TECHNICAL SPECIFICATIONS

(Section VI – Employer’s Requirements)

Client: Ministry of Health

Consultant: Riyan Pvt Ltd

Funding Agency: Government of Maldives

**TECHNICAL** **SPECIFICATIONS**

**1. PRELIMINARIES .................................................................................................................................... 1**

1.1 STANDARD AND CODES ............................................................................................................................ 1

1.2 DRAWINGS AND SPECIFICATIONS ................................................................................................................ 1

1.3 TRANSPORTATION TO THE SITE................................................................................................................... 1

1.4 SCHEDULE AND EXECUTION PLAN ............................................................................................................... 1

1.5 REPAIRING AND CORRECTION .................................................................................................................... 1

1.6 WORKMANSHIP AND MATERIALS................................................................................................................ 1

1.7 OBVIOUS WORK ..................................................................................................................................... 2

1.8 PROTECTION ......................................................................................................................................... 2

1.9 SCAFFOLDING......................................................................................................................................... 2

1.10 CONSTRUCTION MACHINERY, PLANTS AND EQUIPMENT’S ................................................................................2

1.11 SAMPLES............................................................................................................................................... 3

1.12 ORDERING MATERIALS............................................................................................................................. 3

1.13 WATER AND ELECTRICITY FOR THE WORKS ................................................................................................... 3

1.14 SITE OFFICES FOR CONTRACTOR ................................................................................................................. 3

1.15 CONTRACTOR’S SITE AREA ........................................................................................................................ 4

1.16 PROGRESS MEETINGS .............................................................................................................................. 4

1.17 PROGRESS PHOTOGRAPHS ........................................................................................................................ 4

1.18 SETTING OUT ......................................................................................................................................... 5

1.19 BILLBOARDS........................................................................................................................................... 5

1.20 LOADING IN EXCESS OF DESIGN LOAD .......................................................................................................... 5

1.21 BUILDING PERMIT ................................................................................................................................... 5

1.22 PERMANENT DRAINAGE, ELECTRICITY AND WATER CONNECTION ....................................................................... 6

1.23 HANDING OVER...................................................................................................................................... 6

**2. SITE WORKS............................................................................................................................................... 7**

2.1 DEMOLITION.......................................................................................................................................... 7

2.2 SITE CLEARANCE ................................................................................................................................... ...8

2.3 EXCAVATION ........................................................................................................................................ ..8

2.4 DE‐WATERING...................................................................................................................................... ..9

2.5 BACKFILL............................................................................................................................................. 10

**3. CONCRETE WORKS.................................................................................................................................. 11**

3.1 GENERAL............................................................................................................................................. 11

3.2 CEMENT............................................................................................................................................. 11

3.3 AGGREGATE......................................................................................................................................... 11

3.4 WATER ............................................................................................................................................... 13

3.5 HANDLING AND STORAGE OF MATERIAL..................................................................................................... 13

3.6 MIX PROPORTION AND STRENGTH ............................................................................................................ 13

3.7 PRODUCTION OF CONCRETE .................................................................................................................... 14

3.8 TRANSPORTING AND PLACING.................................................................................................................. 15

3.9 CONCRETE CURING................................................................................................................................ 16

3.10 TEST .................................................................................................................................................. 16

3.11 CONCRETE........................................................................................................................................... 17

3.12 DEFECTIVE CONCRETE AND FINISHES ......................................................................................................... 17

**4. CONCRETE FORMWORK.......................................................................................................................... 18**

4.1 STRUCTURE AND MATERIAL..................................................................................................................... 18

4.2 PERFORMANCE..................................................................................................................................... 18

**5. STEEL REINFORCEMENT .......................................................................................................................... 21**

5.1 MATERIAL ........................................................................................................................................... 21

5.2 CLEANING ........................................................................................................................................... 21

5.3 BENDING AND LAPS ............................................................................................................................... 21

5.4 REINFORCEMENT COVER......................................................................................................................... 21

5.5 PLACING ............................................................................................................................................. 21

**6. WATER PROOFING.................................................................................................................................. 23**

6.1 DESCRIPTION OF WORK .......................................................................................................................... 23

6.2 MATERIALS.......................................................................................................................................... 23

6.3 STORAGE OF MATERIALS ......................................................................................................................... 23

6.4 SURFACE PREPARATION .......................................................................................................................... 23

6.5 APPLICATION ....................................................................................................................................... 24

6.6 CURING .............................................................................................................................................. 24

**7. EMBEDDED DAMPPROOF MEMBRANE.................................................................................................... 25**

7.1 GENERAL............................................................................................................................................. 25

7.2 PRODUCTS........................................................................................................................................... 25

7.3 WORKMANSHIP.................................................................................................................................... 25

**8. STRUCTURAL STEEL................................................................................................................................. 26**

8.1 SCOPE ................................................................................................................................................ 26

8.2 MATERIALS.......................................................................................................................................... 26

8.3 FABRICATION ....................................................................................................................................... 26

8.4 BOLT.................................................................................................................................................. 27

8.5 WELDING............................................................................................................................................ 27

8.6 ERECTION AND FIELD PAINTING................................................................................................................ 28

8.7 ANCHOR BOLT...................................................................................................................................... 29

**9. MASONRY .............................................................................................................................................. 30**

9.1 MATERIALS.......................................................................................................................................... 30

9.2 GENERAL............................................................................................................................................. 30

9.3 BLOCKWORK ........................................................................................................................................ 31

**10. PLASTERING.......................................................................................................................................... 33**

10.1 GENERAL............................................................................................................................................. 33

10.2 MATERIALS AND STORAGE ...................................................................................................................... 33

10.3 MIXING RATIO...................................................................................................................................... 33

10.4 THICKNESS OF COATING ......................................................................................................................... 33

10.5 FINISH ................................................................................................................................................ 34

10.6 GENERAL PREPARATION ......................................................................................................................... 34

10.7 EXTERNAL PLASTERING........................................................................................................................... 34

10.8 INTERNAL PLASTERING ........................................................................................................................... 35

10.9 EXTERNAL RENDERING ........................................................................................................................... 35

10.10 METAL MESH LATHING / REINFORCEMENT FOR PLASTERED/COATINGS........................................................ 36

**11. CARPENTRY AND JOINERY..................................................................................................................... 37**

11.1 MATERIALS.......................................................................................................................................... 37

11.2 PRESERVATION OF TIMBER ...................................................................................................................... 37

11.3 HARDWARE ......................................................................................................................................... 37

11.4 DIMENSIONS AND FINISH ........................................................................................................................ 37

11.5 WORKMANSHIP.................................................................................................................................... 38

**12. ALUMINIUM DOORS AND WINDOWS................................................................................................... 39**

12.1 ALUMINIUM DOORS AND WINDOWS......................................................................................................... 39

12.2 ALUMINIUM LOUVERS ............................................................................................................................ 40

12.3 TOP HUNG WINDOWS, VENTILATORS AND SIDE HUNG DOORS .......................................................................... 41

12.4 INSTALLATION ...................................................................................................................................... 41

12.5 SEALING JOINTS .................................................................................................................................... 42

12.6 GLASS INSTALLATION ............................................................................................................................. 42

**13. DRY WALL PANELS................................................................................................................................ 44**

13.1 REFERENCES.............................................................................................................................................. 44

13.2 SYSTEM DESCRIPTION.................................................................................................................................. 44

13.3 SUBMITTALS.............................................................................................................................................. 45

13.4 QUALITY ASSURANCE .................................................................................................................................. 46

13.5 DELIVERY, STORAGE & HANDLING ................................................................................................................. 46

13.6 PROJECT CONDITIONS ................................................................................................................................. 47

13.7 WARRANTY............................................................................................................................................... 47

PRODUCTS .................................................................................................................................................... 47

13.8 COMPOSITE FIRE RESISTIVE METAL PANELS ....................................................................................................... 47

13.9 PRODUCT SUBSTITUTIONS ............................................................................................................................ 47

13.10 COMPOSITE METAL PANEL MATERIALS ......................................................................................................... 47

13.11 ACCESSORIES........................................................................................................................................... 48

13.12 RELATED MATERIALS................................................................................................................................. 48

13.13 FABRICATION........................................................................................................................................... 48

13.14 FINISHES ................................................................................................................................................ 48

13.15 SOURCE QUALITY ..................................................................................................................................... 49

EXECUTION ................................................................................................................................................... 49

13.16 MANUFACTURER’S INSTRUCTIONS................................................................................................................ 49

13.17 EXAMINATION ......................................................................................................................................... 49

13.18 PREPARATION.......................................................................................................................................... 49

13.19 INSTALLATION.......................................................................................................................................... 49

13.20 FIELD QUALITY REQUIREMENTS ................................................................................................................... 49

13.21 ADJUSTING ............................................................................................................................................. 49

13.22 CLEANING............................................................................................................................................... 50

13.23 PROTECTION ........................................................................................................................................... 50

**14. ROOFING .............................................................................................................................................. 51**

14.1 SCOPE ................................................................................................................................................ 51

14.2 ROOF CLADDING................................................................................................................................... 51

14.3 PRODUCTS........................................................................................................................................... 51

14.4 WORKMANSHIP.................................................................................................................................... 51

14.5 FIXING................................................................................................................................................ 52

14.6 FITTINGS AND FEATURES ........................................................................................................................ 52

**15. FINISHES............................................................................................................................................... 54**

15.1 GENERAL............................................................................................................................................. 54

15.2 MANUFACTURERS ................................................................................................................................. 54

15.3 CERAMIC AND VITREOUS TILE MATERIALS .................................................................................................. 54

15.4 FLOORING........................................................................................................................................... 54

15.5 WALL PAPERS ..................................................................................................................................... 56

15.6 WOOD VENEERS ................................................................................................................................... 56

15.7 CEILING.............................................................................................................................................. 56

15.8 CORNER GUARDS ................................................................................................................................. 57

15.9 SKIRTING ............................................................................................................................................ 57

15.10 CRASH RAILS ....................................................................................................................................... 57

15.11 SPLASH PROTECTION ............................................................................................................................. 57

15.12 RADIATION PROTECTION ........................................................................................................................ 58

15.13 BENCH TOPS……………….......................................................................................................................... 58

15.14 PARTITION WALLS .............................................................................................................................. 58

15.15 MORTAR MATERIALS ............................................................................................................................ 58

15.16 CEMENT COLOURS............................................................................................................................... 59

15.17 WATERPROOFING ……………................................................................................................................. 59

15.18 INSTALLATION REQUIREMENTS .............................................................................................................. 59

15.19 FLOOR TILE INSTALLATION ..................................................................................................................... 59

15.20 WALL TILE INSTALLATION ………………..................................................................................................... 60

15.21 GROUTING ……................................................................................................................................... 60

15.22 DEFECTS IN TILES AND TILE LAYING ......................................................................................................... 60

15.23 GUARANTEES ..................................................................................................................................... 61

**16. PAINTING ................................................................................................................................................ 62**

16.1 MATERIAL ............................................................................................................................................... 62

16.2 DEFINITION OF TERMINOLOGY ..................................................................................................................... 62

16.3 PAINT FINISH SYMBOLS .............................................................................................................................. 63

16.4 PAINTING IN GENERAL ............................................................................................................................... 63

16.5 PROCEDURE OF PAINTING ........................................................................................................................... 64

**17.PLUMBING...................................................................................................................................................71**

17.1 GENERAL ..............................................................................................................................................71

17.2 DRAWINGS AND INFORMATION REQUIRED...................................................................................................72

17.3 RECORD DRAWING.................................................................................................................................72

17.4 OPERATING AND MAINTENANCE INSTRUCTIONS............................................................................................72

17.5 TESTS .................................................................................................................................................72

17.6 WORK IN COMMON PIPING......................................................................................................................73

17.7 WATER SUPPLY WORK ............................................................................................................................79

17.8 WATER PUMPS .....................................................................................................................................79

17.9 SPACING OF SUPPORTS ..........................................................................................................................80

17.10 DRAINAGE WORK .................................................................................................................................80

17.11 LAYING OF PIPES ..................................................................................................................................80

17.12 LAYING OF SEWER WATER MAINS............................................................................................................. 81

17.13 SEWERS .............................................................................................................................................81

17.14 U.P.V.C PIPES ......................................................................................................................................82

17.15 BENDS AND OTHER SPECIALS ..................................................................................................................82

17.16 FLANGED JOINTS .................................................................................................................................82

17.17 SUPPORT FOR U.P.V.C PIPES ...................................................................................................................82

17.18 SEWER PIPES ......................................................................................................................................83

17.19 AIR VALVES ........................................................................................................................................83

17.20 SCOUR WASHOUT VALVE.......................................................................................................................83

17.21 FOOT VALVES AND STRAINERS ................................................................................................................83

17.22 PRESSURE REDUCERS ..........................................................................................................................83

17.23 WATER METER ..................................................................................................................................83

17.24 EQUILIBRIUM BALL VALVES .................................................................................................................83

17.25 FITTINGS.........................................................................................................................................84

17.26 MANHOLES, MANHOLE COVERS AND FRAMES...........................................................................................84

17.27 INTERCEPTOR MANHOLE ....................................................................................................................85

17.28 FIXTURES AND ACCESSORIES ...............................................................................................................85

17.29 AS BUILT DRAWINGS .........................................................................................................................85

17.30 MISCELLANEOUS ..............................................................................................................................85

**18.ELECTRICAL INSTALLATIONS...................................................................................................................90**

18.1 GENERAL .............................................................................................................................................90

18.2 CONDUIT AND CONDUIT ACCESSORIES ........................................................................................................93

18.3 WIRES, CABLES AND CORDS ......................................................................................................................94

18.4 WIRING ACCESSORIES..............................................................................................................................95

18.5 LIGHT FIXTURES .....................................................................................................................................96

18.6 TESTING ...............................................................................................................................................98

18.7 INSTALLATION INSTRUCTION .....................................................................................................................98

18.8 DISTRIBUTION BOARD .............................................................................................................................99

18.9 TELEPHONE SYSTEM................................................................................................................................99

**19.HVAC SYSTEM………………….....................................................................................................................100**

19.1 GENERAL .............................................................................................................................................100

19.2 BASIS OF DESIGN ...................................................................................................................................100

19.3 REGULATION AND SHOP DRAWING ............................................................................................................100

19.4 HVAC SYSTEM........................................................................................................................................100

19.5 AIR CONDITIONING SYSTEM ......................................................................................................................100

19.6 REFRIGERENT AND CONDENSATE PIPEWORK .................................................................................................101

19.7 DUCT WORK AND INSULATION ..................................................................................................................102

19.8 AIR DIFFUSERS/ REGISTERS/ GRILLES/ LOUVRES .............................................................................................102

19.9 MECHANICAL FANS.................................................................................................................................102

19.10 SITE TESTING AND COMMISSIONING…………………………….............................................................................103

**20.CCTV SPECIFICATION……….....................................................................................................................104**

20.1 SYSTEM DESIGN .....................................................................................................................................104

20.2 SYSTEM PERFORMANCE CRITERIA ..............................................................................................................104

20.3 GENERAL REQUIREMENT OF CCTV EQUIPMENT ..............................................................................................105

20.4 REGULATIONS AND CODE OF PRACTICE........................................................................................................105

20.5 TESTING ..............................................................................................................................................105

20.6 ITEM SPECIFICATION …………………………….................................................................................................106

**21.PUBLIC ADDRESSING SYSTEM & BACKGROUND MUSIC (PA & BGM) SYSTEM SPECIFICATION………........113**

21.1 SYSTEM DESIGN .....................................................................................................................................113

21.2 SYSTEM PERFORMANCE CRITERIA ..............................................................................................................113

21.3 GENERAL REQUIREMENT OF PA & BGM EQUIPMENT........................................................................................114

21.4 REGULATIONS AND CODE OF PRACTICE........................................................................................................114

21.5 TESTING ..............................................................................................................................................114

21.6 ITEM SPECIFICATION …………………………….................................................................................................115

**22.FIRE DETECTION AND PROTECTION SYSTEM…………………………………………………………………………..……........122**

22.1 GENERAL...............................................................................................................................................122

22.2 STANDARDS AND CODES ……………............................................................................................................122

22.3 TECHNICAL SPECIFICATION FOR WET RISER / FIRE HOSE REEL SYSTEM...................................................................123

22.4 TECHNICAL SPECIFICATION FOR PORTABLE FIRE EXTINGUISHER...........................................................................131

22.5 TECHNICAL SPECIFICATION FOR FIRE DETECTION AND ALARM SYSTEM .................................................................133

**23.ELECTRONIC ACCESS CONTROL SYSTEM (EACS)………………………………………………………………………..…….......149**

23.1 APPLICATION OF THE SECTION....................................................................................................................149

23.2 GENERAL……………………… ……………............................................................................................................149

23.3 OPERATION AND MAINTENANCE MANUALS………………………………………...................................................................149

23.4 APPROVAL OF INFORATION SUBMITTED…………………………………............................................................................149

23.5 TESTING AND COMMISSIONING OF SYSTEMS ………………………………................................................................149

23.6 EQUIPMENT, MATERIALS, FITTINGS AND ACCESSORIES……………………................................................................149

23.7 PRODUCT BRANDS ……………………………….................................................................................................150

23.8 DRAWINGS ………………………………..........................................................................................................150

23.9 MAINTENANCE ACCESS AND OPENINGS ………………………………......................................................................150

23.10 CODES AND STANDARDS ……………………………….........................................................................................150

23.11 SYSTEM DESIGN ………………………………....................................................................................................150

23.12 SYSTEM PERFORMANCE CRITERIA ………………………………..............................................................................151

23.13 GENERAL REQUIREMENT OF EACS EQUIPMENT ……………………………….............................................................151

23.14 REGULATIONS AND CODE OF PRACTICE ……………………………….......................................................................152

23.15 TESTING………………………………...............................................................................................................152

23.16 ITEM SPECIFICATIONS ……………………………….............................................................................................153

**24.NURSE CALL SYSTEM SPECIFICATION……………………………………………………………………………………..…….........162**

24.1 SYSTEM DESIGN .....................................................................................................................................162

24.2 SYSTEM PERFORMANCE CRITERIA….............................................................................................................162

24.3 GENERAL REQUIREMENT OF NURSE CALL SYSTEM EQUIPMENT……….....................................................................163

24.4 REGULATIONS AND CODE OF PRACTICE………………………………….............................................................................163

23.5 TESTING………………………………...............................................................................................................163

23.6 ITEM SPECIFICATIONS ……………………………….............................................................................................164

**25.ELECTRONIC ACCESS CONTROL SYSTEM (EACS)………………………………………………………………………..…….......167**

25.1 SCOPE OF WORK.....................................................................................................................................167

25.2 PABX SYSTEM IN GENERAL…..………............................................................................................................167

25.3 SYSTEM HARDWARE………………………………….………………………………………...................................................................168

25.4 SYSTEM SOFTWARE………………………………….....................................................................................................169

25.5 SYSTEM CAPACITY ……………………………….................................................................................................170

25.6 NUMBERING PLAN…………………….............................................................................................................170

25.7 PABX FEATURES AND FACILITIES……………….….................................................................................................170

25.8 PC BASED ATTENDANT CONSOLE.……..........................................................................................................174

25.9 DIGITAL TELEPHONE……………………………. ………………………………......................................................................180

25.10 SINGLE LINE TELEPHONE SET.………………………….........................................................................................180

25.11 EARTHING ………………………………...........................................................................................................180

25.12 TECHNICAL SUPPORT STAFF ……………………………….....................................................................................180

25.13 WARRANTY ……………………………….........................................................................................................180

25.14 TRAINING ………………………………...........................................................................................................180

**26.TELEPHONE SYSTEM SPECIFICATION……………………………………………………………………………………..…….........181**

26.1 GENERAL ...........................................................................................................................................181

26.2 TELEPHONE WIRING AND INSTALLATION......................................................................................................181

26.3 TELEPHONE MANHOLE AND PIT……………………………………………………….....................................................................182

26.4 EARTHING…………………………………………..………………………………….............................................................................183

26.5 TESTING AND COMMISSIONING…................................................................................................................183

**27.SOLAR PANEL SYSTEM……………………………………………………………………………………………………….…..……........184**

**1. 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, And Australian Health Facility Guidelines (AusHFG) 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 trade marks or names of all the various types of materials and

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

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 co‐ordinating 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 centimetres 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 (2.88m2) 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.** **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.

**2.3 Excavation**

2.3.1 Excavation shall be performed to the required depth as shown in the Drawings.

2.3.2 A survey of the existing site shall be made and the results of same submitted to the Consultant before commencement of the work

2.3.3 Excavation area shall be protected from any water flowing in. Sides of excavations shall be shored or inclined to retain excavation unless otherwise specified

2.3.4 Excavation near adjoining structures shall be executed with care so as not to damage those structures.

2.3.5 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.

2.3.6 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.

2.3.7 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.

2.3.8 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.

2.3.9 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.

2.3.10 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.

2.3.11 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.

2.3.12 Excavated material shall be deposited within specified areas as directed unless otherwise specified.

2.3.13 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.

2.3.14 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.

2.3.15 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

2.3.16 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

2.3.17 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.

2.3.18 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.

2.3.19 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.

2.3.20 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.

2.3.21 The Contractor shall erect temporary barricades around the excavations and if necessary make provisions of red lamps.

2.3.22 The Contractor shall remove/maintain/restore all service lines like telephone, water supply, electricity etc. without any extra charges.

**2.4 De‐watering**

2.4.1 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.

2.4.2 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.

2.4.3 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.

2.4.4 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.

2.4.5 Unless prior approval has been obtained no water must be disposed of in the Municipality's sewer systems.

**2.5 Backfill**

2.5.1 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/m3.

2.5.2 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

2.5.3 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.

2.5.4 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 lay.

2.5.5 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.

2.5.6 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.

2.5.7 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.

2.5.8 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.** **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 washin g test (%)** | **Organic impurity (%)** | **Water soluble chloride (%)** |
| Coarse aggregate | <= 2.5 | <= 3.0 | => 55 | <= 0.25 | <= 1.5 | 0 | <= 0.25 |
| Fine aggregate | >=2.5 | <= 3.5 | ‐ | <= 1.0 | <= 3.0 | 0 | <= 0.01 |

Colour of test solution not to be darker than standard solution

**Grading** **requirements** **for** **aggregates**

Percentage passing each sieve by weight (%)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agg.** | **Max. size (mm)** | **Nominal sieve size (mm)** |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 40 | 30 | 25 | 20 | 15 | 10 | 5 | 2.5 | 1.2 | 0.6 | 0.3 | 0.1 |
|  |  | 5 |
| Coarse | 25 | 100 | 100 | 90 | 60 |  | 20 | 0 | 0 |  |  |  |  |
| ‐ | ‐ |  | ‐ | ‐ | ‐ |  |  |  |  |
| 100 | 90 |  | 50 | 10 | 5 |  |  |  |  |
|  | 20 |  |  | 100 | 90 |  | 20 | 0 | 0 |  |  |  |  |
|  |  |  | ‐ |  | ‐ | ‐ | ‐ |  |  |  |  |
|  |  |  | 100 |  | 55 | 10 | 50 |  |  |  |  |
| Fine |  |  |  |  |  |  | 100 | 90 | 80 | 50 | 25 | 10 | 2 |
|  |  |  |  |  |  | ‐ | ‐ | ‐ | ‐ | ‐ | ‐ |
|  |  |  |  |  |  | 100 | 100 | 90 | 65 | 35 | 10 |

3.3.7 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 The maximum size of coarse aggregate shall be 25 mm.

3.3.10 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/mm²

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.

3.6.7 The lean concrete shall be 15 N/mm²

**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 2.0 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.** **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 sing 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 leads 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.** **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 CONRETE 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.** **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 cementatious 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 Constructions 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, filing 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 water proofing 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.** **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 vapour barriers embedded in the fabric of the building. It does not deal with the weather‐ proof roof sheeting, or with vapour 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.** **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 chiselled 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 boltholes 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 Bolthole 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 bolthole shall be precise so that the center of all holes aligns.

8.4.2 Protection against loosing of Nuts

8.4.2.1 Nuts shall be protected against loosing 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 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**

8.6.1 Erection

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

8.6.1.2 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.

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

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

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

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

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

8.6.2 Field Painting

All steel work shall delivered 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.

**8.7 Anchor Bolt**

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

**9.** **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**(For sizes refer to drawings) . The average compression strength should be not less than 2.8N/mm2 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.** **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

|  |  |  |
| --- | --- | --- |
| **Grading of sand** | **Mortar plastering** | **Plastering** |
| 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:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Base** | **area of**  **application** | **first coat**  **cement:sand** | **Dabbing out**  **cement:sand** | **Finish coat**  **cement:sand** |
| 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)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Base** | **Area of**  **application** | **First coat** | **Dubbing**  **out** | **Second**  **coat** | **Finish coat** | **Total** |
| 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 finsh | 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 centres 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 trowelled in. Do not lap ends of scrim.

**10.8 Internal Plastering**

10.8.1 Accuracy of plaster 15mm 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 trowelling 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/mm2. 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.** **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 tennon, 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.** **ALUMINIUM** **DOORS** **AND** **WINDOWS**

**12.1 Aluminium Doors and Windows**

12.1.1 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.

12.1.2 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

12.1.3 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 packings used.

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

12.1.5 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

12.1.6 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).

12.1.7 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 |

12.1.9 Prior to import and / or purchase of the Aluminium 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.

12.1.10 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.

11.1.11 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.

12.1.12 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.

12.1.13 Aluminium 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.

12.1.14 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 aluminium Snap‐On beading as per detail drawing and instructions. Necessary continuous rubber gaskets of approved make shall be provided.

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

**12.2 Aluminium louvers**

12.2.1 Product data shall be submitted for approval; this shall include specified model and AMCA

ratings or equivalent.

12.2.2 Contractor shall submit all shop drawings indicating materials, construction, dimensions, accessories, and installation details.

12.2.3 Contractor shall submit samples of the product for approval.

12.2.5 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.

12.2.6 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.

12.2.7 All louvers shall be installed according to manufacturer’s instructions.

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

12.2.9 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.

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

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

**12.3 Top hung windows, ventilators and side hung doors**

12.3.1 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.

12.3.2 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.

12.3.3 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).

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

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

12.3.6 Windows shall have anodised aluminium handles, colour as framing and a latching mechanism securing the shutter to the frame both at the top and bottom.

12.3.7 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.

**12.4 Installation**

12.4.1 Aluminium 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.

12.4.2 Aluminium 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.

12.4.3 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.

12.4.4 All aluminium 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.

12.4.5 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.

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

12.4.7 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 aluminium manufacturers to remove sealants, discolouration and any other foreign material. Defection of any type determined by the Consultant shall be repaired at the Contractor's expense.

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

**12.5 Sealing joints**

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

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

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

12.5.4 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.

12.5.5 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.

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

**12.6 Glass installation**

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

12.6.2 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.

12.6.3 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.

12.6.4 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.

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

12.6.6 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

12.6.7 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.

**13.** **DRY** **WALL** **PANELS**

**13.1 References**

13.1.1 General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

A. ASTM International:

1. ASTM D1781 Standard Test Method for Climbing Drum Peel for Adhesives.

2. ASTM D1929 Standard Test Method for Determining Ignition Temperature of

Plastics.

3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building

Materials.

4. ASTM E108 (Modified) Standard Test Methods for Fire Tests of Roof Coverings.

5. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and

Materials.

6. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

7. ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.

8. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Wall, and Doors By Uniform Static Air Pressure Difference.

B. American Architectural Manufacturers Association (AAMA):

1. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. International Organization for Standardization (ISO):

1. ISO 9001‐2000 Quality Management Systems ‐ Requirements. D. National Fire Protection Association (NFPA)

1. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non‐Load‐Bearing Wall Assemblies Containing Combustible Components

**13.2 System Description**

13.2.1 Performance Requirements: Provide composite metal panels that have been manufactured, fabricated and installed to withstand loads from deflection and thermal movement and to maintain performance criteria stated by manufacturer without defects, damage or failure.

A. Water and Air Leakage: Provide systems that have been tested and certified to conform to the following criteria:

1. Air Leakage, ASTM E283: Not more than 0.06 cfm per ft2 of wall area (0.003 (L/s m2) when tested at 1.57 psf (0.075 kPa).

2. Water Penetration: No water infiltration under static pressure when tested in accordance with ASTM E331 at a differential of 10% of inward acting design load, 6.24 psf (0.299 kPa) minimum, after 15 minutes.

a. Water penetration is defined as the appearance of uncontrolled water in the wall.

b. Wall design shall feature provisions to drain to the exterior face of the wall any leakage of water at joints and any condensation that may occur within the construction.

B. Fire Performance: Provide composite fire rated panels that have been evaluated and are in compliance with regulatory code agency requirements specified herein.

**13.3 Submittals**

13.3.1 General: Submit listed submittals in accordance with Conditions of the Contract.

13.3.2 Product Data: Submit product data, including manufacturer’s SPEC‐DATA sheet, for specified products.

A. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors and textures.

1. Include details showing thickness and dimensions of the various system parts, fastening and anchoring methods, locations of joints and gaskets, and location and configuration of joints necessary to accommodate thermal movement.

B. Samples: Submit selection and verification samples for finishes, colors and textures.

1. Selected Samples: Manufacturer’s color charts or chips illustrating full range of colors, finishes and patterns available for composite metal panels with factory applied finishes.

2. Verification Samples:

2.1. Structural: 12 inch × 12 inch (305 × 305 mm) sample composite panels in thickness specified from an available stock color, including clips, anchors, supports, fasteners, closures and other panel accessories, for assembly approval. Include panel assembly samples not less than 24 inches × 24 inches (610 × 610 mm) showing 4‐way joint.

2.2. Include separate sets of drawdown samples on aluminum substrate, not less than 3 inches × 5 inches (76 × 127 mm), of each color and finish selected for color approval. Larger samples of standard colors are available with production‐applied coatings.

C. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties, or a third party listing documenting compliance to a comparable code section.

2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements.

3. Manufacturer's Instructions: Manufacturer’s installation instructions.

4. Manufacturer’s Field Reports: Manufacturer’s field reports.

D. Closeout Submittals: Submit the following:

1. Warranty: Warranty documents specified.

**13.4 Quality Assurance**

13.4.1 Qualifications:

1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.

a. Certificate: When requested, submit certificate indicating qualification.

2. Manufacturer Qualifications: Company with a minimum of 5 years of continuous experience manufacturing panel material of the type specified:

a. Able to provide specified warranty on finish.

b. Able to provide a list of 5 other projects of similar size, including approximate date of installation and name of Architect for each.

c. Able to produce the composite material without outsourcing of the coating or laminating process.

d. Able to provide a certificate of registration to ISO 9001‐2000.

3. Fabricator Qualifications: Company with at least 3 years of experience on similar sized metal panel projects and qualified by panel material manufacturer. Capable of providing field service representation during construction

13.4.2 Mock‐Ups: Install at project site a job mock‐up using acceptable products and manufacturer approved installation methods. Obtain Owner’s and Architect’s acceptance of finish color (drawdown samples to be used for color approval of nonstandard coil coated colors), texture and pattern and workmanship standard. Comply with Division 01 Quality Control, Mock‐Up Requirements Section.

1. Mock‐Up Size: to be proposed by contractor

2. Maintenance: Maintain mock‐up during construction for workmanship comparison;

remove and legally dispose of mock‐up when no longer required.

3. Incorporation: Mock‐up may be incorporated into final construction upon Owner’s approval.

13.4.3 Pre‐installation Meetings: Conduct pre‐installation meeting to verify project requirements, substrate conditions, manufacturer’s installation instructions and manufacturer’s warranty requirements. Comply with Division 01 Project Management and Coordination, Project Meetings Section.

**13.5 Delivery, Storage & Handling**

13.5.1 General: Comply with Division 01 Product Requirements Sections.

13.5.2 Ordering: Comply with manufacturer’s ordering instructions and lead time requirements to avoid construction delays.

13.5.3 Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

1. Protection: Protect finish of panels by applying heavy‐duty removable plastic film during production.

2. Delivery: Package composite wall panels for protection against transportation damage. Provide markings to identify components consistently with drawings.

3. Handling: Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

13.5.4 Storage and Protection: Store materials protected from exposure to harmful weather

conditions and at temperatures recommended by manufacturer.

1. Storage: Store panels in well‐ventilated space out of direct sunlight.

a. Protect panels from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.

b. Slope panels to ensure positive drainage of any accumulated water.

c. Do not store panels in any enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).

2. Damage: Avoid contact with any other materials that might cause staining, denting or other surface damage.

**13.6 Project Conditions**

13.6.1 Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

**13.7 Warranty**

13.7.1 Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

13.7.2 Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

1. Warranty Period:

a. Panel Integrity: 10 years commencing on Date of Substantial Completion. b. Finish: 10 years commencing on Date of Substantial Completion.

**PRODUCTS**

**13.8 Composite Fire resistive metal panels**

13.8.1 Manufacturer: Mitsubishi Plastics Composites America, Inc.

**13.9 Product Substitutions**

13.9.1 Substitutions: No substitutions permitted.

**13.10 Composite Metal Panel Materials**

13.10.1 ALPOLIC/fr Composite Fire Resistive Metal Panels:

1. Panel Thickness: 4 mm.

2. Core: Thermoplastic core material with inorganic fillers that meets performance characteristics specified when fabricated into composite assembly.

3. Face Sheets: Aluminum alloy 3105 H14 and as follows:

a. Coil coated with a fluoropolymer paint finish that meets or exceeds values expressed in AAMA 2605 where relevant to coil coatings.

b. Spray coated with specified finish (quantities less than 7500 ft2 (700 m2)).

4. Bond Integrity: Tested for resistance to delamination as follows:

a. Peel Strength (ASTM D1781): 22.5 in‐lb/in (100 N‐m/m) minimum.

b. No degradation in bond performance after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F (21 degrees C).

c. Thermally bonded to the core material in a continuous process under tension.

5. Fire Performance:

a. Flamespread, ASTM E84: <25.

b. Smoke Developed, ASTM E84: <450.

c. Surface Flammability, Modified ASTM E108: Pass. d. Ignition Temperature:

1) Flash, ASTM D1929: 716 degrees F (380 degrees C).

2) Ignition: 752 degrees F (400 degrees C).

e. Flammability, Exterior, Non‐load‐bearing wall assemblies and panels, NFPA 285:

Pass.

6. Product Transparency:

a. Provide a Product Transparency Declaration (PTD) for the Composite metal panels

13.10.2 Production Tolerances:

1. Width: +/‐ 2.0 mm.

2. Length: +/‐ 4.0 mm.

3. Thickness (4 mm Panel): +/‐ 0.008 inch (0.2 mm).

4. Thickness (6 mm Panel): +/‐ 0.012 inch (0.3 mm).

5. Bow: Maximum 0.5% length or width.

6. Squareness: Maximum 0.2 inch (5.1 mm).

7. Edges of sheets shall be square and trimmed with no displacement of aluminum sheets or protrusion of core material.

**13.11 Accessories**

13.11.1 General: Provide fabricator’s standard accessories, including fasteners, clips, anchorage devices and attachments for specific applications indicated on contract documents.

**13.12 Related Materials**

13.12.1 General: Refer to other related sections in Related Sections paragraph specified herein for related materials, including coldform metal framing, flashing and trim, joint sealers, aluminum windows, glass and glazing and curtain walls.

**13.13 Fabrication**

13.13.1 General: Shop fabricate to sizes and joint configurations indicated on drawings.

1. Where final dimensions cannot be established by field measurements, provide allowance for field adjustment as recommended by the fabricator.

2. Form panel lines, breaks and angles to be sharp and true, with surfaces that are free from warp or buckle.

3. Fabricate with sharply cut edges and no displacement of aluminum sheet or protrusion of core.

**13.14 Finishes**

13.14.1 Factory Finish: Lumiflon‐based fluoropolymer resin coating that meets or exceeds values expressed in AAMA 2605 where relevant to coil coatings.

1. Color: Prismatic Champagne ME010

**13.15 Source Quality**

13.15.1 Source Quality: Obtain composite panel products from a single manufacturer.

**EXECUTION**

**13.16 Manufacturer’s Instructions**

13.16.1 Compliance: Comply with manufacturer’s product data, including product technical bulletins, product catalog installation instructions and product carton instructions.

**13.17 Examination**

13.17.1 Site Verification of Conditions: Verify that conditions of substrates previously installed under other sections are acceptable for product installation.

**13.18 Preparation**

13.18.1 Surface Preparation: -

**13.19 Installation**

13.19.1 General:

1. Install panels plumb, level and true in compliance with fabricator’s recommendations.

2. Anchor panels securely in place in accordance with fabricator’s approved shop drawings.

3. Comply with fabricator’s instructions for installation of concealed fasteners and with provisions of Section 07 90 00 for installation of joint sealers.

4. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: 0.25 inch in 20 feet (6.4 mm in 6.1 m), noncumulative.

13.19.2 Related Products Installation Requirements: Refer to other sections in Related Sections paragraph herein for installation of related products.

**13.20 Field Quality Requirements**

13.20.1 Field Quality Control: Comply with panel system fabricator’s recommendations and guidelines for field forming of panels.

13.20.2 Fabricator’s Field Services: Upon Owner’s request, provide fabricator’s field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with fabricator’s instructions.

1. Site Visits: As requested by owner

**13.21 Adjusting**

13.21.1 Adjusting:

1. Repair panels with minor damage such that repairs are not discernible at a distance of 10 feet (3 m).

2. Remove and replace panels damaged beyond repair.

3. Remove protective film immediately after installation of joint sealers and immediately prior to completion of composite metal panel work.

4. Remove from project site damaged panels, protective film and other debris attributable to work of this section.

**13.22 Cleaning**

13.22.1 Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris.

**13.23 Protection**

13.23.1 Protection: Protect installed product’s finish surfaces from damage during construction.

1. Institute protective measures as required to ensure that installed panels will not be damaged.

**14.** **ROOFING**

**14.1 Scope**

14.1.1 This Section deals with steel profiled sheeting used as external weather‐proof cladding of roofs.

**14.2 Roof Cladding**

14.2.1 Sheet type: Spandek hiten roofing sheets manufactured by John Lysaght, No.18 Benoi

Sector, Jurong, Singapore 2262 or equivalent.

14.2.2 Structural support: timber sections as per drawings.

14.2.3 Fastening: No. 12‐14x45mm hexagonal head self‐drilling and tapping screw seal.

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

14.2.5 Side laps: as per manufacturer’s recommendations.

**14.3 Products**

14.3.1 The profiled sheeting shall be in galvanized sheet steel with a factory per finished protective

PVC film with colour to approval.

**14.4 Workmanship**

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

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

14.4.2.1 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

14.4.3.2 Imposed loads other than wind and maintenance load, 1.5 KN/m2 concentrated on a 300mm2 which ever produces the greater stress. Maintenance point load: 0.9 KN concentrated on any 125mm2.

14.4.3.3 Dead load: allow for self‐weight of sheeting.

14.4.3.4 Roof pitch: as indicated on drawings.

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

**14.5 Fixing**

14.5.1 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 calculation completes the drying process.

14.5.2 Structure: Check that structure is in a suitable state to receive sheets before commencing fixing. Contractor must confirm acceptance to consultant

14.5.3 Structure: Do not fix profiled sheeting until final coats of paints have been applied to outer surfaces of supporting structure.

14.5.4 Isolating Tape: Apply to those surfaces of supports which would otherwise be in contact with sheeting or accessories after fixing.

14.5.5 Cutting and drilling:

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

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

14.5.5.3 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.

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

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

14.5.7 End Laps: to be fully supported.

14.5.8 Sealant:

14.5.8.1 Install to manufactures recommendation.

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

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

14.5.8.4 Do not over compress.

**14.6 Fittings and Features**

14.6.1 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.

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

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

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

14.6.3 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.

14.6.4 Insulation:

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

**15.** **FINISHES**

**15.1 General**

15.1.1 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.

15.1.2 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.

15.1.3 Contractor to get Client approval on all materials prior to purchasing.

**15.2 Manufacturers**

15.2.1 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.

15.2.2 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

**15.3 Ceramic and Vitreous Tile Materials**

15.3.1 Ceramic and Vitreous clay Wall Tiles:

15.3.1.1 All tiles for wall installation shall be have cushion edge, impervious, polished or semi‐polished porcelain and highly glazed surface. Colours 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.

15.3.2 Floor Ceramic and Vitreous Tiles

15.3.2.1 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.

**15.4 Flooring**

15.4.1 Vinyl flooring:

15.4.1.1 Marbleised, 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 utilised 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.

15.4.1.2 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)

15.4.2 Carpeting:

15.4.2.1 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.

15.4.2.2 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)

15.4.3 Cement Flooring:

15.4.3.1 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)

15.4.3.2 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)

**15.5 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)

**15.6 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)

**15.7 Ceiling**

15.7.1 Suspended Ceilings:

15.7.1.1 Suspended aluminium ceilings shall be powder coated with a material, preferably epoxy, polyester or epoxy polyester with the approval of consultant.

15.7.1.2 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.

15.7.1.3 Provision of plain mineral fibre acoustical suspended ceilings with fibres mixed with wet process with a high quality vinyl emulsion paint surface coating.

15.7.1.4 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)

15.7.2 Composite Board:

15.7.2.1 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)

**15.8 Corner Guards**

15.8.1 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.

15.8.3 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

15.8.3 Corner Guards rails must comply with relevant requirements in AS1428 (Australian Standards) series.

**15.9 Skirting**

15.9.1 Integral coved, on-site formed, skirting involved dressing the floor dressing the floor material up the wall over a preformed coving fillet usually 20 to 38mm radius.

15.9.2 Coved skirting should be a minimum of 150mm high. The skirting can either be tapered at the top to provide a minimal horizontal dust catching edge or finished with a capping seal profile.

15.9.3 The combination of sheet resilient flooring with wielded seams and integral coved skirting, as described above, is generally recommended for all patient care, clinical, wet and other areas where hygiene, infection control, ease of cleaning and decontamination are desirable or required.

15.9.4 For semi-industrial and food process / waste handling areas, seamless coatings or ceramic tiling, may be used as appropriate to function.

15.9.5 Where used for wet, clean or similar applications, vinyl wall finishes may be welded to the vinyl floor finish provided that both finishes are homogenous with a matching or 2mm minimum thickness. The use of vinyl wall sheet products of 1mm thickness carried down over skirting and glued with an overlap is not recommended for healthcare use.

**15.10 Crash Rails**

15.10.1 Crash rails must comply with relevant requirements in AS1428 (Australian Standards) series.

15.10.2 Crash rails shall be 150mm wide and comprise of fireproof PVC plastic acrylic cover with aluminum alloy inner‐support.

**15.11 Splash Protection**

15.11.1 Apply Splash protection to walls in areas such as; laboratories, formula rooms, beverage bays, kitchen, bathrooms, showers, and dirty utility rooms in addition to hand basins, scrub troughs, cleaners and laundry sinks.

**15.12 Radiation Protection**

15.12.1 Radiation protection will depend on individual room requirements. Material used and the extent of radiation shielding should be determined by a radiation services consultancy in accordance with governing regulations and guidelines.

**15.13 Bench Tops**

15.13.1 Benchtops should have a smooth, impervious and durable finish and to be resistant to stains. Joins should be avoided where possible for ease of cleaning. The design and materials used should adequately meet all functional, sustainable and life cycle requirements. A range of products are suitable,

e.g. Laminates, synthetics and stainless steel.

15.13.2 The junction between wall and bench top work surface may be sealed, provided with an upstand and / or wall protection, or designed with an upstand and / or cleanable gap, as required by function,

e.g. Cleaning, Infection control

**15.14 Partition Walls**

15.14.1 Provision of Aluminum Composite board partition wall framed with aluminum extrusion, covered by powder coating. The infill panel shall be laminated glass consisting of two layers 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.

15.14.2 Tempered glass partition walls at described locations as per finishing schedule / details drawings shall be 12mm thick and insulated properly.

15.14.3 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.

15.14.4 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)

**15.15 Mortar Materials**

15.15.1 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.

15.15.2 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.

**15.16 Cement Colour**

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

**15.17 Waterproofing**

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

**15.18 Installation Requirements**

15.18.1 As far as possible, tile lay out work should be in such a way that no tiles less than half size occurs.

15.18.2 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.

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

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

**15.19 Floor Tile Installation**

15.19.1 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.

15.19.2 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.

15.19.3 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 trowelled surface readily assumes a smoothed, slickened appearance.

15.19.4 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.

15.19.5 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.

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

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

15.19.8 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.

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

**15.20 Wall Tile Installation**

15.20.1 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.

15.20.2 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.

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

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

**15.21 Grouting**

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

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

15.21.3 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.

15.21.4 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.

15.21.5 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.

**15.22 Defects in Tiles and Tile Laying**

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

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

15.22.3 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.

15.22.4 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.

**15.23 Guarantees**

15.23.1 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

**16.** **PAINTING**

**16.1 Material**

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

16.1.2 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*

16.1.3 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, colour of paint and instructions for reducing. Thinning shall be done only in accordance with the manufacturer’s directions.

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

Specification.

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

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

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

**16.2 Definition of Terminology**

16.2.1 **Surface Sealing**

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

16.2.2 **Spot Puttying**

All cracks and depressions shall be filled flush with putty.

16.2.3 **Puttying**

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

16.2.4 **Spot painting**

Spot puttied area shall be touched up by paint

16.2.5 **Touch‐up**

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

16.2.6 **Drying hour**

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

16.2.7 **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.

**16.3 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

**16.4 Painting in General**

16.4.1 Preparation of Paint

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

17.4.1.2 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.

17.4.1.3 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.

16.4.2 Conditions of Painting

16.4.2.1 Work shall not be executed in the following situations

16.4.2.1.1 When humidity is above 85%

16.4.2.1.2 When raining or it is forecast

16.4.2.1.3 When dusts are present

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

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

16.4.2.2.1 When surface is damp and wet

16.4.2.2.2 When condensation is likely to develop on the surface.

16.4.2.2.3 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.

16.4.3 Performance

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

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

16.4.4 Protection

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

**16.5 Procedure of Painting**

16.5.1 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 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.

16.5.2 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 | As per manufacture’s specifications |
| 4. First coating | 1 | Rustproof oil paint |  |
| 5. Second coating | 1 | Synthetic resin mix paint | As per manufacture’s specifications |
| 6. Finish coating | 2 | 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

16.5.3 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 condi

16.5.4 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.

16.5.5 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:

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

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

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

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

16.5.6 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:

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

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

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

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

16.5.7 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,  and surface cleaner |  |
| 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.6.16.5.8 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.

**17. PLUMBING**

**17.1 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 cut to be different from what was excepted.

The Consultant shall instruct the Contractor to purchase and use such materials of particular make

or from particular source as may in his opinion be necessary for proper and reasonable compliance with the specification and execution of the Works.

After all plumbing fixtures and equipment have been set ready for use, and before the Contractor leaves

the job, he shall thoroughly clean all fixtures installed by him, removing all plaster, stickers, rust stains

and other foreign matter of discolouration on fixtures, leaving every part in acceptable condition and

ready for use to the satisfaction of the Consultants.

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

**17.2 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.

**17.3 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.

**17.4 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.

**17.5 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.

**17.6 Work in Common Piping**

17.6.1 Material

17.6.1.1 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.

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

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

**FOR uPVC Pipes and Fittings:**

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. Flanged joints shall be made using flange adapters.
7. 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
8. 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.
9. 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. Colour 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 metres and at every change of direction. Color bands shall be spaced at four metre 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  40 to 50  60 to 150  200 to 250  Over 250 | 25  25  150  150  150 | 5  15  50  60  90 |

1. 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.

1. 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.

17.6.2 Providing Drawings and Manuals

17.6.2.1 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.

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

17.6.2.3 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.

17.6.3 Samples

17.6.3.1 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.

17.6.4 Drawings

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | 17.6.4.1 | | 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. |
| 17.6.4.2 | | 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. |
| 17.6.4.3 | | The architectural drawings shall take precedence over the plumbing drawings |
|  | | as to all dimensions. |
| 17.6.4.4 | | 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. |
| 17.6.4.5 | | The recommend position of the fittings, fixtures, control valves, tanks etc.as |
|  | | shown on the drawings will be adhered to as far as practicable. |
| 17.6.4.6 | | 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. |
| 17.6.5 | | Existing pipes | |  |
|  | | 17.6.5.1 | | 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. |
| 17.6.6 | | Spare Parts | |  |
|  | | 17.6.6.1 | | Necessary spare parts of the plumbing equipment for the one (1) year |
|  | |  | | operation shall be supplied by the Contractor. |
| 17.6.7 | | Excavation | |  |
|  | | 17.6.7.1 | | 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. |
|  | | 17.6.7.2 | | 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. |
|  | | 17.6.7.3 | | 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. |
|  | 17.6.7.4 | | Rates for excavation should include for backfilling in consolidated layers where necessary and as directed by the Consultant. | |
| 17.6.8 | Piping | |  | |
|  | 17.6.8.1 | | 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. | |
|  | 17.6.8.2 | | 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. | |
|  | 17.6.8.3 | | All pipes, fittings etc. shall be kept closed against moisture and foreign matters when stored at site and during installation. | |
|  | 17.6.8.4 | | All pipes shall be fixed clear of one another and be so arranged as toprovide easy access for maintenance and repair. | |
|  | 17.6.8.5 | | 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. | |
|  | 17.6.8.6 | | Materials for the piping and service requirements shall basically conform to the service pressures encountered. | |
|  | 17.6.8.7 | | 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. | |
|  | 17.6.8.8 | | 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. | |
|  | 17.6.8.9 | | Pockets, unnecessary traps, turns and off-sets shall be avoided. When traps or pockets are unavoidable they shall be valved drains. | |
|  | 17.6.8.10 | | 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. | |
|  | 17.6.8.11 | | Where pipes are to be laid directly in the ground, bed shall be sufficiently compacted, necessary protection for piping shall be taken. | |
|  | 17.6.8.12 | | 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. | |
|  | 17.6.8.13 | | 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. | |
|  | 17.6.8.14 | | Pipes, fittings, valves and accessories shall be thoroughly cleaned, both internally and externally before installation and shall be cleaned before putting into service. | |
|  | 17.6.8.15 | | 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. | |

17.6.8.16 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.

17.6.8.17 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

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

17.6.8.19 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

17.6.8.20 Water pipes and waste water pipes should be connected to the sewer systems

**17.7 Water Supply Work**

17.7.1 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.

**17.8 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.

**17.9 Spacing of supports**

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

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

**17.10 Drainage Work**

17.10.1 General

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

17.10.1.2 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.

17.10.1.3 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 degree to the main in all cases.

17.10.1.4 Every toilet should have a gully attached for drainage purposes

17.10.2 Vent stack pipes

17.10.2.1 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.

17.10.2.2 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.

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

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

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

17.10.2.6 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.

**17.11 Laying of Pipes**

17.11.1 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)

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

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

**17.12 Laying of sewer water Mains**

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

17.12.2 Mains running under buildings, if unavoidable, shall be completely surrounded by 150mm

of concrete.

17.12.3 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.

**17.13 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 cook.

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 thefilter.

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 metre the test may

be considered satisfactory.

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

**17.14 U.P.V.C Pipes**

17.14.1 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.

17.14.2 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 .

**17.15 Bends and other Specials**

17.15.1 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.

**17.16 Flanged Joints**

17.16.1 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.

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

17.16.3 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.

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

17.17.1 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. Moulded plastic fitting also should be supported.

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Nominal bore** | 12mm  (1/2”) | 18mm  (3/8”) | 25mm  (1”) | 32mm  (1 1/4”) | 38mm  (1 ½”) | 50mm  (2”) | 75mm  (3”) | 100mm  (4”) |
| **Support distance** | 533mm  (1’9”) | 616mm  (2’0”) | 686mm  (2’3”) | 764mm  (2’6”) | 840mm  (2’9”) | 915mm  (3’0”) | 1220mm  (4’0”) | 1290mm  (4’6”) |

18.12.1For vertical installation supports, distances shall be doubled.

**17.18 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

**17.19 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.

**17.20 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

**17.21 Foot valves and Strainers**

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

**17.22 Pressure Reducers**

17.22.1 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.

**17.23 Water Meter**

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

**17.24 Equilibrium Ball Valves**

17.24.1 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.

**17.25 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.

**17.26 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 cover 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.

**17.27 Interceptor Manhole**

17.27.1 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.

**17.28 Fixtures and Accessories**

17.28.1 All sanitarywares 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 sanitaryware

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

**17.29 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.

**17.30 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.

1. The following central hot water systems shall comply with the relevant provisions of BS 6700:
2. direct vented system
3. indirect vented system
4. direct un-vented system
5. indirect un-vented system.
6. 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 fullway 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.
7. 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 |

1. All hot water storage vessels shall be thermally insulated so that heat loss under normal operating conditions shall at no time exceeds 90 W/m2 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. galvanised 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.

1. 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 direct 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.
2. 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;
   7. 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

**18. ELECTRICAL INSTALLATIONS**

**18.1 General**

18.1.1 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

18.1.2 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.

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

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

18.1.5 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 has to be obtained, and see that they are passed by him.

18.1.6 The Contractor shall be responsible for all necessary permits, approvals, fees, deposits etc., required to complete the Electrical works in accordance with the Contract.

18.1.7 Scope of work

18.1.7.1 The work consist 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) Lightening Protection System

(i) Fire Alarm System

(j) Air Conditioning System

(k) Computer Network Cabling outlet work

18.1.8 Prequalification

18.1.8.1 The Electrification Work shall be carried out only by a licensed contractor authorized to under take such work under the Utility Regulatory Authority

18.1.9 Qualification

18.1.9.1 A licensed Electrical Contractors should have the following qualifications:

(a) Must have in his employment a competent Electrical Engineer registered with Utility Regulatory 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 posses 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.

18.1.10 Rules and Regulations

18.1.10.1 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.

18.1.11 Standards

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

18.1.12 Climatic Conditions

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

Maximum Ambient Temperature = 113° F or 45° C

|  |  |  |  |
| --- | --- | --- | --- |
| Minimum Ambient Temperature |  | = | 28° F or - 2.2° C |
| Maximum Humidity | = | 98% |  |

18.1.13 Specifications

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

18.1.14 Submittal

18.1.14.1 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.

18.1.15 Approval of Drawings and Data

18.1.15.1 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.

18.1.16 Drawings & Data

18.1.16.1 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 meters instruments and their wiring

diagram

18.1.17 Shop Drawings

18.1.17.1 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 carries 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. There 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.

18.1.18 Spare Parts list

18.1.18.1 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.

18.1.19 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.

18.1.20 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.

18.1.21 Test Reports

18.1.21.1 The Contractor shall be responsible for the submitting the test reports/certificates and get the installation inspected passed by the Utility Regulatory Authority

**18.2 Conduit And Conduit Accessories**

18.2.1 Conduit Pipe

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

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

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

18.2.2 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.

18.2.2.3 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.

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

18.2.2.6 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.

18.2.2.7 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.

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

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

**18.3 Wires, Cables And Cords**

18.3.1 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 Utility Regulatory 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.

18.3.2 Installation Instructions

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

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

**18.4 Wiring Accessories**

18.4.1 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.

18.4.2 Switch Socket Outlet Units

18.4.2.1 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.

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

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

18.4.2.4 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)

18.4.2.5 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.

18.4.3 Fans

18.4.3.1 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.

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

18.4.3.2 Exhaust fans used must be plastic

18.4.4 Dimmer

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

the Consultant.

18.4.5 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 bend to have at least 8” (200 mm) extension on both sides for tieing 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.

**18.5 Light Fixtures**

18.5.1 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.

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

18.5.1.4 The type of fixtures with manufacturer catalogue reference are given in

Bill of Quantities.

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

18.5.2 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.

18.5.2 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.

18.5.2.5 The starters shall have radio-interference suppressers.

18.5.2.6 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.

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

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

18.5.3 Installation Instructions

18.5.3.1 The light fitting shall be installed according to manufacturers recommendations or as approved by the Consultant.

18.5.3.2 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.

18.5.3.3 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.

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

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

18.5.4 Main L.T. Switchboard

The L.T. switchboard shall be indoor type, free standing, free supporting, floor mounted, totally enclosed, sheet cald, 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.

18.5.4.4 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.

18.5.5 Distribution Feeder Panel

18.5.5.1Single 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.

18.5.6 Earthing

18.5.6.1 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.

18.5.7 Accessories

18.5.7.1 Designations labels, lifting lugs , foundation bolts, interconnecting nuts blots, 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.

**18.6 Testing**

The following tests shall be conducted on each completed switchboard.

18.6.1.1 Type Tests

(a) Temperature rise test

(b) Mechanical endurance

test Making/Breaking

Capacity test

18.6.1.2 Routing Test High Voltage test

18.6.2 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.

**18.7 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 Earth connections.

**18.8 Distribution Board**

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

18.8.2 Distribution box(DB) used must be wall embedded. Under no circumstances should any other box be used

18.8.3 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.

**18.9 Telephone System**

18.9.1 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 carries 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 local telecommunications operator. 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 shouting purposes. Cable used shall be twisted and shielded 3 cables in the office area and the rest as shown in the drawing.

**19.HVAC SYSTEM**

**19.1. 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

**19.2. 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.

**19.3. 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.

**19.4. 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.

**19.5. Air Conditioning System (VRV/VRF/INVERTER)**

**19.5.1. 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.

**19.5.2. 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.

**19.5.3. 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.

**19.5.4. 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.

**19.5.5. 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.

**19.6. 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 of 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.

**19.7. 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 fibreglass 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 co efficient of 0.70 between 400 and 2000 Hz to the approval of the Engineer.

**19.8. 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)

**19.9. Mechanical Fans**

**19.9.1. 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 combing 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.

**19.10. 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.

**20.CCTV 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 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.

**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. 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

**20.3. 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.

**20.4. 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.

**20.5. 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 analyser before handling over the system.

**20.6. Item Specification**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PROPOSED HITHADOO REGIONAL HOSPITAL** | | |  | |
|  |  |  |  | |
| **CCTV** |  |  |  | |
|  |  |  |  |  |
| **Technical Specifications** | | | | |
|  |  |  |  |  |
| **Item Number: 2 . Network Video Recorder** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 |  |  |
| Expansionable 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 Number : 3. Video Management Server** | | |  |  |
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| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 Number : 4. Network Video Decoder** | | | | |
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| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
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| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 Number : 5. Video Mattrix Controller(CCTV Keyboard)** | | | | |
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| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
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| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 Number : 6. LED Monitor** | | | | |
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| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 Number : 7. Outdoor Network PTZ Camera** | | | | |
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| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 |  |  |
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| **Item Number : 8. Network IR Bulet camera** | | | | |
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| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
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| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | | |  | | --- | |  | |  |  |
| 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 LuxIR 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 Number : 9. Network Fixed Dome Camera** | | | | |
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| **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 Number : 12. 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 Number : 13. Rack** | | | | |
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| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| **Features** | |  |  |  |
| 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 |  |  |

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

**21.1. 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 taken 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 areas 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.

**21.2. 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

**21.3. 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.

**21.4. 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.

**21.5. 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 handling over the system.

**21.6. Item Specification**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PROPOSED HITHADOO REGIONAL HOSPITAL** | | |  | |
|  |  |  |  | |
| **MATV** |  |  |  | |
|  |  |  |  |  |
| **Technical Specifications** | | | | |
|  |  |  |  |  |
| **Item Number: 2 . Digital Integrated System Manager** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 activaed in designated zones | | Available |  |  |
| Run designated audio file in predefined recurrent shedule 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 Number : 4. Power Amplifier** | | |  |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 Number : 5. Digital Multi-audio Player** | | |  |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| 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 impendence |  | FM:75Ω |  |  |
| Power supply |  | ~ 230V 50/60Hz |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
|  |  | |  | | --- | |  | |  |  |
| **Item Number : 6. Network Resource Interface** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| Auxiliary input | No. of Chanels | 4 or better |  |  |
|  | S/N | > 85 dB |  |  |
| Trigger inputs | No. of Chanels | 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 Number : 8. Ceiling Speaker** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | | |  |  |
| 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 |  |  |
| Mterial | | |  | | --- | | 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 Number : 9. Wall Speaker** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | | |  |  |
| 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 Number : 10. Horn Speaker** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | | |  |  |
| 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 Number : 10. Network Paging Console** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | | |  |  |
| 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 Number : 11. Volume Control** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | | |  |  |
| Rated power available | | 6W / 30W/ 60W/ 120W |  |  |
| 24V DC forced overide relay | | Available |  |  |
| wire systems | | 4 wire |  |  |
| Size |  | standard 86 × 86 electrical back box |  |  |
| Accessories | | Any required acessory not specifically refered to install/use the equipment |  |  |
|  |  | |  | | --- | |  | |  |  |
| **Item Number: 10. System Management Software** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | | |  |  |
| Network Display |  | Display as a visual map |  |  |
| Device status monitoring | | Available |  |  |
| Event logs | | |  | | --- | | Available | |  |  |
| Fault logs | | Available |  |  |
| Backing up the system data | | |  | | --- | | Available | |  |  |
| Shedule playback configuration | | Available |  |  |
| Logicl Zone groups | | Available |  |  |
| Accessories | | Any required acessory not specifically referred to install/use the equipment |  |  |
|  |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item Number: 14. Rack** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| **Features** | |  |  |  |
| 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 acessory not specifically referred to install/use the equipment |  |  |

**22. FIRE DETECTION AND PROTECTION SYSTEM**

**22.1. 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.

**22.2. 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.

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

22.3.1 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.

22.3.2 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.

22.3.3 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.

22.3.4. 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.

22.3.5. 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 handwheel.

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.

22.3.6. 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.

22.3.7 Nozzle

The nozzle shall be of approved jet/spray type.

22.3.8 Couplings

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

22.3.9 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.

22.3.10 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.

22.3.11 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.

22.3.12 Earthing

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

22.3.13 Calibration

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

22.3.14 Testing

The complete installation shall be tested hydraulically to one and a half time 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.

22.3.15 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.

22.3.16 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.

22.3.17 PUMP OPERATION

22.3.17.1 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 drains 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.

22.3.17.2 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.

22.3.17.3 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 value 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 pump’s 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.

22.3.17.4 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.

22.3.17.5 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.

22.3.17.6 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.

22.3.17.7 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

**22.4. Technical Specifications for Portable Fire Extinguishers**

22.4.1. 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.

22.4.2. 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 than5 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.

22.4.3 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.

22.4.4 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.

22.4.5 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.

22.4.6 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.

22.4.7. 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.

22.4.8 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.

22.4.9 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.

**22.5. Technical Specifications for Fire Detection & Alarm System**

22.5.1. 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 2000m2.

• 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

22.5.2. Equipment Specification

The Main Fire Alarm Panel (MFAP) shall be of the multiple processors 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

22.5.3 Interfacing Facility

22.5.3.1 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.

22.5.3.2 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.

22.5.3.3 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.

22.5.4. 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

22.5.4.1 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.

22.5.4.2 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.

22.5.4.3 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.

22.5.5. 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

22.5.6. 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.

22.5.6.1 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.

22.5.6.2 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 colour 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.

22.5.6.3 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

22.5.7 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 provided, 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 a 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

22.5.8. 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 he extended facility will be.

LEVEL 2 LEVEL 3

Message handler Program panel output

Program loop devices

Program loop outputs

Load/Save program data

Clear output

22.5.9 LOOP and Field Devices

22.5.9.1 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.

22.5.9.2 Loop Communications

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

22.5.9.3 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.

22.5.9.4 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.

22.5.9.5 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.

22.5.9.6 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.

22.5.9.7 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.

22.5.10 Detector Common Requirements

22.5.10.1 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.

22.5.10.2 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.

22.5.10.3 Detector Remote Output

Provision shall be made for on 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.

22.5.10.4 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.

22.5.10.5 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.

22.5.10.6 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.

22.5.10.7 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.

22.5.10.8 Approvals

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

22.5.11 Detection devices

All analogue addressable field devices shall have an integral microprocessor on board. All these devices 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.

22.5.11.1 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.

22.5.11.2 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. Is 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 an 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.

22.5.11.3 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.

22.5.11.4 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 secures. 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 rang - 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 100m2 at a height of up to 12m. The installation and sitting of the detectors must conform to BS 5839 1980 or similar Standards, ruling in the local region.

22.5.11.5 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 100m2 at a height of up to 12m.

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

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

22.5.11.6 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 50m2 at a height of up to 9m.

The device shall monitor 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.

22.5.12 Manual Call Stations

22.5.12.1 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.

22.5.12.2 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.

22.5.12.3 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.

22.5.13. 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.

22.5.13.1 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.

22.5.13.2 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 corporate a set of change offer 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.

22.5.13.3 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.

22.5.13.4 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 pup 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).

22.5.14. 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.

22.5.14.1 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.

22.5.15. 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 1.5mm2. For loop lengths of up to 1000 meters, 2.5mm2 will be used for 1000 meters to 2000 meters lengths.

22.5.15.1 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.

22.5.15.2 Cable Markers

All cable cores will be identified using ferrules to provide numbering and symbols as required.

22.5.15.3 Spare Capacity

Each loop will populate to 80% capacity, providing 20% spare for future expansion and or change of use.

22.5.15.4 Hard Copy Program

The successful contractor shall supply for approval hard copies of all text programming information, including all input to output configurations.

**23. ELECTRONIC ACCESS CONTROL SYSTEM (EACS)**

**23.1 Application of the section**

Items described under this section shall apply to all the sub sections of this specification

**23.2 General**

* + 1. This specification covers the submittals of shop drawings, sample approvals, setting to work, supply, installation, inspection, testing & commissioning, as built drawings and operation and maintenance manuals and periodic maintenance.
    2. The Tenderer’s shall read this section in conjunction with Tender drawings and Bill of Quantities. They shall clarify any discrepancies between tender drawings and Bill of Quantities.
    3. The Tenderer shall submit their offer complying with all the conditions of contract, specification, tender drawings and Bill of Quantities.
    4. EACS System supplier with more than 5-year experience shall supply and install the system.
    5. Specification, drawings and BOQ are meant to provide sufficient information to the tenderers and it is the contractor’s responsibility to supply and install complete systems to working order.
    6. All the sub systems under this section shall be supplied, installed, tested & commissioned by the respective contractors.

**23.3 Operation and Maintenance Manuals**

The Contractor shall submit 3 copies of Operation & maintenance Manuals, which shall contain Product literature, Specific operating instructions and Maintenance instructions.

**23.4 Approval Of information Submitted**

The Consulting engineer has the right to decide the adequacy of information submitted by the contractor and request further information as necessary if required

**23.5 Testing and commissioning of Systems**

The contractor shall perform all the equipment and devices testing as directed by the Consulting Engineer. The Contractor shall bear the cost for such tests and any items found defective shall be replaced at no extra cost. Such replaced items shall be re- tested for verification.

**23.6 Equipment, Materials, Fittings and Accessories**

The equipment, material used, fittings and devices shall comply with the Architectural and design criteria, design concepts and performance requirements.

When selecting products the contractor shall consider the space limitations, weight limitations, compatibility with other existing devices and systems.

Contractor shall obtain approval from consulting engineer for all the equipment, material, fittings and accessories before commencing installation.

All the products supplied under this contract shall be guaranteed for a period of one (1) year from the final handover date.

**23.7 Product Brands**

All the Materials, Equipment and Devices and Accessories supplied under this contract shall bear the Manufacturer names and make. The consulting Engineer has the right to accept or reject any Equipment, Material and device brands based on the past performance records.

**23.8 Drawings**

The contractor shall familiarize himself with the site conditions before preparing shop drawings. He shall verify the dimensions shown in the drawings and advise the consulting engineer any discrepancies.

The contractor shall submit 3 copies of shop drawing for approval. Contractor shall obtain approval for shop drawings before commencing installation work.

**23.9 Maintenance Access and Openings**

The contractor shall provide all necessary access openings where required for maintenance.

**23.10 Codes and Standards**

All equipment, materials and workmanship shall conform to the relevant British Standards, Maldives Standards and codes of Practice. All electrical installations shall comply with 17th Edition of IEE wiring regulations. Keep 30cm distance from electrical and other interference sources or use metal enclosed earthed conduits/trunks if the distance could not be maintained.

Use earthed metal enclosure to install control panels in service ducts. The shield of all cables shall be earthed at control panel and the other end should be kept open. Joints in cables shall not be permitted.

**23.11 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 reliable access control solution.

The EACS system must have standalone two door controllers installed in service ducts. It should control two doors, i.e., two proximity readers, monitoring two door sensors, two push buttons & monitor two emergency door release units. Every control panel should be connected to EACS server via Ethernet. The card access rights should be able to program in EACS software and it could be uploaded to panels. The access rights should be based on combination of weekday, holidays, time zones & card reader. The control panels must be in normal operation even after shutting down the server. The events shall be automatically buffered in control panel until the server comes on line. Subsequently, the buffered events shall be automatically downloaded to server. No data losses shall experience in any condition.

Valid card, Invalid card, Inactive card, Invalid time zones, Door Ajar, Door forced open, Push Button pressing, Emergency door release press events should be reported in software real-time and it should be recorded.

The emergency door release unit shall directly disconnect EML power on activation. All alarms should popup and should be audio alerted.

All predefined doors should be open in fire alarm condition. It could be activated through EACS server automatically. A normally open dry contact will be provided at fire alarm panel for fire integration.

The system should able to produce history reports of all events.

The EACS database backup should weekly uploaded to given location automatically (Scheduled backup).

Backups, time & date updates of control panels should be able to scheduled. The panel date & time should be synchronized with server time automatically once a week.

The user rights for system monitoring & card programming (adding, editing & deleting) should be able to separately assign.

Control panel & field equipment shall be modular in construction. Exact location of readers, push buttons, BGU & locks shall be proposed by architect. The positions shown are suggested locations in public areas as shown in the drawings.

**23.12 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. Door opening on valid card
2. Opening of door for push button
3. Directly disconnects lock power when emergence door release is pressed
4. Proximity reader LED color change in valid card
5. Real-time status reporting and events recording in database
6. Data base backup & restoring
7. (Automatic) scheduled backup
8. (Automatic) scheduled Panel date & time update
9. Manual door opening through EACS software
10. Open door on fire alarm condition

**23.13 GENERAL REQUIREMENT OF EACS EQUIPMENT**

1. General

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 EACS 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 EACS system shall be installed so that the combination of equipment actually employed should work as a full functioning system which does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, hum bars, transients, ghosting, etc.

**23.14 REGULATIONS AND CODE OF PRACTICE**

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

**23.15 TESTING**

The Contractor shall make all the necessary setting of the equipment after installation. The programming of door open time, Shunt times of door sensor 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.

**23.16 Item Specifications**

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| --- | --- | --- | --- | --- |
| **PROPOSED HITHADOO REGIONAL HOSPITAL** | | |  | |
|  |  |  |  | |
| **EACS** |  |  |  | |
|  |  |  |  |  |
| **Technical Specifications** | | | | |
|  |  |  |  |  |
| **Item Number: 2 . SMART Card Readers** | | |  |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| Smart Card compatibility | | ISO 15693, ISO 14443B4 on 13.56MHz |  |  |
| Indicators | Audio | Inbuilt buzzer |  |  |
| Host LED control | single tri-color (green-yellow-red) |  |  |
| Tamper output | | Optical sensor |  |  |
| Output | | Wiegand output |  |  |
| IP Rating | | IP55 |  |  |
| Mounting Size | | Switch plate size, single-gang electrical box |  |  |
| Typical Read Ranges |  | 3" |  |  |
| Operating Voltage | | 5 - 16 VDC from control panel |  |  |
| Operating Temperature | | 31º to 150º F (-35º to 65º C) |  |  |
| Operating Humidity | | 5 to 95% relative humidity (non-condensing) |  |  |
| Approvals | | USA : FCC ,Europe: CE Mark Approval |  |  |
| Other |  | Should work with reader/control panel/EACS software |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
|  |  | |  | | --- | |  | |  |  |
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| **Item Number: 3. Finger Print Readers** | | |  |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| Interface | | Ethernet TCP/ IP |  |  |
| Fingerprint verification | | 1:1 and 1:N |  |  |
| Fingerprints templates | | 500 or better |  |  |
| No. of Transactions | | 30000.00 |  |  |
| Fingerprint sensor | | Optical fingerprint sensor without film |  |  |
| USB Interface | | Available |  |  |
| False Rejection Rate | | ≤0.01% or better |  |  |
| Web Server support | | Available |  |  |
| First In- Last Out Report | | Available |  |  |
| Multiple shift base configuration extend to two days | | Available |  |  |
| Time & Attendance Management software | | Included |  |  |
| Finger enrolment software | | Included |  |  |
| Fingerprint Enrolment | | Possible |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
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| **Item Number: 5. Push Button** | |  |  |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| Type | | Proximity |  |  |
| Operating Voltage | | 5.0 - 12 VDC (works from control panel power) |  |  |
| Output | | Normal open & Normally closed dry contact |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
|  |  | |  | | --- | |  | |  |  |
| **Item Number: 6. Emergency Door Release** | | |  |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| Colors | | Green |  |  |
| Output | | Dry contact, Normally Close/ Normally open two contact, 2A/24VDC |  |  |
| Type |  | Plastic Resettable, No replacing items required to reset when unit is activated |  |  |
| Size | | Switch plate size, single-gang electrical box |  |  |
|  |  |  |  |  |
| **Item Number: 7. Electromagnetic lock with door position sensor** | | | |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| Holding Force | | 1200 lbs |  |  |
| Mount | | Surface Mount |  |  |
| Construction |  | Magnet & Armature plate |  |  |
| Voltage Spike Suppressor | | Available |  |  |
| Operating Voltage |  | Dual Voltage 12V / 24 V |  |  |
| Door Sensor |  | Available |  |  |
| Indication |  | LED dual color |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
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| **Item Number: 8. Control Panel** | | |  |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| Make | | |  |  |
| Model | | |  |  |
| Country of origin | | |  |  |
| **Features** | |  |  |  |
| Operation | server off-line | Available |  |  |
| Connectivity | With server | Ethernet |  |  |
| With Proximity readers | Wiegand |  |  |
| Card Database | | 10,000 cards or better |  |  |
| Transaction buffer | | 25,000 transactions or better |  |  |
| Access level | | 100 or better |  |  |
| Holidays | | 200 or better |  |  |
| Time zone | | 100 or better |  |  |
| Card reader formats |  | Wiegand format support |  |  |
| Credential facility codes |  | 6 or better |  |  |
| Dedicated tamper alarm | | Available |  |  |
| Dedicated power fail alarm | | Available |  |  |
| Real time clock | | Available |  |  |
| Onboard I/O | | 2 Readers, 8 Supervised inputs, 4 Relay outputs |  |  |
| Operational modes |  | Card only & Card and PIN |  |  |
| Anti-Passback support |  | Local, Global, Forgiveness |  |  |
| Approvals | | USA and Canada: FCC ,Europe: CE Mark Approval |  |  |
| Humidity | | 0 to 85% RHNC |  |  |
| Temperature | | 0 to 50° C |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
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| **Item Number: 9. Control Panel Enclosure** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| **Features** | |  |  |  |
| Type | | Metal, Powder coated, lockable |  | - |
| Size |  | Suitable to install control panel, power supply |  |  |
| Ventilation |  | Suitable for heat dissipation from control Panel/power supply |  |  |
| Tamper |  | Enclosure door tamper condition reports EACS software via control panel |  |  |
| Knockouts | | Provision of knockouts |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
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| **Item Number: 10. EACS Software** | | |  |  |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| **Features** | |  |  |  |
| Edition |  | Standard or Professional (Not Express version) |  |  |
| event monitoring |  | Real Time |  |  |
| Alarm monitoring |  | Control and response, including acknowledge, clear and annotate, Audible notification |  |  |
| Door modes |  | PIN Only, Card+PIN, Card or PIN, Card Only |  |  |
| Reporting | | History Reports, Export facility, database info reports |  |  |
| Anti-pass back | | Hard or Soft |  |  |
| Floor plan | | GUI to locate devices |  |  |
| License | | 5 user clients |  |  |
| Holiday types | | 2 or better |  |  |
| Card numbers | | up to 20 digits or better |  |  |
| Database Backup/Restore | | Available |  |  |
| Scheduling Control panel Sync | | Available |  |  |
| Manage the system from more than one workstation | | Available |  |  |
| Server Application supported operating System | | Windows Server 2012 R |  |  |
| Client Application supported operating system | | Windows 7 Professional (64 bit) |  |  |
| Database |  | SQL Server 2012 Express or better |  |  |
| operator user right defining | | Customizable |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
|  |  | |  | | --- | |  | |  |  |

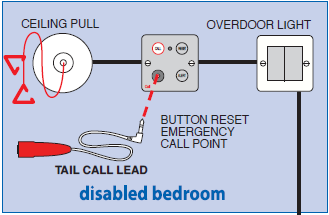
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item Number: 11. Smart Card** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| **Features** | |  |  |  |
| Dimensions | | 2.125" W x 3.370" H x 0.030" T (5.4cm W x 8.6cm H x 0.076cm T) |  | - |
| Finish |  | Gloss White |  |  |
| Construction |  | PVC Laminate |  |  |
| ISO Standards |  | ISO 15693, ISO 14443B4 on 13.56MHz |  |  |
| Operating Temperature | | -40° - 158° F (-40° - 70° C) |  |  |
| Operating Humidity | | Operating Humidity |  | - |
| Application AREA |  | 16 or better |  |  |
| Other |  | Should work with reader/control panel/EACS software |  |  |
| Accessories | | Any required accessory not specifically referred to install/use the equipment |  |  |
|  |  | |  | | --- | |  | |  |  |
| **Item Number: 15. EACS server** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| **Features** | |  |  |  |
| **OS** |  | Windows Server 2012 R |  |  |
| Processor |  | Intel® Xeon® or better |  |  |
| Miscellaneous | | Branded unit |  | - |
| Must complied to EACS software requirements |  |  |
| CPU |  | 2.8GHz or better |  |  |
| RAM |  | 8 GB or better |  |  |
| HDD |  | 500GB or better |  |  |
| Network |  | 100Mbps |  |  |
| Database |  | SQL Server 2012 Express or better |  |  |
| Accessories | | DVD Writer |  |  |
| Monitor 19" or better |  |  |
| Any required accessory not specifically referred to install/use the equipment |  |  |
|  |  |  |  |  |
| **Item Number: 14. EACS Client PC** | | | | |
|  |  |  |  |  |
| **DESCRIPTION** | | | **Bidder's Response** | **Page No.** |
| **Features** | |  |  |  |
| OS |  | Windows 7 Professional (64 bit) or better |  |  |
| Processor |  | Intel® Core™ i5 or better |  |  |
| Miscellaneous | | Branded unit |  | - |
| Must complied to EACS client software requirements |  |  |
| CPU |  | 3.1 GHz or better |  |  |
| RAM |  | 8 GB or better |  |  |
| HDD |  | |  | | --- | | 500GB or better | |  |  |
| Network |  | 100Mbps |  |  |
| Accessories | | DVD Writer |  |  |
| Monitor 19" or better |  |  |
| Any required accessory not specifically referred to install/use the equipment |  |  |

**24. NURSE CALL SYSTEM SPECIFICATION**

**24.1 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 reliable emergency call system.

The user calls for assistance by activating a ceiling pull, standard call point. A confidence light on the calling device illuminates to reassure the user that the call has been registered. At the system’s indicator panel-Nurse Control Panel (s), an indicator light illuminates and a buzzer sounds to inform staff that someone is in need of assistance. Relevant over door lights (if available) also operate (as fitted) to provide additional visual indication of the call. A member of staff visits the calling room to assist the user and resets the calling device to return the system to normal. The following shows sample items for reference.



The master reset button of system’s indicator panel-Nurse Control Panel should be able to enable or disable as this facility allows standard calls to be globally cancelled without the source of the call being investigated. The “Mute” button allows any standard calls on the system to be silenced but it leaves relevant indicator light(s) lit. Although a new call from a different call point will re-activate the sounder.

Exact location of call points & remote indicators, etc. shall be proposed by architect. The positions shown are suggested locations in areas as shown in the drawings.

**24.2 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:

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

1. Test call registering of each call point in Nurse Control Panel
2. Test Visual and audible alert generate at Nurse Control Panel by each call point
3. Test call resetting of each call point
4. Test remote indicator function

**24.3 GENERAL REQUIREMENT OF NURSE CALL SYSTEM EQUIPMENT**

General

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 Nurse Call 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 nurse call 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.

All trunk, branches and interconnecting cables and unused ports/taps shall be terminated.

**24.4 REGULATIONS AND CODE OF PRACTICE**

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

**24.5 TESTING**

The Contractor shall make all the necessary setting of the equipment after installation. The call registering, resetting shall be tested in each call point 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 before handling over the system.

**24.6 ITEM SPECIFICATION**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | |  | |  | |  | |  | |
| **Item Number : 2 . Emergency Mater Panel (Nurse Station Panel)** | | | | | | | | |  | |
|  | | |  | |  | |  | |  | |
| **DESCRIPTION** | | | | | | | **Bidder's Response** | | **Page No.** | |
| Make | | | | | | |  | |  | |
| Model | | | | | | |  | |  | |
| Country of origin | | | | | | |  | |  | |
| **Features** | | | | |  | |  | |  | |
| Zone capacities (Number of zones supported by a single panel panel) | | | 10 | | Available | |  | |  | |
| 20 | | Available | |  | |  | |
| 30 or better | | Available | |  | |  | |
| Availability of indicator light to inform an activation of call button | | | | | Available | |  | |  | |
| Possibility of observe all active calls simultaneously | | | | | Possible | |  | |  | |
| Ability to identify bed numbers of call points activated simultaneously | | | | | Possible | |  | |  | |
| Availability of buzzer sounds to inform an activation of call button | | | | | Available | |  | |  | |
| Buzzer sound level | | |  | | 60dB/A or better | |  | |  | |
| Simultaneous call notification (Any number of call button activations notify on the panel) | | | | | Available | |  | |  | |
| Methods of reset - Reset key or Reset button | | | | | Available | |  | |  | |
| Master reset button(calls to be globally cancelled) | | | | | Available | |  | |  | |
| Master reset button Enable/Disable facility | | | | | Available | |  | |  | |
| Mute buttons | | | | | Available | |  | |  | |
| Mute button silence calls but it leaves relevant indicator light(s) lit | | | | | Available | |  | |  | |
| Mute button Enable/Disable facility | | | | | Available | |  | |  | |
| Muted panel re-activate sound when a new call is received | | | | | Available | |  | |  | |
| Battery backup with charging | | | | | 2 hours or better | |  | |  | |
| Supply voltage | | | | | 230V AC | |  | |  | |
| Operating Voltage | | | | | 12V DC | |  | |  | |
| System Type | | | | | Wired zones | |  | |  | |
| Accessories | | | | | Any required accessory not specifically referred to install/use the equipment | |  | |  | |
|  | | |  | | |  | | --- | |  | | |  | |  | |
| **Item Number : 4. Button Reset Emergency Call Point without tail call lead** | | | | | | | | |  | |
|  | | |  | |  | |  | |  | |
| **DESCRIPTION** | | | | | | | **Bidder's Response** | | **Page No.** | |
| Make | | | | | | |  | |  | |
| Model | | | | | | |  | |  | |
| Country of origin | | | | | | |  | |  | |
| **Features** | | | | |  | |  | |  | |
| Powering | | | | | By Master panel | |  | |  | |
| confidence light (Availability of light on the calling device which illuminates to reassure the user that the call has been registered in master panel) | | | | | Available | |  | |  | |
| Reset Method | | | | | Button Reset | |  | |  | |
| Remote socket for tail call lead | | |  | | Available | |  | |  | |
| Tail call lead | | |  | | Not available | |  | |  | |
| Calling method | | |  | | Button call point | |  | |  | |
| Size | | | | | Standard switch box size, compact | |  | |  | |
| Accessories | | | | | Any required accessory not specifically referred to install/use the equipment | |  | |  | |
| **Item Number : 5. Button Reset Emergency Call Point with tail call lead** | | | | | | | | |  | |
|  | | |  | |  | |  | |  | |
| **DESCRIPTION** | | | | | | | **Bidder's Response** | | **Page No.** | |
| Make | | | | | | |  | |  | |
| Model | | | | | | |  | |  | |
| Country of origin | | | | | | |  | |  | |
| **Features** | | | | |  | |  | |  | |
| Powering | | | | | By Master panel | |  | |  | |
| confidence light (Availability of light on the calling device which illuminates to reassure the user that the call has been registered in master panel) | | | | | Available | |  | |  | |
| Reset Method | | | | | Button Reset | |  | |  | |
| Remote socket for tail call lead | | |  | | Available | |  | |  | |
| Tail call lead | | | Availability | | Available | |  | |  | |
| Length | | 1.8m (6ft) | |  | |  | |
| Calling method | | |  | | Button call point or removing tail call lead | |  | |  | |
| Size | | | | | Standard switch box size, compact | |  | |  | |
| Accessories | | | | | Any required accessory not specifically referred to install/use the equipment | |  | |  | |
| **Item Number : 6. Button Reset Emergency Call Point with ceiling pull code** | | | | | | | | |
|  |  | |  | |  | |  | |
| **DESCRIPTION** | | | | | **Bidder's Response** | | **Page No.** | |
| Make | | | | |  | |  | |
| Model | | | | |  | |  | |
| Country of origin | | | | |  | |  | |
| **Features** | | |  | |  | |  | |
| Powering | | | By Master panel | |  | |  | |
| confidence light (Availability of light on the calling device which illuminates to reassure the user that the call has been registered in master panel) | | | Available | |  | |  | |
| Reset Method | | | |  | | --- | | Button Reset | | |  | |  | |
| Remote socket for tail call lead |  | | |  | | --- | | Not Available | | |  | |  | |
| Tail call lead | Availability | | Not Available | |  | |  | |
| Calling method |  | | Pull code | |  | |  | |
| Size | | | Standard switch box size, compact | |  | |  | |
| Accessories | | | Any required accessory not specifically referred to install/use the equipment | |  | |  | |
| **Features** | | |  | |  | |  | |
|  |  | | |  | | --- | |  | | |  | |  | |
| **Item Number : 7. Over Door Indicator (Remote Indicator)** | | | | | | |  | |
|  |  | |  | |  | |  | |
| **DESCRIPTION** | | | | | **Bidder's Response** | | **Page No.** | |
| Make | | | | |  | |  | |
| Model | | | | |  | |  | |
| Country of origin | | | | |  | |  | |
| **Features** | | |  | |  | |  | |
| Indication | | | Light Illumination | |  | |  | |
| Size | | | Standard switch box size, compact | |  | |  | |
| Accessories | | | Any required accessory not specifically referred to install/use the equipment | |  | |  | |

**25. PRIVATE AUTOMATIC BRANCH EXCHANGE (PABX) SPECIFICATION**

**25.1 Scope of work**

The work to be carried out under this tender specification shall consist of the supply, delivery to site, installation, testing, commission, handover in approved work order and maintenance during the defects liability of period of a proposed digital private automatic branch exchange (PABX) in accordance to the specification, supplementary notes, condition of contract, drawing attached herewith.

Cabling and any necessary trunking or cable trays from the Telekom main distribution frame to the PABX room shall be included in the tender price.

Tenderer shall liaison with relevant Local Telecommunication Authority, for lines application, testing and commissioning of the incoming lines to ensure the PABX system is fully functional in accordance to the works schedule.

Tenderer shall provide basic operation and maintenance training of the PABX system, digital phones, call billing system and Administration Tools to the company staff and company in-house maintenance team.

**25.2 PABX system in general**

The proposed PABX shall be fully digital and adhere to ITU-T recommendations for A-Law PCM switching.

The proposed PABX system shall use the same hardware and software across all line size and modular in design. Expansion shall only involve adding of cards and shelves or line trunk units in the existing cabinet. PABX system that uses different type of cards in different shall not be consider at all.

The proposed PABX system shall be have ‘Universal Port Architecture, design to allow flexible system configuration and maximum utilization of all available card slots.

The proposed PABX shall be a fully non-blocking system. The traffic flow of the proposed PABX system shall be 1 Erlang per port. The number of ports supported shall be met by the same number of time slots in the PABX switching matrix.

The system shall facilitate expansion from the initial proposed capacity to the maximum capacity of 5,000 users by only addition of cards and shelves in the existing cabinet of the offered PABX.

The proposed PABX system shall support the same features and applications across all the line sizes without having to upgrade to the next higher model. The only cost that will incur in the future shall due to the expansion of present capacity only. PABX system that involve changing of whole system and cards for expansion from the present model to the next higher model shall not be considered at all. The proposed PABX system shall support the following features without any software upgrade:

• Normal PABX features

• Networking

• IP Telephony

The ISDN primary rate interface (PRI) shall be supported as incoming to the proposed PABX system. The software needed for ISDN applications shall be a standard package of the proposed PABX system and shall not incur any cost. The PABX system shall support both: -

• Decadic pulse and dual tone multi-frequency DTMF) based analogue/single line extension telephone sets

• 2-wire digital extension telephone sets using ITU-TU interface signaling protocol in any combination

• Single line telephone set with RJ11 data port built-in. These single line phones shall be in either one line or two lines.

The proposed PABX system shall be able to connect to 100% digital telephone sets up to its maximum capacity.

The proposed PABX system shall be able to restart automatically without human intervention when the external AC power supply is resumed after complete power failure, where backup batteries are also depleted.

Tenderer shall supply a modem together with the proposed PABX system for automatic system failure alert or remote maintenance purposes.

The proposed PABX system shall support multi-signaling protocol such as MFC R2, DPNSS, Q-sig and ISDN on digital 2Mbps link.

The proposed PABX system shall support multi-carriers. The communication links shall be bi-directional on any of the 64kbps channel.

**25.3 SYSTEM HARDWARE**

The designed/architecture of the proposed PABX system must meet the following requirement: -

a. Client/Server model using LAN technology

b. Standard market components such as Intel processor

c. No traffic saturation whatever the number of users

d. Common bus absence, a problem of one link does not interfere with the other links.

e. Decentralized functions on all interfaces; switching, tone detection, conference.

f. Decentralized power supply on all boards. Modules that are require power supply will not be considered.

The tenderer shall supply external rectifier as charger to the backup batteries and to convert the power supply from AC to DC.

The proposed PABX system shall be placed in an air-conditioned PABX room. The ambient condition of the PABX room shall be as follows to ensure optimum system performance.

Room temperature: 16 - 40°C Absolute humidity :6 - 18 g H2O/m2 Relative humidity: 20 - 70%

The proposed PABX system shall be ventilated by convection air flow. No cooling fans shall be used in any part of the PABX cabinets.

The proposed PABX system shall use a same set of line, trunk and other interface cards across all the line sizes or models within the same family. The initial investment shall be protected when proposed PABX system is expanded later.

The analogue extension cards of the proposed PABX system shall have 32 circuits each and in the form of 2-wire connection.

The digital extension cards of the proposed PABX system shall have 32 circuits each and in the form of 2-wire connection.

The analogue trunk cards of the proposed PABX system shall have 8 circuits each.

The module that houses all the line cards must be based on universal card slots with minimum 14 slots per cabinet.

The digital extension card must not only support the digital telephone but also the DECT base stations. Tenderer shall supply one lot of high-quality maintenance free sealed lead acid batteries with battery racks for 4 hours power back-up together with the proposed PABX system. These batteries shall be connected to the PABX charger. Tenderer shall submit some battery data sheet together with the submission.

The proposed PABX system shall come with a dump terminal as system administration and maintenance terminal.

**25.4 SYSTEM SOFTWARE**

The proposed PABX system shall use the Unix Chorus real time micro-kernel open operating system. The operating system shall control the execution of the system programs and administration of the PABX resources.

The software is structured in three (3) layers:

a. The Unix Chorus real time micro-kernel supervises the other two layers

b. The interface layer (APIs) allows the applications to communicate with the CPU and guarantees real time processing.

c. The application layer with the real time applications servers and the Unix applications servers

The proposed PABX system shall have uniform system software for all the line size models within the same PABX family.

The system software shall be stored in a hard disk. The system software can be back-up in diskettes.

**25.5 SYSTEM CAPACITY**

The proposed PABX system shall be equipped with the following capacity: -

Description Capacity

The number of C.O. lines 10

The number of analogue extensions 250

The number of digital extensions 5

The number of Screen based attendant consoles 1

The power failure transfer unit0 -

The music on hold facility 1

Duplicated CPU for Redundancy 1

The following telephone sets shall be supplied together with the PABX system: - X Number of single line phone for analogue extensions.

X Number of 2-wire digital phone with display, programmable feature buttons and semi-handsfree. X Number of 2-wire digital phone with display, programmable feature buttons and full-handsfree.

**25.6 NUMBERING PLAN**

The proposed PABX system shall variably numbering scheme where a combination of extension numbers from 1 digit to 6 digits is supported.

The proposed PABX system shall have a flexible numbering plan. Both closed and open numbering plan shall be supported.

**25.7 PABX FEATURES AND FACILITIES**

25.7.1 Alternating between two parties

The proposed PABX system shall allow a user to switch back and forth between 2 connections either internal or external as often as possible. During this process, one party is connected to the user while the other is being on hold and provide with system music-on-hold.

25.7.2 Authorization code and password for call billing identification.

The proposed PABX system shall be able to request the users to enter an authorization code or a password via the keypad before making a call. The code shall be captured by the call detail recording system together with the number dialed to billing identification purposes.

25.7.3 Automatic Ringback for Transferred Unanswered Calls

Incoming calls transferred by an extension to the destination extensions shall ring back automatically at the extension where the calls are transferred if these calls are not answered by the destination extensions within a period of time. This feature shall be applicable to all PABX extensions including the attendant console.

25.7.4 Call Back - Busy and No Answer

An extension calling a busy extension or an extension with no answer shall be able to enter a code for back request and as soon as the busy extension is free or the no answer extension is used once, both the calling extension and destination extension are automatically rung and connected upon answering.

25.7.5 Call Forward

This service feature shall allow all calls destined for an extension to be forwarded to another extension or to the PABX operator regardless of the state of the extension, whether it is busy or idle.

25.7.6 Call Hold

This feature shall enable an extension user to hold an ongoing call and free his line to initiate another call or request for a service feature.

25.7.7 Call Park

This feature shall enable an extension user to park his existing call and retrieve the call from any other telephone by dialing a pre-arranged code.

25.7.8 Call Pick-up

Incoming calls to an extension in a group of extensions with call pick-up facility shall be able to be picked up by any extension within the same group by just dialing a code. There shall be no limit for the number of analog extensions per group or 25 digital extensions per group.

25.7.9 Call Tracing

This feature shall print out the number of a caller on a printer for logging purpose.

25.7.10 Call Transfer

This feature shall permit an extension user to transfer an existing call to another extension without the assistance of the PABX operator.

25.7.11 Camp-on

This feature shall enable to calling extension that calls a busy extension to hold the call in a special waiting mode and send a comp-on tone indication to the busy extension. When the busy extension becomes idle, it is automatically rung and connected to the waiting trunk call.

25.7.11 Class of Service

This service feature permits all extensions to be assigned a class of service in accordance with the degree of feature usage desired. The proposed PABX system shall be able to provide class of service to all its users. 16 group of class of service shall be possible. Each user shall have 2 class of service. The class of service shall be switchovered by attendant console or by entering a password (12 digits maximum) by the user on the telephone set or automatically at predefined time.

25.7.12 Day/Night Class of Service

This feature shall enable any extension to alternate between two different class of service - one for day and another for night. The PABX system shall be programmed in such a way that the class of service of extension will change automatically when night service is activated by the PABX operator.

25.7.13 Conference - 3 parties

This feature shall allow an extension user to add another extension user of the same PABX

system to an existing connection for a 3-party conference.

25.7.14 Decadic Pulse and DTMF Dialing

The proposed PABX system shall support telephone sets with decadic and DTMF dialing.

25.7.15 Digit Translation

The proposed PABX system shall be able to delete or insert digits from the string of digits dialed by the users. The PABX system shall convert up to 6 digits.

25.7.16 Direct Digital Interface

This proposed PABX system shall be able to be connect to private or public 2Mbps network. The transmission medium shall be twisted copper pair.

25.7.17 Direct Inward Dialing

This feature shall enable incoming calls to reach the extension without operator assistance. The calls shall dial 3 digit or 4-digit prefix allocated by Telekom Malaysia and follow by the

4 digit or 3-digit extension number they wish to reach.

25.7.18 DISA

The proposed PABX shall enable the user to dial to the PABX system to obtain a connection to dial out to another destination using normal CO trunks, tie trunks or leased lines. This feature shall be able to be protected by a password to prevent unauthorized usage of the facility. In the event of PABX dials out using CO lines, the proposed PABX system shall be able to drop the connection immediately upon termination of call to avoid excessive billing by Telekom Malaysia. The user shall pay only local call charges for the call to PABX and the rest of the call charges shall be billed to the PABX system.

25.7.19 Distinctive Ringing

The PABX system shall be able to have distinctive ringing tones for internal and external calls.

25.7.20 Display

The digital telephone set with display shall have the flexibility to display one of the following modes:

• The calling number and name of caller (internal calls and external calls if call line identification is possible).

• The calling number only (internal calls and external calls if call line identification is possible).

• The calling name only (internal calls and external calls if call line identification is possible).

25.7.21 Display During Calls

The calling party’s number shall be displayed at digital telephone set being reached with display together with the ringing tone. In case of incoming line without call line identification, only incoming calls are displayed. As for internal calls, the name and number of the calling extension shall be displayed.

25.7.22 Display During Dialing

The proposed PABX system shall allow the number being dialed to be displayed at digital telephone set with display. In case of internal calls, the name of the destination extension shall also be displayed throughout the conversation.

25.7.23 Do Not Disturb

The extension user shall be able to enter a code from his/her telephone set to prevent incoming calls. During this time, outgoing calls are still possible from this extension. However, the attendant console and urgent calls shall override this do not disturb status.

25.7.24 Howler Tone

The proposed PABX system shall send howler tone to an extension which remains in an off-hook state for a pre-assigned duration or to an extension which has not replaced the handset properly after finishing a call and alert the user to replace the handset properly.

25.7.25 Hotline Service

This feature shall allow an extension to call another pre-assigned extension by merely lifting the handset. There shall be two types of hotlines: immediate and timed delay. For immediate hotline, the predetermined extension shall be immediately rung by lifting of the handset of the hotline phone. For timed delay hotline service, the predetermined extension shall be rung after the time out delay by lifting of the handset of the hotline phone.

25.7.26 Music on Hold

This feature shall provide music to a party who is being on hold under conditions such as consultation hold, call transfer, etc.

25.7.27 Night Service

The proposed PABX system shall direct all incoming calls to a pre-arranged extension, a group of extensions or a bell for attention after working hour.

25.7.28 Number Redial

The extension user shall be able to store any internal numbers up to 6 digits or external numbers up to 22 digits for subsequent redial purposes.

25.7.29 On-hook Dialing

The proposed PABX system shall allowed all users with digital telephone sets to originate an internal or external call by dialing the number straight away with the handset on-hook and without activating the speaker button.

25.7.30 Password protection for administration extension

The proposed PABX system shall enable the company administration staff to lock their phones whenever required to prevent unauthorized staff from making any long-distance calls.

25.7.31 Power Failure Transfer

The PABX system shall be equipped with the power failure transfer unit to switch over the incoming lines to some pre-determined single line telephone sets in the event of complete power failure to enable the users to communicate with outside world.

25.7.32 Speed Dial - System

The proposed PABX system shall support 1,000 speed dial numbers which are accessible by all PABX users. Each speed dial number shall be up to 22 digits maximum. These speed dial numbers shall be divided into system list (accessible by everybody) and department list (accessible by users in that particular department only). The numbers for the system speed dial lists shall be programmed by the system administration and maintenance terminal.

25.7.33 Speed Dial - Individual

Besides the system speed dial list, the proposed PABX system shall have individual speed dial list for each user. These individual speed dial lists shall be maintained by the user himself/herself. Each individual speed dial list shall have 10 numbers maximum and each number shall be up to 22 digits long.

25.7.34 Timed reminder service

The proposed PABX system shall allow an extension user to enter a time from his/her telephone set for automatic ring back at the pre-set time and deliver a reminder message. The system shall support 1 time reminder per analog extension and 20-time reminders per digital extension.

**25.8. PC BASED ATTENDANT CONSOLE**

The proposed PABX system shall be equipped with attendant console with Handset and Headset and utilized the PC monitor only.

In the event of the failure of the PC monitor, the attendant console must still operate under normal circumstances except without display.

The attendant console shall be connected to a digital extension of the PABX system using a 8-wire connection.

The monitor of the attendant console shall display the day, date, time, internal and external call queue counter, calling extension, call process and the status of the extensions. Attendant consoles with LED display will not be considered as it will not display sufficient information to the operators and the display will be difficult to see in dim lighting conditions.

When the operators are free, the attendant consoles shall generate audible and visual call indication whenever there are incoming calls to alert the operators. The loudness of the call indication shall be adjustable.

When the operators are engaged with a call, the attendant consoles shall generate only visual indication whenever there are incoming calls to alert the operators.

The console shall be reached by the normal operator extension i.e., “0” or a personal extension number. The console shall have a counter for queuing trunk calls and internal calls.

The console shall have separate buttons to answer internal, external and personal calls. These call answer buttons shall allow operator to toggle between internal, external and personal calls. While answering a call, the other party shall be put on hold automatically.

The console shall incorporate the functions and facilities for business environment.

The attendant console shall be able to be connected to a tape recorder for recording of conversations. The attendant consoles shall be able to be connected to headset and handset.

The attendant console shall be able to transfer all calls in blind transfer mode or supervised mode.

All transferred calls that are not answered shall ring at the attendant consoles again after time-out factor.

25.8.1 Console Facilities

25.8.1.1 Camp-On with Tone Indication

This feature shall allow an operator to hold an incoming call in a specific waiting mode when the destination extension is busy. The operator shall send a camp-on tone indication to the busy destination extension. When the busy extension becomes idle, it is automatically rung and connected to the waiting party. Camp-on warning tone shall only be heard by the internal extension. Music-on-hold shall be provided to the waiting party.

25.8.1.2 Operator Override

This feature shall allow the operator to enter a busy trunk connection by operating the appropriate key and keying the trunk number. A warning tone shall be heard by the connected parties, after which the connected parties and operator will be connected in three-way connection.

25.8.1.3 Call Number Display

This feature shall allow the called extension number to be displayed on the console when a call is answered by the attendant operator.

25.8.1.4 Call Processing Indication

The screen shall provide indications to the operator relating the status of calls being processed.

25.8.1.5 Call Queuing

Calls directed to the console shall be placed in a ‘First-in/First-out’ queue. The operator may answer these calls in order of the arrival of the call by depressing the ‘Answer’ key.

25.8.1.6 Call Waiting Indicator

When the total number of calls waiting in queue for operator processing exceed a preset number of calls (e.g., 4 calls), this indicator shall flash at the operator console.

25.8.1.7 Display of Extension Information

Extensions calling or called by the operator will be identified by extension number, class of service and tenant number on the console display.

25.8.1.8 Individual Operator Access

The system shall be able to assign an individual number to each operator console in the system and allow the extension users to gain access to the specific operator console by dialing the assigned individual number.

25.8.1.9 Individual Trunk Access

This feature shall allow an operator to access individual trunks by dialing a access code.

25.8.1.10 Incoming Central Office Call to Tie Line Connection

This feature shall permit an operator to connect an incoming exchange call to an extension of a distance PABX via a tie line.

25.8.1.11 Lamp Check

Each operator console shall be equipped with a key which illuminates all LED’s and sounds an audible signal to the console audible simultaneously, allowing the operator to confirm proper operation of each indicator.

25.8.1.12 Non-Delayed Operation

This feature shall allow the operator to complete dialing of all types of calls (extension to trunk, trunk to trunk, trunk to extension) while the calling party holds on the line. The held calling party is then automatically connected to the called party.

25.8.1.13 Passing a Dial Tone/external trunk

The PABX operator shall be able to pass a dial tone to a restricted extension user to enable the user to make a call.

25.8.1.14 Time-out for dial tone / external trunk extended

The dial tone / external trunk extended by the operator to a user shall be clear down automatically if it is not used by the user within a certain period of time.

25.8.1.15 Class-of-service changeover on extending of dial tone/external trunk

The user shall receive a class-of-service which is normally higher than his/her normal class-of-service for the time the dial tone/external trunk is extended to the user.

25.8.1.16 Splitting

This feature shall allow the PABX operator to confer privately with one party on a operator- handled connection without the other party overhearing it.

25.8.1.17 Text messaging

The system's telephone application will enable the operator on transfer call status to send a short text message to a selected internal subscriber equipped with a terminal with a display. The operator will have the option of sending the message immediately onto the display panel of the subscriber if the line is engaged, or sending it to a text mailbox linked to the terminal, whether the called party is free or not. To facilitate the operation of this service, the operator should have the choice of several types of messages:

• Pre-programmed messages to answer most common cases (example: call back the switchboard, a visitor is waiting for you in reception etc.),

• Pre-programmed messages to be completed (example: call back number XYZ)

• Free messages to be composed entirely by the operator.

The tender will describe clearly all the characteristics of the service and the size of message, which can be sent in the various communication positions.

**25.9 DIGITAL TELEPHONE**

The proposed PABX system shall support digital telephone set. The proposed PABX system shall be able to support 100% full digital telephone connection.

The digital telephone sets shall have the programmable one touch button for the following features:

25.9.1 Call back - busy / no answer

It shall be able to initiate callback to a dialed station, irrespective of whether the called party is busy or receive no answer.

The connection is set up as soon as the called party cradles the handset or returns to his desk and uses the telephone.

25.9.2 Number Redial

It shall be possible to store a dialed internal or external number and dial it again later.

25.9.3 Call Forwarding

It shall be possible to reroute immediately all incoming calls to another telephone or the

Voice Mail Service.

A preset call forwarding tot a specific destination (such as a voice mailbox) or variable call forwarding to a programmable station is possible. Once call forwarding has been activated, it shall be able to transfer to another station by means of the “follow me’ facility.

25.9.4 Call Pick-up

It shall be able to pick-up a call which is ringing at another station within the same group by just pressing the call pick-up key at any telephone within the group.

25.9.5 Speed Calling - System

It shall be able to access to access centralized speed calling lists containing internal and external numbers which is stored into the PABX system. Tenderers shall state down the maximum speed calling numbers available in the system.

25.9.6 Speed Calling - Individual

Besides centralized speed dialing, each user shall be able to enter individual sped calling destinations for internal and external numbers. Each user is able to access to an individual speed calling list. Tenderers shall state down the maximum individual speed calling numbers available in the system.

25.9.7 Second Call

The digital telephone set shall be able to receive a second call even if he is engaging on one line. There shall be a “second call” indicator button on the phone to signal the user and he is able to put the first caller on hold and take the second call if he wishes to.

25.9.8 Volume Control

The digital telephone shall have electronic “+” and “-” push buttons to control the loudness of receiving signal of the loudspeaker or handset earpiece.

25.9.9 Variable Ringing Tone

The users shall be able to loudness, frequency and pitch of their digital telephone set to set a unique ringing tone for their telephone set.

25.9.10 Adjustable Display Darkness

The digital telephone sets shall be able to adjust the darkness of the display by using the electronic “+” and “-” push buttons.

Tenderers shall purpose the following type of digital telephone sets together with this tender.

Executive Level Telephone Set complete with all the following capabilities: -

• 2x20 characters display

• Display contrast adjustment

• Five contextual keys linked to the display, providing telephone services

• Alphabetic keyboard

• Hands-free and loud speaker

• Handset volume control

• 18 programmable keys

• Personal repertory: 40 names

Options:

Analogue Z 600 Ohm interfaces, with power feeding and ringing generator

60 additional programmable keys

Management level Telephone Set complete with all the following capabilities: -

• 1x20 characters display

• Display contrast adjustment

• Alphabetic keyboard

• Hands-free and loud speaker

• Handset volume control

• 6 programmable keys

• Personal repertory: 15 names

Options:

Analogue Z 600 Ohms interface, with power feeding and ringing generator

60 additional programmable keys

Standard User Telephone Set complete with all the following capabilities: -

• 1x20 characters display

• Display contrast adjustment

• Loud speaker

• 2 programmable keys

• Personal Repertory: 15 names

**25.10 SINGLE LINE TELEPHONE SET**

Tenderer shall provide single line telephone sets together with the tender.

• Message waiting light

• Redial Key

• Flash Key

• Parallel Data Port

25.10.1 Main Distribution Frame

The tenderer shall provide main distribution frame for equipment side only together with the proposed PABX system.

The terminal block shall be vertical mounting connector type for ease of installation and maintenance.

All terminal blocks for the exchange lines and extension lines shall be equipped with gas discharge lightning arrestors.

Tenderer shall also provide power failure transfer circuits together with the main distribution frame.

**25.11 EARTHING**

The PABX earthing shall be of 1 ohm or less. The cost of installation of the PABX equipment shall include the cost of providing a good earthing for the equipment.

**25.12 TECHNICAL SUPPORT STAFF**

The tenderer shall provide a list of their technical support staff together with their working experience on PABX system.

Tenderer’s technical support staff shall be trained in the principal’s regional office on PABX system. Tenderer shall submit a copy of the certificate of training of the staff together with the tender submission.

Tenderer shall indicate the location of their nearest front line support office, branch office and dealer’s office in relation to the proposed site of the PABX. The names and experience of the technical support staff stationed there shall be provided.

**25.13 WARRANTY**

Tenderer shall provide 12 months full warranty on the PABX and all associated equipment from the date of successful commissioning against any manufacturing defects.

**25.14 TRAINING**

Tenderer shall provide training for the users and staff prior to commissioning of the PABX to ensure that they are competent enough to use the telephones and features.

**26. TELEPHONE SYSTEM SPECIFICATION**

**26.1 GENERAL**

The following specification covers the supply, delivery, installation, testing and commissioning of a complete Telephone System including maintenance during the defects liability period. All work pertaining to the system shall be in accordance with these specifications and shall meet all applicable Rules & Regulations of the local telecommunication authority.

The specifications and drawings are intended to provide the minimum basic performance and characteristics for the supply and installation of a complete system and the required standards of workmanship and materials in the design, manufacture, supply, installation, testing and commissioning of the system.

System provided shall be complete and operable, and shall include the required accessories, fastenings and supports. One coat of primer shall be applied for all fastenings and supports.

**26.2 TELEPHONE WIRING AND INSTALLATION**

The entire telephone wiring installation, as shown on the relevant drawings accompanying this document, shall be supplied, installed and commissioned by the Contractor who shall also be a Registered Contractor with the local telecommunication authority. If the contractor is not registered with the local telecommunication authority, he shall then obtain the services of a Registered Contractor and submit the name of such contractor to the Consulting Engineer for approval prior to engaging the services of the said contractor. In the event of the contractor engaging the services of an approved Registered Contractor, he shall be fully responsible for all works undertaken by such Registered Contractor, including all terms and conditions stated under this Contract.

The entire telephone wiring installation shall include all accessories necessary for the completion of the works in every respect and to the satisfaction of the local telecommunication authority, whether such be mentioned in this specification and the drawings or not.

The telephone under floor trunking shall within the building shall be carried out in concealed, rigid PVC under floor trunking of gauges and type approved by the local telecommunication authority. The trunking runs shall be laid in floor screeds below floor finishes. Where possible, the Contractor shall closely liaise and arrange for chases of suitable depths and widths to be cast in the floor screeds to accommodate the trunking, the final concreting of chases shall be undertaken under approval from the Consulting Engineer and local telecommunication authority.

Telephone floor trunking shall, as far as possible, be supplied in lengths to suit the trunking runs. Where joints are unavoidable the joints shall be coated with an approved jointing compound during assembly and be made watertight. All joints shall be so constructed that cables can be conveniently drawn through without damage.

A piece of suitably flexible and strong draw-in-multi-strand wire shall be left in every section of the underfloor telephone trunking between adjoining junction boxes. These draw-in wires are for the running of future telephone cables.

Where riser ducts are used in the building for telephone cabling the scope shall include perforated cable tray covering the whole wide of the riser ducts.

Distribution boxes used outside riser enclosure shall be made of mild steel material 16 SWG minimum thicknesses and fitted with locks. Those distribution boxes used inside locked riser enclosure shall be made of mild steel and fitted with clipped-on-covers.

The junction boxes must be watertight, made of stainless steel with durable screw-on covers of 10 SWG thickness and flush with the floor covering. Telephone outlet box may be round or square as indicated and the outlet hole 6mm diameter in which rubber grommet shall be fitted. Where building structure prohibits the use of trunking of more than 25mm depth, then the width of the trunking shall be increased proportionately.

Telephone outlet and junction boxes shall be of molded type and type approved by the Consulting Engineer and local telecommunication authority. The boxes shall be recessed in the floors and provided with removable, non-corrodible metal covers (metal covers to be flush with floor finishes.

A gasket shall be provided around the end of each junction box to prevent seepage of water into the box when the cover has been screwed in position. The screws used shall be of non-corrosive type (preferably of brass) and countersunk so that their heads do not protrude above the finished floor levels when installed.

The junction boxes are to be supplied in terminal though way, tee-off or intersection patterns as required on the drawings. The opening where trunking enters each box shall be filled smooth so that the PVC sheath of the telephone cables will not be damaged during installation.

Cable terminal unit used for telephone risers shall be of the galvanized type and generally conform to the requirements for cable trays.

All necessary cable trays used for risers shall be of the galvanized type and generally conform to the requirements for cable trays.

All materials used for wiring must be approved by the local telecommunication authority. Internal telephone cables shall comprise tinned, annealed copper conductors, PVC insulated and PVC sheathed with Grey/Black color code of conductors according to local telecommunication authority Specification.

**26.3 TELEPHONE MANHOLE AND PIT**

Telephone manholes and pits shall be constructed according to local telecommunication authority requirements. The manhole and pit shall be of waterproof construction.

If the site selected for a manhole be encroached upon by any obstruction, as for instance, a pipe main, Contractor shall arch the walls round such obstruction, or make other arrangement as may be required by the Engineer.

Conduits shall enter manholes and pits at such a depth to ensure a clearance of at least 450mm between the top of the barrel of the uppermost conduits and the underside of the roof of the manhole or pit.

Where the duct capacity of any proposed manhole is not fully utilized the space shall be fitted with dummy ducts for future duct growth. The dummy ducts shall be sealed with 13mm cement mortar inside the chamber wall.

To ensure that cables can easily be housed in manholes and pits with a minimum of bending, the conduits should be splayed over the last length to enter the manhole and pit equally on either side. The manhole and pit shall be constructed throughout of Class ‘B’ concrete.

**26.4 EARTHING**

All necessary earthing requirements for the whole installation should be included in the cost.

**26.5 TESTING AND COMMISSIONING**

The contractor shall liaise with the local telecommunication authority and be responsible for getting the installation tested and approved.

**27. SOLAR PANEL SYSTEM**

Design, supply and complete installation of Solar PV, according to Utility Regulatory Authority Regulations and Guidelines with a minimum capacity of 50Kw. Please refer to detailed drawing for further information.