

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-3/4)

Section 4000 Series - Architectural Works

Section 5000 Series - Mechanical Works

Section 6000 Series - Electrical Works

Section 7000 Series - Special Equipment

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-3/4)

Section 4000 Series: Architectural Works

Section 5000 Series: Mechanical Works

Section 6000 Series: Electrical Works

Section 7000 Series: Special Equipment



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 4000 Series: Architectural Works

SPECIFICATIONS

SECTION 4000 SERIES : ARCHITECTURAL WORKS

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SECTION 4050

GENERAL REQUIREMENTS FOR ARCHITECTURAL WORKS

1.0 GENERAL

1.1. This Section shall apply generally to all Section 4000 – Architectural Works and to other Sections of the Specification containing Building Works items, unless otherwise stated.

- (1) Component-4: Building Works include the following sections:
 - (a) Section 4000: Architectural Works,
 - (b) Section 5000: Mechanical Works,
 - (c) Section 6000: Electrical Works, and
 - (d) Section 7000: Special Equipment
- (2) The provisions herein are additional to, and are to be read in conjunction with, Section 1000.
- (3) Work under Section 4000 – ARCHITECTURAL WORKS, consists of the execution and completion of all Architectural Works, as indicated in the Specification and on the Drawings or as instructed by the Engineer.
- (4) The General Requirements are broad-scope and specify requirements in general terms only. The Contractor shall be responsible for all works necessary to provide work and operations as intended under and required by these specifications. Any items of Work which are not indicated on the Drawings or described in the Specifications but which are necessary to provide complete and operable Architectural Works shall be deemed to be included.
- (5) Associated Plant, materials and workmanship included in this Section, (such as concrete, steelwork, metalwork, finishing, Electrical, Mechanical Works and the like) shall comply fully with the Specifications for other Sections, unless otherwise particularly specified in this Section.

2.0 GENERAL DESIGN REQUIREMENTS

2.1. Generally

- (1) The Contractor shall be responsible for the Design of the selected parts of the Architectural Works where so stated in the particular parts of the Specification for this Section. Where so specified, the Contractor shall design and provide equipment and complete Systems that comply with the performance requirements of the Drawings and Specifications.
- (2) The Contractor shall be responsible for providing all design, fabrication and installation drawings and details necessary to provide work and operations as intended under and required by the Drawings and Specifications.
- (3) For requirements and procedures relating to Contractor's Design refer to Section 1000.
- (4) The design and construction shall include arrangements and space for future expansion and additions, including sizing of main cables, supports and space for

future cables, spare terminals in panel boards and the like for future connections and the selection of upgradeable components.

- (5) The design shall take account of and include measures to control all noise and vibration.

3.0 SUBMISSIONS

3.1. Initial Submissions

- (1) Prior to commencement of work under each detailed component of the Architectural Works, the Contractor shall prepare a detailed Method Statement describing the labour, materials and Contractor's Equipment to be used and the method of work execution and obtain the Engineer's written approval.
- (2) The Statement shall also describe the safety precautions to be adopted and all measures for compliance with environmental requirements and the preservation and protection of any structures, utilities or services which are to remain in place and operational.
- (3) In addition and prior to commencement of the particular parts of the Architectural Works, the Contractor shall prepare and submit the following (as further detailed herein) for the Engineer's approval:
 - (a) Details of any equipment and material manufacturers and of any specialist subcontractor(s) including description of work experience, major equipment, labour, methods of quality control and safety control, etc
 - (b) Manufacturer's detailed technical data, specifications and installation instructions for all equipment and major materials and other components and accessories within this Section
 - (c) Manufacturer's Certification for all equipment and major materials shall be provided by the Contractor (prior to installation) and indicating compliance with the requirements of the Specification. Where so instructed by the Engineer, the Contractor shall obtain independent certification for materials, equipment and/or systems from independent and approved testing agencies, all at the expense of the Contractor.
- (4) Materials and equipment shall not be ordered or fabricated until the above submissions have been approved by the Engineer.

3.2. Further Submissions

- (1) Submissions shall be in accordance with Section 1000 of the Specification, unless otherwise noted herein or in the Specifications for respective sections of the Works. The following submissions are required in addition to or in clarification of the requirements of Section 1000:
- (2) Equipment/Material lists; A comprehensive schedule of the equipment and major materials shall be provided.
- (3) Shop and coordination drawings for all work required under this Section; Special attention shall be paid to the coordination of every section with all other sections of the Works including Civil, Special Equipment, Mechanical, Electrical and Utility, and all other Section 4000 Architectural Works.
- (4) Shop Drawings shall clearly indicate the particular manufacturer's document number

and fitting details used as reference in the development of the shop drawings.

- (5) Shop drawings shall be complete submissions for approval and, where applicable, shall include scale plans, and details of the equipment, structures, piping, cable and wiring and shall show the method of installation with all conduits, trays and other cable and pipe support and conveying systems and all foundations supports and accessories.
- (6) All Field dimensions shall be verified and included on shop drawings showing exact locations and dimensions.
- (7) Samples and test certificates of materials and equipment as specified or as requested by the Engineer. Any materials delivered thereafter that the Engineer considers not equal to the approved samples, shall be rejected and removed from the Site.
- (8) Samples should be the same as the permanent items to test the performance and show the workmanship, colour and finishes.
- (9) Samples are not returnable, nor included in quantities listed for the Works.
- (10) Approved samples shall be kept on Site for reference.

3.3. **As Built Drawings**

- (1) Maintenance Instructions
 - (a) The Contractor shall be responsible for obtaining from the manufacturer, for each type of fitting, control and accessory, the recommended operation and maintenance manual including tools required and types of cleaners to be used
 - (b) The Contractor shall incorporate the manufacturer's information within the Operation and Maintenance Manuals.
- (2) Operating and Maintenance Manuals

4.0 **QUALIFICATIONS**

4.1. **Generally**

- (1) The equipment and materials shall be obtained from manufacturers who have been approved by the Engineer.

4.2. **Manufacturers**

- (1) To qualify for approval of their products, manufacturers shall:
 - (a) Have regularly produced the same or similar Plant and equipment for more than 5 years prior to Bid opening;
 - (b) Possess necessary certificates and licences for the manufacture and sale of required products;
 - (c) Take full responsibility for all requirements of the Plant, equipment, materials or systems where specified under respective sections of the Specification;
 - (d) Be capable of providing the Maintenance and Repair Services specified herein including the provision of emergency call out services within 24 hours, after notification by the Engineer or the Employer;

- (e) Be capable of entering into a full service maintenance agreement with the Employer after completion of the Defects Notification Period; and
 - (f) Directly employ well trained and experienced workmen and supervisors.
- (2) The manufacturer shall fully substantiate all requirements hereof with sufficiently comprehensive and authentic documentation, in the English language for the review and approval of the Engineer.
 - (3) The types of Plant and equipment proposed for approval shall have been in commercial service for at least three (3) years with satisfactory performance evidenced if so required by the Engineer.
 - (4) In any one item of equipment or in any System, items and components shall generally be the product of one (1) manufacturer and units and parts thereof shall be readily interchangeable.
 - (5) Quality of products shall be of the highest international standard used for similar type of Project

5.0 APPLICABLE STANDARDS

- (1) All work shall be in accordance with Standards listed in Section 1000.
- (2) The International System of Units (SI) only shall be used.
- (3) All plant materials and equipment shall be new, of good quality, and be approved by and bear the label of UL (Underwriter's Laboratory) or another independent safety testing laboratory acceptable to the Engineer.
- (4) Plant materials and equipment installed outdoors including protected areas (such as building soffits) and indoors in areas subject to water or extreme humidity shall be UL listed for damp locations.

6.0 SURVEY AND LAYOUT REQUIREMENTS

- (1) Further to the requirement of Conditions of Contract Sub-Clause 4.7 the Contractor shall prior to commencement of and during construction operations:
 - (a) Establish building column/grid reference system, and boundary or primary perimeter lines of buildings and various other structures included under this Contract.
 - (b) Establish utility entrance points at perimeters of buildings or other structures or areas, as applicable.
 - (c) Establish and control floor levels, and other structures; and finish grades for other areas within boundaries of work for this Contract.
 - (d) Establish reference points adjacent to Architectural Works areas sufficient for accurately locating utilities entering those areas and for laying out buildings and other structures within such areas.
 - (e) Coordinate and check all dimensions and levels, as work progresses, to ensure compliance with requirements.
 - (f) As work progresses, provide primary guide lines or points throughout each interior area as necessary to facilitate detailed layout of partitions, doors, windows,

equipment foundations, ceilings and various other structures.

- (g) Provide lines or marks on sub-floors as required, using paint or means sufficiently durable for the time required.
- (h) 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.
- (i) Recheck and verify layout, locations and dimensions prior to making rough-ins or setting of other Work.

7.0 COORDINATION AND CORRELATION REQUIREMENTS

7.1. Precautions

- (1) Observe and comply with precautions and instructions of manufacturer when using any toxic, noxious or otherwise hazardous material.
- (2) Use materials and perform operations as necessary to avoid fire damage or other injury or accident as required and dictated by good safety knowledge and judgment.

7.2. General

- (1) Utility rough-ins, including required tests and other work to be covered up or concealed shall be completed and approved before such is enclosed or otherwise made inaccessible.
- (2) Notify the Engineer not less than fourteen (14) days in advance for each item of work being ready for testing or inspection.
- (3) Rough-in work shall be approved by the Engineer prior to being covered, concealed or otherwise made inaccessible.
- (4) Power systems to be provided under any separate contracts shall be tested and approved prior to actual energizing of such power into electrical systems work required under this Section.
- (5) Systems under this Contract shall be completed, tested and approved to ensure safety prior to utilisation of said power sources.

7.3. In Advance of Work

- (1) Coordinate all work under this Section with layouts and all work in other Sections and incorporate adjustment as and where necessary to ensure a properly coordinated installation and complete and operable Systems as intended as required by and intended under these Contract Documents.
- (2) Coordination includes, among others, considerations of locations, sizes, capacities and performance characteristics of equipment furnished and installed under other Sections and Divisions.
- (3) Coordination further includes providing adjustments in the electrical work to meet needs of said equipment and cooperation with other contractors or subcontractors as may be necessary to make the determination required.
- (4) Ensure that correct anchor and fixing systems are selected compatible with substrate types and conditions.

- (5) Provide layout, templates and or instruction as necessary for proper preparation of supporting construction.
- (6) Provide all necessary sleeves, inserts, bolts, backing plates or other incidentals embedded in concrete or masonry or attached to and/or concealed by work under other Sections and Divisions.
- (7) Furnish in quantities and deliver at times necessary for properly arranged and timely installation.

7.4. **Drawings**

- (1) Drawings shall be examined and developed as necessary to achieve fully coordinated and proper installations as intended herein.
- (2) Mechanical, Electrical and Terminal Equipment Works indicated in the Drawings are generally diagrammatic and location of openings, outlets, Plant, equipment, fixtures and fittings are approximately only.
- (3) Verify that sizes and locations are adequate and proper and develop as required.
- (4) Exact routings and locations including layouts and positions of Plant, equipment, pipes, cables, wires, trays, conduits, outlets, equipment and other items shall be coordinated by the Contractor with all civil, building , structural, mechanical, electrical and utility works in other Divisions to avoid conflict and to provide systematic and well organised Plant, equipment, pipe, cable/wire and related works installation.
- (5) Contractor designed routings and locations shall be coordinated in order to ensure easy maintenance and proper operation.
- (6) Arrange for additional facilities and openings for access or maintenance where and as may be required.

8.0 **MATERIAL AND PRODUCT REQUIREMENTS**

8.1. **Generally**

- (1) All Plant, materials and equipment for Architectural Works shall be designed, fabricated and constructed for purposes and uses intended and in accordance with or capable of meeting standards as specified herein.
- (2) Compliance shall be substantiated by sufficient and adequate prototype testing or otherwise evidenced by such operational reports and data as may be required by the Engineer to fully demonstrate performance characteristics, operational qualities, reliability, safety and other relevant considerations.

8.2. **Product Requirements**

- (1) Unless otherwise shown, specified or approved, shall be Manufacturer's first quality line of standard and/or series of factory fabricated items.
- (2) Plant, Materials and equipment specified shall conform to JIS, ASTM, or equivalent international standards and where so directed by the Engineer, shall be tested, in accordance with relevant standards by an approved independent agency and shall be certified as conforming to such requirements.
- (3) Comparable materials, assemblies and systems of manufacturers other than as

specified may be proposed where the same or differing in minor details only and otherwise comply with requirements shown or specified, subject to prior approval by the Engineer.

- (4) Materials and equipment shown or specified shall be essentially standard catalogue products of an approved manufacturer and any variations thereto shall be only as specified or approved by the Engineer.
- (5) Where two (2) or more units of same class, type or kind are required, units shall be products of a single manufacturer.
- (6) Where a device or part of a piece of equipment is referred to in singular number, such reference shall apply to as many services or parts as are needed to complete work required.
- (7) Similar mechanical and similar electrical parts and components should be identified throughout each system and be readily interchangeable.
- (8) Mechanical System or principal components thereof of similar type shall be designed, fabricated and supplied by a single manufacturer for all work under this Contract.
- (9) Substitution of keyed locks not complying with specified requirements shall not be permitted.
- (10) Substantial increase in overall size(s) of items of equipment or major components shall not be permitted, unless approved in advance by the Engineer.

9.0 EXECUTION REQUIREMENTS

9.1. Prerequisite Conditions

- (1) Work shall not proceed until the Contractor has verified that supporting construction is in proper condition per requirements specified herein and any improper construction conditions have been corrected and re-inspected and that layouts, location and tolerances are correct for this work.

9.2. During Construction

- (1) Remove waste and debris as work progresses and on completion.
- (2) Service and adjust moving or mechanical parts for smooth, quiet and proper operating condition.
- (3) Touch-up abraded or damaged prime painting or galvanizing and leave clean and ready for finishing work required all to approval.

9.3. Mock-ups

- (1) The Contractor shall construct full-scale mock-ups to allow the Engineer to appreciate assembly details, finished aspects, color 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 in accordance with Section 1165 of the Specification 1000.

9.4. Supervision

- (1) Furnish the full-time services of one (1) or more experienced professional engineer well qualified in directing and overseeing all phases of the various work all as approved by the Engineer.

- (2) Furnish the services of manufacturer's representatives or other especially qualified persons as necessary to supervise installation of equipment, major or specialist materials, all ducts and pipework all as instructed or approved by the Engineer.

9.5. Protection

- (1) Protect work herein during construction and after completion.
- (2) Protect adjacent construction and finishes.
- (3) Repair or replace at the Contractor's expense and as directed by the Engineer any works or any adjacent exposed surfaces stained or otherwise damaged resulting from use of materials or operations under the electrical work.

9.6. Operation before Final Acceptance

- (1) Should the Employer require that any portion of the Works or any Plant or equipment be operated for testing purpose prior to date of substantial completion and Taking Over, the Contractor shall consent and such operation shall be under supervision and direction of the Contractor. The operation so required prior to substantial completion shall not be construed as nor constitute acceptance of work so operated, nor construed contrary to requirements for early activation of systems.

9.7. Upon Completion

- (1) Exposed and concealed surfaces shall be clean and free from dust, dirt, scratches, dents, broken parts, misaligned or improperly fitted joints, stains, discolouration or other defects or damage.
- (2) Installation shall be free from exposed fastenings, unnecessary cuts, holes, blank plates or advertising labels or signs other than indicated, specified or approved.
- (3) Exterior or below grade installation watertight throughout and free from leaks or entry of water into a through interior or concealed spaces of the structure.
- (4) Each item, unit, or assembly shall be tightly and rigidly secured in place, free from unnecessary movement, squeaks or rattles.
- (5) Each item, unit assembly shall be set straight, plumb and level, accurately positioned at locations required and adjacent similar units accurately aligned.
- (6) Movable or mechanical items or devices shall be serviced and adjusted to operate smoothly, quietly, easily and free from binding, superfluous or unwanted noises.
- (7) Electrical devices assemblies or systems shall be properly connected and grounded and operating in compliance with the performance requirements and tested as specified.

9.8. Work not in Compliance

- (1) Repair or replace as directed by the Engineer.

9.9. Equipment Identification Requirements

- (1) Exposed surfaces of fixtures, Plant and equipment shall be free from shop or factory applied manufacturer's/vendor's labels, advertising, insignia, emblems, decals or other like devices.

- (2) All items shall be otherwise identified in compliance with the requirements specified herein.
- (3) Manufacturer's identification labels are required for all factory fabricated fixtures, Plant and equipment. They shall be applied so as to be concealed when the item is installed and normally closed, but shall be readily visible and readable when opened.
- (4) Each label shall be of standard manufacture, non-corrosive and durable and permanently affixed.
- (5) Labels or nameplate shall state fixture or equipment item type, model number, rating and current characteristics.
- (6) Product Identification Signs are required for each electrical equipment item, in readily visible locations, each sign installed level and accurately and symmetrical positioned. Sizes shall be suitable for equipment, colours shall be as instructed by the Engineer and lettering shall be plain block or gothic style only
- (7) Circuit Directories are required for every panel containing electrical control or safety devices and directories shall be installed on the inside of all panel doors. Each directory shall be correlated with the panel in which it is installed and shall be in typewritten tabular form. Each directory shall be protected by a laminated plastic cover and secured to the door with a suitable metal frame all to the approval of the Engineer.

9.10. **Protective Coating / Painting**

- (1) Unless otherwise specified or approved, ferrous materials used in Plant, equipment and materials, shall be shop galvanised. Internal components shall generally be electro-galvanised, external components shall generally be hot dip galvanised.
- (2) Alternatively Aluminium alloy may be used subject to obtaining the approval of the Engineer
- (3) Exposed surfaces of Plant, materials and equipment shall also be finish painted. Unless otherwise approved, finish painting shall be factory applied. Surfaces shall be cleaned, primed with two coats of rust inhibiting primer , finished with two (2) coats of enamel and baked (colour shall be selected by Engineer), in accordance with approved manufacturer's standard factory processes.
- (4) Special finishes shall be provided where shown or specified.
- (5) Unless otherwise specified or approved Site finish painting shall be two coats of high gloss enamel or stove enamel as appropriate, with primer and undercoat as appropriate and approved.
- (6) Painting work and materials required herein and not otherwise specified shall be in accordance with applicable requirements specified under Division 31100.

9.11. **Lubrication/Maintenance Requirements**

- (1) Lubrication facilities shall be provided for all parts involving friction and wear other than where suitably covered or protected by resilient materials or where provided with life-time packing or fittings.
- (2) Provide all necessary facilities including grease fittings, oiling caps or other like facilities as required to maintain equipment properly protected and with all like items essentially identical and serviceable using same lubrication tools throughout.

- (3) Locate lubrication facilities where readily visible and position where easily accessible.

9.12. **Safety Guards**

Required for all sheaves, couplings and other running equipment which could cause physical injury upon accidental or inadvertent contact.

10.0 GUARANTEE

- (1) Refer to respective section of the Specification.
- (2) Any guarantees/warranties required by respective Divisions of the Specification shall be provided in writing and in a form approved by the Engineer and Employer, for the due and faithful observance and performance of this obligation. Such guarantees/warranties shall be delivered to the Engineer for approval at the same time as the Request for Approval (RFA) as specified in Section 1000 of the relevant part of the Works, Plant, System, equipment, materials or manufacturer of the particular Division.

11.0 MEASUREMENTS AND RATES

11.1. **Generally**

- (1) Measurement/Rates for Architectural Works shall be in accordance with the detailed requirements included in the respective sections of the Specification.

SECTION 4110

EARTHWORK FOR BUILDING WORKS

1.0 GENERAL

1.1. Scope of Application

This Section shall apply to all excavation of soil and execution of all earthwork necessary for the construction of all buildings.

1.2. Items of Work

This Section includes:

- (1) Excavation generally
- (2) Supports to sides of excavations
- (3) Backfilling
- (4) Disposal
- (5) Gravel bed
- (6) Finishing of Site

1.3. Interface with Civil Works, Section 2100

- (1) The Contractor shall preserve and protect the prepared ground surface provided by the Civil Works contractor and for making up any deficiencies or defects arising out of a failure to preserve and protect such surfaces, including providing any additional embankment material in accordance with the requirements of Civil Works Section 2140, as a consequence of settlement, erosion or surface damage of whatever cause. This work shall be at the Contractor's expense.

2.0 GENERAL DESCRIPTION OF THE WORK

Existing Services

Refer to para. 4.0 of Section 1110.

3.0 GENERAL WORKING DIRECTIONS

3.1. General

- (1) The working methods and Contractor's Equipment for earthwork shall be subject to the approval of the Engineer. The methods and equipment shall take into account the nature of soils and any rock likely to be encountered, the presence of cavities or sinkholes and the potential presence of the ground water table.
- (2) The Contractor shall keep excavations free from all ground, running and surface water at all times. Water from excavations shall not be permitted to flow directly into the new drains or other construction work.

- (3) Where pumping is necessary, the material in and around the excavations shall not be disturbed by pumping, and all sumps shall be formed by the measures to be taken hereunder described and clear of excavations for permanent work:
 - (a) Water pumping at all low points shall be provided continuously until the permanent drainage systems are finished and connected to the existing drainage network;
 - (b) The drains shall be built as excavation progresses;
 - (c) Effective temporary settlement basins shall be installed before the water is drained into recently completed or existing drainage systems; and
 - (d) The drainage network for the water coming from the work area, whether it is included in the jobsite or down-stream, shall be permanently protected against pollution, maintained and kept clean until the end of work.
- (4) The Contractor shall organize each section of the earthworks rationally so as to eliminate prolonged exposure of subgrades and bottoms of excavations during bad weather.
- (5) All materials arising from Excavation shall remain the property of the Employer and the Engineer will direct the Contractor where the materials are to be transported and deposited.
- (6) The concept of Site development is “cut and fill” and consequently no excavated materials shall be removed from the Site. Excavated materials shall all be set aside for re-use including where necessary treating by crushing, grading or otherwise, placed and compacted in the permanent Works to meet the requirements of the Specification, including transporting and placing by the Contractor to various locations around the Site.
- (7) Where specifically and exceptionally instructed in writing by the Engineer that materials are not required to be kept on Site or retained by the Employer, materials shall be removed by the Contractor from the Site to a disposal area to be selected by the Contractor (and approved by the Engineer) at the expense of the Contractor.

3.2. **Excavations**

- (1) Excavation shall be carried out to the dimensions lines and levels, of the permanent structures as indicated on the Drawings.
- (2) Excavation shall be performed carefully to avoid over-excavation, overbreak or unnecessary disturbance of adjacent surfaces. Any over excavation, overbreak or disturbance caused by excavation operations shall be backfilled with satisfactory excavated materials or insitu concrete Class B3 as instructed by the Engineer and at the expense of the Contractor.
- (3) Trenches, foundation pits for structures or structural footings shall be excavated to lines and grades or elevations shown on the Drawings or as subsequently directed by the Engineer and shall be of sufficient size to permit placing of structures or structural footings of the full width and length shown.
- (4) In certain instances, elevations of bottoms of footings as shown may be considered inappropriate and the Engineer may order, in writing, such changes in dimensions or elevations of footings as may be deemed necessary, to secure a satisfactory foundation.
- (5) After each excavation is completed the Contractor shall notify the Engineer to that

effect, and no footing, or other material shall be placed until the Engineer has approved the depth of excavation and character of exposed foundation material.

- (6) Any concrete or other work put in before the excavation has been inspected and approved, shall if so directed by the Engineer, be removed at the Contractor's expense.
- (7) The bottoms of excavation shall be cleaned of all loose material and cut to a firm surface, either level, stepped, or serrated as directed by the Engineer; all seams or crevices shall be cleaned and grouted; and all disintegrated hard material and thin strata shall be removed.
- (8) Excavation to final grade shall not be made until immediately prior to placing of concrete foundation or filling.
- (9) When foundation material is soft or otherwise unsuitable, as determined by the Engineer, the Contractor shall remove unsuitable material and backfill with approved granular material; placed and compacted in 150mm layers or with concrete Class B3 as instructed by the Engineer up to foundation elevation at the Contractor's expense.
- (10) The bottom of excavations shall be free from mud and water, trimmed clean, protected from the effect of weather and thoroughly compacted and consolidated by approved methods.
- (11) Subgrades to ground floor concrete beds shall be fully compacted so that the dry densities over 300mm depth shall be at least equal to 95% of the maximum density (Proctor compaction test).
- (12) The subgrades shall be approved by the Engineer before any of the layers covering them are placed. The subgrades shall be covered immediately after their acceptance.
- (13) The subgrade adjustment tolerance shall be + 20mm.
- (14) Any traffic threatening to cause deformations of accepted subgrades shall be forbidden. This implies as mentioned hereunder that the Contractor:
 - (a) Organizes the Site so that the materials are supplied hereunder without moving over those already in place: and
 - (b) Uses low-pressure type equipment.
- (15) In case any damage is caused to the subgrades, this shall be repaired by the Contractor at his own expense.
- (16) After the placing of any blinding concrete required by the Contract, no trimming of the side faces shall be carried out for twenty-four (24) hours.
- (17) The excavation tolerances for foundations with respect to the specified levels, shall be - 30mm and + 10mm.
- (18) If the Contractor does not comply with this tolerance, he shall execute at his own expense, either adjustment by soil removal, or by filling of excess depths with blinding concrete.
- (19) The excavation bottoms shall be adjusted as the excavations are finished. As soon as the bottom is accepted by the Engineer, the blinding concrete shall be poured immediately.

3.3. **Excavation in Rock**

- (1) The Contractor shall immediately notify the Engineer of the presence of any rock in the excavations.
- (2) Rock shall be defined as hard, dense, stratified naturally occurring material, which in the opinion of the Engineer cannot be excavated without using special rock removal methods such as drilling and/or blasting.
- (3) Any material which in the Engineer's opinion can be removed with normal excavation methods such as with hydraulic excavators, draglines, scrapers, bulldozers (with or without rippers or similar attachments) and the like, shall not be classified as Rock.
- (4) The Contractor shall keep such contemporary records and take such measurements as are required by and in the presence of the Engineer in order to compute the volume of rock required to be excavated.

3.4. **Supports to Sides of Excavations**

- (1) Where required by the nature of the materials to be excavated, or the nature of the structure to be accommodated, or as directed by the Engineer the Contractor shall provide all necessary sheet piling, planking, strutting and shoring required to safely and securely uphold the face of the excavation and any necessary staging.
- (2) The Contractor shall be responsible for the design, supply, fixing and removal of all sheet piling and planking and strutting required.
- (3) The sheet piling and planking and strutting shall be of sufficient strength to resist all anticipated loadings, to ensure the safety of the workmen and to prevent damage to any adjoining property.
- (4) The Engineer may direct that such supports be left in position at the expense of the Contractor. Alternatively, subject to the prior approval of the Engineer and at no additional expense, the face of the excavation may be suitably battered.

3.5. **Re-use of Excavated Material**

- (1) Material arising from the excavations shall be used as backfill to structures or in the inner structural embankment works of the Civil Works all as directed by the Engineer.
- (2) In general all other material arising from the excavations shall be used as general site filling or in the outer embankment works of the Civil Works unless otherwise instructed by the Engineer.
- (3) Suitable material is defined as excavation material that complies with Sub-Section 2140.
- (4) The Contractor's working methods shall ensure that the highest proportion of suitable material is cleanly excavated without contamination and suitable material shall be clearly segregated.
- (5) Material that becomes unsuitable as the result of incorrect handling or construction methods or contamination by the Contractor shall be conditioned and used or disposed of, and replaced at the expense of the Contractor all in accordance with the written instructions of the Engineer.

3.6. **Disposal of Unsuitable or Surplus Excavation Material**

- (1) All excavated materials, either within or beneath the design excavation limits that in the opinion of the Engineer, will be detrimental to the permanent works shall be

designated “unsuitable material”.

- (2) Unsuitable materials shall include soils which:
 - (a) Have a low natural density less than 800 kg/m³, or
 - (b) Are highly expansive, or
 - (c) Have hazardous chemical or physical properties.
- (3) Unsuitable material shall be disposed of according to the instructions of the Engineer generally in common or outer embankment.
- (4) All disposal sites provided and used by the Contractor shall comply with the relevant Philippine laws and regulations concerning the Protection of the Environment.
- (5) Unsuitable material shall only be removed from the Site following the written instruction of the Engineer.
- (6) No other excavated material shall be removed from the Site.

3.7. **Backfilling**

- (1) Structural backfill shall comply with the requirements for structural embankment according to Section 2140.
- (2) Excavated areas around foundations and structures shall be backfilled with approved selected previously excavated material in horizontal layers not exceeding 200mm, after compaction, up to the level of original ground surface; each layer moistened or dried as required and thoroughly compacted with mechanical tampers.
- (3) Backfill material shall be placed simultaneously to approximately the same elevation on both sides of structure. Should conditions require the placing of backfill appreciably higher on one side than on opposite side, such additional material shall not be placed until approved by the Engineer. No material shall be placed until concrete or masonry has been in place fourteen (14) days, or until tests establish that concrete or masonry has attained sufficient strength to withstand any pressure created by the methods used and materials placed without damage or strain beyond a safe factor.
- (4) Backfill shall not be placed behind walls of concrete culverts, trenches or rigid frame structures until the top slab is placed and cured.
- (5) The dry densities of the fill in place after compacting shall be at least equal to 90% of the maximum dry density (Proctor compaction test).
- (6) Excavation shall not be backfilled until the foundations or structures have been inspected and approved by the Engineer.
- (7) The Contractor shall be responsible for making good to the satisfaction of the Engineer, all settlement in backfilling that may occur.
- (8) Backfill material arising out of excavation in rock shall be prepared by crushing.

3.8. **Gravel Bed**

- (1) The Gravel Bed indicated on the drawings, shall comply with the requirements for crushed aggregate according to Section 2220.

- (2) The Contractor shall be responsible for making good to the satisfaction of the Engineer, all settlement in the embankment under this Gravel Bed, that may occur and for grading and compacting the embankment to at least 95% of the maximum dry density. Material and workmanship used in such filling shall comply with the requirements of Section 2140, inner structural embankment.

3.9. **Damp proof membrane**

Refer to Section 1400.

3.10. **Finishing of Site**

- (1) The ground shall be levelled as indicated on the Drawings or as directed. The surplus excavated material shall be used for forming levels or removed as directed.
- (2) Unpaved areas shall be free from weeds and reduced to the required level and left in a neat and tidy condition. Where required, approved suitable fill shall be supplied and laid to the Engineer's satisfaction.
- (3) Rubbish, weeds and combustible rubbish shall be removed from the Site and disposed of at the Contractor's expense. The burning of rubbish will not be permitted on the completed works.
- (4) Any part of the Site damaged or disturbed shall be made good to the Engineer's satisfaction.

4.0 **MEASUREMENT AND RATES**

4.1. **Measurement**

- (1) Work under this Section shall be measured according to the item classifications and units contained in the Bills of Quantities (BOQ).
- (2) Excavation shall comprise all types of excavation, including excavating oversite to reduce levels, excavating for pits and trenches, working space etc. all of which shall be measured in cubic meters (m³).
- (3) Reduced level excavation shall be measured as the net plan area necessary to accommodate the permanent reinforced concrete foundations and floor slab. Starting level shall be the formation levels, indicated in para. 1.3 of this Section (unless officially varied by the Engineer in writing). No allowance shall be made for the volume of working space or sloping faces. Finished level shall be the underside of the gravel bed as indicated on the Drawings.
- (4) The volume of pits and trenches for structural foundations shall be computed net, based upon the net plan area necessary to accommodate the permanent reinforced concrete foundation works as measured from the Drawings or to levels instructed by the Engineer. Starting level shall be the level after reduced level excavation.
- (5) There shall be no allowance in the quantities for any additional volume of Excavation, Disposal or Backfill that may be required to accommodate working space to any excavation, space for earthwork supports or sloping sides of excavations, even if same is indicated on the Drawings.
- (6) Excavation in rock shall be computed from the starting level of rock according to the agreed Site records as inspected and signed by the Engineer and the direct plan area necessary to accommodate the permanent works.

- (7) Disposal shall be measured in cubic meters (m³). The quantity shall be computed net of the volume of excavated material to be disposed of and no allowance shall be made for bulking. The quantity shall generally be the volume of the permanent concrete structures within the excavation.
- (8) Backfilling shall be measured in cubic meters (m³). The quantity shall be computed net of the finished compacted volume of backfilling required with quantities taken from the Drawings. The quantity shall generally be the balance volume computed by deduction of the total measured volume of Disposal from the total measured volume of excavation.
- (9) Gravel bed shall be measured in square meters (m²). The quantity shall be computed net of the finished area on the Drawings.
- (10) Damp-proof membrane shall be measured in square meters (m²). The quantity shall be computed net with no allowance for laps.

4.2. **Rates**

- (1) The rates shall be full compensation for all plant, materials, transport, labor, equipment, temporary works, establishment charges, overheads, profits and taxes required to complete the work described in this Section of the Specification and/or shown on the Drawings.
- (2) Rates shall further include for:
 - (a) forming any trial holes to locate existing services, cables or drains
 - (b) excavating and filling by hand or machine
 - (c) settlement
 - (d) bulking and multiple handling
 - (e) Excavating in any materials likely to be encountered including all clays, sands, silts, boulders or old foundations and rock as defined herein
 - (f) All necessary supports and protection to uphold and maintain sides of excavations
 - (g) All required additional volume of excavation to accommodate working space including additional backfilling, disposal, earthwork supports and all other additional costs associated therewith
 - (h) Pumping, dewatering and diverting water from the excavations including all temporary works, Contractor's equipment and labor to keep excavations and the works free of all ground, surface other water
 - (i) Settlement basins
 - (j) Depositing carefully in designated locations as agreed with the Engineer;
 - (k) Trimming, grading, levelling and compacting surfaces of excavation or fill
 - (l) Protection.
- (3) Rates for backfilling and filling to make up levels shall further include for:
 - (a) Earthwork support

- (b) Selecting suitable material
 - (c) Treating excavated rock by crushing, screening, grading all as approved or directed by the Engineer.
 - (d) Placing, conditioning, watering and consolidating in layers including all required tests
 - (e) Finishing.
- (4) Rates for Gravel Bed shall further include for:
- (a) Selecting suitable material
 - (b) Placing and compacting
 - (c) Finishing surface to receive concrete or membrane including blinding with sand
 - (d) Preparing and compacting underlying embankment
- (5) Rates for damp-proof membrane shall further include for:
- (a) Laps
 - (b) Fitting around obstructions
 - (c) Cutting
 - (d) Turning up at edges of concrete slabs, bedding into block work
 - (e) Protection.

SECTION 4120

TERMITE CONTROL

1.0 SCOPE OF WORK

The Contractor shall execute toxic anti-termite treatment to all ground, embankment and fill surfaces in contact with or adjacent to the structures.

2.0 MATERIAL

2.1. Qualification of Pesticide Applicator

The work shall be executed by a specialist firm or specialist personnel in the employ of the Contractor. The pesticide applicator's principal business shall be pest control and the pesticide applicator shall be a Philippine Government Certified pesticide applicator which includes structural pest control, and certified in the Philippines.

2.2. Materials

Materials used for the termite control shall be selected such that they have no detrimental effect on the materials used for the construction of the Works nor on the load bearing capacity of the ground and surfaces so treated. A copy of the manufacturer's label (chemical analysis) and Material Safety Data Sheet shall be submitted to the Engineer for approval, prior to the treatment commencing.

2.3. Samples

The Contractor shall submit on request, or the Engineer may draw at any time and without prior notice, from stocks at the job site, samples of the pesticides used in this work and the Contractor shall provide analyses of such samples. Should such analysis, indicate such samples to contain less than the amount of active ingredient specified on the label, work performed with such products shall be repeated, with pesticides conforming to this specification, at no additional cost to the Employer.

2.4. Delivery, Storage and Handling

The pesticides shall be delivered to the Site in sealed and labelled containers in good condition as supplied by the manufacturer or formulator. The pesticide shall be stored, handled and in accordance with manufacturer's labels and instructions. Labels shall bear evidence of registration under the Philippines or foreign Insecticide, Fungicide, and Rodenticide Acts or Laws, as amended or appropriate for Philippine regulations.

2.5. Safety Requirements

The pesticides and their containers shall be formulated, treated and disposed of in accordance with label directions. The water for formulating shall be drawn only from sites designed by the Engineer, and the filling hose shall be fitted with a backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of the Contractor to prevent overflow. The pesticides and related materials shall be secured under lock and key when unattended. Proper protective clothing and equipment shall be worn and used during all phases of termiticide application. Used pesticide container shall be disposed off the Airport property.

3.0 APPLICATION

3.1. Verification of Conditions

At the time of application, the soil shall have a sufficiently low moisture content to allow uniform distribution of the treatment solution throughout the soil. Applications shall not be made during or immediately following heavy rains or when conditions may cause run-off and create an environmental hazard.

3.2. Soil Treatment

- (1) After excavation of foundation trenches and the like, the bottoms and sides of the excavation shall be sprayed with termite protection which shall be applied as a coarse spray and in such a manner as to provide uniform distribution into the soil surface. The treatment shall be applied prior to placement of a vapour barrier or waterproof membrane and at least twelve (12) hours prior to concrete pouring.
- (2) After backfilling foundation excavations the surface of the backfill shall be sprayed together with the surfaces of the gravel beds.
- (3) Manufacturer's warnings and precautions in the handling and use of the materials shall be strictly observed and the Contractor shall ensure that the chemicals do not enter water systems or endanger plant and wildlife.
- (4) The Engineer shall be informed at least forty-eight (48) hours prior to beginning of treatment, and the formulating, mixing and application shall be performed in the presence of the Engineer or Engineer's representative.

3.3. Rates and Materials of Application

The pesticide shall be sprayed at a rate of cover of not less than three (3) litres/m² or per manufacturer's recommendation.

3.4. Application Report

Upon completion of the treatment, a Pest Management Data System Application Report shall be submitted to the Engineer identifying brand name and manufacturer of pesticide, dilution, and method and rate of application used.

4.0 WARRANTY

A 3-year written warranty shall be furnished commencing after the end of the Defects Liability Period and in a form approved by the Engineer, against infestations or reinfestations by subterranean termites of the buildings constructed under this contract. Annual inspections of the building shall be performed. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, the Contractor shall at his own cost:

- (1) Re-treat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;
- (2) Repair damage caused by termite infestation; and
- (3) Re-inspect the building approximately 180 days after the retreatment.

5.0 MEASUREMENT AND RATES

5.1. Measurement

- (1) The unit of measurement of the anti-termite soil treatment shall be square meter (m²).
- (2) The quantity to be measured for all treatment shall be the single horizontal plan area of the building plus a projection of 3 meters beyond the face of the building computed from the Drawings with no allowance for vertical sides or multiple treatments.

5.2. **Rates**

The rates shall be full compensation for all plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the work describe in this Section of the Specification and/or shown on the Drawings.

SECTION 4130

SOIL IMPROVEMENT

1.0 GENERAL

- 1.1. As a result of soil investigation under Section 1175 and in accordance with the Engineer's decision thereof, if the soil is required to be improved, the Contractor shall, prior to commencement of earthworks for Passenger Terminal Building and ATC Operation & Administration Building and Control Tower, carry out the soil improvement work by means of grout injection into the subsoil on the foregoing sites as instructed by the Engineer in the manner as specified hereunder.
- 1.2. The work shall consist of grouting, monitoring and testing of grouting to meet the acceptance criteria as established in the approved method statement.
- 1.3. The Contractor is encouraged to engage the reputable subcontractor specialising in the work under this section.
- 1.4. Before commencement of the work, the Contractor shall submit the method statement stating work plan, schedule, and layout of grout injection locations, equipment and materials and organization of the specialist subcontractor for approval of the Engineer. The Contractor shall be fully aware of any permits to be obtained from the local authority and environment restrictions under the law (if required) and incorporate such procedures and requirements into the Works under this Section.

2.0 WORK EXECUTION

- 2.1. Cement grout shall meet the requirements specified in Section 1400.
- 2.2. Prior to grouting works, the Contractor shall conduct preliminary plate load test in accordance with ASTM D 1196 on the subsoil at the elevation and location as confirmed by the Engineer to determine the original soil bearing capacity. This test shall also be implemented after soil improvement has been accomplished and cement was cured at 28 days from the start of the injection.
- 2.3. The injection method may be proposed by the Contractor, i.e. packer injection with a Tube A Manchette (TAM), packer injection direct into rock, grout injection direct via drilling tools, etc., depending on the approved specialist sub-contractor's proposal to suit the purpose and site conditions. The following equipment may be used:
 - (a) Drill rig
 - (b) Pressure pump
 - (c) Packer
 - (d) Grout accessories, i.e. hose, etc.
 - (e) Grout mixer

3.0 LABORATORY TESTS

- 3.1. Laboratory test of grout mix – moulded grout mix will be subjected for compressive strength test based on standard procedures.

- 3.2. Laboratory test for grouted soil – this is to determine the extent of grouted soil. The properties of the soil that will be used for the computation of soil bearing capacity.

4.0 REPORTING

4.1. Daily Report

The Contractor shall submit the daily report during and after cement grouting as per standard procedures.

- (1) Drilling reports – as a minimum requirement, drilling inspection reports should contain all the technical attributes that require in the contract documents, such as hole diameter depth and spacing.
- (2) Grouting reports – grouting inspection reports contains all the technical attributes that are required in the contract documents, such as the mix used, injection pressure and quantity of grout injected into each hole.

4.2. Summary Report

The Contractor shall submit to the Engineer, four (4) copies of the summary report of the program and soft copy. This report shall include all details of sampling, inspection and testing, packing and marking in accordance with the normal standard practice and the approved method statement.

5.0 MEASUREMENT AND RATE

5.1. Measurement

Measurement for work under this Section shall be measured according to the unit stated in the Bill of Quantities.

5.2. Rates

Rates shall include all cost necessary of material, equipment and labour to complete the soil improvement works including drilling, sampling and testing specified in this Section.

SECTION 4220

CONCRETE WORK FOR BUILDING WORKS

1.0 IN SITU CONCRETE

Refer to **Section 1400**.

2.0 STEEL REINFORCEMENT

Refer to **Section 1420**.

3.0 FORMWORK/FINISHING

Refer to **Section 1440**.

4.0 MEASUREMENT AND RATES

4.1. Measurement

- (1) Work under this Section shall be measured according to the item classification and units contained in the Bills of Quantities (BOQ).
- (2) Quantities shall be computed from dimensions on the Drawings.
- (3) Concrete generally shall be measured in cubic meters (m³). No deductions from volume shall be made for volume of steel reinforcement or embedded steel sections.
- (4) Concrete formwork to reinforced concrete shall be measured in square meter (m²). The quantity shall be measured net from the Drawings of the finished surface in contact with concrete. Formwork shall not be measured to plane in situ concrete.
- (5) Concrete reinforcing bar shall be measured in kilogram (kg). The quantity shall be computed net from lengths indicated on the Drawings and the nominal weight/meter shall be derived from standard approved weight tables.

4.2. Rates

- (1) The rates shall be full compensation for all plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the work described in this Section of the Specification and/or shown on the Drawings.
- (2) Rates for concrete work shall further include for:
 - (a) All surface treatments and worked finishes including tamped, brushed floated, trowelled and the like, working to falls and cross-falls
 - (b) Cutting or forming all holes, mortises, chamfers, rebates, chases, grooves and the like, and other labours, and all sealing and making good around pipes, ducts, cables and the like including sleeves and first topping sealant where required
 - (c) Forming, reinforcing filling and sealing all expansion joints, movement joints, contraction joints, and the like (where not measured separately)
 - (d) All formworks to plane in situ concrete

- (e) Sloping members and slabs
 - (f) Protection
- (3) Rates for formwork shall further include for:
- (a) All square, raking or curved cutting and profiling
 - (b) Forming all holes and openings of 1.00 m² or less
 - (c) Providing different surface finishes as required by the Engineer
 - (d) Cutting and fitting around projections
 - (e) Forming chamfers to all exposed arises
 - (f) All mouldings, throats, rebates, grooves and the like
 - (g) All strutting, bolting, wedges, striking, removing and making good
 - (h) Constructing all roof slabs and other slabs requiring a surface fall, cross fall or gradient, to fall, cross fall or gradients
- (4) Rates for bar reinforcement shall further include for:
- (a) Producing approved bending schedules
 - (b) All tying wire
 - (c) Rolling margins
 - (d) All necessary ordinary and special spacers and chairs
 - (e) All bending and cutting
 - (f) Protection

SECTION 4230

STRUCTURAL STEELWORK

1.0 GENERAL

1.1. Scope of Application

- (1) The work to be executed by the Contractor under this section shall comprise all structural steel support structures and framings on all buildings. All work shall be constructed in accordance with the locations, dimensions, lines and grades shown in the Drawings or established by the Engineer.
- (2) Where necessary, reference shall also be made to Section 4350 Metal Works.

1.2. Items of Works

- (1) Structural steelwork to be executed by the Contractor shall include the following:
 - (a) Procuring all material, fabricating, erecting, testing and inspection of structural steel;
 - (b) Shop preparation and prime painting of structural steel members;
 - (c) Incidental steel construction
- (2) Field painting after erection (including touch up shop primer and apply second coat of primer to all members) shall be included under Section 4370 Clause 9.0 Painting / Clear Finishing.

1.3. Specific Standard

- (1) The work shall be carried out in accordance with the requirements of AISC, ASTM, AWS and JIS and all to the approval of the Engineer.

1.4. Submissions

- (1) Prior to commencement of the structural steelwork, the Contractor shall prepare and submit as specified hereunder for the Engineer's approval:
- (2) All manufacturer's original and printed catalogues, detailed technical data, specifications and installation instructions for all components and items;
- (3) Fabricator's original and printed brochures indicating work records, major machine, devices, method of quality control, etc.
- (4) Shop drawings for all works required indicating, in detail, the fabrication, assembly and erection requirements, fitting, material lists, joint and connection details and details. Shop drawings indicating fabrication requirements shall be submitted not less than (1) month before fabrication commences. In addition, the Contractor shall submit structural calculations for any work proposed which is at variance with work as shown or specified.
- (5) A method of work execution indicating the proposed methods, sequences, standards, etc., to be adopted, for the approval of the Engineer;

- (6) Independent test agency's original and printed brochures showing company profile, list of test devices, qualified tester, number of tester by category, etc.

2.0 MATERIALS FOR STRUCTURAL STEELWORK

- 2.1. Structural Steel – steel to be used for fabrication and erection of steel structures shall comply with all the pertinent provisions of the American Institute of Steel Construction or other equivalent international standards.
- 2.2. Wide flange, angles, channels, plates shall conform to ASTM A36 or other equivalent international standards.
- 2.3. Cold roll formed (pressed) “C” channel lipped purlins shall be high tensile steel heavy duty galvanized in accordance with JIS G3350 and JIS G3317 or other equivalent international standards.
- 2.4. All bent or curved steel purlins, steel beams or other members shall be factory formed by the approved fabricator by acceptable means and without causing any structural deformation or degradation. Bending shall be carried out before any galvanizing or other final treatment is applied.
- 2.5. Unless otherwise indicated, bolts shall be of equal strength to the following standards or equivalent international standards.
 - (1) High Strength Steel Bolts to ASTM A490
 - (2) Structural Bolts to ASTM A325
 - (3) Anchor Bolts to ASTM F1554 Grade 105
- 2.6. All welds shall be in accordance with AWS D1.1. Shield metal arc welding process may be used at the option of fabricator upon the approval of Engineer.
- 2.7. Structural steel decking shall be galvanized cold rolled formed panels manufactured from a high strength steel in thickness of 1.2 mm in accordance with JIS G 3352 (5,600 kg/cm² minimum tensile strength) and JIS G 3302 Z27 or other equivalent international standards.
- 2.8. The steel shall be finished by hot dip galvanizing with minimum coating mass of 275 g/m². The panels shall be of 300mm nominal width with raised edge seams and ribs formed to a depth of 51mm. Seams shall be connected with 16mm x 10 g hex. head screws.
- 2.9. Anti-corrosion primer paint shall comply with JIS K 5625, Class 2 or other equivalent international standards.

3.0 QUALITY CONTROL

3.1 Steel Shapes

- (1) Every batch of structural steel shapes for fabrication shall have the manufacturer's mill certificates, showing their chemical and physical properties.
- (2) The Engineer shall request the Contractor to undertake destructive or non-destructive testing of samples to ensure compliance of materials used for the Works.

3.2 Weld Finish

All welds shall be free from undercuts, pinholes and cracks, non-destructive testing shall be conducted at welds deemed not in conformity with the specification and all testing, and

repairs shall be to Contractor's account.

4.0 FABRICATION OF STRUCTURAL STEELWORK

4.1. Workmanship

- (1) Structural steelwork shall be shop fabricated and assembled in complete members off the Site in an approved fabrication facility, and field assembled or pre-assembled and erected in sections; as approved by the Engineer. "Complete members" shall comprise trusses, braces, or columns, each fully fabricated and separately assembled prior to site delivery.
- (2) The fabrication facility shall be proposed by the Contractor for the inspection and approval of the Engineer. The Contractor shall make all arrangements for the Engineer to visit and inspect the facility. Fabricators must have been performing the same quality and volume of work for at least ten (10) years to qualify for approval, have suitable equipment for all fabrication operations and have full capability and responsibility for preparation of shop drawings. In case of disapproval, Contractor shall propose alternative facility at his own expense and with no effect upon the Time for Completion.
- (3) Workmanship shall be subject to approval and shall equal best standard modern shop and trade practices as applicable to the types of work required; fabrication shall be performed by appropriately skilled and qualified operators.
- (4) The steelwork shall be shop fabricated, pre-fitted, assembled and connected where possible and within practical limits.
- (5) Joints shall be accurately fitted and aligned, ground free from burns or projections. Joints in frames exposed to weather shall be made watertight by continuous welding.

4.2. Straightening Material

- (1) Rolled material, before being laid out or worked, shall be within tolerances permitted in accordance with applicable ASTM standards or other equivalent international standards.
- (2) When straightening is necessary, it may be done by mechanical means or by application of a limited amount of local heating; with temperature of heated areas, as measured by approved methods, not exceeding 645 °C.
- (3) When bending of steel is required, care shall be taken not to damage or mark the exterior surface. Bends shall be made to the radius or angle required without leaving hammer marks.
- (4) Distortion of raw material or distortion developed by fabrication shall be remedied without damaging the material.

4.3. Oxygen Cutting

- (1) Oxygen cut edges which will be subjected to sizable stress or which are to have weld metal deposited on them shall be reasonably free from gouges. Occasional notches or gouges more than 5mm deep will not be permitted; and gouges greater than 5mm that remain from cutting shall be removed by grinding. Re-entrant corners shall be shaped notch-free to a radius of at least 12mm.
- (2) Contact surfaces between base or bearing and columns or other elements bearing directly upon such plates shall be ground or milled as necessary for maximum

effective bearing.

- (3) Edges for welding shall likewise be properly prepared.
- (4) Gas burning of holes for high-strength bolt assemblies shall not be permitted and elsewhere only as specifically approved by the Engineer.

4.4. **High Strength Bolt Assembly Preparation**

- (1) Where surface of a high strength bolted part has a slope of more than 1:20, a washer shall be used to compensate for lack of parallelism.
- (2) High strength bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials.
- (3) When assembled, all joint surfaces, including those adjacent to washers, shall be free of loose scale, burrs and other defects that would prevent solid seating of the parts.
- (4) Contact surfaces within friction-type joints shall be free of oil, paint, and lacquer or galvanizing.

4.5. **Connections**

- (1) Welded or bolted, of type and arrangements, detailed, noted or approved.
- (2) Connections not specifically shown shall be equivalent to similar connections indicated and approved by the Engineer.
- (3) Splices will be permitted only where shown, or in accordance with approved, shop drawings.
- (4) The minimum length of fillet welds shall not be less than 4 times the nominal size. For intermittent welds, the length of segment shall not be less than 4 times the weld size with a minimum of 40mm.
- (5) Side or end fillet welds terminating at ends or at sides, shall be returned continuously for a distance not less than twice the nominal size of the weld.
- (6) The minimum and maximum edge distance of bolts shall conform to the requirements of AISC.
- (7) Minimum pitch on centre spacing of bolts shall not be less than 2.5 times the nominal diameter.

4.6. **Welding Personnel**

- (1) Manual welding shall be applied only on the areas approved by the Engineer, the area shall be clearly indicated on the shop drawings.
- (2) Manual welding shall be performed only by qualified welders as directed or approved by the Engineer.
- (3) At the expense of the Contractor, welders shall be pre-qualified by submitting for laboratory tension tests samples for each welded connection per type of weld for evaluation and approval by the Engineer.

4.7. **Welding Construction**

- (1) All built-up columns, beams and girders shall be fabricated by approved arc welding devices continuously, with submerged arc welding method, at only one (1) approved fabricator's factory.
- (2) Welds shall be sufficient, adequate and suitable to perform the structural requirements, and subject to approval by the Engineer.
- (3) Welding rods shall be of the same alloy as the pieces to be joined.
- (4) All welding for steel work shall conform to the AWS and AISC Standards.
- (5) Welded joints shall be free from porosity, cracks or holes, and shall be finished to match the adjacent surfaces.
- (6) All welds which shall be exposed in the finished work shall be ground to a smooth uniform finish for paint finish.

4.8. **Setting (Levelling) Plates**

- (1) Required for all base plates supported by concrete construction, whether or not specifically detailed.
- (2) Each setting plate shall be fabricated to exactly match size and anchor bolt location of respective base or bearing plate, using structural steel plate in thickness of 6mm, unless otherwise shown.

4.9. **Headed Studs**

- (1) Required for locations and in sizes shown on the Drawings.
- (2) They shall be secured in place using automatic and welding equipment as approved.

4.10. **Fabrication Tolerances**

- (1) Compression members shall not deviate from straightness more than 1/1000 of axial length between points which are to be laterally supported.
- (2) Completed members shall be free from twists, bends and open joints.
- (3) Sharp kinks or bends shall be cause for rejection of material.
- (4) Variation of 0.8mm is permissible in overall length or member with both ends finished as specified herein.

5.0 **ERECTION OF STRUCTURAL STEELWORK**

5.1. **General**

- (1) Erection and assembling shall be carried out by only one (1) approved specialist firm or specialist qualified personnel, in the employment of the Contractor.
- (2) The frame of steel structure shall be erected true and plumb, within the limits defined in code of structural practice of the American Institute of Steel Construction. Temporary bracing shall be provided to resist all loads including erection equipment. Bracings shall be left in place as may be required for safety.
- (3) No riveting, permanent bolting or welding shall be done until the structure has been properly aligned.

- (4) Sagrods and cross bracings shall be installed and tightened before installation of roofing or wall cladding.
- (5) Work shall be erected and installed as per approved shop drawings.
- (6) All items and assemblies shall be correctly located, properly positioned and securely anchored for full bearing of members upon supporting structural elements.
- (7) Erection and bracing operations and procedures shall not damage work previously placed nor overstress any part of the building. Damage caused during hauling or by operations herein shall be repaired as directed by the Engineer at the Contractor's own expenses.

5.2. **Anchor Bolts**

- (1) Anchor bolts, nuts and washers shall be in accordance with ASTM F1554 Grade 105, unless otherwise noted elsewhere.
- (2) Anchor bolts shall be positioned and fixed at each location required utilizing templates for respective locations; and as follows:
 - (a) Hook ends shall be positioned and in symmetrical arrangements as shown on the Drawings; and
 - (b) Threaded ends shall be projecting sufficiently to provide not less than 10mm clear projection above top of anchoring nuts and washer when base or bearing plates are set and secured.

5.3. **Base Plates**

- (1) Base plates shall be set to elevations required by utilising levelling nuts; each plate bearing fully on all levelling nuts; and each temporarily secured into place utilizing anchor nuts turned thumb tight only, but firmly holding plate.
- (2) Under each setting shall be solidly filled using an approved type of non-shrink dry packed grout. Bearing loads shall only be applied to setting plates after the grout is well-cured and of sufficient attained strength.
- (3) Temporarily placed anchor nuts shall be retained for as long as needed to assure setting plates remain at required positions and elevations.
- (4) Shimming in lieu of levelling nuts and/or grouting as required herein will not be permitted.

5.4. **Temporary Bracing**

- (1) As work progresses all strutting braces and frames shall be installed as necessary to adequately support, securely fix and to assume loads or forces due to equipment transfer/erection operations or completion of other work.
- (2) Temporary or permanent work members, temporary strutting braces and frames or other members or items of work shall be provided as necessary and maintained in place until permanent work is properly connected and other construction installed.
- (3) When building materials are to be piled on or supported on steel framing, suitable and adequate provisions for safety shall be included to handle additional stresses resulting therefrom.

- (4) Extent and quality of temporary bracing shall be as necessary against wind and all other loads, including seismic intensity not less than those which the permanent structure is designed to resist.

5.5. Adequacy of Temporary Connections

As erection progresses, work shall be securely bolted, or welded to take care of all dead loads, wind and erection stresses.

5.6. Alignment

No permanent bolting or welding shall be done until as much structure as will be stiffened has been properly aligned.

5.7. Field Welding

- (1) Any shop paint on surfaces adjacent to joints to be field welded shall be wire brushed to reduce paint film to a minimum.
- (2) Field welding shall conform to requirements specified here before, except as applicable to strictly shop welding procedures.

5.8. Standard Bolting

- (1) Initially, bolts and nuts shall be tightened sufficient to maintain integrity of work.
- (2) Finally, after final alignment and truing, all bolts and nuts shall be re-tightened for full and tight bearing.
- (3) Before being permanently concealed, bolts shall be re-checked and re-tightened as necessary.

5.9. Correction of Errors

- (1) Corrections of minor misfits by moderate use of drift pins and a moderate amount of reaming, chipping or cutting will be permitted and shall be provided as part of erection work.
- (2) Any errors which prevent proper assembly of parts by these measures, or which require correction or adjustment, shall be immediately reported to the Engineer, and such corrections and adjustments shall be made as necessary and only by means approved in writing by the Engineer.
- (3) Cutting or alterations other than is approved will not be permitted.

5.10. Erection Tolerance

- (1) Upon completion, any variations in erected steel framing shall not exceed tolerances as specified herein.
- (2) Member working points are, unless otherwise shown elsewhere, defined as follows:
 - (a) For members other than horizontal members, member working point is actual center of member at each end of the member;
 - (b) For horizontal members, working point is actual centreline of top flange or top surface at each end; and

- (c) Other working points may be established for ease of reference provided they are consistent with this definition.
- (3) Member working line is defined as a straight line connecting member working points.
- (4) Individual columns shall be considered plumb if slope of working line does not exceed 1:1000 provided that members working points of exterior column are displaced from established column line no more than 25mm toward nor 50mm away from the building line.
- (5) Horizontal alignment of members connecting to columns shall be considered acceptable if any error in alignment is caused solely by variation in column alignment within permissible limits.
- (6) Elevation of members connecting to columns shall be considered acceptable if distance from member working point to upper milled splice line at column is not more than plus 5mm or minus 8mm distance specified on the Drawings.
- (7) Tolerances of members not covered above shall be considered plumb, level and aligned if displacement of individual members does not exceed 1:500 from a straight line struck between its support points.

5.11. **Installation**

Structural decking can be cut using a power saw with a suitable disk. When cutting, the panels should be turned over with the ribs downward. If holes or openings are required, these are generally classified into the following categories:

- (a) Less than 250mm (measured at right angles) requires no special treatment. These holes or openings are usually for passage of other trade work and therefore can be made by the trades concerned or alternatively they can be formed prior to the concrete pour, and once the concrete has attained 70% to 75% of its design strength, the panel can be cut out by a hole saw or drill;
- (b) For openings of 250mm to 750mm the decking can be reinforced prior to the concrete pour by using reinforcing bars or small channels, welded to the panel around the perimeter of the opening to distribute the loads to the adjoining panels; and
- (c) For large predetermined openings greater than 750mm such as for stairs, elevators, etc. the most practical method generally is to supply supplemental structural framing to the support system for the structural decking.

6.0 **TESTING ON WELDED PORTION**

6.1. **Visual Inspection and Testing**

Testing shall be in accordance with relevant part of AWS D1.1.

6.2. **Testing Along Full Penetration Welding**

- (1) Ultrasonic test shall be in accordance with relevant part of AWS D1.1.
- (2) Welding at factory shall be tested as follows:
 - (a) A "lot" of welds shall be defined as 220 welded points.
 - (b) One (1) welded point shall be defined as:

- A junction between column and girder or beam: upper, lower or side counted as one (1) each
 - Every 300mm of continuous welding
 - Each welded edge of stiffener plate
- (c) For each lot of welds, 20 welded points shall be selected by the Engineer and tested.
- (d) A lot shall be considered as passed if all tests on the selected welded points therein have passed.
- (e) If the number of failed tests on selected welded points in each lot is up to 2, a further 20 welded points shall be selected by the Engineer and tested.
- (f) If the number of failures in such further testing of these selected welded points is less than 3, the particular lot shall be considered as passed.
- (g) If the number of failures in such further testing of these selected welded points is 3 or more welded points, then particular lot shall be considered as failed and all welded points in the lot shall be tested.
- (h) All detected failures in lots and welded points shall be remedied and retested until a pas is achieved.
- (3) Welding at Site shall be tested as follows:
- All junctions welded in full penetration at Site shall be tested.
- (4) Testing agency shall be as approved by the Engineer.
- (5) All testing shall be carried out at the Contractor's own expense and shall be witnessed by the Engineer.

6.3. **Corrections of Failed Member**

- (1) Crack along junction shall be corrected as follows:
- (a) Weld metal shall be removed throughout the corresponding junction, then welding shall be carried out and tested.
 - (b) Even if ends of crack are identified by ultrasonic or X-ray, weld metal within 50mm away from crack shall be removed.
- (2) Weld metal at defective welding found by ultrasonic test shall be removed completely, and then re-welding and re-testing shall be done.
- (3) Diameter of arc welding electrodes for re-application shall be not greater than 4.0mm.
- (4) Pit shall be removed, and then re-welding and re-testing shall be done.
- (5) Additional weld metal shall be applied along inadequate welded junction. Excess bead, etc., shall be placed for this kind of correction to prevent rapid cooling cracks. Corrected junction shall be re-tested.

- (6) Extravagant weld metal shall be ground out carefully without any affect upon the adjacent parent materials.
- (7) Parent materials with crack caused by welding shall not be utilized again.

7.0 NON-SHRINK GROUT

- 7.1. Grout shall be a mixture of finely granulated iron compound, set accelerators, cement dispersing agents and an oxidizing catalyst. It shall be mixed with cement, sand and water to form a non-shrinking, high strength grout.
- 7.2. The space between base plates and pedestals shall be fully filled by non-shrink grout. Non-shrink grout injection method shall be to the Engineer's approval.

8.0 REINFORCING FOR OPENINGS

8.1. General

- (1) Requirements herein apply to conditions where duct, pipe or other penetrations or openings are required through decking which is supported by structural steel framing.
- (2) When openings or holes and reinforcing are specifically shown in the Drawings, steel reinforcing shall be provided as part of work and the cost thereof shall be deemed to be included in the unit rates.
- (3) When openings or holes are not specifically detailed in the Drawings, but are necessary for work, steel reinforcing and formwork shall be provided as part of the works, respective to other sections under which any such openings or holes are required and the cost thereof shall be deemed to be included in the unit rates of other relevant Sections.

8.2. Requirements for Reinforcement around Openings

- (1) Holes or openings 125mm and below need not be reinforced subject to the Engineer's confirmation.
- (2) Larger holes or openings shall be reinforced as shown or, if not shown, using steel and connections of strength adequate for size of opening and loads to be supported.
- (3) All reinforcement around openings or holes shall be approved by the Engineer prior to fabrication.

9.0 PAINTING OF STEELWORKS

- (1) Structural steelwork including secondary structural steel elements shall be abrasive blasted in workshop to approval, prepared and treated with anti-corrosion primer painting accordance with the procedures of the approved paint manufacturer and as specified under the paint system Type P-8 in Clause 9.5 of Section 4370 : Finishes.
- (2) Anti-corrosion primer paint shall not be applied on the following surfaces:
 - (a) Surfaces that touch or are embedded inside concrete,
 - (b) Areas within 200mm of site welding, subject to anti-corrosion primer application after the weldings Inner surfaces of members at high strength friction grip joints,
 - (c) Inner surfaces of closed boxes.

- (d) Any steel structures or members required to be galvanized unless otherwise specified.
- (3) Galvanizing shall be in accordance with JIS G3302 or equivalent international standards as follows:

The nominal weight of zinc coating will be 200 g/m² on each side, i.e. a minimum thickness of 25 microns.

10.0 MEASUREMENT AND RATES

10.1. Measurement

- (1) Structural steelwork generally shall be measured in metric kilogram (kg). The quantity shall be computed of the net cut dimensions of all components indicated in the Drawings, multiplied by the appropriate nominal unit weights indicated thereon or derived from standard approved weight tables.
- (2) No allowance shall be made in the quantity computation for the weight of bolts or welds.

10.2. Rates

- (1) The rates shall be full compensation for all plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the work described in this Section of the Specification and/or shown on the Drawings.
- (2) Rates shall further include for:
 - (a) Temporary bracing and supports
 - (b) Bending steel members to curves and profiles
 - (c) Cutting, drilling, notching, bevelling, grinding and all other labours
 - (d) Rolling margins
 - (e) All necessary steel shims, wedges and packings
 - (f) Turnbuckles, bolts and anchor bolts
 - (g) All washers, nuts, sleeves and other accessories for bolts and anchor bolts
 - (h) All necessary welding (fabrication or erection)
 - (i) Checking and adjusting level of structural supporting elements
 - (j) All delivery, unloading, hoisting and erection
 - (k) All necessary concrete padstones
 - (l) Application of anti-corrosion primer in fabrication shop
 - (m) Welding test
 - (n) Forming bolt boxes, recesses, etc. in foundations, and levelling, fixing and grouting

- (o) Non-shrink grout to base plates including formwork to edges
 - (p) Protection.
- (3) Rates for structural steel decking shall further include for:
- (a) All square, raking and curved cutting and profiling
 - (b) Cutting and fitting around projections, forming all holes and openings
 - (c) Reinforcing and formwork around projections, holes and openings
 - (d) All strutting, bracing, frames, bolting, wedges and other temporary works and all making good
 - (e) Protection

SECTION 4315

BLOCKWORK

1.0 GENERAL

1.1. Scope of Application

The work to be executed by the Contractor under this Section shall comprise all masonry to external and internal walls, above and below ground to all buildings. All work shall be constructed in accordance with the dimensions, lines and levels and in the locations shown on the Drawings or instructed by the Engineer.

1.2. Description of the Works

The works to be executed and completed by the Contractor are as follows:-

- (1) To execute the blockwork including reinforcement and accessories,
- (2) Mortar and grout,
- (3) Installation materials required to be incorporated into masonry specified to be furnished and delivered under other Sections including bolts, anchoring devices, unit frames and other items as may be required; and installing reinforcing dowels embedded in masonry for adjacent concrete placed following masonry work,
- (4) Incorporating adjacent work pre-set under other Sections,
- (5) Cutting or forming and subsequently filling, sealing and making good all holes, openings, mortices and chases etc., necessary for the execution of the various mechanical and electrical installations.

1.3. Submissions

Prior to commencement of the blockwork, the Contractor shall prepare and submit for the Engineer's approval:-

- (1) Manufacturer's detailed technical data, specifications and installation instructions for all components and accessories within this Section
- (2) Shop drawings for all work required under this Section. Special attention shall be paid to openings for frames, masonry panel stiffening etc. Working drawings shall be produced to clearly indicate all details of block work including layout of stiffener beams after coordination with layout of grooves in plaster work, doors and windows, electrical switches, outlets and panel boards, fire hose cabinet, fire extinguisher cabinet, etc.
- (3) A detailed construction plan indicated the proposed methods, sequences, standards, etc., to be adopted.
- (4) Samples and test certificates of all materials specified in this Section. Any materials delivered thereafter that the Engineer considers not equal to the approved samples, shall be rejected and removed from the Site. The Engineer may request that mock-up of block work be constructed by the Contractor to demonstrate the proposed quality of workmanship for approval.

- (5) Regular analysis tests shall be taken of all hollow blocks, cement, sand and water, used together with compressive strength test of hollow blocks and mortars, and detailed reports shall be submitted to the Engineer for his approval.

2.0 MATERIAL

2.1. Concrete Hollow Blocks

- (1) All hollow blocks shall be non-load bearing hollow concrete blocks, machine made, hydraulically pressed and of uniform texture and color and conforming to ASTM C 129 with a minimum compressive strength of 4.14 MPa per average net area for average of 3 units.
- (2) Thickness of hollow blocks shall be as shown on the Drawings.
- (3) All hollow blocks shall have grooved surface for horizontal reinforcing bar setting.

2.2. Mortar

Mortar for masonry and filling shall be Type M1 specified in **Section 1400**, minimum 14 N/mm² compressive strength.

2.3. Concrete

Shall be as specified in Section 1400:

- (a) Class B2 for reinforcement column and beam
- (b) Class B2 for concrete lintels

2.4. Reinforcement Bar

As specified in **Section 1420**.

2.5. Material for Formwork

As specified in **Section 1440**.

3.0 EXECUTION

3.1. Setting Out

- (1) The Contractor shall provide proper setting out profiles and lines for all walls and shall set out all works accurately.
- (2) The Contractor shall build the various walls and piers to the thickness, widths and heights shown on the approved working drawings.

3.2. Bond

- (1) All walls shall be built in approved bonds.
- (2) All piers, intersections and angles of walls shall be properly bonded together.
- (3) All perpend, reveals, quoins and other angles of the walls etc., shall be built strictly true and square. No broken bricks or bats shall be used except where closers are required at quoins, jambs, etc. to make bond.

3.3. Use of Mortar

- (1) The mortar shall be carefully mixed upon properly constructed timber platform and prepared in small quantities as required.
- (2) No mortar which has commenced to set may be used or mixed with any other mortar.
- (3) Mortars shall be mixed with only sufficient water to achieve a stiff mix.
- (4) The above noted mixes for mortar may be adjusted to achieve acceptable workability and strength.

3.4. Laying and Jointing

- (1) All blocks shall be moistened before being laid. Top of walls, where left off, shall be well wetted before recommencing laying of blocks.
- (2) All joints are to be flushed up and grouted in solid as the work proceeds.
- (3) Blocks shall be laid plumb and true to line; horizontal courses level; vertical lines plumb; corners and reveals plumb and square.
- (4) Blocks shall be laid to maintain modular dimensions, with horizontal joints equal in thickness to vertical joints, unless otherwise shown or specified as necessary for take-up in horizontal layouts and to maintain level coursing.
- (5) The work shall be executed course by course, no four courses shall exceed by 40 mm the height of the blocks laid dry.
- (6) Every third course shall be levelled.
- (7) The walls shall be carried up in a uniform manner, no one portion being raised more than 1 m above another at any time.
- (8) Before mortar sets, joints shall be tooled to required profiles to receive the appropriate finishing.
- (9) Completed faces shall be left smooth, dense and free from voids and other irregularities.
- (10) Tools of proper types and designs shall be used for all operations.
- (11) Joints or edges, which are to receive sealing materials, shall be raked out before mortar has set, to the required depth, and contact/exposed surfaces left clean and smooth.
- (12) When cured and before grouting, joints shall be reinspected and repointed as directed by the Engineer.
- (13) During the time units are laid and when grout is placed, work shall be covered and protected as specified to extend hydration period without damage to the work.
- (14) Curing by repeated applications of water will not be permitted.
- (15) All constructed masonry exposed to the sun must be kept damp immediately after completion and also during the following day.
- (16) Blocks shall be laid at the designated locations within ± 10 mm variations and the

substrate surfaces shall not have variation in plane exceeding 10mm per 3 meters.

- (17) Line blocks shall be provided where possible. Line pins shall be used in joints only when unavoidable; and when pins are removed, hole shall be cut out square and packed solid with mortar.

3.5. **Openings Generally**

Unless otherwise noted on the Drawings, all openings in walls shall be reinforced around all edges as follows:

- (a) Walls thickness 150mm and less : 2 No. 12mm diameter bars

3.6. **Openings for Frames**

- (1) Openings for doors, windows, etc., shall be properly marked out and left un-built until the frames have been fixed in position.
- (2) All door frames, window frames and louver frames, plates, etc., shall be bedded in mortar of Type M2 specified in **Section 1400**.
- (3) All frames shall be carefully fixed and stayed in position and shall be anchored into walls with galvanized steel anchors, one end securely to frame, and other end built into joints of masonry. Anchors shall be spaced at approximately 600 mm centers or as shown on the Drawings.
- (4) All timber or metal sub-frames shall be built in as the work proceeds unless otherwise approved by the Engineer.
- (5) In addition to the provisions of para. 3.9 of this Section, the Contractor is to ensure that all openings are to be adequately provided with reinforced concrete lintels, to the approval of the Engineer.

3.7. **Holes, Openings, Mortices, Chases, etc.**

Holes, mortices, chases, grooves, etc., shall be cut or formed as required for all pipes, ducts, cables, beams and the like, and all supports shall be cut and pinned or built-in. Masonry shall be made good around such pipes, ducts, cables, bearers and supports by building in, grouting and neatly and tightly sealing in either mortar or sealants as instructed by, and all to the approval of the Engineer.

3.8. **Bonding Ends and Heads of Walls**

Where indicated on the Drawings, masonry walls abutting concrete or steel columns and beams, masonry walls shall be adequately tied by the reinforcement bars as shown in the Drawings or approved anchors/bonding ties, built into the concrete and securely fixed to steelwork as approved by the Engineer. Walls shall have bars and anchors/bonding ties every 400mm vertically and every 600mm horizontally at ends.

3.9. **Stiffener Beams and Columns**

- (1) Every vertical angle in masonry walls shall be made by constructing a concrete stiffener column to the full wall thickness.
- (2) Tops of all walls shall, according to the details indicated on the Drawings shall always be finished by constructing a reinforced concrete stiffener beam.
- (3) The height or length of any masonry wall must not exceed 25 times the thickness of the wall. If exceeded reinforced concrete stiffener columns and beams shall be

provided according to the details indicated on the Drawings.

3.10. Reinforcement and Filling to Voids

All concrete hollow block walls, unless otherwise shown in the Drawings, shall be reinforced with 10mm diameter mild steel rods at 400mm centres horizontally and 600mm centres vertically. All voids in hollow concrete block walls shall be filled with concrete mortar type M1. Reinforced concrete lintels shall be provided at openings where required.

3.11. Height of Concrete Hollow Block Walls

- (1) The concrete hollow block wall, if not otherwise specified, shall be fully constructed between floor slab and upper level slab according to the details indicated on the Drawings:
- (2) The bottom level of top concrete stiffener beam for concrete block walls shall be at least 25mm higher than finished ceiling level.

3.12. Cleaning General

- (1) As work progresses, daily just before noon hour and at end of day's work, masonry faces shall be washed and cleaned free from mortar and cement stains.
- (2) Washing and cleaning shall be done using fresh water and fibre brushes or wooden scrapers.
- (3) Metal implements and excessive water shall not be permitted.

3.13. Cleaning Surfaces to Remain Exposed

- (1) After final curing and surfaces have dried, all masonry shall be thoroughly cleaned and made free from any remaining mortar, using cleaning methods and materials approved by the Engineer.
- (2) Solutions or agents for cleaning or other purpose shall not be applied or used on masonry work unless thoroughly tested, examined and determined by the Engineer to have no damaging effect on masonry or adjacent work.
- (3) Cleaning agents shall be used in strict compliance with manufacturer's instructions.
- (4) Efflorescence shall be removed as recommended by masonry blockwork manufacturer.

3.14. Re-cleaning

- (1) Where exposed masonry and mortar surfaces cannot be cleaned to appearance intended by normal cleaning procedures, such surfaces shall be, at Contractor's expense, sandblasted or treated by approved means to effect intended results.
- (2) Proper equipment, experienced operators, protection and clean-up work necessary shall be included.
- (3) Sandblasting shall be no heavier than necessary to remove mortar and stains to degree of appearance directed by the Engineer.
- (4) Where so required, entire wall or panel surface shall be treated for uniform appearance throughout.

3.15. Completion Requirement

- (1) Exposed surfaces shall be clean and free from dust, dirt, mortar smears or streaks, broken units, chips, cracks, misaligned or improperly fitted joints, stains, discoloration, or other defects or damage.
- (2) Each partition or screen wall shall be erected straight, plumb, level and accurately positioned at locations required.
- (3) All work of like kind shall be uniform in appearance and workmanship throughout.

4.0 MEASUREMENT AND RATES

4.1. Measurement

- (1) Blockwork generally; to be measured in square meters (m²) for each of the indicated thickness and item classifications described in the Bill of Quantities. No deductions shall be made for openings of one (1) square meter or less. The quantity shall be computed from the Drawings.
- (2) Lintel beams, stiffener beams and columns to be measured in linear meters (m). The quantity shall be computed from the Drawings.

4.2. Rates

- (1) The rates shall be full compensation for all plant, materials, transport, labor, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the Work described in this Section of the Specification and/or shown on the Drawings.
- (2) Rates shall further include for:
 - (a) Mortar for bedding, pointing, jointing and filling
 - (b) All cutting, forming all angles and intersections, wedging and pinning to soffits, bonding to other surfaces
 - (c) Cutting and pinning or building in all supports for pipes, ducts, equipment, trays, cables, etc.
 - (d) cutting or forming all holes, mortices, chases, all sealing (if necessary with fire resisting material) and making good around pipes, ducts, cables, and the like
 - (e) Forming all expansion joints and other construction joints, filling and pointing with approved materials
 - (f) Forming all types of finishing to masonry surfaces
 - (g) Providing compressible fire proof material, where applicable, in joints to soffits of concrete beams and suspended slabs
 - (h) Bedding and pointing ends of walls at junctions with columns with sealant
 - (i) All reinforcement, anchors and ties
 - (j) Building in, bedding and pointing all wood frames
 - (k) Filling all voids with concrete and reinforcing as required

- (l) Protection
- (3) Rates for lintel beams, stiffener beams and columns shall further include for:
 - (a) Reinforcement, anchors, ties
 - (b) Formwork
 - (c) Stooled ends
 - (d) Building in
 - (e) Protection.

SECTION 4320

WATERPROOFING AND VAPOUR BARRIER

1.0 GENERAL

1.1. Scope of Application

The work to be executed by the Contractor under this Section shall comprise all waterproofing and vapour barrier to all buildings under the Contract. All works shall be constructed in accordance with the dimensions, lines and levels and in the locations shown on the Drawings or instructed by the Engineer.

1.2. Item of Works

Waterproofing shall include the followings:

Para 2.0 WATERPROOFING AND VAPOUR BARRIER MEMBRANE

Para 3.0 INSULATION GENERALLY

Para 4.0 SEALANTS GENERALLY

1.3. Submissions

Prior to commencement of Waterproofing and Vapour Barrier works, the Contractor shall prepare and submit for the Engineer's approval:

- (a) All manufacturer's original catalogues, detailed technical data, specifications and installation instructions for all components and accessories within this Section.
- (b) Shop drawings for all works required under this Section.
- (c) A detailed construction plan indicating the proposed methods, sequences, standards, etc., to be adopted.
- (d) Samples and test certificates of all materials and accessories within this Section as required by the Engineer.

2.0 WATERPROOFING MEMBRANE

2.1. Description of Works

The works to be executed and completed by the Contractor are as follows:

- (a) Complete built-up waterproofing system with concrete topping (WP-1)
- (b) Complete built-up waterproofing system without concrete topping (WP-2)
- (c) Urethane waterproof coating (WP-3)
- (d) Polymer Modified Cement Waterproofing (WP-5)
- (e) Polyethylene sheet for vapour barrier (WP-7)

- (f) All necessary compatible fittings, accessories, connectors, bolts, fasteners and fixing

2.2. **Materials**

- (1) Waterproofing Membrane

Unless otherwise specified high tensile flexible rubberized asphalt waterproofing membrane shall conform to JIS A 6013 Type R or equivalent.

- (2) Liquid-applied compounds for waterproof coating

Urethane waterproof coating specified in JIS A6021 or equivalent

- (3) Silicate waterproof coating

Silicate waterproof coating Type T-301 JASS 8 or equivalent

- (4) Asphalt Bitumen

JIS A 6011 Type 3 or 4 as recommended by manufacturers for installation requirements

- (5) Polyethylene Rigid Board:

Refer to para. 3.0 INSULATION GENERALLY of this section.

- (6) Others

- (a) Primer and adhesive shall be as per recommendations and/or instructions of manufacturer(s) of waterproofing membrane

- (b) Protection concrete: Grade CLASS B3 specified in Section 1400.

- (c) Welded mild steel wire mesh: JIS G3551 or equivalent. Size: 100 x 100 x 4.0 mm

- (d) Rubber asphalt sealant: refer to para. 4.0 SEALANT GENERALLY of this Section

- (e) Metal lath: JIS A 5505 flat lath Type 2 or equivalent; zinc coated.

- (f) Ready-made contraction gap filler: preformed joint filler combining PVC capping and polyethylene form

2.3. **Built-up Waterproofing System**

- (1) All built-up membranes/assemblies shall consist of compatible materials, fully conforming to the manufacturer's printed instructions and specifications.

- (2) Built-up systems shall be as follows unless recommended to the contrary by the particular manufacturer and approved by the Engineer.

- (3) All subsidiary sealing and flashing materials shall be provided as types produced by or approved by the respective membrane manufacturers and the Engineer.

- (4) The component parts of the various assemblies shall, where possible, be consistently obtained from the same manufacturer.

(a) WP-1 Hot Applied Rubberised Asphalt Waterproofing System with Concrete Trowel Finish

- (i) Location : Roof deck
- (ii) Primer : 1 coat - 0.3 lit/m²
- (iii) Cut back bitumen : 1st coat - 1.2 kg/m²
- (iv) Built-up bituminous Felt Roofing : 3 layer, lapped joints, hot applied bitumen bonding between layers, 1.5kg/m²
- (v) Cut back bitumen : top coat for insulation bonding - 1.5kg/m²
- (vi) Board insulation : 30 mm thickness (except vertical portions)
- (vii) Protection concrete : Class B3; 60 mm thickness with 4 mm welded mild steel wire mesh, 100 x 100 mm (Topping to have 25 mm sealed contraction gaps at 3000 mm centres both ways)

(b) WP-2 Hot Applied Rubberized Asphalt Waterproofing System Exposed Type

- (i) Location : Canopy or as directed by the Engineer
- (ii) Primer : 1 coat - 0.3 lit/m²
- (iii) Cut back bitumen : 1st coat - 1.5 kg/m²
- (iv) Perforated sheet : 1 layer
- (v) Cut back bitumen : 1st coat - 1.5 kg/m²
- (vi) Flexible high tensile roofing membrane : 1 layer - 2.4 kg/m² (minimum 2 mm thickness)
- (vii) Cut back bitumen : 2nd coat - 1.5 kg/m²
- (viii) Mineral surface roofing membrane : 1 layer - 3.3 kg/ m²

(c) WP-3 Urethane Waterproofing Coating

- (i) Location : Toilets, Shower rooms, Kitchens, Pantries, Janitor's closet.
- (ii) Primer : 0.2 kg/m²
- (iii) Urethane waterproofing coating : 1st coat - 0.3 kg/m²
- (iv) Reinforcing cloth

(v) Urethane waterproof coating : 2nd coat - 1.5 kg/m²

(vi) Urethane waterproof coating : 3rd coat - 1.2 kg/m²

2.4. **WP-4 Acrylic Rubber Waterproof Coating**

Not used.

2.5. **WP-5 Polymer Modified Cement Waterproofing**

- (a) Location : External surfaces of elevator pit, dropped slabs and trenches.
- (b) Manufacturer/type : Dainichi Chemical Co., Ltd.(JAPAN) Polymer Modified cement Type PA-1 or equivalent.
- (c) Material : Polymer Modified cement:
- (d) Application : RA-3 Method of Dainichi Chemical Co., Ltd.(JAPAN) Primer:0.3 kg/m², Base coat: 1.0 kg/ m², 2nd Base coat 1.0kg/ m², Top coat, or equivalent.
- (e) Mixing/Application : as per manufacturer's recommendation

2.6. **Polyethylene sheet for vapour barrier (WP-7)**

- (a) Location : Under all concrete slabs on ground
- (b) Specification : JIS A6930 or Equivalent
- (c) Material : Polyethylene sheet 0.15
- (d) Colour : To be selected by Engineer
- (e) Width of laps : Not less than 300mm.

2.7. **Contraction Gap**

- (1) Contraction gap shall be provided on the roof at the locations specified on the Drawings and as follows:
 - (a) Generally 3,000mm intervals, but not exceeding 4000mm intervals.
 - (b) 600mm away from roof gutter shoulder or parapet surface
 - (c) 1,500 to 2,000mm intervals, perpendicular to roof gutter centreline; between contraction gaps along both side of roof gutter
- (2) Ready-made contraction gap filler shall be set prior to application of finishing mortar and/or protection concrete.

Material: Products of Arch Yamade (Japan) 'Dry N' or equivalent.

Cap: Glass fibre reinforced Polyethylene, Separator and Base: expanded polystyrene foam, Fix pins: Polyethylene, For height adjustment: In-situ expanded urethane form.

2.8. **Execution Generally**

- (1) All work shall be carried out in full conformity with the manufacturer's requirements and to the approval of the Engineer.
- (2) Substrate surfaces shall be completely smooth, clean, dry, free from dust, dirt or other foreign materials.
- (3) Any defects on concrete such as cold joint shall be remedied properly, i.e., chipping off of defective area and provision of fresh concrete with epoxy, prior to primer application.
- (4) No work shall be commenced when rain is imminent, during rain or immediately thereafter.
- (5) Manufacturer's instructions shall be complied with for lapping, staggering cross joints, nailing, except as specified, taping, flashing, dressing and other applicable details and operations.
- (6) All membranes shall be adequately bonded over the entire area.
- (7) Each sheet shall fit closely into corners with a minimum of gaps and unsupported areas.
- (8) Sheet shall be cut, trimmed and double overlapped around vertical corners; all laps and joints shall be thoroughly sealed.
- (9) Curb treatments shall be secured in place, until covered by the other materials, by cementing or otherwise.

2.9. **Flashings and Penetrations**

- (1) Flashings, capping, soakers, collars and clamps shall be provided as necessary to perimeters, abutments, gutters, penetrations etc. Particular care shall be given to each detail and operation to ensure complete, watertight installations throughout.
- (2) Membranes shall be sealed carefully around drains, pipes and other penetrations.
- (3) Types generally shall be consistent with roofing assemblies, based upon the manufacturer's standard details.

2.10. **Completion Requirements**

- (1) Finished surfaces shall be clean and free from dirt, debris, sticks, etc., rips, cuts, wrinkles or bubbles, unsealed joints, stains, discoloration or other irregularities, defects or damage.
- (2) The installation shall be free from unsealed or exposed fastenings.
- (3) All layers or plies of assemblies shall be smooth, flat and fully adhering.
- (4) Installation shall be watertight throughout and free from leaks or entry of water into or through interior or concealed spaces of structure, other than via waterways or provisions for drainage as particularly provided for or approved.

2.11. **Tests**

Waterproofing shall be hydraulically tested prior to provision of covering and also on completion to all areas using methods selected or approved by the Engineer. shall include roof drain, balcony drain, floor drain, floor clean-out, etc.

2.12. **Guarantee**

The whole of Waterproofing works or each complete type thereof shall be executed by specialist firm or firms or specialist qualified personnel in the employ of the Contractor, all to the approval of the Engineer.

The Contractor shall submit a ten (10) year written guarantee of the water-tightness and durability of the waterproofing. The Guarantee shall be in a form approved by the Engineer and Employer, for the due and faithful observance and performance of this obligation, and it shall be delivered to the Engineer at the same time as the request for approval (RFA) of the waterproofing system.

3.0 **INSULATION GENERALLY**

3.1. **Description of Works**

The works to be executed and completed by the Contractor are as follows:-

- (a) Polystyrene rigid board installation (for WP-1)
- (b) All necessary compatible fittings, accessories, etc.

3.2. **Materials**

- (1) Polystyrene Rigid Board
 - (a) Conforming to JIS 9511 or equivalent
 - (b) Thickness: not less than 30 mm.
 - (c) Specific gravity: not less than 35 kg/m³.
 - (d) Moisture Resistant: dimensionally stable.
 - (e) Incombustible and waterproof
 - (f) Uses: in built up waterproofing assemblies.

3.3. **Execution and Completion**

- (1) Insulation shall be carried out strictly in accordance with the manufacturer's requirements (together with the manufacturer(s) of the waterproofing assemblies) and to the approval of the Engineer.
- (2) Insulation shall be completely and evenly supported, secured in place and free from sagging, warping, defects and damages.
- (3) Joints shall be closely fitted.

4.0 **SEALANTS GENERALLY**

4.1. **Description of Works**

The works to be executed and completed by the Contractor are as follows:-

- (a) Silicon resin sealant installation (SLT-1)

- (b) Polysulfide resin sealant installation (SLT-2)
- (c) Polyurethane resin sealant installation (SLT-3)
- (d) Asphalt rubber sealant installation (SLT-4)
- (e) All necessary compatible fittings, accessories, etc.

4.2. **Materials Generally**

Sealants shall be chemically compatible with the background to which they are applied, of the selected approved colours and suitable for the intended purpose. Bonding tests will be required. Sealants shall be delivered to the site in sealed containers, labelled to show the designated name, formula or specification number, lot number, colour, date of manufacture, shelf life, and curing time at 21 degrees Centigrade (21°C), manufacturer's directions, and name of the manufacturer.

4.3. **Material Types**

- (1) Type SLT-1: Silicon Resin Sealant
 - (a) For visible joints in glass
 - (b) Type G JIS A5758 or equivalent
- (2) Type SLT-2: Polysulfide Resin Sealant
 - (a) For joints in metal, ceramic tile, etc.
 - (b) Type F of JIS A5758 or equivalent
- (3) Type SLT-3: Polyurethane Resin Sealant
 - (a) For intentionally provided joints in concrete sub-wall as shown on the Drawings.
 - (b) Type F of JIS A5758 or equivalent
- (4) Type SLT-4: Asphalt Rubber Sealant
 - (a) Along top and/or bottom ends of waterproofing
 - (b) Type F of JIS A5751 or equivalent
- (5) Preformed Joint Filler
 - (a) Materials: consisting of ethylene – propylene – terpolymer foamed filler strip with butyl adhesive facing, or equivalent approved.
 - (b) Sized not less than as shown; after compressed into place.
 - (c) Uses: Expansion and similar joints in concrete.
- (6) Others
 - (a) Primers
 - As recommended and required by sealant manufacturer.

(b) Backing Filler

- (i) Back-up materials shall not stick or bond to sealant and shall not give any affection to sealant. Back-up material shall be as per sealant manufacturer's recommendation and/or instruction.
- (ii) Form, shape and size to suit joints where required and to provide firm resistance during sealant installation.

4.4. **Execution and Completion**

- (1) All surfaces to receive sealants shall be prepared and primed as recommended by the approved manufacturer.
- (2) Dimensions shall be appropriate to the required joints.
- (3) Backing fillers shall be installed in longest single lengths available and practical; and set by forcing straight into the joint pocket. Stretching fillers lengthwise to aid installation shall not be permitted.
- (4) Fillers shall be set to required depths using wood or other gauging tools formed for the purpose.
- (5) Sealants shall be extruded into place with approved equipment; accurately applied in one continuous operation; to full joint or pocket depths and widths required; and using sufficient pressure to ensure complete and continuous contact and adhesion.
- (6) Surfaces of sealants shall be finished off approximately level with and parallel to adjacent finish surfaces.
- (7) Sealant surfaces may be slightly below, but never higher than, adjacent finish surfaces, unless otherwise approved.
- (8) Where edges of joints are rounded or otherwise eased off, sealant shall be recessed into joint just sufficient to avoid contact with such edges.
- (9) Preformed joint sealers shall be installed in locations shown and in accordance with the manufacturer's specifications. Preformed joints sealers shall always be placed in compression.
- (10) The surfaces adjoining sealed joints shall be cleaned of smears or other soiling resulting from the sealing application.

5.0 MEASUREMENT AND RATES

5.1. **Measurement**

- (1) Work under this Section shall be measured according to the item classification and units contained in the Bills of Quantities (BOQ). Quantities shall be computed on the Drawings.
- (2) Each complete Waterproofing System: to be measured in square meters (m²). No deductions shall be made for openings for of one (1) square meter or less. The quantity shall be computed net with no allowance for laps.
- (3) Protection concrete: to be measured in square meters (m²).

- (4) Contraction gaps: to be measured in linear meters (m).

5.2. **Rates**

The rates shall be full compensation for all plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the works described in this Section of the Specification and/or shown on the Drawings.

- (1) Rates for waterproofing membrane shall further include for: -
- (a) Insulation boards
 - (b) Polyethylene film
 - (c) Sealant SLT-4 for end of waterproofing membrane
 - (d) Laps,
 - (e) Cutting, fitting, sealing and flashing to perimeters, abutments, gutters and penetration etc.
 - (f) Working to all surfaces and profiles.
 - (g) Preparing substrate surfaces
 - (h) Applying primer if required
- (2) Rates for protection concrete shall further include for: -
- (a) Steel wire mesh installation
 - (b) Preparing formwork
- (3) Rates for contraction gaps shall be deemed to be all inclusive.
- (4) Insulation generally: unless otherwise measured in the BOQ Insulation shall not be measured or priced separately, but shall be deemed to be included within the other rates of the Bill of Quantities
- (5) Sealants generally: shall not be measured or priced separately, but shall be deemed to be included within the other rates of the Bill of Quantities.

SECTION 4330

ROOFING, CLADDING AND FACADES

1.0 SCOPE OF WORK

1.1. The works to be executed and completed by the Contractor are as follows:-

- (a) Single Folded Steel Plate Roof
- (b) Double Folded Steel Plate Roof with Insulation.
- (c) Aluminium faced composite panel.
- (d) Miscellaneous flashings and copings
- (e) All necessary secondary or intermediate structural supports, brackets and framing
- (f) All necessary and compatible fittings, accessories, connectors, bolts, fasteners and fixing

2.0 MATERIALS

2.1. Single Folded Steel Plate Roof with insulation

- (1) Single profiled steel plate: fluorine-resin coated aluminised steel plate (JIS G3302), 0.8mm thickness with interlocking joints, corrugations not more than 54.5mm high, 375mm wide panels as indicated on the drawing, factory bent to curve where applicable.
- (2) Insulation (to partial areas): as indicated on the Drawings.
- (3) Gutters, roof verges, closures and all integral flashings shall be designed and provided by the same manufacturer to ensure a complete and integrated roofing system.
- (4) Colour: Standard colour selected by Engineer.
- (5) Other application: as per manufacturer's recommendation
- (6) Accessories, as generally shown on the Drawings, are to be manufacturer's standard items or custom fabricated where necessary:

2.2. Double Folded Steel Plate Roof with Insulation

- (1) Outer skin roofing panel
 - Type: Sanko shell roof F-80 type roof (Inter-lock System) or equivalent
 - Material: Acid –resistant high polymer clad steel sheet or NS Tuffshield clad steel sheet equivalent.
 - Base Metal: Hot-dip zinc-aluminium-magnesium alloy-coated steel sheet 0.8mm thick
 - JIS G3323, K-14
 - Exposed Surface: Chromic acid rust proofing, 5 μ

- Frame-resistant high-polymer clad, 115 μ
 - Weather-resistant Acryl, 50 μ
 - Color shall be selected from standard manufacturers color range or as directed by the Engineer.
 - Unexposed Surface: Chromic acid rust proofing, 5 μ
 - Frame-resistant high-polymer clad: 115 μ
- (2) Inner skin roofing panel
- Type: Sanko shell roof F-80 type roof (Inter-lock System) or equivalent
 - Material: Acid –resistant high polymer clad steel sheet or NS Tuffshield clad steel sheet equivalent.
 - Base Metal: Hot-dip zinc-aluminium-magnesium alloy-coated steel sheet 0.8mm thick
 - JIS G3323, K-14
 - Exposed Surface: Chromic acid rust proofing 5 μ
 - Frame-resistant high-polymer clad 115 μ
 - Weather-resistant Acryl 50 μ
 - (Color shall be selected and decided from color sample by Engineer)
 - Unexposed Surface : Chromic acid rust proofing, 5 μ
 - Frame-resistant high-polymer clad, 115 μ
- (3) Core Insulation
- Fibre glass wool t=100mm Density 10kg/m³ single layer
- (4) Accessories
- Fixing accessories and others
 - Roof connector: Roof connector to purlin (Heat insulated type)
 - Hot-dip Zinc coated steel sheet t=4.5 x W=50.0mm
 - JIS G3302, SGCC, Z-27.with insulation ABS resin packing t=10 x W50 x 72
 - Fixing clips: Hot-dip Zinc coated steel sheet t=0.8mm(for roof connector) with M8 nut and special washer
 - Hot-dip Zinc coated steel sheet t=0.8mm (for intermediate)
 - Fastener: 6mm dia. Self drilling screw Ruspert finish with SUS Special washer and Butyl packing
 - Rivets: 4mm dia. Waterproof type
 - Aluminium Alloy head,
 - Caulking: Modified Silicone caulking
 - With / Primer
 - Flashings (Flashing for roofing)
 - Flashing for outer skin roof

- Flashings for outer skin roof shall be referred as in the article 3-1-1, materials of outer skin roofing panel and single skin roofing panel.
- Flashings for inner skin roof
- Flashings for inner skin roof shall be referred as in the article 3-1-2, materials of inner skin roofing panel.
- Solar panel attachments and rails shall be provided by solar panel works with metal roof manufacturer standard in accordance with selected solar panel specification.

2.3. **Aluminium Faced Composite Sheet Cladding**

- (1) Material: “Alpolic” sheeting by Mitsubishi Plastics or at least equivalent to approval.
- (2) Composite aluminium sheet panel comprising non-combustible polyethylene core, aluminium skin to both faces, minimum 4mm overall thickness
- (3) Surface finish and colour: Metallic according to Engineer’s selection to match curtain wall.
- (4) Jointing, steel framing and fixings as per manufacturer’s recommendation
- (5) Closing infill at PTB curtainwall, at level 4600 + along gridline C, to allow penetration of mechanical piping..
- (6) Sealant: SLT-2 (refer to Section 4320)
- (7) Accessories shall be manufacturer’s standard items or custom fabricated where necessary

2.4. **Asphalt roofing felt**

JIS A6005 or equivalent; nominal weight minimum 940 g/m²

2.5. **Miscellaneous Aluminium Flashings and Copings**

- (1) Aluminium sheet: conforming to JIS 4100 A6063S or equivalent
- (2) Surface finish: anodising with electro deposition finish confirming to the relevant JIS H8602 A1 or equivalent.
- (3) Sections and profiles as shown on the Drawings
- (4) Thickness: minimum 2.0 mm for less than 200 mm wide; minimum 3.0 mm for not less than 300 mm width
- (5) Color: according to Engineer’s selection from manufacturer’s standard colour range.
- (6) Accessories shall be manufacturer’s standard items or custom fabricated where necessary

2.6. **Glass Wool Layer**

- (1) Conforming to JIS 6301 or equivalent
- (2) Thickness: not less than 100 mm.

- (3) Specific gravity: not less than 16 kg/m³.
- (4) Foil faced both sides
- (5) Laid over purling, supported by galvanised chicken wire mesh
- (6) Incombustible, heat insulation
- (7) Uses: Roofs or as indicated on the Drawings
- (8) Accessories: all accessories required shall be provided.

3.0 EXECUTION

3.1. Generally

- (1) All sheet coverings and accessories shall consist of compatible materials fully conforming to manufacturer's printed instructions and specifications.
- (2) All work shall be carried out in full conformity of the approved shop drawings, manufacturer's requirements and to the approval of the Engineer.
- (3) End joints within the roof shall be avoided and roofing and cladding shall comprise single continuous sheets all as approved by the Engineer.
- (4) Layout of roof and cladding sheets shall be uniform, symmetrical and meet completed appearance as specified.
- (5) Each sheet shall be securely attached in accordance with the manufacturer's recommendations and to the Engineer's approval.
- (6) Adjacent roof sheets shall be securely interconnected at joints using fasteners uniformly spaced in between fasteners at bearings; spaced as per manufacturer's instructions.
- (7) Bolts shall be installed head end in for roofing.
- (8) Each exterior nut shall be set over washer unit and tightened sufficiently to effect positive watertight connection without unnecessary over-compression of resilient washer.
- (9) Curved or profiled sheets shall be produced to curve by the manufacturer with his own specialist equipment and specialist qualified personnel at the Site to undertake this process. Curving and profile shall be carried out in such a manner as not to cause any deformation of corrugations or of the roof panel joints and shall not in any way prejudice the watertightness of the roof.
- (10) Joints shall be interlocking, fixed dry and shall not rely on the use of sealants to provide watertightness.
- (11) Site cutting shall only be allowed with the approval of the Engineer. All cut metal portions and edges shall be adequately protected to prevent future degradation and treated to match roof sheet colour; carefully applied for complete coverage without excessive paint on adjacent sheet areas.
- (12) Installation shall be complete with all accessories shown on the Drawings or required by the manufacturer's instructions and shall include all ancillary fixings such as galvanised mild steel flats and angles, bolts, brackets, anchors and any other item

necessary for the watertight and secure installation of the roofing system.

3.2. **Completion Requirements**

- (1) The installation shall be free from unnecessary cuts, holes or blank plates.
- (2) The installation shall be completely watertight throughout and free from leaks or entry of water into or through interior or concealed spaces of structure.
- (3) Each roof sheet shall be tightly and rigidly secured in place; free from movement, squeaks or rattles.
- (4) Corrugations of roofing sheets shall be parallel throughout each roof area; and square and normal to ridge and eaves lines.
- (5) Each respective item of ancillary coloured galvanized sheet works shall include for providing and installing all associated sealants, flashing and other related materials.

3.3. **Guarantee**

- (1) The roofing and cladding work shall be executed by a specialist firm or firms or specialist qualified personnel in the employ of the Contractor, all to the approval of the Engineer.
- (2) The Contractor shall submit a ten (10) year written guarantee of the stability, watertightness and durability of the roofing system together with verges and for all cladding systems. This guarantee shall also cover the color fastness of the material which shall be guaranteed not to fade differently to other external building components. The Guarantee shall be in a form approved by the Engineer and Employer, for the due and faithful observance and performance of this obligation, and it shall be delivered to the Engineer at the same time as request for approval (RFA) of the particular roofing or cladding items.

4.0 **MEASUREMENT AND RATES**

4.1. **Measurement**

- (1) Work under this Section shall be measured according to the item classifications and units contained in the Bills of Quantities (BOQ). The quantities shall be computed on the Drawings.
- (2) No deductions shall be made for openings for of one (1) square meter or less. The quantity shall be computed net (flat on plan) with no allowance for corrugations or laps.

4.2. **Rates**

The rates for Work under this Section shall be full compensation for all Plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the works described in this Section of the Specification and/or shown on the Drawings.

- (1) Rates shall further include for: -
 - (a) Support frames and brackets
 - (b) Insulation

- (c) Laps, joints and sealants
- (d) Cutting and fitting to perimeters, abutments and around penetrations.
- (e) Sealants (SLT) , flashings, collars, and aprons to perimeters, abutments and around penetrations
- (f) All fittings, fixings, fasteners, anchor plugs, screws, connectors, clips and accessories

SECTION 4340

WINDOWS / DOORS

1.0 GENERAL

1.1. Scope of Application

The work to be executed by the Contractor under this Section shall comprise all doors, windows and louvers to all buildings. All works shall be constructed in accordance with the dimensions, lines and levels and in the locations shown on the Drawings or instructed by the Engineer.

1.2. Item of Work

The works of doors, windows and louvers generally to be executed by the Contractor shall include the following: -

Para 2.0 WOOD DOORS

Para 3.0 STEEL DOORS

Para 4.0 ALUMINIUM WORKS

Para 5.0 GLAZING TO DOORS / WINDOWS

Para 6.0 SPECIAL OPERATING DOORS / SHUTTERS

Para 7.0 IRONMONGERY

1.3. Submissions

Prior to commencement of the Work, the Contractor shall prepare and submit for the Engineers approval: -

- (1) All manufacturer's original catalogues, detailed technical data, specifications and installation instruction for all components and accessories, within this section.
- (2) Shop drawings for all work required indicating in detail, the fabrication, assembly and erection requirements, material lists, joint and connection details and filling details.
- (3) Shop drawings shall further indicate location and installation details of all finish ironmongeries.
- (4) Shop drawings indicating fabrication requirements shall be submitted not less than one (1) month before fabrication commences. In addition, the Contractor shall submit structural calculations for any work proposed which is at variance with work as shown or specified.
- (5) A detailed construction plan indicating the proposed methods, sequences, Standards, etc., to be adopted.
- (6) Samples and test certificates shall be provided of aluminium finishes and colours, together with cut lengths of full size aluminium section and profiles, as requested by the Engineer. Samples of other materials, accessories assembling, ironmongeries and

finishing shall also be submitted.

- (7) Full size samples shall be provided for each corner connection and component detail, cut away as necessary to clearly indicate all door, window and frame construction and fabrication features, such as typical joints, connections, welding, seam treatments, finishing and other characteristics. Samples of all finish ironmongery to be used in the work, shall be submitted to the Engineer for approval and no finish ironmongeries shall be fitted until it has been approved.

1.4. **Delivery and Storage**

- (1) Doors, frames and accessories delivered to the site shall be inspected for damage, unloaded and stored in suitable and accessible spaces with a minimum of handling.
- (2) Use all means necessary to protect materials before, during and after installation. In the event of damage, immediately make all repairs and replacements necessary for the approval of the Engineer and at no additional cost to the Employer.

2.0 **WOOD DOORS**

2.1. **Description of the Work**

The works to be executed and completed by the Contractor are as follows: -

- (1) Flush doors, louver doors (WD)
- (2) To be complete with frames, sub-frames, cover strips, glazing beads, timber grounds, glazing strips, all finish ironmongeries, accessories, fixings and finishing.

2.2. **Materials**

- (1) Flush Doors (WD)
 - (a) Hardwood frame; with semi-solid (50%) timber core (JIS A6931)
 - (b) Faces of 2.7mm thick veneered plywood with paint type P-2 or P-5 or melamine sheet (minimum 1.5mm thick) on plywood backing, as specified on the Drawings.
 - (c) Hardwood edged all round.
 - (d) Top and bottom frames and edgings shall have air vent of 3mm square hole.
 - (e) Timber glazing beads to be provided to all glazed openings. Fixing to be by brass cups and screws on varnished or laminated doors.
 - (f) Louver and frame: hardwood; blade with inverted "S"-section, opening area not less than 50 %
- (2) Others
 - (a) Door thresholds: stainless steel sheet SUS 304
 - (b) Wood door frames (jamb and head): hardwood
 - (c) Wood backing for jamb and head installation: hardwood
 - (d) Glass: clear float glass (CG) thickness 6.0 mm, as specified in para. 5.0 Glazing to Doors/Windows of this Section

- (e) Reinforcing blocks of hardwood shall be provided for finish ironmongery installation.
- (f) Treatment: all wood shall be treated with preservative as specified in Section 4360.
- (g) Sizes and thickness as shown on the Drawings

2.3. **Finishing**

- (1) Wood doors shall be finished with either paint or clear varnish as indicated on the Drawings.
- (2) All concealed surfaces of wood doors shall be prepared and painted with one (1) coat of approved wood priming paint or undercoat as appropriate before fixing.

2.4. **Fabrication and Installation**

- (1) Frames shall fit neatly into the openings to be finished where necessary to receive door inserts, etc.
- (2) Door jambs and heads shall be fixed in accordance with the details shown on the Drawings. All ferrous anchoring materials shall be pre-treated, complying with the requirements of **Section 4350**.
- (3) Doors shall be installed so they hang plumb and true.
- (4) Upon completion, all items shall be free from warp. Joints shall be secure and undamaged, and all surfaces shall be either finished or in satisfactory condition for finishing as required.
- (5) Top and bottom edges of doors shall also be finished by paint type P-2.
- (6) All work shall be fabricated with approved water-resistant adhesive. The adhesive shall be non-staining when items are scheduled to receive varnish or natural finish.
- (7) Door leaves shall have constant clearances with jambs, sills, heads and other leaves as shown on the Drawings.
- (8) Jambs and heads shall be fabricated as shown on the Drawings.

2.5. **Completion Requirements**

- (1) Flush doors and louver doors shall comply with tolerance requirements specified in para. 3.0 of this Section.
- (2) Exposed surfaces shall be clean and free from scratches, dents, warping, stains, discoloration or other defects or damage.
- (3) The works shall be free from unnecessary cuts or holes.
- (4) The work shall be properly framed and jointed together without the use of nails or other metal fixings. No individual framing member shall be less than 32mm nominal width.
- (5) All necessary blocking pieces for ironmongery and additional infill members or rails for door closers, or top fixing of kicking plates shall be provided as required.

3.0 **STEEL DOORS**

3.1. **Description of the Work**

The works to be executed and completed by the Contractor are as follows:-

- (a) Steel doors (SD)
- (b) Steel sliding doors to handicapped toilets to be with honeycomb core or other approved material, to be of suitable weight fit for purpose.
- (c) To be complete with louvers, frames, sub-frames, cover strips, glasses, glazing beads, timber grounds, glazing gaskets, galvanizing, factory applied finishing paint where indicated, all finish ironmongeries, accessories and fixings as required.

3.2. **Materials**

Steel doors (SD)

- (1) Galvanized steel sheets: JIS G3302 SGHC (Z12 or F12, i.e., zinc coating 120 g/m² per side or more)
- (2) Shape steel: JIS G3101 or equivalent; plus galvanizing as per Section 4350 Metal Works
- (3) Glass: clear wired glass (CWG) thickness 6.8 mm, as specified in para. 5.0 Glazing to Doors/Windows of this Section
- (4) Door thresholds: stainless steel sheet SUS 304
- (5) The thresholds shall be securely fixed to concrete slab re-bars. Voids inside threshold shall be filled by mortar as follows:-
 - (a) The filling mortar shall be of one (1) part of cement to three (3) parts of sand
 - (b) Voids inside threshold shall be also filled by the said mortar which shall be held by stainless steel rods to be welded to threshold prior to mortar filling.
- (6) Door astragal: stainless steel strips SUS 304, 2.5mm thick with neoprene insert.
- (7) Airtight material: neoprene
- (8) Finishing screws: stainless steel SUS 304
- (9) Mortar: one (1) part of cement to three (3) part of sand, plus waterproof agent
- (10) Void filler: rock wool
- (11) Finishing paint: type P-3 (refer to Section 4370 para. 8.0) or epoxy polyester baked paint
- (12) Structural bonding tape: as per manufacturer's recommendation (manufacturer shall submit specifications, records, etc. of structural bonding tape).
- (13) Thickness of steel doors shall be as follows:
 - (a) Door leaf frames, backing plates, anchorage, jambs, heads, bottom jambs, reinforcing plates, etc.: 2.3mm

- (b) Thresholds: 2.0mm
- (c) Face panels and others: 1.6mm

3.3. Performance

- (1) All external doors shall meet the requirements of JIS A4702 (1,500 Pa or over).
- (2) Steel doors and light gauge steel doors shall meet the requirements of JIS A4702 and required categorized performance shall be as follows:
- (3) Fire doors and frames shall be provided where indicated on the Drawings. Fire doors shall be rated one (1) hour fireproof and officially tested and certified as such by a testing agency approved in writing by the Engineer. Louvered grilles in fire doors shall be fitted with fusible links so that in event of fire, louvers close and entire door assembly provides continuous fire resistance for at least one (1) hour.

3.4. Finishing

- (1) Finishing Paint (P-3)
 - (a) Prior to full assembling of steel doors at factory, all galvanized surfaces shall have applied complete anti-rust treatments in accordance with the requirements of Section 4350 after removal of oil, grease, other foreign matters and rust (by sandpapers #100 to #180).
 - (b) After fabrication:
 - (i) All surfaces shall be cleaned, free from oil, grease and other foreign matters;
 - (ii) Cut ends and/or welded portion of galvanized elements shall be touched up in accordance with the requirements of Section 4350.
 - (c) Primer shall be applied on exposed surface of steel doors.
 - (d) Finishing paint type P-3 shall be applied on exposed galvanized surfaces of steel doors prior to finish ironmongeries installation.
- (2) Epoxy polyester oven baked powder paint (EXP)

Shall be applied at factory according to manufacturer’s standard.

3.5. Allowable Tolerance

Table 4340.1 Steel Doors – Tolerances

Jamb, Head	Tolerance mm	Door leaves	Tolerance mm	Others	Tolerance mm
Opening width	+ 1.5	Width	+ 1.5	Ironmongeries location	+ 3.0
Opening height	+ 1.5	Height	+ 1.5	Gap between leaf and jamb	+ 1.5
Jamb Width	+ 1.0	Thickness	+ 1.0		

Differences between inner diagonals	< 2.0	Differences between diagonals	< 2.0		
Differences between outer diagonal	< 2.0	Twistiness	< 2.0		

3.6. Fabrication

- (1) Jambs (head, side and bottom) shall have continuous longitudinal members and shall be welded each other tightly and properly at factory.
- (2) Thresholds shall be fixed to side jambs or bottom jambs by welding at factory. Welding marks shall not be exposed.
- (3) Reinforcing plates shall be provided where finish ironmongeries will be provided.
- (4) Rockwool shall be placed and compressed well prior to face panels installation.
- (5) Reinforcing fastening plates shall be provided along jamb elements longitudinal joints and fixed by welding at 600mm on centre or less.
- (6) Anchoring plate shall be fixed to jambs (head, side and bottom) by welding onto jamb reinforcing fastening plates.
- (7) Main frames shall be provided all around the door leaf and intermediate frames shall be provided at 300mm on centre or less.
- (8) Face panels with backing sheets shall be fixed to main frames by continuous welding, and to intermediate frames by structural bonding type.
- (9) Reinforcing plates for finishing ironmongeries shall be always fixed onto backing sheets but not onto face plates.
- (10) Finish ironmongeries shall be pre-fitted at factory, as per approved shop drawings.

3.7. Installation

- (1) On concrete or brick walls shall be as follows:
 - (a) Dowel bars of walls shall be fixed to jamb anchoring plates but not onto jambs.
 - (b) Welded portion of steel anchoring plates shall receive touch-up anti-corrosion paints in accordance with Section 4350 Metal Works.
 - (c) Voids between sub-walls and jambs or threshold shall be filled by mortar.
 - (d) The said filling mortar shall be of one (1) part of cement to three (3) parts of sand, and with waterproofing agent where 300mm above finished floor height or below.
 - (e) Voids inside threshold shall be also filled by the said mortar which shall be held by stainless steel rods to be welded to threshold prior to mortar filling.
- (2) On light gauge steel wall framings shall be as follows:
 - (a) The items (1) (c)-(e) of para. 3.7 shall be followed.
 - (b) The jambs shall be fixed by galvanized bolts and nuts with wood adjusting blocks

as shown on the Drawings. Preservative treatment on wood shall be conducted in accordance with the requirements in Section 4360 para. 2.0.

- (c) Glazing shall be completed in accordance with the requirements of para. 5.0 of this Section.

3.8. **Completion Requirements**

- (1) Exposed surfaces shall be clean and free from scratches, dents, warping, waviness, buckling, misaligned or improperly fitted joints, or other defects or damages.
- (2) Work shall be free from exposed fastenings, unnecessary cuts, holes or blank plates and advertising labels or signs, other than as particularly shown, specified or approved.
- (3) Each unit or assembly shall be tightly and rigidly secured in place, free from unnecessary movement.
- (4) Each frame shall be set square, plumb, level; each door shall be set level and plumb in all positions of swing.

4.0 **ALUMINIUM WORKS**

4.1. **Description of Works**

The works to be designed, executed and completed by the Contractor are as follows:-

- (a) Aluminium doors (AD)
- (b) Aluminium windows, aluminium back-mullion curtain wall framing system (AW)
- (c) Aluminium louvers (AL)
- (d) Aluminium glazed screens (AS)
- (e) To be complete with frames, sub-frames, sills, trims, water creasings, cover strips, glasses, glazing beads, glazing gaskets, insect screens, waterproofing mortar, anchorages, all finish ironmongeries, accessories and fixings
- (f) Aluminium louvers to external walls for connection of mechanical works, shall always include an approved typed of insect proof screen with aluminium framing as specified in para. 4.2.4 of this Section.

4.2. **Materials**

- (1) Aluminium Frames
 - (a) Conforming to JIS H 4000, H4100 or equivalent
 - (b) Thickness, unless otherwise specified, shall not be less than as follows:
 - (i) Load carrying members shall be per manufacturer's standards for profile sections required and as necessary to meet structural requirements
 - (ii) Glass mouldings : 1.8mm

- (iii) Exposed flashings : 1.6mm
 - (iv) Concealed flashings : 0.8mm
- (c) Finishing of aluminium materials shall be as follows:
 - (i) Anodised: JIS H8602, class B or equivalent
 - (ii) Anodising electro with deposition: confirming to relevant JIS H8602 or equivalent; thickness not less than 16 microns
 - (iii) Colour: as directed by the Engineer from manufacturer's standard colour range
 - (iv) Exposed surfaces to be mechanically polished, free from scratches, pits and any other imperfections or blemishes before anodising
- (d) Size of aluminium louver for generator shall be coordinated with specification of generator.
- (2) Glass
 - As specified in para. 5.0 of this Section.
- (3) Fastenings
 - (a) Aluminium to steel shall be stainless steel only.
 - (b) Exposed and where permitted only, aluminium finished to match work with cross-slotted flat head types, countersunk flush.
 - (c) Exposed stainless steel to colour anodised work and where permitted only, heat-treated to simulate anodising colour.
- (4) Others
 - (a) Reinforcement, anchoring, etc.: stainless steel, hot-dip galvanized carbon steel or aluminium alloy, per applicable requirements specified under Section 4350.
 - (b) Air tightness components shall be made of polyamide.
 - (c) Hinges, arms, etc. shall be made of stainless steel or aluminium alloy.
 - (d) Insect screens shall be installed to all opening windows of all building Screens shall be opening or sliding according to the approval of the Engineer and fixed in secondary frames on the face of the windows. The frame of screen shall be made of aluminium alloy of similar finish to the windows. The screen shall be polyester mesh 18 mesh / square inch . Material shall be special polyester thread below 40 micron : Core: High strength and low elongation polyester , Sheath: High adhesive performance for photosensitizing agent polyester.
 - (e) Mortar to be applied to the voids between aluminium doors/windows frames shall be of one (1) part of cement and three (3) parts of sand with waterproofing agent.
 - (f) Stainless steel door sills shall be 2mm thick, hairline finish.
 - (g) Sealant shall be of polysulfide and with polyurethane back-up.

- (h) Glazing recesses, glazing channels and gaskets shall be as shown on the Drawings.
- (i) Wood adjusting blocks shall be of hardwood and shall be pre-treated in accordance with the requirements of Section 4360.

4.3. Performance

- (1) Aluminium sash doors and windows (for Curtain wall, VFR room of CTO and Building Height: more than 30m)

External aluminium sash doors and windows shall comply with the requirements of JIS A4702 (doors) and JIS A4706 (windows). National Structural Code of the Philippines (Wind load pressure at Zone II), ASTN (E283 for Air tightness, and E331 for water tightness) and categorized requirement shall be as follows:

- (a) Against wind pressure :
 - 2400 Pa or over for Curtain wall
 - 2880 Pa for VFR room and Building
 - Height = more than 30m.
- (b) Air tightness : class A-4
- (c) Water tightness : 768 Pa or over

- (2) Aluminium sash doors and windows (Building Height: more than 9m to 30m)

External aluminium sash doors and windows shall comply with the requirements of JIS A4702 (doors) and JIS A4706 (windows), National Structural Code of Philippines (Wind load pressure at Zone II), ASTN (E283 for Air tightness, and E331 for water tightness) and categorized requirement shall be as follows: (a) Against wind pressure : 2400 Pa or over

- (b) Air tightness : class A-4
- (c) Water tightness : 768 Pa

- (3) Aluminium sash doors and windows (Building Height: 0 to 9m)

- (a) Against wind pressure : 2000 pa or over
- (b) Air tightness : class A-4 or 300pa
- (c) Water tightness : 768 Pa

- (4) Stainless steel windows

Stainless steel windows shall comply with the requirements of JIS A4702 (doors) and JIS A4706 (windows), National Structural Code of the Philippines (Wind load pressure at Zone II), ASTN (E283 for Air tightness, and E331 for water tightness) and categorized requirement shall be as follows:

- (a) Against wind pressure : 2400 Pa or over
- (b) Air tightness : class A-4
- (c) Water tightness : 768 Pa

4.4. Design Requirements

- (1) The dimensions of aluminium profile indicated on the Drawings for the aluminium work are references only.
- (2) Each type shall be designed by the Contractor (or his specialist subcontractor) in order to achieve a completely coordinated integrated system of components complying in all respects to sizes, types, designs, performance, appearance and finishes shown or specified in provisions of the Specification or the Drawings.
- (3) Particular attention shall be paid to the performance and compatibility of the curtain wall system (AW) in combination with insect screen (MS) and wooden louver (LV) at the Passenger Terminal Building.
- (4) Doors and windows shall be operated smoothly at 50 N, shall have no defects after 100,000 operations (doors) or 10,000 operations (windows).
- (5) Member deflection shall not exceed limits specified in JIS A4702 or JIS A4706.
- (6) Members exceeding the specified limits shall be provided with heavier wall thickness or internally reinforced as required and in lieu of increasing overall size differing from that shown or specified.
- (7) The assemblies of curtain wall framings, doors, windows and louvers shall be designed and arranged to form and maintain an airtight and watertight assembly, free from leakage and rattling when subjected to a maximum dimensional changes (expansion and/or contraction).
- (8) All necessary weather drips, sealants, internal gutters, sleeves, weep holes and other work as necessary shall be provided.
- (9) Stops, glazing recesses and neoprene glazing channels shall be provided, each sized to properly receive glass or panel thickness required, and with depths to meet or exceed minimum edge grips required by manufacturer of glass to be used.
- (10) Allowance shall be made for expansion, contraction, building movement and settlement as required, with slip-joints or other special features as necessary.
- (11) Anchors and connections to building structures shall be designed to safely resist all design loads; of types required and best suited for installation conditions likely to be encountered.
- (12) Anchoring of jamb, water creasing and other main parts of doors/windows by bolting or screwing shall not be allowed.
- (13) Mullions, transom bars and other intermediate or special items shall be provided as shown or approved.

4.5. Fabrication Requirements

- (1) 4.4.1 Aluminium Welding

- (a) To be performed only by qualified welders, experienced in the type of work required.
 - (b) Welds shall be in concealed locations only; exposed surfaces shall be free from evidence of welding.
- (2) Exposed Joints in Aluminium Work
- (a) Intermediate joints in running members shall be permitted only if or where shown or approved.
 - (b) Joints shall be prepared for precision fit for neat, hairline appearance free from voids, burrs or other irregularities.
 - (c) Matching sleeves shall be provided for interior side of joints where opened space for contraction and expansion.
- (3) Protection
- (a) After fabrication, members and assemblies shall be suitably protected against weather or other damages, maintained in place and in good repair for as long as necessary.
 - (b) After erection, surfaces not otherwise shop protected shall be coated using clear, not-yellowing, high-gloss lacquer or equivalent proprietary protective coating applied and removed in accordance with manufacturer's instructions. Coatings which adversely affect colours or finishes or leave permanent residual deposits shall not be permitted.
- (4) Assembly Requirements
- (a) Doors, windows and louvers shall be factory assembled only, other than surface mounted or other finish ironmongery items projecting above finished surfaces.
 - (b) Other units: optional factory or field assembly.
- (5) Allowable Tolerances

Table 4340.2 Aluminium Works – Tolerances

Location/Position	Sizes (m)	Tolerances (mm)
Clearance Frame Opening	less than 2.0	+ 1.5
	less than 3.5	+ 2.0
	3.5 or more	+ 2.5
Differences between Diagonal Clearances of Frame Opening	less than 2.0	=< 2.0
	less than 3.5	= < 3.0
	3.5 or more	=< 4.0
Height and Width of Leaf	- - -	+ 1.5
Differences between Surfaces of Leaf	- - -	=< 2.0
Differences between Diagonals of Leaf	- - -	=< 3.0

4.6. Installation Requirements

- (1) Frames
 - (a) Shall be connected to building structures, by anchors
 - (b) Shall be installed in straight alignments parallel to building or column lines.
 - (c) Units set plumb, square and level, edges uniformly spaced and shimmed for sealant recesses.
 - (d) Members securely attached and free from movement, other than allowances for thermal variations as required.
- (2) Doors
 - (a) Installed accurately aligned with frames; plumb in all positions of swing, adjacent leaves accurately aligned.
 - (b) Each unit square; faces true to plane and free from warps.
 - (c) Each unit plumbs in all positions of swing.
 - (d) Complete with vinyl or neoprene seals.
- (3) Water Flashing/Sills
 - (a) Shall be installed accurately set to align with doors and frames, at positions required for operation of exit devices where required
 - (b) Shall be secured in place level, and grouted per requirements.
 - (c) Fastener heads shall be flushed, countersunk.
- (4) Windows/Louvers
 - (a) Shall be installed in straight alignments, parallel to walls and building lines, adjacent units accurately aligned.
 - (b) Units shall be set plumb square and level, vents and blades level in all positions of swing, pivoted windows plumb in all positions of rotation.
 - (c) Each unit shall be well fitted and securely attached to supporting frames.
 - (d) Screens shall be mounted flat, square and securely attached using clips as specified.
 - (e) Shall be complete with vinyl or neoprene seals.
- (5) Door Threshold

Shall be installed in accordance with the requirements in Section 4340 para. 2.0.

4.7. **Completion Requirements**

- (1) Exposed surfaces shall be clean and free from scratches, dents, warping, waviness, buckling, broken parts or units, misaligned or improperly fitted joints, streaks, stains, discoloration or other defects or damage.

- (2) Installations shall be free from exposed fastenings; unnecessary cuts, holes or blank plates; and exposed steel connections or reinforcing, other than as particularly shown, specified or approved.
- (3) Installation shall be watertight throughout and free from leaks or entry of water into or through interior or concealed spaces of structure; other than via waterways or provisions for drainage as particularly provided for or approved.
- (4) Each assembly shall be tightly and rigidly secured in place and free from unnecessary movements, squeaks or rattles.
- (5) Movable or mechanical items or devices shall be serviced and adjusted to operate smoothly, quietly, easily and free from squeaking or binding.

4.8. **Guarantee**

- (1) The whole of aluminium works shall be executed by specialist firms or specialist qualified personnel in the employ of the Contractor, all to the approval of the Engineer.
- (2) The Contractor shall submit a ten (10) year written guarantee of the water-tightness and durability and colour fastness of the aluminium work items. The Guarantee shall be in a form approved by the Engineer and Employer, for the due and faithful observance and performance of this obligation, and it shall be delivered to the Engineer at the same time as request for approval (RFA) of the aluminium work items.

5.0 **GLAZING TO DOORS/WINDOWS**

5.1. **Description of Works**

The works to be executed and completed by the Contractor are as follows:-

- (a) All interior and exterior glass to curtain walls, doors and windows
- (b) Anti-shatter film to doors in aluminium glazed screens (AS) and external glazing (AW) to be in compliance with Clause 207.5.9.3 (Wind-Borne Debris) of the National Structural Code of the Philippines Volume I, 6th Edition.
- (c) Installation of glazing sealants, beads, stops, glazing strips, glazing gaskets

5.2. **Materials**

- (1) Glass

Types of glass shall be as indicated on the Door and Window Schedule and as follows:

- | | | | |
|-----|-------------------------|---|--|
| (a) | Clear Float Glass (CG) | : | thickness 6mm for Aluminium Glazed Screen (AS), thickness 8 mm for external and 6 mm for internal Aluminium Windows (AW) |
| (b) | Clear wired Glass (CWG) | : | thickness 6.8 mm for steel door (SD), Aluminium Glazed Screen (AS), Aluminium Door (AD). |

- (c) Heat absorbing glass (HAG) : Thickness 10.0 mm Aluminium windows (AW)
- (d) Laminated Safety Glass (LG) : Heat absorbing tempered glass (HTG) thickness 8 mm + 1.52 PVB + clear float glass thickness 8 mm + 1.52 PVB + clear float glass thickness 8 mm for glass roofed canopy and airside walkway at Passenger Terminal Building.
- (e) Pair Glass (PG) : Fixed clear tempered glass 15mm + air gap 10mm + fixed clear glass 15mm, for Control Tower Windows
- (f) Tempered Glass (TG) : Thickness 8 mm or 10 mm (as per door and window schedule) for aluminium doors (AD), in exterior the glass to be heat absorbing to match the HAG glass for AW.
- (g) Colour : Colours as directed by the Engineer from manufacturer's standard colour range.

(2) Anti-shatter Film

As per JIS A 5759 type 2-I or equivalent; thickness minimum 100 micron

(3) Personnel Protection Markings

Approved type of self adhesive continuous strip films, 150mm high. Design, pattern and colour as directed by Engineer.

(4) Sealant

SLT-1 or SLT-2 as specified in Section 4320 para. 4.0.

(5) Glazing Gasket

As per JIS A5756 or equivalent

5.3. Fabrication Requirements

- (1) Each glass panel shall be factory or shop prepared to dimensions verified at the Site or otherwise certified.
- (2) Each glass edge shall be straight, square and free from chips, fissures, projecting flares or other conditions which do or could subject glass to excessively unequal stresses.
- (3) Each glass panel shall be sized to effect edge grips and edge clearances as required for

various types and sizes of glass.

- (4) Glass grains shall be horizontal throughout, unless otherwise approved, and in any case, consistent throughout any one (1) or more locations or elevations which can be seen from one (1) position.
- (5) Exposed edges shall be mechanically belt ground square, flat, straight and uniform in texture, edges eased by neat bevelling.

5.4. **Installation Requirements**

- (1) Setting blocks shall be required for each glass panel. They shall be positioned at bottom edge at two points, at quarter-points in from vertical side edges. For larger or heavier panels, additional units shall be provided at intermediate locations as or where recommended by glass manufacturer.
- (2) Spacers shall be required for each glass panel. They shall be positioned along vertical and top edges, uniformly and symmetrically placed. Quantity of units shall be just sufficient to prevent undue flexure of glass until fully and completely sealed.
- (3) Accurately set each panel square with and centred in opening, edges and faces with clearances not less than as shown or approved.
- (4) Temporary identification shall be as follows:
 - (a) Required to be provided as work progresses, and maintain for as long as necessary when any other work is being performed which could cause accidental breakage.
 - (b) Glass panels shall be identified as installed using brightly coloured fabric or plastic tape strips, set at about one (1) meter above floor line on interior side, temporarily secured to frames.
 - (c) Adhesive tapes or coatings applied directly to glass surfaces will not be permitted.
 - (d) Signs or any other coverings which partially cover glass on outside, resulting in highly unequal thermal stresses; will not be permitted.
- (5) Glazing to steel or aluminium doors, windows and frames, shall be bedded and sealed with approved sealants, firmly held in position with screwed or clipped metal beads. The sealant shall be described in Section 4320.
- (6) Personnel protection film shall be applied to all clear glass screens without handrail where there is risk of personnel colliding with the screens.

5.5. **Completion Requirements**

- (1) Exposed surfaces shall be completely clean and free from scratches, warping, waviness, broken units, chips or cracks, stains, discoloration or other defects or damages.
- (2) Exterior installations shall be airtight and watertight throughout, free from leaks or entry of water into or through interior or concealed spaces of structure, other than via waterways or provision for drainage as particularly provided for or approved.
- (3) Each panel shall set plumb, level, accurately positioned at locations required, adjacent units accurately aligned.
- (4) Gaskets, strips or sealants shall be smooth surfaced, accurately cut to vision lines,

neatly squared at corners, well-bonded to adhering surfaces, and free from gouges, pits, pulls, string or other defects or damages.

6.0 SPECIAL OPERATING DOORS / SHUTTERS

6.1. Description of Works

The works to be executed and completed by the Contractor are as follows:-

- (a) Motor operated roller shutter Door (RD)
- (b) Motor Operated Roller Shutter (RS)
- (c) To be complete with frames, sub-frames, hoods, trims, waterproofing mortar, anchorages, all finish ironmongeries, accessories and fixings
- (d) To be complete with electrical system such as motor, switches, cabling to local isolator, etc.

6.2. Motor Operated Roller Shutter Door (RD)

- (1) Manufactured to the following requirements:
 - (a) Type: horizontal slat vertical roller door.
 - (b) Hot dip galvanized steel according to JIS G3131 or G3140 or equivalent. Galvanized requirement not less than 180 gm/m².
 - (c) Slat type as selected from manufacturer's standards; vision slats as indicated on the Drawings.
 - (d) Slat thickness: minimum 1.6 mm
 - (e) Each slat in single length units only for full span required. Intermediate spliced, welded or joints will not be permitted.
 - (f) Bottom edge: T type edge; reinforced with back to back 50 x 50 x 4 mm thick galvanized steel angles.
 - (g) Finish: paint type P-3 (refer to Section 4370).
 - (h) Overhead electrical motor drive.
 - (i) Manual opening with chains and pulleys.
- (2) Operation requirements are as follows
 - (a) General: essentially self-contained power operators, designed and arranged for service required; with components and accessories as specified or necessary for satisfactory performance under installation conditions shown.
 - (b) Reduction gears: operates in oil bath with drip proof casing
 - (c) Motor: high torque totally enclosed with thermal protective device; 220 V, 60 Hz, 3-phase.
 - (d) Disc brake: automatically locks doors in position.

- (e) Limit switches: automatically stops door in proper open and close positions.
- (f) Magnetic reversing contactors: JIS C8325, Class A-1-2.
- (g) Emergency manual operation: endless hand chain.
- (h) Interior push-button station at each door, with UP, DOWN and STOP buttons.

6.3. **Motor operated Roller Shutter (RS)**

- (1) Manufactured to the following requirements:
 - (a) Type: horizontal slat shutter for baggage handling conveyors
 - (b) Hot dip galvanized steel according to JIS G3131 or G3140, or equivalent. Galvanized requirement not less than 180 g/m².
 - (c) Slat type as selected from manufacturer's standards.
 - (d) Slat thickness: minimum 1.6 mm
 - (e) Each slat in single length units only for full span required. Intermediate spliced, welded or joints will not be permitted.
 - (f) Bottom edge: T type edge; reinforced with back to back 50 x 50 x 4 mm thick galvanized steel angles.
 - (g) Finish: paint type P-3 (refer to Section 4370)
- (2) These doors are to be provided under Architectural but they shall also be provided with an automatic override coordinated with Section 7300 (BHS).
- (3) Shutter guides shall be as manufacturer's standards.

7.0 **IRONMONGERY**

7.1. **Description of Works**

The works to be executed and completed by the Contractor are to supply and install all finish ironmongeries for all doors, windows, louvers, fixtures etc.

7.2. **Locking and Keying Requirements**

- (1) The Contractor shall develop from the Drawings a final Passenger Terminal Building Security Zoning plan with the Employer under supervision of the Engineer. Such final security zones shall be incorporated in the Access Control System (ACS) and the coordinated with the Fire/Emergency Exit requirements to comply with the fire and building codes.

The Fire/Emergency exits as indicated on the Drawings shall be equipped with panic bars controlled strikes, which at locations shown are combined with electrical (deadbolt) locks connected to the Fire detection and Alarm System (FAS) and/or Access Control System, to override the security system and unlock the (exit) door during emergency situations.

Where electrical locks are required (i.e. doors with Access Control, Fire/Emergency Doors related to the Building Security) the door(s) shall be equipped with electric

controlled hinge(s).

- (2) The Contractor shall provide master keying system.
- (3) The Contractor shall with the Employer, under supervision of the Engineer, develop a master keying system covering all buildings and facilities.
- (4) The Contractor is to propose a detailed system for the following groups for the Engineer's approval:
 - Great grandmaster key (GGMK)
 - Grandmaster key groups (GMK)
 - Master key groups (MK)
 - Reversed master key groups (RMK)
- (5) Requirements for keys shall be as follows:
 - (a) The Contractor shall hand over three (3) nos. of originally manufactured keys to the Employer.
 - (b) The Contractor shall use construction keys during construction, and permanent keys shall not be used for work execution.
 - (c) Each key shall be permanently embossed.
 - (d) Each set of keys shall be tagged, using approved tags (refer to para. 7.3.21 of this Section); each tag suitably identified to properly correlate with respective lock, and master keying groups.
 - (e) The Contractor shall store the keys with respective tags, including keys for other Works, inside a bake-painted steel key box (refer to para. 7.3.22 of this Section), and key boxes containing master keys shall be handed over to the Employer separately from boxes for slave keys.
 - (f) The Contractor shall provide suiting lists of keys in accordance with the following:
 - (i) A plastic laminated key list shall be placed on the back of key box front cover
 - (ii) Two (2) further sets of list shall be provided with key location map and door/window ironmongery list; and
 - (iii) An ironmongery list shall indicate master key group, key number, tag number, name of manufacturers, model numbers, usage, etc.
 - (g) Construction keys shall be lent to the Engineer only by means specifically directed by the Engineer, during construction period.
 - (h) Even if one (1) key is damaged or lost, the Contractor shall replace corresponding lock set completely.
 - (i) Double-assignment of same key numbers shall not be allowed.

7.3. **Materials**

(1) **General**

- (a) The finish ironmongery to be supplied by the Contractor shall be carefully fitted and fixed with screws of the same material or finish as the part to be fixed.
- (b) All exposed parts of locks shall match the finish of the handles (furniture). Any woodwork, other work or ironmongery which is damaged, spoiled in appearance or weakened, shall be removed and entirely replaced if so ordered by the Engineer at the Contractor's expense.
- (c) The Contractor shall give special attention in ordering ironmongery and shall not modify any part of ironmongeries as originally manufactured.
- (d) The Contractor shall provide comprehensive list of ironmongery for each door, including type, model number, quantity and manufacturer of each ironmongery, door number, door size, door symbol, door location, master key group, etc. with door layout drawings, for the Engineer's approval prior to ordering. (Refer to para. 7.4 Ironmongery List of this Section) .

(2) **Butt hinges (BH)**

Stainless steel SUS 304 with nylon washer; 2.5mm thick, 100 x 100 mm; 10 nos. of stainless screws of 4.1mm dia.; three (3) sets per door leaf.

(3) **Loose joint hinge (LH)**

Stainless steel SUS 304; 3.0mm thick x 125mm; 8 nos. of stainless screws at 5.0mm dia.; four (4) sets per door leaf (three (3) sets per door leaf of which height is less than 1.8m, and two (2) sets for less than 900mm high door).

(4) **Pivot hinges (PH)**

Stainless steel SUS 304 with stainless steel ball bearing; heavy duty; four (4) nos. of 6mm dia. flat head screws on head jamb, leaf top and threshold parts; five (5) nos. of 6mm dia. flat head screws on leaf bottom parts.

(5) **Lavatory spring hinges (SH)**

Stainless steel SUS 304; two (2) sets per leaf

(6) **Flush bolts (FB)**

- (a) Shall be of stainless steel, with countersunk screws.
- (b) Shall be lever action flush type with face plates to suit door edges.
- (c) Levers shall be located at bottom 300mm (min.), top 1,800mm (max.) above finish floor. A extension rod from the same manufacturer for flush bolts shall be provided where necessary.
- (d) Faceplates and levers shall be of stainless steel.
- (e) Dust proof striking plate shall be provided where engaging floor or threshold; regular plates for head frames.

- (7) Mortise Locks and Lever Handle (ML)
- (a) Cylinder shall be “rotary disc” or “disc” type, shall have more than six (6) disc tumblers positioned systematically in more than 10 chambers, and tumblers shall be of phosphor bronze or stainless steel.
 - (b) Mortise locks shall consist of case, face plate, roller, dead bolt, latch bolt, cylinder and strike with dust box, and shall be provided by only one (1) approved manufacturer.
 - (c) Back sets for aluminium doors shall not be less than 20mm and for other doors, not less than 64mm.
 - (d) Mortise locks, for aluminium door, for double and single leaf door; the maximum projection of dead bolt shall be 25mm, and lock sets shall be installed onto vertical door leaf frames.
 - (e) Mortise locks and latches shall be fitted with approved stainless lever handle, knob furniture or flush-clip handle, as indicated on the Drawings.
 - (f) Mortise locks shall have cylinder, thumb-turn, dummy trim, etc. as per Engineer’s instruction.
- (8) Cylindrical Lock (CL)
- (a) Shall be stainless steel or aluminium finish, as directed by the Engineer.
 - (b) Back set shall be 70mm unless otherwise specified.
 - (c) Locks shall be compatible with function of room enclosure.
- (9) Deadbolt Mortice Lock (DL)
- (a) Shall have stainless steel body.
 - (b) Backset shall be less than 30mm.
 - (c) Locks shall be compatible with function of room enclosure.
 - (d) Locks shall have cylinder, thumb-turn, dummy trim, etc. as per Engineer’s instruction.
- (10) Deadbolt Mortice Locks with Emergency Opening Device (EL)
- (a) Shall have stainless steel body.
 - (b) Shall be released once touched.
 - (c) Shall be equipped with an emergency release plate which, if pushed in the direction of the door opening, releases the lock.
- (11) Exit Device
- (a) Standard: BHMA A156.3, BHMA Grade 1, or equivalent.
 - (b) Certified Products: Provide exit devices listed in BHMA's "Directory of Certified Exit Devices.", or equivalent.

- (c) Panic Exit Devices: Listed and labelled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- (d) Fire Exit Devices: Complying with NFPA 80 that are listed and labelled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- (e) Outside Trim: Lever with cylinder; material and finish to match design for locksets and latch sets.
- (f) Exit Devices shall be "UL" listed for life safety. All exit devices for labelled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labelled wood doors shall be thru-bolted or per the manufacturer's listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.
- (g) All exit devices shall be of a heavy duty, chassis mounted design, with one-piece removable covers, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.
- (h) All trim shall be thru-bolted to the lock stile case.
- (i) All Exit device levers operating trim shall be rated for a minimum of 1,000 inch pounds of pressure without allowing access.
- (j) Rail assemblies of all exit devices shall be solid stainless steel, brass or bronze base material; plated to standard architectural finishes as required in the hardware sets. Painted or anodized aluminium finishes will not be considered acceptable for the heavy-duty usage required on this project.
- (k) Provide protective Lexan touch pad installed on the exit device rail to prevent scratches and to serve as a visible guide to the user.
- (l) Chassis shall be mounted and operable without rail and be operable for use during construction without subjecting the finished device to damage.
- (m) All exit devices shall be by the same manufacturer, no deviations will be considered.
- (n) All exit devices to have metal end caps formed from the same base metal as the push and mounting rails
- (o) All exit devices, non-labelled devices, requiring hex dogging to the latch in the "dogged" or open position with the rail and all latch bolts remaining fully depressed, thereby offering completely silent operation and the absence of push rail movement and noise during this energized mode.
- (p) All exit devices with outside lever handle to have L-shape trim with escutcheon.
- (q) Adjustable strikes shall be provided for mortise type & concealed vertical rod devices.
- (r) Both leafs to have outside trim with cylinder and key.
- (s) All exit devices with outside pull handle for aluminium doors to have key retract latch.
- (t) Available Manufacturers: Subject to compliance with requirements, manufacturers

offering products that may be incorporated into the Work include: Similar or equivalent to Sargent USA Series 80 narrow

- (12) Mortise Electric locks
- (a) Meets ANSI A 156.13 series 1000, operational grade 1
 - (b) Meets A 117.1 Accessibility Code.
 - (c) Meets UL10B and UL10C
 - (d) Electrically controlled mortise lock provides solenoid-operated remote locking and unlocking.
 - (e) Electric locks to have the following features:
 - 1. 24 VDC/VAC @ 390mA
 - 2. Fail secure
 - 3. Mechanical key override
 - 4. Used with a security Pyramid cylinders
 - 6. Doors are locked at all time
 - 7. Entry or exit is permitted for authorized personnel by presenting a valid key card code as indicated in the access control section
 - 8. Dull stainless steel finish
 - (f) Approved manufacturers: Corbin ML20940 or equivalent.
- (13) Electromagnetic Locks
- (a) Electromagnetic locks to comply with ANSI 156A 23 .It is applied recessed on the frame and have the following features;
 - 1. Provides 1200lb holding force
 - 2. Mounts fully concealed in wood, steel or aluminum doors
 - 3. The lock is mortised in the frame and the strike is mortised in the door.
 - 4. It has an instant release circuit
 - 5. No residual magnetism
 - 6. Fully sealed electronics
 - 7. Tamper proof and weather proof
 - 8. 10 feet of jacketed ,standard conductor
 - 9. Automatic dual voltage, no field adjustment required
 - 10. 24V(175Ma)
 - 11. With lock status sensing
 - (b) Approved vendor Folger Adam USA; Fasam Shear Lock, or equivalent.
- (12) Hook Lock (HC)
- (a) Shall have stainless steel body.
 - (b) Back set shall be 51 mm.
 - (c) Lock shall be compatible with function of room enclosure.

- (13) Passage Latches (PL)
- (a) The requirements (1) to (5) of para. 7.3.7 of this Section shall be followed.
 - (b) Passage latches shall be obtained from approved mortise lock manufacturer.
- (14) Lavatory Latch Bolts with Indicator (LL)
- (a) Rim slide bolts shall be made of stainless steel for exposed parts and bronze for concealed parts, shall consist of case, face plate, slide bolt with indicator, strike, etc.
 - (b) Indicator shall change colour from blue to red showing, when locked from inside.
- (15) Crescent Sash Lock (CS)
- (a) Shall be made of electrolytic ally colored anodic oxide coated aluminium with plastic smother/protector.
 - (b) Shall consist of lever, strike, bolts, etc.
 - (c) Shall be selected from all standard variations of approved aluminium doors/windows manufacturer.
- (16) Door Checks (Door Closer)
- (a) Shall be highly efficient rack and pinion mechanism incorporating hardened forged steel pistons and hardened steel precision made pinions.
 - (b) Door checks shall conform to recognized international standards such as JIS A 5544.
 - (c) Door checks shall have a high quality precision aluminium die-casted body, arm, arm cover, fitting, etc., all resistant to corrosion, and friction-free mechanism inside.
 - (d) Door checks shall be of compact body sizes projecting maximum 45mm (ordinary) or 70mm (heavy duty) from the door face, and permitting door opening through 180 degrees. Special arm(s) or other features as scheduled or necessary to meet specified requirements or installation conditions shall be provided.
 - (e) Parallel arm (and back check for external doors) shall be provided for outside opening doors, i.e. any door checks shall be not installed on the door panel surface outside room.
 - (f) A built-in pressure relief valve shall be incorporated to prevent possible damage through forceful closing.
 - (g) The adjusting valve shall have a built-in thermostat which together with the high quality hydraulic fluid shall permit constant closing speeds even under extreme temperature changes.
 - (h) Provide door checks to manufacturer's standards and Engineer's approval as applicable to door type, size, location and function required.
 - (i) Door checks installed on fire doors or where the door's opening angle is limited, shall be one (1) size larger than manufacturer's standards or the door checks shall have spring power adjustments, valve controls, adjustable sweep range (180

degrees to 130 degrees), back check (70 degrees to 180 degrees), latch range (13 degrees to 0 degrees), all concealed behind the front slider-cover.

- (j) Fire rated door checks shall have 70°C fusible link to automatically close, and shall be installed on doors with fire rated grilles.
- (k) Door checks shall have holding mechanism generally unless otherwise instructed by the Engineers.
- (l) Door checks shall be guaranteed for a period of five (5) years against any defects.

(17) Push and Pull Handle (PP)

- (a) Shall be of anodised aluminium or stainless steel as instructed, with countersunk screws.
- (b) Push and pull handle: diameter 22mm; 60mm x 600mm; with cylinder escutcheons.
- (c) Push plate: 150 x 330 x 2mm with rounded corner, bevelled edges.

(18) Door Stops

- (a) The Contractor shall propose various kinds of door stops, considering type, location of doors and conditions surrounding door, for the Engineer's approval, unless otherwise specified hereunder.
- (b) Body shall be stainless steel or directed.
- (c) Resilient pads or buttons shall be replaceable.
- (d) Floor or wall mounted type shall be anchored into concrete but not into mortar and shall not give any damage to waterproofing membrane.
- (e) Door stops for lavatory booth doors shall be of door leaf mounted type and of chrome coated bronze (20mm dia. x 100mm) with synthetic rubber head.

(19) Kick Plates

- (a) Shall be stainless steel. Thickness not less than 1.3 mm, 3 sides bevelled, screw heads countersunk.
- (b) Lengths shall be door width minus 25mm
- (c) Height shall be 300mm, unless otherwise shown or scheduled.

(20) Door Name Plates

- (a) Shall be made of stainless steel (hairline finish), size at 250mm wide x 150mm high.
- (b) Shall indicate room name and key number.
- (c) All letters shall be embossed and filled with paint.

(21) Key Tags

- (a) Of coloured plastic, at least six (6) original colours; with plastic covering on tag

name sheet

- (b) Each master key group shall be assigned one (1) individual colour of tag.

(22) Key Boxes

- (a) Of factory bake-painted steel; with lock sets and demountable key holder inside box; demountable box with carrying strap
- (b) The Contractor shall propose adequate sized boxes per building or facility.
- (c) Corresponding key names shall be indicated on key holders.

(23) Access Control for CTO

- (a) The Control Tower entrance at 8th FL (SD-9) shall be provided by an access control and monitoring system to prevent access by unauthorized personnel.
- (b) The Control Tower access control and monitoring system shall be designed as a stand-alone system, microprocessor based and shall comprise:

- Access control key pad;
- LCD display with backlight, 15 characters x 3 lines
- Finger reader
- Uninterruptible Power Supply (UPS) for the system
- All necessary interconnection wiring, equipment and interface requirements to provide a complete and fully operational system

- (c) The basic local control measure shall be by finger reader in combination with an electro-magnetic lock system. System performance, as a minimum, shall be:

- (i) Maximum of 100 fingers enrolments (one person can register more than one finger)
- (ii) Identification speed at 0.1 second
- (iii) Correct identification rate of over 99.9%
- (iv) False acceptance rate of 0.00%
- (v) ID number from one to six digit number unique to each other
- (vi) Operational
 - Manager Level 3 – can perform all management operations.
 - Manager Level 2 – can assign and modify enrolment within the division concerned.
 - Manager Level 1 – can set-up time, schedule, or search through records.

– User – cannot perform any management operations.

- (d) The system shall be provided with door exit push button or equivalent to comply with fire and building codes.
- (e) The system shall have an appropriate interface with the Fire Detection and Alarm System (FAS) allowing FAS to override the security system and unlock the door (exit door) during emergency situations.
- (f) The system shall have an appropriate interface with the CCTV system such that the CCTV cameras automatically zoom in on areas where alarms are initiated.
- (g) Clock time used by the system shall be derived through the master clock.
- (h) Design and installation of the system shall be closely coordinated with the Engineer.

7.4. Ironmongery List

- (1) The Contractor shall submit lists of ironmongery with key location map for the approval of the Engineer, prior to ordering.
- (2) The list shall indicate number, name, type and size of doors, type, applicability, quantity, manufacturer name and model number of ironmongery, master key group, and pattern and colour of sign.
- (3) Size, fixing method and location of each ironmongery shall be reflected to the fabrication drawings of all doors and windows.

7.5. Execution

- (1) The Contractor shall install all finish ironmongeries after application of finishing to doors and windows.
- (2) Any scratched ironmongeries shall be replaced by new ones at the Contractor's expenses.
- (3) Ironmongeries shall be free from oil, grease, dust and other foreign matters.
- (4) Top hinges shall be installed with the centre of hinge not more than 280mm below the top of the door.
- (5) Bottom hinges shall be installed with the centreline of hinge not more than 330mm above the finish floor.
- (6) Intermediate hinges or pivots shall be installed equal distance between the top and bottom hinges or pivots.
- (7) Door pulls and strikes, shall be centred 1m above finish floor.
- (8) Locks, latches, and strikes locations shall be determined by the following:
 - (a) Centring the strike of knob locks and knob latches 1m above the finish floor;
 - (b) Centring the strike of mortise dead-locks 1m above the finish floor; and
 - (c) Centring the strike of roller latches 1m above the finish floor.

8.0 MEASUREMENT AND RATES

8.1. Measurement

Work under this Section shall be measured according to the item classifications and units contained in the Bills of Quantities (BOQ). The quantities shall be computed from the Drawings.

8.2. Rates

The rates shall be full compensation for all plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the Work described in this Section of the Specification and/or shown on the Drawings.

- (1) Rates for wood doors shall further include for:
 - (a) Frames, jambs, head and transoms, name/number plates (except Passenger Terminal Building to be priced as per signage schedule)
 - (b) Water creasing, sills, trims, thresholds, name plates
 - (c) Tracks, guides, opening lights and sliding panes
 - (d) Stainless steel threshold
 - (e) Wood primer for concealed surfaces
 - (f) Glass, glazing seals, sealant, sealant back-up, glazing gaskets and glazing beads
 - (g) All ironmongery including, hinges, locking mechanisms, closing mechanisms, indicators, handles, exit devices, etc.
 - (h) Fixings, anchorages, anchor rebars, welding, plugs, screws, nails and other proprietary fixings
 - (i) Void filling mortar
 - (j) Protection
- (2) Painting P-2 and P-5 to wood doors shall be included with Section 4370 para. 8 .0.
- (3) Rates for steel doors shall further include for:
 - (a) Frames, jambs, head and transoms, name/number plates (except Passenger Terminal Building to be priced as per signage schedule)
 - (b) Water creasing, sills, trims, thresholds, astragals, name plates
 - (c) Tracks, guides, opening lights and sliding panes
 - (d) Stainless steel threshold
 - (e) Glass, glazing seals, sealant, sealant back-up, glazing gaskets and glazing beads
 - (f) Galvanizing and anti-rust primers
 - (g) All ironmongery including, hinges, locking mechanisms, closing mechanisms, indicators, handles, exit devices, etc.

- (h) Fixings, anchorages, anchor re-bars, welding, plugs, screws, nails and other proprietary fixings
 - (i) Void filling mortar
 - (j) Protection
- (4) Prime painting and epoxy-polyester oven-baked powder paint (EPX) for steel doors shall be included within the rates for this Section. Other finish painting P-3 for steel doors shall be included with Section 4370 para. 8.0.
- (5) Rates for aluminium curtain wall framing shall further include for: -
- (a) Back-mullion and horizontal mullion
 - (b) Frames, jambs, head and transoms for window
 - (c) Weather mouldings
 - (d) Expansion joints
 - (e) Glass, glazing seals, sealant, sealant back-up, glazing gaskets and glazing beads;
 - (f) Anti-shatter film
 - (g) All ironmongery including, hinges, locking mechanisms, closing mechanism, indicators, handles etc.
 - (h) Fixings, plugs, screws, nails and other proprietary fixings
 - (i) Contractor design
 - (j) Protection
- (6) Rates for aluminium doors/windows/louvers/glazed screen shall further include for: -
- (a) Frames, jambs, head and transoms, name/number plates.
 - (b) Water creasing, sills, trims, thresholds, name/number plates (except Passenger Terminal Building to be priced as per signage schedule),
 - (c) Tracks, guides, opening lights and sliding panes
 - (d) Stainless steel threshold
 - (e) glass, glazing seals, sealant, sealant back-up, glazing gaskets and glazing beads
 - (f) Anti-shatter film for external doors and windows
 - (g) Insect screen for external louver /openable windows
 - (h) All ironmongery including, hinges, locking mechanisms, closing mechanisms, indicators, handles, exit devices, etc.
 - (i) Fixings, anchorages, anchor re bars, wildings, plugs, screws, nails and other proprietary fixings
 - (j) Void filling mortar

(k) Protection

- (7) Glazing to doors/windows (including anti-shatter films): shall not be measured or priced separately, but shall be deemed to be included within the other rates of the Bills of Quantities
- (8) Special operating doors/shutters/grilles: rates shall be deemed to be all inclusive.
- (9) Ironmongeries (including name plates and key boxes): shall not be measured or priced separately, but shall be deemed to be included within the other rates of the Bills of Quantities.

SECTION 4350

METALWORK

1.0 GENERAL

1.1. Scope of Application

- (1) The work to be executed by the Contractor under this Section shall comprise all miscellaneous metal works to all buildings.
- (2) All works shall be constructed in accordance with the dimensions, lines and levels and in the locations shown on the Drawings or established by the Engineer.

1.2. Scope of Work

Metalwork generally to be executed by the Contractor shall include the following:-

Para. 2.0 METAL WORKS

Para. 3.0 MISCELLANEOUS ITEMS OF METALWORK

1.3. Submissions

- (1) Prior to commencement of metalwork, the Contractor shall prepare and submit for the Engineers approval:
- (2) All manufacturer's original catalogues, detailed technical data, specifications and installation instructions for all components and accessories, within this Section.
- (3) Shop drawings for all work required indicating, in detail, the fabrication, assembly and erection requirements, material lists, joint and connection details and filling details. Shop drawings indicating fabrication requirements shall be submitted not less than one (1) month before fabrication commences.
- (4) A detailed construction plan indicating the proposed methods, sequences, standards, etc., to be adopted
- (5) Samples shall be provided of aluminium finishes and colours, together with cut lengths of full size aluminium sections and profiles, as requested by the Engineer. Samples of other materials, accessories and finishing shall also be submitted as requested by the Engineer.

2.0 METAL WORKS

2.1. Structural Steel Materials

- (1) Heavyweight hot-rolled shapes and plates: JIS G 3101, Grade SS 400 or ASTM A 36.
- (2) Tubes: JIS G 3444, Grade STK 400.
- (3) Square pipe: JIS G 3466, Grade STKR 400.
- (4) Steel plate JIS G3302
- (5) Sizes as shown on the Drawings

2.2. Coloured Galvanized Steel Sheets

Steel sheet shall be coated completely by hot-dip zinc-aluminium conforming to JIS 3314 SA2C

2.3. Galvanized Steel Pipes

Shall conform to JIS 3452 or equivalent

2.4. Stainless Steel Materials

- (1) Stainless steel pipe: JIS G 3459, SUS304 TP; sizes as shown on the Drawings.
- (2) Stainless steel bar, plate, sheet, strip and fittings: JIS G 4305 or G 4303, SUS 304.
- (3) Stainless steel work shall be hairline finish after fabrication, unless otherwise shown on the Drawings and/or in other Sections.

2.5. Aluminium Materials

Aluminium materials shall comply generally with the requirements of Section 4340.

2.6. Cast Iron

Shall conform to JIS G5501, G5502 or equivalent

2.7. Brass Pipe

Not used

2.8. Expanded Metal Sheet

Flattened mesh conforming to ASTM-F 1267 Type II

2.9. Plain Washers

Conforming to JIS B1256, ASTM F436 M or equivalent

2.10. Metal Lath

JIS A 5505 Flat Lath Type 2 or equivalent; galvanized finish

2.11. Bolts and Fastenings

- (1) Generally
 - (a) Bolts and fastenings generally shall be selected to match the colour of surrounding metalwork.
 - (b) For stainless steel shall be the same as alloy of other stainless steel with oval heads of flush type where subject to contact with hands.
 - (c) For plain steel shall be JIS B 1179: oval head or flush type where subject to contact with hands.
 - (d) For aluminium shall be the same as alloy of other aluminium or stainless steel; oval head or flush type where subject to contact with hands

- (e) Exposed fastenings permitted only where approved.
- (f) Anchors, fixing items, embedded components and accessories, shall be hot-dip galvanized according to JIS H 8641 or stainless steel as approved.
- (g) Stainless steel fastenings shall be nickel chromium steel.

(2) Anchor Bolts

- (a) Steel: JIS G 3101, ASTM A 36
- (b) Bolts: JIS B 1180, ASTM A 307 hexagonal head.
- (c) Nuts: JIS B 1181, ASTM A 563 M, hexagonal.

2.12. **Miscellaneous Materials**

(1) Sheathed Welding Electrodes for Steel

Shall conform to JIS Z 3211, ASTM A 233 or equivalent.

(2) Submerged Arc Welding Electrodes

Shall conform to JIS Z 3351, ASTM A 558 or equivalent.

(3) Plastic Sheet

JIS K 6718 colour and transparency as selected by the Engineer

(4) Post Setting Grout

Shall proprietary type hard setting grout as approved.

2.13. **Priming Paint**

Anti-corrosion paint : External JIS K 5625 class 2 (two coats)
Internal JIS K 5621 (two coats)

2.14. **Galvanized Coating**

- (1) Unless otherwise specified, galvanizing shall be hot dipped (JIS H8641, Class 2) as follows:

Thickness of steel plates, pipe, etc. (mm)	Less than 1.6	1.6 and above	3.2 and above	4.5 and above
Zinc coating code		HDZ35	HDZ45	HDZ55
Zinc coating weight (g/sqm)	300	350	450	550

- (2) Galvanized surfaces shall be finished without:

- (a) Any voids or non-coated surfaces greater than 2mm diameter
- (b) Considerable scratches and drip lines
- (c) Drips on surfaces for friction jointing

- (3) Remedial work shall be as follows:

- (a) Large non-coated surfaces shall be re-coated.
- (b) Small non-coated surfaces or scratched surfaces shall be treated by measures to be approved by the Engineer.
- (c) Drip lines and drips on surfaces for friction jointing shall be removed by sandpaper, file, etc. and surface shall be plain and smooth.
- (4) Primer on galvanized finish for paint finish:
 - (a) Shall apply Two-pack paint Amine Adduct epoxy resin base primer for Galvanized surface.
 - (b) Reference standard of material shall be JIS K 5551:2008 Type A and Type B.

2.15. Fabrication and Installation Generally

- (1) The requirements of Section 4230 shall apply equally to this Section, noting that metalwork items generally, are of architectural finish standard, and therefore quality of workmanship, materials and finishing, shall be appropriately commensurated.
- (2) Materials shall be cut accurately, fabricated and assembled perfectly true, plumb and square within tolerances specified or as approved by the Engineer.
- (3) All cut edges shall be ground smooth and exposed sharp corners of members shall be slightly radiused.
- (4) Bends in linear items shall be formed to uniform radius and be finished even, free from buckles and twists.
- (5) Exposed ends of pipes and hollow sections shall be capped with plates of the same material, welded on and ground smooth with radiused edges.
- (6) All exposed welds shall be ground perfectly smooth and flush to blend with adjacent surfaces but without affecting structural performances.
- (7) All angled joints intersections in linear items (such as handrails and angle frames etc.), shall be accurately mitered or notched, welded and ground smooth.
- (8) Welding shall be free from cracks, burnouts, holes or other defects.
- (9) Welding shall be subjected to selective tests as required by the Engineer. Defective welding shall be repaired as directed by the Engineer. All testing, repairs, re-inspection and re-testing of welds shall be at the expense of the Contractor.
- (10) Aluminium work shall be fabricated, assembled and installed in accordance with the manufacturers' recommendations, and to the approval of the Engineer. Particular care shall be taken to protect the surface coatings of anodized finish, and any scratched or otherwise damaged work shall be rejected by the Engineer.
- (11) Aluminium panel work, shall be complete with all necessary permanent stiffeners and bracings, fixed in such a manner that the finished work is completely supported and free from sags, bends and other defects. All stiffeners and bracings, shall be constructed from compatible materials and securely fixed in such a manner than fixing points are not visible on exposed surfaces.
- (12) The various anodized aluminium components and items, must be fully and carefully

color controlled and coordinated by the Contractor such that all such components shall be of the same matching color and shade when installed. Any components or items which have not been controlled / coordinated by the Contractor during manufacture, storage or installation, or which have faded unevenly such that color matching cannot be achieved to the satisfaction of the Engineer, will be rejected. Replacement shall be at the Contractor's expense. This requirement shall apply to all components and items included in this Section and also with and between anodized aluminium components contained in Section 4340 and any other Section of the Specification generally.

- (13) Unless otherwise defined in Section 4230, non-galvanized and non-baked-painted steel or iron shall be finished as follows:
- (a) Dirt, dust, grease, oil or other foreign matter shall be removed completely by scrapers, wire brushes, solvents, soap and clean water;
 - (b) Abrasive blasted in workshop to approval;
 - (c) One (1) primer coat of anti-corrosion paint shall be applied in workshop (first coat at 0.14 kg/m²);
 - (d) After erection/installation, primer shall be touched up and one (1) further coat of anti-corrosion priming paint applied (second coat at 0.14 kg/m²);
 - (e) Further painting shall be included under Section 4370.
- (14) All cut ends and welded portion of galvanized elements shall have anti-rust paint applied as follows:
- (a) Zinc coating 250 g/sqm or more

High density zinc compound paint (zinc: 90% or more); two (2) coats; total weight of paint shall be more than 1.5 times of designated zinc coating.
 - (b) Zinc coating less than 250 g/sqm

Anti-rust paint (JIS K 5629) : two (2) coats; 0.12 kg/sqm each.

2.16. **Completion Requirements**

- (1) The finished metalwork items shall be straight, true to line, level and profile, smooth and free from scratches, dents, twists, waviness, buckling and any other defects or damage.
- (2) All items shall be correctly assembled with tight, rigid joints, free from unnecessary movements, squeaks and/or rattles.
- (3) All movable components shall be lubricated.
- (4) Discoloration of stainless steel shall not be permitted.
- (5) Protective coverings and coatings shall be carefully removed, and all stainless steel and aluminium surfaces shall be thoroughly washed using clean water and soap and rinsed with clean water. Acid solutions, abrasives or steel wool shall not be used for cleaning stainless steel or aluminium.

3.0 **MISCELLANEOUS ITEMS OF METALWORK**

3.1. Metal Sheet Gutters

- (1) Gutter: coloured galvanized steel sheets; thickness minimum 0.8 mm
- (2) Hanger: galvanized steel flat bar; width 32 mm, thickness 4.5 mm, length as shown; 900mm pitch on centre.
- (3) Finish: paint type P-3 (refer to Section 4370).
- (4) Size, shape, location shall be as shown on the Drawings.

3.2. Metal Sheet Flashing

- (1) Metal sheet: coloured galvanized steel sheets; thickness minimum 0.8 mm
- (2) Galvanized steel channel: 100 x 50 x 20 x 3.2 mm
- (3) Sealant: SLT-2 (refer to Section 4320)
- (4) Finish: paint type P-3 (refer to Section 4370)
- (5) Size, shape, location shall be as shown on the Drawings.

3.3. Stainless Steel Mesh for Roof drain (Basket strainer)

- (1) Stainless plate: round plate forming to fix the mesh strainer; diameter not less than 300mm; thickness minimum 3.0 mm
- (2) Stainless socket: to connect galvanized steel down spout
- (3) Stainless mesh: diameter 0.95 mm; 5.0 x 5.0 mm mesh; shall be removable.
- (4) Size, shape, location shall be as shown on the Drawing.

3.4. Roof Drain Outlet (RD 10)

- (1) Conforming to JIS A 5522 or equal standard; diameters as shown on the Drawings
- (2) The Outlet shall be the baked coal tar finish cast iron roof drain.
- (3) The installation of the roof drain outlet shall include all associated work to the roof finishing consisting of but not limited to:
 - (a) Dishing and trowel to falls in-situ roof finishing
 - (b) Cutting and forming roof insulation around roof outlet
 - (c) Cutting and forming waterproof membrane around roof outlet
 - (d) Framing out and providing support or mounting for roof drain
 - (e) Providing sealants to the perimeter of the drain outlet recess
- (4) Roof drain outlet shall be connected to vertical rainwater pipe ensuring that the installation of the drain and connection provides a complete watertight assembly.

3.5. Downspout (RD 10)

- (1) Pipe diameter 100 mm, 150 mm or 200 mm.
- (2) Material as shown on the Drawings
- (3) Jointing sockets shall be provided for pipe connections.
- (4) Bracket: Galvanized steel
- (5) Finish: paint type P-3 (refer to Section 4370)

3.6. **Expansion Joint Assemblies (EJD 1 to 8)**

- (1) For Roof and External Wall (EJD 1, EJD2, EJD3, EJD4, EJD9, EJD11)
 - (a) Aluminium parapet coping: thickness minimum 2.0 mm for less than 200 mm wide; minimum 3.0 mm for not less than 300 mm width; profiles as shown on the Drawings.
 - (b) Flashing: stainless steel thickness 1.2 mm; profiles as shown on the Drawings.
 - (c) Cover plate: stainless steel thickness 1.2 mm; profiles as shown on the Drawings.
 - (d) Frame and bracket: extruded aluminium
 - (e) Water stop: polyvinyl chloride weather stop minimum 1.00mm thick
 - (f) Clip: SUS 301; maximum 400 mm pitch on centre
 - (g) Anchor plug: maximum 600 mm pitch on centre
 - (h) Screws: stainless steel
 - (i) Size, shape, location shall be as shown on the Drawings

- (2) For Ceiling, Internal Wall (EJD 5, EJD6, EJD7, EJD9)

Material: InPro Corporation 611 series or equivalent.

- (a) Cover plate: extruded aluminium thickness minimum 2.0 mm; profiles as shown on the Drawings.
- (b) Adapter: extruded aluminium
- (c) Anchor plug: maximum 600 mm pitch on centre
- (d) Gaskets: manufacturer's standards
- (e) Screws: stainless steel
- (f) Size, shape, location shall be as shown on the Drawings

3.7. **Steel Stairway**

- (1) Open string: galvanized steel; C-250 x 90 x 9 x 13 mm

- (2) Tread, landing: galvanized steel grating as indicated on the Drawings; thickness 6.0 mm
- (3) Tread support: galvanized steel; L-30 x 30 x 3 mm
- (4) Baluster: galvanized steel tubes; diameter 22 mm
- (5) Handrail: galvanized steel tubes; diameter 50 mm
- (6) Base: reinforced concrete; CLASS B2 (refer to Section 4220)
- (7) Finish: paint type P-3 (refer to Section 4370)
- (8) Shall be installed without any damage to waterproofing
- (9) Size, shape, location shall be as shown on the Drawings

3.8. Stainless Steel Ladders

- (1) Side rails: stainless steel tubes; diameter 25 mm
- (2) Rungs: stainless steel tubes; diameter 22 mm
- (3) Stainless steel anchor; bar 50 x 6 mm less than 500 mm depth; L-50 x 50 x 6 not less than 500 mm depth; 1050 mm pitch on centre
- (4) Size, shape, location shall be as shown on the Drawings

3.9. Galvanized Steel Steps

- (1) Galvanized steel tubes: diameter 22 mm, 400 mm width, 350 mm depth (150 mm cast into concrete for anchor), 350 mm pitch on centre
- (2) Finish: paint type P-3 (refer to Section 4370)

3.10. Handrails, Guardrails and Railings

- (1) Type I: Floor mounted, details as shown in common details (MD 11)
 - (a) Handrail: stainless steel pipe, diameter 50 mm, thickness 1.5 mm
 - (b) Intermediate rail: stainless steel pipe, diameter 25 mm, thickness 1.5 mm
 - (c) Baluster: stainless steel tubular bar, thickness 1.5mm, 25mm x 50mm, 1,000 mm pitch at centre
 - (d) Escutcheon: stainless plate, 45mm x 70mm, thickness 3 mm
 - (e) Finishing: stainless hairline finish
- (2) Type II: Wall mounted, details as shown in common details (MD 12)
 - (a) Handrail: stainless steel pipe, diameter 50 mm, thickness 1.5 mm
 - (b) Bracket: stainless steel pipe, diameter 25 mm, thickness 1.5 mm, 1,000 mm pitch at centre
 - (c) Escutcheon: stainless steel plate, 100 mm x 50 mm, thickness 1.5 mm

- (d) Finishing: stainless hairline finish
- (e) Column corner bead: Stainless or plastic by Engineer's approval.
- (3) Type III: Mullion mounted, details as shown in common details (MD 13)
 - (a) Handrail: stainless steel pipe, diameter 50 mm, thickness 1.5 mm
 - (b) Bracket: stainless steel pipe, diameter 25 mm, thickness 1.5 mm, 1,000 mm pitch at centre
 - (c) Escutcheon: stainless steel plate, 100mm x 50 mm, t=3mm
 - (d) Bracket: stainless steel pipe, diameter 25mm, thickness 1.5 mm, 1,000 mm pitch at centre
 - (e) Finishing: stainless hairline finish
- (4) Type IV: Item for Passenger Terminal Buildings
 - (a) Trolley protection rails: Material: Stainless steel pipe ϕ 73 t=3mm
 - (b) Trolley Bay Protection : Material Stainless Steel pipe ϕ 51 t=1.5mm, Rubber for cushion.
- (5) 100 mm long sleeves of material to match pipe shall be provided where posts are set into concrete and welded to concrete reinforcement and which are sleeved over to provide secure fitting.
- (6) Tubular handrails shall have approved type flush joints with internal sleeves, each located within 300 mm of posts and adequate provision shall be made for expansion and contraction and sealing against water penetration.
- (7) Top rails and intermediate rails shall be continuous over posts.
- (8) Posts shall be vertical and in single units.
- (9) Approved type flanges shall be used for fixing ends of rails to other surfaces.
- (10) Railing assemblies forming gates and doors shall be complete including all necessary ironmongery and fittings.
- (11) Shall include for all, panels, fixings, anchors and all other accessories as detailed on the Drawings and necessary to provide completed units.

3.11. Handrail for Handicap Toilet

- (1) Type I:
 - (a) Material: stainless steel tube plastic resin covering; diameter 34 mm
 - (b) Reference: TOTO T112CP3 or equivalent
- (2) Type II:
 - (a) Material: stainless steel tube plastic resin covering; diameter 34 mm
 - (b) Vertical Hinge type

(c) Reference: TOTO T112HK7 or equivalent

3.12. **Protection Pipe (MD 25)**

- (1) Galvanized steel pipes filled with concrete; 150 mm diameter x 4.0 mm thick.
- (2) Finish: primer for galvanised surfaces and paint type P-3 (refer to Section 4370)
- (3) The pipes shall be complete with anchors and any other fixings cast into concrete slab.
- (4) Size, shape, location shall be as shown on the Drawings

3.13. **Raised Floor System (F-9/F-10)**

- (1) The Contractor shall supply and install raised floor systems at the locations shown on the Drawings, in accordance with the requirements of the Specification, the Drawings and the Bills of Quantities.
- (2) Performance requirements shall be as follows:
 - (a) Deflection: not more than 2.0mm (500 kgf/50mm dia. at panel centre)
 - (b) Allowable ultimate load: not less than 1500 kgf
 - (c) Allowable seismic force: not less than 0.6 G (load 500 kg/m²)
 - (d) Available cabling space: not less than 260mm
- (3) The flooring system shall have a rigid frame
- (4) Materials shall be as follows:
 - (a) Panel frame shall be of baked paint coated carbon steel;
 - (b) Panel shall be fibre board construction
 - (c) Panel finishing: anti-static vinyl tiles or anti-static carpet tiles as shown on the Drawings
 - (d) Panel size: 500 x 500 mm
 - (e) Pedestal: Baked paint coated carbon steel with adjustable joints
 - (f) Base: Electrolytic zinc-coated steel, E24
 - (g) Accessories, fittings, fixings: as per manufacturer's standard
- (5) Installation
 - (a) The work shall be done after drying levelling mortar with hardener.
 - (b) The work shall be executed and completed as per the manufacturer's instructions.
 - (c) 10-mm wide cushion of rubber based plastic or approved shall be provided and set along junctions between raised floor system and other floor finishing or wall.
 - (d) Panel shall be set tightly and be levelled properly.

3.14. Trench and Duct Cover and Frames (MD 31)

- (1) The covers shall be 4.5 mm thick checker steel plate and the frames mild steel, and the components shall be either custom fabricated or standard proprietary items, to the Engineers approval.
- (2) Finishing: Paint type P-3
- (3) The covers and frames shall be installed into prepared openings and shall be complete with all steel supports, framework, fittings, fixings and accessories and finishing to top surface of cover where required.
- (4) Lifting mechanisms such as handles etc. should be provided with suitable spares for handing to Employer.
- (5) Size, shape, location shall be as per the Drawings.

3.15. Manhole Covers

- (1) Shall be manufactured in cast-iron in accordance with JIS G5501 FC200 or G5502 FCD500
- (2) The manhole covers and frames shall be installed into prepared openings and shall be complete including all fittings, fixings, accessories, seals and finishings to top surface of cover where required.
- (3) Lifting mechanisms such as handles etc. should be provided with suitable spares for handing to Employer.
- (4) Size, shape, location shall be as per the Drawings.

3.16. Floor Hatches

- (1) Floor hatches shall be ready-made with handles and clipping.
- (2) Frame: extruded aluminium
- (3) Strip: stainless steel
- (4) Base board: with reinforcement: galvanized steel sheet and member
- (5) Handle: stainless steel hair line finishing
- (6) The work shall be complete with anchoring, necessary additional reinforcement onto surroundings, etc.
- (7) Shall properly coordinate location of floor hatches with layout of other elements of floor, top of floor hatch to be finished with same material as floor where hatch is placed.
- (8) Size, shape, location shall be as per the Drawings

3.17. Ceiling Inspection Hatches (6/MD)

- (1) Propriety items
- (2) Swing down recessed aluminium door, ceiling finish set on door panel to match adjacent ceiling finish.

- (3) Frame: Extruded aluminium.
- (4) Flush screwdriver – operated cam latch and continuous concealed hinge.
- (5) Size, shape, as shown in the drawings, locations as required

3.18. **Baggage Conveyer Opening**

- (1) Frame: galvanized steel frame, thickness 2.3 mm
- (2) Blind guard plate: Galvanized steel plate, thickness 1.6mm
- (3) Finish: paint type P-3 (refer to Section 4370)
- (4) Draft curtain fittings as shown in drawings.
- (5) Size, shape, location shall be as per the Drawings

3.19. **Blind Boxes**

- (1) Shall be aluminium ready-made blind box
- (2) Size, shape, location shall be as per the Drawings

3.20. **Range Hood**

- (1) 1.6 mm thick galvanized sheet steel; reinforced as necessary; formed to fit brackets and securely fastened
- (2) Finish paint type P-3 for exposed hood
- (3) Filter shall be installed
- (4) Size, shape, location shall be as per the Drawings

3.21. **Trolley, Hoist and Beam Rail**

The Contractor shall supply and install the trolley hoists and beam rails at the location on the Drawings, in accordance with the requirements of para. 1.0 of this Section of the Specification, the relevant paragraph in Section 4230 (as appropriate), the Drawings and the Bills of Quantities.

- (1) The shape, size and design load of trolley hoists and beam rails shall be as per the Drawings.
- (2) Materials
 - (a) Manually operated chain hoist: JIS B8802; The Contractor shall provide adequate length of chain at each Site.
 - (b) Manually operated trolley : JIS C9620
 - (c) Beam rail: JIS E1101. The Contractor shall adjust the length of rails.
 - (d) Rail jointing plates: JIS E1102
 - (e) Bolts and nuts for rail jointing plates: JIS E1107

(f) If the Contractor will fabricate rails, all requirements of Section 4230 shall apply to the work.

(3) The trolley hoists and the beam rails shall be covered by paint type P-3 in accordance with the requirements of Section 4370 of the Specification.

(4) Anchor bolts and head units shall be set properly prior to the beam concrete pouring.

3.22. **Stainless Steel Nosing (MD 15A)**

Cast nosing, custom-made to exact size and shape as selected by the Engineer. Shall also have cast abrasive surface and rounded nosing edge.

3.23. **Aluminium-Cased Vinyl Nosing (MD15B)**

- (1) Heavy-duty extruded aluminium
- (2) Raised-type vinyl abrasive filler
- (3) Rounded nosing edge
- (4) Size: as shown on the Drawings
- (5) Shape or profile as selected by the Engineer

3.24. **Maintenance Bar for Roof**

- (1) Maintenance pipe: stainless steel pipe, diameter 90 mm, thickness 3mm.
- (2) Anchor bracket: galvanized steel angle 6mm x 65 x 65
- (3) Roof anchor: galvanized FB 3.2 mm x 180.
- (4) Roof anchor installation shall be properly coordinated with roofing installer.
- (5) Bolts and fastenings: refer to para. 2.11 of this Section.

3.25. **Catwalk (for PTB BHS)**

- (1) Framing: refer to para. 2.0 of this Section.
- (2) Flooring: Checker Plate $t=3.0$.
- (3) Sizes, shape, location shall be as per the Drawings.
- (4) Railing and post: SGP 35A, SGP 30A, SGP 25A as indicated on the Drawings. All to be finished with P-3.

3.26. **Maintenance Ladder**

- (1) Ladder frame : SST pipe, diameter 75mm, thickness 1.5mm.
- (2) Ladder rungs : SST pipe, diameter 30mm, thickness 1.5mm.
- (3) Guide rail : SST pipe, diameter 90mm, thickness 1.5mm.
- (4) Carriers : heavy-duty SST double trolley on track with safety features.

- (5) Anchors : SST plate 9mm thick and stainless steel bolts. Installation shall be properly coordinated with curtain wall manufacturer.

4.0 MEASUREMENT AND RATES

4.1. Measurement

- (1) Work under this Section shall be measured according to the item classification and units contained in the Bills of Quantities (BOQ).
- (2) Quantities shall be computed from the Drawings.

4.2. Rates

The rates shall be full compensation for all plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the work described in this Section of the Specification and/or shown on the Drawings.

- (1) Rates for metal sheet gutters shall further include for:
- (a) Metal sheet gutter
 - (b) Fixings, fittings, and supports
 - (c) Sealants
 - (d) Finishing paint P-3
- (2) Rates for stainless sheet gutter for shall further include for:
- (a) Stainless sheet gutter
 - (b) Fixings, fittings, and supports
 - (c) Sealants
- (3) Rates for metal sheet flashings shall further include for: -
- (a) Metal sheet flushing
 - (b) Fixings, fittings, and supports
 - (c) Sealants
 - (d) Finishing paint P-3
- (4) Rates for stainless steel mesh for roof drain (basket strainer) shall further include for:
- (a) Stainless plate, socket and mesh
 - (b) Fixings, fittings, and supports
 - (c) Sealants
- (5) Rates for roof drain outlets shall further include for: -
- (a) Roof drain outlet

- (b) Connection to vertical rainwater pipe
 - (c) Associated work to roof covering and waterproofing
 - (d) Precast concrete gargoyle
 - (e) Fixings, fittings, and supports
 - (f) Sealants
- (6) Rates for downspout shall further include for: -
- (a) Downspout pipe
 - (b) Fixings, fittings, and supports
 - (c) Finishing paint P-3
 - (d) Excavation, disposal and backfilling for the underground installation
- (7) Rates for expansion joint assemblies shall further include for: -
- (a) Parapet copings
 - (b) Expansion joint covers and capping
 - (c) Anchor bolts, expansion anchors, stainless steel screws and all other fittings, fixings, fasteners, connectors and the like
 - (d) Sealants and other waterproofing items
- (8) Rates for steel stairway shall further include for:
- (a) All components in stairway assembly
 - (b) Concrete bases
 - (c) Finishing paint P-3
- (9) Rates for stainless steel ladders shall further include for all components in ladder assembly.
- (10) Rates for galvanized steel steps shall further include for:
- (a) All components in step assembly
 - (b) Finishing paint P-3
- (11) Rates for stainless steel handrails, railings shall further include for:
- (a) All components in railings assembly
 - (b) Ramps, wreaths and bends in rails
 - (c) Joints, sleeves and expansion details
 - (d) Fixings, flanges, fittings, and cast in sleeves and anchors

- (e) Hair line finishing
- (12) Rates for toilet handrail shall further include for all components in handrail assembly.
- (13) Rates for protection pipe shall further include for: -
 - (a) All components in guard post assembly
 - (b) Concrete base
 - (c) Ceiling inside column protection with mortar
 - (d) Finishing paint P-3
- (14) Rates for trench and duct covers shall further include for: -
 - (a) Covers and frames
 - (b) Gaskets and sealants
 - (c) Lifting mechanisms
 - (d) Anchors, fixings and fittings
 - (e) Finishing paint P-3
- (15) Rates for manhole covers shall further include for:
 - (a) Covers and frames
 - (b) Gaskets and sealants
 - (c) Lifting mechanisms
 - (d) Anchors, fixings and fittings
- (16) Rates for floor hatches shall further include for: -
 - (a) Covers and frames
 - (b) Gaskets and sealants
 - (c) Lifting mechanisms
 - (d) Anchors, fixings and fittings
- (17) Rates for blind boxes shall further include for all components in blind box assembly
- (18) No separate rates for the ceiling inspection hatches, the cost for these items are included in the rates for ceilings, The rates ceilings shall further include for:
 - (a) Covers and frames
 - (b) Gaskets and sealants
 - (c) Locks and hinges
 - (d) Anchors, fixings and fittings

- (19) Rates for stainless steel nosing shall further include for:
- (a) Stainless steel
 - (b) Anchors, fixing and fittings
- (20) Rates for aluminium-cased vinyl nosing shall further include for:
- (a) Extruded aluminium
 - (b) Vinyl filler
 - (c) Anchors, fixing and fittings
- (21) Rates for maintenance bar for roof shall further include for:
- (a) Stainless steel pipe
 - (b) Galvanized steel brackets
 - (c) Welding
 - (d) Fixing, fittings and supports
 - (e) Sealant
- (22) Rates for catwalk shall further include for:
- (a) Framing and flooring materials
 - (b) Railing
 - (c) Bolts and fastening
 - (d) Welding
 - (e) Finishing paint P-3
 - (f) All necessary components for connection to other building structure
- (23) Rates for maintenance ladder shall further include for:
- (a) Frame and rungs
 - (b) Guide rails
 - (c) All components of carrier assembly
 - (d) Anchor bolts, expansion anchors, stainless steel screws and all other fittings, fixing, fasteners, connectors and the like
 - (e) Sealants and Lubricants

SECTION 4360

WOODWORK AND PARTITIONS

1.0 GENERAL

1.1. Scope of Application

The work to be executed by the Contractor under this Section shall comprise all WOODWORK/PARTITIONS to all buildings. All works shall be constructed in accordance with the dimensions, lines and levels and in the locations shown on the Drawings or instructed by the Engineer.

1.2. Item of Works

WOODWORK/PARTITIONS generally, to be executed by the Contractor shall include the followings; -

Para. 2.0 WOODWORK

Para. 3.0 DRY PARTITIONING (W-7)

Para. 4.0 WOODEN DOOR and FRMAES

Para. 5.0 CUBICLES

1.3. Submission

- (1) Prior to commencement of woodwork/partition works, the Contractor shall prepare and submit for the Engineer's approval:
- (2) Shop Drawings for all works required under this Section, indicating in detail, the jointing, assembly and installation requirements, material lists. Shop drawings shall be submitted not less than one (1) month before fabrication commences.
- (3) All manufacturer's original catalogues, detailed technical data, specifications and installation instructions for all components and accessories within this Section.
- (4) Samples and test certificates of all materials and accessories within this Section, as required by the Engineer
- (5) Detailed construction drawings indicating the proposed methods, sequences, standards, etc., to be adopted for the approval of the Engineer.

2.0 WOODWORK

2.1. Description of Work

- (1) The works to be executed and completed by the Contractor are as follows: -
 - (a) External Louver
 - (i) External louver shall be "Fire Retardant", FSC certified, tight grain, quarter sawn wood batten which conforms to Class 1, or a flame spread rating, according to ASTM E-84.

- (ii) Material shall be pressure treated Merbau, Bankirai,Ipe, (Western Red) Cedar, or equivalent suitable for exterior applications. Size 25mm thickness 150mm width, 2000 length.
 - (iii) Bracket of the louver shall be stainless steel SUS304 blast finish.
 - (iv) Intermediate bracing support shall be stainless steel pipe 8mm diameter include all accessories for fixing, SUS304 blast finish
 - (v) Louvers shall be either finished with P-5 (Clear Lacquer) or P-5A (Woodstain) to match the tonality with Wood Batten Ceiling.
- (b) Wood Batten Ceiling
- (i) Wood batten ceiling shall be "Fire Retardant", FSC certified, tight grain, quarter sawn wood batten which conforms to Class 1, or a flame spread rating, according to ASTM E-84.
 - (ii) Material shall be pressure treated (Dark Red) Meranti or equivalent suitable for internal applications and Merbau, Bankirai,Ipe, (Western Red) Cedar, or equivalent suitable for external applications Size 25mm thickness 200mm width, 2000 length, with staggered joints
 - (iii) Louvers shall be either finished with P-5 (Clear Lacquer) or P-5A (Woodstain) to match the tonality with External Louver.
- (c) Wood Skirting (S-3)
- (i) Thickness 25 mm Height 50 mm
 - (ii) Material: Hard wood with clear lacquer
 - (iii) Location as shown on the finishing schedule Drawings
- (d) Infill Timber for Curtain Wall (MD-3)
- Profile as shown on the Drawings
- (e) Wood Batten on FIDS display-
- (iv) Material: Hard wood with clear lacquer
- (f) Wood Shelves at writing counter
- (v) Material: Hard wood with clear lacquer
- Dimension: 300x2400x30mm thickness
- (g) All necessary compatible fittings, accessories, connectors, bolts, fasteners and fixing

2.2. Materials

- (1) Timber shall be the best of its kind, sawn die square, well seasoned, free from shakes, waney edges, large or unsound knots, spongy or brittle heart, and any other defects.
- (2) Timber, unless otherwise shown on the Drawings, shall be kiln dried.
- (3) Moisture content; at the time of delivery to the Site, timber shall have a maximum moisture content of 25% for members more than 25mm in thickness, and a maximum moisture content of 19% for members less than 25mm thickness.
- (4) Finish woodwork which will be exposed in the finished work, unless otherwise described on the Drawings, shall be finished with a smooth finely planed and glass papered surface.
- (5) All wood shall be treated using a high-pressure process to be approved by the Engineer (chemical JIS A9201, process JIS A9108), against fungal decay and insect attack. Preservative treatment is to be carried out after all cutting and shaping is completed and prior to assembly and care is to be taken to avoid damage to surfaces of treated wood in subsequent handling. If treated wood is unavoidably cut or damaged a liberal application of preservative is to be made by cutting off damaged surface or the affected area.
- (6) Particular care shall be taken in treating members of finish woodwork to ensure that the treatment type and methods do not have a deleterious effect upon the painting or finishing of such members and the Engineer's approval of the treatment process does not remove this responsibility from the Contractor.
- (7) After preservative treatment, wood is to be carefully open stacked in a well-ventilated covered place to ensure complete evaporation of surplus preservative. All treated wood is to be dried before incorporation in the work.
- (8) Priming woodwork generally, all woodwork shall be treated with one (1) coat of primer or undercoat as appropriate before fixing.
- (9) Nailing shall be with common steel wire nails where concealed. Finish nails for exposed work shall be covered by wood plug at 5mm deep.
- (10) Bolting for connections to hardened concrete, expansion shields in sizes shown on the Drawings or as approved by the Engineer.
- (11) Screws to be stainless steel, oval heads or countersunk as approved.
- (12) Plugs of woodwork shall generally be fixed to concrete and masonry by screwing and plugging.
- (13) Plugs shall be stout hardwood dovetailed plugs, dipped in preservative before fixing, built or cast into background or fixed into cut mortises by grouting. Spacing of plugs shall be at maximum 750mm. Alternatively approved patent plugs may be used, fixed by drilling.
- (14) Anchoring bolts, screws and steel plates as shown on the Drawings shall be anti-corroded in accordance with the requirements of Section 4350.

2.3. Execution and Completion

- (1) Workmanship shall be subject to approval and shall equal the best standard in modern shop and trade practices as applicable to the types of work required; assembly and erection shall be performed by appropriately skilled and qualified operatives.

- (2) One (1) sample of each type of woodwork shall be accurately set out to full size with all joints. Other works connected therewith shall be submitted to the Engineer for approval prior to commencement of respective work. With the Engineer's permission this may be incorporated into the permanent works.
- (3) All work shall be properly mortised, tanned, shouldered, wedged, pinned, screwed, nailed etc. as directed, and to the satisfaction of the Engineer. The work shall be properly glued up with quality approved glue. Where glued joinery work is likely to come into contact with moisture, the glue shall be of an approved waterproof type.
- (4) Exposed corners of frames, glazing bars and other finishes shall be rounded. All visible nails in joinery work shall be punched in and stopped.
- (5) Timber shall be sized to achieve true surfaces for applying finish materials. Assemble members to minimize effect of shrinkage.
- (6) Maximum spacing of repeated members shall be 380mm unless shown otherwise.
- (7) Stud posts to be cut ends square, to uniform lengths and erect plumb.
- (8) Brace, plumb and level all members and secure with sufficient screws, nails, spikes and bolts to ensure rigidity.
- (9) Provide blockings or wood grounds of thickness and sizes as indicated or required to secure work or equipment.
- (10) Provide wood packing behind all joints, ends and wherever else necessary to properly install finish materials.
- (11) Furnish and install all wood grounds, nailing, strips, plugs and blocks, required to secure and complete the work of this and other Sections.
- (12) Refer to the Drawings for layouts, notes and details and provide framing as required for work shown.
- (13) Carefully layout, cut, fit and erect framing, sheeting sub-flooring, grinding, blocking and other items necessary for complete framing.
- (14) The Contractor shall be responsible for the protection of all woodwork. Fixed woodwork which in the opinion of the Engineer is liable to become bruised or damaged in any way, shall be properly cased and protected by the Contractor until the completion of works.

3.0 DRY PARTITIONING

3.1. Description of Work

The works to be executed and completed by the Contractor are as follows:

- (a) Board partitioning with light gauge galvanized wall framing
- (b) Board covering by calcium silicate for roof closer.

3.2. Materials

- (1) Light Gauge Galvanized Wall Framing
 - (a) Material: conforming to JIS A6517 or equivalent

- (b) Runners - galvanized steel channel size 65 x 45 x 0.8 mm thick
 - (c) Studs - galvanized steel channel size 65 x 45 x 0.8 mm thick
 - (d) Horizontal supports - galvanized steel channel size 25 x 10 x 1.2 mm thick
 - (e) Accessories - to comply with framework members manufacturer's recommendations.
- (2) Gypsum Board
- (a) Type: product conforming to JIS A 6901 GB-R or equivalent, with tapered edges.
 - (b) Thickness: Not less than 12 mm; as shown on the Drawings
 - (c) Size: manufacturer's standard.
 - (d) Gypsum Sheathing board conforming to JIS A 6901 GB-S or equivalent, with tapered edges shall be applied to wet area, external area or ceiling expose to external.
- (3) Calcium Silicate Board
- (a) Calcium silicate board: JIS A5430 type 0.8 FK or 1.0 FK
 - (b) Thickness: Not less than 8 mm; as shown on the Drawings
 - (c) Size: manufacturer's standard.
- (4) Corner Beads
- Shall be galvanized steel or PVC to approval
- (5) Insulation Material
- Shall be glass wool layer. Material : Refer to 4330.2.6
- (6) Fixings
- (a) Nails and screws generally shall be galvanized.
 - (b) Nails and screws for use in areas containing sanitary appliances, sinks, washrooms, etc. shall be made of brass, stainless steel or non-rusting alloy.

3.3. **Installation**

- (1) The Contractor shall erect the wall framing to the lines and levels shown on the Drawings, and to details approved on the shop drawings. Generally vertical studs will be fixed at maximum 450 mm centres to top and bottom runners which are securely fixed to the building structure by methods approved by the Engineer.
- (2) Horizontal supports will be provided at maximum 1200 mm vertical centres and additional supports, runners and studs will be provided at openings for doors, windows, hatches and the like.
- (3) The Contractor will provide sufficient additional framing members to ensure the strength and stability of the wall or partition framing system and in particular additional framing members will be provided, as required, to fit around projections

and obstructions, and at corners 2 studs fastened together, will be provided.

- (4) Where concrete infill between the top of window sashes doors, curtain, louvers and aluminium frame screens and structure above is not shown on the Drawings, such infill will be framed up complete in light gauge galvanized steel as specified above.
- (5) Supports shall be true to line and level, properly aligned and accurately spaced to receive gypsum board. Boards shall be installed tapered edge facing out to produce neatly finished, parallel joints having an even surface across the boards.
- (6) Joints between boards shall be entered over supports and joints shall be not more than 5mm wide. Fixing, clips or nails shall be at 150mm centres along all edges and not more than 300mm centres along intermediate supports. Fixings at edges shall be not less than 12mm from the edge. As a rule joints shall not be allowed horizontally.
- (7) Joint paste shall be applied uniformly in the tapered joint with a knife, then jointing tape shall be applied immediately on the tapered edges and worked in sufficiently with a knife to form good bond. Surplus paste extruding on the tape edges or surface shall be smoothed down with the knife.
- (8) After first coating is dried, jointing paste shall be applied thinly over a width of about 150mm so that it will cover the entire jointing tape and taper and will also be level with the board surface.
- (9) After second coating is dried, jointing paste shall be applied thinly and evenly over a width of about 200 - 250 mm to cover up surface irregularities of the second coat. When the paste has dried, it shall be sandpapered lightly to form a true surface.
- (10) Where joint forms a taper-free cut, the cut shall be butt jointed after chamfering its face lightly, and finished by spreading jointing paste thinly as in the jointing finish for tapered boards.
- (11) All external angles shall be provided with metal corner beads. At all internal angles, double-folded jointing tape shall be applied in L-shape and the same jointing finish as applied for tapered boards.

3.4. Completion Requirements

- (1) Exposed surfaces shall be completely clean and free from dust, dirt, smudges, fingerprints, scratches, dents, warping, waviness, buckling, broken parts or units, chips, cracks, misaligned or improperly fitted joints, stains, discoloration or other defects or damage.
- (2) Board joints shall be neatly abutting and flush across adjacent units.
- (3) The installation shall be free from exposed fastenings, unnecessary cuts or holes, other than as particularly shown, specified or approved.
- (4) Each assembly shall be tightly and rigidly secured in place and free from unnecessary movement.
- (5) Each assembly shall be set square, straight, plumb and/or level, accurately positioned at locations and to layouts required, with adjacent like units or members accurately aligned.

4.0 WOODEN DOOR AND FRAMES

4.1. Description of the Work

- (1) The works to be executed and completed by the Contractor are as follows:-
 - (a) To supply and install factory wooden door and frames
 - (b) To be complete with doors, support, guide rails, finish ironmongeries, accessories and fixing as required.

4.2. **Materials**

- (a) Door panel thickness: 44 mm
- (b) Core: Particle core with Timber stand inner stile. 3mm High Density hard board cross band.
- (c) Face Paint on veneer.
- (d) Door frame: Timber frame with paint.
- (e) Material and dimension of the door panels and frames shall be subject to Engineer's approval.

5.0 **CUBICLES**

5.1. **Description of the Work**

- (1) The works to be executed and completed by the Contractor are as follows:-
 - (a) To supply and install factory fabricated toilet cubicles
 - (b) To be complete with doors, support, guide rails, finish ironmongeries, accessories and fixing as required.

5.2. **Materials**

- (1) Panel
 - (a) Total panel thickness: 44 mm
 - (b) Frame: Aluminium
 - (c) Core of impregnated paper honeycomb: JIS A6931
 - (d) Face of melamine (minimum 1.5mm thick) on hardwood backing
 - (e) Continuous edging; stainless steel SUS 304
 - (f) Material: Company Co., Ltd.(JAPAN) Clean Booth (CB) or equivalent.
- (2) Others
 - (a) Runner: stainless steel SUS 304
 - (b) Base anchor: stainless steel SUS 304; with stainless steel adjustable bolts and decorative nuts.
 - (c) Finish ironmongery: lavatory hinges, rim slide bolts with indicator and door stops

for cubicles; as per Section 4340 para. 7.0 and/or specified on the Drawings.

- (d) Ready-made anchoring shall be used as shown on the Drawings.
- (e) Reinforcement of hardwood for finish ironmongery installation
- (f) Wooden materials shall be treated in accordance with the requirements of para 2.0 of this Section.
- (g) Folding door in the passenger terminal building wash room shall be Company Co., Ltd (JAPAN) 'Deard-d (with CB type)' or equivalent.

5.3. **Installation Requirements**

- (1) Assemblies shall be erected as per manufacturer's instructions.
- (2) Assemblies shall be installed as per approved shop drawings.
- (3) Fastenings shall be provided for connections to structures as appropriate for conditions and materials involved and loads to be resisted.
- (4) Each unit shall be straight, plumb and parallel or perpendicular to building lines at locations required.
- (5) Track shall be levelled, adjusted and sealed to account for variations in construction to which it is attached.
- (6) Panel joints shall be plumb and tight fitting.
- (7) Joints between panels shall be of minimal gap.
- (8) Constructed and assembled to the appearance which is consistent with the typical assembly sample work, and as approved by the Engineer.
- (9) Layout of lavatory booth partition shall be coordinated with floor and wall tile layout and the Contractor shall obtain the Engineer's approval on the layout plans showing layout of tile joints, partition, sanitary fixtures, floor drain, entrance doors, etc., prior to the commencement of works.
- (10) Anchorage of lavatory booth partition shall not affect the integrity of the waterproofing.

5.4. **Completion Requirements**

- (1) Exposed surfaces shall be completely clean and free from dust, dirt, fingerprints, scratches, dents, broken parts or units, chips, cracks, misaligned or improperly fitted joints, stains, discoloration or other defects or damages.
- (2) The installation shall be free from exposed fastenings and unnecessary cuts, holes or blank plates, advertising labels or signs, other than as particularly shown, specified or approved.

6.0 **MEASUREMENT AND RATES**

6.1. **Measurement**

- (1) Work under this Section shall be measured according to the item classification and units contained in the Bills of Quantities (BOQ)

- (2) Quantities shall be computed from the Drawings.

6.2. Rates

- (1) The rates shall be full compensation for all plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads and profit required to complete the Work described in this Section of the Specification and/or shown on the Drawings.
- (2) The rates for all woodwork items shall include for anti- termite treatment.
- (3) Rates for board partitioning shall further include for:
- (a) All framing components
 - (b) Framing for in fills between window sashes and structure above
 - (c) Traditional components for framing around openings and obstructions
 - (d) Boards
 - (e) Insulation
 - (f) Fixings, fittings and accessories
 - (g) Cast in anchors and fixings
- (4) Rates for board covering shall further include for: -
- (a) All framing components
 - (b) Boards
 - (c) Insulation
 - (d) Sealant (SLT-3)
 - (e) Fixings, fittings and accessories
 - (f) Cubicles: to be measured in number (no.).
- (5) Rates for wood louver shall include for: -
- (a) Wood Louver, inclusive of all treatments
 - (b) Stainless steel bracket
 - (c) Stainless steel intermediate bracing support
- (6) Rates for wood skirting, shelves, miscl. wood battens shall include for: -
- (a) Wood, inclusive of all treatments
 - (b) Fixings, fittings and accessories
- (7) Rates for Wood batten ceiling

- (a) Wood, inclusive of all treatments
 - (b) Fixings, fittings and accessories
- (8) Rates shall be deemed to be all inclusive.

SECTION 4370

FINISHES

1.0 GENERAL

1.1. Scope of Application

The work to be executed by the Contractor under this Section shall comprise all interior and exterior finishes to all buildings. All works shall be constructed in accordance with the dimensions, lines and levels and in the locations shown on the Drawings or instructed by the Engineer.

1.2. Item of Work

The works of finishes to be executed by the Contractor shall include the following:-

Para 2.0 IN SITU FINISHES

Para 3.0 RIGID TILE/ SLAB/ BLOCK

Para 4.0 CERAMIC TILING

Para 5.0 FLEXIBLE TILE/ SHEET

Para 6.0 SUSPENDED CEILINGS AND BULKHEADS

Para 7.0 CARPETING

Para 8.0 PADDED FABRIC

Para 9.0 PAINTING/ CLEAR FINISHING

1.3. Submissions

Prior to commencement of the Finishing Work, the Contractor shall prepare and submit for the Engineer's approval:

- (1) All manufacturer's original catalogues, detailed technical data specifications and installation instructions for all components and accessories, within this Division. In addition, the Contractor shall provide manufacturer's detailed colour and pattern listings and ranges, for the Engineer's use in selecting types, colours, etc.
- (2) Shop drawings for all works required under this Section, indicating in detail, the jointing, assembly and installation requirements and material lists. Special attention shall be paid for the shop drawings of rigid and flexible tiles and suspended ceilings to be coordinated completely with other finishing elements, door threshold, electrical and/or mechanical elements, etc.
- (3) A detailed construction plan indicating the proposed methods, sequences, standards, etc., to be adopted, for the approval of the Engineer
- (4) Samples and test certificates of all materials and accessories within this Section, as required by the Engineer
- (5) In addition to the general obligation to provide samples of each material, the Contractor shall, before commencing finishes, construct sample panels of minimum size 1 m x 1 m of each type of finishing required, for the selection and approval of the Engineer. All subsequent work shall be equal to the approved completed sample

panels.

2.0 IN-SITU FINISHES

2.1. Description of Works

The works to be executed and completed by the Contractor are as follows:

- (1) Cement render and plaster
- (2) Floor hardener (F-11)
- (3) Shall be completed with all background preparations, finishing and the provision of all accessories

2.2. Materials

- (1) Cement
 - (a) Cement shall be Portland cement to meet JIS R 5210 or equivalent.
- (2) Sand
 - (a) Sand shall be clean, natural, uncrushed or partially crushed sand of a light colour, free from organic matter, suitable for use in plastering and approved by the Engineer.
 - (b) The clay-plus-fine-silt content shall not exceed 5% by weight and 15% by volume. The field test for determining the volume of silt shall be subject to approval.
 - (c) All sand found to contain silt in excess of 15% by volume shall not be used for plastering or in mortars but shall be removed from the Site at the Contractor's expense.
- (3) Lime
 - (a) Lime shall be slaked hydrated non-hydraulic or semi-hydraulic quicklime.
- (4) Floor Hardener
 - (a) Medium duty metallic floor hardener and anti-dusting and anti-dusting compound according to ASTM O 1424, weight not less than 6 kg/cm².
 - (b) Provided with 50mm thick bed of cement render, cast monolithically and finished with a machine floated surface finish.
 - (c) Floor hardener constituents, special metal aggregate non-rusting, special colour additive and Portland cement.
 - (d) Abrasion of the loss weight shall not be less than 0.73 for 2.0 revolutions, with test method by Taber abrasion tester.
 - (e) Non-slip, surface stabilization and anti-dusting qualities
 - (f) Colour as selected from manufacturer's full colour range.
- (5) Water

Water shall be fresh, clean and free from harmful matter and dissolved salts.

(6) Metal Lath

Refer to Section 4350.

(7) Corner Beads and Stop Beads

Angle beads and stop beads shall be PVC or galvanized steel with expanded metal bedded portions or steel anchors, where applicable all to approval.

(8) Aluminium Channel Section Recess Beads (internally)

Aluminium channel section recess beads shall be anodised aluminium channel sections 25 mm wide fixed to walls to function as plaster control joints as indicated in the drawing in Public Areas of Passenger Terminal Building.

(9) Stainless Steel Channel Section Recess Beads (externally)

Stainless steel channel section recess beads (SUS 304) shall be hairline finish channel sections 25 mm wide fixed to walls to function as plaster control as indicated in the drawing in Public Areas of Passenger Terminal Building

(10) Waterproofing Agent

Waterproofing agent shall be to the approval of the Engineer and used strictly in accordance with the manufacturer's instructions.

2.3. Execution

(1) Mixing of Render (Plaster)

Render shall be mixed in mechanical mixers, hand-mixing shall be approved only for small quantities. Caked or lumped material shall not be used. Each batch shall be proportioned by volume, accurately measured by manual or mechanical devices, and thoroughly mixed with the minimum amount of water until uniform in colour and consistency. Re-tempering will not be permitted; plaster that has begun to stiffen shall be discarded.

(2) Preparation of background surfaces

- (a) Concrete and masonry surfaces shall be thoroughly cleaned, free of dust, efflorescence, and any other deleterious substance prior to commencement of plastering.
- (b) No rendering shall be applied on masonry which is less than one (1) week old.
- (c) All joints in masonry shall be raked out at least 10 mm deep, before mortar has set, for all walls to be rendered.
- (d) Concrete surfaces shall be wire brushed or brushed hammered to expose aggregate and form an adequate key according to the instructions of the Engineer. Approved types of bonding agents shall be applied prior to application of render in accordance with the manufacturer's instructions.
- (e) Rendering over joints of differing background material (e.g. masonry and concrete) is to be reinforced over the joint with a strip of expanded metal lath 300

mm wide.

(3) Proportions

The following proportions refer to Section 1400:

- (a) Type M1 shall be two (2) parts of cement to five (5) parts of sand, and shall be used on all walls starting from foundation surface up to 100mm above finished floor level, on walls to bathrooms, toilets and other wet areas. This render shall extend up to 1.60m above finished floor level.
- (b) Type M2 shall be one (1) part of cement to three (3) parts of sand, and shall be used to all floors and roofs.
- (c) Type M3 shall be one (1) part of cement to four (4) parts of sand, and shall be used on all other walls and ceilings.
- (d) Type M4 shall be one (1) part of cement to three (3) parts of sand with approved waterproofing agent, used in accordance with the manufacturer's instructions and shall be used to fill up the voids between doors/windows frames and concrete or brick walls.
- (e) The above proportions may be adjusted, by approval to achieve acceptable workability, strength and finish quality subject to the approval of the Engineer.
- (f) Admixture such as lime, dolomite plaster, less than 5% in weight to sand may be added for final coat on wall, however, this subject to the Engineer's approval.

(4) Thickness of Render (Plaster)

- (a) Render to internal walls, ceilings and columns shall be minimum 20mm thickness.
- (b) Render to external walls, columns and parapets shall be minimum 20mm thickness.
- (c) Render to floors and roofs shall be of the thickness indicated on the Drawings.
- (d) Thickness of each render coat shall not exceed 7mm.

(5) Application of Render to Walls, Ceilings and Parapets

- (a) Render shall be applied in three (3) coats and each proportioned as above, but with finest grade sand incorporated into the top coat.
- (b) The first coat shall be cross scored and well keyed to receive the second coat.
- (c) On backgrounds of low suction and smooth face, the surfaces shall first be treated by applying spatter-dash. This shall be performed by forcibly throwing a wet mix of two (2) parts Portland cement and five (5) parts coarse sand, onto the surface and leaving to harden prior to application of rendering.
- (d) The finishing coat shall be levelled with a wooden float and finished with a steel trowel.
- (e) All arises, internal angles, external angles etc., shall be straight, plumb, slightly rounded and with neatly formed mitres.
- (f) Render shall be stopped at expansion, contraction and control joints with

galvanized expanded metal stop beads fixed on either side.

Aluminium/Stainless Curved Channel Section Recess Beads shall be fixed in Public Areas of Passenger Terminal Building to function as plaster/render control joints locations as required and/or as indicated on the Drawings. Render to substantial areas may be required to be applied in bays, in which case, approved types of control joints where specified at 9 (C) by stainless steel or brass shall be provided around edges bays.

Any render shall not be commenced until completion of installation of frames, thresholds, sills, etc. of doors and windows.

At junctions of different backgrounds (e.g. masonry to concrete) render shall be reinforced with strip of expanded metal lath 300mm wide.

(6) Application of Render to Floors and Roofs

- (a) Render shall be generally applied in one (1) coat.
- (b) Render shall be laid in bays not exceeding 15m² in area with approved types of control joints as specified, for roof as per section 4320 (2.7) and for walls to public view at the Passenger Terminal Building as per (5) g of this section. For other areas material shall be a suitable proprietary product fit for purpose as approved by the Engineer. The surface shall be levelled with a wooden float and finished with a steel trowel.
- (c) Joints in render shall coincide with joints in the concrete base.
- (d) Surfaces shall be accurately laid to falls and cross falls as appropriate to facilitate efficient draining of water from the finished surface.
- (e) Triangular section fillets shall be formed at all junctions of roof render with walls, parapets etc. and to sides of gutters.
- (f) At junctions of different backgrounds (e.g. masonry to concrete) render shall be reinforced with strip of expanded metal lath 300mm wide.

(7) Curing

- (a) Moist conditions shall be maintained, using fine fog spray or vapor barrier covering; provided and maintained as necessary for proper hydration of cement and to prevent excessively rapid drying out of freshly placed surfaces.
- (b) Base coats shall be cured for a minimum of forty-eight (48) hours after application.
- (c) Finish coat shall be cured for minimum of seven (7) days.

(8) Patching

Render showing over sanding, cracks, blisters, pits, checks, discolouration or other defects will not be acceptable. Such render shall be removed and replaced with new. Patching of defective work will be permitted only when directed or approved by the Engineer.

(9) Crack Control Joints

- (a) Crack control joints shall be provided on all cement render finish surface at 3 to 4 meters on centre.
- (b) Layout of crack control joints shall be set after coordination among layout of lintel beams, stiffener columns, wall opening, electrical and mechanical floor/wall elements.
- (c) Crack control joints shall be of stainless steel or aluminium dividing strips generally at the Passenger Terminal Building for areas within public view, and a suitable proprietary product fit for purpose for other areas as approved by the Engineer. First class workmanship shall be required for all to the approval of the Engineer.

2.4. **Floor Hardener (F-11)**

- (1) Substrates shall be cleaned as necessary free from dust, debris and deleterious materials.
- (2) Material: ABC Trading Co., Ltd (JAPAN) 'Ferrocon Hard S' or equivalent.
- (3) Metallic floor hardener shall be applied directly into the fresh concrete or cement render substrate, to obtain a dense and durable, monolithic or integral floor, free from segregation or cracks. The surface shall be finished the same day that the slab concrete or render is placed in accordance with the sequence of placement of slab concrete or cement render, tamping and floating, and application of metallic floor hardener.
- (4) Curing and maintenance shall be as follows:
 - (a) The finished floor shall be cured for seven (7) days with tarpaulin paper or polyethylene sheet or equal.
 - (b) A concrete seal shall be provided to prevent rapid vapour escaping.
 - (c) The finished floor shall be kept clear of all pedestrians and traffic loading for a period of forty-eight (48) hours. Heavy traffic must be avoided for a minimum of three (3) weeks; and
 - (d) The finished and cured floor shall be kept clean.

2.5. **Completion Requirements**

- (a) Exposed surfaces shall be clean and free from dust, dirt, scratches, gauges, cracks, stains, discolouration or other defects or damages.
- (b) Surfaces shall be finished smooth and flat.
- (c) Substrate surface shall be free from variation in place exceeding 2.0mm in 2 meters for vinyl tile finish, carpet tile finish, plaster finish, paint finish and ceramic tile finish.

3.0 **RIGID TILE/SLAB/BLOCK**

3.1. **Description of Works**

The works to be executed and completed by the Contractor are as follows:-,

- (a) Marble stone covering (F-1, S-1) – Not used

- (b) Granite stone for toilet/urinal coping and toilet vanity basins (MD-7) and selected pantry/kitchen counter tops and miscellaneous public counters (check-in etc) at Passenger Terminal Building
- (c) To be complete with all background preparation, mortar beds and backings, vanity basin support brackets, finishing and accessories.

3.2. **Materials**

- (1) Granite Stone
 - (a) Material shall be as JIS A 5003.
 - (b) Size: as indicated on the drawings.
 - (c) Thickness: 20 mm or as indicated on the Drawings
 - (d) Tolerance: ± 1 mm
 - (e) Materials shall be sound dense materials, free from voids, fissures, crack and impurities and with uniform and favourable working qualities; and may have some but very limited natural faults.
 - (f) Materials shall be from an approved overseas location and from an approved quarry, inspected by the Engineer at the expense of the Contractor. When selecting the material for approval the Contractor shall provide at least three (3) alternatives for the selection of the Engineer.
 - (g) Material shall be pre-ground and finished with a high polished surface.
 - (h) Colour, veining and quality: as approved by Engineer
 - (i) Veining shall continue in same direction over horizontal surfaces.
 - (j) Approved type epoxy primer shall be applied to back of granite tiles to reduce water absorption
- (2) Cement Mortar
 - (a) Bedding mortar: type M3 specified in para 2.0 of this Section; 30mm thick
 - (b) Backing grout: Portland cement
 - (c) Joint filler: one (1) part of cement to 0.5 part of sand; covered by colour grout
- (3) Sealant

Shall be polysulfide sealant specified in Section 4320.
- (4) Cleaner
 - (a) Shall be commercial neutral liquid type especially prepared for stone work with a Ph factor between 7 and 10 and free from crystallizing salts or water soluble alkaline salts.
 - (b) Commercial penetrating type, free from harmful alkali or acid content, especially prepared for marble work and having Ph factor between 7 and 10.

3.3. Execution

(1) General

- (a) Stones displaying defects such as cracks, chipped edges and corners, shall be rejected, and in no case incorporated in the work.
- (b) Stonework shall be set in full mortar bed with joints straight and butted tightly. Sealant shall be applied to each joint and between floor and wall. Surfaces shall be smooth and level, unless otherwise shown. The locations, members and sizes shall be as shown on the Drawings.
- (c) Substrate surfaces shall be smooth, clean, dry, free from foreign materials and otherwise in a condition recommended by material manufacturer.
- (d) Substrate surface shall be free from variation in plane not exceeding 2.0mm in 2 meters.
- (e) Bonding or other test shall be conducted for moisture or other substrate conditions per material manufacturer's instruction and as necessary to assure proper adhesion.
- (f) Slabs shall be pre-cut to size.
- (g) Joints between individual panels shall be flush pointed to ensure an even and continuous surface between arises or changes of direction.

(2) Finishing

All stonework shall be prefinished to a uniform glossy, honed or rubbed finish.

Exposed edges shall be protected

Finished faces shall be free from scratches or other defects.

(3) Fixings

- (a) Mortar used for bedding, jointing and pointing shall be in accordance with the requirements of para. 2.0 of this Section.

(4) Joints

- (a) Widths of joint shall be as shown on the shop drawings.
- (b) Backing mortars and backing grouts filling the joint gaps shall be removed.
- (c) Joints filler shall be applied after drying of backing mortars and backing grouts.
- (d) Colour grout shall be applied onto joint filler.

3.4. Completion Requirements

- (1) Exposed surfaces shall be completely clean and free from scratches, broken units, chips, cracks, misaligned or improperly made joints, or stains, discolouration or other defects or damage.
- (2) All surfaces shall be flush and level across adjoining element faces. The maximum possible level difference when measured with a 3 m straight edge shall not exceed 3

mm.

- (3) All joints shall be straight and free from staggers and offsets.
- (4) All elements shall be fully bonded in place, free from hollow sounds when inspected by tapping.
- (5) Where sloped to drains, surfaces shall be free from any standing water.
- (6) Protect finished surface with specified hardeners and sealants.
- (7) The installation shall be watertight throughout and free from conditions which would permit leakage or entry of water into or through interior or concealed spaces of the structure.

4.0 CERAMIC TILE COVERING

4.1. Description of Works

- (1) The works to be executed and completed by the Contractor are as follows:-
 - (a) Ceramic floor tile covering (F-2, F-3, F-4)
 - (b) Ceramic skirting/wall tile covering (S-1, S-2, W-1, W-2, Co-1, Co-2)
 - (c) Ceramic floor tile covering (FLH)
 - (d) To be complete with all background preparation, mortar beds and backings, finishing and accessories.

4.2. Materials

- (1) Ceramic Tile for Public Areas
 - (a) Slip resistant ceramic floor tiles shall be as follows:
 - (i) Shall meet the requirements of INAX IPF-600 or equivalent
 - (ii) Size: 600mm x 600mm (F-2)
 - (iii) Skirting Tiles (S-1) 300mm x 300 mm to match
 - (iv) Thickness minimum 8 mm
 - (v) Colours and patterns shall be selected by Engineer
- (2) Ceramic Tile for Private Areas
 - (a) Slip resistant ceramic floor tiles shall be as follows:
 - (vi) Shall meet the requirements of INAX IF-300/SD or equivalent
 - (vii) Size: 300mm x 300mm (F-3)
 - (viii) Skirting Tiles (S-2) 300mm x 100 mm to match

- (ix) Thickness minimum 8 mm
 - (x) Colours and patterns shall be selected by Engineer
- (3) Internal ceramic wall tiles shall be as follows:
- (a) Shall meet the requirements of INAX NPKC-200/MZ or equivalent
 - (b) Size: 300mm x 300mm (W-1, Co-1)
 - (c) Thickness minimum 5 mm
 - (d) Colours and patterns shall be selected by Engineer
- (4) Slip Resistant Ceramic External Floor Tile (FLH)
- (a) Shall be meet the requirements of INAX IPF-600 or equivalent
 - (b) Shall be suitable for exterior use
 - (c) Size: 600mm x 600mm
 - (d) Thickness minimum 10.3 mm
 - (e) Colours and patterns shall be selected by Engineer
- (5) Ceramic Tile Stair Nosing (MD15A)
- (a) Shall meet the requirements of clause 4.2.1 to 4.2.4 of this Section
 - (b) Shall be compatible to floor tiles
 - (c) Shall be moulded by the manufacturer.
- (6) Setting Beds and Base Mortar
- (a) For floors: shall be 39mm thick base mortar and 3mm thick setting mortar type M2 as specified in Clause 2 of this Section
 - (b) For walls: shall be 19mm thick base mortar and 3mm thick setting mortar type M3 as specified in Clause 2 of this Section
- (7) Cement Grout
- Cement for tile joint finish grouting shall be neat Portland cement, coloured as selected by the Engineer.

4.3. Execution

- (1) Tiling layouts to be coordinated with plumbing and other related fittings to be submitted to the Engineer for approval. All tiling shall be installed in accordance with the manufacturer's instructions and to the approval of the Engineer.
- (2) Mixing of mortar for setting beds, preparation of background surfaces, thickness and application of mortar shall be in accordance with para. 2.0 of this Section.

- (3) Setting beds shall be finished appropriately for the tile finishing and to the approval of the Engineer.
- (4) Ceramic tiles shall be soaked in clean water before fixing. A layer of cement mortar grout (1:3) in 3mm thickness shall be applied to the back of the tiles and the tiles then pressed firmly to the prepared surface and tapped to ensure bonding.
- (5) Width of joints shall be kept as shown on the shop drawings and joints in ceramic tiles shall be filled void with cement mortar and top exposed surface colour grouted as directed by the Engineer.
- (6) Ceramic tiling adhesives may only be used with the Engineer's approval.
- (7) All tiles shall be cut neatly and edges ground smooth to ensure neat junctions with other finishing.
- (8) No cut ceramic tiles shall be used at exposed edges. Special bull nosed, rounded or cover tiles shall always be used to skirting, dadoes, around exposed perimeters and the like.
- (9) Tiles shall be laid to patterns as directed by the Engineer. All joints shall be carefully and accurately laid out.
- (10) Tile flooring shall be finished flush and smooth with constant finished levels maintained between the various types of flooring. Offset or abrupt ramping to meet these requirements will not be accepted.
- (11) Tiles shall be carefully cut, fitted and sealed around all obstructions and penetrations.
- (12) Particular care shall be taken in protecting all tile work from damage.
- (13) Rounded holes in tiles for floor clean out, floor drain, etc. shall be made by the use of diamond core borer, and rectangular holes for switch boxes, socket outlet boxes, etc. shall be cut with rebated edge to allow faceplates to finish flush with the panel surface.

4.4. **Completion Requirements**

- (1) Exposed surfaces shall be clean and free from scratches, broken units, chips, cracks, misaligned or improperly made joints or stains, discolouration or other defects or damages.
- (2) Tile units shall be completely flush and level.
- (3) Tile joints shall be straight and free from staggers and offsets.
- (4) All tiles shall be fully bonded into place and free from hollow sounds when inspected by tapping.
- (5) Tile surfaces shall be free from any standing water and shall be sloped to drains where possible.
- (6) Installation shall be watertight throughout and free from conditions which would permit leakage or entry of water into or through interior or concealed spaces of the structure.

5.0 **FLEXIBLE TILE/SHEET**

5.1. **Description of Works**

The works to be executed and completed by the Contractor are as follows:-

- (a) Vinyl floor tile covering (F-6)
- (b) Anti-static vinyl floor tile covering (F-6, F-10)
- (c) Rubber tile (F-5) – Not Used
- (d) Pre-covered glass wool board (W-8 and C-5)
- (e) Polyvinyl Soft Skirting (S-4)
- (f) To be complete with all background preparation, mortar beds and backings, finishing and accessories.

5.2. **Material**

- (1) Vinyl Floor Tiles (F-6)
 - (a) Shall be of composition PVC flexible tile or homogeneous PVC tile, JIS A5705 CTS or HT
 - (b) Adhesive shall be as per the manufacturer's recommendation
 - (c) Size: 300 x 300 x 2mm generally.
- (2) Anti-static Vinyl Floor Tiles (F-6, F-10)
 - (a) Shall have base of composition PVC flexible tile or homogeneous PVC tile, JIS A5705 CTS or HT
 - (b) Shall have less electrical resistance (107 to 109 ohms/91cm)
 - (c) Adhesive shall be as per the manufacturer's recommendation
- (3) Rubber Floor Tile (F-5) – Not used
- (4) Glass Wool Board, pre-covered (W-8 and C-5)
 - (a) Conforming to JIS 6301 or equivalent
 - (b) Thickness: not less than 25 mm
 - (c) Specific gravity: not less than 32 kg/m³
 - (d) Incombustible, soundproof
 - (e) Finish: covered with glass wool cloth
 - (f) Uses: machine rooms, walls and ceilings for sound insulation
 - (g) Accessories: PVC capped stud fixings, edge sealants
- (5) Polyvinyl Soft Skirting (S-4)
 - (a) Shall be made of flexible composition PVC.

- (b) Shall be of long span, coved at the bottom and with a bullnosed top edge.
- (c) Adhesive shall be as per manufacturer's instruction, and shall be selected to suite various background surfaces, i.e., cement plaster, gypsum board and fiber reinforced cement board.
- (d) Height as shown on the Drawings

5.3. **Execution**

- (1) All tiling shall be installed in accordance with the manufacturer's instructions and to the approval of the Engineer.
- (2) Mixing of mortar for setting beds, preparation of background surfaces, thickness and application of mortar shall be in accordance with para. 2.0 of this Section.
- (3) Setting beds shall be finished appropriately for the tile finishing and to the approval of the Engineer.
- (4) All tiles shall be cut neatly and edges ground smooth to ensure neat junctions with other finishing.
- (5) Metal dividing strips, inserted flush with finished levels shall be provided at junctions of different finishes on floors.
- (6) Splicing location of polyvinyl soft skirting boards shall align to floor tile joint lines, and shall not be located within 500mm from wall corners and door side jambs.
- (7) Polyvinyl soft skirting shall not be cut at wall corners, shall be given shallow V-cut on backside then bent for installation at outside corner, and shall be given V-cut also and cut on coved part then bent at inside corner.
- (8) Tile flooring shall be finished flush and smooth with constant finished levels maintained between the various types of flooring. Offset or abrupt ramping to meet these requirements will not be accepted.
- (9) Tiles shall be carefully cut, fitted and sealed around all obstructions and penetrations.
- (10) Particular care shall be taken in protecting all tile work from damage.
- (11) Rounded holes in tiles for floor clean out, floor drain, etc. shall be made by the use of diamond core borer, and rectangular holes for switch boxes, socket outlet boxes, etc. shall be cut with rebated edge to allow faceplates to finish flush with the panel surface.

5.4. **Completion Requirements**

- (1) Exposed surfaces shall be clean and free from scratches, broken units, chips, cracks, misaligned or improperly made joints or stains, discolouration or other defects or damages.
- (2) Tile units shall be completely flush and level.
- (3) Tile joints shall be straight and free from staggers and offsets.
- (4) All tiles shall be fully bonded into place and free from hollow sounds when inspected by tapping.
- (5) Tile surfaces shall be free from any standing water and shall be sloped to drains where

possible.

- (6) Installation shall be watertight throughout and free from conditions which would permit leakage or entry of water into or through interior or concealed spaces of the structure.

6.0 SUSPENDED CEILINGS AND BULKHEADS

6.1. Description of Works

The works to be executed and completed by the Contractor are as follows:-

- (1) Suspended ceiling framing (MD-4)
- (2) Exposed suspension ceiling system (C-1)
- (3) Double ceiling system 12mm Acoustic rock wool + 9mm Gypsum (C-2)
- (4) Suspended board ceiling calcium silicate board (C-3)
- (5) Suspended board ceiling 12mm +9mm Gypsum boards (C-6)
- (6) Aluminium linear ceiling w=150 (C-7, C-13)
- (7) Aluminium linear ceiling w=300 (C-8)
- (8) Aluminium linear ceiling system w=84 (C-9)
- (9) Gypsum board (C-10)
- (10) Suspended board bulkheads (MD-5)
- (11) Wood batten ceiling (C-12)
- (12) Aluminium baffle ceiling (C-14)
- (13) To be complete with all background preparation, suspension systems, brackets, miscellaneous members and trims, finishing and accessories.

6.2. Materials

- (1) Suspended ceiling framing (MD-4)
 - (a) Galvanized Steel
 - (b) Width: 25 mm,38mm,50mm
 - (c) Hanging Rod: 9 ϕ Galvanized steel bar.
- (2) 12mm Acoustic rock wool + 9mm Gypsum (C-1, C-2, MD5)
 - (a) Rock wool coloured acoustic boards: JIS A6301 type DR
 - (b) Thickness: 12 mm or 15mm
 - (c) Size: 600 x 600 mm
 - (d) Colours and textures of coloured acoustic boards shall be selected by the Engineer

from manufacturer's full colour and pattern ranges

- (e) Exposed suspension system as per manufacture's recommendation, the exposed T-bar shall be narrow reveal edge 14 mm width. The colours of exposed T-bar shall be selected by the Engineer.
 - (f) Colour of acoustic board / other ceiling material in VFR Room of Control Tower shall be flat-black or equivalent colour not to reflect sloped glass.
 - (g) Ceiling Access Hatches as per detail 6-MD, location and quantities as required.
- (3) Gypsum Board (C-2, C-6, C-10, MD-5)
- (a) Type: Product conforming to JIS A 6901 GB-R or equivalent, with tapered edges. Waterproof type to be used in toilets and wet rooms where directed.
 - (b) Thickness: Not less than 9 mm.
 - (c) Ceiling Access Hatches as per detail 6-MD, location and quantities as required.
 - (d) Size: manufacturer's standard.
 - (e) Double ceiling system is composed of 2 layers ceiling board as follow:
 - (i) 1st layer (inner board): gypsum board 9mm thick on suspension framing system
 - (ii) 2nd layer (outer board): rock wool/coloured rock wool ceiling board 15mm thick with adhesive-staple or adhesive-nailing
 - (iii) Adhesives as per manufacturer's recommendation
 - (iv) Accessories: to comply with framework members manufacturer's recommendations.
- (4) Calcium Silicate Board (C-3)
- (a) Calcium silicate board (JIS A5430 type 0.8 FK or 1.0 FK)
 - (b) Thickness: Not less than 8 mm.
 - (c) Size: manufacturer's standard.
 - (d) Ceiling Access Hatches as per detail 6-MD, location and quantities as required.
- (5) Aluminium linear ceiling (C-7,C-8,C-9)
- (a) Stove enamelled 0.5 mm thick aluminium alloy
 - (b) Liner material shall be 75mm-150mm.
 - (c) Colours of aluminium louver shall be selected by the Engineer
 - (d) Suspension system as per manufacturer's recommendation
- (6) Aluminium Baffle Ceiling (C-14)

- (a) Hunter Douglas “High Profile Series Baffle Ceiling System ” or equivalent approved.
 - (b) 38mm wide x 152mm deep
 - (c) Colours and patterns to be selected by the Engineer
 - (d) Suspension system as per manufacturer’s recommendation
- (7) Aluminium End Trimmer and J-moulding (MD-5)
- Shall be stove enamelled aluminium, colour selected by the Engineer.
- (8) Suspension Framing System for Ceiling other than Exposed Suspension Ceiling System
- (a) Main runners: galvanized steel channels size 38 x 12 x 1.2 mm thick at 900 mm pitch at centre.
 - (b) Cross furring (single): galvanized steel channels size 25 x 19 x 0.5 mm thick at 450 mm pitch at centre.
 - (c) Hangers: 9 mm diameter galvanized steel bar with adjustable screwed fixing devices.
 - (d) Cast in anchors: cast iron
 - (e) Accessories: to comply with framework member manufacturer’s recommendations.
 - (f) Double cross furring shall be provided fixed together at joints of ceiling baseboards.
- (9) Suspension Framing System for Bulkhead (MD-5)
- (a) Hangers, vertical members and horizontal members: galvanized steel angle size 38 x 12 x 1.2 mm thick at 900 mm pitch on centre.
 - (b) Cross furring: galvanized steel channels size 25 x 25 x 1.2 mm thick at 450 mm pitch on centre
 - (c) Accessories: to comply with framework members manufacturer’s recommendations.
- (10) Wood Batten ceiling (C-12)
- (a) Timber: (Dark red) Meranti or equivalent. Joint at random or staggered.
 - (b) Fire Retardant process which conforms to Class 1, or A flame spread rating, according to ASTM E-84 is required.
 - (c) Cross rail shall be galvanized steel frame. The frame shall be fixed directly to roof purlins.
 - (d) Accessories: to comply with framework member manufacturer’s recommendations.

- (e) Detail for penetrations for M&E shall be considered by shop drawings.

(11) Others

- (a) Staple, screws and nails shall be of stainless steel.
- (b) Adhesive: JIS A5536 or equivalent
- (c) Joint plaster: JIS A6914 or equivalent
- (d) Joint tapes and metals: as per board manufacture's instruction

6.3. Installation

(1) Suspension Framing System for Ceilings and Bulkhead

- (a) The Contractor shall install the framing system to the lines and levels shown on the approved shop drawings. Generally vertical rod hangers shall be fixed at 900mm centres to anchor cast in the concrete slab. The Contractor is to ensure that the size of the anchor is sufficient to carry the load suspended from it, taking into consideration the varying suspension lengths. The Contractor must produce evidence to show the adequacy of such supports utilized.
- (b) The location of the hangers must be so arranged that the maximum space between the perimeter of the surrounding structure and the nearest hanger is 150mm.
- (c) Inserts shall be set prior to concrete pouring.
- (d) In some locations, as shown on the Drawings, the hanger will be fixed to steel roof framing and the Contractor must submit details of proposed fixing methods for approval.
- (e) Additional steel framing necessary to support hanger rods shall be provided.
- (f) Visible portion of double cross fittings shall be painted with type P-3 or applied coloured plastic tape of which colour shall match ceiling finishing colour, prior to ceiling board installation.

(2) Gypsum Board Installation

- (a) Supports shall be true to line and level, properly aligned and accurately spaced to receive boards. Boards shall be installed tapered edge facing out to produce neatly finished, parallel joints having an even surface across the boards. Joints between boards shall be centred over supports and joints shall be not more than 5mm wide. Fixing clips shall be at 150mm centres along all edges and not more than 300mm centres along intermediate supports. Fixing of edges shall not be less than 12mm from the edge. As a rule joints shall not be allowed horizontally.
- (b) Joint paste shall be applied uniformly in the tapered joint with knife, then jointing tape shall be applied immediately on the tapered edges and worked in sufficiently with a knife to form good bond. Surplus paste extruding on the tape edges or surface shall be smoothed down with the knife.
- (c) After first coating is dried, jointing paste shall be applied thinly over a width of about 150mm so that it will cover the entire jointing tape and taper and will also be level with the board surface.

- (d) After second coating is dried, jointing paste shall be applied thinly and evenly cover a width of about 200mm to 250mm to cover up surface irregularities of the second coat. When the paste has dried, it shall be sandpapered lightly to form a true surface.
 - (e) Where joint forms a taper-free cut, the cut shall be butt jointed after chamfering its face lightly, and finished by spreading jointing paste thinly as in the jointing finish for tapered boards.
 - (f) All external angles shall be provided with metal corner beads. At all internal angles, double-folded jointing tape shall be applied in L-shape and the same jointing finish as applied for tapered boards.
 - (g) Joints directions and locations of backing board and finishing boards shall not be equal.
 - (h) Finishing layers of boards shall be fixed by approved adhesives. Staples, screws, nails shall be allowed on only approved area.
 - (i) Substrate surface shall be free from variation in plane exceeding 2.0mm in 2 meters.
- (3) Aluminium Baffle Ceiling (C-14)
- (a) Panel Hanger Bracket: Ceiling Panel Hanger Bracket with cam actuated locking device designed to positively lock baffle panel in place, with release device to disengage hanger bracket, allowing panel to slide along Primary Support Channel for access. Hanger Bracket connects baffle panel profile to Primary Support Channel.
 - (b) Primary Support Channel: 41.3mm x 41.3mm Strut Channel with 9.5mm return flanges designed to interlock with Panel Hanger Bracket.
 - (c) Material: Aluminium alloy 6063-T6
 - (d) Finish: Painted, factory applied polyester
 - (e) Colour as selected by Engineer
 - (f) All items behind the hanger such as concrete ceiling, mechanical equipment, plumbing and electrical cable tray conduit shall be painted black colour or colour as selected by Engineer.
- (4) Wood Batten Ceiling (C-12)
- (a) Hangers, vertical members and horizontal members: galvanized steel angle size 38 x 38 x 1.2 mm thick at 900 mm pitch on centre.
 - (b) Cross furring: galvanized steel channels size 50 x 50x80 x 1.2 mm thick at 500 mm pitch on centre
 - (c) Accessories: to comply with framework members manufacturer's recommendations.

6.4. Completion Requirements

- (1) Exposed surfaces shall be completely clean and free from dust, dirt, smudges, fingerprints, scratches, dents, warping, waviness, buckling, broken parts or units,

chips, cracks, misaligned or improperly fitted joints, stains, discolouration or other defects or damages.

- (2) Board and tile joints shall be tightly abutting and flush across adjacent units.
- (3) The installation shall be free from exposed fastenings, unnecessary cuts or holes, other than as particularly shown, specified or approved.
- (4) Each assembly shall be tightly and rigidly secured in place and free from unnecessary movement.
- (5) Each assembly shall be set square, straight, plumb and/or level, accurately positioned at locations and to layouts required, with adjacent like units or members accurately aligned.

7.0 CARPETING

7.1. Description of Works

The works to be executed and completed by the Contractor are as follows: -

- (a) Anti-Static Carpet Tile (F-9)
- (b) To complete with all background preparation, mortar beds and backings, finishing and accessories.

7.2. Material

- (1) Anti-Static Carpet Tile (F-9)
 - (a) Shall meet the following requirements when tested in accordance with JIS L 1022, 1023, 1904, 4405, etc.:

(i)	Deviation in length	:	-0.5 to +0.5mm
(ii)	Deviation in corner	:	0.5mm/500mm (maximum)
(iii)	Pile density	:	350g/m ² (minimum)
(iv)	Pulling stress	:	24.5 N (minimum)
(v)	Thickness reduction against dynamic load	:	15% (maximum)
(vi)	Deviation in length against chair caster	:	0.10% (maximum)
(vii)	Deviation in length against water and heat	:	0.10% (maximum)
(viii)	Warp against water and heat	:	1.5mm (maximum)
(ix)	Anti-static electricity	:	0.5 kV (23 °C, 25% RH) (maximum)
(x)	Electrical resistance	:	105 to 108 ohms (23 °C, 25% RH)
(xi)	Colour fastness - against light	:	Grade 4 or more

- (xii) - against skin friction : Grade 4 or more
- (b) Loop pile of nylon fabric (BCF)
- (c) (3) Backing of PVC or bitumen; reinforced by glass wool or equivalent
- (d) (4) Overall 6 to 8mm high
- (e) (5) Adhesive shall be as per the manufacturer's recommendations
- (f) (6) Nominal size : 500 x 500mm matching free access sub-floor panel
- (2) Others
 - (a) All carpets and under lays containing natural fibres shall be mothproofed.
 - (b) Tapes, trims, fixing bar and adhesives shall be as per manufacturer's recommendation.
- (3) Installation
 - (a) Carpets shall be installed by a specialist carpet installer, in accordance with the manufacturer's instructions and to the approval of the Engineer.
 - (b) Setting beds shall be finished appropriately for the carpet finishing and to the approval of the Engineer.
 - (c) All carpet shall be cut neatly and edges ground smooth to ensure neat junctions with other finishing.
 - (d) Gripper strips for carpet shall be fixed to mortar bed with masonry pins around perimeter of all rooms and areas.
 - (e) Metal dividing strips, inserted flush with finished levels shall be provided at junctions of different finishes on floors.
 - (f) Carpet flooring shall be finished flush and smooth with constant finished levels maintained between the various types of flooring. Offset or abrupt ramping to meet these requirements will not be accepted.
 - (g) Carpet shall be carefully cut, fitted and sealed around all obstructions and penetrations.
 - (h) Particular care shall be taken in protecting all carpeting work from damage.
- (4) Completion Requirements
 - (a) Exposed surfaces shall be clean and free from scratches, broken units, chips, cracks, misaligned or improperly made joints or stains, discolouration or other defects or damages.
 - (b) Carpet joints shall be straight and free from staggers and offsets.
 - (c) Tile surfaces shall be free from any standing water and shall be sloped to drains where possible.

8.0 PADDED FABRIC – NOT USED

9.0 PAINTING/CLEAR FINISHING

9.1. Description of Works

The works to be executed and completed by the Contractor are as follows:-

- (a) Synthetic Resin Emulsion Paint (P-1)
- (b) Synthetic Resin Mixed Paint Type – I for wood (P-2)
- (c) Synthetic Resin Mixed Paint Type – II for steel (P-3)
- (d) Synthetic Resin Emulsion Multi-Layer Coating (P-4)
- (e) Clear Lacquer (P-5)
- (f) Wood Stain (P-5A)
- (g) Epoxy Resin Floor Paint (P-6)
- (h) Acrylic Resin Enamel Paint (P-7)
- (i) Fluorine-resin Enamel Coating (P-8)
- (j) Painting to surfaces of fabricated and assembled items that are finish painted by the manufacturer, or specified to be finished painted or primed or varnished under other Sections of the Specification, are to be excluded from this Section and will be deemed to have been included within the respective items in other Sections.

9.2. Materials

All paints shall be delivered in sealed containers that plainly show the designated name, formula or specification number, batch number, colour, date of manufacture, all of which shall be plainly legible at the time of use. Materials shall conform to the painting schedule and to the requirements hereinafter specified. All paints and primers to be used for this work shall be of high quality and obtained from only a single manufacturer.

(1) Primers and Putty

The Contractor shall use the following, unless otherwise specified elsewhere in the Specification:

- (a) Synthetic emulsion putty: JIS K5669, waterproof type
- (b) Surface preparation materials for coatings: JIS K6916 type C-1
- (c) Knot sealers: JIS K5431 type 1
- (d) Etching primer: JIS K5633 class 1

(2) Finish Paints

The Contractor shall supply and apply following paint types:

- (a) Synthetic Resin Emulsion Paint (P-1)
- (b) Synthetic Resin Mixed Paint Type – I (P-2)

- (c) Synthetic Resin Mixed Paint Type – II (P-3)
- (d) Synthetic Resin Emulsion Multi-Layer Coating (P-4)
- (e) Clear Lacquer (P-5)
- (f) Wood Stain (P-5A)
- (g) Epoxy Resin Floor Paint (P-6)
- (h) Concrete Dustproofers (P-6A)
- (i) Acrylic Resin Enamel Paint (P-7)
- (j) Fluorine-resin Enamel Coating (P-8)

9.3. **Cleaning, Preparation, and Pre-treatment of Surfaces.**

(1) General

- (a) Finish hardware, hardware accessories, machined surfaces, plates lighting fixtures and similar items in contact with painted surfaces and not to be painted shall be removed, masked, or otherwise protected prior to surface preparation and painting operations. Such removal shall be done by workmen skilled in the trades involved.
- (b) Exposed nails and other ferrous metal on surfaces to be painted with water-thinned paints shall be spot-primed with zinc dust-zinc oxide, red lead, basic lead silica chromate, or zinc chromate primer.
- (c) Surfaces to be painted shall be cleaned before applying paint or surface treatments. Surfaces not to be painted shall be in a new conditions or shall be wire-brushed and touch up to remove all evidence of rust, corrosion, or abrasion. Oil and grease shall be removed with clean cloths and cleaning solvents shall be of low toxicity and shall have a flashpoint in excess of 38°C. Cleaning and painting shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

(2) Plaster Surfaces

Shall be treated as per following manners and sequences:

- (a) Drying of plaster
- (b) Removal of efflorescence, chalk, dust, dirt, grease, oil, asphalt, tar, excessive mortar, mortar dropping, etc. from plaster surface (No damage on the surface)
- (c) Application of one (1) coat of synthetic emulsion clear paint throughout the surface.
- (d) Application of synthetic emulsion putty to fill up cracks, holes, etc for internal surface
- (e) Application surface preparation materials for coatings to fill up cracks, holes, etc. for external surface
- (f) Grinding by sandpaper #180; after putty drying

- (g) Application of putty as specified in (d) above throughout the surface
 - (h) Grinding of the surface by sandpaper #180; after removal of excess putty and putty drying
- (3) Wood Surfaces
- (a) Wood surfaces, except surfaces which are to be given varnish or natural finish, shall be primed and finish-coated as specified in the painting schedule herein.
 - (b) Wood surfaces to be painted shall be cleaned of dirt, oil, and other foreign substances with mineral spirits, scrapers, and/or sandpaper.
 - (c) Finished surfaces exposed to view shall be made smooth by sandpapering. Small, dry seasoned knots shall be surface scraped and thoroughly cleaned before application of the priming coat.
 - (d) Pitch on large, open unseasoned knots and all other beads or streaks of pitch shall be scraped off, or if still soft, shall be removed with mineral spirits or turpentine and the resinous areas thinly coated with two (2) coats of knot sealers.
 - (e) The surface shall be checked to insure that finishing nails have been properly set; all holes and surface imperfections shall be primed.
 - (f) All surfaces shall be sand papered, #120 and #180.
 - (g) All holes and imperfections in finish surfaces shall be filled with oil putty or plastic wood filler, coloured to match the finish coat if natural finish is required, allowed to dry and sandpapered smooth (#180).
- (4) Ferrous Surfaces
- (a) Non-galvanized and non-baked-painted ferrous surfaces shall be treated as per manners and sequences specified in Section 4350.
 - (b) The semi-transparent film applied to some pipes and tubing at the mill is not to be considered as a shop-coat, but shall be over coated with the specified ferrous metal primer prior to application of finish coats.
- (5) Galvanized Steel Surfaces to be Painted
- Shall be treated in accordance with following:
- (a) Removal of dirt, dust, grease, oil or other foreign matters by scrapers, wire brushes, solvents but not by water with soap or acid
 - (b) Application of one (1) coat of etching primer, 0.05 kg/ m²
 - (c) First coat of finishing paint shall be applied between two (2) and eight (8) hours after application of etching primer.
- (6) Surfaces of Gypsum Boards and Fibre Reinforced Cement Boards
- Shall be treated in accordance with following sequences:
- (a) Trimming along board joints by the use of the materials recommended by the board manufacturer, then dry.

- (b) Removal of oil, grease, rust, stains or other foreign matters by the use of suitable solvents to be recommended/instructed by the board manufacturer (Wire brushing shall not be permitted.)
- (c) Application of synthetic emulsion putty on surfaces imperfections, then dry
- (d) Grinding on the surfaces where putty applied, by sandpaper #180.
- (e) Application of one (1) coat of synthetic emulsion clear paint throughout the surface.
- (f) Application of synthetic emulsion putty throughout the surface
- (g) Removal of excess putty by trowel, then dry.
- (h) Grinding throughout the surface by sandpaper, #180.

9.4. **Paint Application**

(1) General

- (a) The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in colour, texture, and finish. Coverage shall be complete, and each coat shall be so applied as to produce a film of uniform thickness. Special attention shall be given to ensure that all surfaces including edges, corners, crevices, welds and rivets receive a film thickness equivalent to that of adjacent painted surfaces.
- (b) Adjacent areas and installations shall be protected by the use of drop cloths or other approved precautionary measures. Metal or wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched-up prior to the application of water-thinned paints.
- (c) The first coat on plaster shall include such repeated touching up of suction spots to produce a uniform colour. The first coat on both faces of wood doors, shall be applied at the same time.

(2) Coating Progress

Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit adverse weather conditions. Oil base of oleo resinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

(3) Storage, Mixing, and Thinning

At time of application, paint shall show no signs of hard settling, excessive skinning, levering, or other deterioration. Paint shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Where necessary to suit conditions of surface, temperature, weather, and method of application, package paint may be thinned immediately prior to application in accordance with the Manufacturer's directions. The use of thinner for any reason shall not relieve the Contractor from obtaining complete coverage.

(4) Atmospheric Conditions

Paints other than water-based coatings shall be applied only to surfaces that are completely free of surface moisture as determined by sight or touch and under ambient conditions which will not be detrimental to good painting practice.

(5) Colours and Tints

Colours and tints, including shades of stain, shall match the respective colour specimens selected by the Engineer. Stains shall conform in shade to the manufacturer's standard colour. Primers and undercoats shall vary slightly from the colour of the next coat.

9.5. Coating Procedures

(1) Type P-1: Synthetic Resin Emulsion Paint (Resin Acrylic water based Emulsion)

For internal concrete, cement plaster, gypsum board, calcium silicate board surface

(a) Paint: JIS K5663 type 2 (internal)

(b) Sealer: JASS 18 M501

		Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment	Refer to para. 9.3 of this Section			
Primer	Sealer	0.12	2 hrs. (minimum)	As per manufacturer's instruction
1st coat	Paint	0.12	2 hrs. (minimum)	Water 10 to 20%
2nd coat	Paint	0.12		Water 10 to 20%

(2) Type P-2: Synthetic Resin Ready Mixed Type A (for wood)

For wood surface

(a) Synthetic resin mixed paint: JIS K5516 type 1

(b) Oil putty: JIS K5592

(c) Sealer: JASS 18 M-304 (white)

		Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment	Refer to para. 9.3 of this Section			
Sealer		0.12	24 hrs. (minimum)	Thinner 5 to 10%
Sanding	Sand paper #180			
1st coat	Mixed paint	0.12	20 hrs. (minimum)	Thinner 5 to 10%
2nd coat	Mixed paint	0.12		Thinner 5 to 10%

(3) Type P-3: Synthetic Resin Ready Mixed Type -B (for steel)

For ferrous metal surfaces and galvanized surfaces

- (a) Synthetic resin mixed paint: JIS K5516 type 2
- (b) Oil putty: JIS K5592

		Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment	Refer to para. 9.3 of this Section			
1st coat	Mixed paint	0.14	20 hrs. (minimum)	Thinner 5 to 10%
2nd coat	Mixed paint	0.14		Thinner 5 to 10%

(4) Type P-4: Synthetic Resin Emulsion Multi-Layer Coating (Acrylic solvent based)

For Concrete / Mortar surface

- (a) Spray or roller applied
- (b) Base resin: JIS A6909 type E
- (c) Preparation shall strictly follow the manufacturer's instruction
- (d) Painting pattern shall be selected by the Engineer

		Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment	Refer to para. 9.3 of this Section			
Primer	Sealer	0.12	2 hrs. (minimum)	As per manufacturer's instruction
Pattern coat	Base resin	1.80	16 hrs. (minimum)	Water 0 to 5%
Ruggedness Treatment				As per manufacturer's instruction
1st coat	Base resin	0.12	2 hrs. (minimum)	As per manufacturer's instruction
2nd coat	Base resin	0.12		- - -

(5) Type P-5: Clear Lacquer

- (a) Nitrocellulose lacquer : JIS K5531
- (b) Sanding sealer : JIS K5533
- (c) Wood sealer : JIS K5533
- (d) Wood filler : made of synthetic resin

		Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment	Refer to para. 9.3 of this Section			
Sealer	Wood sealer	0.10	2 hrs.	Thinner 30 to 80%

Sealer	Sanding sealer	0.10	(minimum) 4 hrs.	Thinner 40 to 80%
Sanding 1st coat	Lacquer	0.10	(minimum) Sand paper #240 24 hrs.	Thinner 40 to 120%
Sanding 2nd coat	Lacquer	0.10	(minimum) Sand paper #320 24 hrs.	Thinner 40 to 120%

(1) Type P-5A: Wood Stain

Pre-treatment Refer to paragraph 9.3 of this section.

- (a) First Coat: Paste Wood Filler, made of synthetic resin
- (b) Second Coat: Oil Woodstain,
- (c) Third Coat: Hi-Solids Sand Sealer, JIS K5533
- (d) Finish Coat: Solids Lacquer, JIS K5531

Application as per manufacturer's recommendation.

<u>Description</u>	<u>No. of Coats</u>	<u>Theoretical coverage (m²/gal.)</u>	<u>Painting interval</u>
Surface Preparation			Removal of dirt, oil, grease and other foreign materials, Crack repair and surface imperfections shall be carried out accordingly. All surfaces to be stained must be smooth and thoroughly dry and free from dust, scales, salt particles, corrosion products and other contaminants.
Stain	1 FC	20-25	Min: overnight
Sealer	1 FC	20-25	Min: 30 min.
Putty	-	-	Min: 30 min.
Sealer	1 FC	20-25	Min: 30 min.
Topcoat	3	20-25	
Thinner	-	5-10% by volume	
		Lacquer flo (when required)	

(2) Type P-6: Epoxy Resin Floor Paint

(a) Shall be finished with following qualities:

- (i) Tensile strength : 100 N/cm² (JIS A5536) (minimum)
- (ii) Abrasion loss : 200 mg (JIS K7204; CS-17, 9.8N, 1000 rpm) (maximum)
- (iii) Water absorption : 1% (JIS K6911; 23°C water, 1 week)

(maximum)

- (b) Primer, aggregate, etc. shall be as per paint manufacturer's instruction.
- (c) Epoxy putty : JASS 18 M202 (2)
- (d) Epoxy resin floor paint coats shall be finished smooth and without any bubbles.
- (e) Mixing ration and method of reactive components shall be carried out strictly in accordance with manufacturer's instruction. (Hand mixing shall not be permitted)

	Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment	Removal of oil grease, dirt, efflorescence, etc.		
Primer throughout floor	0.15	As per manufacturer's instruction	
Surface imperfection treatment			
Epoxy resin putty		As per manufacturer's instruction	
Under coat	Epoxy resin paint	0.30	As per manufacturer's instruction
Top coat	Epoxy resin paint	0.80	As per manufacturer's instruction

(3) Type P-6A: Concrete Dust proofer

- (a) One-component, water based acrylic concrete sealer and dust proofer.
- (b) Shot-blast or mechanically abrade or remove laitance, curing compounds, sealers and other contaminants and to provide surface profile.
- (c) Vacuum clean concrete to remove all dirt, dust and other loose material.
- (d) Verify that all surfaces are clean, dry and free of any contaminants, which could adversely affect the adhesion of the flooring system.
- (e) Application of concrete dust proofer in compliance with manufacturer's recommendation.

(4) Type P-7: Acrylic Resin Enamel Paint (Not Use)

- (a) Acrylic resin enamel: JIS K 5654
- (b) Synthetic resin putty (Chloride vinyl resin putty): JASS 18 M-202 (1)
- (c) Acrylic resin vanish: JIS K 5653

			Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment			Removal of oil grease, dirt, efflorescence, etc.		
Primer vanish	Synthetic resin		0.08	2hrs. (minimum)	30 – 100 %
Putty	Synthetic resin			5hrs. (minimum)	0 – 20 %
Sanding 1st coat	putty Sand #220	Paper	0.08	3hrs. (minimum)	30 – 100 %
Sanding 2nd coat	Acrylic resin paint Sand #220 Acrylic resin paint	Paper	0.08	24hrs. (minimum)	30 – 100 %

(5) Type P-8: Fluorine Resin Enamel Paint

- (a) Fluorine resin paint for steel: JIS K 5659
- (b) Epoxy resin iron oxide (mica type) paint: JIS K 5555
- (c) Epoxy resin paint: JIS K 5551
- (d) Zinc rich primer: JIS K 5552

			Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment			Removal of oil grease, dirt, efflorescence, etc.		
1st Primer	Zinc rich		0.14	As per manufacturer's instruction	
2nd Primer	Epoxy resin		0.14	24hrs. 7 days (minimum) (maximum)	Brush 0 - 10 % Spray 0 – 20 %
3rd Primer	Epoxy iron		0.14	As per manufacturer's instruction	
1st coat	oxide Fluorine resin		0.14	24hrs. 7 days (minimum) (maximum)	Brush 0 - 10 % Spray 0 – 20 %
2nd coat	Fluorine resin		0.10	72hrs (minimum)	Brush 0 - 10 % Spray 0 – 20 %

Primer works (1st to 3rd) shall be executed after fabrication at factory, however, the portion where is difficult to paint shall be painted before fabrication.

Rust shall be removed from processed portion at factory by disc-sander or sandpaper #120 until the metal surface appear for primer work.

Damage portions after fabrication (paint peeling at connection points, etc...) shall be fixed on site by a disc-sander or sandpaper #120 until the metal surface appear then prime with epoxy resin three times.

(6) Type UE: Polyurethane Enamel Paint

- (a) Polyurethane resin paint for steel: JIS K 5657

- (b) Epoxy resin iron oxide (mica type) paint: JIS K 5555
- (c) Epoxy resin paint: JIS K 5551
- (d) Zinc rich primer: JIS K 5552

		Coverage (kg/m ²)	Recoating Interval	Thinning Ratio against Base Resin Weight
Pre-treatment		Removal of oil grease, dirt, efflorescence, etc.		
1st Primer	Zinc rich	0.14	As per manufacturer's instruction	
2nd Primer	Epoxy resin	0.14	24hrs. 7 days (minimum)(maximum)	Brush 0 - 10 % Spray 0 - 20 %
3rd Primer	Epoxy iron oxide	0.14	As per manufacturer's instruction	
1st coat	Polyurethane resin	0.14	24hrs. 7 days (minimum)(maximum)	Brush 0 - 10 % Spray 0 - 20 %
2nd coat	Polyurethane resin	0.10	72hrs. (minimum)	Brush 0 - 10 % Spray 0 - 20 %

Primer works (1st to 3rd) shall be executed after fabrication in factory, however, the portion where is difficult to paint shall be painted before fabrication.

Rust shall be removed from processed portion at factory by disc-sander or sandpaper #120 until the metal surface appear for primer work.

Damage portions after fabrication (paint peeling at connection points, etc...) shall be fixed on site by a disc-sander or sandpaper #120 until the metal surface appear then prime with epoxy resin three times.

9.6. Completion Requirements

- (1) Exposed finish paint surface shall be left completely clean and free from dust, smudges, fingerprints, scratches, wrinkles, peeling, bubbles, runs, streaks, stains, discolouration or other defects or damage.
- (2) Each type of finish painted surface shall be uniform in appearance, colour, texture and sheen.
- (3) Each finish painted surface shall have been properly prepared, primed and/or finished to meet specified requirements.
- (4) Protect the work and adjacent work and materials at all times by a suitable covering or by other methods. Upon completion of the work, remove paint and varnish spots from floors, glass and finish hardware. All scratched, damaged finishing materials shall be replaced at the Contractor's expenses.

10.0 MEASUREMENT AND RATES

10.1. Measurement

- (1) Work under this Section shall be measured according to the item classification and units contained in the Bills of Quantities (BOQ).
- (2) Quantities shall be computed from the Drawings.

10.2. Rates

The rates shall be full compensation for all plant, materials, transport, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the Work described in this Section of the Specification and/or shown on the Drawings.

- (1) Rates for cement render beds, backings and finishing and all other in-situ finishes shall further include for: -
 - (a) forming all surface finishes including brushed, floated, trowel and the like
 - (b) forming all skirting, covings, edges and nosing
 - (c) working to curves, falls and cross-fall
 - (d) forming all holes, mortises, chamfers, rebates, chases, grooves and the like,
 - (e) sealing and making good around pipes, ducts, cables and the like including sleeves and first topping sealant where required
 - (f) providing scrim and other reinforcement
 - (g) providing expanded metal lathing
 - (h) providing angle, corner and drip beads, plaster stops
 - (i) protection
- (2) Rates for rigid tile/slab/ block shall further include for: -
 - (a) laying to patterns
 - (b) fixings and ties
 - (c) mortar beds and backings
 - (d) jointing and pointing
 - (e) sealants
 - (f) cutting and making good around obstruction, fittings, pipes, cables, ducts and the like
 - (g) finish treatment
 - (h) protection.
- (3) Rates for ceramic tiling shall further include for: -
 - (a) laying to patterns
 - (b) mortar beds and backings
 - (c) jointing and pointing
 - (d) special tiles such as coved tiles, stair noses
 - (e) sealants

- (f) metal dividing strip, threshold, cover stops, stainless steel corner beads for walls.
 - (g) cutting and making good around obstruction, fittings, pipes, cables, ducts and the like
 - (h) protection.
- (4) Rates for flexible tile/sheet shall further include for: -
- (a) laying to patterns
 - (b) mortar beds and backings
 - (c) jointing and pointing
 - (d) sealants
 - (e) stainless steel dividing strip, threshold, cover stops..
 - (f) cutting and making good around obstruction, fittings, pipes, cables, ducts and the like
 - (g) protection.
- (5) Rates for suspended ceilings and bulkheads shall further include for :
- (a) all suspension framing systems and fixings
 - (b) aluminium edge trims
 - (c) aluminium cover strip (where required)
 - (d) forming recessed shadow channel at perimeter of all suspended ceilings at junction of suspended ceiling and walls including providing timber backings, aluminium channel sections and finishing.
 - (e) all accessories, including proprietary access hatches as required.
 - (f) cutting and making good around mechanical and electrical elements and the like
 - (g) protection
- (6) Rates for carpeting shall further include for: -
- (a) laying to patterns
 - (b) underlay
 - (c) jointing and fixing accessories
 - (d) grippers and trims
 - (e) stainless steel dividing strip, threshold and cover stops
 - (f) protection.
- (7) Rates for padded fabric shall further include for:-

- (a) laying to patterns
 - (b) jointing and fixing accessories
 - (c) cutting and making good around mechanical and electrical elements and the like
 - (d) grippers and trims
 - (e) protection
- (8) Rates for painting/clear finishing shall further include for: -
- (a) cleaning, preparation and pre-treatment of surfaces
 - (b) work in single or multi colours
 - (c) protection

SECTION 4380

MISCELLANEOUS / FITTINGS/FURNITURE

1.0 GENERAL

1.1. Scope of Application

- (1) The work to be executed by the Contractor under this Section shall comprise all fitting/furniture to all buildings. All works shall be executed in accordance with the dimensions, lines and levels and in the locations shown on the Drawings or as instructed by the Engineer.
- (2) Manufacturers and types shall be as indicated on the Drawings or at least equivalent and as approved by the Engineer.

1.2. Items of Work

The works of fittings/furniture generally to be executed by the Contractor shall include the following: -

- Para.2.0 FIXTURES
- Para 3.0 FURNITURE
- Para 4.0 MISCELLANEOUS ITEMS

1.3. Submissions

Prior to commencement of the works of fittings/furniture, the Contractor shall prepare and submit the following for the Engineer's approval: -

- (a) All manufacturers' original catalogues, detailed technical data, specifications and installation instructions for all components and accessories, within this Section.
- (b) Shop drawings for all works required under this Section, indicating in detail the jointing, assembly and installation requirements, material lists. Shop drawings shall be submitted not less than four (4) weeks before fabrication commences.
- (c) A detailed Construction Plan indicating the proposed methods, sequences, standards, etc., to be adopted, for the approval of the Engineer.
- (d) Samples of all materials and accessories within this Section, as required by the Engineer

1.4. Fabricators and Manufacturers

- (1) Fabricators and manufacturers of fittings/furniture shall have experience of high quality fittings/furniture manufactured for airport terminal building or similar.
- (2) Skill and quality of fabricator s and manufacturers shall meet international standard.

1.5. Colour

Colour shall be selected by the Engineer from manufacturer's full colour range.

1.6. Execution

- (1) Fixtures, Furniture and Miscellaneous Items shall be produced and installed in accordance with normally acceptable standard for high quality work from the view point of international standards, to details indicated on the Drawings, all to the approval of the Engineer.
- (2) Modifications and alterations of fixtures at Site shall not be allowed generally unless otherwise the Engineer will approve, and such modification and alteration shall be completed by personnel certified by the respective manufacturer.

1.7. Completion Requirements

- (1) Each item unit shall be assembled tightly installed leveled and rigidly secured in place free from unnecessary movement; and free from defects or damages.
- (2) Installation shall be free from exposed fastenings, unnecessary cuts or holes.
- (3) Exposed surfaces shall be clean and free from scratches, dents, warping, waviness, buckling, misaligned or improper fitted joints, or other defects or damage.
- (4) All fittings/furniture shall be smooth and of good high quality appearance.
- (5) All lock sets of fittings/furniture shall be locked when the facilities will be turn-over to the Employer. All keys shall be tagged and stored in the key boxes in accordance with the requirements of **Section 4340** of the Specifications. At least two (2) sets of original keys shall be provided for furniture.
- (6) All other small demountable materials, accessories, etc. as parts of furniture to be supplied by manufacturer shall be properly packed, protected and tagged, and shall be handed over to the Employer.

2.0 FIXTURES

2.1. Description of Works

The works to be executed and completed by the Contractor are as follows: -

- (a) GRP counters
- (b) Toilet wash basin counters
- (c) Baby seat in toilet
- (d) Baby diaper change table
- (e) Free standing walls for FIDS and TV monitor
- (f) Writing Shelves
- (g) Kitchen/Pantry counter, shelves and cupboards
- (h) All necessary compatible fittings, accessories, connectors, bolts, fasteners and fixing

2.2. Materials

(1) G.R.P. COUNTERS

(a) Forms

- (i) Contractor shall guarantee the vacuum-moulded G.R.P. and shall provide the form-facing materials of metal, plastic, wood or other acceptable materials that are non reactive with polyester and shall produce the required surface finishes without any defects for a period of ten (10) years.
- (ii) Forms shall be open mold where the material shall be in contact with one (1) surface only.
- (iii) Forms shall be closed mold where the material is shaped between female and male molds, and where polyester resin is injected in one (1) continuous operation, and cured to give a dimensionally stable and stress-free product.

(b) Materials

- (i) The G.R.P. panels shall be either of a single skin laminate of glassfiber reinforced polyester or of a sandwich construction consisting of a plywood core with a continuous exterior laminate glassfiber reinforced polyester of uniform thickness all around the core.
- (ii) Provide G.R.P. panels factory produced of thickness from 6 mm to 50 mm consisting of the following materials:

(c) Thermosetting Polymer:

- (i) Unsaturated polyester resin consisting of a solution of a polymer resin in styrene, capable of being cured from a liquid to a solid state when subjected to the right conditions, and shall contain sufficient color pigment to assure colouring all through the thickness of the cured laminate.

(d) Colouring Agent:

Must be ultraviolet and alkali resistant, high temperature stable, according to B.S. 4800 (color shall be white).

(e) Glass Fiber:

Known as E glass fiber, of low alkali content, acid resistant and of diameter 0.5 mm to 2 mm.

Elongation at break	3%
Flexural strength	135 N/mm ²
Flexural modulus of elasticity	3500 N/mm ²
Glass content shall be	30% of weight

(f) Gel coat:

The gel coat used shall also be colored and with the following properties:

Specific gravity: > 1.20
Barcol hardness: 46-48

Elongation at break: 4%

(g) Final Finish Coat:

- (i) The final finish coat shall determine the desired sheen and structure of the surface. The final finish coat is based on a modified and colored two (2) components polyurethane with excellent light fastness.
- (ii) The adhesion on polyester shall be such that it can be considered an integral part of the laminate.

(2) Core Materials of G.R.P. Panels/Counters

- (a) Plywood: The plywood core of the G.R.P. shall be first quality grade, manufactured from tropical hardwoods. It shall be made of either rotary-cut or sliced veneers bonded together in balanced, multiply construction with an adhesive of WBP (weather - and boilproof) quality.
- (b) The veneers shall be reasonably matched for color and shall be free from knots, worm and beetle holes, splits, dots, glue stains, filling or inlaying or any kind of other defects. No end joints shall be permitted.
- (c) The plywood shall be highly resistant to weather, micro-organisms, cold and boiling water, steam and dry heat. It shall be free of manufacturing defects such as defective bonding, pleats, overlaps, blisters and gaps.
- (d) Plywood shall be sanded or scraped on both sides equally.
- (e) Any plywood showing delamination or blistering shall be deemed not to comply with the requirements of this specification.
- (f) Other Core Materials for G.R.P Panels: If specified other materials such as MDF (Medium Density Fibreboard), PU (Poly Urethane), etc., shall be used as core material for the production of G.R.P. panels, all materials shall be of first quality.

(3) Rubber Bumper:

- (a) The fronts and sides of free-standing G.R.P. counters shall be fitted with natural rubber bumpers following the sections and profiles as detailed the Drawings. The front bumpers shall be produced by the extrusion process, the side and corner bumper shall be molded. The bumpers shall have a Shore "A" hardness of $70^{\circ} \pm 5^{\circ}$ and shall be internally braced with an aluminium strip to provide rigidity.
- (b) The bumpers shall be fixed to the counters from the inside by means of galvanized steel tap bolts so that no signs of the connection are visible externally. The ends of the bumper shall be fitted with stainless steel flat bar $t=8\text{mm}$ profiled to match rubber bumper.

(4) Joint Seals:

- (a) The joints between G.R.P. panels and between G.R.P. panels and non-G.R.P. components of the counters shall be provided with suitable neoprene or approved equivalent synthetic rubber joint seals having a Shore "A" hardness of 55° minimum.
- (b) The seals shall have the profiles as shown on the Drawings and shall be fixed to the counter elements with contact adhesive tape.

- (5) Stainless Steel:
- (a) Stainless steel where specified shall be made of corrosion-resistant nickel-chromium steel AISI 304 with No. 4 Finish (Abrasion 220-240) and shall conform to the thickness and profile as shown on the Drawings.
- (6) Fasteners:
- (a) Unless otherwise specified, all screws, bolts, nuts and washers shall be galvanized or chromated.
 - (b) All bolts or screwed joints, where applicable, shall be secured against spontaneous turning or loosening by means of self-locking nuts or nuts washers with snap rings.
- (7) Glass and Plastic Glazing:
- (a) All glass irrespective of whether it is clear, tinted or hardened shall be of float quality conforming with Section 4340 specifications of BS Code of Practice. It shall be flat, free from bubbles, specks and other defects and samples shall be submitted for the approval of the Engineer before the glass is fixed in place.
 - (b) Glass panels shall be made of clear or colored hardened glass, is 10 mm thick unless otherwise specified. The glass shall be ground poly edged. Mounting by means of various aluminium profiles or as indicated on the Drawings.
 - (c) All glass shall be delivered in proper crates, boxes or cases with the maker's name, guarantee, type of glass and thickness or weight of glass attached to the outside of the crates, boxes or cases.
 - (d) Toughened glass shall be high quality float glass or soda lime composition produced either by the horizontal or vertical process. It shall possess at least three (3) times the structural strength or ordinary clear float glass. The stress characteristics of the glass shall be unchanged up to about 260°C and shall not be affected by sub-zero temperatures. It shall be capable of being exposed to a thermal gradient of up to 130°C without any sign of distress.
 - (e) The hardened glass shall not, after hardening, be cut or worked to fit the installation, all such work shall be done before hardening.
 - (f) All glass shall neatly fit the rebate or channel of the frame in which it shall be housed. It shall be well bedded all around with an approved type of silicone paste sealant or equal.
- (8) Metal Hardware:
- (a) All hardware shall be of first class quality conforming to Section 4340, and shall be fixed in the positions scheduled on the Drawings.
 - (b) Hardware required for the Works shall not be necessarily limited to the items described in the schedule. All items shall be subject to the approval of the Engineer.
 - (c) All ironmongery and hardware shall be supplied complete with fixing screws, bolts and nuts, unless otherwise directed.
 - (d) All fittings, except door hinges, shall be removed during painting and carefully refixed thereafter unless otherwise specified.

- (e) Drawers of desks, drawer cabinets, etc., to be fully extendable along telescopic slide rails on plastics coated steel ball-bearings.
- (9) Locks:
- (a) All locks shall be provided with at least three (3) keys.
 - (b) The number of locks to be served by one (1) master key shall be decided by the Engineer after the award of Contract.
- (10) Counter Floor Covering:
- (a) The floor covering material shall be a vinyl complying to Section 4370, consisting of oxidized linseed oil and resin, mixed with fillers (cork, wood flour and pigments) and calendared onto an impregnated carrier.
 - (b) Thicknesses shall be between 2 and 3.2 mm, unless otherwise specified.
- (11) Lighting Fixtures:
- (a) All lighting fixtures shall be standard commercial manufacture. Fixtures shall be of the general types indicated on the Drawings for the respective lamp sizes shown and subject to the approval of the Engineer.
 - (b) Each fixture shall contain a permanent label (nameplate) within the lamp housing stating the type, voltage and wattage of lamp to be used, if incandescent.
 - (c) Electrical diagrams and power requirements of all counter head and signs shall be submitted to the Engineer for approval prior to fabrication.
 - (d) All fluorescent ballasts shall be positively grounded to the metal fixture housing and earthed. Each fixture shall be supplied complete with tubes, fuse carrier and fuse designed to fuse at 2 Amps.
 - (e) For all lighting fittings (counter heads, displays, etc.) an AC power connection of sufficient rating shall be supplied by the Contractor within 1 m from the mounting position of the fittings.
 - (f) For the LED display system a separate group, not loaded in any other way, shall be made available by the Contractor.
 - (g) The Contractor shall be responsible for the complete electrical installation within the signs and counter heads and also for the connection of the counter heads to the mains power supply and for ON/OFF switching of same.

2.3. Execution

- (1) Any work rejected through non-compliance with the specification shall be removed and replaced at the expense of the Contractor. The Contractor shall commence work when instructed and shall clear all unused materials and material waste from site when the work is complete.
- (2) G.R.P. shall be thickened at point of fixation where stress concentration will be developed.
- (3) As the deflection of G.R.P. is large a structural form must be used to overcome the lack of stiffness.

2.4. Formation of Moulds

- (1) Moulds shall be formed to produce ornaments and panels of dimensions and thicknesses identical to those indicated on Drawings.
- (2) Surfaces of produced ornaments to contact walls or concrete slabs shall be neat, levelled and of sharp edges.

2.5. Mixing

- (1) The typical mix shall be polyester resin, E glass fiber glass and pigment of any required color as indicated on Drawings.
- (2) Glass fiber can be combined to form thicker bundles or twisted or in the form of woven fabric. Vibrate mix after pouring into form to enable the resin to flow and remove trapped air.

2.6. Inspection

- (1) The Engineer shall inspect completed parts in the workshop for compliance with specification and architectural requirements. No part shall be installed prior to the inspection and approval of the Engineer.

2.7. Installation

- (1) Careful detailing of the jointing system must be made to allow for the differential expansion of G.R.P. and materials in conjunction.
- (2) Installation of G.R.P. counters shall be done and installed at site by the Manufacturer.
- (3) Installation shall not take place until building is weather-tight, wet trades have finished their work, the building is well dried out, all paint work is finished and dry and floor tiling and carpeting has been completed.

2.8. Completion

- (1) Ensure that doors and drawers are accurately aligned and do not bind. Adjust as necessary to ensure smooth operation.
- (2) Check adjust and lubricate ironmongery as necessary to ensure correct functioning.

2.9. Coordination

- (1) The Sub-Contractor(s) for specialized furniture, electrical and mechanical works (conveyors belts), fittings, and finishes, when referred to this Para shall perform the following:
- (2) Liaise with Engineer and Contractor to help ensure coordination of the work with related building elements and services.
- (3) Provide complete fabrication installation drawings and other information of products.

2.10. Cleaning

- (1) Do all final cleaning which may be necessary, surfaces required to be cleaned after installation shall be cleaned using fibre brushes, soap and clear water from a hose.
- (2) Do not use acid.

- (3) Flush copiously and repeat washings until the surfaces are clean.

2.11. **Melamine Plastic Laminated Board**

- (1) Melamine resin sheet
 - (a) Shall be more than 1.5mm thick;
 - (b) Shall be applied throughout the exposed surfaces;
 - (c) For work station, shall be anti-static (10 to 500 k. Ohms per 910mm)
 - (d) Shall be mechanically bent and any splicing line shall not be visible.
- (2) Base materials shall be plywood meeting the requirements of Section 4360.
- (3) Laminates shall consist of layers of melamine and fibrous material impregnated under a thermosetting condensation resin, all consolidated under heat and pressure.
- (4) Water resistance adhesives or waterproof bonded as required and bonding shall be high pressure process.
- (5) Glass
 - (a) All glass for counters, table tops, cupboard doors and shelves, etc., shall be clear tempered plain float glass (JIS R3206) unless otherwise described. Exposed edges shall be polished and corners shall be rounded. Thickness shall be 4mm or more.
 - (b) Sliding glass shall be installed in aluminium clip type sliding bead. Fixing screws of bead shall not be visible.
 - (c) As per Section 4340.
- (6) Toilet Counters
 - (a) Counter top: 20 mm polished granite stone
 - (b) Skirting: 20 mm polished granite stone, 50 mm height
 - (c) Vertical portion: 20 mm polished granite stone, 100 mm height
 - (d) Granite stone shall as specified in Section 4370 para 3.0
 - (e) Support Brackets: 600mm length, 100mm height, galvanized steel with P-3
 - (f) Size, shape, location shall be as shown on the Drawings.
- (7) Kitchenette / Pantry
 - (a) Kitchen sink and sink top:
 - (i) Stainless Steel thickness not less than 1.2 mm polished satin finish.
 - (ii) Shall have over-flow drain per bay (applicable to kitchen sink only).
 - (iii) Shall have stainless steel or copper garbage basket/strainer with plastic coated stainless steel casement, stainless steel cover with rubber gaskets,

PVC flexible drain pipe; per bay.

- (iv) Flexible drain pipe shall be set up to floor or wall drain under Section 5100 Sanitary and Plumbing.
 - (v) Size of kitchen sink as shown on the Drawings
 - (vi) Size of kitchenette sink shall be more than 540mm long x 410mm wide x 200mm deep per bay.
 - (vii) Cabinet/Cupboards: laminated melamine plywood thickness not less than 15 mm
 - (viii) Kitchen/Pantry Counter top: Granite, as specified in Section 4370 para 3.0
 - (viii) Back and side splash: stainless steel thickness not less than 0.8 mm
 - (ix) Kitchen sink drainage with plug shall be provided.
 - (x) Lock sets shall be provided for all doors and drawers
 - (xi) Accessories: as required
- (8) Fixed Counter
- (a) Counter top: laminated melamine surface glue-up core thickness 40 mm
 - (b) Back wall: laminated melamine surface plywood thickness not less than 15 mm
 - (c) Drawer: Solid wood drawer P-2 (refer to Section 4370) with metal side strips or drawer guides
 - (d) Accessories: as required
 - (e) Size, shape, location shall be as shown on the Drawings.
- (9) Baby Seat
- (a) Shall be synthetic resin ready- made baby seat
 - (b) Folding type
 - (c) Shall be equipped with safety belt
 - (d) Reference: TOTO YKA22 or equivalent
- (10) Baby diaper change table
- (a) Shall be synthetic resin ready- made diaper change table
 - (b) Folding type
 - (c) Shall be equipped with safety belt
 - (d) Reference: TOTO YKA25 or equivalent
- (11) Writing Table (Passport Control, Custom Declaration)

- (a) Frame: Stainless Steel
- (b) Top Board: Timber core vanish finish
- (c) Accessories: As shown on the drawing

3.0 FURNITURE

3.1. Description of Works

- (1) The works to be provided and installed by the Contractor are as follows: -
 - (a) Chairs (CH-01)
 - (b) Public Benches and Seats (PF-1-A, PF-1-B, PF-1-C)
 - (c) Work station (PF-2)
 - (d) Trolley (PF-4)
 - (e) Waste Bin (PF-5)
 - (f) All necessary compatible fittings, accessories, connectors, bolts, fasteners and fixing

3.2. Materials

- (1) Seat and Back Upholstery Pad
 - (a) Chairs (CH-01): Cloth Fabric
 - (b) Public Bench (PF-1-A) : Aluminium alloy
 - (c) Public Bench (PF-1-B, PF-1-C) : Vinyl leather
- (2) Upholstery fabric shall be as follows:
 - (a) The materials used in the consideration of finished fabric shall be new and consistent quality and unique design.
 - (b) Fabric used in the production of yarns shall be principally of continuous multi-filament, easily washable without shrinkage.
 - (c) Not less than 100,000 rubs on the Martindale test in accordance with BS 5690: 1991 or equivalent
 - (d) Upholstery fabric shall be flame retardant, and an approved fire test certificate shall be provided.
- (3) Upholstery vinyl leather shall be as follows:
 - (a) Not less than 0.7mm thick
 - (b) Upholstery vinyl leather shall be fire retardant, and an approved fire test certificate shall be provided.
- (4) Polyurethane Foam shall be as follows:

- (a) Shall be heavy contact density conforming with BS 3379:1991(MAD 7126) class X or equivalent
 - (b) Foam thickness shall be not less than 20 mm on the back, 20 mm at the seat edge and 50 mm at the seat centre.
 - (c) The foam shall be flame retardant, and an approved fire test certificate shall be provided.
- (5) Others
- Springs shall not be permitted unless otherwise directed or agreed by the Engineer.
- (6) Cast Aluminium Alloy with Paint
- (a) Casted aluminium-magnesium alloy: JIS H5202 Grade 7A or equivalent
 - (b) Synthetic resin backed coating or equivalent
- (7) Steel Frame with Paint
- (a) Steel: refer to Section 4350.
 - (b) Paint shall be applied in baking process after application of necessary and proper anti-rust treatment.
- (8) Stainless Steel Pipes and Plates
- (a) Stainless steel pipes: JIS G3459, SUS 430
 - (b) Stainless steel bars, plates sheets, strips and fittings: JIS G4305 or G4303, SUS 430
 - (c) Finish: buffed
 - (d) Minimum thickness of faces: 1.0mm
- (9) Melamine Plastic Laminated Board
- (a) Melamine resin sheet
 - (i) Shall be more than 1.5mm thick.
 - (ii) Shall be applied throughout the exposed surfaces.
 - (iii) For work station, shall be anti-static (10 to 500 k. Ohms per 910mm).
 - (iv) Shall be mechanically bended and any splicing line shall not be visible.
 - (b) Base materials shall be plywood meeting the requirements of Section 4360.
 - (c) Water resistance adhesives or waterproof bonded as required and bonding shall be high pressure process.
- (10) Miscellaneous Fittings and Fixings
- (a) All metal fittings and fixings shall be according to the following:

- (i) On wood base: galvanized steel or stainless steel SUS 430
 - (ii) On ferrous base: galvanized steel (electrolytic zinc-coated steel: JIS G3313 E32) or stainless steel SUS 430
 - (iii) On stainless steel base: stainless steel SUS 430
 - (iv) On aluminium alloy: stainless steel SUS 430
- (b) Counters, workstations, etc. shall have levelling adjusting devices.
- (11) Rubbish Bin
- (a) Stainless steel t=1.0 Bending
 - (b) Approximate Dimension: 1,100mm width 350mm depth 800mm
 - (c) Drops: Two drops for two rubbish segmentations.
 - (d) Removable galvanized containers (inserts) for placement of rubbish bags, each approximate dimensions width 500mm x depth 300mm x height 750 mm.
- (12) Baggage trolley
- (a) Wanzl Travel 300 BL or equivalent.
 - (b) Material: Stainless steel electro polished
 - (c) Castors: 2 fixed / 1 swivel 180mm Diameter
 - (d) Nesting: Required
 - (e) Load capacity: Static 300 kg / Dynamic 200 kg

4.0 MISCELLANEOUS ITEMS

4.1. Anti -Shatter Film

- (1) Section includes: Safety film.
- (2) Related sections: Section 4340 Windows/Doors, Subsection: 5.0 Glazing to doors/windows
- (3) References: National Structural Code of the Philippines Volume I, 6th Edition, article 207.5.9.3 Wind-Borne Debris.
- (4) Performance Requirements:
 - (a) Flammability: Surface burning characteristics when tested in accordance ASTM E 84:
 - (b) Flame spread index: 25, maximum.
 - (c) Smoke development Index: 450, maximum
 - (d) Abrasion Resistance: Film must have a surface coating that is resistant to abrasion

such that, less than 5 percent increase of transmitted light haze will result in accordance with ASTM D 1044 using 50 cycles, 500 grams weight, and the CS10F Calibrase Wheel.

- (e) Safety Film: Safety and Security Window Films: Optically clear micro-layered polyester film, with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The film to be clear and shall contain dyed polyester.
- (5) Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of five (5) year experience.
- (6) Subcontractor Qualifications: All products listed in this section are to be installed by a single specific subcontractor with a minimum of three (3) years demonstrated experience in installing products of a similar type and scope as specified.
- (7) Performance: Safety and Security Window Film:
 - (a) Physical / Mechanical Performance Properties:
 - (i) Film Color: Clear.
 - (ii) Thickness: Nominal 4.0 mils (0.1 mm).
 - (iii) Tensile Strength (ASTM D 882): 30,000 psi.
 - (iv) Break Strength (ASTM D 882) (Per Inch Width): 120 lbs.
 - (v) Tear Resistance (ASTM D 1004): Greater than 780 lbs.
 - (vi) Puncture Propagation Tear (ASTM D 2582): 7.5 lbs.
 - (vii) Young's Modulus (ASTM D 882): 500 kpsi nominal.
 - (b) Solar Performance Properties:
 - (i) Visible Light Transmission (ASTM E 903): 86 percent.
 - (ii) Visible Reflection (ASTM E 903): Not more than 11 percent.
 - (iii) Ultraviolet Transmission (ASTM E 903): Less than 1 percent.
 - (iv) Solar Heat Gain Coefficient (ASTM E 903): 0.79.
 - (c) Windstorm Protection:
 - (i) Film shall pass impact of Medium Large Missile "C" and withstand subsequent pressure cycling (per ASTMs E1996 and E1886).
 - (ii) Film shall pass impact of Small Missile "A" and withstand subsequent pressure cycling (per ASTMs E1996 and E1886).

4.2. Clear Mirrors

- (a) Glass: type JIS R 3202 or equivalent; clear
- (b) Quality silvering float or polished

- (c) Thickness not less than 4 mm
- (d) Silvering: two (2) coats; each electro-deposited.
- (e) Protection: copper, one (1) coat electro-deposited.
- (f) Paint: one (1) coat; manufacturer's standard, spray or applied; colour distinctly different from copper colour.
- (g) Exposed edges ground as specified.
- (h) Fixing: countersunk brass screws with chromium plated domical caps or approved metal bracket.
- (i) Framing: stainless steel edge framing where directed.

4.3. **Venetian Blinds**

- (a) Vertical PVC impregnated fabric strips, varied colours to approval
- (b) Anodized aluminium top tracks
- (c) Adjustable for sliding and tilting

4.4. **Roll-up Film curtain (Control Tower)**

- (1) The Contractor shall supply and install all roll-up film curtain at the locations on the Drawings, complete with curtain box, supports, hangers, fixing, operating mechanism and other accessories, in accordance with the requirements of para. 1.0 of this Section, the Drawings and the Bill of Quantities.
- (2) Materials
 - (a) Film shall be as follows:
 - (i) Thickness: more than 100 microns
 - (ii) Color: smoke grey
 - (iii) Lapping: not allowed on film of which width less than 1,820mm
 - (iv) Others: lapping width less than 5mm
 - (v) Total solar heat elimination ratio: more than 55%
 - (vi) Solar energy shielding ratio: more than 51%
 - (b) Curtain boxes shall be as follows
 - (i) Face shall be made of electrically colour anodic oxide coated aluminium.
 - (ii) Rolling pipe : minimum 50mm dia. of stainless steel.
 - (iii) All axis of rotation shall have ball bearings of stainless steel.
 - (iv) Face of side guide rails and bottom bars shall made of electrically coloure anodic oxide coated aluminium or stainless steel.

- (3) Roll-up mechanism shall be as follows:
 - (a) Wire : twisted stainless steel; minimum 7.0mm dia. x 7 x 7 – 49.
 - (b) To be operated manually.
 - (c) Scheme and details of the mechanism shall be approved by the Engineers prior to fabrication.
 - (d) Pulley shall be made of stainless steel or polyamide with stainless steel ball bearing on shaft.
- (4) Size
 - (a) As shown on the Drawings.
- (5) Installation and compression requirements
 - (a) Manufacturer shall issue at least five (5) years guarantee.
 - (b) Roll-up and down shall be done smoothly, any stacking will be subject to the rejections.
 - (c) Faces of head boxes, side guide rails, etc. shall be fixed by clip but not exposed screws or bolts, etc.
 - (d) Manufacturer's instructions and recommendations shall be followed strictly.
 - (e) All materials shall be free from dust, paint, rusts and other foreign matters.
 - (f) Any materials with scratches, damages, etc. shall be replaced by originally manufactured ones at the Contractor's expense.
- (6) Tactile Paving Tile
 - (a) Material:
 - (i) Synthetic Rubber
 - (ii) 400mm x400mm: Thickness 2 mm
 - (iii) Blister pattern and way indication pattern.
 - (b) Execution
 - (i) Adhere rubber tile on finished floor (internal) or pavement (external) using primer and adhesive.
 - (ii) Primer and adhesive shall comply to manufacture's recommendation.

5.0 MEASUREMENT AND RATES

5.1. Measurement

- (1) Work under this Section shall be measured according to the item classification and

units contained in the Bills of Quantities (BOQ).

- (2) Quantities shall be computed from the Drawings.

5.2. Rates

- (1) The rates shall be full compensation for all plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the Work described in this Section of the Specification and/or shown on the Drawings.
- (2) Rate for fixtures shall further include for:
 - (a) all component including electrical fittings
 - (b) all ironmongeries including hinges, locking mechanisms, handles, etc.
 - (c) anchors, fixings and fittings
 - (d) protection
- (3) Rate for furniture shall further include for:
 - (a) all component
 - (b) anchors, fixings and fittings
 - (c) protection.
- (4) Rate for clear mirror shall further include for:
 - (a) clear mirror
 - (b) stainless steel edge framing
 - (c) fixing, plugs, screws, nail and other appropriate fixings
 - (d) protection
- (5) Rate for venetian blind shall further include for:
 - (a) all components in venetian blind
 - (b) fixings, plugs, screws, nails and other appropriate fixings
 - (c) protection
- (6) Rate for shower curtain shall further include for :
 - (a) all components in shower curtain
 - (b) fixings, plugs, screws, nails and other appropriate fixings
 - (c) protection
- (7) Roll-up Film Curtain shall further include for:
 - (a) roll-up film curtain

- (b) all component
- (c) anchors, fixings and fittings, and protection

SECTION 4390

SIGNAGE

1.0 GENERAL

1.1 Scope of Application

The work to be executed by the Contractor under this Section (unless otherwise specifically directed in other Sections), shall comprise all signs both internal and external, to all buildings. All work shall be constructed in accordance with the dimensions, lines and levels and in the locations shown in the Drawings or established by the Engineer.

1.2 Description of Works

The works to be executed and completed by the Contractor are as follows: -

- (a) Illuminated signs
- (b) Panel signs, with and without frames
- (c) Cut out letter signs
- (d) Door name plates
- (e) Factory finishing of signs, units and supporting members
- (g) Testing and commissioning
- (h) Terminating of electrical cables shall be excluded from this Section and included separately in 6000 series Electrical Works.

1.3 Submissions

Prior to commencement of Works, the Contractor shall prepare and submit the following for the Engineer's approval:-

- (a) All manufacturer's original catalogues, detailed technical data, specifications and installation instructions for all components and accessories, within this Section
- (b) Shop drawings for all works required under this Section, indicating in detail the joining, assembly and installation requirements, material lists. Shop drawings shall be submitted not less than four (4) weeks before fabrication commences.
- (c) A detailed Construction Plan indicating the proposed methods, sequences, standards, etc., to be adopted, for the approval of Engineer.
- (d) Samples and Test Certificates of all materials and accessories within this Section, as required by the Engineer.

- (e) Submit manufacturer's certificate of conformity for acrylic resin sheet.

1.4 Materials

- (1) Illuminated sign box: rib-profiled extruded aluminium; thickness not less than 3 mm; as specified in **Section 4340**; size as shown on the Drawings
- (2) Back board for single face illuminated sign box: aluminium sheet thickness not less than 2 mm
- (3) Face screen: acrylic resin sheet conforming to ASTM D702, Type III; thickness not less than 3 mm; colours shall be printed in screen process in sheet surface; two or three colours as directed by the Engineer
- (4) Cut Out Letters: Exterior use: Stainless Steel built-up signs thickness not less than 1.5 mm, sign depth 100 mm for 1200 mm letter height and 50 mm for 500 mm letter height. Interior use: Aluminium built-up signs thickness not less than 2 mm, sign depth 50 mm. Acrylic Front t=3mm for illuminated building sign, with 4mm. aluminium composite cladding backing. Fixation (raised from substrate from face of sign by 100mm.) by stainless steel accessories. Roof sign support by painted galvanized steel pipe section.
- (5) Door Name/Number Plates: Stainless Steel, t=3mm.
- (4) Hanger for suspension: aluminium pipe: diameter 20 mm
- (5) Electrical items such as fluorescent tube / LED lights, breaker, terminal, choke shall be in accordance with 6000 series Electrical Works

1.5 Fabrication and Execution

- (1) Illuminated box shall be to prevent access of insects to the interior of the box.
- (2) Illuminated box shall have one demountable side to facilitate maintenance.
- (3) The signs of up to 3 m length shall be manufactured in one length.
- (4) Hanger shall be adjustable and disconnectable form.
- (5) Fluorescent/LED tubes inside illuminated sign box shall provide an even shadow-free illumination of screen.
- (6) Illuminated signs and panel sign assemblies shall be manufacturer's first quality of factory fabricated signs for field erection, complying with requirements as shown on the Drawings or specified herein.
- (7) Illuminated sign units shall be completely self-contained units, with all necessary supports, sign letters, fluorescent lights, components, accessories and fixings.
- (8) All parts shall be mutually compatible and properly integrated to provide functions and operations as intended.
- (9) Components and accessories of all types of signs shall be suitable for use and exposure to various conditions of weather.
- (10) Fabricate and install all signs, components, accessories and fixings in accordance

with manufacturer's instructions and shop drawings, all to the approval of the Engineer.

- (11) Provision of manufacture's recommended spare parts sufficient for five (5) years operation and as approved by the Engineer.

1.6 Completion Requirement

- (1) Exposed surfaces shall be clean and free from dust, dirt, scratches, dents, broken parts or units, chips, cracks, misaligned or improperly fitted joints, stains, discolouration or other defects or damage.
- (2) Installations shall be free from exposed and unnecessary cuts, holes or blank plates, advertising labels, other than as particularly shown on the Drawings, specified herein or approved by the Engineer.
- (3) Each unit shall be assembled tightly and rigidly, secured in place and free from unnecessary movement.
- (4) Each unit assembly shall be set straight, plumb, level, accurately positioned and spaced at locations required.

2.0 MEASUREMENT AND RATES

2.1 Measurement

- (1) Work under this Section shall be measured according to the item classification and units contained in the Bills of Quantities (BOQ).
- (2) Quantities shall be computed from the Drawings.

2.2 Rates

- (1) The rates shall be full compensation for all Plant, materials, transport, labour, equipment, temporary works, establishment charges, overheads, profit and taxes required to complete the Work described in this Section of the Specification and/or shown on the Drawings.
- (2) Rate for signposting shall further include for:
 - (a) all component including electrical fittings
 - (b) all ironmongeries including hinges, locking mechanisms, handles, etc.
 - (c) anchors, fixings and fittings
 - (d) spare parts
 - (e) protection

New Bohol Airport Construction and Sustainable Environmental Protection Project

Specifications

Section 5000 Series: Mechanical Works

SPECIFICATIONS

SECTION 5000 SERIES: MECHANICAL WORKS

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SECTION 5050

GENERAL REQUIREMENTS FOR THE 5000 SERIES

1.0 GENERAL

- 1.1.** The provisions of Section 1140 are applicable to some items of Plant and systems and are to be referred to in connection with the 5000 Series of the Specification.
- 1.2.** The following provisions are additional to, and are to be read in conjunction with, Section 1140, and are particular to the 5000 Series of the Specification.

2.0 SCOPE

- 2.1.** This Section shall apply generally to the following Sections:
- (a) Section 5100 : Sanitary and Plumbing System
 - (b) Section 5200 : Ventilation and Air Conditioning System
 - (c) Section 5300 : Fire Protection System
- 2.2.** The provisions herein are the general requirements and it shall be the Contractor's responsibility to provide and comply with them. Where these provisions are not identified separately in the Bills of Quantities they are deemed to be included in the Contract Price.

3.0 QUALIFICATIONS

3.1. Manufacturer of Mechanical Equipment and Systems

- (1) Shall have manufactured/produced required equipment for not less than five (5) years before the closing date of the Bid.
- (2) Shall take full responsibility for all requirements of particular equipment or system where specified under the respective Sections of the Specification.
- (3) Capable of providing immediate emergency service within three (3) official working days after notification by the Employer.
- (4) Capable of entering into a full service maintenance agreement with the Employer. (Refer also to Section 1155)
- (5) Capable of providing well-trained and experienced workmen in types of work required and who are in direct employment of mechanical equipment manufacturer.

3.2. Mechanical Subcontractor

- (1) Company shall have regularly provided types of work required for not less than five (5) years prior to closing date of Bid.
- (2) Shall take full responsibility for all requirements under the Mechanical Work except as or otherwise specified above and including all necessary coordination of and with manufacturers of mechanical equipment and systems.
- (3) Shall be capable of providing well-trained and experienced workmen in work on types required.

4.0 SUBMITTALS REQUIREMENTS

4.1. General

- (1) Submittals are required as specified herein.
- (2) Materials and equipment shall not be ordered or fabricated until respective submittals have been approved.

4.2. Materials Lists

- (1) Shall comprise the listing of equipment proposed under the Mechanical Work, each item shall identified by reference to an item number in the schedule, which is cross referenced to the items in the Specification and shown on the Drawings.
- (2) Each item or system should be accompanied by manufacturer's complete specifications, technical data and installation instructions.
- (3) Each specification or technical data sheet shall be annotated as to specific item described, required or proposed. General or multiple-item sheets not so identified will be rejected.

4.3. Other Schedules

- (1) Equipment identification schedule
- (2) Valve tag schedule
- (3) Anti-vibration equipment schedule

4.4. Shop Drawings

Refer to para. 2.0 of Section 1165.

4.5. Material / Color Samples

Material / Color Samples shall be provided for primary materials, finishes or other components as and when requested by the Engineer.

4.6. Certification of Materials

Certification of Materials shall be provided from equipment or system manufacturers or from independent testing agencies employed by them indicating compliance with requirements of Specification herein for various items of equipment and system.

4.7. Certification of Installation

- (1) Required for all Mechanical Work;
- (2) Prepared by the Contractor or by independent testing agencies regularly providing test and inspection work of types required and as retained by the Contractor;
- (3) Reports shall be provided inclusive of information and / or data as specified under the mechanical testing requirements.

4.8. Operation and Maintenance Manuals

Refer to para. 16.0 of **Section 1165**.

4.9. Training of Employer's Personnel

- (1) The provisions of Section 1150 are applicable and are to be referred to in connection with 5000 series of the Specification.
- (2) The following provisions are additional to, and are to be read in conjunction with, Section 1150, and are particular to 5000 series of the Specification.
- (3) Local on Site training for operation and maintenance of some of the Mechanical Systems will be conducted by the Contractor covering the minimum required schedule shown below.
- (4) The Contractor shall include the cost of instruction for the trainees, together with training manuals and materials to be used in the courses, in his unit rates or lump sum prices, unless identified separately in the Bills of Quantities.
- (5) The minimum required schedule is

- (a) Section 5200 : Ventilation and Air Conditioning System:

VRF Unit and Automatic control system

Type of training : operation maintenance

No. of personnel : 4 4

Duration : 5 days 10 days

- (b) Section 5300: Fire Protection System

Type of training : operation maintenance

No. of personnel : 2 2

Duration : 1 day 5 days

4.10. Tools and Spare Parts

- (1) The provisions of para. 17.0 and para. 18.0 of Section 1165 are applicable and are to be referred to in connection with 6000 Series of the Specification.
- (2) The following provisions are additional to, and are to be read in conjunction with, paras. 17.0 and 18.0 of Section 1165, and are particular to the following mechanical equipment in the 5000 Series.
 - VRF Units
 - Fan Coil Units
 - Split Air Conditioners
 - Fresh Air Filter Units
 - Fans
 - Automatic Control System
 - Pumps
 - Solar Heater
 - Water Softener

- (a) The Contractor shall supply spare parts sufficient for two (2) years normal operation of equipment and systems. This two (2) year period commences after the issuance of Taking-over Certificate.
- (b) The Contractor shall assure the availability of the same type or substitutes of equal or better quality for at least ten (10) years after the issue of the Defects Liability Period.
- (c) The Contractor shall be responsible for the spare parts list recommended. This list shall be prepared by the Contractor and submitted to the Engineer within one hundred and twenty (120) days from the Commence Date. Thus during the Maintenance and Repair Period should any defect occur which would require replacement of parts other than the spare parts recommended by the manufacturer, the Contractor shall supply as soon as possible the needed spare parts at his own expense.
- (d) The quantity of spare parts shall be recommended by the manufacturer for the period stated in para 4.10 (2) (a) above. The recommended quantity shall be approved by the Engineer who shall have the right to reject the quantity offered.

5.0 RELATED REQUIREMENTS

5.1 Approvals

- (1) The Engineer shall be notified not less than ten (10) days in advance for each item of work being prepared for testing or inspection.
- (2) Rough-in work shall be inspected and approved by the Engineer prior to being covered, concealed or otherwise made inaccessible.

5.2 Precautions

- (1) When using any toxic, noxious or otherwise hazardous material, the Contractor shall follow and comply with the precautions of manufacturer.
- (2) Safety precautions regarding materials and installations shall be followed at all times to avoid damage or injury caused by fire or accident.

5.3 Protection

- (1) The work herein described shall be protected during construction and after completion.
- (2) Adjacent construction finishes shall be protected. Should adjacent exposed surfaces become stained or otherwise damaged resulting from use of materials or operations under this Section they shall be repaired at the Contractor's expense and as directed by the Engineer.

5.4 Maintenance Services

Refer to Section 1155.

5.5 As-built Drawings

Refer to paragraph 5.0 of Section 1165.

5.6. Valve Identifications

- (1) To be provided for all control and shut-off valves, except hose bibs.
- (2) Type shall be round or hexagonal, approximately 40mm size solid plastic plate with brass tie wire, permanently stamped or embossed with suitable name or number per approved schedule.
- (3) Number/name/function code schedule or name system schedule shall be developed and provided for all valves requiring tags.
- (4) A complete listing for valves and accompanying code identifications shall be provided and the systems shall be approved prior to ordering or fabrication of tags.

6.0 COORDINATION/ CORRELATION REQUIREMENTS

6.1. General

- (1) Utility rough-ins, including required tests, and other work to be covered up or concealed shall be completed and approved before such is enclosed or otherwise made inaccessible.
- (2) Power systems included in the scope of work of other Sections shall be tested and approved prior to connection to the systems in this Section.
- (3) Systems under this Section shall be completed, tested, and approved to ensure safety prior to utilization of said power sources.
- (4) The Contractor shall provide completely coordinated shop, coordination and working drawings in accordance with the requirements of paragraph 3.0 of Section 1165.

6.2. In Advance of Work under this Section

All work under this Section shall be coordinated with layouts and other requirements for associated work under other Sections and adjustments shall be incorporated as and where necessary for properly coordinated installations.

6.3. In Advance of Work under other Sections

- (1) Specific and proper construction or substrate conditions necessary to effect securely anchored or attached work included in other Sections shall be ensured by the Contractor.
- (2) Layouts, templates and/ or instructions shall be provided as necessary for proper preparation of supporting construction.

6.4. Embedded or Concealed Items

All necessary sleeves, inserts, bolts and backing plates, or other items to be embedded in concrete or masonry or attached to and concealed by work under other Sections shall be provided. They shall be supplied complete with layout plans, templates and/ or instructions as required.

6.5. Contract Drawings

- (1) Contract Drawings shall be examined as necessary to achieve fully coordinated and proper installation as intended herein.

- (2) Mechanical systems layout indicated are generally diagrammatic, and equipment layout is approximate only. Therefore the layouts and positions of conduits, outlets, equipment and other items to be coordinated with architectural and structural elements shall be determined and the necessities of work of other Sections identified.
- (3) The Engineer shall be notified of any discrepancies or deviations discovered in the Contract Documents.

7.0 SUPERVISION OF WORK

- 7.1.** Full-time services of experienced superintendents well qualified in directing and overseeing all phases of the various works under this Section shall be furnished.
- 7.2.** Services of manufacturer's representatives or other especially qualified persons as necessary shall be furnished to supervise mechanical system or equipment installations when regular full-time supervisors are not otherwise fully qualified.

8.0 OPERATION BEFORE FINAL ACCEPTANCE

- (1) Should the Employer require that any portion of building, Plant or equipment be operated prior to date of substantial completion, the Contractor shall consent, and such operation shall be under the supervision and direction of the Contractor.
- (2) These operations so required prior to substantial completion shall not be construed as nor constitute acceptance of work so operated.

9.0 CODES, STANDARDS AND REGULATIONS

In addition to the Codes and Standards listed in para. 10.0 of Section 1135 the design and installation of the systems and apparatus shall comply with the following codes, standards and regulations:

- (a) Fire Code of the Philippines
- (b) FM - Factory Mutual Inc.
- (c) LWUA - Local Water Utilities Administration Technical Standards
- (d) PSME - Philippine Society of Mechanical Engineers, Codes and Standards
- (e) PSSE - Philippine Society of Sanitary Engineers Code on Philippine Sanitation
- (f) The National Plumbing Code of the Philippines
- (g) UPC - Uniform Plumbing Code
- (h) ASHRAE - American Society of Heating, Refrigeration and Air-conditioning Engineers
- (i) ASME - American Society of Mechanical Engineers
- (j) ASTM - American Society for Testing and Materials
- (k) ARI - Air-conditioning and Refrigeration's Institute
- (l) NFPA - National Fire Protections Associations
- (m) SMACNA - Sheet Metal and Air-conditioning Contractors National Associations
- (n) CTI - Control Tower Institute

10.0 PRODUCT REQUIREMENTS

10.1. Mechanical Materials, Assemblies and Systems

- (1) Unless or except as shown, specified or approved, manufacturer's first quality line of standard and/or custom series of factory fabricated items shall be provided as shown or specified.

- (2) Comparable materials, assemblies and systems of manufacturers other than as specified may be proposed where differing in minor details only and otherwise compliant with requirements shown or specified, subject to prior approval by the Engineer.
- (3) Materials and equipment shown or specified shall be essentially standard catalog products of approved manufacturer, and variations therefrom shall be only as specified.
- (4) Where two (2) or more units of same class, type or kind are required, units shall be products of a single manufacturer.
- (5) Where a device or part of a piece of equipment is referred to in singular number, such reference shall apply to as many such devices or parts as are needed to complete work required.
- (6) Similar mechanical and electrical parts and components should be identical throughout each system and be readily interchangeable.
- (7) Mechanical equipment of similar type shall be designed, fabricated and supplied by a single manufacturer for all work included in this Section.
- (8) Substitutions of keyed locks not complying with specified requirements shall not be permitted.
- (9) Substantial increase in overall size(s) of pieces of equipment or major components shall not be permitted, unless approved in advance by the Engineer.

10.2. Fabrication/Construction Requirements

- (1) All products for work under this Section shall be designed, fabricated and constructed for purposes and uses intended, and in accordance with standards for mechanical work as specified herein.
- (2) Compliance shall be substantiated by sufficient and adequate prototype testing or otherwise, evidenced by such operational reports and data as may be required by the Engineer to fully demonstrate performance characteristics, operational qualities, reliability, safety and other relevant considerations.
- (3) All exposed pull and terminal boxes, panel boards and switchgear enclosures, including cabinet frames and bodies, fronts, doors and like parts, shall be cleaned, primed, finished with two (2) coats of gray enamel and baked, in accordance with approved manufacturer's standard factory processes.
- (4) Unless otherwise specified, materials shall be galvanized or otherwise protected by approved standard factory processes.
- (5) Special finishes shall be provided where shown or specified.
- (6) Requirements under other Sections of the mechanical work shall govern material requirements to the extent applicable and as follows:
 - (a) Piping and accessories, valves, meters and gauges;
 - (b) Pumps and tanks;
 - (c) VRF Units, fan coil units, split type air-cooled air conditioners, Fresh air filter units and fans;

- (d) Air ducts and insulations;

11.0 EXECUTION REQUIREMENTS

11.1 Prerequisite Conditions

- (1) Prior to work commencement, the following shall be required:
 - (a) All provisions shall be reviewed for/from other Sections, for requirements affecting this work;
 - (b) Details of work shall be reviewed with the Engineer and adjustments incorporated that are deemed necessary and as directed;
 - (c) Building shall be adequately enclosed and/ or protected for interior work; and
 - (d) For mechanical systems or other sensitive equipment or components, building shall be entirely enclosed and fully protected.
- (2) The work shall not proceed until ancillary work is in proper condition, per requirements specified herein and any incorrect construction conditions have been corrected and reinspected.
- (3) The Contractor shall ensure all installation work is carried out under the direct active supervision of persons who have adequate technical qualifications and experience, and that a sufficient number of trained personnel and adequate facilities are available to perform the installation.
- (4) When required by the Engineer the Contractor shall provide competent factory representatives to supervise the installation, start-up, test and adjustment of equipment, and to orient the Employer's personnel in the proper operation and maintenance of the equipment.

11.2 Completion Requirements

- (1) During construction the Contractor shall:
 - (a) Remove waste and debris resulting from the work in this Section as work progresses and on completion.
 - (b) Service and adjust moving or mechanical parts for smooth, quiet and proper operating condition.
 - (c) Touch-up abraded or damaged prime painting or galvanizing and leave clean and ready for finishing work required.
- (2) Upon completion the Contractor shall ensure the following:
 - (a) Exposed surfaces shall be clean and free from dust, dirt, scratches, dents, broken parts, misaligned or improperly fitted joints, stains, discoloration or other defects or damage.
 - (b) Installation shall be free from exposed fastenings, unnecessary cuts, holes, blank plates or advertising labels or signs other than as particularly shown, specified or approved.
 - (c) Exterior or below grade installations shall be watertight throughout and free from leaks or entry of water into or through interior or concealed spaces of the

structure.

- (d) Each item, unit or assembly shall be tightly and rigidly secured in place free from unnecessary movement, squeaks or rattles.
 - (e) Each item, unit or assembly shall be set straight, plumb and level, accurately positioned at locations required and adjacent similar units accurately aligned.
 - (f) Movable or mechanical items or devices shall be serviced and adjusted to operate smoothly, quietly, easily and free from binding or superfluous or unwanted noises.
 - (g) Electrical devices, assemblies or systems shall be properly connected and grounded and operating in compliance with the performance requirements and tested as specified.
- (3) Mechanical work not in compliance shall be repaired or replaced as directed or required by the Engineer at the expense of the Contractor.

11.3. Collateral Work Requirements

Collateral work listed below shall be provided and included as part of the work associated with this Section:

- (a) Excavation - refer to **Sub-Section 2130 and 4110**
- (b) Concrete - refer to **Section 1400**
- (c) Structural steel - refer to **Sub-Section 4230**
- (d) Sealant work - refer to **Sub-Section 4320**
- (e) Aluminum works - refer to **Sub-Section 4350**
- (f) Galvanizing requirements - refer to **Sub-Section 4350**

11.4. Detailed Coordination

- (1) Provisions herein are in addition to para. 5.0 of this Section.
- (2) Work under this Section further includes coordination of and with works under other Sections, to provide and affect complete and operable systems and equipment throughout the Works as required under the Contract Documents.
- (3) Coordination includes, among others, considerations of location, size, capacities and performance characteristics of equipment furnished and installed under other Sections.
- (4) Coordination further includes providing adjustments in this Section of work to meet needs of said equipment and cooperation with other subcontractors as necessary to make determinations required.
- (5) Minor adjustments shall be provided as and where necessary or directed by the Engineer at no additional cost to the Employer.
- (6) The Drawings shall be reviewed for openings and access provisions to be provided for the mechanical work. The sizes and locations shall be verified that they are adequate and proper and additional openings shall be arranged where and as may be required.

- (7) The Drawings of utilities serving systems in this Section shall be reviewed. The sizes, capacities and locations shall be verified that they are adequate for proper systems. Installations shall be adjusted as required to correlate with utility service connection points and types of connections necessary.
- (8) The Drawings of electrical services and facilities to be provided for this Section shall be reviewed. The precise electrical needs, power requirements and electrical characteristics for this Section shall be determined and compared and verified with the provisions of the Contract Documents. Drawings, diagrams or other information necessary relative to the mechanical work shall be provided by the Contractor and additional service, outlets or connections provided where and as may be required.
- (9) Electrical characteristics of this Section shall be as follows:
 - (a) Power
 - Single phase, 100V, 60Hz. and A.C.
 - Single phase, 230V, 60Hz. and A.C.
 - 3 phase, 230V, 60Hz and A.C.
 - (b) Control
 - Single phase, 230V, 60Hz. and A.C.
 - (c) Lighting
 - Single phase, 230V, 60Hz. and A.C.
 - (d) Emergency circuits shall be as follows:
 - (i) Power
 - Single phase, 230V, 60Hz. and A.C.;
 - 3 phase, 230V, 60Hz and A.C.
 - (ii) Lighting
 - Single phase, 230V, 60Hz. and A.C.

11.5. Protective Painting

- (1) Protective painting is required for materials, Plant and equipment not otherwise galvanized, pre-finished, protected or included for field painting under this Section and includes all locations, whether exposed or concealed in completed work.
- (2) Surfaces to be painted shall be cleaned free from dirt, dust, rust, grease or foreign matter. They shall be thoroughly wiped clean, using suitable solvent where necessary.
- (3) Surfaces shall be primed and undercoated with rust inhibitive metal primer.
- (4) Finish painting shall be high gloss enamelled or stove enamelled as appropriate.
- (5) For concealed secondary or support surfaces black asphalt type paint shall be applied.
- (6) Anti-corrosive painting is required for the following and shall be two (2) coats, unless otherwise specified:

- (a) Black iron or steel items inaccessible after installation;
- (b) Steel pipe, including valves and other accessories within 7 days following installation; and
- (c) Hanger rods and devices and other items not galvanized.

11.6. Cutting and Patching

All necessary holes, accesses and supports shall be provided wherever necessary and where prior arrangements therefore have not been otherwise provided including any and all cutting and removal, sleeves, frames, escutcheons or other accessories required, replacements, repairs and patching, sealing with fireproof material cleaning and refinishing, and other work as may be required to make good. All work to be approved by the Engineer.

12.0 HANGERS, ANCHORS ETC.

12.1. General

- (1) Types of hangers, anchors, fixing etc. shall be appropriate for materials and conditions encountered and only as shown, specified or approved. The sizes shall be adequate for loads and forces involved.
- (2) Power-actuated types in lieu of removable mechanical fastenings shall not be permitted, unless otherwise shown or approved.
- (3) Inserts of carbon steel to hold hangers and supports shall be placed prior to concrete pouring on slab, beam and columns, in order to protect reinforcing bars, embedded pipes, etc.
- (4) Cutting or welding to structure for support shall be permitted only as and where shown, specified or approved for each specific condition or location.
- (5) Supporting piping or equipment by attaching directly to metal shall not be permitted.
- (6) Steel items throughout shall be hot-dip galvanized or corrosion resistant painted, plated or treated by approved methods.

12.2. Continuous Supports

- (1) Continuous supports shall be manufacturer's standard prefabricated type of C-channel, roll formed from steel strip of thickness not less than 2.5mm, in standard length units for minimum of splices. The type shall be complete with matching splice covers, insert devices suitable for hanger rods, etc. that are required to be supported.
- (2) They shall be secured to overhead concrete using unit anchors as specified hereinafter, set through pre-punched holes in C-channel webs, spaced at not over 200mm from each end channel unit and at not more than 600mm centers in between.

12.3. Unit Anchors

- (1) Unit anchors shall be manufacturer's standard type of steel insert bolts designed for use in hardened concrete with pre-tested and pre-determined load values and in various types and sizes suitable for varying installation requirements. Each unit shall be selected in accordance with manufacturer's certified load carrying capacity tables as approved.
- (2) Each unit shall be selected to safely support work required and when under full load

conditions, and as appropriate for strength or conditions of concrete to which attachment is being made.

- (3) The selection shall be determined using factor of safety not less than 5 times actual or real load to be supported.
- (4) In any and all cases, bolt shank diameter shall not be less than 15mm.

12.4. Other Connections

- (a) Heavy items to steel framing
Machine bolts, nuts and washer set through drilled holes.
- (b) Light items to steel framing
Machine screws set into drilled and tapped holes or set through drilled holes with nuts and washers.
- (c) Light items to sheet metal
Headed fasteners with threads designed for sheet metal work, self-drilling, self-tapping.
- (d) Sizes
Appropriate for load to be supported and as approved.

12.5. Attachments not permitted

- (a) Wood blocking embedded in concrete.
- (b) Wood, fiber, plastic or lead type inserts.

13.0 EQUIPMENT REQUIREMENTS

13.1. Wiring Diagrams

- (1) Wiring diagrams are required for all motors and controls and for each mechanical system included under the mechanical work. They shall be provided singularly, where practical, or in sets as necessary to clearly portray all relevant connections and interconnections. All sheets shall be in one (1) uniform size.
- (2) Complete sets of wiring diagrams shall be included with the Operation and Maintenance Manuals.
- (3) In addition, complete sets of all diagrams shall be provided for permanent wall mounting for each type or group of diagrams located in different locations as directed by the Engineer. Each shall be provided with cover of clear plastic in thickness not less than 3.0mm for diagram sizes 400mm x 400mm and larger, 1.5mm for smaller sizes retained in neatly fabricated aluminium frame secured to wall using matching screws.

13.2. Lubrication Requirements

- (1) Lubrication facilities shall be provided for all parts involving friction and wear other than where suitably covered or protected by resilient materials or where provided with

lifetime packing or fittings.

- (2) All necessary grease fittings, oiling caps or other like facilities as required shall be included to maintain equipment properly protected and with all like items essentially identical and serviceable using same lubrication tools throughout.
- (3) Lubrication facilities shall be located where readily visible and easily accessible.
- (4) Lubrication tools shall be required as follows:
 - (a) One (1) complete set for each type; and
 - (b) Set of hand tools of suitable types and adequate sizes contained in suitable box or panel.
- (5) Removable units shall be securely supported and fastened in place constructed using wire mesh in steel angle or flat bar frames each mechanically secured into place against accidental removal. Wire mesh shall be woven, galvanized steel wire not less than 1.4mm, mesh size not larger than 7.0mm by 7.0mm.

14.0 ANTI-VIBRATION BASE AND HANGERS

14.1. General Requirements

- (1) Anti-vibration bases and hangers are required for work and equipment as shown or specified.
- (2) Types and specifications and products or standard prototypes shall be of one (1) manufacturer regularly providing items of the type required.
- (3) The bases shall be secured to supporting construction using bolts with sound-deadening grommets.
- (4) Vibration absorption factor shall be 95% as minimum.

14.2. Submissions

Complete design data shall be submitted for supplementary bases and isolators, including spring diameter, size and constant values of free, operating and solid heights of springs and isolation efficiency all complete and together with the shop drawings.

14.3. Springs

- (1) Minimum static deflection shall be as specified, with additional travel of 25% between design height and solid height.
- (2) Spring diameters shall not be less than compressed spring height.
- (3) Lateral spring constant shall be equal to vertical spring constant.
- (4) Surfaces exposed to exterior shall be neoprene coated.

15.0 PIPING AND ACCESSORIES

15.1. Materials

- (1) Materials required and not otherwise specified herein shall be provided in accordance with applicable requirements of other Sections of the Specifications and the Drawings.

- (2) Pipes, fittings, and accessories to be described hereafter shall be of a first quality standard series or product lines of manufacturers regularly providing items of the type required.
- (3) Piping accessories components of kind, type and size shall be produced by a single manufacturer for all work included in this scope of Work.
- (4) Polyvinyl chloride pipe (for cold water supply lines) shall comply with:
Pipe: JIS K 6742 (VP)
Fittings: JIS K 6743
- (5) Polyvinyl chloride pipe (for soil, waste water, kitchen waste, underground storm water drainage and condensate drain piping) shall comply with:
Pipe: JIS K 6741 (VP)
Fittings: JIS K 6739
- (6) Polyvinyl chloride pipe (for aboveground sanitary vent) shall comply with:
Pipe: JIS K 6741 (VU)
Fittings: JIS K 6739
- (7) Galvanized carbon steel pipe (for aboveground storm water drainage piping) shall comply with:
Pipe: JIS G 3452 SGP-ZN
Fittings to be as follows:
 - (a) Screwed type malleable cast iron pipe fittings – JIS B 2301;
 - (b) Steel butt-welding pipe fittings for ordinary use – JIS B 2311;
 - (c) Steel welding pipe flanges- JIS B 2220; and
 - (d) Zinc hot dip galvanizing – JIS H 8641 or equivalent.
- (8) Carbon Steel Pipe (for fire protection systems) shall be comply with:
Pipe: ASTM A 53
Fittings: ASTM A 74
- (9) Seamless galvanized carbon steel pipe (for FM-200 gas fire protection system) shall comply with:
Pipe: ASTM A 53
Fittings: ASTM A 123/A 123M-09 Zinc coated
- (10) Copper pipe (for hot water lines and refrigerant piping) shall comply with:
Pipe: ASTM B 88-03, L type
Fittings: ASTM D1598-97
- (11) Pipe hanger shall be specifically designed units for purpose intended as approved by the Engineer and in accordance with specified requirements.

(a) Rods

Solid steel sizes not less than as follows:

Supported pipe (mm)	Rod diameter (mm)
80 and smaller	9
100 through 125	13
150 and larger	16

(b) Support capacity requirements

Not less than 5 time the actual loading capacity resulting from total weight of pipe when filled with water. This shall apply to entire hanger assembly, including connections or fastenings to structures.

Rod or connection sizes shall be increased where necessary to meet these requirements.

(c) Support capacity requirements

Not less than 5 times the actual loading capacity resulting from total weight of pipe when filled with water. This shall apply to entire hanger assembly, including connections or fastenings to structures.

Rod or connection sizes shall be increased where necessary to meet these requirements

(d) Supporting multiple pipes

Hanger rod shall be 16mm or greater.

Width not exceeding 1.2m

Spacing between hangers not exceeding 2m

(e) Steel parts

Hot dip galvanized or painted or as indicated in the Drawings or as instructed by the Engineer.

(12) Anti-corrosive coverings shall be applied to underground steel pipes.

(a) Material

(i) Anti-corrosive tape: 1.1mm thick petrolatum tape (JIS Z 1902)

(ii) Anti-corrosive sheet: shall consist of anti-corrosive layer of transformed petrolatum and non-vulcanized rubber sheet; 4 mm minimum overall thickness.

(iii) Primer: petrolatum anti-corrosion paste (JIS Z 1903)

(iv) Plastic tape: 0.4mm thick polyethylene film with self-conglutinant adhesive

(b) Work procedure

- (i) Removal of oils, dirt, dust, other foreign material
 - (ii) Primer
 - (iii) Anti-corrosive tape; half lapping
 - (iv) Plastic tape: half lapping
 - (v) Around joints and fittings: petrolatum filler, anti-corrosive sheet, and then plastic tape (half lapping)
- (13) Other materials and accessories
- (a) Material
 - (i) Rubber

Durable and suited for pressure, temperature and water characteristics of work as required
 - (ii) Liquid

Synthetic rubber compound specially formulated for service intended.
 - (b) Sealing tape

For threaded connections, Teflon tape suitable for temperatures ranging from minus 50 °C to 180 °C.
 - (c) Welding rods

JIS Z 3211, JIS approval marked on containers.
 - (d) Solder

Tin and silver (Sn-Ag) alloy 220 ° C melting points.
 - (e) Adhesive

For polyvinyl chloride pipe, polyvinyl chloride resin in solvent specifically formulated for use with specified pipe.
 - (f) Special neoprene fittings

As shown on Drawings, for connections between vitreous china fixtures and drainpipe.
 - (g) Flexible joints
 - (i) General

Synthetic rubber combined with reinforcement inside diameter same as pipe, conforming to specified requirements.
 - (ii) Rubber

Tensile strength: not less than 10 kg/cm².

Elongation: not less than 104%
Reinforcing: cotton fabric for rubber hose conforming to JIS L 2512

(iii) Stainless Steel

Tensile strength: not less than 40 kg/cm².
Elongation: +2% to - 3%.
Reinforcing stainless steel blade for stainless steel below conforming to JIS G 4305

(iv) Flanged ends

JIS B 2210 or equivalent

15.2. Pipe Joints and Connections

- (1) When removal may be required after installation, flanged joints shall be used except for copper tube or pipe as follows:
 - (a) 32mm or smaller; flared joints; and
 - (b) 38mm and larger; flanged joints
- (2) Elsewhere joints shall be as follows:
 - (a) Carbon steel pipe
65mm or smaller; screwed;
80mm and larger; welded;
 - (b) Galvanized steel pipe, PVC lined galvanized steel pipe
65mm or smaller; screwed;
80mm and larger; flanged or screwed;
 - (c) PVC pipe: elastomeric neoprene "O" ring or solvent cement or welded joints;
and
 - (d) Copper tube or pipe: push-in capillary soldered joints.
- (3) Joints between copper and steel pipe shall be dielectric flanges or unions.
- (4) Cutting and jointing of pipe shall be as follows:
 - (a) Pipe and tubing shall be cut by power hacksaw, circular cutting machine with abrasive wheel, hand hacksaw or square end sawing vice only. Metallic wheel cutters shall not be permitted.
 - (b) Rough edges and burrs shall be removed from inside and outside surfaces. Inside edges shall be reamed smooth and to net free bore size.
 - (c) During period work is not in progress, pipe, fitting and valve ends shall be shut against entry of foreign matter.
- (5) Screwed pipe joints shall be executed as follows:
 - (a) Joint compound or tape shall be applied uniformly and smoothly on male

screw only. Compounds or tape applied into fittings shall not be permitted.

- (b) Joints shall be securely tightened and free of leakage using suitable tongs or wrenches. Use of Stiltson or other sharp toothed wrenches for non-ferrous pipe work shall not be permitted.
 - (c) Leaky joints shall be disassembled, cleaned and remade using new materials only. Screw cement or caulking to remake joints shall not be permitted.
- (6) Flanged joints shall be executed as follows:
- (a) Gasket is required between all flanges.
 - (b) Bolts shall be tightened evenly around flange to maintain even pressure on gasket.
- (7) Welded joints shall be executed as follows:
- (a) Unless specified otherwise, all steel pipes may be joined by welding.
 - (b) Welding procedure shall be approved by the Engineer.
 - (c) After welding all welded areas shall be cleaned and prime painted using non-organic zinc paint or equivalent approved.
- (8) Copper tubing joints shall be executed as follows:
- In constructing push –in type joints for outside of pipe and inside of fitting it shall be thoroughly cleaned and, after pressing together, all parts evenly heated to promote full flow or solder into all parts of joint.
- (9) PVC pipe joints shall be executed as follows:
- Preparation and installation of pipe and fitting to be as manufacturer’s instructions, performed only by workmen well experienced in techniques of welding PVC materials of the types required.

15.3. Pipework Installation

- (1) Piping, components and accessories shall be installed as per manufacturer’s instructions, per approved shop drawings.
- (2) Piping and related work shall be pre-planned and pre-arranged and coordinated with work of other trades as necessary and as specified.
- (3) Coordination shall be made to avoid modifications, changes, and adjustments in layouts, routings and positions and to provide complete and properly operating piping systems as intended under this Specification.
- (4) Piping shall be installed in chases or recesses in walls where provided, through openings in floors, and in ceilings; exposed pipes shall be permitted only where approved in advance. Piping shall not be run in floor fill, unless otherwise shown on the Drawings.
- (5) Piping systems shall be installed parallel to walls to present neat appearance in both workmanship and grouping.
- (6) Piping shall be installed free of traps or unnecessary bends and shall be arranged to

conform to building requirements and to suit necessities of clearance for equipment ducts, flues, conduits or other work including due allowance for access, maintenance and servicing.

- (7) Provision shall be made for drainage of lines and elimination of air where shown and at additional points as required.
- (8) Piping shall be installed as soon as possible following trenching or excavation. Special consideration will be required to provide anti-corrosive covering for underground piping work.
- (9) No piping shall be permanently closed up, boxed in or covered before approval of the Engineer or before all necessary tests have been made and defects corrected.
- (10) Ends of pipe shall be capped or plugged immediately after installation to prevent entrance of foreign matter, and left in place until removal is necessary for completion of installation.
- (11) Each piping system shall be thoroughly flushed until proven clean before connecting to apparatus.
- (12) Each piece of pipe and each fitting shall be inspected carefully for defective workmanship on, or obstructions in pipes and fittings.
- (13) Exposed polished or enamelled connections from fixtures or equipment shall be installed with special care, showing no toll marks or threads at fittings.
- (14) Pipes shall be protected against transmitting sounds by using various absorbing elements with supports and hangers.
- (15) Upon completion, inside of pipe shall be thoroughly cleaned free from foreign matter.
- (16) Thrust blocks shall be provided as follows:
 - (a) They are required for water mains below grade at changes in direction and at branch take – off 50 mm and larger.
 - (b) They shall formed using concrete placed to entirely fill space required between pipe and trench and sized sufficient to adequately resist thrusts created by maximum internal water pressure. Refer to Section 1400 for concrete specifications.
- (17) Provisions for expansion shall be as follows:
 - (a) The pipelines shall be arranged and anchored as required to evenly distribute stress and strain.
 - (b) Swing joints or expansion loops shall be provided wherever shown and required.
 - (c) Underground pipe anchors shall be steel plates welded to pipe and encased in concrete.
- (18) Reducers shall be provided as follows:
 - (a) They are required where any pipe changes in size.
 - (b) Eccentric type where free line drainage is required.

- (c) Bushings shall not be permitted
- (19) Unions shall not be used. Generally flange or socket type joints shall be used. Flanges for PVC pipe shall be socket type, molded PVC, 10 kg/cm² class. Elsewhere, type shall be suitable for system and location required. Each item shall be positioned for easy removal of adjacent equipment, tank, or valve. They shall be located where shown and as follows:
- (a) At each connection to all equipment and tanks;
 - (b) All connections to all automatic valves, such as temperature control valves;
 - (c) Downstream from each manually operated screwed valve; gate, globe or check; and
 - (d) Elsewhere where necessary to facilitate assembly of piping or installation of equipment.
- (20) Cold water piping shall be installed as follows:
- (a) Generally level and free from traps or unnecessary bends or offsets.
 - (b) Pipe work laid in a common trench with sewer lines shall be wrapped with anti-corrosive tape and shall also be:
 - (i) Permitted only when approved in advance;
 - (ii) Bottom of water line shall be not less than 500mm above top of the sewer line at any point along common run;
 - (iii) Not less than 500mm horizontally between common trench lines; and
 - (iv) Bottom of water line shall be supported on excavated shelf to one (1) side of trench, width not less than pipe size plus 200mm.
 - (v) Approved type of marker shall be installed above corner of underground pipe.
 - (vi) Pipe indicating tape of vinyl or aluminium shall be laid above underground pipe and approximately 150mm below finished grade.
 - (c) A connection to utilities works water distribution line flange with gate valve shall be made at location shown on the Drawings.
- (21) Hot water piping shall be installed as follows:
- Grade up to high point shall be at rate of 6mm per 3 m of run in direction of flow, with returns grading down at same rate.
- (22) Soil, waste and drain piping shall be installed as follows:
- (a) Horizontal sanitary and storm drain piping shall be graded uniformly inside building at 6mm per 300mm for pipe smaller than 75mm and 3mm per 300mm for pipe 75mm and larger, unless otherwise shown on the Drawings.
 - (b) Sewer piping shall be run as straight as possible. Changes in direction shall be made as shown or required using standard offset fittings only and as approved

for the various locations required.

- (23) PVC piping shall be installed as follows:
 - (a) Make-up and installation shall be as per manufacturer's instructions.
 - (b) Runs shall be straight and uniformly graded.
 - (c) Installation shall be arranged to be free from unnecessary stresses on pipe or fittings.
 - (d) Provisions shall be incorporated to compensate for expansion and contraction as required.

15.4. Pipe Hangers and Supports

- (1) The provisions below are not to be read in conjunction with paragraphs 12.0 and 15.1(ii) of this Section.
- (2) Adequate and sufficient hangers and supports are required throughout for all piping above grade.
- (3) Piping or equipment supported by wire, plumber's tape, rope or other means or arrangements other than as specified shall not be permitted.
- (4) Support components and fastenings shall be sized to adequately resist forces and stresses developed under full capacity loadings, including dead loads and reaction forces under full operation, and including weight of fluids conveyed and seismic considerations.
- (5) Pipe or equipment supported by valves or other line accessories shall not be permitted.
- (6) Vertical piping shall be supported as follows:
 - (a) Risers: clamps with extended arms to rest at least on each floor.
 - (b) Copper pipe or tubing: clamps with rubber liner.
 - (c) All pipes: secure to lowest floor and every third floor above.
 - (d) Vinyl pipe: secure at one (1) or more places at each floor.
- (7) Horizontal piping shall be supported as follows:
 - (a) Pipes shall be attached to or supported from structure using hangers and devices as specified or approved.
 - (b) Supports spacing shown or specified are the maximum permitted.
 - (c) In addition, at changes of direction in either vertical or horizontal plane, a support device shall be provided near change point. However it may be omitted when coincidental with required standard spacing location.
- (8) Hanger spacing shall be as the following Table 5050.1.

Table 5050.1 Hanger Spacing

Type of Pipe	Size of Pipe			
	20mm diameter or less	25 to 40mm diameter	50 to 80mm diameter	100mm dia. or more
Steel Pipe	1.8 m	2.0 m	3.0 m	4.0 m
Copper Tubing	1.5 m	2.0 m	2.5 m	2.5m
PVC Pipe	1.0 m	1.2 m	1.5 m	1.5 m

- (9) Locknuts shall be provided for each threaded connection on hanger rods.
- (10) Low temperature pipe insulation shall be required for refrigerant lines at points of support between pipe and hanger using method specified and approved.
- (11) Copper pipe and tubing isolation shall be required for each point of contact with hangers or other ferrous materials. Polyvinyl, pressure-sensitive adhesive tape, 75mm wide, thickness not less than 0.025mm, double- wrapped at each required location shall be provided. The tape shall be standard product specifically designed for purposes intended.

15.5. Pipe Sleeves and Escutcheons

- (1) Pipe sleeves shall be provided where the pipe passes through concrete floors, walls, columns, beams and concrete hollow block wall, and shall be of sufficient size to allow for required packing and sealant and for free movement of pipe, including allowance for insulation where required.
- (2) In floor slabs, beams and walls below ground level permanent sleeves shall be of PVC pipe or galvanized steel pipe; shall be finished flush in wall and extend to a minimum of 50mm above floor slabs; space between pipe and sleeve shall be sealed with oakum and mastic sealant and made positively watertight.
- (3) In other locations sleeves shall be prefabricated expandable type or field made to size required, galvanized sheet steel in thickness not less than 0.7mm.
- (4) In concrete, they shall be removed after form removal and before installing pipe (except galvanized steel pipe sleeves).
- (5) Through fire-rated construction, the sleeve shall be packed using approved incombustible packing and sealing materials.
- (6) Escutcheons shall be required for pipe passing through floors, walls and ceilings in all interior spaces, whether or not pipe is insulated. Typical sizes shall be by standard type split-escutcheon with either spring or setscrew clamping. Over-sizes shall be fabricated to size required using sheet metal, secured using matching screws of type required. Finishes in toilet and shower rooms, kitchens and other wet areas shall be polished chrome plated, elsewhere prime painted steel.
- (7) For pipes through concrete fire wall and floor slabs, penetration space shall be filled using rock wool or other approved incombustible material. Where required to be watertight, penetration space shall be filled using suitable backup material and seal using sealant as approved.

15.6. Piping Identification

- (1) Piping systems under this Section shall be identified by using colored stencilled legends or pre-printed labels as specified, including flow direction arrows.
- (2) Piping shall be cleaned and completely painted prior to application.

- (3) The legend and flow at valve locations shall be applied at points where piping enters or leaves walls, partitions, bulkheads, clusters of piping or similar obstruction and at 6m intervals on pipe runs.
- (4) Wherever two (2) or more pipes run parallel, printed legend and other markings shall be applied in same relative location so as to be in either vertical or horizontal alignments.
- (5) Paint shall be prepared enamel brushed on or sprayed from pressurized cans, in colors and approved hues per schedule herein, uniform throughout.
- (6) Where pipe marking colors are not easily visible over background, (e.g. brown on soil pipe, orange on copper pipe, or similar such combinations), a neat white or aluminium colored background shall be painted on pipe before markings are applied.
- (7) Pre-printed marking shall be pressure-sensitive adhesive backed cloth labels with black letters and arrows in sizes scheduled, backgrounds in colors scheduled as below.

Table 5050.2 Schedule of Lettering

Outside diameter of pipe or covering (mm)	Size of stencil letter (mm)	Minimum length of flow arrow (mm)
20 to 40 incl.	12	60
50 to 100 incl.	25	100
125 to 175 incl.	50	125
200 and larger	75	150

Table 5050.3 Schedule of Marking and Identification Color

Pipe Line	Letter Sign	Identification Color
Cold water supply	CW	Green
Hot water supply	HW	Yellow
Sanitary sewer	S	Brown
Storm water drain	DRN	Brown
Sanitary vent	VNT	Brown
Refrigerant	R	Blue
Fire water	FW	Red
Gas fire-protection	FM	Red

16.0 VALVES

16.1. Scope

This Section covers the following items;

- (a) Gate valves
- (b) Globe valves
- (c) Angle valves
- (d) Swing check valves
- (e) Hammerless check valve with spring
- (f) Strainers
- (g) Butterfly valves

- (h) Ball valves
- (i) Cock valves
- (j) Ball taps
- (k) Valve boxes

16.2. Products Requirements

- (1) Reused or reconditioned or rebuilt valves shall not be permitted.
- (2) Valves shall be of first quality of standard series of lines of products from manufacturers regularly providing items of types required.
- (3) All valves of like kind, type and size shall be products of a single manufacturer throughout for work under this Section with like units and like parts and readily interchangeable. Section 5100 of the Specification, the Drawings and Bills of Quantities shall be referred for the applicability of each type of valves.
- (4) Type of connections shall be as follows:
 - (a) Valves 50mm diameter or smaller – screw ends; and
 - (b) Valves 65mm diameter and larger – flanged ends;
- (5) Gate valves shall be as follows:
 - (a) Type
Inside screw (bronze valve) or inside screw and yoke. Outside screw and yoke for fire protection.
 - (b) Materials
50mm Diameter and smaller: bronze body and trim.
65mm Diameter and larger: cast-iron body and bronze trim.
 - (c) Pressure rating
5 kg/cm² or 75 psi
10 kg/cm² or 150 psi
10 kg/cm² or 150 psi, UL and/or FM rated for fire protection
 - (d) Applicable standard
Screwed ends to meet JIS B 2011
Flanged ends to meet JIS B 2031
- (6) Globe valves shall be as follows:
 - (a) Type
Outside screw or outside screw and yoke
 - (b) Materials
50mm Diameter and smaller: bronze body and trim.

- 65mm Diameter and larger: cast-iron body and bronze trim.
- (c) Pressure rating
 - 5 kg/cm² or 75 psi
 - 10 kg/cm² or 150 psi
 - (d) Applicable standard
 - Screwed ends to meet JIS B 2011
 - Flanged ends to meet JIS B 2031
- (7) Angle valves shall be as follows:
- (a) Type
 - Outside screw
 - (b) Materials
 - 50mm Diameter and smaller: bronze body and trim.
 - 65mm Diameter and larger: cast-iron body and bronze trim
- (8) Swing check valves shall be as follows:
- (a) Type
 - Solid seat or renewable seat top covered. Rubber seated for fire protection.
 - (b) Materials
 - 50mm Diameter and smaller: bronze body and trim.
 - 65mm Diameter and larger: cast-iron body and bronze trim
 - (c) Pressure Rating
 - 10 kg/cm² or 150 psi
 - 10 kg/cm² or 150 psi, UL and/or FM rated for fire protection
 - (d) Applicable Standard
 - Screwed ends to meet JIS B 2011
 - Flanged ends to meet JIS B 2031
- (9) Hammerless check valves with spring shall be as follows:
- (a) Type
 - Inside screw bronze valve or inside screw and yoke
 - (b) Materials
 - 50mm Diameter and smaller: bronze body and trim.
 - 65mm Diameter and larger: cast-iron body and bronze trim
 - (c) Pressure rating

- 5 kg/cm² or 75 psi.
 - 10 kg/cm² or 150 psi.
- (d) Applicable standard
 - Screwed ends: JIS B 2011
 - Flanged ends: Per manufacturer's standard
- (10) Strainers shall be as follows:
 - (a) 50mm and smaller
 - Screw type, cast-iron or bronze, Y-shape.
 - (b) Larger than 50mm
 - Flange type, cast-iron or stainless steel, Y-shape or bucket type. All moving parts brass or bronze and remainder of unit corrosion resistant material or coated for protection as approved.
 - (c) Strainer plugs
 - Brass and bolted cast-iron cover for bucket type.
 - (d) Strainer screen
 - Stainless steel mesh or brass mesh
 - (e) Strainer to be connected to vinyl lined galvanized steel pipe
 - To be lined by nylon 11 or 12.
- (11) Butterfly valves shall meet the requirements to JIS B2064
- (12) Ball valves shall be long neck type when to be used for insulating pipe, as per manufacturer's standard.
- (13) Cock valves shall be the requirements of JIS B 2191
- (14) Ball taps (to be supplied and installed not as a part of sanitary fixtures, etc.) shall be as follows:
 - (a) Bronze with ball of brazed copper.
 - (b) Anti-water hammer type
 - (c) Fitting: 50mm diameter or less: threaded
65mm diameter more: flanged
 - (d) Tap: 20mm diameter or less: single/simplex
25mm diameter or more: multiple/duplex
 - (e) Connected to level regulating valve
- (15) Valve Boxes
 - (a) Shall be provided to all service valves in toilet, kitchen and kitchenette inside

buildings, outdoor valves such as garden hose valves, main service gate valves, and valves to be installed outside of RC water reservoir tanks;

- (b) Valve boxes to be installed outside of RC water reservoir tank shall be equipped with weatherproof lock sets;
- (c) Valve boxes inside buildings: shall be stainless steel SUS 304, 0.8mm thick embedded to wall with identification logo;
- (d) Valve boxes outside buildings: shall be cast iron with paint coated (HASS 209), molded identification logo;
- (e) Valves to be set much below finished grade level shall be equipped with round type valve box cover at 80 or 125mm diameter, galvanized extension pipe and galvanized valve protection pipe or box. Valve box cover shall be of cast iron with paint coated (HASS 209), molded identification logo. The Contractor shall hand over valve operation rod of galvanized steel to the Employer.

16.3. Execution

Valve components and accessories shall be installed as per manufacturers' instructions and approved shop drawings.

17.0 METERS AND GAUGES

17.1. Scope

This Section includes the following items:

- (a) Water meters;
- (b) Pressure and compound gauges;
- (c) Thermometers;
- (d) Water level sensor (electrode); and
- (e) Related work.

17.2. Product Requirements

- (1) Meters and gauges shall be of first quality of standard series or lines or products from manufacturers regularly providing items of types required.
- (2) Water meters shall be of the following types:
 - (a) For 13mm diameter wheel – single jet, wet dial, flat type; and
 - (b) For 20mm diameter to 40mm diameter wheel – double jet, wet dial, flat type and with inverse type current water volume dial indicators.
- (3) Pressure and compound gauges shall be as follows:
 - (a) Outside diameter shall be 100mm and equipped with a cock.
 - (b) Scale shall indicate working pressure of system, highest scale shall indicate 150% to 300% of working pressure.
 - (c) Vacuum scale of compound gauge shall be 760mm hg (0.1M Pa).

- (d) Applicable standards shall be JIS B 7505 or equivalent
- (4) Thermometers shall be glass made immersion type, L shape, with brass or bronze protection for sensing bulb, direct reading –10 to 50 degree Celsius range, conforming to JIS B 7411 or equal as approved by the Engineer.
- (5) Electrodes shall be rod steel of stainless steel (SUS 304), and shall consist of hanger/support/holder/spaces of synthetic resins, and shall be protected by PVC pipes when to be used in sewage tank.

17.3. Execution

- (1) Meters and gauges and related accessories shall be installed as per manufacturer's instructions and approved shop drawings.
- (2) Thermometer shall be installed at location clearly legible at eye level.
- (3) Pressure gauges shall be installed as required at pump suction and discharge line.

18.0 FIELD TEST AND INSPECTION

18.1. General

- (1) The provisions of Section 1145 are applicable and are to be referred in connection with 5000 series of this Specification.
- (2) The following provisions are additional to, and are to be read in conjunction with, Section 1145, and are particular to 5000 series of this Specification.
- (3) Materials, equipment, and the completed installation will be inspected by the Engineer.
- (4) All equipment, materials, or work rejected because of defects or nonconformance with the Drawings and the Specification shall be replaced or corrected by the Contractor as directed at no additional cost.

18.2. Scope of Testing

- (1) Upon completion and prior to acceptance of the installations, the Contractor shall subject the units to operating tests to demonstrate satisfactory functional and operational efficiency.
- (2) The Contractor shall furnish all materials, instruments, equipment and test personnel required for tests.

18.3. Test Requirements

- (1) Each mechanical system shall prove satisfactory and acceptable in accordance with requirements throughout and under the Contract Documents.
- (2) In addition to requirements herein, tests shall be concluded as work progresses as required elsewhere under this Specification.
- (3) Testing required herein shall be performed in the presence of the Engineer, and schedules duly arranged for in advance in accord with notification requirements.
- (4) Sufficiently qualified personnel, time, materials and fuel shall be allotted and provided by the Contractor as necessary to provide and conduct all required tests.

- (5) Upon completion of electrical equipment (panel board, motor, control equipment, etc.) the Contractor shall not operate any equipment without the express approval of the Engineer.

18.4. Test Programs

- (1) Quality and commissioning test shall be carried out and conducted per programs as prepared and issued by the Contractor and approved by the Engineer.
- (2) Test programs shall also include such forms as deem necessary by the Engineer, which the Contractor shall utilize and execute accordingly and as applicable to the various kinds of work to be tested.
- (3) Tests required shall be completed on schedule for activation of mechanical systems as required in accordance with this Section.

18.5. Tests Reports and Records

- (1) Forms to be issued by the Engineer shall be devised by the Contractor with appropriate information and data to be recorded.
- (2) Within 14 days after completion of testing, one (1) copy of test records and results shall be furnished to the Engineer for review.
- (3) Exact indication of site, date, hour, types of instruments used and precision of such instruments shall be recorded; in addition necessary notes shall be registered regarding operations plus observed deficiency. This report shall be signed by the Contractor's representative and by the Engineer and shall serve as a basis for final documentation required under the Contract.

18.6. Repetition of Test

- (1) If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is achieved at the Contractor's expense.
- (2) In cases where it may be necessary to perform a partial test and flaws are discovered at a later date such will be corrected by the Contractor at his expense.

18.7. Quality Test

- (1) Quality testing shall include and consist of all such examinations, measurements and inspections via visual, mechanical, instrumental or other means as is necessary to demonstrate work does in fact meet all quality standards and performance requirements as shown or specified.
- (2) At least two (2) pressure gauges shall be used with a total range of the scale not exceeding 130% of the test pressure. Precision shall not be less than 5%.
- (3) All piping shall be tested at completion of roughing in before permitting work to be covered or concealed per following schedule. Piping shall show no loss in pressure or visible leaks after a minimum duration of 4 hours at test pressures indicated.
- (4) Testing methods shall be as shown below:

System tested	Test pressure	Test using
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Soil, waste, drain, vent piping, and storm water headers	Fill with water to top of highest part allow to stand 2 hours; or longer when directed by the Engineer	Water
Water piping: cold water supply piping	10 kg/cm ² or 150 psi, 2 hours or longer	Water

18.8. Demonstration Tests

- (1) Demonstration testing shall include and consist of operating systems under various and varying conditions as are necessary to demonstrate work does in fact operate and function as intended under the Contract Documents.
- (2) Techniques or methods for quality testing shall be employed as necessary for certain demonstrations.
- (3) Demonstration tests shall be distinctly separate from other tests required as specified under the Mechanical Work.
- (4) When deemed by the Engineer as practical, feasible and not disruptive to the Contractor's efforts, the Employer's operating personnel shall be permitted to attend such tests or demonstrations as will be helpful to their understanding of work for which they will eventually be responsible.
- (5) Operational and functional demonstration tests shall be carried out for all systems required under this Section.

19.0 MEASUREMENT AND RATES

19.1. Measurement

- (1) Measurement of pipes shall be in linear meters (m). The quantity shall be measured net from the Drawings, along the centreline of all pipes, through all bends tees and other in-line fittings.
- (2) Measurement of sheet metal in air-conditioning and ventilation ducts shall be in square meters (m²). The quantity shall be measured net from the Drawings along the centreline of all ducts, through all bends, reducers and other in-line fittings multiplied by the girth of the duct.
- (3) Quantities for pipes and ducts shall be based upon the system layouts as shown on the Drawings. Unless otherwise approved by the Engineer, no additional quantities shall be measured due to changes in Plant or equipment proposed by the Contractor or due to routings selected by the Contractor for his own convenience or to remedy his own deficiencies.
- (4) All other items shall be measured in linear meters (m), number (No.), or lump sum (Sum), according to the item classification described in the Bill of Quantities (BOQ). All quantities shall be computed from the Drawings.

19.2. Rates

- (1) The rates and lump sums shall be full compensation for all plant, materials, labor, equipment, transport, temporary works, establishment charges, overheads, profit and taxes required to complete the work described in this 5000 Series of the Specification and/or shown on the Drawings.
- (2) The rates and lump sums shall further include, if not itemized separately in the BOQ

Sections of 5000 Series:

- (a) Contractor's design (where applicable)
 - (b) Training for equipment and systems
 - (c) Spare parts
 - (d) Testing and commissioning
 - (e) Maintenance tools and special tools
 - (f) Protection
- (3) Particular inclusions in rates are the following, unless measured and identified separately in the Bills of Quantities:
- (a) Pipework
 - (i) All short lengths and joints in the running lengths, including the provision of all loose collars, couplings and similar items where required and all jointing and sealing materials including gaskets, bolts and nuts.
 - (ii) Providing all necessary fittings including elbows, tees, reducers, thrust blocks, expansion joints, isolation joints, other special joints and fittings.
 - (iii) Wrapping underground pipes with approved anti corrosive covering material.
 - (iv) Forming trial holes to locate existing services cables or drains (where relevant).
 - (v) Excavating by hand or machine all trenches in any material for underground pipes, including all demolition and reinstatement, disposal of surplus, supports, working space, protection and maintenance of sides, dewatering, providing concrete beds, surrounds, markers, indication tape, anchor blocks (where relevant), protective sand and protective concrete around under ground pipe.
 - (vi) Fixing to and embedding in any surface including providing all clips, brackets, hangers, tacks, screws, bolts and cutting out chases, finishing over and all making good.
 - (vii) Capping open ends of pipe work during the progress of the work to prevent ingress of dirt or water.
 - (viii) Wrapping pipes in felt where they pass through slabs, walls and beams where sleeves are not required.
 - (ix) Providing all sleeves, pre-cut to lengths with square or splayed ends as required, for casting into building in by other trades where pipes pass through slabs, walls or beams.
 - (x) Caulking between pipes and sleeves, having the same fire resisting rating as the walls and floors, where required.

- (xi) Painting identification color bands on concealed pipes and finish painting exposed pipes.
 - (xii) Escutcheons, dielectric flanges cover plates and the like.
 - (xiii) Physically checking, marking, modifying where required all the Drawings and sketches, to ensure satisfactory pipe work installation.
 - (xiv) Inspection, check fit assembly, offering to equipment connections, adjusting where necessary to obtain a good fit for all pipe work.
 - (xv) Formation of dirt pockets and the provision and installation of drain points and isolating valves complete with the drain piping, as described, to the nearest drain.
 - (xvi) Provision and installation of orifice plates as required.
 - (xvii) Provision of pipe supports (e.g. clips, saddles, pipe hooks, holder bats, pipe stays, collars, metal brackets, wooden insulators, rollers, chains, hangers, spring compensators, vibration isolation hangers, back plates, anchors, guides, and the like) seismic restraints and all associated cutting, pinning and painting.
 - (xviii) Provision of earthing terminals, screw holes and other suitable connection by the electrical installation contractor, of equip-potential bonding conductors.
- (b) Sanitary Fittings
- (i) Assembling, forming all necessary joints to services, waste, overflow, vents, etc.
 - (ii) Cutting and pinning and screwing brackets, etc. to brickwork, block work or concrete.
 - (iii) Providing and applying all sealants, making good and adjusting and leaving in perfect working order.
 - (iv) Waste, plugs, chains and stays, brackets, traps and splash backs.
- (c) Manual Valves
- (i) Stripping down, repacking glands and preparing spindles as required, prior to installation.
 - (ii) Providing valve tags as required.
 - (iii) Valves boxes as required.
- (d) Pumps
- (i) Accessories, anchor bolts, washers and nuts.
 - (ii) Pressure tank (if applicable).
 - (iii) Foundation of reinforced concrete; with drain piping.

- (iv) Wiring, cabling, conduit with protection between pump unit and power distribution board.
- (v) Wiring, cabling, conduit with protection for each pump unit, between control panel and control & alarm sensor.
- (vi) Anti-corrosive and finishing paint.
- (e) Storm and Sewer Pits

Accessories, covers, ladders, excavation, disposal of waste material, backfilling, levelling concrete, gravel bedding, etc.
- (f) Ductwork
 - (i) Extra weight of seams, stiffeners, supports and fixings.
 - (ii) Provision of any materials, heat, bolts, nuts washers, sealant, supplementary steel sections and everything else necessary for making joints.
 - (iii) Fixing to and embedding in any surface all components for supporting ductwork (e.g. brackets, hangers, insulators, spring compensators, and vibration isolation hangers), seismic restraints and all associated cutting, pinning and painting.
 - (iv) Cutting or forming openings, provision and fixing of duct sleeves, sealing and anchoring collars, wall plates, floor plates, trim plates, caulking and all other associated items required where ductwork penetrate walls, slabs and beams.
 - (v) Ductwork turns, test holes and covers, access doors and openings, stiffeners, flashing plates, companion frames and the like.
 - (vi) Chamber for supply air and return air duct.
 - (vii) Protective coating and finish painting as necessary.
 - (viii) All associated work required as part of normal good installation practice whether or not specifically mentioned on the Drawings or in the Specification. The Contractor shall therefore allow for the same in his pricing of work and no claim shall be entertained as a result of his failure to do so.
- (g) Grilles, Vent Caps and Pipe Hoods
 - (i) Jointing to ductwork and external wall grilles.
 - (ii) Demountable air filters for fresh air use.
 - (iii) Insect screens on vent caps, pipe hoods, external ceiling grilles.
 - (iv) Protective and finish paint as required.
 - (v) Plenum boxes.

- (vi) Cutting or forming openings and making good.

- (h) Air-Conditioners
 - (i) Controller and other accessories.
 - (ii) Piping for refrigeration, drain.
 - (iii) Wiring, cabling and conduit between:
 - Indoor unit and outdoor unit
 - Indoor unit and power distribution board
 - Indoor unit and wall mounted controller
 - (iv) Floor drain, strainers and PVC drain pipe to catch basin.
 - (v) Insulation, covering tapes (wrapping) and ready-made colored PVC jacketing for refrigerating and drain piping, wiring and cabling.
 - (vi) Stainless steel pipe bracket, bolts, washers and nuts.
 - (vii) Thermostat and wiring.
 - (viii) Provision of opening for pipe sleeves.
 - (ix) Pipe sleeves, void filler, sealant, etc.
 - (x) Frame, base and foundation with finishing for units.

- (i) Ventilation Fans
 - (i) Duct connection.
 - (ii) Wiring, cabling and conduit between unit and power distribution board.
 - (iii) Single pole switches with pilot lamp; complete with wiring, conduit and switch boxes.
 - (iv) Thermostat controller complete with cabling, conduit, wiring, boxes, etc. for fans at electrical rooms and engine generator rooms.
 - (v) Operation control boxes or panels, related to emergency generator operation, complete with cabling, wiring, conduit, etc. for fans at emergency generator room.
 - (vi) Operation control boxes or panels, related to elevator operation; complete with cabling, wiring, conduit, etc. for fans at elevator hoist ways.
 - (vii) Frame, support, hangers.
 - (viii) Cutting or forming openings and making good, including void filler, sealant, etc.

- (ix) Anti-corrosive paints and finishing paints.
- (j) Fire Protection System
 - (i) Piping with supports, hangers, valves, switches, sprinkler heads, alarms, etc.
 - (ii) Wiring, cabling and conduit between switches and fire alarm control panel.
 - (iii) Protective and finish paint as required.
 - (iv) Hose cabinets, hose racks, hoses and nozzles.
 - (v) Cutting or forming opening and making good.
 - (vi) Anchoring of cabinet, provision of metal lath for finishing work, void filler, etc.
 - (vii) Anti-corrosive paint and finishing paint, etc. on cabinets.
- (k) Gas Fire Protection System
 - (i) Piping with supports, hangers, nozzles, solenoid valve, etc.
 - (ii) Control panel, manual gas discharge station, abort switch.
 - (iii) Gas cylinders with gas, cylinder holders, hangers, etc.
 - (iv) Wiring, cabling and conduit for control system and between system and panel board; including necessary boxes.
 - (v) Anti-corrosive paints and finishing paints.
 - (vi) Cutting or forming openings and making good.
- (l) ABC and CO2 Fire Extinguishers
 - (i) Recessed type wall mounted extinguisher cabinets.
 - (ii) Cutting or forming opening and making good.
 - (iii) Anchoring of cabinet, provision of metal lath for finishing work, void filler, etc.
 - (iv) Anti-corrosive paint and finishing paint, etc. on cabinets.
 - (v) Metal brackets for fire extinguishers not located in cabinets.
- (m) Plant and Equipment
 - (i) Pipework connections and the provision of mating flanges, couplings, connectors, unions and everything else necessary for connection to Plant or equipment.
 - (ii) Ductwork connections and the provision of mating flanges,

connectors, flexible connectors and everything else necessary for jointing.

- (iii) All supports, plinths, curbs and concrete foundations including components for supporting Plant and equipment (e.g. metal frames, suspension brackets supports) seismic restraints and vibration mounting, anchor bolts and the like.
 - (iv) All necessary thermal and acoustic insulation, cladding, waterproof membranes, casings, protective treatment and painting.
 - (v) All fees and charges for the attendance, as required, of the equipment manufacturer's representative to assist in the installation and subsequent testing, balancing and commissioning of the equipment.
- (n) Thermal and Acoustic Insulation
- (i) Rock wool blanket insulation and plastic strap.
 - (ii) Elastomeric closed cell insulation and aluminium pipe jacket.
- (o) Others
- (i) Electrical supplies associated with the mechanical engineering installation are measured and included in the appropriate sections for electrical work.
 - (ii) Protective and decorative painting and covering is deemed to be included in the rates of all items.

SECTION 5100

SANITARY AND PLUMBING SYSTEM

1.0 GENERAL

1.1. Scope

- (1) This work shall consist of the supply, installation, testing and commissioning of the complete Sanitary and Plumbing System for the Passenger Terminal Building, Operation and Administration Building, Control Tower, Fire Rescue and Maintenance Building, Car park Toilet, Guard House, Toll Booth, Water Tank and Pump Room, Power House, STP Control Room, Material Recovery Facility, LLZ Building, GS Building, VOR Building at the Airport. Any item of work that is not specifically indicated but necessary for the safe and efficient operation of the system, shall be deemed to be included.
- (2) The complete plumbing system includes, but shall not be limited to, the following equipment and ancillaries:
 - (a) Cold water supply system complete with piping, fittings and all necessary accessories.
 - (b) Hot water supply system complete with piping, fittings, solar heater, water softener, electric water heaters and all accessories.
 - (c) Soil, waste and vent piping systems complete with fittings, floor drains, clean outs, and all accessories.
 - (d) Stormwater drainage system complete with piping system, catch basin and all accessories.
 - (e) Plumbing fixtures and trim with all accessories.
 - (f) Stub-outs for concessionaires including isolating valve and sub-water meter.
 - (g) Cleaning-up, painting and labeling of all, pipe work and accessories installed.
 - (h) Testing and commissioning of all equipment and services.
 - (i) Interfacing of plumbing system with the Building Management System (BMS)
 - (j) Submission of shop drawings, as-built drawings, test results, spare parts and tools for maintenance, operating instruction and maintenance manuals of all equipment and services installed

1.2. Interface Work

- (1) Interface work with the Building Management System (BMS) shall be as follows:
 - (a) The Contractor shall provide all BMS interface points for the BMS to monitor the following but not limited to:
 - (i) On/off status monitoring of all pumps
 - (ii) Alarm/trip monitoring of all pumps

- (iii) High water level alarm for drain pumps
 - (b) The Contractor shall provide dry contacts, transducers and other interface equipment necessary to interface with the BMS.
 - (c) Discrete/digital input and output such as contact status/maintained, momentarily etc. as well as voltage and current signal requirements shall be coordinated with the BMS to ensure proper operation.
- (2) Interface work with the civil works shall be as follows:
- Soil, waste water and storm water drainage piping shall be interfaced at the terminal manholes with the civil works as shown on the Drawings. The Contractor shall coordinate all interface requirements between plumbing and civil works.
- (3) Interface work with the water supply works shall be as follows:
- Potable cold water supply piping shall be interfaced at the terminal stub-outs with the civil works as shown in the drawings. The Contractor shall coordinate all interface requirements between plumbing and water supply works.

2.0 TECHNICAL SPECIFICATIONS

2.1. Pipes, Valves and Fittings

- (1) Piping materials for the various systems shall be as follows:

System	Pipe Material	Pipe Size
Cold Water	PVC (VP)	All
Hot Water	Copper, Type L	All
Soil/Waste	PVC (VP)	All above ground
Kitchen	PVC (VP)	All above ground
Water Drain	PVC (VP)	All above ground
Storm water	PVC (VP)/SGP/SUS	Refer to Drawings
Sanitary Vent	PVC (VU)	All

- (a) Cold and Hot Water Supply Pipes
Refer to item 15.0 of **Section 5050**.
- (b) Soil, Waste Water, Kitchen Waste and Water Drainage Pipes
Refer to item 15.0 of **Section 5050**.
- (c) Storm water Drainage Pipes
 - (i) Pipes shall be polyvinyl chloride pipe conforming to JIS K 6742 (VP). Fittings shall be in accordance with JIS K 6743;
 - (ii) Galvanized carbon steel pipe conforming to JIS 3452-ZN; Fittings shall be in accordance with JIS B 2311 or JIS H 8641; and
 - (iii) Stainless steel pipe conforming to JIS G 3459; Fittings shall be in

accordance with JWWA G 116.

(d) Sanitary Vent Pipe

Refer to para 15.0 of **Section 5050**.

(e) Hot Water Supply Pipe

Refer to para 15.0 of **Section 5050**.

(f) Hot Water Piping Insulation

All hot water piping, after being tested, shall be cleaned and insulated with 20mm thick closed cell elastomeric insulation. Insulation shall be continuous through valves, sleeves, fittings, hangers, etc.

(2) Valves and Fittings

(a) Gate Valves

(i) Refer to para. 16.0 of Section 5050

(ii) Pressure Rating : 10kg/cm² or 150psi

(b) Check Valves

(i) Type

- 50 mm diameter and smaller : Swing check valve
- 65 mm diameter and larger : Hammerless check valve

(ii) Materials

- 50 mm diameter and smaller : Bronze body and trim
- 65 mm diameter and larger : Cast-iron body and bronze trim

(iii) Joint

- 50 mm diameter and smaller : Threaded ends
- 65 mm diameter and larger : Flanged ends

(iv) Pressure Rating : 10kg/cm² or 150psi

(v) Applicable Standard

- Threaded ends : JIS B2011 or approved equal
- Flanged ends : JIS B2031 or approved equal

(c) Automatic Air Vent Valves

Type : Float operated
Material : Cast bronze body
Joint : Threaded ends, 20mm in nominal size

Each vent shall be equipped with one (1) 20mm gate valve.

(d) Water Meters

Water meter shall be cast bronze body, double jet, vane wheel type direct reading water flow accumulator with dry type indicating elements and union coupled ends.

(e) Pressure and Compound Gauges

Refer to para 17.0 of Section 5050.

(f) Gasket

(i) Rubber : Durable and suitable for pressure, temperature and water characteristics of works as required.

(ii) Liquid : Synthetic rubber compound specifically formulated for service intended.

(g) Sealing Tape

For threaded connections; Teflon tape suitable for temperatures ranging from -50°C to +180°C.

(h) Flexible Joints

(i) General : Synthetic rubber combined with reinforcement; inside diameter same as pipe conforming to specified requirements.

(ii) Rubber

- Tensile Strength : Not less than 10 kg/cm²
- Elongation : Not less than 104 percent
- Reinforcing : Cotton fabric for rubber hose

(iii) Stainless Steel

- Tensile Strength : Not less than 14 kg/cm²
- Elongation : Plus 2 to minus 3 percent
- Reinforcing : Stainless steel blade for stainless steel below.
- Flanged Ends : approved equal

2.2. Pumps

(1) Booster pump unit for Control Tower shall be as follows:

(a) The unit shall be compact type inverter control consisting of 2 Nos. pumps, pressure tank, control panel, double type back flow preventor, strainer and standard accessories.

(b) Pump capacity – 80 L/min x 37m head x 1.1 kW

(c) Pump Operation – automatic and manual alternative operation of pumps.

(d) The pumping set to contain the following standard accessories:

- Gate valve and check valve
- Pressure gauge and compound pressure gauge
- Drain cock or plug
- Air vent valve (if necessary)
- Flexible joint
- Anchor bolts, nuts and washers
- Nameplate
- Common bed

2.3. Solar Heater

- (1) Solar heater unit shall be as follows:
 - (a) The unit shall be open and natural circulation type with 220 L storage capacity and galvanizer steel base.
 - (b) Solar panel area – 3.22 m² / unit
 - (c) Unit shall be consist of solar panel(SUS304) and storage tank (High density Polyethylene).

2.4. Plumbing and Sanitary Fixtures

- (1) Supply and installation of all sanitary fixtures, faucets and fittings in the toilet areas shall be inclusive of the connections to the water supply and sewerage piping system.
- (2) All plumbing fixtures shall be provided with complete fittings and trims recommended by the plumbing fixture manufacturer.
- (3) All fittings, metal trims, escutcheons, traps, exposed piping, etc. shall be chromium plated brass or bronze with polished bright surface.
- (4) Respective units of equipment as shown or specified shall be the manufacturer's first quality line of standard and/or custom series of factory fabricated items.
- (5) Where two or more units of the same class, types or kind are required, the units shall be products of a single manufacturer. However, various component parts of a system need not be products of the same manufacturer.
- (6) Comparable assemblies of manufacturers other than the one specified may be proposed if they differ in minor details only and otherwise comply with the requirements shown or specified, subject to prior approval by the Engineer.
- (7) Table 5100.1 shows a list of sanitary fixtures and fittings to be installed. The model number used is those of Toto Company and is used as reference of the type, quality and features desired. Types installed shall be as this range or at least equivalent. (Refer to Equipment Schedule for usage and reference description).

**Table 5100.1 Reference Standard for Sanitary Fixture
For PTB Public area**

Description		Model No.
1. Water Closets	WC-1 WC-2 for Handy capped	CS494,TC301,TEV30MWH CS494,EWC441R,TEV30MWH
2. Urinals	UR-1 UR-2	UFH500,TEA62ADR U310,TEA62ADR
3. Lavatories	LAV-1 LAV-2for Handy capped	L548U,TEN41AW L103CFV7,TEN41AW
4. Toilet Paper Holder	TPH-1	R5504B
5. Baby Sheet		YKA25
6. Paper Tower Holder		R3601

**Table 5100.2 Reference Standard for Sanitary Fixtures
For PTB Other Area and Other Building**

Description		Model No.
1. Water Closets	WC-3 WC-4 for Handy capped	HCG C5517 HGC CS5518Q, Cellox C603
2. Urinals	UR-3	HCG U999
3. Lavatories and Faucets	LAV-3 LAV-4 LAV-5 for Handy capped	HCG L4011 HCG L60 HCG L60
4. Service Sink	SS-1	SKW 322B
5. Shower Set	SHW-1	Moen 2086
6. Hand Dryer		HD908H
7. Toilet Paper Holder	TPH-2	BA588
8. Soap Holder		BA581
9. Faucet for Pantry Sink		KF3000PX
10. Faucet for Kitchen Sink		KF3000PX
12. Grease Interceptor		Kaneso KSGT-200

(a) Water Closet (WC-1)

Fixture : Vitreous china, monobloc, wash down type, floor mounted.

Fittings : Level actuator type flush valve with vacuum breaker, closed front plastic double seat, handy type flushing nozzle and accessories.

(b) Water Closet for Handicapped (WC-2)

Fixture : Vitreous china, monobloc, wash down type, floor mounted.

Fittings : Level actuator type flush valve with vacuum breaker, closed front plastic double seat, handy type flushing nozzle and accessories.

(c) Water Closet (WC-3)

Fixture : Vitreous china, monobloc, with high base for handicapped persons, floor mounted.

Fittings : Level actuator type flush valve with vacuum breaker, closed

front plastic double seat, handy type flushing nozzle and accessories

- (d) Water Closet for Handy capped (WC-4)
 - Fixture : Vitreous china, monobloc, wash down type, floor mounted.
 - Fittings : Level actuator type flush valve with vacuum breaker, closed front plastic double seat, handy type flushing nozzle and accessories.
- (e) Urinal (UR-1)
 - Fixture : Vitreous china, wall hung urinal stall with integral trap
 - Fittings : Infra-red sensor actuated flush valve and accessories.
- (f) Urinal (UR-2)
 - Fixture : Vitreous china, wall hung urinal stall with integral trap.
 - Fittings : Infra-red sensor actuated flush valve and accessories.
- (g) Urinal (UR-3)
 - Fixture : Vitreous china, wall hung urinal stall with integral trap.
 - Fittings : Push button actuated type flush valve and accessories
- (h) Lavatory (LAV-1)
 - Fixture : Vitreous china, under counter type lavatory.
 - Fittings : Sensor actuated lavatory faucet with mixed hot and cold water, supply pipe with stop cock and stainless steel flexible hose, pop-up lavatory waste with P-trap and accessories.
- (i) Lavatory for Handicapped (LAV-2)
 - Fixture : Vitreous china, wall mounted type lavatory
 - Fittings : Lavatory faucet, supply pipe with mixed hot and cold water supply pipe with stop cock and stainless steel flexible hose, liquid soap dispenser, pop-up lavatory waste with P-trap and accessories
- (j) Lavatory (LAV-3)
 - Fixture : Vitreous china, over counter type lavatory.
 - Fittings : Sensor actuated lavatory faucet with mixed hot and cold water, supply pipe with stop cock and stainless steel flexible hose, pop-up lavatory waste with P-trap and accessories
- (k) Lavatory (LAV-4)

- Fixture : Vitreous china, wall mounted type lavatory.
- Fittings : Lavatory faucet, supply pipe with stop cock and stainless steel flexible hose and accessories.
- (l) Lavatory for Handicapped (LAV-5)
- Fixture : Vitreous china, wall mounted type lavatory.
- Fittings : Lavatory faucet, supply pipe with stop cock and stainless steel flexible hose, liquid soap dispenser, pop-up lavatory waste with P-trap and accessories
- (m) Service Sink (SS)
- Fixture : Vitreous china, rectangular type, wall mounted.
- Fittings : Chromium plated sink faucet, cast iron sink waste with S-trap, rim guard and accessories.
- (n) Shower Set
- Flexible shower head and fixed shower valve assembly, chromium plated.
- (o) Faucet
- Cast bronze or brass body, chromium plated.
- (p) Hand Dryer
- The hand dryer shall be automatic operated with electrical capacity of 110V, AC, 60Hz, 1075 watts; safety devices consist of thermal fuse, circuit breaker and stop timer.
- (q) Electric Water Heater
- The water heater shall be single point instantaneous type for each shower and multipoint instantaneous type for group of lavatories. Electrically heated and designed for wall or ceiling mounted.
- (r) Grease Interceptor
- Grease interceptor shall be of stainless steel (SUS 304) with compartments complete with inlet, outlet and removable cover for maintenance. Capacity shall be 50 liters / min.
- (s) Floor Drain
- Floor drains shall be cast iron body with integral trap and threaded end. Strainer shall be cast bronze chromium plated.
- (t) Shower Drain
- Shower drains shall be cast iron body with integral trap and threaded end. Strainer shall be cast bronze chromium plated.
- (u) Floor Cleanout

Floor cleanout shall be bronze or brass body with counter sunk tap on screwed plug, chromium plated.

(v) Underfloor or Surface Cleanout

Cleanout shall be cast iron ferrule and cast bronze or brass threaded plug with square head assembly.

(w) Valve Box

Refer to para. 16.0 of Section 5050.

2.5. Sewer, Storm and Catch Basin

- (1) Pits shall have a variable chamber size and depth as indicated on the Drawings. Chamber shall be constructed of reinforced concrete with ductile cast-iron cover.
- (2) Casting shall meet the following requirements:
 - (a) Covers at road and car park : JIS G5502 FCD500-7 (spheroidal graphic iron casting), Safety load 5,000 kgf
 - (b) Other covers : Gray iron casting
Safety load 500 kgf.
- (3) Cast iron cover for sewage manholes shall be air tight type.
- (4) Each cover shall have molded letterings identifying usage of manholes such as drainage, sewer, electrical, etc.
- (5) All covers shall be set at higher elevation at 5mm than surrounding concrete or finishing on which three (3) to four (4) percent slope shall be provided.

3.0 INSTALLATION

3.1. General

Component and accessories of plumbing fixtures shall be installed per manufacturer's instruction and shop drawings as approved.

3.2. Wall Mounted Fixtures

- (1) Wall hung fixture shall be provided with back or wall hanger.
- (2) Other mounting methods may be applied if approved by the Engineer.

3.3. Floor Mounted Fixtures

Floor mounted fixtures shall be set and secure using anchor bolts and nuts.

3.4. Installation of Fixtures

- (1) Rough-ins for carriers, drains and supplies shall be laid out, spaced and aligned for final fixture locations required.
- (2) Compression stops shall be required for each supply as specified.

- (3) All pipes passing through walls, floors and ceilings in all interior spaces shall be provided with escutcheons.
- (4) Traps and vents shall be provided for each fixture whether or not shown.
- (5) Rimmed edges shall be set full contact all around with watertight sealant or compound.
- (6) Sealed edges where shown or specified shall be set with space for sealant.
- (7) Fixtures height unless otherwise shown shall be adjacent to, and accurately aligned with, other fixtures.
- (8) Each fixture shall be set square, plumb and level and rigidly secured to support free from movement.

3.5. Sealant Work

- (1) Sealant work shall be clear or white, one component, pre-packaged silicone type as approved.
- (2) Preparation of surfaces, installation and securing of sealants shall be per manufacturer's instructions.
- (3) Sealant joint width shall not be less than 3mm and not more than 6mm.
- (4) Sealant depth shall not be less than 6mm.
- (5) Finished surfaces shall be smooth and free from pits, strings or other irregularities.
- (6) Sealant joints shall be watertight throughout.

4.0 TESTING AND INSPECTION

Refer to para. 18.0 of Section 5050.

5.0 DISINFECTION/STERILIZATION OF PIPELINES

5.1. General

- (1) Upon completion of the testing as above, the cold water supply pipeline shall be flushed and disinfected to the satisfaction of the Engineer prior to commissioning of the system for general usage.
- (2) The costs incurred in disinfection, testing of the water, etc. shall be included in the Contractor's pipe laying rates.

5.2. Disinfection/Sterilization Method

- (1) Shall be executed via a pump which shall be connected to valve and service line to water system specifically provided for this purpose
- (2) Service line shall not be less than 25mm diameter and connected to system not more than 50mm from point of system connection to main water supply service.
- (3) The pump and service line shall be installed prior to system pressure and leakage tests.
- (4) The pump shall be hand operated type rated not less than 7kg/cm², suitable for injecting work required.

5.3. Sterilization Agent

- (1) Type: Commercial hydrogen chloride.
- (2) Available chlorine content: Not less than 5.25 percent.
- (3) The following preparation works needs to be completed before the disinfection/sterilization process commences:
 - (a) Equipment and fixtures shall be installed and connected, throughout.
 - (b) Pressure and leakage tests shall be performed and system proven acceptable.
 - (c) Systems shall be thoroughly flushed, by opening valves until water flow appears clear at each valve.
 - (d) Systems shall be completely filled with water.
 - (e) During disinfection, each outlet shall be posted with suitable sign forbidding use of water.

5.4. Sterilization Procedure

- (1) Supply valve shall be opened; faucets and bibs shall be opened for uniform trickle flow from each location.
- (2) The agent shall be injected slowly and continuously at even and constant rate until orthotolidine test at each and every outlet indicates chlorine residual concentration is not less than 50 parts per million (ppm).
- (3) Injecting agent in large doses or surges will not be permitted.
- (4) When the above process is completed, the supply valve and all outlets shall be closed and kept closed for a minimum of 24 hours.
- (5) Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 10 ppm, of chlorine at the extreme end of the system by the end of the retention period.
- (6) The system will not be approved until satisfactory bacteriological results have been obtained.

5.5. Completion

- (1) The system shall be flushed with clean water until the residual chlorine is reduced to less than 0.1 ppm.
- (2) After completion of disinfection all valves shall be closed tightly.

SECTION 5200

VENTILATION AND AIR CONDITIONING SYSTEM

1.0 SCOPE

1.1. General

- (1) The scope of works shall cover the complete supply, delivery, installation, testing and commissioning in good working condition of the entire air conditioning and ventilation system for the Passenger Terminal Building, Operation and Administration Building, Control Tower, Fire Rescue and Maintenance Building, Car park Toilet, Guard House 1, Guard House 2, Toll Booth, Water Tank and Pump Room, Power House, Sewage Treatment, Material Recovery Facility, LLZ Building, GS Building, VOR/DME Building, Ancillary Buildings, Utilities Building and other support utilities of the Project.

1.2. Scope of Works

The complete air conditioning and ventilation system includes, but shall not be limited to, the following equipment and ancillaries:

- (a) VRF system for Passenger Terminal Building and Operation and Administration building;
- (b) Fresh Air Filter Unit for Passenger Terminal Building and Operation and Administration building;
- (c) Split air conditioners including piping and other accessories for other Buildings/Utilities;
- (d) Duct works including insulation, grilles, registers and diffusers for proper air distribution and of approved quality;
- (e) Automatic control system;
- (f) Air distribution system inclusive of noise control material and equipment to maintain the specified noise criteria;
- (g) Mechanical ventilation system including mechanical room, electrical room, storage areas, toilet areas, pantry, generator rooms;
- (h) Kitchen exhaust system including ductwork and fans;
- (i) Electrical equipment complete with motor control panel, control system, cabling for the proper operation of the equipment;
- (j) Interfacing of the air conditioning and ventilation system with the Building Management System (BMS) and other services e.g. fire protection services;
- (k) Control of noise and vibration;
- (l) Cleaning up of all installed equipment and accessories;
- (m) Painting and labelling of all installed equipment and accessories installed;

- (a) Passenger Terminal Building
By VRF (Variable Refrigerant Flow) system, (i.e. Multi-Packaged Air Conditioner System).
VRF (outdoor unit) + FCU (indoor unit) system
- (b) Control Tower
By individual packaged/split air conditioner (PAC) system
- (c) Operation and Administration Building
By VRF (Variable Refrigerant Flow) system, (i.e. Multi-Packaged Air Conditioner System).
VRF (outdoor unit) + FCU (indoor unit) system
- (d) Power House
By individual packaged/split air conditioner (PAC) system.
- (e) Fire Station
By individual packaged/split air conditioner (PAC) system
- (f) Sewage Treatment Plant
By individual packaged/split air conditioner (PAC) system
- (g) VOR Building
By individual packaged/split air conditioner (PAC) system
- (h) LLZ Building
By individual packaged/split air conditioner (PAC) system
- (i) GS Building
By individual packaged/split air conditioning (PAC) system

3.0 AIR CONDITIONING EQUIPMENT

3.1. VRF (Variable Refrigerant Flow) system-VRF Outdoor Unit

- (1) The VRF outdoor units shall comprise high COP, scroll compressors and electronic expansion devices. They shall be factory assembled, single-piece units. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge (R410A), and special features required prior to field start-up.
- (2) Units shall be rated in accordance with Japanese Industrial Standards B 8613, latest revision and shall be manufactured in a facility holding ISO 9001 certification.
- (3) The units shall be stored and handled per unit manufacturer's recommendations and the unit controls shall be capable of withstanding -20 ~ +45 °C storage temperatures in the control compartment.

3.2. VRF (Variable Refrigerant Flow) system-VRF Indoor Unit

- (1) The FCU units shall consist of fan, direct expansion coil, drain pan, speed regulator, drain pump and accessories.
- (2) Acceptable noise level shall be as shown in Table 5200.2

Table 5200-2 FCU Noise Levels

Supply air (m ³ /h)	Noise level dB (A)
not less than 780	30
not less than 1150	34
not less than 1500	36
not less than 4500	48

- (3) The main components shall be as follows:
 - (a) Casing
 - (i) Casing shall be constructed with galvanized steel sheet conforming to JIS G 3141, G 3302 or JIS G 3313 or approved equivalent and not less than 0.8mm thickness.
 - (ii) Casing insulation shall be applied at factory, and tropical proof type.
 - (b) Drain Pan
 - (i) Drain pans shall be stainless steel sheet conforming to JIS G 4305 or approved equivalent.
 - (ii) Thickness shall be not less than 0.8mm and provided with anti-sweat insulation externally.
 - (c) Fan
 - (i) Fans shall be double-inlet centrifugal type.
 - (ii) Fan blades shall be aluminium sheet conforming to JIS H 4000 or approved material.
 - (iii) Fan coil units shall provide schedule capacity at medium speed operation and shall be set in the field to operate at medium speed, or approved by the Engineer.
 - (d) Air Filter

- (i) Filter shall be permanent washable, high efficiency type:
 - (ii) Holding frames shall be steel conforming to JIS G 3141 or aluminium sheet conforming to JIS 4000, or approved equivalent.
 - (iii) Steel sheet holding frames shall be provided with anti-rust coating.
 - (iv) Filters shall be manufacturer's standard and shall be non-combustible type.
 - (v) Filter shall be removable without unlocking the unit from panel or cabinet.
- (e) Motor
- Motor shall be single phase, induction type variable speed.

3.3. Fresh Air Filter Unit

- (1) Fresh air filter units shall be provided at Passenger Terminal Building, Operation and Administration Building
- (2) The units shall be floor mounted, draw through units consisting of fan, motor, air filter section, vibration isolator and accessories.
- (3) Acceptable noise levels of Fresh air filter unit shall be as shown in Table 5200.3

Table 5200.3 Fresh Air Filter Unit Noise Levels

Total static Pressure (mm Aqua)	Supply Air (m ³ /h)				
	Less than 12,000	12,000 to 18,000	18,000 to 24,000	24,000 to 30,000	30,000 to 40,000
80 ~ 90	70	75	75	80	85
90 ~ 100	75	75	75	80	85
100 ~ 300	75	75	75	85	85

Note: Unit of noise levels shall be dB (A)

- (4) The main components shall be as follows:
 - (a) Casing
 - (i) Casing frame shall be assembled with structural shaped steel conforming to JIS G 3101 and JIS G 4051, or approved equivalent.
 - (ii) Casing plate shall be not less than 0.5mm thickness sandwich double skin panel (total 1.0mm) with synthetic resin formed insulation, hot dip aluminum-galvanized steel sheet conforming to JIS G 3321 or approved equivalent.
 - (iii) Casing insulation shall be applied at factory, shall be acoustically suitable and shall be 50mm thick foamed polyurethane material.
 - (iv) Inspection doors for fan section shall be not less than 300mm width and 500mm height.
 - (b) Fan
 - (i) Fans shall be double-inlet centrifugal type with each fan in a separate scroll.

Fans shall be statically and dynamically balanced at the factory after assembly in the air handling unit.

- (ii) Fans shall be mounted on steel shaft, accurately finished and supported in ball-type bearings provided with lubrication facilities.
 - (iii) Fans shall be driven by a unit mounted motor connected to fans by V-belt drive complete with belt guard. Belt drives shall be designed for not less than 150 percent of the connected motor capacity, and sheaves shall be adjustable to provide not less than 20 percent speed variation.
 - (iv) Motors for V-belt drives shall be provided with adjustable bases.
 - (v) Sheaves shall be selected to drive the fan at such speed as to produce the specified capacity when set at the approximate mid point of sheave adjustment.
- (c) Motor
- (i) The fan motor shall be 230V three phases, induction type conforming to manufacturer's standard. The motor speed shall not exceed 1500 RPM and the system shall be able to operate normally from 110% to 120% of design capacity without going into a surge condition. The motor shall be constructed with the motor mounted inside the air handling unit. The belt and pulley guard shall be installed with hinges for ease of removal when servicing the pulleys or adjusting the fan belt.
 - (ii) The motor shall be mounted on a rigid but fully adjustable base to allow for belt tension adjustment.
 - (iii) All belts, pulleys, couplings and drives shall be selected strictly in accordance with the driven manufacturer's recommendation. Each individual drive shall be aligned with a straight edge.
- (d) Air Filter
- (i) The pre-filter (AFI 80% above) and medium filter (NBS 80% above) shall be permanent washable, high efficiency types:
 - (ii) Holding frames shall be fabricated from steel sheet conforming to JIS G 3141 or aluminum sheet conforming to JIS H 4000 or approved equivalent.
 - (iii) Steel sheet holding frames shall have anti-rust coating.
 - (iv) Filters shall be non-combustible type and initial resistance shall be not greater than 12mm Aqua.

3.4. Room Air Conditioner

- (1) Room air conditioner (i.e. split packaged air conditioning units) shall be required for particular rooms in Control Tower, Fire Station, Power House, STP Buildings, VOR Building, LLZ Building and GS Building.
- (2) Room air conditioner shall comprise of indoor unit, outdoor unit and refrigerant piping as follows:

- (a) Indoor unit, consisting of compressor, air cooling coil, fan, motor, safety devices and enclosing cabinet
- (b) Outdoor unit, consisting of axial flow fan, air cooled condenser and enclosing cabinet.
- (c) Refrigerant piping connecting the units
- (3) Unit shall be free from excessive operating vibrations and noise and shall perform to required capacities.
- (4) Room air conditioners shall be provided with the following accessories:
 - (a) Anchor bolts with washers and nuts
 - (b) Refrigerant piping with insulation

4.0 AIR CONDITIONING PIPING

4.1. Pipes and Fittings

- (1) Refrigerant piping for individual type packaged air conditioning units shall be seamless copper tubing, soft type conforming to JIS H 3300 and soldering type copper tubing fittings conforming to JIS H 3401 or approved equal.
- (2) Drain pipe shall be polyvinyl chloride pipe conforming to JIS K 6741 and the pipe fittings conforming to JIS K 6739 or equal approved by the Engineer.

4.2. Drain Piping

- (1) Horizontal piping shall have a uniform grade and shall be installed as straight as possible.
- (2) Standard grade shall be as follows:

<u>mm in nominal</u>	<u>mm minimum gradient</u>
65 and less	1/50
75~100	1/100
125	1/150
150 and above	1/200

5.0 VENTILATION EQUIPMENT

5.1. General

- (1) Fans shall be the products of manufacturers regularly engaged in the manufacture of such products. Fans shall essentially duplicate equipment that has been in satisfactory use for at least ten (10) years prior to Bid opening.
- (2) Fans and accessories fabricated from ferrous metals that do not have a zinc coating or duplex coating of zinc and paint shall be treated for prevention of rust with factory coating or paint system.
- (3) Fans may be directly connected to the motor shaft or indirectly connected to the motor by means of a V-belt drive unless otherwise specified.

- (4) Where V-belt drives are used, such drives shall be designed for not less than 150 percent of the connected driving capacity, and motor sheaves shall be adjustable to provide not less than 20 percent speed variation.
- (5) Fans shall be provided with screens or guards on both suction and supply ends except where ducts or dampers are connected to the fan.
- (6) Fans and motors shall be provided with vibration isolation supports or mountings.
- (7) Bearings for fans and motors shall be precision anti-friction type with provision for self-alignment and for radial and thrust loads imposed by the service.
- (8) Bearings shall be grease lubricated with provision to preclude overheating due to excess lubricant. Grease supply fittings shall be surface ball check type.
- (9) Applicable standards shall be as follows:
 - (a) Fan construction: JIS B 8331, JIS C 9603 or approved equivalent
 - (b) Testing method: JIS B 8330 or approved equivalent
- (10) Electrical works shall be as follows:
 - (a) Electrical-motor-driven fans specified herein shall be provided complete with motors, motor starters, and controls.
 - (b) Motor starter shall be provided with thermal overload protection and other accessories.
 - (c) Electrical equipment and wirings shall be in accordance with **Section 6000**.
 - (d) Electrical characteristics shall be 3 phase, 230V, 60Hz and 1 phase, 230V, 60Hz.

5.2. Centrifugal Fans

- (1) Centrifugal fan shall be fully enclosed single-width single-inlet, or double-width double-inlet, as required or indicated.
- (2) Impellor wheels shall have backward inclined or backward curved blades of the non-overloading type, except wheels 300mm or less in diameter may have forward curved blades.
- (3) Impellor wheels shall be rigidly constructed, accurately balanced both statically and dynamically, and free from objectionable vibration or noise.
- (4) Fan shafts shall be carbon steel, accurately finished, and shall be provided with key and key seats for impellor hubs and fan pulleys.
- (5) Fan outlets shall be designed for the attachment or angles and bolts for attaching flexible connections.
- (6) Each fan inlet shall have manually or motor operated dampers, and for fan outlet gravity or motor operated dampers shall be provided.
- (7) The motor, unless otherwise indicated, shall not exceed 1,500 rpm and shall be totally enclosed and fan cooled type.

- (8) Fan and motor shall be mounted on a common base.
- (9) Fan capacity shall be as indicated on the Drawings.
- (10) Material shall be as follows:
 - (a) Enclosure : JIS G 3101 SS41 or approved equivalent
 - (b) Blades : JIS G 3101 SS41 or approved equivalent
 - (c) Shaft : JIS G 4051 S35C or approved equivalent

5.3. Axial Fans

- (1) Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically, and free from objectionable vibration or noise.
- (2) Fan shall be directly connected to the motor or connected to the motor by a V-belt drive.
- (3) Fans and motor shall be supported on heavy metal frame with steel sheet casing.
- (4) Fan shafts shall be carbon steel, accurately finished.
- (5) Fan inlets and outlets shall be designed for attachment of angles and bolts for attaching flexible connections.
- (6) Materials shall be as follows:
 - (a) Propeller : JIS G 3141 or approved equivalent
 - (b) Shaft : JIS G 4051 or approved equivalent
- (7) Fan capacity shall be as indicated on the Drawings
- (8) Accessories shall be provided as follows:
 - (a) Combination flanges
 - (b) Power cables or terminal box (terminal box shall be contained in motor)
 - (c) Nameplate

5.4. Silencer Box Type Fans

- (1) Shall be compact centrifugal fans (reference outside diameter of blades: less than or equal to 250mm) or mixed flow fans, those which are contained in silencer box (boxes or cylinder).
- (2) Silencer boxes shall be steel sheet (thickness 0.8mm or above) or approved by the Engineer, and the sections with continuous welded flange and shall have demountable face for maintenance.
- (3) Glasswool board (JIS A 6301, No.2 class, 40kg/m³, 25mm minimum thickness) with glasswool cloth (JIS R3414, EP18) shall be fixed inside silencer boxes.
- (4) Fans itself shall meet the requirements of items (1)Centrifugal Fans and (2)Axial Fans, or (3) Mixed Flow Fans, above.

- (5) Motor and paints as per manufacturer's standard.
- (6) Accessories shall be provided as follows:
 - (a) Combination flanges (if necessary)
 - (b) Power cables or terminal box
 - (c) Nameplate

5.5. Industrial Type Wall Mounted Fans with Hood

- (1) Axial fans complete with steel frame, guards, stainless steel hoods (SUS 430 or 304, thickness, minimum 1.0mm), stainless steel insect screens automatic shutters (electrical for intake fans, mechanical for exhaust fans) and control systems.
- (2) Fans at engine generator rooms shall be controlled by both thermostat (on/off at 35°C) and signal from engine generator.
- (3) Fans at electrical rooms shall be controlled by thermostat (on/off at 35°C)
- (4) All fans shall be connected to manual switches also.
- (5) The Contractor shall propose complete individual control system, with specifications for Engineer's approval.

5.6. Industrial Type Wall Mounted Fans with Duct.

- (1) Axial fans complete with PVC or galvanized steel pipe duct, chamber, steel frame, guard, automatic mechanical shutter, control systems, pipe hood.
- (2) Fans shall be controlled by signal from elevators.
- (3) The Contractor shall propose complete individual control system with specifications for Engineer's approval.

5.7. Ceiling Mounted (Cassette Type) Fan

Silencer box type fans (compact centrifugal) complete with demountable grille (one-touch spring type or similar), reverse flow prevention shutter, galvanized steel sheet spiral duct, duct hood, wall mounted switches (with pilot lamp, switch box, wiring, cabling, conduit, etc.)

5.8. Electrical Wall Fans

- (1) Fans shall be installed in Guard Houses and Toll Booths with thermal cut-off 400 mm fan blade 3-speed selection wattage.
- (2) Fan capacity shall be as indicated on the Drawings

5.9. Equipment Installation

- (1) Install fans and related equipment, components and accessories per manufacturer's instructions and approved shop drawings.
- (2) The equipment shall be installed level on foundations with full bearings for base. Axis of equipment shall be accurately aligned prior to setting anchor bolts and the bolts shall be set and the dry packing cured prior to tightening of nuts.

5.10. Testing

- (1) Upon completion, prior to approval of the installation, the Contractor shall perform operation test to demonstrate satisfactory functional and operating efficiency.
- (2) Test data indicating the following shall be submitted to the Engineer.
 - (a) Specified air quality and static pressure
 - (b) Installed motor's running current
 - (c) Fan speed

6.0 AIR CONDITIONING AND VENTILATION DUCT

6.1. General

- (1) Air conditioning and ventilation ducts shall consist of galvanized steel sheet rectangular duct and galvanized steel sheet mechanical rolling spiral duct.
- (2) The materials shall meet the following Standards:
 - (a) Galvanized steel sheet – JIS G 3302 and structural steel form conforming to JIS G 3191, G 3192 and G 3193 or approved by the Engineer.
 - (b) Bolts and nuts – JIS B 1180 and JIS B 1181
 - (c) Rivets – JIS B 1213 steel or copper or aluminium alloy.
 - (d) Wire screen – JIS G 3555.
 - (e) Gasket – JIS K 6380
 - (f) Sealing compound – silicone rubber base or nitrite rubber base as approved by the Engineer
- (3) The ducts passing through walls shall be filled by mortar or rock wool with sealant. Pipe sleeve, back-up material, waterproofing, mortar and sealant shall be used as shown on the Drawings if walls are external ones.

6.2. Rectangular Duct

- (1) Rectangular duct shall be suitable for low velocity duct system and shall be fabricated at factory and/or at job site.
- (2) Thickness schedule for galvanized steel shall be as shown in Table 5200.4.

Table 5200.4 Duct Thickness

Duct Size Largest Dimension (mm)	Steel Sheet Thickness (mm)
Less than 450	0.5
450 ~ 750	0.6
750 ~ 1,500	0.8
1,500 ~ 2,200	1.0
Over 2,200	1.2

- (3) Flanges shall be by structural steel form conforming to JIS G 3191, G 3192 and G

3193 or approved equal.

- (a) Spacing of flanges shall be shown in Table 5200.5.

Table 5200.5 Flange spacing

Duct Size (largest dimension) mm	Size of L shape (mm)	Maximum Spacing (mm)
Less than 750	25 x 25 x 3	1820
750 ~ 1,500	30 x 30 x 3	1820
1,500 ~ 2,200	40 x 40 x 3	1820
Over 2,200	40 x 40 x 5	1820

- (b) Rivet for flange to duct shall be 4.5mm diameter and 65mm on center maximum.
- (c) Bolts and nuts for duct flanges shall be as shown in Table 5200.6

Table 5200.6 Flange bolts

Size of Duct Largest Dimension (mm)	Size and Spacing (mm)
Less than 750	8mm dia. x 100mm O.C.
Larger than 750	8mm dia. x 100mm O.C.

- (4) Reinforcing shall be provided at the centreline between flange joints and as shown in Table 5200.7

Table 5200.7 Duct reinforcing

Duct Size (Largest Dimension) mm	Size of L shape (mm)
450 ~ 750	25 x 25 x 3
750 ~ 1,500	30 x 30 x 3
1,500 ~ 2,200	40 x 40 x 3
Over 2,200	40 x 40 x 5

- (5) Duct width or height 450mm or above and not insulated shall be reinforced with reinforcing ribs spaced at 300mm on center.
- (6) Duct construction shall be as follows:
- (a) Longitudinal corner seams : Pittsburg Lock or Button Punch snap Lock.
 - (b) Cross joints : Transverse Duct Connector (TDC) or Angle Flange System for joint as required.
 - (c) Joints in direction of flow : Permitted only when necessitated by the standard size of steel sheet, and shall be Acme Lock-Grooved Seam.
 - (d) Spacing of seams on the same plane : 900mm minimum on center and kept at least 300mm away from the side seam.
- (7) Duct bend construction shall be as follows:
- (a) Duct bend shall be not less than 1½ times of width of the duct at centerline radius. When smaller radius is required, permission from the Engineer shall be obtained.

- (b) Changes between sections of ducts shall be by gentle slope not greater than 15 degrees and where space requirements dictate, slope may be increased to 30 degrees but only when approved by Engineer.
- (8) Turning vanes shall be provided according to following requirements:
 - (a) For all duct bends with largest dimension 460mm and over and for all turns 45 degrees and over
 - (b) For radius turns, single guide vane shall be provided as shown on the Drawings.
 - (c) For square bends, airfoil type double vanes manufactured specifically for purpose shall be provided and spacing shall be as shown on the Drawings.
- (9) Air extractors shall be provided for all branches from main supply duct to supply air diffusers and registers at right angles to air flow, and elsewhere when necessary. They shall be standard product specifically designed for specified use, and types to provide uniform distribution of air throughout branch duct or register opening with a minimum turbulence. Vanes of extractor shall be adjustable for all locations.

6.3. Spiral Duct

- (1) Spiral duct shall be fabricated from galvanized steel sheet conforming to JIS G 3302 or approved by the Engineer and shall be formed by mechanical rolling with locked or welded joints.
- (2) Galvanized steel sheet thickness shall be as shown in Table 5200.8:

Table 5200.8 Spiral Duct Thickness

Duct Size Nominal diameter (mm)	Steel Sheet Thickness (mm)
Less than 450	0.5
450 ~ 710	0.6
710 ~ 1,000	0.8
1,000 ~ 1,250	1.0

- (3) Duct size shall be based on inside diameter and tolerance shall be zero to plus 2mm (0~+2mm).
- (4) Pitch of seams shall be as shown in Table 5200.9

Table 5200.9 Seams

Duct Size Nominal diameter (mm)	Maximum Seam Pitch (mm)
Less than 100	125
100 ~ 1,250	150

- (5) Width of seams shall be 4.8mm or above.
- (6) Joints shall be formed and constructed as follows:
 - (a) Galvanized steel sheet thickness for joints shall be as shown in Table 5200.10

Table 5200.10 Duct Joints

Duct Size Nominal diameter (mm)	Steel Sheet Thickness (mm)
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Less than 300	0.6
300 ~ 710	0.8
710 ~ 800	1.0
800 ~ 1,250	1.2

- (b) End laps of joints shall be as below:

Table 5200.11 Duct End Laps

Duct Size Nominal diameter (mm)	End Laps (mm) Minimum
Less than 125	60
125 ~ 300	80
300 ~ 1,250	100

- (c) Joints in larger than 710~1000mm nominal diameter ducts shall be reinforced with 30 x 30 x 3 mm thickness L-type formed steel flange.
- (d) Joints in larger than 1000~1250mm nominal diameter ducts shall be reinforced with 40 x 40 x 3 mm thickness L-type formed steel flange.
- (e) Rivets for formed steel flanges and duct shall be 4.5mm diameter and 65mm on center maximum.
- (f) Bolts for flanges shall be 8mm diameter and 100mm on center maximum.

6.4. Flexible Duct

- (1) Silent flexible ducts shall meet the following requirements:
- (a) The silent flexible duct for air conditioning system shall be a high quality heat insulation and soundproof type and made from nylon non woven material with galvanized steel wire (1.0 mm - 1.6 mm dia.)
 - (b) The insulation shall be glass wool (24 kg/m³, 25mm thick) with vinyl chloride film.
 - (c) The silent flexible duct materials shall be non-flammable.
 - (d) The flexible duct shall be installed without any damage on the effective section.
- (2) Flexible ducts shall meet the following requirements:
- (a) The flexible duct for ventilation system shall be of non-combustible material, and shall be corrosion resistant and pressure resistant, e.g. aluminum, galvanized steel or stainless steel material.
 - (b) The flexible duct shall be installed without any damage on the effective section.

6.5. Kitchen Hood Ducts

- (1) All kitchen exhaust ductworks shall comply with the requirements of all local authorities having jurisdiction.
- (2) The kitchen hood shall be fabricated from 1.0 mm or above stainless steel (SUS 430 or 304) with duct joint

- (3) The duct material shall be galvanized steel, and the thickness shall be same as shown in para. 7.2 rectangular duct.
- (4) Outdoor hood shall be fabricated also of stainless steel (SUS 430 or 304, minimum thickness 1.0mm) with stainless steel insect screen and automatic shutter.
- (5) Locations shall be coordinated with layout of ready-made kitchenette cabinets, etc., under Architectural Work.
- (6) Grease/oil filter shall meet the following requirements:
 - (a) At least 75% of oil shall be removed within the hood, before exhaust duct, when tested. Vapor for test shall be generated by the manner that one (1) part of oil to three (3) parts of water shall be simultaneously dropped into aluminum pan to be kept at 270°C.
 - (b) Oil deposit efficiency shall be not more than 10%.

$$\text{Oil deposit efficiency} = \frac{\text{Mass of deposit}}{(\text{Mass of deposit}) + (\text{Mass of recovery})}$$
 - (c) Filter shall have mechanism for automatic oil collection and easy cleaning.
 - (d) Filter shall be of stainless steel (SUS 304) or equivalent.

6.6 Hangers and Supports

- (1) The Contractor may at his option, use various hanger systems for ducts. All systems and components shall be approved by the Engineer prior to installation and shall be coordinated with the metalwork ceiling suspension system.
- (2) Hanger spacing shall not exceed 3.6 meters for 1,500mm (maximum dimension) duct or smaller and 2.4 meters for over 1,500mm (Rectangular ducts), and not exceeding 4.0 m (Spiral ducts).
- (3) Supports and hangers shall be Steel angles same as specified for duct flanges.
- (4) Hanger rods shall be provided and, where not required to be angles the diameter shall be not less than 9mm for 2,200mm wide supports or smaller and 12mm for over 2,200mm wide.

7.0 DUCTWORK ACCESSORIES

7.1. Plenum Chamber

- (1) Plenum chambers shall be fabricated with same materials as rectangular duct shown in para. 7.2 of this Section.
- (2) Thickness for galvanized steel sheet shall be as shown in Table 5200.12.

Table 5200.12 Plenum Chamber

Longest Dimension of Plenum Chamber (mm)	Steel Sheet Thickness (mm)
Less than 750	0.8
750 ~ 1,500	1.0

1,500 or above	1.2
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- (3) Requirements for reinforcing shall be as shown in Table 5200.13.

Table 5200.13 Plenum Reinforcing

Largest Dimension of Plenum Chamber (mm)	Reinforcing Size (mm)	Maximum Spacing (mm)
Less than 750	25 x 25 x 3	925
750 ~ 1,500	30 x 30 x 3	925
1,500 ~ 2,200	40 x 40 x 3	925
2,200 or above	40 x 40 x 5	925

- (4) Access panels, described hereinafter, shall be provided for plenum chamber.
- (5) Duct connections shall be made by flange with gasket.
- (6) Acoustical linings shall be provided at inside of all plenum chambers except those to be used for ventilation system. They shall be made by glass wool with reinforcing and constructions shall be approved by the Engineer:
- (a) 25mm thick for fan coil plenum chamber ducting.
 - (b) 25mm thick for supply/return air diffuser plenum chamber box.
 - (c) 50mm thick for air handling return plenum chamber ducting for baggage claim area, check-in lobby, arrival concourse and gate lounge.

7.2. Canvas Joint

- (1) Canvas joint shall be provided with two (2) layers of vinyl canvas with steel wire reinforcing.
- (2) For air conditioning supply side, there shall be two (2) layers of vinyl canvas with insulation.
- (3) Canvas joint to duct or equipment shall be by flanges or straps as shown on the Drawings.
- (4) Longitudinal seams shall be stitched tightly.
- (5) Required spaced between duct ends or duct end and equipment shall be not less than 150mm.

7.3. Volume Dampers (VD)

- (1) Volume dampers shall consist of frame, movable vanes and operators. Vanes shall have low airflow resistance and shall not vibrate or generate noise.
- (2)
- (3) Vanes shall be made by galvanized steel sheet conforming to JIS G 3302 or approved equal with thickness not less than 1.2mm.
- (4) Number of vanes shall be one each 200mm of duct height or fraction thereof.
- (5) Lap of vanes shall be not less than 15mm.

- (6) Vanes and frame shall be prime painted at factory.
- (7) Operator shall be:
 - (a) Cast iron or bronze made with stops and indications for open and close.
 - (b) Manual dampers shall be provided with operating quadrant and set screws.
 - (c) Motor operated dampers shall not be required.

7.4. Fire Dampers (FD)

- (1) Construction shall be similar to volume dampers except where specified herein.
- (2) The blades shall be fixed in fully open position by fusible link, to close automatically with parting of link, without outside operator.
- (3) Frame and vanes shall be made by sheet metal except thickness not less than 1.6mm.
- (4) Inspection doors shall be provided to access fusible link from outside of duct.
- (5) Fusible link rating shall be as follows:
 - (a) Kitchen exhaust and other dampers subjected to high temperature 120°C or above.
 - (b) All others shall be 72°C or above.

7.5. Non-Return Dampers - Check Dampers (CD)

Non return dampers shall generally be in accordance with the specification for Volume Dampers, but in addition shall incorporate felt rubber at the tips of the blades to provide positive shut off.

7.6. Duct Sleeves

- (1) Duct sleeves shall be provided for ducts passing through prepared openings of floor, walls, ceiling or roofs.
- (2) Sleeve material shall be 1.0mm thickness, galvanized steel duct

7.7. Pipe Hood – Vent Cap (VC)

As shown on the Drawings.

7.8. Diffusers

- (1) Types shall be low noise generating type.
- (2) Gaskets shall be sponge rubber or felt, thickness not less than 5mm, and shall be applied for continuous around full perimeter of each outlet.
- (3) Dampers and shutters shall be adjustable type for easy control of air volume and without removing unit from outlet.
- (4) Finishing shall be factory applied painting with baked enamel or melamine resin paint, colour shall be indicated by the Engineer.

- (5) Ceiling supply air diffusers (Anemostat Type) shall be as follows:
 - (a) Types shall be anodized aluminum construction with dampers or air deflector.
 - (b) Thickness of outer core shall be not less than:
 - (i) Neck diameter less than 250mm : 0.6mm
 - (ii) Neck diameter larger than 250mm : 0.8mm
- (6) Linear Diffusers shall be as follows:
 - (a) Linear diffuser shall be BL, TL and CL type. For BL and TL type, the flow direction shall be adjustable.
 - (b) The body and vane of BL type shall be of aluminum material. The thickness shall be not less than 1.0mm. But when the shape of vane is pouch, the thickness shall be 0.5mm or above.
 - (c) The body of TL type shall be steel sheet, the thickness shall be 0.6mm or above. The vane shall be aluminum material and the thickness shall be 1.0mm or above.
 - (d) CL type shall be aluminum material or steel sheet, the thickness shall be 1.0mm or above.
- (7) Nozzle type diffusers shall be as follows:
 - (a) The frame shall be steel sheet and the thickness shall be 0.8mm or above.
 - (b) The aluminium material shall be 1.0mm or above.
 - (c) The punkah louver shall be adjustable for flow and flow direction up to 60° or above. The body shall be aluminum material and the thickness shall be 0.8mm or above.

7.9. Registers

- (1) Supply air registers (VHS) shall be as follows:
 - (a) Frame and vanes shall be made from aluminum and frame thickness shall be not less than 1.0mm.
 - (b) Vanes shall be 4-way adjustable for supply air register.
 - (c) Shutters shall be roll-formed steel or other material approved by the Engineer and shall be adjustable from front without removal of unit.
- (2) Return air grilles shall be as follows:
 - (a) Frame and vanes shall be same requirements as for supply air registers.
 - (b) Vanes shall be fixed type for return air register.
 - (c) Shutters shall not be provided.
- (3) External wall louvers (refer to Architectural Works)

- (4) External ceiling grilles shall be as follows:
 - (a) Made from aluminium, minimum thickness 1.0mm
 - (b) Effective area shall be not less than 60%.
 - (c) VH (vertical blades outside, horizontal blade inside) type with gasket (sponge, rubber or felt, minimum thickness 5mm, continuous around full perimeter at each outlet)
 - (d) Complete with insect screen inside.
 - (e) Visible screwing and riveting shall not be allowed.
 - (f) All grilles shall be connected to plenum boxes. External ceilings grilles shall be further equipped with demountable air filters.
- (5) Internal ceiling grilles and wall grilles shall be as follows:
 - (a) Aluminium steel minimum thickness 1.0mm, baked paint coated at factory (color shall be selected by Engineer from manufacturer's full color range), or aluminum (minimum thickness 1.2mm).
 - (b) Effective area shall be not less than 60%.
 - (c) Demountable VH type with gasket (sponge, rubber or felt, minimum thickness 5mm, continuous around full perimeter at each outlet)
 - (d) Visible screwing and riveting shall not be allowed
- (6) Access panels shall be as follows:
 - (a) Access panels shall be provided where required for access or cleaning.
 - (b) Access panels shall hinged type with gasket all around and shall be provided with suitable locking devices to maintain positive air seals.
 - (c) Where ducts are provided with acoustical lining, access doors also shall be provided with lining of the same materials.

8.0 DUCT AND ACCESSORIES INSTALLATION

8.1. General

- (1) The duct shall conform accurately to the dimensions required and shall be straight and smooth on the side, with joints neatly finished.
- (2) Ducts shall be made substantially air tight and no dust mark from air leaks shall show at duct joints or connections to grilles, registers or diffusers.
- (3) All edges and slips shall be hammered down to leave a smooth interior duct finish.
- (4) Duct shall be constructed and installed as to be completely free from vibration under all conditions of operation.
- (5) Ducts shall be anchored securely to the structural slab or framing in the building and the method of anchoring or fastening shall be shown on the Drawings.

8.2. Joints

- (1) All flanged joints shall be provided with suitable gasket as approved by the Engineer.
- (2) Insert joints for spiral duct shall be installed as follows:
 - (a) Meeting surfaces of duct shall be coated with sealant just prior to joining.
 - (b) Sections shall be joined and effected with sheet metal screws 300mm on center maximum, 3 per joint minimum.

8.3. Exposed ducts

- (1) Ducts in wet area such as kitchen, shower or toilet, shall have all joints sealed on exterior with sealant or filled with solder.
- (2) Where duct outlets are visible through grilles or registers, interior of outlet box shall be painted with sprayed matt black paint.

8.4. Duct ends

- (1) Duct ends shall extend to not less than 20mm beyond surface of wall or ceiling finish material.
- (2) Duct ends shall be clip notched as necessary and turned back to lay flat against finish material. The flanges shall be secured flat and against movement using screws.
- (3) When complete, flanged and turned back edges of duct ends shall not be visible when grilles or registers are set into place.

8.5. Measurements Holes

- (1) Measurement holes shall be provided at fan discharge and suction, main duct suction, plenum chamber outlet, and elsewhere as required for proper balancing of system.
- (2) Fitting shall have hole not less than 25mm in diameter, and shall be airtight with readily removable plug or cap.

8.6. Registers and Grilles

- (1) Registers and grilles shall be set over gaskets, positioned square plumb and level and secured using screws with matched finish colour of frame.
- (2) When complete they shall be positively free from side leakage of air under frame flanges.

8.7. Duct Supports

- (1) Supports shall be attached to duct using screws or otherwise to prevent slippage or noise.
- (2) Wall or overhead supports shall be anchored to structure using bolts of suitable type and adequate size, or other methods suitable for conditions or materials encountered, only as approved by the Engineer.
- (3) The following shall not be permitted:

- (a) Securing supports to metal decking or roofing unless into or through other structural members.
- (b) Supporting ducts or duct hangers or supports from air handling equipment.
- (4) Upon completion, all wires or other temporary supports shall be removed.

8.8. Field painting

Painting required for surfaces not otherwise specified and finish painting of items primed only at the factory shall be deemed to be included.

8.9. Testing

Ducts, plenums, and casings shall be tested and made substantially airtight at static pressure indicated for the system before covering with insulation or concealing in masonry.

9.0 INSULATION

9.1. General

Air conditioning system shall be provided with insulation work for equipment piping and ducts.

9.2. Glass Wool (For Duct)

- (1) Glass wool insulation board duct coverings, strips and blankets shall conform to JIS A 9504 or approved equal.
- (2) Insulation board shall be (No.2 Class) 32kg/m³ and 40kg/m³ rating.
- (3) Basic materials of insulation strips shall be (No.2 Class) 40kg/m³ insulation board.
- (4) Insulation blankets shall be C type reinforced by metal lath conforming to JIS A 5505.

9.3. Rock wool

- (1) Heat insulating board, cylinder, band and blanket of rock wool shall be standard products conforming to JIS A 9504 (rock wool heat insulating and mineral wool heat insulating materials).
- (2) Heat insulating board shall be class 2, but that used for circular air duct shall be class 2 material covered with glass fiber on one surface.

9.4. Closed Cell Elastomeric Thermal Material (For Refrigerant Pipe and Drain Pipe)

- (1) The material shall be a closed cell and low density of not less than 0.06~0.1gm/cm³ and a low stable K value of 0.035~0.039 w/m³K (at 10~32.2°C mean temperature).
- (2) The material shall be of high molecular weight synthetic elastomers to obtain outstanding weather resistance.
- (3) The material shall contain no toxic or volatile compound and also material shall comply with the ASTM Standard D635, UL-94V, and JIS K 6911.
- (4) All refrigerant pipe work shall be insulated as Table 5200.14.
- (5) Where pipe lines pass through a sleeve, the space between insulation and sleeve shall

be filled with diffusive proof materials. If passing firewall and floor, the filling shall be fireproof.

9.5. Finishing Materials

(1) Galvanized Steel Sheet

- (a) Galvanized steel sheet shall conform to JIS G 3302 or approved equal.
- (b) For outside diameter of insulation, 250mm and smaller shall be 0.3mm thickness.
- (c) For outside diameter of insulation, not less than 250mm shall be 0.4mm thickness.

(2) Aluminium Sheet

- (a) Aluminium sheets shall conform to JIS H 400 or approved equal.
- (b) For valve covering, thickness shall be 0.5mm.
- (c) For outside diameter of insulation, 250mm and smaller shall be 0.5mm thickness, greater than 250 mm shall be 0.6mm thickness.

(3) Stainless Steel Sheet

Stainless steel sheet shall conform to JIS G 4305 and 0.3mm thickness or approved equal.

(4) Vinyl Tape

Conforming to JIS Z 1901, 0.2mm thickness or approved equal.

(5) Asphalted Jute Cloth

Jute cloth shall conform to JIS L 3405, No.7 Asphalt shall conform to JIS K 2207 or approved equal.

9.6. Auxiliary Materials

(1) Kraft Paper

Kraft paper shall weigh not less than 370g/m².

(2) Asphalted Roofing Paper

Conforming to JIS A 6005, weight not less than 940g per m² or approved equal.

(3) Asphalted Felt

Conforming to JIS A 6005, weight not less than 430g per m² or approved equal.

(4) Adhesive Tape

Pressure sensitive polyvinyl chloride conforming to JIS Z 1525. Type 1, 0.2mm thick, width as required or approved equal

- (5) Rivet
 - (a) Use : For securing insulation boards to rectangular ducts.
 - (b) Type : Specifically designed for intended use; with large flat galvanized steel washer under heads for securing insulation.
 - (c) The Contractor may at his option use copper plate spot welded pin.

10.0 INSULATION INSTALLATION

10.1. Piping

- (1) Insulation for drain piping shall be 20mm thickness closed cell elastomeric thermal material covering.
- (2) Insulation for refrigerant piping shall be as follows:
 - (a) It shall be covered with closed cell elastomeric thermal material covering; thickness of covering shall be as shown on Table 5200.14

Table 5200.14 Refrigerant Pipe Insulation

Pipe Size (mm)	Thickness (mm)
~ 41.3	30
53.9 or above	50

- (b) Finishing shall be same specification as for chilled water piping.
- (c) PVC casing shall be used for exterior exposed pipes.

10.2. Ducts

- (1) All supply and return air ducts in air conditioning system shall be insulated.
- (2) The sequence of insulation shall be as follows:
 - (a) Rectangular Ducts Interior Exposed
 - (i) Rivets
 - (ii) Glass wool insulation board
 - (iii) Corners and joints taped
 - (iv) Adhesive
 - (v) Cotton cloth
 - (vi) Paint
 - (b) Rectangular Ducts Interior Concealed:

- (i) Rivets
 - (ii) Glass wool insulation board
 - (iii) Tape all joints
 - (iv) Wire mesh cover
- (3) Thickness of insulation for supply air duct (exposed and concealed) shall be 50 mm, and for return air duct shall be 25 mm
- (4) The following ducts shall not require insulation:
- (a) Ventilation ducts
 - (b) Outside air intake ducts
 - (c) Flexible canvas ducts and joints
 - (d) Ducts and chamber lined with acoustical lining.

10.3. Acoustical Linings

- (1) Provide, where indicated on the Drawings, acoustical duct linings. This lining will be applied internally for acoustical elbow to achieve or restrict the transmission of sound.
- (2) The linings will be applied with wire strips of insulation adhesive:
- (a) On centers
 - (b) At joints in lining
- (3) Additionally the linings will be secured and fastened with welded pins and speed clips located not more than 75 mm from the edges of the duct and spaced at not more than 400 mm centers.
- (4) All joints between insulation batts shall have not less than 50 mm wide overlaps of surface material and shall be adhered as appropriate to present a neat and smooth appearance. Joints in perforated metal shall be lapped with perforating matching and secured with pop rivets at close center to prevent lifting.
- (5) All-end-pieces shall be complete with sheet metal nosing and all corners shall be held firm with angles formed from galvanized sheet steel.
- (6) Acoustic lining shall conform to JIS-A 9504 with a thermal conductivity rating of not more than $.036W/^{\circ}k$ at a mean temperature of $24^{\circ}C$ and shall be of the semi-rigid glass wool type material, having density of not less than 40 kg/m^3 . The insulation shall be 50mm thick with perforated zinc anneal sheet for acoustical elbow.

11.0 AUTOMATIC CONTROLS

11.1. General

- (1) Automatic control system for air conditioning and ventilation equipment shall consist of the functions as follows:
- (a) Air Conditioning Equipment Control System

- (i) Fresh air filter units control system
- (ii) VRF system

11.2. Requirements for Air Conditioning Equipment Control System

- (1) The air conditioning equipment shall be remote controlled for operation by Central Air Conditioning Operation Control Desk installed at Communication Room.
- (2) The air conditioning system shall be divided into three (2) types of operation control system by type or usage of equipment as follows:
 - (a) VRF Control System

VRF air conditioning units shall be operated individually by electrical power from Local Air Conditioning System Motor Control Panel.
 - (b) Packaged/Split Air Conditioning Units Control System

Packaged/Split air conditioning units shall be operated individually by electrical power from Local Air Conditioning System Motor Control Panel.

11.3. Remote Operation Control System

- (1) Air conditioning equipment provided at Passenger Terminal Building, Operation Building, Administration Building, Fire station Building Power house and other buildings shall be controlled for operation by Local Air Conditioning System Motor Control Panel installed at each Mechanical Room.
- (2) Air conditioning and ventilation equipment provided at Passenger Terminal Building shall be remote controlled for operation by Central Air Conditioning System Control Desk installed at Communications Room in Passenger Terminal Building. For the remote operation equipment, see the point schedule of the BMS.

11.4. Operation Monitoring System

- (1) Room conditions for major point of air conditioned areas in Passenger Terminal Building shall be indicated and recorded by a function of Central Air Conditioning System Control Desk. The location of temperature sensors shall be selected as same locations as cooling thermostat installed.
- (2) In order to prevent the spread of fire and smoke via air conditioning system, all air handling units shall be provided with fire dampers in the return air ducts.
- (3) In case of an alarm by automatic smoke detectors, fire detectors or manual operated fire alarm buttons, Fresh air filter unit serving the area shall be switched off.

12.0 TESTING AND BALANCING

12.1. General Requirement

- (1) Tests shall be carried out for all systems required under this Section.
- (2) Testing and balancing shall be included as part of work under the mechanical work.
- (3) Testing and balancing shall be performed by one company or agency especially qualified

- (4) Testing and balancing shall be provided in three (3) phases A, B and C as specified.

12.2. Service Qualifications

- (1) Company (or agency) shall have been regularly performing services of types required for not less than five years prior to Bid Submission date and shall be adequately staffed and owning sufficient equipment.
- (2) Such compliance shall be substantiated by sufficient evidence, given in detail; and submitted with other initial submittals required under the mechanical work.
- (3) Personnel conducting the tests shall be fully knowledgeable and with sufficient experience.
- (4) Equipment and instruments shall be provided as necessary and adequate for the measurements and tests required.

12.3. Phase A – Preliminary

- (1) Preparation
 - (a) Contract Documents shall be examined, together with submittals and service manuals
 - (b) Systems as installed shall be inspected
 - (c) Equipment and adjustment points shall be determined, located and identified
 - (d) Balancing and adjusting sequence schedule shall be prepared
- (2) Fire dampers shall be inspected; air-filters shall be checked and dirty filter elements replaced by disposal or reprocessing.
- (3) Static pressure and velocity readings shall be taken on all major duct branches, and adjustments made in damper settings to approximately specified design conditions.
- (4) Air temperature discharge from direct expansion cooling coils fan discharge, supply and return grilles and diffusers, outside and recycled air, space wet and dry bulbs and other critical points shall be adjusted.
- (5) Air flow and distribution through grilles diffusers, registers and panels in conditioned spaces shall be balanced by adjusting to within 5% of designed air quantities.

12.4. Phase B – Pre-Occupancy – First Stage

- (1) Blower motors shall be inspected and alignment, belt tightness, bearing operation, lubrication and vibration isolations all checked for proper condition operation and efficiency.
- (2) Air filtration system shall be inspected and filter plenums checked. Overall filter banks and individual filter cells or units shall be checked to determine if proper medial and flashing seals are in place to prevent passage of unfiltered air.
- (3) Velocity reading over face of filter media shall be taken.
- (4) Control circuits and automatic filtering equipment shall be checked by simulating operating tests.

12.5. Phase B – Second Stage

- (1) When partitions, furnishings and equipment are in place, air distribution devices in conditioned spaces shall be inspected and re-checked.
- (2) Any problem areas due to object interference with the planned air-flow shall be located and eliminated.
- (3) Temperature and velocity readings shall be taken at work (desk top) and floor levels.
- (4) Mechanical equipment, accessories and devices deemed necessary to effect conditions intended shall be re-adjusted.
- (5) When, with reasonable attention and effort, acceptable conditions cannot be obtained by re-adjustment,
 - (a) The circumstances shall be reported to the Engineer.
 - (b) Further effort shall be delayed until appropriate instructions have been issued by the Engineer.

12.6. Phase C – Occupancy

- (1) Individual space and air outlet temperature adjustment shall be made to meet actual occupancy conditions.
- (2) Building and maintenance personnel shall be instructed in normal operating procedures.
- (3) Additional instruction periods shall be arranged (if required) on equipment requiring highly technical or detailed procedures.

12.7. Report Data Requirements

- (1) The following data, as a minimum, is required to be submitted to the Engineer during testing and commissioning:
 - Blower RPM
 - Calculated CFM
 - Outlet velocity
 - External and total static pressure
- (2) At any minimum outside air
- (3) At any maximum outside air with filter clean
- (4) Other relevant data
 - Air filter net face and media velocities
 - Initial resistance to air flow
 - Grille and diffuser calculated m/s
 - Average grille discharge velocity
 - Occupancy level air velocity and motion
 - Outlet discharge temperatures
 - Diffuser neck and jet velocities
 - Space temperature
 - Branch and main duct velocities and pressures

- Average face velocity
- Increases produced by equipment motors, air whirls or fluid whirls, etc.
- Other readings, data or notations necessary for full evaluation of system functions and operation.

13.0 LIST OF ACCEPTABLE MANUFACTURERS (REFERENCE)

13.1. The following list of equipment and suggested manufacturers is to be used as a reference only as to the required quality and standard. The foregoing Specification requirement indicates minimum performance levels, and the Contractor is expected to satisfy all the requirements by his selection of equipment.

(1) Manufacturer	
VRF	DAIKIN TOSHIBA MITSUBISHI
Fresh Air Filter Unit	SINKO KOGYO KIMURAKOKI
Split Air Conditioner	DAIKIN TOSHIBA MITUBISHI
Automatic Control	AZBIL MATSUSHITA ELECTRIC BUILD SYSTEM
Fans	TERAL KYOKUTO EBARA MITSUBISH
Valves	KITZ YAMATO YOYO
Solar heater	CHIRYU HEATER YAZAKI NORITU
Plumbing Fixture	TOTO INAX HCG

SECTION 5300

FIRE PROTECTION SYSTEM

1.0 GENERAL

1.1. Scope

- (1) This work shall cover the furnishing of all labor, materials, equipment and services necessary or incidental for the complete installation, testing and commissioning of the following Fire Protection systems specified herein.
 - (a) Electric Driven Fire Pump
 - (b) Diesel Engine Fire Pump
 - (c) Jockey Pump
 - (d) Controller
 - (e) Pipe & Fittings
 - (f) Day Tank
 - (g) Sprinkler System
 - (h) Hose Stations
 - (i) Standpipe System
 - (j) FM-200 Gas System
 - (k) Fire Extinguishers
 - (l) Deluge Valve
- (2) Any item of work that is not specifically indicated, but is necessary for the safe and efficient operation of the system, shall be deemed to be included.

1.2. Reference Documents

- (1) The Contractor shall read this Section of the Specification in conjunction with the Conditions of Contract and design requirements specified elsewhere including, but not limited to, the following:
 - (a) Section 1000: General Requirements
 - (b) Section 5050: General Requirements of Mechanical Works
 - (c) Contract Drawing

1.3. Codes and Standards

- (1) In addition to the Codes and Standards listed in para. 10.0 of Section 1135 and para 9.0 of Section 5050 all Fire Protection system works shall be in accordance with the following standards and codes as applicable.

- (a) Fire Code of the Philippines (P.D. No. 1185)
- (b) National Fire Protection Association (NFPA)
 - (i) NFPA 10 Portable Fire Extinguisher
 - (ii) NFPA 13 Sprinkler System
 - (iii) NFPA 14 Standpipe and Hose System
 - (iv) NFPA 20 Stationary Pumps for Fire Protections
 - (v) NFPA 415 Airport Terminal Buildings, Fuelling Ramp Drainage & Loading Walkways
 - (vi) NFPA 2001 Clean Agents
 - (vii) NFPA 750 Water Mist Fire Protections Systems
- (2) Philippine Society of Mechanical Engineers (PSME)

1.4. Interface Work

- (1) Interface work with the Fire Alarm System shall be as follows:

Status of each sprinkler water flow detector switch and supervisory switch shall be monitored by the fire alarm control panel (FCP).
- (2) Interface work with the Water Supply works shall be as follows:
 - (a) The construction and provision of the following shall be the responsibility of the Water Supply works.
 - (i) Water Receiving Tanks which contain the fire protection water reserve to monitor level of water.
 - (ii) Fire Protection Pump Unit and Jockey Pump
 - (iii) Outdoor Hydrant System
 - (b) The Contractor shall coordinate all interface requirements between Fire Protection and Water Supply works. (Refer also to Section 3100)
- (3) Interface work with the Electrical Work shall be as follows:

The normal/necessary power shall be supplied to all electric operated equipment and fixtures, including mechanical ventilation fans or the ventilation system fire dampers.

2.0 SPRINKLER SYSTEM

2.1. Alarm Check Valve

- (1) Shall be Victaulic Fire Lock Series 751, 1 ½-8" (DN 40-DN200) spring assisted Alarm Check Valves, as Underwriters Laboratories Listed (Canada and USA) and Factory Manual Approved, for Vertical and Horizontal Installations, supplied with grade "E" EPDM clapper seal, housing cast of ductile iron conforming to ASTM A-536, Grid 65-45-12, serviceable without removal from the line, with grooved 1 ½- 8" (DN-DN200) or Flanged by grooved 4"-8" (DN 100- DN 200) ends for installations with ANSI class 150 Flange or Victaulic grooved end coupling as applicable, 1 ½- 6" (DN

40- DN 150) rated for service up to 300 psi(2065 kPa). Working pressure, 8 “(DN 200) rated for service up to 225 psi (1550 kPa) working pressure.

(2) Accessories:

- Retarding chamber with complete trimmings-Series 752 with high strength ductile iron body with corrosion resistant exterior or interior coating, suitable for operating pressure to at least 300 psi (2065kPa).
- Retard Vent Kit-Series 752 V –For use with retard chamber when an electric alarm pressure switch is installed without a water motor alarm.
- Water motor alarm-Series 760-Red enamel finished gong shell, with internal components of non-corrosive stainless steel or aluminum, with upstream strainer.
- Alarm Pressure Switch- System Sensor Model “EFS”
- Water flow Detectors- System Sensor Model “WFD”
- Strainer
- Auxiliary Drain Assembly
- Pressure Gauges with Shut –Off Valves
- Alarm Test By-Pass

(3) The drain and the alarm test valves shall have standard identification signs, painted fire red with white lettering. The signs shall be attached to the valve in a conspicuous position.

2.2. Water Motor Alarm

- (1) Water Motor Alarm shall consist of a turbine driven gong incorporating a revolving striking hammer, rotator nozzle, screen, gong and gong cover. The gong shall drain to waste.
- (2) The alarm gong shall be a minimum of 300 mm in diameter and of weather proof construction.
- (3) The gong turbine shall have bronze rotor and sleeve bearings. Provision shall be made for lubricating the rotor bearing in accordance with the manufacturer’s recommendation.
- (4) The water motor alarm should be place visible in the wall near the Fire Alarm tank.

2.3. Water Flow Detector Switch

- (1) Water flow detector switches shall be provided for every zone of the sprinkler system. It shall be interfaced with the Fire Detection and Alarm System, indicating the zone in operation when activated.
- (2) It shall be of paddle flow, clamp-on type with vane projecting into waterway through a hole drilled in the pipe, instantly resetting with 30 to 60 seconds adjustable retard.

2.4. Supervisory Switch

- (1) Supervisory switches shall be provided in each zone at every floor to detect open or close position of valves.
- (2) Any tampering with the valve or switch shall cause a notification alarm to the fire

alarm control panel (FCP).

2.5. Sprinkler Heads

- (1) Types of sprinkler heads shall be as follows:
 - (a) Pendant type (ordinary) – For private areas and offices
 - (b) Pendant type (flush mounted) – For public areas
 - (c) Upright type
 - (d) Side-wall type
- (2) Unless otherwise specified, all sprinkler heads shall be of the bulb type suitably rated and designed for fusing temperatures as follows:

(a) Exposed heads to occupied spaces	68 °C
(b) Ceiling voids or similar	79 °C
(c) Roof spaces	93 °C
(d) External to building shaded/unshaded	93/141 °C
(e) Concessionaire	141 °C
- (3) Sprinkler heads shall be complete with fixed escutcheons plate where applicable.
- (4) Final sprinkler head finishes and/or color shall be specified by the Engineer and shall be submitted by the Contractor for approval.
- (5) Sprinkler heads installed where they may be exposed or subjected to mechanical damage shall be furnished complete with head guards.
- (6) The number and arrangement of required sprinkler heads shall be coordinated with the architectural works to give a neat and aesthetically satisfactory ceiling layout acceptable to the Engineer but notwithstanding this, the entire sprinkler installation shall strictly conform to the relevant Rules and Regulations.
- (7) A stock of spare sprinklers shall be provided within the pump room at the Central Plant complete with the necessary spanners required for replacement.
- (8) The sprinklers shall be stored with the spanners in a suitably sized sheet metal cabinet painted with red baked enamel finish and labeled in white 25 mm high letters with the words “SPARE SPRINKLERS”. Spare sprinklers shall be stocked for all types and/or temperature ratings installed within the protection systems.

2.6. Fire Department Connection

- (1) The fire department connection shall consist of two (2) 65mm diameter instantaneous male coupling connections with caps secured by a suitable length of chain, and an escutcheon wall plate lettered “AUTOMATIC SPRINKLER – FIRE DEPARTMENT CONNECTION”.
- (2) All materials shall be chrome plated brass with polished bright surface.

3.0 STANDPIPE SYSTEM

3.1. Standpipe Riser

The standpipe shall be a wet system and shall be fitted with a 65mm pressure restricting hose valve with cap secured by a chain as shown on the Drawings. The topmost location of the riser shall have a pressure gauge rated for 20kg/cm² (300 psi).

3.2. Fire Department Connection

Same as fire department connection for sprinkler system but wall plate shall be marked "STANDPIPE – FIRE DEPARTMENT CONNECTION".

4.0 HOSE STATIONS

4.1. Fire Hose Cabinet (Including other Building)

- (a) The fire hose cabinet shall be manufacturer's standard enamelled steel box recessed type, with frame and door suitable for mounting conditions as indicated on the Drawings.
- (b) The finish of the cabinet shall be white baked enamel. Door shall be full glass panelled with steel door frame painted to match adjacent surface unless otherwise noted.
- (c) The cabinet shall be equipped with valve; hose rack assembly and a 4.5kg multi-purpose ABC dry chemical fire extinguisher and or Carbon Dioxide Fire Extinguisher if the area is in Electrical Room.
- (d) Valve for hose service shall be provided with male hose thread outlet compatible with semi-rigid hose couplings. The finish shall be rough brass.

4.2. Hose Rack Assembly

- (1) Hose rack shall be listed type and fitted with a 40mm diameter x 30 meter long single jacketed rubber lined hose with an adjustable straight fog nozzle.
- (2) The nozzle assembly shall be constructed of gunmetal, brass or other sufficient robust and corrosion resisting material.

5.0 FM 200 GAS SYSTEM

5.1. System Description

- (1) The Contractor shall design, supply, install and guarantee the performance and selection of the components of the complete gas extinguishing system and complying with the Specification and relevant codes.
- (2) FM 200 system shall consist of but not limited to the following:
 - (a) The system shall be designed to provide a minimum 7% volume concentration of extinguishing agent.
 - (b) Cylinders of FM 200 gas system shall be complete with discharge valves and discharge cables.
 - (c) Manual discharge break-glass device.
 - (d) Pipe work shall be seamless carbon steel pipe for pressure service and in accordance with ASTM A 53. Schedule 40 for 20mm and smaller, schedule 80 for 25mm and larger. Class 300 malleable iron fittings for 50mm and forged steel fittings in all larger

sizes.

- (e) Gas discharge nozzles.
- (f) Cross-zone smoke or heat detectors for detection and actuation of the gas system.
- (g) Wiring in metal conduit.
- (h) Control panel complete with battery charger, booster charger, pre discharge timer, high quality maintenance free sealed lead acid battery, 12 or 24 VDC alarm bell, alarm test switches and automatic and solenoid valve actuation provision etc. The Engineer shall approve the complete control system.
- (i) All necessary warning, sign and instruction.
- (j) Red and green flashing indicator lights.
- (k) The containers shall be designed for holding the liquid gas form at ambient temperatures. Containers shall be distinctly and permanently marked with the type and quantity of agent contained therein, together with the degrees of super pressurization.
- (l) Manifold containers shall be adequately mounted and suitably supported in a design for convenient individual servicing or content weighing.
- (m) The system shall be designed so there is no agent loss from the manifold if the system is operated when any containers are removed for maintenance. A reliable means of indicating (other than weighing) pressure shall be provided to determine the pressure in refillable containers.
- (n) Pressure indication shall take the variation of container pressure with temperature into account. In a multiple cylinder system, all cylinders supplying the same manifold outlet for distribution of agent shall be interchangeable and preferably of one selected size and charge.

5.2. Detection and Automation Equipment

- (1) Automatic detection and actuation shall be used. Automatic detectors shall be an approved combination of ionization smoke detectors and heat detectors capable of detecting and indicating conditions that are likely to produce fire.
- (2) The detector shall be of cross-zone system, that the actuation of one zone shall be verified by another zone prior to activation of the gas pre-discharge timer.
- (3) Operating devices shall include the gas releasing devices, discharge controls and shutdown equipment and other necessary items for an efficient and reliable performance of the system.
- (4) Operation shall be by approved electrical means and electrical detection shall be of the normally open contact type. An adequate and reliable source of energy consisting of lead acid battery and normal electrical supply shall be used in the detection and operation of the system.
- (5) All devices shall be located, installed or suitably protected so that they are not subjected to mechanical, chemical or other damage, which would render them inoperative.
- (6) All automatically operated valves controlling agent release and distribution shall be provided with approved independent means for emergency manual operation break-glass type or pull-box (linkage type) and shall be easily accessible.
- (7) All devices for shutting down supplementary equipment shall be considered an

integral part of the system and shall function with the system operation.

5.3. Operating Alarm and Indications

- (1) Upon activation of the fire alarm for the evacuation of the personnel from the hazard area, the control system shall shutdown the mechanical ventilation fans or the ventilation system fire dampers.
- (2) An alarm indicating failure of supervised devices or equipment shall give prompt and positive indication of any failure and shall be distinct from alarms indicating operation conditions.
- (3) Warning and instruction signs at entrances to and inside protected areas shall be provided. RED flashing indicating lights with the word "EVACUATE" shall indicate pending the gas discharge.

5.4. Wiring System

- (1) All wirings shall be carried out in accordance with the Specifications of the Electrical Works and the Fire Detection and Alarm System.
- (2) End of line resistors shall be provided for supervising the continuity of each fire alarm group or zone.

5.5. Control Panel and Alarm System

- (1) Control module complete with battery charger, high quality heavy duty maintenance free sealed lead acid battery, alarm, meters and gas discharging system shall be supplied and installed.
- (2) Indication of alarm and fault conditions of the system shall be provided to the control panel.
- (3) The control panel shall be provided with but not be limited to the following:
 - Ammeter and battery test facilities.
 - Mains on, charger on, and DC on indicating light.
 - Alarm reset switch.
 - Buzzer silence switch and indicating light.
 - Bell silence switch and indicating light.
 - Fault indicating light.
 - Fuse indicating light.
 - The gas actuated indicating light and buzzer.
 - The gas cut off switch and indicating light.
 - Heat zone of isolation / normal fault test, amp fault test, isolation switch, indicating alarm and isolated light.
 - Smoke zone of isolation / normal fault test, amp fault test, isolation switch, indicating alarm and isolation light.
 - Air conditioning or ventilation fan and ventilation system fire dampers cut-off relay with separate alarm reset switch.

5.6. Discharge Nozzles

- (1) Discharge nozzles shall be listed and approved for their intended use and discharge characteristic. The discharge nozzles shall consist of the orifice and any associated horn, shield or baffle.
- (2) The size of the orifice shall be compatible with the design discharge rate. Orifices shall be of corrosion resistant metal.
- (3) Nozzles shall be permanently marked to identify them and to show the equivalent single orifice diameter regardless of shape and number of orifice.
- (4) Discharge nozzle shall be provided with frangible discs or blowout caps where clogging by foreign materials is likely. These devices shall provide an unobstructed opening upon system operation.

6.0 FIRE EXTINGUISHERS (INCLUDING OTHER BUILDING)

- 6.1.** Multi-purpose ABC dry powder extinguishers shall be of steel cylinder with brass valve body, brass valve check and stainless steel spring with discharge horn. Portable type, 4.5kg capacity shall be provided in all fire extinguisher cabinets (FEC), fire hose cabinets (FHC) and on the required place as indicated on the drawings.
- 6.2.** Carbon dioxide extinguisher shall be seamless aluminum alloy cylinder. The brass valve assembly shall be of the squeeze grip type and have a molded horn attached to the valve assembly.
- (a) Portable type, 4.5kg or 9.0kg capacities shall be used in all mechanical, electrical, electronics and kitchen areas.
 - (b) Wheeled type, 23.0kg capacity shall be used in generator room, switchgear room and transformer room.
- 6.3.** Brackets designed to prevent accidental dislodgement of extinguisher shall be provided for portable type extinguishers not located in cabinets.
- 6.4.** Fire extinguisher cabinets (FEC) shall be recessed type steel body with baked enamel finished. Steel door frame shall be painted to match adjacent surface unless otherwise noted. Cabinet door shall be glass paneled, allowing full view of the extinguisher.

7.0 PIPEWORK, VALVES AND FITTINGS

7.1. Fire Protections Piping and Buried Piping

- (1) Steel Pipe: ASTM A 795 and/or ASTM A 53; Schedule 40, black
- (2) Steel Fittings: ANSI/ASME B 16.5, Steel Flanges and Fittings
- (3) Cast Iron Fittings: ANSI/ASME, b 16.1, Flanges and Fittings
- (4) Joints: ANSI/AWS D10.9, welded
- (5) Casing: Polyurethane Insulations with high density polyethylene jacket and heat shrink sleeves.

7.2. Fire Protection Piping and Buried Looping Piping

- (1) Centrifugal Cast Iron: AWWA C151;

7.3. Fire Protection Piping above Ground Piping

- (1) Steel Pipe: ASTM A 795 and/or ASTM A 53; Schedule 40, black
- (2) Steel Fittings: ANSI/ASME B 16.11, forged steel socket welded and threaded
- (3) Cast Iron Fittings: ANSI/ASME, b 16.4, Screwed Fittings
- (4) Malleable Iron Fittings: ANSI/ASME B 16.3,screwed type
- (5) Mechanical Grooved Couplings: Coupling shall be cast of ductile iron conforming to ASTM A-395,Grade 65-45-15,and or ASTM A-536,Grade 65-45-12,with bolts/nuts conforming to ASTM A- 449 and A-183.Standard Grade “E” gaskets to be used for all Fire Protections systems in Pump House .
 - (a) Rigid Joints- Rigid couplings shall be of the angle pattern bolt pad type, and shall provide system support and hanging requirements in accordance with NFPA 13. Rigid couplings shall be fully installed at visual pad to pad offset contact. (Tongue and recess type couplings, or any couplings that requires exact gapping of bolts pad on each side of the coupling at specified torque ratings, are not allowed.).
 - (b) Flexible Joints-For flexibility and seismic considerations, couplings shall be Victaulic Style 75, Fire –Lock.
 - (c) Reducing Joints-Shall be Victaulic 750 with Grade E standard gaskets and zinc electroplated bolts/nuts for direct connections of pipe of different sizes.
 - (d) Outlet Couplings-All joints designated Outlet Couplings, or where feasible to replace reducing outlet tees, shall be Victaulic Style 72.
 - (e) Gaskets:

Fire Protections Service	Temperature Range	Gasket Recommendations	Remarks
Water /Wet System	Ambient	Grade EPDM, Type A	

- (6) Fire department connection piping shall be carbon steel pipe for pressure service, schedule 40, and conform to the requirements of ASTM A 795. Fittings and joining of the pipes are same as the above.
- (7) FM 200 Gas System pipe work shall be seamless carbon steel pipe for pressure service and in accordance with ASTM A 795.
 - (a) Schedule 40 for pipes 20mm and smaller
 - (b) Schedule 80 for pipes 25mm and larger
 - (c) Fittings shall be same as the above.
- (8) All sites welding shall be made by the electric arc process. The welding process shall be approved by the Engineer. Only qualified welders approved by the Engineer shall be employed in making welded joints.

7.4. Valves and Fittings

- (1) Gate Valves

All gate valves shall be listed, outside screw and yoke and position indicator shall be fitted with supervisory switch directly hooked-up to the fire alarm control panel (FCP).

- (a) Materials : 50mm dia. and smaller by bronze body and trim
65mm dia. and larger by Ductile Iron conforming to ASTM A-536
- (b) Joint : 50mm dia. and smaller by screw ends
65mm dia. and larger by Victaulic
- (c) Pressure rating : 10kg/cm² or 150 psi
- (d) Applicable standard : Body, ductile iron conforming to ASTM A-536
O S & Y Cast iron conforming to ASTM A-126-B

(2) Check Valves

Shall be Victaulic Series 717 Fire Lock Check Valve
Ductile iron body to ASTM A-395, grade 65-45-15 and ASTM A-536

(3) Pressure Relief Valve

Pressure relief valve shall be listed and conforms to UL designation, "Special System Water Control Valve Class II". Body of the valve shall be cast iron, trim and pilot system shall be brass, bronze or stainless steel components.

(4) Pressure Gauges

- (a) Outside diameter shall be 100mm and equipped with a cock. Scale shall indicate the working pressure of the system and the highest scale shall be 150% to 200% of the working pressure.
- (b) Applicable standard shall be ASME B 40 including the attachment in conformance to the Specifications ASME B 40.1 & ASME B 40.7.

(5) Deluge Valve

- (a) Deluge Valve features a high strength, low weight, ductile iron body with pneumatic, hydraulic and electrical actuations methods.
- (b) The straight –through body design provides superior flow and low pressure drop.
- (c) It offers simple access to all internal parts for easy maintenance. All internal parts are replaceable. The valve is painted inside and out to increase corrosion resistance.
- (d) Maintenance and service can be performed from the installed positions. The rubber clapper seal is replaced easily without removing the clapper from the valve.
- (e) The body is tapped for main drain and all available trim configurations. The low differential design is not subject to water columns. The systems can only be installed in a vertical configuration.
- (f) The valve allows the water to operate a water motor alarm and /or electric pressure alarms, which continue until the flow of water stops.

- (g) The valve can be configured for wet pilot, dry pilot or electrical activations.
 - (h) The valve is rated to 300 psi/2065 kPa water working pressure and is factory tested hydrostatically to 600 psi/4135 kPa for sizes 1 ½ -8”/40 -200 mm . When applicable, required air pressure is 13 psi/90 kPa.
 - (i) The series 769 is available in grooved x grooved. Standard grooved dimensions conform to ANSI/AWWA C 609.
- (6) Installations Options:
- (a) The Victaulic series 769 Firelock NXT Deluge Valve is available bare, or in the following configurations.
 - (b) Pre Trimmed
 - (i) The pre trimmed valve comes completely assembled with all necessary trim components.
 - (c) Vic-Quick Riser
 - (i) The Vic-Quick riser comes completely pre trimmed and includes a shut off valves (uses a Series of 705 W Firelock Butterfly valves-request publications of 10.18; for 1 ½ and 2”/40 and 50 mm sizes, the vic-quick risers comes with a series of 728 Ball Valve-request publications 10.17 for system shut off, pressure switches, and a drain for ease of installations.
 - (ii) For complete Vic –Quick Riser Information’s request publications is 30.20.

7.5. Testing of Pipe Work

- (1) Progressive hydrostatic testing of all pipe work shall be carried out as follows:
 - (a) Sprinkler system – 13.33kg/cm² (200 psi)
 - (b) Hose stations – 1.5 times working pressure
 - (c) Standpipe riser piping – 13.33kg/cm² (200 psi)
 - (d) FM-200 piping – 20.0kg/m² (300 psi)
- (2) Allowable pressure drops must not exceed 5% of test pressure during the test period. Welded joints with leak are not to be caulked but shall be cut and re-welded. Any other work shall be replaced if found defective.

8.0 FIRE PUMP AND JOCKEY PUMP

8.1. Summary

This Section covers providing all labor and materials for the installation of electric motor driven fire and jockey pumps complete with controllers, valves, piping, supports, alarms and supplementary items necessary for a complete, operational, code compliant and approved system.

8.2. Reference Standards

- (1) The latest published edition of a reference shall be applicable to this Project unless

identified by a specific edition date.

- (2) All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- (3) All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - (a) Factory Mutual System (FM) - Approval Guide and Loss Prevention Data Sheets
 - (b) NEMA MG-1 - Motors and Generators
 - (c) NEMA 250 - Enclosures for Electrical Equipment (1000 Volt Maximum)
 - (d) NFPA 20 - Installation of Centrifugal Fire Pumps
 - (e) NFPA 70 – National Electric Code
 - (f) UL - Fire Protection Equipment Directory
 - (g) UL 448 - Pumps for Fire Protection Service
 - (h) UL 778 - Motor Operated Water Pumps
 - (i) UL 1478 - Fire Pump Relief Valves

8.3. Regulatory Requirements

- (1) Conform to NFPA 20 and FM Data Sheet 3-7N for installation and testing of fire pumps, drivers and controllers.
- (2) Panglao Municipal Fire Department
- (3) Panglao, Bohol Fire Department Standards

8.4. Quality Assurance

- (1) Perform Work in accordance with NFPA 20 and FM Guidelines.
- (2) Obtain and become familiar with requirements of Owner's insurance underwriter and incorporate all applicable provisions for compliance.
- (3) Thoroughly and clearly document all Project related communications with code and regulatory agents and expediently forward communication documentation to Project Manager.
- (4) Equipment and components shall bear UL and FM label or marking.
- (5) Maintain at least one copy of all system related documents on Site.
- (6) Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. The manufacturer shall supply all necessary pump accessories (controller, driver and accessories, gauges, etc.) to provide a complete pump installation, as detailed in FM Global Property Loss Prevention Data Sheets. The pump manufacturer shall be held accountable for the complete pump package and installation.

- (7) Installer's Qualifications: The system shall be installed by a firm having minimum three year experience regularly engaged in the installation of automatic fire pump systems in accordance with requirements of the National Fire Protection Association
- (8) The manufacturer of the fire pump system shall be responsible for compliance with all applicable codes.

9.0 DELIVERY, STORAGE AND HANDLING

- 9.1. Accept fire pumps and components on site in factory packing. Inspect for damage. Comply with manufacturers rigging and installation instructions.
- 9.2. Protect fire pumps and components from physical damage including effects of weather, water, and construction debris.
- 9.3. Provide temporary inlet and outlet caps, and maintain in place until installation.

10.0 MAINTENANCE SERVICE

- 10.1. Furnish service and maintenance of fire pump, driver, and controller for one year from date of Taking-over.
- 10.2. Provide one complete set of gaskets, screens and seals for each pump type and model supplied.

11.0 PRODUCTS

- 11.1. All materials shall meet or exceed all applicable referenced standards, local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- 11.2. Pressure ratings of pumps, pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the anticipated system pressures in which they are installed.
- 11.3. The Contractor shall ascertain for himself the space and access available for the installation of a factory assembled packaged unit and as an option may assemble the various components in place at the Site in lieu of providing a factory assembled unit. However, all components of the system shall be compatible and be furnished by a single source manufacturer and all electrical services and interconnecting equipment wiring must be provided for within this Contractors bid.
- 11.4. All of the equipment listed herein, shall be mounted on a structural steel base that is equipped with grout holes. All wiring and piping including pressure sensing lines, bypass with check valve and shut-off valves, as well as approved pump suction and discharge valves shall be furnished firmly anchored to the steel base by means of structural steel supports and arranged such that single point connections are required for piping and power supply.
- 11.5. The packaged pumping system shall include all electrical wiring between components and shall be completed and tested at the factory prior to shipment. The entire assembly shall be painted red after hydrostatic and electrical tests.
- 11.6. All pilot lights and visual indicators shall be illuminated from the rear by long life LED lamps. Neon and incandescent lamps are not acceptable.
- 11.7. All similar components shall be of one manufacturer, (i.e., controllers).
- 11.8. Refer to fire and jockey pump schedules on Contract Drawings for required pump capacities and electrical characteristics.

12.0 FIRE PUMP

- 12.1. The fire pump** shall deliver not less than 150% of the rated capacity at a pressure of not less than 65% of the rated head. The shutoff head shall not exceed 140% of the rated head.
- 12.2.** The pump shall be a horizontal split case, bronze-fitted, centrifugal pump with the pump driver complete with flexible coupling and coupling guard. The pump shall have a common horizontal centerline between the suction and discharge connections. The suction and discharge connections shall be the same size.
- 12.3.** Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- 12.4.** Impeller: Bronze double suction fully enclosed, balanced and keyed to shaft.
- 12.5.** Bearings: Grease lubricated ball bearings, grease able and replaceable without opening casing, selected for minimum 50,000 hour life.
- 12.6.** Shaft: Alloy steel with replaceable bronze shaft sleeve.
- 12.7.** Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 230 degrees F maximum continuous operating temperature.
- 12.8.** Base plate: Cast iron with integral drain rim.
- 12.9.** The following manufacturers are acceptable provided their products meet or exceed these Specifications and the Contract drawing schedules: Aurora, Peerless, Patterson or Allis-Chalmers.
- 13.0 FIRE PUMP ACCESSORIES**
- 13.1.** Eccentric suction reducer and OS&Y gate on suction side of pump. No butterfly valve shall be installed on suction side of pump.
- 13.2.** Concentric increaser and check valve in pump discharge and OS&Y gate or butterfly valve on system side of check valve.
- 13.3.** Fire pump bypass fitted with normally open and supervised OS&Y gate or butterfly valves and double-check valve assembly.
- 13.4.** Suction pressure gauge, 3-1/2 inch minimum diameter dial with snubber, valve cock and lever handle.
- 13.5.** Discharge pressure gauge mounted on board attached to pump, 3-1/2 inch minimum diameter dial with snubber, valve cock and lever handle.
- 13.6.** Float operated 3/4-inch automatic air release valve.
- 13.7.** Venturi flow meter system, FM approved, meter reading in GPM, flow sensor, and all required accessories.
- 13.8.** Fire pump test header with number and size of hose valves per NFPA 20.
- 14.0 FIRE PUMP ELECTRIC MOTOR DRIVE**
- 14.1.** The electric motor for the fire pump shall be a standard NEMA design B, open drip proof, continuous duty rated, suitable for wye-delta start with 1.15 service factor and UL listed for fire pump applications.
- 14.2.** The locked rotor current shall not exceed the values specified in NFPA 20. The motor shall be

wound for 230 volts, three phase, 60 cycles' operation, and 1750 rpm with operating horsepower as scheduled on Contract Drawings and as required by the fire pump to meet NFPA Standards.

15.0 ELECTRIC FIRE PUMP CONTROLLER

15.1. The controller shall be UL listed and FM approved for fire pump service and shall meet or exceed all the requirements of the latest editions of NFPA 20 and the National Electric Code, NFPA 70.

15.2. The fire pump controller shall be of the combined manual and automatic type designed for wye/delta reduced voltage closed transition type operation having the same horsepower, voltage, phase, and frequency rating as required of the motor, be housed in a NEMA 3R enclosure and include the following:

- (1) Time delay circuit breaker set at 300 percent motor full load current.
- (2) Isolation switch with single external operating handle interlocked with circuit breaker. Operating mechanism shall be flange or side mounted.
- (3) Non-fused control power transformer.
- (4) START and STOP pushbuttons for manual control.
- (5) Ammeter test links and voltmeter test studs
- (6) POWER AVAILABLE pilot light to indicate power on the load side of the circuit breaker and PHASE REVERSAL pilot light for the line side of the motor starter. Pilot lights shall be mounted externally.
- (7) Surge protector wired to the line side of the isolation system.
- (8) Solid state pressure switch and transducer with energize to start relay. Pressure switch shall be differential adjustable type with LED indicators for trip and reset.
- (9) Minimum run time, adjustable 0 - 10 minutes with timed-out LED indicator; Per NFPA 20 and FM pump should be arranged for "manual stop" the run-timer and auto stop function must be disabled.
- (10) Magnetic contactors with externally operable mechanical start mechanism.
- (11) Two sets each of dry form "C" contacts for remote indication of PUMP RUNNING, POWER FAILURE and PHASE REVERSAL.
- (12) The electric fire pump controller shall also include an automatic start relay of the drop-out type, and a local built-in alarm panel powered from a separate reliable 120 VAC power source.
- (13) The local alarm panel shall have individual indicating lights with a common alarm bell and silence button for POWER FAILURE, PUMP RUNNING, PHASE REVERSAL, LOW DISCHARGE PRESSURE, TRANSFER SWITCH IN EMERGENCY, ISOLATION SWITCH OPEN and REMOTE START.
- (14) A local indicating light and two sets of remote alarm contacts shall be furnished to monitor SUPERVISORY POWER of the local alarm panel.
- (15) Two sets of dry form "C" remote alarm contacts shall be provided for LOW DISCHARGE PRESSURE, TRANSFER SWITCH IN EMERGENCY and

ISOLATION SWITCH OPEN.

- (16) A separate pressure switch shall be supplied to monitor discharge pressure.
- (17) All indicators shall be illuminated from the rear by long life LED lamps. Incandescent lamps are not acceptable.
- (18) The electric fire pump controller shall be manufactured by Metron, Firetrol, Master, or equivalent.

16.0 AUTOMATIC TRANSFER SWITCH

16.1. The automatic transfer switch shall be wired to the fire pump controller and mounted in a separate compartment with an isolation barrier.

16.2. The automatic transfer switch shall include an isolation switch and externally operable handle, voltage and frequency sensitive relays for normal power, voltage and frequency sensitive relays for emergency power sensed from emergency control power transformer, normal and emergency control power transformers, and time delays for ENGINE START, TRANSFER TO EMERGENCY, RETRANSFER TO NORMAL and ENGINE COOLDOWN.

16.3. The transfer switch shall also include provisions for preventing higher than inrush currents when transferring power in direction, a TEST switch and pilot lights for NORMAL POWER and EMERGENCY POWER.

16.4. The automatic transfer switch shall be manufactured by Metron, Firetrol or Master.

17.0 PRESSURE MAINTENANCE (JOCKEY) PUMP

17.1. Electrically operated, horizontal turbine close-coupled or vertical multi-stage centrifugal type with standard open drip-proof motor.

17.2. The following manufacturers are acceptable provided their products meet or exceed these Specifications and the Contract drawing schedules: Grundfos, Aurora, Peerless or Allis-Chalmers

18.0 JOCKEY PUMP CONTROLLER

18.1. The electric jockey pump controller shall include a circuit breaker, magnet starter with overloads, pressure switch, H-O-A selector switch, minimum run timer, dual fused control power transformer, START pushbutton, two sets of dry form "C" remote alarm contacts for PUMP RUNNING and NEMA 3R enclosure.

18.2. The jockey pump controller shall be manufactured by Metron, Firetrol or Master

19.0 EXECUTION

19.1. Installation

- (1) Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- (2) All installation shall be in accordance with manufacturer's published recommendations.
- (3) Provide access space around pumps for service. Provide no less than minimum as

recommended by manufacturer.

- (4) Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings or pump suction and discharge.
- (5) Flow meter shall discharge into atmospheric suction tank. Flow meter loop shall not circulate back to the pump suction line.
- (6) Locate fire pump test hose valve header on exterior wall accessible from grade level.
- (7) Provide piping to, and route discharge from all relief valves and drains to exterior of building and terminate at a location and in a manner to prevent any damage to surrounding areas.
- (8) Provide full line size bypass with double-check valve assembly around surge tank and fire pump.
- (9) Coordinate connection to electrical service.

19.2. Instructions and start-up

- (1) Contractor shall provide for the service of a competent factory-trained supervising agent from the fire pump manufacturer to inspect the completed installation, start the system and acquaint the operators with the proper operation and maintenance of the equipment.

19.3. Testing

- (1) Perform acceptance and operation testing on entire system in accordance with NFPA 20.
- (2) Test shall be witnessed by UTMDACC Environmental Health and Safety Department representative or designee.
- (3) A field performance characteristic curve shall be produced and compared for verification to the factory performance curve.
- (4) Submit verification of test results to Architect/Engineer and include within operation and maintenance manual.
- (5) Check, align, lubricate and certify pumps per NFPA 20 prior to startup. Notify Owner 48 hours in advance of alignment check.

19.4. Warranty

- (1) The complete system shall be warranted in writing against defects in materials or Workmanship under normal use and service for a period of one year after date of Substantial Completion.

New Bohol Airport Construction and Sustainable Environmental Protection Project

Specifications

Section 6000 Series: Electrical Works

SPECIFICATIONS

SECTION 6000 SERIES: ELECTRICAL WORKS

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SECTION 6050

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

1.0 GENERAL REQUIREMENTS

- 1.1 The provisions of **Section 1140** are applicable to some items of Plant and systems and are to be referred to in connection with 6000 Series of the Specification.
- 1.2 The following provisions are additional to, and are to be read in conjunction with, Section 1140, and are particular to 6000 Series of the Specification.
- 1.3 Reference shall also be made to Section 3200 for applicable requirements.

2.0 SCOPE

- 2.1 This Section shall apply generally to the following Sections:
 - (a) Section 6100 : Power Feeder System
 - (b) Section 6200 : Lighting and Wiring Devices System
 - (c) Section 6300 : Telephone and PABX System
 - (d) Section 6400 : Cable TV System
 - (e) Section 6500 : Public Address System
 - (f) Section 6600 : Master Clock System
 - (g) Section 6700 : Closed Circuit Television (CCTV) System
 - (h) Section 6800 : Fire Detection and Alarm System
 - (i) Section 6900 : Lightning Protection and Grounding System
- 2.2 As well as the manufacture, supply, installation, testing and commissioning of the Electrical Systems the Contractor shall also be responsible for:
 - (a) Application of electric power, telephone connections and Cable TV services including preparation of all necessary drawings, forms and related documents, payment of all required fees and charges, and coordination with other authorities (Government and Private) or persons involved in the procedures. Such coordination and application submittals shall be executed in sufficient time to ensure permanent electric supply shall be available to meet the requirements of the Contract. The Contractor shall coordinate early and properly with Telephone and Cable TV Companies regarding the actual fees and charges based on actual installation and requirements.
 - (b) All permits and fees required for inspection and certification of the Electrical Systems by the proper City of Municipal Government after completion of the work. The

Contractor shall prepare all drawings, forms and related documents required by the approving authorities.

3.0 QUALIFICATIONS

3.1 Manufacturers of Electrical Equipment and/or Systems

- (1) Shall have been regularly producing equipment or systems of types required for not less than five (5) years prior to closing date of the Bid.
- (2) Shall take full responsibility for all requirements of electrical equipment or systems where specified under respective Sections of the Specification.
- (3) Shall be capable of providing immediate emergency service within three (3) official working days after notification by the Employer.
- (4) Shall be capable of entering into full service maintenance agreement with the Employer. (Refer also to Section 1155)
- (5) Shall be capable of providing well trained and experienced workmen in types of work required, and in direct employment of electrical equipment manufacturer.

3.2 Electrical Subcontractor

- (1) Company shall regularly provide types of work required for not less than (10) years prior to closing date of Bid.
- (2) Shall take full responsibility for all requirements under the Electrical Work, except as or otherwise specified above and including all necessary coordination of and with manufacturers of electrical equipment and systems.
- (3) Shall be capable of providing well trained and experienced workmen in work of types required.

4.0 SUBMITTALS REQUIREMENTS

4.1 General

- (1) Submissions are required as specified herein.
- (2) Materials and equipment shall not be ordered or fabricated until respective submissions have been approved.

4.2 Material Lists

- (1) Shall comprise listing of equipment proposed under Electrical Work, each item identified by reference to item number, schedule and detail as shown on the Drawings or included in this Specification or in the Bills of Quantities.
- (2) Each item or system should be accompanied by manufacturer's complete specifications, technical data and installation instructions.

- (3) Each specification or technical data sheet shall be annotated as to specific item described, required or proposed. General or multiple-item sheets not so identified shall be rejected.
- (4) Equipment identification schedule shall also be provided.

4.3 Shop Drawings

Refer to para. 2.0 of Section 1165.

4.4 Material/Color Samples

Shall be provided for primary materials, finishes or other components as and when requested by the Engineer.

4.5 Certification of Materials

Required from equipment or system manufacturers or from independent testing agencies employed by them indicating compliance with requirements of Specification herein for various items of equipment and system.

4.6 Certification of Installation

- (1) Required for all Electrical Work.
- (2) Prepared by the Contractor, or by independent testing agencies regularly providing test and inspection work of types required and as retained by the Contractor.
- (3) Reports shall be provided inclusive of information and/or data as specified under the electrical testing requirements.
- (4) All permits and fees required for Electrical Work shall be obtained by and at the expense of the Contractor. The Contractor shall furnish the Engineer with final certificates of electrical inspection and approval from the proper Government authorities after completion of the work. The Contractor shall prepare all drawings and all forms and documents required by the approving authorities.

4.7 Operation and Maintenance Manuals

Refer to para. 16.01 of Section 1165.

4.8 Training of Employer's Personnel

- (1) The provisions of Section 1150 are applicable and are to be referred to in connection with 6000 series of the Specification.
- (2) The following provisions are additional to, and are to be read in conjunction with, Section 1150, and are particular to 6000 series of the Specification.
- (3) Local on Site training for operation and maintenance of some of the Electric Systems shall be conducted by the Contractor covering the minimum required schedule shown below.

- (4) The Contractor shall include the cost of instruction for the trainees, together with training manuals and materials to be used in the courses, in his unit rates or lump sum prices, unless identified separately in the Bills of Quantities.
- (5) The minimum required schedule is

(a) Section 6300: Telephone and PABX System:

Type of training	Operation	Maintenance
No. of personnel	2	2
Duration	1 day	5 days

(b) Section 6700: Closed Circuit Television (CCTV) System

Type of training	Operation	Maintenance
No. of personnel	2	2
Duration	1 day	5 days

(c) Section 6800: Fire Detection and Alarm System

Type of training	Operation	Maintenance
No. of personnel	2	2
Duration	1 day	5 days

4.9 Tools and Spare Parts

- (1) The provisions of para. 17.0 and para 18.0 of Section 1165 are applicable and are to be referred to in connection with 6000 Series of the Specification.
- (2) The following provisions are additional to, and are to be read in conjunction with, paras. 17.0 and 18.0 of Section 1165, and are particular to the 6000 Series.
- (a) The Contractor shall supply spare parts sufficient for two (2) years normal operation and equipment and systems. This two (2) year period commences after the issue date of the Taking-over Certificate.
- (b) The Contractor shall assure the availability of the same type or substitutes of equal or better quality for at least ten (10) years after the issue of the Defects Notification Period.
- (c) The Contractor shall be responsible for the spare parts list as recommended. This list shall be prepared by the Contractor and submitted to the Engineer within one hundred and twenty (120) days from the Commencement Date. Thus, during the Defect Notification Period should any defect occur which would require replacement of parts other than the spare parts recommended by the manufacturer, the Contractor shall supply as soon as possible the needed spare parts at his own expense.

- (d) The quantity of spare parts shall be recommended by the manufacturer for the period stated in para. 4.9(2)(a) above. The recommended quantity shall be approved by the Engineer who shall have the right to reject the quantity offered.

5.0 RELATED REQUIREMENTS

5.1 Approvals

- (1) Notify the Engineer not less than ten (10) working days in advance for each item of work being prepared for testing or inspection.
- (2) Rough-in work shall be inspected and approved by the Engineer prior to being covered, concealed or otherwise made inaccessible.

5.2 Precautions

- (1) When using any toxic, noxious or otherwise hazardous material, the Contractor shall follow and comply with precautions of manufacturer.
- (2) Safety precautions regarding materials and installations shall be followed at all times to avoid damage or injury caused by fire or accident.

5.3 Protection

- (1) The work herein described shall be protected during construction and after completion.
- (2) Adjacent construction finishes shall be protected. Should adjacent exposed surfaces become stained or otherwise damaged resulting from the use of materials or operations under this Section they shall be repaired at the Contractor's expense and as directed by the Engineer.

5.4 Maintenance Services

Refer to Section 1155.

5.5 As-built Drawings

Refer to para. 5.0 of Section 1165.

6.0 COORDINATION/CORRELATION REQUIREMENTS

6.1 General

- (1) Utility rough-ins, including required tests and other work to be covered up or concealed shall be completed and approved before such is enclosed or otherwise made inaccessible.
- (2) Power systems to be provided under any separate contracts shall be tested and approved prior to actual energizing of such power into electrical systems work required under this Section.

- (3) Systems under this Section shall be completed, tested and approved to extent necessary to ensure safety prior to utilization of said power sources.
- (4) The Contractor shall provide completely coordinated shop, coordination and working drawings in accordance with the requirements of para. 3.0 of Section 1165

6.2 In Advance of Work under this Section

All work under this Section shall be coordinated with layouts and other requirements for associated work under other Sections and adjustments shall be incorporated as and where necessary for properly coordinated installation.

6.3 In Advance of Work under other Sections

- (1) Specific and proper construction or substrate conditions necessary to effect securely anchored or attached work under other Sections shall be ensured by the Contractor.
- (2) Layouts, templates and/or instructions shall be provided as necessary for proper preparation of supporting construction.

6.4 Embedded or Concealed Items

All necessary sleeves, inserts, bolts, backing plates or other incidentals embedded in concrete or masonry or attached to and concealed by work under other Sections shall be provided. They shall be supplied complete with layout plans, templates and/or instructions as required.

7.0 CONTRACT DRAWINGS

- 7.1 Contract Drawings shall be examined as necessary to achieve fully coordinated and proper installations as intended herein.
- 7.2 Electrical systems layouts indicated on the Drawings are generally diagrammatic and location of openings, outlets and equipment are approximate only. Therefore the exact routings and locations including layouts and positions of conduits, outlets, equipment and other items to be coordinated with architectural and structural elements shall be determined and the necessities of work of other Sections identified.
- 7.3 The capacity of circuit breakers and sizes of cables may have to be modified due to changes in capacity of the equipment to be proposed by the Contractor. Such modification shall be executed after approval from the Engineer. The cost thereof shall be deemed to be included in the Contract Price.
- 7.4 The Engineer shall be notified of any discrepancies or deviations discovered in the Contract Documents.

8.0 SUPERVISION OF ELECTRICAL WORK

- 8.1 Full-time services of experienced Professional Electrical Engineers well qualified in directing and overseeing all phases of the various works under this Section shall be furnished.
- 8.2 Services of manufacturer's representatives or other especially qualified persons as necessary shall be furnished to supervise electrical systems or equipment installations when regular full-time supervisors are not otherwise fully qualified.

9.0 OPERATION BEFORE FINAL ACCEPTANCE

- 9.1 Should the Employer require that any portion of building, Plant or equipment be operated prior to date of substantial completion, the Contractor shall consent and such operation shall be under supervision and direction of the Contractor.
- 9.2 These operations so required prior to substantial completion shall not be construed as nor constitute acceptance of work so operated.

10.0 CODES, STANDARDS AND REGULATIONS

Standards for materials, equipment and/or installation, shall comply with the relevant codes, Standards and regulations listed in para. 10.0 Section 1135.

11.0 PRODUCT REQUIREMENTS

11.1 Electrical Materials, Assemblies and Systems

- (1) Unless or except as shown, specified or approved, manufacturer's first quality line of standard and/or series of factory fabricated items shall be provided as shown or specified.
- (2) Comparable materials, assemblies and systems of manufacturers other than as specified may be proposed where differing in minor details only and otherwise compliant with requirements shown or specified, subject to prior approval by the Engineer.
- (3) Materials and equipment shown or specified shall be essentially standard catalog products of an approved manufacturer, and variations therefrom shall be only as specified.
- (4) Where two (2) or more units of same class, type or kind are required, units shall be products of a single manufacturer. However, component parts of a system need not be products of the same manufacturer.
- (5) Where a device or part of a piece of equipment is referred to in singular number, such reference shall apply to as many devices or parts as are needed to complete work required.
- (6) Similar mechanical and electrical parts and components should be identical throughout each system and be readily interchangeable.
- (7) Electrical equipment of similar type shall be designed, fabricated and supplied by a single manufacturer for all work included in this Section.
- (8) Substitution of keyed locks not complying with specified requirements shall not be permitted.
- (9) Substantial increase in overall size(s) of pieces of equipment or major components shall not be permitted, unless approved in advance by the Engineer.

11.2 Fabrication / Construction Requirements

- (1) All products for work under this Section shall be designed, fabricated and constructed for purposes and uses intended and in accordance with or capable of meeting standards for the electrical work as specified herein.
- (2) Compliance shall be substantiated by sufficient and adequate prototype testing or otherwise evidenced by such operational reports and data as may be required by the Engineer to fully demonstrate performance characteristics, operational qualities, reliability, safety and other relevant considerations.
- (3) All pull and terminal boxes, panelboards and switchgear enclosures, including cabinet frames and bodies, fronts, doors and like parts, shall be cleaned, primed, finished with two (2) coats of grey enamel and baked, in accordance with approved manufacturer's standard factory processes.
- (4) Unless otherwise specified, materials shall be galvanized, sherardized or otherwise protected by approved standards factory processes.
- (5) Special finishes shall be provided where shown or specified.
- (6) Requirements under other Sections of the electrical work shall govern material requirements to the extent applicable; .

12.0 EXECUTION REQUIREMENTS

12.1 Prerequisite Conditions

- (1) Prior to work commencement the following shall be required:
 - (a) All provisions shall be reviewed for/from other Sections for requirements affecting this work.
 - (b) Details of work shall be reviewed with the Engineer, and adjustments incorporated that are deemed necessary and as directed.
 - (c) Building shall be adequately enclosed and/or protected for interior work.
 - (d) For electrical systems or other sensitive equipment or components, building shall be entirely enclosed and fully protected.
- (2) The work shall not proceed until ancillary work is in proper condition per requirements specified herein and any incorrect construction conditions have been corrected and reinspected.
- (3) The Contractor shall ensure all installation work is carried out under the direct active supervision of persons who have adequate technical qualifications and experience, and that sufficient number of trained personnel and adequate facilities are available to perform the installation.
- (4) When required by the Engineer the Contractor shall provide competent factory representatives to supervise the installation, start-up, test and adjustment of equipment, and to orient the Employer's personnel in the proper operation and maintenance of the equipment.

12.2 Completion Requirements

- (1) During construction the Contractor shall:
 - (a) Remove waste and debris resulting from the work in this Section as work progresses and on completion.
 - (b) Service and adjust moving or mechanical parts for smooth, quiet and proper operating condition.
 - (c) Touch-up abraded or damaged prime painting or galvanizing and leave clean and ready for finishing work required.
- (2) Upon completion the Contractor shall ensure the following:
 - (a) Exposed surfaces shall be clean and free from dust, dirt, scratches, dents, broken parts, misaligned or improperly fitted joints, stains, discoloration or other defects or damage.
 - (b) Installation shall be free from exposed fastenings, unnecessary cuts, holes, blank plates or advertising labels or signs other than as particularly shown, specified or approved.
 - (c) Exterior or below grade installations shall be watertight throughout and free from leaks or entry of water into or through interior or concealed spaces of the structure.
 - (d) Each item, unit, or assembly shall be tightly and rigidly secured in place, free from unnecessary movement, squeaks or rattles.
 - (e) Each item, unit, or assembly shall be set straight, plumb and level, accurately positioned at locations required and adjacent similar units accurately aligned.
 - (f) Movable or mechanical items or devices shall be serviced and adjusted to operate smoothly, quietly, easily and free from binding, superfluous or unwanted noises.
 - (g) Electrical devices, assemblies or systems shall be properly connected and grounded and operating in compliance with the performance requirements and tested as specified.
- (3) Electrical work not in compliance shall be repaired or replaced as directed or required by the Engineer at the expense of the Contractor.

12.3 Collateral Work Requirements

Collateral work listed below shall be provided and included as part of the work associated with this Section:

- (a) Excavation: refer to Sub-Section 2130.
- (b) Concrete: refer to Section 1400.
- (c) Structural steel: refer to Sub-Section 4230.

- (d) Miscellaneous metal: refer to Sub-Section 4350.
- (e) Sealant work: refer to Sub-Section 4320.
- (f) Aluminum work: refer to Sub-Section 4350.
- (g) Galvanizing requirements: refer to Sub-Section 4350.

12.4 Detailed Coordination

- (1) Provisions herein are in addition to para. 5.0 of this Section.
- (2) Work under this Section further includes coordination of and with work under other Sections, to provide and effect complete and operable systems and equipment throughout the Works as required under the Contract Documents.
- (3) Coordination includes, among others, considerations of locations, sizes, capacities and performance characteristics of equipment furnished and installed under other Sections.
- (4) Coordination further includes providing adjustments in the electrical work to meet needs of said equipment and cooperation with other subcontractors as may be necessary to make the determination required.
- (5) Minor adjustments shall be provided as and where necessary or directed by the Engineer at no additional cost to the Employer.
- (6) The Drawings shall be reviewed for necessary openings and access provisions to be provided for the electrical work. The sizes and locations shall be verified that they are adequate and proper and additional openings shall be arranged where and as may be required.
- (7) Services that shall be provided under the electrical work shall be verified and adjustments incorporated where and as may be necessary to adequately and properly serve referenced Plant and equipment.
- (8) Conduit, cable, wire, service line controls or other items necessary for but otherwise not provided as part of equipment shall be included in scope of work.
- (9) Outlets, switches, etc. shall be located for easy and convenient access when work is complete.
- (10) The electrical work systems shall be activated as and when necessary for equipment start-up, testing, adjusting and preliminary and demonstration operation. The systems shall be activated sufficiently in advance to permit completion of the above specified operations not later than scheduled preliminary test of the items of equipment.
- (11) The electrical work requirements herein are defined in general terms only. The Contractor and manufacturers shall be responsible for all design and fabrication details necessary to provide work and operations as intended under and required by this Specification.
- (12) Electrical service characteristics shall be as follows:

230V, 3 phase, 3 wire or 4 wire or single phase 2 wire, 60Hz, AC

- (13) All equipment and systems shall be designed and installed free from creating any electromagnetic or other emissions which could cause interference with any communications or signal systems required in the operation of the airport whether installed under this Contract or under other contracts.

12.5 Protective Painting

- (1) Protective painting is required for materials, Plant and equipment not otherwise galvanized, prefinished, protected or included for field painting under this Section, and includes all locations, whether exposed or concealed in completed work.
- (2) Surfaces to be painted shall be cleaned free from dirt, dust, rust, grease or foreign matter. They shall be thoroughly wiped clean, using suitable solvent where necessary and dried.
- (3) Surfaces shall be primed and undercoated with rust inhibitive metal primer.
- (4) Finish painting shall be high gloss enameled or stove enameled as appropriate.
- (5) For concealed secondary or support surfaces only black asphaltum type paint shall be applied.
- (6) Painting for the following shall be two (2) coats, unless otherwise specified:
 - (a) Galvanized steel and items inaccessible after installation;
 - (b) Galvanized pipe including valves and other accessories within seven (7) days following installation; and
 - (c) Hanger rods and devices and other items not galvanized.

12.6 Cutting and Patching

All necessary holes, accesses and supports shall be provided wherever necessary and where prior arrangements therefore have not been otherwise provided, including any and all cutting, removals, sleeves, frames, escutcheons or other accessories, required replacements, repair, patching, cleaning, refinishing and other work as may be required and make good. All work to be approved by the Engineer.

13.0 HANGERS, ANCHORS, ETC.

13.1 General

- (1) Types of hangers, anchors, fixing etc. shall be appropriate for materials and conditions encountered and only as shown, specified or approved. The sizes shall be adequate for loads and forces involved.
- (2) Power-actuated types in lieu of removable mechanical fastenings shall not be permitted, unless otherwise shown or approved.

- (3) Inserts of carbon steel to hold hangers and supports shall be placed prior to concrete pouring on slab, beam and columns, in order to protect reinforcing bars, embedded pipes, etc.
- (4) Cutting or welding to structure for support shall be permitted only as and where shown, specified or approved for each specific condition or location.
- (5) Supporting piping conduit or equipment by attaching directly to metal shall not be permitted.
- (6) Steel items throughout shall be hot-dip galvanized or corrosion resistant painted, plated or treated by approved methods.

13.2 Continuous Supports

- (1) Continuous supports shall be manufacturer's standard prefabricated type of C-channel, roll formed from steel strip of thickness not less than 2.5mm, in standard length units for minimum of splices. The type shall be complete with matching splice covers, insert devices suitable for hanger rods, etc. that are required to be supported.
- (2) They shall be secured to overhead concrete using unit anchors as specified hereinafter, set through pre-punched holes in C-channel webs, spaced at not over 200mm from each end channel unit and at not more than 600mm centers in between.

13.3 Unit Anchors

- (1) Unit anchors shall be manufacturer's standard type of steel insert bolts designed for use in hardened concrete with pre-tested and pre-determined load values and in various types and sizes suitable for varying installation requirements. Each unit shall be selected in accordance with manufacturer's certified load carrying capacity tables as approved.
- (2) Each unit shall be selected to safely support work required and when under full load conditions, and as appropriate for strength or conditions of concrete to which attachment is being made.
- (3) The selection shall be determined using factor of safety not less than 5 times actual or real load to be supported.
- (4) In any and all cases, bolt shank diameter shall not be less than 15mm.

13.4 Other Connections

- (a) Heavy items to steel framing
Machine bolts, nuts and washer set through drilled holes.
- (b) Light items to steel framing
Machine screws set into drilled and tapped holes or set through drilled holes with nuts and washers.
- (c) Light items to sheet metal

Headed fasteners with threads designed for sheet metal work, self-drilling, self-tapping.

- (d) Sizes

Appropriate for load to be supported and as approved.

13.5 Attachments not Permitted

- (a) Wood blocking embedded in concrete.
(b) Wood, fiber, plastic or lead type inserts.

14.0 EQUIPMENT REQUIREMENTS

14.1 Wiring Diagrams

- (1) Wiring diagrams are required for all motors and controls and for each electrical system included under Electrical Work. They shall be provided singularly, where practical, or in sets as necessary to clearly portray all relevant connections and interconnections. All sheets shall be in one (1) uniform size.
- (2) Complete sets of wiring diagrams shall be included with the Operation and Maintenance Manuals.
- (3) In addition, complete sets of all diagrams shall be provided for permanent wall mounting for each type or group of diagrams located in different locations as directed by the Engineer. Each shall be provided with cover of clear plastic in thickness not less than 3.0mm for diagram sizes 400mm x 400mm and larger, 1.5mm for smaller sizes retained in neatly fabricated aluminum frame secured to wall using matching screws.

14.2 Lubrication Requirements

- (1) Lubrication facilities shall be provided for all parts involving friction and wear other than where suitably covered or protected by resilient materials or where provided with life-time packing or fittings.
- (2) Include all necessary grease fittings, oiling caps or other like facilities as required to maintain equipment properly protected and with all like items essentially identical and serviceable using same lubrication tools throughout.
- (3) Locate lubrication facilities where readily visible and easily accessible.
- (4) Lubrication tools shall be required as follows:
- (a) One (1) complete set for each type of necessary system; and
- (b) Set of hand tools of suitable types and adequate sizes, contained in a suitable box or panel.
- (5) Removable units securely supported and fastened in place, constructed using wire mesh in steel angle or flat bar frames each mechanically secured into place against

accidental removal. Wire mesh shall be woven, galvanized steel wire not less than 1.4 mm, mesh size not larger than 7.0 mm by 7.0 mm.

14.3 Safety Guards

Safety guards shall be provided for all sheaves, couplings and other running equipment which could cause physical injury upon accidental or inadvertent contact.

14.4 Keyed Locks and Switches

- (1) Locks and switches required to be keyed shall be masterkeyed to one (1) set or sets for common types of facilities, such as panelboards and for various different locations (i.e. different building).
- (2) Exact requirements for keying shall be as directed by the Engineer at later date after commencement of the Works.

15.0 EQUIPMENT IDENTIFICATION REQUIREMENTS

15.1 General

- (1) Exposed surfaces of fixtures, Plant and equipment shall be free from shop or factory applied manufacturer's/vendor's labels, insignia, emblems, decals or other like devices.
- (2) All items otherwise identified only in compliance with the requirements specified herein.
- (3) A complete listing of signs required, giving full text proposed for each item, shall be submitted to the Engineer for approval. Approval must be obtained prior to ordering or fabrication of signs.

15.2 Manufacturer's Identification

- (1) Required for each factory fabricated fixture or equipment item, shall be applied so as to be concealed when item is installed and normally closed, readily visible and readable when opened.
- (2) Each such label or nameplate may be of standard manufacture, shall be non-corrosive and durable and each permanently affixed.
- (3) Labels or nameplate shall state fixture or equipment item type, model number, rating and current characteristics.

15.3 Product Identification Signs

- (1) Required for each electrical equipment item, in readily visible locations, each sign shall be installed level and accurately and symmetrical positioned.
- (2) Sign size : suitable for equipment
Colors : as indicated by the Engineer
Letters : plain block or gothic style only

15.4 Circuit Directory

- (1) Required for each panel containing electrical control or safety devices installed on inside of panel doors.
- (2) Each directory shall be correlated with panel as arranged and installed and in typewritten form only.
- (3) Each directory shall be protected and retained by suitable frame and clear plastic cover.

16.0 SCOPE OF ELECTRICAL WORK

16.1 Main Distribution Lines

General extent of work is listed below but should not be considered as being complete:

- (a) Supply, construction, completion and testing of all distribution boards, main and sub-main circuits.
- (b) Supply, installation, completion and testing of all main lines between distribution boards and loads including local switches.
- (c) Supply, installation, completion and testing of all branch lines between distribution boards and motor control panels.
- (d) Control circuits between motors and control panels.
- (e) Grounding of equipment.

16.2 Systems Installation

The detailed scope of installation work is set out in the relevant Section of the Specification.

17.0 CABLE AND WIRE

17.1 General

The requirements hereunder shall be applicable to all electrical and wire materials and installations required for work under this Contract, except as may be additionally specified or otherwise under other Sections.

17.2 TW Wire – 0.6 kV Grade

- (1) Polyvinyl-chloride (PVC) insulated, applied on conductor concentrically in circular form.
- (2) Insulation shall be free from flaws, bubbles and other defects.
- (3) Maximum allowable temperature of conductors, in normal condition shall not exceed 60°C.
- (4) Wire shall withstand 1.5 kV to 3.5 kV for at least one (1) minute of dielectrical test.

- (5) TW type, 0.6 kV conductor's sizes required shall comply with requirements of PEC.
- (6) Insulation and thermoplastics shall conform to IEC 228, JIS C 3307 or equivalent.

17.3 THHN Wire – 0.6 kV Grade

- (1) Cross-linked polyvinyl chloride (PVC) insulated, applied on conductor concentrically in circular form.
- (2) Insulation shall be free from flaws, bubbles and other defects.
- (3) Maximum allowable temperature of conductors, in normal condition, shall not exceed 90°C.
- (4) Cable shall withstand 1.5 kV to 3.5 kV for at least one (1) minute of dielectrical test.
- (5) THHN type, 0.6 kV conductor sizes required shall comply with requirements of PEC.
- (6) Standards shall comply with JIS C 3317 or equivalent.

17.4 PVC/PVC Wire – 0.6 kV Grade

- (1) Polyvinyl chloride insulated, applied on conductor concentrically in circular form in PVC sheathing.
- (2) Insulation shall be free from flaws, bubbles and other defects.
- (3) Maximum allowable temperature of conductors, in normal condition shall not exceed 60°C.
- (4) Required number of insulated conductors shall be stranded together with suitable fillers to create circular form and wrapped with rubberized cloth tape.
- (5) Polyvinyl chloride sheathing applied over taped insulated conductors and fillers concentrically in circular form.
- (6) PVC/PVC cable shall withstand 1.5 kV to 3.5 kV for at least one (1) minute of dielectrical test.
- (7) Standards shall comply with IEC 228, JIS C 3342 or equivalent.

17.5 TF Wire – 0.6 kV Grade

- (1) Polyvinyl chloride insulated, applied on conductor concentrically in circular form.
- (2) Insulation shall be free from flaws, bubbles and other defects.
- (3) Maximum allowable temperature of conductors, in normal condition shall not exceed 60°C.
- (4) Wire shall withstand 1.5 kV to 3.5 kV for at least one (1) minute of dielectrical test.
- (5) Standards shall comply with IEC 228, JIS C 3401 or equivalent.

17.6 XLPE Cable – 0.6 kV Grade

- (1) Cross linked insulated, applied on conductor concentrically in circular form.
- (2) Insulation shall be free from flaws, bubbles and other defects.
- (3) Maximum allowable temperature of conductors, in normal condition shall not exceed 90°C.
- (4) Wire shall withstand 1.5 kV to 3.5 kV for at least one (1) minute of dielectrical test.
- (5) Insulation and sheathing (if required) Standards shall conform with IEC 228, JIS C 3605 or equivalent.

17.7 Telephone Cable

- (1) Telephone cable shall be color-coded polyethylene insulated and outer sheaths shall be manufactured from a material having Low Smoke and Fume (LSF), non-halogen properties.
- (2) Conductors shall be 0.50 mm in diameter (minimum) of annealed copper, tinned, Unshielded Twisted Pair (UTP), category 5e to be used for floor distribution cabling.
- (3) Insulated conductors, uniformly twisted pair together to form a quad and with insulated conductors positioned.

18.0 CABLE AND WIRE - INSTALLATION

18.1 General

- (1) Conductors or cables shall not be installed in cable rack, conduits, raceways or cable pits until such system has been completed.
- (2) The Contractor shall exercise due care to prevent damage to conductors, insulation or sheathing.
- (3) All feeder cables installed in the building shall be continuous from origin to panel or equipment terminations without running splices in intermediate pull or splice boxes except to where tapes and splices are necessary and approved by the Engineer. In such cases they shall be made in approved splice boxes and using suitable connectors.
- (4) All cable and wire splices shall be made in pull boxes, junction boxes, manholes or handholes.
- (5) Conductors of different systems shall be installed as follows:
 - (a) Conductors for light and power systems of 600 V or less shall be permitted to occupy the same enclosure, without regard to whether individual circuits are insulated for maximum voltage of any conductor within the enclosure;
 - (b) Excitation, control, relay and ammeter conductors used in connection with any individual motor or starter shall be permitted to occupy the same enclosure as the motor circuit conductors; and
 - (c) Conductors of signaling or radio systems shall not occupy the same enclosure with conductors of light or power systems.

- (6) All cable terminals and splices shall be made secure using solderless pressure-type connectors unless otherwise specified; where solder joints are specified, cable joints shall be mechanically strong before soldering with solder to be carefully applied without use of acid and wrapped with insulating plastic tape in the approved manner.
- (7) The Contractor shall furnish and install all hangers, cable cleats and supports required to make a neat and substantial cable installation.
- (8) Each cable when completely erected shall have permanently attached to it at each end and at intermediate positions as may be considered necessary by the Engineer, non-corrosive metal plates upon which shall be engraved or stamped, identification number of cable, voltage, rating conductor size and make.
- (9) Cable identification numbers shall comply with cable schedules which shall be prepared by the Contractor according to cables as actually installed. These cable schedules shall indicate cable numbers, cable sizes, voltage, number of conductors, conductor size, termination and connections at each and cable route.
- (10) Where cable passes through building exterior walls and ground floors, cable holes shall be completely filled using suitable non-flammable and waterproof sealing materials.

18.2 Installation in conduit

- (1) No cable or wire shall be installed until inside of conduit has been cleaned.
- (2) Sum of cross-sectional area of cables or wires installed in conduit shall be less than 40% of cross-sections are of conduit.
- (3) Conductor ends at least 15 mm in length shall be left at each outlet and switch point for splices or for connection of fixture or devices.
- (4) All cables and wires shall be installed in good order in pull-boxes, junction boxes, manholes and handholes.
- (5) Wires and cables for power and lighting shall be in separate conduit from any wires of cables for communication and signal systems.

18.3 Installation in cable trench

- (1) All cables shall be supported in trench using cable rack fixed on the base of the cable trench.
- (2) All cables shall be installed in orderly rows.
- (3) Where cable passes through metallic covers of cable trench, adequate space shall be provided between cable and cover.

18.4 Installation in metal cable ducts

- (1) Cable splices made and insulated by approved methods shall be permitted only at junctions of cable and where accessibility is secured.
- (2) The weight of cables shall not directly be loaded to cover of ducts.

- (3) Cables/wire identification shall be provided at junctions and other important points along ducts.
- (4) Cable protector of PVC or other synthetic resin shall be provided at cable entrances.
- (5) Carbon steel divider (1.6mm minimum thickness) shall be provided between ordinary cables/wires and cables for fire alarm and detection systems (excluding heat proofed cables or fire rated cables).

18.5 Installation on cable racks

- (1) Cable splices made and insulated by approved methods shall be permitted within a cable rack provided they are accessible and do not project above side rails.
- (2) Cable shall be fastened securely to transverse members of cable racks.
- (3) Where single conductor cables comprising each phase or neutral of a circuit are connected in parallel, conductor shall be installed in groups consisting of not more than one (1) conductor per phase or neutral, to prevent current imbalance in paralleled conductors due to inductive reactance and single conductor shall be bound in circuit groups to prevent excessive movement due to faulty current magnetic forces.

18.6 Installation in raceways

- (1) For splicing cables, joints boxes matching raceways shall be provided.
- (2) Cable protection of PVC or other synthetic resin shall be provided at cable entrances.
- (3) Cables and wires shall be laid in raceways in good order.
- (4) Sum of cross-sectional area of cables and/or wires installed in raceway shall not exceed 20% on internal cross-sectional area of raceways.

19.0 CONDUIT - MATERIALS

19.1 Intermediate Metallic Conduit (IMC)

- (1) Fabricated of steel strips and tubed by welding without any seam, except seams parallel to tube axis.
- (2) Conduit shall be practically straight, uniform in thickness and shall have both ends cut at right angles to long axis and each end reamed or chamfered.
- (3) Both internal and external surfaces shall be galvanized
- (4) Surfaces shall be smooth both internally and externally.
- (5) Special care shall be taken to maintain internal surface free from burrs or other harmful projections.
- (6) Thin type and threadless type shall be used inside concrete only.

19.2 Flexible Metal Conduit

- (1) Side walls shall be constructed of two (2) layers of strip steel inside and out and coiled in opposite directions with fiber insulation in between.
- (2) Couplings shall be cast-iron or steel-plate not less than 1.6 mm thickness.

19.3 Unplasticized Polyvinyl Chloride Conduit (Above ground installation)

- (1) Conduits shall be straight, uniform in thickness and with both ends cut at right angles to long axis and each reamed or chamfered free from burrs or other projections.
- (2) The external and internal surfaces shall both be smooth.

19.4 Unplasticized Polyvinyl Chloride Pipes (Underground installation)

- (1) Underground pipes shall be protected by concrete (minimum 15mm thick, 180 kg/cm²)

20.0 CONDUIT INSTALLATION

20.1 General

- (1) Conduits shall be installed and supported in a rigid and satisfactory manner.
- (2) Where a conduit enters a box or fitting a bushing shall be provided to protect the wire from abrasion, unless design of box or fitting is such as to afford equivalent protection.
- (3) Conduit runs between outlet and outlet, fitting and fitting or outlet and fitting, shall not contain more than the equivalent of 4 quarter bends, 360 degrees total, including those bends immediately at outlet or fitting.
- (4) All cut ends of conduit shall be reamed to remove rough edges.
- (5) Where conduit is threaded in the field, an electrical conduit thread cutting die with a taper shall be used.
- (6) Conduit shall be firmly fastened within 0.9 m of each outlet box, junction box, cabinet or fitting and intermediately supported at least every 1.5 m.
- (7) Conduits runs which extend through areas of different temperatures or atmospheric conditions or which are installed partially indoors and outdoors shall be arranged in a manner which shall prevent drainage of condensed or trapped moisture into pull boxes, cabinets or enclosures.
- (8) Raceways shall be installed at right angles or parallel, to building lines.
- (9) Embedded conduits shall be installed as close to the middle of concrete slabs, walls or columns as practical without disturbing reinforcement in accordance with the following:
 - (a) Outside diameter of embedded conduit shall not exceed 1/3 of the slab thickness and adjacent conduits shall be spaced not closer than 3 diameters centers;

- (b) Approved type spacers shall be provided to maintain proper clearance between reinforcement and conduit; and
 - (c) Conduit shall be secured prior to placing concrete or like materials to prevent movement during placing operation.
- (10) During construction conduits shall be plugged to prevent entrance of foreign matter, plugs shall not be removed until ready for cables or wires.
- (12) Conduit for future use shall have No. 16 galvanized pull wire, or nylon pull rope minimum 3 mm diameter, 0.5 m minimum extending at each end, coiled and tagged to identify location of opposite end.
- (13) All conduits and pipes exposed to the surfaces to receive mortar shall be covered by at least 210 mm wide metal lath. Any conduits and pipes shall not directly receive mortar, unless otherwise specified herein.
- (14) The opening of walls for conduits, pipes or cable racks shall be closed in the following manner:
- (a) Pipe sleeve in concrete walls
 - (i) Galvanized steel pipe type: to be fixed prior to concrete pouring. Void between and conduit to be filled by:
 - waterproofing mortar, polystyrene back-up and polysulfide, sealant (external wall)
 - mortar (internal wall)
 - waterproofing mortar, polystyrene back-up and polyurethane sealant around entrances on both inside and outside of manhole. End of synthetic resin at cable entrance.
 - (ii) Galvanized steel sheet type: Galvanized steel sheet: 1.2 mm thick, zinc coating 380 g/m² with galvanized steel anchoring materials. Void filler shall be silicone grey filler, including neoprene gasket and polysulfide sealant all around galvanized steel sheet and cables; 20 mm thick waterproofing mortar all around in opening of wall.
 - (b) Opening through CHB wall
 - Void between conduit and wall to be filled by:
 - mortar (internal wall)
 - waterproofing mortar, polystyrene back-up and polysulfide sealant (external wall)
 - (c) Fiber reinforced cement board covers on slabs and fire rated walls:
 - Fiber reinforced cement board shall be calcium silicate board, 25 mm minimum thickness; void filler shall be rockwool, 200 kg/m³ or more; sealant

shall be all around cables and fiber reinforced cement board, and shall be heat resistant; 20mm thick mortar finish to opening of wall

20.2 Installation of Flexible Metal Conduit

Any run of conduit for concealed raceway between outlet and outlet, fixture and fixture or outlet and fixture shall not contain more than equivalent of 4 quarter bends, 360 degrees total.

20.3 Installation of Steel Pipe Conduit

- (1) Shall be installed where shown, spacing not less than as shown, all joints shall be made up using couplings only as approved, each joint tight and secure.
- (2) Trench bottoms shall be formed with curved transitions at slope changes to avoid over-stressing conduit or joints.

20.4 Installation of Polyvinyl Chloride Conduit

- (1) Bends of conduit shall be so made that conduit shall not be damaged and the internal diameter of conduit shall not be effectively reduced.
- (2) Field bends shall be made only using bending equipment intended for the purposes and with radius of curve of inner edge of bends not less than six (6) times nominal diameter of conduit.
- (3) All joints between lengths of conduit and between conduit and couplings, fittings and boxes shall be made by a method approved for the purpose.

21.0 SPECIAL WIREWAY

21.1 General

All special wire way specified hereunder shall be grounded.

21.2 Ready-Made Metal Cable Duct

- (1) Materials shall be as follows:
 - (a) Metal duct and separator shall have factory paint coating and shall be of 1.6 mm thick carbon steel with zinc coating or phosphated carbon steel (minimum thickness 1.6 mm) with anti-rust painting.
 - (b) Cover plates greater than 800 mm wide shall be divided into two (2), and opening for cover shall be reinforced by angular bars.
 - (c) Ducts shall be fabricated and assembled free from sharp edges, burrs or projections.
 - (d) Jointing of ducts shall be done by coupling. (Outside frames may be allowed where approved)
 - (e) Jointing between ducts and pull boxes, panel boards, etc. shall be by outside frames.
 - (f) End of ducts shall be closed.

- (g) Cable hangers of steel pipe or flat bars shall be fixed not exceeding 600 mm horizontally and 750 mm vertically. Numbers of hanger layers as follows:

Location of cover	Depth of Ducts (mm)	
	less than 200	more than 200
Top	none	1 layer
Bottom or front	1 layer	2 layer

- (h) Grounding terminal shall be properly set at end of ducts and at connections between ducts and pull boxes, panel boards, etc.
- (i) The cable ducts shall be of sufficient strength and rigidity to provide adequate support for contained cables and shall be complete with all fittings and shapes necessary for changes in direction of runs or changes in elevation or runs and with side rails for all runs.
- (j) Incombustible covers or enclosures shall be included where additional protection is required.
- (2) Installation of the ducts shall comply with the following:
- (a) Carbon steel inserts (SS 400) for supports and hangers shall be placed and fixed prior to concrete pouring of slab, beams and columns. Expansion bolts shall be allowed only into CHB walls.
- (b) Spacing of supports shall not exceed 300 mm horizontal, and vertical ducts shall be tightly secured at each slab level.
- (c) Nominal size of hanger rods shall be not smaller than 9 mm for the duct 600 mm wide or less and 12 mm for other ducts.
- (d) Ducts, panel boards, pull boxes, etc. shall not be joined within the walls or floor slabs.
- (e) Each duct shall be spliced mechanically to provide essentially 100% electrical continuity.
- (f) Ducts and panel boards, pull boxes, etc. shall be connected by bonding wire of copper.
- (g) Visible ends of ducts shall be covered by escutcheons of which material shall be same as ducts or colored-anodized aluminum, as approved by the Engineer.
- (h) Fire protection measures shall be provided inside duct passing through fire rated walls or floor slabs. Void around ducts shall be filled by mortar.
- (a) Walls : A pair of calcium silicate boards (JIS A 5430, minimum thickness 25 mm) with reinforcement of steel angular sections all around, void filler of rock wool (JIS A 9504 200 kg/m³ or more) and heat resistant sealant around each cables/wire; overall thickness not less than 250 mm. Ducts shall be supported by triangle supports of steel angular sections on walls.

- (b) Floors : Generally same as for “walls”. Ducts shall be supported by steel C-channel (75 x 40 x 5 mm on floor) and steel angular section (75 x 75 x 9 mm on C-channel).

21.3 Cable Ladder

- (1) Materials shall be as follows:
 - (a) The ladder shall be constructed from hot dipped galvanized steel or aluminum.
 - (b) Main bars and cross bars shall be connected to each other by welding or bolting in order to provide essentially 100% electrical continuity.
 - (c) Assembled parts shall be connected to each other by bolts and nuts of galvanized steel complete with all necessary bends, tee pieces and adopters for changes in width of trays where required and 100% electrical continuity shall also be secured.
 - (d) The pitch of cross bars shall be 250 mm along straight portion. The pitch along curved portion shall be as per manufacturer’s recommendation, subject to the Engineer’s approval.
 - (e) The surfaces of racks adjacent to cables/wires shall be free from sharp edges, burrs or projections.
 - (f) End covers of manufacturer’s standard and grounding terminal shall be provided at the end of rack.
 - (g) Cable ladder of sufficient width, including sufficient tiers shall be provided, to allow for an additional 25% of cables installed at a future date.
- (2) Installation of cable ladders shall comply with the following:
 - (a) modifications so made that electrical continuity of cable rack system and support for cables shall be maintained.
 - (b) Cable racks shall be securely supported at intervals not exceeding 1.5 m, insert for supporting rods shall be set prior to concrete pouring.
 - (c) Supports shall be provided to prevent stress on cable where they enter another raceway or enclosure from cable rack system.
 - (d) Each run of cable rack shall be completed before installation of cables.
 - (e) Sufficient space shall be provided and maintained around cable racks to permit adequate access for installing and maintaining cables.
 - (f) Fire protection measures in accordance with para. 20.0 of this Section shall be equally applied where cable rack passes slab or fire rated wall.

21.4 Raceways and Wireways

- (1) Materials shall be as follows:

- (a) Raceways shall consist of galvanized mild steel sheet and pre-painted C-channels (1.5 mm minimum thickness) complete with necessary fittings, jointing supports, etc. The use of PVC raceway shall not be permitted. Raceway and wireway shall be electrically continuous.
- (b) Raceways shall be fabricated straight, free from burrs, sharp edges or projections.
- (c) Cover shall be tightly secured
- (d) All wireways shall be sized after allowing for 20% spare capacity and provide means for retaining conductors in the wireway when the covers are removed.

<u>Type</u>	<u>Width (mm)</u>	<u>Height (mm)</u>
A	40 ± 1.5	30 ± 1.5
B	40 ± 1.5	40 ± 1.5
C	40 ± 1.5	45 ± 1.5
D	45 ± 1.5	30 ± 1.5
E	45 ± 1.5	40 ± 1.5
F	45 ± 1.5	45 ± 1.5

- (e) Where the wireway system connects to distribution boards or other apparatus all cable entries shall be via an aperture equal to the area of the duct. The aperture shall be trimmed with PVC molding. The wireway shall be bonded to the distribution board or apparatus by two counter-sunk head brass-nuts and bolts.
 - (f) The complete wireway system shall be electrically continuous and each length of fittings shall be electrically bonded to the next or adjacent length.
- (2) Installation of raceways and wireways shall comply with the following:
- (a) Spacing of hanger rods shall not exceed 1.5 m
 - (b) Diameter of rods shall be nominal 9 mm or more, with braces.
 - (c) Jointing of raceways shall be as per manufacturer's standard fittings (100% electrical continuity shall be secured).
 - (d) Raceways and pull boxes, conduits panel boards, etc. shall be connected by bonding of copper wires, copper boxes or cross linked copper wires.

22.0 WIRING DEVICES

22.1 Switches

- (1) Contacts and finger switches shall stop at "on" and "off" positions.
- (2) Switches shall not arc in switching operation
- (3) General lighting switches shall be of the 15 amperes AC rating suitable for both inductive and fluorescent lighting loads. All switches shall be fixed to an adjustable grid plate, complete with earthing termination.

- (4) Installation generally shall be as follows:
 - (a) All switches boxes or switch banks shall be installed vertically.
 - (b) The center of cover plate shall generally align to the level at 1.30 m to 1.37 m above finished floor level. Level and location of switch boxes on tile finished wall be set along tile joints of tile center.
 - (c) Splices of conductors 5.5 mm² or smaller shall be provided with an insulated pressure type connector or equivalent.

22.2 Socket Outlets

- (1) Plugs shall be easily inserted and removed and shall have good electrical contact.
- (2) All general purpose receptacles shall be rated 15 amperes, 250V, 2 pole, 3-wire, parallel slot, grounding type. Locking type and other special purpose receptacle outlets, where applicable, shall be indicated on the Drawings.
- (3) Locking type receptacles shall be such that plug is inserted and turned clockwise to insert plug prongs to make electrical contact.
- (4) Receptacle outlets connected with the emergency generator supply shall be identified separately from other receptacles connected with the normal power.
- (5) All outlets on exposed conduit work shall be cast alloy conduit fittings of approved manufacturer.
- (6) All outlets on concealed conduit work shall be provided with hot galvanized pressed steel outlet boxes of standard make. These boxes shall be in all cases standard and where such boxes are not available on the market, special boxes shall be secured by the Contractor at his own expense.
- (7) All utility boxes intended for outlet devices shall be especially designed to receive the particular type of device to be mounted and should be deep enough to accept and fit the total number of conductors and devices required as per Drawings, but in no case, depth shall not be less than 24mm.
- (8) In case of fixtures, their outlet fittings shall be provided with suitable supports of size and kind required by the fixture to be hung. Fixture studs if required shall be 98mm diameter.
- (9) Installation generally shall be as follows:
 - (a) The center of cover plates shall generally align to the level at 300 mm above finished floor level. Level and locations of convenience outlets at kitchen, kitchenette and toilet shall be set after coordination among layout of furniture, sanitary fixtures, tile joint, etc.
 - (b) Splices of conductors 5.5 mm² or smaller shall be provided with an insulated pressure type connector or equivalent. Splices in conductors 8 mm² or larger shall be made using solderless connectors and covered with an insulation material equivalent to the conductor insulation.

- (c) Plug slot direction of convenience outlets shall be set vertical at any location.
- (d) The direction, quality and general appearances of cover plates shall be unified after coordination on this matter among all systems.
- (e) Colors of cover plates for normal power outlets and emergency power supported outlets, telephone outlets shall be significantly different as approved by the Engineer, in order to secure easy identification.

22.3 Waterproof switches and socket outlet

- (1) Surface-mounted shall be cast non-corrosive metal housing specifically constructed to house exterior switches and plugs, complete with all gaskets and screw-on cover plates.
- (2) Terminals of switches and receptacles shall be recessed into switch body not less than 3 mm with head recesses filled using non-hygroscopic sealing compound after connection are made.
- (3) 4 mm Minimum clearance shall be maintained between box and terminal face of switch or receptacle.
- (4) Insulation material shall be provided to the box, exposed to weather shall be porcelain, urea resin moldings, phenol resin moldings or other approved weather-proof types.
- (5) Gaskets shall be neoprene or other approved synthetic rubber, closed-cell type only.

22.4 Cover plates

- (1) For interior, shall be white bronze or stainless steel, satin or brushed finished, or plastic with smooth surface plain plates without markings.
- (2) For exterior, shall be non-corrosive metal castings, with cover plate for switches with “on” and “off” markings cast into face.

22.5 Marking

On body of switch and back box shall be indelibly marked with the information of rated current, rated voltage and name of manufacturer.

22.6 Plugs and receptacle

Unless otherwise specified in other Section(s) plugs and receptacles to be installed shall follow the following requirements.

- (a) Pole arrangement shall be of two (2) flat poles (face to face) and one (1) grounding between and below poles.
- (b) Performance on following shall comply with the requirements of the standards.
 - Retaining force
 - Temperature rise
 - Contact resistant
 - Make and break
 - Insulation resistance
 - strength of board fixing part
 - strength of enclosure
 - strength of cord anchorage
 - strength of cord outlet
 - performance of screwless terminal

- Dielectric withstand voltage
- Resistance to heat
- Strength of terminal
- endurance to ammonia gas
- tensile load
- waterproof

22.7 Wiring Box

- (1) Wiring boxes shall include all outlets back boxes, switch back boxes and pull boxes used in buildings.
- (2) Pull box sizes shall be determined by location and number of wires, cables and raceways involved and direction of intersections.
- (3) Boxes for mounting lighting shall not be less than 100 mm square (or octagonal), except that smaller boxes may be installed as required by fixture configurations, as approved by Engineer.
- (4) Metal pull boxes shall comply with following:
 - (a) Welded constructions, of carbon steel at 1.6 mm thick or more or of stainless steel at 1.2 mm thick or more.
 - (b) Carbon steel, unless otherwise galvanized, shall be anti-rust paint coated (non-organic zinc powder coating or equivalent) with phosphating.
 - (c) At least one (1) cable holder shall be provided with box if longer edges length of the box is more than 600 mm.
 - (d) Cover shall be divided into two (2) and opening of box shall have back reinforcement of angular steel section, in case the length of longer edge of cover is more than 800 mm.
 - (e) Boxes shall have approved type of grounding terminal.
- (6) External metal pull boxes shall comply with items (a) to (e) above and further comply with:
 - (a) Weatherproof with drip hole
 - (b) Neoprene or equivalent gasket
 - (c) Stainless screws
- (7) Metal pull boxes for raceways shall be as per raceways manufacturer's standard and in general shall be as follows:
 - (a) Shall be of the cast-metal hub type as follows:
 - (i) when located in normally wet locations
 - (ii) when installed exposed up to 2m above interior floors and walkways
 - (iii) when surface mounted on outside of exterior surfaces
 - (iv) when installed in hazardous areas

- (b) Boxes in other locations shall be galvanized sheet steel or code-gauge aluminum
 - (c) Each box shall have the volume required by code for the number of conductors enclosed in the box
 - (d) Boxes for mounting lighting shall not be less than 100mm square (or octagonal), except that smaller boxes may be installed as required by fixture configurations, as approved.
 - (e) Gaskets shall be provided for cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces.
 - (f) Boxes and supports shall be fastened with machine screws or welded stubs on steelwork.
 - (g) In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support.
 - (h) Sheet metal boxes shall be supported directly from the structure or by bar hangers. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type of fastener not more than 600 mm from the box.
 - (i) Boxes shall be furnished with a common pull box.
 - (j) The feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation.
- (8) PVC back boxes for outlets may be used for low voltage system only. PVC pull boxes shall comply with the following:
- (a) Length of longer edge: shall not exceed 600 mm
 - (b) Wall thickness: shall not be less than 3 mm
- (9) Installation requirements are as follows:
- (a) Unless otherwise specified, maximum number of conductors, excluding number of fixture wires, permitted in a standard box shall be per PEC.
 - (b) Requirements above apply where no fittings or devices, (i.e. fixture studs, cable clamps, switches, or receptacles), are contained within a box, where no grounding conductors comprise a part of wiring within a box and otherwise, it shall comply with the following requirements:
 - (i) Where one (1) or more fixture studs or cable clamps are contained in a box, the number of conductors shall be one (1) less than as tabulated;
 - (ii) An additional deduction of one (1) conductor shall be made for each strap containing one (1) or more devices, and a further deduction of one (1) conductor shall be made for one (1) or more grounding conductors entering a box; and

- (iii) A conductor running through box shall be counted as one (1) conductor, and each conductor originating outside of box and terminating inside box counted as one (1) conductor.
- (c) Pull-boxes shall comply with the following requirement:

In straight pulls, the length of the box shall not be less than 8 times nominal diameter of largest conduit to be connected thereto; and
- (d) All boxes and metallic conduits shall be bonded or grounded together.
- (e) In damp or wet locations, boxes shall be so placed and constructed so as to prevent moisture from entering or accumulating within the box. Boxes installed in wet locations shall be specifically approved for the purpose.
- (f) Boxes used to enclose flush devices shall be completely enclosed on back and sides, and shall provide substantial support for wiring devices.
- (g) Screws for support of boxes shall not be used for attachment of devices.
- (h) All pull boxes shall be set flush with finished surface on which mounted.
- (i) Outlet, switch and concrete boxes mounted in wall or ceilings of concrete, tile, or other noncombustible materials, shall be so installed that front edges of or covers shall not recess below finished surface more than 6 mm.
- (j) In walls and ceilings constructed of wood or other combustible materials, box covers shall be flush with finished surfaces.
- (k) Boxes shall be securely and rigidly fastened to surface upon which they are mounted, or securely and rigidly embedded in concrete or masonry and shall be supported from a structural member of building either directly or by using a substantial and approved metal braces.
- (l) In pull boxes or junction boxes having any dimension over 1.8 m, all conductors shall be cabled or racked in an approved manner.

23.0 ELECTRODE SWITCHES

23.1 General

- (1) These shall be used for opening and closing of electrical circuits with variation of water level inside water tanks.
- (2) Switches shall consist of rod or strip electrode, electrode supports and relays.
- (3) Voltage shall not exceed 24 V.
- (4) Electrodes shall be stainless steel.

23.2 Installation of Anchorage to Structures

- (1) Each cabinet, panel, pole or other individual piece of equipment or device shall be securely anchored to structure walls or floors, as applicable, using adequate and sufficient means to prevent dislodgment or overturning due to seismic forces (earthquake).
- (2) Anchors shall be installed only through main frame of cabinets or panels.

23.3 Installation of Panels or Cabinets on Walls

- (1) Each unit shall be set square, plumb and level at heights required, securely anchored to structure as specified.
- (2) Surface mounted units shall be set with backs tight against and fully closing with wall surfaces.
- (3) Recessed units shall be set with face frames tight against and fully adjacent to wall surfaces.

24.0 GROUNDING

24.1 System Requirements

- (1) Grounding systems shall be classified into three (3) as listed below:
 - (a) Grounding for equipment, metal conduits, steel pipes and special wireways: Enclosures, casing and metallic bases of all electric equipment, metal conduits, steel pipes, special wireways and sheathing of cable ends shall be grounded with grounding resistance maximum (5) ohms.
 - (b) Grounding for transformer:
 - (i) Instrument enclosure and secondary circuits of transformer shall be grounded separate from the grounding for equipment and lightning protection system.
 - (ii) Grounding resistance for the transformer shall be determined based on the formula listed below:

$$R = 150/I \text{ (Ohm)}$$

where R : Grounding resistance

I : Current of the secondary circuit of the transformer (Ampere)

- (iii) Grounding conductor shall be PVC insulated wire (IV) and the size shall be determined based on the capacity of the transformer as shown below:

<u>Capacity of Transformer</u>	<u>Size of the Conductor</u>
10 kVA or less	Not less than 5.5 mm ²
20 kVA or less	Not less than 8 mm ²
40 kVA or less	Not less than 14 mm ²
75 kVA or less	Not less than 22 mm ²
125 kVA or less	Not less than 38 mm ²

200 kVA or less	Not less than 60 mm ²
250 kVA or less	Not less than 100 mm ²
1000 kVA or less	Not less than 200 mm ²

- (c) Grounding for lighting protection.
- (2) Grounding resistance shall be below the value mentioned above. However, in case less value of grounding resistance is required to assure performance of the Plant to be installed by the Contractor, the grounding system shall be so installed by the Contractor. Cost thereof shall be deemed to be included in the Contract Price.
- (3) Installation requirements shall be as follows:
- (a) Grounding for lightning, transformer and equipment grounding system shall be separated from each other.
 - (b) Conductors shall be securely fastened to structure at intervals not exceeding 1.5 m.
 - (c) Point of connection of grounding conductor to interior metal raceways shall be as neat as practical to source of supply.
 - (d) Connection of conductor to a grounding electrode shall be made at a point and in a manner that shall assure a permanent and effective ground.
 - (e) Conductors and bonding jumpers shall be connected by pressure connectors, clamp, or other approved means. Connection devices or fittings that depend on solder shall not be permitted.
 - (f) Where more than one (1) equipment grounding conductor of a branch circuit enters a box, all such conductors shall have good electrical contact with each other and shall be arranged such that disconnection or removal or any receptacle, fixture, or other device fed from the box shall not interfere with or interrupt grounding continuity.
 - (g) Connection shall be made between equipment grounding conductors and metal boxes using grounding screws, and which shall be used for no other purpose, or by using approved grounding devices.
 - (h) Equipment grounding conductors brought into a nonmetallic outlet box shall be arranged that a connection can be made to any fitting or device in that box requiring grounding.
 - (i) Three (3) test terminal wells with concrete cover for each grounding system shall be installed at appropriate locations in the electrical room suitable for testing. The distance between the grounding electrode for each grounding system shall be more than five (5) meter apart.
 - (j) Not more than one (1) conductor shall be connected to an electrode by a single clamp or fitting, unless such clamp or fitting is approved for multiple connections.
 - (k) Where damage occurs, clamps and fittings shall be enclosed with a protect covering approved by the Engineer.

- (1) Paint, lacquer and other nonconductive coatings on equipment to be grounded shall be removed from contact surface to assure good electrical continuity.

25.0 ELECTRICAL TEST REQUIREMENTS

25.1 General

- (1) The provisions of **Section 1145** are applicable and are to be referred in connection with 6000 series of this Specification.
- (2) The following provisions are additional to, and are to be read in conjunction with, Section 1145, and are particular to 6000 series of this Specification.
- (3) Materials, equipment, and the completed installation shall be inspected by the Engineer.
- (4) All equipment, materials, or work rejected because of defects or nonconformance with the Drawings and the Specification shall be replaced or corrected by the Contractor as directed at no additional cost.

25.2 Scope of Testing

- (1) Upon completion and prior to acceptance of the installations, the Contractor shall subject the units to operating tests to demonstrate satisfactory functional and operational efficiency.
- (2) The Contractor shall furnish all materials, instruments, equipment and test personnel required for tests.

25.3 Test Requirements

- (1) Each electrical system shall prove satisfactory and acceptable in accordance with requirements throughout and under the Contract Documents.
- (2) In addition to requirements herein, tests shall be concluded as work progresses as required elsewhere under this Specification.
- (3) Testing required herein shall be performed in the presence of the Engineer, and schedules duly arranged for in advance in accord with notification requirements.
- (4) Sufficiently qualified personnel, time, materials and fuel shall be allotted and provided by the Contractor as necessary to provide and conduct all required tests.
- (5) Upon completion of electrical equipment (panel board, motor, control equipment, etc.) the Contractor shall not operate any equipment without the express approval of the Engineer.

25.4 Test Programs

- (1) Quality and commissioning test shall be carried out and conducted per programs as prepared and issued by the Contractor and approved by the Engineer.

- (2) Test programs shall also include such forms as deem necessary by the Engineer, which the Contractor shall utilize and execute accordingly and as applicable to the various kinds of work to be tested.
- (3) Tests required shall be completed on schedule for activation of electrical systems as required in accordance with this Section.

25.5 Tests Reports and Records

- (1) Forms to be issued by the Engineer shall be devised by the Contractor with appropriate information and data to be recorded.
- (2) Within 14 days after completion of testing, one (1) copy of test records and results shall be furnished to the Engineer for review.
- (3) Exact indication of site, date, hour, types of instruments used and precision of such instruments shall be recorded; in addition necessary notes shall be registered regarding operations plus observed deficiency. This report shall be signed by the Contractor's representative and by the Engineer and shall serve as a basis for final documentation required under the Contract.

25.6 Repetition of Test

- (1) If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is achieved at the Contractor's expense.
- (2) In cases where it may be necessary to perform a partial test and flaws are discovered at a later date such shall be corrected by the Contractor at his expense.

25.7 Quality Test

Quality testing shall include and consist of all such examinations, measurements, inspections, by visual, mechanical, instrumental or other means, as is necessary to show and prove that work so tested does in fact meet all quality standards and performance requirements as shown or specified.

25.8 Measurement of Grounding Resistance

- (1) Grounding resistance of all grounding electrodes and grounding terminals shall be measured using a transistor earth tester.
- (2) Grounding resistance shall be less than values stipulated in this Specification, or in accordance with PEC when not so specified, or manufacturer's recommendation.

25.9 Insulation Resistance Tests

- (1) Insulation resistance between ground and high tension busbars, high tension cable conductors and ground, and high tension cable conductors shall be measured using 1,000 V meggar meter.
- (2) Insulation resistance between all low tension and ground, all branches and ground, and conductors of feeder/branches shall be measured using 500 V meggar meter.

- (3) All measured values of high tension circuits shall be not less than 100 meg. ohm, and of others low tension shall be not less than 0.2 meg. ohms.

25.10 Dielectric Strength Test

All high tension equipment, busbars and cables shall be tested by withstanding voltages as specified under various Specification Sections and before they are energized.

25.11 Relay Test

- (1) Characteristics of all relays shall be tested.
- (2) All relays shall be adjusted and set to assure adequate characteristics for respective system.

25.12 Demonstration Tests

- (1) Demonstration test requirements shall include and consist of operating systems under various and varying condition as is necessary to show and prove that work so tested does in fact operate and function as intended under these Contract Documents.
- (2) Techniques or methods for quality testing shall be employed as necessary for certain demonstrations.
- (3) Demonstration tests shall be distinctly separate from other tests required as specified under the Electrical Work.
- (4) When deemed by the Engineer as practical, feasible and not disruptive to the Contractor's efforts, the Employer's operating personnel shall be permitted to attend such tests or demonstrations as shall be helpful to their understanding of work for which they shall be eventually responsible.
- (5) Operational and functional demonstration tests are required for electrical equipment, individually and separately as installed, and each and every system required under this Section.

26.0 MEASUREMENT AND RATES

26.1 Measurement

Work under this Section and the following Sections of the 6000 Series shall generally be measured according to the item classification and units contained in the Bills of Quantities (BOQ).

26.2 Rate

- (1) The rates and lump sums shall be full compensation for all plant, materials, labor, equipment, transport, temporary works, establishment charges, overheads, profit and taxes required to complete the work described in this Section and the following Sections of the 6000 Series of the Specification and/or shown on the Drawings.
- (2) The rates and lump sums shall further include, if not itemized separately in the BOQ, for the Sections of the 6000 series:

- (a) Contractor's design (where applicable)
 - (b) Training for equipment and systems
 - (c) Spare parts
 - (d) Testing and commissioning
 - (e) Maintenance tools and special tools
 - (f) Protection
 - (g) All permits and fees required from Government authorities for inspection/certification.
- (3) The rates for cabling shall further include for:
- (a) Trenches excavated by hand or machine, and in all types of ground including backfilling, disposal of surplus material, supports, protection and maintenance of sides, dewatering, etc.
 - (b) Galvanized steel or PVC conduit (where not measured separately)
 - (c) Terminations, including gland assemblies, lugs, ferrules, seals, earth tags, shrouds, markers and connections
 - (d) Cable supports and protection, including rigid or flexible conduits, (unless separate pay items have been specifically included in the Bill of Quantities), cable trays, trunking, ladders and for all fittings, fixing, supports, brackets thereto
 - (e) Maintaining earth continuity
 - (f) Cable sleeves for casting into the structure and caulking between cables and plugging sleeves with fire resistant material
 - (g) Fixing to and embedding in any surface the foregoing items including providing all clips and fixings, cutting out holes, mortices and chases, finishing over and all making good
 - (h) All necessary marker post, marker tape, plates or tiles
- (4) The rates for duct, conduits and special wireways (where measured separately) shall further include for:
- (a) All short lengths and joints in the running lengths, including the provision of all loose collars, coupling and similar items where required and all jointing and sealing materials including gaskets, bolts and nuts
 - (b) Providing all necessary fittings including joints, markerplates or posts r plugs, drawcords and the like, and all necessary hangers, supports, braces, etc.
 - (c) Wrapping underground work.

- (d) trenches excavated by hand or machine, in all types of ground including backfilling, disposal of surplus material, supports, protection and maintenance of sides, dewatering, etc., providing concrete beds and surrounds, etc.
- (5) The rates for electrical manholes and handholes shall further include for:
- (a) excavating by hand or machine in any material including backfilling, disposal of surplus materials, supports, protection and maintenance of sides, dewatering, etc.
 - (b) Concrete, reinforcement and formwork
 - (c) Covers and frames and cable supports
 - (d) Forming holes for and building in ducts
 - (e) Forming rebates for and building in frames
- (6) The rates for switchboards and distribution boards shall further include for all fittings and fixings, supports and brackets.
- (7) The rates for light fittings shall further include for:
- (a) Suspension systems and supports, brackets, fixing bolts and the like necessary to install the fittings to correct finished position and level
 - (b) Provision and installation of lamps, fluorescent tubes and the like
 - (c) Terminations and all facilities necessary to achieve proper earth continuity
- (8) The rates for switches and socket outlets shall further include for:
- (a) Assembly, as required
 - (b) Provision of flush steel or surface metal clad boxes
 - (c) All screws and fixing to any background
 - (d) Facilities necessary to achieve proper earth continuity
- (9) The rates for equipment shall further include for:
- (a) Assembling equipment where necessary
 - (b) All facilities necessary to achieve proper earth continuity
 - (c) Checking and repairing or replacing any damaged parts
 - (d) Setting and fixing in position on any background including the provision of holding down bolts, fixing, name tags and the like, as described
 - (e) All fees and charges for the attendance, as required, of the equipment manufacturer's representative to assist in the installation and subsequent testing, and commissioning of the equipment

SECTION 6100

POWER FEEDER SYSTEM

1.0 SCOPE OF WORKS

1.1 The scope of works includes the provision of a 230V Low Voltage (LV) Distribution System to all buildings comprising, but not limited to, the following:

- (a) All normal Distribution Panels (DP), and emergency Distribution Panel (EDP), normal Lighting Panel (LP) and emergency Lighting Panel (ELP), and normal Enclosed Circuit Breaker (CB) and emergency Enclosed Circuit Breaker (ECB) complete with all the necessary electrical components and accessories.
- (b) Feeder cables fed from the emergency power supply, from (emergency) LV Switch Boards (ELVSB) to each EDP, and from EDP to each ELP and ECB.
- (c) Feeder cables fed from the normal power supply from (normal) LV Switch Boards (LVSB) to each DP, and from DP to each LP and CB.
- (d) All feeder cables, branch circuits and interconnecting wiring for all electrical, mechanical, fire, BMS, FIDS, Security and CCTV, Master Electric Clock, Cable TV, PABX, Public Address, Signage, Elevators, Escalators, Boarding Bridges, Baggage Handling Systems, and Air conditioning Equipment, etc.
- (e) All floor ducts, conduits, junction boxes and accessories from the panel board to general use receptacle outlets.
- (f) Associated grounding systems for the LV systems.
- (g) All wire ways, cable trays and necessary wiring accessories for the LV wiring systems.

1.2 The scope of work includes the provision of all labor, materials and equipment necessary for the complete execution of all the Electrical Systems as shown on Electrical Drawings. Scope of work shall include but is not limited to, the following principal items of works:

- (a) The provision and installation of cable trays, cable ladder and conduits when not included in other sections.
- (b) The provision and installation of all circuit breakers, disconnect switches and other protective devices when not included in other sections.
- (c) Painting of all exposed electrical conduits, enclosures and equipment.
- (d) Execution of all terminations for Electrical Systems.
- (e) Complete testing of Electrical Systems and Equipment.
- (f) All work, materials, equipment, fittings, supports, etc. which are necessary for the completion of the works shall be included in this scope of work.
- (g) Full coordination with all electrical trades.

2.0 CABLES AND WIRES - MATERIALS

2.1 Generally

All main power supply (230V) shall use multi-core cable routed into cable trays, cable ladder, or underground conduits.

2.2 Main cables

- (1) All cables from main low voltage switchboards (230V) located in each substation/electrical room, to the distribution panels, shall be considered as the “Main Cables”.
- (2) All these cables shall be multi-core XLPE type (except where otherwise specified)
- (3) All cables shall follow the JIS or PEC guidelines installation or equivalent standard for type and size.

2.3 Secondary Cables and Wire

- (1) The cables to be considered as “Secondary Cable and Wires” shall be the cables from distribution panels to final load.
- (2) When possible these secondary cables and wires shall be of the same type as the main cables. (XLPE multi-core cables)
- (3) When wires shall be used for secondary connection (only), the wires shall be in accordance with the following:
 - (a) All wires shall be copper, soft-drawn and annealed, shall be of 99% conductivity, shall be smooth and true of cylindrical form and variation shall be within 1% of the actual size called for.
 - (b) All wires and cables shall comply with the requirement of the Underwriters Laboratories, the A.S.T.M., I.C.E.A. and other relevant Standards as they apply to the particular usage.
 - (c) All wires and cables shall be as manufactured from a reputable and approved manufacturer.
 - (d) Wires and cables for power and lighting system shall be plastic insulated for 600 volts working pressure type “THHN” type unless otherwise noted on plans or specified.
 - (e) All wires for lightings power shall be stranded copper.
 - (f) For lighting and power systems no wire smaller than 3.5 mm sq. shall be used, except for control leads or otherwise specified.
 - (g) Color Coding

Shall be provided for all service, feeder, branch, control and signaling circuit conductors. Color shall be green for grounding conductors, and black for neutrals. The color of the underground conductors in different voltage systems shall be as follows:

- (i) 230 volt, 1-phase : Phase A – Red
Phase B – Yellow
- (ii) 460 volt, 3-phase : Phase A – Red
Phase B – Yellow
Phase C – Blue
- (iii) The grounded conductors should be only of yellow/green type.

(h) Splices and Termination Components

Connectors for wires 5.5 mm² and smaller shall be insulated pressure-type or twist lock splicing connector. Solderless terminal lugs shall be provided on stranded conductors.

2.4 Control Cables

- (1) All control cable shall be as JIS, PEC, NEC or equivalent standard. Control cable shall be rigid copper type with minimum size of 1.0 mm², PVC or XLPE insulation. They shall be of the control type with a standard number of cores of 12, 19, 27 or 37.
- (2) The instrumental cable type can be used as well if of the following type:
 - (a) Collectively screened
 - (b) No armour
- (3) The collectively screened instrument cable type shall be used when electromagnetic influences are present, or to ease installation.
- (4) The instrument cable type shall include only the following standard number or pairs 5, 10, 30 or 50.

2.5 Cable Marking and Splices

- (1) The Contractor shall develop a cable numbering list to be submitted to the Engineer for approval.
- (2) All main and control cables shall be labeled at both ends with clear indication of the cable number in accordance with the developed cable list.
- (3) Conductor identification shall be provided within each enclosure where a tap, splice or termination is made. For conductors 16 mm² and smaller, color coding shall be factory applied color impregnated insulation. For conductors 22 mm² and larger, color coding shall be by plastic-coated self-sticking markers, colored nylon cable ties and plates, or heat-shrink type sleeves. Control circuit terminations shall be identified.
- (4) Splices shall be made in accessible locations; splices in conductors 5.5mm² and smaller shall be made with an insulated pressure type connector, splices in conductor 8 mm² and larger shall be made with a solderless connector and covered with an insulation material equivalent to the conductor insulation.

3.0 CABLE AND WIRES - INSTALLATION

3.1 Main Cable Routing

- (1) All main cables shall be routed by use of cable trays or cable ladder when installed horizontally or vertically in an open area.
- (2) No intermediate metallic conduit shall be used for horizontal and vertical routing of main cables, in an open area.
- (3) Intermediate metallic conduit may be used for concrete embedded installation or special use when required.

3.2 Secondary Cables and Wires Routing

- (1) Secondary cables and wire shall use cable trays or ladder.
- (2) Where this is not possible the routing has to be made in accordance with the following:
 - (a) Conduits in general shall be Intermediate Metallic Conduit (IMC) with an interior coating.
 - (b) Polyvinyl-chloride conduit (PVC) shall be heavy wall, schedule 40, with factory made bends, couplings and fittings.
 - (c) No conduits shall be used in any system smaller than 20mm (3/4 inch) diameter electric trade size, nor shall have more than four (4) 90 degree bends in any one run and where necessary, pull boxes shall be provided as directed.
 - (d) No wire shall be pulled into any conduit until the conduit system is completed in all details, in the case of concealed work until all rough plastering masonry has been completed, and in the case of exposed work until the conduit work has been completed in every detail.
 - (e) The ends of all conduits shall be tightly plugged to avoid entrance of plaster, dust and moisture while the construction of building is in progress. All conduits shall be reamed to remove all burrs.
 - (f) All pipes and fittings on exposed work shall be IMC and be secured by means of metal clips, which shall be held in place by means of machine screws. When running over concrete surface, the screws shall be held in place by means of expansion sleeves. All pipes on exposed work shall be run at right angles to and parallel with the surroundings walls. No diagonal runs shall be allowed and all bends and offsets shall be avoided as much as possible. Where necessary conduit fittings shall be used. Conduits in all cases, shall be run perfectly straight and true, satisfactory to the Engineer. Conduits shall be supported at 1.50 meter intervals maximum.
 - (g) No splicing of wires shall be made inside the conduit run from equipment to box or from one box to another box. Splicing shall be done only in boxes.

3.3 Insulated Bushings

Bushings shall be made in such way to protect cables and wires as well as allowing easy maintenance.

4.0 PANEL AND CABINETS

- 4.1 Except when specified, all panels and cabinets shall be of the surface mounted type.
- 4.2 Standard panels and cabinets, as much as possible, shall be used and assembled on Site. All panels shall be dead front construction, furnished with trims for mounting as required. Cabinets shall be of code gauge steel with gutters at least 100mm wide and wider if necessary. The trim for all panels shall be finished in industrial gray enamel over a coat of rust inhibitor.
- 4.3 Panelboard main bus work shall be ampacity rated to equal or exceed overcurrent protective device immediately ahead of it. All buswork shall be properly secured to withstand available short circuit forces at the location.
- 4.4 Distribution panels shall be equipped with two poles and three poles air circuit breakers of sizes, voltage ratings and interrupting capacity as called for on the Drawings.
- 4.5 Panelboard buses: copper bus bars shall be supported on bases independent of the circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. A separate ground bus marked with a green stripe along its front shall be provided and bonded to the steel cabinet for connecting grounding conductors.
- 4.6 Mounting heights: panelboards, circuit breakers and disconnecting switches shall be mounted so the height of the operating handle at its highest position shall not exceed 1.8 m from the floor.

5.0 INDIVIDUAL BREAKERS AND SWITCHES

5.1 General

- (1) Individual circuit breakers, safety switches and disconnect switches shall be provided where indicated on the Drawings or as required by the situation and the price is deemed to be included in the bid.
- (2) Voltage ratings shall be suitable in each case of service application.
- (3) Enclosures shall be General Purpose.
- (4) Unless otherwise specified, minimum interrupting level for 230 volts circuit breakers shall be 10 KA.

5.2 Operation type

- (1) Circuit breakers shall consist of a quick-make, quick-break type entirely trip-free operating mechanism with contact, arch-interrupter, and thermal magnetic trip unit for each pole, all enclosed in a molded-phenolic case.

- (2) The thermal-magnetic trip unit shall provide time-delayed overload protection in case of overload or short circuit current in any one pole.
- (3) Circuit breaker shall be trip indicating, with the tripped position of breaker handle midway between “ON” and “OFF” positions.

5.3 Residual Current Circuit Breaker (RCCB)

- (1) Shall be pole 250 volts maximum, 60 Hz, rated at 25 amperes with adjustable ground fault current sensitivity.
- (2) RCCB shall provide protection against ground fault (earth-leakage) current.
- (3) It shall stay independent in operation using a core balance current transformer for differential current sensing and tripping.
- (4) RCCB shall have complete mounting box and accessories.
- (5) RCCB shall be of approved manufacture.

6.0 DISCONNECT MEANS

- 6.1 Disconnect means shall be provided as indicated on the Drawings at motor locations. Disconnect switches shall be fusible or non-fusible as required and of sizes as indicated on the Drawings.
- 6.2 Disconnects shall be KW rated, of sufficient capacity to carry the continuous current of the load it controls and of the correct voltage rating.
- 6.3 Air or gas circuit breakers shall be used where feeder and motor protective means require. Circuit breaker shall be provided at each motor location where it is not within the sight of respective control starter, unless indicated otherwise on the Drawings. All circuit breakers shall be totally enclosed.

SECTION 6200

LIGHTING AND WIRING DEVICES SYSTEM

1.0 SCOPE OF WORKS

- 1.1 The scope of works for the lighting & wiring devices system consists of design, (where applicable) manufacture, supply and installation, testing and commissioning of the complete Lighting & Wiring Devices System. Wiring Devices shall include receptacles, switches and device plates.
- 1.2 The scope of works for the lighting system shall consist of the followings:
- (a) All lighting fixtures and accessories for interior use including those lighting fixtures mounted on the exterior surfaces of the building.
 - (b) All lamps, lighting switches, lighting control systems and wiring accessories.
 - (c) All essential / emergency lighting, exit signs, directional and information lighted signs and security lighting system.
- 1.3 The works to be executed under the wiring devices system shall also include:
- (a) General receptacle outlets and plates are to be installed at various area of the airport complex, which includes indoor and outdoor types, flush mounted or surface mounted.
 - (b) Installation of conduit, wireways, trunking and other accessories.

2.0 DESIGN CRITERIA

- 2.1 The system is designed in accordance with the following conditions:
- (a) Operating ambient temperature : 10°C to 40°C
 - (b) Enclosure : 0° to 60°C
 - (c) Operating ambient humidity : + 50% to 99% RH
 - (d) Operating voltage for all luminaries : shall be 230 volts at 60 Hz
- 2.2 The lighting design general requirements for the interior and exterior lighting system in the entire complex and other facilities are designed in accordance with the applicable requirements of the latest edition of PEC Part 1 and Part 2, NFPA 101, IES, UL & other internationally accepted Standards and the following requirements:
- (a) Ambient lighting design shall use the following:
 - (i) Actual lumen output shall be 85% of the specified lamps' initial lumens and a power factor correction to at least 0.9.
 - (ii) Maintenance factor of 0.85 for down lights and 0.65 for up-lights

- (b) Emergency illumination shall be provided throughout the airport complex in the event of normal lighting failure.
- (c) Where paneled ceilings/ ceiling tiles shall be erected, particular care shall be taken in setting out to ensure that the luminaries are symmetrically disposed in relation to the ceiling panels; except where otherwise specified the centers of luminaries shall coincide with the centers of the ceiling panels.

3.0 LIGHTING CONTROL

- 3.1 In public areas (indoor and outdoor) the lighting system shall be remote control and monitored by the Building Management System (BMS) for optimal usage. Therefore, all these lighting panel boards shall be interfaced with the BMS (refer to **Section 7600**).
- 3.2 Areas such as offices, private shops, specific technical room/areas and other non-public areas shall be directly controlled through local switches as usual.

4.0 SUBMITTALS

4.1 General

- (1) The provisions of **Section 1165** are applicable and are to be referred to in connection with Section 6200 of the Specification.
- (2) The following provisions are additional to, and are to be read in conjunction with, Section 1165, and are particular to this Section of the Specification.

4.5 Shop Drawings

- (1) Shop Drawings shall clearly indicate the Document number of fitting details used as reference in the development of the shop drawings.
- (2) Shop drawings shall be complete submissions for approval and maintenance and, where applicable, shall include the wiring diagram, scale plans, and details showing the method of installation of lampholders, lamps, reflectors, transformers and secondary feeds.
- (3) Where applicable, field dimensions shall be verified and included on shop drawings showing exact locations of lampholders, and lamp shapes and lengths.
- (4) The Contractor shall coordinate all his lighting fitting drawings with the Drawings and details of the Architectural, Structural, and Electrical, Mechanical, and other related trades to assure conformance with the Engineer's requirements.

4.3 Samples

- (1) After shop drawing review, and prior to release for ordering, the Contractor shall furnish one sample of each fitting on the fitting schedule Drawings for which sample requirement is noted. These should be a working model of the luminaries to test the performance and show the workmanship and finishes.

- (2) Samples are not returnable, nor included in quantities listed for a project. Approved samples shall be kept on Site for reference.
- (3) Samples must be actual working unit of materials to be supplied.

4.4 Other Submittals

The Contractor shall be responsible for obtaining from his supplying lighting manufacturers, for each type of special light fitting, photo-electric lighting controls, a recommended maintenance manual including:

- (a) Tools required
- (b) Types of cleaners to be used
- (c) Replacement parts identification lists

5.0 PRODUCTS

5.1 General Requirements for Standard Lighting and LED Lighting.

- (1) Ballasts for tubular fluorescent lamps shall have a maximum value of harmonic complying with the relevant Standard. Power factor correction shall be provided and this shall be not less than 0.95 lagging unless otherwise indicated.
- (2) All light fitting/fixtures shall comply with the current IEC or JIS Standard.
- (3) Housings shall be so constructed that all electrical components are easily accessible and replaceable preferably without removing fittings from their mountings, or disassembly of adjacent construction.
- (4) All castings shall be exact replicas of the approved patterns and shall be free of sandpits, blemishes, scales and rust, and shall be smoothly finished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished castings shall accurately fit in their designated locations.
- (5) All lamp sockets in light fitting shall be suitable for the indicated lamps and shall be set so that lamp is positioned in optically correct relation to all lighting fitting components. If adjustable socket positions are provided, socket should be preset in factory for lamp specified. If different socket positions are specified for same fitting, sockets shall be preset for each type, where practical and cartons marked accordingly.
- (6) All fittings shall be completely wired at the factory.
- (7) Outdoor fittings: fittings for use outdoors or in areas designated as damp locations shall be suitably gasketed to prevent the entrance of moisture. Approved wire mesh screen shall be provided for ventilation openings. All dissimilar metal materials shall be separated by a non-conductive material to prevent galvanic action.
- (8) For steel and aluminum fittings, all screws, bolts, nuts and other fastenings shall be cadmium or equivalent plated. For stainless steel fittings, all fastenings shall be stainless steel. For bronze fittings, all fastenings shall be stainless steel or bronze.

- (9) Mechanical: All lenses, louvers, or other light diffusing elements shall be removable, but positively held so that swinging or other normal motion shall not cause them to drop out.
- (10) Lampholders shall comply with the table below. Other types shall be used only where indicated.

Table 6200.1 Lampholders

LAMP TYPE	RATING WATTS	LAMPHOLDERS
Fluorescent	18-58	Bi-pin
HID	Up to 150	Bayonet B22d
	200	Edison Screw E27
	Above 200	Edison Screw E40

- (11) Fluorescent lampholders shall be white urea plastic; contacts spring-loaded-silver-plated phosphor bronze.
- (12) High intensity discharge lampholders shall be porcelain; screw shell: nickel-plated brass, pre-lubricated with silicone compound; contact: spring-loaded silver-plated phosphor bronze.
- (13) White finishes: Minimum of 85% reflectance.
- (14) Lamps shall be of the type and rating as indicated
- (15) Furnish and install all lamps.
- (16) All lamps of a given type shall preferably be supplied by the same manufacturer.
- (17) Fluorescent light fittings shall be as follows:
- (a) General construction and materials: housing end plates, socket bridges, reflectors, wiring channels and ballast covers shall be die formed of not less than 0.9 mm thick cold rolled steel, unless specified otherwise.
 - (b) Construct fittings so that ballast may be serviced or replaced preferably without removal of fitting housing.
 - (c) Ballasts must be the manufacturer's best sound rating, and the sound rating indicated on the ballast. Ballasts found by the Engineer to be unduly noisy shall be replaced without charge prior to acceptance of the job. Ballasts shall be high power factor, high efficiency, low loss type.
 - (d) Relative light output: (percentage of light emitted with reference tube and ballast) shall be not less than 95%.
 - (e) Electrical characteristics: ballasts shall be designed for single frequency operation, 60 Hz. nominal, and shall operate at the nominal voltages indicated on label, 230 volt.
 - (f) Outdoor ballasts shall be suitable for operation and starting at 10°C minimum.
 - (g) Ballast shall bear a manufacturer's label that has been certified.

5.2 High Intensity Discharge Light Fittings

- (1) General construction and materials: Lamps and ballasts shall be of one manufacturer to ensure proper and consistent lamp performance.
- (2) Exterior high intensity discharge fittings shall be enclosed completely.
- (3) Capacitors shall be high quality aluminum cylinder type for the type of service intended. Outdoor ballasts shall use capacitors with 90°C. temperature rating.
- (4) Ballasts shall be rated for 55°C. ambient temperature
- (5) Mercury vapor: indoor ballast shall be constant wattage or stabilized wattage type with a power factor not less than 90%. Regulation: 13% variation in line voltage shall vary lamp watts by no more than +2%. Ballast shall provide sufficient voltage at lamp with a line voltage drop as much as 40% below nominal to prevent lamp from being extinguished.
- (6) Outdoor ballast shall be constant wattage type or approved equal with power factor of not less than 90% or approved equal. Regulation: +10% variation in line voltage shall vary lamp watts by no more than +5%. Ballast shall sustain line voltage drop as much as 40% (typical) without extinguishing lamp.
- (7) Metal halide ballasts shall be auto-stabilized type with lead peaked circuiting, and power factor not less than 90% or approved equal. Regulation: +10% variation in line voltage shall vary lamp watts by no more than +10%. Ballast shall provide sufficient voltage at lamp with a line voltage drop as much as 40% below nominal to prevent the lamp from being extinguished.
- (8) High pressure sodium vapor ballasts shall be the voltage-stabilized type with not less than 90% power factor. Regulation: +10% variation in line voltage shall vary lamp watts not greater than +3%. Ballast shall provide sufficient voltage at lamp with a line voltage drop as much as 30% below nominal to prevent the lamp from being extinguished. Ballast shall be complete with 180°C insulation system and 80°C rated capacitors. Ballast shall be capable of starting and operating lamp up to 11m away from the ballast.

5.3 Exit Signs

- (1) Self contained and maintained and non-maintained type Exit signs shall be constructed with removable gear tray that is independent of housing to facilitate ease of installation, maintenance and replacement of lamps. Housing shall be galvanized steel with epoxy powder coating, except in external application, which shall use polycarbonate IP54 or IP65 enclosure, as appropriate for the location. Exit signs shall comply with most recent JIS, PEC, IEC 598-2-22 and other applicable international Standards.
- (2) Exit signs shall have the following features:
 - (a) Face plate : single face or double face with or without directional signs
 - (b) Lamp : 1 x 10W fluorescent lamp
 - (c) Mains Supply : 230 volt, 60Hz

- (d) Charge monitor : red L.E.D. 5mm diameter
- (e) Diffuser : fire retardant acrylic

5.4 Photo-Electric Lighting Control

- (1) General: photoelectric control shall be provided for exterior lighting specially on the Access Road. Photoelectric unit shall automatically turn lights “ON” at dusk, “OFF” at dawn.
- (2) Photoelectric devices: base and cover shall be constructed of high impact resistant, non-corroding and non-conductive molded materials. They shall be complete with encapsulated cadmium-sulfide photocell for long life and reliability with built-in surge protection and time delay.
- (3) By-pass control switch: by-pass control switch shall be provided where specified in Specification or shown on the Drawings.

5.5 Lighting Switches

- (1) Lighting switches shall be rated 15 amperes, 230 volts, and 60Hz and shall be selected by the Engineer for final color appearance. Except for weatherproof, all lighting switches shall be toggle, quiet type; and spring operated.
- (2) Lighting switches shall be:
 - (a) Single-gang switch (one single pole switch in one cover plate).
 - (b) Two-gang switches (two –single pole switches in one cover plate).
 - (c) Three-gang switch (three-single pole switches in one cover plate).
 - (d) Three way switch (one switch in one cover plate, for switching of lamps in two or more locations).
 - (e) Four way switch (one switch in one cover plate, for switching of lamps in three or more locations, wired together with three way switch).

5.6 Neon Lighting

- (1) Lamps shall provide a continuous line of light. Maintained lamp lumen output shall not depreciate from initial lumen output more than 20% after 10,000 hours of operation. Lamp color to be selected by Engineer based on samples provided. Lamps showing darkening, stains, discolorations, spiraling or sputtering shall be rejected.
- (2) Lampholders shall be electrodes approximately 2400mm on center maximum, approved for 7500 volts minimum. All lamp terminations to be made in #200 Pyrex sockets enclosed in metal. These shall give good electrical contact and properly support the lamps. Provide additional lamp supports for curved or bent lamps.
- (3) Transformer shall be located as symmetrically as possible in relation to the lamp run. Provide self-contained, approved transformers in 16 gauge steel housings with secondary and primary wiring compartments, and a disconnect switch which shall automatically disconnect the primary switch when the wiring compartment cover is

removed. The transformer shall operate on low voltage. The wiring compartments must be accessible. Install transformers only in accessible and ventilated areas (40°C. maximum ambient temperature) with air circulation on all sides to dissipate about 300 watts each.

- (4) Wiring shall be approved secondary feeds with run to transformer not to exceed 4.5 meters. All feeds shall be within aluminum flexible conduit terminating within metal enclosure at Pyrex socket. Transformer shall be located as close to lamps as possible to avoid long secondary feeds in metallic conduit and corona discharge, which can lead to overloading, transformer failure, shortened lamp life, and audible noise.
- (5) The Contractor shall install the lampholders so that all lamps make secure electrical contact in the lampholders.
- (6) Circuit breakers controlling the circuits feeding the neon transformers shall be capable of being locked in the open position.

5.7 LED Lighting

- (1) The issue of global warming and protection of the environment are only some of the few reason why we are adopting in our design the use of LED lighting in the majority of the areas for Passenger Terminal Building and Control Tower.
- (2) The present design of the LED lighting is for the Contractor to use as the basis for a more sustainable final design in collaboration with a Lighting Manufacturer to obtain a maximum level of optimal usage.
- (3) The Contractor shall proposed a LED lighting system as follows;
 - (a) Shall deliver energy savings
 - (b) Shall minimize maintenance cost without any compromise on brightness
 - (c) A bulb with a minimum life span of 30,000 burning hours
 - (d) A housing/fixture that is suitable for harsh environment
 - (e) Others as required by the Engineer

5.8 Receptacle Outlets and Plates

- (1) Outlets shall be rated 15 Amperes, 230 Volts, 60 Hz. For flushed mounting unless otherwise specified or instructed by the Engineer.
- (2) Provide 2 pole, 3 wire grounding type with screws or as required by the Engineer.
- (3) Provide cover plates as required by the Engineer.

6.0 INTERFACE WORKS

6.1 Mechanical & Electrical Rooms

Mounting height and location of light fitting shall be coordinated to clear mechanical, electrical and plumbing equipment and to illuminate adequately meters, gauges and equipment.

6.2 Interface with Building Management System (BMS).

- (1) Terminal strips shall be provided inside the lighting control panel of the BMS or installed in a separate panel (to be used as the interface point between BMS and the electrical works).
- (2) The necessary wiring from the lighting control panel to the BMS interface panel shall be provided.
- (3) All necessary sensors, relays and other accessory as required for status and control of lighting circuits shall be provided. Specific items to be used shall be coordinated with BMS supplier to ensure compatibility of the above items to BMS.

SECTION 6300

TELEPHONE AND DATA SYSTEM

1.0 SCOPE OF WORK

- 1.1 This section specifies the technical requirements for the design, (where applicable) manufacture, installation, testing and commissioning of the Telephone and PABX system. The PABX shall be installed in the Passenger Terminal Building.
- 1.2 The Contractor shall design the system specified herein with a full understanding of the design concept, system description and performance required by the Specification. The design shall incorporate high levels of redundancy for reliable system operation and flexibility for future expansion of the system.
- 1.3 The complete Telephone and PABX System shall include the following:
 - (a) Private Automatic Branch Exchange (PABX) complete with distribution frame located at the PABX room in Passenger Terminal Building.
 - (b) Main Distribution Frame(s) (MDF) located at the PABX room.
 - (c) Telephone Terminal Cabinet (TTC) distributed throughout the airport complex.
 - (d) Block cabling between MDF and TTC
 - (e) Facility wiring to telephone points nominated
 - (f) End user handsets
 - (g) Operator's desk consoles
 - (h) Operator's headsets
 - (i) Cross connections, jumpers, cabling and connectors
 - (j) Diagnostic facilities, development and commissioning of software
 - (k) Billing system
 - (l) Grounding and necessary work and materials associated with efficient operation of the telephone system
 - (m) Charger with back-up batteries Integrated with the PABX

2.0 DESIGN CRITERIA

2.1 System Requirements

The Main Incoming Telephone Lines shall be distributed into different building users. They shall be generally classified as follows and shall be used as reference only:

- (a) Passenger Terminal Building
- (b) Control Tower and Operation Building and Administration Building
- (c) Maintenance Building and Fire Station Building
- (d) Sewage Treatment Plant
- (e) Pump Room

2.2 PABX Design Criteria

- (1) The PABX system provided shall be able to interface to the public automatic telephone network of the Philippines and shall function satisfactorily with telephone instruments for the extensions provided by Public Telephone Network Provider (PTNP).
- (2) The PABX system provided shall allow Integrated Service Digital Network (ISDN) access from Dual Tone Multiple Frequency (DTMF) Terminals.
- (3) All the equipment cabinets shall be of the latest design and completely sealed against entry of dust, moisture and vermin. The design shall allow easy access for maintenance purposes.
- (4) The PABX shall be designed based on the modular concept. This shall afford a cost effective and systematic means for future expansion.
- (5) All equipment and circuit interfaces shall be compatible with PTNP public exchange network and shall conform to CCITT recommendations. The PABX equipment shall be able to accept "Line Tone Reversal" signal from PTNP without additional hardware.
- (6) The power to the system shall be a DC voltage at + or – 5 % of nominal value.
- (7) UPS battery back up shall be rated for 4 hours at busy hour load.
- (8) All MDF's shall be sized to the number of lines and extensions needed for the covered area and have 25% of spare capacity for future expansion.
- (9) All termination for external extension lines shall be equipped with gas-discharge protectors for surge protection.

2.3 Operations and Maintenance Design Criteria

- (1) All Plant shall be designed to permit simple and economic operation and maintenance.
- (2) All Plant shall be designed to include self-diagnostic functions to facilitate rapid location of faulty components or replaceable modules. Replacement of failed components or modules shall be easily undertaken with minimum reference to the Operation and Maintenance Manuals.

3.0 SYSTEM DESCRIPTION

- 3.1 Telephone service to the Panglao Airport Complex that includes offices, check-in counters, commercial and other areas shall be provided.
- 3.2 The system shall be distributed throughout the airport complex from one (1) MDF room located at the ground level.
- 3.3 In the normal daily operation, incoming calls to the airport complex shall be answered by either the user (depending on the class of service and location) or by an operator who shall then forward the call to the appropriate person or function.
- 3.4 Direct lines to the pay phones, card phone concessionaires, offices, etc. shall also originate from the common MDF and all the equipment, using the Structured Wiring System, to connect their end unit devices.
- 3.5 There shall be direct lines dedicated to the Security Offices and Terminal Operations Center for use by firemen, security, and aviation communications hotline systems.
- 3.6 The Telephone system shall have call accounting hardware, systems software, and application software that shall allow reconciliation and billing of telephone usage.
- 3.7 The telephone system shall have the following minimum features:
 - (a) Class of Service Distinction
 - (b) Automatic Call Distribution
 - (c) Flexible Numbering System
 - (d) System Park
 - (e) Trunk Barring Service Classes
 - (f) Night Routing Restriction
 - (g) Add On Conference
 - (h) Abbreviated Dialing
 - (i) Automatic Call Forwarding
 - (j) Automatic Ring Back
 - (k) Distinctive Tones
 - (l) Data Transmission
 - (m) Tie Line Access
 - (n) Call Forward
 - (o) Hunting On Free
 - (p) Call Waiting

- (q) Call Pick-up
- (r) Call Transfer
- (s) Line Lockout
- (t) International Dialing
- (u) Access To Operator
- (v) Extension Hunting
- (w) Music on Hold

4.0 TECHNICAL REQUIREMENTS

4.1 Telephone System

- (1) The PABX equipment shall be solid state, stored program controlled, and time-division-switching system complete with on-line automatic, self-diagnostic maintenance features.
- (2) The signaling techniques used by the PABX equipment shall conform to the requirements of public carrier and otherwise with the Common Channel Signaling Scheme No. 7 as defined by CCITT (Consultative Committee for International Telephone and Telegraph).
- (3) The PABX equipment shall be based on a modular and interactive design in order to facilitate simple installation, expansion and maintenance.
- (4) Standalone PABX equipment cabinets shall be of the expandable type with interchangeable plug-in control cards, telephone line cards, external line cards and assemblies. The central processing equipment shall be designed with non-volatile memory and for DC operation.
- (5) The PABX, including any cabinets, shall be capable of future expansion with respect to the number of trunk lines, extensions and internal connecting links without causing interruption to normal operations being provided to existing users.
- (6) To permit maximum flexibility of operation, all extension telephone features between extensions shall be made through the PABX by software assignment. Hardware assignment of features shall not be acceptable.
- (7) Hardware equipment and software utilities shall be provided for the re-starting of the PABX. Upon resumption of power supply following a long-term power failure, re-starting of the PABX shall be initiated automatically without manual intervention.
- (8) All PABX control and switching circuits shall utilize solid state, processor based technology and shall be stored-program controlled and shall be designed for 24 hours per day continuous operation.
- (9) All Printed Circuit Board's shall be modular in construction and be arranged such that interconnection between different units can be achieved by means of prefabricated connectors.

- (10) The system memory shall have sufficient expansion capability not only to allow for the ultimate design capacity of the system but also to allow for new options and customized software utilities besides the standard packages required in this Specification.
- (11) Semiconductors memories used for controlling vital system functions, which are necessary for the system to operate, and set ups shall retain their stored data, resident in the semiconductor memory, for a period of at least 8 hours when the power supply has been cut off.
- (12) Secondary memory storage shall be provided for administration, maintenance and statistical purposes in the form of either high-speed tape or disk. The storage capacity shall be capable of storing all software programs and 6 months operational and accounting data for administration, maintenance and statistics during normal operation.

4.2 Standard Extensions – Digital Multi-function Terminals

- (1) Extension circuits (ports) shall support system integral handsets capable of multi-line/multifunction operation.
- (2) Protocol shall support the ISDN Basic Rate interface operation.
- (3) The circuits shall be capable of handling handset operation using the Unshielded Twisted Pair (UTP) category 5.
- (4) Initially, about ten (10) units of digital multi-function terminals shall have an LCD display dedicated for managers. The rest of the units shall have no LCD display.

4.3 Operator Console Facilities

- (1) The consoles shall as a minimum include a digital keypad with DTMF facilities to signal numerical codes for initiating calls to extensions, exchange lines and tie lines as well as for other miscellaneous functions.
- (2) The system shall be designed to provide efficient delivery of basic service to the public through the telephone system of the airport. The number of operator consoles shall be sized to ensure that there is a minimal queuing of calls for normal operation and capable of expanding at a future date.
- (3) The consoles shall also include other single-function or multiple-function keys or buttons, visual display and audible alarms as are detailed below and necessary to facilitate the speedy handling of calls.

4.4 Public Exchange Connections

- (1) The predominant connection to Philippine Public Network service or equivalent shall be via an Integrated Service Digital Network (ISDN) based service.
- (2) The telephone system shall be capable of full operation with the public network service providers and the derived circuits shall be capable of being configured flexibility or used flexibly as incoming (with inward dialing) or outgoing circuits.

- (3) In particular, for outgoing calls, the telephone system shall be capable of detecting the called party answer to enable, accurate timing and therefore costing of chargeable calls.

4.5 Alternate Routing

The telephone system shall be programmable such that alternate routing can be provided automatically for public network access, or tie lines.

4.6 Least Cost or Most Efficient Routing

The telephone system shall be programmable to analyze dialed codes and automatically select the least cost or most efficient route.

4.7 System Traffic Handling Capacity

The telephone system must be equipped with sufficient internal traffic dependent and handling devices to satisfy a grade of service (GOS) of 0.001 based on:

- (a) the extension and exchange line levels and operation as per the wiring for capacities given in the appended facilities schedule; and
- (b) an average traffic level of 0.1E (Erlang) per extension with average call hold time of 3 minutes (average of 2 calls/extension/hour);

4.8 Digital Multi-function Handsets

- (1) The Contractor shall be responsible for the initial physical programming, installation and operational testing of all multifunction buttons and general handset functions on each system integral handset, in accordance with the programming data provided as advised by the Engineer.
- (2) The digital handsets shall possess the following facilities:
 - (a) Keypad Dialing – 12 keys, 0 to 9 and # and * which, when touched/depressed, communicate to the PABX the digit associated with the key.
 - (b) Recall Button – when the button is depressed, the telephone system recall occurs.
 - (c) Ringing Volume Control – the loudness or volume of the ringing signal shall be adjusted from no signal through to a high volume signal of 75 dB (A) at 0.5 meters (preferably continuously adjustable across the range).
 - (d) * and # Keys – if either of the * or # keys are depressed, the associated DTMF code set shall be transmitted directly to the telephone system, and not be utilized within the handset to operate specific handset facilities such as to access or to store abbreviated dialing code sets. These shall be provided so that the telephone system facility codes can be accessed via * and # codes.
 - (e) Line Powering – the handset shall not require external AC mains supply for operation.

- (f) Ringer Tone Control – the tone (as distinct from volume) of the ringing signal shall be adjustable. At least three different settings shall be provided.
- (g) Adjustable Volume Control for the receiver/loudspeaker – the received level shall be able to be adjusted (increased / decreased) in volume.
- (h) On-hook Dialing – using this facility, provision shall be made to enable the dialing of a number without removing the handset from its cradle, with monitoring of call progress (tones etc) via the loudspeaker.
- (i) Loud-speaking / Hands-free Operation with Mute Facility - this facility enables two-way conversation with the handset ‘on-hook’; the telephone is equipped with a loudspeaker for receipt of incoming speech and an in-built microphone to transmit speech; provision shall be made to enable, by button action, the muting the microphone whilst still receiving the incoming speech.
- (j) Intercom Calling Facilities – to a definable group of system integral handset users, provision shall be made to enable operation as an intercom station.
- (k) Hold Key – operation of the hold key shall place the current call ‘on hold’ and enable selection of another line for answering or making a call. Operation of the line key associated with the call ‘on-hold’ shall return the connection to that call.
- (l) Single Key Access – handsets shall allow single key access to the following telephone system facilities:
 - (i) memory for stored numbers (minimum 5 numbers);
 - (ii) call transfer;
 - (iii) last number redial;
 - (iv) automatic callback on no answer and busy;
 - (v) call forwarding
 - (vi) group call pick-up; and
 - (vii) hotline facility.
- (m) Number of Pairs – all telephones shall be a maximum of 2-pairs.
- (n) Function/Line Keys – the handset shall be equipped with a minimum of eight programmable function keys and associated lamps, programmable for access to line terminations or telephones system facilities.
- (o) Visual Display – a visual display (for LCD type only) which shall show:
 - (i) the duration of calls in progress;
 - (ii) the extension number of a calling party;
 - (iii) the number dialed when making a call;

- (iv) indication of called extension status;
- (v) group call pick-up;
- (vi) message waiting indication.

4.9 Cost Accounting.

- (1) The following cost accounting facilities shall be provided:
 - (a) Provide the facility to analyze charges for local, international calls and also charges for calls on private network routes.
 - (b) Provide the facility to analyze all originating and international destination numbers and determine the appropriate charge rate.
 - (c) Provide the facility to provide organization and department and section summary billing.
- (2) As a minimum, costs shall be calculated and recorded for:
 - (a) international telephone calls, based on destination, time-of-day and call duration;
 - (b) tie-line/network calls, based either on usage or a fixed sum;
 - (c) equipment, based on a fixed sum or percentage;
 - (d) services (annual and connection fees), based on a fixed sum or percentage; and
 - (e) on-going costs such as maintenance and administration / management

4.10 Station Message Detail Recording (SMDR) Analysis

The PABX shall provide the necessary equipment and software to analyze call patterns and system resources to allow for tuning of the PABX System (e.g. adding PNTP lines, tie lines, hardware and software resources).

SECTION 6400

CABLE TV SYSTEM

1.0 SCOPE OF WORKS

- 1.1 The scope of works in this Section consists of the design (where applicable), manufacture, supply and installation, testing and commissioning of the Cable TV System.
- 1.2 The scope of works also includes obtaining all relevant Authorities' approvals in respect of the Works;
- 1.3 The complete Cable TV System shall include the following:
- (a) Lightning/voltage surge suppressors
 - (b) Channel amplifier modules
 - (c) Splitter units/tap-off units
 - (d) TV outlets
 - (e) 14" Test tuner color monitor
 - (f) VHS, VCD/DVD player
 - (g) Remote control system
 - (h) Co-axial cables, conduit and trunking

2.0 DESIGN CRITERIA

2.1 System Requirements

- (1) The cable TV signal shall be served by the Bohol Cable TV or Zafra Cable, a local cable TV company. The Contractor shall provide all the necessary ducting from TV head end at PTB Command Control Office up to the external concrete pedestal (see Drawings) and Cable Company shall provide cabling up to the head end equipment.
- (2) The Contractor shall provide all the line and distribution amplifiers, where applicable, to all areas concerned to boost and distribute the signal down to the various outlets.
- (3) The Cable TV System shall be designed to receive signal from Cable TV to be distributed by co-axial cable to all TV outlets around the buildings. The Contractor shall ensure proper reception of the pictures to all TV sets.
- (4) Television outlets shall be located at the following areas:
 - (a) Gate lounge (PTB) : 7 TV outlets
 - (b) Administration building & Operation building : 4 TV outlets
 - (c) Fire station building : 3 TV outlets

- (5) The Contractor shall provide a dedicated channel that shall carry information and announcements from the head end and another channel/s for video cassette recorder and VCD/DVD player.
- (6) The head-end amplifiers shall be of modular construction for easy maintenance.

2.2 Signal Requirements

- (1) The signal output levels at any outlet irrespective of system loading shall be as follows:

Television output	1mV (72 dBuV) minimum	8 mV (74 dVBuV) maximum
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- (2) The signal to noise ratio at any outlet shall have minimum value of 46 dB and mains supply hum should be less than 60 dB.
- (3) Cross modulation shall not be visible or audible at any outlet point with all the input signal or equivalent artificial input, connected to the distribution system.
- (4) The distribution system shall not introduce any form of impulse or spark type interference signals at any outlet in the system, which would be visible or audible on a standard television receiver.
- (5) The frequency amplitude response of the distribution system shall not vary by more than +/-1 dB, over any one channel.
- (6) The amplitude ratios of sound carrier to vision carriers shall not be varied by more than 10 dB to -2 dB between the input of the distribution system and the output at any outlet.
- (7) The signal level of each video channel at any outlets shall be between 60 to 74 dB

2.3 Equipment Requirements

- (1) All equipment shall be modular, easy to house and accessible for maintenance.
- (2) The system shall meet NTSC transmission system standards.
- (3) The cabling of the distribution system shall be run in galvanized steel conduit/trunking.
- (4) Distribution amplifiers shall be provided with test points and two outputs, each capable of delivering an approximate maximum signal level at 110 dBuV. The D.C. power requirement for the distribution amplifiers shall be derived from a separate power supply unit. The distribution amplifier shall have provision for the insertion of plug-in equalizer board when the need arises, without modifications.
- (5) Splitters and tap-offs between the power supply unit and the distribution amplifiers shall be of the power passive version. The input and output impedance of all splitters and tap-offs shall be 75 ohms with isolation between output circuits at min. 18 dB.
- (6) The TV outlets shall be flush mounted type and have 75-ohm impedance unbalanced.

- (7) The cable to be used for distribution shall be co-axial versions having nominal impedance of 75-ohms and with attenuation loss not exceeding 6 dB/100m for main drops and 12 dB/100m for secondary runs. The cable shall be polythene dielectric with stranded a plain copper wire conductor and copper braid screen and an outlet PVC sheath for protection.
- (8) Industrial VHS video recorder/player and a VCD/DVD player shall be provided and mounted on custom-made lockable cabinets with finishes, to the Engineer's approval.
- (9) Co-axial cables shall be provided and terminated to provide a complete in-house video system for all television receivers.
- (10) The in-house video channels shall be selected to provide non-interference to the existing local TV channels provider.
- (11) High quality, durability and fidelity system are called for and direct TV connector shall be provided with no additional power pack required.
- (12) All videocassette recorders shall operate to NTSC color and CCIR standards. Power requirement shall be suitable for 230 V, 60 Hz.
- (13) The standard system impedance shall be a 75-ohms and the cable used shall be of high quality, co-axial type.
- (14) Subsequent expansion and addition of channels or in-house movie channels shall require addition/modification at the headend equipment only.

3.0 INTERFACE REQUIREMENTS

- 3.1 The Contractor shall closely coordinate all the works with the Bohol Cable TV Company.
- 3.2 TV face outlet & locations shall be coordinated with the Architectural works to the approval of the Engineer.

SECTION 6500

PUBLIC ADDRESS SYSTEM

1.0 SCOPE OF WORKS

- 1.1 The scope of works in this Section consists of the design (where applicable), manufacture, supply and installation, testing and commissioning of the Public Address System.
- 1.2 The public address system shall be used to make flight information announcements and background music to passengers and staffs. In the Passenger Terminal Building (PTB) and the concourse complex, the system shall be used as Flight Information Announcement System, i.e. the system shall provide boarding status, flight delays/cancellation and other relevant information. Besides the flight information announcements, it shall also provide the background music to selected areas.
- 1.3 The public address system also shall be used as a part of the evacuation systems. When an emergency situation occurs, the system shall broadcast necessary announcements to people to evacuate from the area.
- 1.4 The complete public address system in the Passenger Terminal Building and the concourse complexes shall include the following:
 - (a) Central microphone;
 - (b) Information desk microphone;
 - (c) Gate microphone;
 - (d) Emergency microphone;
 - (e) Spot announcement machine;
 - (f) CD player;
 - (g) Cassette player;
 - (h) AM/FM tuner;
 - (i) Matrix panel;
 - (j) Graphic equalizer;
 - (k) Automatic volume control with noise sensing microphone;
 - (l) Power amplifier;
 - (m) Monitor speaker panel;
 - (n) Loudspeaker (various types);
 - (o) Wall-mounted attenuator;
 - (p) Terminal panel;

- (q) Equipment rack with blower fan unit;
- (r) Interface panel (with Flight information display system);
- (s) Personal computer with CRT and keyboard;
- (t) All the necessary cables and termination equipment;
- (u) All the necessary cable conduit, tray, ladder, trunking, and connection terminals/boxes.

2.0 SUBMITTALS

2.1 General

- (a) The provisions of **Section 1165** are applicable and are to be referred to in connection with 6500 of the Specification.
- (b) The following provisions are additional to, and are to be read in conjunction with Section 1165, and are particular to this Section of the Specification.

2.2 Shop Drawings

Shop drawings shall include where applicable, the following:

- (a) Manufacturers wiring drawings such as matrix panels, microphones, noise-sensing microphones for AVC (Automatic Volume Control), speakers.
- (b) Schematic and wiring diagrams for system components.
- (c) Control panels.
- (d) Rack arrangement
- (e) Wiring drawings detailing power, signal, and control systems and differentiating clearly between manufacturer-installed and field installed wiring.

2.3 Other Submittals

Product data including:

- (a) Product data for each type of product specified.
- (b) Fully detailed parts list, including numbered parts of each items of equipment.
- (c) Product certificates signed by equipment manufacturers certifying that their products comply with specified requirements.
- (d) Report of field tests and observations including acoustic measurement.

3.0 SYSTEM DESCRIPTION

- 3.1 The public address system shall be designed to provide paging, automatic flight announcements, emergency announcements and background music to all or selected zones in the main terminal building and the concourse complex.
- 3.2 The central microphone shall be able to make paging and announcements to individual zones or all zones.
- 3.3 The information desk microphone shall make limited paging and announcements to pre-programmed zones.
- 3.4 The Gate microphone shall make only boarding announcements and last call announcements only to its own gate lounge.
- 3.5 Prior to any announcement, an electronic chime shall be heard to arrest the attention of the audience, in the area to be selected for the announcements.
- 3.6 The emergency announcement shall make emergency announcements for evacuation with the top priority.
- 3.7 The spot announcement unit shall distribute repeated announcement to the pre-programmed zones.
- 3.8 The background music shall be distributed to the preset zones from any of the CD player, the cassette player or AM/FM tuner.

4.0 DESIGN CRITERIA

4.1 System Requirements

- (1) The public address system shall be designed to provide clear announcements during public addressing and one-way voice communication during an emergency, the secondary function shall be to provide background music where required.
- (2) The system shall be capable of delivering the following sound pressure levels at the listening level in the designed areas while the listening level shall be taken to be 1.5m above floor level.
 - 80dB A at listening level to the office and VIP/CIP lounge areas.
 - 85dB A at listening level to the general and public areas.
 - 90dB A at listening level to the plant/machine room areas.
- (3) The reinforced sound shall be distributed evenly throughout the listening area; the total variation in each area shall not exceed (+) 4dB for frequency up to 4kHz.
- (4) Sound pressure level for outdoor speakers shall be provided.
- (5) It shall be assumed that the ambient noise is not more than 70dB in the general and public areas, or 80dB in plant/machine room areas.

- (6) The Speech Transmission Index value of more than 0.5 shall be maintained for 80% of any area served. The reverberation time of the various areas shall be assumed to be between 2.0 and 3.5 seconds, for large areas and greater than 1.5 seconds for other areas.
- (7) There shall be two (2) PA announcer consoles in the PA operations room. These consoles shall perform identical functions, and serve as back up for each other.
- (8) The central microphone shall come complete with a flexible gooseneck microphone, a 20-key zone selection buttons, a chime buttons, a non-locking press-to talk button and shall be illuminated when depressed, and zone in-use indicators. The VU meter on the console shall be used to monitor the announcement level. This meter shall be ideally located for easy viewing by the announcer.
- (9) Announcements shall be able to be made from the central microphone to all or selected zones.
- (10) When paging zones are selected by the selection buttons, a chime shall first be heard, followed by the announcement. The push buttons in each zone selection panel shall be interlocked to enable only one selection at a time.
- (11) The information desk microphone shall come complete with a 10-key zone selection buttons, a chime button, a press-to talk buttons, and zone in-use indicators.
- (12) Announcement shall be able to be made from the information desk microphone to limited zones.
- (13) There shall be four (4) gate microphones at the gate lounges and bus lounges and each gate microphone shall come complete with a chime button, a press-to talk button. Announcements shall be able to be made from the gate microphone only to its own gate lounge.
- (14) It shall be possible for the system to function with different microphones in operation simultaneously, provided there is no conflict in the zones being called by these microphones.
- (15) The automatic announcement subsystem shall be designed for the announcements of scheduled and non-scheduled flight departures and arrivals in the main terminal building and the concourse complex.
- (16) The two official languages of English and Tagalog shall be used for the announcement.
- (17) The central systems shall have a monitoring system to continuously monitor the speaker lines, power amplifier, and matrix. At a minimum, the monitoring system shall monitor ground leakage, short circuits, and open circuits.
- (18) All programming shall be done via the display & keyboard of the central system
- (19) The spot announcement unit shall be provided for repeated announcement. The unit shall allow message to be recorded, and played back as and when required.
- (20) There shall be background music to selected areas. It shall be possible to pre-program any of the input music sources to any of these zones. Sources provided shall be a continuous cassette player, a compact disc player and AM/FM tuner.

- (21) The emergency microphone shall provide emergency announcements for evacuation and emergency procedures. It shall have the highest priority and be able to override all other announcements.
- (22) The main equipment shall be housed in standard 19-inches equipment racks.
- (23) The central system shall be microprocessor controlled and shall be flexible and easy to operate. Specific functions shall be easily programmed and changed.
- (24) The matrix unit shall be provided for the routing of the inputs of the system to the output loudspeaker circuits. The system shall have flexibility of expansion. The zonings are as shown on the Drawings.
- (25) A graphic equalizer (2/3 octave) shall be provided at each of the matrix outputs to adjust acoustic equalization in the zones.
- (26) The automatic volume control (AVC) shall be provided only for the zones of the check-in customs, check-in counter, baggage claim and arrival lobby. The ambient noise-sensing microphone shall be located on the ceiling of these zones.
- (27) The AVC shall be capable of,
 - (a) Sampling the ambient noise level, except during calls (sampling is blocked during actual call).
 - (b) Varying the output volume to compensate for changes in the average noise level.
- (28) Several types of loudspeakers shall be provided to meet the acoustic requirements for the above mentioned,
 - (a) Ceiling type; areas with ceiling height less than 7m.
 - (b) High power box type; Concourse corridor.
 - (c) Wall-mounted box type; M/E plant areas.
 - (d) Horn type; baggage handling areas.
- (29) The wall-mounted attenuator shall be provided in all VIP/CIP lounges and offices.
- (30) For each speaker line circuit, cabling shall be 3-wire method. This shall allow for an emergency announcement to be heard even if the attenuator is set to the off position. Minimum size of wire shall be 1.25 mm² (#16 AWG), copper wire.
- (31) Car Paging System shall be provided as follows:
 - (a) An independent car paging system shall be installed in the main car park. There is no link between this system and the public address system of the passenger terminal building.
 - (b) Car park control system and equipment rack assembly shall also be located at the public address system main equipment premises.

- (c) A microphone-outlet set shall be installed at the arrival hall's information counter, along side with the two (2) units telephone outlets. A second microphone-outlet set shall be installed at the public concourse near center courtyard (see Drawing B1-6500-3).
- (d) Two assemblies of 3-unit – outdoor type speakers shall serve the main car park complex. Each assembly of 3-unit speakers shall be mounted at the two main car park's lighting mast. Mounting height shall be 3m above ground level.

Minimum size of conductor shall be 1.5mm², copper.

4.2 Technical Specifications

- (a) Matrix unit
 - Number of audio input : Max, 64
 - Number of audio outputs : 128
 - Control inputs : Max. 128
 - Control output : Max. 128
 - Frequency characteristics : 20Hz-20kHz
 - Buses : 16 digital buses
 - Host PC interface : RS-232C
- (b) Central microphone
 - Microphone
 - 20 switch buttons for paging zone selection
 - Zone in-use indicator
 - Chime
 - Press-to-talk button
- (c) Information desk microphone
 - Gooseneck microphone
 - 10-key button for zone selection
 - Zone in-use indicator
 - Chime
 - Press-to-talk button
- (d) Gate microphone
 - Gooseneck microphone
 - Press-to-talk button
- (e) Emergency microphone
 - 20 switch buttons for paging zone selection
 - Zone in-use indicator
 - Emergency switch
 - Press-to-talk button
- (f) Spot announcement unit
 - Memory element : ATA flash memory card (2 cards)

- Memory capacity : Max. 10,632 sec./85M ATA flash memory card
 - Sentence : Max. 256
 - Frequency response : 20Hz-20kHz (Sampling at 44.1kHz)
- (g) CD player
- Compact disc size : 12 cm
 - Disc capacity : 5 discs
 - Frequency response : 20Hz – 20kHz
 - S/N ratio : 96 dB
 - Harmonic distortion : Less than 0.001% (1kHz)
- (h) Cassette player
- Type : Heavy duty double cassette deck
 - Useable tape : Compact cassette type
 - Frequency response : 50Hz – 15 kHz
 - S/N ratio : 60dB (Dolby NR; ON)
 - Distortion : Less than 3% (1kHz)
 - Playing system : Auto reverse
- (i) AM/FM tuner
- Tuning range : FM: 87.9-107.9kMz(20kHz step); AM: 520Hz -1710kHz(10kHz step)
 - Antenna input-FM : 300 ohms balanced, AM; Loop antenna
 - Audio output-FM : -7dBV + 4dBV
- (j) Graphic equalizer
- Type : 2-channel 2/3 octave
 - Input level : +4dBV (Rated)
 - Output level : +4dBV (Rated)
 - Frequency response : 20Hz – 20kHz
 - Distortion : less than 0.01% at 1,000Hz
 - Equalization center frequency : – 400, 630, 1000, 1600, 2500, 4000, 6300, 10000, 16000Hz
- (k) Automatic volume control
- Type : plug in module type
 - Audio input level : 0dBV
 - Noise input level : -70dBV
 - Attack time : 16msec to 5msec.
 - Attenuation Ratio A : 0, -3, -6, -9, -11, -13dB,
 - Ratio B : 0, -3, -6, -9, -11, -12, -13dB
 - Ratio C : 0, -3, -6, -9, -13, -17 dB
- (l) Power amplifier
- Program input : 0dBv 100k ohms

- Priority input : 0dBV 100k ohms
 - Output power : 120W RMS
 - Output impedance : 83 ohms
 - Frequency response : 40Hz – 16 kHz +/-2dB
 - S/N ratio : 80dB
 - Distortion : Less than 1% at rated power
- (m) Ceiling speaker
- Sound pressure level : 92dB(1W1m)
 - Frequency response : 100Hz – 12kHz
 - Speaker component : 16cm dynamic cone type
 - Speaker grille : Aluminum, off-white paint (spring catch)
- (n) High power box splash proof speaker
- Rated power : 20W
 - Sound pressure level : 94dB(1W1m)
 - Frequency response : 100Hz – 20kHz
 - Speaker component
 - Mid/low frequency : 13cm cone speaker
 - High frequency : CD Horn w/driver unit
 - Finish; enclosure : ABS resin
 - Punching net : Zinc-coated steel plate, painted
- (o) Wall-mounted box speaker
- Rated power : 3W
 - Sound pressure level : 91dB (1W1m)
 - Frequency response : 120Hz – 15kHz
 - Speaker components : 12cm dynamic cone type
 - Speaker grille : ABS resin, off-white
- (p) Horn speaker
- Rated power : 15W
 - Sound pressure level : 112dB (1W1m)
 - Frequency response : 250Hz – 10kHz
- (q) Attenuator
- Type : wall-mounted
 - Input range : 0-30W
 - Attenuation : 5 steps (0, -6, -12, -18, OFF)

SECTION 6600

MASTER CLOCK SYSTEM

1.0 SCOPE OF WORKS

- 1.1 The scope of works in this Section consists of the design (where applicable), manufacture, supply and installation, testing and commissioning of the Master Clock System.
- 1.2 The Master Clock System shall include, but not necessarily be limited to the following:
- (a) Time Code Master Clock System
 - (b) Global positioning system satellite (GPS) receiver antennae, down-feed cables, receiver/decoders and time-synchronizing interfaces to the time-of-day generator;
 - (c) Serial data output from the time-of-day generator comprising “year/ month / day / hour / minute / second” plus synchronization information in ASCII format, repeated once per second;
 - (d) Digital-format secondary clocks and connecting cables in public and non-public areas.
 - (e) Containment systems for cables between clock equipment and cabling termination frames;
 - (f) Equipment cabinets;
 - (g) Uninterrupted Power Supply (UPS) system
 - (h) Other materials to provide a complete & fully operational clock system.

2.0 STANDARDS

In addition to the Codes and Standards listed in para 10.0 of **Section 1135** the following shall also be applicable:

- (a) IEEE Standard, or
- (b) IRIG B Standard, or alternatively
- (c) EIA specifications

3.0 SYSTEM DESCRIPTION

- 3.1 A highly accurate microprocessor based Master Electric Clock System shall be installed in the Equipment Room, 2nd Floor, Control Tower Building. The time base provided from the Master Clock shall be of a high accuracy type with automatic synchronization with a radio time code signal. This time base shall be relayed to individual slave clocks located at designated area of the whole building such as the corridors, check in concourse, gate lounge arrival hall office etc.

- 3.2 The Master Electric Clock Systems master control shall be installed at the located at the 2nd floor of the Control Tower Building, Equipment Room. From here, this equipment shall provide an accurate time base control with synchronization & ratio time code signal.
- 3.3 This time base shall be relayed to individual slave clocks located at designated areas of the complex using concealed wiring.

4.0 DESIGN CRITERIA

4.1 System Requirements

- (1) The time base shall be of a high accuracy radio controlled type with automatic synchronization with a radio time code signal (GPS).
- (2) Each designated level of the above complex shall be installed with slave digital or analog type clocks. The Passenger Terminal Building shall have digital as well as analog types, and the Control Tower and Operation Building, and Administration Building shall have analog type only.
- (3) The Master Electric Clock system shall have high reliability accurate to +/- 5 seconds per month or better.
- (4) The Master Electric Clock System shall operate on Uninterrupted Power Supply (UPS) 220V, 60Hz, 1 phase electrical supply and with internal rechargeable batteries to maintain the accuracy of operation.
- (5) The system shall be required to operate without failure continuously for 24 hours a day, 365 days a year without any maintenance period.
- (6) The Master Clock System and individual slave clock units should maintain accuracy with the loss of the GPS signal.
- (7) All clocks to be installed in the areas of high ceiling such as the Departure Level of the Main Terminal Building shall be incorporated with the signage, e.g., with the Flight Information Display System.
- (8) A highly accurate microprocessor based Master Electric Clock control system providing a uniform and accurate time.
- (9) All secondary Digital clocks shall relay this common time around designated areas of the whole PTB complex and other buildings.
- (10) All master control and program wiring systems shall be complete with cabling, conduits, and trunkings to individual clock outlets to every clock location.

4.2 Technical Specification

- (1) The following major components comprise the Head End equipment:
 - (a) GPS antennae and feeder cable
 - (b) GPS receiver / decoder
 - (c) Master time-of-day generators

- (d) Synchronization mechanism and
 - (e) Serial data generator
- (2) GPS antennae and feeder cable shall be as follows:
- (a) The GPS antennae shall be of the omni-directional plate type; fully weatherproofed and suitable for roof mounting.
 - (b) The Contractor shall make appropriate GPS signal strength measurements on Site before finally selecting the equipment to be provided.
 - (c) Where the predicted signal-to-noise ratio at the GPS receiver is insufficient to meet the system performance and reliability requirements of this Specification, the Contractor shall install a low noise antenna head-end amplifier.
- (3) GPS receiver/decoder shall be as follows:
- (a) The GPS receiver/decoders shall be capable of simultaneously receiving a minimum of three (3) global positioning satellites, and determining the date and universal time coordinate (UTC) to an accuracy of better than $\pm 1\mu\text{S}$ at any time.
 - (b) The receiver shall additionally produce a signal to indicate whether the resulting information is GPS synchronized or not.
- (4) Master Time-of-Day Generator (Master Clock) shall be as follows:
- (a) The Contractor shall provide a temperature controlled crystal oscillator with a high accuracy rate.
 - (b) The Contractor shall provide date and time divider chain logic, driven by the temperature controlled crystal oscillator, to resolve the following information:
 - (i) year
 - (ii) month
 - (iii) day of the month
 - (iv) hour of the day in 24-hour format
 - (v) minutes
 - (vi) seconds to a resolution of $1\mu\text{s}$
 - (c) Adjustment for leap year changes shall be automatic.
- (5) Battery support system shall be as follows:
- (1) The Contractor shall provide sealed-for-life rechargeable batteries to accommodate short interruptions in power supply to the head-end, such interruptions, the temperature controlled crystal oscillator and divider chain shall continue to function without disturbance.
 - (2) Where secondary cells are used, they shall be trickle charged during normal operation.

- (3) Where primary cells are used, the Contractor shall provide a means of indication when cells require replacement during routine maintenance.
- (6) Manual controls shall be as follows:
 - (a) The Contractor shall provide a system of manual controls whereby each element of the divider chain can be individually controlled. It shall be sufficient to control seconds to the nearest whole second.
 - (b) The controls shall be disabled when the oscillator and divider are synchronized by GPS, as defined below.
 - (c) The Contractor shall provide digital indicators next to each of the controls to show the date and time currently produced by the divider chain to a resolution of 1 second. The character height shall be a minimum of 25mm.
- (7) Synchronization mechanism shall be as follows:
 - (a) The Contractor shall provide a means whereby the master time-of-day generator and divider chain are automatically synchronized to signals from the GPS receiver/decoder, whereby:
 - (i) the divider chain product shall be offset from the GPS UTC values by 8 hours in order to indicate Philippine standard time;
 - (ii) the master oscillator shall continue to free-run when GPS-synchronization is lost;
 - (iii) if after a period of free-running, the divider chain is behind the correct time when re-synchronization occurs, it shall be immediately corrected; and
 - (iv) if after a period of free-running, the divider chain is ahead of the correct time, its state shall be frozen momentarily and restarted at the correct time. The divider chain shall never be corrected backwards except by manual control.
 - (b) The Contractor shall provide an indicator LED on the head-end control panel to show when GPS synchronization is operational.
- (8) As much as possible, clocks of the same brand and type shall be chosen in each of the cases, in order to ensure over-all compatibility.
- (9) Digital format clocks (Slave Clocks) shall be as follows:
 - (a) The Contractor shall provide 24 hour format digital clocks:
 - (i) Clock face shall comprise hour and minute displays in either:

plasma discharge technology; or
transflective LCD technology.
 - (ii) Character height shall be nominally 120mm.
 - (b) Viewing Angle

- (i) The viewing angle permitted by the front glass screen shall be measured in degrees from a line perpendicular to the screen. The viewing angle shall be defined as the angle over which the contrast ratio remains greater than 4:1.
- (ii) The viewing angle in the horizontal plane shall be a minimum of +/- 60° (a total of at least 120°). The viewing angle in the vertical plane of +/- 40° (a total of at least 80°).
- (c) **Brightness**
 - (i) The clock face shall be clearly legible in ambient light conditions varying from 10 lux to 10,000 lux. The Contractor shall state the range of ambient light in which the clock face shall be clearly legible and shall detail the method(s) used to attain this method.
 - (ii) The degree of backlighting use by a clock face shall vary automatically to match the display brightness to the ambient light. Preset triggered illumination levels shall be manually settable and programmable.
- (d) **Contrast Ratio**

The minimum contrast ratio perpendicular to the clock face (or wherever the equivalent point is if the vertical viewing angle is biased downward) shall be 20.
- (e) **Glare and Reflections**
 - (i) The Contractor shall take measures to eliminate glare and reflections from the clock face.
 - (ii) The controller derives the status “valid data” or “invalid data” on the basis of three consecutive data strings.
- (f) Power requirements: 230V AC, 1PH, 60HZ
- (g) They shall operate on a stand-alone basis and according to a preset duration.
- (10) The Contractor shall ensure that the system is capable of future expansion of compatible slave clock for Government and private concessionaire offices and other buildings of the airport.

SECTION 6700

IP CCTV SYSTEM

1.0 SCOPE OF WORK

- 1.1 A dedicated IP CCTV security surveillance system shall be provided for remote observance of designated vital points and areas in and around the building complex.
- 1.2 The scope of works in this Section consists of the design (where applicable), manufacture, supply and installation, testing and commissioning of the IP CCTV System
- 1.3 The IP CCTV System shall include:
 - (a) TV cameras for security system
 - (b) Mixers / video switching matrix
 - (c) Video recorder / digital video storage units
 - (d) Camera remote control panels
 - (e) Cabling including conduit and fittings
 - (f) Computer Sets / Station
 - (g) Internet Equipment
 - (h) Network Switches
 - (i) Other related works

2.0 STANDARDS

In addition to the Codes and Standards listed in para. 10.0 of **Section 1135** the following shall be applicable:

- (a) “International Standards and Recommended Practices for Security” – ICAO Annex 17
- (b) IEEE Standard
- (c) Applicable Standard of FCC or IEC, or equivalent internally recognized standard for electromagnetic interference, electro-magnetic compatibility.

3.0 SYSTEM DESCRIPTION

- 3.1 The Monitoring Control Center of the Closed Circuit Television (CCTV) security surveillance system for the airport complex shall be installed at the ground floor, Command Control Office of the Passenger Terminal Building. A remote controller and a TV monitor shall also be installed at the 9th floor of the Control Tower to monitor the Apron area.
- 3.2 Initially, four (4) general areas/building shall be installed with PTZ (Pan, Tilt & Zoom) type CCTV surveillance camera, namely: Passenger Terminal Building, Operation Building, and at the Car park area.
- 3.3 The following specific area shall be monitored by CCTV. Majority in the Passenger Terminal Building.
 - (a) Public concourse

- (b) Baggage claim & breakdown area
- (c) Check-in lobby
- (d) Baggage make-up area
- (e) Transit counter
- (f) Departure hall
- (g) Gate lounge
- (h) Stand (air side/Apron area)
- (i) Operation Building's ground floor corridors

4.0 DESIGN CRITERIA

4.1 System Requirements

- (1) The following conditions are applicable applied for the CCTV System:
 - (a) Ambient Conditions
 - (i) Temperature 10°C to 40°C
 - (ii) Relative humidity 10% to 99%
 - (b) Power Supply Conditions
 - (i) 230V AC, 60HZ, single phase
- (2) Design conditions for the equipment shall be as follows:
 - (a) Applicable temperature, humidity condition:
 - (i) Equipment installed outside exposed to weather
 - 70 degree C
 - 100% relative humidity
 - rain waterproof
 - (ii) Equipment installed outside but under the shade
 - 55 degree C
 - 100% relative humidity
 - splash waterproof
 - (iii) Equipment installed inside the building without air conditioning
 - 45 degree C
 - 100% relative humidity without condensation
 - suitable protection against water and dust
 - (iv) equipment installed inside the building with air conditioning
 - 15 to 40 degree C
 - 90% relative humidity
 - suitable protection against water and dust
 - (v) equipment installed inside the building with computer air conditioning

- 35 degree C
 - 85% relative humidity
 - suitable protection against water and dust
- (b) Applicable standard of IEC or equivalent internationally recognized standard for enclosure/protection of the equipment shall be applied.
- (c) Other environmental conditions:
- The degree of protection provided for equipment against environmental conditions such as, presence in the air of microscopic particles, water, dust, temperature, humidity, vibration, noise, etc. shall be determined by, and suitable for, the environment in which the equipment is installed. For example, out-door cameras shall be suitably protected against heat, vibrations, electro-magnetic noise, lightning strikes, surges, restrained against wind loads, seismic movement, etc.
- (d) Design requirements for electrical supply
- (i) voltage variation:
 - steady state variation : +5%, -10%
 - transient variation : +/- 10%
 - (ii) frequency variation:
 - steady state variation : +/- 5%
 - transient variation : +/- 5%
 - (iii) All equipment and devices for the CCTV system shall be on the same phase.
- (3) All camera video signals shall be transmitted via coaxial cables. Line amplifiers shall be provided as required, to ensure an acceptable video signal level at the video matrix switcher without degrading the picture quality at the VDU in the control console. The Contractor shall also determine the appropriate cable system for the PTZ (Pan, Tilt & Zoom) control signals.
- (4) The television cameras' scanning system shall meet NTSC standards (National Television System Committee for Radio Communication).
- (5) Switching of video signal, control of remote positioning devices and integration with the ACMS (Access Control and Monitoring System) shall be accomplished with a micro-processor based matrix video switching system.
- (6) The required interface (hardware and/or software) shall be provided between the CCTV system and the ACMS such that CCTV cameras automatically zoom in on areas where alarms are initiated.
- (7) The system shall allow remote access from the internet via Laptop, PC's, I pads, Iphone and all other smartphones.
- (8) The video signals of the air side stand (Apron area) shall also be routed via looping outputs and distribution splitters/amplifiers to the Control Tower (9th floor). Selected

camera outputs from the video switcher outputs may also be transmitted to the Control Tower for other purposes.

- (9) All mounting base and protective housing of cameras shall be of heavy gauge stainless steel sheet metal with attachment points for mounting the camera along both horizontal and vertical planes.
- (10) For exterior surveillance applications, the camera is housed in a waterproof stainless steel with gasket and anti-reflection baffle and protection factor index of IP 66. The Contractor shall detail the method use to prevent internal condensation, e.g., heater coil with thermostat.

4.2 Technical Requirements

- (1) Cameras and accessories shall comply with the following:
 - (a) Cameras shall consist of lens, image pickup tube, housing/mounting base, solid state 1/3" CCD and related devices.
 - (b) Motor operated remote zoom type cameras shall be equipped with focus range smoothly adjustable from 8 to 64 mm.
 - (c) Image pickup element: 1/3" charge coupled device, resolution of 768 lines horizontal and 494 lines vertical, or equivalent.
 - (d) Picture scanning method: random interlace system.
 - (e) Sensitivity: minimum required illumination of 1 lux.
 - (f) Camera mounting base shall be installed with motor driven remote controller to direct camera smoothly adjustable in ranges of 340 degrees horizontally and 75 degrees vertically.
 - (g) Capacity and specification of CCTV monitor console shall be expandable up to additional 30 cameras.
 - (h) Fixed type and motor operated remote zoom type cameras shall be equipped with focus range smoothly adjusted from 8 to 64mm. Visible distance at maximum zoom condition shall be 60m.
 - (i) Total number of PTZ cameras: 22
- (2) When zoom lenses with auto iris are employed the following minimum specification shall be met, while other specifications are in compliance with requirements of the place of use.
 - (a) Full transit time of focusing system shall be less than 5 seconds.
 - (b) Full transit time of zooming system shall be less than 5 seconds.
 - (c) Full transit time of iris system shall be less than 4 seconds (60 to 3000 lux)
- (3) When pan & tilt heads are employed:

- (a) Maximum load : shall be selected taking relevant camera & its accessories in to consideration.
 - (b) Pan speed : 6 Degrees / sec.
 - (c) Tilt speed : 6 Degrees / sec.
 - (d) Pan & tilt torque : shall be selected taking relevant camera & its accessories in to consideration.
- (4) Video Matrix and Matrix Control System shall be as follows:
- (a) The Video Matrix shall be a microprocessor based type and of modular in construction.
 - (b) The Matrix Control System shall be of microprocessor controlled, modular system. Processing unit, storage, power supplies and other important modules shall be duplicated.
 - (c) The control system shall control the matrix to route video information received from various cameras into monitors provided in the monitor consoles as well as to the digital video storage units (loggers) / video records.
 - (d) Matrix control system & matrix shall support displaying of video in quad format on the video wall.
 - (e) Matrix control system & matrix shall support recording of all video input on the digital video / image storage units during normal operations by employing suitable multiplexing technique. On special events cameras selected by operators shall be directed to an additional and standby digital storage units for continuous recording/ storage.
 - (f) Matrix control system & matrix shall support change over from main to standby digital storage units on malfunctioning of storage unit.
 - (g) Personal Computer (PC) may be interfaced locally to the matrix control system for programming, administration and system monitoring & maintenance.
 - (h) System shall have hierarchical password scheme for administration & operational purposes. Access to the system shall be recorded.
 - (i) During the system programming video cameras to be accessed by local and remote operators shall be configured. Provision shall be available to overlap cameras to be monitored by two or more operators. In such a case control shall be given to either “the first operator selected the camera” or “operator having higher access level” and the same shall be configured during the system programming.
 - (j) Operator keyboards in the monitor console (number to be proposed & supplied by the Contractor) shall be connected to the matrix control system for the execution of commands required for the operation of CCTV system.
 - (k) The system shall execute only the commands given by authorized personnel logged to the system through operator keyboard or other control terminals

- connected. Also the system shall maintain a log of all such accesses (operator sign on / off) to the system and alarm conditions.
- (l) Matrix control system shall execute PTZ (pan, tilt & zoom) commands (i.e. controlling of selected cameras) and video selections (routing of video from selected cameras to monitor on the operator console) originated from the operator keyboards.
 - (m) Input video capacity of the matrix control system shall be adequate to cater proposed number of cameras plus additional 10% and shall be expandable.
 - (n) There shall be a minimum of two (2) video matrix controllers (multiplexer) to be provided at the PTB control center.
 - (o) Output capacity of the matrix control system shall be adequate to cater proposed number of monitors plus additional 5%, digital storage units and shall be expandable.
 - (p) Provisions shall be made for synchronizing all the cameras connected to the matrix in order to prevent picture rolling during image switching.
 - (q) Image switching shall be performed during the vertical interval.
 - (r) Cameras shall be either have the facility to display the camera identification number superimposed on the video image generated (when displayed on a monitor), or the matrix control system shall provide the facility by superimposing numbers on the video received from the cameras.
 - (s) Matrix control shall maintain master date & time generator, information of which shall be displayed in suitable manner and shall be injected to other systems such as digital storage units. Authorized person shall handle changes in the settings of the generator.
 - (t) Loss of video on a camera or cameras shall generate an alarm.
 - (u) Availability of tracking facility (person) in the system using a camera or group of cameras shall be included
 - (v) All hardware shall be mounted on standard, well-ventilated, lockable cabinets.
- (5) Operator keyboards shall be as follows:
- (a) Operator keyboard shall be basically employed to:
 - (i) Initiate PTZ [pan, tilt & zoom] commands to a camera selected by the keyboard;
 - (ii) Selection of “number of cameras to be monitored” on the console monitors;
 - (iii) Selection of “camera or cameras” to be displayed on the console monitors;
 - (iv) Operation of the additional or standby digital storage units for continuous recording of cameras;

- (v) Playback controls for the standby digital storage units. (Note: This is a facility to be restricted and used only on very special occasion)
 - (b) The following information shall be monitored on a display built in to the keyboard or monitored on the console video display.
 - (i) The no. of the video input / camera selected for monitoring & control.
 - (ii) Whether the camera is presently controlled by another operator.
 - (c) Keyboard shall be equipped with joystick for the pan & tilt functions and separate keys shall be available for the zoom control.
- (6) Video recording system shall be as follows:
- (a) Playback at the Monitoring & Control Center shall be allowed to selected personal only.
 - (b) The stored video shall be play back and reproduction shall be realistic view of the actual event occurred.
 - (c) Failure of storage unit should be indicated on operator console by audio and visual alarm.
 - (d) Technical requirement are as follows:
 - (i) Type of recording material : Storage media shall be specified. For transferring image files from recorder to Replay center, widely used method shall be used (e.g. DAT Tapes).
 - (ii) Multiple channels to be stored in a single time lapse video cassette
 - (iii) Three (3) such cassettes shall be required at any given time for normal storage
 - (iv) Time & date : shall use time and date signals from matrix control system.
 - (v) Search function : date and time search function shall be provided for play back.
 - (vi) Lockable control panel : controls shall be password protected for digital storage.
- (7) Video Monitor
- (a) CCTV monitors shall be LCD type rack mounted or custom mounted.
 - (b) Size : 19 inch
 - (c) Resolution : 2560 x 1600 or more.
 - (d) Control and adjusting switches shall be provided as required.
 - (e) Brighness : 400 cd/m²
 - (f) Latest features/specifications of the above.

- (8) All types of cables proposed should be suitable for the environmental conditions prevailing at the Site. Specifications published by the cable manufacturer shall be provided. Armoured cables shall be employed for external installations.
- (9) Suitable multiplex method and optical terminals shall be used at isolated locations to combine cameras and connect to the ring.
- (10) Power to the multiplexer terminal shall be connected taking backup requirement in to consideration.

5.0 INTERFACE REQUIREMENTS

- 5.1 Exact location & method of installation shall be approved by the Engineer.
- 5.2 Interface work shall be required with the Access Control & Monitoring System (ACMS) regarding the electro-magnetic lock at the control Tower.
- 5.3 CCTV clock system shall be derived through the Master Clock System.

SECTION 6800

FIRE DETECTION AND ALARM SYSTEM

1.0 SCOPE OF WORKS

1.1 The scope of works in this Section consists of the detailed design, manufacture, supply and installation, testing and commissioning of the complete Fire Detection and Alarm System .

1.2 The complete Fire Detection and Alarm System includes, but is not limited to the following:

- (a) Fire Alarm System (Addressable)
 - (i) Fire Alarm control Panel (FCP) complete with visual zone display monitor. FCP shall have additional space to house Firemen's Intercom System and remote control of relevant ventilation & air conditioning equipment.
 - (ii) Smoke/heat detectors (addressable type) in all enclosed areas even though it may be protected by sprinkler system and also in the airconditioning return duct.
 - (iii) Addressable manual call points (break glass) and alarm bells in all areas of the airport complex.
 - (iv) Fire signal wiring to interfaced systems from distributed I/O modules.
- (b) Electrical equipment complete with data gathering panels, control system and cabling for the proper operation of the equipment.

1.3 The scope of Contractor's design is as follows:

- (a) The Drawings and Specification define the engineering design intent of the proposed system. The Contractor shall ascertain the various building aspects and produce a detailed design based on the architectural drawings, the engineering design concept and the Specification.
- (b) The Schedule of Fire Detection and Alarm System is given for information only. It is the responsibility of the Contractor to fully design and select all Plant and equipment so as to comply with the requirements of the Specification.

2.0 DESIGN CODES AND STANDARDS

In addition to the Codes and Standards listed in para. 10.0 of **Section 1135** the following shall also be applicable.

- (a) Provisions of National Fire Protection Association (NFPA) NFPA 72A, 72B, 72D, 72E.
- (b) National Fire Alarm Code 1993, and 1221, installation, maintenance and use of the Public Fire Service Communication System - 1991
- (c) Philippine Electrical Code Part I and II

- (d) Fire Code of the Philippines and Regulations PD No. 1185

3.0 SYSTEM DESCRIPTION

- 3.1 Smoke/heat detectors (spot type); manual call stations (activated by a double knock system) and alarm sounders shall be provided in all areas of the Passenger Terminal Building as well as other buildings.
- 3.2 The main fire control panel (FCP) shall be located at the Command Control Office located at level 1 of the Passenger Terminal Building. The fire control room shall house the fire control panel that shall supervise the entire fire alarm/detection system for the PTB and all other building facilities. The fire control panel shall receive information from data gathering panels. Fire zone layout shall be provided for all areas. Addressable manual call points shall be located along escape routes and at a maximum horizontal distance of 60 meters from any given point on any floor in the building, except in public areas where the maximum distance shall be 35 meters.

4.0 DESIGN CRITERIA

4.1 System Requirements

- (1) The system shall serve all enclosed areas including areas without sprinkler provisions.
- (2) The system shall be a multiplex, electrically supervised Class A, addressable, non-coded, pre-signal, zone-annunciated fire alarm system.
- (3) The system shall include the Fire Alarm Control Panel (FCP), Data Gathering Panels with trouble bell and lights, manual call stations, automatic detectors, alarm sounders, distributed I/O module for interfacing with other systems using a dry switch and a standby batteries.

4.2 Technical Requirements

- (1) Fire Alarm Control Panel (FCP-A) shall be as follows:
 - (a) The FCP shall be of the analog addressable type, obtaining information from data gathering panels (DGP). Data, gathering panel monitors addressable devices wired in class "A" loops. The FCP, DGP, detectors and distributed I/O modules (DIOM) shall be from the same manufacturer or supplier of the system.
 - (b) The FCP shall supervise & monitor the status and the operation of all devices on the loops for fire, short-circuit faults, open circuit fault complete with hard printout of English words & numerals such as date, time, device number/type/location.
 - (c) The panel shall be of console free standing type or wall mounted fitted with a hinged door with stainless steel trim provided with chrome-plated combination lock. Six sets of keys shall be provided to fit all locks.
 - (d) The system shall be based on a highly advanced microcomputer technology and data communication techniques to be able to structure the system into

any large size or according to the present and future facility demands. Redundancy in the system's network shall also be considered.

- (e) LCD monitor : - English and numeral with illumination light (40 character x 8 lines)
- Indicates: Various menu, alarm, 7 segment LED, and 6 figure indications.
- (f) LED indicator lamp : 18 status indicator
- (g) Operator switch : 5 switches including 10 keys
- (h) Firemen's Intercom System, which operates between FCP and a plug-in hand set in the manual call points.
- (i) Printer unit : English & numerals, 40 characters
- (j) Auxiliary equipment : - battery
- booster unit
- interface unit

(2) Supervision Workstation shall be as follows:

- (a) Type : floor mounted type
- (b) Transmission method : LT net line: token passing method
- (c) Monitor : 20 inches color monitor, 1024 x 768 dot pitch resolution, 50 sheets of active mimic drawing floor plan.
- (d) CPU : Pentium processor 800 mHz or more
- (e) Power requirements : AC 230 V, 60 Hz, 1Ø

(3) Fire Alarm Control Panel (FCP-B) shall be as follows:

- (a) Type : self standing type, analog addressable (with time delay functions)
- (b) Transmission method : LT net line : token passing method
trunk line : multiple transmission polling method
- (c) LCD monitor : - English and numeral with illumination light (40 characters x 8 lines).
- Indications: various menu, alarm, setting 7 segments LED, 6 figure indication
- (d) LED indication lamp : 18 status indicator
- (e) Operation switch : 5 switches including 10 keys

- (f) Function : Addressable, self-diagnosis in automatic test, resounding system of panel alarm, fire alarm, gas leakage alarm, warning & fault alarm.
 - (g) Firemen's Intercom System, which operates between FCP and a plug-in hand set in the manual call points.
 - (h) Printer Unit : English and numerals, 40 characters
 - (i) Auxiliary equipment :
 - Battery box
 - Booster unit
- (4) Annunciator Panel shall be as follows:
- (a) Type : wall mounted type
 - (b) Circuit voltage : DC24V, power supply is supplied by Fire Alarm Control Panel
 - (c) Transmission method : LT net line: token passing method
 - (d) LCD monitor : English and numeral with illuminations light (40 characters x 2 lines)
 - (e) LED indication lump : 4 status indicator
 - (f) Operation switch : 3 switches
 - (g) Maintenance telephone : 3 wired capable or communicating between 3 (max) different places at one time
 - (h) Contents of indication : Same indications as Fire Alarm Control Panel installed in PTB
- (5) Local Control Panel With Loop Units shall be as follows:
- (a) Type : self-standing type
 - (b) Power Supply : AC230V, 60Hz, 1Ø
Stand-by battery shall be sufficient capacity to operate all the system for 10 minutes of alarm condition with all bells ringing, 10 minutes of two-way telephone communication between the central panel and the most distant remote telephone station and 24 hours supervision under power failure.
 - (c) Transmission method : LT net line : token passing method
trunk line: multiple transmission polling method
 - (d) Nos. of loops and addresses : 1 loop (max), 254 addresses (max), 254 addresses (1020 zones)/ loop

- (e) Maintenance telephone : 3 wired capable of communicating between 3 (max) different places at one time
 - (f) Auxiliary equipment : battery box assembly
- (6) Local Control Panel With Loop Units shall be as follows:
- (a) Type : self-standing type
 - (b) Circuit voltage : DC24V, power supply is supplied by Fire Control Panel
 - (c) Transmission method : LT net line : token passing method
trunk line : multiple transmission polling method
 - (d) Nos. of loops and addresses : 2 loops (max), 254 addresses (1020 zones) / loop
- (7) Remote Station Box shall be as follows:
- (a) Type : wall mounted type
 - (b) Circuit voltage : DC24V, power supply is supplied by Fire Alarm Control Panel or Local Control Panel with loop units
 - (c) Transmission method : trunk line; multiple transmission polling method
 - (d) Maintenance telephone : 2 wired capable of communicating between 2 different places
 - (e) Auxiliary equipment : adapter for trunk line
remote station for fire (1L/1AD)
remote station for bell (3L/1AD)
remote station for control and indication (3L/1AD)
 - (f) Number of monitoring zones: refer to the monitoring line/ address list
- (8) All zone alarm bell shall be sounded simultaneously according to the building zoning.
- (9) Addressable detector with self-diagnostic function shall be capable of monitoring as one zone/detector
- (10) All wiring for addressable detectors shall be used for HP1.2-1P cable except in the place where harmful unexpected electro-magnetic impulse or surge of high voltage for signal transmission is likely to exist. In that case, copper or aluminum shield type cable, such as HPS1.2-1P shall be used for the place.
- (11) Standard identification of building shall be as follows:
- PT : Passenger Terminal Building AO : ATC Operation Building

FM : Fire Station & Maintenance
PH : Power House
LL : LLZ Building
VO : VOR Building

WP : Water Tank & Pump House
ST : Sewage Treatment Plant
GS : GS Building

New Bohol Airport Construction and Sustainable Environmental Protection Project

Specifications

Section 7000 Series: Special Equipment

SPECIFICATIONS

SECTION 7000 SERIES: SPECIAL EQUIPMENT

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SECTION 7050

GENERAL REQUIREMENTS FOR SPECIAL EQUIPMENT

1.0 GENERAL

- 1.1 The provisions of Section 1140 are applicable and are to be referred to in connection with the 7000 Series of the Specification.
- 1.2 The following provisions are additional to, and are to be read in conjunction with, Section 1140, and are particular to the 7000 Series of the Specification.

2.0 SCOPE

- 2.1 This Section shall apply generally to the following Sections:
- (a) Section 7100 : Not used
 - (b) Section 7200 : Elevators
 - (c) Section 7300 : Baggage Handling Systems
 - (d) Section 7400 : Airport Security System
 - (e) Section 7500 : Flight Information Display System
 - (f) Section 7600 : Building Management System
- 2.2 The provisions herein are the general requirements and it shall be the Contractor's responsibility to provide and comply with them. Where these provisions are not identified separately in the Bills of Quantities they are deemed to be included in the Contract Price.

3.0 DESIGN REQUIREMENTS

- 3.1 The Special Equipment requirements herein are broad scope and specify requirements in general terms only. The Contractor shall be responsible for all design, fabrication and installation necessary to provide work and operations as intended under and required by this Specification.
- 3.2 The power requirements for both normal and emergency operations as follows:
- Normal power: 230V, 60 hertz, 3 phases, 4 wires, AC.
 - Emergency power: 230V, 60 hertz, 3 phases, 4 wires, AC.
- 3.3 All equipment and systems designed and installed shall be free from creating any electromagnetic or other emissions which could cause interference with any communications or signal systems required in the airport's operation and the air traffic control, whether installed under this Contract or under other contracts.

4.0 FABRICATION AND CONSTRUCTION REQUIREMENTS

- 4.1 All products for Special Equipment shall be designed, fabricated and constructed for purposes and uses intended and in accordance with or capable of meeting standards as specified herein.
- 4.2 Compliance shall be substantiated by sufficient and adequate prototype testing or otherwise evidenced by such operational reports and data as may be required by the Engineer to fully demonstrate performance characteristics, operational qualities, reliability, safety and other relevant considerations.
- 4.3 Finishes requirements shall be as specified hereunder or in respective Sections of the Specification.
- 4.4 Exposed pull and terminal boxes, panel boards and switchgear enclosures, including cabinet frames and bodies, fronts, door and like parts, shall be cleaned, primed, finished with two (2) coats of enamel and baked (colour shall be selected by Engineer), in accordance with approved manufacturer's standard factory processes while elsewhere, materials shall be galvanized, sherardized or otherwise protected by approved standard factory processes; special finishes shall be provided where shown or specified.

5.0 COORDINATION

- 5.1 Work under the Special Equipment includes coordination with work under other Sections, to provide and effect complete and operable systems and equipment throughout the Works as required by and intended under these Contract Documents.
- 5.2 Coordination includes, among others, considerations of locations, sizes, capacities, and performance characteristics of the Special Equipment furnished and installed under other Section.
- 5.3 Coordination further includes providing adjustments in the Special Equipment work to meet needs of said equipment, and cooperation as may be necessary to make the determinations required.
- 5.4 Such items of coordination include, but are not limited to, the following:
 - (a) All the Drawings shall be reviewed for necessary openings and access provisions provided for the Special Equipment work.
 - (b) Sizes and locations shall be verified to ensure that they are adequate and proper.
 - (c) Additional openings shall be arranged where and as may be required.
 - (d) Drawings, instructions or information shall be supplied as necessary therefor.
 - (e) The Drawings and related provisions specified under electrical work shall be reviewed.
 - (f) Services to be provided under the Special Equipment work shall be verified and adjustments incorporated where and as may be necessary to adequately and properly serve referenced equipment.

- (g) Conduit, cable, wire, service line controls or other items necessary for but otherwise not provided as part of equipment shall be provided.
- (h) Outlets, switches, etc. shall be located for easy and convenient access when work is complete.
- (i) The Special Equipment systems shall be activated as and when necessary for equipment start-up, testing, adjusting and preliminary and demonstration operation.
- (j) Systems shall be activated sufficiently in advance to permit completion of above specified operations not later than 60 days prior to official date of substantial completion or date determined in advance by the Engineer.

6.0 EXECUTION REQUIREMENT

6.1 Prerequisite Conditions

- (1) Prior to work commencement, the following shall be required:
 - (a) All provisions shall be reviewed for/from other Sections, for requirements affecting this work.
 - (b) Details of work shall be reviewed with the Engineer, and adjustments incorporated that are deemed necessary and as directed.
 - (c) Building shall be adequately enclosed, watertight and protected.
- (2) The Contractor shall verify that the supporting construction is in proper condition, per requirements specified herein and that any incorrect construction conditions have been corrected and reinspected.
- (3) The Contractor shall ensure all installation work is carried out under the direct active supervision of persons who have adequate technical qualifications and experience, and that a sufficient number of trained personnel and adequate facilities are available to perform the installation.
- (4) When required by the Engineer the Contractor shall provide competent factory representatives to supervise the installation, start-up, test and adjustment of equipment, and to orient the Employer's personnel in the proper operation and maintenance of the equipment.

6.2 Completion Requirements

- (1) During construction the Contractor shall:
 - (a) Remove waste and debris resulting from this work, as work progresses and on completion.
 - (b) Service and adjust moving or mechanical parts for smooth, quiet and proper operating condition.
 - (c) Touch-up abraded or damaged prime painting or galvanizing and leave clean and ready for finishing work required.

- (2) Upon completion the Contractor shall ensure the following:
- (a) Exposed surfaces shall be clean and free from dust, dirt, scratches, dents, broken parts, misaligned or improperly fitted joints, stains, discoloration or other defects or damage.
 - (b) Installation shall be free from exposed fastenings, unnecessary cuts, holes, blank plates or advertising labels or signs other than indicated, specified or approved.
 - (c) Exterior or below grade installations shall be watertight throughout and free from leaks or entry of water into a through interior or concealed spaces or structure.
 - (d) Each item, unit, or assembly shall be tightly and rigidly secured in place, free from unnecessary movement, squeaks or rattles.
 - (e) Each item, unit, or assembly shall be set straight, plumb and level accurately positioned at locations required, adjacent like units accurately aligned.
 - (f) Movable or mechanical items or devices shall be serviced and adjusted to operate smoothly, quietly, easily and free from binding, superfluous of unwanted noises.
 - (g) Electrical devices assemblies or systems shall be properly connected and grounded operating in compliance with performance requirements and tested as specified.

6.3 Operation before Final Acceptance

- (1) Should the Employer require that any Special Equipment be operated prior to date of substantial completion, the Contractor shall consent, and such operation shall be under supervision and direction of the Contractor.
- (2) Any such operation so required prior to substantial completion shall not be construed as nor constitute acceptance of work so operated.

6.4 Adjustment

Provide as and where necessary or directed by the Engineer at no added cost to the Employer, adjustment upon substantial completion and during the Defects Notification Period.

6.5 Collateral Work Requirements

Collateral work listed below shall be provided and included as part of work associated with this Section:

- (a) Excavation – refer to Sub-Sections 2130 and 4110
- (b) Concrete – refer to Section 1400
- (c) Structural steel – refer to Sub-Section 4230
- (d) Shop prime painting - refer to Sub-Section 4230
- (e) Galvanizing – refer to Sub-Section 4350
- (f) Sealant work – refer to Sub-Section 4320
- (g) Aluminium work – refer to Sub-Section 4350

- (h) Master keying of keyed locks and other keys - refer to Sections 5050 and 6050
- (i) Ventilation – refer to Section 5200
- (j) Power supply and grounding – refer to 6000 Series
- (k) Lighting – refer to Section 6200
- (l) Provisions for pipe and line penetrations - refer to Sections 5050 and 6050
- (m) Other collateral detail items and requirements as specified, as applicable

6.6 Cutting and Patching

Provision shall be made under the Special Equipment for passage or support of the Special Equipment work wherever necessary and where prior arrangements therefor have not been otherwise provided or incorporated. This shall include any and all cutting and removals, sleeves, frames, escutcheons or other accessories required, replacements, repairs and patching, sealing with fire proof material, cleaning and refinishing, and other work as may be required. All work to be approved by the Engineer.

6.7 Detailed Coordination

- (1) Work under this Section further includes coordination of and with works under other Sections, to provide and effect complete and operable systems and equipment throughout the Works as required under the Contract Documents.
- (2) Coordination includes, among others, considerations of location, size, capacities and performance characteristics of equipment furnished and installed under other Sections.
- (3) Coordination further includes providing adjustments in this Section of work to meet needs of said equipment and cooperation with other subcontractors as necessary to make determinations required.
- (4) Minor adjustments shall be provided as and where necessary or directed by the Engineer at no additional cost to the Employer.
- (5) The Drawings shall be reviewed for openings and access provisions to be provided for the mechanical work. The sizes and locations shall be verified that they are adequate and proper and additional openings shall be arranged where and as may be required.
- (6) The Drawings of utilities serving systems in this Section shall be reviewed. The sizes, capacities and locations shall be verified that they are adequate for proper systems. Installations shall be adjusted as required to correlate with utility service connection points and types of connections necessary.
- (7) The Drawings of electrical services and facilities to be provided for this Section shall be reviewed. The precise electrical needs, power requirements and electrical characteristics for this Section shall be determined and compared and verified with the provisions of the Contract Documents. Drawings, diagrams or other information necessary relative to the mechanical work shall be provided by the Contractor and additional service, outlets or connections provided where and as may be required.

7.0 ATTACHMENTS TO STRUCTURES

7.1 General

- (1) Type shall be appropriate for materials and conditions encountered and only as shown, specified or approved. The sizes shall be adequate for loads and forces involved.
- (2) Power actuated types in lieu of removable mechanical fastenings shall not be permitted, unless otherwise shown or approved.
- (3) Cutting or welding to structure for support shall be permitted only as and where shown, specified or approved for each specific condition or location.
- (4) Supporting piping or equipment by attachments directly to metal decking shall not be permitted.
- (5) Steel items throughout shall be hot-dip galvanized or corrosion resistant painted, plated or treated by approved methods.

7.2 Continuous Supports

- (1) Continuous supports shall be manufacturer's standard prefabricated type of C-channel, roll-formed from steel strip of thickness not less than 2.5mm in standard length units for minimum of splices. They shall be complete with matching splice covers, insert devices suitable for hanger rods, etc. that are required to be supported.
- (2) They shall be secured to overhead concrete using unit anchors as specified hereinafter, set through pre-punched holes in C-channel webs, spaced at not over 200mm from each end each channel unit and at not over 600mm centres in between.

7.3 Unit Anchors

- (1) Unit anchors shall be manufacturer's standard type of steel insert bolts designed for use in hardened concrete, with pre-tested and pre-determined load values, and in various types and sizes suitable for varying installation requirements. Each unit shall be selected in accordance with manufacturer's certified load carrying capacity tables, as approved.
- (2) Each unit shall be selected to safely support work required and when under full load conditions, and as appropriate for strength or condition of concrete to which attachment is being made.
- (3) The selection shall be determined using factor of safety not less than 5 times actual or real load to be supported.
- (4) In any and all cases, bolt shank diameter shall not be less than 15mm.

7.4 Other Connections

- (a) Heavy items to steel framing
Machine bolts, nuts and washers set through drilled holes.
- (b) Light items to steel framing

Machine screws set into drilled and tapped holes or set through drilled holes and with nuts and washers.

- (c) Light items to sheet metal

Headed fasteners with threads designed for sheet metal work self-drilling, self-tapping.

- (d) Sizes

Appropriate for loads to be supported and as approved.

7.5 Attachments not permitted

- (a) Wood blocking embedded in concrete.
(b) Wood, fibre, plastic or lead type inserts.

8.0 EQUIPMENT REQUIREMENTS

8.1 Wiring Diagrams

- (1) Wiring diagram area required for all motors and controls and for each specialty system included under the Special Equipment, prepared to indicate:
- (a) Work as proposed initially, along with shop drawing submittals; and
(b) Work exactly as installed finally, when completed and approved.
- (2) They shall be provided singularly, where practical, or in sets as necessary to clearly portray all relevant connections and interconnections. All sheets in any one (1) set shall be uniform in size.
- (3) Complete sets of wiring diagrams shall be included with the Operation and Maintenance Manuals
- (4) In addition complete sets of all diagrams shall be provided for permanent wall mounting, each type or group of diagrams located in different locations as directed by the Engineer. Each shall be provided with cover of clear plastic in thicknesses not less than 3.0mm for diagram sizes 400mm x 400mm and larger, 1.5mm for smaller sizes, retained in neatly fabricated aluminium frame secured to wall using matching screws.

8.2 Lubrication Requirements

- (1) Lubrication facilities shall be provided for all parts involving friction and wear other than where suitably covered or protected by resilient materials or where provided with lifetime packing or fittings.
- (2) Include all necessary grease fittings, oiling caps or other like facilities as required to maintain equipment properly protected, and with all like items essentially identical and serviceable using same lubrication tools throughout.

- (3) Lubrication facilities shall be located where readily visible and easily accessible.
- (4) Lubrication tools shall be required as follows:

Two complete sets for each type of necessary system
- (5) Removable units shall be securely supported and fastened in place constructed using wire mesh in steel angle or flat-bar frames each mechanically secured into place against accidental removal. Wire mesh shall be woven galvanized steel wire not less than 1.4mm, mesh size not larger than 7.0mm by 7.0mm.

8.3 Safety Guards

All sheaves, couplings and other running equipment which could cause physical injury upon accidental or inadvertent contact are required.

8.4 Keyed Locks and Switches

- (1) Locks and switches required to be keyed shall be master-keyed for common types of facilities, such as panel boards, and for the particular building).
- (2) Exact requirements for keying shall be instructed by the Engineer at later date after commencement of Works.
- (3) Contractor shall provide three (3) sets of original keys.

9.0 TRAINING OF EMPLOYER'S PERSONNEL

- 9.1** The provisions of Section 1150 are applicable and are to be referred to in connection with 7000 series of the Specification.
- 9.2 The following provisions are additional to, and are to be read in conjunction with, Section 1150, and are particular to 7000 series of the Specification.
- 9.3 Local training for operation and/or maintenance shall be required to be conducted by the Contractor for all systems included in the 7000 series of the Specification. Some systems shall also require training to be conducted in the equipment's country of manufacture.
- 9.4 The Employer shall nominate candidates for the trainees of the training program who have been, or shall be, assigned to the same facility and who have the ability to train maintenance personnel after completion of the factory training.
- 9.5 Factory training of the Employer's trainees shall be conducted at least covering the minimum required schedule in the manufacturer's home country before shipment of the equipment. The Contractor shall pay all expenses required for such training, such as international flights between Manila and manufacturer's country, local transportation fares, accommodation and subsistence allowance.
- 9.6 The minimum required schedules for both local and overseas training are indicated in the relevant Sections of the 7000 series of the Specification.
- 9.7 The Contractor shall include the costs of both local and overseas training in his unit rates or lump sum prices, unless identified separately in the Bills of Quantities.

10.0 MEASUREMENT AND RATES

10.1 Measurement

Measurement of the Special Equipment items and components shall be made in accordance with the item classification and unit stated in the Bills of Quantities.

10.2 Rates

- (1) The rates and lump sums shall be full compensation for all plant, materials, labour, equipment, transport, temporary works, establishment charges, overheads, profit and taxes required to complete the work described in 7000 Series of the Specification and/or shown on the Drawings.
- (2) The rates and lump sums shall further include, if not itemized separately in the BOQ Sections of the 7000 Series:
 - (a) Contractor's design
 - (b) Training for equipment and systems
 - (c) Spare parts
 - (d) Testing and commissioning
 - (e) Maintenance tools and special tools
 - (f) Protection
 - (g) All fees and charges for the attendance, as required, of the equipment manufacturer's representative to assist in the installation and subsequent testing, and commissioning of the equipment

SECTION 7200

ELEVATORS

1.0 SCOPE OF WORKS

The work to be executed by the Contractor under this Sub-Section shall include the following:

- (a) Design, manufacture, supply and installation of machine-room-less electric elevator system (CEV1) in the Control Tower, and all ancillary equipment required for installation.
- (b) Provision of spare parts
- (c) Testing and commissioning
- (d) Training

2.0 ELEVATOR SCHEDULE

2.1 General Feature

- (a) Control Tower

Elevator ref: CEV-1

Number	: one (1)
Service	: passenger
Operation	: electric
Control	: automatic
Rated capacity	: 630 kilograms; 9 persons
Rated speed	: 60 meters per minute
Total travel	: 26,600 mm
Landings	: Total 3; GF, 2F, 8F
Openings	: Total 3; all one side
Hoistway doors	: 2 panels, centre opening
Car doors	: 2 panels, centre opening
Door opening size	: 900 mm wide x 2,100 mm high
Entrance	: Narrow jamb; 500mm width, stainless steel
Emergency Opening	: 2 total; at 4F, 6F (H1200mm x W 600mm)

2.2 Car Enclosures

- (a) CEV-1

Entrance frames	: stainless steel; hairline finish
Car doors	: steel face panels; 1.5 mm baked enamel finish
Car wall panels	: steel face panels; 1.5 mm baked enamel finish
Ceiling	: CEV-1; steel face panels; 1.5 mm baked enamel finish
Skirting	: stainless steel
Floor covering	: durable vinyl tile as selected from all standard series available; 2.0 mm thickness

Handrails	: stainless steel pipe; 38 mm diameter; hairline finish.
Car accessories	: light fixtures, emergency light, car operating panel, car position indicator, interphone, etc.

2.3 Car Operating Panel

Car operating panel shall include the following:

- Floor call buttons
- Panel direction indicators
- Floor indicator panel
- Door open/hold button
- Door close button
- Interphone
- Emergency stop switch
- Alarm bell button
- Ceiling light switch
- Fan switch
- Overload buzzer
- Identification plate; clearly stating:
 - Type of service
 - Maximum number of persons permitted
 - Maximum load permitted

3.0 WORK REQUIREMENTS

3.1 General

- (1) Requirements herein describe equipment, accessories and operations in general terms only. The Contractor shall be responsible for all design and fabrication details necessary to provide work and operations as intended under and required by this Specification.
- (2) Requirements herein shall be applicable to all elevators required. Exceptions shall be only as particularly specified or scheduled for an individual elevator.
- (3) Each elevator system shall be complete unto itself and independent from other elevators, except respective to emergency power operations as specified.
- (4) Operating characteristics, physical features, finishes and other requirements shall be as scheduled herein.

3.2 Performance Requirements

- (a) Elevator Rated Speed
 - (i) Defined as speed of elevator travel in Up direction when under full capacity loading as scheduled.
 - (ii) Speed variations: shall not exceed plus or minus 5 percent of rated speed when under any loading conditions and when traveling either Up or Down.

- (iii) Up and Down speeds: shall be uniform between stops for full height of travel.
- (b) Elevator Rated Capacity
 - (i) Defined as full weight of dead load to be carried within car at scheduled speed, exclusive of weights of cars and other elevator equipment and accessories.
 - (ii) Elevators shall be capable of lowering, stopping and holding cars when under 125 percent of scheduled capacity.
- (c) Stop level accuracy

Any variation between car floor or sill and landing floor or sill shall not exceed plus or minus 10 mm when car is under any loading conditions.

3.3 Operational Requirement

- (1) Starting and levelling: shall be smooth, comfortable without obvious stops or accelerations.
- (2) Stopping: shall be smooth and without jars or jumps.
- (3) Riding under full speed: shall be free from vibration or swaying.
- (4) When stopped and doors standing open: cars shall be firmly held at landing level and free from teetering or rocking under varying distributions of loadings throughout cars.
- (5) When doors open and close: cars shall be free from noticeable sway.
- (6) Emergency stopping: rapid but comfortable to occupants.

3.4 Structural Requirements

- (a) Rails, brackets and spreaders
 - (i) Assemblies for cars and counterweights shall be designed and selected to safely resist loads imposed, including dead, live and seismic.
 - (ii) Assemblies or units shall be designed to resist vertical and horizontal seismic acceleration not less than 0.5 gravity unit.
 - (iii) Counterweight spreader brackets shall be fabricated from structural steel plate; thickness not less than 9 mm on 65 x 65 mm steel angle, and spaced sufficient that at least 2 spreaders occur in length of counterweight frame when in any position within height of hoistway. They shall also be spaced to meet requirements specified for rail brackets.
 - (iv) Car rail brackets shall be one at each of the following locations:
 - Near pit floor
 - At bottom floor of building
 - Midway between first and second floors
 - Near each of all other floors

- (b) Car and counterweight retainers
 - (i) Shall be fabricated from structural steel plate; thickness not less than 6 mm, or equivalent construction.
 - (ii) Shall be designed to span guide rail tongue not less than 50 mm and to extend to within 10 mm of rail clips.
 - (iii) Shall be required for sliding shoe mountings at top and bottom of counterweight frames and top of car frames.
 - (iv) Retainer shall clear rails under normal operations.
 - (v) Deflection of upper and lower frames of car shall be 0.1% or less when full loaded.
- (c) Machine beams

Shall be designed and anchored against shifting or tipping; reinforced as necessary; and shall safely resist seismic acceleration not less than 2.0 gravity unit.
- (d) Elevator Machines:
 - (i) There shall be restraining members on 4 sides of each unit; and they shall be designed to safely resist vertical and horizontal seismic acceleration not less than 1.0 gravity unit.
 - (ii) Restrainers shall be equipped with hard neoprene isolators, thickness not less than 25 mm, positioned between restrainer and equipment.
 - (iii) Additionally there shall be anti-tip protection consisting of horizontal members extending over each foot or bed plate.
 - (iv) Restraining and anti-tip members shall be securely and adequately anchored to structure.
- (e) Controllers and selectors

Shall be designed to safely resist over-turning under seismic acceleration not less than 1.0 gravity unit, and shall be securely and adequately anchored to structure.
- (f) Car platform

Shall be designed to safely carry rated capacity when loading is either uniformly distributed or concentrated at relatively small area at centre
- (g) Engineering designs and calculations

Shall be prepared and signed by licensed structural engineer retained by the Contractor.

3.5 Anti-Snag Protection

Methods shall be proposed by the Contractor and approved by the Engineer.

3.6 Safety Guards

- (1) Shall be required for all sheaves, couplings and other running equipment which could cause physical injury on accidental or inadvertent contact.
- (2) Shall be required to cover counterweights at pit areas; to heights shown.
- (3) Removable units shall be securely supported and fastened in place; constructed using mesh in steel angle or flat-bar frames.

3.7 Sheave Guards

- (1) Required for all sheaves; shall be designed to prevent cables or ropes from leaving sheaves in event of earthquake or otherwise which might cause any loosening.
- (2) Methods shall be proposed by the Contractor and approved by the Engineer.

3.8 Painting

- (a) General
 - (i) All surfaces shall be cleaned before painting
 - (ii) Governors shall not be painted
- (b) Finish Painting
 - (i) Shall be provided for exposed ferrous steel surfaces and not otherwise scheduled.
 - (ii) Surfaces shall be filled, smooth and bonderized
 - (iii) Paint shall be sprayed not less than three coats with the last two baked.
 - (iv) Finish colours shall be selected by the Engineer
- (c) Protective Painting
 - (i) Shall be provided for ferrous steel surfaces throughout where not exposed to corridors or car interiors.
 - (ii) The coatings shall be touched up as required after installation.
 - (iii) Colours shall be selected from manufacturer's standard.

3.9 Electrical Wiring

- (1) Wiring: Sheathed types only shall be used throughout; shall be installed in conduit or other approved wireways, complete with boxes, covers and devices and accessories necessary to complete work as required.
- (2) Terminal blocks: Each terminal shall be permanently tagged and labelled for ready identification of circuit or service, in machine rooms and elsewhere required.

- (3) Car fan and light circuits shall be separate from power source to motor and shall be circuited for automatic transfer to essential power source, in case of failure of normal power.

3.10 Electrical Service Requirements

- (1) Power for motors shall be 230 V, 60 Hz, 3 phase and A.C.
- (2) Power for lighting shall be 230 V, 60 Hz, single phase and A.C.
- (3) Power for the emergency shall be 230 V, 60 Hz, 3 phase and A.C.

3.11 Lubrication Facilities

- (1) Shall be required for all parts involving friction and wear, other than where suitably covered by neoprene or plastic as specified.
- (2) All necessary grease fittings, oiling cap, wicks, etc. as required shall be provided to maintain equipment properly protected and all essentially identical for all elevators.
- (3) Lubrication facilities shall be located where readily visible and positioned where easily accessible.
- (4) Additionally, one (1) set of lubrication hand tools of adequate type and size, contained in suitable box or panel, shall be provided for each elevator.

3.12 Sign and Identification Requirements

- (1) Motor and other electrical apparatus shall be labelled and identified per requirements therefor specified under electrical requirements.
- (2) Automatic starting equipment: post with signs stating: WARNING - THIS EQUIPMENT MAY START OPERATING AT ANY TIME or similar wording as approved, in English shall be provided.
- (3) Devices operated by public shall be the following characteristics:
 - (a) Languages: English.
 - (b) Numbers: Arabic.
 - (c) Styles: manufacturer's standard block series or other as selected.
 - (d) Sizes: large as practical and reasonable for uses required.
 - (e) Embossing or engraving: treated for permanency and in colour contrasting with base material to facilitate ease of reading.
 - (f) Applied devices: secured free from exposed fastenings unless otherwise approved.
- (4) Hoistway floor identification numbers shall be as follows:

- (a) Each area between landing levels shall be identified with floor number respective to landings immediately above and below; using number agreeing with those used on devices or car operating panels.
- (b) They shall be arranged to be readable from car should car stop and doors open at any location between normal landing stop levels.
- (c) Pairs of numbers shall be provided above and below, neatly hand painted in colour, contrasting with background colour; each number not less than 100 mm high.
- (d) For excessively high distances between landings, additional numbers shall be provided and spaced at locations to effect results intended.

3.13 Face Plate Requirement

- (1) General: The following shall be applicable to all to panel or fixture face plates where exposed to public areas and inside of cars.
- (2) Designs: plain and free from striations, grooves, decorative patterns or other embellishments and may be manufacturer's standard pattern series when otherwise essentially satisfying other specified requirements.
- (3) Materials: stainless steel or aluminium type or alloy suitable for general architectural purposes.
- (4) Finish: satin or achieved by final belt sanding in one (1) direction using grit, or hair line finished aluminium.
- (5) Each unit shall be neatly and accurately fabricated: corners square, cut outs accurately formed, edges eased by light sanding; all areas free from burrs or any superfluous marks.
- (6) After fabrication, exposed surfaces shall be protected using strippable pressure-sensitive adhesive paper sheets.

3.14 Keyed Locks and Switches

- (1) All keyed locks and switches required for elevator work, shall be keyed to one key only.
- (2) The Contractor shall provide three (3) sets of originally manufactured keys in accordance with the requirements of para. 7.0 of **Sub-Section 4340** of the Specification.

3.15 Product Requirements

Elevators shall be as designed and fabricated by a single manufacturer and installed by himself or his authorized agent.

4.0 COMPONENTS

4.1 Operating Equipment

- (a) Machines
 - (i) Type: Manufacturer's standard type; designed for passenger elevator service: brake mounted.
 - (ii) Brake shall be of direct current magnet type.
 - (iii) Bedplate: Shall be continuous under each machine; built-up structural steel or cast iron with isolation pads for machines.
- (b) Motors, Controllers and Selectors
 - (i) Type: manufacturer's standard type
 - (ii) Overload relays: thermal type
 - (iii) Controller and selector enclosures shall be per requirements of referenced electrical division, as applicable, with doors equipped not to fly open during earthquake.
 - (iv) Motors: 60 minute rated; temperature rise not exceeding 50 degrees C
 - (v) Starting switches shall be horsepower rated.
 - (vi) Controllers shall be of VVVF (Variable Voltage, Variable Frequency) inverter type
- (c) Beams

Structural Steel: shall be designed for all loads imposed and to meet structural requirements; securely anchored to structure.
- (d) Guide Rails
 - (i) Type: Standard steel Tee rails; weight shall not be less than 8 kg/m; for cars and counterweights.
 - (ii) Intermediate joints shall be to Engineer's approval, with backs machined for splice plates.
- (e) Sliding Guides
 - (i) Type: Manufacturer's standard swivel type.
 - (ii) Required for top and bottom of each car and counterweight.
 - (iii) Car and counterweight guides: designed to clear rails to permit proper actuation of safety devices and to restrain car from leaving guides in event of earthquake.
- (f) Over-Speed Safety Devices

- (i) Governor: centrifugal speed type, with ratchet or tied down type tension frame and switches; located in and securely anchored to floor of machine room.
 - (ii) Safety Shoes: mounted on bottom of cars and designed to brake car travel due to over-speed.
 - (iii) Governor and safety shoes shall be interconnected by cable passing over governor sheave and under idler sheave mounted in and securely anchored to pit floors.
- (g) Counterweights
- (i) Weights: sectional carryings or as required; designed to be positively retained by frame.
 - (ii) Frame: structural steel, securely attached to and controlled by hoist ropes.
 - (iii) Retainer rods: steel, diameter not less than 25 mm.
- (h) Buffers
- (i) Type: spring type shall comply with standards as referenced in Section 7050.
 - (ii) Cars: spring type.
 - (iii) Counterweight: spring type.
- (i) Ropes and Cables
- (i) Hoist: Traction steel wire rope designed for elevator service.
 - (ii) Governor: Wire rope, diameter shall not be less than 8 mm.
- (j) Travelling Electrical Cables
- (i) Shall be installed as required between cars and hoistway outlets, with sufficient number of individual conductors for services required, plus not less than 2 spares each car.
 - (ii) Flexible type designed for elevator service, shall be resistant jacketed, with conductor sizes adequate for services required.
 - (iii) All conductors necessary shall be combined in one travelling cable where possible, otherwise in least number of cables feasible and possible.
 - (iv) Shall be located in front section of hoistway where possible, to avoid contact with counterweights, spreaders, etc.
 - (v) Shall be secured to cars and outlets in manner to not exert any strain on any individual or small group of conductors.
- (k) Power Panel

- (i) Shall be installed as required for each elevator system; for handling and control of all incoming electrical power.
- (ii) All necessary enclosures, positive cut-off switches, fuses, etc. shall be included.

4.2 Elevator Cars

- (a) Cage Frames
 - (i) Shall be designed as necessary to safely resist contact loads; shall be reinforced and braced to securely support enclosures and accessories and with adequate factors of safety.
 - (ii) Shall be rolled or formed structural steel members, assembled into rigid units by welding or bolting.
- (b) Platforms
 - (i) Steel frame; steel or wood stringers
 - (ii) Plywood subfloor; underside covered with sheet steel; thickness shall not be less than 0.4 mm; top surfaces smooth and level
 - (iii) Resilient pads between cage frame and platform; shall be designed to isolate transmission of sounds and vibrations.
- (c) Car Enclosures
 - (i) Walls and ceiling shall be manufacturer's standard construction for type of materials and finished as approved; panels adequately reinforced and secured; rivet fastenings exposed inside cars shall not be permitted.
 - (ii) Base: recessed type; formed stainless steel.
 - (iii) Entrance frames shall be hollow metal type, material and finish as approved, to profiles as shown or approved; each jamb and head member in single unit only for full length required. Frame corners and joints shall be accurately cut and machined for neat hairline fit and jambs designed to securely anchor to car enclosure framing; with brackets and bolts as required; and securely anchored to sills. Concealed surfaces shall be coated with sound deadening materials as specified for cars exteriors; exposed fastenings shall not be permitted.
 - (iv) Entrance sills shall be extruded hard aluminium with grooves accurately formed for minimum clearance with door guides; each member in single unit only for full length required. Built-up or multiple members and exposed fastenings shall not be permitted. They shall be securely anchored to platform as approved, level and free from movement when in place as required.
- (d) Emergency Exit
 - (i) Flush mounted door shall be provided in ceiling to match finishing.

- (ii) Door shall be removable from inside car without the need for tools of any kind and shall be accessible from top of car.
- (iii) Size and position of door to allow for handling of a ladder minimum 3 m long.
- (iv) Near the exit door above canopy, a power outlet, manual operation switch and manual safety stop switch shall be provided.
- (e) Ventilation

Ducts, vents and blower necessary to evenly distribute air within car shall be provided. The blower shall be single speed type of sufficient capacity controlled by switch in car panel; quiet and free from vibration.
- (f) Lighting

Fixtures, lenses, lamps, etc. complete as required shall be provided, type and details as approved.
- (g) Emergency light

Shall be complete with automatic recharging battery of capacity more than 30 minutes lighting; The light shall be automatically turned on and off when power fails and power resumes respectively.
- (h) Convenience Outlets:

Standard singleplex type; set flush in base below inspection switch; one each car.
- (i) Accessories for Disabled Person
 - (i) Handrail: continuous 3 sides each car where scheduled; material and finish as approved.
 - (ii) Mirror: size 600mm wide x 900mm high, bottom level of the mirror height shall be 900mm from floor level of car, 6mm thickness with anti-shatter film
- (j) Car Wall Protection:

Padded blankets fabricated for specified car, with metal hanger grommets; supported by sufficient number of stainless steel hanger brackets attached to walls near ceiling.

4.3 Hoistway and Car Doors

Requirements herein shall be applicable to both hoistway and car doors, except as particularly specified otherwise.

- (a) Doors
 - (i) Two (2) side centre opening panel type; material and finish as scheduled, thickness not less than 28 mm, exclusive of any applied finishes or treatments.
 - (ii) Sheet steel face panels, welded to continuous internal reinforcing members;
 - (iii) Constructed to be fire resistant.

- (iv) Bottom edges provided with non-metallic and replaceable door guides sized to suit grooves in sills.
- (v) Leading edges provided with matching non-vision wings as required.
- (b) Track
 - (i) Single length unit each opening fabricated from roll-formed or cold drawn steel.
 - (ii) Sheave bearing surfaces rounded, and with non-metallic covering when not so provided from sheaves.
- (c) Hangers
 - (i) Sheaves type suitable for operation required; two per door panel; designed for Up and Down loadings.
 - (ii) Grease packed ball bearing wheels of diameters not less than 56 mm for car doors, 56 mm for hoistway.
 - (iii) Wheel tires shall have non-metallic covering when not so provided for track.
 - (iv) Units adjustable by means of eccentric stud or other approved device
- (d) Door Operators
 - (i) Electric motors high speed, VVVF (Variable Voltage Variable Frequency) type, designed to operate car and hoistway doors simultaneously at any landing.
 - (ii) Door shall have power opening, power closing with speeds: opening - not less than 2.2 second; closing - not more than 3.6 second.
 - (iii) Door movements electrically or otherwise positively controlled to provide uniform, smooth and quiet operation, cushioned at both limits of travel.
 - (iv) Motors mounted on separate structural means; not on car enclosures
- (e) Interlock and Unlocking Devices
 - (i) Required for hoistway doors.
 - (ii) Approved type interlocks designed to prevent car operation until doors are in locked position; and to prevent opening doors from corridor side unless or until car is within levelling zone at same landing.
 - (iii) Approved type mechanical unlocking mechanisms designed to permit authorized access to hoistway at any time and regardless of car location; each such device concealed or in location not readily visible.
- (f) Contact Devices

Required for car doors; approved type contacts design to prevent car operation until doors are fully closed.

- (g) Door Edge Safety Devices
 - (i) Required for car doors.
 - (ii) One device each leading edge door, comprising resilient cushioned retractable bars extending full height and projecting beyond edge of door.
 - (iii) Each set of devices arranged such that any accidental or manual retraction of device bar when doors are closing, shall cause doors to reverse and travel to full open position, and reclose after predetermined time interval; when doors are standing full open, shall cause doors to remain open until bar is released.
 - (iv) Such reopening/reclosing operations shall repeat as long as any obstruction remains in doorway, and remain full open for as long as bar is manually held back.
 - (v) Distance of projection beyond door edge and length of travel of bar device shall be adjustable.
 - (vi) Time delay between reopening and start of reclosing shall be 5 seconds.
 - (vii) When delay edge bar is actuated, door travel shall not exceed 40 mm before reversing.

4.4 Hoistway Entrances and Safety Fascia

- (a) Entrance Frames
 - (i) One side metal type, material and finish as scheduled.
 - (ii) Profiles as shown or approved; each jamb and head member in single unit only for full length required.
 - (iii) Frame corners and joints accurately cut and machined for neat hairline fit.
 - (iv) Jamb designed to securely anchor to structure, with brackets and bolts as required, and securely anchored to sills or structure floors.
 - (v) Where shown, solidly filled with cement grout, otherwise concealed surfaces coated with sound deadening material as specified for cars exteriors.
- (b) Entrance Sills
 - (i) Extruded or bar hard aluminium, with grooves accurately formed for minimum clearance with door guides; each member in single unit only for full length required.
 - (ii) Built-up or multiple member and exposed fastenings not permitted.
 - (iii) Shall be securely anchored to structural support as approved; level and free from movement when grouted in place as required.

(c) Door Hanger Supports

Formed from rolled or formed steel shapes thickness not less than 3.0 mm; securely bolted to structure as required.

(d) Cover Plates

Sheet steel, thickness not less than 2.0 mm; extending full door travel; removable for ease in servicing hangers; fastenings arranged to permit removal of cover without removing fastenings from header.

4.5 Auxiliary Features

(a) Car-Top Inspection Station

(i) Required on top of each car to permit operation of elevator for inspection purposes.

(ii) Inspection station consisting of special unit containing master-keyed ON-OFF switch, continuous pressure type buttons for UP and DOWN travel and emergency STOP button.

(b) Car Maintenance Stations

(i) Required for top and bottom of each car.

(ii) Each station consisting of toggle switch controlling lamp with wire guard; and standard duplex type, grounded convenience outlet; in outlet box or boxes with suitable covers or plates.

(c) Pit Car Stop Buttons

(i) Required in pit area for each elevator.

(ii) Momentary contact switch located to prevent inadvertent actuation.

(iii) Circuiting arranged such that, upon actuation of switch, car shall stop immediately regardless of position in hoistway.

(d) Car Interphones

(i) Required inside each car; located where approved, to be accessible by person in wheelchairs; incorporated as part of car operating panel, unless otherwise approved.

(ii) Interphones: any standard type or style suitable for 2-way voice communications. Interconnected to separate direct open-line circuit to Communication room in PTB/ Security room in CTO, arranged to automatically ring switchboard any time phone receiver is removed or lifted.

(iii) Panels to have metal enclosure for recess mounting.

(iv) Door skin material and finish to match panel face plate as specified under para 3.13 herein; each equipped with matching pull or handle and friction catch and mounted using concealed pivots or hinges.

- (v) Doors embossed INTERPHONE or similar wording as approved.
- (e) Interim Power Source
 - (i) Separate and independent from either normal or emergency sources, other than any charging from normal power sources.
 - (ii) Capable of automatically and instantly starting and maintaining operative all elevator lights, and bell during any period between shutdown of normal power and starting of emergency power.
- (f) Car Load Weighting
 - (i) Required for each elevator, to predetermined monitor car loading of 110%.
 - (ii) Sensing device, mounted on car platform, interconnected to car overload buzzer.
 - (iii) To automatically and continuously emit warning signal during all times car is overloaded. For purposes herein, overload is any loading exceeding 5 percent of rated capacity.

4.6 Emergency Power Requirements

- (1) Requirements: herein applicable to elevators, except certain interrelated but different operational requirements as specified.
- (2) System: for transfer from normal to emergency power conditions completely automatic.
- (3) Contractor shall coordinate and make arrangements for all necessary facilities, wiring, connections and related work to be provided under Electrical works.
- (4) As part of work under this section, the Contractor shall provide all other wiring, circuitry, interconnections and related work necessary to meet requirements herein.
- (5) In event of outage of normal power source
 - (a) All elevator cars shall automatically stop regardless of position or direction of travel.
 - (b) Lights shall immediately resume operation, via interim power sources specified.
 - (c) Special signals in car operating panels shall flash on and off, in red letters: EMERGENCY POWER.
 - (d) After predetermined delay sufficient to permit emergency generator to effect power required, each elevator shall start in sequence intervals not sooner than 10 seconds.
 - (e) Elevator in Control Tower shall remain operative under emergency power.

- (f) Elevators shall be operative for Firemen's Service upon command by actuation of respective control switches, in car operating panel.
- (g) In event of outage when car is standing shut-down at other than car operating panel landing, system to start-up and car to lower same as specified herein above, and in proper sequence.

4.7 Car Operating / Signal Features

- (a) Floor Call Buttons
 - (i) Micro click type which require momentary contact but positive mechanical pressure for actuation; with integral illumination, color range; either square or round style; size not less than 25 mm across.
 - (ii) One button each floor served, each engraved in button face with respective floor number.
 - (iii) Each number clearly readable, whether or not illuminated.
 - (iv) Automatically illuminated in response to call placed from either car or hall buttons; automatically extinguished upon arrival of car at respective floor level.
 - (v) Each set of numbers in orderly sequential and vertical arrangement in panel face plate.
 - (vi) Exclusive call button for disabled person shall be installed. The bottom level of button shall be installed 1000mm from floor level.
- (b) Door Close Buttons
 - (i) Description similar to car floor call button, except that they shall be non-illuminating and the face engraving shall be: CLOSE.
 - (ii) Interconnected with door operator circuits, to over-ride normal door closing time sequences to permit doors to close after predetermined interval following actuation of button.
 - (iii) Time interval: 5 seconds.
- (c) Door Open / Hold Buttons
 - (i) Description similar to car floor call button, except that they shall be non-illuminating and the face engraving shall be: OPEN
 - (ii) Interconnected with door operator circuits, to over-ride normal door closing operations to permit, upon actuation of button: while doors are closing, instant re-opening of doors to full open position; and thereafter to reclose after normal predetermined time delay; while doors are standing open, to hold doors fully open for as long as pressure is applied to button;
- (d) Panel Direction Indicators

- (i) Digital dot matrix LED in panel face plate; with translucent window inserts of neutral colour when not illuminated.
 - (ii) Illumination colours: orange
 - (iii) Automatically illuminated to indicate respective direction of travel while traveling; or, if not traveling, direction in which car is to travel in response to prior calls placed.
 - (iv) Automatically extinguish when all calls in respective of travel have been answered.
 - (v) Automatically reverse to opposite indicator when last has been answered for one direction of travel and shall next travel in opposite direction.
- (e) Status Display Screens
- (i) Rectangular cut-out in panel face plates, with translucent screen window of neutral colour when not illuminated.
 - (ii) Equipped to illuminate wordings in red colours as specified under Emergency Power Requirements.
- (f) Alarm Bell Buttons
- (i) Single buttons of types which require positive mechanical pressure for actuation; integrally colored red; size not less 19 mm across.
 - (ii) Identified in adjacent location by permanent engraving in panel face plates: IN EMERGENCY-PUSH; or similar wording as approved.
 - (iii) Interconnected to actuate bell and signals.
- (g) Emergency Stop Switches
- (i) Single types of either toggle or rocker switch or push-pull switch require positive position change for actuation; integrally colored red; size adequate for service required.
 - (ii) Side guards provided to prevent inadvertent operation.
 - (iii) Identified in adjacent location by permanent engraving in panel face plates: EMERGENCY STOP; or similar wording as approved.
- (h) Car Position / Direction Indicator
- (i) Required for each elevator car.
 - (ii) Separate fixture mounted over door head; containing Up and Down direction arrows and set of floor numbers.
 - (iii) Direction indicators shall be digital dot matrix LED in face plates of fixtures, with translucent window inserts of neutral colour when not illuminated; illuminations colours: Up-green; Down-red; functions: same as specified for panel direction indicators.

- (iv) Floor number indicators shall be digital dot matrix LED in face plates of fixture, with translucent window inserts of neutral colour when not illuminated; illumination colour: orange; automatically illuminated to indicate zone of respective floor where car is located; and when traveling, automatically progress as successive floors are neared or passed; remain illuminated for respective floor as long as car remains at that floor level.
- (v) Face plates: as specified under para 3.13 herein.
- (vi) Electrical chime mounted in the ceiling

4.8 Car Operating Panels

- (1) One set for each elevator, comprising main panel; each panel containing items scheduled herein.
- (2) Function/operation of various items contained as individually specified elsewhere herein.
- (3) Panels shall have:
 - (a) Metal enclosures for recess mounting.
 - (b) Face plate: material and finish as specified under para 3.13.
- (4) Panels to be located as approved; main car operating panel to right side of and when facing car doors.

4.9 Hall Operating / Signal Features

- (a) Car Call Buttons
 - (i) Micro click type which require momentary contact but positive mechanical pressure for actuation; integral illumination; either square or round style; size not less than 25 mm across.
 - (ii) Types based upon principal of heat or variations of capacitance or induction shall not be permitted.
 - (iii) Single buttons in one face plate at top and bottom terminal landing; two buttons in one face plate all landings in between; all arranged and to appropriately indicate directions to be called for.
 - (iv) Each button automatically self-illuminating upon actuation; orange when illuminated
 - (v) Automatically extinguished upon arrival of car at respective floor level when car is traveling in same direction called for.
 - (vi) Face plates: as specified under para 3.13, herein.
 - (vii) Exclusive call button for disabled person shall be installed. The bottom level of button shall be installed 1000mm from floor level.

- (b) Hall Position / Direction Indicators
 - (i) Fixtures, features and functions same as specified for car position/direction indicators, except as specified.
 - (ii) Required for and mounted adjacent to each hoistway entrance door on each elevator.
 - (iii) Face plates: as specified under para 3.13, herein.
- (c) Door Reopen Feature
 - (i) Feature operative only when doors are in closing phases, and until doors are fully closed and respective doors to reverse to full open position; by hall call buttons at landing respective to where car is standing.
 - (ii) Button actuation to automatically cause doors to reverse to full open position.
 - (iii) When no prior calls have been registered in car, doors to open or reopen by actuation of any hall button at respective landing or by any car button.
 - (iv) When any yet unanswered prior calls remain registered for the car, doors shall reopen only by the actuation of button respective to direction in which car is next to travel.

5.0 SERVICE REQUIREMENTS

5.1 System Description

- (1) Automatic type; consisting of all mechanical, electrical and electronic equipment, devices, controls, signals, accessories and arrangements necessary to operate, govern, control and indicate elevator activates as specified or scheduled.
- (2) Functions and operations instantaneous and automatic, except as necessarily otherwise to effect proper sequences and times meeting specified requirements.
- (3) Basic operational system per requirements specified herein for normal services; circuited and otherwise arranged to integrate other services complying with specified requirements.

5.2 Basic Operation

- (1) Start up shall be as follows:
 - (a) Automatic; upon receiving any one signal from hall call button, car call button, emergency switch or actuation of keyed switch in car operating panel to positions other than OFF.
 - (b) Energizes machinery: car lights and fan turn on; all controls and signals operative.
- (2) Shut down shall be as follows:

- (a) Automatic; after predetermined time delay, after car doors have closed at landing of last registered call.
- (b) Door remain closed; lights and fan turn off; machinery de-energizes.

5.3 Car Levelling

- (1) Automatic self-levelling system for all required stops; to stop or maintain car at landings to within specified levelling tolerances.
- (2) Landing error: shall be less than 10 mm.
- (3) When traveling, to de-accelerate and stop car level with landing; without overrun (run-by) and return to effect levelling.

5.4 Car Direction Reversal

- (1) Automatic; to reverse direction of travel when all registered calls in one direction or trip phase have been answered and other calls remain registered or are so registered after car stops.
- (2) When standing at landing of last call for that direction and as passenger unloading progresses; direction change to register on hall, car and panel position/direction indicators; doors to remain open and reclose under normal time delay; then car to travel in reversed direction.

5.5 Normal (Basic) Service

- (a) Car Standing
 - (i) Car to remain standing at ground floor; system shut down.
 - (ii) When call is placed from 1st floor doors to close, if open; car to start and travel toward that landing.
 - (iii) When call is placed from ground floor door to open if closed or remain open if still open; close after normal time delay period; car to start and traveling direction respective to hall call as placed at that landing.
- (b) Door Operation
 - (i) Hoistway doors to operate simultaneously with car doors.
 - (ii) Doors to open automatically when car has reaches proximity of landing levelling zone; and close automatically after predetermined time interval.
 - (iii) Doors to fully close before car starts to travel.
 - (iv) Whether car stop is responding to hall call or car call, time delay between door opening and closing shall be for predetermined interval;
 - (v) When standing open, leading edges of doors shall be flush with entrance jambs.

- (vi) When closing, doors to respond immediately in response to actions as specified for safety edge, door open/hold button and hall button reopen feature.

5.6 Car Emergency Service

- (1) Effected by actuation of emergency stop switch to ON position.
- (2) Car to immediately but comfortably stop travel, regardless of direction or location; registered calls for stops to cancel; system to remain operative; lights and fan to remain in operation.
- (3) Hall call buttons inoperative; car under control of occupant only until arrival at base landing; but only by constant pressure maintained on button selected.
- (4) Car travel down only.
- (5) Requirements for door interlocks to remain in effect; hall and car direction/position indicator to remain active.
- (6) Car to travel non-stop down and stop at landings selected; doors to remain closed until actuation by constant pressure on door open hold button; doors to reclose upon momentary actuation of door close button.
- (7) Automatic door reclose feature inoperative.
- (8) Upon arrival at base landing, car to stop; doors to open and remain open; system, lights and fan to remain in operation.
- (9) No further car operations effective until appropriate adjustments have been made via key switches or reset buttons.
- (10) Monitor signal to control room(s) required for all elevators to monitor daily operation and to detect an accident. Refer to **Section 7600**.

5.7 Seismic measure

- (a) Seismic Design

All equipment, devices, components, etc. under this Section shall be designed and properly installed to stand seismic forces described in the “National Structural Codes of the Philippines”.

- (b) Seismic Sensor

- (i) Shall have following performances:

Sensing direction: horizontally non-directional

Frequency characteristics: flat from 1 to 5 Hz

Sensitivity: + (setting level x 0.1 + 0.07) m/sec², i.e., + (setting level x 0.1 + 7) gal

- (ii) Shall be of electrical type or mechanical type, shall be able to be tested by non-artificial vibration, shall consist of maintenance devices, operation

indicator, adjustable mechanism (horizontally and vertically) and level gauge, shall be almost free from secular change, and shall not act wrongly.

- (iii) If P wave sensor shall be employed, this shall be set inside hoistway pit.
- (iv) Setting level shall be as follows:

	Rope Type	Hydraulic Type	Remarks
Level 1	0.8m/sec ² (80 gal) or P wave sensor	0.3m/sec ² (30 gal)	
Level 2	1.2m/sec ² (120 gal)	0.6m/sec ² (60 gal)	Resetting can be done by manually

5.8 Auxiliary Services

- (a) Car Light and Fan Shut Off

Car lights and fans shall be automatically shut off when there is no call registered within a pre-set period.

- (b) Door Nudging

An override alarm sounds to alert the passengers that the door must close, when the doors are kept open longer than the pre-set time duration.

- (c) Secret Call

Car buttons shall be able to be locked and accessed only when a pre-set code numbers are entered onto the car operating panel.

- (d) Attendant Mode

The operation mode of elevator shall be able to be interchanged from/to full automatic mode to/from attendant mode, by selection switch on the car operating panel.

- (e) Extended Door-Open

The doors shall be able to remain open, by selection switch on the car operating panel, cancelling service (b) above tentatively.

- (f) Safety Door Edges

To detect passengers or objects, sensitive mechanical door edges shall be provided.

- (g) Attentive Announcement

In the event of normal operation interruption, announcement shall be given to the passenger. Announcement shall be in English and shall inform instruction, cause of interruption.

5.9 Hoistway Inspection Service

- (1) Effected by actuation of hoistway car-top inspection switch.

- (2) Car-top switch ON; hall and car call buttons inoperative; car operative only by constant pressure on inspection station buttons operative; and system otherwise fully operable.

6.0 INSTALLATION

6.1 General

- (a) Elevators and related and associated work shall be installed as per approved shop drawings and per applicable requirements specified or referenced.
- (b) Components shall be erected at times required; in advance where necessary; all fixed items accurately positioned and rigidly secured to structure.

6.2 Testing Requirements

(a) General

- (i) Three (3) persons from the Employer/Engineer shall be available for the factory inspections of the elevators.
- (ii) Test elevators and equipment shall be tested in presence of and as directed by the Engineer.
- (iii) General testing of elevators shall comprise not less than full and complete operation of elevators to demonstrate satisfactory performance of all features and services.
- (iv) Cars shall be tested for speed, performance times, levelling accuracy; as well as for performance under half-load and full-load conditions.
- (v) Operations required for emergency power operations shall be tested using emergency power.
- (vi) All general testing shall be complete prior to overload testing.

(b) Overload Testing

Overload testing requirements for all elevators are as follows:

- (i) Elevator shall be weighted to not less than 125 percent of rated capacity.
- (ii) Elevator shall be operated continuously Up and Down in rated load stopping not less than 10 seconds at each landing and in each direction and its performance monitored.
- (iii) Temperature of hoist motor or relevant motors and generator motor before, during and after testing using well shielded thermometers. The temperature of motors shall not exceed 50 degrees C above ambient just prior to start of test.

7.0 TRAINING REQUIREMENTS

Operation and maintenance training shall be carried out as follows: -

- (1) In manufacturer's factory
 - (a) Number: four (4) persons
 - (b) Duration: minimum five (5) days per each person
 - (c) Location: prepared by the Contractor
- (2) In the Site
 - (a) Number: eight (8) persons
 - (b) Duration: minimum five (5) days per each person
 - (c) Location: prepared by the Contractor

SECTION 7300

BAGGAGE HANDLING SYSTEMS

1.0 SCOPE OF WORKS

The work to be executed and completed by the Contractor under this Section shall include the following: -

- (a) Design, manufacture, supply and installation of Baggage Handling System (BHS) in Passenger Terminal Building and all ancillary equipment required for installation.
- (b) Provision of spare parts
- (c) Testing and commissioning
- (d) Training

2.0 SUBMISSIONS

Prior to commencement of the BHS works, the Contractor shall prepare and submit the following for the Engineer's approval:

- (a) All manufacturers' catalogues, detailed technical data, specification and installation instruction.
- (b) Shop drawings for all work where specifically required under this section, indicating in detailed, the jointing, support, assembly and installation requirements, material list and paint schedule.
- (c) All BHS Computer network with Programmable Logic Control (PLC), and interphase PLC and BHS Computer network
- (d) Testing and training schedule indicating in detail test items and training items.

3.0 WORK REQUIREMENTS

3.1 General

- (1) The requirements herein describe equipment, accessories and operations in general terms only. Contractor shall be responsible for all design and fabrication details necessary to provide work and operations as intended under and required by these specifications.
- (2) The requirements herein shall be applicable to all conveyors required.
- (3) Exceptions shall be only as particularly specified or scheduled for an individual conveyor or group of conveyors.
- (4) Each conveyor system shall be essentially self-contained, complete unto itself and independent from other conveyors, except respective to emergency power operations as specified.

3.2 Performance Requirements

- (1) Conveyor rated speed is defined as speed of conveyor belt travel when under full capacity loadings as scheduled. Speed variations shall not exceed plus or minus two percent of rated speed when under any load or no-load conditions within rated capacity.
- (2) Conveyor rated capacity is defined as full weight of dead load to be carried on conveyor belt at rated speed, exclusive of any parts of conveyor system. Conveyor shall be capable of handling and moving dead load at rated capacity when fully loaded for entire length of conveyer.

3.3 Operational Requirement

- (1) Belt starting and stopping: smooth, easy and free from overly rapid stops or accelerations resulting in jumping or tilting of baggage due to inertia.
- (2) Emergency stopping: rapid but not unsafe for baggage.
- (3) Belt movements shall be:
 - (a) flat, true to plane in all positions along its line of travel and free from obvious side sway or humps and depressions;
 - (b) quiet and free from squeaks, clattering or other objectionable sounds along entire course of travel, including when both concealed and exposed.
- (4) **Powered system in operation shall be:**
 - (a) irrespective of loading or non-load conditions, system quiet, even and free from clattering, groaning or other unusual noises or readily detectable variations in sounds normally emitted.
 - (b) speed controlled and uniform under either constant or rapidly changing load conditions.

3.4 Structural Requirements

- (1) All elements of conveyors shall be designed and engineered for proper support and rigidity under all dead and live load conditions, including seismic.
- (2) Factors of safety: not less than 2.0.
- (3) Conveyor and components shall be securely and adequately anchored within themselves and to structure; designed to safely resist seismic acceleration not less than 0.2 G.
- (4) Engineering designs and calculations shall be prepared and signed by licensed structural engineer retained by the Contractor.

3.5 Electrical Requirements:

- (1) Wiring: sheathed types only throughout; installed in conduit or other approved wireways; all complete with boxes, covers and devices and accessories necessary to complete work as required.

- (2) Terminal blocks: Each terminal shall be permanently tagged and labelled for ready identification of circuit or services; in machine rooms and elsewhere required.
- (3) Normal power: 230 volt, 60 hertz, 3 phases, 4 wire, AC
Emergency power: 230 volt, 60 hertz, 3 phases, 4 wire, AC

3.6 Lubrication Requirements:

- (1) Lubrication facilities shall be required for all parts involving friction and wear, other than where suitably covered or protected by resilient materials; or where provided with life-time packing or fittings.
- (2) All necessary grease fittings, oiling caps or other like facilities as required shall be provided to maintain equipment properly protected; and with all like items essentially identical and serviceable using same lubrications tools throughout.
- (3) Lubrication facilities shall be located where readily visible and positioned where easily accessible.
- (4) One complete set of lubrication hand tools of suitable types and adequate sizes, contained in suitable box or panel, shall be provided for each type of conveyor system.

3.7 Cleanness Requirements:

- (1) Each conveyor system shall be designed, constructed and arranged to positively preclude any greases, oils or other lubrication materials reaching any belt or roller surfaces upon which baggage will be conveyed.
- (2) Same requirement shall apply to all surfaces which baggage might contact during any mode or phase of handling and transport at, on or in vicinity of conveyors.
- (3) Likewise, each system shall be designed or equipped with drip pans or otherwise to preclude grease or oil dripping onto floors and/or running out from under conveyor areas.

3.8 Products Requirements:

Conveyors shall be as designed and fabricated by a single manufacturer, and installed by himself or his authorized agent. Any component not to be manufactured or fabricated by himself shall require Engineer's approval prior to fabrication. However, such approval shall not relieve the Contractor from his responsibility for the whole conveyor system.

4.0 SYSTEM REQUIREMENTS

4.1 System Design

- (1) General: to meet requirements shown, specified or scheduled.
- (2) Duty: continuous operation at rated speed and rated capacity as scheduled for each system; and not less than 4 hours at any given time.
- (3) Sizes: arrangements to suit spaces and space limitations as shown.

- (4) Independence: each line one complete system and operable at any time upon demand completely independent of other lines or systems
- (5) Speed: as scheduled; uniform and consistent for various power drive sections comprising one system.
- (6) Capacity: as scheduled; capable of starting and immediately gaining required speed when stopped and loaded to full capacity.
- (7) Serviceability:
 - (a) System completely demountable for major repair or over-haul.
 - (b) Individual components removable and replaceable; and with relative ease and minimum of effort.

4.2 System Operation

- (1) System control: independent control station comprising START-STOP-RESET pushbuttons.
- (2) Starting: manual, by actuation of START pushbuttons.
- (3) Stopping:
 - (a) Manual, by actuation of stop pushbutton.
 - (b) Automatic, caused by either conveyor overload or transfer of power from normal to emergency source.
- (4) Re-starting: manual, by actuation of RESET pushbutton; after any automatic stopping other than from any line flow control devices herein.
- (5) Stop control: when stopping is initiated, belt to cease motion within not more than 30 cm of travel.

5.0 COMPONENTS

5.1 Conveyor Frame

Steel materials for structure and machinery shall be new and are to be in accordance with JIS standard.

a) Frame

- i) The minimum thickness of the conveyer frame shall be 3mm.
- ii) The conveyor frame shall be constructed rigidly to withstand all chain and belt tensions and drive forces. The conveyor frame including slider plates shall be sufficiently strong to allow personnel to walk on the conveyor without causing any deformation or distortion.
- iii) As a minimum, the height of side guards shall be 300 mm above the conveying surface of the conveyor on both sides unless approved otherwise.

- iv) The slider bed shall be fabricated from channel section.
 - v) The side and slider plates at all junctions shall be designed in a manner to eliminate all gaps or openings and to prevent a tag or baggage being caught by the end pulley or the frame.
 - vi) All joints for either side guard or conveyor frame shall be smooth finished without rough or sharp edges and with no protruding portion which may cause injury to personnel or damage to baggage.
 - vii) The gap between the bent corner of the slider bed and the side guard of the bent channel shall be sealed and finished smoothly to prevent a tag or baggage being caught and damaged.
 - viii) Material for the structure in public view shall be stainless steel with hair line finish.
 - ix) Material for the structure not in public view shall be paint finished on mild steel or other approved equivalent material.
 - x) All slider beds exposed in public view shall be of stainless steel for the entire part of the conveyor system.
- b) Side Cover
- i) A side cover for the structural frame shall be provided for the visible portion at the baggage check-in area and baggage claim area. In addition, a side cover shall be provided at breakdown position and other manned position for manual coding for safety.
 - ii) It shall be constructed with minimum 2.0 mm thick. It shall be stainless steel with hair line finish in public view and paint finished on mild steel or other approved equivalent material for other area.
 - iii) The side cover shall be fitted over the conveyor frame and extended under the edge of the frame.
- c) End Cover
- i) The end cover shall be provided for the visible portion at the baggage check-in area. For other portions of the conveyor, end covers shall be provided as required for safety.
 - ii) Covers shall be constructed with minimum 2.0 mm thick. It shall be stainless steel with hair line finish in check-in area and paint finished mild steel or other approved equivalent material for other area.

5.2 Belt

- a) The top surface color of the belt shall be black or dark grey.
- b) Belt shall be compatible for maximum 50kg/per baggage that is strong enough for a man to stand on it

- i) For weighing, dispatch conveyors; use one of the following:
 - Carcass : 2ply Polyester
 - Bottom face : Fabric
 - Top face : Urethane, plain or gripping type
 - Belt pull : 1% elongation 10N/mm

5.3 Drive Unit

- a) The drive unit shall be designed to produce a smooth, quiet movement within the specified noise levels. All drive units shall have safety guards for the moving parts.
- b) Belt Conveyor
 - i) Unless otherwise specified, the drive unit shall be either suspended or supported beneath the conveyor frame.
 - ii) It shall consist of a geared motor or motor and reducer with roller chain or timing-belt connection to the drive pulley and shall be totally enclosed in a sheet metal guard for safety.
 - iii) The shaft mounted type geared motor or reducer shall also be applicable on the drive pulley shaft.

6.0 SCHEDULE OF CONVEYORS

6.1 Check-in BHS

Check-in BHS shall consist of the following. All conveyors conveyor shall be able to operate simultaneously and individually.

(1) C1: Weighing Conveyor

- (i) Type : slider bed type of belt conveyor equipped with baggage weigh scale.
- (ii) Width : 785mm (effective belt width 650mm)
- (iii) Length : 1.2 m
- (iv) Height : FL + 300mm
- (v) Belt : Plain type
- (vi) Sensor : shall be installed to search for vacant spaces on the collecting conveyor.
- (vii) Side cladding : side cladding shall be of 3mm Stainless steel (JIS-G4304 or equivalent) within public view.

- (viii) Geared motor : totally enclosed fan cooled type, 3 phase motor with brake, 0.4 kw, pre-assembled with gear case at factory.
- (2) Weigh Scale (Pressure sensor)
- (i) Type : Electronic airport baggage scale
- (ii) Weighing range : 0 to 150Kg
- (iii) Graduation : digital increment of 0.1Kg
- (iv) Accuracy : 1/1000
- (v) Weigh detector : Load cell type
- (vi) Display : desk mounted digital display by 15mm, 7 segment characters. One display for operator and one display for passenger side in check-in counter desk.
- (vii) Control : The following functions shall be performed
- on/off switch for weight display
 - adjustable zero switch for reset
 - total clear switch
 - total set switch
 - belt jog, carry on switch
- (3) C2: Dispatch Conveyor
- (i) Type : slider bed type
- (ii) Width : 785mm (effective belt width 650mm)
- (iii) Length : 1.5 m
- (iv) Height : FL + 300mm to 400mm inclined
- (v) Belt : Plain or gripping type
- (vi) Geared motor : totally enclosed fan cooled type, 3-phase motor with brake, 0.4kw.
- (vii) Side cladding : The side cladding shall be of 3mm Stainless steel (JIS-G4304 or equivalent) within public view.
- (viii) Tipping Device : A suitable tipping device shall be employed to assist in proper loading of the baggage from the dispatch conveyor to the collecting conveyor.
- (4) C3: Collecting Conveyor
- (i) Type : slider bed type

- (ii) Width : 1000mm between side guards
- (iii) Length : 35 m (two 17.5-m long conveyors)
- (iv) Height : FL + 360mm
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 2.2 kw.
- (vi) Side guard : 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. The side guards shall be of Type 304 stainless steel (JIS-G4304 or equivalent) within public view.
- (vii) Side cladding: The side cladding shall be of 3mm Stainless steel (JIS-G4304 or equivalent) within public view.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(5) C4: Up-sloped Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 1.5 m
- (iv) Height : FL + 360mm to 600mm inclined
- (v) Belt : Gripping type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. The side guards shall be of Type 304 stainless steel (JIS-G4304 or equivalent) with hair line finish.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(6) C5: Queuing Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 1.5 m

- (iv) Height : FL + 600mm
 - (v) Belt : Plain type
 - (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
 - (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. The side guards shall be of Type 304 stainless steel (JIS-G4304 or equivalent) with hair line finish.
 - (vii) Side cladding: The side cladding shall be of 3mm Stainless steel (JIS-G4304 or equivalent) within public view.
 - (viii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.
- (7) C6: Induction Conveyor
- (i) Type : slider bed type
 - (ii) Width : 1200 mm between side guards
 - (iii) Length : 2.5 m
 - (iv) Height : FL + 560mm
 - (v) Belt : Plain type
 - (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
 - (vi) Side guard: 300 mm high on 3 sides. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. The side guards shall be of Type 304 stainless steel (JIS-G4304 or equivalent) with hair line finish.
 - (vii) Side cladding: The side cladding shall be of 3mm Stainless steel (JIS-G4304 or equivalent) within public view.
 - (viii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

6.2 Inline Screening BHS

BHS in the In-line Hold Baggage Screening system (In-line HBS) shall consist of the following. All conveyors conveyor shall be synchronized with the performance of EDS and able to operate simultaneously and individually.

(1) S1: Up-sloped Conveyor

- (i) Type : slider bed type
- (ii) Width : 1200mm between side guards
- (iii) Length : 2.4 m
- (iv) Height : FL + 560mm to 1040mm inclined
- (v) Belt : Gripping type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(2) S2: EDS Pre-entry Conveyor

- (i) Type : slider bed type
- (ii) Width : 1200mm between side guards
- (iii) Length : 3.4 m
- (iv) Height : FL + 1000mm
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(3) S3: EDS Entry Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 1.5 m

- (iv) Height : FL + 1000mm inclined
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(4) S4: EDS Exit Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 1.5 m
- (iv) Height : FL + 970mm
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(5) S5: Curved Conveyor

- (a) Type : slider bed type
- (b) Curve degrees : 90 degree.
- (c) Curve radius of center: 1500mmR
- (d) Height : FL+970mm
- (v) Belt : Plain type
- (f) Side guard: 300 mm high on both sides. Joint for side guard shall be finished smooth without rough or sharp edges and with no protruding

portion which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.

- (g) Geared motor: totally enclosed fan cooled type, 3 phase motor, 0.4 kw, pre-assembled with gear case at factory.
- (h) Support: all supports shall be adjustable for height and shall be cross-braced for rigidity.

(6) S6: Screening Judgement Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 8.8 m
- (iv) Height : FL + 970mm
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 1.5 kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(7) S7: Queuing Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 1.5 m
- (iv) Height : FL + 970mm
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.

- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(8) S8: Bi-direction Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 1.5 m
- (iv) Height : FL + 970mm
- (v) Belt : Plain type
- (vi) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
- (vii) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
- (viii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(9) S9: EDT Holding Line

- (i) Type : Roller type
- (ii) Width : 1000mm between side guards
- (iii) Length : 1.5 m
- (iv) Height : FL + 970mm
- (v) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
- (vi) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(10) S10 : Cleared Baggage Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 5.9 m

- (iv) Height : FL + 970mm
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.75 kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

6.3 Departure BHS

Departure BHS shall consist of the following. All conveyors conveyor shall be able to operate simultaneously and individually.

(1) D1: Induction Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 4.8 m
- (iv) Height : FL + 970mm
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.75 kw.
- (vi) Side guard: 300 mm high on both side to top of finished floor level. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. The side guards shall be of Type 304 stainless steel (JIS-G4304 or equivalent) with hair line finish.
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(2) D2: Up-sloped Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 5.7 m
- (iv) Height : FL + 970mm to 2790mm inclined

- (v) Belt : Gripping type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 1.5 kw.
- (vi) Side guard: 300mm on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. The side guards shall be of 3mm stainless steel (JIS-G4304 or equivalent) with hair line finish.
- vii) Side Cladding: The side cladding shall be of 3mm Stainless steel (JIS-G4304 or equivalent) within public view. Side cladding at lower section shall be extended to floor so that ground support is hidden from public view.
- (viii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, and fixed to the floor using anchor bolts at lower side, and suspended by appropriate steel embedded from upper concrete slab.

(3) D3: Transition Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 1.5 m
- (iv) Height : FL + 2790mm
- (v) Belt : Plain type
- (v) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4 kw.
- (vi) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. The side guards shall be of Type 304 stainless steel (JIS-G4304 or equivalent) with hair line finish.
- (vii) Support: rest on the catwalk suspended by appropriate steel embedded from upper concrete slab, and shall be adjustable for height and shall be cross-braced for rigidity.

(4) D4: Curved Conveyor

- (i) Type : slider bed type
- (ii) Curve degrees : 90 degree.
- (iii) Curve radius of center: 1500mmR
- (iv) Height : FL+2750mm

- (v) Belt : Plain type
 - (vi) Side guard: 300 mm high on both sides. Joint for side guard shall be finished smooth without rough or sharp edges and with no protruding portion which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
 - (vii) Geared motor: totally enclosed fan cooled type, 3 phase motor, 0.4 kw, pre-assembled with gear case at factory.
 - (viii) Support: rest on the catwalk suspended by appropriate steel embedded from upper concrete slab, and shall be adjustable for height and shall be cross-braced for rigidity .
- (5) D5: Straight Conveyor
- (i) Type : slider bed type
 - (ii) Width : 1000mm between side guards
 - (iii) Length : 7.8 m
 - (iv) Height : FL+2750mm
 - (v) Belt : Plain type
 - (vi) Side guard: 300 mm high on both sides. Joint for side guard shall be finished smooth without rough or sharp edges and with no protruding portion which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent.
 - (vii) Geared motor: totally enclosed fan cooled type, 3 phase motor, 0.75 kw, pre-assembled with gear case at factory.
 - (viii) Support: rest on the catwalk suspended by appropriate steel embedded from upper concrete slab, and shall be adjustable for height and shall be cross-braced for rigidity.
- (6) D6: Down-sloped Conveyor
- (i) Type : slider bed type
 - (ii) Width : 1000mm between side guards
 - (iii) Length : 5.3 m
 - (iv) Height : FL + 2750mm to 1040mm inclined
 - (v) Belt : Gripping type
 - (vi) Sensor : shall be installed to search for vacant spaces on the make-up racetrack.

- (vii) Motor : totally enclosed fan cooled type, 3-phase motor, 0.75 kw.
- (viii) Side guard: 300mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent..
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(7) D7: Final Induction Conveyor

- (i) Type : slider bed type
- (ii) Width : 1000mm between side guards
- (iii) Length : 3.5 m
- (iv) Height : FL + 1040mm
- (v) Belt : Plain type
- (vi) Sensor : shall be installed to search for vacant spaces on the make-up racetrack.
- (vii) Motor : totally enclosed fan cooled type, 3-phase motor, 0.4kw.
- (viii) Side guard: 300 mm high on both side. All joints for side guard shall be finished smooth without rough or sharp edges and with no protruding portions which may cause damage to baggage. Material shall be electronically galvanised mild steel (SGHC:JIS-G3302) or equivalent..
- (vii) Support: all supports shall be adjustable for height and shall be cross-braced for added rigidity, fixed to the floor using anchor bolts.

(8) D8: Make-Up Racetrack

- (i) Type : Overlapping slat, inclined-type racetrack
- (ii) Width : 1500mm
- (iii) Height : FL+1000mm
- (iv) Overall center length: 51m (see layout drawing)
- (v) Conveyor speed : 25m/min.
- (vii) Slat : material shall be polypropylene or synthetic rubber 6mm thick with ripple finish.

- (vii) Motor : totally enclosed fan cooled type, 3-phase motor, 2.2 kwx2.
- (viii) Curve radius of center: 1500mm at the centre of transporting link.
- (i) Maximum load : 60 kg/m
- (j) Support: All supports shall be adjustable for height and shall be cross-braced for rigidity. All supports shall be attached directly to floor by mechanical anchor bolt. Maximum support spacing shall be 1500mm.

6.4 Arrival BHS

(1) A1: Claiming Racetrack

- (i) Type : Overlapping slat, flat-type racetrack
- (ii) Width : 1000mm
- (iii) Height : FL+350mm
- (iv) Overall center length: 61m (see layout drawing)
- (v) Conveyor speed : 25m/min.
- (vii) Slat : material shall be polypropylene or synthetic rubber 6mm thick with ripple finish.
- (vii) Motor : totally enclosed fan cooled type, 3-phase motor, 1.5x2 kw.
- (viii) Curve radius of center: 1500mm at the centre of transporting link.
- (i) Maximum load : 60 kg/m
- (j) Support: All supports shall be adjustable for height and shall be cross-braced for rigidity. All supports shall be attached directly to floor by mechanical anchor bolt. Maximum support spacing shall be 1500mm.
- k) Side Cladding: The side cladding shall be of 3mm Stainless steel (SUS 304 HL) within public view, and 3mm galvanized steel for airside.
- (k) Side guard: The side guard is required at airside. The height of the side guard shall be 300 mm above conveying surface and be constructed of 3mm galvanized steel reinforced with braces, rigidly fastened to the frame.

7.0 AUXILIARY COMPONENTS

7.1 Control Panel

- (1) A Control panels shall be required for the conveyor system.

- (2) The control panel shall be provided with key lock covered enclosure; with lock master-keyed to meet specified requirements.

7.2 Programmable Logic Control (PLC) and Network Architecture

- (1) Programmable Logic Control (PLC) shall be configured with BHS Computer network. All communication between PLC and BHS Computer network shall be performed with TCIP/IP capability for connection to the LAN switch layer 2 using Ethernet 10/100 Base-T.
- (2) PLC shall be direct interface between all Input and output devices.
- (3) Each PLC shall be provided with a minimum of 20 % excess memory, a capacity for 20 % expansion, and further each I/O module with expandable for 20 %. All PLC shall be provided with a battery back-up system capable of storing data for a minimum period of two (2) hours when power fails.
- (4) Manufacturer's standard software development tool shall be used for all control programmes. Programming shall be standardised and unitised as much as possible for similar function of control unit. The Contractor shall submit the BHS software development specification to the Engineer for approval prior to development for, but not limited to, the following:
 - Function Detail as specified in Control Function Requirement
 - Unit sequence
 - Abnormal control procedure
 - Fault recovery procedure
 - Clearly indicated I/O signal.
 - Clearly indicated interlock function
 - Debugging procedure at shop.

7.3 Draft Curtains

- (1) Rubber slat curtains shall be provided to all openings in walls, where the racetracks emerge from the baggage handling area. In addition galvanized steel slat curtains shall be provided to these openings under Section 4340.
- (2) These curtains shall operate automatically upon the activation or shut-off of the baggage handling system and the controls therefor shall be included in the scope of work for the baggage handling system.

7.4 Blind Plate

Blind plate shall be provided to fill the space below draft curtain, and be constructed of 1.6 mm sheet steel reinforced with braces, rigidly and securely fastened to the racetrack frame.

7.5 Warning Chime and Emergency Stop

Each racetrack unit shall be provided with a warning chime which shall sound prior to start up. At least three (3) "Emergency Stop" buttons shall be provided per one claim conveyor with at least two (2) of them in the claim area.

7.6 Switch Box

Type of control panels shall be standard three (3) push buttons, momentary contacts and each position shall be as shown on the Drawings.

7.7 Stop Switch

Stop switch shall be provided in the baggage claim area as shown on the Drawings.

7.8 Wiring Diagrams

- (1) Wiring diagrams shall be required for all motors and controls and for each conveyor system included under this Section, which shall be prepared to indicate as follows:
 - (a) Initially: work as proposed; included with shop drawing submittals.
 - (b) Finally: work exactly as installed when completed and accepted.
- (2) In addition, complete set of all diagrams shall be provided for permanent wall mounting; each type or group of diagrams located in different locations as directed by the Engineer; and each provided with cover of clear plastic; in thickness not less than 3.0 mm for diagram sizes 40 x 40 cm and larger, 1.5 mm for smaller sizes; retained in neatly fabricated steel frame, baked enamel finish secured to wall using matching screws.

8.0 INTERFACE WITH THE BUILDING MANAGEMENT SYSTEM (BMS)

- 8.1 The Contractor shall provide, if shown and/or as directed in the drawings, all BMS interface points for the BMS to monitor the following but not limited to:
 - BHS Operation – Status
 - BHS Shutdown – Alarm
 - BHS Emergency Stop – Alarm
 - BHS Area Fire – Alarm
- 8.2 The Contractor shall provide dry contact, transducers and other interface equipment necessary to interface with the BMS.
- 8.3 Discrete/digital input and output such as contact status maintained, momentarily, etc. as well as voltage and current signal requirements shall be coordinated with the BMS to ensure proper operation.

9.0 INSTALLATION

9.1 General

- (1) Conveyors and related and associated work shall be installed as per approved shop drawings and per applicable requirements specified or referenced.
- (2) Components shall be erected at times required; in advance where necessary; all fixed items accurately positioned and rigidly secured to structure.

9.2 Testing Requirements

- (1) Three (3) persons from the Employer/Engineer shall be available for the factory inspections of Baggage Handling System
- (2) Conveyors and equipment shall be tested in presence of and as directed by the Engineer.
- (3) Each system shall be tested individually; to extent necessary to demonstrate satisfactory performance of all services and features.
- (4) Testing shall be done by full and complete operation under various and varying conditions as follows:
 - (a) under partial, full and over-load conditions
 - (b) under normal and emergency power conditions.

10.0 TRAINING REQUIREMENTS

Operation and maintenance training shall be carried out as follows: -

- (1) In manufacturer's factory
 - (a) Number: two (2) persons
 - (b) Duration: minimum five (5) days per each person
 - (c) Location: prepared by the Contractor
- (2) At the Site
 - (a) Number: four (4) persons
 - (b) Duration: minimum five (5) days per each person
 - (c) Location: prepared by the Contractor

SECTION 7400

AIRPORT SECURITY SYSTEM

1.0 SCOPE OF WORKS

The work to be executed and completed by the Contractor under this Section shall include the following: -

- (a) Design, manufacture, supply and installation of baggage inspection equipment by means of X-ray method, and all ancillary equipment required for installation.
- (b) Design, manufacture, supply and installation of walk-through metal detection equipment by means of electromagnetic method and all ancillary equipment required for installation.
- (c) Design, manufacture, supply and installation of Explosive Detection System (EDS): Multi-view type x-ray certified by TSA for BHS in-line baggage screening and associated works;
- (d) Design, manufacture, supply and installation of Electronic Trace Detector (ETD) – Desktop trace detector for in-line baggage screening and associated works;
- (e) On-line double conversion UPS for baggage inspection equipment and gateway metal detection equipment
- (f) Public sign boards
- (g) Provision of spare parts
- (h) Testing and commissioning
- (i) Training

2.0 WORK REQUIREMENTS

2.1 General

Requirements herein describe equipment, accessories and operations in general terms only. The Contractor shall be responsible for all design and fabrication details necessary to provide work and operations as intended under and required by this Specification.

2.2 Design Requirements

- (1) System shall be essentially self-contained, complete unto itself, and independent from other systems, except as specified for power.
- (2) System shall be designed specifically for airport baggage inspection and metal detection services; and for continuous and frequent daily service.
- (3) System shall be readily serviceable, by qualified personnel.

- (4) Like components shall be alike in design, finish and appearance.
- (5) Housing and other exposed components shall be in neat and clean line design, free from unnecessary embellishments or decorations.
- (6) Conveyor systems shall be adjustable to compensate for belt wear.
- (7) Detection system shall be adjustable to components for certain local or environmental conditions; and detection sensitivity shall be variable and re-adjustable.
- (8) System shall be designed and equipped to provide all operations, functions, controls and signals as specified.

2.3 Electrical Requirements

- (1) All items necessary for work under this section and beyond shall be provided to services connection points provided under 6000 Series Electrical Works.
- (2) Wire, cable, conduit, grounding and installations: per applicable requirements under 6000 Series.
- (3) Motors: per applicable requirements
- (4) Wiring: Sheathed types only throughout; installed in conduit or other approved wire ways; all complete with boxes, covers and devices and accessories necessary to complete work as required.
- (5) Terminal blocks: Each terminal shall be permanently tagged and labelled for ready identification of circuit or service; in machine rooms and elsewhere required.
- (6) Electrical service requirements shall be as follows:
 - (a) Normal and emergency power: 1 phase - 230 V, 60 Hz
 - (b) On-line double conversion UPS for each X-ray baggage inspection equipment and gateway metal detection equipment shall be provided. Capacity shall be 120% of full loads of equipment and backup time at full load shall be not less than eight (8) minutes.

2.4 Finishing Requirements

- (1) All metallic surfaces shall be either of corrosion-resistant materials or otherwise protected with appropriate applied finished.
- (2) Finishes per manufacturer's standard processes, except as specified, and as approved.
- (3) Surfaces receiving paint finishes shall be properly cleaned, pre-treated and prime painted.
- (4) Colour shall be selected from manufacturer's standard series; and one only or one combination only throughout for all baggage inspection work; as approved by the Engineer.

2.5 Identification Requirements

- (1) Equipment components shall be identified with permanently attached and engraved product plates giving name of manufacturer, catalogue number, electrical ratings and like data necessary.
- (2) Operational and indicator features shall be clearly, uniformly and permanently engraved and finished in colour contrasting with backgrounds.
- (3) Permanent operational and precautionary signs shall be attached as and where necessary.

3.0 BAGGAGE INSPECTION SYSTEM

3.1 Location

Equipment	Q'ty	Location
Small Goods (Type 1)	1	Staff - Goods Lobby (151)
Hand Baggage (Type 2)	2	Security Area 1 (158)
Odd Size Baggage (Type 3)	1	Check-in Area 1 (172)

3.2 Components

Baggage inspection equipment shall comprise primary components as follows:

- (a) X-ray generator tube
- (b) X-ray monitor system
- (c) X-ray detector
- (d) Digital video memory unit
- (e) Image processing unit
- (f) 19" high resolution colour screen or more
- (g) Shield housing, including hood, conveyor and alarm system
- (h) Controller
- (i) Feeding and discharge roller conveyor
- (j) Control desk for each unit
- (k) Stainless Steel inspection table, approx. dimension 700 x 2,100 mm.

3.3 X-Ray Tube Indicator Circuitry

- (1) Double type system of indicator circuitry shall be provided for each X-ray tube unit; to illuminate indicator lamps on control panel when X-rays are emitted. Each part of each double circuit shall be arranged to operate entirely independently of corresponding part.
- (2) Failure of any one circuit shall not affect any other circuit.

3.4 Public Notice Sign

Notice signs shall be provided, suitably type set and printed on substantial poster board; in type and background colours as selected by the Engineer; Texts shall be in English language and as approved by the Engineer prior to printing.

3.5 Performance Requirements

- (1) Conveyor capacity shall be as follows:

- (a) Defined as full weight of dead load to be carried on conveyor belt at rated speed, exclusive of any parts of conveyor system.
 - (b) Conveyor capable of handling and moving dead load at rated capacity when fully loaded for entire length of belt.
 - (c) The baggage can be inspected continuously through monitor as it moves on traveling conveyor.
 - (d) Speed of conveyor shall be not less than 0.14 m per second.
 - (e) Speed variations: not exceeding plus or minus five percent of rated speed when under any load or no load conditions within Rated Capacity.
- (2) Detection method: item to be inspected will be sliced by narrow X-ray beam as it moves on traveling conveyor. The items that do not absorb the beam will be detected by X-ray sensor located in line at the opposite side and converted directly from X-ray to video signal through solid state circuit, stored in Digital Memory Unit and displayed on a monitor.
- (3) Penetration : more than 20 mm steel.
 - (4) X-ray dosage : less than 0.1 mR per inspection.
 - (5) Resolution : 36 AWG solid wire (0.15 mm diameter) or more
 - (6) Contrast sensitivity : minimum of 22 Grey levels visible on monitor as measured with step wedge or more
 - (7) Zoom facility : enlargement of 2 and 4 times for image section of 9 on monitor.
 - (8) Material distinction : State of the art colour renditions of material's atomic weight with computerized picture enhancement techniques. Images in different colours for organic objects such as Plastic Explosives and inorganic objects; irrespective of surrounding metal objects and orientation of organic material and the metals
 - (9) Film safety : Guaranteed for high speed films up to ISO 1600 (33 DIN).
 - (10) Duty cycle : 100%
 - (11) Maximum Baggage Sizes
 - Type 1: Small Goods
Maximum size: 750 x 550 mm (W x H)
 - Type 2: Hand Baggage
Maximum size: 650 x 450 mm (W x H)

Type 3: Odd Size Baggage

Maximum size: 1,000 x 1,000 mm (W x H)

(12) Conveyor Belt Height

Small Goods (Type 1)	700 to 750 mm from Finishing Floor Level
Hand Baggage (Type 2)	700 to 750 mm from Finishing Floor Level
Odd Size Baggage (Type 3)	300 to 350 mm from Finishing Floor Level

(13) Ambient Working Conditions: Temperature: zero to 40 degrees C; Humidity: 10 to 95 percent.

3.6 Conveyor Operational Qualities

- (1) Belt starting and stopping: smooth, easy, and free from sudden stops or over acceleration resulting in jumping or tilting of baggage due to inertia.
- (2) Emergency stopping: rapid but not unsafe for baggage.
- (3) Belt movements shall be:
 - (a) Flat, true to plane in all positions along its line of travel and free from obvious side sway or humps and depressions.
 - (b) Quiet and free from squeaks, clattering or other objectionable sounds along entire course of travel including when both concealed and exposed.
- (4) Powered system in operation
 - (a) Irrespective of load or no-load conditions, system shall be quiet, even and free from chattering, groaning or other unusual noises or readily detectable variations in sounds normally emitted.
 - (b) Speed controlled and uniform under either constant or rapidly changing load conditions.
- (5) Stop control: when stopping is initiated, belt to cease motion within not more than 300 mm of travel.

3.7 Cleanness Requirements

- (1) Conveyor system shall be designed, constructed and arranged to positively preclude any grease, oil or other lubrication materials reaching any surface upon which baggage is conveyed.
- (2) Same requirements shall apply to all other surfaces which baggage might contact during any mode or phase of handling, and transport at, on or in vicinity of the conveyor system.
- (3) Likewise, system shall be designed or equipped with drip pans or otherwise to preclude grease or oil dripping onto floors and/or running out from under conveyor areas.

- (4) Any metal edges not hemmed or turned back or concealed shall be sanded smooth and made free from burrs of other conditions which might in any way scratch, cut or otherwise damage baggage, straps or other parts thereof.

3.8 Structural Requirements

- (1) All elements of conveyors and other components shall be designed and engineered for proper support and rigidity under all dead and live load condition, including seismic.
- (2) Conveyor and components shall be securely and adequately anchored within themselves and to structure; designed to safely resist seismic acceleration not less than 0.2 G.

3.9 Radiation Safety

Designed to comply with all applicable radiation and health regulation for radiation emitting devices.

3.10 Baggage Inspection Requirements

- (1) Each piece of baggage irradiated and randomly zoomed to facilitate object recognition.
- (2) Inspection methods specified continuously changeable and selectable by inspection personnel.
- (3) Irradiation dosages and emission time intervals automatically and closely controlled not to exceed limit specified.
- (4) Any exposure reading can be stored in Digital Memory Unit and readings can be displayed continuously on monitor screen until cancelled by inspector.

3.11 Operation Requirement

- (1) The system shall be controlled as follows:
 - (a) System operation under control of one ON-OFF key switch in control panel.
 - (b) System operations permitted only when key switch is in ON position.
 - (c) Key switch shall not be operable without use of assigned and properly cut key; and key shall be removable only when switch is in OFF position.
 - (d) All illumination or indicator devices to extinguish when system switch is turned OFF.
 - (e) System power under control of one-key ON-OFF line switch on control panel; ON power signalled by illumination of respective indicator lamp.
- (2) The power for the entry, exit and X-ray housing conveyor systems shall be operated by respective electric motors; all under control of one pair of momentary contact type ON and OFF push buttons on control panel.

3.12 X-Ray Requirements

- (1) X-ray Generator shall be as follows:
 - (a) Manufacturer's standard type,
 - (b) Rate voltage: approx. 140 kV
- (2) System shall be designed and equipped to limit leakage of X-ray radiation in a distance of 50 mm from housing to less than 0.1 mR per hour.
- (3) Baggage entry and exit ends of housing shall be provided with lead-rubber curtains as required
- (4) Radiation ports inside housing shall be provided with masks designed to limit primary X-ray beams within irradiation field.
- (5) System shall be designed and equipped to automatically stop or prevent operation of X-ray tubes or emissions when:
 - (a) Any emergency stops are actuated.
 - (b) Excess over temperature on cabinet enclosure and important units
 - (c) Safety interlock switch of access panels is activated
- (6) The X-ray detector shall be as per manufacturer's standards

3.13 Service Requirements

- (1) The items of equipment shall be of a type which requires minimum lubrication or maintenance.
- (2) One complete set of service tools shall be required for baggage inspection system equipment. These will include any specialized hand tools necessary for regular upkeep service which are of types not usually carried or readily available. Additionally a test sample for performance check will be included.

3.14 Maintenance Requirement

- (1) Test signals/test patterns shall be made available in the system itself for testing of circuit and monitors.
- (2) Panels of the equipment shall be easily removable for maintenance.
- (3) All system components such as card racks, power supplies, X-ray generator, component of conveyor and all other repairable items shall easily accessible for preventive and corrective maintenance, in order to minimize system down time.

3.15 Key Requirements

- (1) Baggage inspection control keys shall be unique from all others required for work under this Contract.
- (2) 6 Keys for each key lock or keyed switch required shall be provided.

- (3) Keys handled by persons other than duly authorized or assigned shall be positively prohibited.
- (4) 2 spare keys each shall be provided, properly tagged, for deposit with Security Office in Passenger Terminal Building.

4.0 WALK-THROUGH METAL DETECTION SYSTEM

4.1 Location of Gate Type Walk-Through Metal Detection

Equipment	Q'ty	Location
Walk-Through Metal Detection	1	Staff - Goods Lobby (151)
	2	Security Area (1-49)
	1	Check-in Area (172)

4.2 Components

Metal detection equipment shall comprise primary components as follows:

- (a) Detection unit housing; 1 each
- (b) Built-in amplifier/control unit; 1 each
- (c) Remote alarm unit; 1 each
- (d) Accessories; 1 set; consisting of interconnecting cords or cables, chime, fuses and standard test piece.

4.3 Detection Unit

Comprising primary elements as follows:

- (a) Cast plastic side standards, overhead arch and interconnecting internal wiring.
- (b) Outside floor braces and inside guide plates; each side of unit.
- (c) Related mechanical fastening and electrical connection facilities.

4.4 Built-in Amplifier/Control Unit

Suitable for top installation of gateway comprising primary elements as follows:

- (a) Power switch
- (b) Sensitivity selector and adjuster (potentiometer) by key or password operation
- (c) Alarm and its volume control
- (d) Digital display counter & reset button

4.5 Alarm Unit

Suitable for desk-top installation in vicinity of amplifier unit or elsewhere required; comprising indicator lamps; 1 each detector element on housing unit

4.6 Chime Unit

Suitable for remote mounting where required; with sounding sufficiently loud to be readily heard by any or all inspectors in vicinity of inspection station/area.

4.7 Performance Requirements

- (1) Items to be detected : manufacturer's standard metal test sample; less than 30 grams in total weight.
- (2) Items not to be detected if desired (adjustable sensitivity) shall include personal items such as wrist or pocket watches, cigarette cases, small quantities of keys or coins, etc.
- (3) Items not to be affected:
 - (a) Pacemakers.
 - (b) Photographic films.
 - (c) Magnetic recording materials (tapes, diskette).
 - (d) Any external metal parts in the proximity of the gateway unit.
- (4) Gateway aperture dimensions shall be as follows:
 - (a) Passage : 2,000 mm high, 700 mm wide or more
 - (b) Overall : 2,220 mm high, 950 mm wide or less
- (5) Detection sensitivity shall be adjustable by selection by inspection personnel.
- (6) Presence of detectable object with field of any detector element shall be indicated by immediate sounding of alarm chime and 0.4 second illumination of respective indicator lamps on both detector unit housing and amplifier unit.
- (7) Conditions for detection shall be as follows:
 - (a) Person being inspected: walking through and at approximate centerline between sides of housing and at normal walking speed.
 - (b) Other person: not closer than 600 mm away from any outside surface of detection housing

4.8 Control Requirements

- (1) Primary power control: from circuit of adjacent x-ray inspection system ; not available when x-ray system is turned off.
- (2) Local power control: by switch on amplifier unit.
- (3) Power switch control:

- (a) When off: entire system inoperative.
- (b) When on: all functions and indicators operative.
- (4) Chime control: chime operative or non-operative in accordance with switch on or off positions.

4.9 Installation Requirement

Necessary measures shall be taken to avoid the effect from X-ray equipment and other metal detection equipment

5.0 IN-LINE SCREENING MACHINE

5.1 Explosive Detection System (EDS) – Multi-view type X-ray equipment

- (1) EDS shall be one certified by Transportation Security Administration (TSA) of USA.
- (2) EDS shall meet the following requirements:
 - (i) Type : L3 MVT-HR, or equivalent
 - (ii) Tunnel size : 1000mm wide x 800mm high
 - (iii) Height : FL+980mm (conveying height)
 - (iv) Output : 1800 bags per hour
 - (vii) Workstation : 4 Workstations, with 5 chairs (2 each for Levels 2 and 3). Memory capacity of 12 bags Level 2 screening, and 24 bags for Level 3 screening
- (3) EDS shall be installed at the location shown in the Drawings, interface and coordination shall be taken with Baggage Handling System under Section 7300.

5.2 Electronic Trace Detector (ETD) – Desktop trace detector

- (1) ETD shall meet the following requirements:
 - (i) Type : GE Itemizer, or equivalent
 - (ii) Analysis Time : Default 8 seconds
 - (iii) Detection : Explosive, Narcotics
 - (iv) Table : Suitable table for placement of ETD.
Size fir for purpose
- (3) ETD shall be installed at the location shown in the Drawings, interface and coordination shall be taken with Baggage Handling System under Section 7300.

5.3 Maintenance and Repair Services

- (1) The Contractor shall be responsible for providing full maintenance and repair services for the duration of the Defect Notification Period.

- (2) Regular routine maintenance and inspection procedures at intervals detailed in the relevant Operation and Maintenance Manuals
- (3) The provision of all consumables, lubricants, spare parts and replacement parts
- (4) 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)

6.0 TRAINING REQUIREMENTS

6.1 Baggage Inspection System

Operation and maintenance training shall be carried out at the Site as follows:

- (1) Operation Training at site
 - (a) Number: eight (8 persons)
 - (b) Duration: minimum three (3) days
- (2) Maintenance Training
 - (a) Number: four (4 persons)
 - (b) Duration: minimum five (5) days

6.2 In-line Screening Machine

Operation and maintenance training shall be carried out at the Site as follows:

- (1) Operation Training at factory
 - (a) Number: three (3 persons)
 - (b) Duration: minimum eight (8) days including travel
- (2) Operation Training
 - (a) Number: eight (8 persons)
 - (b) Duration: minimum five (5) days
- (3) Maintenance Training
 - (a) Number: four (4 persons)
 - (b) Duration: minimum five (5) days

SECTION 7500

FLIGHT INFORMATION DISPLAY SYSTEM (FIDS)

1.0 GENERAL

1.1 This Section specifies the technical requirements for the design, manufacture, installation, testing and commissioning of the Flight Information Display System (FIDS). The FIDS controls shall be installed in the Passenger Terminal Building. The FIDS shall provide flight information details for the convenience of passengers, airport operators and airport users, so as to support the smooth operation of the terminal.

1.2 The Contractor shall design the system specified herein with a full understanding of the design concept, system description and performance required by the Specification. The design shall incorporate high levels of redundancy for reliable system operation and flexibility for future expansion of the system.

2.0 SCOPE OF WORKS

2.1 Work included in the Section

- (1) The scope of work covered by this Section of the Specification shall include but is not necessarily limited to, the following works to provide the Airport with a complete and fully operational FIDS:
 - (a) Supply and installation of:
 - (i) FIDS equipment (hardware and software).
 - (ii) Display monitors and information terminals.
 - (iii) Local Area Network (LAN) for interconnection of distributed monitors, information terminals and the FIDS server
 - (iv) All wiring and conduit connections between the FIDS and other sub-systems
 - (b) Supply of test and measuring equipment
 - (c) Testing and commissioning
 - (d) Provision of spare parts
 - (e) Training
- (2) The Contractor shall furnish all items required to provide a complete and operational FIDS except for items specifically stated herein as excluded.
- (3) The Contractor shall obtain all necessary governmental or regulatory approvals, and shall supply and install anything not mentioned in this Specification but required by any governmental or regulatory body.

- (4) The Contractor shall coordinate and implement interface requirements such as for the BMS and other systems, in a timely manner.

2.2 Location of Work

- (1) The work concerns the following premises:
 - (a) The communication room at PTB where the flight information data is processed.
 - (b) The airline offices at PTB where the flight information data can be given to Command and Control Office in.
 - (c) The public display monitors are located in:
 - (i) PTB (1st floor)
 - (ii) VFR room, ATC FIC office and airport manager room at Control Tower
 - (iii) Driver's lounge in parking area
 - (iv) Observation room at fire station

3.0 SYSTEM DESCRIPTION

3.1 System Description

- (1) The purpose of this system is to disseminate information to passengers and operating staff of the airport concerning all matters relating to flight schedules.
- (2) The FIDS System Architecture and lay-out are shown on the FIDS plans & drawings.
- (3) The whole flight information shall be gathered & processed by the FIDS server.
- (4) Two (2) operating stations using information terminals shall be provided for flight data configuration and operation of the system. These operating stations shall enable to operate the flights for input, modification or editing of provisional, operation and historical data. The FIDS server and two operating stations shall be connected to the LAN and both located at communication room.
- (5) Coordinated flight schedules are disseminated to the related offices and public areas by liquid crystal display (LCD) from the FIDS Server at communication room through the LAN.
- (6) The FIDS server shall retain within its hard disk six (6) months scheduled flights.
- (7) The system shall provide real time control over the various monitors. The screen output shall use the web-based architecture that utilizes the newest display technology.
- (8) The operating authority of FIDS server, is required at least three.
 - (i) System administrator
 - (ii) Command and Control Office Staff
 - (iii) Airline Staff (only their own company)

3.2 Information Display Requirements

- (1) The information to be handled by the FIDS shall include:
 - (a) Display of departure information
 - (b) Display of information for boarding gate
 - (c) Display of arrival information
 - (d) Display of guidance for baggage claims.
 - (e) Display of information for baggage make-up and breakdown. (Reference only)
 - (f) Display power management to be installed in the public area.

3.3 Data Base

- (1) The FIDS server shall have the data base including both seasonal flight schedule data and daily flight schedule data.
- (2) Seasonal flight scheduled data shall be able to input, modify and delete, and to generate next-day flight schedule data.
- (3) The daily flight schedule data shall be managed on a real time basis being updated from the information terminals. It shall be possible to download the latest operational files from this data base at any time and when edited data upload, it shall be reflected to data base.

3.4 Communication Links

The communication links between terminals dispersed in the Passenger Terminal Building, Control Tower, Fire station and the FIDS server at Command and Control Office shall be constructed as follows:

- (a) A dedicated FIDS Main LAN network.
- (b) Final sub-network cabling dedicated for LCD type monitors with PC operational terminal at airline office.
 - Four (4) LCD type monitor, 21.5 inches with PC operational terminal
- (c) Final sub-network cabling dedicated for LCD type monitors.
 - One (1) LCD type monitor, 17 inches
 - Ten (10) LCD type monitor, 21.5 inches
 - Thirty (30) LCD type monitor, 40 inches
 - One (1) LCD type monitor, 46 inches

4.0 PERFORMANCE REQUIREMENT

4.1 Design Conditions

- (1) The following ambient conditions shall be applied for the FIDS.
 - (a) Ambient condition which shall be depended on location of equipment
 - (i) Temperature: 10 °C to 40 °C
 - (ii) Relative humidity: 20% to 80%
 - (b) Power supply condition
 - (i) 230 V, Single phase (between line to neutral)
- (2) Design condition for the equipment shall be as follows
 - (a) Applicable standard for EMI, EMC

Applicable standard of FCC or IEC, or equivalent internationally recognized standard for electro-magnetic interference, electro-magnetic compatibility shall be applied
 - (c) Other environmental condition

The equipment installed at various locations shall be suitably protected against environmental conditions such as water, dust, temperature, humidity, vibration, noise, etc. in relation to the location of the equipment installed.
 - (d) Design condition of electrical supply
 - (i) Voltage variation:

Steady state variation	: +5% - 10%
Transient variation	: +/- 10%
 - (ii) Frequency: steady state and transient variation: +/-5%
 - (iii) UPS equipment incorporating voltage and frequency stabilization and surge suppression shall be provided to avoid shut down the system in the emergency related to electrical power supply condition while operating airport.

4.2 Hardware Configuration

- (1) FIDS Server

Processor	: Intel Xeon E5-2603 4core 1.8GHz or higher
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Memory	:	24GB RAM or more
Hard drive	:	400GB×2, or more
LAN	:	Dual - 100BASE – TX
Power supply module	:	Dual in redundant configuration
Fan	:	Redundant configuration
DVD	:	16X DVD +/- RW Dual Layer
Peripheral	:	Keyboard: U.S. type keyboard
Peripheral	:	Mouse: PS 2 or USB
Design	:	Rack mounting type
Display screen size	:	LCD 17 inches
Page printer	:	16ppm, A4 size paper

(2) Information Terminal

Processor	:	Intel 3.06GHz Core i3 or higher
Memory	:	2GB RAM or more
Hard disk	:	100GB, SATA 3G b/s, 7200rpm or more
LAN	:	100BASE-TX
DVD	:	16X DVD +/- RW Dual Layer
Peripheral	:	Keyboard: U.S. type keyboard
Peripheral	:	Mouse: PS 2 or USB
Display screen size	:	LCD 21.5 inches

(3) Digital Display Controller for Airport Staff

Processor	:	Intel 3.16GHz Core2Duo or higher
Memory	:	2GB RAM or more
Hard disk	:	100GB, SATA 3G b/s, 7200rpm or more
LAN	:	100BASE-TX
DVD	:	16X DVD +/- RW Dual Layer
Display screen size	:	LCD 17 and 21.5 inches

(4) Digital Display Controller for Public Area

Processor	:	Dual Core ATO 1.6GHz or higher
Memory	:	2GB RAM or more
Hard disk	:	32GB, SSD or more
LAN	:	10BASE-T/100BASE-TX

Display screen size : LCD 40 and 46 inches

4.3 Display Monitor

(1) LCD type monitor

(a) 17 inches monitor

Screen size	:	17 inches diagonal
Faceplate brightness	:	250cd/m ²
Contract	:	1000:1
Resolution	:	1280(H) x 1024(V) pixels
Colour reproduction	:	16.7 million colours
Input terminals	:	Mini D-sub15 pin or DVI-D
Visual angle	:	Displayed data shall be larger than 160° right and left, and up and down.
Average life span	:	Not less than 30,000 hrs. (The average life span refers to the time period for the screen brightness attenuated to half of the original one)
Video Controller	:	External installation

(b) 21.5 inches monitor

Screen size	:	21.5 inches diagonal
Faceplate brightness	:	250cd/m ²
Contract	:	1000:1
Resolution	:	1920(H) x 1080(V) pixels
Colour reproduction	:	16.7 million colours
Input terminals	:	Mini D-sub15 pin, or DVI or Display Port
Remote control function	:	Power on/off, input source select, OSM control, visual control
Visual angle	:	Displayed data shall be larger than 160° right and left, and up and down.
Average life span	:	Not less than 30,000 hrs. (The average life span refers to the time period for the screen brightness attenuated to half of the original one)
Video Controller	:	External installation

(c) 40 inches monitor

Screen size	:	40 inches diagonal
Faceplate brightness	:	500cd/m ²
Contract	:	3000:1

Resolution	:	1920 (H) x 1080(V) pixels
Colour reproduction	:	16.7 million colours
Input terminals	:	DVI or Display Port
Remote control function	:	Power on/off, input source select, OSM control, visual control, ID select
Visual angle	:	Displayed data shall be larger than 160° right and left, and up and down.
Average life span	:	Not less than 30,000 hrs. (The average life span refers to the time period for the screen brightness attenuated to half of the original one)
Video Controller	:	External installation or slot-in monitor

(d) 46 inches monitor

Screen size	:	46 inches diagonal
Faceplate brightness	:	500cd/m ²
Contract	:	3000:1
Resolution	:	1920(H) x 1080(V) pixels
Colour reproduction	:	16.7 million colours
Input terminals	:	DVI or Display Port
Remote control function	:	Power on/off, input source select, OSM control, visual control, ID select
Visual angle	:	Displayed data shall be larger than 160° right and left, and up and down.
Average life span	:	Not less than 30,000 hrs. (The average life span refers to the time period for the screen brightness attenuated to half of the original one)
Video Controller	:	External installation or slot-in monitor

4.4 FIDS Network and Peripherals

(a) Switching hub

Standard	:	IEEE 802.3, IEEE 802.3u, IEEE 802.3x
I/O Port	:	100BASE-TX, 24port minimum
Transmission	:	100 Mbps

(b) Ethernet Extender

Cable connection	:	RJ45 (Ethernet), RJ11 (VDSL2)
Data Rate	:	Auto-baud (up to 100Mbps)
VDSL2 Line Code	:	Discrete multi-tone (DMT) modulation

VDSL2 Transmission Mode	:	packer Transfer Mode (PTM)
Ethernet Port	:	2 x Auto-sending 10/100Mbps Ethernet port with Auto MDIX

4.5 Display of Flight Information

- (1) The applicable flight information display lines shall be colored alternately by 2 colours, line by line for the convenience of passengers.
The colour and font which are displayed on a screen need to be recognizable for colour blindness people.
- (2) Failure monitoring shall be carried out at the FIDS server to check if terminals are operating normally or not, by periodically sending “sensor commands” and interpreting the response.
- (3) Addition/deletion of flight information on the basis of one flight per assigned line shall be controlled by the information terminal.
- (4) Function of “blinking flight information” shall be applied for the status of boarding soon, final call, baggage available, arrival soon and arriving.
- (5) Emergency information shall be input by the operator at the operating stations and displayed on the last rows of all LCD monitors.
- (6) Clock times indicated on the monitor shall be derived through the master clock system.
- (7) Details of required monitor categories and information to be displayed at each location are as follows:
 - (a) Display of flight information for Check-in counter
 - (i) Equipment : 40 inches LCD monitor
 - (ii) Mounting place : Check-in counters
 - (iii) Display content : Counter no., airline logos, flight no., class of cabin
 - (iv) Display scope : Flight at the check-in counter
 - (v) Sample of display is shown below:



(b) Display of Departure Information

- (i) Equipment : 40 and 46 inches LCD monitor
- (ii) Mounting place : Departure Hall, Departure Concourse and Concession
- (iii) Display content : Current time, airline logos, flight no., estimated time, boarding gate, flight status, and destination
- (iv) Display scope : Flights with estimated departure time
- (v) Display format : Each board shall display a maximum of 10 flights
- (vi) Flight remarks : CHECK IN, BOARDING, DEPARTED, CANCELLED
- (vii) Sample of display is shown below:

Departure Information					06:30
Airline	Flight	Time	Gate	Remarks	To
PAL	PR381	7:30	A1	CHECK IN	CEBU
CEBU	5J161	7:40	A2	CHECK IN	CEBU
AIR	2P732	8:00	A3		MANILA
PAL	PR40	8:30	A1		MANILA
AIR	2P734	12:10	A3		MANILA
CEBU	5J456	12:30	A2		MANILA
PAL	PR42	12:50	A1		MANILA
PAL	PR245	13:40	A1		PUERTO PRINCESA
AIR	2P736	14:00	A3		MANILA
PAL	PR44	17:30	A1		MANILA

(c) Display of Arrival information

- (i) Equipment : 40 inches LCD monitor
- (ii) Mounting place : Arrival Concourse
- (iii) Display content : Departure and arrival information shall share a common LCD monitor however, display shall be alternately appear on the screen between arrival & departure information at predetermined time interval.

Basic flight information shall be typical for both arrival & departure, except: ETA, delayed, arrived, etc.

(d) Display of flight information for Gate Lounge

- (i) Equipment : 40 inches LCD monitor
- (ii) Mounting place : In front of each boarding gate on the 1st floor of concourses
- (iii) Display content : Gate no. current time, airline logos, flight no., estimated boarding time, destination, boarding status

- (iv) Display scope : Flights boarding or that shall be board at the gate
- (v) Display format : each board shall display a maximum of 2 flights
- (vi) Boarding status : BOARDING, CANCELLED
- (vii) Sample of display is shown below

Gate	A1		07:35
PAL		PR381	07:30
		CEBU	
		BOARDING	
PAL		PR245	13:40
		PUERTO PRINCESA	

(e) Display of guidance for Baggage Area

- (i) Equipment : 40 and 21.5 inches with waterproof box LCD monitor
- (ii) Mounting place : Baggage claims, Baggage breakdown and Baggage make up area on the 1st floor
- (iii) Display content : current time, belt no, airline logos, flight no., from
- (iv) Display scope : Flight already arrived and with belt already allocated
- (v) Display format : each board shall display a maximum of 8 flights.
- (vi) Sample of display is shown below

Baggage Claim			09:00
No	Airline	Flight	From
A1	PAL	PR380	CEBU
A2	CEBU	5J451	MANILA
A1	AIR	2P731	MANILA
A2	PAL	PR246	PUERTO PRINCESA

4.6 General Requirement for Electronic / Computer system

- (1) Supplier of computer hardware including peripherals, UPS, network equipment shall be standardized or minimized.
- (2) LCD type monitors to be used for operation and monitoring at the command and control office shall be 21.5 inches.
- (3) The FIDS server shall be of the redundant or fault tolerant type. Switchover from the duty to stand-by system shall be made automatically by detection of duty machine failure as well as manual switchover. Switchover time shall be within a second and arranged such that no manual intervention is required during starting stand-by machine.
- (4) Screen ergonomics, alarm and event reporting, color scheme, etc. shall be standardized.
- (5) Operation ergonomics shall be based on a “Window” system.
- (6) Supplier of off-the-shelf software packages shall be standardized.
- (7) The Contractor shall standardize, as far as possible, all the communication exchange protocols between computer systems.
- (8) Internationally recognized standards and/or defacto-standards shall be applied for the communication protocol.
- (9) Message priority control, queuing, switching, error detection, error recovery and message buffering shall be considered for all network communications between computers.

4.7 Maintenance Requirements

- (1) As the system shall be used 24 hour a day and 365 days per year, the FIDS shall be carefully designed with a realistic and feasible maintenance scheme.
- (2) The self-diagnosis function and fault analysis function for each component shall be provided for easy maintenance. Preventive maintenance programme shall be established for the maintenance of FIDS to make the maintenance work effective.
- (3) The Contractor shall propose the maintenance procedure and programme.
- (4) To facilitate the maintenance work and to reduce the down time of the system, the design of the equipment and system should be coordinated so that maintenance staff can replace a part or component quickly. The design of the component of the equipment should be standardized to the maximum extent possible to allow quick replacement work and to reduce the stock volume.
- (5) The Contractor shall supply all necessary tools and accessories required for maintenance of the system.

4.8 Interface Requirements

The design shall allow for the following interfaces:

- (a) Interface with the BMS regarding the utilization of lighting for arrival and departure areas. The Contractor shall coordinate with the BMS under Section 7600 regarding the necessary interface equipment and other requirements.
- (b) The building works shall provide the supporting or fixing structure and casing work for the display monitors. Accordingly, close coordination shall be required with the building work for the installation and location of the LCD monitors.
- (c) Electrical power supplies for the equipment associated with this system shall be taken from the UPS distribution board.
- (d) Clock times indicated on the monitor shall be derived through the master clock.

5.0 INSTALLATION

5.1 Design Submittals

The Contractor shall submit the following in accordance with Conditions of Contract and Section 1000 of this Specification.

- (a) Product Data for each principal component or product of each component and system including certified test reports on required testing. The product data shall indicate capacities, sizes, performance and operating characteristics, features of control system, finishes and similar information. The product data shall indicate any variations from specified requirements.
- (b) Shop Drawings including dimensioned drawings showing plans, elevations, sections and large-scale details indicating service at each work station, coordination with building structure and relationship with other construction, and details of enclosures and appearances. The drawings shall include system diagrams to indicate all subsystems and components.
- (c) Wiring diagram detailing wiring for power, data communication and control systems differentiating clearly between manufacturer-installed wiring and field-installed wiring. The diagram shall indicate maximum and average power demands.
- (d) Provide full detailed user operating and maintenance manuals.
- (e) Any other necessary information of data requested by the Engineer.
- (f) Virus protection: the computer system shall be protected from viruses by utilizing virus protection software. Removable memory storage media, such as, floppy disk, CD-ROM, zip drive, etc. shall not be used for initial version/upgrade installation of software on the computers. Use of such removable memory storage media shall be limited to authorized maintenance personnel at the server computer(s).
- (g) Software licence: all software license(s) including operating system, middleware and application ware installed on the computer system shall be assigned to the end user upon the commencement of the system.

- (h) State of the art Technology: equipment applied to this airport shall be of the state of the art technology. The Contractor shall provide latest applicable versions of computer hardware and software including operating system of computer system at a time of delivery of the system.

5.2 Fabrication / Construction Requirements

- (1) All products for work under this Specification shall be designed, fabricated and constructed for the purpose and use intended; and in accordance with or capable of meeting standards for electrical work as specified herein or approved by the Engineer.
- (2) Exposed pull and terminal boxes, panel boards and switchgear enclosures, including cabinet frames and bodies, front, doors and like parts, shall be cleaned, primed, finished with two (2) coats of enamel and baked, in accordance with manufacturer's standard factory processes approved by the Engineer.
- (3) Special finishes shall be provided where shown, specified or instructed by the Engineer.

5.3 Execution Requirements

- (a) The Contractor shall either engage the FIDS manufacturer or an installer approved by the FIDS manufacturer to install the system. The Contractor must submit to the Engineer details of the installer's previous experience of the systems of similar design and extent and give evidence of successful in-service performance. The Engineer shall review the details submitted and if satisfied shall approve the Contractor's proposed installer.
- (b) Submittal
 - (i) The Contractor shall submit complete listings of equipment and facilities required, giving full test procedures proposed for each item.
 - (ii) The Contractor shall obtain the Engineer's approval prior to manufacture, procurement or fabrication of equipment.
- (c) Setting out

The setting out and installation of all works shall follow closely the approved shop drawings except on-site variations as approved by the Engineer.
- (d) Electrical work requirement
 - (i) Requirements herein are stated in general terms only. The Contractor and manufacturers shall be responsible for all design and fabrication details necessary to provide, install and operate the system as intended and required by these Specifications.

- (ii) Circuit schedules shall be supplied for each panel containing electrical control or safety devices. They shall be installed on the inside of panel doors. Each schedule shall be correlated with the panel as arranged and installed. They shall be in type written form only. Each schedule shall be protected and retained by a suitable frame and clear glass or plastic cover.
- (e) Project identification signs
 - (i) A project identification sign shall be required for each major equipment item, in readily visible location, each sign installed level and accurately. They shall be symmetrically positioned.
 - (ii) Sign size: Suitable for equipment.
 - (iii) Colours: As indicated by the Engineer
 - (iv) Letters : Plain block or gothic style only

5.4 Testing and Commissioning

- (1) This section of the Specification sets out the basic requirements for testing and commissioning of the FIDS. The Contractor shall perform testing, calibration and setting of equipment and controls associated with this installation. The Contractor shall also supply all materials and labor necessary for the testing and commissioning.
- (2) The Contractor shall program, test and commission the complete system including the following specific test:
 - (a) Manufacturer's routine tests (witnessed by the Engineer).
 - (b) Factory tests on production items before dispatch.
 - (c) Preliminary and acceptance site tests to demonstrate satisfactory operation and performance of the system and components.
 - (d) Final tests and end of Defects Notification Period tests to demonstrate that the system has been properly maintained.

6.0 TRAINING

Operation and maintenance training shall be carried out as follows:

- (1) In manufacturer's factory
 - (a) Number : four (4) persons
 - (b) Duration : minimum five (5) days for each person
 - (c) Location : manufacturer's factory

- (2) At the Site
 - (a) Number : eight (8) persons
 - (b) Duration : minimum five (5) days for each person
 - (c) Location : prepared by Contractor

SECTION 7600

BUILDING MANAGEMENT SYSTEM (BMS)

1.0 GENERAL

1.1 This section specifies the technical requirements for the design, procurement materials, manufacture, installation, testing and commissioning of the Building Management System (BMS). The function of the BMS is to manage the equipment and system to be installed under the separate section of the works in the buildings under the Contract, ensuring efficient and effective management of the equipment and system.

1.2 The Contractor shall design the BMS in accordance with the requirements specified herein with a full understanding of the design concept, system description and performance required by the Specification. The design shall incorporate high levels of redundancy for reliable system operation and flexibility for future expansion of the system.

2.0 SCOPE OF WORKS

2.1 The scope of work to be covered by this Section shall include, but is not limited to, the following works:

- (1) Supply and installation of all BMS equipment (hardware and software) including but not limited to:
 - (a) Central processor unit (CPU) to provide supervisory control and monitoring functions over the BMS and to interface workstations and peripheral devices such as printers, loggers and data storage devices, etc. to the BMS distributed control system.
 - (b) Stand alone, fully intelligent, remote I/O panels (R I/O).
 - (c) BMS network linking the distributed Remote Input/Outputs (R I/O) with each other and with the CPU for the transfer of data between them.
 - (d) All necessary hardware and software to enable the BMS to function in accordance with the requirements of the Specification.
- (2) Supply of test and measuring equipment
- (3) Testing, commissioning, and training
- (4) Provision of spare parts.
- (5) The Contractor or Supplier of electrical equipment shall include the media converter for BMS interface.

2.2 The Contractor shall furnish all items required for completion of the BMS except for items specifically stated herein as excluded.

- 2.3 The Contractor shall obtain all necessary governmental or regulatory approvals. The Contractor shall comply and install anything not mentioned in this Specification but required by any governmental or regulatory body.
- 2.4 The Contractor shall be responsible for coordination of the other sub-contractors, such as the air conditioning, ventilation, plumbing, electrical distribution supplier(s), etc. as required, in good time to resolve all the necessary interface issues.

3.0 SYSTEM DESCRIPTION

- 3.1 The BMS System Architecture & layout are shown on the BMS drawings.
- 3.2 The BMS shall be based on a distributed system of fully intelligent, stand-alone remote I/O panels (R I/O), operating in a multi-tiered, multi-tasking, multi-user environment on the BMS network.
- 3.3 The BMS shall allow both remote and central control and monitoring capabilities to minimize energy usage and manpower.
- 3.4 The BMS shall include all workstation software and hardware, remote I/O panels (R I/O), and the BMS network, as required for a complete and fully operational system. The Contractor shall also include and provide all interface components for the BMS including volt free contacts, cables and transducers to interface with other M&E systems and equipment.
- 3.5 The redundant workstations as Client PC shall be installed at Passenger Terminal Building (PTB) Power House respectively. These workstations shall have a standard number of equipment and peripherals, typical software and hardware.

4.0 PERFORMANCE REQUIREMENTS

4.1 Design Conditions

- (1) The following ambient conditions shall be applied for the BMS:
 - (a) Ambient conditions
 - Temperature : 10° to 40 °C
 - Relative humidity : 20% to 80%
 - (b) Power supply conditions
 - 230V (220V nominal) single phase, 60Hz
- (2) Design condition for the equipment shall be as follows:
 - (a) Applicable temperature and humidity conditions

- (i) Equipment installed outside exposed to weather
 - 70 °C
 - 95% relative humidity
 - Rain waterproof

- (ii) Equipment installed outside but under the shade
 - 55 °C
 - 95% relative humidity
 - Splash waterproof

- (iii) Equipment installed inside the building without air conditioning
 - 45 °C (28°C WB)
 - 95% relative humidity without condensation
 - Suitable protection against water and dust

- (iv) Equipment installed inside the building with air-conditioned area
 - 40 °C
 - 90% relative humidity
 - Suitable protection against water and dust

- (v) Equipment installed inside the building with computer air conditioning
 - 35 °C
 - 85% relative humidity
 - Suitable protection against water and dust

- (b) Applicable standards for EMI, EMC

Applicable standard of FCC, CE or IEC, or equivalent internationally recognized standard for electromagnetic interference, electro-magnetic compatibility shall be applied (Contractor to specify which).

- (c) Other environmental conditions

The equipment installed at various locations shall be suitably protected against environmental conditions, such as water, dust, temperature, humidity, vibration, noise, etc.

- (d) Design condition of electrical supply:
 - (i) Voltage variation:
 - Steady state variation: +5% - 10%
 - Transient variation: +/-10%

- (ii) Frequency of steady state and transient variation: +/-5%.
- (iii) UPS shall be provided for the BMS power supply system including its peripherals, Remote Input/Output (R I/O) under the work of Section 6000, which includes panel, etc.

4.2 Functionalities

- (1) Control and monitoring of ventilation and air-conditioning system shall be as follows:
 - (a) The VAC remote control can use the existing BMS transmission network for its own data transmission and to ensure a high efficiency of the airport air-conditioning, a large quantity of VAC data shall be reported to the BMS. These data items shall include ON/OFF positions and failure report of the following equipment:
 - VFR
 - AHU
 - FCU
 - (b) Other monitoring data includes:
 - (i) stop (OFF) operation only of VFR, AHU and elevator hoist way exhaust fan during emergency (CTO) (such as in the event of fire, etc.)
 - (ii) input electrical power measurements (peak electrical power) and input electrical energy measurements (integrating data)
 - (iii) “ON”, “OFF”, “FAILURE” monitoring of VFR, AHU system and FCU electrical power source
 - (iv) totalization of hours run by the VFR, AHU, FCU and mechanical ventilation/exhaust fans for the purpose of preventive maintenance
 - (v) general alarm of each unit.
- (2) Control and monitoring of lighting system shall be as follows:
 - (a) Particular areas shall include:
 - Public areas
 - Departure hall, check-in and boarding areas.
 - Arrival hall and baggage claim areas.
 - Public passage and stairways
 - Baggage handling
 - Corridor
 - External areas
 - Neon lighting system
 - Road and car park (power monitoring only, photo-cell controlled)
 - Arrival and departure façade canopy

- Apron lighting (power monitoring only)
 - Obstruction lights (power monitoring only, photo-cell controlled)
 - Other external areas
- (b) Each concerned area is covered by at least 3 different lighting circuits, i.e. normal circuits, stand-by generator circuit, emergency (UPS) circuit, so as to ensure:
- The reliability of the system
 - The possibility of lighting level graduation
- (c) All public lighting circuits shall be connected to the concerned lighting panel board. A contactor drive all lighting circuits directly remote controlled by the BMS and located in each lighting circuit of the panel board. The various lighting panel boards shall be connected to the BMS R I/O panels covering assigned area/s.
- (d) Lighting Remote Schedule Table
- (i) The BMS shall allow the remote control of each lighting circuit referring to parameter such as:
- Area
 - Time
 - Day
 - External lighting condition (checked/controlled by outside light cell)
 - Security purpose
- This procedure shall ensure the optimum light control for:
- Safety
 - Comfort
 - Energy saving
- (ii) When BMS remote control is not applicable, i.e. in:
- Offices
 - Private shops
 - Specific technical room/areas
- then lighting shall be directly controlled through local switches as usual.
- (e) Emergency (UPS) Lighting
- The transfer from 230V normal supply to 230V UPS supply of small amount of lighting fixture shall not be remote controlled by BMS. This automatic transfer shall be ensured directly by the static switch of the Emergency Light UPS covering this area.

- (f) Control and/or monitoring of various lightings at the Passenger Terminal Building (PTB) shall be done at the PTB BMS workstation. These include public area lighting, passenger area lighting, façade canopy lights and other PTB external lightings.
 - (g) Control and/or monitoring of Road and Car park lightings shall be by the BMS workstation at the Power House.
- (3) Monitor operation and alarm status of elevators (CTO).
- (4) Control and Monitor electrical power supply system including monitoring only of stand-by generators and UPS equipment.
- (a) The whole airport terminal complex shall be supplied from the local power utility company, through its 13.2KV power.
 - (b) Domestic emergency supply (4.16KV) – Two (2) x 400kVA / 4.16kV diesel generators that shall ensure the essential supply of the project (see Section for Electrical Works).
 - (c) Principle of use:
 - (i) The system shall control and monitor the 13.2kV incoming power distribution system as well as the 4.16kV and the 230V system.
 - (ii) In case of normal power failure the generators shall automatically start and supply selected essential loads through remote manual reloading. BMS has no control of the generator but it shall monitor the status of the generator.
 - (d) Transformers

The transformers shall be of indoor and outdoor type, majority are located inside the Power House including the 13.2KV vacuum circuit breakers and all other distribution switchgears and generators.
 - (e) Energization of main 13.2KV switchgear

The closing and opening operation of the main 13.2KV VCB switchgear shall be remote manual as well as the 4.16kV VCB switchgears Branches.
 - (f) Equipment References

All items and components of the general power distribution network are identified such as:

 - TR : Transformer
 - VCB : Vacuum Circuit Breaker
 - MCB : Low Voltage Main Circuit Breaker
 - CB : Low Voltage Circuit Breaker

- B : Main Bus Bar
 - C : Contactor
 - F : Fuse
- (5) Monitor plumbing system.
- (6) Monitor Baggage Handling System (BHS) status.
- (7) The Contractor can propose other detailed data that should be collected and the nature of the reports to be produced by the system, for approval by the Engineer.
- (8) The interfaces with each sub-system shall be designed to facilitate the preventive maintenance and energy management of the system as a whole, e.g. monitor equipment total operation time and energy.
- (9) Monitor operational status of the Solar Power supply system and the following parameters;
- Voltage
 - Current
 - Other parameters as recommended by the Manufacturer/Contractor.
- (10) System to be controlled and/or monitored by BMS: see APPENDIX BMS Interface Summary.

4.3 Hardware and Network Requirements

- (1) General requirement for electronic / computer system shall be as follows:
- (a) Supplier of computer hardware including peripherals, UPS, network equipment shall be standardized or minimized.
 - (b) All the electronic and computer equipment shall be tropicalized and protected from the effects of temperature, humidity and fungus.
 - (c) Minimum size of visual display units that are used for operational purposes in the control room shall be 21 inches.
 - (d) The network must be a product already tested in industrial plant and in airport terminal building management system.
 - (e) The BMS system server shall be redundant configuration. Switch-over from the duty to stand-by system shall be made automatically by detection of duty machine failure as well as manual switch-over time shall be within a second and arranged that no manual intervention is required during starting stand-by machine.
 - (f) The system network shall be flexible that allows it to be configured on a multi-speed network (Token Ring, Ethernet 10/100 Mbps, etc.) and can be implemented over a wide choice of communication wiring arrangement such

as fiber optic, twisted pair, etc. This arrangement allows for maximum flexibility while maintaining compatibility with networks.

- (g) Main processors for both workstation and the R 1/0 panels shall utilize, as a minimum, a 64 bit type processor.
- (h) All network terminals must be non-specialized and terminals shall be done from a centralized unit. The terminal disconnection and reconnection must be automatic. The failure of one network component must not result in the network failure.
- (i) Screen ergonomics, alarm and even reporting, color scheme, etc. shall be standardized.
- (j) The operating system shall be “Windows” based.
- (k) The Contractor shall standardize, as far as possible, all the communication exchange between computer systems.
- (l) Internationally recognized standard and/or defacto-standard shall be applied for the communication protocol.
- (m) Message priority control, queuing, switching, error detection, error recovery and message buffering shall be considered for all communication between computers through the network.
- (n) The capacity of the network shall be determined based on the data throughput, bandwidth, etc.
- (o) Network capacity/traffic performances such as speed, real time operation, etc., shall be determined based on the data size and data traffic. Details of the analysis performance shall be submitted for the Engineer’s review.

4.4. Servers

System Servers shall comprise of several servers on server-client system structure. The number of system servers shall differ depending on the system requirements. Servers shall include Server for System Management and Server for Data Storage. Servers shall be built on the full open platform using Linux system.

4.4.1. Server for System Management

- (1) A Server for System Management shall carry out distribution of information for the display, setting, and operations of the management information of the overall system (data point, program, etc.) through the Web browsing software installed in the Client PC. Server shall support access of up to five (5) client PCs simultaneously.
- (2) Server shall be provided with dedicated hardware using full open platform Linux system and come with 64 bit CPU with main storage capacity of SDRAM 4 GB. Auxiliary memory unit HDD shall be 500 GB. Maximum BACnet objects manageable shall be 30,000 objects. Server shall back up data up to 72 hours.

4.4.2. Server for Data Storage

- (1) A Server for Data Storage shall store necessary database for BMS. The server shall manage the data transmitted from an Advanced Building Controller as BMS databases and provide the data to display or print the historical trending graphs as well as daily, monthly, and yearly reports.
- (2) Server shall be provided with dedicated hardware using full open platform Linux system and come with 64 bit CPU with main storage capacity of SDRAM 4 GB MB. Auxiliary memory unit HDD shall be 500 GB. Maximum BACnet objects manageable shall be 30,000 objects. Server shall back up data up to 72 hours.

4.4.3 Server for Energy Management

- (1) A Server for Energy Management shall store necessary database for the purpose of energy consumption management.
- (2) The server shall be connectable and communicable with other devices via BACnet IP network.
- (3) The server shall be provided with PC based hardware and come with enough memory capacity storing 3 years and current fiscal year of daily report, 15 years of monthly report formed by hourly data, 15 years of yearly report formed by monthly data, and 15 years of multiple year data formed by yearly data.
- (4) Energy Management software shall be installed to PC with the following minimum hardware requirements.
 - CPU: 2.20GHz or faster.
 - RAM: 1GB or more.
 - Hard Disk Drive: 500 GB or more.
 - DVD-R drive: Built-in at least 1 drive.
 - USB ports: Built-in at least 4 ports.
- (5) In addition to the above, RAID card shall be mountable as an optional to increase reliability of the server.

4.5. Server Redundancy

- (1) System Servers shall be capable of dual-redundant system. Dual-redundancy shall be configured by setting 2 servers respectively with one to one warm-standby system. The system runs 2 servers simultaneously and when trouble occurred on either one server, another one shall backup immediately.
- (2) Servers carry out the backup of critical data such as Monitoring Data and Historical data. When trouble occurred below measures shall be applied to backup data.

- (3) Assume there are 2 servers “Server A” and “Server B”. When “Server A” information cannot be browsed from Client PC due to the network trouble, it is judged as “Server A: Down”, and then “Server B” (normally Standby) becomes Active, and the Client PC connection is switched to “Server B” automatically.
- (4) When network trouble is solved and “Server A” is restored, (Client PC is restored to be able to browse server information), as “Server A: Active”, automatically carry out restorations (acquiring trending data during “Server A” is down from Advanced Building Controller and copying the difference between Client PC settings and data for scheduled copy).
- (5) After restored as “Server A: Active”, Client PC still maintain the connection to Server B. Operator has to re-login to switch the connection to Server A.

4.6. Client PC

- (1) A Client PC shall be the PC with web-browsing software for accessing the database achieved and stored in System Servers. Client PC is basically installed in the supervision room to supervise the whole building. It supervises the following features:
 - Monitoring: status, alarms, and measurement of each facility
 - Operation: remote ON/OFF control
 - Data output: operating status, alarm status, and measuring data
 - Data analysis: operating status, alarm status, and measuring data
- (2) Up to 5 Client PCs shall be able to access Server simultaneously.
- (3) Client PC shall comply with the specifications as follows:
 - OS: Windows Latest version
 - Internet Browser: Internet Explorer 6 or later
 - CPU: Pentium® IV processor, 3 GHz and above
 - Main storage capacity: 500 GB and above
 - Loading function: IPv6, Java® vm 1.4 and above, XGA, Acrobat® Reader, IE6.0 and above
- (4) Remote I/O Panels shall be as follows:
 - (a) All points in the system shall be monitored and/or controlled through the use of “intelligent” remote I/O panels (R I/O). Each R I/O in the system shall contain its own microprocessor and memory with adequate capacity of battery backup.
 - (b) The following point types shall be supported by the R I/O:
 - Discrete/digital input (contact status).

- Discrete/digital output (maintained, momentary, dual momentary, floating).
- Analog input (4-20 mA / 1-5 VDC with 12-bit A/D conversion resolution minimum).
- Analog output (4-20mA / 0-10 VDC with 8-bit D/A resolution minimum).

Above parameters and values shall be coordinated with the other sections of work to ensure proper operation.

- (c) Each R I/O shall contain the necessary hardware & software to function independently in case of a network failure. All BMS application specific software shall be resident in each R I/O for fast and intelligent operations. No software including active energy management or environmental control sequences required by the R I/O shall be resident in the CPU or workstations.
- (d) Each R I/O in the system shall be a completely independent, fully stand-alone, “Master” with its own hardware clock calendar including all hardware and software for autonomous operations.
- (e) R I/O shall contain sufficient memory and processing capability features to perform the following functions in a fully stand-alone mode:
 - Scheduled start/stop
 - Adaptive optimized start/stop
 - Duty cycling
 - Automatic temperature control
 - Event initiated control
 - Scanning and alarm processing
 - Trend logging
- (f) At each R I/O location the Contractor shall make provision for connection of a local hand-held operator’s console (computer laptop for example). If the console is not of the portable type, a permanent door mount type with display shall be provided at each R I/O. When connected to any R I/O on the BMS network the console shall be capable of full global communications with all other R I/Os on the network.
- (g) It shall be possible to perform as a minimum the following functions through the local operator console:
 - Set/display date.
 - Set/display time.
 - Display the status or value of all points connected to the R I/O
 - Control the outputs connected to the R I/O
 - Enable/disable any or all-automatic control outputs
 - Perform R I/O diagnostic testing.
 - Place any or all points in “Test” mode
 - Display R I/O CPU “percentage processing time” so that system and R I/O processor loading may be determined. Also, display the

amount of R I/O programming memory available and the amount currently used.

- (h) R I/O panel shall be wall mounted and the dimensions of the panel shall be sized to allow 20% for fittings and additional terminal blocks after completion of work.
 - (i) Ventilation of the cabinet shall be considered carefully so as to take into account the heat generated by the panel components.
 - (j) Cabinet shall have two 230V/15A power sockets (American Standard) reserved for the programming console and maintenance check-up power supply.
 - (k) A lighting mechanism assembly shall be provided for the cabinet interior.
 - (l) Key: Doors shall be equipped with locks barring access to unauthorized personnel.
 - (m) The panel shall have additional 5% spare input/output modules, equipped and wired down to the terminal block.
 - (n) Cable run racks shall be sized allowing 30% for additional wiring. Panel wirings shall be well neat and organized.
 - (o) Panel shall be equipped with individually sized circuit protection for transient suppression (for lightning strikes and electrical noises) and overload protection.
 - (p) The panel power supply shall be from UPS.
 - (q) Painting: The panel shall be fabricated from black steel sheet, code gauge, power-baked of approved color. Minimum protection index (IEC65)
 - (r) Wiring and marking
 - (i) All metallic mass shall be bound to the existing earthing general interconnection.
 - (ii) Wiring shall be provided as required to obtain intended operational functions of the system. Wiring shall be accomplished in workmanlike manner.
 - (iii) All earth connections shall be done using an additional wire provided for in the power supply cables, or using bare copper conductor which ever is applicable. Input/output wiring shall be done using 1.0 mm² wire.
 - (iv) The wire marking shall be done on both ends using color rings of the "Oval grip" type or equivalent.
 - (v) Each wire shall be identified through its I/O number.
- (5) BMS network requirements are as follows:

- (a) The BMS shall provide communication between the R I/Os and the CPU over a dedicated network. The network shall be designed to provide the required speed of system operation described elsewhere in this Specification, under maximum foreseeable traffic conditions.
- (b) The Contractor shall determine the required capacity of the BMS network in accordance with the required number of R I/Os, allowing for a future growth in the number of R I/Os of 25%.
- (c) A break in the communication path of the BMS network shall be announced as an alarm and shall automatically initiate a reconfiguration of the BMS network such that the remaining sections of the network continue to function without any degradation.

4.4 Software Requirements

- (1) General requirements for software shall be as follows:
 - (a) Operating system to be used shall be the latest version of Windows.
 - (b) Operating system and application software shall be suitable for real time monitoring and control applications.
 - (c) Window basis user interface shall be applied to achieve ergonomic man-machine interface.
 - (d) Graphical user interface shall also be applied to achieve user-friendly man-machine interface.
 - (e) Main graphical screen shall be arranged to provide a graphical overview of all sub-system, with facility to zoom-in on each sub-system, e.g. for the following sub-systems.
 - Electrical power supply systems stand-by generator and distribution network.
 - Lighting system
 - Ventilation and air conditioning
 - Plumbing system
 - Elevator system (CTO)
 - Baggage Handling System
 - From this overview and zoom-in screen, all control and monitoring shall be possible.
- (2) Text screen shall be as follows:
 - (a) Channel numbers shall be assigned to each system, and system alarm displays shall be in tabular format.
 - (b) Channel numbering shall be as per the system ID sequence number.

- (c) For the display of each channel, channel number, channel identification text, status, run, stop, normal, abnormal, and in case of measuring point, measured value, and in a case of alarm, set value. Channel location information shall also be included.
- (3) Trend display/data recording shall be as follows:
- (a) The system shall be able to make the historical recording of all reported events (time & date stamped) with a selectable time span basis of hourly, daily, weekly, etc., such as:
 - Operation time per item
 - Alarms (failure, trips, general fault/no power, etc.)
 - Temperatures, pressure, etc.
 - (b) These recording of data shall allow the establishment of statistic to improve maintenance, and operation of the Airport Terminal.
 - (c) This various data shall be recorded on large capacity hard disk, with an automatic back up procedure in a sufficient capacity drive such as CD ROM or other mass storage equipment to ensure the security of the complete system. This data shall be accessible only to authorized persons.
- (4) Alarm screen requirements are as follows:
- (a) Pop up window with alarm identification text, channel number, time, measured value, set value, etc. in the event of alarm. This pop-up window shall appear in any case on the operator terminal (depends upon the set level).
 - (b) In addition to the alarm pop-up window, it shall be possible to call up a table of alarms received in the form of a list, in chronological order. It shall be possible to print the list. It shall also be possible to look up alarm levels or names of points. Any alarms still in alarm condition shall be displayed in red color. It shall also be possible to call up an alarm summary screen showing just the currently active alarms.
- (5) Status monitoring function shall be as follows:
- (a) Operational status of each components/systems shall be monitored on the basis of running hour, system start/stop counts, or system operation hours.
 - (b) The operational status of each component/system shall be displayed on the operation status screen or graphs. Graphs shall show actual conditions & various data for the device. Data shall be up-dated at predetermined intervals.
- (6) Logging function shall be as follows:
- (a) Alarm log of occurrence and recovery shall be printed by utilizing the logging printer with alarm text, channel number and time stamp.

- (b) Status log of monitoring points shall be made in certain interval, such as once per four hours, or one per two hour by utilizing logging printer. Further to the automatic logging, manual-logging function shall be provided.
 - (c) The Contractor shall propose a logging format for the Engineer's review.
- (7) Monthly, weekly and daily reporting function shall be provided. The Contractor shall propose a reporting format for the Engineer's review.

4.5 Operational Requirements

- (1) Operator terminal shall be designed for operation on a multi-windows basis which is user friendly, easily understood and easily identified by the operator.
- (2) BMS operation shall be suitable for real time basis monitoring and control of the building sub-systems. Screen update, screen change, updating of data, updating of status shall also be suitable for real time basis.
- (3) The Contractor shall establish a numbering system for the control, monitoring, and alarm status of systems and sub-systems that shall facilitate easy identification of origin within the systems and sub-systems. For the purpose, individual grouping of systems and sub-systems shall be considered.
- (4) The BMS shall be a distributed type system to increase its availability, reliability and maintainability. No single failure within the distributed system shall cause a failure of the total system.
- (5) Capacity of the data storage shall be suitable for storing the data for logging, reporting, trend and history data for a minimum of 48 hours. The data shall be arranged such that it may be exported to the external data storage medium for longer-term storage. The data shall be exported in Excel, Lotus or other equivalent format which can be analyzed off line.
- (6) BMS monitoring and control shall be capable of energy management so as to facilitate conservation of electrical energy consumption. Monitoring and control points shall be determined or selected for this purpose, for example, monitoring of electrical power consumption from the operator terminal.
- (7) Analogue indication of measured values in a bar graph or analogue meter display or display of actual quantity with corresponding engineering units shall be provided.
- (8) Remote control operation from the operation terminal shall be re-confirmed prior to performing actual control operation.
- (9) Scheduled operation, such as seasonal, weekly, daily scheduled operation shall be available for the zone control of lighting and air conditioning, etc.
- (10) Parameter setting windows shall be provided for setting control parameters, alarm set points, etc.
- (11) Alarm inhibit function shall be provided to inhibit the alarm when system not in use or under maintenance road. Automatic alarm inhibit shall be applied, where applicable.

4.6 Maintenance Requirements

- (1) As the BMS is required to be operational 24hrs/day and 365 days/year, the BMS shall be carefully designed with a realistic and feasible maintenance scheme.
- (2) Self-diagnosis function and fault analysis function for each component shall be provided for the easy maintenance, and also preventive maintenance programme shall be established for the maintenance of BMS to make maintenance work effective.
- (3) The Contractor shall propose the maintenance procedure and programme.
- (4) To facilitate the maintenance work and to reduce the down time of the system, the design of the equipment and system should be coordinated so that maintenance staff can replace a part or component quickly. The design of the component of the equipment should be standardized to the maximum extent possible to allow quick replacement work and to minimize the stock holding of spares.
- (5) The Contractor shall supply all necessary tools and accessories required for maintenance of the system.

4.7 Interface Requirements

BMS shall interface with other operational systems including, but not necessarily limited to the following:

- (1) The interfaces for control and monitoring purposes, between the BMS remote I/O panels and the equipment control panel or interface panel of the other sub-systems.
- (2) The Contractor shall co-ordinate interface requirements, such as physical, electrical, data communication protocol and format, and also interfaces schedule of each sub-contractor.
- (3) Design details of the BMS interface requirements for the remote I/O units shall be provided well in advance of the schedule design start dates of other systems. This is to enable the other system suppliers to provide the necessary interface connections within their equipment (e.g. main switchboard, distribution board, sub-station switchboard, etc.).
- (4) DDC (Direct Digital Controller) including field sensors associated cabling, cabling support system and associated works for ventilation & air-conditioning system shall be included under the scope of works.
- (5) The BMS scope of works shall include providing the necessary device, e.g. modem, gateways, etc., to be able to control and collect data from various VAC DDC controllers.
- (6) The detail BMS Interface Summary to be taken into account for each subcomponent and system is shown in Appendix to Section 7600.

5.0 INSTALLATION

5.1 Design Submittals

The Contractor shall submit the followings in accordance with Conditions of Contract and governing law applicable of this Specification.

- (1) Product Data for each principal component or product of each component and system including certified test reports on required testing. The product data shall indicate capacities, sizes, performance and operating characteristics, features of control system, finishes and similar information. The product data shall indicate any variations from specified requirements.
- (2) Shop Drawings including dimensioned drawings showing plans, elevations, sections and large-scale details indicating service at each workstation, coordination with building structure and relationship with other construction, and details of enclosures and appearances. The drawings shall include system diagrams to indicate all sub-systems and components.
- (3) Wiring diagram detailing wiring for power, data communication and control systems differentiating clearly between manufacturers installed wiring and field-installed wiring. The diagram shall indicate maximum and average power demands.
- (4) Provide full detailed user operating and maintenance manuals as well as the software details.
- (5) Any other necessary information or data requested by the Engineer.
- (6) Software license: all software license(s) including operating system, middleware and application ware installed on the computer system shall be assigned to the end user upon the commencement of the system.
- (7) Supply of source code: all the source code of application software excluding commercial off the shelf shall be provided for the maintenance purpose.
- (8) State of the art technology: equipment supplied for this project shall be 'state-of-the-art' technology. The Contractor shall provide latest applicable versions of computer hardware and software including the operation system of the computer, at the time of supply of the system.

5.2 Fabrication / Construction Requirements

- (1) All products for work under this Specification shall be designed, fabricated and constructed for the purpose and use intended; and in accordance with or capable of meeting standards for electrical work as specified herein or as approved by the Engineer.
- (2) Exposed pull and terminal boxes, panel boards and switchgear enclosures, including cabinet frames and bodies, front, doors and like parts, shall be cleaned, primed, finished with two (2) coats of enamel and baked, in accordance with manufacturer's standard factory processes approved by the Employer's Representative.
- (3) Special finishes shall be provided where shown, specified for approval by the Engineer.

5.3 Execution Requirements

- (1) The Contractor shall either engage the BMS manufacturer, integrator or an installer approved by the BMS manufacturer to install the system. The Contractor is requested to obtain a prior approval of the Engineer for BMS manufacturer, integrator or an installer.
- (2) The Contractor shall submit to the Engineer details of the installer's previous systems of similar design and extent and give evidence of successful in-service performance. The Engineer shall review the details submitted and if satisfied shall approve the Contractor's proposed installer.
- (3) Submittal
 - (a) The Contractor shall submit complete listings of equipment and facilities required, giving full test procedures proposed for each item.
 - (b) The Contractor shall obtain the Engineer's approval prior to manufacture, procurement or fabrication of equipment.
- (4) Setting out

The setting out and installation of all works shall follow closely the approved shop drawings except on-site variations as approved by the Engineer.
- (5) Electrical work requirement
 - (a) Requirements herein are stated in general terms only. The Contractor and manufacturers shall be responsible for all design and fabrication details necessary to provide, install and operate the system as intended and required by this Specification.
 - (b) Circuit schedules shall be supplied for each panel containing electrical control or safety devices. They shall be installed on the inside of panel doors. Each schedule shall be correlated with the panels as arranged and installed. They shall be in type written form only. Each schedule shall be protected and retained by a suitable frame and clear glass or plastic cover.
- (6) Project identification signs
 - (a) A project identification sign shall be required for each electrical equipment item, in readily visible location, each sign installed level and accurately. They shall be symmetrically positioned.
 - (b) Sign size: Suitable for equipment.
 - (c) Colours: As indicated by the Engineer.
 - (d) Letters: Plain block or gothic style only.

5.4 Testing and Commissioning

- (1) This section of the specification sets forth the basic requirements for testing and commissioning of the BMS. The Contractor shall perform all testing, calibration and setting of equipment and controls associated with this installation. The Contractor shall also supply all labor and materials necessary for the testing and commissioning.
- (2) The Contractor shall program, test and commission the complete system including the following specific tests:
 - (a) Manufacturer's routine tests (witnessed by Engineer)
 - (b) Factory tests on production items before dispatch.
 - (c) Preliminary and acceptance site tests to demonstrate satisfactory operation and performance of the system and components.
 - (d) Final tests: The Contractor shall conduct the performance test of BMS after completion of the equipment and systems such as, air-conditioning system and lighting system.
- (3) The Contractor shall notify the Engineer in writing of his programme to test and commission the equipment and systems at least three (3) months before the actual execution.

6.0 TRAINING

Operation and maintenance training shall be carried out at the Site by the Contractor / Manufacturer as shown below:

- (a) Number : ten (10) persons
- (b) Duration : two (2) weeks
- (c) Location : prepared by Contractor

APPENDIX TO SECTION 7600

BMS INTERFACE SUMMARY

1. Digital points are two (2) or three-state points (that is, ON/OFF, energized/de-energized, or FAST/SLOW/STOP). An example of a field digital input points is a flow proof switch and an example of a field digital output point is a motor starter.
2. Analog points have numerical values and represent values such as the position of a damper or valve (0 to 100% open), temperature and flow rates. An example of a field analog input is a temperature sensor. An example of a field analog output point is a damper actuator,

Input : has to be understood as “Input to BMS”

Output : has to be understood as “Output from the BMS”

3. It is noted that “M1” is for Normal Power and “M2” is for Generator Power

ELECTRICAL SUPPLY AND DISTRIBUTION SYSTEM

Schedule 1: Main 13.2 KV VCB

Digital Output:

1. 13.2 KV VCB – Open
2. 13.2 KV VCB – Close

Digital Input:

1. 13.2 KV VCB – Status
2. 13.2 KV VCB – Alarm (Trip/Failure)
3. 13.2 KV VCB – Overcurrent
4. 13.2 KV VCB – Ground Fault
5. 13.2 KV VCB – Under/Over Voltage
6. Earth connected – Status
7. D C Battery Charger –Alarm

Analog Input:

1. 13.2 KV Incoming Current (Amp)
2. 13.2 KV Incoming Voltage
3. 13.2 KV Incoming Frequency (Hz)
4. 13.2 KV Incoming True Power (KW)
5. 13.2 KV Incoming KWH (Pulse)
6. 13.2 KV Incoming Power Factor (PF)

Schedule 2: 4.16 KV Automatic Transformer Switch (ATS) M1 & M2

Digital Output:

1. 4.16 KV VCB M1 – Open
2. 4.16 KV VCB M2 – Close
3. 4.16 KV VCB M2 – Open
4. 4.16 KV VCB M2 – Close

5. 4.16 KV VCB M2 – Interlock Status

Digital Input:

1. 4.16 KV VCB M1 & M2 – Status
2. 4.16 KV VCB M1 & M2 – Alarm (Trip/Failure)
3. 4.16 KV VCB M1 – Overcurrent
4. 4.16 KV VCB M1 – Ground Fault
5. 4.16 KV VCB M1 – Under/Over Voltage
6. VCB M1/ VCB M2 – Interlock Status
7. Earth connected – Status
8. DC Battery Charger – Alarm

Analog Input:

1. 4.16 KV Incoming Current (Amp)
2. 4.16 KV Incoming Voltage
3. 4.16 KV Incoming Frequency (Hz)
4. 4.16 KV Incoming True Power (KW)
5. 4.16 KV Incoming KWH (Pulse)
6. 4.16 KV Incoming Power Factor (PF)

Schedule 3: All 4.16 KV VCB Feeder

Digital Output:

1. 4.16 KV VCB – Open
2. 4.16 KV VCB – Close

Digital Input:

1. 4.16 KV VCB – Status
2. 4.16 KV VCB – Overcurrent (Trip/Failure)
3. 4.16 KV VCB – Ground Fault (Trip/Failure)

Analog Input:

1. Current (Amp)
2. Voltage

Note: Include also All 4.16 KV Outdoor/Indoor LBS for Digital Input.

Schedule 4: Capacitor Bank

Digital Input:

1. All 200 KVAR Capacitor Bank – Status
2. All 200 KVAR Capacitor Bank – Alarm (Trip/Failure)

Schedule 5: All Low Voltage (230Volts) Switchgear Main CB and Tie Breaker

Digital Output:

1. All Main CB – Open
2. All Main CB – Close
3. All Tie Breaker CB – Open
4. All Tie Breaker CB – Close

Digital Input:

1. All Tie Breaker CB – Status
2. All Tie Breaker CB – Trip (Alarm)
3. All Main CB Switchgear – Status
4. All Main CB Switchgear – Trip (Alarm)

Analog Input:

1. Current (Amp)
2. Voltage

Schedule 6: Standby Engine Generator

Digital Input:

1. Oil Low Level – Alarm
2. Oil High Level – Alarm
3. Generator operation – Status
4. Generator Heavy Fault – Alarm
5. Generator Light Fault – Alarm
6. Generator VCB Operation – Status
7. Generator VCB Failure (Trip) – Alarm

Analog Input:

1. Voltage
2. Current (Amp)
3. Frequency (Hz)
4. True Power (KW)
5. Power Factor (PF)

Schedule 7: Road and Car park Lighting (RCPN & RCPNE)

Digital Output:

1. All Circuits – Open/Close

Digital Input:

1. All Circuits – Status
2. All Circuits – Alarm (Trip)
3. Main CB – Status
4. Main CB – Alarm (Trip)

Schedule 8: Uninterruptible Power Supply

Digital Input

All Sizes of UPS

1. UPS General Failure – Alarm
2. Supply Status – Alarm
3. Battery Low – Alarm

PART OF AERONAUTICAL GROUND LIGHTING (AGL)

Schedule 9: Apron Flood Light

Digital Input:

1. Main CB – Status
2. Main CB – Alarm

Note: Remote control of Apron Flood Light to be done by Control Tower (VFR Controller)

WATER SUPPLY AND DISTRIBUTION

Schedule 10: Water Tank and Pumps

Digital Input:

1. Jockey Pumps – Status/alarm
2. Fire Pumps – Status/Alarm
3. Configuration Pumps – Status/alarm
4. Water Tank 1 & 2 Overflow – Alarm
5. Water Tank 1 & 2 Dry – Alarm
6. Water Tank 1 & 2 Low Level – Alarm
7. Water Flow Rate – Totalizer
8. Double Suction Pump – Status/Alarm

BUILDINGS

A. Passenger Terminal Building

Ventilation and Air Conditioning

Schedule 11: Variable Refrigerant Flow, Air Handling and Fan Coil Units (VRF, AHU & FCU)

Digital Output:

1. All VRF and AHU – Start/Stop
2. All Public FCU – Start/ Stop
3. Immediate Stop of all VRF and AHU (in case of fire)
4. Immediate Stop Of All Public FCU (in case of fire)

Digital Input:

1. All VRF and AHU – Status
2. All VRF and AHU – Failure (Alarm)
3. All Public FCU – Status
4. All Public FCU – Failure (Alarm)

Analog Input:

1. Supply Air Temperature
2. Public Area Temperature

Schedule 12: Ventilation

Digital Input:

1. Fresh Air Fan – Status
2. Fresh Air Fan – Failure (Alarm)
3. All type of Fan (includes Technical Rooms) – Status/Alarm

Digital Output:

1. All Public Restroom Exhaust Fan – Start/Stop
2. Exhaust Fan of Elevator Hoist way – Start/Stop (CTO)

Schedule 13: Baggage Handling System (BHS)

Digital Input:

1. BHS Operation – Status
2. BHS Shutdown – Alarm
3. BHS Emergency Stop – Alarm
4. BHS Area Fire – Alarm

Schedule 14: X-Ray and PWTM

Digital Input:

1. X-Ray and PWTM Operation – Status
2. X-Ray and PWTM Failure - Alarm

Schedule 15: Communication Systems

Digital Input:

1. Monitoring of all Power Supply of Communication Systems.

Schedule 16: Lighting

Digital Output:

1. Each Circuits of all Public Lightings – Close/Open

Digital Input:

1. Each Circuits of all Public Lightings – Status
2. All Main CB of Lighting Panel board – Failure (Alarm)

B. Control Tower, ATC Operation and Administration Building

Ventilation and Air Conditioning

Schedule 17: Air Conditioning

Digital Input:

1. FCU Equipment Room – Status
2. FCU Equipment Room – Alarm
3. ACU in the 8th and 9th Floor – Status and Alarm

Schedule 18: Ventilation

Digital Input:

1. Elevator Hoist way Exhaust Fan – Status
2. Elevator Hoist Way Exhaust Fan – Alarm
3. Fresh Air Fan (Elev. Hall) – Status
4. Fresh Air Fan (Elev. Hall) – Alarm
5. Stair well Pressurization Fan – Status
6. Stair well Pressurization Fan – Alarm
7. In Line Axial Fan (8th Flr Mech Rm) – Status

Schedule 19: Elevator

Digital Input:

1. Elevator Operation – Status
2. Elevator Failure – Alarm

Schedule 20: Navigational Equipment s

Digital Input:

1. UPS Nav aids – Status
2. Main Power Supply of all Nav aids Equipment – Status and Alarm

C. Power House

Ventilation and Air conditioning

Schedule 21: Air conditioning

Digital Input:

1. ACU in CCR Room – Status
2. ACU in CCR Room – Alarm

Schedule 22: Ventilation

Digital Input:

1. Transformer Room Exhaust Fans – Status
2. Transformer Room Exhaust Fans – Alarm
3. Transformer Room Fresh Air Fan – Status
4. Transformer Room Fresh Air Fan – Alarm
5. Generator Room Exhaust Fans – Status
6. Generator Room Exhaust Fans - Alarm

Schedule 23: Solar Panel System

Digital Input:

1. Status
2. Trip/Failure

Analog Input:

1. Current (Amp)
2. Voltage (V)
3. True Power (KW)
4. Others as recommended

Schedule 24: Network Panels

Digital Input:

1. General Failure
2. Network Failure
3. UPS Failure

The POINTS enumerated above shall generally be a part and guide for the overall design and installation of the whole BMS. Spare and Future Points shall also be considered. Additional Points during the development/design of the total system shall be considered.

SECTION 7800

ACCESS CONTROL SYSTEM (ACS)

1.0 GENERAL

1.1 The work to be executed and completed by the Contractor under this section shall include the following:

- (1) Design, manufacture, supply, installation, testing, commissioning and maintenance for the complete Access Control System for the Passenger Terminal Building (PTB);
- (1) Design, manufacture, supply, installation, testing, commissioning and maintenance for the complete Access Control System for the Control Tower ATC Operation and Administration Building (CTO)

2.0 SCOPE OF WORK (PTB)

2.1 Work under this Section consists of the design, manufacture, supply, installation, testing, commissioning and maintenance of the complete Access Control System (ACS) all as specified herein, indicated on the Drawings or as instructed by the Engineer.

2.2 The Contractor shall be responsible for checking and developing the design of the ACS and for ensuring that the System as constructed achieves at least the specified levels of performance.

2.3 The scope of works for the ACS at PTB is as follows:

- (1) Main Control Units (MCU) comprising host computer, including equipment for ID photo processing and badge printers located in the Command and Control Office (CCO) of the Passenger Terminal Building;
- (2) Door Control Units (DCU) including access equipment for the actuation of the access points opening/closing door positions;
- (3) Software package to allow the proper operation of the system and its accessories;
- (4) Interfaces with the Fire Alarm and Detection System (FADS) to allow safe and efficient escape.
- (5) Emergency Exits control system.

2.2 The Contractor shall be responsible for the proper coordination between Architectural Works, doors design and installation works of ACS, as well as any needs of wiring or interfaces with any other Systems or disciplines.

3.0 SYSTEM CONSTRAINTS

3.1 Generalities

- (1) The ACS to be provided by the Contractor shall correspond to the need to control the access of staff throughout the various zones, but also the need to ensure the control of Emergency Exits, by means of secure equipments. The ACS provided and installed shall be of proven efficiency.
- (2) The ACS shall be provided to various users to control the public, passengers and personnel flows within the Passenger Terminal Building and to prevent access by unauthorised personnel to restricted areas.
- (3) The Contractor shall develop, from existing Drawings, the final Passenger Terminal Building Security zoning plans with the Employer, under the supervision of the Engineer.
- (4) The Contractor shall develop proposition for the Access Pass delivery procedure with the Employer and other involved parties, under the supervision of the Engineer.

3.2 Controlled Doors Equipment

- (1) For automatic control and monitoring of doors while ensuring the crossing between zones of different security status, some of the card readers shall be installed on one or both sides of the door, according to the security status.
- (2) The equipment shall be connected to a Door Control Unit (DCU) interfaced to the Central Access Control System.

3.3 Emergency Exit Control System

- (1) Emergency Exits shall be controlled by Fire Alarm and Detection System as a stand-alone system and supervised by both the ACS System and Fire Alarm and Detection System.
- (2) In case of a confirmed general or local Fire Alarm, the System shall be able to automatically release the electrical locks of the Controlled Emergency Exits in the Area or in all the Building.
- (3) The Contractor shall ensure the coordination with Building Works, Fire Alarm and Detection System, and in general with all aspect of the Fire Protection due in this Project to ensure the safety of persons and building.
- (4) Based on the Project Design, the Contractor shall ensure the proper and full coordination with the Employer to propose a general solution and technical criteria, to ensure the homogeneous and safe operation of all Controlled Emergency Exits. Such process shall be done under the supervision of the Engineer.

3.4 Interfaces with other Systems

The Contractor shall ensure the coordination with the Fire Alarm and Detection System.

4.0 SYSTEM DESIGN / PERFORMANCE REQUIREMENTS

4.1 Generally

- (1) The system shall be designed to allow future expansion.
- (2) As part of the responsibility for Design, the Contractor shall ensure compliance of the Design with the required levels of recognised international practice.
- (3) The ACS shall be designed as a stand-alone system with distributed processing capability, to card readers.
- (4) A host computer (ACS Workstation) shall be provided with all the necessary hardware, software drivers, transceivers, switch devices and miscellaneous data communications devices as required for the Workstation to control and administer the ACS.
- (5) The Proximity Card Readers shall be designed such that upon presentation of an ACS access card, unique card identification data is transmitted to the associated Access Control Interface Panel (AIP). The system shall read the data, identify the person, issue authorisation and instruct the DCU to unlock the associated door locking mechanism.
- (6) The installation of local control measure such as electromagnetic locks and Proximity Cards Readers, shall be closely coordinated with the Building Works Doors and frames shall be fabricated to receive the components and wiring of the ACS without the need for excessive on site dismantling, cutting or drilling.
- (7) Wiring to connect the moving part of the door shall be routed through a flexible spiral made of stainless steel only, with its built-in wires, to be part of the Building Works. The necessary coordination shall be due by the Contractor.
- (8) The Contractor shall be responsible for the entire coordination between the installations of any ACS equipment with any other systems or trades, ACS equipments incorrectly located shall be relocated at the Contractor's expense.
- (9) Installations shall be concealed within doors and frames and external items shall match the architectural appearance of the doors to which they are attached. All finishes shall be selected by the Engineer.
- (10) For the Controlled Emergency Exit Doors, the coordination between the ACS and the Fire Alarm and Detection System (FADS) shall be under the responsibility of the Contractor, equipments incorrectly located or operating as per agreed as per Fire Protection needs, shall be replaced at the Contractor's expense.

- (11) The interface between the Door Control Unit (DCU) related to the concern door and the local Fire Alarm Control Panel (FACP) shall be part of the Fire Alarm and Detection System. The operation of the Controlled Emergency Exit Doors shall be of the highest level in terms of Fire Safety, The Contractor shall ensure the proper coordination between both Systems.
- (12) The system shall have an appropriate interface with the Fire Detection and Alarm System (FDAS) allowing the FDAS to override the security system and unlock doors (exit door) during emergency situations.

5.0 CONSTRUCTION REQUIREMENTS

5.1 Plant, Equipment and Materials Generally

- (1) All Plant, equipment and materials shall be in accordance with Standards as specified in Section 1135.
- (2) The entire system with all component Plant, equipment and materials including the AIP and DCU's, shall be supplied by the same manufacturer to the approval of the Engineer.
- (3) All Plant, equipment and fittings shall be compatible with all applicable Safety and Protection Constraints.
- (4) All Plant, equipment and materials shall be suitable for their intended purpose and environment, e.g. watertightness, ambient temperature and humidity, vandal resistant, etc.

5.2 Door Control Units (DCU)

Door Control Units (DCU) shall control the following devices:

- Proximity Card reader (CR)
- Electro -magnetic lock
- Panic bar

5.3 Locks/Switches

Locks and Switches shall be as follows:

- The selection of electromagnetic locks shall be approved by the Engineer and shall be at least 200 kgf.
- The electro-magnetic locks shall be operated at 24 VDC.
- The electro-magnetic lock shall operate in the fail-safe mode.

6.0 INTERFACE WORKS

6.1 The ACS shall be connected to the following Systems:

- (a) Section 6800- Fire Alarm and Detection System (FDAS);
- (b) The FDAS shall have an appropriate interface with the ACS allowing the FDAS to override the ACS and unlock doors (exit door) during emergency situations.

7.0 SCOPE OF WORK (CTO)

7.1 Access Control and Monitoring System (Control Tower)

- (1) The Control Tower entrance at 8th FL (SD-9) shall be provided by an access control and monitoring system to prevent access by unauthorized personnel.
- (2) The Control Tower access control and monitoring system shall be designed as a stand-alone system, microprocessor based and shall comprise:
 - Access control key pad;
 - LCD display with backlight, 15 characters x 3 lines
 - Finger reader
 - Uninterruptible Power Supply (UPS) for the system
 - All necessary interconnection wiring, equipment and interface requirements to provide a complete and fully operational system
- (3) The basic local control measure shall be by finger reader in combination with an electro-magnetic lock system. System performance, as a minimum, shall be:
 - (a) Maximum of 100 fingers enrolments (one person can register more than one finger)
 - (b) Identification speed at 0.1 second
 - (c) Correct identification rate of over 99.9%
 - (d) False acceptance rate of 0.00%
 - (e) ID number from one to six digit number unique to each other
 - (f) Operational
 - Manager Level 3 – can perform all management operations.
 - Manager Level 2 – can assign and modify enrolment within the division concerned.

- Manager Level 1 – can set-up time, schedule, or search through records.
 - User – cannot perform any management operations.
- (4) The system shall be provided with door exit push button or equivalent to comply with fire and building codes.
 - (5) The system shall have an appropriate interface with the Fire Detection and Alarm System (FAS) allowing FAS to override the security system and unlock the door (exit door) during emergency situations.
 - (6) The system shall have an appropriate interface with the CCTV system such that the CCTV cameras automatically zoom in on areas where alarms are initiated.
 - (7) Clock time used by the system shall be derived through the master clock.

Design and installation of the system shall be closely coordinated with the Engineer.

8.0 TESTING / COMMISSIONING

8.1 General

The Contractor shall carry out complete operating and performance tests of the System and all Plant and equipment therein to demonstrate that the specified levels of performance have actually been achieved.

8.2 Quality Control of Components

The Contractor shall supply certificates of conformity signed by the manufacturer or the importer of the component, certifying that the product supplied complies with the standards which define it.

8.3 Complete Operating and Performance Tests on the Equipment

- (1) After complete installation of the systems, the operating and performance tests shall take place in the operational environment of the project.
- (2) The content of the tests is set out in detail below:
 - Systematic operation tests of all system components:
 - Redundancy of hardware, i.e. duplicated CPU, power supply etc:
 - All other tests required by the Engineer to prove compliance with Specification.
- (3) The Contractor shall provide such instruments or equipment necessary and perform measurements for channels so designated.
- (5) All inspection and test data shall be submitted to the Engineer.

9.0 MEASUREMENT AND RATES

9.1 Measurement

Work under this Section shall be measured according to the item classification and units contained in the Bills of Quantities (BOQ).

9.2 Rates

- (1) The rates and lump sums shall be full compensation for design, supply and installation of all plant, materials, labor, equipment, transport, temporary works, establishment charges, overheads, profit and taxes required to complete the work described in this Section.
- (2) The rates and lump sums shall further include, if not itemized separately in the BOQ, for the Sections of the 6000 series:
 - (a) Contractor's design (where applicable);
 - (b) Training for equipment and systems;
 - (c) Spare parts;
 - (d) Testing and commissioning;
 - (e) Maintenance tools and special tools;
 - (f) Protection; and
 - (g) All permits and fees required from Government authorities for inspection/certification.