

---

# TECHNICAL SPECIFICATIONS

---

*PROPOSED 03 STOREY  
HOARAFUSHI COUNCIL OFFICE  
BUILDING  
AT HA. HOARAFUSHI*

---

RIYAN PVT LTD

---

# **TECHNICAL SPECIFICATIONS**

## **Contents**

<b>1. PRELIMINARIES.....</b>	<b>7</b>
1.1 STANDARD AND CODES.....	7
1.2 DRAWINGS AND SPECIFICATIONS .....	7
1.3 TRANSPORTATION TO THE SITE.....	7
1.4 SCHEDULE AND EXECUTION PLAN .....	7
1.5 REPAIRING AND CORRECTION.....	7
1.6 WORKMANSHIP AND MATERIALS.....	7
1.7 OBVIOUS WORK.....	8
1.8 PROTECTION .....	8
1.9 SCAFFOLDING .....	8
1.10 CONSTRUCTION MACHINERY, PLANTS AND EQUIPMENT'S .....	8
1.11 SAMPLES.....	9
1.12 ORDERING MATERIALS .....	9
1.13 WATER AND ELECTRICITY FOR THE WORKS .....	9
1.14 SITE OFFICES FOR CONTRACTOR .....	9
1.15 CONTRACTOR'S SITE AREA .....	10
1.16 PROGRESS MEETINGS .....	10
1.17 PROGRESS PHOTOGRAPHS.....	10
1.18 SETTING OUT.....	10
1.19 BILLBOARDS.....	11
1.20 LOADING IN EXCESS OF DESIGN LOAD .....	11
1.21 BUILDING PERMIT .....	12
1.22 PERMANENT DRAINAGE, ELECTRICITY AND WATER CONNECTION .....	12
1.23 HANDING OVER .....	12
<b>2. SITE WORKS .....</b>	<b>12</b>
2.1 DEMOLITION.....	12
2.2 SITE CLEARANCE.....	13
2.2 EXCAVATION.....	13
2.3 DE-WATERING.....	14
2.4 BACKFILL.....	15
<b>3. CONCRETE WORKS .....</b>	<b>16</b>
3.1 GENERAL.....	16
3.2 CEMENT .....	16
3.3 AGGREGATE.....	16
3.4 WATER.....	18
3.5 HANDLING AND STORAGE OF MATERIAL .....	18
3.6 MIX PROPORTION AND STRENGTH .....	18
3.7 PRODUCTION OF CONCRETE.....	19
3.8 TRANSPORTING AND PLACING.....	20
3.9 CONCRETE CURING .....	21
3.10 TEST .....	21
3.11 CONCRETE .....	22
3.12 DEFECTIVE CONCRETE AND FINISHES .....	22
<b>4. CONCRETE FORMWORK .....</b>	<b>23</b>
4.1 STRUCTURE AND MATERIAL .....	23
4.2 PERFORMANCE.....	23
<b>5. STEEL REINFORCEMENT.....</b>	<b>26</b>
5.1 MATERIAL.....	26

5.2	CLEANING .....	26
5.3	BENDING AND LAPS.....	26
5.4	REINFORCEMENT COVER .....	26
5.5	PLACING.....	26
<b>6.</b>	<b>WATER PROOFING .....</b>	<b>27</b>
6.1	DESCRIPTION OF WORK.....	27
6.2	MATERIALS .....	27
6.3	STORAGE OF MATERIALS .....	27
6.4	SURFACE PREPARATION.....	27
6.5	APPLICATION .....	28
6.6	CURING .....	28
<b>7.</b>	<b>EMBEDDED DAMPPROOF MEMBRANE.....</b>	<b>29</b>
7.1	GENERAL.....	29
7.2	PRODUCTS .....	29
7.3	WORKMANSHIP.....	29
<b>8.</b>	<b>STRUCTURAL STEEL .....</b>	<b>30</b>
8.1	SCOPE .....	30
8.2	MATERIALS .....	30
8.3	FABRICATION .....	30
8.4	BOLT .....	31
8.5	WELDING.....	32
8.6	ERECTION AND FIELD PAINTING .....	33
8.8	ANCHOR BOLT .....	34
<b>9.</b>	<b>MASONRY .....</b>	<b>34</b>
9.1	MATERIALS .....	34
9.2	GENERAL.....	34
9.3	BLOCKWORK.....	35
<b>10.</b>	<b>PLASTERING .....</b>	<b>37</b>
10.1	GENERAL.....	37
10.2	MATERIALS AND STORAGE.....	37
10.3	MIXING RATIO .....	37
10.4	THICKNESS OF COATING.....	37
10.5	FINISH .....	38
10.6	GENERAL PREPARATION .....	39
10.7	EXTERNAL PLASTERING .....	39
10.8	INTERNAL PLASTERING .....	40
10.9	EXTERNAL RENDERING.....	40
10.10	METAL MESH LATHING / REINFORCEMENT FOR PLASTERED/COATINGS.....	41
<b>11.</b>	<b>CARPENTRY AND JOINERY .....</b>	<b>42</b>
11.1	MATERIALS .....	42
11.2	PRESERVATION OF TIMBER .....	42
11.3	HARDWARE .....	42
11.4	DIMENSIONS AND FINISH.....	42
11.5	WORKMANSHIP.....	42
<b>12.</b>	<b>ROOFING .....</b>	<b>44</b>
12.1	SCOPE .....	44
12.2	ROOF CLADDING .....	44
12.3	PRODUCTS .....	44
12.4	WORKMANSHIP.....	44
12.5	FIXING.....	45
12.6	FITTINGS AND FEATURES.....	45

<b>13. FINISHES.....</b>	<b>46</b>
13.1 GENERAL.....	46
13.2 MANUFACTURERS .....	46
13.3 CERAMIC AND VITREOUS TILE MATERIALS .....	46
13.4 FLOORING.....	46
13.5 WALL PAPERS .....	47
13.6 WOVEN THATCH MAT WALL FINISH .....	47
13.7 WOOD VENEER.....	48
13.8 CEILING .....	48
13.9 CORNER GUARDS .....	48
13.10 CRASH RAILS .....	49
13.11 PARTITION WALLS.....	49
13.12 MOTAR MATERIALS .....	49
13.13 CEMENT COLOR .....	49
13.14 WATER PROOFING .....	50
13.15 INSTALLATION REQUIREMENTS.....	50
13.16 FLOOR TILW INSTALLATION .....	50
13.17 WALL TILE INSTALLATION .....	51
13.18 GROUTING .....	51
13.19 DEFECTS IN TILE & TILE LAYING.....	51
13.20 GUARANTEES .....	51
13.21 CORAL STONE CLADDING .....	52
<b>14. PAINTING .....</b>	<b>53</b>
14.1 MATERIAL.....	53
14.2 DEFINITION OF TERMINOLOGY .....	53
14.3 PAINT FINISH SYMBOLS .....	54
14.4 PAINTING IN GENERAL .....	54
14.5 PROCEDURE OF PAINTING.....	55
<b>15. ALUMINIUM DOORS AND WINDOWS.....</b>	<b>59</b>
15.1 ALUMINIUM DOORS AND WINDOWS.....	59
15.2 ALUMINIUM LOUVERS .....	61
15.3 TOP HUNG WINDOWS, VENTILATORS AND SIDE HUNG DOORS .....	62
15.4 INSTALLATION .....	62
15.5 SEALING JOINTS .....	63
15.6 GLASS INSTALLATION .....	63
<b>16. PLUMBING.....</b>	<b>64</b>
16.1 GENERAL .....	64
16.2 DRAWINGS AND INFORMATION REQUIRED.....	65
16.3 RECORD DRAWING.....	65
16.4 OPERATING AND MAINTENANCE INSTRUCTIONS.....	65
16.5 TESTS .....	65
16.6 WORK IN COMMON PIPING.....	66
16.7 WATER SUPPLY WORK .....	72
16.8 WATER PUMPS .....	72
16.9 SPACING OF SUPPORTS .....	72
16.10 DRAINAGE WORK .....	73
16.11 LAYING OF PIPES .....	73
16.12 LAYING OF SEWER WATER MAINS.....	74
16.13 SEWERS .....	74
16.14 U.P.V.C PIPES .....	74
16.15 BENDS AND OTHER SPECIALS .....	75
16.16 FLANGED JOINTS .....	75
16.17 SUPPORT FOR U.P.V.C PIPES .....	75
16.18 SEWER PIPES .....	75

16.19	AIR VALVES .....	75
16.20	SCOUR WASHOUT VALVE .....	75
16.21	FOOT VALVES AND STRAINERS .....	76
16.22	PRESSURE REDUCERS .....	76
16.23	WATER METER .....	76
16.24	EQUILIBRIUM BALL VALVES .....	76
16.25	FITTINGS.....	76
16.26	MANHOLES, MANHOLE COVERS AND FRAMES.....	76
16.27	INTERCEPTOR MANHOLE .....	77
16.28	FIXTURES AND ACCESSORIES .....	77
16.29	AS BUILT DRAWINGS .....	77
16.30	MISCELLANEOUS .....	78
<b>17.ELECTRICAL INSTALLATIONS.....</b>		<b>82</b>
17.1	GENERAL .....	82
17.2	CONDUIT AND CONDUIT ACCESSORIES .....	85
17.3	WIRES, CABLES AND CORDS .....	86
17.4	WIRING ACCESSORIES.....	87
17.5	LIGHT FIXTURES .....	88
17.6	TESTING .....	90
17.7	INSTALLATION INSTRUCTION .....	90
17.8	DISTRIBUTION BOARD .....	91
17.9	TELEPHONE SYSTEM.....	91
<b>18. HVAC SYSTEM.....</b>		<b>92</b>
18.1	GENERAL .....	92
18.2	BASIS OF DESIGN .....	92
18.3	REGULATION AND SHOP DRAWING .....	92
18.4	HVAC SYSTEM.....	92
18.5	AIR CONDITIONING SYSTEM .....	92
18.6	REFRIGERENT AND CONDENSATE PIPEWORK .....	93
18.7	DUCT WORK AND INSULATION .....	93
18.8	AIR DIFFUSERS/ REGISTERS/ GRILLES/ LOUVRES .....	94
18.9	MECHANICAL FANS.....	94
18.10	SITE TESTING AND COMMISSIONING.....	94
<b>19. CCTV SPECIFICATION.....</b>		<b>95</b>
19.1	SYSTEM DESIGN .....	95
19.2	SYSTEM PERFORMANCE CRITERIA .....	95
19.3	GENERAL REQUIREMENT OF CCTV EQUIPMENT .....	96
19.4	REGULATIONS AND CODE OF PRACTICE.....	96
19.5	TESTING .....	96
19.6	ITEM SPECIFICATION .....	97
<b>20.PUBLIC ADDRESSING SYSTEM &amp; BACKGROUND MUSIC (PA &amp; BGM) SYSTEM SPECIFICATION.....</b>		<b>104</b>
20.1	SYSTEM DESIGN .....	104
20.2	SYSTEM PERFORMANCE CRITERIA .....	104
20.3	GENERAL REQUIREMENT OF PA & BGM EQUIPMENT.....	105
20.4	REGULATIONS AND CODE OF PRACTICE.....	105
20.5	TESTING .....	105
20.6	ITEM SPECIFICATION .....	106

## **21. FIRE DETECTION AND PROTECTION SYSTEM..... 113**

21.1	GENERAL.....	113
21.2	STANDARDS AND CODES .....	113
21.3	TECHNICAL SPECIFICATION FOR WET RISER / FIRE HOSE REEL SYSTEM.....	113
21.4	TECHNICAL SPECIFICATION FOR PORTABLE FIRE EXTINGUISHER.....	122
21.5	TECHNICAL SPECIFICATION FOR FIRE DETECTION AND ALARM SYSTEM .....	124

## **22. LIFT SPECIFICATION..... 139**

22.1	SCOPE OF WORK.....	139
22.2	GENERAL REQUIREMENTS .....	139
22.3	REGULATIONS AND STANDARDS.....	140
22.4	SYSTEM DESCRIPTION.....	140
22.5	EQUIPMENT .....	142



## **01. PRELIMINARIES**

### **1.1 Standard and Codes**

- 1.1.1 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.
- 1.1.2 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**

- 1.2.1 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.
- 1.2.2 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**

- 1.3.1 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 labour to and from the site.

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

- 1.4.1 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**

- 1.5.1 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**

- 1.6.1 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.
- 1.6.2 The Contractor shall submit for the approval of the Consultant a list of names and addresses of the manufacturers and trademarks or names of all the various types of materials and goods



he proposes to use in the Works. The list shall include reference to the specifications clause or article to which the materials and goods apply.

- 1.6.3 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.
- 1.6.4 No orders for materials and goods shall be placed until approval has been obtained for the materials and goods from the consultant.
- 1.6.5 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 should the consultant reject the alternatives.

## **1.7 Obvious Work**

- 1.7.1 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**

- 1.8.1 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.
- 1.8.2 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**

- 1.9.1 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.
- 1.9.2 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**

- 1.10.1 All necessary construction machines shall be provided and maintained by the Contractor and shall be approved by the Consultant.
- 1.10.2 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.

- 1.10.3 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**

- 1.11.1 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
- 1.11.2 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.
- 1.11.3 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.
- 1.11.4 Samples shall be furnished so as not to delay fabrication, allowing the consultant reasonable time for consideration of the sample submitted.
- 1.11.5 Each sample shall be properly labelled 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**

- 1.12.1 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.
- 1.12.2 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.
- 1.12.3 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**

- 1.13.1 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, adept and maintain temporary work as necessary and remove and make good at completion.
- 1.13.2 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**

- 1.14.1 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.

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

1.14.3 The Contractor shall obtain the approval of the Consultant of the proposed site layout, type and drainage arrangement of all the buildings prior to erection of same. All buildings shall be supplied and maintained in good condition and of neat appearance, all maintenance to same as instructed by the Consultant shall be carried out at the Contractor's expense.

1.14.4 Under no circumstances shall overnight accommodation be permitted on Site except for the site watchman in carrying out his duties.

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

1.15.1 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.

1.15.2 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**

1.16.1 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.

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

1.16.3 Prior to such meetings the Contractor shall give to the Consultant's Representative details in writing of that portion of the Works he proposes to construct during the coming two weeks with details of the plant and method he proposes to employ. These proposals shall be discussed at the meeting and no work based on such proposals shall proceed without the approval of the Consultant's Representative.

1.16.4 The Contractor shall submit all reports as instructed by the Consultant in connection with progress meetings and the day to day management of the Works.

#### **1.17 Progress Photographs**

1.17.1 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.

1.17.2 The photographs shall be submitted in three copies un mounted of a size not less than 15 x 10 centimeters with the description of the viewpoint stamped in ink on the back. The negative shall have the date on it and remain the property of the Consultant and no prints from these negatives may be supplied to others unless previously authorized in writing by the Consultant.

#### **1.18 Setting Out**

1.18.1 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.

- 1.18.2 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
- 1.18.3 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 Billboards**

- 1.19.1 The Contractor shall provide and maintain two billboards for the Site each consisting of a plastic board panel of size not more than 2.4m x1.2m (2.88m<sup>2</sup>) supported 2.5m above the ground with steel angle framing or similar material and fixed in concrete foundations.
- 1.19.2 Each board shall have the following written in both Dhivehi and English (letter height not to exceed 100mm) 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***

- 1.19.3 A scaled layout shall be prepared and submitted for the Consultant's approval before fabrication.
- 1.19.4 No advertising material other than the above will be permitted.
- 1.19.5 The location and layout of Sub-Contractors or Manufacturer's billboards, if allowed, must be submitted for the Consultant's approval.

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

- 1.20.1 No loading in excess of the design loading shall be placed on any portion of the structure without the written permission of the Consultant
- 1.20.2 If such permission is granted, all beams or other members of the structure which are subjected to loading other than the designed loading shall be strengthened and supported to the

satisfaction of the Consultant, and the Contractor shall be responsible for any resulting additional costs

- 1.20.3 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 such excess loading.

#### **1.21 Building Permit**

- 1.21.1 The Contractor shall allow for obtaining the building permit and for paying all fees in connection therewith.

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

- 1.22.1 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**

- 1.23.1 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.

### **2.0 SITE WORKS**

#### **2.1 Demolition**

- 2.1.1 Demolition includes the complete demolition including grubbing up of foundations and the proper termination of all services as required by the Drawings including the removal and disposal of all demolished materials. The demolition work shall be executed in a systematic manner.
- 2.1.2 Demolition operations and the removal of debris shall be carried out to ensure minimum interference with roads, streets, footpaths and other adjacent occupied or used facilities.
- 2.1.3 Damage caused to adjacent facilities by demolition operations shall be repaired by the Contractor at his own expense. The Contractor shall arrange and pay for the disconnecting, removing and capping of utility services, notify the affected utility agency in advance and obtain written approval before commencing work.
- 2.1.4 Before commencement of work, submit a method statement to the Consultant as to the proposed method and sequence of demolition of the building and a safety plan which shall cover the risk assessment and safety measures for such method statement. The Consultant reserves the right to prohibit any method of execution of the Works which he regards as unsafe.
- 2.1.5 Drawing information, particularly for unconventional layouts and special structures, will be made available to the Contractor if possible. The Contractor shall state in his method statement if it is based on such drawings. In the absence of drawings, the Consultant may require a detailed structural survey to be carried out and endorsed by a Registered Structural Engineer (or equivalent) to define the existing structure and the appropriate method and sequence of demolition.

- 2.1.6 No work on site shall be allowed to commence until the proposed method statement has been accepted and all precautionary measures, hoardings, covered walkways, and other requirements are in place.

## **2.2 Site Clearance**

The Site shall be cleared of all vegetation, rock, boulders, etc. and surface soil shall be removed as directed by the Consultant. The trees which are to be retained shall be protected from damage

Spreading, levelling and consolidating on site where required, shall be made with suitable surplus excavated material obtained from the Site. Other soils used for filling shall be approved by the Consultant

The Contractor shall dispose all unsuitable and surplus excavated material

The Contractor shall tidy up and leave the Site in a clean and sanitary condition at all times during the execution of the Works.

## **2.2 Excavation**

- 2.2.1 Excavation shall be performed to the required depth as shown in the Drawings.
- 2.2.2 A survey of the existing site shall be made and the results of same submitted to the Consultant before commencement of the work
- 2.2.3 Excavation area shall be protected from any water flowing in. Sides of excavations shall be shored or inclined to retain excavation unless otherwise specified
- 2.2.4 Excavation near adjoining structures shall be executed with care so as not to damage those structures.
- 2.2.5 The Contractor shall take all necessary precautions during the excavation for the Works particularly those excavation which are adjoining existing buildings and shall protect such buildings from the damage or collapse by means of temporary or permanent shoring, strutting, sheet piling or underpinning or excavation in short lengths and/or other methods as he deems fit and also he shall properly support all foundations, trenches, walls, floors, etc. affecting the safety of the adjoining existing buildings.
- 2.2.6 The Contractor shall alter, adopt and maintain all such works described above for the whole period of the Contract and shall finally clear away and make good all damages done.
- 2.2.7 The construction and efficiency of the shoring, underpinning, strutting and the like for the purpose for which it is erected shall be the responsibility of the Contractor, should any subsidence or any other damage occur due to the inefficiency of the shoring, underpinning, strutting and the like or any other support provided, the damage shall be made good by the Contractor at his own expense and responsibility.
- 2.2.8 The shoring, strutting, piling and the like, shall be executed in such a manner as to cause as little inconvenience as possible to adjoining owners or the public and the Contractor shall be responsible for negotiating with the adjoining owners the means to safeguard their property

and for the use of any portion of their land for the purpose of executing the excavations and no claims submitted on this ground will be entertained.

- 2.2.9 The Contractor shall be held solely responsible for the safety of the adjoining existing buildings, the sufficiency of all temporary or permanent shoring, underpinning, piling, and the like.
- 2.2.10 The Contractor shall keep the Consultant informed as to manner in which he intends to proceed with the execution of the excavations and obtain his approval. Such approval if given shall not absolve the Contractor of his responsibility.
- 2.2.11 Excavation shall extend a sufficient distance from walls, footings, etc. to allow space for placing and removing shoring and formwork, for performing all work in the excavations and for the inspection of same.
- 2.2.12 Excavated material shall be deposited within specified areas as directed unless otherwise specified.
- 2.2.13 The Contractor is deemed to have inspected the site and to leave ascertained for himself as to the nature of the soil, etc. and also the areas where to collect and stack the materials for which necessary site clearance shall have to be made at his own cost.
- 2.2.14 Stacking or excavated materials shall be done at places approved by the Consultant and he shall have recorded the original ground levels of such places jointly with the Contractor before commencement of stacking operation.
- 2.2.15 Extra excavation and allied lead/lift required specifically for providing working space to workmen or shuttering to walls of basement etc. shall be measured for payment, no extra claim being allowed for such work incidental to development and executions of allied jobs. Only authorized excavation approved by the Consultant shall be paid for
- 2.2.16 Sufficient clear working space shall be left all around excavated area. The disposal of waste/unserviceable materials may be in filling and/or in embankment according to nature of place of disposal. The appropriate specifications for filling and/or embankment shall apply
- 2.2.17 All foundation trenches shall be excavated to the full widths and depths shown on the drawings or to such greater or smaller depths as may be found necessary in the opinion of the Consultant and so instructed by his representative.
- 2.2.18 Should any excavation be taken down below the specified levels, the Contractor shall fill in such excavation at his own cost with cement concrete specified for foundations, well rammed in position until it is brought up to the level.
- 2.2.19 The Contractor shall notify to the Consultant when the excavation is completed and no concrete or masonry shall be laid until the Consultant has inspected of the soil for each individual footing.
- 2.2.20 All foundation pits shall be refilled to the original surface of the ground with approved materials, which shall be well consolidated as instructed by the Consultant.
- 2.2.21 The Contractor shall erect temporary barricades around the excavations and if necessary make provisions of red lamps.
- 2.2.22 The Contractor shall remove/maintain/restore all service lines like telephone, water supply, electricity etc. without any extra charges.

### **2.3 De-watering**

- 2.3.1 Where the excavation level is below the natural water table and it is necessary to pump continuously from the excavation or to install a specialist type of dewatering equipment around

the perimeter of the site or excavation, the Contractor will be responsible for ensuring the safety and stability of all adjoining structures and services or utilities above or below ground level.

- 2.3.2 It will also be the responsibility of the Contractor that the equipment installed shall ensure that the excavation and subsequent construction is carried out in dry conditions.
- 2.3.3 Continuous or permanent de-watering of the excavation or Site may not be undertaken without the written approval of the Consultant and the methods to be employed shall also comply with Codes of Practice and Local Authority requirements.
- 2.3.4 The water pumped from the excavations or well points shall be pumped to disposal points or sumps approved by the Consultant and the Local Ward Office and if so required be passed through settling tanks before disposal.
- 2.3.5 Unless prior approval has been obtained no water must be disposed of in the Municipality's sewer systems.

## **2.4 Backfill**

- 2.4.1 All earth used for filling shall unless otherwise stated, be selected hard dry material from the excavation. The maximum dry density of the fill material shall be not less than 1600 kg/m<sup>3</sup>.
- 2.4.2 The backfill of excavations shall be placed in horizontal layers not exceeding 300mm in thickness. Each layer shall be compacted by hand or other mechanical means to the required density before the next layer is added.
- 2.4.3 Care shall be taken when filling or back-filling to avoid any wedging action or eccentric action upon or against the structure of the work.
- 2.4.4 Before placing of fill, the surface of the sub-grade shall be compacted at optimum water content to the same percentage of maximum dry density required of subsequent layer.
- 2.4.5 The Consultant will inspect all compacting devices that the Contractor proposes and shall have the right to reject any device which he feels is unsuitable for the job.
- 2.4.6 Heavy equipment for spreading and compacting fill and backfill shall not be operated closer to walls than a distance to the difference in height between the top of the footings and the layer being compacted.
- 2.4.7 When back-filling behind retaining walls, basement walls and the like the said structures shall be kept propped during the complete operation. The hydraulic compaction of fill shall not be permitted and the back filling shall be carried out in layers not exceeding 150mm thick.
- 2.4.8 Each layer shall be compacted to 90% of the modified compaction. No back filling shall be carried out until the wall concrete has achieved its full works cube strength and care shall be exercised so as not to damage the external tanking membrane and its protection.



### **3.0 CONCRETE WORKS**

#### **3.1 General**

- 3.1.1 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.
- 3.1.2 Materials shall be transported, handled and stored on the site or elsewhere in such a manner to prevent damage, deterioration or contamination.

#### **3.2 Cement**

- 3.2.1 Cement shall be Ordinary Portland cement of an approved brand.
- 3.2.2 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.

#### **3.3 Aggregate**

- 3.3.1 Fine aggregate shall be river sand conforming to BS 882.
- 3.3.2 Coarse aggregate shall be crushed stone excluding limestone or derivatives of limestone conforming to BS 812.
- 3.3.3 Aggregate shall not contain injurious amount of rubbish, dirt, organic impurities and other foreign matters.
- 3.3.4 Strength of aggregate shall be more than that of hardened concrete paste.
- 3.3.5 Shape of coarse aggregate shall not be flat or slender.
- 3.3.6 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	$\leq 2.5$	$\leq 3.0$	$\geq 55$	$\leq 0.25$	$\leq 1.5$	0	$\leq 0.25$
Fine aggregate	$\geq 2.5$	$\leq 3.5$	-	$\leq 1.0$	$\leq 3.0$	0	$\leq 0.01$

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

### Grading requirements for aggregates

Nominal size	Amount Passing Each Sieve (% Mass)					
	37.5mm	20.0mm	14.0mm	10.0mm	5.0mm	2.36mm
Graded 40-5mm	90-100	35-70	*	10-40	0-5	*
Graded 20-5mm	100	90-100	*	30-60	0-10	*
Graded 14-5mm	100	100	90-100	50-85	0-10	*
Single-size 40mm	85-100	0-25	*	0-5	*	*
Single-size 20mm	100	85-100	*	0-25	0-5	*
Single-size 14mm	100	100	85-100	0-50	0-10	*
Single-size 10mm	100	100	100	85-100	0-25	0-5

*British gradation limits for coarse aggregate (BS 882)*

\*Not specifically specified in BS 882.

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

3.3.8 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.

3.3.9 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.

### **3.4 Water**

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

3.4.2 Ground water shall not be used for concrete works.

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

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

### **3.5 Handling and Storage of Material**

#### **3.5.1 Cement**

3.5.1.1 Cement shall be stored in a manner to prevent weathering.

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

3.5.2 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.

#### **3.5.3 Aggregate**

3.5.3.1 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.

3.5.3.2 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.

### **3.6 Mix Proportion and Strength**

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

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

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

3.6.4 The specified design strength of reinforced concrete shall be 25 N/mm<sup>2</sup>

3.6.5 The required slump of concrete shall be 100 mm.

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

### **3.7 Production of Concrete**

#### **3.7.1 Field-mixed Concrete Plant**

3.7.1.1 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.

#### **3.7.2 Measuring**

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

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

#### **3.7.3 Mixing Control**

3.7.3.1 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.

#### **3.7.4 Quality Control**

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

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

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

3.7.5.1 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.

The tolerance between actual slump and required slump of the concrete shall be  $\pm 20$  mm

3.7.5.2 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.

### **3.8 Transporting and Placing**

#### **3.8.1 General**

- 3.8.1.1 The Contractor shall establish manner and schedule for transporting and placing of concrete and obtain approval of the Consultant.
- 3.8.1.2 Concrete shall be transported in a manner to minimize segregation, spill, age and other changes in quality thereof.
- 3.8.1.3 Concrete shall be placed and consolidated in a manner to insure uniformity and optimum density.
- 3.8.1.4 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.

#### **3.8.2 Time Limit**

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

#### **3.8.3 Preparation prior to Placing.**

- 3.8.3.1 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.

#### **3.8.4 Construction Joint**

- 3.8.4.1 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.
- 3.8.4.2 The locations of shapes of construction joints shall be consulted and approved by the Consultant.

#### **3.8.5 Concrete Placing**

- 3.8.5.1 Concrete placing shall be proceeded to keep the surface of placed concrete as horizontal as possible.
- 3.8.5.2 Concrete shall be continuously poured to compact around reinforcing bars and corners of formwork.
- 3.8.5.3 The maximum time interval between placements 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.

#### **3.8.6 Consolidation**

- 3.8.6.1 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.
- 3.8.6.2 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.

- 3.8.6.3 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.

### 3.8.7 Placing Speed

- 3.8.7.1 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.

## 3.9 Concrete Curing

### 3.9.1 Curing Method

- 3.9.1.1 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.
- 3.9.1.2 As a rule, no foot traffic or loads shall be permitted on concrete for at least 24 hours after placement.

## 3.10 Test

### 3.10.1 General

- 3.10.1.1 The contractor shall be required to conduct all tests according to BS method and procedure.
- 3.10.1.2 Test, as a rule, shall be conducted at the locations directed or at the testing institutions approved by the Consultant.
- 3.10.1.3 The Consultant shall conduct test, as a rule.
- 3.10.1.4 In case of failure in test, measure shall be taken as instructed by the Consultant.
- 3.10.1.5 The Contractor shall keep test records during the work and for 2 years after completion of the contracted work.

### 3.10.2 Material

- 3.10.2.1 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.

- 3.10.2.2 Aggregate test:
  - (1) Grading and fineness modules.

### **3.11 Concrete**

#### **3.11.1 Fresh concrete**

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

#### **3.11.2 Compressive strength test of concrete**

Test for estimation on strength of concrete in structure:

- 3.11.2.1 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.
- 3.11.2.2 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.
- 3.11.2.3 Test pieces shall be made in accordance with British Standards, and sampling shall be taken as near as possible at the point of placement.
- 3.11.2.4 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.
- 3.11.2.5 The test results shall be expressed in the average value by calculating the average compressive strength of all test pieces. The average value must be equal to or greater than the specified strength.

### **3.12 Defective Concrete and Finishes**

- 3.12.1 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.
- 3.12.2 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

## **4.0 CONCRETE FORMWORK**

### **4.1 Structure and Material**

#### **4.1.1 Structure**

- 4.1.1.1 Formwork shall be performed to obtain accurate concrete in accordance with the designated drawings.
- 4.1.1.2 Formwork shall be firmed and secured to bear the force of concreting and tightened to avoid cement paste seeping.

#### **4.1.2 Materials**

- 4.1.2.1 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.
- 4.1.2.2 Form liners shall be sound and suitable materials to accurately and safely cast the in-situ concrete structure as shown on the Drawings.
- 4.1.2.3 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.

#### **4.1.3 Other Material**

- 4.1.3.1 Fastening hardware to be used shall be those with allowable tensile strength guaranteed by manufacturer through strength tests.
- 4.1.3.2 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.

### **4.2 Performance**

#### **4.2.1 Design of formwork**

- 4.2.1.1 Formwork shall be designed to withstand construction loads during concreting, lateral pressure of fresh concrete, shock and vibrators due to concrete placing.
- 4.2.1.2 Formwork shall be free of injurious leakage of water, easy to remove, and shall not damage concrete at removal.
- 4.2.1.3 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.

#### **4.2.2 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.



### Standard Values of Dimensional tolerances

Item	Tolerance (mm)
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

#### 4.2.3 Fabrication and Erection

- 4.2.3.1 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.
- 4.2.3.2 Sheathing shall be fabricated and installed accurately to match the locations, shapes and dimensions of members called for in the Drawings.
- 4.2.3.3 Sheathing shall be installed tightly so as not to permit cement paste or mortar to escape from joints.
- 4.2.3.4 Pipes, boxes and other embedded hardware shall be properly secured to sheathing or others so that they will not move during concrete placing.
- 4.2.3.5 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.
- 4.2.3.6 Shoring shall be erected paying special attention to safety.
- 4.2.3.7 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.

#### 4.2.4 Inspection

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

#### 4.2.5 Striking of forms

- 4.2.5.1 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.
- 4.2.5.2 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.
- 4.2.5.3 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.
- 4.2.5.4 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

#### 4.2.6 Relocation of Support

4.2.6.1 Supports under concrete shall be not relocated

#### 4.2.7 Removal of formwork

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

4.2.7.2 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.

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

## **5.0 STEEL REINFORCEMENT**

### **5.1 Material**

- 5.1.1 Reinforcing steel shall be of the dimensions given in the Drawings.
- 5.1.2 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.
- 5.1.3 Dia 6mm reinforcing steel shall be round mild steel bars, and 12mm, 16mm, 20mm and 25mm shall be deformed high strength bars.
- 5.1.4 Any other non-specified reinforcing steel shall be used only with the approval of the Consultant.
- 5.1.5 All reinforcing steel and binding wire shall be stored under cover and shall be at least 250mm above the ground.

### **5.2 Cleaning**

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

### **5.3 Bending and Laps**

- 5.3.1 The reinforcement shall be bent cold in an approved bar bending machine.
- 5.3.2 Preferably bars of full length shall be used. Lapping of bars where necessary shall conform to BS1487 'Bending Dimensions of Bars of Concrete reinforcement.'

### **5.4 Reinforcement Cover**

- 5.4.1 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
CEAR COVER IN SIDES OF BEAMS	30	MM
CLEAR COVER IN COLUMNS	40	MM

### **5.5 Placing**

- 5.5.1 Reinforcement intended for contact when passing each other shall be securely tied together with binding wire.
- 5.5.2 Binders and stirrups shall tightly embrace the longitudinal reinforcement to which they shall be security bound or spot welded.
- 5.5.3 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.

## **6.0 WATER PROOFING**

### **6.1 Description of work**

- 6.1.1 Extent of water proofing work is shown on drawings.
- 6.1.2 Install slurry type waterproofing to top surfaces of balcony slabs and external surfaces of underground concrete work.
- 6.1.3 Install crystalline type water proofing to underground water tanks and roof slabs in strict accordance with the approved manufacture's printed instructions.

### **6.2 Materials**

- 6.2.1 Crystalline Type: Material used shall be a cementitious coating containing catalytic chemicals which migrate in to the concrete using moisture present in the concrete as the migrating medium, and which cause the moisture and the un-hydrated cement in the concrete to react causing the growth of non-soluble crystals of dendritic fibers in the void and capillary tracks of the concrete that allow passage of water, there by rendering the concrete itself water proof.
- 6.2.2 Acceptable products: Xypex concentrate, modified, ultra-plug and quick set as manufactured Xypex chemicals (Canada) Limited (or equivalent).

### **6.3 Storage of materials**

- 6.3.1 General: All materials shall be stored in original undamaged containers with manufactures seals and labels intact. Material shall be stored off the ground in a dry enclosed area.

### **6.4 Surface preparation**

- 6.4.1 General: All surfaces shall be examined for form tie holes and defects such as honeycombing, rock pockets, cracks, etc. These areas shall be repaired in accordance with these specifications and the manufactures printed instructions.
- 6.4.2 Concrete finish: concrete surfaces shall have an open capillary system to provide tooth and suctions shall be clean; free from scale, excess form oil, laitance, curing compounds and other foreign matter.
- 6.4.3 Smooth surfaces or surfaces covered with excess form oil or other contaminants shall be washed lightly sandblasted, water blasted, or acid -etched with muriatic acid, as required to provide a clean absorbent surfaces.
- 6.4.4 Horizontal surfaces shall not be troweled or power - troweled, and shall be left with a rough float finish or a broom finish. Vertical surfaces may have a sacked finish. Comply with manufactures specifications for requirements pertaining to minimum 'age' of concrete deck surface scheduled to receive water proofing.
- 6.4.5 Surface moisture: Water proofing shall be applied to 'green' concrete as soon as possible after forms have been stripped or to older pours which have been thoroughly moistened with clean water prior to application. Free water shall be removed prior to application.

Mixing of crystalline water proofing compound: comply with manufactures specification for 2-coat installation.

## **6.5 Application**

- 6.5.1 General: Apply all materials under the direction of the manufacturer's representative.
- 6.5.2 Construction joints and surface defects: Comply with waterproofing material manufacturer's printed directions in the preparation, and treatment of construction joints and surface defects.
- 6.5.3 Surface application: After all repair, patching and sealing strip placement has been prepared in accordance with manufacturer's recommendations and approved by manufacturer's representative, treat concrete surface with first coat slurry mix of crystalline waterproofing compound.
- 6.5.4 Brushing: Use a short bristle or broom to work the slurry well into the concrete, filling all hairline cracks and surface pores.
- 6.5.5 Second coat: Apply second coat while first coat is still 'green' but after it has reached an initial set, all as recommended by the waterproofing material manufacturer.

## **6.6 Curing**

- 6.6.1 General: Curing shall begin as soon as the waterproofing materials have set up sufficiently so as not to be damaged by a fine spray. Treated surface shall be sprayed three times a day for a three-day period. Allow material to set 12 days before filling the structure with liquid
- 6.6.2 Protect treated surfaces from damage due to wind, sun, rain and temperatures below 35 degrees F. For a period of 48 hours after application, arrange protections to permit proper curing conditions for waterproofing material.
- 6.6.3 Clean up: Remove all surplus materials from the premises and leave all areas broom-clean. In the case of temporary protections remove all such items carefully to avoid damage to treated surfaces. Assemble all such materials and remove from premises followed by broom cleaning as noted.

## **7.0 EMBEDDED DAMPPROOF MEMBRANE**

### **7.1 General**

- 7.1.1 This section deals with laying of flexible sheet as damp proof membranes or has chemical or vapor barriers embedded in the fabric of the building. It does not deal with the weather- proof roof sheeting, or with vapor barriers.

### **7.2 Products**

- 7.2.1 Polythene sheets for under slab DPM: gauge 500, manufacturer and reference to approval.
- 7.2.2 Adhesive tape: A type recommended by the sheet manufacturer.

### **7.3 Workmanship**

- 7.3.1 Manufacturers Recommendations: to be strictly followed for all products and materials. Apply sheets to clean, dry surfaces with all joints sealed to give a completely water proof continues membrane.
- 7.3.2 Polythene Sheet Under-Slab DPM: lay a level bed of fine sand, not less than 13mm thick or as specified to receive membrane.
- 7.3.3 Polythene Sheet DPM: ensure that sheets are clean and dry. Lay single layer loose on base, lap edges 150mm and seal with mastic or adhesive tape.
- 7.3.4 Pipe Etc: where pipe etc. pass through sheeting make junction completely watertight by forming collars fully bonded / sealed to both pipes and sheeting.
- 7.3.5 Project: finished sheeting adequately and prevent puncturing during following work sheet to be covered by permanent over laying construction as soon as possible.

## **8.0     STRUCTURAL STEEL**

### **8.1     Scope**

- 8.1.1     This section shall apply to the work involved with structural steels. All incidental items of structural steel shall be stated in the particular specification.

### **8.2     Materials**

#### **8.2.1     Steel**

- 8.2.1.1             Shape of steel shall be precise and straight and free of injurious scratches and rust.
- 8.2.1.2             All steel sections shall be galvanized sections of strength class 43 A.
- 8.2.1.3             Dimensions of steel section and tolerance of dimension shall conform to standard dimension of steel regulated in ASTM or BS standard.

#### **8.2.2     Bolt**

- 8.2.2.1             Shape of bolt, nut, and washer shall be in accordance with requirement of BS 4190 & BS 3692.
- 8.2.2.2             Quality of bolt shall be SC 43 A.

#### **8.2.3     Welding Rod**

- 8.2.3.1             Arc welding rod shall conform to materials to be welded, and position.

### **8.3     Fabrication**

- 8.3.1     Main fabrication shall be done in workshop unless otherwise specified or approved by the Consultant.
- 8.3.2     Full scale drawing of each section shall be drawn prior to fabrication and checked by the Consultant.
- 8.3.3     Section of each material shall be cut perpendicular to axis unless otherwise specified in the drawing.
- 8.3.4     Saw and angle cutter shall be used for cutting, and cut section shall be free of any noticeable defect.
- 8.3.5     Deformation caused by cutting shall be corrected.
- 8.3.6     Normal temperature or hot drawn process shall do bending process. Steel shall be red heat in hot drawn process.
- 8.3.7     Those directed in the drawing shall be chiseled finish and completely attached. Materials shall be checked for bend, distortion, warp, etc. before fabrication.

## 8.4 Bolt

### 8.4.1 Bolt Hole

8.4.1.1 Spacing of bolt holes shall be as directed in the following table.

Diameter of Bolt	Standard Pitch	Minimum Pitch	End Distance	Edge Distance
12	50	30	30	25
16	50	40	40	30



- 8.4.1.2 Minimum pitch and end distance for lightweight steel shape shall be more than 3 times and 2.5 times a Bolt diameter respectively.
- 8.4.1.3 Diameter of hole shall not be over 0.5 mm larger than bolt diameter. However, for anchor bolt 5mm clearance shall be allowed between bolt diameter and diameter of hole unless otherwise specified.
- 8.4.1.4 Bolt hole shall either be drilled open or reamed after sub punching. Punching can only be permitted for a material thickness less than 13 mm.
- 8.4.1.5 Rolled edge around a hole shall be removed.
- 8.4.1.6 Position of a bolt hole shall be precise so that the center of all holes aligns.
- 8.4.2 Protection against loosening of Nuts
  - 8.4.2.1 Nuts shall be protected against losing by concrete covering, double nuts or other proper means.
- 8.5 Welding**
  - 8.5.1 Welding
    - 8.5.1.1 Welder shall have an authorized qualification in Maldives and approved by the Consultant.
    - 8.5.1.2 Other tests shall be conducted to confirm welder's skill in accordance with type of work.
    - 8.5.1.3 Tack welding shall be carried out by the welder approved by the Consultant.
  - 8.5.2 Welding Machine
    - 8.5.2.1 Arc welding machine shall be alternate or direct current type, which provides sufficient and adequate current.
  - 8.5.3 Preparation
    - 8.5.3.1 Welding shall be done as much downward as possible using a jig such as Rotary frame.
    - 8.5.3.2 Welding rod shall be always kept in a dry area and if necessary, dried by drying equipment.
    - 8.5.3.3 Welding surface shall be free of water, scale or others injurious to welding work. Slag appeared on the created surface in the middle of welding shall be cleaned before starting again.
  - 8.5.4 Fabrication
    - 8.5.4.1 Welding edge shall be smoothed by automatic gas cutting or other proper finishes.
  - 8.5.8 Finishes
    - 8.5.8.1 Surface of welds shall be as smooth as possible and size and length of welds shall not be less than designed dimensions.
    - 8.5.8.2 Reinforcement of weld shall not exceed  $0.1s + 1 \text{ mm}$  (s: Designated size) in fillet welds.
    - 8.5.8.3 Welded parts shall be free of undercut, overlap, crack, blow hole, lack of welds, and lack of weld settlement, rolled up slag or other defects.
    - 8.5.8.4 Crater at the end of bead shall be carefully heaped up and slag, sputter, etc. shall be completely removed after welds.

#### 8.5.9 Safety

8.5.9.1 Safe scaffoldings shall be provided for the field welds work.

8.5.9.2 Welding facilities shall be such that there shall be no electric leakage of electric shock. There also shall be sufficient protection for fire.

8.5.9.3 Electric shock protection device shall be used and also care shall be taken not to get suffocated or intoxicated by gas when welding in small area.

#### 8.5.10 Inspection

8.5.10.1 Welding parts shall be inspected before, during and after welding in accordance with work schedule.

### 8.6 Erection and Field Painting

#### 8.7.1 Erection

8.7.1.1 Erection procedure shall be prepared by the contractor and be approved by the Consultant prior to the erection.

8.7.1.2 Material shall be stored on flat surface in order not to get distortion, twist or other defects. Correction shall be made to those distortions or twisted before erection.

8.7.1.3 Horizontal reinforcement and bracing shall be placed and bolts are temporary tightened as trusses are put up.

8.7.1.4 Connection of materials by bolts, etc. shall be made after distortion on plumb is thoroughly corrected.

8.7.1.5 Temporary bracing or other reinforcement shall be placed to resist wind pressure or other loads erection.

8.7.1.6 When heavy objects are placed on a horizontal element in the course of erection, they shall be reinforced with prior approval of the Consultant.

8.7.1.7 Care shall be taken on all facilities so that there is no accident.

#### 8.7.2 Field Painting

All steel work shall deliver to site unprimed shall be cleaned of impurities, scrapped and wire brushed to remove rust and painted with one coat of priming paint applied by brush.

Steelwork delivered to Site primed shall be cleaned of impurities and damage to the priming paint and made good with priming paint.

Galvanized steelwork to be painted shall be cleaned of impurities. Where rusting has occurred the rust shall be removed by wire brushing and made good with an approved rust inhibitor. The surfaces shall be coated with a mordant solution, washed

with clean water and painted with two coats of priming paint applied by brush.

Steelwork, which is to be concealed shall be prepared and primed as above and shall be painted with two priming coats and one finishing coat of paint applied by brush.

## **8.8 Anchor Bolt**

- 8.8.1 The other methods for movable burying shall be as directed by the Consultant.

## **9.0 MASONRY**

### **9.1 Materials**

- 9.1.1 Material used for masonry and plastering work shall conform to Section 3 - CONCRETE WORKS.
- 9.1.2 Masonry work shall be done with cement bricks or blocks of approved quality unless specified otherwise.
- 9.1.3 The blocks shall be free from excessive amounts of salt or other impurities and shall be inspected and approved by the Consultant.

### **9.2 General**

#### **9.2.1 Execution Drawing**

- 9.2.1.1 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. Execution drawing of block or brick alignment (inclusive of indication for hanging bolt, wood plug and conduit pipe), detail reinforcement, window opening, and other requirement shall be prepared and submitted for the Consultant.

#### **9.2.2 Stake-Board**

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

#### **9.2.3 Transportation and storing**

- 9.2.3.1 Care shall be taken for damage during transportation of materials and any defect of natural finished concrete blocks or bricks shall be rejected.
- 9.2.3.2 Different size of material shall be stored separately and projected from dirt and other impurities.

#### **9.2.4 Curing**

- 9.2.4.1 Any shock or load shall not be applied until concrete mortar or other fills hardened. Corner, projection and top of cement block or brick work shall be protected from rain, dryness, cold, damage and stain by covering.
- 9.2.4.2 Void between blocks or bricks shall not be intruded by rainwater.

### 9.3 Blockwork

#### 9.3.1 Material

9.3.1.1 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 **Solid cement blocks 150 mm thick for external walls and hollow cement blocks 100 mm thick for internal walls**. The average compression strength should be not less than 2.8N/mm<sup>2</sup> and shall comply with physical requirements of ISO 6073: 1981

#### 9.3.2 Horizontal reinforcement for concrete block wall;

9.3.2.1 Horizontal reinforcement shall be provided at end of wall adjoining to concrete column. Reinforcing bar shall be anchored into end block and column.

9.3.2.2 Horizontal reinforcing bar for block wall shall be 6 dia. @ 1000 mm.

#### 9.3.3 Placing Blocks & Bricks

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

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

9.3.3.3 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.

9.3.3.4 In case concrete block wall is attached to structural concrete, block wall shall be placed before concreting structure.

9.3.3.5 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.

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

9.3.3.7 Blocks shall be placed with cavity side under.

#### 9.3.4 Joints

9.3.4.1 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 this joints or removed due to raking of joints shall not be reused.

#### 9.3.5 Lintel

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

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

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

#### 9.3.6 Frame of Opening

9.3.6.1 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.

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

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

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

#### 9.3.7 Piping

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

9.3.7.2 In case electric conduit pipe is placed in cavity of concrete blocks, care shall be taken not to obstruct reinforcing bar, and cavity shall be completely filled.

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

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

## **10.0 PLASTERING**

### **10.1 General**

10.1.1 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.

10.1.2 Cement rendering to floor shall be same as above.

### **10.2 Materials and Storage**

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

10.2.2 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% 0.15mm sifting less than 10%	for first coat for finish coat	for first coat and dubbing out
2.5mm sifting through 100% 0.15mm sifting less than 10%	for finish coat	for second coat

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

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

### **10.3 Mixing ratio**

10.3.1 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

### **10.4 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	8	-	8	4	15

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

## 10.5 Finish

### 10.5.1 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	

## **10.6 General Preparation**

- 10.6.1 Remove efflorescence, laitance, dirt and other loose material by thoroughly dry brushing.
- 10.6.2 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 otherwise.
- 10.6.3 In-situ Concrete Surfaces: Scrub with water containing detergents to ensure complete removal of mould oil, surface retarders and other materials in compatible with coating . Rinse with clean water and allow to dry unless specified otherwise.
- 10.6.4 Organic Growths: Treat with fungicide to manufacturer's recommendations and bush off.
- 10.6.5 Hacking for Key: roughen specified surfaces thoroughly and evenly by removing the entire surface to a depth of 3mm by scabbling, bush hammering or abrasive blasting, clean surfaces by washing and brushing.
- 10.6.6 Smooth Concrete Surfaces: where no keying or mix or bonding agent is specified, wet smooth concrete surfaces immediately before plastering.

## **10.7 External Plastering**

- 10.7.1 Dissimilar Solid Backgrounds for Plastering: where plaster is to be continued without 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.
- 10.7.2 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.
  - 10.7.2.1 Cover the face of the column /beam/ lintel with building paper extending 25 mm on the adjacent background.
  - 10.7.2.2 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.
- 10.7.3 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 otherwise.

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

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

## **10.8 Internal Plastering**

10.8.1 Accuracy of plaster 16mm thick or more: maximum permissible gap between an 1800mm straight edge and any point on the surface to be 3mm.

10.8.2 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.

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

10.8.4 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.

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

10.8.6 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:

10.8.6.1 Plastered rigid sheet and plastered solid backgrounds.

10.8.6.2 Dissimilar solid backgrounds.

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

## **10.9 External Rendering**

10.9.1 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.

10.9.2 Under Coats for hand applied finishes:

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

10.9.2.2 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.

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

10.9.2.4 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 whenever 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.

## **10.10 Metal Mesh Lathing / Reinforcement for Plastered/Coatings.**

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

### **10.10.2 Products:**

- 10.10.2.1 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.
- 10.10.2.2 Wire Ties: Unless other specified, annealed iron, galvanized to B.S 443.
- 10.10.2.3 Clout Nails: galvanized steel or stainless steel nails to B.S 1202: Part 1, table 3.
- 10.10.2.4 Staples: Galvanized steel wire staples to B.S 1494: Part 2.

### **10.10.3 Workmanship**

- 10.10.3.1 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.
- 10.10.3.2 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.
- 10.10.3.3 Wire Ties: twisted ends tightly together, cut off surplus and bend ends of wire away from face of coating.
- 10.10.3.4 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.

## **11.0 CARPENTRY AND JOINERY**

### **11.1 Materials**

- 11.1.1 Timber shall be in accordance with the requirements of BS 1186 'Quantity of Timber and Workmanship in Joinery', Part 1, 'Quality of Timber'.
- 11.1.2 Timber and timber products shall be subject to the inspection and approval of the Consultant.
- 11.1.3 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.
- 11.1.4 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.

### **11.2 Preservation of Timber**

- 11.2.1 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.
- 11.2.2 All rafters, purlins, framing scribe pieces, wall plates, and trusses 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.
- 11.2.3 Treatment shall be carried out after all cutting and shaping is completed.

### **11.3 Hardware**

- 11.3.1 Hardware shall be standard quality and samples shall be submitted to the Consultant for approval.
- 11.3.2 All hinges shall be stainless steel or brass and shall be approved by the Consultant.
- 11.3.3 The dimensions and quality of hardware shall meet the requirements and shall not be rested, deformed or defective.

### **11.4 Dimensions and Finish**

- 11.4.1 All dimensions of timber given are finished dimensions.
- 11.4.2 All elements and others of structural nature, which are exposed, must be machine planed to a smooth finish.
- 11.4.3 All unexposed timber shall be machine planed to a rough finish.
- 11.4.4 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.

### **11.5 Workmanship**

- 11.5.1 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.
- 11.5.2 Timbers containing defects or distortions shall not be used.
- 11.5.3 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.

- 11.5.4 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 connections.

## **12.0    ROOFING**

### **12.1    Scope**

12.1.1    This Section deals with external weather-proof roofing systems.

12.1.2    Section Includes: Fabrication, supply, installation and testing of all roof system

### **12.2    Roof Cladding**

12.2.1    Roof cladding shall be local thatch or equivalent.

12.2.2    Structural support: timber sections as per drawings.

12.2.3    Fastening: No. 12-14x45mm hexagonal head self-drilling and tapping screw seal.

12.2.4    End laps: 200mm and should be sealed with a recommend sealant for pitches below 7 degrees.

12.2.5    Side laps: as per manufacturer's recommendations.

### **12.3    Products**

12.3.1    The roofing shall be local thatch material as approved by Engineer, with color to approval.

### **12.4    Workmanship**

12.4.1    Accessories: Flashing, trims, filler pieces, spacers, tapes, sealant, etc. where not specified to be the types recommended by the sheet manufacturer.

12.4.2    Fastening: Select types and location of fastenings to meet the following requirements.

12.4.2.1        Wind suction loaded: Calculate in accordance with CP 3: Chapter5: Part2, making due allowance for any internal pressure.

- Basic wind speed: 45 m/sec.
- Topography factory S1: 1.0
- Ground roughness, building size and height Factory (S2): as determined from CP3:Chapter5: Part 2, Table 3.
- Statistical factor (S3): 1.0

12.4.3.2        Imposed loads other than wind and maintenance load, 1.5 KN/m<sup>2</sup> concentrated on a 300mm<sup>2</sup> which ever produces the greater stress. Maintenance point load: 0.9 KN concentrated on any 125mm<sup>2</sup>.

12.4.3.3        Dead load: allow for self-weight of sheeting.

12.4.3.4        Roof pitch: as indicated on drawings.

12.4.3.5        Distance between not less than 900mm or as indicated on the drawings.

## **12.5 Fixing**

12.5.1 Quality of Work: Handle and store to preserve surface using clean dry gloves. Do not slide sheets over rough surface or each other. Packs of all sheets must be kept dry in transit and stored clear of the ground under cover to prevent water and /or condensation being trapped between adjacent surfaces. If packs become wet, sheets should be separated, wiped with a clean cloth without delay and placed so that air circulation completes the drying process.

12.5.5 Cutting and drilling:

12.5.5.1 Cuts sheets accurately with clean, true lines and no distortion with a power saw with abrasive cutting disc.

12.5.5.2 Cut openings in sheet for outlets, vent pipes, flues etc. to the minimum size necessary. Reinforce edges of openings with structural members.

12.5.5.3 Drill all holes. Position at regular intervals in straight lines. Holes for primary fastenings to be 1.5mm larger than the diameter of fastening unless self-drilling type is used.

12.5.5.4 Remove burrs, drilling swarf, lubricant, dust and any other foreign matter before finally fixing sheets into position.

12.5.6 Direction of Laying: Lay sheets with exposed joints of side lap away from prevailing wind.

12.5.7 End Laps: to be fully supported.

12.5.8 Sealant:

12.5.8.1 Install to manufacturer's recommendation.

12.5.8.2 Position in straight, unbroken lines parallel to edges of sheets. Placed into corrugations. Do not allow to sag into position.

12.5.8.3 Ensure continuity and effectiveness of seal, especially at corners of sheets.

12.5.8.4 Do not over compress.

## **12.6 Fittings and Features**

12.6.1 Profile Fillers: use where specified and wherever necessary to close off corrugation cavities from the outside and inside of the building. Position on the line of, or above, fastening and ensuring a tight fit and leaving no gaps. Where sealed laps are specified bed profile fillers in sealant on top and bottom surface, but do not obstruct channels for ventilation or condensation drainage.

12.6.2 Flashing Trims: All fittings for flashing / trim shall be as per manufacturers' recommendation and lapped at joints as follows:

12.6.2.1 Vertical and sloping flashing / trims: end lap to be the same as for adjacent sheeting.

12.6.2.2 Horizontal flashing / trims: end laps to be 150mm and sealed.

12.6.3 Gutter: Ensure that gutters are fully supported at each joint and at intermediate position not more than 900mm apart. Fix with spigot ends up the slope and make all the joints fully watertight. Position sheeting to leave a clear width across the gutter of not less than 230mm.

12.6.4 Insulation:

- 75mm thick Rock Wool insulation blanket with aluminium foil backing on both sides laid between purlins at 1000 centers, including wire mesh. Manufacturer and reference - to approval.

## **13.0 FINISHES**

### **13.1 General**

- 13.1.1 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.
- 13.1.2 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.

### **13.2 Manufacturers**

- 13.2.1 All tiles, ceramic or homogenous, for the project shall be manufactured as mentioned on finishing schedule / details drawings. Required brands of tile shall be use only described locations and tile brands shall not change if only approved by consultant.
- 13.2.2 Following brands of tiles shall use for described locations as per finishing schedule / details drawings. All the tiles shall be submitted to Consultant for approval prior to use.
- Niro
  - Cotto
  - Lanka tile
  - White horse

### **13.3 Ceramic and Vitreous Tile Materials**

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

- 13.3.1.1 All tiles for wall installation shall be having cushion edge, impervious, polished or semi-polished porcelain and highly glazed surface. Colors shall be as selected by the Consultant and shall include trimmers, corner pieces, bullnose and all other special shapes indicated or required. All this shall be free from flaws, cracks and crazing.

#### **13.3.2 Floor Ceramic and Vitreous Tiles**

- 13.3.2.1 All porcelain floor tiles should exhibit required texture as indicated or required (polished, semi-polished, no skid or heavy duty) and it should be laid with 3mm groove. Floor tiles shall be specially prepared for floor use but shall have all the qualities of ceramic tiles listed above for wall use.

### **13.4 Flooring**

#### **13.4.1 Vinyl flooring:**

- 13.4.1.1 Marbleized, directional vinyl sheet and tile flooring with extra strong polyurethane reinforcement with a subtle blend of light through to dark tones. All vinyl flooring, homogenous or permanently static dissipative pressed, shall be utilized at specified locations as indicated in the drawing. It shall have the required thickness as indicated in the drawing and shall include coving, cover formers, end cap strip on coving top.

13.4.1.2 Following brands of vinyl flooring shall use for described locations as per finishing schedule / details drawings. All types of vinyl flooring shall be submitted to Consultant for approval prior to use.

- Tarkett (United States of America)
- Objectflor Art and Design GmbH covering (Germany)

#### 13.4.2 Carpeting:

13.4.2.1 Both loop and cut pile plain fiber carpets must meet the requirements of EN 1307 and should be 100% permanent colour polypropylene having a 5mm underlay with imported grippers. It shall include aluminium single side edging and must be soil and stain resistant.

13.4.2.2 Following brands of carpets shall use for described locations as per finishing schedule / details drawings. All types of carpets shall be submitted to Consultant for approval prior to use.

- danfloor (United Kingdom)
- Forbo flooring systems (Switzerland)

#### 13.4.3 Cement Flooring:

13.4.3.1 Thin section cement render (2-4 mm thick per coat) shall be used as cement rendering over bricks and/or blocks to achieve a modern rendered finish and shall possess high water resistance. Following brands of cement render shall use for described locations as per finishing schedule / details drawings. All types of cement render shall be submitted to Consultant for approval prior to use.

- SUPA COAT (Australia)
- Hanson Portland-limestone Cement (Germany)

13.4.3.2 Provision of external cement paving of 450mmX450mmX50mm as well as 75mm interlocking paving as indicated in the drawing for external walkways and car port area respectively. Following brands of paving shall use for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.

- PRIORA MARSHALLS (United Kingdom)

#### 13.5 Wall papers

Provision of acrylic/vinyl coated wall papers on plastered walls with 100mm high timber skirting. The plastered walls must be kept dry before placing wall papers to ensure proper adherence of wall paper to the wall and also aides for future removal. Following brands of wall papers shall use for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.

- Brewster Home Fashions (United States of America)
- Mirage Wall coverings (United States of America)

#### 13.6 Woven Thatch Mat Wall Finish

Wall cladding / finish with 5mm thick woven synthetic thatch mat fixed to 20mm thick exterior plaster finish with 25x25mm timber frame at 600x600mm span.



**13.7 Wood veneer** Wood veneer shall comply with ISO 9001 (Quality Management) and ISO 14001 (Environment Management) and finish up to ceiling level with 100mm timber skirting. Its natural wood surface shall be protected by a proprietary wear-resistant film or coat. Following brands of wood veneers shall use for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.

- Proligna (Prodin-Prodema – Spain)
- Gunlocke (United States of America)

## **13.8 Ceiling**

### **13.8.1 Suspended Ceilings:**

- 13.8.1.1 Suspended aluminium ceilings shall be powder coated with a material, preferably epoxy, polyester or epoxy polyester with the approval of consultant.
- 13.8.1.2 Aluminium concealed clip-in grid ceiling system comprising a “spring T” or ‘A spring” that supports the ceiling tiles. It shall be fixed to and below a primary grid, usually a galvanized channel section as indicated and approved by the Consultant.
- 13.8.1.3 Provision of plain mineral fibre acoustical suspended ceilings with fibres mixed with wet process with a high quality vinyl emulsion paint surface coating.
- 13.8.1.4 Following brands of ceiling types shall use for described locations as per finishing schedule / details drawings. All finishing materials shall be submitted to Consultant for approval prior to use.
  - Technical Metal Industrial Co.L.C.C (United Arab Emirates)
  - Hebei Optimum Construction Materials Co., Ltd (China)

### **13.8.2 Composite Board:**

- 13.8.2.1 Zinc Aluminium Composite board with multi-layer Ti-Zinc treated surface protected by fluorocarboned resin paint FEVE. Following brands of crash rails shall be used for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.
  - Alucobond (Germany)

### **13.8.3 Suspended Flat Ceiling:**

- 13.7.3.1 All interior spaces with suspended flat ceiling with 12mm thick plywood panels under 50x50mm hardwood trellis with emulsion paint finish.
- 13.7.3.2 All toilets or wet rooms with suspended flat ceiling with 12mm thick calcium silicate boards under 50x50mm hardwood trellis with emulsion paint finish.

### **13.8.4 Exposed rafter ceiling:**

- 13.8.4.1 All exposed rafters are finished with woven bamboo matt pasted under 6mm thick plywood panels with clear matt lacquer finish.

## **13.9 Corner Guards**

- 13.9.1 Surface mounted guards consisting of a continuous retainer with Snap-On Acrovyn 4000 cover. Color matched end caps to be provided for both partial and full height applications and shall be approved by Consultant.

- 13.9.2 Following brands of corner guards shall be used for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.
- C/S Acrovyn

### **13.10 Crash Rails**

- 13.10.1 Crash rails shall be 150mm wide and comprise of fireproof PVC plastic acrylic cover with aluminium alloy inner-support.

### **13.11 Partition Walls**

- 13.11.1 Provision of Aluminium Composite board partition wall framed with aluminium extrusion, covered by powder coating. The infill panel shall be laminated glass consisting of two layer of normal glass sandwiched with the underlay polyvinyl butyral (PVB) firm. This shall be provided at described locations as per finishing schedule / details drawings with excellent sound & thermal insulation as well as 100% water proof and resistant to stains.
- 13.11.2 Tempered glass partition walls at described locations as per finishing schedule / details drawings shall be 12mm thick and insulated properly.
- 13.11.3 All laminated phenolic board partition systems shall be impregnated with melamine resin and decorated on both sides. It must be resistant to damage from impacts or stains, including indelible inks and highly durable.
- 13.11.4 Following brands of partition walls shall be used for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.
- Reliance Metal Industries Sdn Bhd (Malaysia)
  - MDP Enterprises (India)
  - Hufcor (United States of America)
  - Ironwood Manufacturing (United States of America)

### **13.12 Mortar Materials**

- 13.12.1 Standard brand of light gray or white Portland cement as specified in drawings/Finishing schedule/ BOQ, conforming to current British Standard specifications shall be used.
- 13.12.2 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.

### **13.13 Cement Color**

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

### **13.14 Waterproofing**

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

### **13.15 Installation Requirements**

- 13.15.1 As far as possible, tile lay out work should be in such a way that no tiles less than half size occur.
- 13.15.2 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.
- 13.15.3 Verify locations of accessories before installing tiles. Work shall be coordinated with plumbing and other trades before starting of tile work.
- 13.15.4 Installation of ceramic and vitreous tile shall be in accordance with manufacturer's instructions.

### **13.16 Floor Tile Installation**

- 13.16.1 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 laying.
- 13.16.2 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.
- 13.16.3 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. Where of correct consistency, the troweled surface readily assumes a smoothed, slickened appearance.
- 13.16.4 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.
- 13.16.5 After bed has set sufficiently to be worked over, trowel or brush a thin layer, 3mm in thickness, of neat Portland cement or special tile adhesive (approved by Consultant) paste over the surface of the back of tile.
- 13.16.6 Do not prepare larger setting bed than can be covered with tile before the mortar sets.
- 13.16.7 Press tile firmly into the bed tapping with wood blocks to obtain firm bedding of total tile area and a smooth top surface.
- 13.16.8 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.
- 13.16.9 Tiles shall be fitted closely around pipes running through walls and floors. Pitch floors to drains.

### **13.17 Wall Tile Installation**

- 13.17.1 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.
- 13.17.2 Setting bed of tiles shall be done with cement slurry or special tile Adhesive (approved by Consultant). The thickness of slurry bed shall be 3mm thick minimum for setting tiles and walls.
- 13.17.3 Installation of tiles shall be in accordance with standards and applicable requirements previously specified for floor tile.
- 13.17.4 Tiles shall be installed in perfect vertical plumb and as per the pattern and joints if shown on drawings

### **13.18 Grouting**

- 13.18.1 Grouting shall not commence for at least 24 hours after placing of tiles.
- 13.18.2 Grout for floor and wall ceramic and vitreous tiles shall be waterproof, neat white Portland cement with dry cement color added as directed by the Consultant. If white grout is selected, cement shall be white.
- 13.18.3 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.
- 13.18.4 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.
- 13.18.5 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.

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

- 13.19.1 The surface of all tiled floors shall be perfectly in level and shall be executed by experienced workers in the field of tile laying.
- 13.19.2 A sample panel of laid tiles of each type shall be approved by the Consultant before commencement of tile laying.
- 13.19.3 Mismatches of colour, 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.
- 13.19.4 Mismatches of colour in tiles installed by the Contractor shall be rejected and shall have to be replaced by the Contractor at his own cost and risk.

### **13.20 Guarantees**

- 13.20.1 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 Documents.

### **13.21 Coral Stone Cladding**

13.21.1 The surface of the exterior wall plastering should be levelled before applying coral stone cladding.

13.21.2 Corals should be cut and adjusted on site to fit corners and edges.

13.21.03 Coral stone to be installed on to the existing exterior plastering with white plastering for aesthetics.

13.21.04 Coral stone cladding to be done by experienced workers.

## **14.0 PAINTING**

### **14.1 Material**

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

14.1.2 All paints and finishes used for the project shall be manufactured by or under license from the following manufacturer;

**Nippon Paints (Japan)**

**Imperial Chemical Industries (UK)**

**Sigma Paints (Saudi Arabia)**

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

14.1.3 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, color of paint and instructions for reducing. Thinning shall be done only in accordance with the manufacturer's directions.

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

14.1.5 Color, luster, color scheme, finish shall be decided by the Consultant after checking sample paint test.

14.1.6 The painting shall be performed by experienced and competent painter.

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

### **14.2 Definition of Terminology**

#### **14.2.1 Surface Sealing**

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

#### **14.2.2 Spot Puttying**

All cracks and depressions shall be filled flush with putty.

#### **14.2.3 Puttying**

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

#### **14.2.4 Spot painting**

Spot puttied area shall be touched up by paint

#### **14.2.5 Touch-up**

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

#### **14.2.6 Drying hour**

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

#### **14.2.7 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.

### 14.3 Paint Finish Symbols

OP	Synthetic resin mix paint finish
VP	Solvent-polyvinyl chloride resin paint finish
EP	Polyvinyl acetate resin emulsion paint finish
AEP	Synthetic resin emulsion paint finish
CL	Clear lacquer finish
EXP	Epoxy resin paint finish
Stipple (OP)	Stippled finish (oil mix paint finish)
Stipple (EP)	Stippled finish (polyvinyl acetate resin emulsion paint finish)

### 14.4 Painting in General

#### 14.4.1 Preparation of Paint

- 14.4.1.1 Mixing: Paint content with pigment shall be thoroughly stirred to make a uniform consistency.
- 14.4.1.2 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.
- 14.4.1.3 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.

#### 14.4.2 Conditions of Painting

- 14.4.2.1 Work shall not be executed in the following situations
  - 14.4.2.1.1 When humidity is above 85%
  - 14.4.2.1.2 When raining or it is forecast
  - 14.4.2.1.3 When dusts are present
  - 14.4.2.1.4 When temperature of surface is high under hot weather and bubbles are likely to develop on the painted surface.
- 14.4.2.2 Conditions of Surface to be painted: Work shall not be executed or proper means shall be taken in the following situations.
  - 14.4.2.2.1 When surface is damp and wet
  - 14.4.2.2.2 When condensation is likely to develop on the surface.
  - 14.4.2.2.3 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.

#### 14.4.3 Performance

Paint shall be evenly and uniformly 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.

#### 14.4.4 Protection

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

### 14.5 Procedure of Painting

#### 14.5.1 Exterior - Surface of Mortar, Plaster and Concrete

AEP- Weather shield Exterior paint

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Dry, clean and free from impurities	
2. Surface sealing	1	Exterior Wall Sealer	As per manufacture's specifications
3. Texture base	2	texture base putty mechanically sprayed uniformly	As per manufacture's specifications
4. Surface finishing		Flatten with masonry trowel uniformly surfaced	
5. First coating	1	Weather shield paint	As per manufacture's specifications
6. Finish coating	2	Weather shield paint	As per manufacture's specifications

Notes:

Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5

Puttying and sanding process shall be allowed to omit depending on the conditions of the surface.

Drying time of putty shall be long enough for sanding to proceed.

Amount of sealer for surface sealing shall be adjusted with direction of the Consultant as it varies with the surface conditions.

#### 14.5.2 Exterior - Iron Products in General

OP - Synthetic resin mix paint

Coating Process	No. of Coats	Type of Paint	Drying hour
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	As per manufacture's specifications
3. Touch-up		Touch-up rustproof oil paint	
4. First Coating	1	Rustproof oil paint	As per manufacture's specifications
5. Second coating	1	Synthetic resin mix paint	As per manufacture's specifications



6. Finish coating	1	Synthetic resin mix paint	As per manufacture's specifications
-------------------	---	---------------------------	-------------------------------------

Note:

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

#### 14.5.3 Exterior - Wood

OP - Synthetic resin mix paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Clean and sand to plane surface	
2. Knot treatment	1-2	Lacquer varnish	As per manufacture's specifications
3. First coating	1	First coat paint of oil mix paint	As per manufacture's specifications
4. Second Coating	1	Oil mix paint	As per manufacture's specifications
5. Finish coating	1	Oil mix paint	As per manufacture's specifications

Note:

Puttying and sanding shall be done after process No.2 when there are cracks, etc. on the surface putty shall be oil-putty, but drying time shall vary depending on conditions.

#### 14.5.4 Interior - Mortar, board, etc.

Stipple (EP) - Polyvinyl acetate resin emulsion paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Dry, clean and free from impurities	
2. Surface sealing	1	Sealer for emulsion paint	As per manufacture's specifications
3. Puttying		Putty for emulsion paint	
4. Grinding		Grind with proper grinding tool	
5. Spot painting		Second coating paint of polyvinyl acetate resin emulsion paint	
6. Second Coating	2	Polyvinyl acetate resin emulsion paint	As per manufacture's specifications
7. Finish Coating	1	Polyvinyl acetate resin emulsion paint for stipple-finish	As per manufacture's specifications

Notes:

Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5

Puttying and sanding process shall allowed to omit depending on the conditions of the surface.

Drying time of putty shall be long enough for sanding to proceed.

Amount of sealer for surface sealing shall be adjusted with direction of the Consultant as it varies with the surface conditions.

#### 14.5.5 Interior - Mortar, plaster, concrete, etc.

##### VP Solvent - Polyvinyl chloride resin paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Dry, clean and free from impurities	
2. Surface sealing	1	Sealer for emulsion paint	As per manufacture's specifications
3. Puttying		Putty for polyvinyl chloride resin paint	
4. Grinding		Grind with proper grinding tool	
5. Spot painting		Solvent-polyvinyl chloride resin enamel emulsion paint	
6. Second Coating	1	Solvent-polyvinyl chloride resin enamel emulsion paint	As per manufacture's specifications
7. Finish Coating	2	Solvent-polyvinyl chloride resin enamel emulsion paint	As per manufacture's specifications

##### Notes:

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

#### 14.5.6 Interior - Mortar, plaster, concrete, etc.

##### EP Polyvinyl acetate resin emulsion paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Dry, clean and free from impurities	
2. Surface sealing	1	Sealer for emulsion paint	As per manufacture's specifications
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	As per manufacture's specifications
7. Finish Coating	1	Polyvinyl acetate resin emulsion paint	As per manufacture's specifications

##### Notes:

- Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5
- Puttying and sanding process shall be allowed to omit depending on the conditions of 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.

#### 14.5.7 Interior - Iron products, steel.

##### OP - Synthetic resin mix paint

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Completely remove rust, moisture, oil and other impurities by sander, cleaner and surface	
2. First Coating	1	Synthetic resin rust-proof. Red lead-type, lead compound-type	As per manufacture's specifications
3. Touch-up		Touch-up rust proof paint	
4. First Coating	1	Synthetic resin rust-proof paint. Red lead-type, Lead compound-type	As per manufacture's specifications
5. Second Coating	1	Synthetic resin mix paint	As per manufacture's specifications
6. Finish Coating	1	Synthetic resin mix paint	As per manufacture's specifications

##### Notes:

- (a) Paint for touch-up painting shall be the same as used for first coat in process No.2
- (b) When oil rust-proof paint is used instead of synthetic resin rust proof, its specification shall conform to No. 5 and No.6.

#### 14.5.8 Floor - Concrete and Mortar

##### EXP - Epoxy resin paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface treatment		Dry, clean and free from impurities	
2. First coating	1	First coating paint for epoxy	As per manufacture's specifications
3. Finish Coating	2	Epoxy resin paint	As per manufacture's specifications

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.

## **15. ALUMINIUM DOORS AND WINDOWS**

### **15.1 Aluminum Doors and Windows**

15.1.1 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.

15.1.2 All frames should 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

15.1.3 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 should be sealed with an approved silicone product, compatible with other sealants and packing used.

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

15.1.5 The tolerances are 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

15.1.6 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).

15.1.7 All surfaces shall have an anodized protective surface layer of minimum 60 Micron thickness.

12.1.8 Glazing shall be done as specified by the Consultant. Glass shall be tinted, 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. but not exceeding 12sq. ft.	6mm
Exceeding 12sq. ft.	> 8mm or as approved by consultant

- 15.1.9 Prior to import and / or purchase of the Aluminum 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.
- 15.1.10 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.
- 15.1.11 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.
- 15.1.12 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.
- 15.1.13 Aluminum 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.
- 15.1.14 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 aluminum Snap-On beading as per detail drawing and instructions. Necessary continuous rubber gaskets of approved make shall be provided.
- 12.1.15 Color for doors and windows shall be approved by the Consultant.

## **15.2 Aluminum louvers**

- 15.2.1 Product data shall be submitted for approval; this shall include specified model and AMCA ratings or equivalent.
- 15.2.2 Contractor shall submit all shop drawings indicating materials, construction, dimensions, accessories, and installation details.
- 15.2.3 Contractor shall submit samples of the product for approval.
- 15.2.5 Louvers shall comply with AAMA specification 2605 "Voluntary Specification for High Performance Organic Coatings on Architectural extrusions and panels", ASTM B244 -68, AAC22A41 or equivalent.
- 15.2.6 Louvers shall be well suited for the design environment (temperature, humidity, and ventilation); i.e., it shall be within manufacturer's recommended design environment limits for optimum results.
- 15.2.7 All louvers shall be installed according to manufacturer's instructions.
- 15.2.8 All units shall be installed plumb, well fitted and securely attached to supporting frames.
- 15.2.9 Delivery of materials to site in shall be in manufacturers' original, unopened containers and packaging with labels clearly indicating manufacturer, material and location of installation.

15.2.10 Materials shall be stored in a dry area indoors and protected from damage in accordance with manufacturer's specifications.

15.2.11 Materials and finishes shall be protected during handling & installation to prevent damage.

### **15.3 Top hung windows, ventilators and side hung doors**

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

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

15.3.3 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).

15.3.4 The shutters of the windows and doors should be assembled with stainless steel pins and nylon washers. Handles shall be anodized aluminium finished to match the aluminium sections and mounted with self-lubricating nylon washers.

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

15.3.6 Windows shall have anodized aluminium handles, color as framing and a latching mechanism securing the shutter to the frame both at the top and bottom.

15.3.7 Required fittings;

12.3.7.1 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.

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

12.3.7.3 Escape doors to have panic bolts assembly with vertical elements concealed in the sill and door closer as in 12.3.7.1.

### **15.4 Installation**

15.4.1 Aluminum 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.

15.4.2 Aluminum 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 weather-proof and to satisfy all other requirements of the Consultant.

15.4.3 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.

15.4.4 All aluminum 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.

15.4.5 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.

- 15.4.6 Repair work shall be identical to the manufacturer's applied finish with regard to gloss, finish and visual appearance. Field touch up of painted aluminum 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.
- 15.4.7 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 aluminum 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.
- 15.4.8 Extreme care shall be taken when cleaning the exterior portion to protect all other adjacent works.

## **15.5 Sealing joints**

- 15.5.1 The Contractor shall ensure that joints are dry and remove all loose material, dust and grease.
- 15.5.2 Joints shall be prepared in accordance with sealant manufacturer's recommendations using recommended solvents and primers where necessary.
- 15.5.3 Adjoining surfaces which would be impossible to clean if smeared with sealant shall be masked.
- 15.5.4 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.
- 15.5.5 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.
- 15.5.6 Excess sealant shall be removed from adjoining surfaces using cleaning materials recommended by the sealant manufacturer, and shall be left clean.

## **15.6 Glass installation**

- 15.6.1 Workmanship shall generally be in accordance with CP 152 and respective British Standards.
- 15.6.2 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.
- 15.6.3 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.
- 15.6.4 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.
- 15.6.5 All mastic is to be neatly struck off to agree exactly with site lines inside and out.
- 15.6.6 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
- 15.6.7 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.



## **16.0 PLUMBING**

### **16.1 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 Project manager.

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 discoloration on fixtures, leaving every part in acceptable condition and ready for use to the satisfaction of the Consultants.

Substitution: Substitutions will only be considered when a product becomes unavailable from the manufacturer due to no fault of the Contractor. The Contractor shall document each request with complete data substantiating that the proposed substitution complies with the Contract Documents. Substitution request must be submitted 30 days prior to commencement of any plumbing works. Only one request for substitution will be considered for each product. When substitution is not accepted, the Contractor shall provide the specified product.

QUALITY ASSURANCE - All pipe, fittings, valves, appurtenances and accessories furnished shall be new and from a current manufacturer. A certificate from the manufacturer stating the materials furnished are new and of a recent manufacture shall be furnished to the Engineer. The Contractor shall also provide the Employer with an affidavit (four copies) from the manufacturer stating that the pipe, fittings, valves, appurtenances and accessories comply with the provisions of these specifications. Certificates that the items comply with the relevant ISO 9000 series for manufacturing processes are also required from the manufacturer

## **16.2 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.

## **16.3 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.

## **16.4 Operating and Maintenance Instructions**

- 17.4.1 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 Project manager, by the Contractor.

## **16.5 Test**

Leak test of plumbing and drain to be completed above ground pressure. 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. Ensure that all installation work related to the pipe network that are to be tested are completed. The Underground pipe works are to be leak tested prior to ground screed laying.

Once the leak tests are completed in portions of pipe networks, underground pressure pipe works are to be pressure tested as whole network unit as per site requirements. Vent pipes to be tested for the purpose of remove trapped in air. Supply water pipe works shall be pressure tested according to their respective utility company. (state the no. of bar and the time duration stated by the utility company).

The water test shall be made in accordance with all local requirement. 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 Project manager. 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.

## **16.6 Work in Common Piping**

### **16.6.1 Material**

- 16.6.1.1 Piping and fitting material shall be uP.V.C, Hard Impact P.V.C. or High Temperature P.V.C. and approved by the Consultant.
- 16.6.1.2 Piping material shall comply with requirements of water supply and sewerage and other relevant authorities.
- 16.6.1.3 Materials for the piping and service requirements shall basically conform to the service pressures encountered.

#### **FOR uPVC Pipes and Fittings:**

- A. Pipes shall conform to ISO-4422 and shall be installed in accordance with the manufacturer's guidelines. All jointing shall be by socket and spigots with sealing rings which shall conform to BS 7874. Solvent welded joints are not permitted. Pipes shall be capable of withstanding ultraviolet degradation and shall incorporate a rodent inhibitor. Pipes shall be furnished in standard laying lengths of 6 m and shall be grey in colour.
- B. Fittings made of uPVC shall conform to BS 4346 and shall be manufactured by heat injection moulding or extrusion machine only. Fittings shall have the same strength as the connecting pipe.
- C. All joints shall be designed to have the same characteristics and strength as the connecting pipe. Unless otherwise specified;
  - 1. joints for underground pipes and fittings 90 mm and larger shall be push in type using rubber gaskets;
  - 2. joints for underground pipes and bends of 63 mm shall be welded using solvent cement;
  - 3. joints for other underground fittings of 63 mm shall be push in type using rubber gaskets;
  - 4. joints for all exposed pipes, and pipes smaller than 63 mm, shall be welded using solvent cement.

- D. For push in joints, the pipes shall have an integral socket end and spigot end. The socket shall be designed by the manufacturer. One neoprene ring shall be furnished for each joint. The neoprene ring shall conform to JIS K6353, BS 2494, ASTM F477, or equivalent.
- E. For welded joints, the pipes shall have an integral socket end designed by the manufacturer. Solvent cement shall conform to ISO 8588:1987 or BS 4346 and shall be mixed in strict accord with the manufacturer's instructions. Any impurities in the cement shall be cause for rejection. Data on the pot life of the cement shall be approved by the Engineer.
- F. Flanged joints shall be made using flange adapters.
- G. Testing of pipes and fittings shall be carried out in accordance with JIS K6741, JIS K6742 or equivalent. Each pipe and fitting shall be tested under an internal hydrostatic pressure of not less than 118 Pa for the duration of 60 seconds. The Contractor shall furnish test certificates of tests carried out for quality control during the manufacture of the pipes in accordance with ISO-4422

H. and Appendices A to E of BS 3505:1986 and shall, if required by the Engineer, undertake such additional tests as the Engineer considers necessary.

- I. PIPELINE IDENTIFICATION - All exposed and/or non-buried pipe, including tubing, galvanized pipe, polyvinyl chloride pipe, GRP and stainless steel pipe, shall be identified by color to show its use function. Color bands of an approved tape type may be used on PVC, and all other pipe not readily susceptible to painted finish. Markers shall be adhesive type with extra strength and suitable for continuous duty at 120°C. All markers shall have a protective silicone film. Both the direction of fluid flow, and the name of the fluid in the pipe shall be stenciled on all pipe at least once every six meters and at every change of direction. Color bands shall be spaced at four meter intervals and every change in direction. The size of the letters and color bands shall be as specified in the table below:

Outside diameter of pipe or covering (mm)	Width of color band (mm)	Height of legend or letters (mm)
10 to 30	25	5
40 to 50	25	15
60 to 150	150	50
200 to 250	150	60
Over 250	150	90

- J. **Testing** - The Contractor shall submit, for the Engineer's approval, details of his proposed methods and program for testing (including details of test equipment) and shall arrange for all tests to be witnessed by the Engineer, or other person appointed by the Engineer. The Contractor shall provide all things necessary for carrying out testing and cleaning including water, pumps, compressors, gauges, piped connections, stop ends, and all other temporary works. Pipelines shall be properly completed and supported before being put under test except as hereinafter detailed. No testing will be permitted until ten days after thrust blocks and other holding down works have been completed. Trenches shall not be left open at joints prior to testing pipelines except in exceptional circumstances and as permitted by the Engineer who may lay down certain restricting conditions. In addition to any tests of individual joints or other interim tests, which may be specified elsewhere, the Contractor shall submit all parts of the pipelines to a final test. Notwithstanding the foregoing, the Contractor

may at any stage of construction, carry out such other tests as he considers desirable to check materials and workmanship on the pipeline but this shall not relieve the Contractor of his obligations to achieve successful tests under the Contract. All water required for testing and cleaning the pipelines shall be treated or raw water, depending on the final product to be carried by the pipeline, and shall be provided by the Contractor at his cost. Potable water shall be used for potable water lines.

- Pressure pipelines carrying liquids shall be pressure tested as specified herein.

Gauges used for testing pressure pipelines shall be either of conventional circular type, calibrated in metres head of water or shall have a digital indicator capable of reading increments of 0.1 metre head. Before any gauge is used, the Contractor shall arrange for it to be checked independently and a dated certificate of its accuracy shall be provided to the Engineer. One additional gauge as above shall be handed over to the Engineer's representative

1. for purposes of verification during testing. Calibration of pressure gauges shall be carried out by the Contractor, at regular intervals, as required by the Engineer.
2. The Contractor should note that since valves cannot be guaranteed to be perfectly drop-tight, testing against closed valves shall not be permitted unless with the written approval of the Engineer. The "open" ends of the pipeline (or sections thereof) shall normally be stopped off by blank flanges, or cap ends, additionally secured where necessary by temporary struts and wedges. No claims whatsoever will be entertained on account of leaking valves, or any other difficulties in closing of lengths of pipework for testing, which shall be entirely at the Contractor's expense.
3. The Contractor shall remain responsible for the care of the works during testing of the pipework. For purpose of interim testing, the pipeline shall be divided into sections. Each section shall be separately tested to the Engineer's satisfaction for deflection and pressure when each section is completed. The Contractor shall submit to the Engineer detailed procedures for performing hydrostatic pressure tests of installed piping, fittings, valves, meters and appurtenances for approval. Procedures for performing hydrostatic pressure tests for each section of pipeline shall indicate:
  - location and capacity of the test pump,
  - test pressure at the pump and at the high and low points in the pipeline,
  - procedures for venting the air from the pipeline,
  - disposing the water after satisfactory testing.
4. Each pipeline or section thereof shall be filled with water and all air removed as far as possible. If permanent air vents are not located at all high points, the Contractor shall install suitable cocks at such points so that the air can be expelled as the line is filled with water. The line shall be filled slowly to prevent possible water hammer. The test pump and gauge shall be connected to the pipeline at a location other than the highest point in the line to facilitate the release of air from the highest point. Pressure in the pipeline shall then be raised steadily up to 1.5 times the working pressure, and maintained at the working pressure for a period of not less than 24 hours, to allow for absorption and achieve conditions as stable as possible for testing. The standing period will commence from the time at which the working pressure was reached successfully, after which all exposed joints shall be carefully inspected for evidence of leakage.

## 16.6.2 Providing Drawings and Manuals

16.6.2.1 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.

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

16.6.2.3 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.

## 16.6.3 Samples

16.6.3.1 The Contractor shall provide samples of all sanitary fittings, pipes and specials man-hole 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.

## 16.6.4 Drawings

16.6.4.1 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.

16.6.4.2 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.

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

16.6.4.4 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.

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

- 16.6.4.6 Should 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.
- 16.6.5 Existing pipes
- 16.6.5.1 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.
- 16.6.6 Spare Parts
- 16.6.6.1 Necessary spare parts of the plumbing equipment for the one (1) year operation shall be supplied by the Contractor.
- 16.6.7 Excavation
- 16.6.7.1 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.
- 16.6.7.2 Should 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.
- 16.6.7.3 In refilling trenches after excavation this should 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.
- 16.6.7.4 Rates for excavation should include for backfilling in consolidated layers where necessary and as directed by the Consultant.
- 16.6.8 Piping
- 16.6.8.1 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.
- 16.6.8.2 Pipe runs shown in the drawings are approximate and intended to indicate the general run and locations only. The exact locations of all pipework shall be determined on Site.
- 16.6.8.3 All pipes, fittings etc. shall be kept closed against moisture and foreign matters when stored at site and during installation.
- 16.6.8.4 All pipes shall be fixed clear of one another and be so arranged as to provide easy access for maintenance and repair.

- 16.6.8.5 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.
- 16.6.8.6 Materials for the piping and service requirements shall basically conform to the service pressures encountered.
- 16.6.8.7 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.
- 16.6.8.8 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.
- 16.6.8.9 Pockets, unnecessary traps, turns and off-sets shall be avoided. When traps or pockets are unavoidable they shall be valved drains.
- 16.6.8.10 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.
- 16.6.8.11 Where pipes are to be laid directly in the ground, bed shall be sufficiently compacted, necessary protection for piping shall be taken.
- 16.6.8.12 Backfill shall be done after the approval of the Consultant in such a manner not to damage the pipe line and shall be restored to the original stage.
- 16.6.8.13 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.
- 16.6.8.14 Pipes, fittings, valves and accessories shall be thoroughly cleaned, both internally and externally before installation and shall be cleaned before putting into service.
- 16.6.8.15 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.
- 16.6.8.16 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.
- 16.6.8.17 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
- 16.6.8.18 Vertical pipe shall be braced at more than 2 point in every story.
- 16.6.8.19 After pipes are laid out and before they are hidden, water pressure should be checked. It should only be hidden after determining there are no problems with the pressure
- 16.6.8.20 Water pipes and waste water pipes should be connected to the sewer systems



## 16.7 Water Supply Work

### 16.7.1 Materials

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

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

- The use and installation of unplasticized PVC pipework shall comply with the relevant provisions of BS 3505. Solvent welded joints and fittings for PVC-U pipes shall comply with the relevant provisions of BS 4346: Part 1. Mechanical joints and fittings for PVC-U pipes shall comply with the relevant provisions of BS 4346: Part 2.

## 16.8 Water Pumps

The specification 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 and Fresh water pump: Flow rate = 60L/min, Head = 70m, Type : End suction Hydro pneumatic pump, 220/440V, 3-Phase, 50 Hz. Alternate and parallel operation. Fire pump: 50L/min, 70m head, Vertical multistage pump with alternative operations.

Water pumps placed should be Grundfos or a pump of that standard. After it is placed it should be shaded and kept accessible in case there is a problem. All the procedures for electricity and water connections should be given to the pump.

## 16.9 Spacing of supports

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

Nominal Dia.	upto 40	more than 50
Space (m)	1	1.

## 16.10 Drainage Work

### 16.10.1 General

16.10.1.1 High Pressure uP.V.C pipe and fittings shall be used for all drainage work including vent pipes.

16.10.1.2 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.

16.10.1.3 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 degrees to the main in all cases.

16.10.1.4 Every toilet should have a gully attached for drainage purposes

#### 16.10.2 Vent stack pipes

16.10.2.1 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.

16.10.2.2 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.

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

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

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

16.10.2.6 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.

### 16.11 Laying of Pipes

16.11.1 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. (11.11)

16.11.1 The trench should be compacted before pipes of septic tank and leach field are placed

16.11.2 Water pipes and sewer pipes should be laid down in accordance to the drawing

## **16.12 Laying of sewer water Mains**

16.12.1 All mains shall be laid on a good solid, bottom to prevent subsidence and consequent fracture.

16.12.2 Mains running under buildings, if unavoidable, shall be completely surrounded by 150mm of concrete.

16.12.3 In case of mains passing through a well, the weight of the latter shall be carried by a lintel or a suitable relieving arches.

All rising mains shall be properly plugged to all wall brackets at regular intervals as given in the drawings.

All mains shall be concealed inside wall as far as possible except for vertical sewer mains, cleaning doors shall be provided in the walls whenever necessary and as directed by the Consultant.

## **16.13 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 pipe line 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.

## **16.14 U.P.V.C Pipes**

16.14.1 Manufacturer's instruction should 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.

16.14.2 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.

#### **16.15 Bends and other Specials**

16.15.1 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.

#### **16.16 Flanged Joints**

16.16.1 All flanged joints shall be made by painting the faces of the flanged with red lead freely and bolting the flanges evenly on all sides. A thin fiber of lead wool may be used in making the joints water tight when facing of the flanges is not true. Rubber insertions may be used with approval. Sewage resistant rubber insertion is to be used for sewer lines.

16.16.2 All joints should be connected properly with Aslon glue or equivalent.

16.16.3 Elbow or T joints should not be used for for drainage. Instead a junction should be kept in the areas where T/Elbow joints were going to be used.

#### **16.17 Support for U.P.V.C Pipes**

16.17.1 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 uP.V.C pipe and support shall be placed on either side of the fittings mentioned above. Molded plastic fitting also should be supported.

16.17.2 Maximum allowable horizontal support distance for uP.V.C are given below.

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

16.17.3 For vertical installation supports, distances shall be doubled.

#### **16.18 Sewer pipes**

17.18.1 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

#### **16.19 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.

#### **16.20 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

#### **16.21 Foot valves and Strainers**

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

#### **16.22 Pressure Reducers**

16.22.1 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.

#### **16.23 Water Meter**

16.23.1 The water meters shall be from FENAKA/MWSC and shall be approved by the consultant before installation.

#### **16.24 Equilibrium Ball Valves**

16.24.1 These should 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.

#### **16.25 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 should 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 gun metal. All tanks to be made fly-proof and to the complete satisfaction of the Consultant. Rates should include for all cutting and waste, bends, taps junctures, cleaning eyes, tees.

#### **16.26 Manholes, Manhole covers and Frames**

Concrete cover slabs or top rings of manholes shall provide a suitable seating for a rectangular cover. The frame shall have a clear opening of 0.61m x 0.61m or alternatively a circular or double triangular cover depending on the type of cast iron manhole cover to be used. The rate for manholes shall allow for such provision. Where the supply of cast iron manhole covers and frames is payable separately the cost of setting, surrounding, painting and materials for same shall be allowed for in the rate for manholes.

Suitable lifting rings, hooks or brackets shall be provided in the precast manhole sections. Box holes shall be separately grouted with 1:2 cement mortar.

The contractor shall supply two manhole keys for each pattern of cover without additional charge over the rate for covers (or manholes).

Heavy duty (grade a) cast iron manhole cover and frames shall be of the double triangular type to bs and having a clear opening of 550mm dia.

Medium duty (grade b) cast iron manhole covers and frames shall be of the circular type having a clear opening of 550mm dia or the rectangular type having a clear opening of 0.61m x 0.61m and confirm to bs. They shall be of the single seal type, the weight of cover frame being approximately 127.00 kgs.

Light duty (grade c) cast iron manhole cover and frames shall be of the doubles seal flat type having a clear opening of 0.61m x 0.61m conforming to bs. Weight of cover and frame approximately 50.75kgs.

All manhole covers and frames shall be supplied, coated with a black bituminous composition and be given two coats of bituminous paint after bedding.

No extra rate is payable for drop and/or junction manholes but piping in and surrounds of drop lines are payable at that relevant rates for s.w piping and manholes.

In drop manholes where the difference in level between the incoming drains and the sewer does not exceed 0.610m in 75mm and there is sufficient room in the manhole, the connecting pipe may be brought directly through the manhole wall, and the fall accommodated by constructing a ramp in the benching of the manhole. The ramp shall be of concrete and finished equal to that of the benches. No extra rate is payable.

#### **16.27 Interceptor Manhole**

16.27.1 All gravity sewer lines should be, connected through an intercepting inspection chamber before connecting to the main sewer line, and the dimensions of the manhole and trap to be in conformity with FENAKA.

#### **16.28 Fixtures and Accessories**

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

1. American Standard
2. Ideal Standard
3. American Briggs
4. Armitage Shanks
5. Cotto
6. Star sanitary ware

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

#### **16.29 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.

Before the final payment is made to the Contractor, he shall submit to the Project manager through the consultant, all As-Built Drawings incorporating the changes made and noted in the marked plans retained by him. The As-Built Drawing incorporating all the changes made and noted in the marked plans

retained by him. The As-Built Drawings shall be prepared on reproducible form  
The Plumbing contractor shall prepare and submit the As-Built Drawings without extra cost to the Project manager.

### 16.30 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 fire protection system at each building shall be provided by the Contractor during the construction period. This shall be of sufficient capacity to put out any fire that may break out at any of the building floors due to construction period. This in addition to temporary fire extinguishers required.

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.

1. There should have a Specs requirement for Testing and Commissioning/Start-up

#### HOT WATER SUPPLY SYSTEM:

The hot water system shall be capable of providing hot water at the locations, in the quantities and at the temperatures required and as specified.

- A. The following central hot water systems shall comply with the relevant provisions of BS 6700:
  1. direct vented system
  2. indirect vented system
  3. direct un-vented system
  4. indirect un-vented system.
- B. Pumped circulation shall be provided in all cases where the natural circulating pressure available is insufficient to circulate the water through the system. Immersed rotor (glandless) type circulating pumps shall be used on primary circuits only. Pumps for boosting or secondary circulation shall be adequately resistant to corrosion. Inlet and outlet connections to a circulating pump shall be fitted with full way valves. Circulating pumps shall be quiet in operation. The circulating pump shall be installed in accordance with the manufacturer's recommendations and space shall be allowed for maintenance and removal. Circulating pumps shall comply with the relevant provisions of BS 1394.
- c. Pipes in hot water supply systems that exceed the maximum lengths given below, shall be thermally insulated in accordance with BS 5422.

Outside diameter of pipes (mm)	Maximum length (m)
12	20
Over 12 up to and including 22	12
Over 22 up to and including 28	8
Over 28	3

- d. All hot water storage vessels shall be thermally insulated so that heat loss under normal operating conditions shall at no time exceeds 90 W/m<sup>2</sup> surface area.

#### INSTALLATION OF WATER STORAGE TANK:

- Where possible and practicable, tanks shall be positioned in locations where they can be easily accessed for inspection, cleaning and maintenance.
- Tanks positioned outside buildings shall be provided with covers and a suitable shade.
- Each tank shall be fitted with a 25 mm diameter outlet for connection to a drain pipe. The outlet shall be flush with the bottom of the tank. The floor of tank shall be laid at a slight fall towards the outlet. A drain pipe and a stop-tap shall be fitted to the outlet. The drain pipe shall be run to a point as detailed in the Project Specification or shown on the Project Drawings.
- Every pipe supplying water to a cistern shall be fitted with a float operated valve or some other equally effective device to control the inflow of water and maintain it at the required level.
- Distribution pipes from tanks shall be connected so that the lowest point of the outlet is not less than 50 mm above the bottom of the tank.
- Connections to distribution pipes feeding hot water apparatus shall be set at a level of at least 25mm above connectors to pipes feeding cold water outlets.
- Hot Water Storage Tank:

Hot water storage tanks shall be constructed in accordance the relevant provisions of BS 843 and the following:

- 1       galvanized steel tanks shall comply with the relevant provisions of BS 417: Part 2 of BS 1565
- 2       copper tanks shall comply with the relevant provisions of BS 699, BS 1566: Part 1,BS 1566: Parts 2 or BS 3198.
- 3       cast iron tanks shall comply with the relevant provisions of BS 1563
- 4       pressed steel sectional tanks shall comply with the relevant provisions of BS 1564.

A cistern type storage water heater incorporating a cold water feed cistern shall be so located that the water heater base is higher than the level of the highest outlet to be served and gives adequate flow at the outlets.

Unless otherwise stated, the temperature of the stored water shall never exceed 65°C.

Every vessel shall be fitted with a thermostat acting on the heat input and in addition, every hot water storage vessel of capacity greater than 150 litres shall be fitted with an automatic control capable of stopping and starting the heat input to the stored water at pre-set times. A pressure relief valve shall be incorporated into the system, be mounted on the top of the tank and be vented to a suitable position.

#### DISINFECTION

- All hot water systems and cold water systems installed shall be disinfected before being taken into use. For installation with more than one cistern, all cisterns shall be cleaned and chlorinated simultaneously as described below.



- All visible dirt and debris shall be removed from the cistern. Then the cistern and distributing pipe work shall be filled with clean water and then drained until empty of all water. The cistern shall be filled again and the supply closed.
  - A measured quantity of sodium hypochlorite solution of known strength shall be added to the water in the cistern to give a free residual chlorine concentration of 50 mg/l in the water.
  - The cistern shall be left to stand for 1 hour. Then each draw-off fitting shall be successively opened working progressively away from the cistern. Each tap or draw-off fitting shall be closed when the water discharged begins to smell of chlorine. The cistern shall not be allowed to become empty during the operation; if necessary it shall be refilled and chlorinated as detailed above. Should refilling be necessary, the cistern and pipes shall be left for a further hour before continuing the disinfection procedure.
  - The tap furthest from the cistern shall be opened and the level of free residual chlorine in the water discharged from the tap shall be measured. If the concentration of free residual chlorine is less than 30 mg/l the disinfecting process shall be repeated.
  - Finally, the cistern and pipes shall remain charged with chlorinated water for at least 16 hours and then thoroughly flushed out with clean water until the chlorine concentration at the taps is no greater than that present in the clean water from the supply main.
- A. All potable water pipes, fittings, valves, meters and appurtenances shall be disinfected by the Contractor, as specified herein, unless otherwise directed by the Engineer. All water and chlorine required for disinfection of pipelines shall be provided by the Contractor at his own expense. Bacteriological testing will be performed by an approved laboratory. The attention of the Contractor is directed to the requirements of these specifications whereby he is responsible for preventing the entry of foreign material of any kind into the pipework. The Contractor shall take extreme care to keep the interior of the pipework free of dirt and other foreign material. If in the opinion of the Engineer, dirt or other foreign material, which will not be removed by flushing, enters the pipework then the Contractor shall clean and swab the interior of the pipework with a five percent sodium hypochlorite disinfecting solution to the satisfaction of the Engineer.
- B. After testing, and immediately before commissioning, all pipelines shall be washed out and disinfected as follows:
1. All mains shall be flushed out with clean water until there is no evidence of foreign matter or color in the waste flushing water
  2. A stock disinfecting solution shall be prepared by mixing, for about 5 minutes, in a clean container, sodium hypochlorite solution (15 percent available chlorine) and distilled water in the proportion of 0.8 litres to 1000 litres water by volume. Stock solutions shall be made up fresh daily;
  3. The main, to be disinfected, shall be filled with potable water at the same time as the stock solution is added through a convenient air valve in such quantities (to be determined by the Contractor and approved by the Engineer) as will result in a final solution containing 50 mg/l free chlorine. Care shall be taken to ensure that the stock solution is added at a constant rate, commencing when water is fed into the main and ending as soon as the main is full;

4. Every main charged with disinfecting solution shall stand for 24 hours, after which a sample shall be taken at a washout valve by the Contractor in the presence of the Engineer, from whom the sampling bottle shall be obtained. If the sample does not show at least 2 mg/l free chlorine, disinfection shall be repeated. If the sample is satisfactory the main shall be emptied, flushed out and filled with treated water and allowed to stand for 1 hour;
5. Two further samples shall then be taken as before, one for a further determination of free chlorine and the other, in a sterilized bottle, for bacteriological analysis. If the free chlorine determination shows more than 4 mg/l free chlorine the main shall be flushed out again. If the bacteriological analysis is unsatisfactory disinfection and sampling shall be repeated until satisfactory results are obtained before the main is commissioned;
6. The Contractor shall provide all equipment, materials and testing apparatus, etc., as may be necessary for the effective disinfection of all pipelines;

Water used for disinfection may be re-used in an adjacent section if the level of free chlorine is again brought to the level specified.

## **17.0 ELECTRICAL INSTALLATIONS**

### **17.1 General**

- 17.1.1 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
- 17.1.2 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.
- 17.1.3 Earthing shall invariably be done in the presence of the Consultant or his representative.
- 17.1.4 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.
- 17.1.5 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 have to be obtained, and see that they are passed by him.
- 17.1.6 The Contractor shall be responsible for all necessary permits, approvals, fees, deposits etc., required to complete the Electrical works in accordance with the Contract.

#### **17.1.7 Scope of work**

- 17.1.7.1 The work consists of furnishing all tools, plants, labour, materials and equipment and performing the internal electrical Works comprising of:
  - (a) Light and power wiring
  - (b) Fans and fixtures
  - (c) Wires and Cables
  - (d) Telephone System
  - (e) Sub- Station Equipments:
  - (f) Distribution Fusegear
  - (g) Earthing System
  - (h) Lightning Protection System
  - (i) Fire Alarm System
  - (j) Air Conditioning System
  - (k) Computer Network Cabling outlet work

#### **17.1.8 Prequalification**

- 17.1.8.1 The Electrification Work shall be carried out only by a licensed contractor authorized to undertake such work under the Maldives Energy Authority

#### **17.1.9 Qualification**

- 17.1.9.1 A licensed Electrical Contractors should have the following qualifications:
  - (a) Must have in his employment a competent Electrical Engineer registered with Maldives Energy Authority
  - (b) Must have in its employment an Electrical Consultant having certificate of competency who will exclusively supervise this work.
  - (c) Must have necessary tools, plant and instruments.
  - (d) Must have adequate experience of similar works.
  - (e) If a contractor does not possess the above qualifications he shall be allowed

to sublet the Work to a competent Sub-Contractor provided an application for his prequalification is made to the engineer for his approval. Decision of the Engineer in this case shall be binding on the Contractor.

#### 17.1.10 Rules and Regulations

- 17.1.10.1 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.

#### 17.1.11 Standards

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

#### 17.1.12 Climatic Conditions

- 17.1.12.1 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%               |

#### 17.1.13 Specifications

The Contractor shall furnish all material and equipment at site, conforming fully to the specifications given herein and to the accepted standards, the Institution of Electrical Engineers and the Maldives Energy Resource Unit.

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 all 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 herein-after.

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.

#### 17.1.14 Submittal

- 17.1.14.1 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.

#### 17.1.15 Approval of Drawings and Data

- 17.1.15.1 The Contractor shall provide detailed electrical drawings, wire diagrams, etc. for all electrical switchgear, fusegear and all other systems etc. for the Consultant to review and approval. Three sets of equipment drawings shall be provided for obtaining approval.

#### 17.1.16 Drawings & Data

- 17.1.16.1 Three sets of drawings and data for each equipment shall be furnished by the Contractor for the Consultant approval before commencement of work. The drawings to be supplied by the Contractor shall be as follows: -
- Electrical Drawings showing: -
- (a) Single-Line diagram
  - (b) Detailed wiring diagram
  - (c) All interconnections
  - (d) Relays, their locations, and internal wiring diagrams
  - (e) Other electrical devices including meter instruments and their wiring diagram

#### 17.1.17 Shop Drawings

- 17.1.17.1 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. Three prints of each shop drawings shall be submitted for obtaining approval. 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.

#### 17.1.18 Spare Parts list

- 17.1.18.1 A list of spare parts required for the one year's operation of each equipment where deemed necessary together with unit price of each part, shall be supplied by the contractor.

#### 17.1.19 Guarantee

The Contractor shall furnish written guarantee in triplicate of the manufacturer for successful performance of each equipment. Such guarantee shall be 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.

#### 17.1.20 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 Project manager. These updated and approved shop drawings depicting clearly all changes and revisions made on site shall be called As-Built Drawings.

#### 17.1.21 Test Reports

17.1.21.1 The Contractor shall be responsible for the submitting the test reports/certificates and get the installation inspected passed by the Maldives Energy Authority

### 17.2 Conduit and Conduit Accessories

#### 17.2.1 Conduit Pipe

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

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

17.2.1.3 The wires running throughout the ceiling and walls should be inside hard conduit.

#### 17.2.2 Conduit Accessories

The use of factory made round PVC junction boxes shall be used and should have nipples to receive PVC pipe with force fit, shall be used for ceiling outlets. The wall type junction box shall also be PVC.

Each junction box shall be provided with one piece cover which shall be fitted on the box with screws.

- 17.2.2.3 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.
- 17.2.2.5 All accessories e.g. boxes, coupling, bends, solid plugs, bushes, reducers, checkouts etc. shall be equal in quality to the specified conduit.
- 17.2.2.6 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.
- 17.2.2.7 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.
- 17.2.2.8 Adequate expansion joints shall be provided in all conduit runs passing across the expansion joints in the concrete slab of the buildings.
- 17.2.2.9 All the free ends of conduit shall be solidly plugged till such time as final and proper terminations are made.

### **17.3 Wires, Cables and Cords**

#### **17.3.1 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 Energy Authority

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

BOQ. Wires used must be 2.5sqmm(7/0.67mm) unicable or a wire of the same standard.

#### **17.3.2 Installation Instructions**

- 17.3.2.1 All wiring shall be continuous between terminations and use of connectors or joints is not be allowed. Spur and tee connections are strictly prohibited.
- 17.3.2.2 Manufacturers recommended lubricant shall be allowed to facilitate pulling of wires. Use of any kind of oil and soap is prohibited.

## **17.4 Wiring Accessories**

### **17.4.1 Switches**

8.4.1.1 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 moulded plastic, one, two, three or four gang with integral built in moulded plastic face plate.

8.4.1.2 Weatherproof switches shall conform to B.S. standard.

### **17.4.2 Switch Socket Outlet Units**

17.4.2.1 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 face plate. Each socket shall have its control switch by the side of it on a common face plate. Thus the complete unit specified in BOQ shall be as switch and a socket outlet unit.

17.4.2.2 All the circuits, sockets, switches, ELCB and MCCB must use Legrand or products in equivalent standards to this.

17.4.2.3 Waterproof sockets must be used for areas which come in contact with water or water motors.

17.4.2.4 All the lights and sockets inside and outside the building must follow the Maldives Electricity Bureau regulations while placing the circuit. (13Ampere with 2 socket- 1 circuit, 15Ampere with 1 socket and one circuit, and for six fans or 6 lights, there must be one circuit placed)

17.4.2.5 Lights should have a circuit of 6 Amperes, and normal sockets should have a Socket of 10 Amperes. Air conditioner and high voltage appliances must have a circuit of 15 Amperes.

### **17.4.3 Fans**

17.4.3.1 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 should be within the limits of +3 dB.

17.4.3.1 Ceiling fans used must be at least 1400mm in diameter and from Usha brand or equivalent to this

17.4.3.2 Exhaust fans used must be plastic

### **17.4.4 Dimmer**

17.4.4.1 The dimmer shall be recessed type as required and shall be approved by



the Consultant.

#### 17.4.5 Fan Hook

The fan hook shall be made of 12 dia mild 5/5 steel rod bent to shape of approved design. It should 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.

### 17.5 Light Fixtures

#### 17.5.1 General

The description of light fixtures is given in the Bills of Quantities, and stated on the Drawings, and all relevant material 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.

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

17.5.1.4 The type of fixtures with manufacturer catalogue reference are given in Bill of Quantities.

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

#### 17.5.2 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 enamelled sheet steel body. It may also be satin brass or aluminium anodised 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.

#### 17.5.2 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 day light, cool day light 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.

17.5.2.5 The starters shall have radio-interference suppressers.

17.5.2.6 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.

17.5.2.7 The louvers of light fixtures shall be made of anodized aluminium and/or moulded plastic. The diffusers shall be made of acrylic perspex.

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

#### 17.5.3 Installation Instructions

17.5.3.1 The light fitting shall be installed according to manufacturer's recommendations or as approved by the Consultant.

17.5.3.2 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.

17.5.3.3 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.

17.5.3.4 All the lights outside the building and in the garden should be in accordance with the drawings with photocell switches placed.

17.5.3.5 Each light should be assigned to a different switch. Each switch should light up one light only.

#### 17.5.4 Main L.T. Switchboard

The L.T. switchboard shall be indoor type, free standing, free supporting, floor mounted, totally enclosed, sheet clad, dust and suitable for operation on 3 phase 4 wire system, 415 v , 50 Hz, AC supply .

The board shall be suitable for installation back to the wall and capable of front attendance. The switch board shall be designed to suit service conditions and ensure security and safety during operation , inspection , operation , cleaning and maintenance.

The switch board shall be designed and tested to IEC recommendations. Each panel shall withstand strain of 2000 volts insulation level for one minute power frequency test.

17.5.4.4 The L.T. switch board shall consist of the following: Maldives Energy Resource Unit incoming panel.  
KWh meters ( To be approved and checked by MEB )  
Out going distribution feeders.

17.5.5 Distribution Feeder Panel

17.5.5.1 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.

17.5.6 Earthing

17.5.6.1 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.

17.5.7 Accessories

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

## 17.6 Testing

The following tests shall be conducted on each completed switchboard.

17.6.1.1 Type Tests  
(a) Temperature rise test  
(b) Mechanical endurance test  
Making/Breaking  
Capacity test

17.6.1.2 Routing Test  
High Voltage  
test

17.6.2 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.

## 17.7 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.

The electrician operating must be someone who has permission from the Maldives Energy Authority Under no circumstances should someone without permission carry put the work.

After electrical connections are placed and wire testing is done, the STELCO certificate copy must be submitted to the consultant and client.

Before materials are bought for electrical wiring, it should be presented to the client and their approval must be obtained

All incoming and outgoing cable connections shall be made from the bottom including E a r t h connections.

## **17.8 Distribution Board**

- 17.8.1 The distribution boards shall be either free standing, cubical type or wall mounting type suitable for recessed mounting. Each distribution board (DB) shall be tropical in design, fully dust and vermin proof and liquid repellent.
- 17.8.2 Distribution box(DB) used must be wall embedded. Under no circumstances should any other box be used
- 17.8.3 After the electrical wiring has been completed, the connection shall be taken from the main switch board to the distribution board. The thickness of the cable shall be approved by the consultant. Hence, the scope of work includes the installation of DB cables, burying of cables and other respective tasks should be carried out.

## **17.9 Telephone System**

### **17.9.1 General**

The design drawings do not show conduit routes and depict only the position of various telephone 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. Three prints of each shop drawings shall be submitted for obtaining approval before commencement of work.

No piece of work shall be allowed to be executed at site without the availability of these approved shops drawings. 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.

The contractor shall furnish and install the type of Telephone outlets approved by Dhiraagu. All the floor mounted telephone boxes shall be concealed in a PVC box with openable cover for easy access.

Both ends of each set of conductors shall be properly identified with durable tags with the same identifications of both ends, at the outlet and the telephone terminal cabinets to facilitate the installations of the telephone instrument in the future and for trouble shooting purposes. Cable used shall be twisted and shielded 3 cables in the office area and the rest as shown in the drawing.

## **18.0 HVAC SYSTEM**

### **18.1. General**

The scope of the project includes the Design check, the Supply, Installation and commissioning of Air Conditioning System (VRV/VRF/ Inverter Units) and mechanical ventilation system for the specified project & as shown on drawings

### **18.2. Basis of Design**

Heat load calculation shall be carried out to work out TR/KW capacities of units and nominal capacity of units shall be based on outdoor conditions being 35.0 Deg C db / 32 Deg C wb  
The capacity of the unit shall be rated in accordance with ARI Standard 210 and shall not be less than the minimum required when operating under the specified conditions. The capacity shall have to be suitably derated to take into account any differences in level between the evaporator blower unit and the remote condensing unit and also the length of refrigerant piping involved.

### **18.3. Regulations and Shop Drawings**

All work shall be carried out in keeping with the rules and regulations of the relevant local authorities and will comply with the latest codes of practice in this field. The minimum capacities, drawings and bills of quantities will serve only as a guide line. The contractor will be totally responsible for the ability of the system to achieve the conditions set out in these specifications, and as such will have to provide shop drawings, for the approval of the Engineer. 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.

### **18.4. HVAC System**

The Air conditioning system shall be a VRV/VRF /inverter system. It shall be composed of Wall mounted/Ceiling concealed/4 - way cassette type indoor units with a distributed refrigerant cycle, electrical components and enclosing cabinets. Ventilation system shall include axial fan, centrifugal fan, cabinet type fan etc, All accessories and appurtenances, spare parts, associated civil and external works required to complete, commission and maintain the systems to the fullest satisfaction of the company with all field and factory testing and inspections as required. Both indoor and outdoor units shall be properly assembled, internally piped, wired and completely suitable in the Maldives climate condition.

### **18.5. Air Conditioning System (VRV/VRF/INVERTER)**

#### **18.5.1. Air cooled- Condensing/compressor unit (Outdoor unit)**

The VRV/VRF/Inverter outdoor unit shall be energy efficient and integrally built multiple type light weight with weatherproof construction suitable for balcony/roof top installation. Air cooled VRF / VRV system working in R410A / R -407C or equivalent refrigerant. The system shall be suitable to operate on 3 phase, 380-415 V, 50Hz AC power supply & shall comprises with multiple no's of inverter, digital scroll/screw compressors, air cooled condenser fan with motor, microprocessor control panel, starter controls for all scroll/screw compressors and condenser fan motors along with internal control and power wiring, cooling coil with internally interconnected refrigerant pipes, charging port and all other required

accessories, & hardware's. The entire unit shall be with weather resistant powder coating paint for withstanding all ambient conditions for continuous outdoor operation.

#### **18.5.2. Concealed type DX Air handling unit**

Air Handling Units complete with, double skin sandwich panel with injected Puf foam minimum density 40-50 kg/cu.m, 40mm thick Panel, 0.6/0.8 GI inner skin & Pre-coated GI outer skin with thermal break aluminium extruded profile, Air Handling Units complete with DX coil, backward/forward curve belt driven/plug type fan, 18G SS drains pan, G4 prefilters & F8 fine filter. All units shall be suitable for 415+/- 10% volts and required lengths of wiring as per site requirement to be included.

#### **18.5.3. Wall Mounted**

The wall mounted unit suitable for wall hang and comprising of DX Cooling coils, blower, electric motor, insulated sandwiched drain Tray, junction box for electrical connections, HDPE washable filter. wall mounted wireless remote control.

#### **18.5.4. Cassette Unit**

The cassette unit suitable for ceiling suspended and comprising of fan, motors, filters, built-in pump, drain pan, cooling coil, supply and return air grilles, fresh air provision, controls and all associated accessories.

#### **18.5.5. Controls**

Entire system shall have Microprocessor Controls. Microprocessor should have Auto Check Function to indicate Piping and cabling errors. Microprocessor should control speed or switching or by pass of Compressors, Condensers, Fans, and liquid management Functions along with the system for proper oil return and stable and safe operation of system.

### **18.6. Refrigerant and Condensate Pipework**

The whole of the condensate and refrigeration pipe lines including gas suction line, all fittings, valve and strainer bodies, flanges, etc., on the refrigeration equipment's shall be insulated with 25mm thick insulation. Thermal conductivity shall not exceed 0.0039 W/M degrees C for a mean temperature of 24 degrees C. All surfaces over which the insulation is to be applied shall be dry and grease free. Exposed pipe work will be provided with two layers of 25mm thick insulation. Suitable weather proof paint as per manufacturer's recommendation shall be applied.

#### **19.6.1. Pipe installation**

- All pipework's shall be so installed and supported so that it is free from excessive stressing due to its own weight and its contents, equipment vibration or movement, and thermal movement.
- Care shall be taken to achieve a neat installed appearance. All pipes and fittings shall be cleaned before erection and free from scales, burrs, sand and other foreign matters.
- Sufficient unions or flange joints shall be allowed for satisfactory removal and reassembly of equipment, valves fittings for inspection or repair.
- All pipes shall be laid to correct fall for venting and drainage. All high sections of pipework where air may collect shall be provided with an automatic air vent and drain provided at low point of horizontal run.
- All open ends of pipework during erection shall be blanked off by a metal or plastic cap.
- All refrigerant and condensate drain pipes shall be coordinated and run-in trucking or pipe tray.
- Maximum pipe length shall be as per equipment manufacturer recommendations
- Aluminium cladding over the insulation for the exposed Pipe work on roof.

### **18.7. Duct work and Insulation**

The Contractor shall provide and install the galvanized sheet steel ductwork, dampers, make all ductwork, unless specifically noted otherwise, of galvanized sheet steel conforming to BS 2989 or ASTM A653A, 653M, G90 (Z275). The galvanizing shall be carefully done and the sheets shall be of such quality that they may be bent flat on themselves with no fracture to the coating or the base metal. Construction

and jointing of ductwork & fittings shall be in accordance with the latest edition of SMACNA Low Pressure Standards. The Contractor shall in all cases ensure that sufficient bracing is provided to prevent sagging, drumming or vibration of ductwork. Volume dampers shall be installed at branch connections to main ducts regardless whether they are shown on the drawings or not.

The Contractor shall provide internally insulated ductwork (except Operation theater) of scrim covered mineral wool of 96 kg/cu.m. density or fiberglass 48 kg/cu.m. density insulation of specified thickness to Engineer's approval. The lining and facing material shall be suitable for velocities up to 12 m/s without erosion of the lining and to the Engineer's approval. Internal insulation shall be sheathed with fire resistant insulation with perforated galvanized iron sheets metal of free area not less than 30% with minimum average noise reduction coefficient of 0.70 between 400 and 2000 Hz to the approval of the Engineer.

#### **18.8. Air Diffusers/Registers/Grilles/Louvers**

All diffusers, grilles, louver and registers shall be supplied completely extruded aluminum factory powder coated. Finish colour shall be to the approval of the Interior Designer. All supply grilles and diffusers will have opposed blade balancing dampers. All will have foam rubber sealing band around the edge to seal to the structure

All diffusers shall be appropriately selected to meet the noise criteria of the space they are serving.

Generally, two requirements are to be fulfilled:

- if the diffusers are spaced far apart, each diffuser shall be selected with acoustic performance to meet the noise criteria of the space.
- if the diffusers are spaced close to each other, group acoustic performance shall be considered for the selection in order to meet the criteria of the space.

All diffusers and registers shall be selected to meet (a) with acoustic performance at least 3dB lower than the criteria of the space they are serving, and 5dB to meet (b)

#### **18.9. Mechanical Fans**

##### **18.9.1. Duct in Line Fans**

In line duct fans, shall have non-overloading characteristics to suit the performance duty specified. In line duct fans, shall be of direct driven type. The fan blades shall be aerodynamically designed, backward/forward curved, constructed of aluminum plate and combining the impeller with the rotor of the external rotor motor. Motors and impeller shall be factory matched and statically and dynamically balanced. Motors shall be suitable for operating in atmosphere of up to 95% and up to 40 deg. C. The fan housing or casing shall be constructed in heavy gauge (1.4 mm minimum) mild steel with paint finish or epoxy powder coating and stored dried, and flanged at both ends for bolting direct to connection ductwork.

##### **19.9.2. Toilet Exhaust Fan**

The fan shall be suitable for wall mounted/ceiling mounting and comprising of Automatic reverse flow shutter, condenser motor with thermal cut-off. The fan shall be energy efficient with low noise.

#### **18.10. Site Testing and Commissioning**

Tenderer shall submit with the tender, a complete proposal with time schedule for testing and commissioning of the air conditioning & ventilation system. The program shall include a trial 77 operation of all main equipment with any necessary adjustments to ensure that the system is working correctly. The Contractor shall provide all instruments and equipment together with commissioning engineers and adequate assistance for carrying out the commissioning and testing activity which shall be done in accordance with the recommendations of relevant Standards. If any portion of the works fails to pass the tests, the Contractor shall, at his own expense carry out such alterations or replacements as are required to the satisfaction of the Engineer. The Contractor shall provide commissioning spares at his own expense.

## **19.CCTV SPECIFICATION**

### **19.1. System Design**

The system shall be designed taking into account following specification, tender drawing and the client requirement by specialist contractor with experience in the trade to provide a high quality uninterrupted CCTV images at each and every viewing points.

The CCTV system shall be capable to handle 512 IP camera streams in 25 frames per second in D1 resolution. IT should be able to handle 1.2 Gbps data throughput. The CCTV system consist of indoor network fixed dome cameras, Outdoor network bullet cameras, pan tilt zoom cameras positioned in the hospital premises. All the cameras streams video to four Network Video Recorders installed in server room. The CCTV control room in ground floor is equipped with dedicated video decoders, monitors and a CCTV network keyboard. The viewing channel changing on monitor, split setup changes & PTZ controlling could be conducted via this keyboard. Any camera shall be viewed in any monitor via keyboard.

The video client software shall be installed in EACS PC in ground floor CCTV room (check EACS client PC configurations, it should match CCTV client software requirements (otherwise provide a CCTV client PC). The image play back & backup shall be conducted via this client PC. The video management server shall manage all user authentication, and video streams with e-map facility.

3m extra cable provision shall be kept inside ceiling for small scale changes. The system should view at highest resolution when single camera is viewed on a monitor. The lower resolution video stream shall be automatically set when multiple cameras are viewed on a monitor. Simultaneous ten client users could be view images simultaneously over the network.

Installer shall provide 30 days of recorded images under D1 resolution, 8 IPS in continuous recording of all cameras. The system shall have provision for expanding NVR storage up to 144TB for each NVR using external storage devices. The NVR should also have provision for RAID levels 0,1,5,6. The system also should have provision for N+1 redundancy of NVRs.

Exact location of cameras shall be proposed by architect. The positions shown are suggested locations in public areas as shown in the drawings.

### **19.2. System Performance Criteria**

The system performance criteria shall follow international agreed standards and local regulations. They shall be, but not be limited, to the following:

1. Live video clarity in real time
2. Achieving record duration
3. PTZ tour programming and tour function
4. Image record water mark testing
5. Play back image via calendrer



### **19.3. General Requirement of CCTV Equipment**

All equipment to be supplied under this specification shall be new and the current model of a standard product of a Manufacturer of record. A Manufacturer of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied.

1. Maintains a factory production line for the item submitted
2. Maintains a stock of replacement parts for the item submitted.
3. Maintains engineering drawings, specifications, and operating manuals and for the items submitted.
4. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the tender issue.

Specifications of equipment as set forth in this specification are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity or performance characteristics of items furnished in the CCTV system. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.

The total CCTV system shall be installed so that the combination of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, hum bars, transients, ghosting, etc.

### **19.4. Regulations and Code of Practice**

It shall be the Contractor's responsibilities to ensure that the whole CCTV system shall comply with all statutory, regulations and requirements of all authorities having jurisdiction over the work.

### **19.5. Testing**

The Contractor shall make all the necessary setting of the equipment after installation. The gain, IPS, resolution, recording channel frequencies of camera shall be adjusted to suit the usage. All settings shall be clearly marked upon final adjustments.

The contractor shall carry out performance tests in the presence of the Engineer with prior approved test methodology which shall incorporate a spectrum analyzer before handing over the system.

## 19.6. Item Specification

<b>CCTV</b>	
<b>Technical Specifications</b>	

### Item: Network Video Recorder

DESCRIPTION			Bidder's Response	Page No.
Make				
Model				
Country of origin				
<b>Features</b>				
System throughput capacity		340 Mbps		
Throughput allocation @ D1 resolution in real time	Live Video	128 channels or better		
	video playback	20 channels or better		
	video forwarding	20 channels or better		
Network		2 x 1Gbps Ethernet(Dual)		
RAID controller		SAS 9260 (6Gb/s per port)		
Maximum storage support		48TB		
Storage		30TB		
Expansion able Maximum total storage		144TB		
Hardware Redundancy		Power supply and fan module redundancy		
Video Compression		H.264, MPEG4		
Video Resolution		1080P / 720P / Megapixel / D1 / 4CIF / VGA / CIF		
Frame Rate		25 fps (PAL)		
Recording Mode		Time and events, alarm, manual trigger, continuous video		
Hard Disk Hot Plug		Support		
Expansion Interface		SAS		
RAID Level		RAID 0, 1, 5, 6		
Rack Mountable		Support		
Certification		CE, FCC		
Accessories		Any required accessory not specifically referred to install/use the equipment		

**Item: Video Management Server**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
Live Video Display with Different Layouts	Support		
Digital Zoom In/Out	Support		
Instant Playback from live view window	Support		
Alarm / Event / Status / Log Management	Support		
Digital Virtual Matrix(Any camera to any monitor)	Support		
E-map support	Support		
Record searching by time, camera number, event, devices	Support		
Archive evidence at local storage / central storage / remote site	Support		
playback modes	8 / 16 / 32 / 64x		
Configurable tours and patrols on workstation monitors or video walls	Support		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item : Network Video Decoder**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
Network	1 Gigabit Ethernet		
Video Compression	H.264, MPEG4		
Display Resolution	1080P / 720P / Megapixel / D1 / 4CIF / VGA / CIF		
Video Split	Full Screen, 2x2, 3x3, 4x4, 6, 8, 9, 13, 16 split screen		
Video Output	4 x HDMI ports to digital display screen		
Certification	CE, FCC		

Accessories	Any required accessory not specifically referred to install/use the equipment		
-------------	-------------------------------------------------------------------------------	--	--

**Item: Video Matrix Controller(CCTV Keyboard)**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
Joystick	3-axis proportional control		
Connection	LAN & USB		
Password Protection	Support		
Camera Functions	Pan/Tilt/Zoom		
	Program and run presets		
	Program and run tours		
Decoder functions	change monitor split matrix		
	Assign any camera to any split screen slot		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item: LED Monitor**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
Video Input interface	HDMI		
Design	Color		
Panel type	Wall Mount		
Resolution	1366 x 768		
Size	24" or better		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item: Outdoor Network PTZ Camera**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
IP rating	IP66		
360° continuous rotation	Support		
True Day/Night (TDN)	Support		
Wide Dynamic Range (WDR)	Support		
High Light Compensation (HLC)	Support		
Zoom	37x		
Resolution	D1		
Presets	50 or better		
Tours	4 or better		
IR beam	100m		
Digital Zoom	OFF / ON (X2 ~ X16)		
Min. Illumination	IR LED ON - 0 Lux IR LED OFF - Color: 0.02 Lux, F1.6 B/W: 0.001 Lux, F1.6		
Focus length	f=3.5 - 129.5mm		
Iris Control	Auto / Manual		
Day/Night	Auto		
Manual Speed	0.1° - 150°/s		
Auto Pan	Continuous		
Dual Streams	Support		
Network Protocols	IPv4, TCP, UDP, HTTP, HTTPS, SMTP, FTP		
Frame Rate	1fps - 25fps		
Power Supply	DC12V		
Certificate	FCC		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item : Network IR Bullet camera**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
IP rating		IP66	
Power over Ethernet		IEEE 802.3af	
True Day/Night (TDN)		Support	
Wide Dynamic Range (WDR)		Support	
High Light Compensation (HLC)		Support	
Resolution		1080P (1920 x 1080),	
IR beam		30 - 40m	
Min. Illumination		IR LED ON: 0 Lux IR LED OFF: Color: 0.02 Lux @ F1.4 B/W: 0.005 Lux @ F1.4	
Focus length		2.8 - 12mm	
Iris Control		DC IRIS	
Day/Night		Auto	
Dual Streams		Support	
Network Protocols		IPv4, TCP, UDP, HTTP, HTTPS, SMTP, FTP	
Frame Rate		1fps - 25fps	
Certificate		FCC	
Accessories		Any required accessory not specifically referred to install/use the equipment	

**Item : Network Fixed Dome Camera**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
Features			
Power over Ethernet	IEEE 802.3af		
True Day/Night (TDN)	Support		
Wide Dynamic Range (WDR)	Support		
Resolution	1280x1024		
IR beam	15m		
Min. Illumination	Color: 0.2 lux @ F1.2; B/W: 0 lux (IR on)		
Focus length	3.3 - 12mm		
Iris Control	DC IRIS		
Dual Streams	Support		
Network Protocols	IPv4, TCP, UDP, HTTP, HTTPS, SMTP, FTP		
Frame Rate	1fps - 25fps		
Certificate	FCC		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item: Power Over Ethernet lightning arrester**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
Features			
Power over Ethernet	IEEE 802.3af		
Connection Method	RJ45 In/Out		
Data Rate	Gigabit Ethernet		
Max Continuous Current	1.5 Amps		
Protection Modes	Line-Ground (All)		
Service Voltage	48V		
Clamp Voltage	72V		

Peak Surge Current	30A/pair		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item: Rack**

DESCRIPTION		Bidder's Response	Page No.
<b>Features</b>			
Type	19" floor standing		
Size	Suitable to install all CCTV room items inside the rack		
Ventilation	Suitable for heat dissipation from rack mounted items		
Finish	heavy gauge steel with baked on paint finish		
Security	Lockable, Two keys		
Free Rack Space	9U		
Accessories	Any required accessory not specifically referred to install/use the equipment		



## **20. PUBLIC ADDRESSING SYSTEM & BACKGROUND MUSIC (PA & BGM) SYSTEM SPECIFICATION**

### **20.1. System Design**

The system shall be designed taking into account following specification, tender drawing and the client requirement by specialist contractor with experience in the trade to provide a high quality audio broadcasting at each and every speaker of the hospital.

The PA & BGM is based on 100V audio system. The all in one digital audio unit (Digital Multi-Audio Player) will be used as a CD/DVD player, FM tuner and USB loaded MP3 file player. There are four paging consoles in three locations to manage public addressing.

The system is based on IP distributed architecture. The Digital Integrated System Manager manages IP audio streams and it delivers the desired audio channels to Power amplifiers connected to it. The power amplifier will drive speakers connected. One backup power amplifier for each Digital Integrated System Manager is available and it should be automatically take over function of faulty power amplifier.

The system should capable to switch any audio source to any speaker zones depicted in the schematic diagram. Further the system should allow creating zone groups which consists with multiple physical zones. For an example, there are several waiting area zones in different floors. The system must be capable to define a global waiting area logical zone and it should be able to call from paging selector. The volume controllers should be overwritten during paging. The zones and logical zone groups could be selected from paging console.

The fire alarm panel should provide three dry contacts. One is to broadcast "Fire Alert Message" the second contact is to broadcast "Fire Evacuation Message", third is to broadcast "All clear Message". Predefined zones will receive corresponding messages on activation of dry contact. The volume controllers should be overwritten during message broadcasting.

The power amplifier wattages shall be selected according to the total speaker load it drives. 20% power margin should be kept in every power amplifier. The volume controller's wattage must be equal or greater than that of the total speaker load it handles. It is PA & BGM installer's responsibility to cable up to the fire alarm panel for integration.

### **20.2. System Performance Criteria**

The system performance criteria shall follow international agreed standards and local regulations. They shall be, but not be limited, to the following:

1. The required sound pressure level shall be 70 dBA.
2. STI shall be greater than 0.45

### **20.3. General Requirements of PA & BGM Equipment**

All equipment to be supplied under this specification shall be new and the current model of a standard product of a Manufacturer of record. A Manufacturer of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied.

1. Maintains a factory production line for the item submitted.
2. Maintains a stock of replacement parts for the item submitted.
3. Maintains engineering drawings, specifications, and operating manuals and for the items submitted.
4. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the tender issue.

Specifications of equipment as set forth in this specification are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity or performance characteristics of items furnished in the PA& BGM system. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.

The total PA & BGM system shall be installed so that the combination of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, hum bars, transients, ghosting, etc.

### **20.4. Regulations and Code of Practice**

It shall be the Contractor's responsibilities to ensure that the whole PA & BGM system shall comply with all statutory, regulations and requirements of all authorities having jurisdiction over the work.

### **20.5. Testing**

The Contractor shall make all the necessary setting of the equipment after installation. The power tapping of each speaker shall be adjusted to suit the usage. All settings shall be clearly marked upon final adjustments.

The contractor shall carry out performance tests in the presence of the Engineer with prior approved test methodology which shall incorporate a spectrum analyzer before handing over the system.

## 20.6. Item Specification

<b>MATV</b>	
<b>Technical Specifications</b>	

### Item :Digital Integrated System Manager

DESCRIPTION			Bidder's Response	Page No.
Make				
Model				
Country of origin				
<b>Features</b>				
Input	Amplifier interfaces	4 or better		
Ethernet interfaces	Ethernet speed	10 M / 100 M		
	Number of Ethernet interfaces	4 or better		
Output	100V line dry contacts(Output channels)	4 or better		
	circuit fault detection function	Available		
	Max. output load	500W or better		
	Monitoring loudspeaker	Available		
Storage space to upload audio files		1 GB or better		
Ability to store voice file & play via paging console		Available		
Ability to store voice file & play via BGM software		Available		
Ability to play message when trigger input is activated in designated zones		Available		
Run designated audio file in predefined recurrent schedule in predefined zones		Available		
Power supply		~100 - 240 V,50/60 Hz		
Operating Temperature		-10 °C ~ +55 °C		
Humidity		< 95 %, non-condensing		

Certifications Voice Alarm	EN 54 (Part 16)	Available		
Certifications Safety	CE	Available		
19"Rack mountable		Available		
Control parameter memory		Retains after power off conditions		
Accessories	Program	Software base full configuration with		
		Any required accessory not specifically referred to install/use the equipment		

**Item: Power Amplifier**

DESCRIPTION			Bidder's Response	Page No.
Make				
Model				
Country of origin				
<b>Features</b>				
Audio signal input	Ethernet	Available		
ventilation		forced air cooling fan		
Fault detection	overheat	Available		
	overcurrent	Available		
	overvoltage	Available		
	under voltage	Available		
Audio outputs		100V		
19"Rack mountable		Available		
Power supply		~ 220 - 240 V, 50/60 Hz		
Operating Temperature		0 °C ~ +40 °C (0 ~ 104 °F)		
Humidity		< 95 %, non-condensing		
Safety Certifications	CE	Available		
Available nominal power output (capacities))	500W	Available		
	250W	Available		
	125W	Available		
Accessories		Any required accessory not specifically referred to install/use the equipment		

**Item : Digital Multi-audio Player**

DESCRIPTION			Bidder's Response	Page No.
Make				
Model				
Country of origin				
<b>Features</b>				
Inputs/sources	DVD player	Available		
	USB	Available		
	SD	Available		
	Mp3 file	Available		
	FM/AM tuner	Available		
	DVD videos	Available		
Output	Stereo RCA	Available		
Band frequency range (FM)		FM : 87.5MHz ~ 108MHz		
Band frequency range (AM)		AM : 531KHz ~ 1710KHz		
Antenna input impedance		FM:75Ω		
Power supply		~ 230V 50/60Hz		
Accessories		Any required accessory not specifically referred to install/use the equipment		

**Item: Network Resource Interface**

DESCRIPTION			Bidder's Response	Page No.
Make				
Model				
Country of origin				
<b>Features</b>				
Auxiliary input	No. of Channels	4 or better		
	S/N	> 85 dB		
Trigger inputs	No. of Channels	8 or better		
Audio Storage		4 GB SD card 500 MB Flash		
Power supply		~ 220 - 240 V, 50/60 Hz		
Operating Temperature		-10 °C ~ +55°C		
Humidity		< 95 %, non-condensing		
Ability to store voice file & play via paging console		Available		

Ability to store voice file & play via BGM software	Available		
Ability to play message when trigger input is activated in designated zones	Available		
Run designated audio file in predefined recurrent schedule in predefined zones	Available		
Accessories	Any required accessory not specifically referred to install/use the equipment		

### **Item: Ceiling Speaker**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
IP Code	IP54		
Rated power	6 W		
Power taps @ 100 V	6 W / 3 W / 1.5 W		
SPL at 6 W / 1 W (120 Hz-18 KHz, 1 m)	97 dB / 89dB		
Material	ABS		
Frequency range(-10 dB)	80 Hz - 20 KHz		
Dispersion angle (1 KHz / -6 dB)	184 / 90		
Certification	CE		
Accessories	Any required accessory not specifically referred to install/use the equipment		

### **Item: Wall Speaker**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
Rated power	15 W		
Power taps @ 100 V	15 W / 5 W / 3W		

SPL at 10 W / 1W ( 2k Hz, 1m)	87 dB		
Material	ABS		
Frequency response ( - 10 dB )	20 Hz - 20k Hz		
Dispersion angle	H : 90° - V: 90°		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item : Horn Speaker**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
Rated power	30W		
Power taps @ 100 V	10 W / 20 W / 30W		
SPL at 1W ( 2k Hz, 1m)	98 dB		
Material	Horn cover	ABS	
	Bracket	Stainless steel	
Frequency response	120 Hz - 15k Hz		
IP Code	IP65		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item: Network Paging Console**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
LCD	4.3-inch color		
	touch screen		
Microphone	gooseneck		
Communication			

	TCP/IP		
Built-in monitor loudspeaker	Available		
MIC Frequency response	80Hz~16KHz		
Power supply	DC 12V / 24V		
Operating Temperature	-10 °C ~ +55°C		
Humidity	< 95 %, non-condensing		
Accessories	Any required accessory not specifically referred to install/use the equipment		

#### **Item: Volume Control**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
Rated power available	6W / 30W/ 60W/ 120W		
24V DC forced override relay	Available		
wire systems	4 wire		
Size	standard 86 × 86 electrical back box		
Accessories	Any required accessory not specifically referred to install/use the equipment		

#### **Item: System Management Software**

DESCRIPTION		Bidder's Response	Page No.
Make			
Model			
Country of origin			
<b>Features</b>			
Network Display	Display as a visual map		
Device status monitoring	Available		
Event logs			



	Available		
Fault logs	Available		
Backing up the system data	Available		
Schedule playback configuration	Available		
Logical Zone groups	Available		
Accessories	Any required accessory not specifically referred to install/use the equipment		

**Item : Rack**

DESCRIPTION		Bidder's Response	Page No.
<b>Features</b>			
Type	19" units mountable		
Size	Suitable to install service duct equipment		
Ventilation	Suitable for heat dissipation from rack mounted items		
Finish	heavy gauge steel with baked on paint finish		
Security	Lockable, Two keys, Fire rated		
Free Rack Space	9U		
Accessories	Any required accessory not specifically referred to install/use the equipment		

## **21. FIRE DETECTION AND PROTECTION SYSTEM**

### **21.1. General**

This section outlines the minimum acceptance standards for equipment and materials which are to be provided. Any deviation therefrom or alternative offer of materials must be approved by the Architect prior to placement of orders.

Minor equipment and materials not specified herein shall be provided in accordance with the best trade practice.

### **21.2. Standards & Codes**

Fire Detections & Protection System should comply with following standards.

- Fire extinguishing systems - BS EN 3.
- Foam fire protection system - BS EN 13565.
- Fire extinguishing installations and equipment's - BS 5306
- Fire Detection and Fire Alarm System - BS EN 54-20
- Fire Hose reel system - BS EN 671-2011
- Fire Wet riser system - BS 9990:2006

The Supply, installation and commissioning of the Fire hose reel system and wet riser system shall be in 100% compliance to British Standard excluding requirement of fire Engine in addition to their compliances to relevant Local Authority Fire Department Regulation. Pipes should be sized using hydraulic calculation method in accordance with the recommendations of BS-EN-12845.

The development has all its common areas protected by an automatic fire alarm system. Manual break glass and alarm bell will be provided to all floors. All fire alarms will be monitored by the main fire panel in the Fire command center. Mimic-panels will be provided on every lift lobby with the ability to interconnect with the main and other sub-panels to form a loop control in ensuring its reliability

- Do not use firefighting water pipes to supply water for other purposes.
- Support horizontal pipes at intervals not exceeding 3 m.
- Support vertical pipes at every floor.
- Install hangers without regard to location of pipe sleeves through walls. Center pipes in sleeves and do not use sleeves for pipe support. Attach to concrete ceilings with expansion bolts.
- Fire pump relief valve, when required, should be piped back into the suction, except where on-site storage tank is available.

### **21.3. Technical Specification for Wet Riser/ Fire Hose Reel System**

#### **21.3.1 Scope of Work**

The System shall comprise of the following works to provide fully operational system: -

- 100 mm dia. Wet riser piping, valves including pressure regulating valves, canvas hose, hose cradle, coupling and nozzle, Pressure reducing Valves, Fire Hose reels.
- 4-way breeching inlet connected to the fire riser.

The installation shall be complete in every respect, including all fittings, materials and accessories necessary for the complete functioning of the system.

### 21.3.2 Piping Materials

Unless otherwise specified, all pipes used shall be hot dipped galvanized wrought steel pipes to BS EN 10255, Heavy Duty. All piping shall be new and free from defects. The pipe fittings shall be malleable iron and wrought iron galvanized conforming to the following British Standards:

- B.S 143 Malleable C.I Pipe Fittings
- B.S 1256 Malleable C.I and Cast Copper Alloy Pipe Fittings
- B.S 1740 Wrought Pipe Fittings.

Pipe joints shall, except otherwise indicated, be screwed and socketed joints. Welded joints shall not be used. All screw threads shall be made up to full depth of the socket and shall be cleaned and square with the axis of the pipe bore. Only Teflon or equal approved P.T.F.E thread sealing tape shall be used in jointing. Hemp or similar organic substances shall not be permitted.

An all piping, bends shall be long radius bends with turning not less than five time the pipe diameters. If this cannot be achieved, alternative bends of approved type shall be used.

Reduction in the diameter of through-flow pipes shall be by means of reduction sockets. Eccentric reducing sockets shall be used on horizontal pipes and concentric reducing sockets on vertical pipes only.

### 21.3.3 Hose Reel Assembly

The hose reel assembly shall be of either fixed or recessed swing-out type as indicated, being suitable for swift withdrawal of the hose in any direction.

Each hose reel assembly shall consist of a rubber hose, a metal reel, a stop valve, a hose guide and nozzle. The whole hose reel assembly is permanently connected to the water supply.

The reel shall be of metal construction of not less than 8 in. (200mm) inner case diameter and not more than 30 in. (750mm) rim diameter. It shall extend not more than 18 in. (450mm) from the wall or mounting surface. The side plates shall extend at least 1/2 in. (12mm) radially beyond the wound-up hose. The Overall width of the reel should be no more than 850mm. The overall height of the reel should be less than 850mm including Hose and Integral Flexi guide for hose withdrawal guide. The overall depth of the Hose reel should be no more than 150mm. Color of the Reel should be red, fitted with operating instruction plate.

The hose shall be of non-kink smooth bore construction, conforming to the specifications of BS 3169 and rated for a bursting pressure of not less than 600 psi (4.14 MPa). The nozzle assembly shall be constructed of gunmetal, brass or other sufficiently robust and corrosion- resistant material. The nozzle shall be permanently marked to indicate the open and shut position. Product should be UL listed or FM approved.

The whole of the hose reel assembly shall rotate on the horizontal axis and the water supply connection to the hose shall be arranged such that the hose is not obstructed or kinked when the hose is wound up. The piping from the stop valve to the hose reel shall be of non-ferrous material or galvanized.

Wherever necessary, a pressure reducing valve or orifice plate shall be provided for the hose reel for controlling the static pressure to within 18-30 psi (0.12 - 0.2 MPa). The nozzle shall be adjustable for spray and jet discharge.

Every hose reel assembly shall bear the name of the manufacturer and the instructions for operation. Where hose reels are located in recesses or in non-prominent positions, a notice bearing the words "FIRE HOSE REEL" in red letters on a white background shall be provided. Hose reels shall be provided with recessed housing.

#### 21.3.4. Breeching Inlets

The breeching inlet shall be of 4-way breeching in connections. Each inlet shall consist of a 2 1/2 in. (65mm) instantaneous male coupling and back pressure valve and protected by a cap secured with a suitable length of chain. A drain of 1 in. (25mm) diameter complete with drain valve shall be fitted at the lowest points of the riser. Product should be FM approved or UL Listed.

All fittings shall be located on the external wall of the building at ground level to the approval of the Local Fire Brigade and enclosed in a glass-fronted box.

Breeching inlet shall be of types approved by Fire Authority.

The door of the box containing the inlets shall be glazed with wired glass as indicated by the words " DRY RISER BREECHING INLET" painted on the inner face of the glass in 2" (50mm) block letter. It shall be fastened only by means of a spring lock which can also be operated from inside without the aid of a key after the glass have been broken.

The size of the inlet box shall be 22" x 22" x 12" (560mm x 560mm x 305mm) deep with a fall of 1" (25mm) towards the front at the base.

#### 21.3.5. Pressure Regulating Landing Valves

Each landing valve shall be Constant Outlet Pressure Hydrant type and 65mm bore gunmetal with flanged of B.S.P screwed inlet, and 65mm instantaneous female coupling outlet fitted with removable plug secured by a chain. Product should be FM approved or UL Listed.

The valve shall be supplied with a 65 mm bore renewable valve washer for screw down valve and 20mm minimum diameter spindle and 165mm diameter hand wheel.

It shall withstand a test pressure of 300 psig (20.7bar) and be marked with Manufacturer's Name. Landing valves shall be installed between 0.90m and 1.07m above level at the Riser Duct as shown in the accompanying drawing. They shall be installed such that ample clearance is allowed for easy insertion of canvas hose coupling.

Landing valves shall be normally kept in closed position by leather or canvas strap secured by padlock. All padlocks shall be operable by a master key.

#### 21.3.6. Hose

The canvas hose shall be 2 1/2" (65mm) diameter and 30 m/45 m in length capable of withstanding a test pressure of 150psig. The canvas hose shall be of an approved type to the requirements of the local Fire Brigade & product should have UL Listed & FM approved.

#### 21.3.7 Nozzle

The nozzle shall be of approved jet/spray type.

#### 21.3.8 Couplings

Couplings shall be of gunmetal or other corrosion resisting material, which is sufficiently robust to withstand rough treatment.

#### 21.3.9 Air Release Valve

Approved type automatic air release valve shall be provided at the highest point of every main riser to allow air in rising main to discharge to the atmosphere when water is being pumped in. Each air release valve shall be complete with an isolating valve and piped to the nearest drain or waste.

#### 21.3.10 Pressure Relief Valve

A pressure relief valve shall be provided on a branch off the pump discharge before the non-return valve with the outlet piped to discharge over the suction tank.

#### 21.3.11 Test Pipe

A test pipe branch with valve shall be taken from the discharge pipe, after the non-return valve assembly, and extend to discharge over the suction tank.

#### 21.3.12 Earthing

The rising mains shall be electrically earthed to the external of the building. Earthing resistance shall not exceed 1 ohms.

#### 21.3.13 Calibration

Each landing valve shall be separately adjusted to deliver water in accordance with Local Fire Department requirements.

#### 21.3.14 Testing

The complete installation shall be tested hydraulically to one and a half times the working pressure measured at the base. The pressure shall be maintained over 24 hours and shall not drop more than 5% after correction for temperature.

#### 21.3.15 Wet Riser Pumps

GENERAL REQUIREMENTS Pumps shall consist of:

- Casing impeller
- Suction and discharge connections
- Driven shaft
- Couplings
- Motor
- Shaft seal

(Pumps shall be complete with shaft water seals).

The motor terminal box shall be suitable for flexible conduit connection. Installations shall comprise:

- I. Eccentric reducers for suction pipes and concentric reducers for discharge pipes
- II. Expansion pieces directly connected to the pipe connection
- III. Vibration isolation equipment
- IV. Gland drain and tail pipes arranged to discharge into an open tundish adjacent to the pump base
- V. Support brackets or plinths incorporating anti-vibration material.

Pumps and supplementary assemblies shall be entirely suitable for the systems pressures and temperatures specified in Drawings or Bill of Quantities.

Gate valves shall be provided on suction and discharge. Strainers shall be fitted on the inlet unless otherwise specified. Final pump duties shall be verified taking into account certified resistances of system components. Unless otherwise specified, pumps shall be to:

- I. BS 1394: Parts 1 and 2
- II. BS 4082: Parts 1 and 2
- III. BS 5257

Pump duties shall be achieved with the impeller shaft speed not exceeding 48rev/s (2900rpm) unless otherwise specified. Where duty and standby pumps are required, provision for automatic changeover shall be made with non-return valves fitted in each pump discharge line.

Pump connections shall be screwed to BS 21 up to DN 50 and flanged to BS 4504, PN 16 for DN 65 and above. Pump suction and discharge flanges shall be drilled and tapped for pressure gauge connections. Closing plugs shall be supplied.

Pump casings shall have drain plugs fitted at the lowest point. Direction of rotation shall be indicated. All drive connections between drivers (motor or engine) and pumps shall be fully protected against accidental contact. Provision shall be made for shaft speed measurement.

Each pump shall be furnished with splash guards where applicable. Pumps shall be correctly aligned before start-up. Tied bellows type flexible pipe couplings shall be installed at all pipework connections to pumps. No pump load shall be imposed on the connecting pipework.

Impellers and couplings shall be keyed to the drive shaft; the impeller being retained by a hexagonal nut. Shafts shall be fitted with water deflectors.

### 21.3.16 MATERIALS OF CONSTRUCTION

Pump Component	Cast Iron	Stainless Steel	High Grade Gun- Metal	Phosphor Bronze
Casing	x			
Seal Housing	x			
Baseplate	x			
Sub frame	x			
Shaft		x		
Impeller			x	
Renewable Casing				
Wearing Rings				x
Glands shall be fitted with a self-adjusting mechanical seal unless otherwise specified.				
Impeller shaft extensions shall have a liquid shield.				

Generally, materials used for construction shall be:

- I. Pump casings: close grained cast iron
- II. Impellers: cast iron or gunmetal (bronze)
- III. Shafts: stainless steel.

The permissible service pressure of cast iron pump casings shall be generally in accordance with the manufacturer's recommendations. No pump part or component part shall be subjected to a gauge pressure in excess of 16 bar, except where specifically listed in the Equipment Data Sheets.

### 21.3.17 PUMP OPERATION

#### 21.3.17.1 END-SUCTION CENTRIFUGAL PUMPS

The pumps shall be selected to suit the type of service encountered. End covers, body rings, bearing, housing and casing shall generally be of cast iron construction. Impellers shall be of bronze or gunmetal and shafts of stainless steel. Case sealing rings, intermediate bushes and water lubricated journal bearings shall be of phosphor bronze material. Shaft seal shall be of high quality gland packed type and bearings shall be ball thrust type on the outboard and self-aligning ball bearing type on the inboard end.

Pump casing shall be axially split or back pull type to permit removal of impeller without disturbing the piping connections. Each pump shall be fitted with an air valve, grease lubricator, water shaft seal connection, copper gland drain fitting and tapping's in the pump head casing for discharge pressure gauge. Proper drainage shall be provided for all points around the pump set mounting. Copper gland drain shall be piped to the nearest drain or waste.

The pumps shall be constant speed with the pump driver coupled directly to the pump and the whole mounted on a common base plate bolted onto a concrete plinth. The plinth shall be provided to suit the manufacturer's requirements and shall raise the pumps to at least 6in. (150mm) above the known flood level of the pump set location. Mounting of the pump sets on the plinth shall be

complete with adequate padding or vibration absorbers. The hose reel pumps installation shall comply with the requirements of the authority having jurisdiction and the specifications in this contract.

The nominal ratings of the hose reel pumps shall be as specified in the Hose Reel Pump Schedule.

#### 21.3.17.2 ELECTRIC MOTOR FOR FIRE PUMPS

The electric motors shall be AC squirrel cage induction motor of the totally enclosed fan cooled (TEFC) type. The motor shall be in compliance to BS 5000 and of sufficient capacity to effectively fulfill the pump horsepower requirements. The continuous maximum motor rating shall be to BS 2613 and shall have a minimum overload factor of 15% in excess of the power requirements at maximum pump discharge and minimum total head condition.

The motor windings shall be insulated to BS 2757, class 'F' and suitably impregnated to withstand damp tropical conditions. Anti-condensation heaters shall be fitted for motors 10 HP and above. Stator frames, end shields, terminal box and cover shall be cast iron or other approved material. Fan and fan cowl shall be of corrosion protected material.

The motor shall be suitable for 415V, 3 phase, 50 Hz power supply. All electrical works pertaining to the motor installation shall be provided. The motor shall be suitably earthed and provided with an overload trip protection. The thermistor protection is not required.

The motor shall comply with all the regulations of the local authorities and be provided with an approved type motor starter to limit the inrush starting current. Starters for the pumps motors shall be direct on line for motor with 1 to 3 Hp, star-delta for motor with 3 to 10 Hp and auto-transformer for 10 Hp and above. The starting current shall not exceed 150% of full load current. Capacitors shall be incorporated where necessary to maintain the power factor of the installation to 0.85 or higher. Unless otherwise specified, motor starters shall be to BS 4941:

- I. Suitable for three-phase, four-wire 415/240V 50Hz ac supply.
- II. Fitted with 220-250V ac operating coils.

The pump motor shall generally be flanged motor and suitable for horizontal operation. Coupling between the pump and the motor shall be by flexible self-aligning type complete with bolt-type metal guard. The pump and motor combination shall be mounted on a common base-plate of heavy-duty fabricated steel or cast iron and the complete unit installed on a suitable foundation plinth. The plinth shall be provided to suit the Manufacturer's requirements. Mounting of the pump sets on the plinth shall be complete with proper drainage and adequate vibration padding or an isolating efficiency of not less than 95% against the lower fundamental disturbing frequency. The minimum acceptable static deflection in the spring and shall be 1 inch (25mm) for machines having a fundamental frequency of 1000 rpm or above, increasing to 1/2 inch (40mm) at 500 rpm. Spring mounts shall be fitted with approved levelling devices.

The electric and power supply to the motor shall be always available. Any switches on the power feed to the motor shall be clearly labelled 'POWER SUPPLY FOR FIRE PUMP. DO NOT SWITCH OFF'. An indicator lamp or lamps shall be provided to show that the power is available to the motor. In the event of power failure to the motor starting switch, an automatic warning shall be given visually and audibly at the Main Fire Alarm Control Panel.



The pumping system shall operate as follows:

- a) A fall in the piping installation pressure shall activate the pressure switch.
- b) The pressure switch transmits a signal to the pump control panel with automatically operates the electric booster pump.
- c) The pump control panel shall indicate the actuation of the pump and transmit a signal to the FIB.
- d) The FIB shall indicate the operation of the booster pump both audibly and visually.
- e) Upon failure of the duty pump and/or further pressure drop in the piping installation a second pressure switch shall actuate the standby pump.
- f) A signal shall be displayed at the FIB and pump control panel indicating the failure of the duty pump and/or the operation of the standby pump.

#### 21.3.17.3 Jockey Pumps

Jockey pumps shall maintain system pressure on the installation side wet riser system. The following general requirements shall apply to jockey pumps:

- a) A fall in the system pressure on the installation side of the control valve will activate the pressure switch controlling the Jockey Pump.
- b) The pressure switch transmits a signal to the jockey pump control panel and activates the jockey pump to maintain system pressure on the installation side of wet riser system.
- c) Jockey pump shall have rated capacities not less than normal leakage rate and sized to make up the allowable leakage within 10 minutes at a rate of flow not exceeding 4 l/min.
- d) Jockey pump shall have a shut-off pressure not exceeding the working pressure rating of the fire protection equipment.
- e) The power supply to the jockey pump shall be such that any failure of this pump does not affect the power supply to the main fire pump.

Starter provisions and controls for each jockey pump shall be such that any failure of this pumps panels.

Jockey pumps shall be low capacity in line centrifugal pumps. Pump impeller and shaft shall be stainless with a cast iron casing. Motors shall be totally enclosed, fan-cooled, squirrel-cage type.

#### 21.3.17.4 PUMP NAME PLATES

Each pump shall be provided with a plate giving the output pressure at zero suction lift at the nominal flow rating. Where the performance characteristic of the pump is to be achieved using an orifice plate not integral with the pump delivery, the plate shall carry a reference to the fact that the performance given is that of the pump and orifice plate combination, together with the 'K' factor of the orifice plate.

In all case, the pump plate shall give the rated speed for the pressure and flows specified and the maximum power absorbed at the rated speed.

#### 21.3.17.5 CONTROLS FOR FIRE PUMPS

The controller shall be arranged to include the following minimum requirements and specifically tested for fire pump service, all in accordance with Fire Authority Requirements: -

- Manual/Automatic control of the duty and stand by fire pumps with constant output

governed by the discharge pressure control situated in the distribution mains.

- Operation of the fire pump sets in a duty/standby mode with manual facility for lead pump selection. The standby pump shall be set to come into operation on failure of the duty pump.
- The 'OFF-MANUAL-AUTOMATIC' selection sequence shall be controlled by a three-way switch. Any position other than AUTOMATIC shall sound an alarm.
- In addition to the automatic and manual starting systems, the control panel shall be provided with a device that will enable the pumps to be started from the control circuit in case of any failure.
- Operation of the controls shall be possible from the front of the panel without the need to open the panel doors.
- Pressure switches shall be provided for the starting of the pumps when the pressure in the fire service distribution main falls to a value not less than 80% of the rated operating pressure unless otherwise specified. The pressure switches shall have independent high/low calibrated adjustments and be able to withstand a hydrostatic pressure of 300% of the rated working pressure for five (5) minutes.
- Once started, the pumps shall run continuously until manually stopped or when the system pressure has reached the cut out pressure setting. Starting of the pump(s) shall at the same time initiate a visual and audible alarm.
- The controllers shall be provided with pilot lights, common alarm bell and individual contacts for the connection of remote signal devices which operate in the event of the following: -
  - AC power failure
  - Failure of duty pump to start
  - Failure of standby pump to start
- Provision in the form of contacts shall be included for the connections for remote alarm and signals which correspond to the pilot lamps in the controller.
- All alarm and signals shall be able to operate under manual as well as automatic conditions.
- Audible alarms shall be of minimum 85-dBA rating at a distance of 5 m.
- An electric motor lockout shall be provided for dis-connection of any wires that interconnect the electric motor control and shall not interfere with the proper operation of either controller.
- The fire pumps shall be monitored by the Main Fire Alarm Panel.

#### 21.3.17.6 PUMP CONTROL PANEL

The fire pump control panel shall be a self-contained, extensible, wall- mounted flush-fronted metal cubicle board completely assembled, wired, and tested by the Fire Pump Supplier/Installer before delivery from the Factory. The controller shall be so arranged as free standing independent from the pumps and the contractor shall indicate if the controller is to be supplied with the enclosure designed to be inspected and service from the rear. The controller shall be fixed not further than 3 m from the pump, and be within sight of the driver.

The pump control panel shall be designed to receive an electrical supply of 415/240 V, 3 phase, and 50 Hz AC current. All motor starters shall be incorporated within the control panel. The control panel shall incorporate spare contacts that will close upon operation of the electrical and/or any warning signal. The contacts shall energize a remote electrical bell/or lamp within the main Fire Alarm Panel.

All switches, which are required to keep the controller in the 'Automatic' positions shall be within locked cabinets having break glass panels.

All other items as required or standard to, the manufacturer's equipment shall be supplied.

#### 21.3.17.7 PUMP PERFORMANCE TESTS

The fire pumps shall be tested for its performance prior to delivery to site at the pump manufacturer's factory. The pump casing hydrostatic test shall also be carried out in accordance to the Hydraulic Institute Standards. All testing certificates shall be submitted to the Engineer for approval prior to delivery.

The fire pumps shall also be tested for its head/flow characteristic under normal operating conditions after the installation.

- Pump Efficiency

Pump efficiency shall not be less than the following:

Shaft kW	Minimum Efficiency
----------	--------------------

Up to 1 kW	0.35
1 to 2 kW	0.5
2 to 5 kW	0.6
5kW and above	0.7

#### **21.4. Technical Specifications for Portable Fire Extinguishers**

##### 21.4.1. General

The Sub-contractor shall supply and install portable type fire extinguishers in the location as shown in the drawings.

All extinguishers provided shall meet with the requirements of the Local Fire Authority and with the relevant BS and NFPA Standards.

##### 21.4.2. Location AND INSTALLATION

Extinguishers shall be conspicuously located where they will be readily accessible and immediately available in the event of fire. They shall, in general, be located along normal paths of travel and not to be obstructed or obscured from view.

In locations where visual obstruction cannot be completely avoided, means shall be provided to indicate the location.

Hangers, hooks and mounting brackets used for the installation of the extinguishers shall be to the approval of the Engineer. Where extinguishers are installed under conditions subject to dislodgement, such brackets shall be specifically designed to cope with the problem. Extinguishers installed under conditions where they are subject to physical damage shall be protected from impact. The exterior finish of the extinguishers shall be suitable for external or internal location as required. All extinguishers shall be installed such that the extinguisher operating instructions face outward. Extinguishers having a gross weight not exceeding 40 lbs. (18 kg) shall be installed so that the top of the extinguisher is not more than 5 ft. (1.5m) above the floor. Except for wheeled types, all heavier extinguishers shall be so installed that the top is not more than 3 1/2 ft (1m) above the floor. In no case shall the clearance between the bottom of the extinguisher and the floor be less than 4 in (0.1m).

The words 'FIRE EXTINGUISHERS' shall be painted using luminous paint on the wall above where the fire extinguisher is installed.

#### 21.4.3 Approval from Fire Authority

The contractor shall be responsible for obtaining approval from the Local Fire Authority for all extinguishers installed. The approval fee required for this purpose shall be deemed to have been included in the tender price.

#### 21.4.4 Types of Extinguishers

All extinguishers shall be provided according to the type and capacities as indicated in the drawings. Classifications of five classes are according to BS4547.

#### 21.4.5 Water Types

These shall be general purpose extinguishers of either gas pressure type, water/CO2 cartridge type, soda acid type or air-charge stored pressure type as specified, being suitable for Class 'A' fires. Each extinguisher shall be supplied complete with plunger, hose and nozzle and mounting brackets. Extinguishers shall comply with BS 1382, BS 138 and BS 3709 as applicable.

Water type extinguishers shall be painted in red.

#### 21.4.6 Compressed Gas Types

These shall generally be CO2 type intended primarily for Class 'B', Class 'C' and Class 'E' fires, being provided complete with alloy cylinder, valve assembly, hose and discharge horn. Extinguishers shall be painted RED, and comply generally with BS 3326 or equivalent.

#### 21.4.7. Foam Types

These extinguishers are intended for use on Class 'A' and Class 'B' fires, and can be either of AFFF type or CO2 cartridge type. They shall comply generally with BS 740 or equivalent. These shall be installed complete with hose, nozzle and mounting brackets and painted RED in color.

#### 21.4.8 Dry Chemical Types

These shall be ordinary dry chemical extinguishers (sodium bicarbonate base, potassium bicarbonate base, potassium chloride base or potassium bicarbonate urea base) suitable for use on Class 'B' and Class 'C' fires or multipurpose dry chemical extinguishers (ammonium phosphate base) suitable for Class 'A', Class 'B' and Class 'C' fires.

They may be either cartridge/cylinder operated type or stored-pressure type, and generally to BS 3465 or equivalent.

Where specified, they shall be provided with special long-range nozzles. Dry chemical type extinguishers shall be painted RED.

#### 21.4.9 Dry Powder Types

These extinguishers and agents shall be intended for use on Class 'D' fires and specific metals, following special techniques and manufacturer's recommendations. They may be hand portable, cartridge- operated or wheeled models as applicable. The extinguishing agent shall generally be composed of sodium chloride base agent.

The body color for such extinguishers shall be RED.

## 21.5. Technical Specifications for Fire Detection & Alarm System

### 21.5.1. General

The system shall be of the analogue addressable type with voice command feature, microprocessor based, audibly and visually supervised, with detection and alert devices distributed where dictated by Code. The life safety system shall be composed of three subsystems for fire detection and alarm annunciation, emergency voice/alarm, and two-way communication. The system shall be zoned and non-coded.

The following measures shall be taken:

- Interface with other systems such as security and door access systems, firefighting, smoke control, stair pressurization, Building Automation and Control Network (BACnet), standby/emergency power supply, Audio Visual system, elevators, LP Gas etc. shall be required,
- Standby emergency power supply system shall be provided to ensure continuity of power supply to loads that are essential to life safety such as the fire alarm system, the FCC and Main Communication Room, the fire pump and mechanical equipment used for smoke control procedures and at least one elevator in every bank with power transferable to any other elevator in the bank.
- A two-way telephone communication service is to be installed for fire fighters use. This system shall operate between the building central command and every elevator car, every elevator lobby and each floor level of exit stairs. Notification of occupants shall be achieved through a voice communication system.

The basic system components shall be the following:

- Main fire alarm annunciation and control panel MFAC, microprocessor based, addressable type, modular expandable, fully electronic, electrically supervised, divided into main compartments for control, annunciation and amplifiers. The system shall have batteries capable of monitoring the system for 24 hours and then sounding the alarm for 30 minutes.
- Color graphics CRT terminal
- Satellite Fire Alarm Panels SFACs for data acquisition, transmission and control. Wiring, between the speakers/horns, visual alert devices, emergency telephone, detectors, and control modules on one hand and the main control panel on the other hand, shall be via the satellite fire alarm panels that have multiplexing features and amplifiers rated for the required audio load. Each building shall have an SFAC assigned to serve its various floors.
- Automatic and manual detectors consisting of smoke, heat, manual, duct smoke and sprinkler water flow. Detectors shall be located to code.
- Alarm notification devices consisting of audible alarms (bells, speakers and horns) and visual alarms (strobe lights). The voice alarm system shall be capable of broadcasting pre-recorded messages and have an interface with the fire fighters station at the main panel. The main fire alarm panel or MFAC/SFAC shall house the amplifiers sized in accordance with the number of speakers and wattage. Speakers shall have different tap settings and shall be adjusted on site for optimum performance and maximum coverage. Alert devices shall be designed to ensure a sound level of 15 dB above ambient noise in each area.
- Interface and control modules for releasing of fire rated doors separating fire zones.
- Fire fighters communication system consisting of telephone handsets located next to the exits on each floor and in every elevator car and elevator lobby for high-rise structures.

- Interface with the Building Management System for smoke management and control, sprinkler and fire pumps and HVAC control and with other systems such as security, standby/emergency power supply, elevators, etc.
- Remote repeater panels at strategic locations such as the main entrances.
- Data Network: each MFAC/SFAC panel is a node of a network with direct communications into the network but operates on a stand-alone basis. Although performing different functions, each MFAC/SFAC serves as a "peer-to-peer" (equal) partner in controlling network communications. Network information is sequentially transmitted from one node to another.

The fire alarm system shall provide visual and audible warning on main annunciator panel for supervisory signals such as:

- Failure or disconnection of power supply to main control panel
- Failure of fuse or protective device
- Removal of detector head on any initiating circuit
- Break or short circuit in wiring of any initiating or alarm circuit
- Valve tamper at fire pumps
- Fire pumps running
- Fire pumps power loss
- Fire pumps phase reversal
- Emergency generator on
- Emergency generator start failure
- Emergency generator low fuel
- Emergency generator low oil pressure

Even though an addressable fire alarm system shall be installed, buildings shall still be divided into zones to identify the location of a fire to help reduce confusion. The following criteria shall be followed in the zoning:

- A single zone shall not exceed 2000m<sup>2</sup>.
- A zone shall not cover more than one story.
- Stairwells, elevator shafts and flue-like openings shall be treated as separate zones.
- The two hours fire separations dictated by the architectural requirements shall be used as separate zones.

The work outlined in this section covers the supply of all materials, which shall be new and unused, equipment and labor necessary for the complete installation, testing and commissioning and handing over in approved working order of the complete system. It shall also be in accordance with rules and regulations of the Local Fire Authority and of the following: -

- a. Local Fire Authority
- b. Fire and Accident Underwriters Association
- c. BS 5839 Part1: 1988

#### 21.5.2. Equipment Specification

The Main Fire Alarm Panel (MFAP) shall be of the multiple processor based truly Analogue Addressable Type, of modular architecture, being of the latest design and manufacture. The FCP shall be suitable for ambient conditions varying between 00C to + 550C, with relative humidity up to 95% non-condensing.

The MFAP shall be manufactured to BS 5750 ISO 9000 quality standards, by an approved and well-known manufacturer who provides design, service back up, and spare parts locally.

The processor system shall as a minimum once per day at the set time automatically adjust all sensing devices to compensate for sensitivity increase due to environmental conditions. This check should also incorporate a full "Check sum" evaluation to detect unauthorized programming changes, or data corruption.

The control panel shall be capable of being extended in modules of 4 loops, up to a maximum of 16 loops. Each 4-loop module shall incorporate its own microprocessor and shall be electrically isolated from the main processor board. The loop board shall incorporate dc/dc converters to prevent loop cross talk. Each converter board shall be provided with step up voltage converter to ensure the correct line voltages are maintained to the detection loops in the event of mains power failure in combination with low battery state.

To increase fault finding capability each loop processor board shall have the LED indicators.

It shall be possible to site a four-loop processor board remotely from the main control panel up to maximum distance of 1000 meters and interconnect with the main panel via a four wire screened data line.

Each loop shall be capable of accepting as a minimum 126 Analogue detectors or control devices. The loop PCB will incorporate "on board" short circuit isolators for both the incoming and outgoing loop wiring.

The system architecture and software will allow for random addressing of each device to suit field conditions, pre-set order or soft addressing will not be acceptable.

Each processor shall continuously monitor the Analogue signal from detectors, and evaluate this signal against a pre-determined set of fire algorithms, to accurately determine the existence of fire and to reduce unwanted alarms.

There shall be no limit to the number of detectors per loop which can be in alarm simultaneously, the vacuum fluorescent display (VFD) shall be capable of reporting all incoming alarms by use of a scroll function the scroll function shall be accessible at all times without the need for "key access".

The FAP shall incorporate as standard a vacuum fluorescent display module, which provides, for power conservation reasons, two levels of brightness output. Level 1 output will "low" for standby conditions, with level two providing "high" output, to signal change of state or alarm processing.

The display shall provide up to two rows of 40 characters.

The FAP shall be able to incorporate an integral printer unit, which shall record all changes of state, alarms, faults and operator actions, overall, the minimum requirements will be: -

- a) list isolated devices
- b) list loop devices
- c) list event log
- d) list panel outputs
- e) list loop outputs
- f) list loop output devices
- g) list check sums for (programming and Eprom error checking)
- h) list single device analogue value

The FAP shall be able to be expanded, to the following features.

- (a) Repeat panel drive (for use to 40 repeat panels)
- (b) remote printer (ASCII expanded text)
- (c) mimic driver
- (d) 32/64/96 way programmable outputs
- (e) BMS system RS 232 output

### 21.5.3 Interfacing Facility

#### 21.5.3.1 Interface with Building Automation System (BAS)

The system shall be provided with an RS232 ASCII protocol and to be integrated with the Building Automation System.

#### 21.5.3.2 Interface with the CCTV systems

Provision shall be made for the Fire Graphics and Text workstation to link up with the CCTV system to provide a real time video display at the Fire GT monitor. The Fire Monitor shall display a live video of the camera capturing the fire location in the event of an alarm. A fire signal corresponding to the location of the fire shall be send to the CCTV system by the FACP to activate the CCTV camera such that a real time video picture can be display at the Fire GT monitor.

#### 21.5.3.3 Interfacing works to future fire alarm panels

The Fire Alarm System shall be designed to interface with future fire alarm panels with a maximum of 64 fire controllers on the Network.

The networks shall be totally flexible and enable the fire controllers to be seamlessly linked together, providing a system capability of up to 160,000 detection addresses and over 14,000 digital I/O points.

The Central Fire Command Station shall be configured to monitor the status of all the fire controllers and transmit signals to the fire controllers for specific actions to be performed.

The system shall be able to incorporate the extension of the Fire Alarm Annunciator and Control Panel to provide remote start/stop of equipment such as fans, dampers etc.

### 21.5.4. Fire Alarm Software

The main processor shall incorporate a "Watchdog" system, which, in the event of processor failure will reboot the system in an attempt to correct the fault and return the system to full operation. Failure to reboot should result in a processor failure being announced both visually and audibly.

All software, program and data shall be held in non-volatile read only memories.

System configuration data shall be stored in memory, which can be electrically erasable or alterable. This system shall be backed up by on board PCB rechargeable batteries with a life span not less than 5 years. PCB battery should be continuously on charge to ensure correct operation. Altered or reconfigured whilst in a live on line situation. All configured data shall be able to be downloaded to the on-board printer for verification and checking purposes.

Alarm processing should incorporate verification scanning before raising any fire or fault signals. The maximum permitted will be:

- 3 Scans Fire



- 6 Scans Fault

A priority interrupt signal will be used for all manual break glass units, which will override the scanning process for fire indication.

The processor systems shall include a software routine to enable pre alarm signals to be raised in the event of Analogue signal value from a detector reaching and maintaining a level of 80% of alarm threshold, after multiple scans. All system configuration data shall be fully field programmable without exception, and shall be able to be

#### 21.5.4.1 Non Alarm Signals

The hardware and software shall be so configured as to allow for incoming 'CHANGE OF STATE SIGNALS' Emanating from floor sprinkler control valve isolation including such signals as pump running. The control panel will process this as change of state only and not raise any executive actions or alarms. The internal printer will log such signals to hard print and also to the historical log function of the panel. All non-alarm signals shall be shown visually on the VFD and at the printer as "ALERT" signals only.

#### 21.5.4.2 Walk Test Facility

A walk test facility shall be included which will allow for single man test and verification of loop or zone devices. This testing shall not at any time prevent a fire signal from being generated by devices on other loops or zones, which, will automatically cancel the test function and raise the normal executive actions of the fire system. It shall be possible to inhibit or have on line during the test all field programmable outputs associated with the detectors in the zone or loop being tested.

#### 21.5.4.3 Historical Event Log

The historical log shall have sufficient memory size to log and record up to 200 fire events or combination or events including all operator actions taken. The details held within the log shall be capable of being down loaded to the fire alarm control panel integral printer.

#### 21.5.5. Panel Hardware

The control panel cabinet shall be manufactured from sheet steel of not less than 1.5mm and be undercoated with corrosion resistant materials with final baked enamel paint finish.

Common master LED indication will be provided to give the following information: -

- a) General Fire
- b) Supply Healthy
- c) Pre alarm
- d) System Fault
- e) Device Fault
- f) External Fault
- g) Processor Fault
- h) Device Isolated

#### 21.5.6. Zone Indication

Zone indicators up to a maximum of 96 zones will be provided. Expandable in 64-way membrane sections, all zone indicators shall be LED type. Each membrane will provide zone designation label stripe, which can be inserted from the rear side of each line of indicators.

#### 21.5.6.1 Vacuum Fluorescent Display Panel

The fire alarm control panel display will employ vacuum fluorescent, twin brightness level type display. The two levels of display brightness output will be Level One "Low" (Standby condition) Level "Two" high (Including alarms or panel in access, and operator action).

The overall display will provide two-line output of up to 40 characters per line. The display will provide the following information.

- a. Device Type (non-abbreviated)
- b. Analogue Value
- c. Device Location
- d. Device address, zone number loop number
- e. Normal condition
- f. Access condition
- g. Fire alarm
- h. Device fault
- i. Pre-alarm
- j. Fault on loop
- k. External fault
- l. Control fault
- m. Alarm fault
- n. Supply fault
- o. Alarms sounded
- p. Alarms silenced
- q. Panel reset
- r. Maintenance mode
- s. Devices isolated
- t. Test mode.

#### 21.5.6.2 Sub-Fire Indicator Board (Mimic Panels)

Sub-fire indicator boards (SIB) shall be supplied and mounted remotely from the FIB. SIBs shall be microprocessor based and include watchdog timers or other appropriate mechanism to ensure ongoing operation. As a minimum configuration, the SIB shall include the following elements.

- Controller microprocessor
- EPROM based software
- Communications controller
- Display (Perspex floor plan with color reverse silk-screen printing)
- Display drives
- Power Supply

SIBs shall communicate with the FIB by means of a high-level communications interface. This shall conform to current ISO or CCITT standards and include error detection mechanism. The SIB and FIB shall communicate via an active transmit-respond polling sequence with appropriate timeout and monitoring mechanism.

The SIB shall annunciate the following events.

- All flow switch status on a per floor basis.
- All pressure switch status inclusive main stop valves shut, low
- tank water, pump running etc.

- Monitored stop valves status.
- Smoke detector groups alarms on a per floor basis and AHU basis.
- Pump status.
- Installation valve activation.
- Power supply and battery charger fault.
- System fault status including fault isolated.
- Provision for 100% annunciator expansion.

SIB annunciators shall be high quality LED type devices. A LED facility shall be supplied. All displays shall be updated with current system information once every 10 second interval.

The FIB and SIB in conjunction shall supply system software capability including the following.

- Ability to annunciate any system monitored point individually
- Be able to add and annunciate new individual or groups monitored points.
- Be able to configure point into groups as required and annunciate status of the group on one display.
- Test diagnostic to ensure communications integrity.

SIBs shall come complete with cabinet power supply and associate equipment that meet the requirements as specified for the FIB.

#### 21.5.6.3 Master alarm board

The master alarm board shall provide as a minimum, the following common alarm and output facilities:

- a) Four sets changeover contacts (Two sets isolatable via on board switch).
- b) 4 alarm sounder monitored output lines rated at 1 amp. each.
- c) Switch output for the following: -
  - i. Manual
  - ii. Fault
  - iii. Auxiliary
  - iv. Buzzer
  - v. Alarm
  - vi. Ext. alarm
- d) A set of contact common/normal open will be provided which are delayed on power up and power down. This contact will be used for extinguishing system output to prevent spurious signals causing accidental operation of system.
- e) Visual indicators shall be provided to announce.
  - i. Alarm fault
  - ii. Earth fault
  - iii. Aux. 1 isolated

#### 21.5.7 Operator Controls

The minimum operator control will be as follows: -

- a) Sound Alarms
- b) Silence Alarm
- c) System Reset
- d) Scroll Alarms

Access to the operator control must only be achieved by authorized personnel and will only be accessible via a key "ACCESS" switch. Alarm scroll to be available at all times without the need for "Key Access".

A 12-way keypad touch sensitive membrane will provide, providing three levels of users control, level two and three only is accessible on successful entry of a pass number code. The levels will provide the following.

Level 1 (Accessible by key switch operation)

- a) isolate/de an isolate device
- b) Set date and time
- c) List loop devices
- d) Select test mode
- e) LED test
- f) Enable / Disable printer.

Level 2 (Assessable by 4-digit code when in level 1) Facilities

- a) Print event log
- b) Read a single device
- c) List isolated devices
- d) Program outputs
- e) Display checksums

Level 3 (Only available from level two) Facilities

- a) Print panel outputs
- b) Print loop devices
- c) Print loop outputs

### 21.5.8. Programming

Level two and three shall be extended, when a hand held or portable computer is connected to allow for down-loading/up loading and programming of loop outputs, loop devices and panel outputs. The facilities required from the extended facility will be.

#### LEVEL 2

Message handler  
Program loop devices  
Program loop outputs  
Load/Save program data  
Clear output

#### LEVEL 3

Program panel output

### 21.5.9 LOOP and Field Devices

#### 21.5.9.1 Loop General

The "loop" shall be a two wire circuit starting and returning at the two associated loop return input terminals of the control. The loop shall be capable of driving as a minimum up to 126 field Analogue Addressable devices offer a maximum total loop distance of 2 km.

#### 21.5.9.2 Loop Communications

The communication to and from each device shall be based on pulse position modulation digitally encoded on the power voltage.

#### 21.5.9.3 Device Addressing

There shall be no preset order for addressing the devices. The devices shall be addressed in an order

appropriate to site conditions. This order will be determined during commissioning and the control panel will have facility to override the address order to re-check any device showing a tendency to the alarm condition.

#### 21.5.9.4 Loop Short Circuit Isolators

Isolators shall be fitted at a maximum spacing of one per 20 devices, or to suit local maximum zone size regulations. The isolators shall protect against short circuits on the loop by isolating that section of the loop where the short circuit occurred, thus maintaining the integrity of the remainder of the system.

Short circuit isolators will be powered by the loop wiring, and will be limited to 10 per loop.

#### 21.5.9.5 Loop Interface Equipment

The loop shall be of receiving information in addition to that from heat and smoke detectors e.g. operation of sprinkler system. The source of this information shall be identified by its own inquire address. Any interface equipment used to achieve this requirement shall be from the standard product range of the same manufacturer as the smoke and heat detectors provided for the loop.

#### 21.5.9.6 Loop Power

The loop wiring shall power the detectors, address, and carry data to any from the field devices by digitally encoded signals superimposed on the power voltage.

#### 21.5.9.7 Automatic Devices Identification

The control panel shall be able to identify what type of device is located at each address in order to protect against accidental fitting of an inappropriate sensor.

### 21.5.10 Detector Common Requirements

#### 21.5.10.1 Detector Power

The detectors shall be suitable for connecting to a two-wire 24 V central system and operate satisfactory within the supply voltage range of 17V-28V DC.

#### 21.5.10.2 Detector Alarm Indication

An indicator LED shall be provided on the detector, which illuminates when the detector has reached a pre-set alarm level. The indicator shall be operated independently of the detector, by a signal command from the central control panel.

#### 21.5.10.3 Detector Remote Output

Provision shall be made for an output from the detector suitable for operating a remote indicator or other device with a current limitation of 4 milli-amps. This output will be initiated by a signal command from the control panel.

#### 21.5.10.4 Detector Mounting Bases

Separate mounting bases shall be required which shall be common in design for all types of detectors to be used. Bases shall enable ready removal of the detectors for maintenance. The bases shall be

fitted with stainless steel terminal springs and stainless steel terminal screw saddles; detector removal will not initiate an open circuit alarm. No detector base shall incorporate electronics of any type.

#### 21.5.10.5 Detector Construction

The construction of the detector and bases shall be in white self-extinguishing polycarbonate plastic. Full circuitry must be protected against moisture and fungus. Smoke entry points will be protected against dust and insect ingress by corrosion resistant gauze. The detectors must be unobtrusive when installed, having a dimension not exceeding 50mm x 100mm diameter maximum, including the mounting base. The detector shall be supplied complete, fully tested and factory pre calibrated.

#### 21.5.10.6 Detector Addressing Method

The unique address of the detector shall be set by the installer by means of a pre coded rigid plug in card, which when fully inserted into the detector base will program the detector address. The coded card when fully inserted will protrude from the detector base, this section of the card will show a pre numbered label for ease of detector identification. In the event DIL or rotary switches are utilized for the setting of address, then part 8.6.2 and 8.6.3 shall apply.

When the address code is set by means of a DIL switch it shall be obscured from sight by means of suitable label. The label shall indicate the relative positions of the DIL switch.

For all detectors with DIL addressing there shall be facility on the mounting base for writing in indelible ink the address of the base. The address code shall be obscured from sight when the detector is fitted to the base.

#### 21.5.10.7 Detector Contamination

The build-up of dirty or similar contamination on the radioactive or optical source will cause the output signal from the detector to gradually change. The control panel shall be capable of monitoring this slow change in signal and at a predetermined level indicate that the detector is in need of servicing or as a minimum false a pre alarm.

#### 21.5.10.8 Approvals

All detectors shall have the relevant manufacturing certificates and accepted for use by relevant authorities.

#### 21.5.11 Detection devices

All analogue addressable field devices shall have an integral microprocessor on board. All this device shall be BS EN54 LPCB approved. These devices shall include, but not be limited to multisensory detectors, smoke and heat detectors, interface modules and gas releasing and suppression modules.

##### 21.5.11.1 Addressable Intelligent Detectors

Each intelligent smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each detector may be individually programmed to operate at any one of five (5) sensitivity settings

Each detector shall automatically change to standalone conventional device operation in the event of a loop controller communications failure. In the standalone detector mode, the detector shall continue to operate using sensitivity and environmental compensation information stored in its microprocessor at the time of communications failure. The MFAP shall monitor the loop and activate a loop alarm if any detector reaches its alarm sensitivity threshold.

Every intelligent detector shall be tested periodically for its sensitivity to ensure that the detector continues to operate accurately within its calibrated sensitivity windows. The detector shall be capable of performing independent check on its sensitivity window and should its sensitivity drifted outside this window a fault message shall be reported automatically to the MFAP. System offering this type of feature shall be supported with document from an independent testing authority such as Underwriters Laboratory (UL) or Loss Prevention Council (LPCB).

All detectors must be immune to external Electro-Magnetic Interference conforming to IEC1000-4-8:1995 and ENV 50149:1995/ En 500082-2:1995 and ENV 50140:1993/ EN 50082-2: 1995.

#### 21.5.11.2 Electronic Horn/Strobe

All electronic horn/strobes shall be provided according to the drawings.

The horn/strobe shall have a red plastic housing, ultra slim, protruding from the wall less than one inch from the wall. It shall have an attractive appearance with no visible mounting screws. It shall fit all standard one-gang electrical boxes with plenty of room behind the signal for extra wire.

A sound output level of 91 dBA average shall be provided.

The strobe shall provide 15 cd or 15/75 cd or 30 cd or 110 cd synchronized flash outputs. The strobe shall have lens markings oriented for wall or ceiling mounting. It shall be possible to replace the lens markings with lens marking kits. Ceiling mounted strobes shall have lens markings with correctly oriented lettering. Removal of a installed Horn/Strobe to change the lens markings shall not be acceptable.

Horn/strobe shall mount to a masonry electrical box (2-1/2" deep)

A delay timer with adjustment from 0 to 5 minutes to set off the building alarm bells after a predetermined delay shall be provided. A manual switch shall also be provided to give an immediate alarm.

#### General:

Average ambient sound levels greater than 105 dBA require visible notification appliances. Total sound pressure levels produced by ambient sound pressure levels and all operating audible notification appliances must not exceed 120 dBA within the occupied area.

#### Public areas

In Public areas signals must have a sound level of at least 15 dB above the average ambient sound level or 5 dB above the maximum sound level having duration of at least 60 seconds, whichever is greater. Measurements must be taken with an A-weighted scale (dBA) at 5 feet above the floor in occupied areas.

#### Apartment Areas

mode signals must have a sound level of at least 10 dB above the average ambient sound level or 5 dB above the maximum sound level for at least 60 seconds, whichever is greater. Measurements must be taken with an A-weighted scale (dBA) at 5 feet above the floor in occupied areas.

In sleeping areas, audible appliances must have a sound level of at least 15 dB above the average ambient sound level, or 5 dB above the maximum sound level for at least 60 seconds, or a sound level of at least 75 dB, whichever is greater. Measurements must be taken with an A-weighted scale (dBA) at pillow level in occupied area.

#### 21.5.11.3 Optical Beam Smoke Detector

The smoke detectors shall be suitable for detecting invisible product combustion as well as visible smoke and be of the dual chamber dual source type to provide good stability in changing environmental conditions.

Detector coverage will be up to 100m (length) x 15m (wide).

The system shall comprise of a transmitter head, a receiver head and a control box.

#### 21.5.11.4 Ionization Analogue Smoke Detectors

The Ionization smoke detectors shall be suitable for detecting invisible product combustion as well as visible smoke and be of the dual chamber dual source type to provide good stability in changing environmental conditions.

The radioactive source shall be Americium 241 mounted in such a way that it is mechanically secured. The device shall have been certified by the National Radiological Protection Board or a similar body. The detector shall be capable of operating within the following environmental limits.

Temperature operating range - 20C to 60C

Humidity operating range 0% to 95% RH non-condensing.

Wind resistance up to 10 meters per second without false alarming

The detector shall be capable of protecting an area up to 100m<sup>2</sup> at a height of up to 12m. The installation and siting of the detectors must conform to BS 5839 1980 or similar Standards, ruling in the local region.

#### 21.5.11.5 Photoelectric (Optical) Analogue Addressable Smoke Detectors

The photoelectric (Optical) smoke detectors shall be suitable for detecting visible smoke such as is produced by slow smoldering fires including decomposing PVC. Detector coverage will be 100m<sup>2</sup> at a height of up to 12m.

The detector shall be capable operating within the following environmental limits. Temperature operating range - 20V to 60C

Humidity operating range 0% to 95% RH non-condensing. Wind – non affected.

#### 21.5.11.6 Analogue addressable Heat Detectors

The heat detector shall be electronic in operation and suitable for connecting to a two-wire 24V central system, which can operate within the voltage range of 17V - 28V DC. Detector coverage will be 50m<sup>2</sup> at a height of up to 9m.

The device shall be monitoring ambient temperature by means of an NTC thermistor. The detector



shall be capable of operating within the following environmental limits. Temperature operating range - 20C to +60C (no icing)

Humidity operating range 0% to 95% RH. (Non-condensing) Wind – effected.

#### 21.5.12 Manual Call Stations

##### 21.5.12.1 Break Glass Type

The Manual Call Stations shall be of the break glass type with key lock for test and reset, unless specified otherwise. The break glass unit shall be cast iron, cadmium plated or other approved type and painted red to BS 381C. The unit shall be of attractive and neat appearance and shall be suitable size and type for surface or flush mounted on the walls. Appropriate label showing “FIRE, BREAK-GLASS” shall be shown on the unit. Breaking the glass cover shall automatically operate the alarm in less than 10 seconds.

##### 21.5.12.2 Analogue Addressable Manual Pull Handle Stations

The Manual Pull handle Stations shall be made of heavy-duty die cast metal or Lexan body and painted red colour. The unit shall be of attractive and neat appearance and shall be suitable size and type for surface or flush mounted on the walls. The unit shall be of a double action type whereby the front cover must be lifted up first before the Pull Handle can be pulled down to initiated an alarm. The unit shall be complete with station reset key.

##### 21.5.12.3 Duct Air Sample Detection

The return air ducting for all zones of HVAC shall be protected by duct mounting detector probe units. The units shall be so designed to minimize the duct preparation work required to install the probe unit. The structure of the duct will be breached only for the insertion of the sample tube by means of two 25mm holes. The duct housing shall incorporate a polyester clear see thorough top, which will allow the detector, and detector led to be clearly seen from ground level.

The housing will be suitable for air sampling in air velocities of not less than 1m per second up to maximum of 20m per second. The velocity across the sample chamber sill is reduced to approximately 1% of the air velocity of the HVAC airflow. Probe units will be installed in straight lengths of the duct, which are not less than 6 times the width of the duct section to ensure least turbulence at the probe unit.

#### 21.5.13. Interface Module Common Requirements

Each interface unit for switch monitoring or output will have use DIL switched to set the address and will be of the same protocol and manufacture. As the detection devices, all interface modules will be supplied complete with LED indicators, which shall illuminate on the operation of the interface device.

##### 21.5.13.1 Switch Monitor Units

Switch monitor units shall be provided to allow conventional to analogue connection for such devices as sprinkler flow switches, floor valve isolation (if applicable) or any such clean contact device as could be deemed necessary for inclusion within the fire system. The switch monitor unit shall be capable of receiving contact configurations of normally open or closed loop. All switch-monitoring units will be powered by the loop wiring without the need for external power source.

#### 21.5.13.2 Input Output Units

Input output units will be provided for the connection to such items as pump start control, lift homing control, or local HVAC shut down. As standard each input output module will incorporate a set of change over contacts to interface with the required service. The input output device shall be capable of being programmed at the control panel to allow for operation by any device on any loop. A separate 24-volt dc input will be required for the input output modules this supply must be derived from a monitored source and is battery backed up.

#### 21.5.13.3 Sounder Circuit Controllers

Analogue addressable sounder circuit controllers shall be required; each unit shall have a unique address and be completely programmable from the fire alarm control panel. Each unit shall have a minimum output of 750 milli-amps. The addressing and switching power supply for the controller will be derived from the loop supply. However, the unit shall require a 24V d.c. supply to power the connected alarm load this supply must be derived from a monitored source and be battery backed up.

#### 21.5.13.4 Multi Input Output Controller

Multi input output controllers shall be used for the collection of existing conventional detection or clean contact input devices. All input signals to the multi-input module will be fully monitored for open and short circuit. The multi-input unit will have minimum 8 inputs and 8 fully programmable outputs, with 2 monitored output circuits for external alarms.

The unit will be provided with 8 alarm and 8 fault LED indicators with internal buzzer and alarm silence control. The unit will generate 8 unique addresses for the conventional input lines and be fully compatible with the detector and main fire alarm control panel protocol.

Multi input output controllers will be used for the collection of the building Fire Water and Fire pumping signals suitably programmed to transmit ALERT/CHANGE OF STATE signals to the main fire alarm control panel. The following inputs will be required.

- a) Pump start
- b) "A" Pump Running
- c) "A" Pump Fail
- d) "B" Pump Running
- e) "B" Pump Fail
- f) Water High
- g) Water Low
- h) Low Pressure

The following programmed outputs will be required.

- a) Pump Start (Programmed from pump start input signal and from fire panel, break glass or sprinkler flow switch alarms)
- b) Pump changeover (Programmed to switch from pump "A" to pump "B" in the event of pump "A" input failure signal being received).

#### 21.5.14. Standby Power Supply Equipment

The overall fire alarm system will be complete with a 24V D.C charger unit completes with sealed lead acid maintenance free batteries. The charging equipment will be of the approved type and be calculated in size to provide full standby back up load for a period of not less than 24hrs. with a full alarm, load for a minimum period of 2 hrs. The battery and charger unit will be supplied in a sheet

steel lockable cabinet of the same construction and finish as the main fire alarm control panel.

#### 21.5.14.1 Battery Calculations

The full alarm load will be calculated for a period of two hours to ensure the battery terminal voltage is sufficient not to cause permanent damage to the battery cells. The charger output should be sufficient to run the full alarm load of the system in the event of battery failure. The output shall also be of sufficient capacity to run the full standby load of the system and fully recharge the battery within a 24-hour period.

#### 21.5.15. Field Installation

Two cable system types are approved namely

- a) Mineral insulated copper covered (M.I.C.C)
- b) Fire resistant cable of the approved type.

Loop cables should be run separate of all other services including alarm power circuits for alarm outputs.

The minimum permitted core size will be 1.5mm<sup>2</sup>. For loop lengths of up to 1000 meters, 2.5mm<sup>2</sup> will be used for 1000 meters to 2000 meters lengths.

#### 21.5.15.1 Cable Terminations

All cable terminations at detectors and break glass devices will use spade type crimp connectors; all devices, which have standard enclosed terminal blocks, will use crimp pins for final termination.

#### 21.5.15.2 Cable Markers

All cable cores will be identified using ferrules to provide numbering and symbols as required.

#### 21.5.15.3 Spare Capacity

Each loop will populate to 80% capacity, providing 20% spare for future expansion and or change of use.

#### 21.5.15.4 Hard Copy Program

The successful contractor shall supply for approval hard copies of all text programming information, including all input to output configurations.

## **22. LIFT SPECIFICATION**

### **22.1 Scope of Work**

This Specification shall be read in conjunction with the attached specific Preliminaries clauses and Drawings. The works to be performed under this subcontract comprise the Design, supply, delivery, installation, testing and commissioning and maintenance of all Lift System and equipment including minor and incidental works to ensure the complete and satisfactory operation.

The Contractor shall ensure that the output of each plant and/or points is adequate for the specified duty under operating conditions. Output shall be as specified in the Specifications and/or Drawings and failing to meet this requirement shall be replaced entirely and all necessary modifications be made to meet the output requirements.

Should the whole or any part of the installation be unable to produce the performance guaranteed under the Contract, the Contractor may be permitted to carry out approved modifications to the installation at his own expenses to improve its performance and allow a reasonable period for the execution of such modification. Such permission will not be granted to carry out the above tasks if it is not in the best interest of the Employer.

Notwithstanding the above, should the installation be unable to produce the performance guaranteed in the Tender after approved modification, the whole or any part of it might be rejected.

The Contractor shall at his own expenses dismantle and remove from site, the whole or any part of the work which has been rejected and will be required to replace it with an approved alternative or to reimburse the Employer for the cost of such replacement carried out by others, provided that the total amount of such reimbursement shall not exceed the original Tender Prices plus the calculated amount of liquidated damages payable as specified in the Conditions of Tender.

The proving that any failure is due to any other cause shall rest with the Trade-Contractor.

The works to be done under this section of the Specifications consists of the Design, supply, delivery, installation, testing and commissioning and maintenance of all Lift System Works at the subject premises, and all work and materials incidental to the proper completion of the installation, except those portions of the work, which are expressly stated to be done by others. All works shall be in accordance with the governing Codes and Regulations and with the Specifications, except where it conflicts with such Codes, etc., the former shall then govern. The requirements in regard to materials and appliances necessary for the complete installation of the work specified herein and indicated on the drawings. These specifications are intended to provide a broad outline of the required equipment, but are not intended to include all details of design and construction.

### **22.2 General Requirements**

All lifts will be homed in sequence to the ground level in the event of fire alarm or emergency conditions such as failure of power incoming supply source. Lift System shall have the battery backup to enable landing of lift cars in nearest floor in the event of an emergency power failure while lift is in operation. The fireman lifts will be supplied with fireman switch for continual operation during fire conditions. Lift parameters (speed, door opening, closing times etc..) shall be properly designed to ensure that waiting time is less than 60 Sec. Elevators shall be provided in buildings to accommodate for the transport of persons, specifically the disabled and for the delivery of Bed/ goods and garbage.

Traffic calculations shall show all parameters considered in the analysis such as estimated building population, traffic patterns, entrance and departure levels and the design criteria adopted such as the optimum interval and handling capacity for the particular application.

Elevators shall conform to the Fire Fighter's Service requirements. Tie-in to the fire alarm system shall be provided to park all elevators on the main entrance level upon receipt of a fire signal. An alternate park floor shall be provided in case the signal originated from the entrance level. Fire detectors shall be placed in hoist-ways and the machine rooms to shut off power and park the elevators respectively in accordance with NFPA 72.

Lighting and socket outlets shall be provided in the pits and in the elevator machine rooms. Disconnecting means, control signals and telephone connections shall also be provided.

Elevators shall be of the electric traction variable volt- age variable frequency (VVVF) type.

The elevator banks operation shall be group automatic. Door operation shall be electronic with up-to-date safety features. Provisions shall be made for future installation of an access control system. Passenger elevators shall be accessible to the handicapped and shall be fitted with Braille operating panels. The interior finishes shall be suitable for the corresponding application and shall be coordinated with the interior requirements.

Cars shall be provided with emergency lighting and partial natural ventilation. Elevators shall be provided with a battery emergency operating system that will operate in the event of power failure to supply power to the:

- The car lighting
- The emergency alarm system and to an emergency lowering device that allows car to descend to the next immediate floor and unlock the doors.

### 22.3 Regulations and Standards

Elevator dimensions shall be selected according to the International Standard ISO 4190-1, "Lift Installation- Part 1: Lifts of classes I, II and III". This Standard identifies the following classes of elevators:

Elevators safety features shall be to the American Society of Mechanical Engineers ASME A17.1, "Safety Code for Elevators and Escalators" and the ADA "Americans with Disabilities Act ".

NEC 2003 Article 620-71 and ASME A17.1 2004 A17.a-2005 Rule 2.7.6 stipulate that a n elevator control panel must be installed outside the hoist way and thereby a separate room is required for control panels.

### 22.4 System Description

All Bed Lifts, Passenger Lift & Service/Fire Lift should be group controlled as per below table and should provide the facility to isolate the lifts whenever requires by means of key switch at ground level.

Lift system should have the necessary provisions for the CCTV, PA and other services as mention on the relevant section on the Technical Specifications.

	Type of Lift	Group Controlled	Machine room Type	Core Size, mm (D)x(W)	Car Size, mm (D)x(W)	Capacity	Door Size, mm (W)x(H)	Speed, Min. m/s
L1/01	Bed Lift	Group Controlled with Facility of	Machine Room Type	3050X2450	2500X1500	1150kg / 15 Pas.	1200x2000	1.5

		isolation of One lift from Group						
L1/02	Fire Lift			2200X1860	2100*1300	1150kg / 15 Pas.	1200x2000	1.5
L2/01	Bed Lift	Group Controlled with Facility of isolation of One lift from Group	Machine Room Less Type	3050X2450	2500X1500	1150kg / 15 Pas.	1200x2000	1.5
L2/02	Passenger Lift			2200X1860	2100*1300	1150kg / 15 Pas.	1200x2000	1.5
L3/01	Bed Lift	Group Controlled with Facility of isolation of One lift from Group	Machine Room Type	3050X2450	2500X1500	1150kg / 15 Pas.	1200x2000	1.5
L3/02	Fire Lift			2200X1860	2100*1300	1150kg / 15 Pas.	1200x2000	1.5
L4/01	Passenger Lift	Group Controlled with Facility of isolation of One lift from Group		3050X2450	2100*1300	1150kg / 15 Pas.	1200x2000	1.5
L4/02	Bed Lift			2200X1860	2500X1500	1150kg / 15 Pas.	1200x2000	1.5
L5/01	Bed Lift	Independent Operation		3050X2575	2500X1500	1150kg / 15 Pas.	1200x2000	1.5
L6/01	Service Lift	Independent Operation		3050X2475	2100*1300	1150kg / 15 Pas.	1200x2000	1.5
L7/01	Service Lift	Independent Operation		3050X2475	2100*1300	1150kg / 15 Pas.	1200x2000	1.5

	Specification of Wheelchair Lift
Model	WL0.25-6.0
Lift Capacity	250 KG
Travel Height	6m (3 stops: 0m, 3m, 6m)
Platform Size	1200x900mm
Ramp	Fixed Ramp
In and Out	Through Access
Power Input	220v 50hz I phase
Speed	0.1m/s
Material	T6063 aluminium alloy
Convenient & Safety Design	
<ol style="list-style-type: none"> <li>1. Drive System: Hydraulic</li> <li>2. Control Mode: Inching Switch on Platform and column</li> <li>3. Control Ways: control panel on platform and vertical control column on ground and second floor</li> <li>4. Double tempered glass full cover</li> <li>5. Door: each set on each floor, total 3 sets</li> <li>6. Working Condition: indoors</li> <li>7. Installation: Non-pit installation, directly fixed to concrete floor (the concrete floor below the platform shall not be lower than the ground)</li> </ol>	
Safety Device: Reliable	
<ol style="list-style-type: none"> <li>1. Bottom Safety Sensor: the lift will be stopped immediately if the safety edge meets obstacles when going down</li> <li>2. Emergency stop: the lift can be stopped immediately in case of an emergency</li> <li>3. Manual decline: The lift can manually decline when the electricity fails.</li> </ol>	

## 22.5 System Description

### 22.5.1 General

22.5.1.1 The lift shall incorporate all necessary standard components required for such application all in accordance with applicable codes having jurisdiction. The Hoisting Machine shall include an Gearless AC drive motor, direct current electro-mechanical brake and integral traction drive sheave, mounted to the back of the car guiderail at the top landing.

22.5.1.2 The Hoisting Machine shall be equipped with an electric drive motor especially

designed for lift service, developing high starting torque with low starting current.

22.5.1.3 Motor horsepower shall be in accordance with the duty specified.

22.5.1.4 Motor shall be protected against over current by means of manual reset devices, which shall disconnect the supply to the motor in all three live conductors. These devices shall be fitted within the controller.

22.5.1.5 A thermistor or other solid state sensor shall be embedded in the windings of motor to detect potential over-temperature and shall operate to stop the motor. When the temperature falls below the sensor setting the motor may be automatically restarted.

22.5.1.6 Mounting of the Hoisting Machine shall incorporate isolation to minimize the transmission of noise and/or vibration to the building structure.

22.5.1.7 The Passenger Lifts shall serve all the levels intended for access by disabled persons. The panel for the lift control buttons shall be positioned between 900mm and 1200mm from the floor level. Grip rails shall be fixed on the sides and the rear of the lift car and shall be positioned not more than 900mm above the floor of the lift.

22.5.1.8 The Contractor shall supply and install all necessary dry contacts to enable the monitoring of the lift operation by the Building Management System.

22.5.1.9 The machine brake shall be electrically released and spring applied. The drive sheave shall be accurately turned and grooved for the quantity and size of Hoist Ropes applicable to this service. The geometry of the brake shall be such that the force between the brake shoes and the drum cannot be affected by assembly tolerances or by wear. The use of asbestos in the brake linings will not be accepted.

22.5.1.10 Traction steel hoist ropes, of size and number appropriate to insure proper wearing qualities, shall be provided. As a minimum, the number and size of ropes shall comply with the factor of safety requirements of the BS EN 81 Code for Elevators.

22.5.1.11 The Elevator System shall include a car frame, car safety, over speed governor and pit buffers for both car and counterweight; all integrated into this system in accordance with application criteria.

22.5.1.11 Counterweight Guard: A Counterweight Guard of the appropriate design and size shall be provided in place at the bottom of the hoist way.

## 22.5.2 Car Frames and Guide Shoes

### 22.5.2.1 Car Frames

The car of passenger lift shall be carried in a steel frame of channel and angle sections securely fixed together and substantially reinforced and braced to relieve the car enclosure of all strain and to withstand the operation of the safety gear under full-load conditions without any permanent deformation.

### 22.5.2.2 Guide Rails

Elevator car and counterweight guide rails shall be provided, erected plumb, and securely fastened to the hoist way framing. Design and provision of hoist way framing shall be of adequate strength and properly



positioned to withstand loads applied in conjunction with data provided by the elevator contractor.

#### 22.5.2.3 Guide Shoes

The car and counterweight frames shall incorporate heavy pattern adjustable sliding guide shoes fitted with renewable linings of durable non-ferrous material. Guide shoes shall be provided and mounted to the top and bottom of both the car and counterweight frame.

The guide shoes shall also be spring-loaded and resiliently mounted and self-aligning. Any necessary lubrication shall be applied by automatic means.

Each guide shoes assembly shall be arranged to maintain constant contact on the rail surfaces.

#### 22.5.2.4 Roller Guide Shoes

When roller guides are installed, they shall comply with the following requirements:

- Lift shall be provided with car and counterweight roller guides. Each roller guide shall consist of six or three wheels tired with a durable resilient material, each rotating on ball bearings having sealed in lubrication, assembled on a substantial metal base. They shall be so mounted as to provide continuous contact of all wheels with the corresponding rail surfaces under all conditions of load in gland operation. The wheels shall run on three finished rail surfaces. The roller guides shall be properly secured at the top and bottom on each side of the car frame and counterweight frame.
- The roller guides shall run on dry guide rails. Sheet metal guards shall be provided to protect the wheels on top of the car and counterweight. The roller wheels for the car shall not exceed 500rpm and the roller wheels for the counterweight shall not exceed 1000rpm at rated speed.
- The car and counterweights are to be statically balanced following fitting of all its equipment and finishes prior to fitting the guide rollers.

### 22.5.3 Safety Gear(s) and Overspeed Governor(s)

#### 22.5.3.1 Safety Gear

Safety gear shall be of an approved design and type tested in accordance with the requirements of BS 5655 or standards acceptable to the Engineers and shall bear the type approval mark. The car safety gear shall be attached to the car frame and shall be preferably placed beneath the car platform.

A dynamic test of the safety gear shall be carried out at the time of witness test(s) and examination. This test is required to establish not only the satisfactory application of the safety gear itself, but also its mounting to the car assembly, its compatibility with the governor, and to ensure the strength of the guiderails at their fixings to the building are adequate. The Contractor will be deemed responsible for damage to any equipment occurring from this test and shall subsequently carry out all necessary remedial works at his own expense.

#### 22.5.3.2 Over speeds Governor

The over speed governor shall be of an approved design and type tested in accordance with BS 5655 or standards acceptable to the Engineers and shall bear the type approval mark.

The design of the governor and its tripping arrangement shall be such that, upon reaching the tripping speed the rope does not travel more than 100mm before actual tripping occurs.

The over speed governor shall preferably be situated above the lift well and be rope driven from the car frame. In any event, the governor shall be accessible from outside the lift well.

Each over speed governor shall be marked with its electrical and mechanical tripping speeds in m/s. A convenient means for the manual release of the governor (jaws) shall be provided.

The governor return tension pulley shall be provided with an electric safety device in accordance with BS 5655 or standards acceptable to the Engineers.

Direction of rotation shall be marked on each over speed governor. The over speed governor guard shall be painted safety yellow, together with the return pulley on the governor tension frame.

#### 22.5.4 Counterweights

##### 22.5.4.1 General

The counterweights shall comprise a structural steel frame with cast iron filler sections held securely in position. The frame shall be fitted with four easily renewable guide shoes, and shall be statically balanced when roller guides are fitted.

The counterweight shall withstand the effect of buffer impact.

The counterweight frame and filler weights shall be painted safety yellow.

##### 22.5.4.2 Counterweight Screen

The counterweight shall be guarded by means of a screen extending from a position 0.2m above the lift pit floor to a position at least 2.5m above the lift pit floor.

The screen shall give adequate protection consistent with the correct maintenance of the equipment.

The counterweight screen shall be painted safety yellow.

#### 22.5.5 Cars

##### 22.5.5.1 Car Walls, Floor and Roof

Suitable facilities for the attachment of protective linings shall be provided in each lift car and the lift manufacturer shall supply a complete set of purpose made protective linings. The protective linings shall not obscure the load plate, the ventilation apertures, the telephone or the push button and signal panels.

The car walls, floor, and roof shall be made of non-combustible materials.

All surfaces within the car enclosure shall have a surface spread of flame not inferior to Class 2 of BS 476: Part 1.

Each wall of the car shall have a mechanical strength such that during the application of a force of 300N, applied at right angles to the wall, at any point, from the inside of the car towards the outside this force being evenly distributed over an area of 5cm<sup>2</sup> in a round or square section, the wall resists without elastic deformation greater than 10mm.

The complete interior finishes and fittings of the lift car including ceiling, walls, door trims, skirting's, floor

and lighting fittings shall be to selected designs, as specified by the ID/architect or to the engineer requirements. The contractor shall allow the provision of these dead load as specified.

The complete platform and car enclosure of each lift shall be effectively isolated from the car frame work by rubber pads or equivalent anti-vibration pads securely keyed into position to prevent displacement of the car platform and enclosure when the fully loaded car is stopped by buffering or application of the safety gear.

The car construction shall be non-resonant.

The car roof shall be fitted with a minimum of four safety hooks. Each clearly marked with its safe working load, for the attachment of safety harnesses.

#### 22.5.5.2 Ventilation

Natural ventilation shall be by apertures at high level and by apertures of similar area at low level. Additionally, a fan shall be fitted in the roof. The fan shall be fed from the car light supply and controlled from a key switch on the car push button panel. The design of the fan unit shall be based on low noise, by use of a plenum chamber and low noise, long life, maintenance free bearings on the fan motor

#### 22.5.5.3 Car Lighting

Interior lighting shall be by at least two fluorescent lamps, suitably enclosed, each operated from independent control gear or otherwise as directed by the engineers/Architect. The total value of illumination at floor level shall not be less than 200 lux.

In addition to mains operated fluorescent lighting an emergency fluorescent lighting system shall be provided for the car and top of car. The emergency lighting shall be energized automatically following the failure of the mains supply to the normal car lighting and shall provide constant illumination. The emergency lighting shall be of the non-maintained type as defined by BS 5266 or to Bomba's requirements.

The emergency lighting system shall be provided with a suitable means of simulating mains failure for test purposes. The installation shall be tested in accordance with BS 5266 and/or Bomba a signed certificate as required by the Standard shall be submitted before Practical Completion.

The luminaries for the emergency lighting shall be located and rated such that, in addition to giving general illumination of the car, they provide a vertical luminance over the front of the car to distinguish the car threshold, the telephone cabinet or intercom and the alarm button.

#### 22.5.6 Inspection Operation

The car top controls shall comply with the requirements of BS 5655 and/or standard acceptable to the Engineers shall also include the following combined into one convenient station:

- a. A door OPEN/CLOSE switch with the open and close positions legibly marked, or two push buttons with the open and close functions legibly marked.
- b. A permanent fluorescent light fitting suitably protected and separately switched.
- c. A 13amp switched socket outlet with RCD protection complying with the requirements of BS 1363, which shall be fed from the car light supply.
- d. An emergency mushroom head 'STOP' button.

An out of service symbol shall illuminate above each landing when on inspection control.

The control station shall be placed and designed so as to prevent it from being operated accidentally.

A maintenance stop limit switch associated with the car top control operation shall be provided, which shall when the car is moving in the upward direction, stop the car with its roof not less than 1.8m from the top of the well, or the lowest obstruction above the roof of the car, and allow inspection personnel on the car roof to open the terminal landing door in the event of a malfunction.

A non-maintained emergency light shall be provided on top of the lift car. The fitting shall be a

Fluorescent luminaries with an acrylic cover suitable for operation from the standby battery supply, and shall have a similar duration to the car interior emergency light.

#### 22.5.7 Fire Lift Operation

Each service/firemen lift shall be suitably indicated by the words "FIREMEN'S LIFT" shall be connected to the emergency supply provided by others such that it will be operative in case of mains failure.

A control switch enclosed in a glass fronted box marked 'FIRE SWITCH' shall be provided at homing level to enable the Fire Services Department to gain immediate control over the lift. Operation of the 'FIRE SWITCH' shall isolate the lift from control by the public and return the lift to homing floor, notwithstanding the direction in which the lift is travelling. On reaching the homing floor, the car buttons shall come into operation again, but the landing buttons shall remain inoperative.

Communication wiring and outlets as specified in the Code of Practice shall be provided.

##### 22.5.7.1 Operating During Mains Power Failure

Emergency power supply sufficient for the continued operation of one lift only in each bank of passenger lifts shall be provided (by others). A pair of normally-open and normally-closed contacts monitoring the Mains Power Supply will also be provided (by others) in each lift machine room. These contacts will change status in the event of a power failure.

The Contractor shall provide everything necessary and make the connections to enable the lifts to be operated in sequence in the following manner: -

Each lifts in the group shall move directly to the homing floor and open their doors to discharge any passengers inside. They shall then shut-down with the doors remaining open. (Note: Any lift proceeding in the upward direction shall reverse and proceed downwards).

One lift in a group shall resume operation on the emergency power until normal power is restored.

It shall be possible to increase the number of lifts which operate on emergency power by reprogramming of the software of the microprocessor control system.

The fire lift shall continue in normal operation on emergency power supply during the Mains power failure.

##### 22.5.7.2 Operating During Fire Alarm Activation

The Contractor shall connect the lift controls to the fire alarm system. A pair of normally-open and normally-closed contacts which will change status when the fire alarm is activated will be provided by others in each lift machine room.

The operation of the lifts when the fire alarm is activated shall be as follows: -

When a fire alarm is initiated, all lifts, whether they may be parked or travelling, shall be arranged to return the homing. On arriving at the designated floors, the lift doors shall open to discharge any passengers and the lifts shall be kept parked in this manner, with all landing and car control buttons being inoperative.

Should the fire alarm be initiated from the homing floor then the lifts shall travel to the designated alternative floor instead of the homing floor.

The fire lifts shall remain operational at all times upon activation of the FIRE switch.

The lifts shall not return automatically to normal service upon de-activation of the fire alarm system. Normal operation of lifts shall only be restored by manual re-setting through the keyboard in the Fire Command Centre.

#### 22.5.7.3. Main Operation and Display Terminal

The main 15" Visual Display Unit (color) and operator keyboard for the microprocessor lift control system shall be located in the Fire Command Centre.

The VDU shall provide continuous monitoring and testing of the Group Supervisory Control System, programmed status information and operational data for all lifts in the building. A high-speed wide -carriage dot matrix printer shall be provided to give hard copy of the VDU display, status, alarm and maintenance reports, etc.

The lift emergency intercom system shall be installed on a desk-type console.

All control and telephone wiring between the lift shafts/machine rooms and the Fire Command Centre shall be laid in concealed conduits and installed by the Contractor.

Lift System should be connected with Building Management System through a open protocol like BacNet/ModBus etc. to monitor to all lift operations/Alarms and all other functions.

#### 22.5.8 Power Door Operator

##### 22.5.8.1 Door Operation

The car and landing doors shall be automatically operated by a door operator mounted on the car. The operator shall impart smooth movement.

A toothed belt driver, V3FAC permanent magnet motor shall be provided to open and close the car and hoist way doors simultaneously. The doors shall be positively coupled and driven in both directions by the operator.

The opening and closing speed of the door operator shall be easily adjusted from within the controller to suit operating conditions. The speeds shall be initially set to the times recommended by the Contractor.

During operation, the door speed shall have sinusoidal characteristics.

Door movement shall be cushioned at both limits of travel. An electric contact shall be provided on the car at each car entrance to prevent the operation of the elevator unless the car door is closed.

An electro-mechanical interlock shall be provided at each hoist way entrance to prevent operation of the elevator unless all doors are closed and locked.

Where the lift door drive motor is controlled to give variable speed the opening movement shall commence in the leveling zone and be substantially complete by the time that the car has stopped at the landing.

Doors shall open automatically when the car has arrived at or is leveling at the respective landings.

Doors shall close after a predetermined time interval or immediately upon pressing of a car button.

A door open button shall be provided in the car. Momentary pressing of this button shall reopen the door and reset the time interval.

It must be possible in the event of a power failure to manually open the car and landing doors simultaneously by means of an emergency release key, after having manually lowered the lift car to a landing.

The car door shall be provided with a protective infrared curtain of light (min 40 beams) device extending the full height. This device shall be designed to sense an obstruction in its path while the doors are closing and automatically cause the car and hoist way door to return to the open position. The doors shall remain open until the expiration of a time interval; the doors will then close automatically.

The interval of time, which the doors are in the fully open position, shall be easily adjustable, to a maximum period of 30 seconds to allow for particular needs of the building, initially set at two (2) seconds.

Door hangers and tracks shall be provided for each car and hoist way door. Tracks shall be contoured to match the hanger sheaves. The hangers shall be designed for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall be polyurethane tires and pre lubricated and sealed-for-life bearings.

#### 22.5.9 Car Doors

##### 22.5.9.1 Doors

Each car door panel shall have two-point adjustable suspension, which shall run on sealed ball/roller bearing wheels in hangers and have robust adjustable anti-tilting devices. Channel tracks shall be self-cleaning.

Each car door shall have a mechanical strength such that during the application of a force of 300N, applied at right angles to the door, at any point, from the inside of the car towards the outside this force being evenly distributed over an area of 5cm<sup>2</sup>, in round or square section, the door resists without elastic deformation greater than 10mm.

The door linkage assemblies shall be robust and incorporate sealed anti-friction bearings.

##### 22.5.9.2 Car Apron

The mechanical strength of the apron fitted to the car sill shall be such that when a force of 300N is applied at right angles at any point this force being evenly applied over an area of 5cm<sup>2</sup>, in round or square section, elastic deformation does not exceed 10mm.

##### 22.5.9.3 Protection during Operation of Doors

The car door(s) shall be provided with one or more of the following protective device(s) fitted to the leading edge(s), as specified in the schedules:

- a. A full height retractable safety edge (RSE)

- b. An electronic safety edge (ESE)
- c. An electronic passenger detector (EPD).

The sensitivity of the doors to an obstruction when closing shall comply with the requirements of BS 5655, and/or standards acceptable to the Engineers with the following:

- a. The protective device(s) shall be effective from not more than 25mm above the sill and to a height of not less than 2.0m above the sill. Where designed to be operated by contact with an obstruction, its operation force shall not exceed 15N. The protective device(s) shall not project beyond the panel(s) when the doors are fully open (to give the specified clear width of door opening).
- b. The protective device(s) shall cause the doors to re-open when the car door is prevented from closing completely by an obstruction that enters the protective device zone.

A concealed infrared photo-electric cell unit shall be provided for each pair of doors.

If during closing at their normal speed the doors meet an obstruction that has not operated the protective device(s) they shall re-open with the minimum of delay. The force exerted on such an obstruction and its maximum and minimum width shall be stated by the Contractor in his Contract.

During the witness tests the Contractor shall demonstrate that performance complies with the figures given in the Contract.

#### 22.5.9.4 Opening the Car Door

It shall not be possible to open a car door whilst the lift is in motion, except during the pre-opening condition. All car doors shall be provided with an electrical and mechanical interlock.

### 22.5.10 Landing Doors and Entrances

#### 22.5.10.1 General

When the landing doors of Hairline Stainless Steel are closed the clearance between panels, or between panels and uprights, lintels or sills, shall not exceed 5mm.

The landing doors shall be provided with automatic closing devices (spring or gravity weight) and have provision for being opened by an emergency release key. This key shall fit the unlocking triangle as defined in BS 5655.

#### 22.5.10.2 Strength of Doors, Frames and Their Architraves

Each landing door car shall have a mechanical strength such that during the application of a force of 300N, applied at right angles to the door, at any point, from the inside of the car towards the outside this force being evenly distributed over an area of 5cm<sup>2</sup>, in round or square section, the door resists without elastic deformation greater than 10mm.

#### 22.5.10.2 Sills, Guides, Door Suspension

Each door shall be complete with a combined track, sill and supporting steel frame. Each door panel shall have two-point adjustable suspension, which shall run on sealed ball/roller bearing wheels in hangers and have robust adjustable anti-tilting devices. Channel tracks shall be self-cleaning.

The Contractor shall be responsible for ensuring that the sills for lift landings are installed so that they are level with the finished floor datum level of the landings and shall co-ordinate the installation with the Main Contractor.

Guide blocks shall be fitted at the bottom of each door panel to prevent twisting of the door panel, even after wear. These guide blocks shall be easily renewable from the well side of the door panel without the door having to be lifted or removed. Each guide block unit shall incorporate a robust safety flange extending downwards into the bottom track such that, in the event of the collapse or breaking adrift of the normal rubbing surfaces of the guide block, the safety flange will prevent the bottom of the door panel from being pushed into the lift well.

#### 22.5.10.3 Locking And Closed Landing Door Check

When multi-panels of doors are indirectly linked, each panel shall be electrically interlocked. The door locking devices shall be of a design type tested in accordance with BS 5655 and shall bear the type approval mark.

Any trailing panel shall be directly hooked to its leading panel in the closed position, separately from its linkage.

#### 22.5.10.4 Landing Door Sight Guards

All landing doors shall be fitted with sight guards with engraved floor designation; this engraved floor designation shall be at least 50mm in height at 1500mm above floor level.

#### 22.5.10.5 Fascia Plates And Apron

Sheet steel fascia plates, at least 100mm wider than the clear door opening, shall be provided between the undersides of each track or sill and the top of the door supporting frame below. A steel ramped apron shall be provided below the lowest track or sill.

The mechanical strength of the fascia plates and apron shall be such that when a force of 300N at right angles is applied at any point, this force being evenly applied over an area of 5cm<sup>2</sup>, in a round or square section, elastic deformation does not exceed 10mm.

#### 22.5.10.6 Architraves And Transom Panels

All architraves and transom panels for lift and associated landing doors of Hairline Stainless Steel shall be supplied and fitted as part of the Contractor and full details of the proposed types shall be submitted with the Contract,

#### 22.5.10.7 Fire Rating

Unless specified otherwise in the schedules, all landing doors and door entrance arrangements shall have a minimum certificated fire rating of 1 hour. A certificate of compliance shall be provided in the O&M manual.

### 22.5.11 Car Fixtures

#### 22.5.11.1 Hands Free Telephone

The lift manufacturer shall provide a 'hands free' Telephone System.

The Contractor shall include for all wiring from the telephone to a connection terminal, including a travelling cable with a termination point in the lift machine room.

The 'hands free' telephone shall be activated by the alarm button, and compatible with the building



telephone system. Fireman Intercom System shall be the system shall be activated if the alarm button is depressed for 5-10 seconds adjustable.

A suitable notice approved by the Architect is to be engraved on the car-operating panel informing passengers that the 'hands free' telephone is activated by the alarm button.

#### 22.5.11.2 Emergency Alarm Device

An emergency signal shall be provided in addition to the hands free emergency telephone. The signal shall be powered by the emergency lighting battery. While depressed, the alarm button in the car shall illuminate to indicate that the emergency signal is functioning. The alarm system shall be capable of being extended by others to a central alarm panel and a volt-free contact with suitable terminals shall be provided for this purpose in the machine room or other specified location.

The emergency alarm signal bell shall be fitted within the lift well at the main entrance level, and an assurance bell shall be fitted on the car roof.

#### 22.5.11.3 Load Plates

A load plate, stating in bold characters approved by the Architect indicating the maximum permissible load in passengers and in kg to be carried, shall be provided in the lift car. The load plate shall be fitted in a conspicuous position, or engraved on the car operating panel(s).

#### 22.5.11.4 Intercom

An intercom including all wiring shall be installed between the lift car, lift motor room and Fireman Control Room, powered from the standby generator set.

The Contractor shall include for all wiring from the instrument to a connection terminal box, including a travelling cable with a termination point in the lift machine room. Before installation, the Contractor shall seek confirmation of the number of cores actually required for the intercom and arrange for at least 4 spare cores in the travelling cable.

### 22.5.12 Push Button and Signal Panels

#### 22.5.12.1 General

Push button and signal panels shall be flush mounted. The floor designations and other markings shall be agreed by the Architect. Any abbreviations shall be clear: e.g. '2' would be acceptable for a 'second floor' but 'OD' would not be permitted for 'open door'. Two such panel (car operating boards) shall be provided. Car and landing push buttons for passengers' normal use shall be located between 900mm and 1200mm from floor level. The emergency alarm button shall not be located above 1200mm from the car floor level. The use of incandescent lamps will not be permitted.

The car controls shall be located at a distance at least 400mm from the front wall of the lift car. Routine maintenance and circuit board replacement shall not involve disturbing any wiring which is not truly flexible and properly anchored.

Push buttons may be of the following types.

- i. Micro movement touch button type
- ii. Non-movement electronic touch-button type
- iii. Vandal resistant type with Braille/tactile markings.

All car and landing controls shall be contained in recessed metal boxes, fitted with a face plate. All face plates of controls and indicators etc, shall be secured with secret fixings.

#### 22.5.12.2 Landing Push Button Panels

On fully automatic push button (FAPB) control or down collective (DC) installations one call button shall be provided at each landing entrance and the panel shall include a signal light to indicate that a call has been registered and will be answered.

On directional (DCC) collective or group (GROUP) control installation:

- a. One call button shall be provided at each terminal landing.
- b. Double call buttons shall be provided at each of the intermediate landings.
- c. The panels shall include a signal light for each button to indicate that a call has been registered and will be answered.

#### 22.5.12.3 Car Indicators

A position indicator shall be provided at an agreed position in each lift car serving more than two floors, together with a direction of travel indicator.

#### 22.5.12.4 Landing Indication

Position indicators shall be provided for all floors. Position indicators for all other lifts shall be located at ground level.

Direction of departure indicators shall be provided at each landing for each directional collective lift to show the next direction of departure.

The Contractor may include for their standard designs providing their equipment fully meets the requirements as detailed in the Specifications and schedules. All markings and symbols proposed for buttons and indicators shall be submitted to the Architect, before manufacture is commenced.

The Contractor shall provide illustrated details with the Contract for all types of car and landing control panels and indicators, including buttons, fascias etc.

Equipment exposed to the weather shall be of weatherproof and non-corroding construction.

#### 22.5.12.5 Car Control Station

The car control station shall contain the following:

- a. Illuminating type alarm push button (colored yellow).
- b. One floor dispatch button, illuminating type, for each opening served.

All other controls listed or Specification, or required for operation.

### 22.5.13 Controllers

#### 22.5.13.1 Control Panels

The controller, which includes panels and all control equipment, shall be situated in the front wall of the hoist way at the top landing and shall comprise a suitably ventilated steel enclosure, with conveniently hinged opening front access door and, where appropriate, removable rear panels.

The cabinets may be unventilated provided that all major heat-producing components such as resistor banks are housed in a separate ventilated cabinet. All resistors shall be adequately supported so that fixings are

not loosened by vibration, over the life of the controller.

The components shall be designed and mounted in a manner, which facilitates inspection, maintenance, adjustment and replacement. Earth connections shall only be made at a common link on the control panel. No short-circuiting between adjacent connections shall create an unsafe condition.

The components shall be permanently labeled and any codes or abbreviations shall exactly match the as fitted wiring diagram. Self-adhesive embossed plastic labels are not acceptable.

The brake solenoids and any retiring ramp shall operate on direct current. Control circuits at normal mains voltage shall be connected between phase and neutral.

Transformers supplying control circuits shall be double wound with earth screen between primary and secondary windings. Where a rectifier is used, the negative pole of such a circuit shall be earthed and no single pole switch, fuse or device other than a link for testing purposes shall be placed in that pole of the circuit. Removal of any link shall prevent operation of the lift. The positive line shall be protected by an instantaneous overload circuit breaker, independently of the protection for the remainder of the control circuitry. All capacitors, resistances and wiring shall be well constructed and correctly installed to ensure that overheating cannot occur.

Within the controller, a separate circuit-breaker shall incorporate adjustable time lagged over-current protection and any necessary protection against overheating for all motor windings, including door operator motor. The use of motor thermistors to protect against over-current will not be acceptable.

Paint finishes shall be in semi-gloss to RAL Color to 9006. Non-combustible material shall be used for control panels and their supporting frames.

Where lifts are operated and controlled by polyphaser a.c. power supplies, the control system shall incorporate means to prevent the motor and brake from being energized in the event of phase failure/reversal. Contactors for reversing direction of travel shall be mechanically and electrically interlocked.

#### 22.5.13.2 Control Panel Equipment

The control system shall be of the microprocessor type. The Contractor shall provide detailed information with his Contract describing its operation and any special requirements especially regarding limiting temperatures/humidities and interference from other apparatus. Contactors shall be suitable for operation at 415/240V. Power fuses MCBs shall be provided to protect the contactors and associated cable links. Fuses MCCBs associated with the drive motor shall be co-ordinate with the motor starting current/time characteristic. All control equipment shall be designed and laid out within the controller enclosure to facilitate ease of maintenance and inspection of said equipment.

Otherwise specified, the wiring from the lift switchboard shall be of the low smoke and fume halogen free(LSF) type insulated to BS 6387 cat C,W,Z in phase colors either in self-colored cable or utilizing appropriate colored ferrules. The color coding shall be as follows:

- i. Phase connections - red, yellow blue
- ii. Neutral connections - black
- iii. Earth connections - green/yellow.

Terminals shall be of the screw-clamp type, or equal alternative. A minimum of 10% spare terminals shall be provided for control wiring. All push buttons, control switches, indicating lamps, indicating instruments, etc, shall be mounted on the front of the panel.

#### 22.5.13.3 Terminal Stopping and Final Limit Switches

Each lift shall be provided with terminal stopping switches and final limit switches at each terminal landing.

Their operation shall be independent from the normal stopping device and they shall be mechanically operated and stop the car automatically before the buffer is engaged. Final and terminal stopping switches, when fixed on the car frame or in the lift well, shall be securely mounted in such a manner that the movement of the switch levers to open the contacts is positive and not affected by normal 'float' of the car.

#### 22.5.14 Power and Operational Controls

##### 22.5.14.1 Power Control

The elevator power control system shall be a digital, solid state based control system. The power control system shall provide smooth, accurate speed regulation and efficient operation.

The power control system shall interface with the microcomputer elevator logic providing closed loop position control.

The power control system shall be designed to vary the alternating current power supply to the AC hoist motor providing smooth acceleration and deceleration regardless of elevator load, and shall use IGBT technology in the power stage in order to deliver power to the motor in a quiet mode, minimizing the need for external power filters for quiet operation.

Solid state load/torque balancing circuitry shall be incorporated to automatically monitor car load prior to start and adjust the hoist motor torque to assure smooth car start-up.

The power control shall be fully factory pre-set, minimizing the need for field adjustment. Computer inputs shall tailor the power control to the specific elevator design parameters. Provision shall be made for minor field adjustment. Such adjustments shall generally be non-interacting. That is, adjustment of one characteristic shall not necessarily affect the adjustment of another.

##### 22.5.14.2 Elevator Operation

Selective Collective Control: Pressure upon one or more car buttons shall send the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed, provided the hoist way door interlock and car door switch circuits are completed.

During this operation, the car shall also answer calls from the landings, which are in the prevailing direction of travel. Each landing call shall be cancelled when answered.

Pressure upon a hall button at a floor above the car location shall cause the car to start up and answer any up calls as they are reached by the car irrespective of the sequence the buttons have been pressed.

The car shall not stop at floors where down buttons only had been pressed. If no further car or up hall calls are registered, the car shall reverse its direction preference to response to car calls or down hall calls.

The car shall start down to answer calls below the car and shall not stop where only up calls are registered. When travelling up, the car shall reverse at the highest call and proceed to answer calls below it. When travelling down, the car shall reverse at the lowest call and answer calls above it.

Should both an up and a down call be registered at an intermediate landing, only the call responding to the direction in which the car is travelling shall be cancelled upon the stopping of the car at the landing.

Terminal limit switches shall be provided in the hoist way designed to automatically stop the car at or near the closest terminal landing. Each elevator machine shall be provided with a tachometer in order to provide accurate feedback to the controller as to car position. All individual elevator control adjustment parameters shall be stored in non-volatile memory within the computer control system.

At each landing, a vane shall be installed to provide the code required floor zone detection. The vane shall also serve as a method for referencing absolute building points for the controller.

In the event of power loss, the elevator shall emergency brake to a stop. When normal power is restored, the elevator shall automatically restart and level to the nearest floor, providing it is safe to do so. If power is restored under Emergency Power Conditions, the elevator shall operate as described in this specification under the separate heading, "Emergency Power Operation".

#### 22.5.14.3 Emergency Power Operation

In the event of cessation of normal building power, the elevator(s) shall brake to an emergency stop. After a predetermined time, interval, emergency power shall be provided to the elevator(s) through the normal disconnect switch(s). The elevator shall start and return non-stop to the emergency power recall floor where it will stop and automatically open its doors. If there is more than one elevator in the bank, each elevator, one at a time, shall also return to the emergency power recall floor and park with its doors either open or closed until all cars have returned to that floor. When all cars have returned, a pre-selected car shall continue to run under emergency power.

Auxiliary Operations and Controls include the following:

- a) Independent Service
- b) Fireman's Control
- c) Home Landing
- d) Zoned Access at bottom floor
- e) Zoned access at top floor
- f) Sequence starting (under emergency power)
- g) Floor key switch lockouts at ground floor.

#### 22.5.15 Signal Fixtures

##### 22.5.15.1 Car Operation Station

Each elevator shall be equipped with a Main Car Operating Station, located integrally in a vertical swing panel and containing call registration buttons in accordance with the logic operation specified. The Main Car Operating Station shall also include alarm button, tactile plates, and light switch, as well as any other device(s) required by applicable code and/or as explained within this Part.

Each Car Operating Station shall be equipped with illuminating pushbuttons which, when pressed, shall signal the car passenger that the call has been registered. The button shall remain illuminated until the call has been answered. All devices operable by the general public and mounted in the car operating panel(s) shall be identified with Braille and/or tactile symbols. The car operating panel(s) and hall pushbutton stations shall be located (vertically) in accordance with code requirements to assist the handicapped. As a minimum, all Braille indicators shall meet the requirements of the Barrier Free Access Code.

##### 22.5.15.2 Car Position Indicator

A car position indicator(s) consisting of a red LED display shall be provided in the car. The position of the car shall be indicated by single or dual numeral and/or letter floor designations along with an arrow indicating direction of car travel. The position indicator shall be located above the Car Operating Station.

##### 22.5.15.3 Hall Pushbutton Stations

Hall pushbutton stations shall be provided at each landing served by the elevator system proposed. One number of hall stations per landing shall be provided. Illuminating pushbuttons shall be provided in each hall

pushbutton station which, when pressed, shall signal the waiting passenger that the call has been registered. The button shall remain illuminated until the call has been answered.

Where hall lanterns are specified, provide a single fixture at all floors. Locate this fixture either vertically aligned or above the hall station(s) or horizontally above the hoist way entrance.

#### 22.5.15.4 Car Direction Signs

Car direction sign(s) shall be supplied which shall include directional indications. The appropriate arrow shall illuminate to correspond with the direction in which the car is set to travel.

#### 22.5.15.5 Hall Lanterns

Hall lanterns, including audible signals, shall be provided. As soon as the car has reached a predetermined distance from a landing and is set to stop at that landing, the hall lantern corresponding to the direction the car shall travel shall be illuminated and the audible signal shall sound. The lantern shall remain illuminated until the doors have closed. Single lanterns shall be furnished at terminal landings and Up/Down lanterns shall be furnished at intermediate landings.

#### 22.5.15.6 Signal Fixture Finishes

All metal used on exterior surfaces of the signal fixtures shall be to ID/architect's approval.

An inspector's operating station shall be provided on top of the elevator car consisting of up and down constant pressure buttons and an emergency stop switch. This device shall also contain a light with guard and switch and a duplex 220 VAC outlet. An emergency stop switch shall be provided in the elevator pit, designed to cut off current supply to motor and bring the car to rest independent of the regular operating devices. An electric alarm bell shall be provided in or adjacent to the elevator hoist way. This bell shall be connected to the alarm button in the car operating panel.

#### 24.5.16 Passenger Cab Enclosure

The elevator cab(s) shall meet the requirements of the CP-2 Elevator Code and all Elevator Code Supplements issued to date, including Code restrictions pertaining to flame spread and smoke generation.

Cab features shall include:

- i. White canopy
- ii. Return wall(s) to be integral design with entrance columns
- iii. Emergency light with battery and charger (EBOPS)
- iv. Emergency exit(s) in ceiling
- v. Finished flooring (supply and installation) is specified under another section of these specifications. Total thickness of flooring, including substrate, shall not exceed 25mm in depth, and finished flooring weight shall not exceed 25kg/m<sup>2</sup> of platform size.

Return walls shall be finished into ID/architect's approval. Side and rear wall panels shall be constructed from 16-gauge steel finished in black baked enamel. The suspended ceiling shall be comprised of removable, translucent, closed cell, vinyl grid panels. Fluorescent light fixtures shall be provided above the suspended ceiling. Fixtures shall be provided insufficient number to meet minimum code requirements. The suspended ceiling shall be supported in a natural anodized aluminum frame. The suspended ceiling shall be supported in a ceiling frame finished in black baked enamel. A drop ceiling, with incandescent down lights for cab ceiling lighting, shall be provided and shall be finished in to ID/architect's approval.

The clear height under the suspended ceiling shall be 2200mm. Provide a steel shell finished in to ID/architect's approval. The wall(s) containing car operating panel(s) shall be of the vertical swing design. Car door panel(s) shall be finished on the car side in baked enamel color as selected from the manufacturers submitted standard color selections. Car door panel(s) shall be clad on car side. A flat metal handrail shall be mounted on rear wall and shall be finished in to ID/architect's approval.

#### 22.5.17 Passenger Type Hoist way Entrances

Hollow metal, horizontal sliding hoist way entrances shall be provided at all openings.

Entrance type and clear opening entrance size shall be in accordance with data at the beginning of these specifications. Sills, struts, headers, hanger covers and unit frames shall be erected by the elevator contractor and set in proper relation to the car guide rails. Such erection is to be accomplished prior to construction of rough walls. Door panels shall be installed by the elevator contractor after the wall erection is completed.

Entrances shall include unit frames, flush design door panels, sight guards, sills, strut angles, headers, hanger covers, fascia plates, toe guards, dust covers, and necessary hardware. Necessary support for entrance sills shall be included.

Material and finish for fascia, hanger covers, toe guards, dust covers and structural members shall be fabricated and finished in accordance with the elevator contractor standards. Entrance Frames: Hoist way entrance frames shall be finished in to ID/architect's approval. Door Panels and Sight Guards: Hoist way door panels and sight guards shall be finished in to ID/architect's approval. Entrance Sills: Entrance sills shall be constructed of extruded aluminum. All hoist way entrance frames shall have a square profile. Standard entrance jamb tactile markings (i.e. jamb plates) shall be supplied on both jambs, at all floors. Plates shall be finished to match hall fixture metal finish.

#### 22.5.18 Electronic Door Safety Device

The elevator car shall be equipped with an electronic protective device extending the full height of the car door. When activated, this sensor (min 4 sensors) shall prevent the doors from closing or cause them to stop and reopen if they are in the process of closing. The doors shall remain open as long as the flow of traffic continues and shall close shortly after the last person passes through the door opening.

#### 22.5.19 Lift Pits

Emergency mushroom head buttons shall be installed in the lift pit which, when activated, shall instantly stop the car and isolate its supply. Buttons shall be of the 'stay put' type.

These buttons shall be positioned adjacent to the pit access door or ladder such that it can be operated before inspection personnel enter the pit and also when they are within the pit, and shall be engraved run/stop.

A socket outlet controlled by a local RCD shall be provided in the lift pit by the Contractor. The pit access ladders shall be painted safety yellow & provided by Contractor.

#### 22.5.20 Maintenance and Spares

##### 22.5.20.1 Maintenance

The Contractor shall furnish maintenance for the entire lift equipment supplied and installed under this Contract for a period of twelve months from date of the Employer's Representative's Certificate of Practical Completion for the Section. This maintenance shall include systematic and periodical fortnightly examination, adjustment, and lubrication of all lift equipment plus 24-hour emergency calls out. The Contractor shall also repair or replace electrical and mechanical parts of the lift equipment whenever this is required and shall use only genuine standard parts produced by the manufacturer of the equipment

concerned. Renewals or repairs necessitated by reason of negligence or misuse of the equipment, or by reason of any other cause beyond the control of the Contractor, except ordinary wear and tear shall not be the responsibility of the Contractor. All work under this maintenance provision shall be performed by competent personnel under the supervision and in the direct employ of the Contractor. At the end of the maintenance period, the Employer's Representative will carry out a further test on the lift plants and any defects shall be rectified by the Contractor without charge to the Employer.

The Contractor shall submit with his tender a totally comprehensive maintenance proposal for all the lifts for a period of three or five years after the first twelve months' defects liability period.

#### 22.5.20.2 Spares Parts

The Contractor shall provide all spare parts necessary for proper maintenance of the lifts during the defects liability period. The Contractor shall also supply a list of manufacturer's recommended spare parts for 1-year operation.

#### 22.5.20.3 Special Tools and Maintenance Equipment

The Contractor shall provide a complete set of special tools and maintenance equipment for maintenance, testing and emergency operation of each of the lifts covered under this Contract.

The set of special tools and maintenance equipment shall be in accordance with the recommendations of the manufacturers of the lift equipment and machinery and shall include all necessary items for emergency rescue operations. The special tools and maintenance equipment shall be contained in freestanding, lockable cabinets of approved design and shall be delivered and installed at locations approved by the Employer's Representative.

### 22.5.21 Testing and Commissioning

#### 22.5.21.1 General

The Contractor shall be responsible for all the tests required to ensure the proper function and operation of the lifts and service hoists under this Contract. A minimum of seven days' notice shall be given to the Employer's Representative, or his representatives, before any testing and commissioning operations are commenced on site.

#### 22.5.21.2 Lifts

Before the lifts are accepted and put into service on the specified maintenance period, each shall, under the supervision of the Employer's Representative, satisfactorily pass the following tests: -

- a. 10% overload test.
- b. 30 minutes full load test.
- c. Lift motor current and speed test.
- d. Door inspection and test.
- e. Electrical insulation resistance to earth test
- f. Earth continuity resistance test.
- g. Safety gear test.
- h. Buffer test.
- i. Break test.
- j. Electrical protective device tests.
- k. Leveling device tests.
- l. Automatic Rescue Device test.

Generally, the lift shall be made to run under various loading conditions from no load to 10% overload in order to check its operation and floor finding accuracy.



The 10% overload test is to ensure that the equipment installed has ample safety margin, above the rated load incorporated in the design and it is not expected that the floor leveling as guaranteed under full load conditions will be maintained during the overload test.

#### 22.5.21.3 Lift Testing and Commissioning

The lift shall also be subject to a 30 minutes test with the car fully loaded during which it shall stop at each floor on the up and down trips, opening and closing its doors at each stop. The test shall be continuous, the stops being ten seconds maximum duration, with the door open or alternatively the number of starts per hour shall be as stated in the specification. During the test, the equipment shall not overheat, spark excessively, become noisy or operate in a faulty manner.

All the tests shall be carried out by the Contractor's Chartered Electrical Engineer and the results shall be signed and recorded in a tabulated form for easy checking and reference.

#### 22.5.21.4 Other Tests

The Contractor shall also carry out any other tests required by the Employer's Representative or the Government Authorities in order to prove that the equipment complies with the contract documents, codes, rules and regulations covering equipment supplied under this Contract.

#### 22.5.21.5 License To Operate Lifts

The Contractor shall complete all necessary Forms, Submissions and Certificates which must be duly signed by the Contractor's Qualified Chartered Electrical Engineer carrying out the tests and forward them to the Employer to enable the Employer to obtain the entire necessary License to operate the lifts.