

**CHAPTER 5**

**ELECTRICAL POWER DISTRIBUTION SYSTEM**



## 5.1 SCOPE

This specification covers the specific technical requirements for the following electrical equipment.

- (1) 10 kV Metal Enclosed Switchgear
- (2) 380 V Metal Enclosed Switchgear
- (3) 10 kV Dry-type Transformer
- (4) Circuit Breakers
  - 10 kV Class Vacuum Circuit Breaker (VCB)
  - 380 V Class Air Circuit Breaker (ACB)
  - 380 V Class Molded Case Circuit Breaker (MCCB)
- (5) Disconnecting Switch
  - 10 kV Disconnecting Switch
- (6) Voltage Transformer
  - 10 kV Voltage Transformer
- (7) Current Transformer
  - 10 kV Current Transformer
- (8) Magnetic Contactor
- (9) Lightning Arrester
- (10) Protective Relay
- (11) Meters
- (12) Battery and Charger (DC Source Panel)
- (13) Uninterruptible Power Supply System
- (14) Stand-by Generating Sets

## 5.2 SYSTEM REQUIREMENTS

- a. The electrical power distribution system for the airfield lights to be equipped in of the Airport shall be the redundant double-end power distribution system supported by two separate power substations, primary and secondary, through use of duplicate feeders which are physically and electrically separate so as to ensure the required level of power availability as well as operational independence in supplying highly reliable and maintenance-easy electric power to the Precision Approach Category II and III Lighting System of Shanghai / Pudong International Airport.
- b. The level of power availability and distribution independence shall be ensured, in addition to the commercial service lines, by the standby power supply system consisting of the emergency standby engine-generators and uninterruptible power system (UPS), which are two (2) mandatory installations required under ICAO's Standards and recommended practices. These mandatory power installations, generator and UPS, shall be perfectly duplicated so that either of the duplicates can be automatically connected for use in the event of the other to be stopped for maintenance services or power failure, etc.
- c. This work shall include all the goods and services that are required for engineering, supply and installation of the electric power distribution facilities and equipment necessary for airfield lighting system, in which the two (2) power substations (Main & Secondary AFL Substations) to be located each about both ends of the runway shall receive power supply through two (2) incoming cables. The installation work of these two (2) incoming cables between Main & Secondary AFL Substations and the power supply source of Main Aerodrome (35 kV / 10 kV) Lighting Substation shall not be included in this work.

- d. Electric power to be supplied to the respective airfield lights and lighted signs shall be low voltage power to be supplied through Main and Secondary AFL Substations. The contractual boundary of this work shall be limited at the secondary circuit of the Molded Case Circuit Breakers (MCCB) furnished at the Main & Secondary AFL Substations, at which this work shall be precluded from such other contract's work as cabling and installation works which are required for connection between MCCB and the Main/Secondary AFL Substations, and those required under the air navigational aids contract.
- e. The Uninterruptible Power System (UPS) shall be designed such that the time interval between failure of the normal source of power and the secondary power supply switchover should not exceed one second in accordance with the relevant standards and recommended practices of ICAO, Annex 14 Aerodrome. The airfield lights shall be included as additional light to be subjected to UPS with the exception of the optional approach barrette lights, all as tabled below:

	UPS assisted Lights	Mandatory under ICAO	Additional
1	Approach Lights (PALS)		o
2	Capacitor Discharge Lights (SFL)	o	
3	Precision Approach Path Indicator (PAPI)		o
4	Runway Edge Lights (REDL)		o
5	Runway Threshold/Wing Bar Lights	o	
6	Runway End Lights (RENL)	o	
7	Runway Center Line Lights (RCLI)	o	
8	Runway Touchdown Zone Lights (RTZL)	o	
9	Taxiway Center Line Lights (TCLL)	o	
10	Taxiway Edge Lights (TWYL)	o	
11	Stop Bar System (STBL)	o	
12	Runway Guard Lights	o	
13	Taxiway Intersection Lights (TISL)	o	
14	Lighted Signs (TXGS)	o	
15	Wind Direction Indicator Lights (WDIL)	o	
16	Apron Flood lighting (FLO)	o	
17	Visual Docking Guidance Lights (VDGS)	o	
18	Aircraft Stand Identification Signs (ASIS)	o	
19	Road-Holding Position Lights	o	

The operational requirements of the UPS are specified in Subsection of this document.

- f. The emergency standby power supply system shall be able to detect a failure of the normal source of power or its voltage drop, and shall be capable of being automatically switched over to be deployed in less than 15 seconds, which time should, however, be inclusive of allowance given to the standby power switchover from drop of light intensity below 80 % until its restoration up to 80 %.

The operational requirements of the emergency standby power supply system are specified in Subsection of this document.

### 5.3 10 kV METAL ENCLOSED SWITCHGEAR

- a. General

The switchgear shall be used for 10 kV, three phases, three wires, 50Hz.

b. Standards

The following standards or equivalent shall be applicable.

- IEC-298 (A.C. Metal-Enclosed Switchgear and Control-gear for rated voltage above 1 kV and up to and including 52 kV)
- IEC-529 (Classification of degrees of protection provided by enclosures)
- JEM-1 425 (A.C. metal-enclosed Switchgear and control gear for rated voltages from 3.6 kV to 36 kV)

c. System

- |   |                         |
|---|-------------------------|
| (1) Three phases, three wires, 50Hz       | : 10 kV (Nominal)       |
| (2) Short-time withstand current (3 sec.) | : 25 kA                 |
| (3) Main bus bar rating                   | : 1000A                 |
| (4) Incoming circuit                      | : cable from the bottom |
| (5) Outgoing circuit                      | : cable from the bottom |
| (6) Insulating withstand voltage          |                         |
| Basic impulse insulation level            | : 75 kV                 |
| Power frequency                           | : 28 kV                 |

d. Enclosures

1) Construction of enclosure

The switchgear shall be of a rigid self-supporting and completely metal-enclosed structure, suitable for mounting on steel base channels, embedded in a concrete floor.

The switchgear shall have the single bus bar, incorporating vacuum circuit breakers, current transformers and voltage transformers inside the metal-enclosure.

The equipment to be proposed for use shall be best suited to the specified application. The panels shall be fabricated from steel sheet (not less than 2.3 mm thickness).

The front doors of panels shall be hinged and fitted with a handle which can be lockable. Doors shall be provided with hinges inside the panels. Provision shall be made to extend the switchgear assemblies at both ends. Each switchgear unit shall be segregated by metal sheets into the following separate compartments:

- Circuit breaker compartment complete with insulated shutters to cover the entrance of the stationary contact.
- Power cable compartment.
- Main bus compartment.
- Voltage Transformer compartment.

The units shall be so constructed that circuit-breakers of the same rating are interchangeable. In addition, means shall be so provided that it is not possible to interchange breakers which have different electrical characteristics.

All accessories such as bolts, nuts and washers necessary for mechanical and electrical assembly of the panels shall be supplied.

Blank bottom plate shall be provided for control cable entry. The entry of power cables shall be from the bottom of the power cable compartment provided with blank gland plate. Cable access areas shall be completely closed off to prevent the entry of vermin into the switchgear enclosures.

2) Bus-bars and connections

The bus-bars shall be electrolytic copper. All bus-bars and connections up to the point of attachment to the fixed contacts of the isolating device shall be capable of carrying the current for one second through fault current which is equivalent to the prospective three phases short circuit current as specified hereof.

The bus-bars, connections and their insulated supports shall be of a suitable construction, mechanically strong, and shall withstand all the stresses which may be imposed.

Connection of bus-bars between panels shall be made without a space for loose interconnecting links. Isolating device orifice contacts shall be silver plated to provide good conductivity with the isolating contacts of the circuit breaker. Bus-bar end covers shall accommodate an end switch panel without a space for an additional panel.

3) Earthing conductor

A copper earthing conductor shall be provided, solidly connected to the switchgear assembly. The earth conductor shall be bolted to the main frame of switchgears. Means shall be provided for coupling earth bars of adjacent units to form a continuous earth bar.

Particular care shall be taken to ensure that:

- The frame of drawout equipment shall be connected electrically through an adequate contact which is intended for connection to the earthing conductor.
- Where equipment are separately mounted, each shall be provided with earthing means.
- Secondary circuits of Current transformer and Voltage Transformer shall be earthed at one point only.
- Each Voltage Transformer metal enclosure shall be connected to the earthing conductor before its primary connections are made.

e. Interlock

Each switchgear shall be provided with complete interlocking device to prevent any dangerous or undesirable operations. It shall be provided to prevent the following operations:

- 1) A closed circuit breaker from being withdrawn or inserted into its service position (mechanical interlock).

- 2) The operation of a circuit breaker unless it is in its service, disconnected, removed, test or earth position (mechanical interlock).
- 3) Closing of the circuit breaker in the service position when the secondary connections between the fixed portion of the switch panel and the circuit breaker are not complete (mechanical or electrical interlock).
- 4) circuit breaker from being put into service unless all its pole parts are in their normal position (mechanical interlock).
- 5) The operation of the tripping mechanism when an attempt is made to isolate a circuit breaker from its service position (mechanical interlock).
- 6) The insertion of an isolated circuit breaker with service position against a locked orifice shutter (mechanical interlock).

f. Safety Shutter

A set of shutters shall be provided to cover each three-phase group of stationary isolating contacts. Each set shall be capable of being individually operated with padlock closed. The shutters shall open and close automatically by a positive drive. To facilitate testing, an integral device shall be provided for fixing (but not padlocking) the shutters in the open position, and, subsequently, for releasing them to the closed position, and this device shall be designed so as to be cancelled by the moving portion to ensure restoration of the automatic features of the shutters.

g. Insulation

Non-tracking solid insulator of cast epoxy resin shall be used for insulation of the bus-bar itself, bus-bar to circuit breaker connectors, circuit breaker isolating contact orifices, circuit breaker to cable box connectors, primary conductor of current transformers, and Voltage Transformers.

h. Circuit Breaker Location

The circuit breaker shall be located in either of the following positions:

- (1) Service position
- (2) Disconnected position
- (3) Test position

It shall be able to leave the circuit breaker within the switchgear compartment in the disconnected, and test positions.

i. Control and Secondary Wiring System

- 1) All secondary wiring for the switchgear relays, instruments, cubicles, etc. shall be for use with 600 V class thermoplastic insulated copper conductor.
- 2) All panel wiring shall have a minimum cross section of 1.0 sq. mm.
- 3) All wires shall be neatly run in groups and shall be securely fixed in the duct or in bundle.

- 4) The DC supplies and AC supplies shall be fed through molded case circuit breakers.
- 5) Wiring diagrams for control and relay circuits shall preferably be drawn as if viewed from the back, and it shall be clearly stated on each diagram as to which view is employed. The diagram shall show the terminal boards to be arranged as it is in service.

j. Indicating Instruments

All indicating instruments shall be of the semi-flush mounted, back connected, 250 degree scale angle, direct-reading, switchboard type, 110 millimeter square, black colour with white dials, black markings and black pointers. The case shall be dust-tight, with a black finish. The accuracy of all instruments shall be within the respective required values for ammeters - voltmeters - wattmeters, power factor meters, and frequency meters.

Moving elements shall be provided with zero adjustments readily accessible from the front of the instruments without disassembly.

k. Control and Instrument Switches

All control and instrument switches shall be of the rotary, switchboard type, with handle on the front and the operating contact mechanisms on the rear of the panels. All control and instrument switches shall be suitable for operation on 110 volt DC circuits.

The switch shall be designed for its mounting on 2.5 mm steel panels and shall possess insulated operating handles as follows;

- Stick type handle for circuit breaker control switches
- Round knurled knob for instrument switches

l. Signal Lamps

The following colours shall be used:

- (1) Red : Circuit breaker closed
- (2) Green : Circuit breaker open

#### 5.4 380V DISTRIBUTION PANEL

a. General

The distribution panel will be used for 380V, three phases, four wires, 50 Hz.

b. Standards

The following standards or equivalent shall be applied:

- JEM - 1265 (Low-Voltage Metal-Enclosed Switchgear)  
IEC - 947 (Low-Voltage Switchgear and Controlgear)



c. System

- |                                      |                                 |
|--------------------------------------|---------------------------------|
| (1) Three phases, four wires, 50 Hz, | : 380/220 V                     |
| (2) Designed interrupting capacity   | : 6.3 kA                        |
| (3) Incoming circuit                 | : Outside cable from the bottom |
| (4) Outgoing circuit                 | : Outside cable from the bottom |

d. Enclosures

1) Construction of enclosure:

The panel shall be of a rigid self-supporting and completely metal-enclosed structure, suitable for mounting on steel base channels, embedded in a concrete floor.

The panels shall be fabricated from steel sheet (not less than 2.3 mm thickness).

The front doors of panels shall be hinged and fitted with a handle which can be lockable. Doors shall be provided with hinges inside the panels. Provision shall be made to extend the switchgear assemblies at both ends.

All accessories such as boots, nuts and washers necessary for mechanical and electrical assembly of the panels shall be supplied. Blank bottom plate shall be provided for control cable entry.

The entry of power cables shall be from the bottom of panel provided with blank gland plate. Cable access areas shall be completely closed off to prevent the entry of vermin into the panel enclosures.

2) Control and secondary wiring system

All secondary wiring for the panel, relays instruments, etc. shall be 450/750 V class polyvinyl chloride insulated copper conductor.

All panel wiring shall have a minimum cross section of 1.0 sq. mm.

All wires shall be neatly run in groups and shall be securely fixed in the duct or in bundle.

The DC supplies and AC supplies shall be fed through molded case circuit breakers (MCCB) and air circuit breakers (ACB).

3) Wiring diagrams

Wiring diagrams for control and relay circuits shall preferably be drawn as if viewed from the back and it shall be clearly stated on each diagram as to which view is employed. They shall show the terminal boards to be arranged as it is in service.

4) Indicating instruments

All indicating instruments shall be of the semi-flush mounted, back connected, 250 degree scale angle direct-reading, switchboard type, 110 millimeters square, black colour with white dials, black marking and black pointers. The case shall be dust-tight, with a black finish. The accuracy of

all instruments shall be within the required values for ammeters and voltmeters.

Moving elements shall be provided with zero adjustments readily accessible from the front of the instrument without disassembly.

5) Control and instrument switches

All control and instrument switches shall be of rotary, switchboard type, with handle on the front and the operating contact mechanisms on the rear of the panels. All control and instrument switches shall be suitable for operation on 200 V AC or 110 V DC circuit.

The switch shall be designed for mounting on 3 mm steel panels and possess insulated operating handles as follows;

- Round knurled knob for instrument switches

5.5 POWER TRANSFORMER (10 kV DRY-TYPE TRANSFORMER)

The transformers shall be three-phase, cast resin dry-type.

The construction of the transformers shall comply with JEC 2200 and IEC 76 (Power Transformers) or IEC 726 (Dry Type Power Transformer) standards.

Iron cores shall be made of low-loss, cold-rolled, grain-oriented silicon steel strip coated with heat-resistant paint to prevent rust.

Conductor of high and low voltage winding coil shall be copper or aluminum. The transformer shall have the following ratings:

Rated capacity	: 800 kVA, 1000 kVA
Number of phase	: 3
Primary voltage	: 10 kV $\pm 2.5\%$ , $\pm 5\%$ (5 tapes)
Secondary voltage	: 380-220 V
Frequency	: 50 Hz
Percent impedance at	: 6% rated kVA
Primary winding	: D
Secondary winding	: Y
Vector group	: Dy 11
Max. temperature rise	: 80 degree C
Withstand voltage	
Basic impulse insulation level	: 75 kV
Power frequency	: 28 kV
Insulation class (Primary)	: B class
Insulation class (Secondary)	: F class

## 5.6 CIRCUIT BREAKER

### 5.6.1 10 KV CLASS VACUUM CIRCUIT BREAKERS

- a. The breakers shall be vacuum interrupting type of horizontal drawout construction and in accordance with JEC 181 (AC Circuit Breaker) and IEC 56 (High-Voltage Alternating-Current Circuit Breakers) standards or equivalent.
- b. Each circuit breaker shall be operated by an electrically charged stored energy operating mechanism complete with shunt-trip coil, auxiliary switches, operation counter, position indicators, interlocks, manual tripping and closing devices and primary and secondary contact devices; all assembled as mobile units for installation into switchgear compartments. All breakers of equal rating shall be interchangeable.
- c. Mechanism of the breakers shall be mechanically and electrically "trip-free" and electrically "anti-pumping". Molded barrier between operating mechanism and high-voltage parts of the circuit breaker shall be provided. Provisions shall be made for manual spring charging of the breaker and for slow closing of contacts.
- d. Both mechanical and electrical life of the breakers shall be more than 10,000 operation times and the breaking unit shall be easily interchangeable.
- e. Control circuit components shall be easily checkable.
- f. Parts such as a tripping coil, closing coil of motor spring mechanism and vacuum interrupter, shall be easily interchangeable.
- g. The primary conductors shall be silver plated copper, designed and fabricated to be self-aligning.
- h. While in the isolated position, the primary conductors shall be disengaged from the stationary contacts and shall be covered by an automatic shutter.
- i. The breaker shall be provided with 4 normally open and 4 normally closed auxiliary contacts.
- j. The following are the minimum position indicators that shall be provided on the circuit breaker:
  - (1) Spring Charged
  - (2) Spring Free
  - (3) ON
  - (4) OFF

All above indicators shall be operated through mechanical means.

If the mechanical indicators are not visible to the operator without opening the front cover or door, additional electrical indicator lamps showing the "ON" and "OFF" positions for the circuit breaker shall be provided on the front of the switch panel. Power supply to these electrical indicators shall be fed from the battery charger through an independent circuit.

k. Rating

Rated voltage	: 12 kV
Rated current	: 800 A or more
Rated frequency	: 50 Hz
Interrupting current	: 25 kA
Making current	: 63 kA
Short-time current 3 sec.	: 25 kA
Insulation level	
Basic impulse insulation level	: 75 kV
Power frequency	: 28 kV
Operating sequence	: O: 0.3 min. - CO: 1.5 min. (O: Open, C: Close)
Operating system	: Motor charged spring operation
Operating voltage	: DC 110 V

5.6.2 380 V CLASS AIR-CIRCUIT BREAKER (ACB)

Low voltage air-circuit breaker shall be used for feeding 380 / 220 V low voltage power according to JIS C8372 (Low Voltage Circuit Breakers) or IEC 947-2 (Low Voltage Switchgear and Controlgear) standards.

Low voltage air-circuit breaker shall have a electromagnetic instant trip device.

Low voltage air-circuit breaker shall have the following ratings.

- Rated Voltage : AC 1000 V
- Rated Current : Refer to Schedule of each substation
- Number of Poles : 4 or 3
- Rated Breaking Capacity : Not less than 50 kA

5.6.3 MOLDED CASE CIRCUIT BREAKER (MCCB)

400V CLASS MOLDED CASE CIRCUIT BREAKER (MCCB)

Molded Case Circuit Breakers shall be used for feeding 380/220V low voltage power in accordance with JIS C 8370 (Molded Case Circuit Breakers) or IEC 947 (Low Voltage Switchgear and Controlgear) standards. Molded case circuit breaker shall have a thermal tripping device or electromagnetic instant trip device.

The molded case circuit breaker shall have the following ratings:

- Rated voltage : AC 460V  
(AC  $\sqrt{2}$  x 400V peak value)
- Rated current : Refer to Schedule of each substation
- Number of poles : 4 or 3 or 2
- Rated breaking capacity : Not less than 10 kA

5.7 DISCONNECTING SWITCH

10 kV DISCONNECTING SWITCH

- a. This switch shall be in accordance with JEC 196 (Disconnecting Switches), or equivalent standards.

b. This switch shall have the following rating:

- Rated voltage : 12 kV
- Rated current : 400 A
- Short time current : 25 kA (3 sec)
- Withstand voltage
  - Impulse : 75 kA
  - Power frequency : 28 kV

## 5.8 VOLTAGE TRANSFORMER

### 10 KV VOLTAGE TRANSFORMER

Voltage Transformer to be used in the Work shall be in accordance with JEC 190 (Instruments Transformers for Protective Relays) or IEC 186 (Voltage Transformer), or equivalent standard.

Voltage Transformer shall be of epoxy resin molded insulation type and have the same insulation level as a switchgear.

Power fuse shall be provided on the primary side except for Engine Generator circuit.

The characteristics of the Voltage Transformer shall be as follows:

- Rated voltage : 12 kV
- Primary voltage : 10 kV
- Secondary voltage : 110 V
- Class : 1.0
- Burden : 100 VA
- Withstand voltage
  - Impulse : 75 kV
  - Power frequency : 28 kV

## 5.9 CURRENT TRANSFORMER

### 10 KV CURRENT TRANSFORMER

Current transformers shall be in accordance with JEC 190 (Instruments Transformers for Protective Relays) or IEC 185 (Current transformers) or equivalent standards.

Current transformers shall be of epoxy resin molded insulation type. They shall be installed so as to be accessible for replacement, and provide sufficient space to permit installation of larger transformers up to maximum circuit breaker rating for the unit.

The characteristics of the current transformer shall be as follows:

- Primary current : 75 A 100A
- Secondary current : 5 A
- Class : 1.0
- Burden : 40 VA
- Maximum voltage : 12 kV

- Withstand voltage
  - Impulse : 75 kV
  - Power frequency : 28 kV

## 5.10 MAGNETIC CONTACTOR

Magnetic contactors shall be in accordance with JEM 1038 (AC Electromagnetic Contactors) and IEC 947 (Low Voltage Switchgears and Controlgears) or equivalent standards.

Magnetic contactors shall be two to four poles, single-throw type.

The magnetic contactors shall have the following rating:

- Rated insulating voltage : AC 440 V
- Rated current : Refer to Schedule of the each substation
- Number of pole : 4 or 3 or 2
- Operating voltage : AC 220 V single phase

## 5.11 LIGHTNING ARRESTERS

### 5.11.1 TYPE

Lightning arresters shall be in accordance with JEC 203 (Lightning Arresters) or equivalent standard, and shall be self supporting, gap-less type.

### 5.11.2 CONSTRUCTION

The lightning arrester set shall consist of a number of non-linear resistor elements in a porcelain housing. Pressure relief diaphragms shall be provided for 14 kV lightning arrester. These diaphragms shall be ruptured when a sudden pressure rise occurs due to burning of the arrester internal parts caused by an abnormal operation condition. The high-pressure gas shall escape into the atmosphere through the bottom of the arrester, preventing the porcelain housing of the arrester from bursting into pieces.

### 5.11.3 RATING

#### 14 kV LIGHTNING ARRESTER

- Rated voltage : 14 kV
- System nominal voltage : 11 kV
- Rated discharge current : 10 KA
- Residual voltage (crest)
  - (for 8 x 20 microsecond discharge current wave)
  - at 5,000A : Less than 43 kV
  - at 10,000A : Less than 47 kV
- Withstand test voltage
  - Basic impulse insulation level : 90 kV
  - (1 x 40 microsecond full wave)
- Low frequency
  - : 28 kV (Dry 1 min.)
  - : 28 kV (Wet 10 sec.)

## 5.12 PROTECTIVE RELAY

All protective relays shall be of static type (refer to the followings) in accordance with JEC 174 (Protective Relays for Power System), or equivalent standards.

- Over-current relay and over current : static type
- ground relay
- Under-voltage relay and over voltage relay : static type
- Voltage relay for SGS : static type
- Directional short circuit relay : static type

Circuits and components used for the relays shall, as far as possible, be standardized and in the event of a fault components, shall be easily replaceable. All parts of the relays shall be fully treated to withstand the temperature and humidity conditions likely to be encountered.

All protective relays shall be withdrawable type without opening the current transformer secondary circuit and without disturbing external circuit, and shall be mounted in dust-proof cases. These cases shall be the semi-flush mounted pattern except in the case where the relays are installed behind a cover of the switchgear. Mechanical fault indicator of protection relay shall be capable of being reset without the necessity of opening the case. It shall not be possible to operate any relay element by hand without opening the case.

The necessary test devices shall be incorporated in the relays completely. No other device shall be affected of the instrument transformer and other external circuit, in order to provide means for testing either from an external source of energy or from the instrument transformer because of multipole test plugs.

Each protective relay shall be practically free from error due to normal variations in frequency, wave form, and power factor and from ambient temperature effects between 5 degrees and 40 degrees centigrade.

All protective relays which are connected to complete either the tripping circuits of a circuit breaker or the coil of an auxiliary tripping relay shall be provided with flag indicators. When relay elements performing a plural number of functions will be applied in a common case (e.g. overcurrent and grounding fault), each function shall be provided with its own flag indicator to enable the type of fault condition to be identified. Each indicator shall be capable of being reset by hand without opening the relay case. Each indicator shall be so designed that it cannot be operated before the relay has completed its function.

All relays shall be suitably marked with the following information:

- (1) Function of relay (e.g. overcurrent, grounding fault)
- (2) Phase
- (3) Characteristic curve where appropriate
- (4) Rated current or voltage

## 5.13 METERS

All meters shall be of the semiflush mounted, back connected, 110 millimeters square, black colour with white dials, black markings and black pointers. The case shall be dust-tight, with a black finish. The accuracy of all meters shall be within the required value

for ammeters - voltmeters - wattmeters, power factor meters at phase angle, and frequency meters.

All meters shall comply with JIS C 1102 (Electrical Indicating Instruments) or IEC, or equivalent standards.

#### 5.14 BATTERY AND CHARGER (DC SOURCE PANEL)

a. Stationary battery device shall be installed in each substation and in drawout steel rack mounted type battery. Stationary battery shall be lead-acid high rate type discharge and of maintenance-free type. The battery shall be installed in the cubicle of the charger with a withdrawable type steel rack.

b. Nominal capacity of the battery shall be sufficient to support the equipment including control of airfield lighting system for the protection time of 30 minutes and not less than the capacity specified hereunder:

- Nominal capacity (10 HR) : 50 AH (for Main AFL Substation)  
: 50 AH (for Secondary AFL Substation)
- Nominal voltage : 110 V (2 V/ cell)
- Floating charging voltage : 133.8 V (2.23 V/cell)
- Number of battery cells : 60 cells

c. Battery charger shall be indoor use, cubicle type self air-cooling, with automatic voltage adjuster. Battery charger shall be provided 2 sets for one set of battery and one of them shall be for standby operation. Rectification system shall be three phases, thyristor controlled type. Load voltage compensating device shall be provided.

Battery charger shall have the following rating:

- Rating : Continuous
- Operation : Automatic and manual
- AC power source : Three phases, 50 Hz, 380 V
- DC setting voltage at floating position  
at floating position : 133.8 V
- Output current of rectifier : A (for Main Substation)  
: A (for Secondary Substation)
- Rating current of load : A (for Main Substation)
- voltage compensation device : A (for Secondary Substation)  
(Type: Silicon dropper)

d. DC source panel shall be complied with the following standards or equivalent:

- (1) SBA (Japan Storage Battery Association)  
6001 (Determining the Capacity of Stationary Batteries)
- (2) SBA 3-007 (Stationary Lead-acid Batteries)
- (3) JIS C 8704 (Stationary Lead-Acid Batteries)
- (4) JIS C 4402 (Thyristor Rectifiers for Floating Charge)

#### 5.15 UNINTERRUPTIBLE POWER SUPPLY SYSTEM (UPS)

a. SYSTEM DESCRIPTION



The Uninterruptible Power System shall be installed one each at both Main and Secondary AFL Substations.

- 1) The Uninterruptible Power System to be installed in the Main AFL Substation shall be defined herein as UPS System-1.

The UPS System-1 shall be a parallel circuit redundant uninterruptible switchover system, and shall consist of the following components, with the rated output capacity of 300 kVA:

3 x UPS (Rated Output 150 kVA)  
3 x Battery bank  
1 x Static Switch Module.

- 2) The Uninterruptible Power System to be installed in the Secondary AFL Substation shall be defined as UPS System-2.

The UPS System-2 shall be a parallel circuit redundant uninterruptible switchover system, and shall consist of the following components, with the rated output capacity of 200 kVA:

3 x UPS (Rated Output 100 kVA)  
3 x Battery bank  
1 x Static Switch Module.

- 3) The UPS Systems shall be normally made in parallel operation with three (3) units at a same time, each supplying 66.7 % of the rated output capacity. In the event of one set in failure or a stop required for inspection and maintenance purpose, the UPS in question shall be disconnected, and the remaining two sets shall be automatically running to supply the rated power supply each at 100 % of the rated output capacity.

- 4) The system shall be capable of being operated in any of the following modes:

#### Normal mode

The primary AC source shall be used to supply power to the rectifier/charger (RF/CH). The RF/CH shall provide converted DC power to support the inverter and also shall provide regulated DC power to maintain the battery in a fully charged condition. The inverter shall receive the stabilized DC power and convert it into regulated AC power for the load.

#### Emergency mode

Upon failure of the primary AC power, the input power for the inverter shall be automatically supplied from the battery. When the AC power is restored, the input power for the inverter shall be automatically supplied from the RF/CH via DC chopper, and the input power for recharging the battery shall be automatically supplied from the RF/CH. If the input power does not return, the system shall automatically shut itself down in an orderly manner when the discharge limit of the battery is reached.

### Bypass mode

If the 2 sets of UPSs must be taken out of services for an internal failure, the transfer switch shall be transferred the load to bypass circuit. In the case of internal failure, the transfer shall be performed by automatic operation. Retransfer from bypass to UPS shall be performed by manual operation.

### b. ELECTRICAL CHARACTERISTIC OF UPS

	UPS System-1	UPS System-2
Rated output capacity	300 kVA	200 kVA
AC Input		
Rated voltage	380 V	380 V
Voltage fluctuation	± 10 %	± 10 %
Rated frequency	50 Hz	50 Hz
Frequency fluctuation	± 5 %	± 5 %
DC Circuit		
Floating voltage	473 V	473 V
AC Output.		
Kind of rating	100 % continuous 125 % 10 min.	100 % continuous 125% 10 min.
Rated voltage	380 V	380 V
Voltage accuracy	± 1.5 %	± 1.5 %
Rated frequency	50 Hz	50 Hz
Frequency accuracy	± 0.5 Hz	± 0.5 Hz
Waveform distortion factor	5 % (rated in/output)	5 % (rated in/output)
Impact voltage rise & dip	± 10 %	± 10 %
Response time	8 cycles	8 cycles
No. of phase	3-phase, 4-wire	3-phase, 4-wire
Rated load power factor	0.8 ragging	0.8 ragging
Allowable load power factor	0.7-1.0 (lag)	0.7-1.0 (lag)
Efficiency (at full rated load)	94 %	94 %

#### Remarks:

\* Output voltage accuracy for 100% continuous shall be guaranteed but not guaranteed for 150% overload.

\* Impact voltage rise and dip shall be specified for the following conditions respectively:

- |     |                                    |   |                                     |
|-----|------------------------------------|---|-------------------------------------|
| (1) | 50% load fluctuation               | : | (between 50 and 100%)               |
| (2) | In case of AC input power failure  | : | (Rated AC input volt. → outage)     |
| (3) | In case of AC input power recovery | : | (DC 380 V → Rated AC input voltage) |

\* Efficiency shall be specified under rated input and rated output conditions at full load, without battery charging.

UPS shall be capable of supplying instantaneously rush current of 150% of its full load.

c. GENERAL REQUIREMENTS FOR SEMI-CONDUCTOR FUSING

The power semiconductor circuit shall be fused if necessary so as to prevent cascaded or sequential semiconductor failures. Indicator denoting blown fuse conditions shall be provided.

Components

All active electronic devices shall be solid-state. All semi-conductor devices shall be sealed. Vacuum tubes shall not be used. All relays shall be provided with dust covers.

Noise

Noise generated by UPS under any condition of normal operation shall not exceed a sound pressure level of 70 dB(A) measured one meter from the surface of the UPS.

d. BATTERY

Battery used as stored energy source for UPS shall be lead-acid high rate discharge type and of maintenance-free type.

Battery shall be mounted on a withdrawable type steel rack and installed in a cubicle. Nominal capacity of the battery shall be sufficient to support UPS for the protection time 10 minutes with UPS operating at rated load and not less than 200 AH / 10 HR (for 100 KVA UPS), 300 AH / 10 HR (for 150 KVA UPS). Number of battery cells shall be 212 cells.

e. TRANSFER SWITCH

Transfer switch shall be used for transfer from UPS to bypass and vice versa.

Type	: Electronic bypass
Rated insulating voltage	: AC 600V
Rated voltage	: AC 440V
Rated current	: 600 A for UPS System-1 : 400 V for UPS System-2
Number of pole	: 3

5.16 STANDBY GENERATING SETS

5.16.1 SCOPE

The work covered by this Section is the supply and installation of two (2) standby generating sets in the Main AFL Substation and another two (2) in the Secondary AFL substation forming part of the main electrical power supply system. Standby generating sets will be installed on the first floor of the Main and secondary Substations respectively.

## 5.16.2 GENERAL

### a. CONSTRUCTION

Standby generating set (Abbreviated as SGS) shall be mounted on a common bed made of forged iron, and mounted on the concrete base (the concrete bases should be provided under contract of the Building Work), with vibration prevented. Flexible coupling shall be provided between the engine and generator.

### b. AUXILIARY AND CONTROL POWER

Auxiliary and control power for SGS shall be supplied from the distribution panel and battery and charger (DC source panel) as specified in the Subsection.

Voltage and phase of auxiliary and control power are as follows;

- Auxiliary power : 3 phases, 3 wires, 380V AC
- Control power : 24 V, DC

## 5.16.3 SYSTEM REQUIREMENTS

a. SGS shall comprise diesel engine-driven generators as specified hereunder, complete with all accessories and auxiliary equipment and facilities necessary for the supply of electrical power to the standby power circuits in the event of the main power failure.

### b. The Rated Output Power of SGS

#### Continuous Power

	KVA	KW	
SGS 1, 2	1100	880	(Main AFL Substation)
SGS 3, 4	880	704	(Secondary AFL Substation)

### c. Operational Requirement of SGS

SGS shall be controllable both manually and automatically as specified hereunder.

#### 1) Automatic Operation

At normal condition; the operation selector switch shall be set at AUTO, and SGS shall be made operative for automatic standby service.

When main power drops to eighty five percent (85%) of normal voltage or rises to one hundred fifteen (115%) of normal voltage at the Main and Secondary AFL Substations, SGS shall automatically start within an adjustable time delay within the range from one-half (1/2) to five (5) seconds.

Once started, SGS shall run up to nominal speed. SGS shall switch on to load within fifteen (15) seconds from the time of main power failure. Switching on to load shall be performed by automatically operating air circuit breakers provided in generator panel, and two (2) air circuit breakers for transfer of commercial and standby power.

Air circuit breaker of commercial power shall be opened and then air circuit breakers of standby power shall be closed.

When main power restored and main power restoration is confirmed by timer with adjustable time of zero (0) to five (5) minutes, air circuit breakers of generator side shall be opened automatically and air circuit breaker of main power side shall be closed automatically. And then, SGS shall begin automatic stop after no load standby running during timer's operation time of zero (0) to five (5) minutes.

When the next main power failure is followed under the period of no load standby running, air circuit breakers shall be automatically operated to feed to load from generating set immediately.

When the next main power failure is followed under the period of stop operation, SGS shall start and switch on to load within fifteen (15) seconds from the time of main power failure.

2) Manual Operation

At occasional condition when the operation selector switch is set at 'Manual' starting and stopping of SGS, air circuit breakers shall be operable by the control operator.

d. PROTECTION SYSTEM

SGS shall have protection system consisting of a device, alarm, indication and others to safeguard SGS from being demanded by dangerous operating condition. The system shall have the following subsystem.

- Stagnation of engine start (within adjustable time of 0-30 sec.)
- Over speed
- Loss of lubricating oil pressure
- High engine jacket cooling water temperature
- Over-current
- Over-voltage
- Under-voltage

5.16.4 DIESEL ENGINE

a. RATINGS AND CHARACTERISTICS

Ratings and characteristics of each engine shall be as follows;

	SGS 1, 2	SGS 3, 4
Rated revolution	1500 r.p.m.	1500 r.p.m.
Cycle	Four-stroke	Four-stroke
Number of- cylinders	16	12
Starter	24V battery motor	24V battery motor

	Rated Load	Fuel Consumption less than	Lubricating Oil Consumption less than
SGS 1, 2	1100 KVA	231 g/PS-hr	3 g/PS-hr
SGS 3, 4	880 KVA	179 g/PS-hr	3 g/PS-hr

b. Running Characteristics

Engine shall run steadily at any load within its rated load according to the governing standards as follows:

Load Variation	Maximum Change of Speed	
On suddenly taking off, or throwing on rated load	Temporary Change:	10% of Rated Speed
	Permanent Change:	5% of Rated Speed
On a change of load by any step of 20% of rated load	Temporary Change:	3% of Rated Speed
	Permanent Change:	2% of Rated Speed

When engine is delivering between 10% to 100% of the rated power output, its steady load speed band shall not exceed 5% of the rated speed.

Recovery time from temporary disturbance to steady load speed band at new load shall not exceed fifteen (15) seconds after taking off or throwing on the rated load; nor exceed five (5) seconds after a change of load of 20% of the rated load.

The engine shall be capable of satisfactorily providing an output of 10% in excess of the rating at the same speed for one hour in any period of 12 hours' consecutive running.

c. Engine control

Engine control panel shall be equipped with the following devices.

- 1 x Start switch
- 1 x Stop switch
- 1 x Priming pump control switch
- 1 x Lubricating oil pressure gauge
- 1 x Cooling water thermometer
- 1 x Tachometer

Engine control panel shall be mounted on the engine.

d. PROTECTION DEVICES

Engine shall be equipped with the following shut-down devices and others, to safeguard the engine from being damaged by dangerous operating conditions;

- (1) Device arranged to give shut-down of the engine upon the loss of lubricating oil pressure to a dangerous level.
- (2) Device arranged to give a shut-down of the engine in the event of high temperature of the engine jacket cooling water.
- (3) Overspeed device arranged to give shutdown of the engine if engine overspeed occurs.

e. **ENGINE ACCESSORIES**

Accessories for each engine shall be as follows:

- (1) Speed Governor
- (2) Lubricating Oil Pump
- (3) Lubricating Oil Heat Exchanger
- (4) Cooling Water Equipment
- (5) Water Thermostats
- (6) Exhaust Piping and Silencer
- (7) Fuel Oil Equipment

1) **Governors**

Electronic type governor shall be sufficiently sensitive to ensure that the engine should comply with specified running characteristics.

2) **Lubricating Oil System**

Engine shall have a forced lubricating oil system, including an oil pump driven by engine, priming pump frequently driven by AC induction motor, if necessary, a cooler, full flow filter, necessary pipe work, and pressure gauges.

Oil Pressure Switch shall be designed to stop engine automatically as soon as lubricating oil pressure drops below permissible level.

3) **Exhaust System**

Engine shall be provided with complete exhaust system, including pipes, silencer, flexible pipe connections, wall frame and vibration insulating hangers.

Wall frame shall have gasket material between frame and pipe which will prevent vibration, maintain waterproof and will allow for thermal expansion of pipe.

Terminus of exhaust pipe shall be protected against entry of dirt, rain and vermin.

All accessories required for installation of complete exhaust system shall be supplied.

The engine shall be provided with an exhaust silencer to be supported inside the engine room.

The exhaust pipe work from the engine through silencer to the building structure shall include a suitable wall frame through which the piping is to be laid. Any space left within the frame shall be filled with a suitable material to accommodate for thermal expansion of the pipe.

Sufficiently flexible connection shall be provided between the silencer and the pipe to prevent vibration being transmitted to the building.

Outdoor portion of the exhaust pipe work shall be erected at a sufficient distance from both the building wall and the ground, and shall be protected against invasion of dust, rainwater and vermin.

All supporting steelwork, ducting, and flexible and rigid supports and fixing accessories shall be supplied in this Work.

Exhaust pipes shall be installed with heat insulation materials and thin steel plate for indoor part.

4) Cooling System

Cooling system shall adopt the radiator method. The cooling water shall be cooled by a radiation. The radiator shall be mounted on a common bed, circulated by a centrifugal pump through a heavy duty radiator cooled by reverse flow fan. A thermostat shall be so designed as to by-passes the normal cooling mode until a pre-determined operating temperature is reached.

5) Fuel Oil System

Fuel oil system shall comprise a pump fed fuel system, complete with main tank, service tank, duplex filters, fuel pumps and injectors, and necessary piping work and valves.

Main Tank for 2-engine in Main AFL Substation	: 1 each
Main Tank for 2-engine in Secondary AFL Substation	: 1 each
Service Tank for Main AFL Substation	: 1 each
Service Tank for Secondary AFL Substation	: 1 each
Capacity of Main Tank 20,000 liter	: 20,000 litres
Capacity of Service Tank 2,000 liter	: 2,000 litres

Requirements for the main tank and service tank shall primarily be in accordance with the technical specification of the Civil Aviation Administration of China (CAAC);

The main tank shall be installed in the inset type concrete housing. The concrete housing shall be completely waterproof. Any space left within the housing after the tank has been installed shall be filled with dry sand.

Main tank liquid level indicator shall be dial type and graduated in liters. Two indicators for the main tank shall be provided, one located directly on main tank and the other with box located in engine room.

The service tank shall be of a cubicle shaped. The service tank shall be mounted on the steel structure. Service tank liquid level indicator shall be float type and graduated in liters. Indicator shall be mounted on service tank.

An electric pump with hand operated bypass pump shall be provided for fuel supply into the service tank, and suitably piped to both the main tank and the service tank. The electric pump shall be automatically controlled to replenish the service tank.

The Contractor shall submit with their tender documents structural calculations and drawings of proposed main tank and housing structures and also service tank and this supporting structures.



- f. Fuel supply pipes and exhaust pipes shall be made of a suitably high quality steel and shall not be galvanized.

All pipes shall be laid through the pits and above floor. Where necessary, flexible hose or any other suitable device shall be employed to absorb vibration. All pipe joints shall be made with flanges or screws. Where necessary piping joints shall be protected against loosening by vibration. Stop valves shall be installed at places easily accessible for maintenance.

- g. Each set of the engine-generators shall be securely mounted on the common bed-plate and supplied by the manufacturer, and the concrete base on which the engine-generator is to be installed shall be provided with holes drilled in the concrete base (Concrete base and hole drilling works shall be the work of other contractor for Building Works). This steel common bed-plate of the engine-generator shall be fastened to the base by anchor bolts firmly laid into the holes, and the holes shall be reinstated thereafter in this Work with concrete mortar or other suitable material.

The Contractor for the engine-generator set shall submit with their tender documents structural calculations and drawings of proposed concrete beds for the engine generators, so that the building work contractor can construct them in time.

#### 5.16.5 GENERATOR

##### a. GENERAL

Generator shall be of the salient pole rotation field stationery armature 3 phases, 3 wires star connected type, having natural air circuit ventilation system, and shall be directly coupled to the engine on the common bed.

Generator shall be designed in consideration of operational harmonics obtained from commutating loads, CCR, UPS, etc.

##### b. RATINGS AND CHARACTERISTICS

Ratings and characteristics of generators shall be as follows;

Type	: 3 phases, 3 wires, 4 poles, : Neutral grounding
Degree of protection	: IP 23
Rated voltage	: 380 AC
Rated frequency	: 50 Hz
Rated speed	: 1500 r.p.m.
Rated load power factor	: Lag 80 percent
Rated capacity	: 1100 KVA (SGS 1, 2) 880 KVA (SGS 3, 4)
Rating	: Continuous
Insulation class	: Class H
Connection	: Star

Each generator shall cater for the 10% overload for maximum period of one hour in any twelve hours.

The neutral point of each generator shall be brought out and adequately insulated to a side-mounted terminal box of sufficient size and capacity and shall be suitable

for accommodating the necessary current transformer as specified herein. The neutral point shall be directly earthed with resistance to ground.

c. **EXCITATION SYSTEM**

Each generator shall be provided with a direct mounted three phases AC exciter to provide generator an excitation power through rotating rectifiers to generator field.

The exciter shall be the brushless type with the output to be rectified by rotating silicon rectifiers.

d. **AUTOMATIC VOLTAGE REGULATORS**

For the excitation system, a compatible automatic voltage regulator using static electrical components sensing on all three phases shall be supplied with generator.

Regulators shall include setting facilities to adjust the output voltage of the generator within the range of  $\pm 5\%$  of the rated voltage.

e. **VOLTAGE REGULATION**

Under steady condition, the output voltage shall be maintained within  $\pm 2.5\%$  of the rated voltage, at all loads from zero (0) to full load. The maximum voltage change shall not exceed 30% of rated voltage when a current equal to 100% of full load current suddenly increases from zero (0) to at any lagging power factor, and the voltage shall be restored to within minus 3% of the rated voltage in less than two (2) seconds.

f. **GENERATOR ACCESSORIES**

Space Heater

Space heater shall be installed, and shall be usually switched on while generator is out of service.

5.16.6 **ELECTRICAL EQUIPMENT**

a. **CONTROL PANEL (AUTOMATIC MAINS FAILURE)**

Generator control panel shall be fabricated from sheet steel, and set on the generator set, properly isolated from vibration for supplying power in the event of the power mains failure. A proper internal access shall be provided to facilitate both connection to and maintenance of the control panel, using the following equipment and instrumentation:

- 1 x AC voltmeter, flush mounting
- 1 x 7-position voltmeter selector switch
- 1 x frequency meter, flush mounting
- 3 x ammeter, flush mounting
- 1 x hours counter, flush mounting
- 1 x lubricating oil pressure gauge
- 1 x engine water temperature gauge
- 1 x battery charge voltmeter

1 x automatic mains failure solid state control unit, designed to meet all requirements for the control and protection of the diesel generating set.

The control unit shall comprise:

- ① Three phase sensing unit for mains, sensing limits 380 V - 270 volts
- ② Generator set running detection unit
- ③ Fail to start lock-out-unit
- ④ Three-attempt engine starting timer
- ⑤ Start delay timer
- ⑥ Transfer

The control unit shall be equipped with an Alarm and Status Indication System, in which each operational sequence alarm, set status and procedure shall be indicated by an illuminated message on the liquid crystal display (L.C.D.) panel in terms of the following panel controls:

**Alarm:**

- Emergency stop
- Low oil pressure
- High engine temperature
- Battery charging alternator fault
- Overspeed
- Fail to start
- Underspeed

**Status:**

- Generator Hz
- R.P.M.
- Generator on load
- Main on load
- Transferring generator / mains
- Warming
- Mains available
- Run on
- Waiting for generator to stop
- Hours run time

**Mains:**

- Available
- Waiting in auto
- On load

**Starting:**

- In auto
- By remote
- In normal
- In test
- Fuel on
- Starter on
- Cracking time
- Attempt on
- Crank at rest

**Running In test:**

- In auto
- In manual
- Remote

**Plant controls:**

**Function selector switch with positions:**

- test off load (mains failure simulation)
- off/alarm reset
- normal
- test on load

**Timers:**

- Start delay adjustable
- Multi-attempt start adjustable
- Protection hold-off
- Mans return delay adjustable
- Engine cool down adjustable
- Contractor delay adjustable

**b. LOAD OUTPUT CIRCUIT BREAKER PANEL**

Load Output Circuit Breaker Panel shall be the vibration isolated panel, mounted on the generating set adjacent to the control panel, and shall consist of:

- 1 x The 3-pole molded cable circuit breaker with thermal and magnetic overload trips.
- 1 x Neutral and neutral earth link
- 3 x Current transformers, complete with all necessary output terminals and aluminum gland plate.

**5.16.7 STARTING BATTERY AND CHARGER (DC SOURCE PANEL)**

Starting battery shall be provided for each SGS and used as energy source for engine starting DC motor.

Battery shall be lead-acid high rate discharge type and contained in transparent container. Battery shall be mounted on a withdrawable type steel rack and installed in a cubicle.

Nominal voltage of two batteries shall be 24V each, and number of cell shall be 12 cells.

Nominal capacity of each battery shall be sufficient to ensure engine starting.

Charger shall be indoor use, cubicle type self air-cooling, with automatic voltage adjuster. Rectification system shall be three phases, thyristor controlled type.

Charger shall have the following ratings:

Rating	: Continuous
Operation	: Automatic and manual
AC power source	: Three phases, 50 Hz, 380 V
DC setting voltage	
at floating position	: 26.2 V
at equalizing position	: 27.6 V

**CHAPTER 6**

**CONTROL AND MONITORING SYSTEM  
FOR APRON FLOODLIGHTS, VISUAL DOCKING  
GUIDANCE SIGNS AND AIRCRAFT STAND  
IDENTIFICATION SIGNS**



## 6.1 SCOPE

This work shall include all the goods and services that are required for engineering, supply and installation of the remote control and monitoring system for the Apron Floodlights (hereinafter called "FLO"), Visual Docking Guidance System ("VDGS") and Aircraft Stand Identification Signs ("ASIS") of Shanghai/Pudong International Airport, unless specified otherwise in this Chapter and in the tender documents.

## 6.2 SYSTEM REQUIREMENT

- a. The control and monitoring system to be provided under the contract shall comprise a system for control and monitoring of the FLO, VDGS and ASIS which shall be installed in the passenger terminal apron, the cargo apron and the maintenance apron.
- b. Such facilities as apron floodlights (FLO), visual docking guidance system (VDGS) and aircraft stand identification signs (ASIS) shall be controlled and monitored at the remote control panel of the General Control Center (GCC) which is located at the passenger terminal building, and the apron flood lights (FLO) to be installed at the cargo apron and maintenance apron shall separately and independently be controlled at each control desk of the cargo and maintenance buildings by the Shanghai/Pudong International Airport Authority.
- c. Interface devices shall be provided at each control position and at each substation and/or each equipment to carry out the control as well as response signal transfer.

## 6.3 GENERAL CONTROL CENTER

### 6.3.1 REMOTE CONTROL PANEL

- a. Remote control panel for control and monitoring of the apron floodlights (FLO), visual docking guidance system (VDGS) and aircraft stand identification signs (ASIS) of the passenger apron spots shall be installed at the General Control Center (GCC) in the passenger terminal building.
- b. Remote control panel shall consist of an operation section and a monitoring section, and the operation section shall be equipped with a touch panel.
- c. Remote control panel shall be of a self-supported construction made of steel plate, with doors or detachable cover to be provided on the front and back sides to ensure easy periodical maintenance and/or inspection.

Furthermore, the panel shall have such other option as to allow internal maintenance and/or inspection in the event that the door or cover is hard to be opened or detached.

- d. The steel plate for the panel shall be more than 2.3 mm thick, and for the door more than 3.2 mm thick to prevent themselves from distortion.
- e. The control section shall have the following functions:
  - i) Capable of switching "ON" and "OFF" for 2-circuit per spot of apron floodlights.
  - ii) Capable of switching "ON" and "OFF" of the obstruction lights collectively all the lights on all the masts.
  - iii) Capable of switching "ON" and "OFF" as well as controlling the "HIGH" and "LOW" intensity of all ASIS collectively on all their parking spots
  - iv) Capable of switching "ON" and "OFF", regulating the 3-stage intensity "HIGH", "MEDIUM" and "LOW" and displaying "TYPES OF AIRCRAFT" on each VDGS independently at every parking spot.
  - v) Capable of changing over between "AUTOMATIC" and "MANUAL" as a future option when the Automated Apron Spot Management System is introduced.
- f. The monitor section shall be able to display the following controlled lighting statuses and execute the following functions:
  - i) Capable of changing the status of each apron flood lights via "ON" and "OFF" function independently at every parking spot
  - ii) Capable of ["ON" and "OFF" operating status] switching of the obstruction lights.
  - iii) Capable of ["ON" and "OFF" operating status] switching of the ASIS.
  - iv) Capable of switching ["ON" and "OFF" operating status], ["OCCUPIED" or "UNOCCUPIED" operating status] as well as of "OCCUPIED AIR CRAFT TYPE" at each parking spot independently.
  - v) Status of the control position



- vi) Unusual situation such as the case of an non-designated aircraft invading the apron spot and overshooting the designated stop position, etc.
- g. An alarm device shall be provided on the remote control panels. The alarm shall be audible with acoustic sound and also visible with a blinking prompt on the monitor. Control of an acoustic sound shall be manual, but a blinking prompt can not be stopped manually but stay on the screen until such a critical situation is recovered.
- h. Intensity adjuster shall be provided for the panel.

#### 6.3.2 COMMUNICATION INTERFACE

- a. The communication interface with microcomputer shall be provided and furnished at the desk of the remote control panel.
- b. The communication interface with microcomputer shall be able to receive the input command signals from the control part, decode and transfer them to the signal cables connected to the GCC's secondary substations and remote apron substations.
- c. The communication interface with microcomputer shall be the type that can provide a "connecting interface" option to the future "AUTOMATED APRON SPOT MANAGEMENT SYSTEM" which will be introduced in the later stage of this project.
- d. The microcomputer shall be able to provide in itself a memory to store all the working data enough for full one (1) day's service. Furthermore, a magneto-optic disc (MO) operating unit with a device driver and a printer shall be provided for printing out all the recorded control and monitoring data and events with memory capacity to be good for one (1) year.

#### 6.4 SECONDARY SUBSTATION IN THE PASSENGER TERMINAL BUILDING AND SECONDARY SUBSTATION FOR REMOTE APRON

- a. Such apron floodlights, aircraft parking indication signs and visual docking guidance system as related to the passenger apron spots shall be supplied of their electric power from any one of the five (5) secondary substations in the terminal building and other two (2) secondary substations for the remote aprons.
- b. Communication interface shall be installed at each substation.

- c. Communication interface shall receive the command signals through the signal cables, decode and transfer them to each of the low voltage switch-gear, and the response signals returned back from these low voltage switch-gear shall be decoded and transferred to the signal cables to display their controlled operating statuses on the remote control panel.
- d. Communication interface shall forward such command and/or information signals as "AIRCRAFT TYPE" received from the remote control panel on to the VDGS, and then send the response signals received from the VDGS back to the remote control panel in such status display as "OCCUPIED", for example.

## 6.5 CARGO APRON SUBSTATION

### 6.5.1 CONTROL AND MONITORING

- a. Remote control panels for the apron floodlights concerning the control and monitoring of the cargo apron spots shall be installed in the cargo terminal building.
- b. Remote control panel shall consist of a operation section and monitoring section, and the operation section shall be of touch panel type construction.
- c. Remote control panel shall be of a self-supported construction made of steel plate, with doors or detachable cover to be provided on the front and back sides to ensure easy periodical maintenance and/or inspection.

Furthermore, the panel shall be so constructed as to permit ready access to its insides for internal maintenance and/or inspection in the event that the door or cover is hard to be detached off.

- d. The steel plate for the panel shall be more than 2.3 mm thick, and for the door more than 3.2 mm to prevent themselves from distortion.
- e. The control section shall be capable of performing the following functions:
  - i) Capable of switching via "ON" and "OFF" for 2-circuit per spot of apron floodlight.
  - ii) Capable of switching via "ON" and "OFF" of the obstruction lights collectively all lights on all the masts.
- f. The monitor section shall be able to display the following controlled lighting statuses and execute the following functions:

- i) Capable of changing the status of each apron flood lights via via "ON" and "OFF" function independently at every parking spot
- ii) Capable of [via "ON" and "OFF" operating status] switching of the obstruction lights.
- g. Illumination dimmer (Intensity adjuster) shall be provided for the panel.

## 6.5.2 COMMUNICATION INTERFACE

- a. The communication interface with microcomputer shall be provided at the desk of the remote control panel.
- b. Communication interface with microcomputer shall receive the input command signals from the control part, decode and transfer them to the signal cables for each of the low voltage switch-gears.
- c. Communication interface shall receive the command signals from the control section, decode and transfer them to each of the low voltage switch-gear, and then after receipt of the response signals from the above low voltage switch-gear and, after decoded and transferred, send them back to the monitor section of the remote control panel for display.
- d. The microcomputer shall be able to provide in itself a memory to store all the working data enough for full one (1) day's service. Furthermore, a magneto-optic disc (MO) operating unit with a device driver and a printer shall be provided for printing out all the recorded control and monitoring data and events with memory capacity to be good for one (1) year.

## 6.6 MAINTENANCE APRON SUBSTATION

### 6.6.1 CONTROL AND MONITORING

- a. Remote control panels for the apron floodlights shall be installed in the aircraft maintenance building.
- b. Remote control panel shall consist of a operation section and a monitoring section, and the operation section shall be of touch panel type construction.
- c. Remote control panel shall be of a self-supported construction made of steel plate, with doors or detachable cover to be provided on the front and back sides to ensure easy periodical maintenance and/or inspection.

Furthermore, the panel shall be so constructed as to permit ready access to its insides for internal maintenance and/or inspection in the event that the door or cover is hard to be detached off.

- d. The steel plate for the panel shall be more than 2.3 mm thick, and for the door more than 3.2 mm thick to prevent the panel from distortion.
- e. The control section shall be capable of performing the following functions:
  - i) Capable of switching via "ON" and "OFF" of each apron floodlight independently at each lighting group on the apron parking spots
  - ii) Capable of switching via "ON" and "OFF" of the obstruction lights which are installed on top of the masts of the apron floodlights and collectively controlled all lights on all the masts.
- f. The monitor section shall be able to display the following controlled lighting statuses and execute the following functions:
  - i) Capable of changing the status of each apron flood lights via via "ON" and "OFF" function independently at every parking spot
  - ii) Capable of [via "ON" and "OFF" operating status] switching of the obstruction lights.

#### 6.6.2 COMMUNICATION INTERFACE

- a. The communication interface with microcomputer shall be provided at the desk of the remote control panel.
- b. Communication interface with microcomputer shall receive the input command signals from the control part, decode and transfer them to the signal cables for each of the low voltage switch-gear.
- c. Communication interface shall receive the command signals from the control section, decode and transfer them to each of the low voltage switch-gear, and then after receipt of the response signals from the above low voltage switch-gear and, after decoded and transferred, send them back to the monitor section of the remote control panel for display.
- d. Microcomputer shall be capable of storing the control and operating status data in a sufficient memory which is good for one (1) day.

A means of MO operating device with a disk driver and a printer shall be furnished with a memory capability to be good for one (1) year service.



**CHAPTER 7**

**CONTROL AND MONITORING SYSTEM FOR  
POWER DISTRIBUTION SYSTEM**





## 7.1 SCOPE

This work shall include all the goods and services that are required for engineering, supply and installation of the remote power control and monitoring system for the Electric Power which shall be distributed to the respective airfield lighting (AFL) and other lighting facilities of Shanghai/Pudong International Airport, unless specified otherwise in this Chapter and in the tender documents.

## 7.2 SYSTEM REQUIREMENT

- a. The system and facilities to be provided under the contract shall comprise a control and monitoring system of the electric power distribution system and the facilities required to be constructed for such a control and monitoring system in the aerodrome such as Main and Secondary Power Substations which will be co-located in the same buildings of Main and Secondary AFL Substations and sharing on the consoles side by side in the same control rooms.
- b. The electric power shall be supplied and distributed from the Main Airfield Substation (35 kV) to the Main Airfield Lighting (AFL) Substation (10 kV). The power distributed to the Main AFL Substation, etc. shall be remotely controlled and monitored from the control panel (touchscreen type), the graphic panel (mosaic type) of the Main AFL Substation, as well as from the local control panels (touchscreen type) of the Secondary AFL Substation.
- c. Interfaces required for the above power control and monitoring system shall be provided respectively at the remote control panel including Graphic panel (mosaic type) in the Control Room of the Main AFL Substation, as well as at the local control panel in the Control Room of the Secondary AFL Substation. These interfaces shall interact, by means of signal cables (optical fiber cable or metal cable), with the Central Processing Facilities to be equipped at the Computer Room (CPU Room) of the Main AFL Substation for transfer of signals relating to the power control and monitoring system.
- d. Direct speech telephone system shall be installed at both Main and Secondary AFL Substations to maintain verbal communication with the Main AFL Substation. The telephone cables required under the this project shall be supplied and installed by other contractor, but all the relay boards and inner side wiring required to be installed to connect the board to the telephone shall be provided in this work under the contract.

## 7.3 CONTROL ROOM OF THE MAIN AFL SUBSTATION

### 7.3.1 SYSTEM CONFIGURATION

The following equipment shall be installed in the Control Room of the Main AFL Substation.;

- |   |       |
|---|-------|
| 1) Remote power control panel with touch control part and status display part | 1 set |
| 2) Graphic panel (Mosaic Type) with control and monitoring function           | 1 set |

- 3) Data processing unit with a display and a printer 1 set
- 4) Direct speech telephone with a relay box 1 set

### 7.3.2. REMOTE POWER CONTROL PANEL

- a. Remote power control panel shall consist of an operation section and a monitoring section, suitable for installation on the console.
- b. Console type desk shall be of a self-supported construction made of steel plate, with doors or detachable covers to be provided on its front and back sides for use during periodical maintenance and/or inspection. In addition, the console shall have an alternate option to permit an internal maintenance and/or inspection in case of its upper panels happen to be so difficult to be removed. The outside appearance of the desk shall match that of the neighboring AFL console.
- c. The steel plate to be used for the panels/desk shall be more than 2.3 mm in thickness, and for the door, more than 3.2 mm to protect the panel/desk from distortion.
- d. The operating section shall have the following functions to allow:
  - 1) the "ON" and "OFF" operation for each Vacuum Circuit Breaker (VCB)
  - 2) the "ON" and "OFF" operation for each Air Circuit Breaker (ACB), and Magnetic Contactors
  - 3) the "CHANGE-OVER" operation between circuit 1 and circuit 2
  - 4) the "CHANGE-OVER" operation between commercial circuit and standby generator circuit
  - 5) the "CHANGE-OVER" operation between UPS circuit and commercial circuit.
- e. The monitoring section shall consist of a display delineated with one (1) line diagram showing the power cable line starting from the 10 kV receiving point to the secondary circuits of the CCRs.
- f. The monitoring section shall have following display functions to allow:
  - 1) the "ON" / "OFF" operating status via "RED" and "GREEN" touch symbols
  - 2) the "active circuit finding status" via the color change from "GREEN" to "RED" indicated on the one-line diagram.
- g. The control panel shall be able to indicate the voltage (V) obtained at primary and secondary circuits of each transformer, the voltage of each UPS at its secondary circuit and the generating voltage respectively through change of the panel screens.
- h. The control panel shall be able to indicate the electric current (A) obtained at all 10000 V, 380 V and 220 V circuits except the secondary current of the CCRs respectively through change of the panel screen.
- i. The warning device shall be incorporated in the system for any fault caused in the operation of the remote panel. Each visual alarm shall appear with a rapid and

distinguishable blinking symbol in red color. Audible beep shall start sounding under such condition. In case of the trouble caused to the engine generator, the warning on the screen shall be classified into "SERIOUS FAULT" and "SLIGHT FAULT" indications depending on the classified types of risks.

- j. By operating the reset symbol, the audio warning shall be stopped, but visual warning shall continue until faults are fully remedied.
- k. Graphic panel (mosaic type) shall be of a self-standing mosaic type and shall be able to indicate figurative one-line diagram with a cable line starting from the 10 kV receiving point to the secondary circuits of the CCRs.
- l. Graphic panel (mosaic type) shall have the same control functions as those of remote power control panel and shall be controlled by means of the touch buttons located close to the figurative switches etc. In addition, graphic panel (mosaic type) shall have the same monitoring functions as those of the remote power control panel and shall be installed close to the control buttons. All pilot lamps shall be of LED type.
- m. The "CHANGE-OVER" switch of the operating positions shall be equipped at the power graphic panel to change the operation positions between remote power control panel and the graphic panel (mosaic type), and between the remote Main Substation power control panel and the local power control panel of the Secondary AFL (Power Control) Substation.
- n. Voltage and current shall be indicated on the remote power control panel with a digital indication.
- o. Graphic panel (mosaic type) shall have warning functions equivalent to that of the above-mentioned remote power control panel.
- p. Graphic panel (mosaic type) shall have a brightness control function to control the pilot lamps.
- q. Graphic panel (mosaic type) shall be provided with a display testing device which shall be made operational by means of a touch button.

#### 7.4 COMPUTER ROOM OF THE MAIN AFL SUBSTATION

##### 7.4.1 SYSTEM CONFIGURATION

Central processing facilities for AFL as specified in the tender document shall be utilized as an interface for monitoring and control of the power distribution system which shall co-dwell with the same central processing facilities of the Main AFL Substation.

##### 7.4.2 AN OPERATION - STORAGE FUNCTION

Such operation-storage functions as control, fault alarm, voltage/current monitoring and storage shall be provided, which shall be good for monitoring and recording the operating behavior/status of the power distribution system.

- 1) A memory shall be able to store the power control and fault record as well as digitized values of the voltage and current per hour for a period of one day. The data thus obtained shall be stored in a MO disk or some other means of memories as good as one-year data volume.

- 2) The recording shall be performed in the following manner:
  - i) The operating state/behavior shall be recorded with featured cases of failure in power and control, and transition of events with date, time and name of equipment to be appended for printing out.
  - ii) Insulation resistance shall be monitored and stored with data obtained at the low tension circuits excluding those obtainable at CCR circuits.
  - iii) The power control and monitoring unit shall print out the above records with a printer installed on the desk of the Control Room.

#### 7.4.3 INTERFACE FUNCTION

The communication interface for control and monitoring of the power distribution system shall be provided to work together with the communication interface for AFL with a co-dwelling computer software engineered, so that the interface can work as an integral part for both AFL and power.

### 7.5 LOCAL CONTROL ROOM OF THE SECONDARY SUBSTATION

#### 7.5.1 LOCAL POWER CONTROL PANEL

- a. Local power control for AFL which shall be equipped on the desk of the Control Room of the Secondary AFL Substation shall work also for the control and monitoring of the power distribution system.
- b. Therefore, the local power control panel in the Secondary AFL Substation shall be provided with the same identical functions to those of the remote power control panel of the Main AFL (Power Control) Substation.

#### 7.5.2 COMMUNICATION INTERFACE

- a. Communication interface for AFL which is installed in the control room shall also work together with that of the power distribution system.
- b. The communication interface shall receive input command signals from the Main AFL Substation, and decode and transmit them to the local control panel.
- c. Furthermore, the communication interface shall receive the response status signals from each equipment and transmit them to the Main AFL Substation
- d. These interface functions shall be integrated as one unit with the AFL interface in function.
- e. The communication line for power distribution system shall be commonly used with that for AFL.

#### 7.5.3 DIRECT SPEECH TELEPHONE SYSTEM

- a. Direct speech telephone system shall be provided at the Control Room of the Main AFL(Power Control) Substation to render the verbal communication services relating to the power control system.

- b. The work to be included in the contract shall be limited to the supply and installation of :
- Two (2) telephones between Main and Secondary AFL Substations
  - One (1) telephone between Main AFL and Main Airfield Substations
  - Two (2) telephone relay boxes
  - The related cabling work necessary for connection up to the inner terminals of the telephone relay box.
- c. The telephone installation(s) at the Main Airfield (35 kV) Power Substation as well as the associated cabling work to be required between the outer terminal of the relay box of the Main AFL (Power Control) Substation and the Main Airfield (35 kV) Power Substation shall be the responsibility of the Shanghai/Pudong International Airport Authority.

#### 7.5.4 SYSTEM RELIABILITY AND REDUNDANCY

System reliability and redundancy shall be as specified in the Specifications.

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**SECTION 2**  
**BUILDING WORKS**





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# **CHAPTER 1 ARCHITECTURAL WORKS**

## **1.1 EXCAVATIONS AND EMBANKMENT**

### **1.1.1 GENERAL**

Except as otherwise provided herein or directed by the Engineer, excavations and embankments works shall conform to Section 2.2 of the Special Provision of Specification for Airside Civil Works.

## **1.2 BACKFILLING**

### **1.2.1 GENERAL**

Except as otherwise provided herein or directed by the Engineer backfills works shall conform to Section 4.2.3.5 of Special Provision of Specification for Airside Civil Works.

## **1.3 SAND AND CRUSHED STONE BED**

### **1.3.1 GENERAL**

Except as otherwise provided herein or directed by the Engineer, sand and crushed stone beds shall conform to section 2.3.2 and 3.1.1.3 of the Special Provision of Specification for Airside Civil Works.

Sand and crushed stone beds shall be provided under slab and footing on grade and other portions as shown on the drawings.

## **1.4 CONCRETE WORKS**

### **1.4.1 GENERAL**

Except as otherwise provided herein or directed by the Engineer, the concrete, reinforcing steel bars and formworks shall be performed in accordance with the provisions of concrete works as stipulated in Section 3 of these Specifications.

The class of concrete to be used for the building and other structures shall be of C20, and leveling concrete shall be of C10. All concrete shall be made with ordinary Portland cement specified hereto.

### **1.4.2 TRANSPORTING AND PLACING**

#### **a) General**

Concrete placement shall be in accordance with Chinese Standards

The contractor shall establish manner and schedule for transporting and placing of concrete and obtain approval of the Engineer. Concrete shall be transported in a manner to minimize segregation, spillage and other changes in quality thereof. Concrete shall be placed and consolidated in a manner to insure uniformity and optimum density.

In case of rain or other conditions which may affect the quality of concrete during concreting, the Contractor shall take necessary measures as instructed by the Engineer.

b) Time Limit

The time limit from start of mixing to completion of placing of a batch, as a general rule, shall be 90 minutes.

c) Preparation Prior to Placing

The place where concrete is to be deposited shall be cleaned and sheathing shall be sprinkled with water. Subsequently, water accumulated in the form shall be removed.

d) Construction Joint

Joint surfaces shall be cleaned, made free of laitance and other foreign matters, and wetted prior to concreting. Joint surface shall be roughened if directed by the Engineer.

The locations and shapes of construction joints shall be discussed with and approved by the Engineer.

e) Concrete Placing.

1) Placing

Concrete placing shall be done in a manner as to keep the surface of placed concrete as horizontal as possible. Concrete shall be continuously poured to complete the portion as planned. Concrete shall be properly placed and compacted around reinforcing bars and corners of form work.

The maximum time interval between placements of continuous concreting shall not exceed 90 minutes. However, when special measures are taken this time limit may be changed according to instruction or approval of the Engineer.

2) Horizontal Movement

Movement may be by means of suitable clean chutes, troughs or pipes. Do not use water to facilitate the movement.

### 3) Vertical Movement

In vertical elements, limit the free fall of concrete to 1500 mm per 100 mm element thickness, up to a maximum free fall of 3000 mm, by means such as enclosed chutes, access hatches in forms, and the like.

As far as practicable keep chutes vertical and full of concrete during placement, with ends immersed in the placed concrete.

#### f) Consolidation

Vibrating of concrete and tapping of form work shall be performed to wall, column and other places difficult for concrete to fill. Proper number of workers for placing and compacting concrete shall be arranged.

Vibrator shall be operated for concrete calling for water tightness, difficult portion for concrete to fill and other cases as directed by the Engineer. However, vibrator shall not touch reinforcing bars and shall not be operated for more than 30 seconds at the same spot.

Concrete shall be placed in separate 0.3-0.6 m in thickness increments when vibrator is used. In case flexible-insert-vibrator is called for, concrete shall not be placed thicker than the length of the insert or vibrator at one pouring.

#### g) Placing Speed

Concrete shall be placed at speed suitable for the workability of the concrete and condition of the place of placement, in order to insure proper consolidation of concrete.

#### h) Hot Weather Placing

The Provisions of this clause shall apply to concreting when the surrounding outdoor shade temperature is greater than 32°C.

Do not mix concrete when the outdoor shade temperature on the site exceeds 38°C, unless otherwise approved and then only subject to such conditions as may be imposed.

Take precautions to prevent premature stiffening of the fresh mix and to reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete as rapidly as possible.

Before and during placing, maintain the formwork and reinforcement at a temperature not greater than 32°C by protection, cold water spraying, or other effective means. When placed in the forms, the temperature of the concrete shall not exceed the following:

<u>Concrete element:</u>	<u>Temperature limit:</u>
Normal concrete in footings, beams columns, walls and slabs:	35°C
Concrete in large mass concrete sections; or Concrete of strength 40 Mpa or greater, in sections exceeding 600 mm in thickness:	27°C

Submit for approval the proposed method or methods of maintaining the specified temperature of the placed concrete, which may include:

- using chilled mixing water; or
- spraying the coarse aggregate with cold water; or
- a combination of these methods.

#### 1.4.3 INSPECTIONS.

##### a) Notice

Give minimum of 24 hours notice so that inspection by the Engineer may be made of the following:

- base or subgrade prior to covering;
- film underlay or membrane installed on the base;
- completed formwork;
- reinforcement and tendons fixed in place;
- cores and embedments fixed in place;
- placing of concrete;

#### 1.4.4 EMBEDMENTS, FIXINGS, JOINTS.

##### a) Embedments and Fixings

Location of embedments and fixings shall not cut or displace reinforcement, or cut hardened concrete unless prior approval has been obtained from the Engineer.

##### b) Joints

Make construction joints as shown on the drawings in accordance with Chinese Standards

Before fresh concrete is placed at a construction joint, roughen and clean the

hardened concrete surface of the joint, so that all loose or soft material, free water, foreign matter and laitance is removed. Just prior to placement, dampen the hardened concrete surface, without leaving free water.

Unless otherwise shown on the Drawings or specified, butt joint the surfaces of adjoining pours. In visually important surfaces make the joint straight and true, and free from impermissible blemishes relevant to its surface finish class.

c) **Monolithic Finish**

Floor slabs to be finished with polyvinyl sheet flooring or permanently exposed shall be monolithic finish. When preliminary floated finish has hardened sufficiently to prevent an excess of fine material from being drawn to the surface, steel trowelling shall be commenced, steel trowelling shaft be performed by mechanical trowelling machine. The finished surface shall be a dense uniform surface, free from blemishes and trowel marks. Spinkling of the surface with dry cement or any other material will not be permitted.

## 1.5 BRICK AND CONCRETE HOLLOW BLOCK MASONRY

### 1.5.1 GENERAL

- a) **Materials and Workmanship**  
Materials and workmanship shall comply with one or more of the current edition of the following Chinese standards.
- b) **Execution Drawing**  
Work shall comply with this specification unless otherwise stated on the drawings. Any work not specified shall be discussed and directed by the Engineer. Execution drawing of block alignment (inclusive of indication for hanging bolt, wood-plug and conduit pipe), detail reinforcement, window opening, door opening, and other requirements shall be prepared and submitted for approval by the Engineer.
- c) **Stake-Board**  
Stake-board shall be provided at each 5 m in length and shall be inspected by the Engineer for accuracy, firmness and secureness. However, suitable ruler, plumb-bob and hand leveler shall be provided for minor performance of concrete block and bricks.
- d) **Transportation and Storing**  
Care shall be taken to prevent damage during transportation of material. Defects of natural finished concrete blocks or bricks shall be rejected. Different size of material shall be stored separately and protected from dirt and other impurities.
- e) **Curing**  
No shock or load shall be applied until concrete mortar or other fills have hardened. Corner, projection and top of concrete block or brick work shall be protected from rain, dryness, cold, damage and stain by covering. Void between blocks shall not be intruded by rain water.
- f) **Cleaning**  
The block work shall be cleaned down on completion by removing all surplus mortar to the satisfaction of the Engineer.



## 1.6 TILE WORK

### 1.6.1 GENERAL

#### a) Materials

Samples of material shall be submitted and approved for manufacture, product name by areas of use, class, shape and size, color tone, body, glaze and quality in accordance with the drawing.

Portland cement shall conform to the requirements of Chinese Standard. Mortar shall be used adding water to machine mixed dry grout. Mortar that has been standing for over an hour after water was added shall not be used. Mixing volume ratio of mortar shall be as follows:

Areas of Use	Cement	Sand
Setting and Paying Mortar(for Floor )	1	4
Setting Mortar for Tile of High Permeability(for wall )	1	2.5
Joint Filler	1	1

Pure cement shall be used in case of joint width less than 3 mm. For use of white cement for joint filler, color hue, mixing ratio, etc., shall be in accordance with the direction of the Engineer.

#### b) Tile Layout

Layout plan shall be made in accordance with the design drawings and as approved by the Engineer.

#### c) Tile Preparation

Color tone, distortion, size, etc., shall be checked and sorted out before preparing tile, and areas of use shall be decided. Tiles with uniform thickness shall be selected for bond setting. Tiles with high permeability shall be soaked without fail before setting.

#### d) Setting

##### 1) Standard Tile.

Preparation of setting bed-leveling mortar shall be applied and scratched. Mortar shall be applied in several separate layers where leveling is needed.

However, foreign objects such as debris of brick or tile shall not be spread. Tile shall be set after mortar has been set for more than 5 days.

Setting bed shall be cleaned and wetted. Leveling string shall be provided in accordance with joint layout, and tiles are set after checking for distortion, joint widths, etc. Backfilling mortar shall be spread into every corner, but care shall be taken not to sprinkle fresh cement. Raking shall be done out to the depth of 5 mm after tile has been set for 3 hours, and tile surface shall be cleaned with cloth or equivalent. Care shall be taken not to apply external force or vibration for 7 days after tile has been set.

The use of waterproofing agent, admixture or special joint filler for joint fill after setting mortar has been hardened shall be in compliance with the specification.

2) Mosaic Tile.

Preparation of setting bed shall comply with that of standard tile.

Setting bed shall be cleaned and wetted. Dry mortar shall be spread to a thickness of 10 mm and tapped with wood trowel until the surface becomes wetted and then screeded to get a level surface. Water pitch shall be provided as necessary. After dry mortar has been set for more than 24 hours, wet mortar with mixing ratio of cement 1 to sand 1 shall be spread to a thickness of 4 mm, and tiles shall be laid after leveling strings have been provided in accordance with joint layout.

Tile top shall be tapped with wood trowel until mortar shows up in joints and then papers shall be taken off after wetting the surface. Tile joint shall be aligned. Glue shall not be used on the above mortar.

Wet neat cement shall be applied to joint after tiles have been set for more than 24 hours. Tile surface shall be cleaned with cloth, etc., and further washed with water after more than 24 hours have passed.

e) Curing

Tile setting work shall be properly cured or stopped temporarily in conditions of direct sunlight, wind, rain, etc., which are injurious to work. Work already executed shall be properly cured depending on place and weather.

f) Cleaning

Tiled surface shall be cleaned as a rule with water after joint has been filled for more than a week. When acid solution is used to clean the surface, tiles already watered

shall be washed with approval of the Engineer by thinner thinned 20 times and soon thereafter washed with water so that there is no acid left in joints. In acid washing, care shall be taken not to leave acid on adjacent finishes such as sash, terrazzo, accessories on sanitary equipment, etc.

## 1.7 CARPENTRY

### 1.7.1 GENERAL.

- a) Scope  
Carpentry work shall conform to this specification unless otherwise specified.
- b) Shop Drawing  
Samples, shop drawings, full scale drawing and other required drawings shall be submitted for the approval of the Engineer according to the drawings.
- c) Standard of Material  
Material shall be suitably dried and conform to required standard and requirement concerned.
- d) Material.
  - 1) Lumber  
Material for fixture shall not be center of wood. All timber shall be well-seasoned and shall be free from large knots, flaws, shakes or blemishes of any kind. Timber with loose, rotten or dead knots will not be accepted.  
  
Dimension specified shall be size of sawn lumber, however dimension specified for fixture shall be size actually finished. Twisted or warped materials shall not be used.
  - 2) Plywood  
Plywood shall conform to;

### 1.7.2 WALL AND CEILING FRAMING.

- a) Material  
Material shall be as otherwise specified or as directed by the Engineer.
- b) Performance  
Performance shall conform to the following items unless otherwise specified on the drawings. Furring strips and studs directly covered by finishing board and other finishing material shall be planned with planner machine.

Wall furring strip and stud shall have size and interval of 75 x 50 mm @450 mm centers.

Nogging for plywood, gypsum and Fiber cement board shall be butted and nailed between studs.

Size of furring strips for ceiling shall be as shown on drawings or as approved by the Engineer. Furring strips shall be provided at all ceiling joint. Interval shall approximately @150 mm centers.

## 1.8 WATER PROOFING WORK

### 1.8.1 GENERAL

#### a) Scope

This chapter covers the requirements for providing all the waterproofing work. The work shall include furnishing all labor materials, equipment, tools and transportation necessary to complete the waterproofing work indicated on the drawings and specified herein.

#### b) Item of Work

Item of the work shall include but not be limited to the following:

- a. Cement mixed waterproofing finishes
- b. Asphalt Waterproofing
- c. Synthetic high polymer-based roofing sheet waterproofing
- d. Urethane-based Film waterproofing
- e. Sealing work

### 1.8.2 MATERIALS

- a) The Contractor shall submit a certificate and samples of the materials to the Engineer for his approval before use.
- b) All waterproofing materials shall be properly protected so as to prevent damage before use.

### 1.8.3 GENERAL REQUIREMENTS

#### a) Climatic conditions

The Contractor shall be responsible for determining in consultation with the Engineer whether or not the waterproofing work shall be carried out when rain is expected or base surfaces are wet due to rain or under such adverse climatic conditions as strong winds or high humidity.

#### b) Base Preparation

- 1) All cement rendered and or concrete surfaces to receive the waterproofing work shall be cleaned and be free from dust, staining, oil and laitance.
- 2) All base surfaces shall be finished true to slope as specified and well drained, especially around drain outlets.

#### c) Waterproofing Test

When the Engineer deems necessary to inspect the performance of waterproofing work, the Contractor shall test in accordance with the instruction of the Engineer.

#### 1.8.4 APPLICATION

- a) Cement Mixed Waterproofing
  - 1) Mixing shall be conducted in accordance with Manufacture's Instructions.
  - 2) The waterproofing mortar shall be applied to have thickness of 25-30 mm and three coat work.
- b) Asphalt Waterproofing
  - 1) Asphalt waterproofing shall be applied to the roof area where indicated on the drawings.
  - 2) Asphalt waterproofing shall be complied as followings.
    1. Primer
    2. Asphalt roofing, Asphalt flow coating
    3. Strech roofing, Asphalt flow coating
    4. Asphalt roofing, Asphalt flow coating
    5. Asphalt brushing
    6. Covering concrete on mortar
  - 3) Application shall be conducted in accordance with the manufacture's Instructions
- c) Synthetic highpolymer-based roofing sheet Waterproofing
  - 1) Synthetic highpolymer-based roofing sheet waterproofing shall be applied to the roof area where indicated on the drawings.
  - 2) Waterproofing layers shall be complied as followings.
    1. Primer
    2. Adhesive coating
    3. Roofing sheet
    4. Finish paint coating
  - 3) Application shall be conducted in accordance with the Manufacture's Instructions.
- d) Urethane-based Film Waterproofing
  - 1) Film waterproofing shall be applied to the roof area where indicated on the drawings.
  - 2) Waterproofing layers shall be complied as followings.
    1. Primer coating
    2. Urethan waterproofing materials, reinforcing cloth.
    3. Urethan waterproofing materials.
    4. Urethan waterproofing materials.
    5. Finish paint.

#### 1.8.5 CURING AND PROTECTION

- a) Cement Mixed Waterproofing

Applied surface shall be properly protected to prevent overrapid drying and be

allowed to harden completely before supporting traffics.

- b) Asphalt Waterproofing, Synthetic highpolymer-based roofing sheet waterproofing, Urethan-based Film waterproofing  
Curing and protection shall be done on accordance with Manufacture's Instruction.

#### 1.8.6 SEALING WORK

- a) Materials

Sealing materials used shall be conform to Chinese Standards or JIS A 5758 "Sealing compounds for Sealing and Glazing in Buildings" and as following or approved equivalent.

- 1) Silicone sealing compounds
- 2) Modified silicone sealing compounds
- 3) Polysulfide sealing compounds
- 4) Other materials such as primer, back-up bond breaker or curing tape shall be necessary and in accordance with manufacturer's instructions.



b) Application

- 1) silicone sealing shall be filled for metal-metal joints, glass-glass joints and metal-glass joints as indicated on the drawings.
- 2) Modified silicone sealing shall be filled for metal-concrete or tiles joints and concrete-precast concrete or tiles joints as indicated on the drawings.
- 3) Polysulfide sealing shall be filled for all exterior construction joints, around exterior door and windows and other joints as indicated on the drawings.

1.8.7 WARRANTY PERIOD

Warranty period of Asphalt waterproofing shall be 10 years after the date of delivery of the buildings.

## 1.9 METAL

### 1.9.1 GENERAL

a) Scope

This chapter applies to steel, iron, non-ferrous metal, ready-made products made of these metals and order-made products as specified in drawings.

b) Material

All materials to be used for the metal works shall conform to Chinese Standards, unless otherwise specified on the Drawings.

Shop drawing of order-made product shall be submitted for approval of the Engineer (ready-made product excluded). Take and confirm dimensions on site, before preparing Shop Drawings where possible.

Quality analysis, strength and other required tests of material shall be performed if directed by the Engineer.

c) Anti-Corrosion Treatment

Anti-corrosion coating for steel products shall be as approved by the Engineer unless otherwise specified, and portion inserted in concrete or exposed outdoor and placed in moisture shall be hot dip galvanized to JISK5621 or equivalent or applied with rust-proof paint unless otherwise specified.

Anti-corrosion coating shall be applied to portion of non-ferrous metal product in contact with other corrosive material according to direction of the Engineer.

Damage to anti-corrosion coating shall be remedied immediately.

d) Protection and Cleaning

Proper protection shall be provided after installation according to direction of the Engineer. At the time of completion, protection shall be removed and product shall be cleaned with care.

### 1.9.2 INSTALLATION.

a) Installation Before Concreting

Position of product or material shall be accurately marked and properly supported according to dimension and weight without obstructing other works such as form work. Level shall be checked and welded, bolted, riveted or other means of securing. Proper attention shall be paid for displacement during concreting.

b) **Installation After Concreting**

Fastener and other jointers shall be placed in position and at intervals strictly according to drawing and suitable for installation. Product shall be firmly installed in designated position by wedging, supporting-packing and other means. Inserted portion of fastener and other jointers shall be packed with mortar 1:3 volume mixture.

1.9.3 **OTHER PRODUCTS.**

a) **Hand-Rail**

Quality and dimension shall conform to drawings. Hand-rail shall be produced from one piece of material and if joint of material is unavoidable, joint shall be firmly welded, brazed or reinforced with additional plate and bolted.

Baluster shall be provided in accordance with drawing. Baluster shall be welded, solder, brazed or bolted to handrail or bottom-rail, and in case bottom-rail is not provided, baluster shall be firmly secured to structural member. Bottom-rail shall be firmly assembled and welded, brazed, screwed or bolted to baluster.

Exposed surface of welding and brazing shall be grinded or sanded even.

1.9.4 **LATH.**

a) **Metal-Lath (Mortar Bedding)**

Metal wire lath shall be of galvanized expanded metal with diamond mesh having a metal sheet thickness of not less than 0.3 mm. Joint of metal-lath shall be lapped more than 50 mm and zigzag stapled at approximately every 300 mm or 150 mm for ceiling.

1.9.5 **LIGHT-WEIGHT GAUGE STEEL.**

a) **Suspended Ceiling Frame**

Light-weight gauge steel for ceiling frame shall conform to drawing and sample or catalog shall be submitted and approved by the Engineer for quality and dimension. Execution drawing of lay-out shall be prepared, according to drawing for approval of the Engineer. Insert-fastener shall be secured to a structural member at every 900 mm. Bolt-hanger shall be 9 mm diameter unless otherwise specified. Main-frame shall be provided at every 600 mm and jointed to bolt-hanger. Sub-frame shall be provided at approximately every 1200 mm and jointed to main-frame. Ceiling frame shall be reinforced at opening.

## 1.10 PLASTER AND CEMENT WORKS

### 1.10.1 GENERAL

a) Storage of Materials

Plaster materials already inspected shall be stored in order to avoid stain, etc. Pigments shall be especially handled with care. Those materials which are affected by moisture such as plaster and cement shall be stored properly.

b) Preparation of Setting Bed

Deformation, unevenness on wall or floor of concrete, brick or concrete block shall be corrected. Concrete surface which is too smooth to plaster shall be roughened with chisel, etc. Base coat for plaster board backing shall be plaster board base coat.

c) Cleaning and Wetting of Backing and Base Coat

Dry backing of concrete, brick or concrete block or dry base coat of cement mortar or plaster shall be properly wetted. Backing and base coat shall be cleaned thoroughly before plastering. Looseness on backing or plastering face shall be immediately corrected.

d) Protection Against Cracks

Around grooves of casing, base board, coping, stile, etc. shall be left unfilled by thickness of a trowel. Those places likely to be cracked such as corners at opening joints of lath, excelsior plate, plaster board shall be applied with cloth in plastering and metal lath inclement mortar. Protection against cracking at joints of concrete and wood, brick or concrete block shall be properly dealt with under the direction of the Engineer.

e) Sample Application

Sample shall be submitted or sample application shall be conducted and approved by the Engineer for those finishes requiring samples for color tone and special surface finish.

### 1.10.2 CEMENT MORTAR PLASTERING

a) Scope

This section shall apply to cement mortar made principally of cement, sand and water for application to building.

b) **Materials**

Cements, sand and water shall conform to those of concrete work. Grading of sand, however, shall be as following:

Grading of Sand	Mortar Plastering	Plaster
5 mm Those Sifting Through 100%		
0.15 mm Those Sifting Less Than 10%	For First and Second Coat	For First Coat and Dubbing Out
2.5 mm Those Sifting Through 100%		
0.15 mm Those Sifting Less Than 10%	For Finish Coat	For Second Coat

White cement shall conform to the requirements of Portland cement, GB175 JISR5210 or equivalent. Pigment shall be alkali-proof and inorganic and one which does not go through noticeable color change under direct sunshine or temperature below 100°C and which does not rust metals by dissolving in the water. The use of admixture shall be approved by the Engineer before its use. The amount of admixture shall be such that mortar strength is affected very little. Waterproof agent shall be best quality.

c) **Mixing Ratio**

Mixing volume ratio of mortar shall be as following:

Base	Area of Application	First Coat on		Finish Coat Cement:: Sand Admixture
		Lath Cement: Sand	Dubbing Out Cement: Sand	
	Floor	-	-	1:2.5
Concrete/ Concrete Block Brick	Interior Wall	1:2.5	1:3	1:3 : 0.1
	Exterior Wall/			
	Others	1:2.5	1:3	1:3
Metal Lath Rib Lath	Interior Wall	1:3	1:3	1:3 : 0.1
	Exterior Wall/			
Wire Lath	Others	1:2.5	1:3	1:3

Note: (1) One part of coarse sand of 3-5 mm shall be allowed to be added to first coat on wire lath

(2) Fiber shall be mixed for first coat on lath if work calls for it.

d) Application

The surfaces which are to receive scratch coat shall be free from all laitance, scum, loose carbonate scale, loose aggregate, dirt and other foreign matters. In case of cement mortar or brick surface, they shall be sufficiently and uniformly dampened immediately before the application of mortar. Concrete surfaces shall be kept wet for 24 hours prior to the application of mortar.

Where shown on the Drawings or directed by the Engineer, metal wire lath shall be fixed to the brick, brick or concrete walls before applying cement mortar plaster. The metal wire lath shall be fixed to the structure with staples.

Cement mortar shall be used within 90 minutes from the time of mixing. Retempering shall not be permitted.

The rendering for tile works shall be made in 2 coats to 18 mm thick and its surface shall be cross scratched. In case of cement mortar finish, mortar shall be applied in 3 coats making the total thickness of 30 mm for floors and 20 mm for other areas. Concrete floors may be plastered in one coat if the surface are smooth and level upon approval of the Engineer. Reduction of number of coats and total thickness in other areas if proposed by the Contractor shall be subject to approval of the Engineer. Cement mortar finish shall be metal trowel finished unless otherwise specified. When the finish coat is applied, the entire surface or a bay of floor, wall or ceiling shall be finished in one operation in order to minimize joint marks.

Where expansion and control joints exist in the base structure, provision shall be made to prevent cracking of the cement mortar by inserting metal expansion beads within the coating thickness in a manner approved by the Engineer.

The finished surface shall be perfectly plumb or level as the case may be except otherwise specified without any bulging runs, bruises or stains.

Scratch coat shall be applied as soon as possible after construction of the base structure to allow at least 1 week drying time until the finish coat.

After application of each coat, the surfaces shall be kept continuously damp for not less than 48 hours, and then allowed to become thoroughly dry. Moistening shall be started as soon as the surface has hardened sufficiently not to cause displacement or damage.

## 1.11 METAL DOORS AND WINDOWS

### 1.11.1 GENERAL.

- a) **Applicable Scope**  
This chapter shall apply to aluminum doors, windows, steel doors, and their frames.
- b) **Common Matters**  
Material, type, shape, dimension, finish, etc., of doors and windows and hardware shall be as indicated in the drawing. Prior to fabrication and installation, shop drawing shall be prepared and submitted to the Engineer for his approval. The shop drawings shall indicate materials, types, dimensions, jointing methods, installing methods, flashings, connection with other works, etc.

If instructed by the Engineer, a sample shall be submitted with regard to type, surface finish, connection of frame corner, other special connections, etc., for approval.

- c) **Performance Conditions**  
Doors and windows including hardware shall be of a construction sufficient to withstand the various loads, including weight, operation and wind pressure, and, if necessary, their safety shall be verified by strength calculation and testing. Aluminum doors and windows shall conform to Chinese Standards or approved equivalent industrial standard.

The louver facing exterior shall be provided with windbreak, flashing, etc., for weatherproofing.

### 1.11.2 ALUMINUM DOORS AND WINDOWS

- a) **Material**  
Frame, mullion, fitting and other main-members shall be fabricated of extruded aluminum section and aluminum plates.
- b) **Accessory**  
Hardware for aluminum sash and door shall be aluminum alloy, galvanized alloy or stainless steel and surface properly treated. Fastening devices such as screws, bolts, nuts, rivets, etc., shall be of aluminum or stainless steel. Runner shall be hard-nylon product with bearing. Stainless steel runner shall be as otherwise specified. Door-stopper shall be aluminum and hard-rubber or vinyl bumper equipped. Washers shall be neoprene rubber, aluminum or stainless steel.

Anchor shall be mild-steel isolated with electro-galvanized plating or varnish-galvanize-plating.

c) Production

Manufacturer shall be approved by the Engineer. Full-scale shop drawing shall be prepared in accordance with sash and door drawing and list and submitted for approval of the Engineer. Prior to fabrication, a complete system description with the following information shall be submitted to the Engineer for approval.

1) Complete system description including the following information :

Names of manufactures of products.

Names, addresses and telephone numbers of local representatives for products.

Types, model numbers and names of products, and indication whether products are "off the shelf" or custom fabricated. Include specific information on finishes - thickness, patented process name, process description and test data.

Detailed information on products manufactured specifically for this project.

Detailed system description including standard details and manufacturer's literature; and large-scale details of specially fabricated products.

2) Statement that the proposed system meet(s) the regularity requirements, thermal, aesthetic and water proofing criteria and wind loading, construction, glazing and warranty requirements specified; noting in detail exceptions.

Sash-bar shall not be defective or deformed. Sash and door shall be accurately produced and tolerance shall be less than 1.5 mm for width and height and less than 2.0 mm for diagonal dimension.

Joint and corner of frame shall be properly and firmly riveted, screwed or welded and caulking shall be provided from back.

d) Surface

Surface shall be provided with anodized coating to JISH8602 Aluminium and Aluminium alloys. Coating thickness shall be not less than 20 microns or as otherwise specified. Anodized coating shall be applied to processed members or treated otherwise as approved by the Engineer. In case powder coating is required, material shall be high durability polyester powder coat. Sample of coating shall be submitted and approved by the Engineer for thickness and color.

e) Insulation

Where aluminum faces come in contact with steel, masonry, or other materials, they shall be treated with a coat of zinc chromate or alkali-resistant bituminous paint before installation.



- f) **Transportation**  
All external faces of aluminum shall be applied with peelable protection film or the like before dispatching from the factory.

Product shall be packed in wood-frame and transported vertically.

- g) **Installation**  
The contractor shall be responsible for installation. Position of sash and door shall be confirmed and adjusted by temporary placing before installation.

- h) **Protection and Cleaning**  
Proper protection shall be provided after installation.

### 1.11.3 STEEL DOOR LEAVES AND FRAMES.

- a) **Material**  
Hollow steel door leaves shall be fabricated from cold rolled sheet steel. The minimum metal thickness shall be as follows:

Panel	:	1.6 mm
Stiffener plates and anchor plates	:	2.3 mm

The door leaves shall be full flushed seamless panel, 40 mm thick unless otherwise specified. Doors shall be mortised and reinforced for hinges and locks. Doors shall be reinforced for closures and other surfaces supplied hardware where required.

Door frames shall be formed of cold rolled sheet steel. The minimum metal thickness shall be as follows:

Frame	:	2.3 mm
Architrave	:	1.6 mm
Threshold	:	2.3 mm

The frames shall be blanked, reinforced, drilled and tapped to receive template hinges and locust strikes. They shall be reinforced for surface mounted closures where required. All frames shall be prepared with rubber bumpers.

All frames shall be fixed to the structure with welded or snap-in anchors. The frames shall be furnished with a spreader bar attached to the bottom of the jambs; where no floor finish occur to conceal these spread bars, stainless steel channel shall be used, welded to the back of the jambs.

Frames shall be securely caulked with approved caulking material on exterior walls. The frames shall be extended to accommodate transom where they occur.

b) Priming

All steel work shall be thoroughly cleaned of rust, oil, grease and other impurities and then given one shop coat of a primer. Parts inaccessible after assembly shall be primed in the shop before assembly.

All shop primed surfaces damaged in the field shall be cleaned and reprimed with the same paint.

c) Installation

Along the rims of the opening in concrete, brick structures for the door, window and louver anchor metals shall be pre-embedded at boom centers as the works progresses.

Before installing the frames of door, window and louver, the rim of the opening shall be cleaned of all loose and foreign matters and the pre-embedded anchor metals shall be exposed and extended.

The frames shall be set in place with suitable wedge plumb and true to line and then rigidly fixed to the structure through the fixing lugs. Exterior perimeters of the frame shall be sealed with approved caulking compound.

After glazing and painting works have been completed, all movable parts of the door and window shall be adjusted to ensure proper fitting and functioning.

#### 1.11.4 HARDWARE

Hardware shall conform to drawing and Chinese Standards. Sample of all hardware shall be submitted for approval by the Engineer.

Hardware shall conform to the following unless otherwise specified.

a) Locks; Pin for cylinder-lock shall be more than 6 pieces.

Tumbler for bit-key-lock shall be more than 3 pieces and back-set shall be 64 mm.

b) Bolt shall be Chromium plated bronze or stainless steel flush-bolt.

c) Hinge shall be brass or stainless steel and number and dimension as in the following;

Door Fitting Size Width x Height (mm)	Dimension of Hinge (mm)	Thickness of Hinge		Number for Each Fitting
		Brass	Stainless SUS 27	
Larger than 900 x 2,100	125	6	3	3
Smaller than 890 x 2,090	100	6	3	3
Smaller than 770 x 2,040	75	4.5	3	2

- d) Knobs, lever handles shall be stainless steel or chromium plated bronze.
- e) Floor-hinge shall be cast iron body with stainless steel cover, oil and spring activated with 90° stop device.
- f) Pivot for pivot-hinge shall be brass.
- g) Door-stopper shall be wall or floor mounted type brass or gun-metal and provided with door-catch and rubber bumper.
- h) Operating-handle shall be as otherwise specified.

In case master-key is otherwise specified, classification and number shall be determined in accordance with key-plan.

Keys shall be labelled and handed over to Client. Each lock shall be provided with three separate sets keys and master keys to pass all locks shall be provided.

Hardwares for ready-made steel sash and door shall be standard hardware supplied by the approved manufacturer, however, samples shall be submitted to the Engineer for approval.

#### 1.11.5 FIXED STEEL LOUVERS AND FRAMES

Frames for the louver shall be fabricated in the same manner as steel door frames as specified before and as shown in the details.

Louver blades shall be made of cold rolled steel plate of 1.6 mm thick and properly formed to prevent storm water from driving into the interior space and to allow air flow at an acceptable resistance.

### 1.11.6 INSECT SCREENS

Insect screen shall be fabricated of extruded aluminum frames with wire secured in frames to the inner side of windows and louvers by means of spline or galvanized screws. Screen unit shall be removable and rewirable. Screen wire shall be aluminum mesh, or other approved wire.

### 1.11.7 STEEL ROLLING SHUTTER

A steel rolling shutter capable of both electrical and manual operation shall be installed as shown on the Drawings.

All steel plates and angles, welding and riveting shall be performed in accordance with the structural steel works as specified in Paragraph I.6 of these Specifications.

The shutter shall be rolled-up type composed of slats, guiderails, rolling drum and cover case, with a motor, motor control gear, safety switch and all wiring from the safety switch and all other necessary accessories.

Specifications for the various components shall be as follows:

Slat	Hollow type, steel plates 1.2 mm thick, designed against a wind pressure of 25 m/sec.
Guiderail	2.3 mm thick roll-formed steel plates, depth of 65 mm with safety stop at a height of 2.2 m above the floor. The guiderail shall be anchored securely to the concrete jambs and shall be finished flush with the surrounding surfaces.
Cover case	1.6 mm thick steel plate with adequate reinforcement and inspection hole.
Motor	Electric power source: A.C., 380-volt, 3-phase, 50 Hz, operation speed: 3 to 5 m/min. Motor to be installed in the cover case.
Operation box	Install on the side wall at adequate height and provided with both electric and manual operation devices complete with all necessary accessories and provided with a stainless steel door.

The manual operation device shall be suitably geared to allow operation by one man.

The Contractor shall submit detailed shop drawings prior to fabrication. Fabrication shall not be commenced until shop drawings have been approved by the Engineer. Painting shall be as specified in Paragraph 1.13 hereof.

## 1.12 WOOD DOORS

### 1.12.1 DOORS

- a) Scope  
Material and performance shall conform to this Paragraph for wood Sash and Door unless otherwise specified.

- b) Material  
Wood material shall be all side cut timber and dried. Moisture content shall be less than 15%. Species of wood shall be as otherwise specified or as directed by the Engineer. Plywood for internal doors shall be of ordinary plywood to Chinese Standards and of standard quality. Plywood shall be more than 3 layers of veneer and thickness of plywood shall conform to the following;

	<u>Thickness</u>
Panel-plate, wainscot-plate	9 mm
Flush door-panel	4 mm

General adhesive shall be urea-resin adhesive or Vinyl Acetate resin emulsion adhesive for wood and adhesive for moistured portion shall be phenol-adhesive for wood unless otherwise specified.

Other materials shall conform to drawing, or approval of the Engineer.

- c) Dimension and General Performance.

#### Construction

Increase the width of stiles and rails above the standard as necessary for sliding door grooves, door closers, and the like. Provide additional frame members where necessary to take fastenings of hardware such as push and kick plates, or to frame openings for panels. Form rebates if required on edges of doors in solid matching edge strips.

Edge strips:	To Chinese Standards, thickness 12 mm
Door thickness:	35 mm generally, 40 mm where door width exceeds 900 mm.

Provide a sub-frame around openings (e.g. for louvers or glazing) of 30 mm thick (finished) timber.

Internal doors shall be hollow core, flush panel except for WC doors which shall be

solid particleboard 30mm thick faced on both sides and all edge with selected laminated plastic.

Provide an additional horizontal rail, minimum 50 mm wide at 1,800mm above bottom of door.

Frames shall be pressed steel 1.6mm thick single rebated fully welded with floor spreader.

d) Protection

Protection shall be provided to already installed sash and door in accordance with instruction of the Engineer and with other works concerned.

1.12.2 HARDWARE.

a) Quality

Hardware shall be standard quality and approved by the Engineer.

b) Classification

Hardware shall be marked with the manufacturer's name or brands, and sample shall be submitted for approval of the Engineer for color, finish, appearance, dimension, mechanism, quality and other necessary points.

Standard of classification, type and grade shall conform to the following unless otherwise specified.

Type	Hardware	Material	Remarks
Hinged-Door	Hinge	Stainless Steel	
	Spring hinge	Painted iron	
	Lavatory hinge	Stainless Steel	
	Floor hinge	Stainless cover	Cast iron body
	Pivot hinge	Stainless Steel	
	Door closer	Cast iron	Two-step adjusting device for oil-pressure type
	Door-spring	Painted iron	
Mortise lock	Stainless Steel	Cylinder lock with 6 pins, bar-lock with tumbler	

Type	Hardware	Material	Remarks
	Panic lock	Stainless Steel	With cylinder lock
	Indicator lock	Stainless Steel	
	Indicator	Stainless Steel	
	Flush bolt	Stainless Steel	
	Door stopper	Stainless Steel	
	Door holder	Stainless Steel	
	Knob	Stainless Steel	
	Lever handle	Stainless Steel	
	Handle	Stainless Steel	
	Button	Stainless Steel	
	Push plate	Stainless Steel	
	Gate bolt	Stainless Steel	
	Latch bolt	Stainless Steel	
	Latch	Brass	

c) Installation

Hardware and other accessories for sash and door shall be correctly and firmly installed with required screw, bolt, rivet or nail. Screw hole shall be drilled and all screw shall be evenly fastened.

All door furniture shall be accurately and neatly fitted to the correct line and levels. Rebates and pockets shall be carefully cut to the correct depths and size.

Erect frames plumb and true. Brace as required until surrounding structure is complete. Install doors in accordance with manufacturer's instructions. Condition doors to average humidity in area prior to hanging. Provide clearance of 3mm at jambs and heads; 3mm at meeting stiles at pairs of doors; 12mm from bottom of door to top of floor finishing and 6mm at thresholds.

Hardware shall be removed and refixed to permit finishing of surround areas to be carried out. Upon completion hardware shall be carefully and properly adjusted and lubricated to ensure smooth efficient operation.



## 1.13 GLASS AND GLAZING

### 1.13.1 GLASS

a) Material

Glass shall be standard quality and approved by the Engineer. Glass type and thickness shall be in accordance with Chinese Standard or approved equivalent industrial standard. Glass shall be free from foam, crack, deformation and other defects. Sample of glass shall be submitted for approval of the Engineer.

b) Maximum dimension of sheet glass

Maximum dimension of sheet glass shall conform to Chinese Standards.

c) Installation

All panes shall be accurately cut to fit in the places with 4 mm clearance all around. All panes shall be sealed with non-structural external weather-proofing sealants of low modulus neutral curing silicone rubber compounds of approved manufacturer using spacer shims, clips, and setting blocks at intervals recommended by the glass manufacturer. Panes for aluminum sashes shall be set evenly in the rebates. Panes for wooden frames shall be fixed with triangular wood stops. All panes shall be cleaned and polished when the building work is completed.

The contractor shall be held fully responsible for any defective glass, curing of glass and all scratched, damaged or broken glass which shall be immediately removed and replaced.

d) Mirror

Chamfering, edge-polishing, frame, thickness, position, fastener and other accessories shall conform to drawing or as instructed by the Engineer.

Elastic-mould-type sealer shall be provided as cushion, in case mirror is directly installed to concrete, mortar, plaster, plywood and other boards with urea-adhesive.

Back of mirror shall be free from salinity, alkali and acid and agent applied on back shall not be damaged. In case installed in moisturous room, mirror shall be moisture-proof as directed by the Engineer. Detail of installation shall be reported for approval of the Engineer.

### 1.13.2 SEALANTS

a) Material

Sealant shall be non-structural external weather-proofing sealant of low modulus

neutral curing silicone rubber compound. Color of the compound shall generally match the color of adjacent materials. Primer, joint filler, bond breaker tape and backing rod shall be of types recommended by the manufacturer of sealant for compatibility.

b) Application

All sealing shall be done in a manner to completely seal the joints against wind, rain and dust.

Where sealant comes in contact with cement, concrete, brick or other porous material, the latter shall be primed to prevent absorption of oils from the compound.

Sealant shall be applied with a caulking gun. Excessive sealant shall be removed.

## 1.14 PAINTING

### 1.14.1 MATERIAL AND GENERAL CONDITIONS

Material shall be product stated in the specification or as approved by the Engineer. Material shall be delivered to the job in the manufacturers' sealed containers for approval of the Engineer. Use of product by the same manufacturer shall be the general rule in each stage of work in this specification. Paint shall be safely stored at storage exclusively for the use of paints. Care shall be given to fire protection. Color, luster, color scheme, finish shall be decided by the Engineer after checking sample paint test. The painting shall be performed by experienced, competent painter approved by the Engineer.

Comply with applicable portions of relevant Chinese Standards.

### 1.14.2 APPLICATION

All metal surfaces shall be oil painted unless other paints are specified. All steel components other than galvanized steel shall be prepared and primed in the shop and finish painted after erection.

All metal surfaces to be painted shall, prior to application of paint, be prepared in the following manner:

- All soil or other foreign matter (other than grease and oil) shall be removed by brushing or scraping.
- Oil or grease shall be removed by wiping the surface with rags or brushes wetted with an approved solvent.
- Excessive rust scale shall be removed by hand chipping or by power impact tools.
- Rough welds and sharp steel edges shall be ground smooth, and all weld spatter shall be removed.
- The whole surface shall be cleaned by means of sand blast or combination of powered steel scrapers or steel brushes and sand papers.

Immediately after completion of the surface preparation, approved primer shall be applied; two coats for the structural steels and one coat for other steels unless otherwise specified.

All wood surface to receive paint shall be cleaned of all dirt, grease, dust or any other deleterious matters. All surfaces shall be thoroughly sanded and all nail holes, cracks and any other defects shall be puttied, re-sanded to a smooth and flush finish. The putty shall be colored to match the color of the finish paint.

Spray painting equipment shall have suitable air pressure and paint flow controls. Air lines shall be equipped with moisture and dirt traps. The paint shall be continuously stirred during the painting process. The paint shall be mixed and applied in accordance with the manufacturer's recommendations.

Drying time: The drying time of double coated paint shall be measured at the temperature of 20°C and humidity of 70%.

Amount of paint: The paint amount shall be standard amount of paint itself not including thinner. It shall increase or decrease depending on shape and surface condition in the process of painting.

Drying time of double coated paint and paint amount shall not be listed in coating schedule when they vary with the conditions of surface to be painted.

The finished surface shall show a smooth and uniform finish, free from any stains and shall be uniform in color and shade.

### 1.14.3 PAINT FINISH SYMBOLS

OP : Gloss enamel-oil based (Synthetic resin mix) paint finish.

VP : Durable gloss enamel-two part water based (Solvent-polyvinyl chloride resin) paint finish.

EP : Low gloss vinyl-water based (Polyvinyl acetate resin emulsion) paint finish.

AEP : Acrylic-water based (Synthetic resin emulsion) paint finish.

CL : Clear polyurethane finish.

EXP : Semi-gloss two part Epoxy enamel (Epoxy resin) paint finish.

### 1.14.4 GENERAL NOTES ON PAINTING.

#### a) Preparation of Paint

##### 1) Mixing

Paint content with pigment shall be thoroughly stirred to make a uniform consistency.

##### 2) Thinning

Potable water shall be used for thinning of acrylic paint and water-soluble paint. Proper thinner, product of the same manufacturer as paint, as a rule, shall be used for other types of painting. Percentage of thinning and

viscosity shall be conducted in accordance with manufacturer's recommendations.

3) Allowable Period of Use

Paint mixing more than 2 types shall be used as directed by the manufacturer or catalogue, as allowable period of use, mixing ratio and mixing method vary. That paint which has passed allowable period of use shall not be used.

b) Conditions at Painting

1) Work shall not be executed in the following situations.

When humidity is above 85%

When raining or it is forecast.

When dust is present.

2) Conditions of surface to be painted:

Work shall not be executed or proper means shall be taken in the following situations.

When surface to be painted is damp and wet.

When condensation is likely to develop on the surface.

All nail holes on veneer, board, etc. shall be covered with proper rust-proof paint before the subsequent painting is applied in accordance with this specifications.

c) Performance

Paint shall be evenly and uniformly applied on the surface. Areas of difficult application such as painted part, internal angle, welded part, etc. shall be thoroughly painted and double coated as necessary to keep uniform coating thickness. Painting shall be properly done by carefully selecting the painting method for the shape of surface and types of paint.

d) Delivery, Handling and Storage

Store materials in designated spaces in a manner which meets the requirements of applicable codes and fire regulations. When not in use, such spaces shall be kept locked and inaccessible to those not employed under this Section. Provide each space with a fire extinguisher of carbon dioxide or dry chemical type bearing a tag of recent inspection.

Bring materials to the building and store in manufacturer's original sealed containers, bearing the manufacturer's standard label, indicating type and color. Deliver materials in sufficient quantities in advance of the time needed in order that work will not be delayed in any way.

### 1.14.5 PROCEDURE OF PAINTING.

a) Exterior-Surface of Mortar, Concrete, Brick and Concrete Block.

AEP: All weather full gloss acrylic (Synthetic resin emulsion paint)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Dry, clean and free from impurities		
2	Surface sealing	1	Sealer for acrylic paint	Longer than 2 hrs	16
3.	Puttying		Putty for acrylic paint		
4.	Sanding		Sand with proper tool		
5.	Spot painting		Acrylic paint		
6.	Second coating	1	Acrylic paint	Longer than 2 hrs	16
7.	Finish coating	2	Acrylic paint	Longer than 2 hrs	16

- Note:
- 1 Degree of dryness on the surface to be painted shall be kept under 6% in water content and below pH 9.5.
  - 2 Puttying and sanding processes shall be allowed to be omitted depending on the conditions of the surface.
  3. Drying time of puttying shall be long enough for sanding to proceed.
  4. Amount of sealer for surface sealing shall be adjusted under the direction of the Engineer as it varies with the surface conditions.

b) Exterior - Steel Surface

OP: Gloss enamel (Synthetic resin mix paint)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Completely remove rust, moisture, oil and other impurities by sander, cleaner and scraper on by sand-blasting		
2	Primer	1	Zinc-rich organic priming paint	Longer than 24 hrs	16
3.	Touch-up		same as above		
4.	First coating	1	All purpose undercoat	Longer than 16 hrs	16
5.	Second coating	1	Enamel paint	Longer than 16 hrs	16
6.	Finish coating	1	Enamel paint	Longer than 16 hrs	16

Note: Paint for touch-up painting shall be the same as used for process No. 5.

c) Exterior - Wood Surface

OP: Gloss enamel (Synthetic resin mix paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Clean and sand to plane surface		
2	Primer	1	Wood primer	Longer than 24 hrs	12
3.	First coating	1	All purpose undercoat	Longer than 16 hrs	16
4.	Second coating	1	Oil mix paint	Longer than 16 hrs	16
5.	Finish coating	1	Oil mix paint	Longer than 16 hrs	16

Note: Puttying and sanding shall be done after process No. 3. When there are cracks, etc., on the surface, putty shall be oil-putty, but drying time shall vary depending on conditions.

d) Interior - Mortar, Board, etc

(EP): Vinyl (Polyvinyl acetate resin emulsion paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Dry, clean and free from impurities		
2	Surface sealing	1	Ultraprep sealer	Longer than 4 hrs	12
3.	Filling		Filler for Vinyl paint		
4.	Sanding		Sand with proper tool		
5.	Spot painting		Ultraprep sealer		
6.	First coating	2	Vinyl paint	Longer than 2 hrs	16
7.	Finish coating	1	Vinyl paint	Longer than 2 hrs	16

- Note: 1 Degree of dryness on the surface to be painted shall be kept under 6% in water content and below pH 9.5
- 2 Puttying and sanding processes shall be allowed to be omitted depending on the conditions of the surface.
3. Drying time of puttying shall be long enough for sanding to proceed.
4. Amount of sealer for surface sealing shall be adjusted under the direction of the Engineer as it varies with the conditions of the surface.



e) Interior - Render, Plaster, Concrete, Brick or Concrete Block, etc.

(EP): Vinyl (Polyvinyl acetate resin emulsion paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Dry, clean and free from impurities		
2	Surface sealing	1	Ultraprep sealer	Longer than 16 hrs	16
3.	Filling		Filler for emulsion paint		
4.	Sanding		Sand with proper tool		
5.	Spot prime painting		Ultraprep sealer		
6.	First coating	1	Vinyl paint	Longer than 2 hrs	16
7.	Finish coating	1	Vinyl paint	Longer than 2 hrs	16

- Note: 1 Degree of dryness on the surface to be painted shall be kept under 6% and below pH 9.5.  
 2 Puttying and sanding processes shall be allowed to be omitted depending on the conditions of the surface.  
 3. Drying time of puttying shall be long enough for sanding to proceed.  
 4. Amount of sealer for surface sealing shall be adjusted under the direction of the Engineer as it varies with the surface conditions.

f) Interior - Iron Products, Steel

OP: Gloss enamel (Synthetic resin mix paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Completely remove rust, moisture, oil and other impurities by sander, cleaner and scraper		
2	Primer	1	Inorganic zinc silicate paint	Longer than 24 hrs	16
3.	Touch-up		Same as above		
4.	First coating	1	All purpose undercoat	Longer than 16 hrs	16
5.	Second coating	1	Enamel paint	Longer than 16 hrs	16
6.	Finish coating	1	Enamel paint	Longer than 16 hrs	16

- Note: Paint for touch-up painting shall be the same as used for first coat in process No. 2

g) Interior - Wood Products in Clear Finish

CL: (Clear Polyurethane Finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Clean and sand to plane surface		
2	Putting		Putty of similar color to timber		
3.	Sealer	1	Sanding sealer	Longer than 16 hrs	16
4.	Sanding		Sand with proper tool		
5.	Finish coating	2	Clear polyurethane	Between 16 hrs	16
6.	Sanding		Sand lightly		
7.	Finish coating	1	Clear polyurethane	Longer than 16 hrs	16

h) Steel Sash

OP: Gloss enamel (Synthetic resin mix paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Phosphoric acid chemical coat treatment by metal surface treating agent		
2	Priming	1	Wash-primer		
3.	Under coating	1	Zinc-rich organic priming paint	Longer than 24 hrs	16
4.	Touch-up		Touch-up primer		
5.	First coating	1	All purpose undercoat	Longer than 16 hrs	16
6.	Second coating	1	Enamel paint	Longer than 16 hrs	16
7.	Finish coating	2	Enamel paint	Longer than 16 hrs	16

- Note: 1 Wash-primer shall be omitted when surface is treated by phosphoric acid in process No. 1  
 2 Paint for processes No. 4 and No. 5 shall be of similar paint used for under coat in process No. 3 or that recommended by the manufacturer.

## 1.15 INTERIOR FINISH

### 1.15.1 FIBRE CEMENT BOARD, GYPSUM PLASTER BOARD AND PLYWOOD

#### a) Material

Fiber cement board, gypsum plaster board, and plywood shall be of standard quality. Types, shapes and size shall be in accordance with the drawing unless otherwise specified.

Wood screw and nail nail for each type of board shall be as set forth in the following. Nail spacing shall be about 120 mm with approval of the Engineer.

- 1) Plywood, hard fiber board, particle board - Brass or stainless nail.
- 2) Gypsum plaster board - Stainless staple
- 3) Fiber cement board - Galvanized Steel or brass wood screw.

#### b) Method of Installation

Backing shall comply with Paragraph 1.6 Carpentry. Material shall be cut in size and planned as indicated in the drawing and as directed by the Engineer. Material shall be installed flat with joints in line by nailing, screwing or adhesive.

Except where otherwise specified or on drawing, gypsum plaster board and fiber cement board shall have flush set joints to manufacturers directions.

#### c) Sus Gyp Ceiling

Sus gyp ceiling shall be a prefinished suspension grid system with moulded gypsum plaster panels with vinyl surface 1200(900) mm x 3000 mm x 9 mm in size. The susgyp ceiling shall include the complete metal suspending ceiling system including suspending bolts, hangers, clips, main runners and furring strips. The gypsum board shall conform to Chinese Standards or approved equivalent. The method of installation shall strictly comply with the manufacturer's specifications.

The entire suspended ceiling shall be installed to the level and lines as shown on the Drawings and the completed surface shall not have a deviation on level or lines of more than 3 mm in 4 m. The suspending bolts shall be fixed to the roof structural members, so that the suspending bolts are systematically and vertically installed.

Main runners shall be provided at intervals as recommended by manufacturer, installed with allowance for adequate camber. They shall be designed for ceiling loads of 60 kgf/m<sup>2</sup>.

Furring strips shall be provided at intervals according to the ceiling material

manufacturer's requirement. Adequate reinforcing and metal framing shall be provided for mounting lighting fixtures, air diffusers and ceiling access holes.

Gypsum board shall be securely fixed to the furring strips with the galvanized screws true to level and line.

Ceiling trims shall be of hard wood and fixed to the wall as shown on the Drawings.

d) Acoustic Boards

Acoustic boards shall be of first grade conforming to JIS A 6307 "Dressed Rockwool Boards for Acoustic Use" or approved equivalent.

## 1.16 MISCELLANEOUS WORKS

### 1.16.1 ROOM NAME PLATES

Where shown on the Drawing or as directed by the Engineer, room name plates shall be provided on the external surfaces of entrance door of each room. The name plates shall be made of acrylic resin plates having approximately 80 mm x 350 mm x 6 mm thick in size and fixed with chromium plated screws to the doors. On the plate shall be engraved the name of the room as directed by the Engineer.

### 1.16.2 INSPECTION-HATCH CEILING

Inspection-hatch locations shall conform to drawing. Inspection-hatch shall be 450 mm square unless otherwise indicated.

### 1.16.3 DOOR SILLS

Door sill for steel flush door shall be made of 2 mm thick stainless steel plate with a dimension of 40 mm wide. Door sill shall be provided for in the joint between different floor finishing and installed with steel anchor lugs the full width of each door width.

### 1.16.4 FLOOR DIVIDERS

Floor dividers shall be provided in the joint between different floor finishes. Floor divider shall be of brass or stainless strips having 4 mm x 12 mm in dimensions.

### 1.16.5 DOWNSPOUT

Downspouts shall be of bell-end type PVC pipe for heavy use, solvent cement connected and provided with adaptable vent for effective water flow. Downspouts shall be strongly secured to concrete columns and walls with 3.0 mm galvanized wall brackets and 2.3 mm metal straps attached by galvanized lug screws and expansion anchors. Wall brackets shall be provided for within 1,500 mm spacing.

### 1.16.6 KITCHENETTE UNITS

Kitchenette sink unit shall be of composite of a sink unit, cooking table and wood cupboard in the dimensions as shown on the Drawings. The sink unit shall consist of stainless steel sink top, stainless steel strainer and melamine resin or polyester faced plywood cabinet. Stainless steel sink top shall be drawn from one-sheet of more than

0.8 mm in thickness. The cooking table shall be made of stainless steel sheet top and melamine resin or polyester faced plywood cabinet.

Wood cupboards shall be framed with dovetailed, housed, rebated or locked joints and shall be accurately finished to the dimensions as shown on the Drawings.

Shelves and bench tops shall be 25 mm thick. Bench tops and exposed edges shall be covered with melamine of approved color and securely glued in place.

Each cupboard shall be fitted with 25 mm thick solid core door, which shall be hung on a pair of steel butt hinges and fitted with an approved push button catch and circular fly-proof ventilator.

Drawer shall be dovetailed, glued and housed with a 20 mm thick front and 12 mm thick sides and back with a 5 mm plywood bottom. Drawer shall be fitted on tallow wood runners and shall have approved handles.

The Contractor may propose ready-made market products to suit the dimensions of the kitchen by submitting catalogues to the Engineer and obtaining his approval.

#### 1.16.7 STEEL HOIST AND RAIL

Steel hoist and hoist rail having the 1.00 ton in suspension capacities shall be provided in the D.E.G. room as shown on the Drawings or directed by the Engineer.

#### 1.16.8 TOILET PARTITION

The toilet partition shall consist of doors and panels with miscellaneous fittings. The doors and panels shall be 40 mm thick panel surfaced with plastic laminated plywoods. The panel and door shall be installed in accordance with the provisions of Paragraph 1-11 Wooden Doors, in these Specifications. The panels shall be firmly supported and fixed to the wall and floor with chromium plated or stainless steel plate supporting hardware and clamps. Each panel shall be securely connected together with stainless steel channels. Each shall be equipped with complete fittings consisting of door stop, latch, and combination coat hook and rubber bumper.