

# **TECHNICAL SPECIFICATIONS**

## **Construction of 3 Storey Police Station at N.Manadhoo**

### **Infrastructure Unit**

Finance and Asset Management

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## **PRELIMINARIES**

### **1.1 Standard and Codes**

The Contractor shall, perform the Works in compliance with all regulations, standard specifications or statutes of the Government of Maldives unless otherwise conform to this specification.

The current British Standard Specifications and Codes of Practice shall apply to and form part of these specifications unless otherwise specified in respect of all materials and works to which they have application.

### **1.2 Drawings and Specifications**

Drawings and Specifications are intended to complement each other, so that if anything is shown on the Drawings, but not mentioned in the specifications or vice versa, it is to be furnished and built as though specifically set forth in all three. If any discrepancies, errors, ambiguities or omissions occur in the Drawings or Specifications, the same shall be referred to the Consultant before proceeding with the Works, and the Consultant decision on such discrepancies, errors, ambiguities or omissions shall be final.

In addition to the Drawings and Specifications attached hereto, the Consultant will during the progress of the Works furnish additional Drawings, Specifications, and instructions as may be necessary, in the opinion of the Consultant for the purpose of the proper and adequate execution and maintenance of the Works, and the Contractor shall make his work conform. Such drawings and instructions shall be deemed to be part of the Contract Documents.

### **1.3 Transportation to the Site**

The Contractor shall provide all necessary transport, handling and storage of all materials, components and the like to their points of installation on site including transport to and from storage. The Contractor shall provide all necessary transport of labor to and from the site.

### **1.4 Schedule and Execution Plan**

The Contractor shall prepare and submit to the Consultant for approval the construction schedule and an execution plan of temporary facilities, stockyards, etc., before the start of the Works.

### **1.5 Repairing and Correction**

Any breakage(s) or defect(s) of existing buildings, road utilities, or part(s) of them caused by the Works including transportation for the works shall be repaired or corrected by the Contractor with his responsibility.

## **1.6 Workmanship and Materials**

All workmanship shall be of the best standard. All goods and materials to be incorporated in the Works must be new, unused, of the most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the contract.

The Contractor shall submit for the approval of the Consultant a list of names and addresses of the manufacturers and trade marks or names of all the various types of materials and goods he propose to use in the Works. The list shall include reference to the specifications clause or article to which the materials and goods apply.

Materials shall be obtained from approved sources and used in accordance with the manufacturer's printed instructions. In the absence of a specification all materials shall comply with a relevant standard. The consultant shall order the removal of any materials, which he has not approved.

No orders for materials and goods shall be placed until approval has been obtained for the materials and goods from the consultant.

The Contractor shall note that it is his responsibility to include in his price for the cost of the materials and products as specified and no adjustment will be allowed shall the consultant reject the alternatives.

## **1.7 Obvious Work**

Where an item of work is obviously required for the type of work being undertaken then it shall be deemed to have been included even though the item is not specifically mentioned or shown in the Drawings or Specifications.

## **1.8 Protection**

The Contractor shall have the Works and adjoining properties protected from inclement weather. Any loss or damage caused by weather, carelessness or lack of skill of workers, accident or otherwise shall be of such property that is affected. The Contractor shall provide all necessary dustsheets, barriers and guardrails and clear away at completion.

The work shall be suspended for such time as may be directed and/or approve by the Consultant if the specified quality of work is difficult to maintain during inclement weather.

## **1.9 Scaffolding**

The Contractor shall provide, erect, maintain, dismantle and clear away at completion proper and adequate including that required for subcontractor and suppliers. Putlog holes shall be made good to match the adjacent surface as the scaffolding is dismantled.

The Contractor shall be responsible for all safety precautions in connection with the scaffolding including the provision of all bracing, scaffold boards, toe boards and the like and for entire sufficiency for the work.



### **1.10 Construction Machinery, Plants and Equipment's**

All necessary construction machines shall be provided and maintained by the Contractor and shall be approved by the Consultant.

If cranes or any other type of plant which places any load on the structure are proposed, all details of such plant shall be submitted to the Consultant for approval before the work is actually commenced. If approved by the Consultant and contractually acceptable, permission may be given for the structure to be strengthened, in order to carry out loads, and the Contractor shall be responsible for any resulting additional costs.

The Contractor shall be responsible for making good to the satisfaction of the Consultant any damage to the permanent structure that may be caused by his plant and equipment.

### **1.11 Samples**

The Contractor shall furnish for the approval with reasonable promptness, all samples as directed by the consultant. The Consultant shall check and approve such materials with reasonable promptness only for conformance with the design concept of the Works and for compliance with the information given in the Contract Document. The Work shall be in accordance with the approved samples

All samples shall be delivered to the Consultant's office with all charges in connection therewith paid by the Contractor and deemed to be included in the Contract Price.

Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Consultant, one for office use and one for the site.

Samples shall be furnished so as not to delay fabrication, allowing the consultant reasonable time for consideration of the sample submitted.

Each sample shall be properly labeled with the name and quality of the material, manufacturer's name, name of project, the contractor's name and date of submission, and the specification clause to which the sample refers.

### **1.12 Ordering Materials**

The Bills of Quantities shall not be used as a basis for ordering materials and the Contractor is entirely responsible for assessing the quantities of materials to be ordered.

Upon receipt of the Consultant's order to commence the Works, the Contractor shall immediately place orders for all required materials and will be held responsible for any delays occurring due to late placing of such orders.

The Contractor shall pay all expenses, taxes and dues etc. incurred on the procurement of materials from abroad

### **1.13 Water and Electricity for the Works**

The Contractor shall make all necessary arrangements and provide all water for the proper execution of the Works, together with all transport, temporary plumbing, storage and distribution, pay all charges and alter, adapt and maintain temporary work as necessary and remove and make good at completion.

The Contractor shall make all necessary arrangements and provide all artificial lighting and power (maintain a generator if necessary) for the proper execution and security of the Works and its protection, with all meters, temporary wiring and fittings, pay all charges and alter adapt and maintain the temporary work as necessary and remove and make good at completion.

### **1.14 Site Offices for Contractor**

The Contractor shall provide maintain and clear away on completion of the Contract all necessary site offices, canteens, messing and welfare facilities, temporary buildings, toilets and the like for all site staff employed by the Contractor and required by subcontractors and suppliers.

The offices shall be open at all normal working hours to receive instructions, notices and other communications.

### **1.15 Contractor's Site Area**

Throughout the period of the Contract the Contractor shall maintain the area of his operation within the limits of the Site in a clean, tidy and safe condition by arranging materials and the like in an orderly manner. All rubbish, debris, waste materials and the like shall be systematically cleared from the Site as it accumulates.

The Contractor shall take all steps necessary as directed by the Consultant to minimize or eliminate dust, noise or any other nuisance, which may occur. Plant emitting dust, smoke, excessive noise or other nuisance shall not be permitted.

### **1.16 Progress Meetings**

During the course of the Works, progress meetings shall be held at fortnightly intervals for the purpose of coordinating the Contractor's works and to ensure that full compliance is maintained.

Minutes of such meetings shall be recorded; copies will be distributed to all persons concerned and full effect shall be given to all instructions contained therein.

### **1.17 Progress Photographs**

The Contractor shall supply once a month, at the time of submitting his Interim Certificates, twelve photographs from 36 exposures showing the progress of the Works. The Consultant shall direct the times and position from which the photographs are to be taken.

### **1.18 Setting Out**

The Contractor shall be responsible for accurately setting out the Works to the specified positions, dimension, levels and Building Lines and also checking the site surveys for dimensional and level accuracy and reporting any discrepancies before building work commences.

The Contractor shall provide the Consultant with all facilities, equipment and labour to enable him to check the setting out and levels of the Works at all times. The checking of any setting out point, line or level by the Consultant shall not in any way relieve the Contractor of his responsibility

All setting out points, benchmarks, site rails, pegs and other survey points shall be clearly marked and protected from damage or disturbance during the execution of the Works

### **1.19 Bill boards**

The Contractor shall provide and maintain one billboard for the Site consisting of a plastic board panel of size not less than 1.2m x2.4m supported 2.5m above the ground with steel angle framing or similar material and fixed in concrete foundations.

Each board shall having the following written in both Dhivehi and English by a skilled sign writer:

The name of Project

The name of Employer.

The name and address of Consultant

The name and address of Contractor

A scaled layout shall be prepared and submitted for the Consultant's approval before fabrication.

No advertising material other than the above will be permitted.

### **1.20 Loading in Excess of Design Load**

No loading in excess of the design loading shall be placed on any portion of the structure without the written permission of the Consultant

### **1.22 Permanent Drainage, Electricity and Water connection**

The Contractor shall allow for arranging and obtaining the permanent drainage, water and electricity connections to the proposed development and he shall be responsible for making all payments in connection therewith.

### **1.23 Handing Over**

Prior to handing over the proposed development the Contractor shall gain the approvals and respective Completion Certificates from all the local government authorities and the like that the work has been completed in accordance with their requirements.

Any payment in connection therewith shall be paid by the Contractor.

## **2.CONCRETE WORKS**

### **2.1 General**

Materials used in the Works shall be new, of the qualities and kinds specified herein and equal to approved samples. Delivery shall be made sufficiently in advance to enable further samples to be taken and tested if required. No materials shall be used until approved and materials not approved shall be immediately removed from the Works.

Materials shall be transported, handled and stored on the site or elsewhere in such a manner to prevent damage, deterioration or contamination.

### **2.2 Cement**

Cement shall be Ordinary Portland cement of an approved brand.

Cement shall conform to BS 12

Cement shall be of recent manufacturer and used within 6 months of manufactured date

The Contractor shall with each fresh consignment of cement delivered to the site furnish the Consultant with a copy of the Manufacturer's statement of compliance with the above Standard Specifications together with the date of manufacture, certified by an independent agency in the country of origin and its date of delivery to Site

Check tests will be required by the Consultant. These tests shall be carried out at the Contractor's expense

Any cement failing to meet the required standards will be rejected and replaced at the Contractor's expense

Any cement not conforming to BS 12 shall not be used unless otherwise approved by the Consultant

### **2.3 Aggregate**

Fine aggregate shall be river sand conforming to BS 882.

Coarse aggregate shall be crushed stone excluding limestone or derivatives of limestone conforming to BS 812.

Aggregate shall not contain injurious amount of rubbish, dirt, organic impurities and other foreign matters.

Strength of aggregate shall be more than that of hardened concrete paste.

Shape of coarse aggregate shall not be flat or slender.

Aggregate to be used in concrete shall possess the qualities indicated in the following tables.

**Quality of Aggregates**

Aggregate type	Open dry specific gravity	Percentage of water absorption (%)	Percentage of solid volume for the evaluation of particle shape (%)	Clay lump (%)	Loss in washing test (%)	Organic impurity (%)	Water soluble chloride (%)
Coarse aggregate	≤ 2.5	≤ 3.0	≥ 55	≤ 0.25	≤ 1.0	0	≤ 0.25
Fine aggregate	≥ 2.5	≤ 3.5	-	≤ 1.0	≤ 3.0	0	≤ 0.01

\* Color of test solution not to be darker than standard solution

**Grading requirements for aggregates**

Percentage passing each sieve by weight (%)

Agg.	Max. size (mm)	Nominal sieve size (mm)											
		40	30	25	20	15	10	5	2.5	1.2	0.6	0.3	0.15
Coarse	25	100	100	90 ↓ 100	60 ↓ 90		20 ↓ 50	0 ↓ 10	0 ↓ 5				
	20			100	90 ↓ 100		20 ↓ 55	0 ↓ 10	0 ↓ 50				
Fine							100	90 ↓ 100	80 ↓ 100	50 ↓ 90	25 ↓ 65	10 ↓ 35	2 ↓ 10

Manufactured sand and blast furnace slag to be use in concrete shall not be used unless otherwise specified or approved by the Consultant

In case of using fine aggregate of 0.01% or more water soluble chloride content, the necessary measures for corrosion inhibiting of reinforcement shall be instructed by the Consultant

The maximum size of coarse aggregate shall be 25 mm

Sources of aggregate shall be to the approval of the Consultant and samples of aggregate from the proposed source shall be submitted to the Consultant at least 28 days before its intended use.

## **2.4 Water**

Water shall not contain injurious amount of impurities that may adversely affect concrete and reinforcement.

Ground water shall not be used for concrete works

Water shall be obtained from a public supply where possible, and shall be taken from any other sources only if approved by the Consultant

Only water of approved quality shall be used for washing out formwork, curing concrete and similar surfaces.

## **2.5 Handling and Storage of Material**

### **2.5.1 Cement**

Cement shall be stored in a manner to prevent weathering.

Bagged cement shall be piled no more than 10 bags so as to permit easy inspection

Cement caked even to the slightest extent shall not be used. Such cement and rejected cement shall be immediately separated from other bags of cement so that they shall not be mistaken for others.

### **2.5.3 Aggregate**

Aggregate shall be stored in a manner effectively separating coarse and fine aggregate according to type and shall be prevented from inclusion of dirt, rubbish and other undesirable foreign matters.

Coarse aggregate shall be unloaded and piled in a manner not to cause segregation of small and large particles. Aggregate to be stored in piles shall be in mounds of moderate height and at a location where good drainage is provided.

## **2.6 Mix Proportion and Strength**

Mix ratio for reinforced concrete shall be in the proportion 1:2:3 (cement: fine aggregate: coarse aggregate) by dry volume.

Mix ratio for lean concrete shall be in the proportion 1:2:6 (cement: fine aggregate: coarse aggregate) by dry volume.

Water-cement ratio for concrete shall be 0.4% to 0.45%

The specified design strength of reinforced concrete shall be 25 N/mm<sup>2</sup> The required slump of concrete shall be 100 mm.

Design mix proportion shall be to obtain required workability, consistency and durability.

## **2.7 Production of Concrete**

### **2.7.1 Field-mixed Concrete Plant**

The Contractor shall select the necessary facilities for storage, batching, mixing and transporting of each of the materials and submit them for approval of the Consultant prior to start work.

### **2.7.2 Measuring**

All materials shall be measure by volume for each batch and water may be measured volumetrically.

Cement shall be measured by number of bags unless automatic cement weight measure is in use.

### **2.7.3 Mixing Control**

Concrete mixture shall be constantly controlled to obtain required workability and mixed strength. Mixing time for each batch shall be not more than 3 minutes.

### **2.7.4 Quality Control**

The Contractor shall conduct tests for quality control toward insuring that concrete of the required quality is constantly produced.

The Contractor shall have all quality control tests report ready for submission as required by the Consultant.

### **2.7.5 Quality Inspection of Concrete at the Point of Placement**

The Contractor shall conduct tests on concrete at the point of placement. When test results meet the tolerances given below, the concrete shall be qualified to have passed the tests.

- (a) The tolerance between actual slump and required slump of the concrete shall be  $\pm 2.0$  mm

For the estimation of compressive strength of concrete in compressive strength tests, when the average value of compressive strength of concrete obtained in a test is not less than the specified design strength, it shall be qualified to have passed the test. In case of failure to the above requirements, the Contractor shall take necessary measures such as to perform appropriate test as instructed by the Consultant.

### **2.7.6 Tolerance**

The dimensional tolerances in location and cross section of concrete member used for designing and construction of formwork shall conform to the following table.

## **2.8 Transporting and Placing**

### **2.8.1 General**

The Contractor shall establish manner and schedule for transporting and placing of concrete and obtain approval of the Consultant.

Concrete shall be transported in a manner to minimize segregation, spill, age 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 that may affect the quality of concrete during concreting, the Contractor shall take necessary measures as instructed by the Consultant.

### **2.8.2 Time Limit**

The time limit from start of mixing to completion of placing of a batch as rule, shall be 30 minutes.

### **2.8.3 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.

### **2.8.4 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 Consultant.

The locations of shapes of construction joints shall be consulted and approved by the Consultant.

### **2.8.5 Concrete Placing**

Concrete placing shall be proceeded to keep the surface of placed concrete as horizontal as possible.

Concrete shall be continuously poured to compact around reinforcing bars and corners of formwork.

The maximum time interval between placement of continuous concreting shall not exceed 0.5 hours. However, when special measures are taken this time limit may be changed according to instruction or approval of the Consultant.

### **2.8.6 Consolidation**

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

Vibrator shall be operated for concrete called for water tightness, difficult portion for concrete to proceed and other cases directed by the Consultant. However, vibrator shall not be touched reinforcing bars and shall not be operated more than 30 seconds at same spot.

Concrete shall be placed 300 - 600 mm thickness at once in case vibrator is performing. 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.



### 2.8.7 Placing Speed

Concrete shall be placed at the speed suited for the workability of the concrete and condition of the place of placement, which insures proper consolidation of concrete.

## 2.9 Concrete Curing

### 2.9.1 Curing Method

After concrete has been placed, the concrete surface shall be kept moist by sprayed with water or by other appropriate methods, and shall be protected from direct sunlight and rapid drying. The top surface of slabs shall be kept flooded with water at all times after concreting for the duration of curing period. This curing period shall be for not less than 14 days.

As a rule, no foot traffic or loads shall be permitted on concrete for at least 24 hours after placement.

## 2.10 Test

### 2.10.1 General

The contractor shall be required to conduct all tests according to BS method and procedure.

Test, as a rule, shall be conducted at the locations directed or at the testing institutions approved by the Consultant.

The Consultant shall conduct test, as a rule.

In case of failure in test, measure shall be taken as instructed by the Consultant.

The Contractor shall keep test records during the work and for 2 years after completion of the contracted work.

### 2.10.2 Material

#### Cement Test

- (1) Setting test.
- (2) Soundness test.
- (3) Compressive strength test.

Note: Item (1) shall be conducted once in every manufacturer.

Item (2) & (3) shall be conducted once in every 2,000 bags.

#### Aggregate test:

- (1) Grading and fineness modules.

## **2.11 Concrete**

### **2.11.1 Fresh concrete**

Slump, air content, shall be conducted daily, and more often at request of the Consultant.

Compressive strength test of concrete. Test for estimation on strength of concrete in structure:

In order to assume estimated strength of concrete in structure, compressive strength test shall be conducted for prepared test pieces on the 7th day and 28th day and those test pieces shall be made for sampling at placing of concreting.

Strength test shall be conducted for each of the following conditions: each days pour, each class of concrete, each change of supplies or source and each 100 cubic meter of concrete or fraction thereof. The number of test pieces to be used in a test shall be not less than 3 for each test of the 7th day and the 28th day unless otherwise instructed by the Consultant.

Test pieces shall be made in accordance with British Standards, and sampling shall be taken as near as possible at the point of placement.

Test pieces shall be stored without being disturbed and shall be covered during the first 24 hours, and carefully transported specimens to the testing laboratory. Test pieces shall be cured in water after de-moulding. The temperature of test pieces shall be kept as close as possible to the temperature of the concrete in structure until the time of testing.

## **2.12 Defective Concrete and Finishes**

Honeycombed surfaces shall be made good or on the instruction of the Consultant be cut out by the Contractor and make good at his own expense.

Concealed concrete faces shall left as from the formwork except honeycombed surfaces shall be made good. Faces of concrete to be rendered shall be roughened by approved means to form a key. Faces of concrete that are to have finished other than those specified shall be prepared in an approved manner as instructed by the Consultant.

### **3.CONCRETE FORMWORK**

#### **3.1 Structure and Material**

##### **3.1.1 Structure**

Formwork shall be performed to obtain accurate concrete in accordance with the designated drawings.

Formwork shall be firmed and secured to bear the force of concreting and tightened to avoid cement paste seeping.

##### **3.1.2 Materials**

Sheathing for formwork shall be waterproof plywood of not less than 12 mm thick. Joint of sheathing shall be butt joint and firmly assembled. In case of using wood board for sheathing, boards shall be 15 mm thick and applied planer. Joint shall be tongued and grooved unless otherwise approved by the Consultant.

Form liners shall be sound and suitable materials to accurately and safely cast the insitu concrete structure as shown on the Drawings.

Timber form boards for sheathing where used for fair-faced concrete shall be of such new materials as not to cause any defects to the surface of the concrete. Special care shall be taken in fabrication, storage and protection of these boards.

##### **3.1.3 Other Material**

Fastening hardware to be used shall be those with allowable tensile strength guaranteed by manufacturer through strength tests.

Form oil shall not have injurious effects on quality of concrete nor to bonding of surface finishing materials and shall be subject to approval of the Consultant.

#### **3.2 Performance**

##### **3.2.1 Design of formwork**

Formwork shall be designed to withstand construction loads during concreting, lateral pressure of fresh concrete, shock and vibrators due to concrete placing.

Formwork shall be free of injurious leakage of water, easy to remove, and shall not damage concrete at removal.

Supports shall be provided with the adequate horizontal and diagonal bracing and/or stays to prevent collapsing, heaving and twisting of formwork due to horizontal loads working during concrete placing.

#### **Standard Values of Dimensional tolerances**

<b>Item</b>	<b>Tolerance (mm)</b>
Tolerance in distance from datum line of each floor to respective members	+ 10
Tolerance in cross section of columns, beams and walls	- 5 , + 10
Tolerance in thickness of floor and roof slabs	0, +10

**3.2.3 Fabrication and Erection**

Erection of formwork, and transportation and storage of materials thereof shall be started only after previously placed concrete has reached an age which acceptance of these loads will not have any adverse effect on the concrete.

Sheathing shall be fabricated and installed accurately to match the locations, shapes and dimensions of members called for in the Drawings.

Sheathing shall be installed tightly so as not to permit cement paste or mortar to escape from joints.

Pipes, boxes and other embedded hardware shall be properly secured to sheathing or others so that they will not move during concrete placing.

Supports shall be erected plumb. Supports at any two vertically consecutive floors shall be erected as near as possible to identical locations on a common plane.

Shoring shall be erected paying special attention to safety.

If sheathing is reused, the surface in contact with the concrete shall be thoroughly cleaned off and sufficiently repaired before reuse. In case of using for fair-faced concrete, the same sheathings shall be used twice after approval of the Consultant.

**3.2.4 Inspection**

Formwork shall be inspected by the Consultant prior to placing of concrete.

**3.2.5 Striking of forms**

The minimum period for keeping the forms in position and for watering after laying the concrete shall be as stated below, except otherwise specified in drawings. Forms shall be removed in such a manner as to ensure the complete safety of the structure, so that there is no shock or vibration as would damage the reinforced concrete.

The responsibility for the safety of the concrete shall rest entirely with the Contractor and the Contractor shall be held liable for any damage done and shall have to make good the same at his own expenses.

The Contractor shall inform the Consultant when he intends to remove shuttering and shall obtain his consent, but the consent of the Consultant shall not relieve the Contractor of his responsibility.

The minimum time for formwork to remain in place shall be as per the following table.

Vertical sides of beams, slabs and columns	24 hours
Soffits of slab	10 days
Soffits of beams	21 days
Cantilevers	28 days

### 3.2.6 Relocation of Support

Supports under concrete shall be not relocated

### 3.2.7 Removal of formwork

Formwork shall be removed gently, after its removal has been approved by the Consultant.

Inspection by the Consultant shall be obtained immediately after the removal of sheathing and defects shall be immediately remedied according to instruction of the Consultant.

After shorings have been removed, members shall be carefully observed for cracking and deflection, when found, they shall be reported immediately to the Consultant.

## **4. STEEL REINFORCEMENT**

### **4.1 Material**

Reinforcing steel shall be of the dimensions given in the Drawings.

Reinforcing bars shall comply with the requirement of B.S.4449 and welded wire fabric, square bar fabric and expanded metal shall comply with appropriate part of B.S.4483.

Dia 6mm reinforcing steel shall be round mild steel bars, and 12mm, 16mm, 20mm and 25mm shall be deformed high strength bars.

Any other non-specified reinforcing steel shall be used only with the approval of the Consultant.

All reinforcing steel and binding wire shall be stored under cover and shall be at least 250mm above the ground.

### **4.2 Cleaning**

Reinforcing bars shall be cleaned before use so that it is free from rust, oil, dirt or other coatings that reduce bond.

### **4.3 Bending and Laps**

The reinforcement shall be bent cold in an approved bar bending machine.

Preferably bars of full length shall be used. Lapping of bars where necessary shall conform to BS1487 'Bending Dimensions of Bars of Concrete reinforcement.'

### **4.4 Reinforcement Cover**

Concrete cover for reinforcement shall be as follows:

FOR ANY STEEL IN UNDER GROUND CONCRETE	50	MM
CLEAR COVER IN SLABS	25-30	MM
CLEAR COVER IN BEAMS SOFFIT	30-35	MM
CLEAR COVER IN SIDES OF BEAMS	30	MM
CLEAR COVER IN COLUMNS	40	MM

### **4.5 Placing**

Reinforcement intended for contact when passing each other shall be securely tied together with binding wire

Binders and stirrups shall tightly embrace the longitudinal reinforcement to which they shall be security bound or spot welded

Binding wire shall be turned in from the formwork and shall not project beyond reinforcing bars.

All reinforcement shall be inspected by the Consultant and approved before concrete is placed in the forms.

## **5. MASONRY**

### **5.1 Materials**

Material used for masonry and plastering work shall conform to Section 3 - CONCRETE WORKS.

Masonry work shall be done with bricks or blocks of approved quality unless specified otherwise.

The blocks shall be free from excessive amounts of salt or other impurities and shall be inspected and approved by the Consultant.

### **5.2 General**

#### **5.2.1 Execution Drawing**

Work shall be complied with this specification unless otherwise stated on particular Specification or Drawings. Any work not specified shall be discussed and directed by the Consultant.

#### **5.2.2 Stake-Board**

Stake-board shall be provided at each 5m in length and shall be inspected by the Consultant for the accuracy, firmness and security. However, suitable ruler, plumb bob and leveler shall be provided for minor performance of cement block.

Transportation and storing

Care shall be taken for damage during transportation of materials and any defect of natural finished concrete blocks shall be rejected.

#### **5.2.3 Curing**

Any shock or load shall not be applied until concrete mortar or other fills hardened. Corner, projection and top of cement block work shall be protected from rain, dryness, cold, damage and stain by covering.

Void between blocks shall not be intruded by rainwater.

### **5.3 Block work**

#### **5.3.1 Material**

Blocks shall be of standard quality low permeability blocks with no defects and sample shall be submitted for approval of the Consultant

Blocks shall be cement solid blocks of 100mm, 150mm and 200mm thickness. The average compression strength shall be not less than 2.8N/mm<sup>2</sup> and shall comply with the relevant British Standard.

### 5.3.2 Placing Blocks

Cement blocks shall be saturated with water and joint shall be cleaned.

Bonding mortar shall be used immediately after mix, and mixed mortar left for more than one hour shall be rejected.

Vertical and horizontal joint of blocks shall be filled completely and suitable with mortar on line shall not be moved or rearranged. Joint and surface of block of exposed finished block wall shall be cleaned immediately after joint is filled.

Mortar for joint shall be touched with steel trowel before hardened and exposed joint shall be finished with uniform width and planned without roughness or cavity.

Height for placing block per day shall be maximum 1.2 m unless otherwise specified.

### 5.3.3 Joints

The thickness of joints shall not exceed 10 mm and the joints shall be rated (13 mm dup.) when the mortar is still floor, so as to provide for proper bond for the plaster. Any mortar which falls on the floor from these joints or removed due to raking of joints shall not be reused.

### 5.3.4 Lintel

Lintel shall be reinforced concrete as approved or directed by the Consultant.

Main reinforcing bar shall be anchored more than 40D (40 x diameter of the bar) at both end.

In case lintel is prefabricated, shop drawing shall be submitted for approval of the Consultant.

### 5.3.5 Frame of Opening

In case frame is temporarily installed before placing of blocks, frame shall be firmly placed and joiner shall be bonded with mortar as placing each block at side and top of frame.

In case frame is installed after placing of blocks, joiner shall be bonded with additional mortar at space or every two blocks or more.

Back of frame shall be filled and compacted with mortar by providing shuttering board.

Wood plug and anchor bolt shall be covered with mortar or concrete.

### 5.3.6 Piping

Principally, piping shall not be placed in block wall unless piping block is in use.

In case chipping and piping on face of blocks is unavoidable, performance shall confirm to instruction of the Consultant.

Joiner and supporter for exposed piping shall be buried at joint which back is filled or otherwise approved by the Consultant.



## **6. PLASTERING**

### **6.1 General**

All masonry walls shall have smooth finished cement plaster on both sides with a surface setting coat of neat cement applied within an hour of the completion of rendering.

Cement rendering to floor shall be same as above.

### **6.2 Materials and Storage**

Plaster materials which are affected by moisture such as plaster and cement shall be stored properly.

Materials used for plastering shall conform to those of Section 3 - Concrete Works. Grading of sand, however, shall be as in table below

<b>Grading of sand</b>	<b>Mortar plastering</b>	<b>Plastering</b>
5mm sifting thorough 100%	for first coat	for first coat and dubbing out
0.15mm sifting less than 10%	for finish coat	
2.5mm sifting through 100%	for finish coat	for second coat
0.15mm sifting less than 10%		

White cement or filler or similar shall confirm to the requirements of Portland cement, BS.12.

The use of mixtures shall be approved by the Consultant's representative. The amount of admixture shall be such that it effects mortar strength very little.

### **6.3 Mixing ratio**

Mixing volume ratio of mortar shall be as in table below:

<b>Base</b>	<b>Area of application</b>	<b>First coat cement: sand</b>	<b>Dabbing out cement: sand</b>	<b>Finish coat cement: sand</b>
Masonry blocks	Floor	-	-	1:4
	Interior wall	1:4	1:4	1:4
	Exterior wall	1:4	1:4	1:4

### **6.4 Thickness of Coating**

Standard thickness of coating (mm)

<b>Base</b>	<b>Area of application</b>	<b>First coat</b>	<b>Dubbing out</b>	<b>Second coat</b>	<b>Finish coat</b>	<b>Total</b>
Masonry block	Floor	-	-	-	as per dwg	as per dwg
	Interior wall	8	-	8	4	15
	Exterior wall	13	-	12	4	25

Thickness of coating shall be standard thickness of coating unless otherwise indicated on the Drawings.

## 6.5 Finish

Type of finish and work schedule

Type	Work Schedule	Notes
1. Smooth Trowel finish	1. Shall be applied flat by metal trowel 2. Shall be finished by pressing with the trowel.	Before applying second coat, corner and edge shall be screed well.
2. Wooden float finish	Shall be applied by wooden float	

## 6.6 General Preparation

Remove efflorescence, laitance, dirt and other loose material by thoroughly dry brushing.

Remove all traces of paint, grease, dirt and other materials incompatible with coating by scrubbing with water containing detergent and washing off with plenty applying coatings unless specified other wise.

In Situ Concrete Surfaces: Scrub with water containing detergents to ensure complete removal of mould oil, surface retardants and other materials in compatible with coating. Rinse with clean water and allow to dry unless specified otherwise.

Organic Growths: Treat with fungicide to manufacturer's recommendations and bush off.

Hacking For Key: roughen specified surfaces thoroughly and evenly by removing the entire surface to a depth of 3mm by scrabbling, bush hammering or abrasive blasting. Clean surfaces by washing and brushing.

Smooth Concrete Surfaces: where no keying or mix or bonding agent is specified, wet smooth concrete surfaces immediately before plastering.

## 6.7 External Plastering

Dissimilar Solid Backgrounds for Plastering: where plaster is to be continued with out break across joints between dissimilar solid backgrounds which are rigidly bonded together, cover the joints with a 200mm wide mesh strip (back grounds in the same plane) or with the corner mesh (internal angle) fixed at not more than 600mm centers along both edges , unless specified or otherwise.

Dissimilar Solid Backgrounds for Plaster: where plaster is to be continued without break and without change of plane across the face of a 300mm and rigidly bonded to the background.

Cover the face of the column /beam/ lintel with building paper extending 25 mm on the adjacent background.

Over lay with expanded metal lathing extending 50mm beyond the edges of the paper and securely fixed with masonry nails at not less than 100mm centers along both edges.

Alternatively, an approved paper and mesh lathing may be used.

Dissimilar Solid Backgrounds for Rendering: where rendering is to be continued without break across joints between dissimilar solid backgrounds which are in the same plan and rigidly bounded together, cover joints with a 150mm wide strip of building paper overlaid with 300mm wide metal lathing fixed at not more than 600mm centers along both edges unless specified other wise.

Service Chases: cover with steel mesh strip fixed at not more than 600mm centers along both edges.

Conduits bedded in under coat to be covered with 90mm wide jute scrim budded in finishing coat mix, pressed flat and towed in. Do not lap ends of scrim.

## 6.8 Internal Plastering

Accuracy of plaster 15mm thick or more: maximum permissible gap between a 1800mm straight edge and any point on the surface to be 3mm.

Dubbing Out: if necessary to correct inaccuracies, dub out in thickness of not more than 10mm in same mix as first coat. Allow each coat to set before the first is applied. Cross scratch surface of each dubbing out coat immediately after set.

Metal Mesh Lathing: Work undercoat well in to interstices to obtain maximum key.

Under Coats: generally to be not less than 8mm with thickness greater than 16mm applied as two equal coats. Rule to an even surface and cross scratch - end coat to provide a key for the next hand applied coat.

Cement Based Under Coats: all to dry out thoroughly but not rapidly, to ensure that drying shrinkage is substantially complete before applying next coat.

Dissimilar Backgrounds: where scrim or lathing or beads are not specified, cut through plaster with a fine blade in a neat, straight line at junctions of:

Plastered rigid sheet and plastered solid backgrounds.

Dissimilar solid backgrounds.

Smooth Finish: trowel or float to produce a tight matt, smooth surface with no hollows abrupt change of level or trowel marks. Do not use water brush and avoid excessive toweling and over polishing.

## 6.9 External Rendering

Dubbing Out: if necessary to correct inaccuracies, dub out in thicknesses of not more than 10mm in same mix as first coat. Allow each coat to dry before the next is applied. Cross scratch surface of each dubbing out coat immediately after set.

Under Coats for hand applied finishes:

Apply first undercoat or dubbing out coat by throwing from a trowel.

Coats to be no less than 8mm thick, with thickness greater than 16mm applied as two equal coats. On weak backgrounds first under coat to be not less than 10mm thick.

Brush down each under coat to remove dust and loose particles and wet thoroughly before application of next coat.

Cross scratch under coat without penetrating the coat, to provide key for following coat(s).

Drying: Keep each coat damp for the first three days by covering with polythene sheet and/or spraying with water. Thereafter prevent from drying out too rapidly. Work in shade when ever possible.

Allow each coat to dry out thoroughly to ensure that drying shrinkage is substantially complete before applying next coat.

Playing Floated Finish: Finish with wood or other suitably faced float to give an even texture.

Do not draw excessive laitance to surfaces.

## **6.10 Metal Mesh Lathing / Reinforcement For Plastered/Coatings.**

Lathing to be provided as reinforcement for plastering in columns, walls or specified in drawings products.

### **6.10.2 Products:**

Plain Expanded Metal Lathing: To B.S 1369 with a minimum weight of 1.9 kg/mm<sup>2</sup>. Manufacturer to approval of the Consultant.

Wire Ties: Unless other specified, annealed iron , galvanized to B.S 443.

Clout Nails: galvanized steel or stainless steel nails to B.S 1202: Part 1, table 3.

Staples: Galvanized steel wire staples to B.S 1494: Part 2.

### **6.10.3 Workmanship**

Framing: fix securely and accurately to help ensure that coatings on lathing , when finished, are true to line and level , within specified tolerances and free from cracks, rippling, hollows, ridges and sudden changes of levels.

Runners/Bearers spanning between concrete beams/ribs: fix with 3mm wire ties twisted around 38 mm X 10 gauge screws driven well into fixing blocks or plugs in sides of beams/ribs.

Wire Ties: twisted ends tightly together, cut off surplus and bend ends of wire away from face of coating.

Plain Expanded Metal Lathing:

(a) Stretch lathing and fix securely in accordance with manufacturers recommendations to give a taut, firm base for plaster/ rendering.

(b) Fix with the long way of the mesh at right angles to supports and with all strands sloping in the same direction.

(b) Lap side edges not less than 25mm. Lap ends 50mm at supports and 75mm between supports. Laps must not occur within 100mm of angles or bends.

## **7. CARPENTRY, JOINERY AND FURNITURE**

### **7.1 Materials**

Timber and plaster board internal wall partitions and concealed/suspended ceilings shall be in accordance with the requirements of BS 1186 'Quantity of Timber and Plaster boards Workmanship in Joinery', Part 1, 'Quality of Timber'.

Timber and plaster board products shall be subject to the inspection and approval of the Consultant.

Timber shall be seasoned to stable moisture content compatible with the finished use, straight and true and free from wind, warp and distortion and in lengths suitable for the members required.

All timber shall be in long lengths and laps, scars or splices shall be over a bearing surface. Where obtainable, finishing timber exposed to view shall be in single lengths.

All office furniture client will select the type and brand. Samples to be submitted to the client for approval.

### **7.2 Preservation of Timber**

All timber shall be treated for insect attack and is to be of the correct moisture content and free from surface moisture content and dirt.

All timber ceiling and low wall partition frames etc. shall be treated for insect attack with approved timber preservative. No extra payment shall be made for such coating and will be considered inclusive in the rate of the respective item in the BOQ.

Treatment shall be carried out after all cutting and shaping is completed.

### **7.3.3 Hardware**

Hardware shall be standard quality and samples shall be submitted to the Consultant for approval.

All hinges shall be stainless steel or brass and shall be approved by the Consultant.

The dimensions and quality of hardware shall meet the requirements and shall not be rested, deformed or defective.

### **7.4 Dimensions and Finish**

All dimensions of timber and plaster boards given are finished dimensions.

All elements and others of structural nature, which are exposed, must be machine planed to a smooth finish.

All unexposed shall be machine planed to a rough finish.

All joinery work shall be dressed on all four sides and hand dressed where necessary and sanded to all exposed surfaces. All arises in any way accessible shall be sanded and smoothed off.

All furniture shall be in good quality and durability.

## **7.5 Workmanship**

All connections whether nailed, screwed, glued, mortised or dove-tailed shall be accurately made and properly executed to provide sound, satisfactory connections for the class of work required.

Timbers and plaster boards containing defects or distortions shall not be used.

All joinery shall be manufactured by skilled tradesman with accurate tolerances and set out and with tools, jigs, machines and equipment appropriate for the work.

Assembly of the joinery units and joinery frames, etc. shall be by means of glued connections appropriate to the work - mortise and tenon, housing and doweling, etc. where practicable including the use of glued blocks wherever required. Nailing, screwing shall only be used with prior approval of the Consultant; corrugated fasteners shall not be used for effecting connection.

All office furniture units shall be in good quality and conditions. All defect furniture will not be acceptable.

## **8. DOORS AND WINDOWS**

### **8.1 Doors and Windows**

All windows and doors are to be constructed by approved specialist suppliers of medium section to the particular requirements noted on the drawings as to weight and profile. All sections shall generally conform to relevant British Standard Specifications.

All frames shall be made to fit the actual openings with a 3 mm clearance all around. Discrepancies in overall width or height exceeding 3mm will not be allowed and the frames will be rejected in such cases. Any small discrepancies shall have the gaps suitably backed and filled with gun-applied water repellent mastic sealant

All sealants used in the assembly of, and in the fixing of cladding and window framing, shall be non-setting to allow thermal movement without detriment to those joint sealants used for peripheral caulking and shall be one part silicone sealant and shall conform to BS 4245. All spliced joints between mullions shall be sealed with an approved silicone product, compatible with other sealants and packing used.

The auxiliary components in sashes as locks, pivots, sliding gear etc. shall comprise of stainless steel or resisting materials.

The tolerance is to be as follows:

- |                                   |             |
|-----------------------------------|-------------|
| a) Inside width of frame          | 3mm Maximum |
| b) Inside height of frame         | 3mm Maximum |
| c) Depth of frame                 | 2mm Maximum |
| d) Opposite side, Inside distance | 2mm Maximum |

The performance - associated requirements are

- 1) Strength (resistance to wind pressure and other forces applied in use)
- 2) Air tightness or ability to cut out drafts.
- 3) Water - tightness against rain or dew.
- 4) Sound arresting effect to (shut off noise from outside as well as inside).
- 5) Fire rated doors at least 1 hour minimum (See Doors/windows schedule drawings for verification)

All surfaces shall have a specified powder coated protective surface layer of minimum 60-80 Micron thickness.

Glazing shall be done as specified by the Consultant. Glass shall be Blue reflective, or as specified in the drawings. Thickness shall be according to the size of panels as given hereunder.

Not exceeding 1 sq. ft.	2mm
Exceeding 1 sq. ft. but not exceeding 2 sq. ft.	3mm
Exceeding 2 sq. ft. but not exceeding 4 sq. ft	4mm
Exceeding 4 sq. ft. but not exceeding 6 sq. ft	5mm
Exceeding 6 sq. ft.	6mm

Prior to import and / or purchase of the Doors and Windows, the relevant specification of the manufacturer, along with samples has to be submitted to the Consultant for approval. This clause shall not be contravened on any account.

The fitting shall be done with utmost care not to spoil the finishes given by the manufactures, and any cleaning done shall be done with cleaners etc. as specified by the Manufactures.

The Contractor shall provide all items, articles, materials, operations, mentioned, or scheduled on the drawings, including all the labour materials, including fixing devices, equipment and incidentals necessary as required for their completion.

The Contractor shall submit shop drawings and/or samples of each type of doors, windows, railings and other items of metal work to the Consultant for approval. The shop drawings shall show full size sections of doors and windows etc. thickness of metal, details of construction hardware as well as connection of windows, doors and other metal work to adjacent work.

Doors and shutters shall be manufactured by an approved manufacturer and shall be of sections, sizes combination and details shown on the drawings. The frame member shall be one piece, corners shall be electrically welded, ground smooth and true and glazing bare shall be threaded or interlocked as approved by the Consultant.

Glazing for doors and windows shall be of specified thickness and of approved quality and shall conform to specification of glazing. Fixing for glazing shall be done with aluminium Snap-On beading as per detail drawing and instructions. Necessary continuous rubber gaskets of approved make shall be provided.

Colour for doors and windows shall be approved by the Consultant.

## **8.2 Louvers**

Samples shall be submitted for approval.

All metal louvers shall be installed according to manufacturer's instructions.

All units shall be installed plum, well fitted and securely attached to supporting frames.



### 8.3 Top hung windows, ventilators and side hung doors

All windows and doors shall be weather stripped. The weather protection shall be achieved by a positive compressive action against the section and shall not depend on external contact. At every contact between two profiles two weather stripping sections shall be provided to complete weather protection.

The bottom section for hinges must be capable of being adjusted vertically if necessary. The gap between section and the floor shall be covered with a pair of special splay-tube sections.

The shutter sections for both windows as well as doors shall be hollow section type and shall be overall size 57 x 45 mm and the door sections shall be overall size 81 x 45 mm (including flanges).

The shutters of the windows and doors shall be assembled with stainless steel pins and nylon washers. Handles shall be powder-coated aluminum finished to match the aluminum sections and mounted with self-lubricating nylon washers.

A mortise cylinder rim automatic deadlock of high quality with double pin tumbler shall be used.

Windows shall have powder-coated aluminum handles, colour as framing and a latching mechanism securing the shutter to the frame both at the top and bottom

Required fittings;

Single action door closer concealed in the head bar of the outer frame and mounted on an adjacent pivot at the threshold and deadlock fitted.

The left hand leaf of double doors with flush bolts at head and sill with deadlock fitted to the right hand leaf

Escape doors to have panic bolts assembly with vertical elements concealed in the sill and door closer as in 8.3

## 8.4 Installation

Door/window work shall be installed adjusted and glazed by experienced workmen all in accordance with the manufacturer's installation instructions and in full conformity with the approved shop drawings, samples and other submitted data. Under no circumstances shall materials be installed on surfaces that contain condensation, dirt, grease or other foreign encountered materials that would hinder or prevent proper installation and functioning for the use intended.

Door/window work shall be carefully and accurately assembled with proper and approved provision for contraction and expansion and set in correct locations as per approved detailed shop drawings, all level, square, plumb and aligned with other work. All joints between framing and structural building shall be sealed in order to be watertight and weatherproof and to satisfy all other requirements of the Consultant.

Frames shall be designed and manufactured with a maximum 2.5mm tolerance around the opening in the structure. These joints are to be finished by applying an approved sealant into a polystyrene foam backing strip.

All Door/window works are to be fully protected for the duration of the contract from damage by other trades. The Consultant shall approve the method of protection.

If for any reason final finishes become scratched, abraded or damaged during transport, delivery, storage or erection, it shall be the Contractor's responsibility to remove or repair those defective areas or components as directed and to the complete satisfaction of the Consultant.

Repair work shall be identical to the manufacturer's applied finish with regard to gloss, finish and visual appearance. Field touch up of painted doors/windows is permitted only with the written permission of the Consultant. Where touch up is not an authorized means of repair the damaged materials must be replaced by new.

Upon completion of work all protective coverings from all exposed surfaces shall be removed. All surfaces shall be cleaned using soap or detergents as recommended by the door/window manufacturers to remove sealants, discoloration and any other foreign material. Defection of any type determined by the Consultant shall be repaired at the Contractor's expense.

Extreme care shall be taken when cleaning the exterior portion to protect all other adjacent works.

## 8.5 Sealing joints

The Contractor shall ensure that joints are dry and remove all loose material, dust and grease.

Joints shall be prepared in accordance with sealant manufacturer's recommendations using recommended solvents and primers where necessary.

Adjoining surfaces which would be impossible to clean if smeared with sealant shall be masked.

Backing strips shall be inserted in all joints to be pointed with sealant. When using backing strips, the Contractor shall not leave gaps and shall not reduce depth of joint for sealant to less than the minimum recommended by the manufacturer.

Cavities shall be filled and jointed with sealant in accordance with the manufacturer's recommendations. Sealant shall be tooled to form a smooth flat bead.

Excess sealant shall be removed from adjoining surfaces using cleaning materials recommended by the sealant manufacture, and shall be left clean.

## 8.6 Glass installation

Workmanship shall generally be in accordance with CP 152 and respective British Standards.

The glass is to be delivered to the site with adequate protection to prevent damage and where possible it is to be fixed in position immediately after delivery. When fixed the Contractor is to take all necessary precautions to prevent damage during succeeding building operations and will be entirely responsible for the replacement of any broken or damaged glass at his own cost.

The Contractor is to be solely responsible for determining the exact sizes of glass required, including a tolerance of 2mm to each edge and he is recommended to check the necessary dimensions on site.

No glazing is to be carried out until rebates have been painted with primer. Glazing beads as applicable are also to be primed before fixing.

All mastic is to be neatly struck off to agree exactly with site lines inside and out.

Rates are to include for all necessary springs, clips, setting blocks, location blocks and distance pieces and for taking off and later re-fixing loose beads.

Glass apertures in timber doors are to be bedded in chamois leather glazing strip, black ribbon velvet or P.V.C. glazing strip to the approval of the Consultant.

## **9. TILING**

### **9.1 General**

Glazed Ceramic Tile shall comply with British Standard specification No. 1281 and shall be approved sizes as shown on Drawings and the product of a reputable manufacturers approved by the Consultant.

Unglazed Ceramic Tile shall comply with the requirements of British Standard No.1286 and shall be of approved sizes as shown on the drawings and the product of a reputable manufacturer.

### **9.2 Manufacturers**

All tiles shall only be used with prior written approval of the Consultant.

### **9.3 Ceramic and Vitreous Tile Materials**

#### **9.3.1 Ceramic and Vitreous clay Wall Tiles:**

All tiles for wall installation shall have cushion edge, impervious porcelain and highly glazed surface. Colours shall be as selected by the Consultant and shall include trimmers, corner pieces, bull nose and all other special shapes indicated or required. All this shall be free from flaws, cracks and crazing.

#### **9.3.2 Floor Ceramic and Vitreous Tiles**

Non-slip ceramic tile for shall be used on all floor locations. Floor tiles shall be specially prepared for floor use but shall have all the qualities of ceramic tiles listed above for wall use.

### **9.4 Mortar Materials**

Standard brand of light gray or white Portland Cement as specified in drawings, conforming to current British Standard specifications shall be used.

Sand: shall be clean, sharp, river sand, conforming to British Standard Specifications and graded fine to coarse within the following limits: 100% passing 8 sieve, 90% to 100% passing 16 sieve, 60% to 90% passing 30 sieve, 25% to 55% passing 50 sieve and 0% to 15% passing 100 sieve.

### **9.5 Cement Colour**

Dry cement colour, chemically inert, non fading, alkali fast, mineral pigment, as approved shall be used wherever refinished.

### **9.6 Waterproofing**

Floors of toilet areas, corridors, terrace and planter boxes shall be treated with an appropriate water proofing coating, approved by the Consultant

## 9.7 Installation Requirements

As far as possible, tile lay out work shall be in such ways that no tile less than half size occurs.

Align joints in wall tile vertically and horizontally except where other patterns are shown or specified, Align joints in floor tiles at right angles to each other straight with walls to conform to the patterns selected.

Verify locations of accessories before installing tiles. Work shall be coordinated with plumbing and other trades before starting of tile work.

Installation of ceramic and vitreous tile shall be in accordance with manufacturer's instructions.

## 9.8 Floor Tile Installation

All ceramic and vitreous clay tile floors shall be in Portland cement setting beds. Concrete surfaces shall be cleaned and surface of concrete shall be wetted prior to placing of setting bed mortar. Tiles shall be immersed in water for minimum of 4 hours before setting.

Setting Bed Mortar Mix: shall consist of one (1) part Portland cement and two (2) parts dry sand, by volume, to which not more than 1/10 part of hydrated lime may be added.

When mixed with water, the mortar mix shall be of such consistency and workability as to produce maximum density. Determine consistency by stroking the mortar surface with a trowel. Whereof correct consistency; the trowled surface readily assumes a smoothed, slickened appearance.

Spread setting bed mortar and screed to provide smooth, dense beds with true planes pitched to drains. The thickness of bed shall be such that the floor tile will finish flush with adjacent finished flooring, but bedding shall have average thickness of 38mm.

After bed has set sufficiently to be worked over, trowel or brush a thin layer, 3mm in thickness, of neat Portland cement paste over the surface of the back of tile.

Do not prepare larger setting bed than can be covered with tile before the mortar sets.

Press tile firmly into the bed tapping with wood blocks to obtain firm bedding of total tile area and a smooth top surface.

All tiles shall be properly aligned with straight joints in even widths. Joints width shall be determined by spacers on ceramic tiles. Tamping shall be completed within one (1) hour after placing tile. Adjust work out of line within this period.

Tiles shall be fitted closely around pipes running through walls and floors. Pitch floors to drains.

## 9.9 Wall Tile Installation

Base Plaster 13mm thick applied to masonry wall shall be one-part Portland cement, three-parts of river sand by volume. Where additional thickness build-up is required to conform to indicated lines, apply as separate coat at no cost to employer.

Setting bed of tiles shall be done with cement slurry. The thickness of slurry bed shall be 3mm thick minimum for setting tiles and walls.

Installation of tiles shall be in accordance with standards and applicable requirements previously specified for floor tile.

Tiles shall be installed in perfect vertical plumb and as per the pattern and joints as shown on drawings

## **9.10 Grouting**

Grouting shall not commence for at least 24 hours after placing of tiles.

Grout for floor and wall ceramic and vitreous tiles shall be waterproof, neat white Portland cement with dry cement colour added as directed by the Consultant. If white grout is selected, cement shall be white.

Grout mixed to a creamy consistency in accordance with manufacturer's directions shall be used for joint filling. Maximum width of joints shall be 3mm.

Force maximum grout into the joints with trowel. Before grout sets, strike or tool joints to base of cushion and fill all skips and gaps. Do not permit setting bed materials to show through grouted joints.

Cure grout joints by maintaining damp condition for three (3) days by sponging down, or other methods approved by the Consultant. Allow floors to set 48 hours before permitting ordinary foot traffic.

## **9.11 Defects in Tiles and Tile Laying**

The surface of all tiled floors shall be perfectly in level and shall be executed by experienced workers in the field of tile setting.

A sample panel of laid tiles of each type shall be approved by the Consultant before commencement of tile setting.

Chipped or damaged tiles installed by the Contractor shall be rejected and shall have to be replaced by the Contractor at his own cost and risk.

## **9.12 Guarantees**

Manufacturer shall provide his standard guarantees for work under this section. However, such guarantees shall be in addition to not in lieu of all other liabilities which manufacturers and Contractor may have by other provisions of the Contract Document

## **10. PAINTING**

### **10.1 Material**

All paints shall be approved by the Consultant for colour, quality and type. All painting work shall be carried out in accordance with the paint manufacturer's specifications unless otherwise directed by the Consultant.

All paints and finishes used for the project shall be manufactured by or under license from one of the following manufacturers;

Imperial Chemical Industries (UK) – exterior walls, interior walls,

- (a) Sigma Paints (Saudi Arabia) - exterior walls, interior walls, wood
- (b) Nippon paint (Japan) - interior walls, wood, steel,
- (c) SKK – (Japan) - exterior walls, floor paint,

Paints from manufacturers not listed above shall only be used with prior written approval of the Consultant

Paint shall be ready mixed and all paints, varnishes, enamels, lacquer stains, paste fillers and similar materials shall be delivered to the site in the original containers with the seals unbroken and labels intact. Each container shall give the manufacturer's name, type of paint, colour of paint and instructions for reducing. Thinning shall be done only in accordance with the manufacturer's directions.

Use of product by the same manufacturer shall be a general rule in each stage of work in this Specification.

Colour, luster, colour scheme and finish shall be decided by the Consultant after checking sample paint test.

The painting shall be performed by experienced and competent painter.

Where walls are specified to be painted, all columns, arches, groove, rough surfaces, reveals, soffits and returns, etc. shall be included and no extra shall be payable.

### **10.2 Definition of Terminology**

#### **10.2.1 Surface Sealing**

Surface to be painted shall be sealed to have uniform suction and prevent lye from oozing out.

#### **10.2.2 Spot Puttying**

All cracks and depressions shall be filled flush with putty.

#### **10.2.3 Puttying**

All surfaces to be painted shall be puttied uniformly flat surface.

#### **10.2.4 Spot painting**

Spot puttied area shall be touched up by paint

#### **10.2.5 Touch-up**

Any damaged area after the prime coat has been applied shall be touched up

**10.2.6 Drying hour**

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

**10.2.7 Amount of paint**

The 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.

**10.3 Paint Finish Symbols**

OB	Oil-Based paint finish
EP	Polyvinyl acetate resin emulsion paint finish
AEP	Synthetic resin emulsion paint finish
EXP	Export Resin Paint finish

**10.4 Painting in General****10.4.1 Preparation of Paint**

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

Thinning: Portable water shall be used for thinning of emulsion 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 with direction of manufacturer or catalogue as they vary with the method of paint, temperature, type of material to be painted.

Allowable period of Use: Paint mixed with more than 2 types shall be used with direction of a manufacturer or catalogue as allowable period of use, mixing ratio and mixing method vary. The paint which has passed allowable period of use shall not be used.

**10.4.2 Conditions of Painting**

Work shall not be executed in the following situations

When humidity is above 85%

When raining or it is forecast

When dusts are present

When temperature of surface is high under hot weather and bubbles are likely to develop on the painted surface.

Conditions of Surface to be painted: Work shall not be executed or proper means shall be taken in the following situations.

When surface 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 specification.



**10.4.3 Performance**

Paint shall be evenly and uniformed applied on the surface. Areas of difficult application such as pointed part, internal angle, welded part, etc. shall be thoroughly painted and double coated as necessary to deep uniform coating thickness.

Painting shall be properly done by carefully selecting the painting method by the shape of surface and types of paint.

**10.4.4 Protection**

Dangerous material such as paint, thinner, etc., excluding emulsion paint and water-soluble paint shall be kept in accordance with regulations concerned.

**10.5 Procedure of Painting****10.5.1 Exterior - Surface of Mortar, Plaster and Concrete****Oil based paint finish (gloss)**

<b>Coating Process</b>	<b>No. of Coats</b>	<b>Type of Paint</b>	<b>Drying hour</b>	<b>Amount (kg/m<sup>2</sup>)</b>
1. Surface preparation		Dry, clean and free from impurities		
2. Surface sealing	1	Sealer for Oil based paint	longer than 4 hours	
4. Grinding		Grind with proper grinding tool		
5. Spot painting		Oil based paint		
6. Second coating	1	Oil based paint	longer than 4 hours	0.10-0.13
7. Finish coating	2	Oil based paint	longer than 4 hours	0.10-0.13

Notes:

- (a) Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5
- (b) Puttying and sanding process shall be allowed to omit depending on the conditions of the surface.
- (c) Drying time of putty shall be long enough for sanding to proceed.
- (d) Amount of sealer for surface sealing shall be adjusted with direction of the Consultant as it varies with the surface conditions.

10.5.6 **Interior - Mortar, plaster, concrete, etc.****Polyvinyl acetate resin emulsion paint finish (matt)**

Coating Process	No. of Coats	Type of Paint	Drying hour	Amount (kg/m <sup>2</sup> )
1. Surface preparation		Dry, clean and free from impurities		
2. Surface sealing	1	Sealer for emulsion paint	longer than 4 hrs	
3. Puttying		Putty for emulsion paint		
4. Grinding		Grind with proper grinding tool		
5. Spot painting		Polyvinyl acetate resin emulsion paint		
6. Second Coating	1	Polyvinyl acetate resin emulsion paint	longer than 4 hrs	0.11-0.13
7. Finish Coating	1	Polyvinyl acetate resin emulsion paint	longer than 4 hrs	0.11-0.13

## Notes:

- (a) Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5
- (b) Puttying and sanding process shall allowed to omit depending on the conditions of the surface.
- (c) Drying time of putty shall be long enough for sanding to proceed.
- (d) Amount of sealer for surface sealing shall be adjusted with direction of the Consultant as it varies with the surface conditions.

10.5.7 **Exterior - Iron Products in General****OB – Oil Based Paint**

Coating Process	No. of Coats	Type of Paint	Drying hour	Amount (kg/m <sup>2</sup> )
1. Surface preparation		Completely remove rust, moisture, oil and other impurities by sander, cleaner and surface.		
2. First Coating 24 hours	1	Rust proof oil paint	longer than 24 hours	0.13-0.15
3. Touch-up		Touch-up rustproof oil paint		
4. First Coating	1	Rustproof oil paint	longer than 24 hrs	0.13-0.15
5. Second coating	1	Oil Based Paint	longer than 15 hrs	0.11-0.15
6. Finish coating	1	Oil Based Paint	longer than 15 hrs	0.11-0.15

## Note:

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

10.5.8 **Floor - Concrete and Mortar**  
**EXP - Epoxy resin paint finish**

Coating Process	No. of Coats	Type of Paint	Drying hour	Amount (kg/m <sup>2</sup> )
1. Surface treatment		Dry, clean and free from impurities		
2. First coating	1	First coating paint for epoxy	Longer than 24 hrs	
3. Finish Coating	2	Epoxy resin paint	Longer than 24 hrs	

Notes:

- (a) Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5.
- (b) Amount of paint and number of paint shall be as directed by the Consultant as they vary with the conditions of surface and required thickness of coating.
- (c) Painted surface shall be kept out of use for more than 7 days after application of final coat.

## **11. PLUMBING**

### **11.1 General**

The materials used and workmanship shall be of highest quality and grade unless otherwise specified shall conform to the latest specifications of British Standards and Codes of Practice for “Water Supply “Sanitary, Pipe Work “Building Drainage “Surface Water and Sub- Soil Drainage” and applicable to details and work indicated on the Drawing and Bill of Quantities. In case of any discrepancy / ambiguity the decision of the Consultants shall be final, and the contractor will act and perform accordingly.

The work shall be executed strictly in accordance with the rules and regulations set by the relevant local authority of the Maldives.

The Contractor shall be responsible for obtaining the necessary approvals and test certificates from the concerned departments of Maldives.

Plumbing work shall be carried out by licensed plumbers and shall produce the copy of the license along with the tenders, or approved by the Consultant

Any damage done by the Contractor to any existing work during the course of execution of his work shall be made good by him at his own cost. Failing which it shall be get done by the Consultants at Contractor's risk and cost.

The Contractor shall be responsible to connect the drainage and water supply to the mains and to obtain the necessary approvals and certificates from the relevant authorities of the Maldives.

All connections to mains and meter installation shall be arranged by the Contractor and payment of fees thereof, if any, shall also be made by him.

The Contractor shall be responsible for the watch and ward of all fittings until the Works is fully completed and handed over to the owner.

The levels, measurements and other information concerning the existing site as shown on the drawings or as described as are supposed to be correct. The Contractor shall, however, verify them by himself and no extra claim whatsoever shall be entertained on account of the errors or omissions in such matters or on account of the descriptions turning out to be different from what was expected.

The Consultant shall instruct the Contractor to purchase and use such materials of particular make or from particular source as may in his opinion be necessary for proper and reasonable compliance with the specification and execution of the Works.

After all plumbing fixtures and equipment have been set ready for use, and before the Contractor leaves the job, he shall thoroughly clean all fixtures installed by him, removing all plaster, stickers, rust stains and other foreign matter of discolouration on fixtures, leaving every part in acceptable condition and ready for use to the satisfaction of the Consultants.

## **11.2 Drawings and Information Required**

The Contractor shall submit shop drawing for the entire installation including installation details for all items required or asked for approval of the Consultant.

Approved by the Consultant of shop drawing for any material, apparatus, devices and layout, shall not relieve the Contractor from the responsibility of furnishing same of proper dimension, size, quantity and all performance characteristic to efficiently perform the requirements and intent of the Contract Documents. Such approval shall not relieve the Contractor from responsibility for errors of any sort in the shop drawing.

If the shop drawings deviate from the contract Documents the Contractor shall advise the Consultants of the deviations in writing accompanying the shop drawings including the reasons for the deviations. At the start of the Project the Contractor shall periodically and thereafter submit to the Consultants list of all shop drawings which will be submitted in the course of the project. The list shall show the disposition of each item including date of submission approval etc. The list shall be kept up to date through the entire course of construction.

## **11.3 Record Drawing**

During Construction the Contractor shall keep an accurate record of all deviations between the work as shown on the Contract Drawings and that which is actually installed.

The Contractor shall secure from the Consultants after approval of his Shop Drawing a complete set of drawing and note changes thereon in ink.

The Contractor shall make a complete record of all changes and revisions in the original design which exist in the completed work.

The cost of furnishing above prints and preparing these for record “ shall be deemed to be include in the tendered cost and its effects spread over other items of work, and as such item shall not be a subject to payment”. When all revisions showing the work as finally installed the corrected Original Transparencies shall be submitted to the Consultants before final payment for the completed work will be made.

## **11.4 Operating and Maintenance Instructions**

Three sets of operating and maintenance instruction covering completely the operation and maintenance of all plumbing equipment, controls, heaters, pumps and the like shall be furnished to the Owner, by the Contractor.

## **11.5 Tests**

The entire system of drains, waste and vent piping inside and outside the building shall be tested by the Contractor under a water test, which shall include the entire system from the lowest point to the highest pipes above the roof.

The water test shall be made in accordance with all local requirements. Every portion of the system shall be tested to a hydrostatic pressure equivalent to latest 15 feet head of water. After filling, the Contractor shall shut off water supply and shall allow it to stand 2 hours under test during which time there shall be no loss or leakage.

The Contractor shall furnish and pay for device, material supplies, labour and power require for all tests. All tests shall be made in the presence and to the satisfaction of Consultant.

Defects disclosed by the test shall be repaired or if required by the Consultant defective work shall be replaced with new work without any extra charge to the Owner. Test shall be operated as directed until the work is proved satisfactory.

Fixture shall be tested for soundness, stability of support and satisfactory operation.

The Contractor shall notify the Consultant at least one week in advance of making the required test, so that arrangements may be made for their presence to witness the test.

Equipment shall be tested in service and the Contractor shall demonstrate that the equipment performs the work intended for it and that it complies with the requirement of these specification for such equipment, to the satisfaction of Consultants.

The rates shall include for all costs associated with tests.

## **11.6 Work in Common Piping**

### **11.6.1 Material**

Piping and fitting material shall be uPVC, Hard Impact PVC. or High Temperature PVC. and approved by the Consultant.

Piping material shall comply with requirements of water supply and sewerage and other relevant authorities.

Materials for the piping and service requirements shall basically conform to the service pressures encountered.

### 11.6.2 Providing Drawings and Manuals

The Contractor shall submit one set of originals and further two copies of layout drawings to the Consultant after completion of the Works. These drawings must give the following information:

- (a) Run of all piping and diameter on all floors and the vertical stacks.
- (b) Location and sizes of all control valves, access panels and other equipment.
- (c) Location of all manholes and their sizes.

No completion certificate will be issued until the drawings are submitted.

The Contractor shall submit to the Consultant for approval, samples, shop drawings, manufacturer's drawings, equipment characteristics and capacity data etc. of all equipment, accessories devices etc. that he proposes to use in the installation.

### 11.6.3 Samples

The Contractor shall provide samples of all sanitary fittings, pipes and specials manhole cover and frames, gratings and water supply pipes and fittings etc. and shall be deposited with the Consultant (which will be returned to the Contractor at the completion of the Works) and shall obtain approval from the Consultant before using in the Works. Any material rejected by the Consultant shall be removed from the site within 24 hours of rejection.

### 11.6.4 Drawings

The works shall be done in conformity with the plans and within the requirements of the general architectural, electrical and structural plans. This work shall be properly coordinated with the work of the other trades. Hangers and sleeves shall be furnished in time for their installation as other work proceeds.

The plumbing drawings are diagrammatic, but shall be followed as closely as actual construction. All deviations from drawings required to conform to the building construction shall be made by the Contractor at his own expense.

The architectural drawings shall take precedence over the plumbing drawings as to all dimensions.

Large size details shall take precedence over small size drawings. The special dimensions in the specifications or schedule of quantities or instructions of the Consultant shall supersede the drawings. The Contractor shall verify all dimensions at site.

The recommend position of the fittings, fixtures, control valves, tanks etc. as shown on the drawings will be adhered to as far as practicable.

Shall there be any discrepancy due to incomplete description ambiguity or omission in the drawings and other documents, whether original or supplementary, forming the contract, either found on completion or during the currency of the installations work, the Contractor shall immediately, on discovering the same, draw the attention of the Consultants and the Consultants decision in final and binding on the Contractor.

#### 11.6.5 Existing pipes

The site shall be examined for field drains and those, when found, shall be either entirely removed or diverted, trenches filled with dry earth in 200mm to 300mm layers and consolidated as directed by the Consultant.

#### 11.6.7 Excavation

All excavations shall be timbered to the satisfaction of the Consultant and the type of timber shall be suitable to the kind of earth encountered. Fixing of timber and removal after completion of work shall be done as directed by the Consultant.

Shall any water accumulated in the trenches, headings or other excavation, the Contractor shall do such work as may be necessary to drain away the accumulated water and shall install pumps as may be required to keep the excavation and trenches dry. The Contractor shall ensure that the flow water in trenches or excavation does not injure or remove cement or aggregate of any concrete that has not set. No subsoil water shall be discharged into open drains or sewer at the site.

In refilling trenches after excavation this shall be done in layers of 150mm after consolidating each layer. Special care shall be to see that the earth is packed uniformly and no injury to the pipe.

Rates for excavation shall include for backfilling in consolidated layers where necessary and as directed by the Consultant.



### 11.6.8 Piping

The Contractor shall, as soon as possible after the award of the contract, prepare and submit to the Consultant for approval, working drawings showing exact locations and pipe runs for all pipework, the layout and setting up of equipment and the connection of piping to the equipment. Such drawings shall include details and methods of supports, anchors and sleeves etc.

Pipe runs shown in the drawings are approximate and intended to indicate the general run and locations only. The exact locations of all pipe work shall be determined on Site.

All pipes, fittings etc. shall be kept closed against moisture and foreign matters when stored at site and during installation.

All pipes shall be fixed clear of one another and be so arranged as to provide easy access for maintenance and repair.

All plumbing work shall be carried out by suitably qualified plumbers in accordance with the British Code of Practice and Regulations and requirements of related Authorities.

Materials for the piping and service requirements shall basically conform to the service pressures encountered.

Each part of the installation of the plumbing work shall be completed in all details as shown in the drawings or as specified and provided with all necessary control valves, etc. that will be necessary for their satisfactory operation.

All piping shall be run plumb, and straight and parallel to walls, except drain line which shall pitch 6mm per 300mm in the direction of flow.

Pockets, unnecessary traps, turns and offsets shall be avoided. When traps or pockets are unavoidable they shall be valved drains.

Piping installed on the concrete slab shall be firmly fixed or anchored to the floor with packing to prevent damage to pipes. Pipes shall not be bent with bender where cross with other pipe or change to upward.

Where pipes are to be laid directly in the ground, bed shall be sufficiently compacted, necessary protection for piping shall be taken.

Backfill shall be done after the approval of the Consultant in such a manner not to damage the pipeline and shall be restored to the original stage.

Where pipes penetrate through waterproof part or fire partition or fire wall, pipe sleeves shall be provided and clearance between pipe sleeve and pipe shall be filled with caulking material approved by the Consultant.

Pipes, fittings, valves and accessories shall be thoroughly cleaned, both internally and externally before installation and shall be cleaned before putting into service.

Plumbing work shall be completed in accordance with the details shown on the Drawings or as specified and provided with all necessary control valves, etc. that will be necessary for their satisfactory operation.

All pipes shall be cut square and true to the pipe axis by means of suitable tools without reducing pipe diameter and cut ends shall be finished smooth. Before making connections, chips, dirt and other foreign matter shall be removed from inside interior of each pipe. Fixing of hangars and embedding of pipe sleeves shall be carried out without delay along with the progress of the work where required.

Pipe connections for the water supply system shall be by uP.V.C high pressure. Jointing shall be generally by means of solvent cement according to manufacturer's instructions

Vertical pipe shall be braced at more than 2 point in every story.

**11.7 Water Supply Work****11.7.1 Materials**

Pipes, joints and fittings for water supply work shall be high pressure uP.V.C.

Materials and workmanship shall comply with the local water supply authority requirements.

**11.7.2 Water Pump**

The specifications herein stated are basic guides only. Other items not so indicated but which are obviously necessary for the proper operation of the system as intended shall be supplied and installed, in accordance with accepted Consulting standard.

Manuals of operation and maintenance and list of spare parts shall be supplied together with the equipment.

The contractor shall submit at least four copies of pump performance curves showing among others, the pump rating and efficiency, properly marked out.

A metal name plate indication in indelible letters for the correct specification of the pump and motor shall be properly attached to the assembly at a location such that the information written thereon can be conveniently read by all concerned.

Well water pump: Flow rate = 60L/min, Head = 70m, Type : End suction Hydro pneumatic pump, 220/440V, 3-Phase, 50 Hz.

**11.8 Spacing of supports**

Support spacing for uP.V.C pipes shall be as follows

Nominal Dia.	upto 40	more than 50
Space (m)	1.2	1.5

**11.9 Drainage Work****11.9.1 General**

High Pressure uPVC pipe and fittings shall be used for all drainage work including vent pipes.

Joints shall be made by the cold-jointing method, and the pipe interior shall have not offset at the joint interfering with the flow. Joint adhesive shall be good quality and shall not be affected by heat and shock.

Where horizontal drain branch joints the main, such branch shall be connected to the main in a substantially horizontal position and at an acute angle of not more than 45 degree to the main in all cases.

### 11.9.2 Vent stack pipes

Vent pipe shall be vertically branched out upward from a horizontal drain branch pipe or other appropriate point. Horizontal branching of the vent pipe shall be done on approval of the Consultant.

Where vent pipes on each floor are to be connected to the vent stack, all connections shall be made at least 150mm above the respective overflow edges of fixture on that floor.

The provision of the preceding item shall also apply to the connection of vent stack vent pipe.

Vent stack shall be connected to the waste stack or soil stack at the lowest part to stack pipe.

Where vent pipe is to be connected to the horizontal drain pipe, such angle shall be more than 45 degree to upward.

Vent stack shall be extended 600 mm from the top of the roof or lead to the wall and top of pipe shall be covered with vent cap.

### 11.10 Laying of Pipes

The pipes shall be laid to proper lines and levels as shown in the plans and directed by the Consultant, as the main is laid, the front pipes in the trench shall always be closed with a plug either of iron or wood and security fastened. The plug shall not be removed except when pipe laying is resumed or for purposes of testing.

### 11.12 Sewers

After the cement has had time to set, the pipes shall be tested in length between manholes in following manner.

In the lowest manhole/intercepting trap as the case may be, a plug shall be inserted in the pipe. The disc in the pipe at the upper manhole shall be fitted with a filling pipe with a right angle bend and an air cock.

The pipe line shall then be filled with water by means of the pipe connection on the upper disc. The air cock on the upper disc shall be kept open while the pipeline is being filled to permit the escape of air.

When the pipes are filled with water and air excluded, the air cock shall be shut and the water shall be poured into conical filler, attached to the filling pipe until the water remains in the filter.

The filling pipe shall then be raised and fastened so that the height of surface of the water in the filler above the invert of the pipe is 1828 mm which will be usual test pressure for S.W pipes.

If the water level does not fall more than 16mm (12mm) in a length of 91.4 meter the test may be considered satisfactory.

The Contractor shall make good all defective work at his own expense

**11.13 U.P.V.C Pipes**

Manufacturer's instruction shall be followed in pipes to be used for water mains. Where specified, pipes shall have integral rubber ring joints and where solvent cement joints are specified, a sufficient number of expansion/contraction joints shall be incorporated in the length of mains to allow for variation of temperature to the recommendation of the pipe manufacturers.

These pipes shall be effectively protected from the direct rays of sun immediately after they are laid and until permission is given for the trenches to be refilled by the Consultant. Subject to such permission being obtained, trenches shall be refilled without delay. Final connection at a fixed point shall be deemed unto the majority of the length of the pipe line has been covered by backfill in order to reduce the effect of expansion and contraction caused by temperature variations .

**11.14 Bends and other Specials**

In fixing bends care shall be taken to see that the axis of the bend is truly vertical or horizontal as the case may be and the spigot of the bend is well in the socket of the pipe with which a joint has to be formed. The Contractor shall be called on to replace any faulty work at his own expense.

**11.15 Support for U.P.V.C Pipes**

When U.P.V.C pipe lines incorporate metal valves or other heavy fittings, it is essential to support the valves directly rather than allowing their weight to be carried by the uPVC pipe and support shall be placed on either side of the fittings mentioned above. Moulded plastic fitting also shall be supported.

Maximum allowable horizontal support distance for uPVC are given below.

<b>Nominal bore</b>	12 mm (1/2")	18 mm (3/8")	25 mm (1")	32 mm (1 1/4")	38 mm (1 1/2")	50 mm (2")
<b>Support distance</b>	533 mm (1'9")	616 mm (2'0")	686 mm (2'3")	764mm (2'6")	840 mm (2'9")	915 mm (3'0")
<b>Nominal bore</b>	75 mm (3")	100 mm (4")				
<b>Support distance</b>	1220 mm (4'0")	1290 mm (4'6")				

For vertical installation supports, distances shall be doubled.

**11.16 Sewer pipes**

All 'P', 'S', 'I' junctions bends etc. required shall be furnished and set without extra charge and shall confirm to the pipe specifications as to quality

**11.17 Air Valves**

These valves to be fitted as per drawings and Bill of Quantities shall be tested and accompanied by a certifying their efficiency.

The floating ball in the valve shall be suitable metal or vulcanite or rubber specially manufactured for tropical conditions.

**11.18 Scour Washout Valve**

These shall be provided at portions shown in place and shall contain in one unit a flanged scour valve with short connection pieces, cast iron bend and T pieces for connection to main pipe.

The rate shall also provide for short length of straight pipe to a convenient as per details complete with covers and surface boxes

**11.19 Foot valves and Strainers**

Foot valve and strainers shall be of reputable manufacture approved by the Consultant and shall be fitted with flushing lever attachment where specified.

**11.20 Pressure Reducers**

Pressure reducing valves shall be of the equilibrium type of approved manufacture and capable of reducing the pressure to the valve required as per plan and Bill of Quantities.

**11.21 Equilibrium Ball Valves**

These shall be of reputable manufacture approved by the Consultant and be of the angle pattern with gun metal valve seats guide bush, copper float with wrought iron lever and links with bronze pins.

**11.22 Fittings**

All sanitary pipes, gullies, water closets/bidets, squatting basins, sinks bath tubs etc. to be of approved design and to be obtained from approved Manufacture and to be of the best stoneware, glazed inside and outside, with burnt hard and sound, free from flaws, blisters, cracks and other imperfections and best quality commonly called 'Firsts'.

Rates shall include for all bends, junctions, traps, cleaning, painting, fixing clear of wall etc. complete as specified as per Bill of Quantities.

All pipes, fittings, flushing cisterns, valves, stop cocks, taps, tanks, surface boxes etc. to be of the best of their kinds and in addition to complying with previous clauses to be from approved Manufacturers and all taps, cocks, valves etc. to be screwed down pipe. Taps to be of brass/nickel coated and valves to be of gunmetal. All tanks to be made fly-proof and to the complete satisfaction of the Consultant.

Rates shall include for all cutting and waste, bends, taps junctures, cleaning eyes, tees

**11.23 Fixtures and Accessories**

All sanitary wares shall be manufactured by one of the following manufacturers.

1. Cotto
2. American Briggs
3. Armitage Shanks
4. Star sanitary ware

Sanitary ware from manufacturers not listed above shall only be used with prior written approval of the Consultant

**11.24 As built Drawings**

The Plumbing Contractor, shall mark down with red pencil on two sets of plumbing plans all the revisions, omissions and/or additions to the various plumbing installation drawings as the construction progress. One set of the plans as marked shall be submitted to the Consultant after completion of the work.

**11.25 Miscellaneous**

Throughout the construction period, open ends of all installed pipelines shall be kept closed by temporary plugs. Drainage lines shall not be used to conduct dirty construction wash-washer, especially, those with cement, to avoid possible clogging.

A temporary potable water supply shall be available to construction workers at each building floor as construction work progresses.

A temporary human Excrete Disposal System shall be provided by the Contractor to serve the workers during the construction period.

## **12. ELECTRICAL INSTALLATIONS**

### **12.1 General**

The work shall be carried out strictly in accordance with the standard specifications and shall also conform to the requirements of Electricity Rules in force in Male', Republic of Maldives.

All materials to be used in the Works shall be of standard make and shall bear the certification marks of local authorities. All materials shall be approved by the Consultant before use in the Works.

Earthing shall invariably be done in the presence of the Consultant or his representative.

All the conduits shall be continuously earthed. Check nuts shall be provided at the point where the conduct enters the I.C. box and junction box.

The Contractor shall arrange for the inspection of all Medium Pressure Installation by the Electrical inspector of the local electric supply authority from where the electricity connections has to be obtained, and see that they are passed by him.

The Contractor shall be responsible for all necessary permits, approvals, fees and deposits etc., required for the completion of the electrical works in accordance with the Contract.

#### **12.1.7 Scope of work**

The work consists of furnishing all tools, plants, labour, materials and equipment and performing the internal electrical Works comprising of:

- Light and power wiring
- Fans and fixtures
- Wires and cables
- Lightening and Earthing System
- Telephone system
- Cable Trench and Cable tray system

#### **12.1.7.2 Standards and Codes**

- (a) The Contractor should perform all the work in compliance with all regulations, standard specifications or states of the government of Maldives unless in conformity to this specification.
- (b) The current British Standard Specifications and Codes of practice shall apply to, and form part of these specifications, unless otherwise specified in respect of all materials and works to which they have application.

#### **12.1.7.3 Drawings and Specifications**

- (a) Drawings and Specifications are intended to complement each other, so that if anything is shown on the Drawings, but not mentioned in the specifications or vice versa, it is to be furnished and built as though specifically set forth in all three. If any discrepancies, errors, ambiguities or omissions occur in the Drawings or Specifications, the same shall be referred to the Consultant before proceeding with the works, and the Consultant's decision on such discrepancies, errors, ambiguities or omissions shall be final.

- (b) In addition to the Drawings and Specifications attached hereto, the consultant my furnish additional drawings, specifications and instruction. Such drawings and instructions should be deemed as a part of this document.

#### 12.1.7.4 **Schedule and Execution Plan**

- (a) The Contractor should prepare and submit to the Consultant for the approval the construction schedule and an execution plan before stating the work. If the contractor fails to follow the execution plan for any reason, a new execution plan with the reason should be submitted to the Consultant within 7 days.

#### 12.1.7.5 **Obvious Work**

- (a) Where an item of work is obviously required for the type of work being undertaken then it should be deemed to have been included even though the item is not specifically mentioned or shown in the Drawings or Specifications.

#### 12.1.7.6 **Insulation Oil**

The Transformers shall be supplied complete with first filling of oil to BS 148/1972. Sufficient oil shall be supplied in sealed drums for the first filling.

#### 12.1.7.7 **Description of the work**

The chapter gives the detailed technical specifications of the items to be supplied under this project.

#### 12.1.7.8 **Outdoor package substation**

#### 12.1.7.9 **Specification for Transformer (400Kva):**

Rating 400 kVA.  
 Phases Three Phase (Double Wound).  
 Frequency Hz. 50 Hertz  
 HV Winding 11,000 Volts.  
 LV Winding 433 Volts. (No Load).  
 HV Insulation Level 12 kV.  
 Power frequency 28 kV. r.m.s.  
 Basic Impulse Level 75 kV. peak.  
 Impedance - % at 75°C 4.75%.  
 HV Tappings  $\pm 2.5\%$  and  $\pm 5.0\%$   
 Tapping Selection By externally operated "off circuit" switch with handle enclosed in a removable M.S. gasketed cover.  
 HV/LV Connections Delta/Star N. pt.  
 B.S. Vector Symbol D,yn11  
 Temperature Rise °C Top Liquid 55° C; Windings 60° C  
 Type : Outdoor/Indoor Packaged Substation. (HV and LV flanges on opposite ends of transformer tank.)  
 Insulating Liquid Type Oil to B.S. 148:1998. Hermetically sealed with nitrogen gas cushion.



**12.1.7.10 Tank Fittings**

Welded on tank lid.  
 Earthing terminal.  
 Filling hole & cover welded over.  
 Base skids drilled for roller axles.  
 Liquid level indicator.  
 Lifting lugs.  
 Rating & Connection plate.  
 Thermometer pocket.  
 Liquid Temp. Indicator + Contacts.  
 Over Pressure Relief Device + Contacts.

**12.1.7.11 HV Terminations**

Directly mounted, via an oil disconnection Chamber, metalclad, non-extensible Merlin Gerin Ringmaster RN2-T1 SF<sub>6</sub> ring main unit complete with Time Limit Protection. The air insulated ring cable boxes should be supplied with blank gland plates to suit the reception of 3 core cables from below.

**12.1.7.12 LV Terminations**

Directly mounted, Merlin Gerin LV Pillar as specified in the attached LV pillar specification sheet.

**12.1.7.13 Specification for Ringman Unit****MERLIN GERIN - MV RINGMASTER RANGE NON-EXTENSIBLE RING MAIN UNIT 200A**

Panel Type	RN2-T1
Application	Transformer protection up to 1.5MVA
Location	Indoor/Outdoor (flange connected)
Normal Current Rating	200A
Busbar Current Rating	630A
Short Circuit Level	21kA 3 seconds
Integral Protection	2 O/C & Inverse time E/F
Protection	Should have provision for Time Limit Fuses
Current Transformers	100/50/5A class 'X'
Cable Entry	Below, vertical
Cable Size	Up to 1x3C 185mm <sup>2</sup> or 3x1C 300mm <sup>2</sup>
Gland Plates	Undrilled
Outgoing connection	Bolted connection to transformer flange to EATS 35-1 type E
Accessories:	Set of time limit fuses including 2 sets as spare.

**12.1.7.14 Specification for LV Feeder pillar****MERLIN GERIN - 1000A LV FEEDER PILLAR**

Outdoor and weatherproof LV feeder Pillar SAIF range, suitable for direct transformer connection ,via centre line flange. All cables from bottom entry.

1 x 3mm Sheet steel ventilated enclosure to IP33, BSEN60529.

1 x Set of 800A TP (1/2 size neutral) busbars, earth bar and removable neutral/earth link.

1 x 800A 4 Pole incoming Merlin Gerin " Masterpact " ACB type NW20 complete with Micrologic 6.0A control trip unit providing selective long time, short time, instantaneous and earth fault protection. (AD module) and 240V AC shunt trip coil.

1 x 600A TP outgoing SAIF fuse ways complete with fuse carriers for **J type HRC** fuses to BS 88 with 92 mm centres (The SAIF fuse way should provide IP2X operator protection even When changing fuses and also a fault make load break switching capability via the use of a portable switching mechanism. Two way should be fitted with spreaders to enable up to:

2 x 150mm<sup>2</sup>, 4-core cables to be terminated.

3 x Combined maximum demand Ammeters c/w ct's.

1 x Voltmeter and selector switch, complete with potential fuses.

2 x set of phase indicating lamps with potential fuses( 1 for incoming and 1 for bus bar)

1 x 16A BS 4343 230V AC Socket outlet

1 x 13A BS Switched Socket outlet

1 x Internal light and door operated switch.

1 x Anti condition heater and switch

1 x Flange extension trucking and plinth

1 x Independent manual spring assisted SAIF switching mechanism

1 x Set of earthed metal work screens covering all live copper work facilitating IP2X operator protection with the doors open and all screen in place.

1 x Set of Undrilled gland plates

**12.1.8 Prequalification**

The Electrification Work shall be carried out only by a licensed contractor authorized to under take such work under the Maldives Electricity Bureau.

**12.1.9 Qualification**

A licensed Electrical Contractors shall have the following qualifications:

Must have in his employment a competent Electrical Engineer registered with Maldives Electricity Bureau.

Must have in its employment an Electrical Consultant having certificate of competency who will exclusively supervise this work.

Must have necessary tools, plant and instruments.

Must have adequate experience of similar works.

If a contractor does not posses the above qualifications he shall be allowed to sublet the Work to a competent Sub-Contractor provided an application for his pre-qualification is made to the engineer for his approval. Decision of the Engineer in this case shall be binding on the Contractor.

#### 12.1.10 Rules and Regulations

The installation in general shall be carried out in conformity with the Electricity Rules, 1937 (UK), and the latest edition of the Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers, London (I.E.). However, in case of conflict between these Specifications and the I.E. Regulations, these Specifications shall be followed.

#### 12.1.11 Standards

The latest relevant British Specifications, and I.E. recommendations shall be applicable and be followed for the equipment specified herein.

#### 12.1.12 Climatic Conditions

All equipment supplied shall withstand, without developing any defect, the following climatic conditions:-

Maximum Ambient Temperature = 113° F or 45° C

Minimum Ambient Temperature = 28° F or - 2.2° C

Maximum Humidity = 98%

### 12.1.13 Specifications

The Contractor shall furnish all material and equipment at site, confirming fully to the specifications given herein and to the accepted standards, the Institution of Electrical Engineers, London, and the Maldives Electricity Bureau.

It is not the intent of these Specifications to include all details of design and construction of various material and equipment to be supplied under this contract.

The Contractor shall supply and install all material and equipment specified herein and also all installation and small material such as nuts, bolts, washers, shims angles, leveling material, insulation, tape, solder, etc. and such required for complete installation as intended by the Specifications.

The contractor shall provide for all the required technical and non – technical personnel, skilled and non-skilled labour, construction equipment, transportation etc., as required for the completion of Work in strict accordance the Technical Specifications laid hereinafter.

All material and equipment supplied by the Contractor shall be new and in all respects conforming to the high standard of engineering design and workmanship.

All material and equipment which have to be supplied and installed by the Contractor shall be passed/approved by the Consultant; even if the same is exactly in accordance with the Bill of Quantities and Drawings.

### 12.1.14 Submittal

The Contractor, after the award of work, shall submit for approval of the Consultant all drawings and cuts of equipment, appliances, fixtures and accessories. Cuts, catalogues and drawings shall be clearly marked to indicate, the items furnished

#### 12.1.15 Shop Drawings

The design drawings do not show conduit routes and depict only the position of various fixtures and outlets. All the planning for the conduit routes shall be carried out, well in advance of the actual execution of work by the Contractor to the satisfaction of the Consultant. For this purpose the Contractor shall prepare shop drawings and obtain prior approval of the Consultant. Prints of each shop drawing shall be submitted for obtaining approval before commencement of the work.

No piece of work shall be allowed to be executed at site without the availability of these approved shop drawings. These shop drawings shall clearly depict the load balancing chart of each Distribution Board.

Time required for the preparation and approval of shop drawings shall be considered to have been included in the total time allowed for the completion of the work.

#### 12.1.16 Guarantee

The Contractor shall furnish written guarantee in triplicate of the manufacturer for successful performance of each equipment. Such guarantees are for replacement which may be found defective in material or workmanship.

The guarantee shall cover a minimum period of 12 months effective from the date of completion certificate.

#### 12.1.17 As-Built Drawings

The Contractor shall, during the progress of work keep a careful record of all changes and revisions where the actual installation differs from that shown on shop drawings. These changes and revisions shall be accurately carried out on the shop drawings and submitted to the Consultant for approval. After approval these drawings shall become the property of the Owner. These updated and approved shop drawings depicting clearly all changes and revisions made on site shall be called As-Built Drawings.

Reproducible tracings of all these As-Built Drawings shall be handed over to the Consultant. Final payment will be withheld until the receipt of the approved As-Built Drawings.

**12.1.18 Test Reports**

The Contractor shall be responsible for the submitting the test reports/certificates and get the installation inspected passed by the Maldives Electricity Bureau.

**12.2 Conduit and Conduit accessories****12.2.1 Conduit Pipe**

The conduit for the wiring of lights, socket outlets and other systems shall be made of PVC confirming to BSS 3505/1968 Class-D.

The conduit shall have following wall thickness and standard weights:

Pipe Size	Wt/100Rft.	Wall thickness
20mm dia	3.4 Kg	0.04 to 0.05
25mm dia	4.5 Kg	0.045 to 0.055

Steel conduit shall conform to BSS 31/latest. The conduit shall be enameled with good quality non- cracking and non-flaking black paint.

**12.3 Wires, Cables and Cords****12.3.1 Wires & Cords**

The wires & cords for the conduit wiring shall be single core, made of stranded copper conductors, PVC insulated, tested to B.S. 6004, 1975. The voltage grade shall be 300/500 volts or 450/750 V unless otherwise specified on Drawings and Bills of Quantities.

All the wire and cables shall be of the approved standard of Maldives Electricity Bureau.

- (a) For light or fan point wiring with 1.5 mm square or as specified in the BOQ.
- (b) For light circuit wiring with 2.5 mm square or as specified in the BOQ.
- (c) For power plug 15A wiring with 4mm square or as specified in the BOQ.

### 12.3.2 Conduit Accessories

The use of factory made round PVC junction boxes shall be used and shall have nipples to receive PVC pipe with force fit, shall be used for ceiling outlets. The wall type junction box shall also be PVC. 12.2.2.2 Each junction box shall be provided with one piece cover which shall be fitted on the box with screws.

Conduit accessories such as switch boxes, socket outlet boxes, pull boxes and inspection boxes shall be made of PVC having dust tight covers. All boxes shall have required number of conduit entry holes. All the rectangular or square shaped boxes shall have nipples to receive PVC conduit force fit.

Manufactured smooth bends shall be used where conduit changes direction. Bending of Conduit by heating or otherwise shall be allowed only at special situations with the permission of the Consultant. Use of sharp 90 degree bends and tees is prohibited.

Bends shall have enlarged ends to receive the conduit without any reduction in the internal diameter of the PVC pipe.

All accessories e.g. boxes, coupling, bends, solid plugs, bushes, reducers, check nuts etc. shall be equal in quality to the specified conduit.

The drawings do not show conduit routes and all the planning for arranging conduit routes shall be carried out by the Contractor to the satisfaction of the Consultant.

The entire conduit system shall be essentially completed before the wiring pulling is taken in hand. Each conduit run shall be tested for continuity and obstructions. All obstructions shall be cleared in an approved manner. Water and moisture that has entered any section of the conduit installation must be dried with suitable swabs to the satisfaction of the Consultant.

Adequate expansion joints shall be provided in all conduit runs passing across the expansion joints in the concrete slab of the buildings

All the free ends of conduit shall be solidly plugged till such time as final and proper terminations are made

### 12.3.3 Installation Instructions

All wiring shall be continuous between terminations and use of connectors or joints are not allowed. Spur and tee connections are strictly prohibited.

Manufacturers recommended lubricant shall be allowed to facilitate pulling of wires. Use of any kind of oil and soap is prohibited.

## 12.4 Wiring Accessories

### 12.4.1 Switches

Indoor switches controlling lights and fans shall be single pole, 5A, one or two way, suitable for 250V, 50 Hz. The body of the switches shall be made of molded plastic, one; two, three or four gang with integral built in molded plastic faceplate.

Weatherproof switches shall conform to B.S. standard.

### 12.4.2 Switch Socket Outlet Units

Switch & socket units shall be single, pole, 3 pin rated 5A, 15A or 20A, 250V, 50 Hz. These shall be moulded plastic type with white integral built-in faceplate. Each socket shall have its control switch by the side of it on a common faceplate. Thus the complete unit specified in BOQ shall be as switch and a socket outlet unit.

**12.4.3 Fans**

All fans shall be capacitor type Deluxe models or equivalent and suitable for operation on 200/220 volts, 50 Hz, A.C Supply. All ceilings fans shall have five speed dimmers. The air displacement shall be 10,000 c.f.m for 48" (1219 mm) Sweep and 12,000 c.f.m. for 56" (1423 mm) Sweep at maximum speed. The fan motor shall be capacitor type and bearings shall be groove type to give noiseless and quiet operation. The noise level relative to a frequency of range 1000 Hz shall be within the limits of +3 dB.

**12.4.4 Dimmer**

The dimmer shall be recessed type as required and shall be approved by the Consultant.

**12.4.5 Fan Hook**

The fan hook shall be made of 12 dia mild 5/5 steel rod bent to shape of approved design. It shall be in the form of a loop about 3-1/4" (87.5 mm) long and about 2" (50 mm) wide. The rod shall be bent to have at least 8" (200 mm) extension on both sides for tying to the reinforcement steel of the slab. All ceiling fan shall be of one make only.

The fan hook shall be installed in the RCC slab of the ceiling at the time of pouring concrete.

**12.5 General**

The description of light fixtures is given in the Bills of Quantities, and stated on the Drawings, and all relevant materials are described in this Section.

The determination of quality is based on certified photometric data covering the coefficient of utilization, light distribution curves, construction material, shape, finish, operation, etc.

The Contractor shall submit samples of each and every lighting fixture specified for approval of the Consultant.

The lighting fixtures shall be manufactured by M/s. Philips, M/s.RZB Lighting, M/s Thorn or equivalent as approved by Consultant.

**12.5.5 Incandescent Light Fixture**

The glass globes/ shades/ diffusers of the incandescent light fixtures shall be first class quality glass free from any air bubbles or voids. The glass shall generally be of opal white colour unless otherwise specified. The shape of the glass may be spherical, hemispherical, flattened bottom or tablet shaped as required.

Surface mounted fixture shall have stove enameled sheet steel body. It may also be satin brass or aluminium anodized finish as required. The fixing holes shall match the outlet box. Wall bracket light fixtures shall have back plates with matching holes of the outlet box and decorative finish as required.

All the lighting fixtures shall be suitable for local climatic conditions



#### 12.5.6 Fluorescent Light Fixture

All the light fixtures shall have lamps and electronic ballasts of the wattage specified. The fluorescent lamp shall be either 2 ft - 18 watts or 4 - 35 watts and the colour shall generally be daylight, cool daylight in the order of preference or as mentioned specifically.

The fluorescent lamps shall be Philips to BSS 1853 but having a minimum useful life of 5000 hours. The new generation of 26mm dia 18 watts and 36 watts energy efficient lamps shall be preferred.

The ballast shall be totally enclosed electronic type suitable for operation on 220 V, 50 Hz, single phase supply, a wiring diagram, wattage, voltage and current ratings shall be printed on the body of the ballasts. The power loss shall not more than 10 watts for 36 watts ballast. The ballast shall be noiseless in operation without any whistling sound.

The manufacture shall be called upon to guarantee a trouble free life of 3 years, effective from the date of completion certificate.

The starters shall have radio-interference suppressers.

The internal wiring of the light fixtures shall be carried out at manufacturers factory with heat resistance wires of size not less than 1.5 mm square.

The louvers of light fixtures shall be made of anodized aluminum and/or moulded plastic. The diffusers shall be made of acrylic Perspex.

All the lighting fixtures shall be suitable for local climatic conditions.

#### 12.5.7 Installation Instructions

Light fittings shall be installed according to manufacturers' recommendations or as approved by the Consultant.

Flexible connecting wires from outlet box to the fixture shall be provided by the contractor; connector made of porcelain or thermoplastic material shall be provided and installed in the outlet boxes for connecting flexible wires to the point wires.

Outlet boxes or any openings in the ceilings and walls shall be covered with appropriately fabricated accessories to provide an architectural entity to conceal them.

#### 12.5.8 Distribution Feeder Panel

Single line diagram of the L.T. switch board shall be approved by the consultant and Maldives Electricity Bureau before placing order for the switch board.

#### 12.5.9 Earthing

The switchboard shall be effectively earth by means of a copper strip of 25mm x 3mm (1" x 1/8") cross -section bolted to connections near the bottom of the switchboard.

#### 12.5.10 Accessories

Designations labels, lifting lugs, foundation bolts, interconnecting nuts bolts, and washers, thimbles, lugs, leveling shims cable glands and/or cable end box for all the sizes of incoming and outgoing cable shall be supplied with the switchboard

## 12.6 Testing

The following tests shall be conducted on each completed switchboard.

### Type Tests

- (a) Temperature rise test
- (b) Mechanical endurance test
- (c) Making/Breaking Capacity test

### Routing Test

- (a) High Voltage test

The Switchboard shall be tested to British/Electricity Council Standard 41-5. Preference shall however, be given to Switchboards fabricated from all components manufactured by only one manufacturer.

## 12.7 Installation Instruction

All labour, equipments, tools and plants required to complete the installation shall be provided by the contractor. The Switchboard shall be fixed firmly on the floor in perfect line, plumb and level position.

All incoming and outgoing cable connections shall be made from the bottom including Earth connections.

## 12.8 Distribution Board

The distribution boards shall be either free-standing, cubical type or wall mounting type suitable for fully recessed mounting. Each distribution board (d.b.) shall be tropical in design, fully dust and vermin proof and liquid repellent.

## 12.9 Telephone System

### General

For the telephone system the contractor is required to provide and install telephone conduit and outlet boxes.

All the telephone lines shall be connected to PABX.

## 12.10 TECHNICAL SPECIFICATIONS GENERATOR

### 12.10 PREAMBLE

The following description attempts to explain to the Tenderers, as best as possible, the nature of work to be carried out, their dimensions and position; however it should be noted this description is not exhaustive and that the successful Tenderer shall proceed with all work as included in the price without exception or reserve, necessary and essential for the correct completion of their assignment

If any items are imprecise or omitted, the Tenderers should, before making their submissions, contact the Owner for any additional information required to make their Tender.

Contractors may never argue that errors or omissions in the plans or estimates precluded them from carrying out all work of their building trade, or be subject to requests for additional payment. In particular, Tenderers should take sole responsibility for their quantities, which should be specified in the form.

Subsequent to these formal clauses, prices submitted shall in no way be susceptible to increase of any nature.

Tenderness should ensure that the offer includes the most updated designs and technology and as far as possible the manufacturers standard equipment.

### 12.10.2 GENERAL REQUIREMENTS

#### 12.10.2.1 Units of Measure

Metric units of measurement (System International) shall exclusively be used in all correspondence, in all technical schedules and on all drawings.

#### 12.10.2.2 Standards

All equipment supplied under these specifications shall conform to the latest editions of the International Electro technical Commission (IEC) specifications, or where no IEC Specifications apply, to British Standard (BS) Specifications, or equivalent national standards as may be approved by the Consultant.

In case the equipment or materials offered from a country where the relevant standards to which the equipment or materials confirms are, in the opinion of the Consultant, better than IEC or BS Specifications, these are acceptable. These standards and full details of differences which affect the design or performance of the equipment or material shall be stated in the Tender and English translations of any such alternative standards shall be supplied by the Contractor when requested by the Consultant.

All installations and materials and cabling shall be in accordance with the IEE Wiring Regulations. All works shall conform to the requirements of the Maldives Electricity Bureau.

12.10.2.3 Design for Climate

All outdoor equipment and materials supplied shall be suitable for operating under the worst tropical conditions, including lightning, cyclonic rains, and high humidity.

Climatic Data

Climate	:	Typical tropical coast line.
Atmosphere	:	Saliferous, corrosive and dusty.
Altitude	:	2 meter above mean sea water level.
Temperature	:	32 °C (mean maximum).
	:	25 °C (mean minimum).
Barometric air pressure:		1010 millibars.
Relative humidity	:	90%.
Average rainfall	:	145 days/year.
Average sunshine	:	24 days/month.
Mean wind speed	:	10.8 knots.
Maximum wind speed	:	15.1 knots.

**12.10.3 GENERAL ELECTRICAL REQUIREMENTS**12.10.3.1 Electrical System Characteristics

1. Nominal system voltage: 400/230 V
2. Maximum system voltage: 440/254 V
3. Type of system grounding: earthed neutral
4. System frequency: 50 Hz

**12.10.4 DIESEL ENGINE AND AUXILIARIES**12.10.4.1 General

The set includes a diesel engine with all the auxiliary systems direct coupled to an alternator and a radiator, all mounted on a common fabricated mild steel base frame aligned, dowelled and assembled. The generator shall be enclosed in a sound attenuated enclosure to reduce the sound level to 75dba @ 1 meter distance. The alternator insulation should be with tropical marine varnished with highest class and engine radiator should be heavy duty tropical radiator. The generating set shall be mounted on anti-vibration mounts of approved make properly matched to the supported loads. **The generating set must be new and unused and the supplier must be able to prove this if requested.** Failure to do so will result in the generating set being rejected.

12.10.4.2 Fuel

The engine shall be capable of running on all commercially available diesel fuels with characteristic data similar to BS 2896 – 1988 Class A1 and A2. The following characteristics could be used as a guideline:

#### 12.10.4.3 Type and Rating

The diesel engine shall be of the four stroke, turbocharged, water cooled type, capable of driving the generator at the specified load under all local climatic conditions stated under clause 2.3, section VI, technical specifications.

#### 12.10.4.4 Engine starting

The engine shall be started by using a 24V starting motor operated by batteries. The supplies shall include an engine mounted 24V alternator for battery charging and heavy-duty lead acid batteries.

#### 12.10.4.5 Engine ventilation

A crankcase breather system, incorporating a flame arrester device shall be provided.

#### 12.10.4.6 Engine Governing

Governing shall be of the electronic type. Over speed protection shall be included.

#### 12.10.4.7 Fuel system

The fuel system shall consist of injectors, pump, filters and interconnecting piping etc. all mounted on the engine as standard supply by the engine manufacturer.

A fuel day tank sized for eight hours operation at full engine capacity shall be included in the supply. Flanged connections shall be provided for filling, outlet, return fuel, drain and overflow.

Included in the supplies shall be a calibrated level indicator (Bayham or equivalent), all pipes, fittings, supports, bolts, nuts, etc. for the connections described.

#### 12.10.4.8 Lubricating oil system

The lubricating system shall include filters, pump, cooler and interconnecting piping etc. A lubricating oil sump shall be provided with a capacity to hold adequate oil for circulation through all lubricated moving parts.

#### 12.10.4.9 Combustion air system

The air inlet shall be taken from within the building. Inlet air filtration shall be provided and shall be suitable to operate in the atmospheric conditions stated in clause 2.3, section VI, technical specification.

**12.10.4.10 Exhaust system**

A separate exhaust system shall be provided for the engine. The system shall accommodate expansion movements and shall be arranged so that vibration from the engine is not transmitted to the building or support structure.

The system shall be designed and surface prepared as to avoid corrosion from;

- Condensate of the flue gas when the engine is operated under any load or ambient conditions (as in clause 2.3, section VI, technical specifications).
- Influence of rain, sea spray and salt on parts external to the power station building.

An exhaust gas silencer with 35 dB attenuating capacity shall also be supplied.

**12.10.4.11 Cooling water system**

The engine cooling water system shall comprise of a jacket cooling system. The jacket water shall be cooled by a heavy-duty tropical radiator together with a pusher type-cooling fan (including fan guard) to be driven by the engine.

**12.10.5 DIESEL GENERATING SET AND AUXILIARIES – ELECTRICAL****12.10.5.1 Generator type and rating**

The generator shall be of radiator cooled, self-ventilated, cylindrical-motor type and rated as follows.

Rated output	:	125 kVA.
Class of rating	:	continuous.
Overload rating	:	110% for one hour in every twelve hours.
Power factor	:	0.8.
Phase and frequency	:	3-phase, 50 Hz.
Rated voltage	:	400 V, 3phase, 4wire
Voltage variation range:	:	± 5%.
Insulation	:	Class H.
Temperature rise:	:	maximum 100 °C according to class.
Degree of protection	:	IP 21.

**12.10.5.2 AVR**

The AVR shall be for single operation excitation and mounted on the generator control panel with easy access for testing, setting and replacement. A terminal block, clearly labelled, shall be provided at the generator terminal box to connect the control cables to the AVR in the control panel.

**12.10.5.3 Winding temperature detectors**

Six numbers temperature sensors (two in each winding) shall be installed in the stator winding to detect the temperature of the winding during operation. A gauge shall be provided to indicate the temperature of each winding.

**12.10.5.4      Voltage waveform**

The voltage waveform for the generator shall not deviate by more than 5 % from a true sine wave.

**12.10.5.5      Efficiency and capability diagram**

The efficiency of the generator at rated voltage and rated power factor shall be stated and guaranteed in the Tender. Capability diagrams shall be provided for the generator, (on which kilowatts are plotted against kilovars) at rated voltage and rated voltage plus and minus 5 %.

**12.10.5.6      Construction**

All parts of the generator shall be designed and constructed to withstand the stresses resulting from normal and abnormal operation including lifting, system faults and operation at over speed. All parts shall operate free from detrimental vibration.

**12.10.5.7      Termination Panels**

A PVC distribution box (with terminals) suitable for all control wire terminations from all engine mounted sensors to the control panel. The panel shall be installed next to the Generating Set.

**12.10.5.8      Stator terminal connections**

The ends of the phase windings shall be brought out to terminals housed in a steel terminal box on the stator frame.

The terminal box shall be suitable for glanding and terminating the generator cables including the neutral point cable.

**12.10.5.9      Enclosure, Ventilation & Cooling**

The generators shall be radiator cooled and filter ventilated. The class of enclosure protection shall be IP21 in accordance with IEC 34.5.

**12.10.5.10      Anti Condensation Heaters**

Low temperature heaters shall be provided for the generator stator to prevent condensation of moisture during shut down periods. The heaters shall be rated to maintain the temperature inside the machine 2.5°C above ambient temperature. The heaters shall be automatically switched on when the generating set is stopped and switched off when running.

## **12.10.6 Testing and inspection**

### **12.10.6.1 Work Tests**

Work tests in accordance with the General Conditions shall be performed on all equipment provided. The tests shall include but not be limited to:

- a) A complete system test shall be implemented to prove the operation of the equipment in conditions as near as possible to those of the final site installation.
- c) The tests on the complete equipment shall include:
  - Visual inspection of all equipment.
  - Load run at full load until the relevant temperatures have remained constant relative to the ambient temperature for 30 minutes (normally about 4 hours).
  - Accuracy checks on all equipment meters.
  - Manual controls.
  - Engine shutdowns and alarm indicators under simulated fault conditions.
  - Check on the operation of the battery charger.
  - Check on the operation of any anti-condensation heaters.
  - Insulation resistance test.
- d) All tests shall be recorded and the values stated.

### **12.10.6.2 Site Tests**

The following tests shall be carried out at site and shall be witnessed by the Employer and the Consultant.

#### **(a) Type Tests**

All items of electrical equipment shall have been type tested and evidence of this produced if requested by the Engineer or shall be so tested at the Works.

#### **(b) Function Tests**

Where items of equipment are connected together to form a functional group, then an operational test shall be carried out at the Manufacturer's Works on each such group to demonstrate satisfactory operation. This includes testing all control sequences. The Contractor shall maintain a quality system that conforms to the current requirements of ISO9001/ISO9002.



### **13. AIR CONDITIONING SYSTEM**

**Air – conditioner shall be a VRV system**

#### **13.1 Fan coils**

Please follow specifications provided by Daikin Air conditioning Systems (Singapore) Pte Ltd. Cooling capacities shall be followed as per the drawings and BOQ provided in the Tender Document.

Manufacturer: **DAIKIN INDUSTRIES (Japan)**

Technology: **VRVIII**

Refrigerant: **R410A CFC FREE TYPE**

Configuration: **CEILING SUSPENDED CASSETTE FXHQ, FXLQ AND FXAQ  
-- MAVE**

Extra Zinc Coat: **YES**

Marine Paint: **YES**

Country of Origin: **SINGAPORE**

#### **13.2 Heat pumps**

Please follow specifications provided by Daikin Air conditioning Systems (Singapore) Pte Ltd. Cooling capacities shall be followed as per the drawings and BOQ provided in the Tender Document.

Manufacturer: **DAIKIN INDUSTRIES (Japan)**

Technology: **VRVIII**

Refrigerant: **R410A CFC FREE TYPE**

Configuration: **DAIKIN VRVIII RXQ – PY1**

Extra Zinc Coat: **YES**

Marine Paint: **YES**

Country of Origin: **SINGAPORE**

#### **13.3 Refnet Joints**

Please follow specifications provided by Daikin Air conditioning Systems (Singapore) Pte Ltd. Cooling capacities shall be followed as per the drawings and BOQ provided in the Tender Document.

### 13.4 Control System

Please follow specifications provided by Daikin Air conditioning Systems (Singapore) Pte Ltd. Cooling capacities shall be followed as per the drawings and BOQ provided in the Tender Document.

All piping shall be installed parallel to, or at right angle with, the building walls and partitions wherever physically possible. A pitch in the direction of flow and drain shall be not less than 1: 500, in general.

All drain water piping shall be installed in such a way that all circuits can be completely drained off and all air pockets in the water circuits shall be suitably vented.

Clearance between pipe works and equipment or machinery shall be adequately provided to facilitate maintenance. Overhead clearance shall be at least 600 mm over access ways, and where possible the projection of valve stems into access ways shall be avoided.

Pipe works shall be so arranged that the removal for maintenance of the equipment can be carried out with minimum dismantling. Provision of all pipe fittings and accessories necessary for the efficient functioning of the various systems shall be included.

Pipes shall be installed in continuous lengths as long as possible. Except where required to be connected to fitting outlets or headers, they shall be jointed by welding, screwing or soldering as approved or indicated in this Specification.

Automatic air vent with gate valve shall be installed in following area:

- Main pipe header.
- Highest point of all pipe risers.
- Other places where specified in drawings or other necessary point.

If not specified in drawings, drain valve size shall be as follows:

<u>Pipe riser size, mm.(inch)</u>	<u>Drain valve size, mm.(inches)</u>
Up to 100 (4)	20( <sup>3</sup> / <sub>4</sub> )
150(6) – 200(8)	25(1)
250(10) – 300(12)	40(1 <sup>1</sup> / <sub>2</sub> )
350(13) – 400(16)	50(2)
400(16) and larger	65(2 <sup>1</sup> / <sub>2</sub> )

Condensate drain pipe, all condensate drain pipes from air conditioning unit shall be equipped with drain trap with pipe slope of not less than 1:100, size of condensate drain pipe if not shown in drawings shall be as follows:

Size of A/C units connected in kW cooling of Fan Coils	Condensate Drain Pipe Size, mm. ( Inches )	
	Horizontal Pipe	Vertical Pipe
0 – 7(2)	0 – 11(3)	20(¾)
7(2) – 18(5)	11(3) – 28(8)	25(1)
18(5) – 106(30)	28(8) – 176(50)	32(1 ¼)
106(30) – 176(50)	176(50) – 264(75)	40(1 ½)
176(50) – 600(170)	264(75) – 880(250)	50(2)
600(170) – 1055(300)	880(250) – 1407(400)	75(3)
1055(300) – 1512(430)	1407(400) – 2110(600)	100(4)
1512(430) – 2110(600)	2110(600) – 3165(900)	125(5)

The piping system for the refrigerant pipes including REFNET joints shall follow the sizes provided in the drawings

### **13.5 Piping System**

#### **13.5.1 Insulation**

Insulation shall be rigid polyurethane foam, conforming to ASTM C1029, with minimum density of two pounds per cubic foot (32 kg./cu.m.), 90-95% closed cell content and initial thermal conductivity  $K=0.16 \text{ btu-in/hr-ft}^2 \text{ } ^\circ\text{F}$  ( 0.023 W/m-K). The insulation shall completely fill the annular space between the pipe and the jacket. Systems using open cell insulation or a non bond design shall not be allowed. The insulation shall be provided to the minimum thickness specified below:

Pipe size, mm (inch)	Minimum Insulation Thickness, mm (inch)	
	Chilled Water	Hot Water
25(1) – 200(8)	25(1)	25(1)
250(10) – 300(12)	25(1)	38(1 ½)
350(14) – 900(36)	38(1 ½)	50(2)

The outer casing protective jacket shall be high density polyethylene in accordance with ASTM D1248, Type 3, Class C. PVC or tape materials are not allowed. The minimum thickness of the HDPE jacket shall be as follows:

Jacket OD, mm (inch)	Minimum Jacket Thickness, mm (inch)
$OD \leq 300(12)$	3.175 (0.125)
$300(12) < OD \leq 600(24)$	3.810 (0.150)
$OD > 600(24)$	4.445 (0.175)

Field joints, the services pipe shall be hydrostatically tested to 150 psig ( $10.55 \text{ kg/cm}^2$ ) or 1.5 times the design pressure whichever is greater. Insulation shall then be poured in place into the field joint area. All field applied insulation shall be placed only in straight sections of pipe. Field insulation of fittings is not acceptable. The installer shall seal the field joint area with a heat shrinkable adhesive backed sleeve. Backfilling shall not begin until the heat shrink sleeve has cooled.

Installation of pre-insulated piping system shall be accordance with the manufacturer's written instructions.

The pre-insulated pipe manufacturer shall provided detailed written instructions for receiving, handling, storage, excavation, assembly, alterations, repairs, testing, inspection, field joint insulation, field joint insulation and jacketing and back filling.

#### RECOMMENDED MANUFACTURERS

KAIFLEX, INABA, SUPERLON

### **13.6 Condensate pipe**

All condensate drain and drain pipes shall be PVC. Class 8.5 conforming to TIS 17-2535, all pipe fittings shall be same standard.

#### RECOMMENDED MANUFACTURERS

KAIFLEX, INABA, SUPERLON

### **13.7 Refrigerant Pipe**

Construction material: Phosphoric acid deoxidized seamless copper for refrigerant. Pipe thickness for refrigerant pipes with diameter less than 12.7 mm shall not be less than 0.8 mm and between 12.7 mm and 15.9 mm, the thickness shall not be less than 0.99 mm.

For half hard pipes, the tensile stress shall not be less than 61 N per square milli-meter. Cold welding with nitrogen shall be utilized for all brass pipe works wherever welding is required.

After completing installation, valves shall be opened as to avoid operation of the unit with the valve shut causing damage to the compressor.

R-410A from the solid pink cylinder shall only be used. All field piping shall be installed by a licensed refrigeration technician and must comply with relevant local and national regulations.

Extreme care shall be taken when brazing copper-to-copper refrigerant piping, particularly HFC refrigerant piping. Instead use phosphor copper brazing filler metal (B-Cu93P-710/795: ISO 3677) which does not require flux.

The contractor shall make sure to use installation tools (gauge manifold charge hose, etc.) that are exclusively used for R-410A installations to withstand the pressure and to prevent foreign materials such as SUNISO mineral oils or moisture from mixing into the system. Screw thread and dimension specifications for flare nuts, service valves, and charging ports are different for R-410A than prior refrigerant types. 2-stage vacuum pump shall be used with a non-return valve and shall make sure the pump oil does not flow back into the system while the pump is not working.

After completing installation, be sure to open the valve. Operating the unit with the valve shut breaks the compressor.

Do not use flux when brazing copper-to-copper refrigerant piping, particularly HFC refrigerant piping. Instead use phosphor copper brazing filler metal (B-Cu93P-710/795: ISO 3677) which does not require flux. Flux has an extremely negative effect on refrigerant piping systems and if chlorine-based flux is used, it causes pipe corrosion. Flux containing fluorine damages refrigerant oil.

Foreign materials inside pipes (including oils for fabrication) must be 30mg/10m or less.

Make sure to use the particular branches of piping that have been selected referring to the Consultant Drawings.

### **13.8 Storage and Cleaning**

Pipes shall be delivered and stored with plugged ends. Ends shall be kept closed with temporary cover during erection.

Before any pipe is installed, it shall be opened and pounded to remove any foreign substances, or swabbed, if necessary, for thorough cleaning.

Pipes shall be stored on racks in a suitable warehouse or under cover to avoid rusting. If necessary, carbon steel pipes shall be coated with anodic rust converter or red lead primer.

During the course of installation, the Contractor shall take every precaution to prevent any debris from being left in the pipes. He shall be responsible for any damage that may occur.

Immediately after erection, exposed threads at all fittings shall be painted with zinc-chromate paint, and after welding each joint shall be wire-brushed and then painted with zinc-chromate paint.

### **13.9 Connections to equipment**

Connections to coils, condensers and other equipment shall be made in such a manner that undue strains between pipes and equipment are eliminated. Unions and/or flanges shall be used to facilitate the removal of the equipment.

### **13.10 Expansion and Contraction**

The piping systems shall be installed so that there will be no damage due to expansion and contraction during operation.

Packless type expansion connection shall be used where the expansion and contraction of the pipe is excessive or cannot be expansion loops or offsets.

### **13.11 Differential settlement**

The piping systems shall be installed so that there will be no damage due to differential settlement of the pipe supports after installation. The problems could be avoided by providing flexible connections, offsets, or loops

### **13.12 Sleeves and Escutcheon**

Vertical pipes passing through floors shall be provided with sleeves of black steel pipes. Sleeves shall be of a proper length to pass through the entire floor construction and shall terminate 1 1/2 inches above the finished floor level.

Horizontal pipes passing through walls and partitions shall be provided with full thickness sleeves made of standard weight black steel pipes.

Sleeves shall be large enough to leave not less than 1/2 inch clearance around the pipe and covering insulation, if there is any. Sleeves shall be set in place when the walls and partitions are built.

Sleeves in concrete work shall be flanged at the bottom or provided with temporary centering caps and securely nailed or screwed to formwork before the concrete is poured.

Chromium-plated escutcheons shall be provided where exposed pipes pass through walls or floors.

Size of escutcheon plate shall be as follows:

- For pipe size up to 4 inches, thickness of plate 2 mm., width of plate 2 inches.
- For pipe size 5 inches and larger, thickness of plate 2 mm., width of plate 4 inches.

When sleeves are installed through a fire wall, the clearance between sleeves and pipes shall be filled with fire-resistant material. The fire rating of the fire-resistant material shall be at least equivalent to that of the fire wall.

When pipes pass through waterproof walls, water retaining rings with approved type of sealant shall be applied.

### **13.13 Threaded joints**

Threaded Joint shall be installed for pipe size up to 2 inch. Parallel Thread shall be used in general and Taper thread (BS 21:1973 or TISI 281 Standard) shall be used in pipe having operating pressure over 150 psig.

All threaded joint shall be sealed with pipe joint compound or Teflon tape.

### **13.14 Flanged joints**

Jointing flanges shall be accurately parallel to each other so that bolts are used only to tighten joints, rather than correct alignment.

Flanges shall be chosen to suit the maximum working pressure of the system at the points of installation in accordance with the ASME standard. They shall be manufactured from a similar material to the pipe works and fittings to which they are to be attached. PVC flanges shall have a metal backing ring.

Either the electric arc or the oxy-acetylene welding method may be used. Welding rods or electrodes shall have such composition that the welds produced by them shall have the same analysis as the parent metal and shall be of an approved type and brand.

All tees or take-offs shall be made with standard welding fittings only.

Prior to silver-soldering or brazing, trichloroethylene shall be used in cleaning the metal surface to be joined in order to remove oil and grease. Scale and any gross oxidation shall be removed by emery cloth, filing or grinding. Care shall be taken in preparation of the joints.

All bronze flanges shall be brazed or soldered on the flat face. All PVC works shall be installed strictly in accordance with manufacturer's instructions.

Bolts and nuts for flanged joints shall be carbon steel except for galvanized steel pipe, the galvanized or cadmium plated bolt and nut shall be used. For pipes buried underground, stainless steel bolt and nut shall be applied.

### **13.15 Hangers and supports**

Hangers or supports shall be provided at intervals as specified herein, both in horizontal and vertical runs. In addition, it is required that a hanger be provided at not more than 12 inches from each change of direction on the side of the longest run and also at point adjacent to all valves, strainers, etc. All hangers and supports for horizontal piping shall be adjustable in height over a minimum distance of 2 inches. The intervals indicated for support are maximum distance between brackets.

For chilled water and condensate piping, rigid insulation of minimum length of not less than the outside diameter of the insulation shall be provided at each support and hanger.

For all pipes where the hanger clips bear directly on pipes and for hanger of dissimilar metals, suitable separation with a layer of felt shall be provided to prevent corrosion. Hangers on structural steel must be clamped in position with hook bolts. Drilling holes in or welding to structural steel is absolutely prohibited, unless with the express approval from the Engineer.

Anchors for steel pipes shall be welded directly to the pipe wall and securely bolted to the building structure. Anchors for copper and PVC pipes shall be of the split ring type. Hangers in chiller plant room shall be supported on the spring vibration isolators.

Supporting brackets shall be fastened to concrete by means of inserts or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry by means of toggle bolts.

Two fixings per bracket shall be provided as follows:-



Nominal Pipe Size, mm (inch)	Fixing Size, mm (inch)
Up to 63(2 ½)	6.3(1/4)
75(3) to 150(6)	9.4(3/8)
200(8) to 300(12)	12.5(1/2)
350(14) and larger	15.6(5/8)

All hanger and steel supports shall be hot-dip galvanized prior to install at job site.

### **13.16 Pipe insulation**

#### ***13.16.1 General***

No insulation shall be applied until pipes have been tested as specified. All pipes shall be painted prior to the application of insulation. All valves and pipe accessories shall be insulated with an insulation having the same thickness as the connected pipes. Insulated piping shall be taken through sleeves and guides and be supported without any interruption of the insulation and the vapor barrier.

All joints between insulation shall be permanently sealed with an adhesive to form a positive vapor seal according to the manufacturer's recommendation. Special care must be given to the sealing of the open ends where the piping is connected to apparatus.

#### ***13.16.2 Aluminium jacket***

Where exposed especially outdoor piping, the pipe insulation shall be covered with aluminum jacket made of aluminum sheet thickness of not less than NO. 22 gauge.

Other exposed pipe (indoor) such as in pump room, under shading area the pipe insulation shall be painted with special paint suitable for insulation surface as recommended by manufacturer.

## **14. FIRE FIGHTING SYSTEM**

### **14.1 Hose Reels.**

Recess HOSE reels approved to BS EN 671-1: 1995, or any other equable International standard

Automatic operation, Right or left hand take off. Including 30m length of Hose, 19mm diameter Hose approved to PR EN 694, or any other equable International Standard, and Nylon twist operated Jet/spray Nozzle on mounting plate with integral flexi guide for HOSE withdrawal device. 03 or 04 fixing holes shall be provided in position indicated to suit M8/M10 sized fixing screws or M12 fixing bolts with a ball valve inlet and Flexible inlet water pipe.

The overall width of the reel shall be no more than 850mm.

The overall height of the reel shall be less than 850mm including HOSE and integral Flexi guide for hose withdrawal guide. The overall depth of the HOSE reel shall be no more than 150mm. Colour of the Reel shall be red, fitted with operating instruction plate.

The HOSE Reel and the related equipment's shall be approved by the NSS Fire and Rescue Service before installation. Special permission shall be taken for other size of the other size of the HOSE reels.

The HOSE reel nozzle retainer or HOSE guide and the inlet valve shall be fitted at a height of about 900mm above floor level.

### **14.2 Hose Reel Cabinets.**

The HOSE Reel Cabinet shall be Recess mounting type with or without glass paneled door for use with the above mentioned sized HOSE Reel Cabinet dimension shall be no more than 900mm in width, 900mm in height, 160mm in depth (including door)

Color of the cabinet shall be Red. Special permission shall be taken for other color.

Recessed Latch Type handle shall be installed. HOSE reel signage shall be in accordance to BS 5499 or any other equable International standard. Fixing holes shall be provided.

The HOSE Reel Cabinets shall be approved by the NSS Fire and Rescue Service before Installation.

### **14.3 Water Supply For Hose Reel system**

As a minimum, the water supply to the HOSE reel shall be such that when the two top most reels in the building are in use simultaneously, each shall provide a jet of approximately 6m in length and will deliver not less than 0.5 liter/s (30 lit/min). Minimum Quantity of water storage required HOSE reel systems only. Minimum Storage required for the first HOSE reel. 2275 lit. For additional HOSE reel. 1137.5 lit up to a maximum of 9100 lit.

Tank or inter-connected tanks supplying water for the HOSE reel shall be automatically supplied from the MWSC's main(s) controlled by ball valve of a minimum diameter 50mm.

Tanks supplying water for domestic purposes shall not be used as suction tanks for hose reel installations unless arrangements have been made for those domestic supplies to be drawn off in such a manner that the requisite reserve of water for the hose reel installation is always preserved.

The piping for the supply of water for hose reel shall be In and Out Galvanized schedule 40. Diameter of the piping shall be not less than 50mm.

The piping details of the supply of water for the hose reel system and the water supply system shall be approved by the NSS Fire and Rescue Service before installation.

Special permission shall be taken if it is different from above.

### **14.4 Hose Reel Booster Pump system**

Hose reel booster pump set complete with In and Out galvanized steel pipe work with or without expansion vessel.

Where the water pressure in hose reel mains needs to be boosted the provision of an electrically driven pump is usually a convenient method. A duplicate standby pump shall also be provided. Both motors and pump shall be sited in fire-protected positions and the electrical supply to them shall be an Exclusive Circuit with the cables following a route of negligible fire risk or be provided with adequate protection. The booster pump system shall come into operation automatically on a drop in pressure or a flow of water. Both pumps shall be automatically primed at all times. All pumps shall also be capable of being started or stopped manually. The standby pumps shall be so arranged that it would operate automatically on a failure for any reason of the duty pump. The Hose Reel Booster Pump set shall be approved by the NSS Fire and Rescue Service before Installation.

Special permission shall be taken if it is different from above.

### **14.5 Fire Extinguishers**

2kg Co2 stored pressure extinguisher approved to BS EN 3. Aluminum Alloy Body approved to BS5045 Part 3 or any other equable International Standard. Red body with black band or Black colored head cap, swivel Horn, English screen Fully charged. The Fire Extinguisher shall be approved by the NSS Fire and Rescue Services before Installation.

Special permission shall be taken if it is different from above.

9 Liter water Extinguisher (Gas cartridge Type) approved to BS EN 3 or any other equable International Standard. Red Body Head cap, English Screen, Fully charged. The Fire Extinguishers shall be approved by the NSS Fire and Rescue Service before Installation.

Special permission shall be taken if it is different from above.

9 kg Dry chemical powder stored pressure extinguisher approved to BS EN 3. Aluminum Alloy Body approved to BS5045 Part 3 or any other equable International Standard. Red body with black band or Black colored head cap, swivel Horn, English screen fully charged. The Fire Extinguisher shall be approved by the NSS Fire and Rescue Services before Installation.

Special permission shall be taken if it is different from above.

Fire Extinguishers shall be located in conspicuous positions on brackets or stands where they will be readily seen by person. The carrying handle of larger heavier extinguishers shall be about 01m from the floor level. But smaller extinguishers shall be mounted so as to position the handle 1.5m from the floor level. Extinguishers installing on the cabinet the height shall be approved by NSS Fire and Rescue Service.

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#### **14.6 Cabinets for Fire Extinguishers.**

Cabinets for Fire Extinguishers shall be of stainless steel with or without glass-fronted doors. Colour of the cabinet shall be Red or to suit the requirements of the architectural surroundings. Recessed Latch Type handle shall be installed.

Fire Extinguisher single cabinets dimension shall be no more than 190mm in width, 640mm in height, 180mm in depth (including door).

Fire Extinguisher Double cabinet dimension shall be no more than 440mm in width, 640mm in height, 180mm in depth (including door).

The Cabinets for fire extinguishers shall be approved by the NSS Fire and Rescue Service before Installation. Special permission shall be taken if it is different from above.

#### **14.7 Fire blankets.**

Fire blankets shall be certified to BS EN 1869: 1997 or any other equable International standard. Fire blankets shall be extremely flexible and drape easily the slim pack of fire blanket shall be red or white.

The Fire blankets shall be approved by the NSS Fire and Rescue service before Installation. Special permission shall be taken if it is different from above.

#### **14.8 Dry riser Gate valve**

Dry riser Gate valve to BS 5041/2, or any other equable international standard, Gunmetal c/w padlock blank cap and chain. Inlet 2 ½" ASA 150 F/F. Outlet 2 ½" Inst. Female couplings to BS 336. colour red.

The Dry Riser Gate Valves shall be approved by the NSS fire and Rescue Service Installation.

Special permission shall be taken if it is different fro above.

Dry riser valves shall be installed with its lowest point about 750mm above floor level.

#### **14.9 Dry riser Outlet boxes.**

Dry riser outlet box for Dry Riser valve, Construction shall be similar to BS 5041. Standard finish color Red.

Glazing: 6mm Georgian wired glass.

Label: self- adhesive label applied to inside of glass

Lettering: White lettering on red back ground to comply with BS5499.

Door: Standard right hand hinged and left hinged as option.

Lock: Standard Yale lock with inside opening lever.

Dry Riser outlet cabinet dimension shall be no more than the below mentioned dimensions.

Height: 610mm

Width: 460mm

Depth: 325mm

The Dry Riser Outlet Boxes shall be approved by NSS fire and Rescue Service before Installation.

Special permission shall be taken if it is different from above.

#### **14.10 Pumping in Breeching**

Twin pumping in breeching approved to BS 5041, or any other equable International Standard, Gunmetal inlets 2x2 ½" BS Instantaneous Male Coupling c/w non- return valves. Outlet 4" ANSI 150 F/F flange.

Pumping in breeching approved by the NSS fire and Rescue Service before Installation, Special permission shall be taken if it is different from above.

#### **14.11 Dry riser inlet box**

Dry Riser inlet box for horizontal/vertical pattern, Double inlet to BS5041 or any other equable International Standard finish color Red.

Glazing: 6mm Georgian wired glass.

Label: self- adhesive label applied to inside of glass.

Lettering: White lettering on red back ground to comply with BS5499.

Door: Standard right hand hinged and left hinged as option

Lock: Standard Yale lock with inside opening lever.

Dry Riser outlet cabinet dimension shall be no more than the below mentioned dimensions.

Twin horizontal pattern:

Height: 395mm

Width: 595mm

Depth: 295mm

Twin vertical pattern:

Height: 595mm

Width: 395mm

Depth: 295mm

The Dry Riser Inlet Box shall be approved by the NSS fire and Rescue Service before Installation. Special permission shall be taken if it is different from above.

#### **14.12 Air release valve**

Air release valve, Gunmetal Inlet 1" BSP Male and located on top level of the building.

The Air release Valve shall be approved by the NSS Fire and Rescue Service before Installation. Special permission shall be taken if it is different from above.

#### **14.13 Piping for Dry Riser System**

The piping for Dry Riser System shall be In and Out Galvanized schedule 40 Diameter of the piping shall be not less than 64mm.

Piping details for Dry Riser System shall approved by the NSS Fire and Rescue service before Installation

Special Permission shall be taken if it is different from above.

#### **14.14 Fire Detection and Alarm System**

Fire Detection and Alarm System shall confirm to BS5839 or other equal International Standard, Fire detection and Alarm System shall be Analogue Addressable System with mimic diagram. A system in which signal from each detector and / or call point are individually identified at the control panel. Fire Detection and Alarm System shall consist of Automatic Detectors, Manual Call Points, Control and Indicating equipment, etc. It shall also covers system capable of providing signals to initiate, in the event of fire, the operation of ancillary services such as fixed fire extinguishing systems and other precaution and actions. Main fire Control Panel shall be located at the reception and the Repeater Panel shall be located in the guardroom.

Red Xenon Beacon shall be weather resistant IP65 rated Xenon.

24 Tone Wall Sounder Compact shall confirm BS5839 Pt or any other equable International Standard.

Wiring for Detectors shall be of Fire Resistant Cable.

Heat Detectors shall comply with BS 5445 or any other equable International standard.

The Fire Detection and Alarm System and all related equipment's shall be approved by the NSS fire and Rescue Service before Installation including all the relevant Equipment's.

Wiring details and the positioning of Detectors, Call point, etc. for Fire Detection and Alarm System shall be approved by the NSS Fire and Rescue Service before Installation.

Special permission shall be taken if it is different from above.

**15. TELEPHONE DATA, CCTV, CATV, TIME ATTENDANCE & ACCESS CONTROL****15.1 Telephone system and cabling****15.1.1 General**

- a) The work covered in this specification are for the supply, delivery, installation and commissioning of Private Automatic Branch Exchange (PABX) and all the associated equipments and cabling.
- b) Telephone Operator's / attendant console to be located at the main reception of the building.
- c) Telephone System (PABX) should be located at the Server Room on the 5th floor of the building.
- d) Separate Grounding bus bar should be provided in the server room.
- e) Battery backup or UPS system should be installed for the telephone system.
- f) Cables should be fixed, bound and guided using cable ladders, trays, trunking or conduits as appropriate.
- g) Surge arresters should be installed on all trunk lines before they are connected to the PBX system.
- h) Main Distribution Frame (MDF) should be installed in the server room.

**15.2 Mains supply**

The operating voltage for the mains operated devices supplied under this contract shall be in the range of 210 Volts to 250 Volts A.C @ 50Hz single phase, with a supply fluctuation of + / - 10% at the nominal operating voltage. Such devices shall confirm to all the relevant requirements and regulations of local authorities.

**15.3 Environmental conditions**

The PABX shall be suitable for continuous and efficient operations under the ambient temperature conditions from 20° C to 40° C and relative humidity of up to 85% (non-condensing).



#### **15.4 Type approval**

The PABX equipment shall conform to the standards of the local telephone service provider for use in Maldives and shall be electrically compatible with the PSTN for connection of analogue or digital (ISDN or E1) trunk lines.

#### **15.5 Pabx Type**

The PABX equipment offered under this contract shall be manufactured using state-of-the-art technology and shall be modular in design and scalable in terms of capacity and facilities. The PABX equipment shall be equipped with the interface facilities for the telecommunication services involving voice, data and video.

The PABX shall be equipped with backup/redundant controlling unit and power supply, one operating as active unit and the other as a back-up unit. It shall be arranged such that back-up unit will automatically takeover with no disturbance to call processing, signaling or call origination in the event any part of the active unit malfunctions

The system should be fully integrated for software programming to control the switching and setup. System devices, components and apparatus shall be of highly stable and reliable type, suitable for communication and for indoor operation. The electronic devices and cards shall be designed and arranged such that the respective defective cards are fully interchangeable and can be easily replaced without affecting the wiring and cabling of the PABX system

#### **15.6 System capacity**

The capacity of PABX system in terms of exchange lines, direct –inward dialing (DID) lines, extensions, and operator consoles shall be as per information given.

#### **15.7 Paralleling of extensions**

The extension capacities referred in the schedule are the number of extensions required in the PABX system initially. Each extension position shall have a separate independent extension number. The use of two or more telephone instruments in parallel to achieve required number of extensions is not permissible.

### **15.8 Access restriction**

The PABX shall be equipped with the feature that it is possible to restrict one or more of the access codes to any of the extensions.

### **15.9 Access to operator**

Access to any of the operator shall be gained by pressing a single digit "0" from any extensions, provided that the extension is not in the particular route restriction. Extensions restricted from directly accessing the outgoing calls may have their calls extended through operator.

### **15.10 Access to outgoing calls**

Access to outgoing calls shall be gained by pressing single digit "9" from any extensions, provided that the extension is not in the particular route restriction. The system shall have automatic call distribution feature for uniform distribution of calls to operator consoles.

### **15.11 Call billing/ call detail recording**

The PABX system shall be equipped with the necessary hardware, printer, software and other interfacing equipments that capture the entire call detail recording. The following information shall be available in call details recording (CDR).

Detail report of each overseas call should be sorted by date, time, durations and the destinations number and called extension and trunk number.

The system should have the capability to store records of all calls made through individual extensions with the total durations of all calls.

The software provided should have the capability to provide a summary report showing the total duration for each extension within respective caller groups.

The system shall be equipped with the sufficient memory to store the call data records so that no calls/data will be lost when the system is stopped or printing voluminous reports.

The contractor shall state the maximum number of call records supported and the capacity of buffer memory in the PABX system.

**15.12 Integrated voice messaging system ( IVMS)**

The integrated voice messaging system shall be an integral part of PABX system, providing voice messaging services to both internal and external callers. When the extensions are busy or unattended, the callers shall be forwarded automatically by the PABX system to IVMS. The callers can then leave voice messages in the user's electronic mail box. A message waiting notification shall be placed at the users mailboxes to remind them to retrieve their voice messages from their electronic mail boxes at their convenience.

**15.13 Operator attendant console with busy lamp field**

The PABX system shall be equipped with operator attendant console with busy lamp field which comprise of following features:

- Alphanumeric Visual Display
- Headset
- Handset
- Exchange Line Status
- External Call Indicators
- Internal Call Indicators
- Display of time and date
- Message indicators for extensions

**15.14 Telephone instrument sets**

Telephone sets shall be of the wall mounted or desktop type of light weight construction made of heavy duty plastic and color to the designers choice.

For the purpose of this contract the types of telephone sets to be provided shall be as follows; the quantity of each type of telephone sets are indicated in the schedule.

Type 1 – Analogue, Normal Desktop Phone

Type 2 – Digital, Desktop type with multi line and programmable feature keys

**15.15 Main distribution frame**

The main distribution frame (MDF) for terminating lines, distribution lines and other PABX connections shall be of capacity as specified.

The MDF shall be of the steel frame, single sided, floor mounting open type single or double vertical Krone MDF or equivalent

The MDF shall be mounted above the raised floor in the server room and proper grounding should be connected. The contractor shall be required to terminate all the cables into the MDF including all the PABX lines and floor cablings. The contractor is responsible for labeling of all the terminal blocks according to the wiring.

**15.16 PABX earthing/grounding**

Separate grounding to the PABX system shall be provided from the equipment main bus bar of the room. The earthing system and the resistance value attained shall not exceed 0.9 ohms and meet the service providers' requirements. The minimum size of the earthing shall be 25mm<sup>2</sup> and the cable insulation shall be green PVC.

All the earth conductors extended from the main earth bus bar in the PABX room or equipment room to all other equipment shall be at least 6mm<sup>2</sup>.

**15.17 Instruction books and records**

The operation and maintenance instructions and instruction cards and drawings shall be provided.

The number of copies of instruction cards to be provided shall be based on the initial number of extensions. The books or cards shall provide detail information to the extension users on how to use the PABX and all its features. These books or cards shall be handed over to the engineer at the time PABX is handed over or commissioning of the system

The number of copies of instruction cards to be provided shall be based on the initial number of extensions. The books or cards shall provide detail information to the extension users on how to use the PABX and all its features. These books or cards shall be handed over to the engineer at the time PABX is handed over or commissioning of the system

The contractor should also prepare the telephone directories for the PBX system. The number of copies of extensions directories to be provided shall be based on the initial number of extensions. The following information shall be supplied in the directories in tabular form and in the order

Name of the user

Room in which the extension is located

Extension number allocated to the officer or room

**15.18 MDF and distribution box cable records**

The contractor shall provide the 3 sets of cable records showing the information in a tabular form. The information should include the vertical and pair numbers of the incoming cables and outgoing distribution cables. Where pairs are jumpered between verticals, the vertical and DB records should give the appropriate cross-reference.

## **16. LAN cabling**

### **16.1 General**

The entire IT network will be based on CAT6e backbone and a structured cabling system. A system of raceways and cable ducts shall run between the equipment racks and floors. Also this network shall be based on an on-wall and open-space system with floor boxes or poke-through devices as service points. The service points shall be served with filtered surge protected isolated ground AC power, RJ45 LAN and RJ11 telephone sockets.

### **16.2 Main supply**

The operating voltage for the mains operated devices supplied under this contract shall be in the range of 210 Volts to 250 Volts A.C @ 50Hz single phase, with a supply fluctuation of + / - 10% at the nominal operating voltage. Such devices shall confirm to all the relevant requirements and regulations of local authorities.

### **16.3 Environmental conditions**

The LAN equipment shall be suitable for continuous and efficient operations under the ambient temperature conditions from 20° C to 40° C and relative humidity of up to 85% (non-condensing).

### **16.4 Type approval**

The LAN equipment shall conform to the standards of the local internet, LAN or data service provider for use in Maldives and shall be electrically compatible with the ISP for connection of internet or data lines.

### **16.5 Cable ladder/ cable tray system**

The cable ladder system shall generally be installed in vertical riser ducts provided for the purpose for parallel runs of cables of various services. The cable tray shall be used on ground floor to the respective riser ducts to run the cables to main equipment room.

The cable ladder system shall be fabricated from 16SWG (2.5mm) thick sheet steel strip and should be hot dip galvanized and painted. All fixing accessories such as rawl bolts, cable clamps, nuts and bolts used for cable ladder system shall be hot dip galvanized and painted.

All cable ladders shall have standard length of 4000 mm and the width of 400 mm. The ladder and accessories shall be subject to prior approval of the project manager or consultant.

The cable ladders shall be installed in perfect line and plumb on the surface of walls in riser ducts by means of galvanized rawl bolts. Alternate ladder step in each length of ladder shall be clamped to the ladder in a neat and orderly manner by means of cable clamps. Depending upon the number of multiple cable runs two or three parallel ladders may be installed side by side, in the same riser ducts in case one ladder is unable to accommodate all the cable runs

### **16.6 Backbone cabling**

All of the horizontal cables are star-wired back to Telecommunications Closets or Wall Distributors where they are terminated in patch panels. These patch panels are connected together via the building backbone cabling via CAT6e standards. All the cables should be terminated to patch panels at the Server Room.

### **16.7 Horizontal cabling (floor cabling)**

The floor cabling for the LAN shall be of CAT 6 standards. Cables are run from user positions to a patch panel in the Server Room. At the patch panel, patch cords link into the switches which will connect to a core switch located in the Server Room. The user position has a wall outlet and this links into the PC on the desk via another patch cord

Outlets to be within 3 metres of the user station.

Outlets to be RJ 45 CAT 6e StandardS

Max cable run to be 90 m

Max total length of patch cords at both ends of the link to be 10 m

Cable and RJ45 to be Cat 6e grade

Cabling standards : EIA/TIA 568A or 568B

## **16.8 Cable containment system**

### **16.8.1 All the cables within the building are protected within as follows:**

- Cable trays
- wire basket/raceway
- cable ladders
- J hooks
- conduit
- PVC trunking
- built-in underfloor duct
- raised floors
- suspended ceilings

### **16.8.2 The following must be taken into account:**

- the density and volume of cables to be organised
- the aesthetic appearance of the cabling within offices and other visible areas
- economics of different schemes
- proximity to power cables and other potential sources of interference
- fire stopping



### 16.8.3 Useful standards are:-

- TIA/EIA 569 Commercial building standard for telecommunications pathways and spaces
- For external applications the choices are underground cable ducts, direct buried, cable trench concrete cable trough.
- In all cases the designer must ensure that all civil works have been carried out, rights of way established and availability of cable ducts and manholes established. Aerial cable routes must keep a minimum distance away from power cables and all external cables must be selected for the environment and temperature ranges in which they are expected to survive.
- External copper cables usually need to be protected by overvoltage and fault current devices where they enter a building.

## **16.9 Cable administration system**

- a) The cabling and its containment system need to be clearly identified and their locations, routes and capabilities recorded in a cable administration system. This usually involves a logical 100 numbering scheme that can be applied to all cables, outlets, patch panels and even containment systems. These schemes can be paper based but for the larger installations a computer based system is advisable.
- b) Useful standards are: TIA/EIA-606 Administration standard for the telecommunications infrastructure of commercial buildings and EN 50174 Information technology – cabling installation.

## **16.10 Earthing scheme**

- a) All exposed metallic elements of the cable system and cable containment system need to be earthed (grounded) for safety and also electromagnetic compatibility requirements. If screened cables are used then special attention must be given to effective bonding of the screening elements. Poorly earthed screened cabling may behave worse than unscreened cabling.

- b) An electrically 'clean' earth must be available at all points where the cabling is terminated, but especially within telecommunication closets, equipment rooms and service entrances. A clean earth is usually defined as a conductive element with not more than 1 volt rms potential difference between it and the real earth.
- c) Some useful standards are: PrEN50303 Application of equipotential bonding and earthing at premises with information technology equipment, PrEN50174-2 Information Technology, Cabling installation, part 2, Installation, planning and practices inside buildings, TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications

### **16.11 Cable testing**

- a) All cables must be tested to demonstrate compliance with the standards and specification to which they were bought. Ideally all cables should be 100% tested.
- b) Copper cables: A hand held copper cable tester that will automatically test the installed cable plant for all the expected parameters may be used for testing the cables. By the use of a remote injector, the cabling must be tested from both ends, which is a condition of the standards. The cabling has to pass the entire suite of tests. Points to remember are; I) What is being tested? The channel (i.e. end-to-end including all the patch cords) or the basic link, i.e., the permanently installed cable from outlet to patch panel). The test figures are different for each setting. It is usually more practical to test the basic link (also referred to as the permanent link). II) What level is being tested? The tester should normally be set to Cat6e link or Class E link if Category 6 cable is being used.
- c) The results are stored electronically and must be in a format recognizable by the cable management software that comes with the tester. There are numerous test standards and draft standards. The most influential is likely to be; IEC 61935 Generic specification for the testing of balanced generic cabling in accordance with ISO/IEC 11801

**16.12 WiFi specification**

- a) Wireless Access Points to conform to IEEE 802.11a/b/g standards.
- b) The Access Points should be installed after carrying out proper site survey for coverage.
- c) The WiFi network should be designed and setup to provide access to only those who are authenticated.

**16.13 Schedule of server room**

- a) The server room should have adequate free space for air flow and shall be floor mounted air-conditioned to attain optimal ambience so as to prevent condensation and dampness inside the equipments.
- b) The server room shall be provided with raised flooring of 300 mm HT and the equipment shall be installed on standard 19" racks.
- c) The servers must be installed on special server racks.
- d) The server room should have a ramp in the main entrance door way.
- e) The server should be provided with a separate grounding bus bar.
- f) The room should have adequate lighting with light bulbs arranged in such a way that the lighting is even and prevents shades.
- g) The room should have adequate AC mains outlets of 13A flat pin type sockets.
- h) UPS power shall be APC 15KVA with 4 hours autonomy.

**17. Closed circuit television network****17.1 General**

- a) The scope of this contract is design, supply, install and commissioning of CCTV equipment as per the specifications given. The CCTV network is based on Internet Protocol (IP) and with Digital Video Recorder, Indoor and Outdoor Camera both fixed dome and PTZ with Keyboard controls.

**17.2 Mains supply**

- a) The operating voltage for the mains operated devices supplied under this contract shall be in the range of 210 Volts to 250 Volts A.C @ 50Hz single phase, with a supply fluctuation of + / - 10% at the nominal operating voltage. Such devices shall conform to all the relevant requirements and regulations of local authorities.

**17.3 Environmental conditions**

- a) The CCTV system including all parts and equipment shall be suitable for continuous and efficient operations under the ambient temperature conditions from 20° C to 40° C and relative humidity of up to 85% (non-condensing).

**17.4 Type approval**

Refer to LAN specifications given under article 16.5 of LAN Cabling of this document.

**17.5 Cable ladder/cable tray system**

Refer to LAN specifications given under article 16.6 of LAN Cabling of this document.

**17.6 Cable containment system**

Refer to LAN specifications given under article 16.7 of LAN Cabling of this document.

**17.7 Earthing scheme**

Refer to LAN specifications given under article 16.8 of LAN Cabling of this document.

## **17.8 Technical specification of CCTV system**

### **17.8.1 Digital Video Recorder**

- Multi Rate Video Coding Technology
- Operating System: UNIX or LINUX
- Flexible Connections: LAN, ADSL, ISDN, PSTN & mobile network
- Dual Connectivity: Simultaneous TCP/IP & dial-up Connections
- Video Transmission up to 100/120fps on LAN
- Recording up to 50/60fps at D1 & 200/240fps at CIF
- Triplex operation: Simultaneous monitoring, recording & playback
- Support both Static & Dynamic IP
- Built in web server
- Independent remote viewers
- Mobile Video monitoring
- Compliance with BS 8418 standard
- System arm/disarm
- Pre-& post alarm video recording
- Tamper & power interruption detection
- 4 x Video Outputs
- Built in CD- Writer
- Unlimited Video Storage Expansion
- Hard Disk: with IDE or SATA Interface capable of recording minimum of 30days of video footage.

- Power Source: 220VAC / 50Hz

### 17.8.2 CCTV Camera

The camera shall be of the type AXIS 209FD/209MFD for fixed cameras and AXIS 212 PTZ for movable cameras.

All the cameras must operate using Power over Ethernet (PoE). PoE is a technology that integrates power into a standard LAN infrastructure. PoE works across standard network cabling (i.e. cat-5) to supply power directly from the data ports to which networked devices are connected.

CCTV equipments are located at server room and all the monitoring will be in security control room.

## **17.9 Technical specification of catv system**

### 17.9.1 Cabling

- a) All trunk cable of the CATV system terminating to tap-off splitters at each floor level should be of the type RG11 coaxial. The distribution cables originating from the splitters up to the cable decoder should be of the type RG6U coaxial cable.
- b) Coaxial Cable : All coaxial cables used shall be of 75 ohm type copper cable designed for transmitting UHF and VHF signals. The subscriber feed shall conform to cable designation 370 or above of BS 5425 Part I and the trunk feeder shall be to cable designation 550 or above of BS 5425 Part I. All coaxial cables shall be installed in a PVC duct system.
- c) All cables shall be screened and low loss coaxial copper cable with polyethylene outer sheath, copper foil outer conductor, and polyethylene insulation. These shall conform to cable designation 550MB or above of BS 5425 Part I. For cables installed as direct buried underground and footbridge, the coaxial cables shall be armored type as mechanical protection.
- d) All coaxial cables used shall have distinctive labels along its length. Trunk line coaxial cable shall be air-spaced dielectric type with wave wire screen over copper tape as outer conductor. Trunk cable shall be specially selected with nominal attenuation at 850MHZ less than 15 db/100m.

- e) The distribution cable shall be of coaxial 'RG6U' type and shall meet the following requirement.

Maximum Attenuation

<u>Frequency (MHz)</u>	<u>at 200C (dB/100m)</u>
5	1.90
55/channel 2	5.25
83/channel 6	6.40
187/channel 9	9.35
211/channel 13	10.00
250	10.82
300	11.64
350	12.65
400	13.61
450	14.43
500	15.29
550	16.08
600	16.73

- f) Cabling: Co-axial cables shall not be bent to a radius smaller than 15 times the overall cable diameter. Joints in such cables and the looping of cables at outlet terminals shall not be permitted. All cable and equipment shall be installed in such locations as to minimize direct pick up from other source of interference. All cabling shall be installed in compliance with the IEE wiring regulations.
- g) Small Items: The incidental sundry components necessary for the complete execution of works and for proper usage of the installation, whether or not these sundry components are mentioned in detail in the specification shall be supplied and installed by Contractor.

## **17.9.2 IP Based TIME & ATTENDANCE Control System**

### **17.9.2.1 The Function**

- a) When configured as a Time Attendance System, a user shall be able to specify whether he/she is clocking-in or clocking-out.
- b) Attendance of each employee shall be printed on the attendance report. The attendance report shall be such that it could be for payroll purposes.

- c) Fingerprint and Smart Card – shall be configured as the primary master for each door that needs to be secured with Fingerprint and smartcard or fingerprint and PIN.
- d) If the solution is for an exterior door or a door that is not in a secure area, a Secure Strike Relay for each door that needs to be protected shall be used.
- e) A door strike or magnetic lock for each door is required.
- f) Power and wiring – A 12v power source (plug in or transformer panel) at each door location is required. Additionally a CAT5 network drop at each door to communicate with the network is required.
- g) Grounding - Each unit must be properly grounded to avoid ESD.

### **17.9.3 Door access control system**

#### **17.9.3.1 The function of access control system**

- a) The Security System shall analyze and compare a person's fingerprint against the previously enrolled record. If the two fingerprints match, the person shall be authenticated. And if the time is within the authorized period for entry, the device shall signal and release the electric door lock.
- b) Access Time restriction – Administrator should be able to define the authorized time for each individual or for a group of individuals.
- c) Terminal restriction – administrator should be able to specify who has the rights to access a particular terminal.
- d) Password/Fingerprint Access – Administrator should be able to define the period in which password can be used instead of fingerprint for access.
- e) Provision for the Access Control Mode shall be available to control the employees from entering the premises. The system shall control the electronic door strike to lock / unlock the door. Administrator should be able to assign users to different departments and the authorized time for users in each department shall be controlled.



**18. LIFT****18.1 General:**

Lifts shall be 2 Nos. P09-CO Mitsubishi (Machine room less). Lift shall be 09 Passenger capacity.

Specification shall be in accordance with manufacturers details.