total Coliform	Sampling Stations	Quarterly		DAO 34
Biological	Sampling Stations	Quarterly	Transect/Quadrat	
* Post-Construction Phase				
Air Quality				
TSP, NO2, SO2	Sampling Stations	Semi-annual	Griess Saltzman for NO2, Pararosaniline Method for SO2, and Gravimetric Method for TSP	DAO 2000-81
Noise	Sampling Stations	Semi-annual	Noise meter	NPCC 1978
Water Quality				
pH, Temperature	Sampling Stations	Semi-annual	pH meter	DAO 34
TSS, TDS	Sampling Stations	Semi-annual	Gravimetric Method	DAO 34
BOD	Sampling Stations	Semi-annual	Azide modification	DAO 34
Oil and Grease	Sampling Stations	Semi-annual	Gravimetric Method	DAO 34
Total Coliform	Sampling Stations	Semi-annual		DAO 34
Biological	Sampling Stations	Semi-annual	Transect/Quadrat	

\*: Although monitoring/sampling requirements after the Works have been Taken over will be the responsibility of the Employer, the Contractor will be required to give assistance during the Defects Notification Period.

## **SECTION 1135**

### **WORKMANSHIP, PLANT AND MATERIALS**

#### **1.0 RESPONSIBILITIES**

- 1.1. No Plant or material shall be used until and unless approved by the Engineer and Plant and materials not approved shall immediately be removed from the Works at the Contractor's expense.
- 1.2. No approval by the Engineer of any work method statement, any item of Plant or material, any drawing, sample or document submitted by the Contractor, will relieve the Contractor of any of his responsibilities or liabilities under the Contract.
- 1.3. The Contractor will remain entirely responsible for the proper execution, maintenance and completion of the Works and the remedying of defects therein, in accordance with the Contract.
- 1.4. The Contractor shall make continuous and thorough inspections of all materials delivered and all work in progress; shall promptly reject and return all defective materials and re-do any substandard work at his own expense without waiting for rejections by the Engineer; and shall check and verify adequate performance or satisfactory results of all tests and inspections before allowing subsequent work to proceed.

#### **2.0 GENERAL**

- 2.1. All Plant and materials used in the Works shall be of the qualities and kinds specified herein and equal to approved samples where samples are required by the Specification or requested by the Engineer. Delivery of materials shall be made sufficiently in advance to enable samples to be taken and tested if required.
- 2.2. The Contractor will produce, as and when requested by the Engineer, certificates of origin, names and addresses of suppliers and proof of purchase of Plant and materials intended for incorporation into the Works.
- 2.3. Plant and materials shall be transported, handled, stored and protected on the Site or elsewhere in such manner as to prevent damage, deterioration or contamination all to the satisfaction of the Engineer. The Engineer reserves the right to inspect any Plant or materials to be used in the Works at any time and at any place of manufacture or storage.
- 2.4. All Plant and materials, which are required to conform to particular Standards, shall bear the approved marks of the relevant Standards or have certificates attached thereto, evidencing their compliance with the required Standards.
- 2.5. Wherever Plant or materials are specified by proprietary name, the phrase "or at least equivalent", is understood always to be included.

#### **3.0 QUALIFICATION OF MANUFACTURERS AND SUPPLIERS**

- 3.1. Manufacturers and suppliers shall have regularly manufactured materials and Plant of the same or similar type to that specified for at least the last five (5) years before the Base Date.
- 3.2. The types of material and Plant proposed for approval shall have been in commercial service for at least 6 month before the Base Date, with satisfactory performance evidenced if so required by the Engineer.

- 3.3. Manufacturers of specialty Plant or systems shall retain full responsibility for entire systems produced by them or for which their Plant constitutes the essential operating part.

#### **4.0 AVAILABILITY OF PARTS AND COMPONENTS**

- 4.1. The Contractor shall select items of Plant and materials for which replacement parts or components will continue to be manufactured and readily available for a period of at least ten (10) years after the date of their incorporation in the Works.
- 4.2. The Contractor shall provide a written guarantee in support of this at the time of submission of the request for approval of the respective items of Plant or material.

#### **5.0 ALTERNATIVE ITEMS OF PLANT OR MATERIALS**

- 5.1. Plant and materials shall meet the quality and performance standards established by the Specification. If the Contractor finds it necessary to deviate from requirements involving one piece of Plant, material, equipment or a subsystem, he shall describe the proposed deviation therefrom, state the reason and the improvement to be expected.
- 5.2. Acceptance or rejection of deviations shall be made in writing by the Engineer. If certain characteristics of equipment, such as dimensions, power requirements and external connections, etc., depend on the manufacturer, any requirement of the Drawings and Specification affected by such characteristics may be varied by the Contractor to suit the equipment proposed, but only subject to the prior approval of the Engineer.
- 5.3. Notwithstanding that the Contractor may have submitted details in the Bid Documents for particular proposed items of Plant and materials to be incorporated in the Works, or subsequently requested approval of any item of Plant or material, the Engineer reserves the right to request the Contractor, at the Contractor's expense, to replace any such item of Plant or material that, upon subsequent examination, the Engineer considers does not fulfill the requirements of the Contract.
- 5.4. The Contractor otherwise, as a general rule, shall not change or substitute the Plant or materials that have been proposed in his Bid, or which is included in the Specification or which has been proposed by the Contractor and submitted to and approved by the Engineer.
- 5.5. In exceptional circumstances the Contractor may be given permission to use alternative Plant and materials if such Plant or material is, in the opinion of the Engineer, equal or superior to that specified in the Contract or approved by the Engineer and that any additional cost of such alternative is to be borne by the Contractor.
- 5.6. If, in these circumstances, the Contractor wishes to use alternative Plant or material, he shall submit his proposal to the Engineer including an explanation of why the alternative is requested and stating the advantage to the Employer of the alternative. The proposal shall include full documentary evidence showing that the alternative product is at least equivalent in respect of material, function, compatibility, reliability, safety, size and, where relevant, appearance.
- 5.7. The alternative submission shall be with samples as required and in sufficient time for the Engineer to approve, or disapprove, the alternative Plant or materials without causing delay to the Works.
- 5.8. Any proposal for use of an alternative must also include proposals for substitution of compatible accessory products and variation of details as necessary, with evidence of equivalent durability, function and appearance of the construction as a whole. If such substitution is approved, and before ordering such Plant or materials, the Contractor shall provide revised drawings, specification and manufacturer's guarantees as required by the

Engineer.

## **6.0 DELIVERY TO SITE**

- 6.1. All Plant and materials, if manufactured or assembled off-Site, must be properly and securely packed in order to prevent damage during transport to the Site.
- 6.2. The Contractor shall crate or box all consignments for ocean shipment in such manner as to protect them from damage in transit, and shall be responsible for and rectify any and all damage due to improper packing prior to shipment. Crates shall have external markings identifying the origin, destination, contents and consignee.
- 6.3. All goods in shipment shall be insured with a reputable insurance company acceptable to the Employer.
- 6.4. The Contractor may be required to furnish the Employer, by air mail, with advance copies of shipping documents, invoices and other pertinent papers, showing the date and origin of shipment, a description of the goods, the shipping weight of each item, destination, name of vessel.
- 6.5. Trans-shipment of goods, until safely delivered at installation sites, shall be the responsibility of the Contractor.
- 6.6. The Contractor is to ensure that adequate storage on the Site is available, before the Plant or material arrives, to properly store and protect the Plant or material in order to prevent damage or deterioration. Air-conditioned or other controlled environment storage may be required for some items of Plant and material.
- 6.7. When Plant or material arrives on Site it shall be inspected by the Contractor in the presence of the Engineer, for damage or deterioration. If damage or deterioration has occurred, payment will not be made in accordance with GCC 14.5 of the General Conditions of Contract and the particular material or item of Plan shall be removed from the Site and replaced or repaired according to the instructions of the Engineer. In some instances, the Plant or material may be packed in such a way that opening for inspection could be harmful, by allowing deterioration to commence or accelerate, and appropriate inspection measures will be determined on Site in such circumstances.
- 6.8. Any action taken by the Engineer in inspection of such Plant or material upon arrival on Site shall not relieve the Contractor of his responsibilities under the Contract.

## **7.0 SUPERVISION OF PLANT OR SPECIALIST EQUIPMENT INSTALLATION**

- 7.1. The Contractor shall employ upon the Site supervisors who are specially trained and experienced in the assembly, installation testing and commissioning of all items of Plant and specialist equipment.
- 7.2. These supervisors may be employees of the Contractor or of his Subcontractors, manufacturers or suppliers and they will remain at the Site for the full period of completion of the particular item of work.
- 7.3. The Contractor, when submitting his request for approval of the particular item of Plant or equipment, shall include details of all such supervision he proposes to use for installation, testing and commissioning.
- 7.4. If such proposals are considered to be unsatisfactory by the Engineer, the Contractor shall arrange for other or additional supervision to be provided at no extra cost and without, in any way, reducing his responsibilities and obligations under this Contract.



## 8.0 STANDARDS

- 8.1. Unless otherwise particularly stated the general minimum applicable Standards for the Works under the Contract shall be internationally accepted Standards that ensure equal or higher quality to that stipulated in the specification.
- 8.2. Alternative Standards may only be used where particularly stated in the Specification or where approved in writing by the Engineer.
- 8.3. Examples of other acceptable Standards are given below. In any case where qualities of Plant or materials or methods of sampling or testing are not stipulated in the Specification, the requirements of the following general Standards shall apply:

AASHTO	: American Association of State Highway and Transportation Officials
ACI	: American Concrete Institute Standard
AISI	: American Iron and Steel Institute
AISC	: American Institute of Steel Construction
AMCA	: Air Moving and Conditioning Association
ANSI	: American National Standards Institute
ARI	: Air conditioning and Refrigeration Institute, USA
ASHRAE	: American Society of Heating Refrigeration and Air conditioning Engineers
ASA	: American Standard Association
ASME	: American Society of Mechanical Engineers
ASTM	: American Society for Testing and Materials
AWWA	: American Water Works Associations
AWS	: American Welding Society
CARRIER	: Handbook of Air Conditioning System Design, USA
HASS	: Heating, Air Conditioning and Sanitary Standards of Japan
ICAO	: International Civil Aviation Organization
IEC	: International Electrotechnical Commission Standard/Publications
IEE	: Institute of Electrical Engineers (UK)
ISO	: International Standards Organization
JASS	: Japan Architectural Standard Specification
JCAB	: General Specifications of Visual Aids and Electrical Facilities Works (4th Edition – 1999)
JCS	: Japan Cable Makers' Association Standard
JEC	: Japan Electrotechnical Committee Standard
JEM	: Japan Electrical Manufacturers' Association Standard
JFS	: Japanese Fire Code
JIS	: Japan Industrial Standard
JSWA	: Japan Sewage Works Association
JWWA	: Japan Water Works Association
NEMA	: National Electrical Manufacturing Association, USA
NFPA	: National Fire Protection Association, Codes and Standard, USA
NSCP	: National Structural Code of the Philippines
PEC	: Philippine Electrical Code
SMACNA	: Sheet Metal and Air-conditioning Contractors National Association, USA
UBC	: Uniform Building Code
UL	: Underwriters Laboratory

- 8.4. Whenever reference is made in the Contract to specific Standards and codes, the provisions of the latest current edition or revision of the relevant Standards and codes shall apply.
- 8.5. Where other Standards or codes are proposed by the Contractor which are national, or relate to a particular country or region, these Standards shall ensure an equal or higher quality than the Standards and codes specified and will be subject to the Engineer's prior review and

written approval. Differences between the Standards specified and the proposed alternative Standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor requires the Engineer's approval. In the event the Engineer determines that such proposed differences do not ensure equal or higher quality, the Contractor shall comply with the Standards specified in the Contract.

8.6. Copies of Standards

- (1) Within 28 days from the Commencement Date, the Contractor shall obtain and keep for inspection on the Site one (1) copy of all codes and Standards applicable to the works. A further one (1) copy of all codes and Standards shall be submitted to the Engineer.
- (2) Should the Engineer require any copies of further Standards, the Contractor shall obtain these and submit them to the Engineer, within 28 days of being requested by the Engineer. The copies should be in the English language.
- (3) If further Standards are required to support any submission of the Contractor, then the Contractor shall provide copies of these with his submission. The Engineer, at the risk and responsibility of the Contractor, may defer response to such submission, unless and until the Engineer receives copies of such further Standards.

## SECTION 1140

### CONTRACTOR'S DESIGN

#### 1.0 SCOPE OF CONTRACTOR'S DESIGN

- 1.1. The Contractor shall be responsible for the design and performance of any specialist systems or items of Plant or materials or components thereof, where the Drawings or Specifications describe such items as Contractor's Design, or specify such system, item or component by its required performance standard (e.g. Special Equipment, pumps, motors, hoists and other electrical and mechanical equipment).
- 1.2. The design shall ensure simple and efficient operation and maintenance, with high economy and low operation and maintenance costs.
- 1.3. The Contractor, in the execution of the Works, shall include for and provide all necessary additional or auxiliary items of Plant, equipment and materials incidental to the Works, whether specifically called for or not, but which in the opinion of the Engineer are necessary to complete all such systems, equipment and facilities in accordance with the Specification, the system performance requirements and where applicable, ICAO criteria.
- 1.4. Any Plant, material, component or item for which the design is the responsibility of the Contractor, shall be compatible with its required function and performance of each system as a whole. Any item of Plant, material or component thereof, which has been previously approved, may not be accepted if the system of which it is part does not give the required performance. It is the Contractor's responsibility to ensure the adequate functioning of entire systems and that all equipment when installed and operated will result in integrated operating systems.
- 1.5. The minimum general design requirements for systems, equipment and facilities to be designed and supplied by the Contractor shall be complete operating systems, including any part, material or process which is essential to this requirement, whether or not specifically called for, detailed or defined, and shall be entirely suitable for the purpose intended and of high quality consistent with the specified requirements. Each system shall be designed to perform the required service with the maximum reliability.
- 1.6. The design, dimension and materials of all parts shall be such that they will not suffer damage under the most extreme operating conditions nor result in deflections and vibration that may adversely affect the structural integrity or the operation of the Plant or equipment.
- 1.7. The Contractor shall also take action as required to ensure that all Plant and system performance specifications are met in the presence of interfering emissions from any electrical and electronic equipment at the airport whether provided under individual Sections of this Specification or from Plant or systems provided directly by the Employer (electromagnetic compatibility).
- 1.8. The Contractor shall take measures at his own responsibility to eliminate harmful radio interference which may arise from any Plant or systems to be provided under this Contract.
- 1.9. In support of these design obligations, the Contractor shall provide to the Employer, in a form approved by the Engineer, a ten (10) year design and performance warranty, under which the Contractor is responsible for any significant failure or substantial reduction in performance, in the systems, Plant, materials or any component thereof.
- 1.10. The Contractor shall be responsible for satisfying the requirements of relevant official authorities in relation to the design and shall obtain all necessary permits, and approval of

the relevant authorities, including the fire department, power and other utility authorities.

## **2.0 DESIGN STANDARDS**

- 2.1. The design shall conform to the best and most up-to-date international engineering practice.
- 2.2. Plant, materials and systems forming part of the Works shall comply in all respects with any relevant international regulations, local Statutory Regulations, by-laws and Orders currently in force, for example planning, environmental building control and fire and safety controls.
- 2.3. Characteristics of the systems shall, except when clearly indicated otherwise in the Specification, conform to the relevant International Civil Aviation Organization (ICAO) Recommendations, International Telecommunication Union (ITU) Radio Regulations, ITU-T and ITU-R Recommendations.
- 2.4. Unless another standard is specifically mentioned in these specifications, all Plant, and materials used and provided under the Contract, and all designs, calculations and tests, shall be in accordance with the authoritative Standards listed in Section 1135 as appropriate to the country of manufacture.
- 2.5. The Contractor shall submit two (2) sets of copies of full complete English volumes of Standards and Regulations for design. If any standards and recommendations are not published in English, the Contractor shall translate the non-English language edition into English using a competent translator.
- 2.6. In the event any Standard, recommendation or regulation mentioned above should be revised after the issue of the Specification, the Contractor shall submit to the Engineer in writing any modifications to Specification that may be necessitated in the light of the governing Standards or regulations. No modification to the work shall be carried out unless so approved by the Engineer in writing.
- 2.7. All of the Works shall be designed using the metric system, except where and unless specifically indicated otherwise.
- 2.8. Sizes of Plant and equipment shall not be significantly bigger than may be shown on the Drawings or otherwise shall generally be selected to fit into the space allocated therefore.

## **3.0 DESIGN DEVIATIONS**

- 3.1. Systems, Plant and materials shall meet the quality and performance standards established by the Specification and Drawings.
- 3.2. If the Contractor finds it necessary to deviate from requirements involving an individual sub-system, piece of equipment or component, he shall describe the proposed deviation therefrom; state the reason and the improvement to be expected. Acceptance or rejection of deviations shall be made with the approval in writing of the Engineer.
- 3.3. If certain characteristics of Plant or material, such as dimensions, power requirements and external connections, etc. depend on a particular manufacturer, any requirement of the Drawings and Specifications affected by such characteristics may be varied by the Contractor at his own expense, to suit the equipment proposed, but always subject to the prior approval of the Engineer.

## **4.0 DESIGN – ENVIRONMENTAL CONDITIONS**

- 4.1. Atmospheric
  - (1) The Plant, materials and systems shall be fully tropicalized unless otherwise

specified.

- (2) The Plant, materials and systems shall be fully suited to the degree of exposure at the Site and particularly selected, designed and finished to withstand the corrosive saline effects of the prevailing sea air.
- (3) There shall be no degradation in performance when the equipment and facilities are operated under the environmental conditions specified hereinafter:

4.2. Outdoor Facilities:

- (a) Ambient temperature up to 50 degrees Celsius
- (b) Relative humidity up to 100%
- (c) Rainfall up to 120mm per hour
- (d) Wind speed up to 200 km per hour, unless otherwise specified
- (e) Saline resistant

4.3. Indoor Facilities:

- (a) Ambient temperature up to 45 degrees Celsius
- (b) Relative humidity up to 90%

4.4. Structural

- (1) All structures, Plant and materials shall be designed and constructed to take into consideration a seismic factor as Zone 4.

4.5. Elevation

- (1) 0 to 200 m above sea level

4.6. Power Supply

- (1) The following power shall be employed:
  - (a) When an AC power supply is employed, it shall be 460, 60 Hz, three-phase or 230V, 60 Hz, single-phase and three-phase.
  - (b) The required performance of the equipment shall be satisfied, even if the specified voltage changes  $\pm 10\%$  and frequency changes  $\pm 5\%$ .

## 5.0 DESIGN CALCULATIONS AND SUBMISSIONS

- 5.1. The Contractor shall prepare all calculations to justify and substantiate the design of all civil, structural, architectural, mechanical, electrical, process and control works and systems for which he is responsible for the design. The calculations shall contain sufficient explanation and diagrams to enable complete understanding without further verbal explanation. All assumption, loadings, alternates and revisions shall be clearly documented.
- 5.2. Computer calculations shall include documentation clearly explaining the program, nomenclature and sign convention used.
- 5.3. Contractor shall prepare and submit a single line diagram indicating the ratings such as capacity, etc. of every item of equipment and protective, metering or any ancillary devices based on the requirements of his proposed equipment. A detailed load computation shall accompany the diagram complete with brochures for each major item to be used.
- 5.4. All calculations, drawings, maintenance schedules, manufacturer's data and other supporting information requested by the Engineer shall be compiled and submitted to the Engineer for review and approval of the proposed/selected item of Plant, material or equipment. The Engineer reserves the right to request full or partial submissions at any time.

- 5.5. Procurement and manufacturing shall not commence prior to such approval being received unless otherwise expressly agreed by the Engineer (in which case the Contractor shall remain responsible if further changes are necessary).

## **6.0 DESIGN AND MANUFACTURE**

### 6.1. Generally

- (1) Plant, materials and systems shall be designed to take account of standardization and interchangeability of components and parts.
- (2) The design, dimensions and materials of all parts shall be such that they will not suffer damage or instability of performance, as a result of stresses under the most severe service conditions.
- (3) The materials used in the construction of the Plant shall be of the highest quality, compatible to each other and selected particularly to meet the duties required of them.
- (4) Subcontracted materials and equipment shall be of the same quality and compatibility.
- (5) Workmanship and general finish shall be of the highest class throughout.
- (6) All Plant shall operate without undue vibration and with the least possible amount of noise and shall not cause nuisance.
- (7) All Plant shall be so designed and manufactured as to ensure safety for all personnel involved.
- (8) All Plant shall be designed to minimize the risk of fire and damage which may be caused in the event of fire.
- (9) All Plant shall be designed to prevent ingress of all vermin, accidental contact with live parts and to minimize the ingress of dust and dirt. The use of materials which may be liable to attack by termites or other insects shall be avoided.
- (10) Keyed door locks, keyed electrical or equipment cabinet locks and the like, shall be designed to form part of one master key system for all Works and to match with any master key system specified for the remainder of the Project.
- (11) Sizes of equipment shall be not significantly bigger than may be shown on the Drawings or otherwise shall generally be selected to fit into the space allocated therefor.
- (12) Lightning and power line surge protection shall be provided for all Plant and systems.

### 6.2. Design for Tropical use

- (1) Air inlets and holes for pipes or cables through racks, panels, walls, slabs or the like, shall be covered with wire mesh or canvas, etc. for preventing ingress of insect or dust.
- (2) Equipment shall be designed and manufactured for tropical use, and shall eradicate any effects or provide treatment to counter the effects of mildew, condensation and corrosion in particular.
- (3) In choosing the Plant materials and their finishes, due regard shall be given to the

humid tropical conditions under which such Plant is to work. Wherever possible Plant shall be hermetically sealed and tropical grade finishes materials shall be used.

- (4) Iron and steel shall in general be galvanized or by exception may be painted with the approval of the Engineer. Indoor parts may alternatively have chromium or copper-nickel plating or other approved protective finish. Small iron and steel parts (other than rustless steel) of all instruments and electrical equipment, the cores of electromagnets and the metal parts of relays and mechanisms shall be treated in an approved manner to prevent rusting. Cores, etc, which are built up of laminations or cannot for any other reason be anti-rust treated, shall have all exposed parts thoroughly cleaned and heavily enameled, lacquered, or compounded.
- (5) When it is necessary to use dissimilar metals in contact, these should, if possible, be so selected that the potential difference between them in the electro-chemical series is not greater than 0.5 volts. If this is not possible, the contact surfaces of one or both of the metals shall be electroplated or otherwise finished in such manner that the potential difference is reduced to within the required limits, or if practicable, the two metals shall be insulated from each other by an approved insulating material or a coating of approved varnish compound.
- (6) The use of iron and steel shall be avoided in instruments and electrical relays wherever possible. Screws for metal works, when used, are to be zinc, cadmium, or chromium plated or, when plating is not possible owing to tolerance limitations, shall be of corrosion resisting steel. Screws for wood work shall be nickel plated brass or of other approved finish. Pivots and other parts for which nonferrous materials are unsuitable shall be of approved rustless steel wherever possible.
- (7) Fabrics, cork, paper and similar materials which are not subsequently to be protected by impregnation shall be adequately treated with an approved fungicide. Sleeves and fabrics treated with linseed oil or linseed oil varnishes shall not be used.
- (8) The use of wood in equipment shall be avoided so far as possible. When used, woodwork will be of thoroughly seasoned approved hardwood which is resistant to fungal decay and shall be free from shakes and warp, sap and wane, knots, faults and other blemishes. All woodwork shall be suitably treated to protect it against the ingress of moisture from the growth of fungus and termite attack, unless it is naturally resistant to those causes of deterioration. All joints in woodwork shall be dovetailed or tongued and pinned as far as possible. Metal fittings where used shall be nonferrous material.
- (9) Adhesive shall be specially selected to ensure the use of types which are impervious to moisture, resistant to mould growth and not subject to the ravages of insects. Synthetic resin cement only shall be used for joining wood.

## **7.0 SYSTEM DESIGN**

### **7.1. Complete Systems**

- (1) The minimum general system design requirements for systems, equipment and facilities to be supplied by the Contractor shall be complete operating systems, including any part, material or process which is essential to this requirement, whether or not specifically called for, detailed or defined and shall be entirely suitable for the purpose intended, of high quality consistent with the specified requirements. Each system shall be designed to perform the required service with the maximum reliability.

### **7.2. System Drawings**

- (1) Unless otherwise specified, the Contractor shall supply the following design

drawings, as a minimum for each system, for the Engineer's approval:

- 7.3. System flow diagrams,  
(1) Electrical power, control and instrumentation

## **8.0 PLANT/EQUIPMENT DESIGN**

### **8.1. General**

- (1) The design to be used in the construction of Plant shall be as specified in the Drawings and detailed equipment specifications.
- (2) The following general specifications shall also be met:
  - (a) Reliability: Equipment shall be designed for continuous operation in the environment specified above. Equipment outages shall be held to the very minimum.
  - (b) Human Engineering: Designs shall take into account human engineering considerations.
  - (c) Personnel Safety: Precautions shall be taken in the design of equipment to ensure the safety of personnel. These shall include, as a minimum the requirements of Safety Design specified below.

### **8.2. Safety Design**

- (1) Personnel Safety
  - (a) Protection for human body shall be taken into consideration when designing, manufacturing and installing any Plant to prevent any accident;
  - (b) Guards shall be provided for moving mechanical parts such as gears, fans or belts to prevent accidental contact by personnel;
  - (c) Sharp projections shall be avoided on cabinets, doors and similar parts; and
  - (d) Suitable access ladders, with enclosed cages where necessary, shall be provided to shafts, towers, manholes, pits and roofs.
- (2) Electrical Equipment
  - (a) Disconnecting devices shall be provided so that power may be cut off while installing or interchanging any Plant or component thereof;
  - (b) The main power switch or circuit breaker shall break the AC line immediately after it enters the equipment via terminal block or connection, before connection to fuses or other parts;
  - (c) Under no circumstances shall the neutral side of the AC line be switched or fused;
  - (d) Where a cabinet or rack contains more than one individual-powered equipment on the same AC branch circuit, each equipment shall have power connector which will permit its removal without interrupting service to adjacent equipment;
  - (e) The outside cabinet, rack, equipment chassis, external parts which are accessible without opening interlocked access doors, shall be at ground potential when the equipment is installed and in operating condition;
  - (f) Antenna and transmission line terminals shall be at ground potential for DC and AC power line frequencies but shall permit normal passage of RF frequencies;
  - (g) Where cabinets or compartments of equipment contain voltage in excess of 250 volts to ground, access into these enclosures shall be through interlocked doors or covers, the opening of which shall remove the voltage; and
  - (h) Restoration of voltage shall not be automatic upon replacing covers. It shall be



necessary to operate a "Reset" or "On" switch.

### 8.3. Maintenance

- (1) All Plant shall be designed and constructed so that all parts, terminals, and wiring are accessible for circuit checking, adjustment, maintenance, and repair. Parts most likely to fail shall be easily replaced. The necessity for readjustment of the Plant as a result of the replacement of any components shall be minimized.
- (2) All Plant shall be designed for ease of access and simplicity of installation, adjustment, operation, maintenance and replacement.
- (3) All Plant shall employ, to the greatest extent practicable, the use of plug-in modular construction. Plug-in units shall be mechanically secured in place to prevent being dislodged during shock and vibration.
- (4) Mechanical and electrical interchangeability shall exist between similar assemblies, sub-assemblies, and replaceable parts.
- (5) The casings covers, filters, motors, etc. which are to be detachable for maintenance or repair shall be designed for detaching by simple manipulation.
- (6) Equipment provided in duplicate to function as working and standby units shall be arranged, so far as possible, to allow either unit to be set up and tested independently of the other unit, to ensure that the items of equipment are in working order.

### 8.4. Design/Provision for Testing

- (1) Test points shall be provided with terminals which are readily accessible for maintenance purposes without opening interlocked doors or covers. Measurements shall be performed as far as possible without affecting equipment operation.
- (2) Plant shall be provided with integral metering sufficient to enable performance of all normal operating adjustments without the use of external test equipment. The accuracy and stability of metering facilities shall be adequate for this purpose.
- (3) The design shall permit standard tools to be used to the greatest extent practicable for installation and maintenance. Type and variety of tools required shall be kept to the absolute minimum.

## 9.0 ELECTRICAL DESIGN

### 9.1. Generally

- (1) Circuit designs shall assure conservative operation of electronic parts for long life and minimum maintenance.

### 9.2. Electromagnetic Interference (EMI) Control

- (1) Plant shall be designed to prevent degradation of its own performance due to undesirable internal coupling, and to prevent radiation of undesirable signals which could degrade the performance of other equipment. Control of such interference shall include but not be limited to the following measures:
  - (2) Proper care in shielding of Plant compartments, cabinets and in the use of RF lines and connectors to ensure that they are RF tight.
  - (3) Operation of Plant in such a manner as to prevent the generation of transients and harmonics of the desired signal

- (4) Proper filtering of RF output circuit to suppress harmonics beyond acceptable levels, which are generated as a normal function of equipment operation.
- (5) Observation of correct grounding practices to prevent undesirable coupling and cross-modulation.

### 9.3. Overload Protection

- (1) Protective devices shall be provided within the equipment for primary circuits and for protection of the equipment from damage due to overload or excessive heating. Equipment protective fuses shall be readily replaceable and shall be located directly on front panels or behind hinged doors on panels.
- (2) All parts likely to carry an overload due to malfunction of circuits, poor adjustments, antenna failures, shall be designed to withstand the overload.
- (3) Where this is impracticable, circuit breakers, relays, fuses or other devices shall be provided. The use of secondary protective devices shall be placed on the ungrounded side of the wiring. Overloads in one phase of multi-phase devices shall operate to remove power to the device from all phases.

### 9.4. Wires and Cabling

- (1) Wiring and cabling shall be neat and sturdy, in accordance with the following criteria:
  - (a) Cables: Insulated wires shall be formed into cables, except where operation of the equipment is adversely affected, or where physically impracticable, for example when resulting cables become so large as to interfere with the operation or maintenance of the equipment.
  - (b) Coaxial Cable and Optical Fiber Bends: Coaxial and twin-conductor RF cable bends shall be made high radius of bend as large as practicable. The radius of the bend shall always be greater than 10 times the outer diameter of the RF cable.
  - (c) Solid and Stranded Wire: Stranded wire shall be used for wires and cables which are normally flexed in use and servicing of the equipment, such as cables attached to the movable half of detachable connectors, and hinging cables attached to removable or movable doors, shields, etc. In all other applications, either solid or stranded wire may be used, provided that stranded wire shall be used where so indicated by good engineering practice.
  - (d) Wire Identification: All insulated wires used in circuit connections shall be identified by color coding wherever this is necessary for the case of replacement of wires after removal.
  - (e) Wiring Identification for Polarized Parts: Wires connecting to polarized part shall be secured or arranged so that when the part is installed according to the polarity markings it will be obvious technically how to connect the leads for proper polarity.
  - (f) Standard Colour Code: A uniform code of standard colours shall be used in chassis wiring for the purpose of identifying circuits associated with electronic devices.
  - (g) Panel-door Cables: Parts mounted on a hinged door shall be wired to the other parts by means of a single cable. However, if physical separation between wires is essential for electrical reasons, or if the number of wires involved is so great as to make a single cable impracticable, more than one flexible cable may be employed.
  - (h) Connection Methods: Wires shall be secured by soldering, or by the use of solderless terminals, except that this is not mandatory in RF circuits provided the method of connection used ensures uniformly secure and low resistance

connections. Non soldered wrapped wire connections are not allowed in non-conditional environments.

- (i) Lugs Connected to Screw Terminals: Where wires are connected to solderless or solder lugs which are clamped under screw terminals so as to be removable by loosening or removing the screws, not more than one wire shall be attached to each lug. Not more than two lugs shall be attached to each screw terminal.
- (j) Connector Wiring: Not more than one wire shall be connected to each contact of cable connectors.
- (k) Shielded Wire Termination: Shielded wires and cables shall have the shield braid terminated so that the insulation is not damaged by soldering heat or mechanical pressure. Compression type sheath connector shall not be used for shielded wire termination in circuits operated above 100 MHz.
- (l) Splices: Wires and cables shall not be spliced, except where the wire or cable is longer than that of normally obtainable single roll, or unless otherwise specified.

#### 9.5. Circuit Directories

- (1) Circuit directories shall be provided for each electrical panel or control cabinet. Directories shall be laminated in plastic and mounted in an approved frame inside the door.

### 10.0 MECHANICAL DESIGN

#### 10.1. Generally

- (1) Cooling means shall be employed to maintain the required performance, life and reliability of parts under any probable combination of service conditions specified herein or elsewhere in the Specification.
- (2) Motors for ventilation and cooling systems shall be of the totally enclosed type and shall be designed for continuous duty. The design and quality of the motors shall be such as to ensure a life expectancy of 50,000 hours of operation. Commutators, or slip-rings, shall not be incorporated in the motors.
- (3) Impellers shall be securely attached to the motor shaft with set screws or an equivalent means which will readily permit removal of the impeller from the motor shaft. The impeller shall produce the required air flow with minimum noise and vibration. Impellers for unit bearing type motors shall be in accordance with the motor manufacturer's recommendation. Impellers shall be enclosed or guarded to eliminate hazards to personnel.
- (4) Centrifugal type blower units and motors driving propeller fans shall be mounted in a manner which will preclude or minimize transmission of vibration from the rotating equipment to the supporting structure.
- (5) When air filters are required, they shall be mounted in a manner which will permit easy and quick removal and replacement. They shall not require replacement or cleaning more frequently than once in thirty days under normal operating conditions. The filters shall be of the maximum practical size.
- (6) The ventilation design shall be such that the ventilated space is maintained under a positive static pressure higher than the surrounding air pressure.
- (7) With the ventilated equipment operating under normal service conditions, the exhaust air temperature measured at just ahead of point of egress inside the equipment shall not exceed the input air temperature measured outside the equipment just ahead of the point of input by more than 15 degrees Celsius.

- (8) Brackets, lugs, flanges, inserts, bolts and other fixing, securing and mounting arrangements shall retain components and parts securely when the equipment is subjected to service conditions.
- (9) Parts made of aluminum, magnesium plastic, or other soft material shall be assembled or mounted by the following means:
  - (a) Metallic tapped bushing, nuts or inserts permanently secured to the structure, where frequent disassembly and re-assembly will be required;
  - (b) Through-bolt secured by a locknut: A flat washer shall be used under the head of the bolt; and
  - (c) Tapped hole protected against wear by applicable thread insert.
- (10) Brittle castings, or parts made of ceramic or other brittle material, shall not be over-strained by the means used to secure them. Not more than three points of contact shall be used between the brittle part and the mounting surface, unless the mating faces are accurately machined. Mounting washers of suitable plastic, rubber, or soft copper, having slight compressibility, shall be provided to prevent local breakage or cracking of the parts. Lead washer shall not be used.
- (11) Screws or similar devices employed for retaining front panels or removal cover plates shall be preferably of captive types and shall employ knurled head compatible in appearance with the general hardware. Quarter turn fasteners may be used as panel and cover plate retaining devices only for non-structural applications.
- (12) Bolts, nuts, and screws shall conform to the metric thread of ISO (International Organization for Standardization).
- (13) Terminals, such as lugs, and bindings posts shall support the wires connected thereto. Terminals shall not turn or loosen when the equipment is subjected to specified service conditions.
- (14) Terminal spacing or barriers shall be employed to prevent corona or breakdown or low leakage resistance under the specified service conditions of high humidity, including condensation, and low barometric pressure.

## 10.2. Painting

- (1) Painting colour and materials samples shall be provided when requested by the Engineer.
- (2) Surfaces of Plant and materials shall be painted after rust-preventive treatment as required.
- (3) Moisture and fungus resistant paint treatment shall be provided where required by the conditions or if specified.

## 11.0 NOISE REDUCTION

- 11.1. Design principles and techniques shall be applied to maintain noise levels, at a distance of one meter from the equipment, no higher than the noise limits defined by the octave band levels, in dB's, listed below:
- 11.2. Maintenance Environment: Plant which is to be located in equipment rooms shall not exceed the following noise criteria curve:

**Octave Bands (Hz)**

Band	20-75	75-150	150-300	300-600	600-1200	1200-2400	2400-4800	4800-9600	9600-20000
dBA	100	89	82	76	73	70	68	67	66

- 11.3. Operating Environment: Equipment which will be located in the operating environment, such as VFR room of Control Tower, etc., shall not exceed the following noise criteria curve:

**Octave Bands (Hz)**

Band	20-75	75-150	150-300	300-600	600-1200	1200-2400	2400-4800	4800-9600	9600-20000
dBA	79	68	59	52	48	45	43	42	41

**12.0 IDENTIFICATION AND MARKING**

- 12.1. All Plant, equipment, panels, valves, parts, assemblies, cables and pipework shall be marked for identification in a permanent and legible manner.
- 12.2. All markings shall be in the English language.
- 12.3. Identification shall generally be with plates, labels or colour coding. Nameplates shall be of laminated plastic material of approved size, colour, shape and fixing.
- 12.4. Scribing and stamping colors shall generally be black, unless otherwise specified.
- 12.5. The Contractor shall submit to the Engineer for approval a schedule of all labels, plates, colour codes and other markings as appropriate. The schedules shall indicate:
- (a) Size of the plate or label;
  - (b) Material and its colour to be used;
  - (c) Information to be shown on the plate or label, such as;
    - (i) Name of the Employer
    - (ii) Item functional description
    - (iii) Model and serial numbers
    - (iv) Year of manufacture
    - (v) Manufacturer's name
    - (vi) Power rating or capacity, or
    - (vii) Warning to the danger or hazard, or
  - (d) Details of proposed colour coding to be used for wires, cables and pipes, or
  - (e) Details of any stamps, engravings or other necessary markings
- 12.6. Identification plate shall be securely fastened to each complete item of equipment, and major component.
- 12.7. Cables: Each cable assembly shall be marked with its designation as it appears on wire-run lists or cable schedules. The marking shall be permanently affixed at each end of the cable. Connectors and check terminals shall be clearly labeled for proper connection of cables and wiring.
- 12.8. Parts Reference Designations: Each part having a function in an electric circuit shall be identified by an appropriate reference designation. The reference designation shall be marked on the chassis or other mounting surface in a visible manner. The reference designations

shall be the same as those used for identifying parts on all types of data including drawings, diagrams, and spare parts lists prepared for the equipment. Where space is at a premium reference designation need not be marked, provided that equipment handbooks include photographs or other media for circuit identification.

- 12.9. Panel Markings: The visible surface on panels, adjacent to panel-doors and connector panels, facilities such as connectors, controls, indicators, jacks, keys, switches and fuse holders shall be marked with a suitable abbreviation, indicating the use or purpose of the part. These markings shall be located so that the operator can readily identify the function of the panel facility. Continuously variable-operating controls shall be provided wherever applicable with markings that permit the operator to set the control easily and correctly to a predetermined point.
- 12.10. Adjusting positions shall be marked with reference points or positions numbers and markings shall be in sequence as much as possible. Positions that require special measuring instruments and tools for adjustment and thus cannot be adjusted at a place other than the factory shall be marked with "Factory Adjustment Only" in red characters.
- 12.11. Battery Circuit Marking: Components designed to operate from internal batteries shall be marked in a convenient form for use by operating and maintenance personnel. The markings to be applied shall include the battery type number, battery location and position, polarity, nominal voltage and interconnection between batteries, if two or more are used. The markings shall be applied on or adjacent to the battery compartment or holder, and on or adjacent to terminals, connectors, contacts, removable leads, etc., that are part of the battery circuit but not of the battery itself. When necessary for clarity, a block or pictorial wiring diagram of the battery circuit and batteries shall be provided instead of or in addition to, the markings. The diagram shall be located on, or as close as practicable to, the battery compartment. When batteries are used in a component, a notice shall be included in a prominent location to indicate that the batteries shall be removed when the proponent is out of service for an extended period of time.
- 12.12. Caution Plate: Each electronic component of the overall equipment having circuits which operate in excess of 220 volts shall bear sign with a red background and white letters and with the following markings: "Danger High Voltage". When the door handles of cabinets accommodating high voltage circuits are grooved and interlocked, they shall be so indicated by filling the grooves with red paint; non-interlocked shall be indicated by filling the grooves with blue paint. Door panels that are interlocked shall be marked by a red arrow and an "S" character at the closed position of the switch.
- 12.13. Ampere Rating: The ampere ratings of fuses shall be indicated at mounting positions of fuse holders. A SB symbol shall also be marked if a slow-blow fuse is used.

### **13.0 DESIGN DOCUMENTS AND DRAWINGS**

- 13.1. Design Approval: The Contractor shall submit the design documents to the Engineer for approval within one hundred and twenty (120) days after the Commencement Date.
- 13.2. The Engineer shall be advised if any change in design is found necessary after original approval is granted. The Engineer will require detailed explanation from the Contractor if such changes involve changes in concept, approach, quantity, size or weight, power requirements, and performance, and the Engineer retains the right to disapprove such change.
- 13.3. Compliance listings shall be submitted showing in simple tabulated form a comparison listing of all pertinent items of the Specification and the actual items proposed, indicating compliance "yes" or "no".
- 13.4. The Contractor shall make on-Site presentations of design concepts as required by the

Engineer before preparation of shop drawings.

- 13.5. Further design documents shall be provided in support of the requirements of this Section and according to the requirements of the Specification.

**14.0 SYSTEM CERTIFICATIONS**

- 14.1. Certification shall be provided for each item of Plant or System certifying compliance with the requirements of the Contract.
- 14.2. At the discretion of the Engineer, these shall be provided either by the Contractor, the manufacturer or an independent testing agency.

## SECTION 1145

### TESTS AND INSPECTIONS

#### 1.0 GENERALLY

- 1.1. The whole of the Works is subject to inspection and test by the Engineer during manufacture, installation and completion at the Site, to be conducted in accordance with GCC 7.3 to 7.6, and relevant specifications.
- 1.2. Further testing and associated work shall be conducted, at the Contractor's expense, in the following circumstances:
  - (1) Re-testing or additional testing or inspections made necessary by receipt of substandard test results, or other factors which indicate work to be below the standards of the Specification and where attributable to the Contractor.
  - (2) Repairs or replacement of work damaged by above specified re-testing or additional testing.
  - (3) Repair or replacement of work that fails to comply with specified test or inspection requirements.
- 1.3. The Engineer shall be given the opportunity of witnessing all tests, and the Contractor shall give at least seven (7) days written notice of all tests to be carried out.
- 1.4. The approval of the Engineer or the passing of any inspection or test shall not prejudice the right of the Engineer to reject the Plant or material if it does not comply with the Specification when installed.
- 1.5. Testing of materials, samples, etc. shall be carried out in the Laboratory on Site, where permitted by the equipment provided therein.
- 1.6. In advance of completion of the laboratory on Site, or when there is lack of facility therein, testing will be performed by one or more independent testing agencies as directed by the Engineer.
- 1.7. The Contractor shall provide and deliver all Plant, materials and samples for all required tests, supplied to the place, in quantities and at the appropriate time and with all necessary cutting, machining, labeling and other preparation and transportation. Wherever possible, test specimens shall be submitted by the Contractor with the request for approval of the item of Plant or material concerned.
- 1.8. The Contractor shall provide sufficiently qualified personnel, materials, testing equipment, instruments and consumables for testing.
- 1.9. The Contractor shall supply to the Engineer any requested certificates of compliance with the Standards.
- 1.10. Records of all tests shall be submitted promptly and in an approved format to the Engineer.
- 1.11. As a general rule, the Contractor shall conduct inspections, testing and commissioning for himself of all Plant, materials and items to ascertain for himself that the item conforms to the requirements of the Contract. After satisfying himself that it does comply, the Contractor shall then apply to the Engineer in writing for the tests to be made in the presence of the Engineer.



1.12. Tests shall be carried out according to a testing programme which has been approved by the Engineer.

## **2.0 PARTICULAR TESTING**

2.1. Particular testing will be carried out according to the requirements of the Specification.

2.2. Factory Tests

- (1) The Contractor is to submit to the Engineer a detailed schedule and description of all factory tests that are to be undertaken.
- (2) Factory tests shall be made by the Contractor on specific items of Plant or equipment to demonstrate compliance with the applicable Specification. All costs associated with such tests shall be borne by the Contractor.
- (3) At the discretion of the Engineer, factory testing shall be either:
  - (a) Tests undertaken by the Contractor, or
  - (b) Witness tests in the presence of the Engineer and Employer; and
  - (c) Number of attendance of the Employer's and Engineer's personnel shall be as specified in the relevant specifications.
- (4) The Contractor shall prepare and submit to the Engineer, at least three (3) months prior to any test being carried out, detailed test procedures and schedules for consideration and approval.

2.3. The records and results of factory tests shall be submitted to the Engineer within fourteen (14) days of them being completed, and shall include:

- (a) Completed test result sheets, signed by the Contractor and the Engineer;
- (b) A record of any engineering changes necessary to correct test results that did not comply with the Specification

## **SECTION 1150**

### **TRAINING**

#### **1.0 GENERAL**

- 1.1. Prior to Taking over of the Works under Clause 10 of the General Conditions of Contract, the Contractor shall provide training for the Employer's operational and maintenance staff of the equipment and system in accordance with the requirements specified in the respective specifications.
- 1.2. The Works shall not be considered completed for the purposes of Taking over until such training has been completed.
- 1.3. Training shall cover the following:
  - (a) Plant operation and process control;
  - (b) Plant maintenance and repair;
  - (c) Laboratory control (sampling and analysis) - for STP operation;
  - (d) Recording and reporting;
  - (e) Emergency operation procedure;
  - (f) Maintenance management procedures;
  - (g) Inventory and store control systems; and
  - (h) Safety
- 1.4. Site training shall be in a classroom fit for the purpose and provided by the Contractor either on Site or off Site, to the approval of the Engineer.

#### **2.0 TRAINING PROGRAMME**

- 2.1. The Contractor shall prepare a comprehensive training programme on site for each item or system with full course notes, reference material and timetable not later than 56 days before the particular training is to commence and submit this to the Engineer for review and consent.
- 2.2. The training shall be sequential and each level completed before moving to the next.
- 2.3. The training program shall include the following components:
  - (1) Courses on general principles with overall objectives for each section
  - (2) Planned lessons with general guidelines for the items containing performance objectives. The lesson plan shall be divided into such major activities as operation, maintenance and repair, laboratory testing, etc.
  - (3) Graphics shall be used as much as possible to minimize text books.
- 2.4. The Contractor shall use visual media as much as possible throughout the training process.
- 2.5. Training on Safety Provisions shall include:
  - (a) Safe working procedure;
  - (b) Housekeeping of the facilities;
  - (c) Identification of accident prone and hazardous conditions; and
  - (D) Safety measures for individual equipment

#### **3.0 CANDIDATES AND CERTIFICATION**

- 3.1. The Employer shall nominate candidates for training.
- 3.2. The Contractor shall have the right to decline any of the candidates for reasons of extreme incompetence and to request the Employer to nominate substitutes.
- 3.3. The Employer shall have those candidates accepted by the Contractor ready and available for the training in accordance with the Contractor's program.
- 3.4. The Contractor shall not be responsible for paying expenses or salaries of candidates attending Site training.
- 3.5. The Contractor shall ensure that all instructors are suitably qualified and competent for the purpose.
- 3.6. The Engineer may choose to send representatives to witness the training.
- 3.7. Unless otherwise required for operational reasons, training shall only be conducted on Mondays to Fridays and between the hours of 9 am and 5 pm.

#### **4.0 MEASUREMENT**

- 4.1. Cost of Training will not be paid separately, and is deemed to be included in the Contract Price, unless otherwise specified particularly.

## **SECTION 1155**

### **MAINTENANCE AND REPAIR SERVICES**

#### **1.0 SERVICES TO BE PROVIDED**

- 1.1. The Contractor shall be responsible for providing full maintenance and repair services for the duration of the Defects Notification Period for the following items of plant, systems and Works:
  - (1) Sewage Treatment Plant as specified in Specification Sections 3305, 3350 and 3370
  - (2) In-Line Screening Machine of Explosive Detection System (EDS) and Electronic Trace Detector (ETD) as specified in Section 7400.
- 1.2. The maintenance and repair services shall include:
  - (1) Regular routine maintenance and inspection procedures at intervals detailed in the relevant Operation and Maintenance Manuals
  - (2) The provision of all consumables, lubricants, spare parts and replacement parts
  - (3) Repair services including an emergency repair capability within 24 hours of a call out from the Employer or Engineer (personnel will be designated in the future for this purpose)
- 1.3. The Contractor shall remain responsible for the effective and efficient performance of the maintenance and repair services throughout the Maintenance and Repair Period and costs thereof shall be paid in the respective rates of the Bill of Quantities.
- 1.4. The maintenance and repair services are to be carried out by the Contractor or by an officially established and locally represented organization under the Contractor's responsibility, certified as being capable and authorized to provide such Services by the Contractor and the manufacturer of particular items of Plant, system or part of the Works concerned.
- 1.5. Maintenance or repair work carried out by such an organization shall not invalidate or in any way affect any the Contractor's express or implied guarantees or warranties for the Works.
- 1.6. The maintenance and repair services should, as far as is practical, be carried out in the presence of the Employer's personnel to serve as ongoing operational and maintenance training.

#### **2.0 LONG TERM MAINTENANCE AND REPAIR SERVICES**

- 2.1. Three (3) months before an anticipated Taking-over of the Works or Sections of any Plant and the Work, the Contractor shall submit a comprehensive Long Term Maintenance Proposal upon the request of the Engineer. This proposal shall include a price proposal with, if necessary, an annual escalation mechanism.
- 2.2. The long term maintenance and repair services are to be carried out by the Contractor or by an officially established and locally represented organization under the Contractor's responsibility, certified as being capable and authorized to provide such Services by the Contractor and the manufacturer of particular items of Plant, system or part of the Works concerned.
- 2.3. Maintenance or repair work carried out by such an organization shall not invalidate or in any

way affect any the Contractor's express or implied guarantees or warranties for the Works.

- 2.4. The Contractor's proposal shall be optional for the Employer to accept or decline at any time during the period of the Contract up to the end of the Maintenance and Repair Period.

## SECTION 1160

### SURVEY AND LAYOUT WORK

#### 1.0 GENERAL

##### 1.1. Scope of Work

- (1) Prior to execution of the Works under the Contract, and at intervals throughout the period of execution, the Contractor shall be required to conduct the topographic surveys of the construction Site or portions thereof in accordance with the survey specifications.
- (2) The Contractor shall conduct all necessary surveys for the due execution of the Works from time to time during the period of construction as specified hereunder for each work item in accordance with the applicable survey specifications provided in this section.

1.2. The instruments and tools to be used in the survey shall be checked and conditioned for proper performance in advance of the operation and approved by the Engineer where so required.

1.3. Field books shall be entered with the name of survey points, date and time of survey, weather, the rating and type of survey instruments and survey values and shall be submitted, together with the results therefrom, to the Engineer when so required.

#### 2.0 CONTROL POINTS

2.1. Location of the reference points are shown in the Drawings and their coordinates are shown in the table below:

**Control Points**

POINT	NORTHING	EASTING	Y	X	ELEVATION
RWY1	1057895.571	364238.442	5000.000	5000.000	-
RWY2	1060042.035	366520.118	5000.000	7500.000	-
PABM1	1058884.025	365067.009	4795.355	6273.454	
PABM2	1058673.780	365419.024	4385.355	6273.454	7.932
PABM3	1058399.150	365254.996	4385.355	5953.560	8.219
PABM4	1058124.490	365091.031	4795.355	5633.665	8.919
PABM5	1058334.710	364738.962	4795.355	5633.665	7.111
PABM6	1057790.680	364414.119	4795.355	5000.000	7.509
PABM7	1056999.230	363941.577	4795.355	4078.245	3.402
PABM8	1057168.070	363658.861	5124.645	4078.245	1.542
PABM9	1057959.500	364131.434	5124.645	5000.000	5.562
PABM10	1058563.540	364492.127	5124.645	5703.560	6.163
PABM11	1058992.830	364748.448	5124.645	6203.560	6.395
PABM12	1059549.380	365080.794	5124.645	6851.780	7.198
PABM13	1060105.940	365413.086	5124.645	7500.000	7.605
PABM14	1060781.480	365816.471	5124.645	8286.799	12.210
PABM15	1060685.230	366142.531	4795.355	8371.345	13.157
PABM16	1059937.120	365695.812	4795.355	7500.000	8.453
PABM17	1059380.550	365363.499	4795.355	6851.780	8.387
RPVT 1	1060863.171	365882.604	5109.884	8391.539	12.994
RPVT 2	1060156.860	365821.720	4803.865	7752.059	9.362
RPVT 3	1058889.967	365100.642	4769.525	6295.798	7.470
RPVT 4	1057186.790	364082.420	4795.079	4310.199	3.911

RPVT 5	1058109.270	364220.500	5124.966	5174.280	6.676
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- (1) It is a condition of this Survey Specification that all spot elevations expressed by means of both figures and contour lines on the Drawings area based on the reference points used in the detailed design.

2.2. The Contractor's submissions required under the Contract, i.e. working drawings, shop drawings and as-built drawings shall be based on the elevations tabulated in the foregoing table.

### **3.0 TRAVERSE SURVEY**

#### **3.1. Instruments**

- (1) The principal instruments and tools to be used in the survey shall be Total Station equipped with Electronic Distance Measuring Equipment (EDM), prism with Tribrach, pole, leveling bubbles, etc., which shall be checked by the Contractor for functional adequacy and approved by the Engineer prior to delivery to the survey site.

#### **3.2. Stations**

- (1) Traverse station shall be fixed at points as directed by the Engineer. Stakes for the stations shall be painted white and consecutively numbered.
  - (a) The distance between two (2) stations shall be measured by EDM. Prism shall be set on Tribrach with tripod on the desired station to be measured.
  - (b) The target prism shall be properly leveled prior to measurement.
  - (c) Distance shall be measured twice, and the average value of the two (2) measurements shall be recorded in the field book. The difference between the two (2) measurements shall not be more than 1/10,000 of the average value.
  - (d) Horizontal angle shall be measured by "double angle method" of both clockwise and counter-clockwise directions. The double angle observations shall be made twice each in both clockwise and counter-clockwise directions and each reading shall have an accuracy of 20 seconds.
  - (e) The control system of angles and directions shall be as determined by the Engineer in each case.
  - (f) The error of angle measured shall not be more than 30 n seconds, where "n" represents the number of angles. The error of angle measured shall be distributed among all survey points in proportion to the distance between the points.

#### **3.3. Calculation**

- (1) Based on the results of observation location of each survey point shall be calculated by the following:
  - (a) Distance calculation
  - (b) Coordinate calculation and
  - (c) Other calculations as deemed necessary by the Contractor

#### **3.4. Results and Records**

- (1) The results and records of survey shall be compiled, prepared and submitted when so required by the Engineer in the following:
  - (a) Field Book comprising
    - Field book of distance
    - Field book of angles

- (b) Calculation Book including
  - Distance calculation included angle calculation
  - Coordinate calculation
  - Area calculation
  - Other calculations as deemed necessary by the Contractor
- (c) Records of stations and
- (d) Traverse network plan with scale-1/5000 or as directed by the Engineer

#### **4.0 LEVELLING**

##### **4.1. Instruments**

- (1) The principal instruments and tools used in leveling shall comprise level, leveling rod, turning plate and they shall be thoroughly checked for function and approved by the Engineer before commencing operation.

##### **4.2. Stations**

- (1) Stations shall be in accordance with the Drawings or as designated by the Engineer.
- (2) Leveling will start from one bench mark and will end at another, or at the starting one.

##### **4.3. Operation**

- (1) Leveling shall be by means of round-trip (closing), or as directed by the Engineer.
- (2) The observations shall be by sighting-recording-sighting.
- (3) Accuracy of observation shall be as specified in the following:
  - (a) Round-trip error shall not be more than  $10 \times \text{square root of } S$  mm, where “S” represents the one (1) way distance in kilometers; and
  - (b) Closed ring error shall not be more than  $10 \times \text{square root of } S$  mm, where “S” represents the total distance in kilometers.
  - (c) Leveling rod distance, number of observations and minimum read out value (accuracy) shall be as specified in the following:
  - (d) Leveling rod distance – Maximum 80 m; and
  - (e) Minimum read-out value – 1 mm

##### **4.4. Calculation**

- (1) Data entered in the field book shall be calculated to obtain the elevation of each point, distance between points, difference in elevations between points, total difference in elevations and the total distance of each line.

##### **4.5. Results and Records**

- (1) The results of surveys shall be recorded in an orderly manner, including such data as location of bench marks, elevation of bench marks, type of leveling rod, serial numbers and brand of rod, date of survey, weather and surveyor’s name.
- (2) The records and date of survey shall be prepared and submitted when so required by the Engineer in the following form:
  - (a) Field Book
    - Leveling survey log
    - Distance survey log



- (b) Calculation Book
  - Leveling calculation
  - Distance calculation
  - Other calculations as deemed necessary by the Contractor and
  - Layout of stations with scale as directed by the Engineer

## **5.0 CENTERLINE SURVEY**

### **5.1. Set Out and Methods**

- (1) The layout of the centerlines shall be performed to set out in the field the center stakes along the centerline of facilities at exact locations designated on the Drawing or as directed by the Engineer.
- (2) The stakes shall be driven into the ground at intervals of 20 m or as directed by the Engineer and shall be numbered consequently in principle from the starting point.
- (3) The methods and accuracy of this survey shall be in accordance with the requirements of “traverse survey”.

### **5.2. Results and Records**

- (1) The results and records of survey shall be compiled, prepared and submitted when so required by the Engineer, in the following forms:
  - (a) Field Book
    - Distance survey log
    - Angle survey log
  - (b) Calculation Book
    - Distance calculation
    - Coordinate calculation
    - Other calculations as deemed necessary by the Contractor and
  - (c) Main center lines plan with scale – 1/5,000 or as directed by the Engineer

## **6.0 BUILDING WORKS**

### **6.1. The Contractor shall prior to commencement of and during construction operations:-**

- (1) Establish building column/grid reference system, and boundary or primary perimeter lines of buildings and various other structures included under this Contract.
- (2) Establish utility entrance points at perimeters of buildings or other structures or areas, as applicable.
- (3) Establish and control floor levels, and other structures; and finish grades for other areas within boundaries of work for this Contract.
- (4) Establish reference points adjacent to Architectural Works areas sufficient for accurately locating utilities entering those areas and for laying out of buildings and other structures within such areas.
- (5) Coordinate and check all dimensions and levels, as work progresses, to ensure compliance with requirements.
- (6) As work progresses, provide primary guidelines or points throughout each interior area as necessary to facilitate detailed layout of partitions, doors, windows, equipment foundations, ceilings and various other structures.

- (7) Provide lines or marks on sub-floors as required, using paint or means sufficiently durable for time required.
- (8) Establish layout and location, as the work progresses, of every fixture, outlet and the like of which details are not specifically shown in the Drawings or the Specifications but supply and installation are required under the Contract.
- (9) Recheck and verify layout, locations and dimensions prior to making rough-ins or setting of other work.

## **7.0 MEASUREMENT AND RATES**

- 7.1. The foregoing submissions requirements shall not be measured and paid for separately and no pay item is included in the Bill of Quantities, but the cost thereof shall be deemed to be included in other rates and prices contained in the Contract.

## SECTION 1165

### CONTRACTOR'S SUBMISSIONS

#### 1.0 RESPONSIBILITIES

##### 1.1. Generally

- (1) No approval by the Engineer of any drawings submitted by the Contractor will relieve the Contractor of any of his responsibilities and/or liabilities under the Contract.
- (2) The Contractor will remain entirely responsible for the proper execution, maintenance and completion of the Works and the remedying of defects therein, in accordance with the Contract.
- (3) Contractor's drawings shall include Shop Drawings, Building Services Engineering Drawings and As-Built Drawings.
- (4) Contractor's drawings shall be provided for all required areas of the Works.

##### 1.2. Specialist Systems

- (1) Special Equipment and other specialist Systems shown on the Drawings are schematic only and indicate the minimum requirements for achieving the desired performances as stated in the Specification and shown on the Drawings.
- (2) In order to develop these requirements into comprehensive systems the Contractor shall:
  - (a) Develop the design and submit fully detailed shop drawings of all aspects of the systems, in accordance with the requirements of Section 1140.
  - (b) Submit full details of all materials and equipment to be used.
  - (c) Provide all other necessary information.

1.3. The submissions shall supplement the information contained in the Drawings and Specification and subject to the Engineer's approval ensure that the overall design criteria, intent and cost parameters are being adhered to.

1.4. In all aspects of this work the responsibility will rest with the Contractor whether or not the details are provided by his subcontractor.

1.5. In addition, the Contractor, in the execution of the Works, shall supply and install all auxiliary materials and equipment incidental to the work to ensure complete, functioning installations and systems.

#### 2.0 SHOP DRAWINGS - SCHEDULE

2.1. The term "shop drawings" shall also be understood to include design and development drawings and working drawings.

2.2. Within 28 days of the Commencement Date the Contractor shall submit to the Engineer two (2) copies of a schedule of shop drawings to be prepared for the Works indicating the following:

- (a) Drawing numbering system;
- (b) Section titles;

- (c) Drawing titles and numbers (preliminary);
  - (d) Planned submission date; and
  - (e) Planned date for completion of the Engineer's review.
- 2.3. In preparing the above the Contractor shall ensure that a minimum of 28 days for each submission is allowed for the Engineer's review, comment or approval. The Contractor shall also allow sufficient time for modification, correction and resubmission where so required by the Engineer.
- 2.4. This schedule shall be updated on a monthly basis and submitted to the Engineer for his review and comment. This submission should include:
- (a) The actual title, number and revision of drawings as and when they are known;
  - (b) The Contractor's drawing preparation status;
  - (c) Revised dates for submission or re-submission; and
  - (d) Status of all submissions
- 2.5. Any failure of the Contractor to include all shop drawings in the Schedule will not relieve of his responsibility to submit all required shop drawings in a timely manner to permit correct processing by the Engineer.
- 3.0 SHOP DRAWINGS – PARTICULAR REQUIREMENTS**
- 3.1. The Contractor shall submit shop drawings where so required by the Contract or as requested by the Engineer.
- 3.2. Shop drawings shall be based upon the Drawings and Specification requirements, to a suitable approved scale, and shall clearly show all working details for manufacture, fabrication, assembly and construction or installation for all structures, Plant and systems.
- 3.3. The shop drawings should include:
- (a) Plans, layouts, sections, elevations and details;
  - (b) Flow charts, wiring diagrams and system diagrams;
  - (c) Piping and instrumentation details;
  - (d) Control system details;
  - (e) Waterproofing details and penetrations of all structures, walls and floors; and
  - (f) Connections, anchorages, fixings, hangers and supports
- 3.4. Shop drawings shall be submitted as soon as possible to the Engineer for review, comment or approval, but in any event not later than the "Planned Submission Date" indicated in the Schedule of Shop Drawings.
- 3.5. All shop drawings shall be provided in four (4) copies and all shall be in an approved CAD format and PDF format.
- 3.6. The Engineer's review, comment and/or approval of shop drawings shall not relieve the Contractor from any responsibility under the Contract, or from the necessity of furnishing material or performing work required by the Drawings and Specification which shall, in the event of any dispute, take precedence over shop drawings.
- 3.7. All drawings submitted, including any produced by subcontractors, manufacturers or suppliers, shall be signed by the Contractor's Representative.
- 3.8. Shop drawings from subcontractors, manufacturers, suppliers or the like, shall be thoroughly reviewed by the Contractor before submission to the Engineer. Such review by the Contractor shall include a study of all technical and dimensional aspects together with a review for coordination purposes to ensure that the work indicated on the shop drawings is

correctly coordinated according to the constraints of all other related works. The Contractor's requirements, comments or corrections, deriving from his review, shall be incorporated by the subcontractor, manufacturer or supplier, prior to submission by the Contractor to the Engineer. Any shop drawing which has clearly not been reviewed by the Contractor, or corrected as aforesaid, may be returned to the Contractor by the Engineer without review.

- 3.9. Shop drawings shall be reviewed and commented upon by the Engineer and will be returned to the Contractor indicating whether they are:
- (1) Rejected
    - (a) Shop drawings which are "Rejected" shall be corrected by the Contractor and returned to the Engineer for approval.
    - (b) Works relevant to the drawing should not proceed at this stage.
  - (2) Approved with Comment
    - (a) Shop drawings which are "Approved with Comment" shall be corrected by the Contractor and immediately resubmitted to the Engineer for approval.
    - (b) Works relevant to the drawing may proceed on the understanding that the Engineer's comments will be incorporated.
  - (3) Approved
- 3.10. Any comment or approval given by the Engineer on shop drawings for work or which the Contractor is responsible for the design shall not in any way limit the Contractor's obligations for the design, nor transfer this responsibility to the Engineer.
- 3.11. Any comment or approval given by the Engineer on shop drawings shall not be construed as an Instruction to vary the Works as provided under the Contract. Should the Contractor consider that the comment or approval does vary the Works, and then he shall notify the Engineer accordingly.
- 3.12. No claims for extra payment will be considered by the Engineer unless such notification is received within 28 days from the return by the Engineer to the Contractor of the shop drawing to which the claim for payment refers.
- 3.13. The submission of shop drawings (in either the original submission or re-submitted with corrections) constitutes evidence that the Contractor has checked all information thereon and that he accepts all responsibility therefor.

#### **4.0 BUILDING SERVICES ENGINEERING DRAWINGS**

- 4.1. Before respective works are implemented on Site, the Contractor shall prepare and submit to the Engineer for his approval Building Services Engineering Drawings (hereinafter referred to as "BSED") to coordinate all elements of all necessary areas under the Work.
- 4.2. This drawings shall include a study of all Plant, mechanical, electrical, special equipment, building and structural elements, to ensure that:
- (1) Routings of pipes, ducts, cables and the like are systematic and as direct as possible, without excessive deviation,
  - (2) Obstructions are anticipated and avoided,
  - (3) Architectural elements (e.g. tiling) are correctly installed to suit their modular sizes, without excessive or uneven cutting,

- (4) Penetrations through tiling or other modular elements, are properly located (generally central),
  - (5) Light fittings, sprinklers, detectors and the like, avoid conflict and are properly located in tiles or modules,
  - (6) Electrical switches, outlets and the like are accessible,
  - (7) Mechanical and electrical Plant and equipment is properly positioned in control rooms, operation rooms and equipment plant rooms, confined or congested spaces and that free access is provided for use, maintenance, repair or replacement.
- 4.3. The BSED shall include plans and sectional details and shall be to scales, all to be approved by the Engineer.
- 4.4. The BSED shall be provided in four (4) copies and soft copy in AutoCAD and PDF format.
- 4.5. The BSED shall be submitted as soon as possible in order that any required modifications can be made, without delaying the progress of the Works. For each submission of BSED a minimum time of 28 days shall be allowed for review, comment and/or approval by the Engineer.
- 4.6. The Engineer's review of BSED does not relieve the Contractor from any responsibility under the Contract.

## **5.0 AS-BUILT DRAWINGS**

- 5.1. As-built Drawings shall be drawings that show the exact "as-built" locations, sizes, layout and routings of all pipes, ducts, and cables actually constructed and installed at the site.
- 5.2. As-built Drawings of each component shall include, at least, the following items:
- (1) Component-2: Civil Works
    - (a) Reference points with height and coordinates;
    - (b) Airport Layout with dimensions and coordinates including Access Road and all buildings and Air Navigation facilities, and Aeronautical Ground Lightings;
    - (c) Runway Centerline Profile and typical cross section (10 cross sections);
    - (d) Centerline profile of access road;
    - (e) Pavement structures;
    - (f) Layout of drainage system and manhole with coordinates and invert height;
    - (g) Longitudinal profile of rip-rap drainage
    - (h) All underground pipes for power supply, drainage, irrigation, water supply and sewage pipes;
  - (2) Component-3-U1: Water Supply System
    - (a) Facility layout of pump house and pipes including pumps and valves with size;
    - (b) Power Supply and connection diagram for Pump House;
    - (c) Pipe network to each building
  - (3) Component-3-U2: Power Supply System
    - (a) Facility layout of power house;
    - (b) Power Supply Diagram of the airport
    - (c) Layout and connection diagram of photovoltaic power generation system
    - (d) Cable route for power supply within airport;
    - (e) Layout and cable route of Lightings for car park and access road

- (f) Location of manholes
  - (4) Component-3-U3: Sewage Treatment System
    - (a) Equipment layout plan of sewage treatment plant;
    - (b) Sewer pipe layout;
    - (c) Equipment layout plan of control room;
    - (d) Power supply and control cable diagram
  - (5) Component-4: Building Works
    - (a) Floor plan of each building and each floor;
    - (b) Typical sections and elevation plan of each building;
    - (c) Floor finishing plans of each buildings;
    - (d) Suspended ceiling plans of each building;
    - (e) Internal finishing schedule;
    - (f) Equipment and pipe layout plan for mechanical works (5000 series);
    - (g) Equipment and cable route plan for electrical works (6000 series);
    - (h) Equipment and system plan for Special Equipment (7000 series)
  - (6) Component-5: Air Navigation Facilities
    - (a) Equipment layout plan of buildings for LLZ, GS and VOR/DME
    - (b) Equipment layout plan of tower and ATC Operation Rooms;
    - (c) Connection diagram for control and power supply
    - (d) Underground cable routes
  - (7) Component-6: Aeronautical Ground Lightings
    - (a) Lights layout plan;
    - (b) Power supply and control cable network diagram;
    - (c) Underground cable routes, manholes, and ducts
- 5.3. Prior to substantial completion and taking over of the Works or any part thereof, the Contractor shall submit to the Engineer draft As-Built drawings for the review of the Engineer.
- 5.4. The Works shall not be considered to be complete for the purposes of Taking Over until such As-Built drawings have been submitted and approved.
- 5.5. The final As-Built drawings will accurately represent the Works as constructed incorporating the effect of all Site changes, variations and instructions and will particularly highlight and detail the size, reference, layout and routing of all pipes, ducts, cables, wires and the like and the location of all Plant and equipment.
- 5.6. The following copies of the final As-Built drawings shall be provided.
- (1) Reduced size (A-3) copy                      3 sets
  - (2) Soft copy of the drawings                      3 sets
- 5.7. After approval by the Engineer these drawings shall be securely bound by the Contractor into separate volumes, with covers and contents pages added. Final submission shall be made to the Engineer for transmission to the Employer.
- 5.8. The approved cable schedule shall be placed inside transparent plastic holder and be placed beside MDF, terminal board and power distribution board concerned.

## **6.0 SUPPLIERS' AND MANUFACTURER'S GUARANTEES**

- 6.1. The Contractor shall obtain warranties or guarantees from manufacturers and suppliers of all types of Plant, materials and installations. The Contractor shall ensure that these are obtained in such a form that the benefits therein are passed to the Employer.
- 6.2. Wherever possible these warranties and guarantees shall be obtained and submitted as part of the Contractor's initial request for approval of the respective items of Plant, materials or installation.

## **7.0 SAMPLES**

- 7.1. The Contractor shall submit samples at his own expense, for all items or components of the Plant and materials where specified under the Contract or whenever requested by the Engineer.
- 7.2. All components, Plant and materials subsequently delivered to the Site for use in the Works shall be identical to the samples approved by the Engineer.
- 7.3. All samples shall be delivered together with the Contractor's submission of a Request for Approval (RFA) no later than four (4) weeks prior to commencement of work incorporating the particular item, in order to give the Engineer sufficient time to give either approval or a response.
- 7.4. The quantity of samples provided shall be sufficient for the Engineer to determine whether or not the samples comply with the standard required.
- 7.5. Each sample shall be labeled indicating the generic name of the sample, the manufacturer's name and model number, brand name and supplier's name, and any other relevant data.
- 7.6. The Contractor's Request for Approval shall also cross-reference the sample to the appropriate drawings sheet and detail and to the respective item in the Specification and the Bill of Quantities.
- 7.7. In addition to the foregoing requirements, the Contractor shall provide sample panels of various work items, well in advance of such item commencing on Site, all as directed by and for the approval of the Engineer.

## **8.0 MOCK-UPS**

- 8.1. The Contractor shall construct full-scale mock-ups to allow the Engineer to appreciate assembly details, finished aspects, colors and qualities of workmanship that will serve as a reference of standards to be achieved for acceptance of the relevant parts of the Permanent Works.
- 8.2. The materials used shall be identical to samples previously approved by the Engineer for incorporation into the Permanent Works.
- 8.3. During the currency of the Contract, the mock-ups shall be protected from damage and inclement weather and maintained in a clean and proper condition until such times as the Engineer orders their removal.
- 8.4. The Engineer may approve the incorporation of mock-ups or materials therefrom into the Permanent Works.
- 8.5. The following mock-ups will be constructed:
- (a) More than 3 x 3m roof assembly, including eaves details, louver detail, gutter section with downpipes, solar panels and ceiling/soffit;
  - (b) More than 3m x 3m panel of homogeneous flooring incorporating



- construction/movement joints and surface treatment;
- (c) More than 3m x 3m panel of Passenger Terminal Building external paving incorporating construction/movement joints and surface treatment, kerbs and edgings;
- (d) Three (3) full height curtain walling panels including louvers of each type, i.e louvers with curtain walling, louvers with insect screen, louvers with block work;
- (e) More than 4m x 4m panel of suspended ceilings for each type of ceiling including curtain wall and internal wall connection details;
- (f) One (1) complete toilet including floor, wall and ceiling finishes, plumbing and lighting fixtures, plumbing accessories, toilet booth;
- (g) One (1) check-in counter and one (1) immigration counter complete with chair;
- (h) Three (3) meter length of each type of handrail, balustrade, barrier, one (1) column protection and one (1) unit of each type of bollard;
- (i) One (1) row of public seats;
- (j) One unit of each type of signage, and;
- (k) Internally, to the public view, exposed mechanical equipment, ducting, grills, sprinklers and suspension systems of each type, including interface with the architectural finishing.

## **9.0 REQUEST FOR APPROVAL**

- 9.1. When making submissions of Requests for Approval (RFA) to the Engineer the Contractor shall comply with the formal procedures of the Engineer, regarding format, numbering and content of submissions.
- 9.2. All Requests for Approval submitted by the Contractor shall be clear and comprehensive to readily permit full detailed review by the Engineer. The submissions for items of Plant or materials shall, therefore, include the following enclosures, prior to ordering, manufacture or fabrication:
- (a) Full documentary description, with manufacturers original brochures;
  - (b) Compliance listings, showing, in simple tabulated form a listing of all pertinent items of Specification compared with the proposed item, indicating compliance "yes" or "no" for each;
  - (c) Results of testing to demonstrate compliance with requirements;
  - (d) Samples;
  - (e) Shop drawings;
  - (f) Manufacturer's guarantee;
  - (g) Schedule and methodology for any related factory and site testing that is proposed;
  - (h) List of proposed spare parts and tools; and
  - (i) Details of companies in the Republic of the Philippines who have the capability of providing maintenance, repair and spare parts

9.3. The Contractor shall allow the Engineer at least fourteen (14) days for review and response to any submitted Request for Approval.

9.4. The Contractor will be responsible for the consequences of inadequate or late submissions.

## **10.0 WORK METHOD STATEMENTS**

10.1. Before the Contractor starts work on any Permanent or Temporary Works, detailed construction method Statements shall be submitted to the Engineer for review.

10.2. The method statements shall initially be based upon the Construction Plan submitted with the Bid.

10.3. Method Statements must contain the following information:

- (a) Location and type of construction or installation activity;
- (b) Temporary Works to be used;
- (c) Contractor's Equipment to be used;
- (d) Materials to be used;
- (e) Sequence of operations;
- (f) Quality control procedures;
- (g) Safety measures to be used and enforced; and
- (h) Adequate provision must be made for all necessary inspections and tests to be carried out and approvals given during the construction activity.

**11.0 RECORDS**

11.1. The Contractor shall prepare records of work progress, number and types of Contractor's Equipment and labour, delivery date of Plant and materials, weather conditions, works tests and inspections, environmental monitoring and testing, etc., and submit these records to the Engineer according to the provisions of the Contract.

**12.0 PHOTOGRAPHS**

12.1. The Contractor shall prepare digital photographs showing the monthly progress of the Works and submit them to the Engineer as part of the Contractor's Monthly Report.

12.2. Before substantial completion and taking over of the Works, the Contractor shall commission a professional photographer and take photographs of the interior and exterior of all sections of the Works.

12.3. Four (4) sets of prints in albums and three (3) sets of soft copy shall be provided and submitted to the Engineer. The albums shall be at least A4 in size and shall have the date and names of the Works (or Section of the Works), the Employer, the Engineer and the Contractor printed on the cover.

12.4. All photographs shall become the property and copyright of the Employer.

**13.0 DIGITAL VIDEO RECORD**

13.1. On a monthly basis, or as directed by the Engineer, the Contractor shall prepare digital video record to demonstrate progress of major construction Works, and submit it as a part of the progress record of the Works.

13.2. Before substantial completion and taking over of the Works, the Contractor shall edit the monthly video records and produce a 60-minute digital video presentation entitled "Record of Construction Works of the Proposed New Bohol Airport. "Each section of the records shall indicate the date upon which it was taken.

**14.0 MISCELLANEOUS**

14.1. Manufacturers' catalogues, manufacturers' specifications of Plant and materials and recommended spare parts lists, and other technical data shall be submitted in a timely manner, for the review, comment or approval of the Engineer where so required by the Contract or as requested by the Engineer.

**15.0 OPERATION AND MAINTENANCE MANUALS**

15.1. Prior to Taking over of the Works under General Conditions of Contract Clause 49, the Contractor shall prepare detailed Operation and Maintenance Manuals for Plant and systems forming the Works, for the Engineer's review and consent.

- 15.2. The Works shall not be considered complete for the purpose of Taking over until such manuals have been submitted and approved.
- 15.3. Two (2) complete sets of manuals and one (1) set of soft copy are to be provided and the cost of providing them shall be deemed to be included in the rates entered in the Bills of Quantities.
- 15.4. The manuals shall be provided for all Sections of the Works as required by the Specification or as directed by the Engineer and shall be sufficient in detail such that the Employer shall be able to operate and systematically maintain and repair the Works after completion.
- 15.5. The manuals shall be securely and presentably properly bound by the Contractor into book form in separate volumes, with covers, index and contents pages and pages numbered. All shall be in the English language and relevant items or particular components within the text shall be clearly highlighted.
- 15.6. Drawings and diagrams shall be reduced to a convenient size and bound into the volume.
- 15.7. The name of the Employer, Engineer and Contractor shall be inscribed upon the cover together with the title of the Works and content.
- 15.8. The manuals are to be divided into sections such that information can be easily accessed.
- 15.9. Separate manuals shall be required for each complete system and for all hardware and software components thereof.
- 15.10. Where one section of the Works comprises a number of separate items of Plant or equipment, the Contractor shall compile all information into one or more complete volumes, which cover the entire section.
- 15.11. The manuals shall contain, but shall not be limited to, the following:
  - (a) The purpose of the manuals and their composition;
  - (b) Complete and accurate technical description of the system and all Plant contained in the system describing the technical characteristics, operating conditions and performance, using both text and drawings. Manufacturer's technical literature may be included in the respective sections;
  - (c) The theory and function of each part of the system or Plant within that system;
  - (d) Installation and adjustment procedures describing unpacking, mounting, wiring and method of adjustment of each component;
  - (e) Operating procedures from start-up to close-down with all intermediate stages;
  - (f) A numerical identification system for components, valves, control points and units;
  - (g) A description of normal value settings, flow diversions, and operational requirements;
  - (h) Complete list of all modules, components and parts of all Plant within the system giving the original manufacturer's name, address and part number and type. Names and addresses of local firm(s) able to provide these parts shall also be given;
  - (i) Complete list of all consumables, and suitable alternatives, with the name and address of the original supplier and the name(s) and address of the local firm(s) able to provide these materials or alternatives;
  - (j) Maintenance instructions describing, in detail, the procedures and test equipment and tools required to properly maintain the performance of the equipment, repair and operate the Plant and equipment installed at the Site, including preventive maintenance schedule and check sheet samples;
  - (k) Troubleshooting symptoms list with chart and description of symptoms; aside

from above list and chart, provide diagnostic procedures for troubleshooting for each unit; and

- (l) Safety measures to prevent accidents to persons or Plant
- 15.12. Manuals must refer to the exact model, style and type of Plant provided. Manuals referring to similar but different models will not be accepted.
- 15.13. Two advance copies of the final draft manuals shall be provided to the Engineer for his review and consent not later than three (3) months before the scheduled date for commissioning of the relevant Plant or system.
- 15.14. After review and consent of the Engineer, the Contractor shall provide four (4) copies of the final version and three (3) sets of soft copy incorporating all amendments and corrections, by no later than 1 month before the actual date for commissioning.
- 15.15. Copies of final versions of the manuals shall be available by the commencement of Employer training and 1 or 2 copies thereof shall be used as reference material at such training.

## **16.0 MAINTENANCE TOOLS AND EQUIPMENT**

- 16.1. Prior to Taking over of the Works under General Conditions of Contract Clause 10, all tools, (including servicing or repair equipment) which are required to operate or maintain any system or any item of Plant supplied, shall be provided by the Contractor at his own expense and handed over to the Employer.
- 16.2. The Works shall not be considered to be complete for the purposes of Taking over until such items have been handed over to the Employer.
- 16.3. Two (2) complete sets of such tools, in suitable containers adequate for the purpose, for each type of system or Plant shall be supplied.
- 16.4. Unless separate pay items are included, the cost of tools and containers shall be deemed to be included in the rates and prices for the Plant.
- 16.5. Lists of maintenance tools, servicing and repair equipment shall be submitted to the Engineer for review and approval, if possible at the same time as approval is being requested for the equipment itself.
- 16.6. The types and quantities so approved shall be handed over to the Employer, prior to substantial completion.

## **17.0 SPARE PARTS**

- 17.1. The term “spare parts” shall be understood also to include “spare materials”.
- 17.2. The Contractor shall, at his own expense, supply spare parts as specified in each section or Bill of Quantities or Specifications to assure efficient and continuous operation of Plant, equipment for repair or replacement of damage to finishes or the fabric of the buildings.
- 17.3. Spare parts shall be handed over to the Employer before substantial completion and Taking over of the Works, and the Works shall not be considered to be complete for the purpose of Taking over until the spare parts have been handed over to the Employer.
- 17.4. Spare parts shall be delivered and unloaded, in the place designated by the Engineer.
- 17.5. All spare parts shall be packed for long storage under the climatic conditions prevailing at the Site.

- 17.6. Each package shall be clearly and indelibly labeled with a description of the contents and quantity.
- 17.7. Packages will require to be opened for inspection by the Engineer. All such opening and resealing shall be at the expense of the Contractor.
- 17.8. The spare parts, which have been handed over to the Employer, are not allowed for use by the Contractor for the maintenance and repair services or for the remedying of any defects during the Defects Notification Period.
- 17.9. In exceptional cases the Employer may permit such usage but the Contractor shall immediately replenish any stocks used.

## **18.0 MEASUREMENT AND RATES**

### **18.1. Measurement**

- (1) Cost under this Section will not paid separately, unless otherwise specified in respective BOQ.

### **18.2. Rates**

- (1) Cost under this Section is deemed to be included in the other items of each section, unless otherwise specified particularly, unless otherwise specified in respective BOQ.

## **SECTION 1170**

### **DAYWORKS**

#### **1.0 DAYWORKS FOR LABOUR**

- 1.1. The cost of labour in dayworks is included in the Bill of Quantities as a schedule of the different categories of labour containing a provisional quantity of hours for each category.
- 1.2. The rates for labour included in the schedule shall be understood to include wages, bonuses and all allowances, social benefits, overtime, traveling time, supervision by the Contractor's staff and foremen.
- 1.3. In calculating payments due to the Contractor for the execution of labour in dayworks, the time in hours will be measured, from the time of arrival at the job site to execute the particular item of daywork to the time of departure, excluding meal and rest periods. Only the classes of labour directly doing work ordered by the Engineer and who are competent to perform such work will be measured. The time of gangers (charge-hands), actually doing work will also be measured but not the time of foremen or other supervisory personnel.
- 1.4. The Contractor shall be entitled to payment in respect of the total time that labour is employed on daywork, calculated at the basic rates entered by him in the Bill of Quantities, together with an additional percentage on the basic rates representing the Contractor's profit, and overhead.

#### **2.0 DAYWORKS FOR MATERIALS**

- 2.1. The cost of materials in dayworks is included in the Bill of Quantities, which shall be understood to be the net invoiced price of materials delivered to Site.
- 2.2. The Contractor shall be entitled to payment in respect of materials used for daywork at the basic rates entered by him in the Bill of Quantities, together with an additional percentage on the basic rates to cover the Contractor's profit and overhead, as follows:
  - (1) The basic rates for material shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, loss etc., and shall provide for delivery to store for stockpiling at the site;
  - (2) The additional percentage payment shall be quoted by the Bidder and applied to the basic rates;

#### **3.0 DAYWORKS FOR CONTRACTOR'S EQUIPMENT**

- 3.1. The cost of Contractor's Equipment in dayworks is included in the Bill of Quantities as a schedule of the different categories of equipment containing a provisional quantity of hours for each category.
- 3.2. The rates for Contractor's Equipment included in the schedule shall be understood to include depreciation, fuel, lubricants, consumables (e.g. electrodes, drill bits, blades, cutting discs and the like), repairs, maintenance, and insurance. The cost of drivers and operators will be paid for separately under the item for daywork labour.
- 3.3. The Contractor shall be entitled to payment in respect of Contractor's Equipment already on site and employed on daywork at the basic rates entered by him in the Bill of Quantities, together with an additional percentage on the basic rates to cover the Contractor's profit and overhead.

- 3.4. In calculating the payment due to the Contractor for Contractor's equipment employed on daywork, only the actual number of working hours will be eligible for payment, except that where applicable and agreed with the Engineer, the travelling time from the part of the site where the Contractor's Equipment was located when ordered by the Engineer to be employed on daywork and time for return journey thereto shall be included for payment.

## SECTION 1175

### SOIL INVESTIGATION FOR CAVITY DETECTION

#### 1.0 GENERAL

- 1.1. Prior to commencement of the earthworks in the Civil Works and in the sites for Passenger Terminal Building and Control Tower, ATC Operation & Administration Building, the Contractor shall carry out the soil survey on the foregoing sites as directed by the Engineer in the manner as specified hereunder.
- 1.2. Soil Investigation including laboratory test and reporting shall be completed within 90 days after the Commencement Date.
- 1.3. Through the course of airfield excavation, when design elevation of subgrade in cut is exposed and before structural embankment below pavement structure commences, the Contractor shall carry out the soil investigation as directed by the Engineer in the manner as specified hereunder.
- 1.4. The purpose of the investigation is to explore soil beneath footings of the buildings or pavement and to detect the existence of unfavorable cavities or sinkholes which might affect the structural integrity.
- 1.5. The location of boreholes shall be as directed by the Engineer. The Contractor shall be responsible for ascertaining the elevation of the ground at these points and the coordinates of the points in relation to the topographic survey carried out by him.
- 1.6. Before commencement of the soil survey the Contractor shall submit the Method Statement stating work plan, schedule, location maps and organization including the qualified geotechnical engineer to be engaged in this work for approval of the Engineer.

#### 2.0 SURVEY METHOD

- 2.1. The survey method shall be of borings and standard penetration tests (SPT) in accordance with ASTM D 1586 and be conducted at the locations shown below or as instructed by the Engineer.
- 2.2. The borings shall be taken generally to a depth of 5 m (for Building Works) or 2 m (for Civil Works) from the ground surface of the areas as possessed under the Contract and the standard penetration tests shall be carried out at 1.0 m intervals.
- 2.3. A disturbed sample shall be retrieved at each borehole in principle. In case that the circumstances in Item 2.5 below arise, a continuous sampling at each interval at such borehole shall be made as instructed by the Engineer.
- 2.4. Location and quantity of the boring are as follows:

Component	Location and Quantity
<b>Component 2: Civil Works</b>	
<b>Runway: 2,000-m long</b> <b>Taxiway: 2 x 220-m long,</b> <b>Apron Taxiway 565 m</b>	Location: 5 m on both side of runway/ taxiway/ apron taxiway; at 50-m intervals Quantity: Runway: 80 holes x 2 = 160 m Taxiway: 20 holes x 2 =40 m Apron taxiway: 24 holes x 2m = 48 m Depth: 2m <span style="float: right;"><b>Total: 248 m</b></span>
<b>Componnet-4: Building Works</b>	
<b>Subcomponent 4-1</b>	Location: at selected points of building column foundation;



<b>Passenger Terminal Building</b>	Quantity: 5m x 100 points = Depth: 5m	<b>Total 500m</b>
<b>Subcomponent 4-3 Control Tower, ATC Operation &amp; Administration Building</b>	Location: at selected points of building column foundation and mat foundation; Quantity: 5m x (4 + 27) points = Depth: 5m	<b>Total 155 m</b>

2.5. A relatively homogeneous silty sand/gravel stratum is anticipated under the surface soil layer according to the geotechnical report. During the execution of boring works, if any change in number of blows or other unusual condition of soil strata attributing to the resistance to penetration is observed, the Contractor shall inform the Engineer immediately.

### 3.0 LABORATORY TESTS

3.1. The soil sample of filling of cavity/sink-hole, if retrieved from the standard penetration test, shall be further investigated at a suitably equipped laboratory approved by the Engineer. Testing shall comprise, but shall not be limited to the following tests.

- (1) Density
- (2) Water content

### 4.0 RREPORTING

4.1. Daily Report

- (1) The Contractor shall submit on a daily basis the copy of factual records of the survey, including date, temperature, operation times, equipment and tools, persons assigned, sample retrieved, etc.
- (2) The Contractor shall keep the factual records in the site and allow the Engineer's access at his discretion.

4.2. Summary Report

- (1) Within two (2) weeks of completion of the survey, the Contractor shall submit to the Engineer, four (4) copies of the summary report of the investigations and soft copy.
- (2) This report shall include all details of survey works and findings of the site investigation including the result of all laboratory tests. The Contractor's comments on the results is also required.

4.3. Borehole Logs

- (1) Borehole logs shall include the following information.
  - (a) Ground elevation of top of borehole;
  - (b) Coordinates of boreholes;
  - (c) Equipment and materials used;
  - (d) Type of casing, diameter and elevation installed;
  - (e) Type of strata penetrated and elevations of any changes in strata;
  - (f) Elevation of ground water levels;
  - (g) Samples taken and elevations of samples in boreholes;
  - (h) Elevation of bottom of borehole; and
  - (i) Any other pertinent information

### 5.0 MEASUREMENT AND RATES

5.1. Measurement

- (1) Measurement for boring and standard penetration test shall be in accordance with the actual depth of boreholes.

5.2. Rates

- (1) Rates shall include all cost necessary to complete the soil investigation works specified in this Section.

**SECTION 1180**

**MEASUREMENT AND RATES**

**1.0 MEASUREMENT**

- 1.1. The description of items in the Bills of Quantities are simplified and abbreviated and interpretation will therefore require reference to be made to the other documents comprised in the Contract. All requirements of such other documents shall be understood to be included in the relevant Bill of Quantity items.
- 1.2. The particular rules for measurement of the items within the Bills of Quantities are contained in the Specification within each relevant Section.
- 1.3. The rules for measurement shall be applied equally to the measurement of proposed works, for Bid Bills of Quantities, for re-measurement of partially completed works for interim payment purposes and of completed works for final account purposes.
- 1.4. Re-measurement of partially completed and completed works shall only be of the items contained in the Bid/Contract Bills of Quantities. New pay items shall not be included in any re-measurement unless directly due to additional work instructed by the Engineer under the Contract.
- 1.5. Permanent works only shall be subject to re-measurement.
- 1.6. Work shall be measured net as fixed in position and each measurement for calculation of item quantity shall be taken to the nearest 10 millimeters; this principle shall not apply to dimensions stated in descriptions.
- 1.7. Units of measurement shall be metric as follows:

Measurement	Unit	Denoted by
enumerate	Number / Piece	No / Piece /nos.
length	lineal meters	m
area	square meters	m <sup>2</sup>
volume	cubic meters	m <sup>3</sup>
weight	kilograms or tonnes	kg ort
fixed items	lump sum	sum
Vehicle month	Vehicle month	vm
time	Hour, day or month	Hr, day, or mth
personnel assignment	man-month	mmth
vehicle assignment	vehicle-month	vmth

- 1.8. The symbol “t” or “T” when used in item description refers to thickness; “h” or “H” refers to height; “w” or “W” refers to width; and “d” or “D” refers to depth.
- 1.9. Final quantities for each item shall be taken to the nearest whole number, with 0.50 and above being rounded up, 0.49 and below being rounded down.
- 1.10. Unless otherwise stated, no deduction shall be made from items required to be measured by area of voids of less than 0.50 m<sup>2</sup>. Minimum deductions of voids shall refer only to voids within the edges of measured areas; voids that are at the edges of measured areas shall

always be deducted, irrespective of size.

## **2.0 RATES/SUMS**

2.1. The following shall be deemed to be included in the rates and lump sums:

- (1) The general and particular requirements stipulated in all other Documents comprising the Contract.
- (2) All costs associated with design, where the item is to be designed by the Contractor.
- (3) Labour and all costs in connection therewith.
- (4) Plant, materials, goods and all costs in connection therewith (e.g. conveyance, delivery, unloading, storing, multiple handling, hoisting, lowering, insurance, levies and the like)
- (5) Fitting and fixing Plant, materials and goods in position.
- (6) All Temporary Works
- (7) Provision and use of Contractor's Equipment, with all fuel and consumables
- (8) Waste of materials.
- (9) Cutting and making good.
- (10) Testing of materials
- (11) Rectification of any work damaged by the Contractor or as a result of Contractor's work method.
- (12) Additional work due to Contractor's construction to incorrect levels, dimensions or tolerances
- (13) Taxes, duties, levies, insurances and the like, according to the requirements under the Contract
- (14) Establishment and overhead charges, plus profit
- (15) All works required as part of normal good engineering practice whether or not specifically mentioned in the Drawings and the Specification or in the Bill of Quantities.

2.2. Unless items have been provided in the Bills of Quantities, the following shall be understood to be included in the rates and sums:

- (a) Samples;
- (b) Shop drawings, coordination drawings and as-built drawings;
- (c) Testing and Commissioning;
- (d) Operation and Maintenance Manuals;
- (e) Spare parts;
- (f) Tools;
- (g) Training; and
- (h) Maintenance and Repair Services

## SECTION 1210

### PROJECT EQUIPMENT

#### 1.0 PROJECT VEHICLES

- 1.1. The Contractor shall provide vehicles for the Employer/Engineer, within 120 days from the Commencement Date. Vehicles shall be complete with air conditioning, CD players, radios, automatic transmission.
- 1.2. Type and quantity to be provided as follows:
  - (1) Type-I: Sedan more than 1.5 liter engine, such as Corolla Altis or equivalent, with anti-lock brake system ABS.
  - (2) Type-II: Rough terrain, 4 wheel drive, 4-seater, double cab, more than 2.4 liter diesel engine, utility vehicles, such as Toyota Fortuner Hilux (or at least equivalent).
  - (3) Type-III: Micro bus more than 3 liter engine, 11 seat capacity, air condition,
  - (4) Type-IVI: Motorcycles, Honda CB110 at least equivalent, 110cc, 4 stroke petrol
- 1.3. Qualified and capable drivers for all vehicles for use of Employer and Engineer except the Motorcycles shall be provided by the Contractor on daily basis for 7 days per week as required. (Contractor shall give preference and first choice to personnel as recommended by the Employer for such positions). No driver shall work in excess of 12 hours in any one day, alternate drivers shift replacements shall be provided.
- 1.4. Vehicles shall be new, and shall be maintained in sound, safe and legal operating condition. The Contractor shall provide:
  - (a) Vehicle registration;
  - (b) Comprehensive vehicle insurance;
  - (c) Revenue license and Emission Test;
  - (d) Fuel;
  - (e) Lubricants;
  - (f) Replacement parts and tires; and
  - (g) Routine servicing and repairs
- 1.5. Vehicle maintenance / servicing shall be carried out as per the manufacturer's recommendations and operational manual and the Contractor to submit relevant documents as proof on regular basis.
- 1.6. The Contractor shall be completely responsible for vehicular accidents from whatever cause and for any damage to vehicles and injury to passengers due to their driver/personnel. The comprehensive insurance policy shall cover this. Neither the Employer nor the Engineer shall have any responsibility.
- 1.7. Replacement vehicles of similar type shall be provided, during any servicing or repair times.
- 1.8. Prior to delivery of the vehicles, the Contractor shall provide three (3) temporary hired vehicles of Rough Terrain type.

#### 2.0 SURVEY EQUIPMENT

- 2.1. The Contractor shall supply for the sole use of the Engineer and the Employer, survey equipment, as detailed below.

- (1) Electronic Total Station with software, standard accessories, aluminum tripod with case and equipment case. Electronic Total Station shall be equivalent to GTS-223 of Topcon or SET500 of Sokkia, or equal approved standard. (1 no)
- (2) The following prism reflector device for Electronic Total Station shall be provided:
  - (a) Single Prism with target, holders and pole, tripods 3 nos
  - (b) Tribrach and Tribrach Adapter 3 nos
  - (c) Cases of above devices 3 nos
- (3) Auto level with standard accessories, aluminum tripod with case and equipment case shall be equivalent of AT-G1 of Topcon or MX-30 of Sokkia, or equal approved standard. 2 nos
- (4) Aluminum leveling rod (5m) with case 4nos
- (5) Leveling Bubble 4nos
- (6) Nylon coated steel measuring tapes with reel
  - (a) 50 m 2 nos
  - (b) 30 m 2nos
  - (c) 20 m 2nos
  - (d) Grip handles for measuring tapes 2 sets
- (7) Survey Poles (2m length) 20 nos
- (8) Hammer (500-900 g) 5 nos
- (9) Steel Nails with cross marks on head
  - (a) Nails for use in concrete structure (length = 3-4cm) 1,000 nos
  - (b) Nails for use in asphalt pavement (length = 5-6cm) 1,000 nos

2.2. Survey equipment is required to be provided from commencement of the Works.

### **3.0 COMPLETION REQUIREMENTS**

- 3.1. A certificate will be issued by the Engineer upon the date that the respective Project Equipment items are delivered, indicating that they are all then ready for use.
- 3.2. The items will not however be taken over at this stage, i.e. GCC 10.2 and GCC 11 will not then apply. They will remain as the property of the Contractor and under his care, until substantial completion and taking over of the whole of the Works, or upon the issue of the Performance Certificate as appropriate.
- 3.3. The Project Equipment shall become the property of and shall be handed over to the Employer upon the issue of the Performance Certificate. Before this date, the Contractor shall refurbish the items including replacement of tires, exhausts and battery of the project vehicles if deemed necessary by the Engineer, and carry out repairs as considered reasonable to the then ages of the respective vehicles. Before the items of Project Equipment are handed over they shall also be repainted / marked with identification symbols, to suit DOTC's requirements.

### **4.0 PAYMENT BASIS**

- 4.1. Pay items are included in the Bills of Quantities for the Project Equipment. The unit rates

shall include for all costs in complying with the requirement of the Contract.

4.2. These rates for these items shall be deemed to include:

- (a) Provision of insurance
- (b) Provision of items all to the approval of the Engineer
- (c) Maintenance, repairs, renewals and replacements
- (d) Checking and recalibrating all survey and measurement equipment at regular intervals throughout the period of the Works and upon completion before handing over to Employer
- (e) Provision of all oils, fuel, servicing, spare and replacement parts
- (f) Refurbishment and repair upon completion before handing over to Employer

## SECTION 1220

### MAINTENANCE EQUIPMENT

#### 1.0 SCOPE OF SUPPLY

1.1. The Contractor shall provide the following airport maintenance equipment in accordance with this Specification.

- (1) Shovel Tractor with rear-backhoe
  - (a) Wheel type having front shovel capacity of not less than 0.25 m<sup>3</sup> and not less than 30-kw engine power;
  - (b) Total quantity required – 1 unit
- (2) Road Vacuum Sweeper
  - (a) Sweeper shall be such as Kato HS400W or equivalent;
  - (b) Total quantity required – 1 unit
- (3) Dump truck
  - (a) Diesel engine driven with a carrying capacity of 2 tons, and hydraulic dumping;
  - (b) Total quantity required – 1 unit
- (4) Rotary Mowers
  - (a) Movers shall be such as KYOEI GM130A or equivalent (grass catchers are not necessarily to be equipped);
  - (b) Total quantity required – 4 units
- (5) Water Sprinkler Truck
  - (a) Water Sprinkler Truck shall be such as SAKAI HEAVY INDUSTRIES, ST2000S or equivalent.
  - (b) Tank capacity shall not be less than 4,000 litres.
  - (c) Truck shall have discharge pressure pump and 20 m-long hose with reel and jet nozzle (inside 25 mm diameter) with reel and sprinkle nozzle.
  - (d) Discharge pressure pump shall be more than 5 kgf/cm<sup>2</sup>
- (6) Hand Type Mowers
  - (a) Hand Type Movers shall be such as OREC GR702 or equivalent,
  - (b) Total quantity required – 4 units
- (7) Aerial Work Platform
  - (a) Self-propelled articulated boom with rotating jib without outriggers, battery operated; to reach vertically 12 m and horizontally 6 m, serviceable for all external vertical surfaces of the PTB, such as GENIE Z-30/20N RJ or equivalent.
  - (b) Total quantity required – 1 unit
- (8) Aerial Work Platform
  - (a) Battery powered personnel lift to reach vertically 8m, serviceable for all ceilings



and vertical surfaces inside the PTB, such as GENIE AWP-20S or equivalent.

(b) Total quantity required – 1 unit

(9) Pressure Washer

(a) Industrial pressure washer such as KRANZLE K 2100 TST or equivalent

(b) Total quantity required – 1 unit

1.2. The airport maintenance equipment shall be new and the vehicles shall be complete with seat belts, spare wheels, tool kits and other accessories as applicable.

## **2.0 MANUALS AND TRAINING**

2.1. The Contractor shall provide the equipment operation and maintenance manuals of the maintenance equipment.

2.2. The Contractor shall provide trained personnel at the time of delivery and provide adequate training for airport personnel in operation and maintenance of the equipment.

## **3.0 COMPLETION REQUIREMENTS**

3.1. The maintenance equipment shall become the property of and shall be handed over to the Employer upon completion of the training at the time of delivery.

## **4.0 MEASUREMENT AND RATES**

4.1. Measurement

(1) Pay items are included in the Bills of Quantities for the purchase and supply to Site of the maintenance equipment. The unit rate shall include for all costs in complying with the provisions of the foregoing paragraphs 1 and 2.

4.2. Rates

(1) The rates shall include all costs in complying with the requirements under this section.

## **SECTION 1310**

### **PROVISIONAL SUM**

#### **1.0 GENERAL**

- 1.1. Amount of Provisional Sum under GCC 13.5 is an amount shown in the Bill of Quantities, and it shall be included in the Contract Amount.
- 1.2. The Provisional Sum shall be expended in part, in total or not all, at the discretion of, and according to, the instructions of the Engineer.

## **SECTION 1400**

### **CONCRETE FOR STRUCTURES – REFERENCE SPECIFICATION**

#### **1.0 SCOPE OF WORK**

- 1.1. This Section provides a common reference for the requirements and procedures for Concrete for Structures, generally including materials, mixing, transporting and placing, vibrating, curing and finishing works.

#### **2.0 MATERIALS**

##### **2.1. General**

- (1) The Contractor shall select material sources to ensure a uniform color and surface finish as required on all exposed surfaces.
- (2) Materials shall be delivered, handled and stored in such a manner as to preserve their quality and condition to the standards required by the Contract. The quantity of materials and components stored on the Site shall be consistent with that necessary for efficient working and located so as to facilitate their prompt inspection.
- (3) Unless otherwise described in the Contract, the handling, use, installation, application or fixing of materials and components shall be in accordance with all applicable recommendations of the manufacturers. Where appropriate, the Contractor shall make use of any technical advisory services offered by the manufacturer.
- (4) Materials that do not comply with the requirements of this Specification will be rejected by the Engineer and removed immediately from the Site. No rejected materials shall be used in the Works.
- (5) As soon as possible after the Contract has been awarded, the Contractor shall submit to the Engineer for his approval a list of his proposed suppliers and sources of materials required for the execution of the Works.
- (6) Samples shall be taken in accordance with the appropriate Standard, or as directed by the Engineer.
- (7) The materials subsequently supplied shall conform to the quality of samples which have been approved by the Engineer.
- (8) Names of additional suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Engineer's approval.

##### **2.2. Cement**

- (1) The cement shall be factory produced standard color Portland cement of the specified type complying in all aspects with ASTM C150 (AASHTO M85).
- (2) One brand of cement as approved by the Engineer shall be used for all concrete works throughout the project unless otherwise authorized.
- (3) The Contractor shall provide manufacturer's test certificates and proof that the specifications have been complied with, and certified by an independent laboratory. The Engineer shall have the power to reject a part or the whole of any consignment

of cement if he considers it to be unsuitable for use in the Works.

2.3. Aggregates – Generally

- (1) All aggregates shall comply with the relevant provisions of AASHTO M6 and M80, and consist of tough, hard and durable particles. The Contractor shall be responsible for satisfactorily processing this material to meet the requirements of the Specifications. At least thirty days before starting work, the Contractor shall advise the Engineer of the sources of aggregates to be used to permit samples to be taken in the presence of a representative of the Engineer and the Contractor to test before being brought to the Site. Approval of aggregate quality and/or gradation shall not waive the responsibility of the Contractor to produce concrete of the strength specified.
- (2) Fine and coarse aggregates shall be tested in accordance with the following standards:

**Table 1400.1      Fine Aggregates**

ASTM /AASHTO	Testing Requirements	Specification
C-40 / T-21	Organic Impurities	Lighter than Standard
C-88 / T-104	Soundness Test	5% max
C-117 / T-11	Material finer than 200 sieve, Mineral aggregate (Manufactured sand)	3% max.
C-117 / T-11	Material finer than 200 sieve, Mineral aggregate (River sand)	1% max.
C-136 / T-37	Fineness Modulus (Sieve Analysis)	2.3 – 3.1
C-142 / T-112	Clay lump & Friable Particles	1% max. by weight
C-123 / T-113	Lightweight Pieces in Aggregate	0.5% max. by weight
D-2419 / T-176	Sand Equivalent Test	75% minimum

- (3) The Contractor shall use only fine and coarse aggregates in concrete that are non-reactive with the alkalis in the cement in an amount not to cause excessive expansion of the concrete. Acceptable aggregate shall be based on satisfactory evidence furnished by the Contractor that the aggregate is free from such materials. This evidence shall include service records of concrete comparable properties under similar conditions of exposure and/or certified records of tests by a testing laboratory. Testing for this shall be in accordance with ASTM C227, ASTM C295 and ASTM C289.
- (4) When requested by the Engineer, the supplier shall provide any of the following information for the purpose of initial assessment of the suitability of an aggregate, and approval prior to delivery to the Site. The information shall be determined in accordance with the relevant Standard.
  - (a) Source of supply : Name and location of the quarry or pit
  - (b) Aggregate type
  - (c) Typical Properties :shape, surface texture, flakiness index, 10% fines, aggregate impact value, particle density, water absorption values, grading, fines, shell content, acid soluble sulphate content, chloride ion content and drying shrinkage.
- (5) Approval of aggregates will not prevent later rejection if results of subsequent tests do not reflect compliance with the requirements of the specified standards.

2.4. Fine Aggregates

- (1) Fine aggregate shall consist of natural or manufactured sand, having hard, strong, durable particles. Fine aggregate shall be clean and free from extraneous materials, clay balls, organic matter or other detrimental material in accordance with this Specification. The maximum combined quantity of soluble chlorides and sulphate in the fine aggregate shall not exceed 1000 ppm fine aggregate.
- (2) The fine aggregates shall be reasonably graded and shall meet the grading requirements contained in Table 1400.2:

**Table 1400.2 - Fine Aggregates**

Sieve Designation		Percentage by mass passing sieve
Alternative	Standard	
3/8 inch	9.5 mm	100
No. 4	4.75 mm	95 to 100
No. 8	2.36 mm	80 to 100
No. 16	1.18 mm	50 to 85
No. 30	0.600 mm	25 to 60
No. 50	0.300 mm	10 to 30
No. 100	0.150 mm	2 to 10

- (3) If required by the Engineer and in order to meet specification requirements, fine aggregates for use in reinforced concrete shall be washed with fresh clean water.

2.5. Coarse Aggregate

- (1) Coarse aggregate for concrete shall comply with all relevant provisions of AASHTO M 80 and ASTM C-33, including quality and grading requirements and be homogeneous, clean, free from extraneous materials, clay lumps, organic matter, and alkaline and detrimental material, or any materials which may have deleterious effect on the reinforcement in such a form or in sufficient quantity to adversely affect the strength and durability of the concrete. The Engineer may order that the coarse aggregate be washed if it is un-clean.
- (2) Aggregate containing iron pyrites shall only be used with the approval of the Engineer.
- (3) Marine aggregates shall not be used for structures in contact with raw or treated water unless specifically agreed with the Engineer.
- (4) Coarse aggregates shall be reasonably graded and shall meet the grading requirements in Table 1400-3.
- (5) The content of Aggregate having length to width ratio of more than 5 to 1 shall not be more than 8% (Flatness).

**Table 1400.3 Coarse Aggregates**

Sieve Designations		Percentage Passing by Weight		
Alternative	Standard	Concrete Class B0, B1, B2 & B3	Concrete Class C1	Concrete Class C2
2½ inch	63.5 mm	--	--	--
2 inch	50.8 mm	--	--	--
1½ inch	38.0 mm	--	100	--
1 inch	25.4 mm	100	90 - 100	100
¾ inch	19.0 mm	90 – 100	40 - 85	90 - 100
½ inch	12.5 mm	-	10 - 40	20 - 55
3/8 inch	9.5 mm	20 – 55	0 - 15	0 - 15
No. 4	4.75 mm	0 – 10	0 - 5	0 - 5
No. 8	2.36 mm	0 - 5	--	--

Note: C-Pertains to Civil Works Concrete  
B-Pertains to Building Works Concrete

- (6) In addition to the above, coarse concrete aggregate shall meet the following requirements:

**Table 1400.3A Coarse Aggregates**

ASTM /AASHTO	Testing Requirements	Specification
C-88 / T-104	Soundness Test	5% max.
C-131 / T-96	Abrasion Test	30% max
C-142 / T-112	Clay lumps and friable particles	0.25 % max. by weight
	Thin and elongated pieces	8% max. by weight
C-117 / T-11	Amount of material finer than 0.075 mm	1% max. by weight
C-123 / T-133	Lightweight pieces in Aggregate	0.5% max. by weight

2.6. Sands and Mortar

- (1) Sands for mortar and grout shall comply with AASHTO M45
- (2) Sands for floor screeds shall comply with AASHTO M45 (Grading Table) Natural Sand.
- (3) Sands for external and internal plastering with lime and Portland cement shall comply with AASHTO M45.

2.7. Cement Grouts

- (1) Cement grout shall be mixed in the relevant proportions using the minimum quantity of water to ensure the necessary fluidity and to render it capable of penetrating the work.
- (2) Cement grout shall be used within one hour of mixing, except where containing a retardant admixture.

2.8. Mortar

- (1) Mortar shall be mixed only as and when required in the relevant proportions indicated in Table 1400.4, until its color and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand.

- (2) All mortar shall be conveyed fresh to the Works as required for use. Mortar which has begun to set or which has been Site-mixed for a period of more than one hour shall not be used.

**Table 1400.4 Mortar**

Symbol	Designation	Composition	Purpose	Characteristics
M1	Masonry Mortar	Cement: dry sand = 1:2.5	Laying and filling masonry blocks	
M2	Mortar for Capping and Coatings	Cement: dry sand = 1:3	Standard facings and capping	
M3	Mortar for Vertical Facings	Cement: dry sand = 1:4	Rendering to walls	
M4	Waterproofing Mortar	Cement: dry sand = 1:3 with approved waterproofing compound	Facings for conduits underground structures	

### 2.9. Water for Mixing and Curing

- (1) Unless otherwise agreed in writing by the Engineer, water for use with cement, curing or in contact with potable water installations shall be of quality that is free from oil, salt, acid, sugar, vegetable or any deleterious substance.
- (2) The Engineer may require additional compliance testing at any time, of any water source.

### 2.10. Admixtures

- (1) Admixtures shall not be used without the written approval of the Engineer. The Contractor shall provide detailed product information of any additive he may wish to use and shall be entirely responsible for the use of any approved admixture in strict accordance with the manufacturer's instructions.
- (2) Accelerating, retarding and water-reducing admixtures for concrete or grout shall comply with the relevant provisions in AASHTO M 194/ASTM C494-92 Air-entraining admixtures shall comply with the relevant provisions of AASHTO M 157. Superplasticizing admixtures shall comply with the relevant provisions of ASTM C1017.
- (3) Calcium chloride or chloride-based admixtures will not be permitted.
- (4) To avoid cold joints the Contractor shall ensure sufficient supply of fresh concrete either on site or at the producing plant and concrete transporting arrangements and use in appropriate retarder when deemed necessary by the Engineer.
- (5) Retarders shall not be used together with other admixtures in the same concrete mix unless data is provided to assess their interaction and to ensure their compatibility and as approved by the Engineer. The fluid content of admixtures shall be considered in the determination of water/cement ratios.
- (6) Preliminary tests of cylinder strength and any other tests shall be carried out for all concrete with admixtures. When the Engineer approves changing the brand or type of cement, the Contractor will be required to carry out further tests and establish a job mix design.

## 3.0 STORAGE OF MATERIALS

### 3.1. Cement

- (1) Cement shall be delivered to the site in sealed bags or water-tight barrels bearing the manufacturer's name, cement type and the date of manufacture. The bagged cement shall be stored in piles not more than eight bags high. Storage areas shall be dry waterproof sheds or other such temporary buildings, exclusively for cement and erected with the floors raised well above the ground in areas agreed with the Engineer. The storage capacity shall correspond to the amount of concrete required for the largest units to be casted. On completion of the Works the storage shall be dismantled and removed, and the site restored to its original condition by the Contractor at his own expense.
- (2) A passage of at least one meter shall be left between the cement and the side walls of the storage sheds. Access ways shall also be left between containers so that everyone is visible. Each consignment of cement shall be stored separately and consignments shall be used in the order in which they are delivered. Any cement showing signs of initial setting or otherwise adversely affected shall be rejected and removed from the Site completely at the Contractor's own expense.
- (3) Access shall be available to the Engineer at all times.
- (4) Cement delivered by bulk carriers shall be stored in purpose made silos. All operations for handling of bulk cement shall be by approved methods that prevent contamination of the cement. The cement storage silos shall be provided with interior moisture control devices that keep the cement dry and prevent premature hydration in the silos. The silos shall be provided with access ladders and entry ways so that samples can be extracted from various levels of each silo for testing purposes.

### 3.2. Aggregates

- (1) Aggregates shall be stored in such a way as to prevent segregation and contamination. Aggregates from different sources or of different grading shall be stored in separate compartments, each having a concrete or similar hard bed, laid to a fall to drain off surface water.
- (2) Aggregates shall be protected from moisture during periods of prolonged severe weather.
- (3) Aggregate which has become segregated or contaminated with foreign matter during storage or handling will be rejected and shall be removed and reprocessed and/or replaced with material of acceptable quality. Aggregates shall be stored in sufficient quantity to ensure that there is no interruption of concreting work at any time.

## 4.0 CONCRETE - CLASSES

### 4.1. General

- (1) The class of concrete to be used in each part of the Works shall be as indicated on the Drawings or as directed by the Engineer, in accordance with the following:

- (a) Civil Works (Infrastructure)

C1: (Lean Concrete) blinding beds under concrete slabs in contact with ground and under foundations.

C2: (Underground/Structural Concrete) buried works in plain concrete or reinforced concrete.

- (b) Building Works



- B0: Concrete shear walls for CTO
- B1: Columns, beams, footing tie beams and suspended slabs
- B2: Slabs on fill, wall footings, lintel beams, matt foundation
- B3: Lean, blinding and mass concrete fill

- (2) The approximate weights or volumes of the components for each class of concrete and any other data given in any table of this Specification are an aid for suggested trial mixes and may be of value to Contractors in determining the approximate quantities of components required. However, the minimum compressive strength at seven (7) days and twenty (28) days must be strictly adhered to. Acceptance of the work by the Engineer will be based on 28-day strength as determined in accordance with requirements and procedures noted under this Specification section.
- (3) Class B3 – Lean Concrete Blinding layers shall, unless shown in the Drawings otherwise, be used under all reinforced concrete, column and wall footings, footing tie beams and the like.

#### 4.2. Structural Concrete

- (1) Concrete for use in Structures shall be in accordance with Table 1400.5, with the properties and strength requirements as follows:

**Table 1400.5 Concrete Properties and Strength Requirements of Structures**

Requirements	Class of Concrete					
	C1	C2	B0	B1	B2	B3
Minimum Compressive Strength of 150mm x 300mm Concrete Cylinder at 28 days (kg/cm <sup>2</sup> )	180	210	350	280	210	180
Maximum Size of Coarse Aggregate	37.5	25	25	25	25	25
Minimum Cement Content (kg/m <sup>3</sup> )	-	-	-	270	-	-
Maximum Free Water / Cement Ratio (max)	0.70	0.65	0.48	0.48	0.58	0.68
Nominal Cover (mm)	35	35	Refer to 4.3 below			
Slump Range (mm)	75-150	75-125	125-175	125-175	125-175	135-185

#### 4.3. Minimum Concrete Covering around Reinforcing bars

- (1) Generally, minimum thickness of concrete covering shall meet the requirements as follows:
  - (a) Concrete cast against and permanently exposed to earth: 75mm
  - (b) Concrete columns and beams: 40mm
  - (c) Concrete Slabs, walls, joints: 20mm
- (2) Tolerance for longitudinal location of bends and ends of reinforcement shall be  $\pm 50$ mm in except at discontinuous ends of members where tolerance shall be  $\pm 12$ mm.
- (3) Minimum Spacing of Reinforcing Bars shall be the greatest of following:
  - (a) 1.25 times of maximum aggregate size: 25mm
  - (b) 1.5 times of outside diameter of reinforcing bars

- (4) Concrete spacers or chairs of which strength shall be same as the concrete to be poured, and shall be provided a minimum concrete cover as specified.

## **5.0 CONCRETE PROPORTIONING**

### **5.1. Design of Concrete Mixes**

- (1) The proportions of all materials entering into the concrete shall in general follow the ACI Standard Recommendation for Selection of Proportions for Concrete (ACI 613). The Contractor shall provide all necessary equipment and plant to determine and control the actual amounts of each material entering each batch to produce the concrete strength required.
- (2) One month ahead of the commencement of the concrete work, the Contractor shall design a mix for each class of concrete listed in para 4.0 and shall submit the designs together with samples of the fine and coarse aggregates proposed for use in each designated mix. The mixes shall be designed in accordance with recommendations in ACI 613 standard.
- (3) Proper attention should be extended to ensure that the mixes shall not develop segregation during handling.
- (4) When submitting the various designs to the Engineer the Contractor shall also include for each mix:
  - (a) The grading of the coarse and fine aggregates in both tabular form and graphical form, the latter plotted to show the relevant grading which shall be within the limits specified.
  - (b) The water/cement ratio by weight
  - (c) Slump test results
  - (d) Full details of the method of concrete quality control which the Contractor proposes to use in the works
- (5) Following the Engineer's written provisional agreement of the Contractor's proposed mix designs for each specified class of concrete, the Contractor shall arrange for trial mixes of each class to be prepared, tested and reported by an independent testing laboratory, referred to in this clause as the Laboratory.
- (6) The Contractor shall deliver to the Laboratory enough quantity of all the constituents agreed to make the trial mixes and carry out the tests, and report to the Engineer.
- (7) The Contractor shall arrange for and shall ensure that the Laboratory forwards direct to the Engineer two (2) copies of the Laboratory's report giving information on the tests specified hereinafter, together with samples, each weighing not less than 3 kgs of each of the aggregates used in the trial mixes. On receipt of this report the Engineer will inform the Contractor whether or not the materials and mix designs are acceptable.
- (8) If the results of those tests are not acceptable to the Engineer, the Contractor shall arrange for the designs of the mixes to be adjusted and the tests repeated until the results are acceptable to the Engineer.
- (9) If the report shows that the materials and mixes comply with this Specification the Engineer's acceptance will not be unreasonably withheld.

### **5.2. The tests to be carried out by the Laboratory shall be:**

- (1) Tests of cement
  - (a) Fineness;
  - (b) Compressive Strength;
  - (c) Setting Time;
  - (d) Soundness
- (2) Test of aggregates (both fine and coarse)
  - (a) Refer to Table 1400.1 and Table 1400.3A: Results Required for Concrete Mix Design Tests

**Table 1400.6 - Concrete Test for Design Compression Strength**

Type of Concrete	Compressive Strength (kg/cm <sup>2</sup> ) on cylindrical specimen		Drying shrinkage of concrete prisms	Slump (mm)
	7 days	28 days		
C1	126	180	--	75 -150
C2	147	210	≤ 0.06%	75 - 125
B0	245	350	≤ 0.06%	125-175
B1	196	280	≤ 0.06%	125 - 175
B2	147	210	≤ 0.06%	125 - 175
B3	126	180	≤ 0.06%	135 - 185

## 6.0 CHEMICAL CONTENT

### 6.1. Chloride Content

- (1) Calcium chloride or admixture containing calcium chloride shall not be used in the production of reinforced concrete or concrete containing embedded metal.
- (2) Steam-cured concrete shall not contain ions, derived from all of its constituents, in excess of 0.1% by mass of its cementitious content. The percentage for all other concrete containing embedded metal in the final work shall not exceed the following:

Portland cement concrete:                    0.4, except that the proportion may be up to 0.5 in not more than 5% of the test results

Concrete made with Sulphate Resisting cement:                    0.2

- (3) Assessment of compliance shall be where practicable, the total chloride content should be calculated from the mix proportions corresponding to the measured chloride contents of each of the constituents.

### 6.2. Sulphates

- (1) The total sulfate content of the constituents of each mix expressed as SO<sub>3</sub>, must not exceed 4% by weight of the cement in the mix.

### 6.3. Alkali-Silica Reaction

- (1) Where the Contractor proposes to use aggregates containing silica which may be susceptible to attack by alkali, precautions shall be taken, and the materials tested in accordance with ASTM C 289-94.

## **7.0 WATER CEMENT RATIO**

- 7.1. The quantity of water used in mixing shall comply with the requirements for the maximum water / cementitious ratio, and be approved by the Engineer on the basis of preliminary tests and trial mixes.
- 7.2. It shall be the least amount that will produce a workable homogeneous plastic mixture which can be worked into the forms and around the reinforcement. In no circumstances shall the consistency of the concrete be such as to permit separation of the aggregate from the mortar during handling. Excess water shall not be permitted and any batch containing such excess will be rejected.
- 7.3. In measuring water for each batch of concrete, allowance shall be made for the water contained in the aggregates. The total water in the batch shall be deemed to consist of the water carried by the aggregates plus the water added.
- 7.4. Frequent tests including the slump test shall be carried out to ensure that a consistent water content is maintained.

## **8.0 TESTING, COMPLIANCE AND RECORDS**

### **8.1 Testing**

- (1) The Contractor shall allow for carrying out preliminary and works concrete tests in accordance with AASHTO T22 and T23 (ASTM C31 and C39), Method for Testing the compressive strength of cylindrical concrete specimens is applicable.
- (2) A minimum of one set of concrete cylinder samples shall be taken by the Contractor on each day of pouring. This rate may be increased at the request of the Engineer for critical elements or at the start of construction or when conditions change to establish the level of quality.
- (3) A set of concrete cylinder samples shall be taken by the Contractor not less than once a day or as specified in Table 1400.7.
- (4) A set shall comprise of seven (7) samples taken at random. Such samples shall be properly leveled indicating the date and place where the concrete was poured. Three (3) samples shall be tested respectively at seven (7) and twenty-eight (28) days. The remaining sample shall be tested only if there is doubt as the result of the six (6) samples tested. The independent laboratory testing agency shall be approved by the Engineer.
- (5) The test specimens shall have the compressive strength specified for each particular quality and class of concrete at the appropriate age. If the required strength has not been attained at twenty-eight (28) days, the Contractor shall cut out and reconstruct all work represented by the test specimen.
- (6) For Specified Mix Proportions the weight of dry aggregate to each 100 kg of cement shall not exceed 105% of that specified. The Engineer may require that analysis tests on fresh concrete be carried out in which case the mix shall be deemed to comply if the weight of dry aggregate to each 100 kg of cement is not more than 110% of that specified.

**Table 1400.7 Average Rate for Sampling**

Type of Structure	Average rate of sampling: Seven (7) samples per or as directed by the Engineer
Critical Structures, eg: cantilevers, columns, suspended slabs	All pours up to 10 m <sup>3</sup>
Intermediate Structures, eg: beams, ground slabs, bridges, decks and walls	20 m <sup>3</sup>
Heavy concrete construction, eg: foundations, solid rafts	50 m <sup>3</sup>

## 8.2. Strength Requirements

- (1) The average strength determined shall satisfy the requirement on Table 1400.5

## 8.3. Records / Test Results

- (1) The Contractor shall keep and make available to the Engineer detailed records showing:
  - (a) Sample reference number;
  - (b) Location and batch from which the sample has been taken;
  - (c) Mixing ratio of concrete;
  - (d) Date of preparation;
  - (e) Weather;
  - (f) Date of testing; and
  - (g) Age and strength of concrete
- (2) Where test results are below the minimum acceptable the Contractor may be given the opportunity to demonstrate that the concrete in the structure has adequate strength. Such demonstration shall be by one of the following methods, as appropriate and agreed by the Engineer.
  - (a) Subjecting the parts of the structure concerned to a loading test, under supervision and to the approval of the Engineer.
  - (b) Cutting core samples for compression testing
- (3) All tests must be carried out in a manner acceptable to the Engineer and shall be conducted by the Contractor's independent Laboratory. The Contractor shall bear all expenses involved in obtaining, cutting-out or sampling all specimens and/or component parts for testing.
- (4) If the Contractor elects to remove and replace the defective concrete without waiting for the results of the twenty-eight (28) day test, concreting can then continue entirely at his responsibility.

## 8.4. Slump Tests

- (1) The Contractor shall when required by the Engineer, carry out slump tests in accordance with ASTM C 143.
- (2) The measured slumps shall be as indicated in Table 1400.5.
- (3) One slump test, or more as directed by the Engineer, shall be carried out on every batch of concrete produced, and the test shall not be deemed valid unless witnessed by the Engineer or his representative.
- (4) Mixes of the stiffest consistency that can be placed efficiently shall be used. Over wet mixes will be rejected.

### 8.5. Maturity Testing

- (1) Maturity testing to determine the compressive strength of concrete may be used for the following situations:
  - (a) To allow early stripping of forms
  - (b) Prior to the application of post tensioning force
  - (c) Prior to launching of a traveler
- (2) The Contractor shall nominate details of his proposed procedure for the use of maturity testing for determination of early concrete strength. This procedure shall address the use of conventional test cylinder results to substantiate maturity testing predictions and the proposed locations of thermocouples within the concrete pour.

## 9.0 CONCRETE MIXING / TRANSPORTING / PLACING / COMPACTING

### 9.1. General

- (1) The Contractor shall not give less than two (2) days' notice in writing to the Engineer of his intention to commence concreting, with a detailed schedule and layout drawing showing location of all construction joints.
- (2) The Contractor shall not pour concrete until the Engineer has inspected and approved the formwork and reinforcement. The method and sequence of placing concrete shall be as approved by the Engineer.
- (3) A period of 6 hours for inspection shall be allowed after the work is clean and ready for concreting. If the work is not approved, the Contractor shall give notice in writing again and allow a further six (6) hours for inspection after the necessary correction or modification has been carried out.
- (4) If concreting is not started within twenty-four (24) hours of approval being given, consent shall be obtained again.
- (5) Delivery of concrete shall be regulated that placing is at a continuous rate unless delayed by the placing operations. If the delivery between batches exceeds thirty (30) minutes, or concreting stops for any other reason, the Contractor shall terminate the placing of the concrete and form stop ends or construction joints in a manner approved by the Engineer.
- (6) The Engineer shall decide whether to abandon the pour and have the concrete removed.
- (7) The Engineer may require that all structural concrete mixing, placement and curing be accomplished in shaded areas.

### 9.2. Ready-mix Concrete

- (1) Where concrete is to be obtained from a ready-mix supplier, the Contractor shall obtain the Engineer's approval of the source.
- (2) The Contractor shall also inform the Engineer of an alternative supplier, available to him if the approved source has to be withdrawn by the Engineer.
- (3) The delivery ticket required for each load of ready-mixed concrete shall detail as a minimum:
  - (a) The type and nominal maximum size of aggregate;
  - (b) The type or name and proportion of any admixture;

- (c) The actual cementitious content; and
  - (d) The position of the concrete in the Works
- (4) All delivery tickets shall be retained on site and shall be made available for inspection by the Engineer.
  - (5) The concrete shall be carried in purpose made agitators, operating continuously, or truck mixers.
  - (6) The concrete shall be compacted and in its final position within two (2) hours of the introduction of cement to the aggregates. The time of introduction shall be recorded on the delivery note.
  - (7) When truck-mixed concrete is used, water shall be added under supervision either at the Site or the central batching plant as directed but in no circumstances shall water be added in transit.
  - (8) Truck mixer units and their mixing and discharge performance shall comply with the requirements of ASTM C94. Mixing shall continue for the recommended number and rate of revolutions, or in the absence of the manufacturer's instructions, mixing shall continue for not less than ten (10) revolutions at a rate of not less than 7 revs/min.
  - (9) The use of any additive to the concrete of the materials is forbidden unless written approval is given by the Engineer.

### 9.3. Contractor's Equipment / On Site Batching Plant

- (1) The Contractor's equipment necessary for handling the materials and performing all parts of the work shall be approved by the Engineer as to design, capacity, and mechanical condition.
- (2) The Contractor's equipment shall be at the job site before the start of construction operations for inspection and approval.
  - (a) Batching Plant and Equipment
    - (i) General

The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and coarse aggregate. If bulk cement is used, a bin, hopper, and separate scale for the cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during the operation. Sufficient dust controls should be installed to conform with any Environmental regulation.
    - (ii) Bins and hopper

The bins with adequate separate compartments for the fine aggregate and coarse aggregate shall be provided in the batching plant. Each compartment shall discharge efficiently and freely into the weighing hopper. Means of control shall be provided so that, as the quantity desired in the weighing hopper is approached, the material may be added slowly and shut off with precision.

A port or other opening for removing an overload of any one of the several materials from the hopper shall be provided.

The weighing hoppers shall be constructed to eliminate accumulations of materials and to discharge fully.
    - (iii) Scales

The scales for weighing the aggregate and cement shall be of either the beam or the springless dial type. They shall be accurate within 0.5 % throughout their

range of use.

When the beam-type scales are used, the provisions such as a "telltale" dial shall be made for indicating to the operator that the required load in the weighing hopper is being approached. A device on the weighing beams shall clearly indicate critical position. The poises shall be designed to be locked in any position and to prevent any unauthorized change. The weigh beam and "telltale" device shall be in full view of the operator while charging the hopper and the operator shall have convenient access to all controls. The scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than 23 kg weights for testing of all scales when directed by the Engineer.

(b) Mixers

(i) General

The concrete shall be mixed in a central mixing plant. The mixer shall have attached in a prominent place a manufacturer's name plate showing the capacity of the drum in terms of volume of the mixed concrete and the speed of rotation of the mixing drum or blades.

A measuring device accurate within 3 % in weight and satisfactory to the Engineer shall be provided at the mixer for determining the amount of air-entraining agent or other admixture to be added to each batch requiring such admixtures.

(ii) Central Plant Mixer

The mixing shall be made 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 of discharging the mixture without segregation.

The central plant mixers shall be equipped with an acceptable timing device that will not permit the batch to be discharged until the specified mixing time has elapsed. The water system for a central mixer shall be composed of either a calibrated measuring tank or a meter and shall not necessarily be an integral part of the mixer.

The mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades.

The pickup and throw-over blades shall be replaced when they have worn down 19 mm or more.

The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

9.4. Transport, Placing and Compacting

- (1) Concrete transportation immediately after mixing shall be in accordance with BS 5328 or ASTM C94, and arranged to prevent the segregation, loss or contamination of material, and maintain workability. The time from mixing to placement in the Works shall not exceed one hour. The concrete shall be deposited as near as practicable to its final position and all equipment for transporting concrete shall be kept clean.
- (2) Concrete shall be placed in its final position within thirty (30) minutes of discharge from the mixer, unless carried in purpose made agitators in operation continuously, when the time shall be within two (2) hours of the introduction of the cement to the mix and within thirty (30) minutes of the discharge from the agitator.
- (3) The Contractor shall always be responsible for the concrete being placed and



compacted within such a time from the addition of the water to the mixer that the previous lift of concrete has not commenced setting.

- (4) Any method involving the use of pipes or chutes for transporting concrete will not be permitted, except with the written approval of the Engineer.
- (5) Before any concrete is placed, the formwork shall be thoroughly cleaned of all dirt, shavings, loose stones, and other debris.
- (6) Forms shall be treated with a non-staining material or shall be saturated with water immediately before the concrete is placed. For all exposed surfaces, the forms shall be treated with a non-staining material, as approved by the Engineer, to prevent the adherence to the concrete.
- (7) The concrete shall be placed gently in position and shall not have a free fall of more than one meter.
- (8) To convey the concrete as near as possible to its final position, drop chutes of rubber or metal shall be used for small sections and bottom dump buckets or other suitable vessels for large sections.
- (9) Concrete shall be placed so as to prevent water from collecting at the ends, corners or along the faces of the forms, and water shall not be placed in large quantities at a given point and allowed to run or be worked over a long distance in the form.
- (10) All concrete shall be placed and compacted in even layers with each batch adjoining the previous one.
- (11) Thickness of concrete layers shall be between 150mm and 300mm for reinforced concrete and up to 450 mm for un-reinforced concrete.
- (12) The concrete shall be carefully and continually compacted and worked around the reinforcement steel without displacing the bars and into the corners of the formwork so that the concrete shall be in close contact with the reinforcement steel and free from honeycombing.
- (13) After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement steel.
- (14) The concrete shall be consolidated with approved mechanical vibrators operating within the concrete, of a type approved by the Engineer. When required, vibrating shall be supplemented by hand spacing with suitable tools to assure proper and adequate compaction.
- (15) Over-vibration of concrete in the formwork by means of vibrators will not be permitted.
- (16) The poker vibrators shall have a diameter compatible with the spacing of the reinforcement, shall be of sufficiently high frequency, and shall be properly handled by experienced personnel. They shall be immersed at regular intervals of approximately ten (10) times the diameter of the vibrator and to such a depth that the fresh concrete will be worked into that previously placed. Care shall be taken not so displace the reinforcement nor to disturb or affect partially set concrete. Vibrators shall not be attached to the reinforcement in any circumstances. Each immersion shall continue until shortly after air bubbles cease to appear on the surface of the concrete, but shall not last more than thirty (30) seconds. The vibrators shall be withdrawn gradually and vertically to ensure that no air pockets are formed.

- (17) The Contractor shall provide at least two vibrators and a spare during all concrete pours.
- (18) The equipment used shall be operated continuously during the placing of each batch of concrete until the expulsion of air has virtually ceased, and in a manner which does not promote segregation of the ingredients.
- (19) All vibration, compaction and finishing operations shall be completed immediately after the placing of concrete in its final position.
- (20) Workers shall not be permitted to walk over freshly placed concrete until it has hardened sufficiently to carry their weight without distortion.
- (21) Care shall be taken to ensure that reinforcement projecting from recently placed concrete is not disturbed so as to damage the initial set of the concrete.
- (22) Concreting in any one part or section of the work shall be carried out in one continuous operation and no interruption of concerning work will be allowed.
- (23) Where beams and slabs together form an integral part of the structure, they shall be poured in one operation, unless otherwise specified or an approved provision is made to form a construction joint.
- (24) After a beam, wall or column has been cast, an interval of one hour shall be allowed before casting the continuous slab. The same applies for all abrupt changes in sections.
- (25) Freshly placed concrete shall be adequately protected from rain, dust storms, chemical attack and the harmful effects of sun, heat, wind, flowing water, vibrations and shocks. It shall also be fenced off or otherwise protected or prevent persons from walking thereon or articles being placed or thrown thereon. This protection shall continue until the concrete is sufficiently set such that it can no longer be damaged by these factors. The Engineer may determine when the protection is no longer required, but in any case this shall not be less than twenty-four (24) hours after the time of placing.
- (26) The Contractor shall take all necessary precautions to prevent differential temperatures across any concrete element exceeding 20 °C during concrete placing and curing.

#### 9.5. Chutes and Troughs

- (1) Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement.
- (2) Where steep slopes are required, the chutes shall be equipped with baffle boards or be in short lengths that reverse the direction of movement.
- (3) All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. The water used for flushing shall be discharged clear of the concrete already in place. The use of aluminum chutes, tremies, troughs, and pipes will not be permitted.

#### 9.6. Pumping

- (1) Placement of concrete by mechanical pumping will be permitted only if authorized by the Engineer. The equipment shall be so arranged that the freshly placed concrete is not affected by any vibrations.

- (2) The operation of the pump shall be such that a continuous stream of concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there is no contamination of the concrete or separation of the ingredients.

#### 9.7. Weather Precautions

- (1) Concrete shall be placed at the coolest time of the day, as practicable, and in no circumstances shall the temperature of concrete when placed exceed 32°C.
- (2) The Contractor shall submit to the Engineer for approval, his proposals to maintain the concrete temperature below 32°C and reduce the rate of evaporation during hot weather, including the cooling of mixing water and aggregates, and shading of aggregates and plant.
- (3) The concrete mixing plant shall be screened and covered as a protection from wind, rain and sun, and similar precautions taken during transporting, placing and curing of the concrete whenever conditions require.
- (4) Fresh concrete placed under strong sunlight shall be shaded from the direct rays of the sun.
- (5) Concrete shall not be placed when it is raining. If rain starts, or it is imminent, work shall stop and a construction joint formed and curing of placed and finished concrete commenced.

#### 9.8. Concrete Piers and Columns

- (1) Concrete in columns and piers shall be placed as approved by the Engineer. The concrete shall be allowed to set at least twelve (12) hours before pier heads and caps are placed, unless otherwise approved by the Engineer.

#### 9.9. Continuity of Concrete Work

- (1) The Contractor shall carry out the concreting work in such a manner that the placing of the concrete in any particular section of the structure shall be executed without any interruption whatsoever from the beginning to the end of the operation. If interruptions are permitted, no fresh concrete shall be deposited on or against the concrete placed before the interruption until the latter is sufficiently set.
- (2) Particular care shall be taken to ensure that partially set concrete shall not be damaged by any cause.
- (3) Casting of concrete shall not commence until a sufficient quantity of approved material is at hand to ensure continuity of operation.
- (4) Concrete work shall not commence until there is sufficient equipment in reserve in case of breakdown.

#### 9.10. Records of Concreting

- (1) The Contractor shall keep up to date records of the dates and times when concreting is carried out and the weather and temperatures at those times. These shall be available for inspection by the Engineer.

#### 9.11. Damp Proof Membrane

- (1) The damp proof sheets shall consist of a single layer of 0.25mm thick polyethylene sheet of a type approved by the Engineer with lapped and folded joints sealed with an approved pressure sensitive tape.

- (2) Care shall be taken to ensure that sheets are not punctured or otherwise damaged by the laying and fixing of reinforcement and pouring of concrete.

#### 9.12. Water Proof Construction

- (1) The underground concrete structure to the water utilities underground tank shall be of waterproof construction. This shall be achieved both by constructing waterproof concrete and placing bituminous membrane waterproofing (WP-5) as specified in Section 4320, under the base slab, to the external faces of walls and over the cover slab to provide a continuous membrane to penetrate water prevention.
- (2) The waterproof membrane shall be used and shall be carefully placed and supported at locations of the construction joints planned by the Contractor. Precaution shall be taken so that the waterproof membrane shall be neither displaced nor damaged by construction operations or other means.
  - (a) All surfaces of waterproof membranes shall be kept free from oil, grease, dried mortar, or any other foreign matter while the membrane is being embedded in concrete;
  - (b) Waterproof membranes shall be tightly enclosed by dense concrete;
  - (c) Waterproof membranes shall comply with the requirements of the following ASTM equivalent test D638, D2240, D543, D570, D1203;
  - (d) Ends, angles and intersections in waterproof membranes shall be securely sealed and jointed by approved adhesive or special fittings.
- (3) In addition the Contractor shall take care over the quality of reinforced concrete construction for these structures. Approved type of waterproofing compound may be used.
- (4) Waterproofing of structures shall be tested to the approval of the Engineer.

#### 9.13. Liquid Retaining Structures

- (1) The Sewage Treatment Plant Structures and underground fire water tank and the like, which contain or convey liquids shall be designated as Liquid Retaining Structures and the Contractor shall comply fully with the requirements of this Section.
- (2) All Liquid Retaining Structures shall be in reinforced concrete watertight construction.
- (3) The Contractor shall take care over the quality of reinforced concrete construction for these structures, with particular regard to the joints and waterproof linings.
- (4) Prior to commencement of any Liquid Retaining Structures, the Contractor shall secure the Engineer's approval for the equipment and materials to be used and the method of work execution.
- (5) All structures subject to groundwater pressure shall be designed to resist flotation.
- (6) Particular care shall be taken during the construction period and in the design for an all-empty condition.
- (7) The Contractor shall take particular care to control the total quantity of chlorides contained in concrete, to eliminate alkali/silica reactivity.
- (8) Waterproof lining shall be to the approval of the Engineer.
- (9) All joints and waterstops shall comply with Section 1460.

- (10) The locations and structure of all joints must be indicated on the shop drawings. The construction and intervals of all joints shall be compliant with this Section and shall take particular consideration of temperature and moisture change, dry expansion and contraction, degree of constraining expansion and contraction, structure type, section thickness and loading and movement characteristics of adjacent structures and buildings.
- (11) Before any filling or backfilling is placed against the outside wall faces, Liquid Retaining Structures shall be filled with water at a uniform rate of not greater than 2 m in twenty-four (24) hours.
- (12) A period of twenty-one (21) days shall be allowed for stabilization after which the water level shall be recorded by approved means at twenty-four (24) hour intervals for a test period of seven (7) days. During the test period the total permissible drop, after allowing for evaporation and rainfall, shall not exceed 1/500 of the average water depth of the full tank or 10 mm whichever is greater.
- (13) Any leakage visible on the outside faces of the structure shall be stopped, by substantial repairs, proposed by the Contractor and approved by the Engineer. Any caulking or making good of cracks in the wall section, shall where practicable, be carried out from the inside face.
- (14) The Contractor shall allow for all costs in providing and filling with water as directed by the Engineer and for emptying the tanks upon successful completion of the tests.

## **10.0 PLACING OF CONCRETE IN OR UNDER WATER**

### **10.1. Submissions**

- (1) Where the Contractor proposes the placement of concrete in or under water, he shall submit full details of his construction method to the Engineer for approval, before proceeding with the work.

### **10.2. Particular Requirements**

- (1) The actual mix proportions and selection of aggregates shall be such as to ensure a resulting concrete with good flow and cohesion characteristics.
- (2) The cement content shall be 25 percent greater than for a comparable mix for use in dry conditions. The minimum works cylinder strength for all concrete shall be approved by the Engineer for the comparable mixes for use in dry conditions.
- (3) Tremie pipes shall be smooth bored, watertight fitted with quick release joints and have an adequate cross-section for the size of aggregate to be used. Aluminum pipes shall not be used.
- (4) Bottom opening skips shall be straight sided, perfectly smooth and fitted with externally operated bottom opening double doors and overlapping canvas flaps.

### **10.3. Method**

- (1) The method of placing concrete in or under water shall keep as much as possible of the concrete being placed out of direct contact with the water and avoid any rapid movement or agitation of the exposed surface.
- (2) The work shall, where possible, be carried out in one operation, where this is impracticable, laitance, washed-out aggregate or foreign matter, which may have accumulated on the previously placed concrete, shall be completely removed prior to

additional concrete being placed. This concrete shall then be placed directly on the cleaned surface.

## **11.0 CURING**

### **11.1. General**

- (1) The Contractor shall prevent excessive rates of evaporation of water from all surfaces due to high temperature and/or drying winds by adequately protecting the concrete.
- (2) All newly placed concrete shall be cured, and curing shall begin immediately after finishing and continue for a minimum of ten (10) days.
- (3) Curing shall be done so that moisture is always present, and shall be an integral part of the concreting operations. Where water is used, sufficient quantities must be available on Site to ensure that the concrete is continually wet throughout the curing period.
- (4) Improperly cured concrete will be considered defective, and the Engineer will stop all of the Contractor's placing operations until proper procedures are put into effect.
- (5) When permitted in writing by the Engineer, the Contractor may use one of the methods specified in this Section or a combination thereof.

### **11.2. Supplying Additional Moisture**

- (1) This shall include supplying additional moisture by ponding, sprinkling, or fogging. Coverings such as burlap shall be used to retain water. Coverings shall be placed as soon as possible after finishing operations have been completed and there is no danger of surface damage. The coverings shall be kept continuously moist, and/or covered with sheet materials as below.
- (2) The use of sawdust will not be allowed and coverings that cause unsightly discoloration of concrete shall not be used. Any method that results in the concrete being alternate wetting and drying and the application of cold water to warm concrete surfaces will be considered an improper curing procedure.

### **11.3. Preventing Moisture Loss**

- (1) Preventing moisture loss from the concrete may be done with the use of approved waterproof paper, plastic, sheets, or liquid membrane curing compound except where other requirements prohibit the use of these compounds. If a formed surface is to be rubbed, the concrete shall be kept moist before and during the rubbing, and the curing shall be initiated immediately following the first rub while the concrete surface is still moist.
- (2) Bridge decks, approach slabs, parapets shall be covered with burlap or similar approved as soon as the concrete is sufficiently set to support this material without damage to finish. This moisture-retaining material shall then be saturated with water and the entire area covered with waterproof sheeting.
  - (a) Sheet materials
    - (i) Shall conform to AASHTO M 171
    - (ii) Waterproof paper and plastic sheets shall be the maximum practicable width with due allowance for adequate laps of the material, and shall be tightly sealed with a pressure sensitive tape, mastic, glue or other approved methods to form a complete waterproof cover of the entire concrete surface. They shall be securely

positioned so that wind will not displace them. If any portion of the sheets are broken or damaged before expiration of the curing period, the broken or damaged portions shall be immediately repaired. Sections that have lost their waterproof qualities shall not be used.

(b) Curing compounds

- (i) Only curing compounds complying with AASHTO M 148 or similar approved may be used as the initial and final curing agents on structural concrete.
- (ii) Application shall be by atomising-type spray equipment fitted with a tank agitator.
- (iii) Compounds shall be applied to unformed areas as soon as the water sheen as practically disappeared from the concrete, or as soon as the forms have been removed from surfaces not to be rubbed. Curing compounds shall not be used on areas receiving a rubbed finish. If there is to be any delay in applying curing compound, the surface shall receive moist curing until the compound can be applied.
- (iv) If the membrane film is broken or damaged at any time during the curing period, the area or areas shall be immediately re-coated to the original requirements.
- (v) The surface shall be sprayed again immediately at right angles to the first application. The rate of each application shall be not less than 1 liter for each 3.6 square meters of surface. Care shall be taken to prevent application to joints where concrete bond is required to reinforcement steel, and to joints where joint sealer is to be placed.
- (vi) Liquid curing membrane shall not be applied while rain is falling.

(c) Forms

- (i) Timber formwork covering the concrete shall be moistened with water at frequent intervals to keep it from drying during the curing period. Metal formwork exposed to the sun must be shaded from its direct rays, painted white or otherwise protected during the curing period.
- (ii) When the Engineer's approval is given to remove forms early, specified curing procedures shall be implemented by the Contractor and continued until the end of the ten (10) day period as specified.

## 12.0 BUILT-IN ITEMS

- 12.1. Where pipes, sleeves, water bars or other items are built into concrete, they shall be rigidly secured in position to prevent movement and shall be free from external coatings which might reduce the bond. The Contractor shall take precautions to prevent the formation of air pockets, voids or other defects whilst the concrete is being placed.
- 12.2. Where pipes, or other built-in items are built into or pass through walls, floors or roofs of concrete structures, the Contractor shall apply details and select methods to sustain the integrity and where necessary the watertight nature of the structure. All such details and methods shall be submitted to the Engineer for approval.
- 12.3. The Contractor shall cast pipes or other built in items into the concrete as the work proceeds unless the Engineer exceptionally agrees to the formation of box-outs. Box outs will generally not be allowed in watertight construction or in concrete requiring Class F3 finish.
- 12.4. For box-outs, the clearance between the outside of the pipe and the structural concrete shall be between 50mm and 200mm and a continuous approved water bar shall be provided. Clearance to cut reinforcement shall be at least 40 mm.
- 12.5. Before casting any concrete around pipes or other built-in items, the Contractor shall provide approved puddle flanges to the item and/or hydrophilic strip, correctly fitted to or around the pipe or built-in at the center of the wall. If there is a flange around the pipe the hydrophilic

strip shall be on the pressure side of the flange.

### 13.0 TOLERANCES

- 13.1. Concrete surfaces in the final work shall have no abrupt irregularities to an extent noticeable to the eye.
- 13.2. Subject to the tolerance requirements of a particular Sub-Section and providing the required concrete cover to reinforcement, the tolerances listed in Tables 1400.8 below are the maximum permissible from the dimensions indicated on the Drawings to be used for acceptance of the work.

**Table 1400.8 Tolerance**

Item	Tolerance in mm unless indicated otherwise
Placing of reinforcement	5
Concrete cover	0 to +5
Footings	
Plan dimensions	Formed footings and pile caps Unformed footings
	-15 to +50 0 to +150
Thickness	< 300 mm > 300 mm
	-5 to +25 -10 to +50
Variation in cross section of columns, piers, slabs, walls, beams and similar (not deck slabs and end posts)	< 3 m > 3 m
	-5 to +15 -10 to +25
Variation from vertical or specified batter of columns, piers, walls, handrail posts and arrises	Unexposed concrete Exposed concrete
	10 mm in 2.5 m 5 mm in 2.5 m
Variation from Grades indicated on Drawings for railings, kerbs and arrises	2.5 mm in 2.5 m
Departure from plan position at any level	
Columns, piers, walls, beams, slabs, kerbs, railings and other similar parts	25
Relative displacement of adjoining components shall not exceed	10
Departure from alignment	
Rows of columns, faces of piers or walls	10
Handrails, faces of handrail posts, kerbs	5
Maximum allowance for irregularities in exposed concrete surfaces	
Sections less than 1 m in dimension when measured with a straightedge across the dimension of the section	2.5
Sections greater than 1 m in dimension when measured with straightedge across the dimension of the section, except that when sections are greater than 2.5 m in dimension, a 2.5 m straightedge shall be used	5

### 14.0 BEAMS AND GIRDERS

- 14.1. Unless otherwise noted in plans, all beams and girders shall be cambered at least 6mm for every 4500mm of span, except cantilevers for which the camber shall be as noted on the Drawings or as ordered by the Engineer but in no case less than 18mm for every 3m of free span.
- 14.2. If beam reinforcing bars end in a wall, the clear distance from the bar to the further face of the wall shall not be less than 25mm. Anchorage length shall be as shown on the Drawings.
- 14.3. If there are two or more layers of reinforcing bars 25mm diameter bar separators shall be used, spaced about 900mm on center. In no case shall there be less than two (2) separators between layers of bars.
- 14.4. Where a beam crosses a girder, beam bars shall rest on top of girder bars. Beam reinforcing



bars shall be symmetrical about the centerline whenever possible.

**15.0 GROUND SUPPORTED SLABS**

- 15.1. All slabs on grade shall be designed with a maximum water cement ratio of 0.40. Any decrease in workability shall be compensated by using a plasticizer.
- 15.2. All slopes shall be poured integral with the slab. Overlays or bounding shall not be allowed.
- 15.3. Continuous wet curing of concrete by ponding shall be done for at least fourteen (14) days.

## SECTION 1420

### STEEL REINFORCEMENT – REFERENCE SPECIFICATION

#### 1.0 SCOPE OF SPECIFICATION

- 1.1. The work under this Section consists of the requirements for Steel Reinforcement to concrete structures.

#### 2.0 MATERIALS

##### 2.1. General

- (1) Steel reinforcement shall comply with the relevant provisions of the following standards:

**Table 1420.1 Standard**

Type	Standard
Carbon Steel Bars	AASHTO M31 / ASTM A 615
Cold-Drawn Steel Wire	ASTM A82

##### 2.2. Reinforcing Bars

- (1) Reinforcing steel bars shall be:
- (a) Deformed high yield steel for 16mm diameter and larger shall be grade 60 with a minimum yield strength of 420 N/mm<sup>2</sup>;
  - (b) Deformed intermediate yield steel, for 10mm and 12mm diameter bars shall be grade 40 with a minimum yield strength of 280 N/mm<sup>2</sup> except for Passenger Terminal Building where 12mm diameter bars and 10mm diameter bars shall be grade 60 with a minimum yield strength of 420N/mm<sup>2</sup>.

##### 2.3. Tie Wires

- (1) Tying wire for steel reinforcement shall be 1.6 mm diameter (Gauge # 16) finely annealed mild steel wire, complying with AASHTO M32/ASTM A-82 or equivalent.

##### 2.4. Dowel Bars

- (1) Dowel bars for expansion and construction joints in concrete shall consist of plain round bars, minimum 250 N / mm<sup>2</sup> with a fusion bonded epoxy coating or galvanized as indicated on the Drawings or approved by the Engineer.
- (2) Dowel bars shall be straight, free from burrs or other irregularities and shall have their sliding ends sawn. The sliding half of each dowel bar shall be provided with a plastic cap at least 100 mm long, the end 20 mm of which shall be fitted with a disc of joint filler.
- (3) Dowel bars shall have a minimum diameter of 20 mm unless otherwise indicated on the Drawings. Metal supports which extend to the surface shall not be used. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted by the Engineer.

##### 2.5. Additional Corner Slabs Reinforcement

- (1) Additional reinforcement shall be provided at corners (external and internal) of all slabs consisting of 7 No, 10mm diameter bars, 1500mm long at 200mm centers.

### **3.0 STEEL QUALITY AND SUPPLY**

#### **3.1. Samples**

- (1) Representative samples of all reinforcement steel that the Contractor proposes to use in the Works must be submitted to the Engineer for his written approval, before work is commenced together with:
  - (a) Manufacturer's certificates stating clearly for each sample the place of manufacture;
  - (b) The expected date and size of deliveries to the Site, and
  - (c) All relevant details of composition, manufacture, strengths and other qualities of the steel
- (2) Reinforcing steel shall conform to the requirement of ASTM A615.

#### **3.2. Testing**

- (1) In the event that a reinforcement steel sample under test fails to meet the Specification requirements at any time, or the Engineer considers that samples which were presented to him for test were not truly representative, or if it becomes apparent that reinforcement steel which has not been approved has been used on the Works, the Engineer may instruct the Contractor to break out and remove completely all such sections of the work already constructed using such suspect reinforcement steel.
- (2) All testing of reinforcement steel bars shall meet the requirements and specification limits of the AASHTO/ASTM or any equivalent designation for the particular size, grade and any additional requirements.

### **4.0 SUBSTITUTION**

- 4.1. Substitution of different grades or size of bars will be permitted only upon specific written approval by the Engineer, and the substitute bars shall provide a steel area equal to or larger than that called for in the design or design requirements or on the Drawings.
- 4.2. Substitution of bars types, designated by number not equivalent in area (to mm bars) shall be closest number bar in area with spacing adjusted to provide the same area per unit spacing. Substitution of millimeter bars for bar sizes not readily available from the Contractor's source may be made on the same basis. All bar substitutions shall be approved by the Engineer in writing.

### **5.0 SCHEDULING**

#### **5.1. Bar lists and bending diagrams**

- (1) The Contractor shall submit detailed bar diagram schedule in accordance with the approved Drawings. Fabrication of material shall not begin until the schedules have been approved.
- (2) The approval of these schedules shall in no way relieve the Contractor of responsibility for the correctness of such information. Any expense incident to the revision of material furnished in accordance with such lists and diagrams to make it comply with the design Drawings shall be borne by the Contractor.

#### **5.2. Spacers and chairs**

- (1) The Contractor shall provide details of the location, spacing and type of spacers and chairs to reinforcement that he intends to use for the approval of the Engineer.

## **6.0 FABRICATION**

### **6.1. Bending**

- (1) Bar reinforcement shall be cut and bent to the shapes shown on the reinforcement drawings and schedules. Fabrication tolerances shall be in accordance with AASHTO M31M. Bending of bars shall be without the application of heat, unless otherwise permitted. Bending shall achieve a substantially constant curvature. Reinforcement shall not be straightened or re-bent without the approval of the Engineer. If permission is given to bend projecting reinforcement, measures shall be taken to prevent damage to the concrete and to ensure that the radius is not less than the minimum specified in ACI-318.
- (2) The Contractor shall make provision on Site for bending steel from stock to accommodate minor variations in reinforcement details.

### **6.2. Bends and Hook Dimensions**

- (1) The dimensions of hooks and the diameters of bends measured on the inside of the bar shall be in accordance with the minimum recommendations of ACI-318.

## **7.0 LAPS AND JOINTS**

### **7.1. General**

- (1) All reinforcement shall be furnished in full lengths indicated on the Drawings unless otherwise approved by the Engineer. Laps and joints shall be staggered as far as possible, and only made at the positions described in the Contract or as agreed by the Engineer.

### **7.2. Laps**

- (1) Laps shall be of the lengths shown on the Drawings or in accordance with the design criteria. If not shown, the length of laps shall be no less than 40 x bar diameter for compression bars and 60 x bar diameter for tension bars.
- (2) At lapped locations, the bars shall be placed and wired in such a manner as to maintain the minimum distance to the surface of the concrete indicated in the Specification.
- (3) No laps shall be permitted at points where critical bending stresses occur. Splices where so permitted shall be as indicated above and on the Drawings. No more than 33% of the bars at any one section shall be allowed to be lapped.

### **7.3. Welding of Reinforcement**

- (1) Reinforcement shall not be welded on Site except where described or permitted under the Contract. All welding procedures shall be subjected to the Engineer's approval.

### **7.4. Mechanical Coupler for Butt Joints**

- (1) For bars in compression the load may be transferred by end bearing of square sawn-cut ends held in concentric contact by a suitable sleeve or other coupler agreed with the Engineer. The concrete cover for the sleeve should not be less than that specified for the reinforcement.
- (2) For bars in tension splices shall only be made if pre-approved or detailed on the

Drawings or authorized in writing by the Engineer, with a mechanical coupler satisfying the following criteria:

- (3) The tensile strength of the coupled bar should not increase by more than ten (10) percent for plain bars, five (5) percent for deformed bars.
- (4) When requested by the Engineer, up to two field splices out of each 100, or portion thereof, placed in the work and chosen at random by the Engineer, shall be removed by the Contractor and tested.

## **8.0 HANDLING**

- 8.1. Rough handling, shock loading and the dropping of reinforcement from a height is to be avoided from the time of shipment until it is placed, together with measures to safeguard surface deterioration from rusting or other causes.
- 8.2. Reinforcement steel stored at the site shall be laid on wood floors or sills suitably spaced so that no reinforcement steel shall be laid upon or come in contact with the ground. Care should be observed so that no reinforcing bar will be subjected to initial strain or stress caused by sagging or during storage or mishandling thereof.
- 8.3. When the weather is dry and the time for storage before installation is limited, housing may be omitted, but if rainy or exceptionally humid weather occurs or is anticipated, bars shall be stored under cover.

## **9.0 FIXING AND PLACING**

- 9.1. The reinforcement steel shall be assembled to the shapes and dimensions as indicated on the Drawings. The bars shall be of the cross-sectional areas indicated and shall be fixed rigidly and accurately in the positions indicated on the Drawings. The bars shall be firmly bound together at intersections to ensure that the reinforcement steel framework as a whole shall retain its shape, and the framework shall be so temporarily secured against displacement as to retain its correct position in the forms during the process of depositing and consolidating the concrete.
- 9.2. Non-structural connections for the positioning of reinforcement shall be made with tie wire or other fixing devices. Precautions shall be taken to ensure that the ends of clips or ties are turned into the main body of the concrete and not allowed to project towards the surface or encroach into the concrete cover.
- 9.3. Spacing blocks shall be of precast concrete of strength at least equal to that of concrete being placed. They shall be as small as practicable and shall be securely fixed in position by means of wires cast into them. They shall be soaked with water immediately prior to concreting.
- 9.4. No temporary metal supports to the reinforcement steel will be allowed by the Engineer to be incorporated in the finished concrete, and metal clips or supports shall not be placed in contact with forms for exposed surfaces.
- 9.5. At the time of concreting, all reinforcement steel shall have been thoroughly cleaned and freed from all loose rust, scale, mud, oil or any other coatings that might adversely affect the steel or concrete chemically or reduce the bond and it shall also have been cleaned of all set or partially set concrete which may have been deposited thereon during the placing of a previous lift of concrete.
- 9.6. The placing of all reinforcement steel bars will be checked by the Engineer and in no case is concrete to be placed around any reinforcement steel that has not been approved by the Engineer. The insertion of bars into or the removal of bars from concrete already placed will

not be permitted by the Engineer. Reinforcement steel temporarily left projecting from the concrete at the joints shall not be bent without the prior approval of the Engineer.

- 9.7. Main reinforcement steel carrying determinate stresses shall be spliced only where indicated on the Drawings or on approved shop drawings.
- 9.8. The minimum spacing center to center of parallel bars shall be 2.5 times the diameter of the bar, but in no case shall the clear distance between the bars be less than 1.5 times the maximum size of the coarse aggregate.
- 9.9. Bundles of reinforcement steel bars shall be tied together at not more than 1.80 m centers.
- 9.10. All reinforcement steel shall have the clear concrete cover as indicated on the Drawings or specified herein.
- 9.11. The cover to reinforcement steel shall be not less than the required cover minus 5mm and, where reinforcement is located in relation to only one face of a member, not more than the required cover plus:
  - (1) 5 mm for bars up to and including 12 mm size
  - (2) 10mm for bars over 12 mm up to and including 25 mm
  - (3) 15 mm for bars over 25 mm size
- 9.12. General limits on bar sizes and spacing of bars shall be as indicated on the Drawings.
- 9.13. Reinforcement which temporarily or otherwise projects from work being concreted or already concreted, shall be adequately supported and should not be bent out of position or in any way disturbed unless agreed in writing with the Engineer. Reinforcement left projecting at a temporary end, which because of a lapse of time between first and second stages of the work is likely to corrode, shall be protected by a thin coat of cement wash. Loose cement shall be cleaned off the bars before concreting the next stage.

## SECTION 1440

### FORMWORK /FINISHING – REFERENCE SPECIFICATION

#### 1.0 SCOPE OF SPECIFICATION

- 1.1. The work under this Section consists of the requirements for Formwork to concrete structures.

#### 2.0 DESIGN

##### 2.1. General

- (1) All formwork shall be the responsibility of and be designed by the Contractor.
- (2) Formwork generally be in accordance with the Engineer's requirement and approval.

##### 2.2. Drawings

- (1) The Contractor shall submit shop and working drawings, calculations, proposed materials and manufactured goods, to the Engineer for approval at least three (3) weeks before construction of the forms.
- (2) The shop and working drawings shall show the proposed details of construction such as sizes of members, spacing of bents, posts, studs, walers, stringers, collars, bolts, wedges, bracing, rate of pour, and the manufacturer's recommended safe working capacity of all form ties and column clasps. All assumptions, dimensions, material properties and other data used in the structural analysis shall be noted on the shop drawings.

##### 2.3. Design loads

- (1) If retarding admixtures are proposed, their effect shall be duly considered in the calculation of the lateral pressures of the fresh concrete. Besides the weight of the formwork and freshly placed concrete, the design loads shall include the weight of workmen, equipment, runways and impact, which together should be taken as not less than 250 Kg/m<sup>2</sup> of horizontal projection. Braces and shoring should be designed to resist all foreseeable lateral loads.

##### 2.4. Prefabricated formwork

- (1) When prefabricated formwork, shoring or scaffolding units are used, the manufacturer's recommendations for allowable loads may be followed if supported by test reports or successful experience records. For materials subject to substantial reuse, reduced allowable load values may be required at the discretion of the Engineer.

##### 2.5. Design factors

- (1) The design of the formwork and bracing shall be such that there is no deformation of the forms under the weight of the plastic concrete, or due to methods adopted for the placing and compacting thereof, or due to any incidental loading. No accessory for supporting the formwork or staging shall be built into the permanent structure except with the Engineer's approval.
- (2) The formwork shall be sufficiently rigid and tight to prevent loss of mortar from the concrete and to maintain the correct position, shape and dimensions of the finished work. It shall also be so constructed as to be removable from the cast concrete

without shock or damage.

- (3) The forms shall produce a consistent color and quality of surface.
- (4) Where holes are required in forms to accommodate projecting reinforcement, fixing devices or other built-in items, precautions shall be taken to prevent loss of mortar matrix.
- (5) Formwork shall allow access for the preparation of joint surfaces before the concrete has hardened.
- (6) For the purposes of compliance with the provisions of para. 8.0 of this Section - Striking of Formwork, the Contractor's method of constructing formwork shall allow for the props to soffit forms to remain in position continuously for the period described.
- (7) 25 mm x 25mm chamfers shall be provided on all exposed arrises, except for rebates for grouted in items, unless otherwise indicated on the Drawings.

### **3.0 MATERIALS**

#### **3.1. Generally**

- (1) General quality plywood is to be minimum thickness 12 mm; WBP bonding sufficiently tight which when immersed in water for 48 hours does not peel-off between plies.
- (2) High quality plywood is to be marine quality, joinery grade finish.
- (3) All plywood used for formwork to temporary or permanent works on potable water supply structures shall be either phenol free or faced with a surfacing which prevents phenol from coming into contact with concrete on the potable water faces.

#### **3.2. Formwork for Ordinary Finish**

- (1) General quality plywood, or sawn timber boarding and reasonable re-use is allowed.

#### **3.3. Formwork for Fair Finish**

- (1) Steel sheet, or
- (2) High quality joinery grade plywood, to give flat non-textured finish, or
- (3) Planed timber to give flat non-textured finish,
- (4) Flush joints, suitably finished to prevent any distortion, line or imprint upon concrete.
- (5) Re-use, if allowed, shall be strictly controlled to maintain constant quality of finish.

### **4.0 CONSTRUCTION**

#### **4.1. Generally**

- (1) The formwork shall be constructed accurately to represent the shape of the concrete as detailed on the Drawings. It shall be of suitable design and substantial construction and be approved by the Engineer. The Contractor shall make any necessary adjustments to allow for shrinkage, settlement or deflection, which may occur during construction so that the finished concrete sections conform accurately to the specified finish and dimensions true to line, level and camber.



- (2) Any formwork that becomes damaged or distorted prior to placing of the concrete will be rejected.

#### 4.2. Exposed surfaces

- (1) Forms for all exposed surfaces shall be constructed with new plywood or metal on the face of the form that will be in contact with the concrete. The surfaces of these forms shall be maintained equal to the new surfaces at all times as needed to produce the desired concrete surface. The form faces shall be replaced, as required by the Engineer.
- (2) Unless otherwise described in the Contract, all formwork joints for exposed surfaces of concrete shall form a regular pattern with horizontal and vertical lines continuous throughout each structure and all construction joints shall coincide with these horizontal or vertical lines.
- (3) All exposed sharp edges except for rebates for grouted in items, shall be chamfered with triangular fillets not less than 25 mm by 25 mm unless otherwise directed by the Engineer. The triangular fillets or chamfer strips shall be milled from clear, straight grain timber and shall be surfaced on all sides. Curved surfaces shall be formed of plywood, metal, or other suitable material.

#### 4.3. Fastening Formwork

- (1) Form clamps or bolts shall be used to fasten forms. Bolts or form clamps shall be positive in action and shall be of sufficient strength and number to prevent spreading of the forms.
- (2) Lifting anchors may be installed in pre-cast members. Bolts, form clamps and lifting anchors shall be of such type that they can be entirely removed or cut back 20mm or more below the finished surfaces of the concrete, leaving no metal within 30mm of the concrete surface.
- (3) All forms for the outside surfaces shall be constructed with stiff whales at right angles to the studs and all form clamps shall extend through and fasten such whales.

#### 4.4. Cleaning and Oiling of Form

- (1) Before placing the concrete, the contact surface of the form shall be cleaned and shall be coated with an approved form oil that will effectively prevent sticking and will not stain the concrete surface.

#### 4.5. Construction Joints

- (1) Construction joints shall not be made without the approval of the Engineer. Joints shall be located so as not to impair the strength of the structure.
- (2) When a construction is made, the surface of the hardened concrete shall be thoroughly clean and all concrete laitance remove. The joint shall be thoroughly wetted and slushed with a coat cement grout before placing the new concrete.

#### 4.6. Placing Concrete

- (1) No concrete shall be deposited in the forms until all work connected with constructing the forms and placing all reinforcing steel, ducts, anchorages, or prestressing steel has been completed for the unit to be poured and the Engineer has given written approval of said forms, reinforcing steel, ducts, anchorages, or prestressing steel.

#### 4.7. Weep Holes

- (1) Drainage holes and weep holes shall be constructed as detailed on the Drawings. Forms for weep holes shall be as approved by the Engineer.

#### 4.8. Built-in Items

- (1) The Contractor shall install in the formwork required inserts, anchors, expansion joint elements, sleeves, and other items specified under other Subsections of this Specification and shall coordinate installation with other trades in the proper location of such items. Ends of piping and sleeves embedded in concrete shall be closed with caps or plugs.

#### 4.9. Removing Formwork

- (1) To facilitate finishing, forms used for parapets, barriers, and exposed vertical surfaces shall be removed in not less than twenty-four (24) hours nor more than forty-eight (48) hours, depending on weather conditions.

### 5.0 SLOPING FORMWORK

- 5.1. Top formwork shall be provided to slopes 30 degree or more from the horizontal

### 6.0 TIE BOLTS FOR FORMWORK

- 6.1. Only tie bolts that avoid embedding any metal parts permanently within 50 mm of the concrete surface shall be permitted. Voids remaining after the removal of all or part of each tie bolt shall be filled flush with the surrounding concrete using a freshly prepared cement and fine aggregate paste.

- 6.2. In the case of Liquid Retaining Structures, the Contractor shall ensure that the measures adopted shall not impair the water tightness of the structure.

### 7.0 GENERAL REQUIREMENTS

- 7.1. The interiors of all forms shall be thoroughly cleaned out before any concrete is placed.
- 7.2. The inside surfaces of forms shall, except for permanent formwork, or unless otherwise agreed by the Engineer, shall be coated with a release agent approved by the Engineer. Release agents shall be applied strictly in accordance with the manufacturer's instructions, applied evenly and shall not come into contact with the reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in formwork to concrete which will be visible in the finished Works.
- 7.3. Where the concrete surface is to receive an applied finish, care shall be taken to ensure the compatibility of the release agent with the finish.

### 8.0 STRIKING OF FORMWORK

- 8.1. The Contractor shall give a minimum of one (1) working day's notice to the Engineer of his intention to strike formwork.
- 8.2. Formwork shall be removed without shock to or disturbance of the concrete.
- 8.3. Materials shall not be placed on any new construction in such a manner as to cause damage.
- 8.4. Formwork to vertical surfaces or sloping formwork not supporting concrete in flexure shall not be removed until the concrete strength shall be sufficient to meet any wind loading upon the concrete likely to arise at the time when the formwork is removed; and
  - (1) The concrete strength (as confirmed by tests from samples cured under

representative conditions) has reached 5 N / mm<sup>2</sup> or

- (2) For concrete containing Portland cement only, in the absence of test results, a minimum period shall have elapsed since the concrete was poured equivalent to eight (8) hours at 20 °C for unsealed plywood forms, or six (6) hours for impermeable forms.

8.5. Formwork supporting concrete in flexure shall not be removed until:

- (1) The concrete strength (as confirmed by tests on samples cured under representative conditions) has reached 10 N / mm<sup>2</sup>, or twice the stress to which the concrete will then be subjected, whichever is the greater or
- (2) For concrete containing Portland cement only, in the absence of test results or any formal procedure agreed in writing with the Engineer, the periods before striking shall be in accordance with the following, Table 1440.1:

**Table 1440.1 Minimum Period before Striking**

Type of Formwork	Minimum period before striking, for Portland Cement Concrete
Vertical formwork to columns, walls and large beams	1 day
Soffit formwork to slabs	4 days
Soffit formwork to beams and props to slabs	10 days
Props to beams	21 days

8.6. The Contractor shall submit specific proposals for striking formwork to the Engineer, with particular reference to variations in cement or admixtures, or to the following factors:

- (a) Concrete strength;
- (b) Stresses in the concrete at any stage in the construction period which, in the case of precast units includes the stresses induced by disturbance at the casting position and subsequent handling;
- (c) Curing;
- (d) Subsequent surface treatment finishes; and
- (e) Presence of re-entrant angles requiring formwork to be removed as soon as possible after concrete has set, to avoid thermal cracking.

**Table 1440.2 Minimum Period of Insulation**

Pour Dimension Thickness ( m )	Minimum Period of Insulation ( Days )
0.5	3
1.0	5
1.5	7

## 9.0 CONCRETE FINISHING - SURFACE FINISHES PRODUCED WITH FORMWORK

9.1. Generally

- (1) All concrete shall be given a surface finish, according to the requirements of this Division or as required by the Engineer.
- (2) The following standard of concrete finish to formed surfaces shall be achieved unless approved otherwise by the Engineer:

**Table 1440.3 Required Finish**

Surface	Required Finish (refer to 10.3)
Reinforced concrete below ground or to receive finishing (footing tie beams, foundations, columns, beams and slabs)	Class F1
Exposed reinforced concrete surfaces inside utility structures (manholes, culverts, STP structures and the like)	Class F2
Exposed reinforced concrete surfaces to Machine Rooms, Mechanical Rooms, Electrical Rooms, parking areas (in Fire Station and Cargo Terminal), Baggage Handling ceilings, small buildings	Class F3

9.2. Sample Panels

- (1) The Engineer shall require sample panels to be provided for all types of finish.

9.3. Class F1 – Ordinary Finish

- (1) No particular finish requirements are prescribed. The finish in this category shall generally correspond to concrete surfaces below ground or to receive further finishing, or of no visual merit, or expressly suitable to their function with workmanship as approved by the Engineer.
- (2) This finish shall be obtained by the use of moulds or properly designed forms of ordinary plywood or closely jointed sawn boards. The surface shall be free from substantial voids, honeycombing or other large blemishes.

9.4. Class F2 – Fair Finish

- (1) This finish is to concrete structures requiring serviceability and structural soundness, with surfaces which have medium visual importance.
- (2) This finish shall be obtained from forms designed to produce a hard smooth surface with true clean arrises. Only very minor surface blemishes shall be permitted and there shall be no staining or discoloration. Any projections shall be removed and the surface made good.
- (3) Any surface blemish must not penetrate more than 5 mm into the concrete. The area of an isolated surface blemish must not be more than 100 mm<sup>2</sup>. The total area of all the blemishes on the face of a particular pour must not be more than 2% of the total surface area of that pour.
- (4) The finish is intended to be left as struck but imperfections such as fins and surface discoloration shall, if required by the Engineer, be made good by methods approved by the Engineer.

9.5. Class F3 – Fair Worked Finish

- (1) This finish is to concrete structures requiring serviceability and structural soundness, with surfaces which are visually important.
- (2) This finish shall be obtained by first producing a F2 Finish and the Contractor shall make good any imperfections in the finish as required by the Engineer by then filling all surface blemishes with a fresh, specially prepared cement and fine aggregate paste whilst the concrete is still green where possible. After the concrete has been properly cured, the faces shall be rubbed down, if required, to produce a smooth and even surface. If the surface is to be exposed in the final work, filling material shall match the color of the concrete.

- (3) The formwork shall be steel work or lined plywood as approved by the Engineer to provide a smooth finish of uniform texture and appearance.
- (4) This material shall leave no stain on the concrete and shall be so joined and fixed to its backing that it imparts no blemishes. It shall be of the same type and obtained from only one source throughout any one structure.
- (5) Internal ties and embedded metal parts will be allowed but only if these ties are positioned in rebates or in other concealed positions as approved by the Engineer.
- (6) If the resultant finish does not provide a uniform fair and visually acceptable surface finish, the Engineer shall instruct the Contractor to prepare the surface and apply render at the Contractor's expense.

#### 9.6. Protection

- (1) Permanently exposed concrete surfaces to Classes F1, F2 and F3 finish shall be protected from rust marks, stains and damage of all kinds.

#### 9.7. Joints

- (1) Unless otherwise instructed by the Engineer or described in the Contract, all formwork joints for exposed surfaces of concrete to Class F1, F2, and F3 finish shall form a regular pattern with horizontal and vertical lines continuous throughout each structure and all construction joints shall coincide with these horizontal or vertical lines.

### **10.0 CONCRETE FINISHING - SURFACE FINISHES PRODUCED WITHOUT FORMWORK**

#### 10.1. Generally

- (1) The following standard of concrete finish produced without formwork shall be achieved:
  - (a) Top surface of walls and other surfaces to good quality concrete, required for serviceability, structural soundness and appearance – steel trowel finish; and
  - (b) Where the type of finish is not given, hidden surfaces shall be screeded finish and exposed surfaces steel trowel finish.
- (2) All surfaces shall be protected after finish is formed.

#### 10.2. Classes of surface finish shall be as follows:

- (1) Class U1 – Screeded Finish: Surfaces to receive further treatment or of no visual merit.
  - (a) The concrete shall be levelled and tamped with a screed and guide boards to produce either a uniform plain, textured or ridged surface.
  - (b) No further work shall be applied to the surface unless it is used as the first stage for a Clause U2 (Steel Trowel) or Clause U3 (Steel Trowel and Float) finish.
- (2) Class U2 – Steel Trowel – surfaces to receive sheet finishing, or where a regular smooth surface is required, but appearance is not of prime importance.(eg. Internal surfaces of tanks, pits or similar containment structures).

After the concrete has hardened sufficiently, the concrete U1 surface shall be floated by hand or machine under light pressure to produce a uniform surface free from screed marks and surface irregularities.

- (3) Class U3 – Steel Trowel and Float Finish – surfaces where appearance is important (eg surfaces of exposed concrete which are visible in the completed Works.)

After the concrete has hardened sufficiently, the concrete U1 surface shall be floated by steel power float to produce a uniform smooth, dense and uniform surface free from screed and trowel marks and surface irregularities. Inaccessible areas shall be finished by steel trowel.

#### 10.3. Tamping

- (1) Tamping for Class U1 Finish, shall be undertaken using approved wooden or metal screeds/tamps of suitable size with guide boards or use of side forms to maintain dimensional control.
- (2) The concrete shall not be over-worked causing damage to the surface. The surface shall have no ridges or steps and where necessary shall be suitable to receive a mortar screed or similar finish.
- (3) Screeds/tamps may be manual or mechanical.

#### 10.4. Power Floating

- (1) Power floating shall be undertaken with approved type of rotating steel power floats. The maximum tolerance may not exceed +/- 6mm in 4.0m.
- (2) If power floated floors are to receive a specified floor finish and because of inadequate finishing or protection, or if the surface of the concrete is not suitable to receive the specified flooring material, it shall be made good by application of a thin leveling compound at the expense of the Contractor to the approval of the Engineer.

#### 10.5. Tolerance

- (1) Surface finish, which is to receive sheet membrane waterproofing, shall be Class U2 or U3, to an accuracy such that when tested with a 3m straight-edge, the maximum depression shall not exceed 10mm.

### **11.0 REMEDIAL TREATMENT OF FINISHED SURFACES**

- 11.1. Any remedial treatment to finished surfaces shall be agreed with the Engineer following inspection immediately after removing the formwork and shall be carried out with forty-eight (48) hours of striking formwork, unless directed otherwise by the Engineer.
- 11.2. Any concrete, the surface of which has been treated before being inspected by the Engineer, shall be liable to rejection.
- 11.3. The Contractor shall submit proposals, including materials and method to the Engineer for preparation and repair of concrete surfaces within twelve (12) hours of striking formwork if required to do so by the Engineer.
- 11.4. The Engineer shall require a test panel in all cases where he considers the size of the repair requires it.
- 11.5. All surfaces to be made good shall be carefully prepared in order to provide a good bonding surface. This preparatory work may involve cutting out, chipping, wire brushing, air blowing and drying to remove curing membranes etc.
- 11.6. All making good of water-retaining concrete surfaces shall be carried out using Phenol-free epoxy resin composition. This material shall be a two part mortar pack which shall be mixed and applied strictly in accordance with the manufacturer's instructions. All materials shall be

approved for use in contact with potable water.

- 11.7. Making good of other concrete surfaces shall be carried out by methods and using materials instructed by the Engineer.
- 11.8. The Engineer shall check the repaired surface for texture, density, soundness and color. The Contractor shall experiment with trial mixes to achieve a color / texture match to the original surfaces that is acceptable to the Engineer.

## **12.0 INFERIOR OR FAULTY WORK**

- 12.1. In the event that any member or portion of the concrete work proving, after removal of the formwork, to be of inferior workmanship or to be in any way whatsoever defective, or should crushing tests on samples taken from the work show that the concrete used therein is of inferior quality, such work shall, at the discretion of the Engineer, be cut out and replaced at the expense of the Contractor

## **SECTION 1460**

### **JOINTS/WATERSTOPS/SEALANTS – REFERENCE SPECIFICATION**

#### **1.0 SCOPE OF SPECIFICATION**

- 1.1. The work under this Section consists of the requirements for joints, waterstops, sealants to concrete structures.
- 1.2. All systems and materials shall be applied in accordance with the manufacturers' written instructions and recommendations and to the approval of the Engineer.
- 1.3. All systems and materials shall be suitable for their use and purpose, compatible with each other and to backgrounds and each complete assembly shall be the product of one manufacturer, unless otherwise approved.

#### **2.0 JOINTS GENERAL**

- 2.1. Joints shall be limited to the positions indicated on the Drawings and of the type specified.
- 2.2. Joints which are not specified in the Contract or generally shown on the Drawings shall be defined as construction joints.
- 2.3. Joint lines shall be pre-planned and arranged to coincide wherever possible with features of the finished work.
- 2.4. All joints shall incorporate adequate protection against the entry of debris or other material that may interfere with the closing of the joints.

#### **3.0 CONSTRUCTION JOINTS**

- 3.1. The Contractor shall design types and positions of construction joints. This shall be described in his methodologies and indicated in shop drawings.
- 3.2. Criteria shall be as follows:
  - (1) Beams and slabs – points of least stress
  - (2) Columns and walls – decided by practical considerations other than at monolithic kicker joints.
- 3.3. Construction joints shall be provided only at locations indicated on the Drawings, as specified herein or approved by the Engineer before any work is commenced.
- 3.4. In cases of breakdown or other unforeseen and unavoidable events, the Engineer shall designate if the joint is to be bonded or unbonded. Concreting shall be carried out continuously up to these joints, which shall generally be formed at right angles to the axis of the member.
- 3.5. Concrete shall not be allowed to taper off in thickness at joints. Vertical joints shall be formed against a stop board suitably notched to accommodate the reinforcement. The top surface of each lift of concrete shall be straight and level unless described otherwise in the Contract.
- 3.6. Where a kicker is used, it shall be a minimum of 70mm high and shall be incorporated with the previous concrete.



- 3.7. Construction joints shall be placed at intervals not exceeding 10 meters except as otherwise indicated on the Drawings or approved by the Engineer. The number of joints shall be kept to a minimum.
- 3.8. The face edges of all joints which are exposed to view shall be carefully finished true to line and elevation. Shear keys, formed into or out from the surface of the previously placed concrete, or steel dowels shall be used where required. Shear keys formed into the concrete shall be formed by the insertion and subsequent removal of beveled wood strips which shall be thoroughly saturated with water prior to insertion. Steel dowels may, at the discretion of the Engineer, be used in lieu of keys. The size and spacing of the keys and dowels shall be as determined by the Engineer.
- 3.9. Care shall be exercised not to damage the concrete or break the concrete-steel bond at any time. In the construction of suspended decks, slabs or floors where longitudinal joints are specified, a platform shall be constructed outside the longitudinal joints and supported on the lower slab form.
- 3.10. Workmen shall not be permitted to stand or walk on the projecting reinforcement bars until the concrete has hardened.
- 3.11. The surface of any concrete against which new concrete is to be cast shall be free from any laitance and shall be roughened to the extent that the large aggregate is exposed but not disturbed. The joint surface shall be cleaned immediately before the fresh concrete is placed against it.
- 3.12. Concrete at the joint face shall be bonded with that subsequently placed against it.
- 3.13. All joints shall provide a permanent liquid-tight seal and achieve full structural continuity across the joint.
- 3.14. Where practicable, preparation of joints shall be carried out when the concrete has set but not hardened.
- 3.15. Particular care shall be taken when forming watertight joints. The Contractor shall be responsible for water tightness, methods shall include:-
  - (1) Incorporation of waterstops where necessary
  - (2) Roughening the surface of the each pour to increase the bond strength and provide aggregate interlock.
  - (3) Horizontal joints shall be roughened, without disturbing coarse aggregate particles, by spraying the joint surface shortly after the concrete has stiffened with a fine spray of water and or brushing with a stiff wire brush.
  - (4) Vertical joints shall be treated similarly, where the use of retarders is approved, to enable the joint surface to be treated after the stop end has been removed.
  - (5) Where joints are not roughened until the concrete has hardened, the larger aggregate particles shall be exposed by bush-hammering or scabbling. Where access is difficult, often around congested reinforcement, and there is a risk of loosening or micro-cracking within the aggregate particles, compressed air-driven needle guns shall be used.
  - (6) Cement grout shall be removed from the joint surface. The joint surface shall be cleaned immediately before fresh concrete is placed against it. Joint surfaces may be dampened.

3.16. Sand / cement mortar or cement slurry coats shall not be applied to joint faces.

#### **4.0 BONDED CONSTRUCTION JOINTS**

##### 4.1. Preparation

- (1) Except where otherwise specified, bonded construction joints where required shall be prepared as 'Construction Joints' above, with the following additional procedures.
- (2) After the concrete has hardened the cement paste can be removed from the concrete surface by washing with water under pressure or by sandblasting to expose clean, well bonded aggregate. To facilitate removal of the cement paste, retarder may be used, where agreed by the Engineer.
- (3) After the surface has been prepared, the concrete shall be left saturated with water until the new concrete is placed, or it shall be saturated for a period of 4 hours before placing the new concrete. Immediately prior to the placing of new concrete, the forms shall be drawn tight against the concrete already in place and the surface shall be covered with a thin coat of 1:2 mortar.

##### 4.2. Joint Completion

- (1) After the header board or form is removed and the concrete has cured for the normal period, the second pour will be bonded to the first pour by the application of a two-component liquid polysulphide polymer epoxy resin concrete adhesive to the concrete joint surface. The epoxy concrete adhesive shall meet the requirements of the Engineer.
- (2) The surface on which the adhesive is to be applied shall be free of oil, dirt, and loose concrete. All unsound concrete shall be removed until a base of strong, undamaged concrete is exposed on which to apply the adhesive. Heavy deposits of dirt or oil products shall be removed by wire brushing or sandblasting. The surface shall be free of moisture and dry before application of the adhesive. The adhesive shall not be applied to newly placed concrete before the normal curing period has elapsed.
- (3) Immediately before application, the two adhesive components shall be combined in the proportions specified by the adhesive manufacturer. The components shall be intimately blended by hand or with a slow speed motor drive mixing device. The mixture of adhesive shall next be thinned by adding and blending the solvent into the adhesive. The amount of adhesive mixed at one time shall be limited to that quantity which can be conveniently applied within the pot life of the adhesive.
- (4) The two components and solvent shall not be mixed more than thirty (30) minutes prior to use. The resulting adhesive shall be brushed onto the concrete in a layer 1 to 2 mm thick. After the adhesive has been applied, concrete shall not be placed against it until the solvent has evaporated. This period shall be between thirty (30) to sixty (60) minutes depending on weather conditions. The adhesive must be tacky and not dry at the time of concrete application. Areas that have been allowed to become dry shall be recoated before concrete is placed.

##### 4.3. Health and Safety

- (1) The Contractor shall ensure that all procedures follow the manufacturer's recommendations on the health and safety, for handling and use of such materials.

#### **5.0 UNBONDED CONSTRUCTION JOINTS**

5.1. Unbonded construction joints shall be made by forcing or striking off the previously placed

concrete to a true and even surface and allowing it to set. After the concrete has set, the new concrete shall be placed in contact with it and thoroughly compacted to secure a close contact between the old and new concrete at all points, with no attempt to secure a bonding of the new to the old work.

## **6.0 EXPANSION JOINTS**

- 6.1. Expansion joints shall be located and formed as indicated on the Drawings, and as specified herein.
- 6.2. Joint filler shall be a non-extruding and resilient, non-bituminous preformed type complying with the requirements of AASHTO-M153; Type I - sponge rubber, or any equivalent materials approved by the Engineer.
- 6.3. The joint filler shall be cut to the same shape as that of the surfaces being jointed. The filler shall be firmly fixed against the surface of the concrete already in place in such a manner that it will not be displaced when concrete is deposited against it. Immediately after form removal, the expansion joint shall be carefully inspected, and any concrete or mortar that has sealed across the joint shall be neatly cut and removed.
- 6.4. Holes in preformed joint filler to accommodate dowel bars shall be accurately bored or punched out to produce a sliding fit on the dowel bars.
- 6.5. Adhesives used to retain preformed joint fillers in place during construction shall have no harmful effects on the concrete and, except for those used in connection with softwood fillers, shall be obtained from the same manufacturer as the joint filler.
- 6.6. Preformed filler for joints in structures to retain aqueous liquids shall have a maximum water absorption of 0.3% by volume and a non-recovered compression set of 20 % of the original thickness, both when tested in accordance with ASTM D3595.
- 6.7. Sealer for joints not coming in contact with bituminous materials shall be a two component, cold curing polysulphide liquid polymer as approved by the Engineer. The sealer shall be gun grade suitable for both horizontal and vertical joints. Application of approved sealer shall be in accordance with the manufacturer's recommendation.

## **7.0 WATERSTOPS AND SEALANTS**

### **7.1. General**

- (1) Waterstops shall be supplied and installed in accordance with the details indicated on the Drawings, the provisions in this Specification and / or as directed by the Engineer.
- (2) Waterstops shall comply with the Engineer's requirement.

### **7.2. Materials**

- (1) Waterstops shall be either Plasticized PVC, or rubber water stop type similar approved by the Engineer
- (2) Rubber waterstops shall be suitable for storage, handling, installation and service in temperatures up to 40 °C.

### **7.3. Integral Type**

- (1) Waterstops of the integral type where not specifically dimensioned shall have a minimum width of 230 mm. Rubber and PVC waterstops shall have a minimum web thickness of 10 mm.

7.4. Surface

- (1) Surface type waterstops where not specifically dimensioned shall have a minimum width of 230 mm and a minimum of two integral ribs, and conform to the cross section indicated on the Drawings.

7.5. Internal Waterstops

- (1) Internal waterstops shall be either eyeleted or with an edge fixing running wire to allow adequate fixing to prevent movement during concreting.

7.6. Jointing

- (1) Site jointing of rubber waterstops shall be by vulcanization, and site jointing of PVC waterstops shall be by heat welding all in accordance with the manufacturer's recommendations.
- (2) No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured in a manner such that any cross section shall be dense, homogeneous and free from all porosity. All junctions in the special connection pieces shall be fully moulded. During the vulcanizing period the joint shall be securely held by suitable clasps.
- (3) Field splices for rubber waterstops shall be either vulcanized, mechanical jointed using stainless steel parts; or made with a splicing union of the same stock as the waterstop.
- (4) A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to weld but not char the plastic.
- (5) Waterstops when being installed shall be cut and spliced at changes in direction as may be necessary to avoid buckling or distortion of the web or flange. Intersections and special junctions such as those that arise between rubber and PVC should be prefabricated.
- (6) Field splices shall develop water tightness equal to that of the unspliced material and have a tensile strength of not less than 50 percent of the unspliced material.

7.7. Positioning

- (1) If after placing concrete, waterstops are materially out of position or shape, the surrounding concrete shall be removed, the waterstop reset, and the concrete replaced, all at the Contractor's expense.

7.8. Composite Waterstops

- (1) Composite water swellable type waterstops shall comprise of a minimum 25 mm wide HDPE strip, coated on both sides with sodium bentonite granules and faced with geotextile on both outer surfaces.
- (2) The waterstop shall be capable of resisting water migration at 10 m head.

7.9. Testing

- (1) The waterstop shall comply with the following test methods:
  - (a) ASTM D146
  - (b) ASTM D412
  - (c) ASTM D638

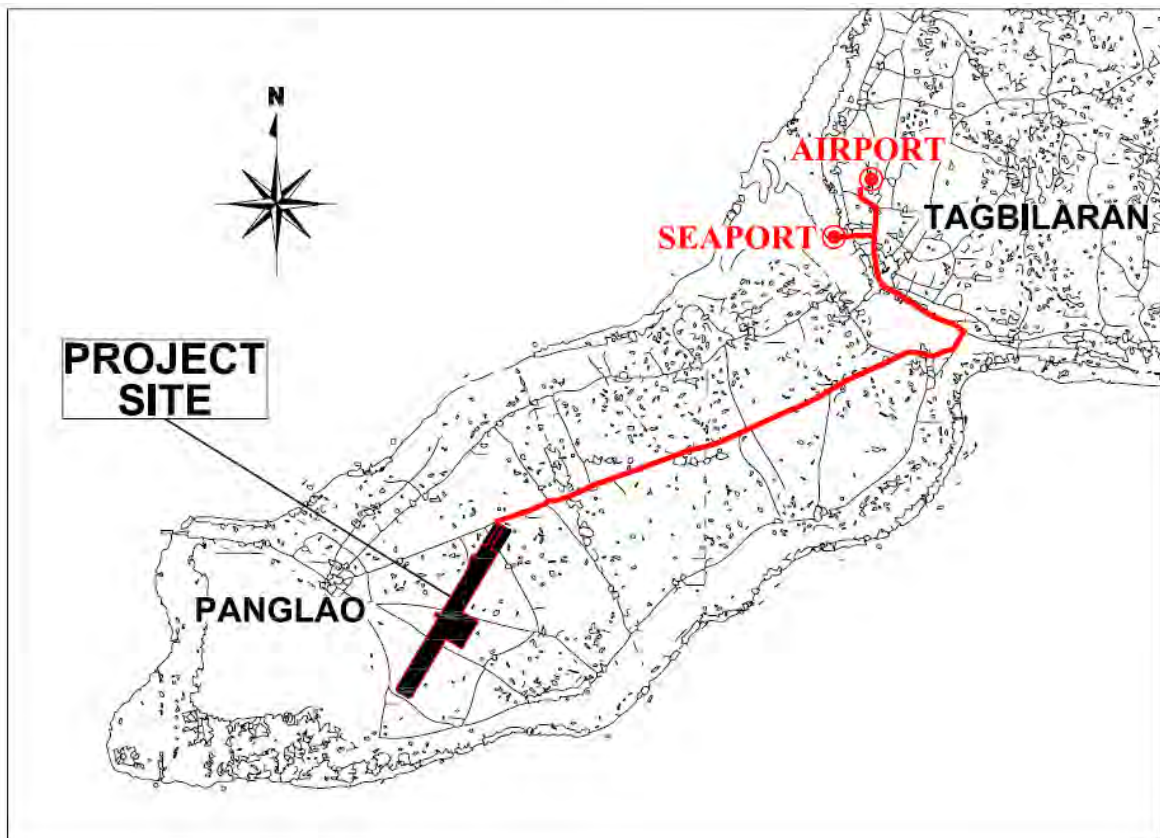
## **8.0 JOINT SEALING COMPOUNDS AND SEALANTS (CIVIL WORKS)**

- 8.1. Joint sealing compounds shall be impermeable ductile materials of a type suitable for the conditions of exposure in which they are to be placed, and capable of providing a durable, flexible and watertight seal by adhesion to the concrete throughout the range of joint movement, all approved by the Engineer.
- 8.2. Hot poured joint sealants shall comply with ASTM D 1854, jet fuel resistant.
- 8.3. Cold poured joint sealants shall comply with ASTM D 5893 Type 2
- 8.4. Silicone based building sealants shall comply with the Engineer's requirements.
- 8.5. Primers for use with joint sealants shall be compatible with, and obtained from the same manufacturers as the adjacent sealant. Primers shall have no harmful affect on concrete.
- 8.6. Sealants and primers which will be in contact with water to be used for potable supply shall not impart to water taste, color or any effect known to be harmful to health, and shall be resistant to bacterial growth.
- 8.7. Joint sealants shall be applied in completely dry and clean conditions, unless agreed otherwise by the Engineer.
- 8.8. The rod backup material or the bond breaker shall comply with ASTM D 5249.

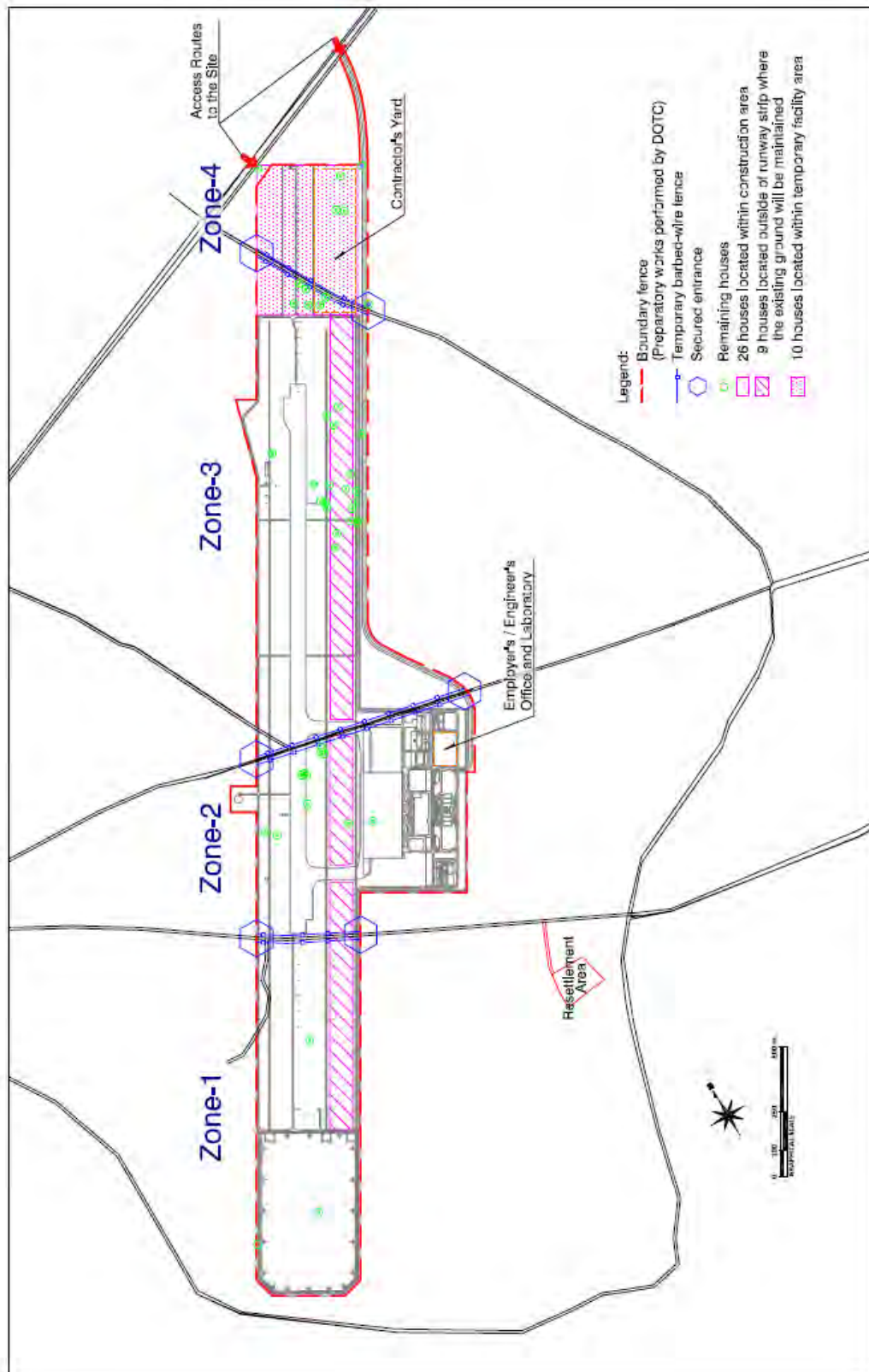
## **ATTACHMENT**

- ATTACHMENT-A: PROJECT SITE**
- ATTACHMENT-B: EMPLOYER'S & ENGINEER'S OFFICE**
- ATTACHMENT-C: LABORATORY BUILDING**
- ATTACHMENT-D: TEST EQUIPMENT**

## ATTACHMENT-A (1/2): PROJECT SITE

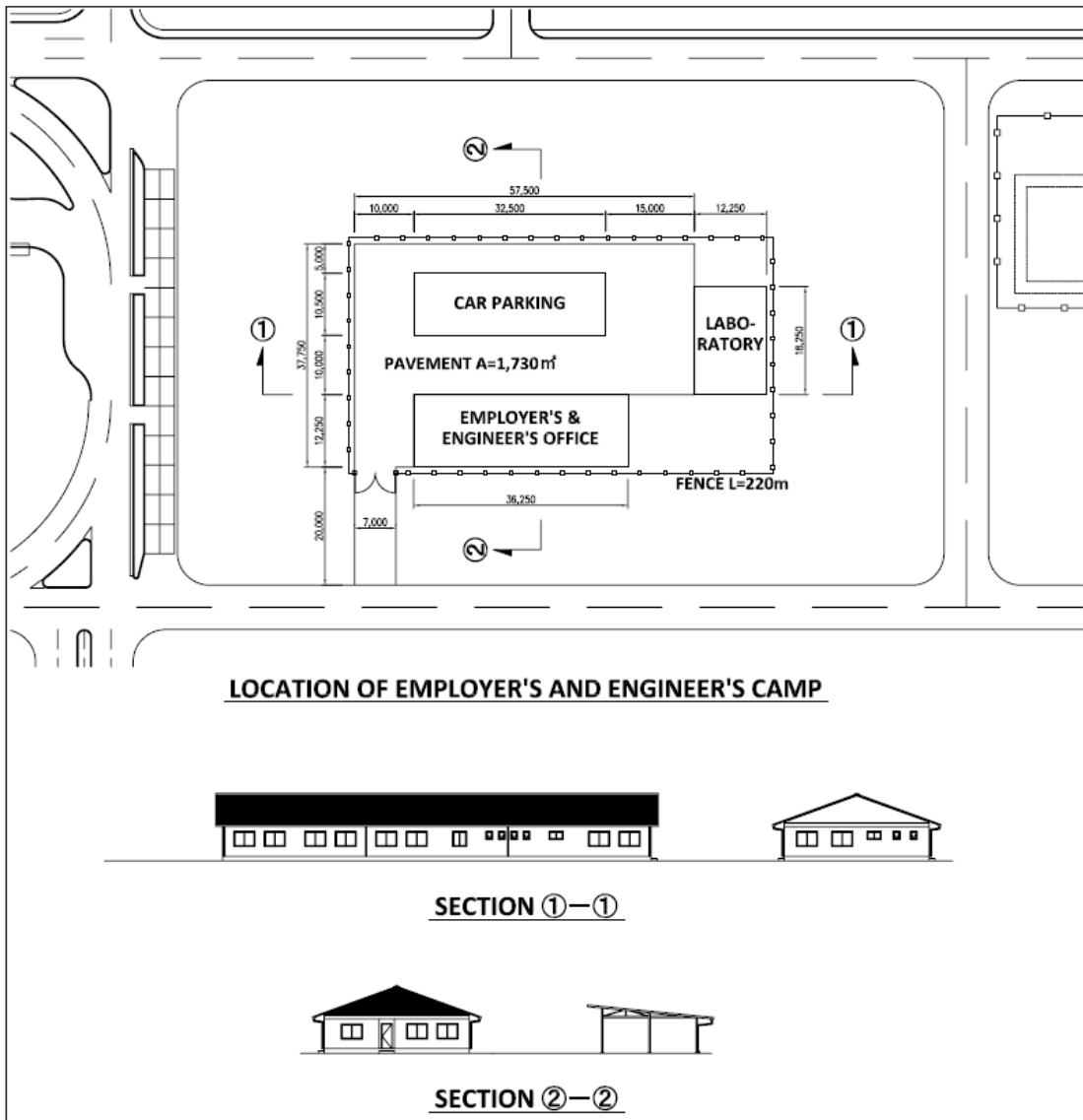


### ATTACHMENT-A (2/2) PROJECT SITE

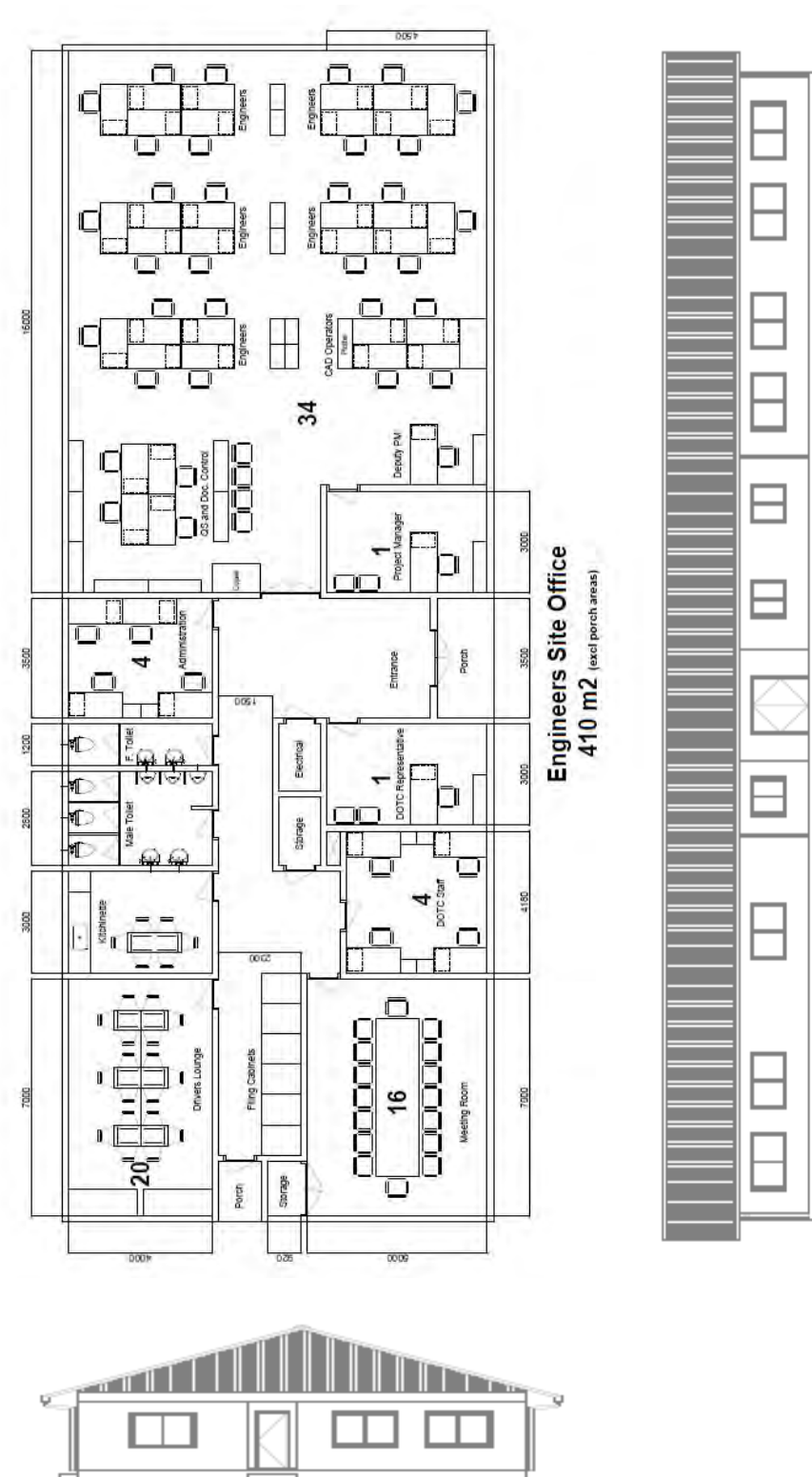




## ATTACHMENT-B(1/2): EMPLOYER'S & ENGINEER'S OFFICE



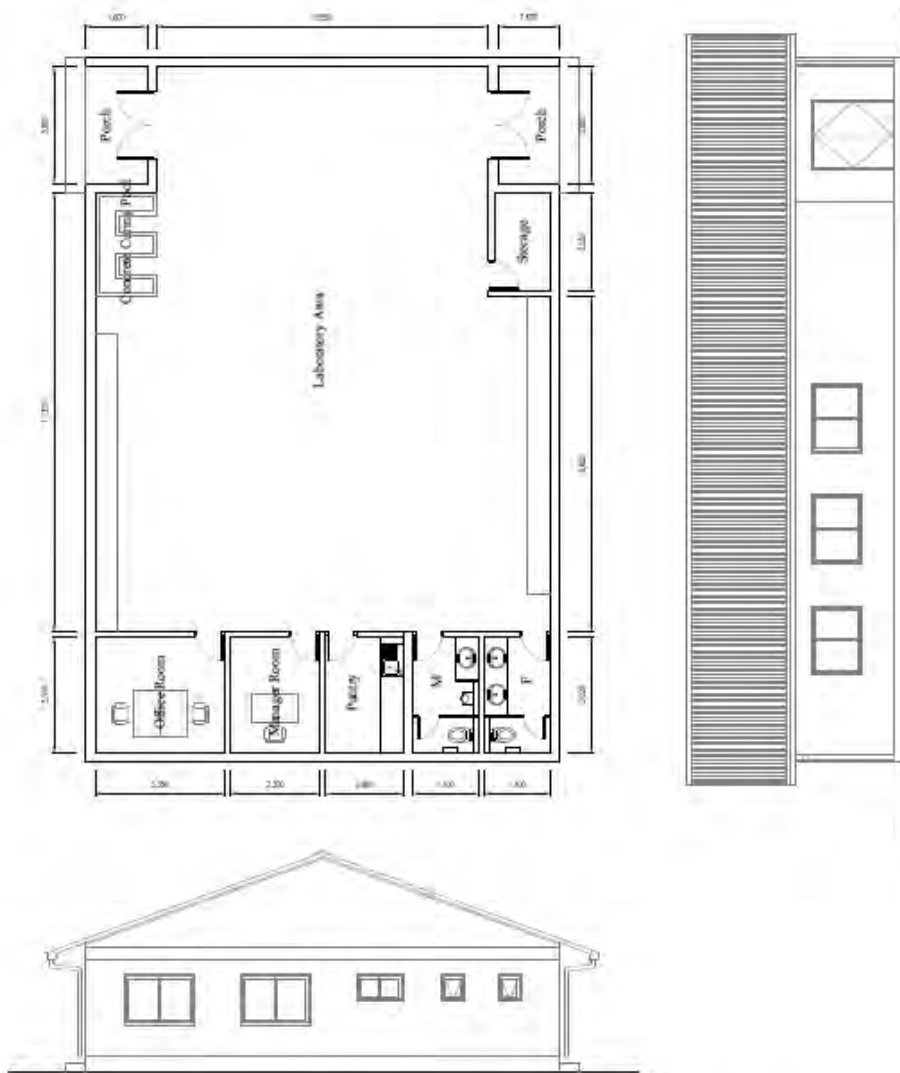
# ATTACHMENT-B(2/2): EMPLOYER'S & ENGINEER'S OFFICE



**Windows, Doors and Finishing Schedule for Employer's and Engineer's Office**

<b>Area</b>	<b>Specification for Finishing, etc.</b>
Roof	Metal Sheet with sound and heat insulation Pouch: Continuous roofing shall be provided to the car park from the office Rain gutters and down pipes around the roof and car park roofing
Ceiling	Gypsum board
Wall	Double brick wall or hallow concrete block, cement render with paint
Floor	DOTC Rep. room: floor carpet tile Project Manger's room: floor carpet tile Meeting Room: floor carpet tile Kitchen: Ceramic floor tile Toilet: Ceramic floor tile Other area: ceramic floor tiles
Catwalk	Concrete trowel finish with rain drain gutter
Windows	Aluminum frame and glazing with lock apparatus Curtain rail and curtain
Doors:	Aluminum frame and board or wooden doors with glazing at the upper half Height: 2100mm
Kitchen	Stainless sink, drain, ventilators
Toilet	Ventilators
Lights	Fluorescent type
Power outlet	As instructed by the Engineer
Outside	Water taps, footbath

## ATTACHMENT-C: LABORATORY BUILDING



OUTLINE OF EXTERNAL FINISHING SCHEDULE

Portions	Finishes
Metal Roof	Coloured galvanized iron sheet 0.5mm
Roof Gutter	Coloured galvanized iron sheet 0.5mm
Wall	Fare faced exposed brick wall
Floor	Concrete screeding
Cornice	Concrete or brick projection with cement render
Windows	Aluminium window
Doors	Aluminium door

INTERNAL FINISHING SCHEDULE

Finishing	Floor		Skirting	Wall	Ceiling			
	Building Element	Finishing	Finishing	Finishing	Finishing			
	Ceramic floor tiles on cement setting bed (200 x 200 mm)	Cement render bed	Ceramic tile (200 x 100 mm)	Cement render h=100 with P-1	Ceramic wall tile(200 x 200 mm)	Cement render with P-1	Gypsum board on light gauge framing system	Exposed steel structure with P-3
Laboratory Area		●		●		●	●	
Storage		●					●	
Office Room	●	●		●		●	●	
Manager Room	●	●		●		●	●	
Pantry	●	●		●		●	●	
Toilet	●	●		●		●	●	

Legend for Paint Type  
P-1 Synthetic Resin Emulsion Paint  
P-3 Synthetic Resin Mixed Paint type II (for steel)

## ATTACHMENT-D:

### LABORATORY/TESTING EQUIPMENT AND CONSUMABLES

#### 1.0 FOR SIEVE ANALYSIS (AASHTO T-27)

Quantity	Unit	Description (8-inch Brass Sieves)
1	pc	3"
1	pc	2-1/2"
1	pc	2"
1	pc	1-1/2"
1	pc	1"
1	pc	3/4"
1	pc	1/2"
1	pc	3/8"
1	pc	No. 4
1	pc	No. 8
1	pc	No. 10
1	pc	No. 12
1	pc	No. 16
1	pc	No. 30
2	pcs	No. 40
1	pc	No. 50
2	pcs	No. 100
2	pcs	No. 200
1	pc	Brass Pan, 8" diameter
1	pc	Brass Cover, less ring, 8" dia.
3	pcs	Wet Washing, Sieve, Mesh No. 200, 8" dia.
1	set	Hand Operated 8" Sieve Dynamic Shaker
1	set	Sample Splitters, 2-1/2" Chute width
1	set	Sample Splitters, 2" Chute width
1	set	Sample Splitters, 1-1/2" Chute width
1	set	Sample Splitters, 1" Chute width
1	unit	Heavy Duty Solution Balance, 1 gm. se. 20 kgs. cap.
2	units	Single-Burner Electric Stove, 8" dia.
2	units	Multi-purpose Field Scale Capacity 16 kgs. Soil test L-770 BM
1	unit	Single wall utility Laboratory Oven Soil test Model L-6

#### 2.0 FOR SPECIFIC GRAVITY AND ABSORPTION TEST AASTO T-84, 85)

Quantity	Unit	Description
1	unit	Triple Beam Scale, 0.1 gram
1	set	Sand Absorption Cone and Tamper
2	sets	Pycnometer Top and Jar
1	pc	Density Basket
2	pcs	Volumetric Flask, 250 ml.
2	pcs	Volumetric Flask, 500 ml

#### 3.0 FOR PLASTIC LIQUID LIMIT TEST (AASHTO T-89, 90)

Quantity	Unit	Description
2	sets	ASTM Liquid Limit Set
2	sets	Plastic Limit Set
1	set	Dia-o-gram Balance, Sensitivity 0.01 Capacity 310 grams
2	dozen	Moisture Cans, 3 ounces

**4.0 FOR MOISTURE DENSITY RELATION (AASHTO T-180)**

Quantity	Unit	Description
2	sets	Modified Compaction Mold. 1/13.33 cu. ft. volume
2	sets	Modified Compaction Hammer, 10 lbs
1	set	Standard Compaction Mold. 1/30 cu. ft. volume
1	set	Standard Compaction Hammer, 5.5 lbs
2	pcs	Straight Edge, Steel 12"
2	pcs	Trimming knife
2	pcs	Wash Bottle, 1000 ml
2	dozen	Moisture Content Cans, 6 oz.

**5.0 FOR ORGANIC IMPURITIES (AASHTO T-21)**

Quantity	Unit	Description
6	pcs	Graduated Test Bottles, 12 oz.
12	pcs	Sodium Hydroxide solution
1	pc	Color Standard Chart

**6.0 FOR CBR (AASHTO T-193)**

**7.0 FOR ABRASION TEST (AASHTO T-193)**

**8.0 FOR PORTLAND CEMENT CONCRETE TESTING AND SAMPLING (AASHTO T-22, 119, 152)**

Quantity	Unit	Description
1	pc	Yield Bucket, 1/10 cu. ft. volume
1	pc	Yield Bucket, 1/2 cu. ft. volume
1	pc	Yield Bucket, 1 cu. ft. volume
1	pc	Tamping Rod
2	pcs	Slump Cones with Base and Tamping Rod
2	pcs	Steel Tape, 2 m.
12	pcs	Heavy Duty Concrete Cylinder Mold with base 6" x 12" (15.24 cm x 30.48 cm)
1	set	Vertical Capping Set – Soil test CT 456-4
2	pcs	Cement Mold brush, brass
12	pcs	Beam Mold 6" x 6" x 21"
1	unit	Motorized Concrete Testing Machine for compressive strength with flexural attachment accessories as per AASHTO T-22. Control Model C-250, dual gauge 0-130 tons, 0.30 tons

**8.1. Miscellaneous Accessories / Supplies**

Quantity	Unit	Description
1	pc	Vernier Caliper, in and outside measurements
2	pcs	Laboratory Tongs
1	pc	Hydrometer, Range 1.15 to 1.31
6	pcs	Sampling Spoon
12	pcs	Field Cans, 1 gal. capacity
4	pcs	Steel Chisel
2	pcs	Rubber Mallet
2	pcs	Trowel, Rectangular
2	pcs	Trowel, Triangular
12	pcs	Pans, G.I. 24" x 3" with handles
1	pc	Speedy Moisture Tester Set 0-20% Moisture

1	unit	Refrigerator, 5 cu. ft.
2	units	Fan, 16", Floor stand type
12	pcs	Basin, Aluminum, Round, 10" dia. x 4
12	pcs	Basin, Aluminum/Plastic, Rectangular

**9.0 ASPHALT CONCRETE TESTING (MARSHALL TEST)**

Quantity	Unit	Description
1	set	Bituminous Compaction Hammer 3-7/8" x 10 lbs. x 18" long
1	set	Compaction Mold with Base and Collar, 4" dia.
1	pc	Compaction Mold Holder
1	pc	Compaction Pedestal including Hammer Guide
1	set	Centrifugal Extractor 220 volts, 50/60 cycle with explosion proof features

**10.0 FOR EXECUTING THE FIELD TESTS THE CONTRACTOR SHALL PROVIDE AS A MINIMUM, THE FOLLOWING EQUIPMENT ON SITE:**

10.1. For Density In Place (Site) (AASHTO T-191)

Quantity	Unit	Description
2	sets	Field Density Set consisting of sand cone apparatus, glass jug and base plate
4	pcs	Plastic Jug for Sand Cone (Replacement)

10.2. For Field CBR (AASHTO T-193)

**ATTACHMENT-E: ENVIRONMENT MONITORING PLAN  
FOR CONSTRUCTION WORKS**



**New Bohol Airport Construction and Sustainable  
Environmental Protection Project**

**Environmental Management Plan  
For Construction Work**

**August 2013**

**Department of Transportation and Communications (DOTC)**

# **Environmental Management Plan**

## **For Construction Work**

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#### Abbreviation

EMP: Environmental Management Plan

EMoP: Environment Monitoring Plan

ECC: Environment Compliance Certificate

EMF: Environment Monitoring Fund

EMoF: Environmental Management Fund

DENR: Department of Environment and Natural Resources, Philippines

DAO: DENR Administrative Order

MMT: Multi-Partite Monitoring Team

LGU: Local Government Unit

NGO: Non-governmental Organization

PENRO: Provincial Environment and Natural Resources Officer

CENRO: Community Environment and Natural Resources Officer

EMB: Environment Management Bureau, DENR

*Environmental Management Plan (EMP)  
For Construction Work  
New Bohol Airport Construction and Sustainable Environment Protection Project*

## **1. Impact Management Plan**

### **1.1 Policy**

To ensure that ecological balance and environmental safety is preserved, proposed a sound environmental management and monitoring plan shall be established for the project. Any adverse effect on the environment could be controlled if it is averted earlier and necessary mitigating measures are applied.

Although the proposed project, in general, has its direct and indirect negative environmental impacts, these could be minimized through sound planning and the introduction of proper construction and monitoring techniques during all phases of project implementation by the concerned government instrumentalities and local government units.

The benefits that are expected to accrue from project implementation far outweigh the expected adverse effects on the environment. In order to ensure that proper designs and operational standards are adhered to and that the environment and public safety is not compromised, appropriate site practices and procedures outlined in this section should be strictly followed throughout the lifetime of the project.

Resources will be wasted and significant environmental impacts may follow in the event of failure to enforce rigorously the specified standards of site and operational management. The Impact Management Plan (IMP) is designed to ensure that the mitigating measures recommended to prevent or control the negative impacts of the different aspects of the project on environment, life, and property are properly followed, while positive impacts are enhanced to gain maximum benefits from the project.

Table 1, the Impact Management Plan is a Matrix of the mitigation and enhancement plan following the DENR format of DAO 03-30.

### **1.2 Responsibility of Implementation**

Total management of the Environmental Management Plan shall be carried out by DENR-EMB Regional VII. The plan shall be implemented by Project Management Office of DENR and Local project Management Team of PGBh.

**TABLE 1 IMPACT MANAGEMENT PLAN**

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact		Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
		Degree	Impact			
<b>1. PRE-CONSTRUCTION PHASE</b>						
Environmental Aspect # 1	A. The Land	B	Scraping of soil for embankment foundation	<ul style="list-style-type: none"> <li>▪ Need suitable soil quality to replace excavated soil</li> <li>• Importation of soil of suitable quality from borrow area</li> </ul>	DOTC Contractor	Terms of Reference (TOR) of the Contractor
		C	Due to refilling of excavated areas, soil erosion and siltation	<ul style="list-style-type: none"> <li>• Newly laid soil will be well compacted. Loose soil to be covered to avoid its erosion. Disposal of unused portion</li> </ul>	DOTC Contractor	TOR of the Contractor
		B	Due to cutting and removal of trees, deprive birds and other wildlife of habitat	<ul style="list-style-type: none"> <li>• None. The wildlife will move to other places</li> </ul>	DOTC Contractor	Government Regulations replacement permit to cut from DENR
		D	Sodding and re-planting of trees	<ul style="list-style-type: none"> <li>• Sod all bare areas and plant trees as per government regulation</li> </ul>	DOTC Contractor	TOR, Government Regulations
		C	Improvement of visual effects after clearing area and landscaping undertaken	<ul style="list-style-type: none"> <li>▪ Collect and remove all demolition debris</li> <li>• Landscape the area</li> </ul>	DOTC Contractor	TOR of the Contractor
Environmental Aspect # 2	B. The Water	B	Due to demolition of structures, soil erosion and siltation and closure of wells	<ul style="list-style-type: none"> <li>▪ Construction of protective measure</li> <li>▪ Construction of siltation canal</li> <li>• Sealing of wells in the alignment</li> </ul>	DOTC Contractor	TOR of the Contractor
		C	Clearing the area	<ul style="list-style-type: none"> <li>• Improvement of water infiltration to groundwater table</li> </ul>	DOTC Contractor	TOR of the Contractor
		D	Sodding and landscaping	<ul style="list-style-type: none"> <li>• Tree planting</li> </ul>	DOTC Contractor	TOR of the Contractor
Environmental Aspect # 3	C. The Air	C	Dust (TSP) due to demolition of structures and removal of debris	<ul style="list-style-type: none"> <li>• Place portable perimeter wall around the structure and sprinkling of water of unpaved grounds (roads, parking lots)</li> </ul>	DOTC Contractor	TOR of the Contractor
		B	Gaseous (SO <sub>2</sub> and NO <sub>2</sub> ) due to demolition of structures and removal of debris	<ul style="list-style-type: none"> <li>• Good repair of trucks especially the exhaust system and use low sulfur construction equipment</li> </ul>	DOTC Contractor	TOR of the Contractor
		B	Nuisance noise due to demolition of structures and	<ul style="list-style-type: none"> <li>• Proper equipment maintenance and exhaust of vehicles must be in good condition especially</li> </ul>	DOTC Contractor	TOR of the Contractor

*Environmental Management Plan (EMP)  
For Construction Work  
New Bohol Airport Construction and Sustainable Environmental Protection Project*

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact		Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
		Degree	Impact			
			removal of debris	the mufflers		
		B	Dust (TSP) due to demolition and trucking of debris and reusable materials	<ul style="list-style-type: none"> <li>During transport and hauling, truck haulers must be covered by tarpaulin and it requires extreme care and precautions</li> </ul>	DOTC Contractor	TOR of the Contractor
Environmental Aspect # 4	D. The People	A	Disruption of existing community. Based on survey, there are 66 houses (55 families) that will be affected	<ul style="list-style-type: none"> <li>Identify/validate affected people/households thru census</li> <li>Determine tenurial status of affected people/households</li> <li>Fair and timely compensation or resettlement assistance (for resettlement, ensure that resettlement site is acceptable to the households to be resettled; with basic utilities such as electricity and water and services such as transportation and communication, etc.)</li> <li>Provide sufficient time for relocation before start of an earth-moving activities</li> </ul>	Provincial Government of Bohol (PGB) DOTC NHA	Memorandum of Agreement (MOA)
		A	Land affected	<ul style="list-style-type: none"> <li>Identify/validate affected land and assessment of values</li> <li>Fair and timely compensation thru land acquisition from owners</li> </ul>	PGB DOTC	Memorandum of Agreement (MOA)
		A	Structures and land improvements affected	<ul style="list-style-type: none"> <li>Identify affected structures thru tagging, identification of owners, and assessment of values</li> <li>Study zoning policies and work for re-classification of affected land if necessary (e.g., obtain permits and clearances, coordinate with LGU's to pass necessary ordinances, etc.)</li> <li>Fair and timely compensation to owners</li> </ul>	PGB DOTC	Memorandum of Agreement (MOA)
		A	Agricultural crops affected	<ul style="list-style-type: none"> <li>Determine agricultural crops affected and assess fair market value</li> <li>Allow harvest of last crop prior to any earth-moving activity. If not possible, provide fair compensation of affected crops (prior to</li> </ul>	PGB DOTC	Memorandum of Agreement (MOA)

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact		Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
		Degree	Impact			
				earth-moving)		
		B	Trees affected	<ul style="list-style-type: none"> <li>Determine affected trees and assess fair market values</li> <li>Identify owners of affected trees</li> <li>Explore possibility of transplanting. If not possible, provide fair and timely compensation of owners</li> </ul>	PGB DOTC	Memorandum of Agreement (MOA)
		B	Acquisition of permits, clearances required by various government; formulation of MOAs needed	<ul style="list-style-type: none"> <li>Proper coordination should be made by the proponent to secure necessary permits at the earliest stage of the project</li> </ul>	PGB DOTC	Government Rules/ Regulations
<b>2. CONSTRUCTION PHASE</b>						
Environmental Aspect # 1	A. The Land	A	Project activities such as the construction of embankment	<ul style="list-style-type: none"> <li>Need suitable soil quality to replace excavated soil</li> <li>Importation of soil of suitable quality from borrow area</li> </ul>	Contractor	TOR of the Contractor
		D	Soil scraping filling for the embankment	<ul style="list-style-type: none"> <li>Strengthen the foundation of the structures</li> <li>Use quality soil for embankment</li> </ul>	Contractor	TOR of the Contractor
		A	Land subsidence/ Alteration of natural drainage pattern	<ul style="list-style-type: none"> <li>Setting up the necessary structural support foundations and adequate drainage channels/use of interceptor dikes, pipe slope drains, sediment trap</li> </ul>	Contractor	TOR of the Contractor
		A	Soil contamination due to oil/fuel spill	<ul style="list-style-type: none"> <li>Close supervision during construction; provision of secondary containment and lining to fuel and oil storage areas</li> </ul>	Contractor	TOR of the Contractor
		B	Loss of vegetation/fish and wildlife disturbance	<ul style="list-style-type: none"> <li>Selective removal of vegetation cover; re-greening of project site</li> </ul>	Contractor	TOR of the Contractor
Environmental Aspect # 2	B. The Water	A	Poorly located/constructed system could cause erosion and weakening of the structure foundation	<ul style="list-style-type: none"> <li>All drainage system will be replaced, in most cases by a better system</li> </ul>	Contractor	TOR of the Contractor
Environmental Aspect # 3	C. The Air	A	Generation of TSP/dust from soil excavation and emission from heavy equipment and	<ul style="list-style-type: none"> <li>Sprinkling of water of loose soil and exhaust of vehicles must be in good condition especially the mufflers</li> </ul>	Contractor	TOR of the Contractor

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Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact		Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
		Degree	Impact			
			trucks bringing construction materials			
		B	Gaseous (SO <sub>2</sub> and NO <sub>2</sub> ) emissions from construction equipment	<ul style="list-style-type: none"> <li>▪ Proper maintenance and repair of equipment and use low sulfur construction equipment</li> </ul>	Contractor	
		A	Noise emission from construction equipment	<ul style="list-style-type: none"> <li>▪ Construction of temporary baffle wall especially near residential areas and exhaust of vehicles must be in good condition especially the mufflers</li> <li>▪ Appropriate planning of construction schedule; regular maintenance of construction equipment</li> </ul>	Contractor	TOR of the Contractor
Environmental Aspect # 4	D. The People	B	Health hazards from noise, dust, smoke, and other suspended particles in the air	<ul style="list-style-type: none"> <li>• Periodic water sprinkling on the ground to minimize dust and suspended particles in the air</li> <li>• schedule use of heavy equipment emitting noise as much as possible during day time or when most people are at work or in school</li> <li>• ensure that the heavy equipment and machines used are well-conditioned to prevent emission of excessive noise and toxic fumes</li> <li>• coordinate with the barangay officials and local health units to issue health bulletins on health hazards brought about by construction activities and offer advice on prevention</li> </ul>	PGB DOTC Contractor	TOR of the Contractor
		A	Heavy vehicular traffic jams	(Please see options for mitigation of bad vehicular traffic under Pre-Construction Phase where a traffic management plan is recommended)	PGB DOTC	TOR of the Contractor
		B	Generation of spoils/waste materials	<ul style="list-style-type: none"> <li>• ensure regular collection of spoils/waste materials such as soil excavated, wood, and waste metals to prevent obstruction of roads, sidewalks, and other open spaces</li> <li>• consider using pre-fabricated slabs and panels to avoid using roads, sidewalks, and</li> </ul>	PGB DOTC Contractor	TOR of the Contractor



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Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact		Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
		Degree	Impact			
				other open spaces as work areas and to minimize spoils/wastes generated in the construction sites		
				<ul style="list-style-type: none"> <li>have an approved disposal site/s for spoils/waste materials generated</li> </ul>		
		B	Safety concerns for motorists and pedestrians passing in the vicinity of the construction sites	<ul style="list-style-type: none"> <li>contractors to ensure safety of motorists and pedestrians passing in the vicinity of construction sites by posting warning signs of ongoing construction in strategic areas, blocking off danger areas, and as much as possible scheduling works in areas during periods when there is least number of motorists and pedestrians</li> </ul>	PGB DOTC	TOR of the Contractor
		B	Safety and health concerns for construction workers and personnel at the construction site	<ul style="list-style-type: none"> <li>First-aid/health service to be available in the area, provision of early warning and alert system, provision of protective clothing and gears for workers, employ health and safety program</li> </ul>	Contractor	TOR of the Contractor
		B	Housing concern for construction workers and personnel	<ul style="list-style-type: none"> <li>contractors to provide acceptable facilities for temporary housing of construction workers and personnel</li> </ul>	Contractor	TOR of the Contractor
		B	Disorganized routing and operations of existing public utility vehicles (e.g. bus, jeepney, and tricycle)	<ul style="list-style-type: none"> <li>help organize or strengthen public utility vehicle operators and drivers associations to complement the planned rail transportation service as well as ensure efficient use of the planned road connector and other access roads by, among others, establishing new transportation lines and routes and rationalizing fares</li> </ul>	PGB DOTC	TOR of the Contractor  Access available resources from cooperating LGU's and other groups
		C	The construction activities will generate short-term employment among local residents including project affected persons	<ul style="list-style-type: none"> <li>The contractor is encouraged to employ qualified project affected persons and local residents, to the extent practicable and reasonable, during construction. The Local Project Management Team (LPMT) of the Bohol Provincial Government already has a</li> </ul>	Contractor	TOR of the Contractor

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact		Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
		Degree	Impact			
				system to assist the contractor in this regard.		
<b>3. OPERATION PHASE</b>						
Environmental Aspect # 1	A. The Land	B	Increased vehicular flow thereby increasing the incidence of traffic congestion due to the operation of the roadway	<ul style="list-style-type: none"> <li>▪ Fielding of traffic enforcers near bus/jeep terminals and place traffic signage and precautions along the roadway</li> </ul>	PGB DOTC	DOTC or PGB
		B	Water ponding in the alignment and soil erosion could weaken the embankment and foundation	<ul style="list-style-type: none"> <li>▪ Cleaning of drainage system of obstructing material before the rainy season starts and during the rainy season</li> </ul>	PGB DOTC	DOTC or PGB
		B	Erosion of loose soil and siltation in low areas	<ul style="list-style-type: none"> <li>▪ Protection of loose soil from action of rain</li> <li>▪ Sodding of bare areas</li> </ul>	PGB DOTC Contractor	DOTC or PGB
Environmental Aspect # 2	B. The Water	B	Water ponding in the alignment and soil erosion could weaken structure embankment and foundation	<ul style="list-style-type: none"> <li>▪ Cleaning of drainage system of obstructing material before the rainy season starts and during the rainy season</li> </ul>	PGB DOTC Contractor	DOTC or PGB
		A	Wastewater generation of domestic influent will be generated Discharge of the untreated wastewater may cause nuisance or produce foul odor and groundwater contamination	<ul style="list-style-type: none"> <li>▪ Establishment of wastewater treatment facility/multi-chambered septic tank; Treatment of wastewater to meet DENR Effluent Standards</li> </ul>	PGB DOTC Contractor	Airport Operation Manual; Sanitation Code of the Philippines, ECC
Environmental Aspect # 3	C. The Air	B	Impact on air quality	<ul style="list-style-type: none"> <li>• None, except proper maintenance and repair of equipment</li> </ul>	DOTC	Airport Operation Manual; ECC
		B	Impact on gaseous (SO <sub>2</sub> and NO <sub>2</sub> ) emission	<ul style="list-style-type: none"> <li>• None, except proper maintenance and repair of equipment and use low sulfur vehicles</li> </ul>		
		B	Noise Pollution	<ul style="list-style-type: none"> <li>• Provision of noise control structures, relocation of affected households</li> </ul>		
Environmental Aspect # 4	D. The People	A	Disorganized routing and operations of existing public utility vehicles	<ul style="list-style-type: none"> <li>• Help organize or strengthen public utility vehicle operators and drivers associations to complement the rail transportation service as</li> </ul>	PGB DOTC	TOR of the Contractor  Access available resources

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Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact		Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
		Degree	Impact			
			(e.g. bus, jeepney, and tricycle)	well as ensure efficient use of the road connector and other access roads by, among others, establishing new transportation lines and routes and rationalizing fares		from cooperating LGU's and other groups
		A	Solid waste generation about 500-1,000 kg/day of solid wastes will be generated	<ul style="list-style-type: none"> <li>• Employ solid waste management plan</li> <li>• Regular solid wastes collection and disposal by solid waste collectors operating in the area</li> </ul>	DOTC	Airport Operation Manual; ECC; RA 9003
			Uncollected, not properly disposed of solid wastes cause sanitation problems and aesthetics of the area			
		C	The operation will employment among project affected persons and local residents.	<ul style="list-style-type: none"> <li>• Qualified project affected persons and local residents will be considered for employment during operation.</li> </ul>	DOTC	MOA between Proponent and stakeholders
		A	Airport accident	<ul style="list-style-type: none"> <li>• Implement contingency response plan</li> </ul>	PGB DOTC	Airport Operation Manual/ Contingency Plan of Bohol

Note: For Degree of Impact    A – High Negative Impact    B – Low Negative Impact    C – High Positive Impact    D – Low Positive Impact

## **2. Waste Management Plan**

### ***Introduction***

Waste management is one of the major issues to mitigate the environmental impact from airport construction work. If not given priority attention it will greatly affect the health and sanitation, aesthetic and social problems to the community in construction phase.

The solid waste management plan is formulated in accordance with Ecological Solid Waste Act of 2000 (RA9003), Implementing Rules and regulations of Republic Act 6969 (DAO1992-29), an Act to Control Toxic Substances and hazardous and nuclear wastes, providing Penalties for Violations thereof, and for other purposes (RA6969), the Updated Bohol Environmental Code (BEC) of the province and Municipal Ordinance/s of the Municipalities of Panglao and Dauis.

Waste segregation should be strictly followed and implemented to reduce waste amount by the contractor, operator and users of the new airport.

Multi-partite Monitoring Team (MMT) will manage and monitor the SWM program described in this Plan and actual conditions at construction and operation phase to keep natural condition of the Panglao Island.

### **2.1 The Roles and Responsibilities**

#### **2.1.1 The roles and responsibilities of the contractors**

The roles and responsibilities of the contractors are as follows:

- 1) The original contractor has responsible for waste discharge in construction phase;
- 2) The original contractor shall effort to reduce, reuse and recycle of construction waste;
- 3) The original contractor shall treat construction waste due to the Laws and Regulations in the Philippines; and
- 4) The original contractor can make contract with other private companies to contract out the transportation, intermediate treatment and final disposal. The original contractor shall pay reasonable cost to the private companies to ensure the suitable treatment.

#### **2.1.2 The Role and Responsibility of the Client and related agencies**

The client and related agencies shall do their duty for the suitable treatment of construction waste, i.e. reduce, reuse and recycle implemented by the original contractor.

- 1) The Client shall request the design documents to consider reduce, reuse and recycle of construction waste;

- 2) The engineers shall prepare the design documents to consider reduce, reuse and recycle of construction waste due to the wishes of the Client;
- 3) Sub-contractor shall cooperate with the original contractor to reduce, reuse and recycle of construction waste; and
- 4) Private companies for waste management shall do suitable treatment according to the contract.

### 2.1.3 The Responsibility for Types of Waste

The responsibilities for types of waste are as follows:

- 1) The Construction waste is from construction work itself and from field office;
- 2) The original contractor shall do suitable treatment for each waste due to each Low and regulations; and
- 3) The waste from the field office shall be treated by the indications of located municipality.

## **2.2 Plan and Management**

### 2.2.1 Establishment of Management Organization

The original contractor shall establish the organization for waste management and make clear the roles and responsibility of each position.

### 2.2.2 Plan and Management at the Construction Site

The original contractor shall formulate the waste management plan to reduce the waste disposal amount. The waste management plan shall include waste reduction methods and segregation method.

The waste management plan shall include the contents as follows:

- 1) Waste treatment policy for the construction work;
- 2) The original contractor shall have closed meetings with private company, if the contractor will contract out the waste management activities;
- 3) The construction waste amount shall be estimated before the actual work;
- 4) Construction method and materials shall be considered;
- 5) Generated construction waste shall be recycled by the limit;
- 6) Non-recyclable waste shall be reduced by intermediate treatment;
- 7) Final disposal waste shall be considered about transportation and disposal method,
- 8) Segregation system shall be introduced;
- 9) The original contractor shall confirm the license and evaluate capacity of private contractor for waste treatment; and
- 10) The management organization shall carry out the monitoring of waste management plan.

## **2.3 Solid Waste Management Plan of New Airport Construction Work**

### 2.3.1 Outline of the Construction Work

The design parameters considered in the proposed project are:

- Design Year - Year 2020
- Annual Passenger - 1,436,000
- Domestic Passenger - 1,393,000
- International Passenger - 43,000
- ICAO Code - 4E
- Design Aircraft - A321

Total area of 229.18 hectares will be provided at the onset of development which includes the following facility requirements:

- Runway: 2,000 m x 45 m
- Runway Strip: 2,120 m x 300 m
- Taxiway: 2
- Apron: A321:6
- Passenger Terminal Building: 8,271 sq.m
- Control Tower: 9-storey, Height 40 m
- Fire and Rescue Station: Category 9
- Car Park: Private Cars:145, Taxi:32, Bus:18
- Air Navigation Facility: VOR/DME; and
- Aeronautical Ground Light: PALS, REDL, TEDL, AFL

The project is scheduled to be 3-year period of construction activities and will be operational by year 2016.

### 2.3.2 Major Construction Work and Waste Sources

Major construction works and waste sources are shown in Table 2.1. The table shows the waste from the construction work are few roots of trees/plans and household waste.

**Table 2.1 Major Construction Works and Waste Sources**

<b>Waste Resource</b>	<b>Types and Sources of Waste</b>	<b>Waste Amount</b>	<b>Note</b>
Preparatory work	Waste from tree trimming/Stumping	Few	The owner has brought own trees and plants to resettlement area. The remaining plants are very few.
Housing for Construction workers	Household waste	Note 1) Around 500kg/day	Household waste from workers daily activities
Earth work	Remaining soil	None	The soil amount of excavation and embankment is balanced. The rock also is used for embankment material after crashing.
Building work	Plate for framework	None	There are few frameworks at building work. The plate shall be brought out from the Island after finish of construction work.
	Hazardous waste (paints, thinners, batteries, spray and others)	None	Hazardous waste is brought out from the Island after finish of construction work. The contractor prepare temporarily storage house.

*Note 1) The household waste amount is calculated as around 500 workers. Unit is 1 kg/person/day.*

### 2.3.3 Waste Management Plan

#### 1) Segregation

Original contractor shall prepare local rules for construction work period. The contractor shall construct temporarily MRF at the housing area for recyclable waste and storage house for hazardous waste.

- Household waste shall be segregated by instruction of appointed waste management manager. The segregation is carried out three types, biodegradable waste, recyclable waste, residual waste. Recyclable waste is segregated as more detailed types, bin, can, plastic and paper.
- Hazardous waste from household and construction waste is once stored at special house and brought out from the Island.

#### 2) Collection/Transportation/Final disposal

The original contractor can contract out the collection/transportation/final disposal of waste to licensed private company. If the private company wants bring into residual waste to public landfill site, the company shall get permission from Local Government Unit located in final disposal facility.

### 2.4 Information, Education and Communication

Information, Education and Communication (IEC) shall be done to all generators and workers to make sure that they will follow what is mandated by the law (RA9003) and local rules pertaining to the waste management. Original Contractor shall develop education materials i.e. flyers, brochures for IEC Campaign and do seminars and workshops.

The original contractor must clearly identify where bins are located and how to use them. Educating sub-contractors and workers about the benefits of recycling reinforces the practice. Place

informational signs on or near bins explaining why recycling is important. The original contractor will develop signs that show products that are made from recycled materials and also display large banners telling workers “Recycles”.

## **2.5 Monitoring**

The original contractor shall submit monthly inspection report to Multi-partite Monitoring Team. The inspector appointed by the original contractor will do visual inspection monthly and as required at the site and around the site. The inspection activity includes not only inspection but also cleaning activities. If some residents request the collection of illegal construction waste dumping, the inspector shall make action to clean up the area as soon as possible. The inspection report will be disclosed at LGU office.

## **3. Emergency Response Plan**

In the presence of any undesirable situation related to environmental disaster, emergency preparedness is therefore important. It is necessary that the proposed airport project formulated contingency plans for dealing with emergencies and should be made available to the administrator of the airport.

Generally a hazard is defined as an inherent physical or chemical characteristic that has the potential for causing harm, while a hazard evaluation study is an organized effort to identify and analyze the significance of hazardous situations associated with a process or activity.

The following probable environmental hazards that could be encountered in this project are as follows:

- Accident disposal of extremely hazardous substance
- Accidental fuel spills/leaks
- Fire
- Accident due to Seismic Activity
- Crash

At any event that the airport facilities accidentally disposed of extremely hazardous substances, as well as fuel spills/leaks, the environmental officer must:

1. Notify the DENR (required by RA6969)
2. Submit plans on containment, decontaminations and disposal
3. Immediately issue notification of any release

Each incident involving the release of hazardous substance presents special problems. Response personnel must evaluate these problems and determine an effective course of action to mitigate the incident. The following phases are involved in safety responding to an incident: (1) site assessment, (2) site entry and (3) site control.



Site assessment will include an evaluation for site approach to keep emergency control personnel out of the hazardous area until identification of the nature and degree of the hazards can personal protective equipment and monitoring. The preliminary safety requirements will be based on the findings of the initial on-site survey and reconnaissance, which may consist of more than one entry. Each situation will be examined individually since no method can select a level of protection in all unknown environments.

Control of the site is necessary to reduce the possibility of exposure to any contaminants present and contaminant transport by personnel or equipment. This may include the setting up of security and physical barriers to exclude unnecessary personnel from the general area and establishing control points to regulate access to work zones. Movement of personnel and equipment between zones and into the site will be limited by these control points.

Accident due to seismic activity could be lessened by employing earthquake proofing of structures. Structures/buildings within the project site shall be designed in accordance with the national building and structural codes and earthquake zoning of the area. Based on the earthquake zoning map prepared by PHILVOLCS and records of earthquake occurrence in the area, the engineering design of the structures should be equal to or greater than the maximum recorded earthquake and based on the geotechnical assessment of the site.

In the event of crash and fire, the airport operation manual prepared by the airport management should be followed. This manual must include 1) crash and fire rescue procedure, 2) security procedure, 3) inspection and maintenance procedures to ensure safe access to the runway and taxiways system, 4) procedures to ensure order and safety at the airside, 5) procedures to ensure security and convenience at the terminal, and 6) other pertinent maintenance procedure.

- Introduction: include airport foreword, content, and distribution of the plan, amendments and alarm principles.
- Instructions: include airport owners, airlines, air traffic control, crash fire and rescue unit, hospital in the airport vicinity, local police authority, other relevant local authorities and post emergency procedures.
- Alter Levels: include crash at known site, potential crash, possible crash at unknown site, procedures for identifying the crash site and list of aircraft and helicopters
- Alarming Lists: include telephone and address list and list of frequencies used in radio communications.
- Maps: include regional maps, airport maps and layout chart.

#### **4. Environmental Monitoring Plan (EMoP)**

An integral part of environmental protection is periodic monitoring of the condition of the immediate environment to determine any occurrence of undesirable changes as a result of the project during construction and post-construction phases.

The monitoring program for the project shall determine the extent of variations and changes in the levels of pollutants in the environment and other parameters and indicators considering the implementation or operation of the project. The monitoring program shall have the following objectives:

- Monitor implementation of mitigation measures;
- Monitor compliance with air, noise and water quality standards; and
- Monitor other parameters and indicators for socio economics and health

#### **4.1 Management of EMoP**

The ECC requires, as a condition, the formation of a Multi-partite Monitoring Team (hereinafter referred to as MMT) and shall be composed of representatives of the DENR-EMB, the DOTC, DOT, CAAP, the LGUs (Provincial Government of Bohol, Municipality of Panglao, Municipality of Dauis, Balangay Tawala, Barangay Danao, Barangay Bolod, Barangay Lourdes), Academe and NGOs.

The MMT shall have the following functions:

1. Monitor project compliance with the conditions stipulated in the ECC and Environment Management Plan
2. Validate proponent's conduct of self-monitoring
3. Validate proponent's, gather relevant information to facilitate the determination of validity of public complaints or concerns about the project and timely transmit to the proponent and EMB recommended measure to address the complaint
4. Prepare, integrate and disseminate simplified monitoring reports to community stakeholders; and
5. make regular and timely submission of MMT report based on the EMB prescribed format.

#### **4.2 Modification of Monitoring Plan**

The monitoring program will be dynamically designed as it could be modified to take into several considerations such as the various stages of the project cycle, revision of standards, enactment of new rules and regulations and development of new methodologies and technologies for environmental monitoring.

#### **4.3 Environmental Monitoring Fund (EMoF) Considerations**

A Memorandum of Agreement (MOA) for the establishment of an Environmental Guarantee and Monitoring Fund for the operation of New Bohol Airport Construction and Sustainable Environment Protection Project will be signed between the Environmental Management Bureau (EMB) and Project

Proponent within two months after the issuance of the Environmental Compliance Certificate (ECC) by the Department of Environment and Natural Resources (DENR).

An Environmental Monitoring Fund (EMoF) will be established to support the activities of the Multi-partite Monitoring Team (MMT). This fund will be replenished based on the actual expenses incurred in the monitoring activities i.e. documentation, meeting expenses, transportation costs and other related expenses.

#### **4.4 Implementation of EMoP**

The Contractor shall develop an organization chart indicating persons with environmental responsibilities, their level of authority, lines of reporting and contact details. Identify other responsibilities held and the proportion of their time allocated to environmental management.

The Contractor will be responsible for carrying out the environmental monitoring program associated with the construction phase and Defects Notification Period of the Project as described hereinafter. Prior to the start of construction the Contractor will carry out a program of environmental monitoring to establish the baseline conditions for air quality, noise, vibration and water quality.

The Contractor shall attend the meetings of Multi-Parties Monitoring Team (MMT), and provide a brief of construction activities and environment monitoring conducted by the Contractor under the Environmental Monitoring Plan.

#### **4.5 Monitoring Items**

The Contractor shall conduct the environment monitoring of water quality, air quality, noise and solid / liquid waste around the site periodically at the locations specified hereinafter and during construction period and Defect Notification Period. Monitoring Reports shall be in writing and submitted on monthly basis. The Report shall include a listing and summary of testing and monitoring results on all aspects.

##### **4.5.1 Water Quality**

Sampling and monitoring of Water Quality shall be conducted at four (4) locations shown in the drawing below. Sampling and mentoring shall be before commencement of the work and at monthly basis of the samples taken at the locations. Monitoring items and sampling / measurement method are as shown in Table 4.6. Locations of sampling points are shown in the picture as below. The Contractor shall confirm the locations of sampling stations of ground water. There is a possibility of change the sampling points for ground water quality examinations.

#### 4.5.2 Air Quality

The Contractor shall monitor the air environmental conditions in the vicinity of the Works to ascertain the environmental impacts of the Project, such as effects of vehicular traffic, heavy construction equipment, and fossil fuel burning. The air quality shall be monitored in five (5) locations, as shown in the drawing attached hereto before commencement of the work at the site and access road and monthly basis. Locations of monitoring points are shown in the picture as below.

#### 4.5.3 Noise

The Contractor shall monitor the air environmental conditions in the vicinity of the Works to ascertain the environmental impacts of the Project, such as effects of vehicular traffic, heavy construction equipment. The noise level shall be monitored in five (5) locations, as shown in the drawing hereto before commencement of the work at the site and access road and weekly during construction period. Noise quality on the same sites at daytime (10:00 to 12:00, 14:00 to 16:00) and night time (22:00 to 24:00) should be monitored quarterly and annually. Wind direction at each point is also measured and recorded. Locations of monitoring points are shown in the picture as below.

#### 4.5.4 Solid Waste

During the construction of the Project, daily monitoring of solid waste at the construction site shall be done to ascertain whether it is disposed of in designated areas or in bin/receptacles if it is collected by the municipal government. Industrial waste from the construction activities should be monitored daily to check whether it has accumulated in the designated areas, not contaminating surface water or nearby ground water sources on or off Site, and whether it is regularly removed from the industrial waste disposal areas by the Contractor in order to minimize the environmental impacts of the Project.

#### 4.5.5 Environment Standards

Standard for National Ambient Air Quality Guidelines for Source Specific Air Pollutants from Industrial Sources/Operations, National Ambient Air Quality Guidelines for Criteria Pollutants, Air Quality Indices, Emission Standards for Noise, Water Quality Criteria for Class D Waters, and Effluent Standards; Pollutants in Class D Water related directly to the Project are shown in the subsequent Tables 4.1 to 4.5.

**Table 4.1 National Ambient Air Quality Guideline for Source Specific Air Pollutants from Industrial Sources/Operations**

Pollutant (a)	Concentration		Averaging Time (Minutes)	Method of Analysis / Measurement (b)
	µg/Nm <sup>3</sup>	ppm		
Ammonia	200	0.28	30	Nesslerization
Carbon, Disulfide	30	0.01	30	Tischer Method
Cl <sub>2</sub>	100	0.03	5	Methyl Orange

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Formaldehyde	50	0.04	30	Chronotropic Acid
Hydrogen, Chloride	200	0.13	30	Volhard Titration
Hydrogen Sulfide	100	0.07	30	Methylene Blue
Lead	20		30	AAS
NO2	375 260	0.20 0.14	30 60	Griess - Saltzman
Phenol	100	0.03	30	4-Aminoantipyrine
SO2	470 340	0.18 0.13	30 60	Colorimetric Pararosaniline
TSP	300	-	60	Gravimetric
PM-10	200	-	60	- do -

- a: Pertinent ambient standards for Antimony, Arsenic, Cadmium, Asbestos, Nitric Acid and Sulfuric Acid Mists in the 1978 NPCC Rules and Regulations may be considered as guides in determining compliance.
- b: Other equivalent methods approved by Department of Environment and Natural Resources may be used.
- c: Ninety-eight percentile (98%) values of 30 minutes sampling measured at 25°C and one atmosphere pressure.
- d: DENR Administrative Order No. 14 Series of 1993: Revising Chapter II, Section 57 to 66 of 1978 Implementing Rules and Regulations of P.D. 984, EMB, DENR

**Table 4.2 National Ambient Air Quality Guideline for Criteria Pollutants**

Pollutant	Short Term (a)			Long Term (b)		
	µg/Ncm	PPM	Averaging Time	µg/Ncm	PPM	Averaging Time
TSP (e)	230 (f)		24 hrs	90		1 yr (c)
PM-10	150 (g)		24 hrs	60		1 yr (c)
Sulfur Dioxide (e)	180	0.07	24 hrs	80	0.03	1 yr
Photochemical Oxidants	140	0.07	1 hr	--	--	--
As Ozone	60	0.03	8 hr	--	--	--
Nitrogen Dioxide	150	0.08	24 hrs	--	--	--
Carbon Monoxide	3.5mg/Ncm 10mg/Ncm	30 9	1 hr 8 hrs	-- --	-- --	-- --
Lead (d)	1.5	--	3 month (d)	1	--	1 yr

- a: Maximum limits represented by ninety eight percentile (98%) values not to be exceeded more than once a year.
- b: Arithmetic mean.
- c: Annual Geometric Mean
- d: Evaluation of this guideline is carried out for 24-hours averaging time and averaged over three moving calendar months. The monitored average value for any three months shall not exceed the guideline value.
- e: SO2 and Suspended Particulate are sampled once every six days when using the manual method. A minimum number of twelve sampling days per quarter or forty eight sampling days each year is required for these methods. Daily sampling may be done in the future once continuous analyzer equipment is procured and becomes available.
- f: Limits for Total Suspended Particulate with mass median diameter less than 25-50 µm.
- g: Provisional limits for Suspended Particulate with mass median diameter less than 10 microns until sufficient monitoring data is gathered to base a proper guideline.

Source: DENR Administrative Order No. 14 Series of 1993: Revising Chapter II, Section 57 to 66 of 1978

Implementing Rules and Regulations of P.D. 984, EMB, DENR.

**Table 4.3 Air Quality Indices**

Indices	Good µg/Ncm	Fair µg/Ncm	Poor µg/Ncm	Serious or Alert Conditions		
				Very Unhealthy (Alert Level) µg/Ncm	Hazardous (Warning Level) µg/Ncm	Extremely Hazardous (Emergency Level) µg/Ncm
Total Suspended Particulates (TSP); 24-hours average	0-80	81-230	231-350	350	600	900
Sulfur Dioxide; SO <sub>2</sub> 24-hours average	0-80	81-180	181-650	650 (0.25 ppm)	1,570 (0.6 ppm)	2,360 (0.9 ppm)
Photochemical Oxidant as Ozone; 1-hour Average	0-80	81-160	161-350	350 (0.18 ppm)	780 (0.4 ppm)	1,180 (0.6 ppm)
Carbon Monoxide; CO, 8-hrs average	0-5 mg/Ncm	5.1-10 mg/Ncm	10.1-17 mg/Ncm	17mg/Ncm (15 ppm)	34mg/Ncm (30 ppm)	46mg/Ncm (40 ppm)

Source: DENR Administrative Order No. 14, Series of 1993: Revising Chapter II, Section 57 to 66 of 1978 Implementing Rules and Regulations of P.D. 984 EMB, DENR.

**Table 4.4 DENR Ambient Quality and Emission Standards for Noise (dBA) 1**

TIME	CLASS 2				
	AA	A	B	C	D
Daytime (0800H – 2200H)	50	55	65	70	75
Morning (0500H – 0900H) And Evening (1800H – 2200H)	45	50	60	65	70
Nighttime (2200H – 0500H)	40	45	55	60	65

Source: Rules and Regulations of National Pollution Control Commission (1978), Official Gazette, Professional Regulation Commission, Manila, Phil., Vol. 74 Nov. 23, 1978

Class AA: Institutional, requires quietness e.g. school, hospital, require quietness within 100 meters

Class A: Used for residential purposes

Class B: Used for commercial areas

Class C: Used for light industrial area

Class D: Used for heavy industrial areas

**Table 4.5 Water Quality Criteria for Class D Waters**

Parameters	Value
Temperature, °C	3 (max. rise in °C)
Color	No abnormal discoloration from unnatural causes
pH, range	6.0 – 9.0
BOD, 5-day 20 °C, mg/l	10 (15)
Total Suspended Solids, mg/l	Not more than 60 mg/L increase
Total Dissolved Solids, mg/l	1,000 (a)
Oil and Grease, mg/l	2
Total Coliform, MPN/100 ml	--
Fecal Coliform, MPN/100 ml	--

Standard of these substances is not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources.

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New Bohol Airport Construction and Sustainable Environment Protection Project*

- (a) Does not apply if natural background is higher in concentration. The latter will prevail and will be used as baseline.

**Table 4.6 Summary Table of Environmental Monitoring Plan**

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling and Measurement Plan			Lead Person
			Method	Frequency	Location	
<b>I. PRE-CONSTRUCTION PHASE/CONSTRUCTION PHASE</b>						
Environmental Aspect # 2 (The Water)	The water (The influences from general construction work)	Copper	DAO 34	Monthly	Two (2) Seawater Sampling Stations	MMT/Contractor
		Total Coliform	DAO34	Monthly		
		Fecal Coliform	DAO34	Monthly		
		pH	DAO34	Monthly		
		Temperature	DAO34	Monthly		
		Color	DAO34	Monthly		
		Dissolved Oxygen	DAO34	Monthly		
		Biological Oxygen Demand	DAO34	Monthly		
		MBAS	DAO34	Monthly		
		Phenols	DAO34	Monthly		
		Total Suspended Solids	DAO34	Monthly		
		Oil and Grease	DAO34	Monthly		
		Iron	DAO34	Monthly		
		Total Coliforms	DAO34	Monthly		
		Escherichia Coli	DAO34	Monthly		
		Heterotrophic Plate Count	DAO34	Monthly		
		pH	DAO34	Monthly		
		Temperature	DAO34	Monthly		
		Color	DAO34	Monthly		
		Settleable Solids	DAO34	Monthly		
		Dissolved Oxygen	DAO34	Monthly		
		Biological Oxygen Demand	DAO34	Monthly		
		Chemical Oxygen Demand	DAO34	Monthly		
		Total Dissolved Solids	DAO34	Monthly		
		MBAS (Surfactants)	DAO34	Monthly		
		Phenols	DAO34	Monthly		
		Total Suspended Solids	DAO34	Monthly		
		Oil&Grease	DAO34	Monthly		
Calcium	DAO34	Monthly				
Magnesium	DAO34	Monthly				



Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling and Measurement Plan			Lead Person
			Method	Frequency	Location	
		Chloride	DAO34	Monthly		
		Silica	DAO34	Monthly		
		Sulfite	DAO34	Monthly		
		Total Hardness	DAO34	Monthly		
Environmental Aspect # 3 (The Air)	The Air (TSP/Dust from Soil excavation/embankment and from heavy equipment/trucks)	SO <sub>2</sub> , NO <sub>2</sub> , Pb, TSP	- Proper maintenance of equipment, sprinkling of water on unpaved grounds and site - 1-hour ambient sampling (DAO14)	- visual inspection (weekly) - Monthly	- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School)	MMT/Contractor
	Noise (Noise from construction work by heavy equipment/trucks)	Noise, dB(A)	- Proper maintenance of equipment - 10-minute averaging time at seven readings (DAO14)	- monthly measurement - weekly hearing	- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School)	MMT/Contractor
Environmental Aspect # 4 (The People)	Solid and liquid waste		Visual inspection	Daily inspection	On-site and around site	MMT/Contractor
	Life Conditions		Interview	Monthly	Around site	MMT
<b>II. Post Construction Phase</b>						
Environmental Aspect # 2 (The Water)	The water (The influences from general construction work)	Copper	Dao 34	Monthly	Two (2) Seawater Sampling Stations	MMT/Contractor
		Total Coliform	DAO34	Monthly		
		Fecal Coliform	DAO34	Monthly		
		pH	DAO34	Monthly		
		Temperature	DAO34	Monthly		
		Color	DAO34	Monthly		
		Dissolved Oxygen	DAO34	Monthly		
		Biological Oxygen Demand	DAO34	Monthly		
		MBAS	DAO34	Monthly		
		Phenols	DAO34	Monthly		
		Total Suspended Solids	DAO34	Monthly		
		Oil and Grease	DAO34	Monthly		
		Iron	DAO34	Monthly	Two (2) Groundwater Sampling Stations	
Total Coliforms	DAO34	Monthly				

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling and Measurement Plan			Lead Person
			Method	Frequency	Location	
		Escherichia Coli	DAO34	Monthly		
		Heterotrophic Plate Count	DAO34	Monthly		
		pH	DAO34	Monthly		
		Temperature	DAO34	Monthly		
		Color	DAO34	Monthly		
		Settleable Solids	DAO34	Monthly		
		Dissolved Oxygen	DAO34	Monthly		
		Biological Oxygen Demand	DAO34	Monthly		
		Chemical Oxygen Demand	DAO34	Monthly		
		Total Dissolved Solids	DAO34	Monthly		
		MBAS (Surfactants)	DAO34	Monthly		
		Phenols	DAO34	Monthly		
		Total Suspended Solids	DAO34	Monthly		
		Oil & Grease	DAO34	Monthly		
		Calcium	DAO34	Monthly		
		Magnesium	DAO34	Monthly		
		Chloride	DAO34	Monthly		
		Silica	DAO34	Monthly		
		Sulfite	DAO34	Monthly		
		Total Hardness	DAO34	Monthly		
Environmental Aspect # 3 (The Air)	The Air (TSP/Dust from Soil excavation/embankment and from heavy equipment/trucks)	SO <sub>2</sub> , NO <sub>2</sub> , Pb, TSP	- Proper maintenance of equipment, sprinkling of water on unpaved grounds and site - 1-hour ambient sampling (DAO14)	- visual inspection (weekly) - Monthly	- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School)	MMT/Contractor
	Noise (Noise from construction work by heavy equipment/trucks)	Noise, dB(A)	- Proper maintenance of equipment - 10-minute averaging time at seven readings (DAO14)	- monthly measurement - weekly hearing	- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School)	MMT/Contractor
Environmental Aspect # 4 (The People)	Waste collection- solid waste collection/ disposal	Solid waste at the airport	<ul style="list-style-type: none"> <li>Provision of coded garbage bins (biodegradable, non-biodegradable and</li> </ul>	Daily as necessary as per refuse collection schedule	Airport/At project site	MMT/Contractor

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling and Measurement Plan			Lead Person
			Method	Frequency	Location	
			recyclables)			
	Life Conditions	General	▪ Interview	Monthly	Around Site	MMT

**Table 4.7 Monitoring Stations of Water**

Sta. ID No.	GPS Readings		Description of Sampling Stations
	Longitude	Latitude	
GW-1	N 09°35'05.7"	E123°46'14.5"	It is located at Airport Site in Brgy. Tawala, Panglao, Bohol. Owned by deceased Mr. Leoncio Boncaron
GW-2	N 09°33'30.6"	E123°45'28.4"	It is located inside compound of former barangay captain Mr. Avito Arcay which is in front of the Brgy. Hall of Brgy. Danao crossing the municipal road in the municipality of Panglao, Bohol.
SW-1	N 09°32'51.1"	E123°46'22.2"	This is situated about 100 meters away from the seashore which is in front of the Alona Kew Beach in Brgy. Tawala, Panglao, Bohol.
SW-2	N 09°34'05.0"	E123°45'03.1"	This is located inside mangrove trees about 150 meters away from seashore in Brgy. Danao, municipality of Panglao, Bohol.

**Table 4.8 Monitoring Stations of Air & Noise**

AS. ID No.	GPS Readings		Description of Sampling Stations
	Longitude	Latitude	
AS - 1	N 09O33'42.3"	E123O46'40.1"	It is located in front of Tawala Elementary School in Brgy Tawala, Panglao, Bohol. It is situated about 10 meters away from center of the municipal road and about 35 meters from the Classrooms.
AS - 2	N 09O33'32.9"	E123O45'27.0"	It is situated almost in front of the Brgy Hall of Brgy Danao in the municipality of Bohol. It is about 7 meters away from center of the municipal road.
AS - 3	N 09O34'50.4"	E123O45'08.4"	It is about 30 meters away in front of the municipal hall building of Panglao and about 25 meters from center of the municipal road.
AS - 4	N 09O34'19.9"	E123O46'28.9"	It is located along access road of the proposed new Bohol airport in Brgy Tawala in the municipality of Panglao.
AS - 5	N 09O34'10.4"	E123O47'14.5"	It is located in front of Bolod Elementary School in Brgy Bolod, Panglao. It is about 2 meters away from the perimeter fence of the school and 5 meters away from center of the municipal road.

Figure.1 Monitoring Stations of Water, Air & Noise

