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FOR

CONSTRUCTION OF SCHOOL OF PHYSICAL SCIENCES AT TANHRIL, AIZAWL, MIZORAM

FOR

MIZORAM UNIVERSITY

VOLUME – IIB

TECHNICAL SPECIFICATION

EXECUTING AGENCY

ENGINEERING PROJECTS (INDIA) LIMITED

(A GOVT. OF INDIA ENTERPRISE)

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All works shall be carried out in accordance with latest CPWD Specifications with up to date correction slips wherever applicable unless and otherwise specified.

PARTICULAR SPECIFICATIONS

1.0 EXPANSION JOINT

1.1 Polyethylene Expansion Joint Filler Board

i) Polyethylene Expansion Joint Filler Board shall be of approved make.
ii) The board shall be waterproof, resilient, non-impregnates, non-staining, non bleeding and chemically inert.
iii) The application shall be done as per manufacturer’s written instructions.
iv) The Board shall be laid flat and stored under shed away from sources of excessive heat and flame.
v) Rates shall be inclusive of all operations including labour material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.

2.0 FLOORING

All work in general shall be carried out as per latest CPWD Specifications with up to date correction slips.

2.1 Whenever flooring is to be done in patterns tiles / stone, the contractor shall get samples of each pattern laid and approved by the Engineer-in-charge before final laying of such flooring for which nothing extra shall be paid.

2.2 Different stones / tiles used in pattern flooring shall be measured separately as defined in the nomenclature of the item and nothing extra for laying pattern flooring shall be paid over and above the quoted rate. No additional wastage if any, shall be accounted for any extra payment.

2.3 The proper gradient shall be given to flooring for toilets, verandah, kitchen, courtyard, etc. as per the directions of Engineer-in-charge.

2.4 Vitrified Tiles

2.4.1 Make

Vitrified floor tiles shall be of approved quality and make with water absorption less than 1%. These shall be flat, true to shape and free from cracks, crazing spots, chipped edges and corners. These shall be of specified size, type and colour and laid to pattern as shown in the drawings or as approved by the Engineer - in - Charge.

2.4.2 Sub-Base

The base shall be prepared as per latest CPWD Specifications with up to date correction slip. Over the prepared base, if required, 1:4 cement mortar shall be laid to make up the total thickness of floor finish as specified. The surface shall be laid to falls and slopes as required and scratched for key.

2.4.3 Laying of Floor Tiles

The tiles shall be laid as recommended by the manufacturer and as per latest CPWD specifications with correction slip for ceramic tiles.
2.4.4 **Pointing**
The joints shall be thoroughly cleaned and grouted with polymer based non-shrink grout of desired colour of approved make.

2.4.5 **Cutting of Tiles**
Care shall be taken to see that full tiles are used as far as possible. Where not possible, the edge tiles shall be neatly cut with a tile cutter to required size and the edges rubbed smooth to ensure straight and true joints. The cut of the tiles shall not be installed in exposed locations.

2.4.6 **Curing**
Curing work shall be done as per latest CPWD specification with up to date correction slip.

2.4.7 **Rates**
Rates shall be inclusive of all operations including labour, material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.

### 3.0 ALUMINIUM DOOR, WINDOW AND VENTILATORS

#### 3.1 Extent and Intent
The work shall be carried out through an approved specialist contractor, who shall furnish all materials, labour, accessories, equipment, tool and plant and incidentals required for providing and installing anodised aluminium doors, windows, claddings, louvers and other items as called for on the drawings. The drawings and specifications cover the major requirement only. The supplying of additional fastenings, accessory features and other items not mentioned specifically herein, but which are necessary to make a complete installation shall be a part of this contract.

#### 3.2 General
Aluminium doors, windows etc. shall be of sizes, section details as shown on the drawings. The details shown on the drawings indicate generally the sizes of the components parts and general standards. These may be varied slightly to suit the standards adopted by the manufacturer. Before proceeding with any manufacturing, the contractor shall prepare and submit complete manufacturing and installation drawings for approval of the Engineer-in-charge and no work shall be performed until the approval of these drawings is obtained.

#### 3.3 Shop Drawings
The contractor shall submit the shop drawings of doors, windows, louvers, cladding and other aluminium work, based on architectural drawings, to the Engineer - in - Charge-in-charge for his approval. The drawings shall show full size sections of doors, windows etc. thickness of metal (i.e. wall thickness), details of construction, sub frame / rough ground profile, anchoring details, hardware as well as connection of windows, doors and other metal work to adjacent work. Samples of all joints and methods of fastening and joining shall be submitted to the Engineer-in-charge for approval well in advance of commencing the work.

#### 3.4 Samples
Samples of doors, windows, louvers etc. shall be fabricated, assembled and submitted to the Engineer-in-charge for his approval. These shall be of sizes, types etc. as decided by Engineer-in-charge. All samples shall be provided at the cost of the contractor.

#### 3.5 Sections
Minimum doors and windows shall be fabricated from extruded section of profiles of detailed on drawings. The sections shall be extruded by the manufacturers approved by the Engineer-in-charge. The aluminium extruded sections shall conform IS designation 63400-
WP (HV9WP Old designation) with chemical composition and technical properties as per IS: 733 and IS:1284. The permissible dimensional tolerance of the extruded sections shall be such as not to impair the proper and smooth function / operation and appearance of doors and windows.

3.6 Fabrication
Doors, Windows, etc. shall be fabricated to sizes as shown, at factory and shall be of section, sizes combinations and details as shown in the Architectural Drawings. All doors, windows etc. shall have mechanical joints. All members shall be accurately machined and fitted to form hairline joints prior to assembly. The joint and accessories such as cleats, brackets, etc. shall be of such material as not to cause any bimetallic action. The fabrication of doors, windows, etc. shall be done in suitable sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the door and window members for anchoring to support and fixing of hardware and other fixtures as approved by the Engineer-in-Charge.

3.7 Anodising /Powder coating
All aluminium materials used shall be specially anodized for protection against corrosion in marine environment in approved shade. The anodic coating shall conform to IS 1868-1968 and shall be of AC25 grade with minimum thickness of 20 Microns when measured as per IS:660/2-1970 and density shall be atleast 32 MG/sqm. The anodic coating shall be double sealed or alternatively sealed with steam and shall be of a minimum thickness of 50 micron. The anodic coating shall be tested in an approved laboratory by Eddy current method as per IS:6012 for thickness. Sulphuric acid shall be used as the electrolyte for the anodic process. Prior to anodizing all aluminium shall be rendered uniform in appearance free from disfiguring scratches, stains or other blemishes and etched in a caustic soda solution. Requisite tests shall also be carried out at the site as required by the Engineer and the contractor shall arrange all assistance and equipments required for the purpose.

Wherever specified, polyester grade machine applied powder coating of minimum thickness 20 micron shall be provided and such coating shall be of approved shade. Samples of powder coated panels shall be submitted by the Contractor well in advance to commencement of work from the approved agency. Pretreatment to frames shall be carried out to suit the requirements of final finishing as stated above.

3.8 Protection of Finish
All aluminium members shall be wrapped with approved self-adhesive non-staining PVC tapes.

3.9 Handling and Stacking

3.9.1 Fabricated materials shall be stacked in an approved manner to protect the material against any damage during transportation. The loading and unloading shall be carried out with utmost care, on receipt of materials at site, they shall be carefully examined to detect any damaged pieces. Arrangements shall be made for expeditious replacement of damaged pieces / parts. Materials found to be acceptable on inspections shall be repacked in crates and stored safely.

3.9.2 In the case of composite windows and doors, the different units are to be assembled first. The assembled composite units should be checked for line, level and plumb before final fixing is done. Units may be serial numbered and identified as how to be assembled in their final location of situation so warrants.

3.9.3 Where aluminum comes into contact with masonry brickwork, concrete, plaster or dissimilar metals, it shall be coated with approved insulation lacquer, paint or plastic tape to ensure that electro-chemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion.
3.9.4 The contractor shall be responsible for assembling composite, bedding and filling the groove with backup roads polysulphide sealant inside and outside, placing the doors, windows etc. in their respective openings. After the doors / windows have been fixed in their correct assigned position, the open hollow sections abutting masonry concrete shall be fitted with approved polysulphide sealant densely packed and neatly finished.

3.9.5 The contractor shall be responsible for doors, windows, etc. being set straight plumb, level and for their satisfactory operation after fixing is complete.

3.10 **Installation**

3.10.1 Just prior to installation the doors, windows, etc. shall be uncrated and stacked on edge on level bearers and supported evenly. The frame shall be fixed into position true to line and level using adequate number of expansion machine bolts, anchor fasteners of approved size and manufacturer and in an approved manner. The holes in concrete / masonry members for housing anchor bolts shall be drilled with an electric drill.

3.10.2 The doors, windows assembled as shown on drawings shall be placed in correct final position in this opening and marks made on concrete members at jambs, sills and heads against the holes provided in frames for anchoring. The frame shall then be removed from the opening and laid aside. Neat hole with parallel sides of appropriate size shall then be drilled in the concrete members with an electric drill at the marking to house the expansion bolts. The expansion bolts shall then be inserted in the holes, struck with a light hammer till the nuts is forced into the anchor shell. The frame shall then be placed in final position in the opening and anchored to the support through cadmium plated machine screws of required size threaded to expansion bolts. The frame shall be set in the opening by using wooden wedges at supports and be plumbed in position. The wedges shall invariably be placed at meeting points of glazing bars and frames.

3.11 **Neoprene Gaskets**

The contractor shall provide and install Neoprene gaskets of approved size and profile at all locations as shown and as called for to render the doors, windows etc. absolutely air tight and weather tight. The contractors shall produce samples of the gaskets for approval and procure after approval only.

3.12 **Fittings**

Hinges, stays, handles, tower bolts, locks and other fittings shall be of anodised aluminum and of approved design, shade and make. Before procuring the material the sample shall be got approved by the Engineer-in-charge/Architect.

3.13 **Manufacturer's Attendance**

The manufacturer immediately prior to the commencement of glazing shall adjust and set all windows and doors and accept responsibility for the satisfactory working of the opening frames.

3.14 **Sealant**

The gaps between frames and supports and also any gaps in the door and windows section shall be raked out as directed and filled with sealant of approved make to ensure complete watertightness. The sealant shall be of such composition that it would not stain the masonry / concrete work, will not sag and shall not set hard or dry out under any conditions of weather. The samples of sealant to be used for this purpose shall be got approved by the Engineer-In-Charge before its actual use.

3.15 **Glazing**

Glazing shall generally be accomplished from the inside of building. The glazing system shall be designed to this end use a continuous E.P.D.M. compression gaskets on both sides (Present Gasket on one side of glazing pocket and roll in gasket on another side). A continuous wet seal shall be employed to ensure a complete water tightness.
Maintain a minimum glazing bite, edge clearance and surface clearance depending on the glass as recommended by the glass manufacturer.

3.16 Protection & Cleaning
The contractor shall adequately protect all components and accessories from damage during shipments, storage at job site, erection and after completion of the work. At such time as may be directed, the sub-contractor shall remove all protective tapes or coating, thoroughly clean all anodised aluminium and glass surfaces with suitable cleaning agent, make final adjustments to all ventilators, etc. and hardware leaving all in first class working order.

3.17 Details of Tests
3.17.1 The various tests on aluminium sections shall be conducted in accordance with the relevant IS codes.
3.17.2 The minimum number of tests for anodic/powder coating and corrosion resistance for Doors, Windows & Ventilators shall be 5% of Nos. manufactured.
3.17.3 The samples of major member of each unit of doors / windows shall be selected at random by Engineer-In-Charge as such that all the aluminium section shall be got tested.
3.17.4 The cost of samples, carriage or the samples and testing charges, if any, shall be borne by the contractor.

3.18 Acceptance Criteria
The aluminium sections shall conform to the provisions of the relevant item of BOQ. For payment purposes only actual weight of sections shall be taken into account. If, however, the sectional weight of any aluminium section is higher than the permissible variation then the weight payable shall be restricted to the weight of the section including permissible variation.

3.19.1 Measurement
Payment by weight shall be made for aluminium sections including beading only and all fixing angles, fittings / fixtures such as handles and hinges etc. shall not be included in the weight to be paid.

3.19.2 Guarantee Bond
Guarantee bond in prescribed proforma of EPI shall be submitted by the Contractor that shall be signed by both the specialised agency and the contractor to meet their liability/ liabilities under the guarantee bond. However, the sole responsibility shall rest with the building contractor.

3.20 The rate of the item shall include the cost of materials including sealant, T&P, Scaffolding and labour, required in all the above operations.

4.0 MISCELLANEOUS WORKS

4.1 Polycarbonate Sheet Roofing

4.1.1 Material
Polycarbonate sheet roofing shall be provided manufactured from amorphous thermoplastic resin and shall be of the required thickness, type and colour and of high impact resistance suitable for use in roof lights. The work shall be carried out by an approved specialist agency.

4.1.2 The specialist contractor shall prepare the detailed design of the roof sheeting system. The
design along with fabrication drawings showing the system details and items of work on suitable scale shall be prepared in accordance with the working drawings for approval of the Engineer-in-Charge.

4.1.3 Installation

The installation shall be carried out strictly in accordance with the approved drawing to the satisfaction of the Engineer-in-Charge. Special care shall be taken to ensure that the roof is leak proof and all precautions and applications that are required for the purpose shall be taken without any extra cost.

The polycarbonate sheet shall be fixed in powder coated aluminium frame with EPDM gasket and aluminium cover strip and fixed to the main frame. Approved sealant and tapes with sufficient elasticity to accommodate thermal expansion and contraction without loss of adhesion to either frame or sheet shall be used. Gaskets of neoprene, EOT or EPDM rubbers shall be used.

The bolts, screws and nuts wherein contact with aluminium will be of stainless steel 304 or 315.

The rates shall be inclusive of sheeting, aluminium members, gaskets and all materials including all operations, labour, T&P, scaffolding etc. all complete. Nothing extra shall be paid on this account. Any steel structure required to support the roofing structure shall be measured and paid separately.

SANITARY AND PLUMBING WORKS

PREAMBLE TO BILL OF QUANTITIES

1.0 GENERAL

1.1 This preamble covers Water Supply, Sewerage, Drainage, Sanitary Fixtures and C.P. fittings, Pumps, Water Treatment and Miscellaneous works etc.

1.2 This preamble shall be read in conjunction with the specifications, conditions of contract, drawings and all other documents accompanying the tender papers.

1.3 For all items of work the rates shall be comprehensive and all inclusive. The rates shall include for all matters and things necessary for satisfactory completion and maintenance of the work in proper working order and to the satisfaction of the Engineer, including testing, making samples, etc., and all that have been indicated in the specifications or other Tender Documents either directly or indirectly, and cover for all obligations of the Contractor under the Contract. No claim for additional payment shall be allowed for any error or misunderstanding by the Contractor of the work involved.

1.4 Unless otherwise mentioned in the description of the item, this Bill of Quantities shall be applicable for work in any height, position or condition.

1.5 Unless otherwise stated, method of measurement as described in the latest editions of I.S.1200 with its parts corresponding to different sections of work shall be followed. In case of any dispute in this matter, the decision of Engineer shall be final, binding and conclusive.

1.6 The following notations have been used throughout the Bill of Quantities:

- \( m \) - Metre
- \( mm \) - Millimetre
- \( m^2 \) - Square Metre
- \( mm^2 \) - Square Millimetre
- \( m^3 \) - Cubic Metre
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1.7 The Contractor shall be deemed to have full knowledge of all his obligations under the Contract and shall be deemed to have made full allowance for complying with all such obligations in his offer.

2.0 TRADE PREAMBLE

2.1 Water Supply Lines

Pipe laying, excavation, bedding, dewatering of the trench where necessary, jointing (include for all joints, gaskets, nuts, bolts, jointing compound) backfilling in trench and disposal of surplus earth pipes shall be measured by length for an average depth as a single item but separately in accordance with type and diameter of pipe. Testing and necessary rectification, and sterilizing the pipe line including supplying of necessary water, chemicals and disinfectant and disposal of the water after use, should be included in this rate.

All pipe work shall be measured by length in accordance with diameters and type of pipes, unless otherwise stated.

**Chambers**

Valve chambers, surface boxes and similar items shall be measured by number constructed according to type.

**Appurtenances**

Valves, metres, taps and similar items shall be measured by number supplied. The installation shall be included in the rate for laying, etc. of the pipes measured by length.

**Fittings**

Pipe fittings, such as tees, bends, elbows, reducers and similar items shall be measured with pipes. Installation shall be included in the linear metre rate for laying, etc. of the pipe line.

2.2 Masonry, RCC Chambers for Valves, Hydrants, etc.

Chambers shall be measured in number according to type. The rates shall include:

a) Necessary excavation in any kind of soil backfilling and disposal of surplus earth as specified.
b) Protecting the excavation with all necessary shoring, strutting and keeping the excavation clear of water;

c) Providing and laying foundation concrete as shown on drawing and as specified;

d) Providing and constructing brick masonry walls in cement mortar/RCC walls including reinforcement as shown on drawing and as specified. The openings required to be left open for pipes and subsequent reinforcement grouting shall also be included in the rates;

e) Providing and casting RCC top slab including reinforcement as shown on drawing and as specified;

f) Providing fitting and fixing C.I. surface box and C.I. access cover including frame as shown on drawing and as specified and/or directed at site by the Engineer.

g) Providing internal cement plaster 1:3 with water proofing compound, 12mm thick inside faces of the chamber walls;

h) Providing external cement plaster 1:4 with water proofing compound 150mm from the bottom of the top slab for the external faces of the chamber walls. All external faces of chamber in touch with soil to be painted with two coats of bitumen coatings;

i) Providing concrete benching, seats, etc. for pipes and valves as shown in the drawing and as directed by the Engineer.

The rates quoted shall be net and should any variation occur either in drawings or in specifications, the rates of individual items of work quoted in Civil Work shall apply.

2.3 Valves, Metre, etc.

For supply of valves, metres, taps and similar items shall be measured by number. This rate shall also include cost of installation and fitting.

2.4 Water Supply pipe laying

Pipe laying as per specifications shall be measured in Running Metre as actually laid measured along the centre line of the pipe line for an average depth. The bends, junctions, specials, fittings shall be included in Running Metre length of the pipe. The rates for pipe laying shall include:

a) Excavation of trenches in any kind of soil backfilling and disposal of surplus earth as specified.

b) Providing required beddings as shown in drawing and as specified;

c) Providing the pipes and fittings, joints, specials, etc. to the site;

d) Lowering the pipes, fittings, etc. into trench, jointing and fixing true to lime and level including providing protective coating and sleeving as per specifications;

e) Providing all equipment, labour and materials, necessary to carry out the above works complete in all respects as specified and/or instructed;

f) Installation of valves, metres, other fittings and similar items, etc. as shown and specified;

g) Construction of thrust blocks as specified, or as directed by the Engineer.

h) Testing, cleaning and sterilisation of pipe lines including supply of required water for such work;

i) Commissioning of completed pipe lines;

j) Backfilling to finished grade level with approved materials as shown and directed by
the Engineer.

k) Removal of surplus excavated materials to an approved dumping yard;

2.5 External Drainage

a) Specified pipes shall be measured per Running Metre for the clear length between the chambers and appurtenances for an average depth. The rate shall be inclusive of the cost of pipes, all fittings, jointing and testing of pipes and fittings etc. as specified;

b) Manholes and chambers shall be measured in number and shall include all works as stated in 2.2

c) Specified gully traps shall be measured by number and the rate shall include the cost of masonry chamber with cover, 150 x 150mm C.I. grating including fixing in position with cement mortar.

2.6 Soil and Waste Vent and Rain Water Pipes

a) Soil, waste, vent and rain water pipes shall be measured in running metres along the centre line of the pipes as actually laid. The cost of all fittings, e.g. bends, junctions, offsets, terminal guards, clamps and jointing shall be measured separately. The rate of pipes shall be inclusive of excavation, backfilling and disposal of surplus earth (where required), cutting chases, holes in walls and floors and making good, testing, etc. all complete as per specifications.

b) Specified floor traps shall be measured by numbers and shall include the cost of CP brass grating of the required size and setting the floor traps in cement concrete with suitable extension pieces where required.

2.7 External/Internal Water Supply

a) Specified pipes for cold and hot water supply shall be measured in running metre along the centre line of the pipe lines and the rate shall include the cost of all necessary fittings, clamps, cutting chases and holes in walls, floors and making good the surfaces, necessary excavation, backfilling and disposal of surplus earth, where required. The rate shall be inclusive of the cost of necessary fittings, testing and commissioning of the pipe lines, as specified.

b) Valves and taps shall be measured by numbers.

c) Insulation to hot water pipes shall be measured separately.

2.8 Sanitary Fixtures

All sanitary fixtures of specified trade mark or equivalent shall be paid by number and rate shall include all C.P. fittings, traps, flushing cisterns, specials, connecting pipes all fixing components, brackets, screws, etc. as stated in Schedule of Rates.

2.9 Mechanical Equipments

All mechanical equipments e.g. pumps, valves, panels etc. shall be measured in No. The rate shall include all items as indicated in the Bill of Quantities. The rate shall also include the cost, of testing and commissioning of the equipments.
3.0 TECHNICAL SPECIFICATIONS FOR PLUMBING AND SANITARY WORKS

3.1 GENERAL

3.1.1 Scope of work

The scope of work comprises supply, installation, testing and commissioning of water supply, sewerage and drainage, sanitary fixtures and fittings, water pumping and water treatment system. The scope of work includes supply of all materials as per specifications and drawings, laying, fitting, fixing, installation and commissioning the same.

3.1.2 All the water supply, drainage and sanitary works shall be carried out strictly as per printed central PWD Specifications, 1996 Vol. (Two), 2002 Edition with up-to-date corrections for sanitary installation, water supply, drainage and miscellaneous works. The works related with pumps and water treatment system shall be carried out as per relevant sections of these Specifications.

3.1.3 All the water supply and sanitary works shall be carried out by the licensed plumbers approved by the Local Authorities and skilled workmen, experienced in the trade.

3.1.4 All works shall be completely concealed either within shafts or chases or in fills and dropped ceilings unless specifically shown in drawings or required otherwise.

3.1.5 All works shall be adequately protected, to the satisfaction of the Engineer, so that the whole work is free from damage throughout the period of construction up to the time of handing over.

3.1.6 No work shall be covered without approval of the Engineer.

3.1.7 The Contractor shall be responsible for coordinating the work with works of other trades sufficiently ahead of time to avoid unnecessary hold-ups. Hangers, sleeves, recesses, etc. shall be left in time as the work proceeds whether or not these are shown in drawings.

3.1.8 All clamps, screws, brackets, hangers and all miscellaneous steel work needed in the work shall be fully galvanised.

3.1.9 Only specified brand of material will be used subject to the approval of the sample.

3.1.10 The Contractor shall submit as directed by the Engineer samples, manufacturer’s drawings, equipment characteristics and capacity data etc. of all equipment, accessories, devices, etc. that he proposes to use in the installation, to the Engineer for approval.

3.1.11 The Contractor shall prepare and submit to the Engineer for approval before the work is commenced, all shop drawings. These shop drawings in triplicate must be submitted by the contractor.

The work shall commence only after the shop drawings are approved by the Engineer.

3.1.12 On completion of work the contractor shall submit to the Engineer one original and two copies of as-built drawings.

3.1.13 Before the work is handed over, the Contractor shall clean all fixtures removing all plaster, stickers, rust stains and other foreign matter of discolouration of fixtures, leaving every part in acceptable condition and ready for use, to the satisfaction of the Engineer.

3.1.14 All sanitary ware and fittings shall conform to I.S. standards. The Contractor shall submit samples of all fittings and fixtures proposed to be used to the Engineer for his approval.
The approved samples shall remain with the Engineer till the completion of the work.

3.1.15 All workmanship shall conform to Indian Standard Codes of Practice. The fixing and finishing shall be neat, true to level and plumb. Manufacturer's instructions shall be followed closely regarding installation and commissioning.

3.2 SANITARY FIXTURES AND FITTINGS

3.2.1 Workmanship

All sanitary-ware shall be fixed in a neat workmanlike manner, true to level and plumb. Manufacturer's instructions shall be followed closely regarding installation and commissioning.

3.2.2 Protection of Fixtures

Fixtures shall be protected throughout the progress of the work from damage. Special care shall be taken to prevent damage and scratching of chromium plated fittings. Tool marks on chromium fixtures, etc. shall not be accepted.

All fixtures shall be fixed with chromium plated brass screws with washers whenever necessary.

Protective paper on fixtures shall be removed with hot water only at the final completion of work.

3.2.3 Sanitary ware

All porcelain sanitary ware shall be of first quality, free from warps, cracks and glazing defects. All sanitary ware, fittings and fixtures shall be as shown in drawings and indicated in Bill of Quantities.

3.2.4 Testing

When the installation has been completed to the satisfaction of the Engineer it shall be tested in the following manner:

a) The entire system shall be slowly filled with water, allowing any trapped air to escape.

b) When all outlets are closed the system shall be checked for water tightness.

c) Each outlet shall then be checked for rate of flow and correct operation.
SPECIAL CONDITIONS OF CONTRACT:

a. The contractor shall obtain all information relating to local regulations, bye-laws, application of any or all laws relating to the subject work as required. No additional claims shall be admissible on this account.

b. Contractor shall obtain approval of the installation from the relevant inspection authorities at all stages and on completion of the installation work, the contractor shall pass on these approvals to the owner.

c. However, any statutory fees payable to the Government/Municipal authorities/statutory bodies for obtaining approvals shall be paid by the owner.

d. It shall be the responsibility of the contractor to arrange and provide power connections to School Building, street lighting, lifts, pump house etc. by making close liaisoning starting from submission of applications of power connections to Local Electricity Board till release of power supply. Nothing extra shall be paid to the contractor on this account.

e. The above said responsibility shall be deemed to have been included with the quoted offer of the contractor; hence, this assignment shall form part of the contract.

f. However, any statutory charges payable to the Govt. for providing the same shall be paid extra.

g. The contractor has to obtain approval for installation of 200 KVA DG set from state/Central Pollution Control Board/Local Electricity Board. Nothing extra shall be paid to the contractor on this account.
TECHNICAL SPECIFICATIONS

1.0 SCOPE: These specification covers the details of electrical equipments to be supplied, inspection, delivery at site, installations, testing, commissioning, putting into operation and handing over the complete installation in working condition to the satisfaction of purchaser.

1.1 The work shall be carried out as per the standard/specifications indicated below:

i) Relevant ISS as modified upto date. Where IS codes do not exist, the British Standards shall be followed.

ii) Indian Electricity Rules 1956 as amended upto date.

iii) The electrical installation work shall be carried out in accordance with Indian Standard Code of Practice. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications.

General Specifications for Electrical works:

Part-I : Internal work - 2005

Part-II : External work - 1995

Wherever these specifications call for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.


v) LIST OF INDIAN STANDARDS

L.T. Switchgear Boards / Panels and other Components

a) Factory built Assemblies of : I.S: 8623-1980 switchgear up to 1000V

b) Heavy duty air break switches and composite units of switches and fuses : I.S: 13947(Pt.-III)

c) Push buttons : I.S: 13947

d) High rupturing fuses : I.S: 13703(Pt.-I)


f) Current transformers, general requirement, measuring and protective : I.S: 2705(part I to IV)

g) Power socket outlets : I.S: 4615
L.T Cables: -

a) PVC insulated, heavy duty cables : I.S: 1554-1988 (part I)
b) Installation & maintenance of cables : I.S: 1255-1983

Earthing


Protective Relays

a) Thermal relays : I.S: 3842 (Part IV)
b) Power relays : I.S: 3842 (Part V)

SAFETY CODE OF PRACTICE (INSTALLATION)

c) Warning symbols for Dangerous voltages : I.S: 8923-1987
d) Degree of protection provided by Enclosures low for voltage switchgear and Controller : I.S:13947(Pt.I)

1.3 A table indicating makes acceptable in respect of some important materials is attached. The contractor can use only the makes specified in the table against a particular item subject to conformity with specifications. For material not covered in above-mentioned table any ISI marked product may be used and if same is not available, then it shall conform to relevant IS/BS and will be used with prior approval of society.

1.4 The following works shall be deemed to be included within the scope of the work to be executed by the contractor:-

i) All minor building work such as cutting holes and chases in walls/ceiling and making good the same with cement mortar 1:4 (1 cement: 4 coarse sand)

ii) Provision of supports and clamps for fixing arrangement including nuts, bolts, cable glands, lugs, terminal blocks etc as a part of the particular item unless given separately in the schedule of quantities.

iii) The dehydration of oil will be done by the contractor free of cost if required.

1.5 MCCB : The MCCBs shall be current limiting type with spreader links, phase separators as standard feature. The breaking capacity shall be Ics value.

1.6 Protection Scheme : Microprocessors based with inbuilt O/L, S/C & E/F protection---Incoming feeder

Thermal magnetic type with inbuilt O/L & S/C protection---Outgoing feeder
2.0 L.T. CABLES:

2.1 Installation of Cables:

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-in-Charge laying shall be carried out as per CPWD specifications.

2.1.1 Joints in Cables:

The contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding of cable joints. The apportioning shall be got approved from Engineer-In-Charge.

2.1.2 Excavation & Back Fill:

All excavation and back fill required for the installation of the cables shall be carried out by the contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer. The contractor shall restore all surface, road ways, side walks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-In-Charge.

2.1.3 Laying of Cables on Cable Tray/Surface of Wall/Ceiling:

Cables shall be laid on perforated MS cable trays. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

2.1.4 Cables Tags:

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside, the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

2.1.5 TESTING OF CABLES:

Prior to installation burying of cables, following tests shall be carried out:

Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a) Before laying

b) After laying

c) After jointing

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer-in-Charge.

a) Insulation Resistance Test (Sectional & overall).

b) Continuity Resistance Test

c) Earth test
All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

3.0 FITTINGS AND FIXTURES:

All electrical fittings and fixtures shall be of approved make and design. The fixing of the fixtures shall be done as per manufacturer’s instructions/standard good engineering practice. Before procurement of the fittings, the contractor shall get the samples approved by the Engineer-in-charge.

4.0 DIESEL GENERATOR:

4.1 The DG set shall be required to operate during emergency condition for maintaining essential services. For safe and smooth running in the event of failure of normal utility power system the emergency Diesel generator system centres to these load through corresponding circuit breaker with assistance of Auto Main Failure Panel.

4.2 Specific requirement of Generator:

The Specification of generator shall be as under:

a) Generator continuous output (net) rating : 200KVA/160KW
b) Power Factor : 0.8 lag
c) Overload capability for 1 hr in 12 consecutive hrs of operation : 10%
d) Rated Voltage : 415V
e) Rated frequency : 50 C/s
f) Number of phases : 3
g) Winding connection : WYE
h) Max. ambient temperature : 45 Deg. C
i) Type of Insulation:
   i) Armature windings : Class F (with temp. rise limited to Class B).
   ii) Field windings : Class F (with temp. rise limited to Class B)
j) Type of enclosure : IP-54
k) Permissible variation of voltage for satisfactory operation at rated KVA, rated speed & power factor : +/-5%
l) Permissible variation of frequency for satisfactory operation at rated KVA, power factor & voltage : +/-1 %
m) Method of neutral grounding : The neutral shall be solidly grounded.

n) Rated Speed : 1500 rpm

4.3 The transient reactance of generator should be as low as possible consistent with the need to limit voltage drop on sudden application of load.

4.4 All parts of the generator and accessories shall be designed to withstand all electrical, mechanical and other stresses which may be experienced during operation, including short circuit and over-speed conditions.

4.5 The line and neutral ends of each phase winding of the generator shall be brought out on six suitably located terminals. The contractor shall provide suitable terminating arrangement for connecting the cables to the machine terminals. The terminals shall be suitably enclosed to prevent short circuits by rodents etc. Suitable cable glands shall be provided on the enclosure i.e. cable terminal box to facilitate entry of the above cables. The space inside the terminal box should be adequate to accommodate current transformers of the rating indicated in enclosed drawing.

If necessary a suitable adopter box may be considered in addition to generator terminal box. The bidders scope shall cover supply and installation of same. The degree of protection and fault level withstand of this box shall be same as that of generator terminal box, which is IP-54 and 50 KA for 1.0 Sec. respectively.

4.6 Excitation System:

The alternator shall be synchronous, self-excited, self regulated and shall be of rotating field type (brushless).

4.7 Voltage Regulator:

The alternator shall be of self-regulated type H/C. The type of regulator & its details are to be supplied with bid.

The regulator shall regulate from generator current and potential signals.

The excitation and voltage regulation shall be designed so as to cause necessary de-excitation in case of any short circuit.

The voltage drop from no load to full load shall not exceed 3%.

The bidder shall indicate the capacitive load rating in terms of percentage of rated capacity. In addition to this, the bidder shall also specify the waveform distortion of output voltage.

4.8 Control of Diesel Generator Set & Auto Main Failure Panel:

a) Tenderer shall carefully study the following equipment regarding the control of the diesel generator set and the AMF panel consistent with these requirements.

b) The Diesel generator set will be normally at rest when the utility AC power supply is available from normal utility power source. In case of an emergency, the diesel generator set shall be started as follows:

c) On failure of normal utility AC supply, an impulse will start from bidder's AMF panel. From this point onwards, all the bringing up to rated speed and voltage shall take place automatically without the help of any operator or any other
bidder's equipment. Contractor shall provide all the necessary accessories required for this purpose of automatic starting.

a) It shall be possible to start the engine manually through a push button mounted on AMF panel. The selection of automatic/manual start shall be done by suitable selector switches to be provided on the AMF panel by contractor.

Tenderer shall note in case of manual starting by push buttons, except for the starting impulse which is manual, all other starting operations shall be automatic.

i. As soon as the diesel generator set reaches its rated speed and the generator its rated voltage (a period not exceeding 10 seconds) a voltage relay, to be supplied by contractor, shall permit the closing of the 415V generator breaker.

ii. The diesel generator supplier shall supply and lay all the necessary control cables for interconnection between the AMF panels and DG sets.

iii. Three attempt starting facility for the set shall be provided and in case the diesel engine fails to start and reach speed within three successive command it shall be disconnected and locked out automatically.

iv. It is not necessary for tenderer to offer any device to trip the diesel set when the main station supply is restored. This will be done manually, when necessary, by means of push buttons on the Auto Main Failure Panel.

4.9 SYSTEM DESIGN:

a) The Diesel Generator unit shall be installed indoor. Suction of air shall be from atmosphere and exhaust will also be out to outside atmosphere, condensate traps shall be provided on the exhaust pipe. The exhaust pipe shall have mineral wool cladding and shall go 2m above the terrace of the building. The cost of this insulated exhaust pipe shall be deemed to be included in the item of DG set. The mineral wool cladding shall be done as per manufacturer's recommendations.

b) The fuel used shall be High Speed Diesel oil (HSD) or Light Diesel Oil (LDO) as per IS:1460.

c) The Diesel Engine shall be water cooled.

4.10 PLANT DESIGN:

a) The equipment shall be safe and proper and without undue vibration or stores for continuous operation at all loads upto rated output at operating and test conditions.

b) The equipment shall have provision for easy maintenance, overhaul, cleaning and inspection and replacement of parts. All tools for operation and maintenance of equipment shall be supplied.

c) Automatic electric starting by DC starter motor shall be provided. Battery (or batteries) with automatic battery charger shall be provided.

4.11 CONTROL AND INSTRUMENTATION:

a) D.G. set shall be provided with suitable instruments, interlock and protection arrangement and indications etc. for proper start up, control, monitoring and safe operation of the unit. One local AMF control panel alongwith DG set shall
be provided by the Supplier to accommodate these instruments, protective relays, indication lamps etc. The AMF panel shall have IP-42 degree of Protection as per IS:12063.

b) The DG set shall be provided with automatic start facility to make it possible to take full load within 30 seconds of Power Supply failure.

c) Testing facility for automatic operation of DG set shall be provided in AMF panel.

d) The following instruments shall be provided with Diesel Engine:

- Starting switch with key.
- Lub. oil pressure gauge.
- Lub. Oil temperature thermometer.
- Engine tachometer/HR.
- Battery charging ammeter.

e) Any other instruments necessary for DG set operation shall be provided as per manufacturer's recommendations.

4.11.1 A suitable battery charger using semi-conductor rectifier shall be provided for quick and trickle charging the battery. AMF panel shall consist of complete battery charging scheme suitable for 12V DC operation. Battery charger shall have input switch, transformer-Rectifier unit, choke, control fuses, necessary filters and suitable characteristic for charging the battery and keeping it in fully charged state. The charger shall be provided with a suitable DC voltmeter, ammeter and output voltage control facility mounted on the control cubicle and shall be suitable for connection to single phase 240V AC supply with +/- 10% voltage variation.

4.11.2 Following indication lamps for purposes mentioned as under shall be provided in AMF panel:

i) Pilot indicating lamp for the following:

a) Mains ON
b) Alternator ON
c) Charger ON/OFF
d) Breaker ON/OFF
e) Main LT Supply ON/OFF

ii) Following shall also be provided in AMF panel:

a) Digital type Frequency meter.
b) 3 Nos. single phase CT’s of suitable class & capacity for metering.
c) One (1) Digital ammeter of suitable size & range.
d) One (1) Digital Voltmeter of suitable size & range.
e) One (1) Voltmeter Selector Switch.
f) One (1) Ammeter Selector Switch.
g) Timers (12 V DC).

h) Two (2) Auto/Manual Selector Switch.

i) One (1) Aux. Contactors suitable for 12V DC.

j) One (1) Wattmeter of range 0-100 KW.

k) One (1) Energy meter (Electronic type)

l) Any other item required for completion of Control Scheme shall be deemed to be included.

4.12 TESTS:

a) The Diesel generator set shall be tested for routine and acceptance tests as per the relevant IS/IEC standards.

b) Commissioning Checks:

In addition to the checks and test recommended by the manufacturer, the Contractor shall carry out the following commissioning tests to be carried out at site.

c) Load Test:

The engine shall be given test run for a period of at least 6 hours. The set shall be subjected to the maximum achievable load as decided by Purchaser without exceeding the specified DG set rating.

During the load test, half hourly records of the following shall be taken:

i) Voltage, wattage & current output.

ii) Frequency in Hz.

iii) Ambient temperature.

iv) Exhaust temperature, if exhaust thermometer is fitted.

v) Lub. Oil temperature where oil cooler fitted.

vi) Lub. Oil pressure.

vii) Colour of exhaust gas.

viii) Speed.

ix) Oil tank level.

The necessary load to carry out the test shall be provided by the contractor.

d) Insulation Resistance Test for Alternator

Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500V megger shall not be less than \( IR = 2 \times (\text{rated voltage in KV}) + 1 \).

e) Check of Fuel Consumption:

A check of the fuel consumption shall be made during the load run test. This test shall be conducted for the purpose of proper tuning of the engine.
f) Insulation Resistance of Wiring:

Insulation resistance of control panel wiring shall be checked by 500V Megger. The IR shall not be less than one mega ohm.

g) Functional Tests:

i) Functional tests on control panel

ii) Functional test on starting provision on the engine

iii) Functional tests on all Field devices

iv) Functional tests on AVR and speed governor

h) Measurement of Vibration:

The vibration shall be measured at load as close to maximum achievable load and shall not exceed 250 microns.

i) Noise Level (sound pressure level) check

Noise level measurement shall be done generally following the guidelines given in IS:12065. The measurement shall be carried out with a calibrated interacting sound level meter as per IS:9779.

Sound level shall be measured all round the DG set at a distance of 1m. from the nearest surface of the machine and at a height of 1.5m from the floor level as illustrated in IS:12065 for electrical machines.

A minimum of 8 points (5 around diesel engine & 3 around alternator) shall be covered for measurement.

The test shall be carried out with the DG set operating at rated speed and at maximum achievable load. Necessary correction for test environment condition & background noise will be applied as per IS:12065.

4.13 SPECIFICATION FOR SOUND PROOF ACOUSTIC ENCLOSURE:

Sound proof acoustic enclosure shall have the following salient features suitable for DG set:

a) Weather resistant polyurethane point on the exterior.

b) Adequate ventilation system to maintain the temperature of the enclosure within 5-8 degree C. of the ambient under full load working condition.

c) Sound insulation material of high density (96 Kg. per Cum) for long lasting insulation characteristics.

d) Engine protection system to shutdown the engine in the event of high water temperature & low lube oil pressure.

e) Temperature control with the assistance of motors manufactured by an ISO certified company.

f) Sound absorption to the extent of 25 dBA as per the latest Central Pollution Control Board norms.
1.0 Scope of Work

1.1 The scope of work for the School Building consists of the following, but is not limited to the same:

1.1.1 Hydrant System consisting of Internal Hydrant Down Commer, Hydrant Stations with all accessories such as Hydrants, Hoses, First Aid Hose Reel, Branch Pipe etc.

1.1.2 Pumping System consisting of Terrace Hydrant Pump and equipments such as Valves, piping, Instrumentation and Motor Starting System.

1.1.3 Supply of Fire Extinguishers such as Water type, Power type etc.

1.1.4 Manual Fire Alarm System for the School Building. This shall include a Main Fire Alarm panel, Manual Call Boxes, wiring and conduiting.

1.1.5 Obtain approval from Local Fire Service for the Systems installed as well as for the overall Building. This shall be without any cost to the Owners.

1.2 Coordination with other Services

The Contractor and his specialist sub Contractors shall be required to co ordinate his activities with all other services such as Electrical and other services.

1.3 Exclusions

All civil / structural builder works, major or minor, shall be included in the scope of the work to be executed by the Main Civil Contractor unless otherwise specified. All such builder works shall be shown in the shop drawing of specialised sub contractor.

The Contractor shall however furnish all details and relevant data required for design and detailed engineering of all such civil work.

1.4 Drawings

The drawings issued are indicative only and are issued for guidance only. The Contractor shall prepare and submit shop drawings / data sheets of all the relevant materials used in the systems.

1.5 System Testing

The Contractor shall arrange interim / stage inspection during execution of the works as and when so called for and shall carry out any rectification / modification as may be required by the Engineer.

Soon after the work is completed, the Contractor shall inform in writing to the Engineer for getting the complete system including all sub-systems and instrumentation, control panels etc. thoroughly inspected and tested for satisfactory performance. After satisfactory completion of tests of the Systems, the Contractor shall be required to carry out all start-up trials of the Systems provided by him.

Any defects noticed during these tests shall be speedily rectified by the Contractor.
1.6 Commissioning of the Systems

After completion of the start-up trials and duly tested by the Engineer, the Engineer may instruct the Contractor for commissioning of the Systems. All the equipments / items in the system shall be operated to establish proper sequencing / synchronisation and co-ordinated working of the equipments / items. Any defect noticed during this period shall be promptly rectified by the Contractor.

1.7 Approval by Local Fire Authority

It shall be the responsibility of the Contractor to get all works in his scope approved from the Local Fire Authority.

The Contractor shall also bring to the notice of the Engineer any deviations from Local Fire Authority / Building Bye Laws Norms for the Systems that he shall install as well as architectural features that may be a hindrance to approval from the Local Fire Authority.

The Contractor shall get his shop drawings approved from the Local Fire Authority before start of work.

1.8 HYDRANT SYSTEM

1.8.1 Each Floor of the Hostel and Teaching Block shall be provided with Hydrant Stations. The Hydrant Station on every Floor shall have one number Hydrant, 2 nos. RRL Hose and a Branch Pipe. The Hydrant Station shall also be provided with a First Aid Hose Reel consisting of a double braided rubber hose wound on a drum. This set shall be connected to the Hydrant Down Commer through a 25 mm dia Ball Valve.

1.8.2 All internal Riser piping shall be M S and shall have welded jointing for pipes above 50 mm dia.

1.9 PUMPING SYSTEM

1.9.1 To cater for the Hydrant and Sprinkler Systems, the following pumps are being provided:

<table>
<thead>
<tr>
<th>No.</th>
<th>Pump Type</th>
<th>Discharge</th>
<th>Head</th>
<th>Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Terrace Main Pump</td>
<td>900 / 450 LPM</td>
<td>35</td>
<td>Electric</td>
</tr>
<tr>
<td>2</td>
<td>Terrace Jockey Pump</td>
<td>180 LPM</td>
<td>35</td>
<td>Electric</td>
</tr>
</tbody>
</table>

1.9.2 Each Pump shall have a Gate Valve on the Suction Side as well as Gate Valve and Non Return Valve on the Delivery Side. The Delivery of each Pump shall be connected to the Common Delivery Header.

1.9.3 The Main Pumps shall be end suction type coupled to motor and at 2900 RPM. All Pumps shall have mechanical seal.

1.9.4 An Air Vessel shall be provided with the Pumps. The Air Vessel shall be partly filled with water and shall provide for dampening effect to prevent water hammer when the Pump starts. The Air Vessel shall be provided with pipe spool piece on which
pressure switches shall be fitted. The Pressure Switches shall be connected to the Starter on the Pump Starter Panel.

2.0 FIRE PUMPS

2.1 General

2.1.1 The Pumps shall be single stage designed for continuous operation and shall have a continuously rising head characteristic without any zone of instability.

2.1.1 The head vs. capacity, input power vs. capacity characteristics, etc. shall match to ensure load sharing and trouble free operation throughout the range.

2.1.1 In case of accidental reverse flow through the pump the driver shall be capable of bringing the pump to its rated speed in the normal direction from the point of maximum possible reverse speed.

2.1.4 The motor shall have a 15% margin of power rating over the rated pump input power.

2.1.5 In case the Pump & Motor are from different manufacturers, the contractor under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

2.1.6 The pump shall be capable of a minimum of 150 percent of rated capacity at a total head of not less than 65 percent of the total rated head. The total shut-off head shall not exceed 120 percent of total rated head on the pump.

2.1.7 An automatic air release valve shall be provided to vent air from the pump. This valve shall be located at the highest point in the discharge line between the pump and the discharge check valve.

2.1.8 Pumps coupled with motor on a common platform shall perform smoothly without any excessive noise or vibration.

2.2 Pumps Casing

2.2.1 The casing shall be capable of withstanding to the maximum pressure developed by the pump at the pumping temperature.

2.3 Impeller

2.3.1 The impeller shall be of bronze and the bush shall also be of stainless steel.

2.4 Pump

2.4.1 The pumps shall be horizontal end suction type.

2.4.2 The impeller shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings.

2.4.3 All screwed fasteners shall tighten in the direction of normal rotation.

2.4.4 All Pumps shall be provided with Mechanical Seal.
2.5 **Shaft**

2.5.1 Shaft size shall be selected on the basis of maximum combined shear stress.

2.5.2 The shaft shall be of stainless steel ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibrations and torques coming in during operation.

2.5.3 Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft and shaft sleeve.

2.5.4 Shaft sleeves shall be securely fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation. The sleeve shall be of stainless steel.

2.6 **Pump Shaft-Motor Shaft Coupling**

2.6.1 All shafts shall be connected with adequately sized flexible couplings of suitable approved design. Necessary guards shall be provided for the couplings.

2.7 **Base Plate**

2.7.1 A common base plate mounting both for the pump and drive shall be provided. The base plate shall be of rigid construction, suitably ribbed and reinforced.

2.7.2 Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimise misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust etc.

2.8 **Vibration & Balancing**

2.8.1 The rotating elements shall be so designed to ensure least vibration during start and throughout the operation of the equipment. All rotating components shall be statically and dynamically balanced at workshop.

2.9 **Instruction Manual & Tools/Spares**

2.9.1 A comprehensive instruction manual shall be provided by the contractor indicating detailed requirements for operation, dismantling and periodic operation and maintenance procedures.

3.0 **ELECTRIC MOTORS**

3.1 The motor shall be designed not to draw starting current more than 3 times normal running current. It shall be designed for continuous full load duty. The motor shall be full load duty & shall be capable of handling the required starting torque of the pumps. Speed of motor shall be compatible with the speed of the pump.

3.2 The cooling fans shall be directly driven from the motor shaft.

3.3 Motors shall be enclosed type and shall have a dust tight construction with suitable means of breathing and of drainage to prevent accumulation of water from condensation.
3.4 All components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved.

3.5 The rating and design shall conform to relevant IS specification.

3.6 The motors shall be Squirrel Cage TEFC Induction type.

3.7 The motors shall be wound for Class-F insulation, and the winding shall be vacuum impregnated with head and moisture resisting varnish, and glass wool insulated to withstand tropical conditions.

3.8 Two independent earthing points shall be provided on opposite sides of the motor for bolted connections.

3.9 415 Volt power terminals shall be suitable for receiving 1.1 kv grade armoured power cables.

3.10 The cable boxes and terminations shall be designed to enable easy disconnection and replacement of cables.

3.11 Motor shall be suitable for +/- 10% variation in voltage and +/- 3 % variation in frequency.

4.0 CONTROL PANEL

4.1 General

4.1.1 The Panel shall be fabricated with 16 SWG for Doors and Covers and 14 SWG for frame and of CRCA M.S. Sheet Construction with Red Oxide Primer and finally with approved colour paint to be stove enameled. The busbar shall be of aluminium with PVC sleeving of appropriate colour code, have a minimum current carrying capacity of 400 Amps. Colour shade shall be RAL 7032 as per DIN and shall be powder coated.

4.1.2 The Panel should be cubical compartmentalised type with separate cable chamber & Busbar Chamber. The Control terminals & Power terminals should be separated and necessary ferrule markings, Colour code shall be followed. A space for 300 mm shall be provided at the Bottom of the panel and necessary M.S. channel for the foundation shall be provided.

4.1.3 The Busbar calculation shall be made for 1 Amp / mm2 for Aluminium. The necessary interlocks shall be provided as per system description. The fuse switch/switch fuse unit shall be IS:4064-1978 and HRC fuse links shall be IS:2208-1962 or IS:9224-1979.

4.1.4 The Contractor shall submit the drawings, interconnections diagram for approval of the Client/Consultant. Drawings shall indicate cable inlets, outlets, chamber dimensions and front and side elevations. Further, the Contractor shall also submit complete schematic of the electrical circuits for all pumps from the point of cable entry upto supply to the pumps. This drawing shall take into account all fuses, contactors, switches, meters etc.

4.1.5 The apparatus and circuits in the panels shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

4.1.6 Provision shall be made in the panel for terminating the incoming cables as required in the single line diagram. Only Top entries shall be permitted and all cables shall be provided with cable terminations.
4.1.7 Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

5.0 CODES AND STANDARDS FOR PUMPS AND MOTORS

5.1 PUMPS

5.1.1 The pumps shall perform to the standards and codes as given below:

5.1.2 IS:1520 Horizontal centrifugal pumps for clear, cold and fresh water.

5.1.3 BS:599 Methods of testing pumps.

5.1.4 PTC:8 ASME Power Test Codes - Centrifugal Pumps.

5.2 MOTOR

5.2.1 The following codes shall be applicable for the motor.

5.2.2 IS:325 Induction motors, three-phase

5.2.3 IS:900 Induction motors, installation and maintenance, code of practice

5.2.4 IS:7816 Guide for testing insulation resistance of rotating machines.

5.2.5 IS:4029 Guide for testing three phase induction motors.

5.2.6 IS:3043 Code of practice for earthing.

5.2.7 Further to those stated above, the design, manufacture, installation and performance of motors shall conform to the latest Indian Electricity Act and Indian Electricity Rules. The motor shall also be acceptable to the Tariff Advisory Committee.

6.0 FIRE FIGHTING ACCESSORIES

6.1 Piping

6.1.1 Pipes of the following types (depending upon the description of item) shall be used:

6.1.2 MS pipes conforming to IS:1239, ISI marked ( heavy / medium grade, as required ) for pipes of sizes 150mm NB and below).

6.1.3 Piping ( for Pipes upto 150 mm dia )

The pipes shall be manufactured by Electric Resistant Welded ( ERW ) / High Frequency Induction Welding or Hot Finished Welded process. The sulphur and phosphorus requirements in steel shall not be more than 0.05 percent each. The tubes shall be manufactured from hot rolled steel skelps / strips conforming to IS:10748.

The following manufacturing tolerances shall be permitted on the tubes and sockets:
Thickness : Shall not be less than 10 percent.
Weight : Shall not vary by more than 10 percent either way.
The pipes shall satisfy the following table with regard to diameter, thickness and weight of tube.
Screwed tubes shall be supplied with threads as per IS:554. Each tube shall be tested for hydrostatic test for leak tightness as an in process test at the manufacturer's works. The finished pipe shall be tested for Tensile Strength, Elongation, Bend Test and Flattening Test.

6.1.4 Hangers and supports shall be capable of carrying the sum total of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipelines movements as necessary.

6.1.5 The piping system and components shall be capable of withstanding 150 per cent of the working pressure including water hammer effects and test pressure upto 10.0 kg/cm².

6.1.6 Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipeline of strategic points to facilitate erection and subsequent maintenance work.

6.1.7 All pipe to pipe recieving edges shall be bevel finished to a clean edge by a electric grinder. A requisite gap determined by the thickness of the weld electrode shall be given between the joints before start of welding.

6.1.8 Weld Electrodes shall be of approved make, of grade and type as suitable for the job.

6.1.9 Joints shall be given a first weld in full width without burrs on the full dia of the pipe. Welding shall be carried out vertically from the surface to be welded. Weld fluxes shall not be so plastic such as to fall or drip down.

6.1.10 After application of first coat the weld shall be ground and then another layer of welding shall take place. The weld shall also be cleaned by grinding. Similarly, a third weld shall also be applied.

6.2 **Valves**

6.2.1 Sluice valves shall be used for isolation of flow in pipe lines For sizes upto 50 mm, gate valves shall be outside screw rising spindle type and shall be as per IS: 778 Class-I and Class-II, as applicable. For sizes 80 mm to 300 mm, gate valve shall be as per IS: 14846, PN=1.0 and shall be of outside screw and rising type and cast iron double flanged. The valves shall, however, be tested to PN:1.6.

6.2.2 Gate valves shall be provided with a hand wheel arrangement.

6.2.3 Non-return valves shall be cast iron spring action swing check type. An arrow mark in the direction of flow shall be marked on the body of the valve. These valves shall conform to IS:5312. The flap shall be of cast iron and flap seat ring of leaded gun metal.

6.2.4 Valves below 50 mm size shall have screwed ends while those of 50 mm and higher sizes shall have flanged connections. Drain lines will have valves for draining.

6.3 **Hydrant**

6.3.1 Hydrant valve shall be as per IS: 5290 of gun metal. The valve shall be oblique type complete with hand wheel, quick coupling connection, spring and gun metal blank cap as per I.S.:5290. The hydrant shall be fixed on Hydrant Riser through a 80 mm dia spool piece, at approx. 1.2 mtr from floor level. The Hydrant shall be IS marked. Orifice plate in 6 mm thick stainless steel with orifice of 32 / 40 / 50 mm dia shall be
IS provided with each Hydrant.

6.3.2 The Hydrant shall be constructed from gun metal as per IS, and finished to a smooth polish on screwed ends. The Hydrant shall have screwed inlet of 75 mm dia, flanged type with 4 nos holes. The outlet shall be 63 mm female instantaneous oblique type. The spindle shall be of gun metal with cast iron wheel. The Hydrant shall have a PVC plug with chain fixed to the main body of the Hydrant. The Hydrant shall conform to IS:5290. The Hydrant shall be tested to 25 kg / cm² test pressure. All threaded joints shall be sealed with Holdtite. The lug shall be wing type.

6.4 First Aid Hose Reel

6.4.1 The Hose Reel shall be cabinet type with in built drum and hub wheel ties. The supply pipe shall be of copper and be a part of the suspension assembly. The drum shall rotate freely on the assembly. The drum shall be fabricated from MS / GI sheet of minimum 18 guage thickness. The drum shall have a glazed front shutter.

6.4.2 The hose reel shall be directly tapped from the riser through a 25 mm dia pipe, the drum and the reel being firmly held against the wall by use of dash fasteners. The Hose Reel shall be swinging type (180 degrees) and the entire Drum, Reel etc shall be as per IS:884 including marking. The tubing shall be of IS:444 marked and rayon double braided. The nozzle shall be 6 mm dia gun metal rotating head shut off type. A Ball Valve shall be used to shut off the water supply to the Hose Reel.

6.5 External Hose Cabinets

6.5.1 Each hydrant / Fire Brigade inlet shall be housed in a Hose Cabinet. The Hydrant Cabinet shall hold single headed hydrant, 2 nos.Hoses and 1 no. Branch pipes or Fire Brigade Inlets.

6.5.2 The cabinet shall be of 2 mm MS sheet with MS angle stand. The Box shall have twin shutter with glass of 5.5 mm thickness.

6.5.3 The box work shall be powder coated with red paint. The words "Yard Hydrant", "Hydrant" etc. shall be painted in white (or red on the glass) in 75 mm high letters. The hose box shall be lockable with socket spanner. All horizontal surfaces shall be sloped adequately with water discharge holes. Vents shall also be located on sides of the Hose Box.

6.5.4 A brick pedestal with brick wall complete with plaster shall also be constructed for supporting the hose box. All surfaces shall be plastered with 1 : 4 ratio ( 1 cement : 4 fine sand ) mortar.

6.6 Air Vessel

6.6.1 The Air Vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pumping set comes into operation. It shall be normally partly full of water, the remaining being filled with air which will be under compression when the system is in normal operation. Air vessel shall be fabricated from 8 mm thick MS plate with dished ends and suitable supporting legs. It shall be provided with a 100 mm dia flanged connections from pump, one 50 mm drain with valve, one water level guage and 25 mm sockets for pressure switches. The air vessel shall be hydraulically tested to 20.0 kg / cm² pressure for 30 minutes. All Valves shall be Ball Valves in gunmetal.
6.6.2 The Vessel shall be at least 1.5 M long (excluding dished ends) and shall be of 450 mm dia.

6.7 Fire Brigade Inlet

6.7.1 Fire Brigade Inlet Connection shall be taken directly to the Down Commer. It shall comprise of multiple instantaneous male inlet coupling with plug and steel chain. The Inlet shall have a dual plate wafer type non return valve and a Butterfly Valve on the line up to the Riser. The Fire Brigade Inlet shall be complete with necessary components like special fittings of medium quality MS bends, flanged tees etc. The plug shall be of moulded PVC.

6.7.2 Fire Brigade Inlet for Tank Filling by Fire Brigade shall be four way with gun metal instantaneous male inlet coupling connection for connection with Fire Brigade vehicles.

6.7.3 The inlets shall be provided with ABS Quality by Plastic Blank caps with chain and arrangement for attaching the blank cap & chain to the FB inlet.

6.8 System Drainage

6.8.1 The system shall be provided with suitable drainage arrangements with MS piping of 40 mm dia, complete with all accessories, and provided with 40 mm dia ball valve.

6.9 Pressure Gauge

6.9.1 The Pressure Gauge shall be constructed of die cast aluminium. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourden tube type Pressure Gauge with a scale range from 0 to 16 Kg / CM square and shall be constructed as per IS: 3624.

6.10 Painting

6.10.1 All Hydrant pipes shall be painted with post office red colour paint. All pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat two coats of enamel paint shall be applied. Each coat shall be given minimum 24 hours drying time. No thinners shall be used. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO. 1" etc. All necessary protection to adjacent objects shall be taken by the Contractor.

6.11 Butterfly Valve

6.11.1 The Butterfly Valve shall be suitable for waterworks and tested to minimum of 20 kg / sq cm pressure. The Valves shall fulfil the requirements of AWWA (American Water Works Association) C 504, API 609 and MSS-SP-67.

6.11.2 The body shall be of cast iron to IS:210 in circular shape and of high strength to take the minimum water pressure of 20 kg / cm². The disc shall be heavy duty ductile iron with anti corrosive epoxy or nickel coating.

6.11.3 The valve seat shall be of high grade nitrile rubber and shall be teflon coated or silicon coated. The Valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be of EN 8 grade carbon steel.
6.11.4 The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages. The flap shall be of ductile iron and nylon coated.

6.11.5 The Valves shall be supplied with manual gear operated opening / closing system by lever as required by the specifications.

6.12 Couplings

6.12.1 Couplings shall be of gun metal, machined and polished to requirements. Both Male and female couplings shall be fitted into each other smoothly and without any unnecessary force. Couplings shall IS:903 marked with the name of the manufacturer. The coupling shall be tested to 25 kg / cm² test pressure. The Male couplings shall be provided with lugs for inserting female coupling. The lugs of the coupling shall be wing type.

6.13 Branch Pipe

6.13.1 The Branch Pipe shall be constructed from Gunmetal and finished to a smooth polish. The Branch shall have hook for control and grip type handle for holding. The Branch pipe shall be able to give straight stream. The Branch shall be as per IS:903. The Branch Pipe shall be tested to 20 kg / cm² pressure.

7.0 Codes & Standards

The following codes and standards and their subsequent modifications shall apply for the design, manufacture, shop testing, erection, fabrication at site, testing and trial operation of piping, valves and specialities requirements:

7.1 IS:554. Dimensions for pipe threads where pressure tight joints are required on the threads.

7.2 IS:638. Sheet rubber jointing and rubber insertion jointing.

7.3 IS:778 Copper alloy gate, globe and check valves for water work purposes.

7.4 IS:780. Sluice valves for water-works purposes (50 mm to 300 mm).

7.5 IS:901. Couplings, double male and double female, instantaneous pattern for fire fighting.

7.6 IS:1239 Mild steel tubes, tubulars and other wrought (Part I & II) steel fittings.

7.7 IS:884. Swinging type wall mounted hose reel with drum.

7.8 IS:388. Hose tubing.

7.9 IS:4038 Foot valves for water-works purposes.

7.10 IS:5290 Landing valves.

7.11 IS:10221 Anti corrosion treatment for underground MS pipes.

7.12 IS:5312 Swing check type reflux (non-return) valves.

7.13 Rules for Automatic sprinkler installation & Tariff Advisory Committee.
8.0  FIRE ALARM SYSTEM

8.1  Scope of Work

8.1.1 Manual Fire Alarm System is proposed for the Teaching and Hostel Blocks.

8.1.2 For the Public Address System there shall be a PA System with the Fire Alarm panel having rack mounted Amplifier with microphone. The PA Console shall be provided with one channel system for allowing the fire signal annunciation to be transferred directly to the floor. The Console shall be provided with a Selector Switch Panel to allow for Voice Announcement for any particular floor.

8.1.3 The work under this system shall consist of furnishing all materials, equipments and appliances and labour necessary and required to install automatic Fire Detection and Alarm System complete with Main Control Panel, Hooters, Manual Push Button, Visual Alarm etc. Any openings / chasing in the wall / ceiling required to be made for the installation shall be made good in manner to the satisfaction of the Engineer. The system shall incorporate a P.A. System at the Main Control Panel with multi Channels, Selector Switch and Hooter / Speaker as indicated in drawings.

8.2.0  Hooter cum Speaker

8.2.1 Dual Tone hooter shall have speaker with line matching transformer and shall give discontinuous / intermittent audible alarm automatically whenever smoke detector or heat detector operates. Hooter shall be complete with magnetic coil and accessories, ready for mounting. The hooter cum speaker should also have facilities for speaker announcement. Each speaker shall be provided with a Line Matching Transformer.

8.2.2 Hooter casing shall be made from high grade ABS of red colour. The Line Matching Transformer shall be as per Approved Makes given.

8.3.0  Manual Push Button

8.3.1 Manual Push Button shall be of Break Glass Type units, completely made from red coloured ABS plastic. with provision for cable or conduit coupling. The Manual Push Button shall have the word prescribed in clear bold letters on facia window “In Case of Fire Break Glass”. Installation of manual push button shall be as per IS:2189.

8.3.2 The Box shall be red colour in Post Office red colour. It shall also have red LEDs to indicate Fire signal. All Manual Call Boxes shall be flush type.

8.4.0  Fire Alarm Control Panel

8.4.1 The Control Panel in general shall conform to IS:2189. The panel shall be totally enclosed dust and vermin proof type made of 2 mm thickness dust inhibited sheet with even baked finish. The panel shall be of completely solid state design. The system shall operate satisfactorily from 5 degrees C to 50 degrees C and 95 % humidity. The components shall be suitable for satisfactory operation even when the auxiliary supply voltage falls to 70 % of their rated voltage.

8.4.2 The primary function of control panel shall be to respond automatically to the operation of one or more Manual Call Box give fire alarm and to indicate area / areas where the device has activated. The operation of one or more MCB shall result in simultaneous alarm given by the following:
The external alarm hooters at floor of actuation.

A visible indication on control panel.

Audible alarm on control panel itself (common for all zone, through a piezo sounder).

8.4.3 The secondary function on the control panel shall be to indicate the faults within the system. An immediate fault warning shall be given by an audible and visual signal on the control panel. A fault warning shall be given in case of any of the following occurring:

Failure or disconnections of leads to all zones.

Failure or disconnections of main normal supply or battery or low voltage battery voltage beyond 5%.

Short circuit or open fault.

Failure of any fuse / protective device.

8.4.4 The system shall be supervised for the following conditions:

Open circuit in detector wiring.

Short circuit in detector wiring.

Normal conditions.

Fire conditions.

A.C Mains failure.

Battery Low Voltage Alarm.

A common fault light shall be provided to indicate each of the above points.

Dual lamps shall be provided to indicate fire conditions and to ensure against lamp failure both lamps shall be connected in parallel. A common electronic audible alarm shall be provided but the fire signal shall be different from the fault signal by providing different tones for fire and fault conditions.

8.4.5 There shall be one indicator for fire and one for fault in the control panel corresponding to each zone. Each zone shall have two illuminating units of fire fault indication. Each indicator shall be clearly labelled with zone number and inscribed with the "Code Name" i.e words "Fire" or "Fault" or "Silence". Separate indicator must be provided in green for system, standby on etc.

8.4.6 The Main control panel shall also have the facility of Public Address system with built in Microphone. The P A System shall be coupled with the Fire Alarm Panel. The P A System shall have a floor wise selector switch to provide announcements to that particular floor.