The maximum cement content for design mix concrete shall be maintained as per the quantity mentioned above. In case where the quantity of cement required as per Design Mix is lower than the quantity specified above, necessary deduction for less quantity of cement used shall be made from the contractor.

4.9 The contractor shall engage one of the IIT Mumbai, VJTI Mumbai, NIT or other Govt. Institute approved laboratories/ test house as approved by Engineer in charge at his own expenses for designing the concrete mix in accordance with relevant IS Codes and to conduct laboratory test to ensure the target strength and workability criteria for a given grade of concrete.

The various ingredients for mix design / laboratory tests shall be sent to the lab / test houses through the Engineer-in-Charge and the samples of such aggregates sent shall be preserved at site by the department.

4.10 In the event, if all the laboratories as mentioned above are unable to carry out the requisite design / testing, the contractor may have it done from any other laboratory with prior approval of the Engineer-in-charge.

4.11 The contractor shall submit the report on design mix from any of above approved laboratories for approval of Engineer-in-Charge within 30 days from the date of issue of letter of acceptance of the tender. No concreting shall be done until the design mix is approved. In case of white Portland cement and the likely use of admixtures in concrete with ordinary Portland/white Portland cement, the contractor shall design and test the concrete mix by using trial mixes with white cement and / or admixtures also, for which nothing extra shall be payable.

4.12 In case of change of source or characteristic properties of the ingredients used in the concrete mix during the work, a revised laboratory mix design report conducted at laboratory established at site shall be submitted by the contractor as per the direction of the Engineer-in-Charge.

4.13 Trial Batches

4.13.1 The designed mix proportion shall be checked for target mean compressive strength by means of trial batches.

4.13.2 The quantities of materials for each trial mix shall be sufficient for atleast six specimens (cubes) and the concrete required for carrying out workability tests.

4.13.3 The workability of trial mix No. 1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics. The water content, if required, shall be adjusted corresponding to the required changes in the workability.

4.13.4 With the modified water content, the mix pro-portions shall be recalculated by keeping with water cement ratio unchanged. The mix proportions, as modified, shall form the Trial Mix No.2 and tested for the specified strength and wo0rkability.

4.13.5 In addition, trial mix No. 3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio + 10 percent of the specified value and tested for their design characteristics.

4.14 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the Contractor including redesigning of the concrete mix wherever required and directed by Engineer-in-Charge.

4.15 APPROVAL OF DESIGN MIX:-

The mix design for a specified grade of concrete shall be done for a target mean compressive strength

Tck = Fck + 1.65s

Where Fck = Characteristic compressive strength at 28 days.

1.65s = Standard deviation which depends on degree of quality control.

The degree of quality control for this work is “good” for which the standard deviation (s) obtained for different grades of concrete shall be as follows:-

GRADE OF CONCRETE	STANDARD DEVIATION(S)
M-10	3.5
M-15	3.5
M-20	4.0
M-25	4.0
M-30	5.0
M-35	5.0
M-40	5.0

Minimum three sets of separate preliminary test shall be carried out for each trial batch of concrete mix. Each test shall comprise six specimens and only one test set of six specimens shall be made on any particular day. Out of the six specimen of each set, three shall be tested at seven days and remaining three at 28 days. The preliminary tests at 7 days are intended only to indicate the strength to be attained at 28 days. The design mix shall be approved only on the basis of test strength of 28 days. The design mix shall be considered satisfactory and approved if atleast three preliminary testsets individually satisfy the following strength and workability criteria.

The average strength of each test sets is not less than the specified target mean compressive strength (TCk).

The strength of any specimen cube is not less than 0.85 Tck.

The concrete mix is required degree of workability and acceptance concrete finish.

4.16 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the Contractor.

4.17 WORK STRENGTH TEST:-

TEST SPECIMEN:-
Work strength test shall be conducted in accordance with IS:516 on random sampling. Each test shall be conducted on six specimen, three of which shall be tested at 7 days and remaining three at 28 days.

TEST RESULTS OF SAMPLES:-

The test results of the sample shall be the average of the strength of three specimen. The individual variation shall not be more than + 15% percent of the average. If variation is more, the test results shall be treated as invalid. 90% of the total tests shall be done at the laboratory established at site by the contractor and remaining 10% in the any Govt. laboratory or in any other laboratory as directed by the Engineer in charge.

LOT SIZE:-

The minimum frequency of sampling of concrete of each grade shall be in accordance with the following:-

QUANTITY OF CONCRETE IN THE WORK (CUBIC METRE PER DAY).	NUMBER OF SAMPLES
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 + one additional sample for each additional 50 cum or part thereof

NOTE: - At least one sample shall be taken from each shift.

4.18 STANDARD OF ACCEPTANCE:-

In case the test results of all the samples are above the characteristic compressive strength, the concrete shall be accepted.

In case the test result of one or more samples fails to meet the requirement (i) above, it shall be accepted if both the following conditions are met:-

i. Any individual test result is not less than (Fck - 4) N/mm2.

ii. The mean of test results from any group of four consecutive samples is more than (Fck + 4) N/mm2.

Concrete of each grade shall be assessed separately.

Concrete is liable to be rejected, if it is porous or honeycombed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met.

4.19 The contractor has to arrange at site centering and shuttering for as per schedule F, within 1.00 Month from date of start of work. Only steel centering / shuttering and scaffolding material unless & otherwise specified shall be used for all R.C.C. work to give an even finish of concrete surface. However, marine-ply shuttering in exceptional cases as per site requirement may be used on specific request from contractor as approved by the Engineer-in-Charge.

4.20 The rate quoted by the tenderer also include cost of special type of centering and shuttering e.g. circular in shape / folded lab or of any other architectural design.

4.21 In order to keep the floor finish as per architectural drawings and to provide required thickness of the flooring as per specifications, the level of top surface of R.C.C. shall be accordingly adjusted at the time of its centering, shuttering and casting for which nothing extra shall be paid to the Contractor.

4.22 As per general engineering practice, level of floors in toilet / bath, balconies, shall be kept 25 mm lower than general floors shuttering should be adjusted accordingly and slabs should be laid with slope towards the drainage point. Nothing extra is payable on this account.

4.23 Production of Concrete

1. The contractor shall engage Ready Mix Concrete (RMC) producing plants to supply RMC for the work. The RMC plant proposed to be engaged by the contractor shall fulfill the following requirements:

i) It shall be fully computerized

ii) It should have supplied RMC for Government/ Public undertaking/ Local bodies projects of similar magnitude.
iii) It should have facility for providing printed dispatch slips showing ingredients of concrete carried by each mixer.

2. The contractor shall within 15 days of award of the work, submit list of at least three RMC plant companies of repute along with details of such plants including details of transit mixer, pumps etc. to be deployed indicating name of owner company, its location, capacity, technical establishment, past experience and text of M.O.U. proposed to be entered between purchaser (the contractor) and supplier (R.M.C. plant) to the Engineer-in-charge who shall give approval in writing (subject to drawl of M.O.U.). The contractor shall draw M.O.U. with approved R.M.C. Plant owner and submit to Engineer-in-charge within a week of such approval. The contractor will not be allowed to purchase ready mix concrete without completion of above stated formalities for use in this project.

Notwithstanding the approval granted by Engineer-in-charge in aforesaid manner, the contractor shall be fully responsible for quality of concrete including input control, transportation and placement etc.

The Engineer-in-charge or his representative Engineer will reserve the right to inspect the plant at any stage and reject the concrete if he is not satisfied about quality of product. The contractor should therefore, draw M.O.U / agreement with R.M.C owner/ company very carefully keeping all terms and conditions/ specifications forming a part of this tender document.

3. The Engineer-in-charge reserves the right to cancel the approval of plant with or without assigning any reason.

4. The Engineer-in-charge reserve the right to exercise control over the:-

i) Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials, recordings of test results and declaring the materials fit or unfit for use in production of mix.
ii) Calibration check of the R.M.C.
iii) Weight and quantity check on the ingredients, water and admixtures added in batch mixing.
iv) Time of mixing of concrete.
v) Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action.

For exercising such control, the Engineer-in-charge shall periodically depute his authorized representative at the RMC plant. It shall be responsibility of the contractor to ensure that all

necessary equipment, manpower & facilities are made available to Engineer-in-charge/ his representative at R.M.C. plant.

5. Ingredients, admixtures & water declared unfit for use in production of mix shall not be used. A batch mix found unfit for use shall not be loaded into the truck for transportation.

6. All required relevant records of R.M.C. shall be made available to the Engineer-in-charge or his authorized representative. Engineer-in-charge shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials & production and transportation of concrete mix which shall be binding on the contractor & the R.M.C. plant.

7. PPC (Conforming to IS: 1489 Part-I) of brand/ make/ source as approved by Engineer-in-charge shall only be use for production of concrete.

8. QUALITY CONTROL OF READY – MIXED CONCRETE

It shall be the responsibility of the contractor to ensure that the RMC producer provides all necessary testing equipments and takes all necessary measures to ensure quality control of ready-mixed concrete.

In General the required measures shall be :-

(I) CONTROL OF PURCHASED MATERIAL QUALITY

R.M.C. producer shall ensure that all the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards with the materials supplier and the requirements of the products, mix design and quality control procedures. This shall be accomplished by visual checks, sampling and testing, certification from material supplier and information/ data for material supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibrated condition at the plant by the R.M.C. producer.

(II) CONTROL OF MATERIAL STORAGE

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for prevention of contamination, reliable transfer and feed systems, drainage of aggregates, prevention of freezing or excessive solar heating of aggregate etc.

(III) COMPUTER PRINT OUTS OF EACH TRUCK LOAD

Each truckload transit mixer dispatched to site shall carry computer printout of the ingredients of the concrete it is carrying. The printout shall be produced to Engineer-in-charge or his representative at site before R.M.C. is used in work.

(IV) TRANSFER AND WEIGHING EQUIPMENT

R.M.C. producer shall ensure that a documented calibration is in place. Proper calibration records shall be made available indicating date of next calibration due, corrective action taken etc. RMC producer shall ensure additional calibration checks whenever required by Engineer-in-charge in writing to contractor. R.M.C. producer shall also maintain a daily production record including details of customers to whom R.M.C. was supplied including details of mixes supplied. Record shall also be maintained of what materials were used for the day's production including water and admixtures.

The accuracy of measuring devices shall fall within the following limits.

Measurement of cement	+/- 2% of quantity of cement in each batch
Measurement of water	+/- 3% of quantity of water in each batch
Measurement of aggregate	+/- 3% of quantity of aggregate in each batch
Measurement of admixture	+/- 3% of quantity of admixture in each batch

The RMC plant shall have the provision of adjusting the plus / minus quantity of various ingredients in the next batch so that there is no variation in quantity of ingredients from design mix in a lot consisting of 5 to 6 batches.

(V) MAINTENANCE OF PLANT, TRUCK MIXERS AND PUMPS

Plant, Truck, Mixers and pumps should be well maintained so that it does not hamper any operation of production, transportation and placement.

(VI) PRODUCTION OF CONCRETE:-

The following precautions shall be taken during the production of RMC at the plant.

i) Weighing (correct reading of batch data and accurate weighing):- For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimated slump, the total amount of water added to the load, the delivery tickets number for that load and the time of loading the concrete into the truck.

ii) Visual observation of concrete during production and delivery or during sampling and testing of fresh concrete, assessment of uniformity, cohesion, workability, adjustment to water content:- The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.

iii) Use of adequate equipment at the plant to measure surface moisture content of aggregates, particularly fine aggregate and the workability of the concrete, cube tests etc. shall also be ensured.

iv) Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.

v) Sampling of concrete, testing, monitoring of results.

vi) Diagnosis and correction of faults identified from observations/ complaints.

The RMC plant produced concrete shall be accepted by Engineer-in-charge at site after receipt of the same on fulfilling all the requirements of mix mentioned in the tender documents.

9. Ready mix concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer-in-charge.

10. If so required by the Engineer-in-charge, the RMC producer shall provide separate storage space/ godowns for storage of materials approved by Engineer-in-charge for the design mix concrete.

11. Frequency of sampling and standard of acceptance shall be as per CPWD Specifications for design mix concrete.

12. The RMC shall be placed by pump of suitable capacity and the contractor shall arrange sufficient length of pipe at site to place the RMC in the minimum required time. The contractors shall co-ordinate with R.M.C. supplier and pump hirer to have effective concrete placement. Nothing extra shall be paid for placing of concrete through concrete pump.

13. The representative of R.M.C. supplier shall attend the site meeting as and when decided by the Engineer-in-charge.

14. i) The contractor shall assess the quantity of R.M.C requirement at site well in advance and order accordingly to the R.M.C. supplier. In case excess R.M.C is received at site, the department shall not be under any obligation to get the extra quantity utilized and no payment for such R.M.C. shall be made.

ii) The contractor shall have to employ labour in shifts to ensure continuous casting of slabs and other RCC members. No extra payment on this account shall be made.

15. The department will recommend to the Traffic Police to issue permits for the entry of the vehicles through the area of no entry zone to the working area. However, absence of such permits will not be cause for delay in completion of the work.

5.0 SHUTTERING / FORM WORK:-

5.1 The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips.

5.2 Steel shuttering as approved by the Engineer-in-Charge shall be used by the contractor. Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required completing the shuttering panels. Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work.

5.3 The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or de-bonding compound shall be applied on the surface of the shutter plates in the requisite quantity before assembly of steel reinforcement.

5.4 The joint filler shall be resilient closed cell expanded polyethene and non-tainting as manufactured by Supreme Industries Ltd. or equivalent manufacturer.

5.5 Providing joint filler of required thickness in position to substrate using either double sided foam adhesive tape or neoprene synthetic rubber adhesive. When forming expansion joint with the Board in in-situ concrete, joint sealing slots can be readily formed in the following matter-

Before installing, simply cut off a strip of the required depth. Then install the filler flush with the finished surface.

Prior to sealing, the top strip can then be pulled easily from the joint to provide an uncontaminated sealing slot ready for preparation and sealing.

6.0 REINFORCEMENT:-

6.1 The reinforcement shall be done as per CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips.

6.2 The reinforcement of RCC work includes all operations including straightening, cutting, bending and **binding with annealed steel** wire or welding and placing in position at all the floors with all leads and lift complete as per CPWD Specification - 2009 - Vol.I &Vol. II with upto date correction slips.

6.3 To avoid displacement of bars in any direction and to ensure proper cover, only factory made round type/rectangular cover blocks shall be used by the contractor. Nothing extra shall be payable on this account.

6.4 All reinforcement in RCC upto plinth level i.e. foundation, raft, walls, columns, beams, UG tanks, STP tanks etc. including plinth beams shall be Fusion Bonded epoxy coated as per relevant standard specification to give anti corrosive treatment.

7.0 AUTOCLAVED AERATED CONCRETE BLOCKS MASONARY WORK:-

7.1.1 Dimensions & Tolerances:

Autoclave Aerated Concrete Block shall be made in sizes and shapes to fit different concrete needs. They include stretcher, corner, double corner or pier, jamb, header, bull nose, partition block and concrete floor units.

Autoclave Aerated Concrete Block shall be referred to by its normal dimension the term 'normal' means that the dimension includes the thickness of the mortar joints. The actual dimension shall be 10mm short of the normal dimension (or 6mm short in special areas finer joints as specified).

The AAC blocks shall have sizes as per requirement at site as approved by Engineer in charge. If different sized of AAC blocks are available, the sizes suitable for the work shall be procured by contractor.

7.1.1.1 The nominal dimensions of the units are so designed that taking account of the thickness of mortar joints, they will produce wall length sand heights which will conform to the principles of modular co-ordination.

7.1.1.2 The maximum variation in the length of the Autoclave Aerated Concrete Block shall not be more than plus/minus 5mm and maximum variation in the height and width of Autoclave Aerated Concrete Block, not more than plus/minus 3mm.

7.1.1.3 The faces of Autoclave Aerated Concrete Block shall be flat & Rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surfaces shall be at right angle to the face of the Blocks.

7.1.1.4 The autoclaved Autoclave Aerated Concrete Block shall as indicated in table:

S. No.	Density in oven dry condition (Kg/m2)	Compressive Strength (Min)	Thermal Condition in Air dry condition (W/m.k)
1.	551 to 650	3.00	0.24

7.1.2 Materials

7.1.2.1 Cement complying with any of the Indian Standard may be used as per the direction of the manufacturer.

7.1.2.2 Use of Fly ash conforming to IS 3812-1981 may be permitted to a limit of 20% in cement conforming to IS 269-1976.

7.1.2.3 The lime shall satisfy the requirement for class C lime specified as IS 712-1973.

7.1.2.4 The aggregate used for the manufacture of Autoclave Aerated Concrete Block shall conform to the following requirements

a) Sand-Conforming to IS 383-1970 except for the grading which may be made to suit the product and silica content shall not be less than 80%.
b) Fly ash – Conforming to IS 3812-1981 with loss on ignition not more than 6%.

7.1.2.5 The water used in the manufacture of Autoclave Aerated Concrete Block shall be free from matter harmful to concrete or reinforcement or matter likely to cause efflorescence in the block and shall meet the requirements of IS 456-2000.

7.1.2.6 Additives and Admixtures may be added either as additives to the cement during manufacturing or as additive or admixtures to the concrete mix. Additive or admixtures used in the manufacture of concrete block may be

a) Accelerating , water reducing and air–entraining admixtures conforming to IS 9103-1979
b) Water proofing agent conforming to IS 2645-1975
c) Colouring pigments

7.1.3 Physical requirements

7.1.3.1 All Autoclave Aerated Concrete Block shall be sound, free of cracks or other defects which interfere with the proper placing of block units, impair the strength or performance of the construction.

7.1.3.2 Where block units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks or other imperfections except that if not more than 5% of a consignment contains slight cracks or small chippings not larger than 25mm, this shall not be deemed grounds for rejection.

7.1.3.3 Dimensions- The overall dimension of the block units when measured shall be in accordance with requirement subjected to the tolerances mentioned in para 6.1.1.2

7.1.3.4 Block Density - The Block density shall conform to the requirements specified in table of para 6.1.1.4, when tested accordance with para 6.1.4.1

7.1.3.5 Compressive Strength - The min. compressive strength being the average of twelve block units shall be as prescribed in table of para 6.1.1.4, when tested accordance with para 6.1.4.2

7.1.3.6 Thermal Conductivity - The thermal conductivity shall be not exceed the values specified in table of para 6.1.1.4 when tested accordance with para 6.1.4.3

7.1.3.7 Drying Shrinkage – the drying shrinkage shall be not more than 0 .05% for grade –1 block and 0.10% for grade-2 block when tested accordance with para 6.1.4.4

7.1.4 Tests

7.1.4.1. Block Density- The block density shall be determined in the manner described in IS 6441 (part-1) -1972

7.1.4.2. Compressive Strength- The compressive strength of block shall be determined in accordance with IS 6441 (part-5) -1972

7.1.4.3. Thermal Conductivity- The thermal conductivity of block shall be determined in accordance with IS 3346 -1980

7.1.4.4. Drying Shrinkages-The drying shrinkage of block shall be determined in the manner described in IS 6441 (part-2) -1972

7.1.5 Sampling

7.1.5.1 Lot - In any consignment, all the blocks of the same size and from the same batch of manufacture shall be grouped together into a minimum number of groups of 10000 blocks or less. Each such group shall constitute a lot.

7.1.5.2 From each lot, a sample of 24 blocks shall be selected at random. The required numbers of Blocks shall be taken at regular intervals during the loading of the vehicle or unloading the vehicles depending on whether sample is taken before delivery or after delivery. When this is not practicable, sample shall be taken from the stack in which case the required number of blocks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks by opening trenches from the top.

7.1.5.3 The sample of blocks shall be marked for future identification of the consignment it represents. The blocks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The tests shall be undertaken as soon as practicable after the sample has been taken.

7.1.6 Number of tests

7.1.6.1 All the 24 Blocks shall be checked for dimensions and inspected for visual defects.

7.1.6.2 Out of the 24 blocks, 12 blocks shall be subjected to the test for compressive strength, 3 blocks to the test for density, 3 blocks to the test for thermal conductivity and 3 blocks to the test for drying shrinkage. The remaining 3 blocks shall be reserved for re-test for drying shrinkage if a need arises.

7.1.6.3 The samples of AAC blocks (each sample consisting of 6 specimen) shall be chosen randomly from the lot procured and tested for various parameters specified in para 6 above.

One samples shall be tested for every **100 cum** or part thereof. However, minimum one sample shall be tested from each lot received at site if the quantity procured in the lot is less than 100 cum. If required, Engineer-in-Charge or his authorized representative shall inspect the factory during production of the material for this work and also collect samples (of materials used for making AAC blocks and precast AAC blocks) from the factory itself.

The contractor shall consider this contingency also while placing the order with one of the approved firms. Nothing extra shall be payable on this account.

7.1.7 Criteria for conformity

7.1.7.1 The number of blocks with dimensions outside the tolerance limit and or with visual defects, among those inspected, shall not be more than two.

7.1.7.2 For density, the mean value shall be within the range specified in Table of para 6.1.1.4

7.1.7.3 For compressive strength, the mean value, say X shall be determined. The test results shall be grouped into groups of 4, individual values of ranges shall be determined, the average range a calculated from these values and shall satisfy the following condition:

X- 0.6 R> minimum value specified in Table of para 6.1.1.4

7.1.7.4 For thermal conductivity, the mean value shall be equal to or less than the value specified in Table of para 6.1.1.4

7.1.7.5 For drying shrinkage, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All these blocks shall satisfy the requirements.

7.1.8 Manufacturer’s Certificate

7.1.8.1 The manufacturer shall satisfy himself that the masonry units conform to the requirements of this specification and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

7.1.9 Storage

7.1.9.1 General requirements of storage of autoclaved cellular (aerated) concrete blocks shall be as described in IS: 4082-1977*.

7.1.10 Marking

7.1.10.1 Each lot of concrete masonry units manufactured in accordance with this specification shall be suitably marked with information-

i The identification of the manufacture
ii The grade and block density of the unit
iii The month & year of manufacturing.
iv Each block may also be marked with the ISI Certification mark

7.1.11 Autoclave Aerated Concrete Block masonry shall be provided with polymer modified adhesive mortar. The polymer modified adhesive mortar shall be provided @ 30 kg per cum or with cement mortar 1:4 (1cement: 4coarse sand).

Autoclave Aerated Concrete Block with 100 mm thick masonry shall be provided with two number 6mm dia. reinforcement steel bar at every third course. R.C.C band at sill level and lintel level 100 mm thick for full width of wall shall be provided.

7.1.12. Autoclaved Aerated Concrete Block shall be confirming the IS Code – 2185 (Part-3) 1984 (Reaffirmed 2005)

8.0 FURNITURE FOR AUDITORIUM:

8.1 The contractor will supply the branded furniture mentioned in the detailed sheet attached with specification. All furniture of Auditorium shall be fabricated in the workshop only on State of Art Modern Machines & advanced manufacturing techniques. No fabrication will be allowed at site except mentioned in detailed sheet of furniture. Various fabricated units shall be transported to site in proper packing & assembled / placed in position as per approved layout. All hardware items shall be of first quality from reputed manufacturers as per approved make and shall be got approved from Engineer-in-charge before actual execution.

8.2 Open plan Auditorium arrangement (OPEA) shall comprise of basic elements / modules / units such as chairs, tables, sofas, catwalk assembly, podiums, carpet, stage, accessories, fixtures and fittings etc. arranged in desired configurations for Auditorium purpose. The basic elements shall be one of standard modular sizes/shapes for specific requirements. The system shall offer flexibility to make subsequent changes / modifications. Specific drawings with exact dimensions shall be finalized before execution according to requirement. Above mentioned furniture are indicative however complete plan of furniture alongwith dimensions to make the auditorium complete functional with all latest amenities shall be submitted, get it approved from Engineer-in-charge. The acoustic arrangement in auditorium with calculations to maintain required sound quality with the help of absorbent materials to avoid echo in auditorium during performance of auditorium, shall be submitted, vetted by VJIT/NIT/IIT or any reputed institution as approved by Engineer-in-charge and executed. Cost of all inputs required to make auditorium fully function are included in rates quoted by the contractor and nothing extra will be admissible on this ground.

8.3 The colour and shade of the MDF/Veneer/ pre-laminated particle board carpet, chairs shall be got approved from the Engineer in Charge prior to fabrication of furniture. All hardware

components like clamps nut/ bolt/ washer, screws, gasket, fitting and fixture, brackets, roller/guide/slide, casters, hardware etc. as may be required or are forming integral part of the system/basic elements/modules/units for construction/installation shall meet relevant structural and other requirements and be provided without any extra cost to the department

8.4 All the materials used for the works shall meet relevant BIS or other applicable standards (latest revision). All particle boards shall be as per manufacturers' specification having lamination of approved colour on exposed face and balancing lamination on the unexposed face.

8.5 The contractor shall procure and provide all the materials from the manufactures / suppliers as per manufacturers' specification for the work. The equivalent brand for any item shall be permitted to be used in the work, only when the specific make is not available. This is, however, subject to documentary evidence produced by the contractor for non availability of the brand specified and also subject to independent verification by the Engineer in Charge. In such cases, the decision of Engineer in Charge as regards equivalent make of the material shall be final and binding on the contractor. No claim, whatsoever, of any kind shall be entertained from the contractor on this account. Nothing extra shall be payable on this account. Also, the material shall be produced only after the written approval of Engineer in Charge.

8.6 The agency shall keep the Engineer in Charge informed about progress of work during manufacturing to enable him to have effective quality control.

8.7 Wherever the testing of any material shall be required the sample shall be collected and got tested from the approved laboratory whose testing charges shall be borne by the department. In case of failure of sample, the testing charges shall be borne by the contractor and material shall be rejected and removed. Testing may also be carried out at the description of the Engineer in Charge, from the lot of finished product brought at site by the contractor. The sample shall be carried to the approved laboratory for testing by the contractor at his own cost.

8.8 The contractor shall be fully responsible for rectifying any defect or replacing any damaged panel or hardware fittings, which may happen during the use up to two years from the date of completion of work. The guarantee @ 2% of the cost of work shall be withheld from final bill. The guarantee of 2% shall be refunded after two years from the date of completion if no defects are observed in the said period or if the defects have been rectified in pursuant in the agreement to the entire satisfaction of Engineer in Charge. For calculation purpose, cost of work shall be considered as Rs. 2.60 Crores.

9.0 SCAFFOLDING:-

Double steel scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

10.0 WOOD WORK:-

10.1 The work in general shall be carried out as per the CPWD specifications.

10.2 The wood shall be selected best quality second-class teak wood.

10.3. The work shall be carried out in accordance with the architectural drawings issued by the department. The architectural drawings shall at all times be properly correlated and architectural requirements have to be fully satisfied.

10.4. All the wood used for the manufacturing of the door shutters including the doorframes, internal & external lipping, beading for fixing glazing etc. shall be seasoned as per the requirements of the CPWD Specifications.

10.5. All the screws used for woodwork shall be fully threaded, counter sunk stainless steel screws, grade 304 and they shall be suitably concealed or plugged.

11.0 DOOR HARDWARE & FITTINGS

11.1. The work in general shall be carried out as per CPWD specifications.

11.2. The contractor shall procure and submit samples of various hardware and fittings for approval, of the Engineer-in-Charge. The material shall be procured and the mass work shall be taken up only after the approval of the samples by the Engineer-in-Charge.

11.3. All hardware and fittings shall be in stainless steel of grade SS 304 unless otherwise specified. The contractor can supply these in stainless steel grade SS 316 instead of stainless steel grade SS 304. However all the pieces of an item shall be of the same grade of stainless steel and same make. Nothing extra shall be payable for supplying the items with SS 316 grade stainless steel instead of SS 304 grade.

11.4. All the hardware and fittings shall be supplied with the required spindles, pivots, stud, connecting bolts, screws, grub screws, nuts, bolts, connecting pin / bolt (including stainless steel washers / shims, PVC washers, PVC buffers etc.) and of the material as per the manufacturer's specifications. Their cost is deemed to be included in the cost of the hardware and fittings to be supplied and these accessories shall not be measured separately for payment. If any of the accessories get damaged during fixing of the hardware and fittings, additional numbers as required shall be supplied by the Contractor at his own cost.

11.5. The size for the hardware and fittings shall be as specified in the schedule of door fittings and the particular specifications. Wherever the size is not mentioned in the particular specifications, it shall be as per the manufacturer's specifications or as directed by the Engineer-in-Charge. The shape has been specified as per the model number mentioned in the manufacturer's product catalogue / information.

11.6 The Contractor shall be permitted to supply items superior than the specified, but only with specific written approval of the Engineer-in-Charge , provided they are aesthetically similar and nothing extra shall be payable on this account.

11.7 The entire supply for each type of hardware and fittings shall be made, preferably in one lot to keep variations in finishes to the minimum.

12.0 FLOORING & DADO

12.1 The work in general shall be carried out as per the CPWD Specifications, as per the architectural drawings and as per the direction of Engineer-in-Charge.

12.2 The Engineer-in-Charge or his representative may, if required, visit the source of supply of the various stones to assess the quality as well as availability of the material in the required quantities. The Department shall bear the cost of such visits of the officers of the Department.

12.3 Based on the samples approved by the Engineer-in-Charge for various flooring and dado / cladding materials as specified hereinafter, the contractor shall prepare mock up(s) at site of work as specified under relevant flooring and dado / cladding items, for approval of quality of workmanship and material specified. If the quality of the workmanship and the material is as per the required standards and approved by the Engineer-in- Charge, the mock up shall be allowed as part of the work and measured for payment. Otherwise, it shall be dismantled by the contractor as directed by the Engineer-in-Charge and taken away from the site of the work at his own cost. The mock up(s) so made shall be kept till completion of respective works for reference. Nothing extra shall be payable on this account.

12.4 The stones / tiles shall be transported to site well packed in boxes or otherwise. These shall be handled carefully to prevent any damage. The various types of stones and tiles, procured shall be free of any surface defect or any edge damage. The damaged stones and tiles shall not be allowed to be used in the work. So, the contactor shall procure additional quantity of the stone and tiles to cover such contingencies. However, nothing extra shall be payable on this account.

12.5 For the enclosures with circular or curved profile, only the actual area of the flooring shall be measured for payment and nothing extra shall be payable for labour, material, wastages and any other incidental charges.

12.6 For the skirting in the enclosures with curvilinear profiles, the tiles / stones shall be cut to the required size and the shape to match the profile and/ or the joints as per the architectural drawings. Similarly, the skirting shall be fixed in a manner as to flush or project from the finished face of the wall as per the architectural drawings and as directed by the Engineer-in-charge. Any chasing of the C.C masonry blocks required for such fixing is deemed to be included in the cost of masonry. Nothing extra shall be payable on this account.

12.7 For flooring work, the joints between the different types of flooring shall be located as per the architectural drawings. Also, the Contractor shall maintain the uniform level of the finished flooring of the different types unless specifically mentioned on the architectural drawings. Nothing extra shall be payable on these accounts.

12.8 All the flooring works specified under this sub -head shall be adequately protected by a layer of plaster of paris which shall be laid over a 400 micron PVC film. The protective layer shall be maintained throughout the execution of works and removed just before handing over of the site for which nothing extra shall be payable.

12.9 At the time of handing over, flooring & dado / cladding shall be free of any scratches, stains etc. The flooring & dado / cladding shall be properly cleaned before handing over. However, abrasive cleaners shall not be used to clean the marks and other scratches.

Granite stone work

12.10 The Contractor shall procure and submit the samples of different types of granite stones, for the approval of the Engineer-in-charge prior to the execution of the item.

12.11 The entire supply for each type of granite stone slab shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one location to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the Engineer -in-Charge, shall not be used in the work and shall be removed and replaced by the Contractor. Nothing extra shall be payable on these accounts. Also no claim of any kind shall be entertained from the Contractor on this account.

12.12 Granite stone slabs shall be pre polished (mirror polished) or given any other surface treatment as per the Architectural drawings and as directed by the Engineer-in-Charge.

12.13 Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the Engineer-in -Charge may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tilesslabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after

installation, shall be rejected and shall be replaced by the Contractor at his own cost. Nothing extra shall be payable on this account.

12.14 The stone work may be required to be carried out in patterns, design and / or in combination with granite stones of different colour and shade with or without borders and in combination of different stone slabs / tiles for which nothing extra shall be payable. The stones shall be provided in sizes and shapes as per the architectural drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account.

12.15 For the flooring portions curved in plan or for in-lay work, the stone slabs (at the edge) shall be cut to the required profile and shape as per the architectural drawings. Nothing extra shall be payable on this account.

12.16 The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the Engineer-in-Charge. Wherever stone slab other than in single piece is allowed to be fixed, the joints shall be provided as per the architectural drawings and as per the directions of the Engineer -in-Charge. In the cabin areas, the joints in sills shall preferably be provided in line with the partition wall. Depending on the number of joints, as far as possible, the stone slabs shall be procured and fixed in slabs of equal lengths as per the architectural drawings and as directed by Engineer-in-Charge.

Vitrified and ceramic tiles work

12.17 The contractor shall procure and submit the samples of approved make, shade and thickness of different types of vitrified and ceramic tiles, for the approval of the Engineer-in-charge prior to the execution of the item.

12.18 The mock up (one each) shall be prepared for flooring and dado, for vitrified tiles etc.

12.19 The entire supply for each type of tiles shall be procured from one manufacturer / authorized dealer, preferably, in one lot to keep variations to the minimum.

12.20 The tiling work may be required to be carried out in patterns, design and / or in combination with tiles of different colour and shade and in combination of different stone slabs / tiles for which nothing extra shall be payable. The tiles shall be provided as per the architectural drawings.

12.21 For the flooring portions curved in plan, the tiles (at the edge) shall be cut to the required profile and shape as per the architectural drawings. Nothing extra shall be payable on this account.

12.22 The Contractor shall obtain and submit to the Department the manufacturer's test certificate for compliance of various parameters for the material as per the manufacturer's specifications, with each lot of material received at site.

12.23 The flooring and dado / cladding should be set out such that the perimeter/ corner tiles are in excess of half a tile so that the edge panels on both the sides are of equal sizes, as far as possible. The tiles shall be cut to required size and shape in a workman like manner but with all precautions, as per the manufacturer's specifications.

12.24 For dado / cladding / skirting work, the tiles shall be chamfered at the meeting edges on the corners in a manner that butt edges are not visible. It shall be ensured that the edges shall be ground / filed to chamfer the edges so that the glazing layer at the edges of the tiles is not chipped off otherwise the work shall be rejected and redone by the Contractor at his own cost.

12.25 The proper gradient shall be given to flooring for toilets, verandah, kitchen, court yard, etc. as per the directions of Engineer-in-Charge. For this there may be extra thickness of dry mortar below the tiles/stone slabs. These gradients should be insured in the shuttering itself. Nothing extra shall be paid on this account.

13.0 ROOFING, WATER PROOFING & INSULATION

Work shall be executed as per CPWD Specifications, 2009 Vol.I & II with upto date correction slips.

13.1 Water Proofing of terrace/ Podium/ basement/Toilets/balconies/UG tank/overhead tanks.

13.1.1 Brick Bat Terracing/ Water Proofing

The water proofing compound used in integral cement based water proofing treatment shall satisfy all the performance requirements indicated in IS : 2645 and shall be got tested before its use. The water proofing compound shall be used @ 2% by weight of cement used or as recommended by the manufacturer.

13.1.2 Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approved of the Engineer-in-Charge in writing. Materials shall be kept under double lock and key and proper account of the water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements.

13.1.3 The finished surface after water proofing treatment for roof slab shall have smooth slope.

13.1.4 Before commencement of treatment on roof surface, it shall be ensured that the outlet drain pipes/ spouts have been fixed and the spout opening have been eased and rounded off properly for easy flow of water.

13.2 Water proofing of toilets, wet area:

Alkaline cement based crystalline water proofing chemical by scarifying surface, removing dust, loose plaster debris etc. and finally cleaning with pressurized water jet, opening up of cracks and treated with a mix of modified cement and sand mortar, premixed with 10% SB bonding emulsion. applied on vertical and horizontal surface after laying of all pipes and smooth plugging of holes.

Concrete surface on which water proofing is desired shall be kept wet for 48 hrs. after cleaning of all dirt, oil grease, bitumen, laitance or other contaminants.

The first coat shall be applied by brush on the cleaned and dampened surface. After a gap of 24 hours, 2nd coat shall be applied on the dampened 1st coat surface. Immediately after applying the second coat polyester fiber mesh shall be spread and laid. The third slurry coat should be applied immediately over the fiber mesh extended up to 100mm on the side walls.

The area be shall be protected from sun & rain for 48 hrs. &shall be continuous flooded for 72 hours to test the area for any leakage/ seepage etc. In case of failure, the process shall be repeated and tested again by the contractor at his risk and cost.

Guarantee Bond

Ten years guarantee bond in prescribed Performa attached at Annexure-II herewith shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liability/ liabilities under the guarantee bond. However, the sole responsibility about efficiency of water proofing treatment shall rest with the main contractor.

(Five percent) of the cost of water proofing work shall be retained as security deposit and the amount so withheld would be released after ten years from the date of completion of the entire work under the agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended to within the specified period, the same will be got done from another agency at the risk and cost of contractor. (Amount of Rs. 1.00 crore shall be considered for water proofing items)

However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of Engineer-in-Charge, if so decided by the Engineer-in-Charge. The security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form.

14.0 FINISHING

14.1 The work shall be carried out as per CPWD Specifications- 2009 Vol.-I & Vol. II with upto date correction slips.

14.2 All painting material shall brought to the site of work in the original sealed containers. The material brought to the site of work shall be sufficient for at least 30 days of work. The material shall be kept under the joint custody of contractor and representative of the Engineer-in-Charge. The empty contains shall not be removed from the site till the completion of the work without permission of the Engineer-in-Charge.

14.3 For melamine polish, the wood/veneer surface before polishing shall be well sanded to obtain smooth and even surface. A coat of appropriate wood sealer of the same manufacturer approved for melamine polish shall be applied over the surface before polishing. The surface shall be sand papered again to remove the excess filler material and to obtain smooth even surface. Melamine polish of approved brand and manufacture in matt or glossy finish stained to required shade shall be machine sprayed in required coats over the prepared surface. Final polished surface shall be even, smooth and free from waviness. Consumption of the melamine polish shall not be less than 0.25 Litre.

15.0 ALUMINIUM DOOR, WINDOW, VENTILATOR WORKS ETC.

15.1 Extent and intent

Minimum wt/m^2 of aluminum for fixed & openable windows with frames and sub-frame shall be 15 kg. Aluminum section of 1" series of minimum medium grade shall be used for work.

The work shall be carried out through an approved specialized agency, who shall furnish all materials, labour, accessories, equipment, tool and plant and incidentals required for providing and installing 25 micron anodized / 60 micron powder coated of any shade (As approved by Engineer in charge) aluminum sections 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.

15.2 General

Aluminum 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 standard 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.

15.3 Shop Drawings

The contractor shall submit the shop drawings of doors. Windows, louvers, cladding and other aluminum work, based on architectural drawings, to the Engineer-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.

15.4 Samples

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

15.5 Sections

Minimum doors and windows shall be fabricated from extruded section of profile of detailed on drawings. The sections shall be extruded by the manufacturers approved by the Engineer-in-Charge. The aluminum extruded sections shall conform IS designation 63400-WP (HV9WP Old designation) with chemical Composition and technical properties as per IS 733 and IS: 1285. 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.

15.6 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 accuratelymachined and fitted to form hairline joints prior to assembly. The joint and accessories such as cleats, brackets, etc. shall be of such materials 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.

15.7 Anodizing / Powder Coating

All aluminum sections shall be anodized 25 micron / powder coated 60 micron to required color as specified and as per approval &direction of Engineer-in-Charge. Polythene tape protection shall be applied on the sections before they are brought to site. All care shall be taken to ensure surface protection during transportation, storage at site and installation. The tape protection shall be removed on installation. The samples will be tested in the approved laboratory and cost of samples, cost of testing, shall be borne by the contractor.

15.8 Protection of Finish

All aluminum members shall be wrapped with approved self adhesive non- staining PVC tapes.

15.9 Handling and stacking

15.9.1 Fabricated materials shall be stacking 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 piece/ parts. Materials found to be acceptable on inspections shall be repacked in crates and stored safely.

15.9.2 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.

15.9.3 Where aluminum comes into contact with masonry brickwork, concrete, planter 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.

15.9.4 The contractor shall be responsible for assembling Composite, bedding and filling the groove with backup roads poly-sulphide sealant inside and outside, placing the doors, windows etc. in their respective opening. After the doors/ windows have been fixed in their correct assigned position, the open hollow sections abutting masonry concrete shall be fitted with approved poly-sulphide sealant densely packed and neatly finished.

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

15.10 Installation:

15.10.1 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 fastenersof 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.

15.10.2 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 are 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 supported and bar plumbed in position. The wedges shall invariably be placed at meeting points of glazing bars and frames.

15.11 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.

15.12 Fittings

Hinges, stays, handles, tower bolts, locks and other fittings shall be of excellent quality and manufacturers shall be approved by the Engineer-in-Charge.

15.13 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.

15.14 Mastic Cement

The gaps between frames and supports and also any gaps in the windows section shall be raked out as directed and filled with mastic cement of approved colour and make to ensure complete water tightness. The mastic cement shall be of such colour and Composition that it would not stain the masonry/ concrete work, shall receive paint without bleeding, will not sag and shall not set hard or dry out under any conditions of weather. The samples of mastic cement to be used for this purpose shall be got approved by the Engineer-in-Charge before its actual use.

15.15 Sealant:

Use modified silicone for joint subject to movement and in glazing.

Surfaces to receive sealant shall be properly prepared, cleaned, primed and excess sealant removed from finished surfaces.

Sealed joints shall be neatly tooled and surfaces smoothed.

Colour of the sealant shall be approved by the Engineer-in-Charge.

15.15.1 Glazing

Glazing shall generally be accomplished from the inside of building.

The glazing system shall be designed to this end use a continuous EPDMcompression 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 complete watertightness.

Maintain a minimum glazing bite, edge clearance and surface clearance depending on the glass as recommended by the glass manufacturer.

15.15.2 Sealant and Gasket Application

Sealant and gasket shall be provided wherever shown in the drawings or required for a permanently weather tight installation. The sealing mechanism is necessary but is not indicated, it shall be of type recommended by the sub-contractor and approved by the Engineer-in-Charge.

All adjoining surfaces shall be protected to receive sealant against staining by masking and/ or other methods.

Joints and joint surfaces shall be clean, dry, and free of any material that may have an adverse effect on the bonding and/ or seal of the sealant and gasket materials.

Apply sealant and gasket under the conditions recommended by the manufacturer(s). Prime all surface to receive sealant and gasket unless recommended otherwise, use no sealant that has started to set in its container or a sealant that has exceeded the self life published by the manufacturer.

Fill all joints continuously and completely with sealant, forming a neat, uniform, concave bead. Finish the material flush with adjoining surfaces unless shown on the drawings. All sealant surfaces shall be tooled smooth.

Tensile or shear stress in structural silicone sealant joint shall not exceed 1.4 kg. / sqm.

15.16 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 anodized / powder coating aluminum and glass surfaces with suitable cleaning agent, make final adjustments to all ventilators, etc. and hardware leaving all in first class working order.

15.17 Details of Tests

15.17.1 The various tests on aluminum sections shall be conducted in accordance with the relevant IS codes.

15.17.2 The minimum number of tests for powder coating / anodizing and corrosion resistance shall be as given below:

Sr. No.	Details	No. of tests
1.	Doors, windows & ventilators	One test of each section per lot

15.17.3 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 aluminum section be got tested.

15.17.4 The cost of samples, carriage or the samples and testing charges, if any, shall be borne by the contractor.

15.18 Acceptance Criteria

The aluminum sections shall conform to the provisions of the relevant working drawings. The sectional weight of any aluminum section within permissible limit / higher than the permissible limit shall be accepted.

15.18.1Guarantee Bond: - All aluminum work shall carry two years guarantee after completion of the work against water leakage, unsound material and workmanship and defective anodizing / powder coating as per guarantee bond at Annexure-III.

Two years guarantee in prescribed Performa attached at Annexure-III must be given by the specialized firm, which shall be counter signed by the contractor, in token of his overall responsibility in addition 10% (Ten percent) of the cost of these items would be retained as

guarantee to which the performance of the work done. The cost guarantee against this item of work shall be in addition to the security deposit mentioned elsewhere in the contract form. If any defect is noticed during the guarantee period, it should be rectified by the contractor within seven days, and if not attended to the same will be got done from another agency at the risk and cost of the contractor. However, this security deposit can be released in full, if bank guarantee of equivalent amount for two years is produced and deposited with the department.(Amount of Rs. 50 lakhs shall be considered for all aluminum items)

15.19 Work shall be carried out as per CPWD Specifications- 2009 Vol. - I & Vol.-II with upto date correction slips.

16.0 SANITARY INSTALLATIONS/ WATER SUPPLY/ DRAINAGE

16.1 The work in general shall be carried out as per CPWD Specifications- 2009 Vol.-I & Vol. II with upto date correction slips. Rate shall include all materials, labour and all the operations mentioned in the respective item unless and otherwise specifically mentioned.

16.2 Hubless Centrifugally cast (spun) iron S & S pipes of required size for sanitary & drainage lines and press fit technology SS 304 Grade pipes & fittings for internal & concealed water supply lines of required size as per design to be approved by Engineer-in charge to be used in the work.

16.3 The contractor shall be responsible for the protection of the sanitary and water supply fittings and other fittings and fixtures against pilferage and breakage during the period of installation and thereafter until the building is handed over.

16.4 The contractor shall furnish all labour, materials and equipment, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Plumbing / Sanitary system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The Plumbing / Sanitary System shall comprise of following:

Internal & external Sanitary Fixtures and Fittings, Internal and External Water Supply pipes & fittings, Internal and External Drainage, Approval from Local Authorities, Balancing, testing & commissioning, Test reports and completion drawings.

16.5 The contractor shall procure and install all pipes, Sockets /Nipples including shut-off valve etc for mounting sensors/transmitters for the interface to Building Automation System.

16.6 Contractor shall use SS pipes 304 Grade and fittings with press free technology as per JIS 3448 for water supply lines. Similarly the sanitary pipes will also be of minimum 100 mm dia. of medium grade. The pipes should be designed accordingly to the pressure.

16.7 The contractor shall ensure that senior and experienced plumbers are assigned exclusively for this work. Such plumber(s) should have valid license from the local authorities. The project management shall be done through modern technique. For quality control & monitoring of workmanship, contractor shall assign at least one engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

16.8 The work shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

16.9 The contractor shall obtain all permits/ licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation without additional cost to the department.

16.10 The Plumbing / Sanitary Drawings given by the Engineer In-Charge or issued with tenders are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The contractor shall follow these drawings in preparation of his shop drawings, and for subsequent installation work.

16.11 The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Engineer In-Charge any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Engineer In-Charge without additional cost to the department.

16.12 All the shop drawings shall be prepared on computer through AutoCAD System based on Architectural Drawings and site measurements. Within two months of the award of the contract, contractor shall furnish, for the approval of Engineer In-Charge, the two sets of detailed shop drawings of complete work and materials including layouts for Plant room, Pump room, Typical toilets drawings showing exact location of supports, flanges, bends, tee

connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; external insulation details for pipe insulation etc.

16.13 These shop drawings shall contain all information required to complete the work. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 4 sets of drawings shall be submitted after final approval along with CD. When he makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further four sets of shop drawings to the Engineer In-Charge for the exclusive use by the Engineer In-Charge and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment / installation.

16.14 Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow the Engineer In-Charge ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

16.15 Samples of all materials like valves, pipes and fittings etc. shall be submitted to the Engineer In-Charge prior to procurement for approval and retention by Engineer-in-Charge and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation without any extra cost.

16.16 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

16.17 All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be in conformity with list of approved manufacturers as per approved list and samples.

16.18 Balancing of all water systems and all tests as called for the CPWD Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and Standards. The installation shall be tested and shall be commissioned only after approval by the Engineer In-Charge. All tests shall be carried out

in the presence of the representatives of the Engineer In-Charge and without additional cost to the department.

16.19 The contractor shall submit completion plans for water supply, internal sanitary installations and building drainage work within 15 days of the date of completion. These drawings shall be submitted in the form of two sets of CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as installed. These drawings shall clearly indicate complete plant room layouts, piping layouts and sequencing ofautomatic controls, location of all concealed piping, valves, controls and other services. In case the contractor fails to submit the completion plans as aforesaid, security deposit shall not be released and these shall be got prepared at his risk and cost.

16.20 "The pig lead, if required to be used in joints of 150mm,100mm, 75mm, 50mm dia. of sand cast iron, centrifugally cast (Spun) iron pipes shall be as per relevant CPWD Specifications". However, in case of 150 mm dia. pipes less use of pig lead by more than the required quantity and the permissible variation thereof, a recovery for such quantity shall be made from the contractor at market rate to be determined by Engineer in Charge whose decision in the matter will be final.

16.21 The contractor shall bear all incidental charges for cartage, storage and safe custody of materials and shall construct suitable godowns, yards at the site of work for storing materials so as to be safe against damage by sun, rain, fire or theft etc., at his own cost and also employ necessary watch and ward establishment for the purpose at his own cost.

16.22 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not elsewhere in this tender document & drawings. Nothing extra whatsoever shall be payable on this account.

16.23 Fixing screws shall be half round head chromium plated brass screws with CP washers where necessary or otherwise as provided in the specification.

16.24 Porcelain sanitary ware shall be glazed vitreous china of first quality free from warps, cracks and glazing defects and shall conform to relevant BIS codes. Colour of sanitary ware, shall be specified or as selected by the Engineer-in-Charge. All sanitarywares & / or sanitary faucets shall be of any of approved brand. Nothing extra shall be payable on this account.

16.25 The chasing, cutting and making holes in the masonry and / or cement concrete and / or RCC works shall be done carefully without causing any damage to the structure. As far as possible, mechanical cutters & core cutting machines shall be used in a workman like manner, for concealing the pipelines and fittings. The chases / holes, so made, shall be

made good with the cement mortar of mix 1: 3 (1cement: 3 fine sand) after testing of the pipe lines for leakage.

16.26 All vertical Sanitary &SS pipes shall be fixed to hot dipped galvanized M.S supporting frame with “U” shaped G.I bolts, threaded at both ends, as specified, with GI nuts, GI washers, GI cleats etc. as approved by the Engineer-in-charge. Supporting frame shall be fixed with approved anchor fasteners as directed by the Engineer-in-charge. In all cases, pipelines shall be fixed, minimum 50 mm away from the finished wall face and shall not be fixed directly to the walls.

16.27 All horizontal pipes shall be fixed to the soffit of beams / slabs etc. with G.I. hanger rods & G.I. frame work as per the approved shop drawings and as directed by the Engineer-in-charge. The pipelines shall be clamped to the structural steel frame work with “U” bolts and nuts, washers, cleats etc., of length and diameter as required and as specified.

16.28 Water supply pipes on the terrace shall be fixed to the walls with GI clamps or by supporting on masonry / plain cement concrete piers cast on slabs as approved by the Engineer-in-charge.

16.29 The ground colour shall be applied throughout the entire length of pipe. Colour bands shall be superimposed on the ground colour and shall be applied near valves, junctions, joints, service appliances, bulkheads, valves, etc. for clear identification of fluid being carried and to avoid confusion. The relative proportional widths of the first colour band to the subsequent bands shall be 4:1.The minimum width of the narrowest colour band shall be 25 mm.

16.30 GENERAL

Cleaning and Disinfection of Pipelines: -On completion of hydraulic tests and before a pipe is disinfected, it shall be proved to be free from obstruction, debris and sediment by scouring or by any other process which the Engineer-in-charge may prescribe. Upon satisfactory completion of testing and cleaning, the pipelines shall be disinfected as order. Chlorine solution shall be applied at the charging point as the pipeline is being filed and dosing shall be continued until the pipeline is full and at least 50 parts of chlorine per million parts of water have been made available and distributed evenly. If ordinary bleaching power is used, proportions will 150 gms. of power to 1000 liter of water. If a proprietary brand is used, the proportion shall be as specified by the manufacturer. The treated water shall be left in pipeline for a period as directed but not exceeding 24 hours chlorine residual tests shall be taken at various points along the pipeline. The disinfection process shall be repeated until the sample of water taken from the pipeline is declared fit for human consumption by a recognized laboratory.

17.0 False Ceilings

1 General (applicable for all kinds of roofing works under this sub-head):

1.1 The work in general shall be carried out as per the CPWD specifications, as per the manufacturer's specifications, as per architectural drawings and as per directions of Engineer-in-Charge.

1.2 Various false ceiling shall be done in different levels in linear and curvilinear pattern in plan and elevation and in combination with other types of false ceiling as specified in brief specifications & as per the architectural drawings.

1.3 The tiles and the suspension system shall be as specified in the item nomenclature. The contractor shall procure and submit the samples of tiles and grid system of approved make, for the approval of the Engineer-in-charge prior to execution of the item.

1.4 The Contractor shall prepare the mock-up at site for approval of material and quality of workmanship by the Engineer-in-Charge. Only after the approval of Mock-up, the Contractor shall start the mass work. If the quality of the workmanship and the material is as per the required standards and approved by the Engineer-in- Charge, the mock up shall be allowed as part of the work and measured for payment. Otherwise, it shall be dismantled by the contractor as directed by the Engineer-in-Charge and taken away from the site of the work at his own cost. The mock up(s) so made shall be kept till completion of respective works for reference.

1.5 Once the material and mock up are approved, the entire material (tiles as well as grid system) shall be procured from the approved manufacturer or its authorized dealer.

1.6 The installation shall be got done through an experienced installer, executing similar works.

1.7 The material shall be transported to site well packed. The ceiling material procured shall be free of any surface defect, edge damage and any other such defects. The contractor shall ensure careful handling and storage and prevent any rough handling, rolling of cartons or dropping cartons to prevent any edge damage or breakage. The defective / damaged material shall not be allowed to be used in the work. So, the contactor shall procure additional quantity of material to cover such contingencies. However, nothing extra shall be payable on this account.

1.8 Adequate care shall be taken before installation as well as afterwards till completion of the work. It shall be protected from rains, excessive humidity, chemical fumes, vibrations, dust etc. Any tile with edge damaged or crack etc. shall not be allowed to be used in the work and shall be replaced by the contractor at his own cost. Similarly, adequate care shall be taken by the contractor while placing or removing and handling the tiles so as not to cause

any damage. The ceiling shall be cleaned as per manufacturer's specifications. Abrasive cleaners shall not be used to clean the marks.

1.9 The Contractor shall obtain and submit to the Department the manufacturer's test certificate / report for compliance of the material to the relevant standards along with each lot of material supplied for the work.

1.10 The suspension system for various types of false ceiling shall be as per manufacturer's specifications. The false ceiling tiles shall be fixed on to coordinated suspension ceiling system with supporting grids system that fully integrates with the ceiling tiles as per manufacturer's specifications. It shall be ensured that the suspension system shall be suitable to take all designed dead, imposed and all incidentals loads efficiently and shall not sag. The true line and levels for false ceiling work shall be maintained.

1.11 The luminaries, air grills / diffusers, signages etc. shall be as far as possible independently supported to avoid any over loading of the ceiling system which may result in excessive deflection or twisting of grids. Any strengthening of grid system by providing additional hangers, fasteners, runners, cross tees etc. or providing additional bracing may be carried out as required for any specific locations or for specific purpose for which nothing extra shall be payable.

Various false ceiling systems shall include cost of all inputs of labour, materials, wastage if any, T&P, scaffolding, staging or any other temporary enabling structure / services etc. and all other incidental charges including making necessary cut outs for A.C diffusers, Light fittings, grills, Fire detection, alarm, sprinklers devices and fittings etc. No deduction in the area shall be made for openings nor anything extra shall be payable for making the openings. Also nothing extra shall be payable on account of any wastage in materials. Also nothing extra shall be payable on account of any strengthening of the supporting suspension system for the false ceiling, around the openings in the false ceiling by using additional hangers, fasteners, runners, cross tees, cross channels, etc.

18.0 REINFORCEMENT COUPLER/MECHANICAL SPLICE NOMINAL SIZES

The nominal sizes of reinforcement couplers based on their internal diameter shall correspond to the nominal sizes of bars covered under IS 1786.

Mechanical Splicing Systems with Parallel Threaded Couplers

A mechanical splice system with parallel threaded couplers is a one in which a parallel thread is cut or formed on the ends of the reinforcing bars, which are then connected by a coupler with matching parallel threads. With parallel threads, the strength of the assembly is directly proportional to the thread engagement length.

Reinforcement couplers shall have adequate strength, length and internal threads as per manufacturer's design to be able to meet the performance requirements as mentioned in this document. All reinforcement couplers shall be finished smooth and shall be free from burrs, cracks and other manufacturing defects. The threads shall be cleanly formed and shall be free from imperfections.

Performance requirements:

i) Static Tensile Test

The tensile strength of the mechanical splice, when tested in accordance with the details given below shall not be less than 125 percent of the characteristic strength of Reinforcement bar used.

ii) Percentage Elongation

The minimum percentage elongation at maximum force, when measured in accordance with the method given below, in the reinforcing bar outside the length of the mechanical splice shall be minimum 3% before the failure of the test piece.

iii) Percentage Elongation at Maximum Force

The percentage elongation at maximum force shall be tested and measured according to IS 1608 outside the length of the mechanical splice on both sides of the connection. Both values shall be recorded and the largest shall be used to assess conformity. The location of failure shall be deemed to be in the bar if it is outside the length of the mechanical splice. A failure located inside the length of the mechanical splice shall be recorded as a splice failure.

iv) Slip Test

The total slip value measured in accordance with the test procedure described below shall not exceed 0.10 mm.

v) Cyclic Tensile Test

The mechanical splice shall withstand 100 cycles of the stress variation from 5 % to 90% of f_y (where f_y = 500 N/mm2) when tested in accordance with the details given below without loss of static tensile strength capacity when compared with like specimen. The static tensile strength capacity of the test piece shall be determined by testing it statically to failure in accordance with the procedure described above under METHOD OF STATIC TENSILE TEST after subjecting it to stress cycles.

INSTALLATION INSTRUCTIONS

The installation procedure of the reinforcement coupler shall as per manufacturer's recommendations. It will be repeatable and able to achieve its performance under different job site circumstances.

SAMPLING AND CRITERIA FOR CONFORMITYACCEPTANCE TESTS

Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of the lot.

In any consignment, all the reinforcement couplers of the same size, type, class, material traceable to the same cast and manufactured under similar conditions of production shall be grouped together to constitute a lot.

For ascertaining the conformity of the lot to the requirements of the specification, samples shall be tested from each lot separately. The number of couplers to be selected from the lot shall depend on the size of the lot and shall be according to Table1.

TABLE 1 SCALE OF SAMPLING AND CRITERIA FOR CONFORMITY

No. of Couplers in the lot	Sample Size	Sub-Sample Size	AcceptanceNo. s
(1)	(2)	(3)	(4)
Upto 500	50	13	0
501 to 1200	80	20	1
1201 to 3200	125	32	2
3201 to 10,000	200	32	2
10,001 and above	315	50	3

The couplers shall be selected at random from the lot and in order to ensure the randomness of selection, random number table shall be used. For guidance and use of random number tables IS 4905 may be referred to.

Workmanship and Finish and Nominal Size

The number of couplers given in column 2 of Table 1 shall be taken from the lot and examined for workmanship and finish and nominal size. A coupler failing to satisfy any of these requirements shall be considered as defective. If no defective is found in the sample, the lot shall be considered as conforming to these requirements.

vi) Static Tensile Test

The lot having been found conforming to requirements of workmanship and finish and nominal size as per 1d(i) shall be tested for static tensile test. For this purpose sub-samples as given in column 3 of Table 1 shall be taken and subjected to this test.

The number of couplers required in the sub-sample may be taken from those already tested and found satisfactory according to 1d(i).

The lot shall be considered to have satisfied the requirement of static tensile test as per 1.d.ii(a) if the number of defective couplers found in the sub-sample is less than or equal to the corresponding acceptance number given in column 4 of Table 1.

19.0 <u>WOODEN FIRE RESISTANT DOOR (FRD) SHUTTERS</u>:

19.1 The fire resistant flush doors along with the frames shall be procured as a set from one of the approved manufacturer and shall be as per the specifications and the approval of the Engineer-in-Charge. The door shutters shall be entirely symmetrical on both faces. The door shutters shall have the required stability and shall satisfy performance required for integrity & insulation as per BS 476: Part 20 & 22. Besides, it shall conform to all the requirements for Flush door shutters as per the relevant IS 1141, 1708, 2191, 2202, 4020 etc. and CPWD Specifications.

19.2 The gap between the shutter and frame, between shutters in case of double leaf shutter should not be more than 1mm. Similar care shall be taken for making rebates for fixing hinges and other hard wares. he workmanship required is of superior class for achieving the desired results.

19.3 Graphite based Intumescent strip seal of size 10x4 mm shall be provided and fixed in the grooves on the door shutters all around the periphery except on the bottom to prevent penetration of smoke and fire. The shutters shall not be worked upon at site to prevent damage to the intumescent strip. In case of double leaf shutters, Intumescent strips, of size 10 mm x 4mm shall be fixed in the rebate portion of meeting styles of each leaf of the shutter.

19.4 All the FRD shutters shall be provided with 12mm thick 2nd class teak wood external lipping all around the shutter. The grooves of required size and shape shall be made in the external wooden lipping for fixing intumescent seal.

19.5 The hinges to be used for fixing the door shutters shall be stainless steel ball bearing hinges of grade 304 fixed with stain steel screws of grade 304. While testing for fire resistance, the whole assembly shall be tested along with the door shutter, doorframe, glass, beadings, hinges, glass panel in the opening etc.

19.6 All the shutters shall be treated for anti-termite treatment, against woodborer, fungus, pests etc. Therefore, it shall be provided with the preservative treatment based on Boron

& Fluoride and as per CPWD Specifications. Nothing extra shall be payable on this account.

19.7 The calcium silicate boards to be used for manufacturing fire rated door shutters shall be from one of the approved brand. It shall be noncombustible and shall conform to BS 476 part 4 and to class 1 of BS476 part 7 for surface spread of flame.

19.8 The contractor shall submit manufacturer's test certificate for specified fire rating for integrity and insulation criteria, required as per the item nomenclature and the specifications. The Contractor shall also co-ordinate and facilitate with the office of the Chief Fire Officer, Mumbai for obtaining clearance for the FRD shutters along with frames including getting the required site visits conducted by such authorities with a view to obtain Fire NOC. The Contractor shall also be responsible for liaising work required, if any, in this regard. Statutory charges, fees etc. required to be paid by the contractor. The contractor shall obtain written prior permission from the Engineer in charge before making any payments.

19.9 Destructive Testing for insulation and integrity criteria of the FRD shutters along with frames shall be done in an accredited laboratory approved by Engineer-in- Charge. The shutters shall be able to resist thermal stresses and should not fail on account of shrinkage, cracking or distortion or any other reason, during testing for the duration for which it is fire rated. The cost of samples of door shutters along with frame (including cost of laminates and / or wooden Veneering, fire rated glass for glazed / vision panels, wooden and G.I beadings, intumescent strips, hinges, screws), packaging, sealing and transportation of samples to the approved laboratory etc., shall be borne by the contractor. At least one sample from each category of fire rating shall be tested. The shutters along with the doorframes shall, therefore, be procured from one of the approved manufacturer and in one lot only. The samples for testing shall have the finish of wood veneer and / or laminate etc. as specified and shall be representative of the actual door shutters along with the frames to be used in the work, as per the architectural drawings. The glazing / vision panel opening of required size and shape shall also be made in the test shutters as per specifications.

19.10 GUARANTEE BOND:

The work shall be guaranteed for a period of five years from the date of N.O.C issued by the CFO, Mumbai (Maharashtra).

The security deposit @ 5% against this item of work shall be in addition to the security deposit mentioned in schedule-F.

The contractor shall execute the necessary guarantee bond against any structural defect, faulty materials, workmanship and defective finish. In addition 5% (five percent) of the cost of this item of work shall be retained as security deposit and the amount so withheld would be released after five years from the date of completion of the entire work under the

agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor along with any incidental repairs to structure, flooring, finishing, fixtures and any other related damaged work within fifteen days of receipt of intimation of such defects in the work. If the defects pointed out are not attended to with the specified period, the same shall be got done from another agency at the risk and cost of the contractor and the cost of attending such repairs shall be deducted from any dues payable to the contractors. However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of Engineer-in-Charge in the prescribed Performa. (Cost of item shall be considered Rs. 10 Lakhs)

20. Curtain glazing, aluminum composite panel cladding, glazed vault roof atrium and aluminum work (PVDF coated)

1 **Scope of work**

1.1. The scope of work under these sub-heads includes design, proof checking of the design through reputed engineering institutions like, IIT, Govt engineering College or any other institution as approved by the SE cum PD / Chief Engineer, supply, fabrication, installation, aligning, fixing, protection and testing of the curtain glazing, aluminum composite panel cladding, glazed vault atrium work and aluminum work (PVDF coated),etc. It also includes guarantee for the works under these sub heads for the system, materials and performance requirements, for a period of 10 years after the date of completion of the work. For executing the work under these sub-heads, the contractor shall associate with one of the agencies mentioned in the list of the specialized agencies. The rate quoted by contractor is deemed to have cost of design, proof checking, supply, fabrication, installation, aligning, fixing, protection, etc. and nothing extra will be paid on this account.

1.2. The work under these sub heads includes cost of all inputs of labour, materials including wastages, T &P, equipments , other enabling temporary structures and services and all other incidental charges, if any, not specifically mentioned here, but as required for complete design, proof checking, engineering, fabrication, assembling, delivery, anchorage, installation, protection of curtain glazing, aluminum composite panel cladding and aluminum work (PVDF coated), etc. and making the system water tight (wherever specified), all complete, all in accordance with the true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and / or described in the specifications , provided that the same can be reasonably inferred there from. The curtain glazing, aluminum composite panel cladding and aluminum work (PVDF coated) shall have framing which shall be structurally and mechanically designed to achieve the architectural elevations as well as performance parameters specified herein. Anchorage shall include all supporting brackets & anchor fasteners, as required to rigidly secure the structural framing to the RCC / Masonry / structural steel members of the building.

1.3. The curtain glazing, aluminum composite panel cladding and aluminum work (PVDF coated), etc. work shall include but will not necessarily be limited to the following:

1.3.1 Frames, fixed glazed / vision panels, spandrels, hard wares, open able panels, as in the drawings inclusive of all accessories and fittings. Glass wool Insulation panel (shadow box), fire stop(barrier) - cum - smoke seals, splice plates, connectors, sleeves, anti-buckling clips etc.

1.3.2 Anodized aluminum work for framing of curtain glazing as well as other aluminum work PVDF coated) for trellis, louvers, fins, box sections, capping, strip etc wherever indicated in the drawings.

1.3.3 Structural, weather and other silicone sealants within and all round the perimeter of all the work under this sub head for fabricating IGUs, holding the glass to the aluminum& glass to glass and to provide water tightness to the curtain glazing.

1.3.4 EPDM / silicone gaskets, trims, shims, setting blocks,double sided spacer tape, spacer blocks, weathering strips etc.

1.3.5 All sealing and flashings including sealing at junctions with the building members.

1.3.6 All brackets, anchor fasteners, screws, inserts, nuts, bolts & washers, and attachments required for complete installation and fixing to the RCC, masonry and / or the structural steel members of the building.

1.3.7 All accessories, fasteners, screws, nuts and bolts, toggles, rivets etc. and other items implied in the drawings and the specifications though are not specifically indicated or mentioned here.

1.3.8 Isolation of all dissimilar metal surfaces as well as moving surfaces by use of TEFLON (PTFE) separators.

1.3.9 Engineering proposals, design, drawings and Architectural data.

1.3.10 Shop drawings, engineering data and structural calculations (analysis & design) of all systems including aluminum structural framing, fasteners, sealants etc.

1.3.11 Scheduling and monitoring of the work.

1.3.12 Cost of all samples of the individual components, mock-ups at site and field tests.

1.3.13 Coordination with work of other agencies employed on site.

1.3.14 Protection during storage and construction until handing over the building for occupation etc.

1.3.15 All final exterior and interior cleaning of the curtain glazing, aluminum composite panel cladding and aluminum work (PVDF coated) etc. before handing over the building for occupation.

CORRECTIONS - NIL OMISSIONS - NIL INSERTIONS - NIL

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1.3.16 Hoisting, staging, scaffolding and temporary enabling structural work/ services, cranes and cradles etc.

1.3.17 Specified tests, inclusive of necessary records, reports, logbook etc.

1.3.18 Design and performance guarantee in the enclosed format**.**

1.3.19 Construction monitoring for regular quality control and technical inspection to ensure the work conforms to the approved shop drawings and details (including any modifications made after field testing) and acceptable standards of quality including monitoring the progress of the work.

1.4 **Standards**

1.4.1 In general, the Contractor shall follow either of the latest Indian/ International Standards as applicable for this sub head.

2 **Contractor's responsibility for design**

2.1 Architectural drawings and specifications only indicate the required basic dimensions, and performance criteria.

2.2 The contractor shall be solely and fully responsible for proper structural analysis and design for various load cases and their combination. This shall include designing and proper sizing of all sections meeting structural and architectural requirements. The anchor assemblies shall meet the performance and design requirements including installation of all inserts, fasteners, clips, bracing and framework as required for the proper anchorage to the structure, unless otherwise specified.

2.3 Design of the curtain glazing system shall comply with all Government codes and regulations. The Contractor shall design the entire curtain glazing system for dead loads, wind loads, seismic loads, storm, air pollution, thermal stresses, building movements and consequent deflections without compromising the performance characteristic. Further, the individual members of the structural framing shall not deflect beyond permissible limits as specified. The design shall comply with the requirements of the relevant National Building Code and Indian Standard Code/ International Standards, unless specified otherwise.

2.4 The curtain glazing system and its elements shall not sustain permanent deformation or failure under loading equivalent to 1.5 times the design wind pressure.

2.5 The specified deflections must be reduced if they are in any way detrimental to curtain glazing system and building.

2.6 The approval of the structural design and shop drawings by the Engineer-in-Charge shall not relieve the contractor from his responsibility for the structural design.

2.7 The Contractor shall ensure that the elevations are strictly as per the architectural drawings and that the intent of the architectural design is retained. Visual appearance shall be a key consideration for acceptance of work.

3 Shop drawings

3.1 Submittals

3.1.1 The contractor shall prepare shop drawings based on approved design and submit the same to the Engineer –in-charge for approval.

3.1.2 The review of the shop drawings by the Engineer-in-Charge shall be limited to their conformity to the architectural and structural design concept & specifications. However, the approval of the shop drawings by the Engineer-in-Charge shall not relieve the contractor from any of his responsibilities and requirements as specified herein.

3.1.3 No fabrication shall be taken up until the shop drawings and all other related submittals, documentation, certification, samples and the mock-up for that work have been reviewed and approved by the Engineer-in-charge.

3.1.4 After approval by the Engineer-in-Charge, the Contractor shall submit 3 sets of the approved shop drawings to the Engineer-in-Charge within three weeks. After the completion of work, two (2) sets and two (2) CD's each of the final approved shop drawings incorporating all the approved modifications, if any as per the site requirements, shall be submitted to the Engineer-in-Charge within two months failing which the final payment shall not be released to the contractor.

3.2 Scope of shop drawings

3.2.1 Shop drawings shall incorporate scaled and dimensioned plans, elevations, sections and complete size details for all the works.

3.2.2 The shop drawings shall indicate the required dimensional profiles and modules, function, design and performance standards and in general cover all dimensions and details required to fabricate and install the curtain glazing system.

3.2.3 The contractor shall verify and co-ordinate the shop drawings with all applicable and inter-related trades, drawings and specifications.

3.2.4 All dimensions / modules, etc., shall be field checked and the drawings shall be modified, if required, based on actual measurements at site.

3.2.5 Details shall show and specify all metal sections, types of finishes, areas to be sealed and sealant materials, gaskets, applicable construction materials including fasteners and welds, all anchorage assemblies and components, fabrication and erection tolerances for the work.

3.2.6 All details shall be subject to the approval of the Engineer-in-Charge, after incorporating all the modifications suggested by the Engineer-in-Charge.

3.3 **Section profiles**

3.3.1 Profile adjustments, if required as per the site conditions may be allowed by the Engineer-in-Charge subject to meeting the architectural / performance requirements. However, this shall be carried out only with the written approval of the Engineer-in-charge provided that the general design and intent of the drawings and specifications are also maintained. Also, if any new / non-standard aluminum extruded section is required as per the site requirement and / or the architectural drawings for functional and / or aesthetic reasons, the contractor shall procure the same from the approved manufacturers for the aluminum sections, even if it entails preparing new die, etc. Nothing extra shall be payable to the contractor on this account.

4 **Documentation and certification**

4.1 The contractor shall obtain and submit to theEngineer-in-Charge the manufacturer's certificate for compliance of the various components/ materials for the works (under this sub head) as per the manufacturer's specifications for the various characteristics. A copy of the manufacturer's test report for each lot of material procured and supplied for the work shall also be obtained from the respective manufacturers and submitted to the Engineer-in-Charge for the record.

4.1.1 **Glass and glazing documentation**

4.1.1.1 Before taking up the work, the glass manufacturer / processor shall submit written certification for the review of the Engineer-in-Charge and record , stating that all glass (properties as specified such as U value, shading coefficient, light transmission, solar factor, relative heat gain etc.) and glazing requirements (including heat strengthening/ toughening, reflective soft coating, low E coating, lamination, fabrication of IGUs including sealants) as per the shop drawings are recommended by them for use related to their specific applications and design parameters and that they are in conformity with the specifications.

4.1.1.2 Tests shall be carried out for glass, including properties after processing, for each lot supplied, by the glass manufacturer / processor in his factory / laboratory or any other accredited laboratory and the copies of the test results shall be obtained by the contractor and submitted to the Engineer-in-Charge for the record.

4.1.2 **Sealant Documentation**

4.1.2.1 All sealant applications must be clearly designated on shop drawings.

4.1.3 **Quality control documentation**

4.1.3.1 The contractor shall submit the methodology and quality assurance statement for quality control procedures for the review and approval of the Engineer-in-Charge before taking up the work to ensure the design integrity and performance of the curtain glazing, aluminum composite panel cladding and aluminum work (PVDF coated).

4.1.3.2 The Engineer-in-Charge or his authorized representatives may visit the plant / workshop / factory to inspect material, fabrication and quality assurance procedures.

5 **Samples and mock-up at site**

5.1. **Submittals**

The samples of the following materials together with detailed technical data / catalogues shall be submitted for review and approval of the Engineer-in-Charge along with the shop drawings. Any omission of an item or items which require the Contractor's compliance shall not relieve him from responsibility.

5.1.1.	Aluminium Composite Panel	: Each type and thickness 600 mm x 600mm
5.1.2.	Aluminium extrusions	: Each section: 500mm long.
5.1.3.	Glass	: Each type 600 mm x 600 mm.
5.1.4.	Gaskets, separators, glass setting blocks / spacer tape, etc	: Each section or unit, backer rods, 300mm long or unit.
5.1.5.	Bracket, fasteners and connecting devices :	Each type and size.
5.1.6.	Finish samples	: After approval of the final finish coating, the Engineer-in-Charge shall be provided with three (3) approved samples.

5.1.7. Ironmongery and accessories, as applicable.
5.1.8. Finished flashing samples
5.1.9. Finished samples of shadow boxes, fire stop (barrier)-cum smoke seals
5.1.10. Structural and weather silicone sealant

5.2. **Mock-up at site**

Before the fabrication and site installation is taken up and after the approval of shop drawings by the Engineer-in-Charge, the Contractor shall prepare a mock-up, of his proposed curtain

glazing system for a size of panel not exceeding 6 sqm. The mock-up shall be essentially put up at site for final approval of all materials and installation details by the Engineer-in-Charge. The mock up shall not form part of the work and shall not be paid for. It shall be dismantled and taken away by the contractor at his own cost, with the prior permission of the Engineer-in-Charge. Nothing extra shall be payable on this account.

6 **Storage, protection and program**

6.1 The contractor shall submit a schedule of procedure for inspection during installation so as to control and assure quality on the job site.

6.2 The Contractor shall submit a detailed method statement for the protection of the surface of the curtain glazing, aluminum composite panel cladding and aluminum work (PVDF coated), etc during delivery and erection, with description as to when the protection can be removed. The protection paper shall be kept for a period as recommended by Engineer-in-Charge and shall be replaced with the fresh protection paper, if so required. Further, it shall not have acid content, which in any manner may affect the substrate.

6.3 Delivery and Storage of Materials: All materials delivered to site shall be stored in allocated spaces where the stored materials shall not get exposed to rainwater, moisture or damage, and shall permit easy access to and handling of the materials. Materials shall be stored neatly and properly stacked.

6.3.1 Factory made glazing units and/or their components shall be transported, handled and stored in a manner to preclude damage of any nature.

6.3.2 Accessory materials, required for erection at the site shall be delivered in labeled containers by the manufacturer / supplier.

6.3.3 All units or components, which are cracked, bent, chipped, scratched or otherwise defective and unsuitable for installation shall be removed and replaced by the contractor. Nothing extra shall be payable on this account.

7 **Performance requirements**

All components, assemblies and completed work shall conform to the various performance standards as applicable in respect of thermal movement of the curtain glazing, allowance for vertical and horizontal expansion and building movement and related building tolerance etc. The design and installation of the curtain glazing system shall accommodate all inherent building movements and deflections and the fabrication and installation tolerances of all related work not involved in this section without the loss of, or any detrimental effect to, the performance requirements herein specified. The contractor shall verify and coordinate all such movements and tolerances with the Engineer-in-Charge before designing the

components of the curtain glazing system so that movements and deflections in the structure do not at any time affect the integrity and safety of curtain glazing system and vice versa.

7.1 **Thermal property**

7.1.1 All insulation materials, fire-stops (barriers)-cum-smoke seal shall comply with the current requirements of the Fire Officer, MIDC and other authorities.

7.2 **Structural properties**

7.2.1 The curtain glazing system shall be anchored to the R.C.C floor through serrated Hot Dipped Galvanized M.S brackets. As far as possible, the contractor shall take all precautions to avoid cutting through any reinforcement bars while fixing the brackets. The contractor may at his own cost provide sleeves/ leave slots at appropriate locations during casting of the concrete itself for making provision for fixing brackets for the curtain glazing system and to avoid chipping/ dismantling of concrete. The slot shall be filled up with concrete of the same grade in a workman like manner, after fixing the brackets. Any defect in alignment/ plumb in the building face shall be rectified by chipping/ dismantling of the concrete/ masonry and repairing the same as specified to achieve the required alignment of the curtain wall as specified. Any change in lengths of bracket/s required on this account and the consequent requirement of their sections and sizes shall be carried out by the contactor at his own cost. Nothing extra shall be payable on this account.

7.2.2 No holes shall be burned, filed or drilled in any structural steel/ RCC members unless expressly approved by the Engineer–in–Charge.

7.2.3 Member shapes and/or profiles if schematically shown on the Architectural drawings are not necessarily the exact shapes required or best suited for the particular conditions. Final shapes and locations shall be as designed by the contractor and are subject to the review and approval of the Engineer – in – Charge.

7.2.4 All framing members shall be shop fabricated and finished as specified.

7.3 **Concrete tolerances**

7.3.1 The contractor shall take all precautions to construct the buildings within specified tolerances in concrete and masonry faces. Any defects beyond the permissible tolerances shall be rectified by the contractor at his own cost to the entire satisfaction of the Engineer – in – Charge. While fixing the brackets for curtain glazing system, the contractor shall take into account the variation in the concrete and the masonry faces to which the structural framework of the curtain glazing system is to be fixed and such variations shall be adjusted in the lengths of brackets to align them in perfect plumb. The bracket shall be designed accordingly. Nothing extra shall be payable on this account.

7.4 **Fire stops (barriers)-cum-smoke seal and interface with building**

7.4.1 Gaps between the building face and the curtain glazing system at soffit level between the successive floors shall be closed as specified with fire-stops (barriers)-cum-smoke seal. It shall have the required fire resistance to be approved by Fire Officer, MIDC. Suitable gap for accommodating deflections of the aluminum framing of curtain glazing system as per the approved shop drawings shall be maintained between the fire-stops (barriers)-cum-smoke seal and the curtain glazing system. This smoke seal shall however be provided using backer rod and weather silicone sealant as specified and as approved by the Engineer-in-Charge.

7.4.2 The fire-stops (barriers)-cum-smoke seal shall consist of 1 mm thick plain G.I. sheet tray with 100 mm thick layer of non inflammable heat insulating material, rock wool, having density of minimum 64 Kg. per Cum. of the make as approved by the Engineer-in-Charge. The rock wool layer shall be attached to G.I sheet using stainless steel rivets/ nuts, bolts and washers. The tray shall be fixed to the RCC / Masonry surface by using stainless steel screws dipped in weather silicone sealant as per the approved shop drawings. Screws with plastic sleeves shall not be allowed to be used for the above fixing.

7.4.3 The contractor shall provide an aluminum flashing of 1.0 mm thick transparent anodized (10 micron thickness) solid aluminum sheet of the approved design and profile at the window sill level and also fill the gap between the aluminum flashing and the curtain glazing using weather silicone sealant as specified and as approved by the Engineer-in-Charge. Also, the fasteners/ screws to be used for fixing flashing shall be dipped in weather silicone sealant before using.

7.5 **Acoustics**

7.5.1 Gaps between the mullions and the partitions of the cabins shall be suitably closed by double skin partition as directed by the Engineer-in-Charge including allowing for permissible deflections of mullions as per design requirements but without affecting the partitions and the curtain glazing system. The payment for this partition work shall be made under relevant item.

7.5.2 Provisions shall also be made to prevent metal to metal rubbing, any rattling, noise due to thermal changes and wind pressure by using Teflon separators and shims.

7.6 **Visual appearance**

7.6.1 The Contractor shall ensure that the elevations are strictly as per the Architectural drawings and that the intent of the architectural design is retained. Visual appearance shall be a key consideration for acceptance of work.

8 **Materials (General)**

8.1 Materials and components used shall be of the first / superior quality and suitable for the purpose.

8.2 All materials shall be free from any defects that may impair the strength, functioning/ performance or appearance of the curtain wall or adjacent construction.

8.3 **Fasteners**

8.3.1 The type, size, alloy, quantity and spacing of all anchor fasteners and/or anchorage devices shall be as required for the specified performance standards.

8.3.1.1 Bolts, anchors and other fastening devices like screws, nuts, washers etc. shall be of approved types as required for the strength of the connections, shall be self-locking, unless otherwise specified. These shall be of austenitic stainless steel of specified grade and shall be torque tightened, wherever required, to achieve the maximum torque tension relationship in the fasteners. Washers, nuts and all accessory items shall be of the same material as fasteners. The rivets/ nuts, bolts and washers for fixing insulation layer to the shadow box or with fire-stops (barriers)-cum-smoke seal shall be stainless steel of approved grade.

Type of fasteners	**Grade of stainless steel**
Anchor fasteners	Stainless steel grade 316
Screws, Nuts, Bolts, Washers	Stainless steel grade 304
Rivets, toggles and the like	Stainless steel grade 304

8.3.1.2 The anchor fasteners shall not be provided using PVC sleeves. Only expandable type self locking fasteners shall be provided.

8.4 **Aluminum extrusions**

8.4.1 In general aluminum alloy for extrusions shall be 6063 T5 or T6 grade as per B.S.1474. However, the grade and tempering specifications shall be as recommended by the supplier for each application.

8.4.2 All extruded aluminum sections shall be anodized in approved colour to a minimum thickness of 20 microns or shall be PVDF coil / spray coated in approved colour and shade with metallic colours to a minimum thickness of 35 microns .The colour and the finish shall be uniform and free of streaks. The aluminum sections, before coating, shall be suitably cleaned, rinsed, buffed properly and sealed and protected after anodizing / PVDF coating, till the completion of the work.

8.4.3 All surfaces of the aluminum sections designed to receive the sealants shall be finished properly to match the finish of the parent section as used for initial testing of sealant and aluminum surface adhesion. Further, it shall be ensured that the entire aluminum surface has adequate sealant contact and adhesion.

8.4.4 Sill sheets, plates and extrusions shall be visually flat under all lighting conditions.

8.4.5 The members of aluminum extruded sections for mullions, transoms, members of sub frames & sash frames shall be in single piece and not be splice jointed in the panel length and height.

8.5 **Aluminum flashing**

8.5.1 All flashings shall be made from 1.0 mm thick solid aluminum sheet transparent anodized to a minimum thickness of 10 microns. It shall be fixed using stainless steel screws dipped in weather silicone sealant.

8.6 **Aluminum composite panels**

8.6.1 The soffits of the canopies / walkways / entrance canopies etc., required as per the architectural drawings, shall be covered with aluminum composite panel material. The top of the canopies / walkways / entrance canopies shall be covered with zincalume sheets. The aluminum composite panel and zincalume sheets shall be bent to the required profile and fixed as per the approved shop drawings prepared on the basis of architectural drawings.

8.7 **Brackets**

8.7.1 The brackets shall be fixed with high degree of accuracy to achieve the elevation as per the architectural drawing. The brackets shall have suitable lengths and sections to align curtain glazing in one face, as required as per the architectural drawings. Nothing extra shall be payable on this account. The brackets shall be fabricated from M.S rolled sections / plates to have the design strength. The quality of the weld shall also be ensured as per the standards. These shall be provided corrosion protection treatment by Hot Dipped Galvanizing. The mass of the zinc coating to be not less than 610 gm. per sqm of steel area to be galvanized. Slots of elliptical or circular shape in the brackets shall be pre-drilled / machine punched and not flame-cut and it shall be done before galvanizing. The surface of the brackets shall be serrated for additional grip before galvanizing. Washers made of serrated plates of the corresponding material shall also be provided for additional grip. The directions of the serration and the slot shall be such that they allow movements as per the design requirement and at the same time prevent any movement in the other direction. Each bracket shall be fixed to the R.C.C using anchor fasteners of suitable capacities and in numbers as required as per the design requirements. The brackets shall be fixed to the structural steel members of the building using stainless steel bolts & nuts / fasteners of required capacity and in numbers as per the design requirement. The holes of the required sizes shall be pre- drilled in RCC/ structural steel for fixing anchor fasteners/ bolts etc. Nothing extra shall be payable on this account.

8.8 **Fittings**

8.8.1 All hardware and fittings such as patch fittings, handles, locks, stay-arms, floor springs, friction stays etc. for doors , windows and open able panels shall be heavy duty and of approved make as specified.

8.8.2 Hinges for open able panels shall be heavy duty top hung stainless steel friction hinges selected for specified wind load and dead loads.

8.8.3 All fittings and locks shall be as specified.

8.8.4 Each open able panel of the Curtain glazing shall be provided with the fittings as specified in item nomenclature.

9 Sealants & gaskets

9.1 Selection of sealants

9.1.1 The compatibility and sequence of installation for all sealants must be carefully considered in all proposals in order to ensure the required curing and performance.

9.1.2 Sealants must not degrade and / or fail under any or all design conditions including wind, thermal and seismic movements, exposure to water and humidity, ultraviolet exposure and / or other adverse environmental conditions.

9.1.3 The designations of sealant types specified herein are intended for general design guidance only. The contractor shall however use sealant equivalent to or superior than that specified herein. Nothing extra shall be payable on this account.

9.1.4 Final selection by the contractor for the sealant types shall be based on their conformity with the Performance Requirements specified herein and as per the recommendations of the sealant manufacturer. The contractor may use sealant of equivalent grade and characteristics, manufactured by the manufacturer other than those specified herein, based on recommendations of those sealant manufacturers for specified use but with the prior approval of the Engineer-in-Charge. The contractor shall submit the documentary evidence in this regard.

9.1.5 All precautions shall be taken during design of structural silicone bite and also during fabrication of the curtain glazing system to prevent failure of sealant during the guarantee period of 10 years after the date of completion of work and even beyond, upto the expected service life of the curtain wall.

9.1.6 Sealants and gaskets shall not leach, discolour, stain or dry.

9.2 Structural silicone sealant

9.2.1 The sealant manufacturer shall design the silicone bite for the design loads as specified and likely to come during the life of the curtain glazing system for arriving at bite size of the structural silicone sealant.

9.2.2 The structural silicone sealant bite as designed by the sealant manufacturer and as per the approved shop drawings shall be provided. If the contractor provides larger bite than that specified, nothing extra shall be payable.

9.2.3 The Structural sealant shall be two part pump-filled Silicone sealant DC 983 of Dow Corning or equivalent recommended by manufacturer and approved by the Engineer-in-Charge. The weather silicone sealant shall be one-part Silicone sealant DC 795 of Dow Corning or equivalent of other approved brand as per the list of approved materials.

9.2.4 The structural sealant to be used as specified for all exposed and concealed metal to metal (including tight or butt type metal to metal assembly prior to assembly) or glass to glass shall be 2-part silicone sealant, conforming to the manufacturer's recommendations for the specific uses and performance criteria. The sealant shall be applied using two-part pump for the same. All the sealing shall be done in a clean and controlled environment as specified by the silicone sealant manufacturer.

9.2.5 In unavoidable circumstances, where it is required to provide structural silicone sealant in - situ, 1-part structural silicon sealant – 995 of Dow Corning or equivalent of other approved brand shall be used with prior approval from the Engineer-in-charge. Mechanical supports shall be provided, if required, till the final curing of the structural silicone. Nothing extra shall be payable on this account.

9.2.6 The contractor of the curtain glazing system may at their own cost provide structural silicone sealant – DC 995 / DC 983 of Dow Corning or equivalent as weather silicone sealant as well for water tightness also, apart for structural requirements, instead of weather sealant - 795 of Dow Corning or equivalent as required and as specified. However, nothing extra shall be payable on this account.

9.3 **Weather silicone sealant**

9.3.1 The grade of weather silicone sealants wherever required like for concealed metal to metal, metal to glass and metal to concrete/ masonry such as embedment and lapping of flashings etc. where elements are to be installed or embedded, the weather sealant shall be of grade 795 of Dow Corning or equivalent for the other approved brand, as per the recommendations of the sealant manufacturers. Also, the gap between the aluminum sections and the glass, if so required, shall be filled with weather sealant as specified above including providing and fixing backer rod wherever required as per the approved shop drawings. The weather silicone sealant shall be of approved colour and shade. The weather silicone sealant for fixing the butt jointed glass for the fixed partitions shall be transparent in colour DC 791 of Dow Corning or equivalent of other approved brands.

9.4 **Compatibility**

9.4.1 All sealants must be non-staining and compatible with adjoining sealants, backup materials, substrate materials and their respective finishes and/or applied colour coatings. Care shall be taken to ensure that two different types of sealant should not come in contact with each other unless compatibility is satisfied as per manufacturer's specifications.

9.5 **Caulking compound**

9.5.1 Dow Corning weather silicone sealant - 795 or equivalent as approved by the Engineer-in-Charge, (of approved colour and shade to match adjacent material wherever exposed and visible) for use around frame/ flashings or between frame/ flashing and RCC/ masonry surface.

9.6 **Gaskets**

9.6.1 Gaskets and seals shall be of approved quality compatible with substrates, finishes and other components they are in contact with. All gaskets exposed directly on the exterior face shall be silicon gaskets, which are UV resistant. They shall not degenerate, discolour or leach on exposure to solar radiations/ rains/ pollutants etc.

9.6.2 Manufacturers' test Certificate shall be submitted as specified.

10 **Glass**

10.1 **General**

10.1.1 All glass and glazing materials shall be as specified.

10.1.2 Vision and spandrel glass shall have characteristics as specified.

THE PERFORMANCE CHARACTERISTICS OF GLASS PANELS, have to be ensured by the contractor within the constraints of aesthetic requirements like colour, shade, reflectivity etc. and performance requirements like light transmission, U value, shading coefficient, relative heat gain etc. as specified. Minor variations in the characteristics of glass on superior side may be allowed, if required by the contractor with the approval of Engineer-in-Charge, but without any extra cost to the Department on this account.

10.2 **Installation**

10.2.1 The Contractor shall procure and install glass panels and carry out glazing work as indicated on the drawings and as specified herein.

10.2.2 All glass panels shall be of accurate sizes as required.

10.2.3 All glass panels shall have clear undamaged edges and surfaces, which are not disfigured.

10.2.4 Any glass panel that does not fit in the curtain glazing system shall be rejected and replaced by the Contractor at his own cost. Therefore, all care and precautions shall be taken by the contractor while procuring the glass panels from the manufacturer / processors of the glass. No claims of any kind or any hindrance shall be entertained from the contractor on this account.

10.2.5 Glass panels shall not be in direct contact with the aluminum framework.

10.3 **Identification**

10.3.1 Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by the Engineer – in - Charge. All glass shall be delivered to site with the manufacturers' / processor's label of identification attached.

10.4 **Breakage**

10.4.1 All glass with any breakage, any damage to the coatings or any other defects caused due to the negligence of the contractor or caused by the installation of faulty work by him shall be rejected. Such defects shall be rectified and /or glass shall be replaced by the Contractor at his own expense to the entire satisfaction of the Engineer – in – Charge. No delay or claim whatsoever of any kind shall be entertained from the contractor on this account.

10.5 **Selection of Glass**

10.5.1 Each type of glass shall be obtained from only one manufacturer and preferably in one lot.

10.6 **Insulated Glazed Units (IGUs) in the vision panels**

11.6.1 Insulated glazed units shall be obtained only from approved manufacturers/ processors as per the approved list.

11.6.2 Insulated units shall be factory assembled, with multiple panes, hermetically sealed, separated by and sealed to spacer tubes perforated on inner exposed face forming airtight dehydrated airspace inside the insulated units. The IGUs shall be assembled (prepared) by the manufacturer/ processor of the glass as per the approved list, in their dedicated workshops/ factory.

10.7 **Laminating units**

10.7.1 The glasses shall be laminated with interlayer of Polyvinyl butyral (PVB) sheet of specified thickness

10.7.2 The interlayer material (PVB) shall be clear or as specified with no tendency to bubble, discolour or lose physical and mechanical properties after laminating glasses.

10.7.3 The laminated panels shall be free of foreign substances, air or glass pockets and shall not delaminate at edges.

10.8 **Precaution in storing and handling glasses**

10.8.1 The glass manufacturer/ processor shall take necessary precautions as stated below besides any other precautions not specifically mentioned herein:

10.8.1.1 The reflective/ low E coating on the glass shall be protected against scratches, surface corrosion, staining and/ or any other abrasion.

10.8.1.2 The glasses shall not be stored without a clean inter-leaving material. Also they should not slide against each other.

10.8.1.3 The glass shall be protected from weld or grinding splatter.

10.8.1.4 The reflective/ low E coating shall be protected against contact with acids or strong alkalies. The cleaners to be used for cleaning the surface shall be as per the manufacturer's recommendations. The glass shall be protected against moisture from humidity, which can stain glass as well as coating.

10.8.1.5 Reflective/ low E coating shall also be protected against splashes from paints etc.

11 **Metal coatings**

11.1 **Anodizing / PVDF coating**

11.1.1 Aluminum extruded sections shall be satin finish colour anodized to minimum 20 microns thickness, as per the approved colour and shade or PVDF coil / spray coated to approved metallic colour and shade to minimum 35 microns thickness.

11.2 **Galvanizing**

11.2.1 The brackets for the curtain glazing system shall be hot dipped galvanized. The mass of the zinc coating to be not less than 610 gm. per sqm of steel area to be galvanized.

11.3 **Samples**

11.3.1 The Contractor shall prepare three samples, which shall define the colour and gloss of anodizing and submit them for approval of the Engineer – in – Charge.

11.4 Matching of finish

11.4.1 Wherever the same colour finish is specified for extruded aluminum sections and composite aluminum sheets, the Contractor shall ensure that the colour of both is matched as closely as possible to the satisfaction of the Engineer – in – Charge.

12 Curtain glazing and aluminum composite panel cladding systems

12.1 General

12.1.1 Movement of building components to which the curtain glazing system is attached including long term and short term movements due to thermal effect, structural effect, wind pressure, seismic forces, erection or dead loads, creep, column shortening, deflection, torsion and vibrations etc shall be free and noiseless. This shall be achieved without any strain or stress being transferred to the glass, without buckling of any components, without excessive stress to any members or assemblies and without compromising on any of the performance requirement of the curtain wall.

12.2 Waterproofing

12.2.1 Following precautions shall be taken by the contractor to ensure that the curtain glazing system is completely water tight during its guarantee period as well as expected service life besides any other precautions not specifically mentioned herein:

12.2.1.1 A drainage system must be incorporated into the curtain glazing system. The curtain glazing system shall have provision for air pressure equalization (all the internal spaces shall be vented by acceptable means to ensure air pressure equalization) so that water leakage and condensation, if any shall be drained or discharged to exterior face of the curtain glazing.

12.2.1.2 Care should be taken that the sections of the aluminum extrusions used for structural framing of curtain glazing provide for proper drainage of water that in-filters into the system by gravity and for this the section should have proper slope and weep holes as required. These shall be clearly indicated on the shop drawings.

12.2.1.3 Movement of water on exposed faces must be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungal growth as a result of standing or trapped water.

12.2.1.4 EPDM gaskets of the quality as specified and of required size and thickness shall be provided at all required locations to prevent ingress of water or moisture. The same shall be indicated on the shop drawings also.

12.2.1.5 EPDM gaskets of the quality as specified and of required size and thickness shall be provided at all required locations to prevent ingress of water or moisture. The same shall be indicated on the shop drawings also.

12.2.1.6 Aluminum sheet flashing using 1.0mm thick transparent anodized (10 microns) aluminum sheet wherever required shall be provided including sealing the gap between the flashing and the other material like RCC, masonry, aluminum etc. by using weather silicone sealant as specified.

12.3 **Mullions and transoms**

12.3.1 The sections of mullions and transoms shall be designed to restrict deflection under dead loads, wind load, seismic loads etc. as specified and shall be rigid and stable enough to support and retain the in-fill panels in position under all conditions. The mullions and transoms shall also be designed for additional horizontal loads from the cleaning equipment and process besides horizontal live loads as specified.

12.4 **Spandrel units**

12.4.1 Spandrel shall be of glass having same colour matching with vision areas after using a shadow box as specified.

12.4.2 Structural spandrel wall, fins, slab or beam, aluminum frame work, anchor fasteners, brackets , shadow boxes, fire stop(barrier)-cum-smoke seals and other construction shall not be visible through the glass in the spandrel portion of the curtain glazing from the exterior and shall be fully concealed behind the shadow box.

12.4.3 A shadow box shall be provided at a distance of minimum 50 mm behind the spandrel glass panel to ensure that the insulation panel material does not come in contact with the soft coating of the spandrel glass to prevent any damage to the coating on account of any chemical reaction or otherwise. It shall consist of an approved black fiber glass non-woven tissue stuck on surface #1of 50 mm thick semi-rigid fiber glass wool insulation panel of minimum density of 48 kg per cum., and 1.5 mm thick transparent anodized (10 microns) solid aluminum sheet tray, on surface #2 by using suitable stainless steel rivets/ nuts, bolts and washers to hold the insulation panel in position. The periphery shall be properly sealed. Surface #1 shall be adequately protected against damage until spandrel glazing is done. Further, care shall be taken that the aluminum sheet backing of the shadow box does not heave or warp due to thermal stresses and/or it's self-weight. Proper gaps at the edges of the tray shall be provided to accommodate movements on account of thermal stresses besides making elliptical slots if required to facilitate movements. The shadow box shall be fixed to the structural framing of the curtain glazing by using stainless steel screws. The fixing arrangement shall be as per the approved shop drawings.

12.5 **Ventilators, open able windows and doors**

12.5.1 Ventilators, open able windows and doors shall be provided at positions as shown on the architectural drawings. The open able panels when in closed position shall remain watertight under all weather conditions and pass the water tightness tests as specified. Besides, the open able panels shall appear similar to the fixed ones from outside.

12.5.2 All hardware and accessories shall be provided and fixed by the contractor and shall be as specified.

12.6 **Coping and soffit trimmer**

12.6.1 All coping and soffit panels shall have aluminum structural frame fixed rigidly to the structure.

12.6.2 Effective drainage system shall be provided to drain out the water that may penetrate through the joints, on to the exterior face of the curtain glazing.

12.6.3 Coping and soffits shall be visibly flat in all lighting conditions.

12.7 **Aluminum composite panel cladding**

12.7.1 Aluminum composite panel cladding material shall be rigid and of adequate strength. It shall have architectural flatness for creating smooth monolithic surface. It shall satisfy all the performance parameters. The panels shall be 4 mm thick composite units with aluminum sheet of 0.50 mm (minimum) thickness on each side and a sandwiched core layer of 3 mm thick non toxic, non-combustible, thermoplastic, low density polyethylene (LDPE) or mineral core, to provide a monolithic composite sheet. Metallic colour coatings to aluminum sheets shall be coil coated to ensure superior colour uniformity and quality. The coating shall be UV resistant exterior grade PVDF (polyvinylidene fluoride) for colour& gloss retention, flexibility and film adhesion for forming, besides resistance to humidity, impact, salt spray, pollution, abrasion and graffiti. For solid (opaque) colours, the total dry film thickness of the coating shall be 25 micron (minimum) consisting of a conversion coat, an inhibitive primer layer and a top colour coat (two coats, two bake system). For metallic colours, the total dry film thickness of the coating shall be 25 micron (minimum) consisting of conversion coat, an inhibitive primer, metallic colour coat colour coating and clear top coat (three coat, three bake system).

12.7.2 The coating system shall meet or exceed all the requirements of AAMA 2605.

12.7.3 The resin content of the PVDF coating shall be minimum 70%.

12.7.4 The reverse side of the panel shall have service coat of polyester / primer (total thickness 3-7 micron thick).

12.7.5 The cladding panels shall have uniform colour and gloss over the entire installation.

12.7.6 The fabrication and installation of the cladding systems shall be carried out as per manufacturers' instructions with invisible/ concealed fastenings, aluminum structural framework, silicon sealants (if shown on drawings) and properly tooled etc.

12.7.7 All cladding panel sheet shall be obtained in one lot from the manufacturer including keeping provision for wastage and damaged sheets.

12.7.8 The fabrication process including cutting, grooving, benching, punching, shearing, brake-forming, roll-forming, folding, drilling, joining, routing, bolting and riveting as well as installation shall be performed as per manufacturers' instructions and as specified herein. The panel shall be fabricated in the workshop/ factory in a workman like manner with perfect mitered joints. The joints shall be strengthened by using aluminum cleats of required size and thickness fixed to the corners of the panels by way of drilling and pop – riveting as per the approved shop drawings.

12.7.9 The aluminum composite cladding panel shall be visually inspected for flatness, edge damage, dimpling, buckling, oil canning, bulge and/ or delamination, if any. Defective material, if any, shall be rejected. Also, it shall be free of dirt, stains, grease marks, discolouration etc. However, defective panels shall be rejected and replaced by the contractor at his own cost.

12.7.10 The PVDF coating shall be guaranteed for colour retention, chalking resistance, humidity resistance, hardness and gloss retention etc as specified.

13 FABRICATION

13.1 General

13.1.1 All assemblies shall be fabricated and assembled in accordance with the architectural/ approved shop drawings and as specified. Deviations of any nature shall not be permitted, without the approval of the Engineer-in-Charge.

13.2 Workmanship

13.2.1 All work shall be performed by skilled workmen, specially trained and experienced in the applicable trades and in full conformity with the specifications and approved shop drawings.

13.2.2 All work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, other building movements, fabrication and installation tolerances and design criteria etc.

13.2.3 All forming and welding operations shall be done prior to finishing, unless otherwise noted.

13.2.4 All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, waves or flaws of any nature impairing strength or appearance; fitted with proper joints and intersections and with specified finishes.

13.3 **Shop assembly**

13.3.1 As far as practicable, all fitting and fabrication work shall be done in the factory/ workshop.

13.3.2 Work that cannot be factory/ workshop assembled shall be temporarily assembled in the factory/ workshop and marked for convenience of assembly at site. The units shall then be disassembled and assembled properly later in the building.

13.3.3 All glazing shall be done in the factory/ workshop.

13.3.4 Gaskets shall be pre-positioned in the factory/ workshop as far as possible.

13.3.5 Site work shall be kept to a minimum required.

13.4 **Sleeves**

13.4.1 Unless otherwise specified, all aluminum sleeves shall be extruded sections minimum 1.5 mm thick transparent anodized (10 microns) 200 mm long and width compatible with the section. It shall be provided on the junction of mullion and transoms and designed to accurately interlock with adjacent sections and incorporate serrated surfaces for the secure bedding of sealant between the parent metal and the sleeve wherever required as per the approved shop drawings.

13.5 **Anchor fasteners**

13.5.1 All anchor fasteners shall be of stainless steel (grade 316) with self locking devices, unless otherwise specified, and of sufficient size and strength to withstand the applicable design loads/ forces with factor of safety as specified for the various materials and of approved make as directed by the Engineer-in-Charge. The spacing and quantities of fasteners shall be as required as per the approved shop drawings to secure or support the framing. Washers and/ or other accessory items shall be of the same material as the fasteners. All assembly fasteners shall be torque tightened to achieve the maximum torque tension in the fasteners.

13.5.2 All fasteners shall be concealed unless otherwise shown or approved. Exposed fasteners shall be finished to match surrounding metal finish.

13.5.3 All fasteners including washers and accessory items shall be scheduled and designated on the shop drawings showing designation, type, size including diameter and length, material, numbers and spacing etc.

13.6 **Protection of metals**

13.6.1 Protection against bimetallic corrosion shall be provided wherever dissimilar metals are in contact by using PTFE (Teflon) separators 0.80 mm thick.

13.6.2 Extruded aluminum section of the structural framing of the curtain glazing system which is to be in contact with concrete, masonry, mortar or plaster shall have the contact surfaces protected by use of suitable separators wherever crevices between the contact surfaces may entrap moisture and corrosive elements. All metals, except stainless steel and aluminum, which are to be in contact with concrete, masonry, mortar or plaster, shall have the contact surfaces protected with epoxy paint.

13.6.3 The Contractor shall furnish a schedule of all protective coatings and related items along with the shop drawings, including the designation of area and/or specific locations, materials used special instruction, specification data sheets, etc.

13.7 **Welding**

13.7.1 All welding in mild steel work shall be done by the inert gas shielded arc or fluxless resistant techniques and with electrodes and/ or by methods recommended by the suppliers of the metals being welded. Type, size and spacing of welds, shall be as shown on approved shop drawings.

13.7.2 Welds behind finished mild steel surfaces shall be so done as to eliminate distortion and/ or discoloration on the finished side. Weld spatter and welding oxides on finished surfaces shall be removed by descaling and/ or grinding. Low heat filled welds using chill bar on finished side shall be used to eliminate dimpling, distortion and/ or discoloration on the finished or exposed surface. Plug, puddle or spot welding shall not be permitted. If weld beads are visible on exposed finished surfaces, the surfaces shall be ground and polished to match and blend with finish on adjacent parent metal.

13.7.3 Structural welds shall be made by certified welders and shall conform to the general recommendations and regulations of AWS Specification D1.0-46.

13.7.3.1 Dirt grease, lubricant, or other organic material shall be removed by vapour degreasing or suitable solvent.

13.7.3.2 Joints rejected because of welding defects may be repaired only by re welding. Defective welds shall be removed by chipping or machining. Flame cutting shall not be allowed.

13.7.4 Where ever welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.

13.7.5 All welds shall be scheduled and designated on the approved shop drawings showing designation, type, size, spacing etc.

13.8 **Soldering**

13.8.1 Soldering and/or brazing, wherever required shall be done as recommended by the suppliers of the metals involved.

14 **Execution**

14.1 **General**

14.1.1 The architectural drawings supplied by the Engineer-in-Charge shall be considered essentially schematic, except for profiles of exposed surfaces which shall be as indicated. If in exceptional cases, in the opinion of the contractor, a change of architectural profile is required in order to meet the specifications/ structural design requirement of the curtain wall, he shall submit a proposal for change with specific reasons for consideration and approval of the Engineer – in – Charge. No deviations from the architectural profiles of the building shall be permitted without prior approval by the Engineer – in – Charge. Nothing extra shall be payable on this account.

14.1.2 The method of assembling, reinforcing and anchorage of the aluminum structural framing of the curtain glazing system, wherever indicated is schematic. Location and method of providing the same shall be responsibility of the Contractor, who shall design, assemble, reinforce and anchor to suit each specified condition in an acceptable manner, suiting main building structure.

14.1.3 All parts shall be secured by concealed means. Screws/ fasteners exposed to view shall in general not be allowed unless otherwise approved on the shop drawings.

14.1.4 All components shall be assembled, secured, anchored, reinforced, sealed and made weather tight in the manner as specified and as per the approved shop drawings. The structural framing shall not restrict movements within the curtain glazing system and also relative to building. The design should be such that it is able to absorb such movements without compromising the performance requirements of the curtain glazing system. Wherever possible, sealants shall be concealed.

14.1.5 Free and noiseless movement of all components of the curtain glazing system due to thermal, structural, seismic loads, wind load, or dead loads etc. shall be achieved without strain to glass, without buckling of any components and without excessive stress to any members or assemblies.

14.1.6 The entire curtain glazing system shall be assembled and installed so that there is no leakage into the building. All leakage, penetration of moisture into the system, and condensation shall be drained and discharged to the exterior face of the curtain glazing system. For this, effective

air pressure equalization shall have to be designed and ensured while executing the curtain wall system.

14.1.7 Movement of water within and on exposed surfaces shall be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungal growth as a result of standing or trapping water.

14.2 **Dimensions**

14.2.1 The dimensions given on Architectural drawings are indicative to enable the contractor for preparing his shop drawings. However, these drawings may require modifications based actual measurements on site. The contractor shall revise the drawings accordingly and submit the same for approval of the Engineer-in-charge, in case of any discrepancy between measurements on site and in drawings.

15 **Performance testing**

15.1 **General**

15.1.1 The contractor shall obtain and submit to the Department the manufacturer's test certificate for various materials for compliance as per the manufacturer's specifications.

15.2 **Site tests**

15.2.1 The Contractor shall carry out site tests at his own cost to determine resistance to water leakage as per recommendations given in AAMA 501 for "Field Check of Metal Storefronts, Curtain Walls and Sloped Glazing Systems for Water Leakage."

15.2.2 The test areas shall be selected by the Engineer – in - Charge at random in typical and non-typical locations, one for every 500 sq.m. approx. of installed curtain glazing. In case of any test failing, more tests shall be conducted by the contractor at his own cost as per the directions of the Engineer – in - Charge. The work carried out under the test area which fails in site testing, shall be rejected and redone or remedial action shall be taken by the contractor to rectify the defects, whatever the case may be at his own cost, to the entire satisfaction of the Engineer-in-Charge.

15.2.3 Each test area shall be approx. 25 sqm. or less depending upon the size of the glazing panels provided in the building for which test is being conducted. The test area shall include vision (fixed and open able) and spandrel panels.

16 **Installation**

16.1 **Workmanship**

16.1.1 All work shall be performed by skilled workmen, especially trained and experienced in the applicable trades employed and in full conformity with specifications and approved shop drawings to execute the work in workman like manner.

16.2 **Setting out**

16.2.1 Bench marks for elevations and building line offset marks for alignment shall be established on each floor level by the contractor. Should any error be found in the alignment, the Contractor shall notify the Engineer – in - Charge in writing and installation work shall not proceed in the affected area until the errors have been corrected?

16.3 **Prior inspection of the structure**

16.3.1 After the setting out has been established and before beginning installation in any area, the Contractor shall examine all parts of the structure on which the curtain glazing system is to be placed. Should any conditions be found which, in his opinion, will prevent the proper execution of his work or endanger its permanency, he shall report such conditions in writing to the Engineer – in - Charge. Installation work shall not proceed in that area until such conditions are corrected or adjusted to the satisfaction of the Engineer – in - Charge.

16.4 **Workmanship**

16.4.1 All parts of the curtain glazing system shall be erected true to plumb and in proper alignment and relation to establish setting out, as shown on approved shop drawings.

16.5 **Installation within and/or adjacent to concrete**

16.5.1 Where work is to be installed within and/or adjacent to concrete, no component of the curtain glazing system other than built in anchor devices shall be put in place until the concrete work is completed and finished.

16.6 **Anchorage**

16.6.1 Anchorage of the curtain glazing system to the structure shall be by approved methods and in strict accordance with approved shop drawings. After the curtain glazing system is properly positioned and aligned, all connections so designated on approved shop drawings shall be rigidly fixed by welding or other positive means in addition to serrated brackets and washers.

16.6.2 All components of the curtain glazing system including anchorage assemblies, shall receive a 100% inspection by the contractor. A check list shall be prepared and maintained by the contractor for entire execution of curtain glazing system work and submitted to the Engineer-in-Charge after the completion of the work. It shall also be made available for inspection during the execution of the work.

16.7 **Welding**

16.7.1 All welding shall be done by skilled mechanics qualified or licensed in accordance with local building regulations. Welds and adjoining burnt areas in prime coated surfaces shall be thoroughly cleaned and painted with one coat of primer. Welds in galvanized steel shall be coated with two coats of zinc rich paint. Special care shall be taken to protect glass and other furnished surfaces from flame and welding spatter and to prevent fires.

16.8 **Use of sealing materials**

16.8.1 Sealing materials shall be used in strict accordance with the Manufacturer's printed instructions/ specifications and shall be applied only by workmen specially trained or experienced in their use. Before applying sealants, all mortar, dirt, dust, moisture and other foreign matters shall be completely removed from surfaces, it will contact. Adjoining surfaces shall be masked when required to maintain a clean and neat appearance. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

16.8.2 The manufacturer(s) of the applicable materials shall, when required render technical assistance prior to the application of any sealant and witness the first application as well as periodic site inspections thereafter. The Contractor shall witness and document all inspections performed by the sealant manufacturer and provide close supervision of all workmen used to apply the sealant. The record so maintained shall be made available for the inspection of the Engineer-in-Charge during execution of the work.

16.9 **Tensioning of bolts**

16.9.1 All bolts/ fasteners shall be correctly fixed /tensioned. The tension shall be specified on shop drawings. 100% of fasteners/ bolts shall be mechanically checked for correct tension by the contractor and the contractor shall maintain a check list in this regard which shall be made available for the inspection of the Engineer-in-Charge during execution of the work.

16.9.2 **Protection and cleaning**

16.9.2.1 The Contractor shall adequately protect all aluminum sections, glazing, cladding sheets, components and accessories from damage during shipment, storage, erection and till the date of completion of the work and handing over the building to the Department by use of protective coverings of approved non-staining quality.

16.9.2.2 At such time as may be directed by the Engineer – in - Charge, the Contractor shall remove all protective coverings and clean the surfaces. All cleaning agents to be used shall not cause any damage to the aluminum, glass, aluminum composite panel and coatings etc. Any defective material shall be replaced by the contractor at his own cost.

17 **Performance guarantee**

17.1 The contractor shall be solely responsible for the design including shop drawings and performance of the installed curtain glazing, aluminum composite panel cladding and aluminum work (PVDF coated), etc. The installations (Sl. No. 18.1 to 18.12) shall be guaranteed by the contractor during the guarantee period, against defective materials, workmanship, water tightness (wherever specified), structural design, performance requirements and other requirements as given in the specifications. The contractor shall submit in the enclosed format a written guarantee for the same for a period of 10 years after the date of completion of the work.

17.2 The Contractor shall indemnify the Department against all claims of whatsoever nature due to defective designing or non-performance during the 10 years Guarantee period. The provisions of this clause shall not in any way limit the rights of the Engineer-in-Charge to take action under other clauses of the contract agreement.

1% (one percent) of the cost of the items shall be withheld towards guarantee as specified above. However, half of this amount (withheld) would be released after five years after the date of completion of the work, if the performance is satisfactory. The remaining withheld amount shall be released after 10 years after the date of completion of work, if the performance is satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of notice to the contractor, at least temporarily to the satisfaction of the Engineer-in-Charge / authorized representative of client, till the permanent rectification of the defects / replacement of defective materials are carried out by the contractor in maximum period of four months. If not attended to, the same shall be got done by the Engineer-in-Charge / authorized representative of client through other agency at the risk and cost of the contractor. However, the amount withheld as guarantee can be released in full, if irrevocable bank guarantee from Schedule / Nationalized Banks, of same amount, for ten years is submitted by the contractor to the Engineer-in-Charge. The defects, if any, shall be rectified in a workmanlike manner, retaining the same aesthetics and other functional parameters of the original work. For this purpose, cost of structural glazing / ACP works will be taken as Rs. 3.00 Cr.

LIST OF SPECIALISED ITEMS:

i. Architectural Design and Structural Design of buildings.
ii. Soil Investigation and Survey Work.
iii. Water proofing treatment work.
iv. Aluminum composite panel & structural glazing.
v. Stainless steel cladding and stainless steel railing
vi. Facade cleaning system and façade cleaning
vii. Fusion bonded Epoxy coating
viii. Electronic / Digital Signages
ix. Sewage Treatment Plant

x. Plumbing work.
xi. Folded plate/shell roof
xii. Architectural Activities and Murals
xiii. Any other item decided by Engineer-in-charge

Procedure for Execution of the Specialized Items:

Such items should be got executed only through associated agencies specialized in these fields. The contractor shall indicate the name(s) of his associated specialized agencies those fulfilling the conditions described in SOP No. 4/7 of CPWD Works Manual-2019 as early as possible and within one month of award of work to Engineer-in-Charge for approval of competent authority.

Specialized Agencies for works shall be approved by the competent authority. The contractor shall quote the rates after careful study of contract conditions, specifications, drawings & schedule of quantities.

It shall be the responsibility of main contractor to sort out any dispute / litigation with the Specialized Agencies without any time & cost overrun to the Department. The main contractor shall be solely responsible for settling any dispute / litigation arising out of his agreement with the Specialized Agencies. The contractor shall ensure that the work shall not suffer on account of litigation/ dispute between him and the specialized agencies / sub-contractor(s). No claim of hindrance in the work shall be entertained from the Contractor on this account. No extension of time shall be granted and no claim what so ever, of any kind, shall be entertained from the Contractor on account of delay attributable to the selection/rejection of the Specialized Agencies.

For specialized items, the main contractor cannot work as a specialized agency unless his name is already included in the list of approved specialized agencies for these items. The contractor shall get these items executed through the specialized agencies as approved by competent authority.

LIST OF APPROVED MATERIALS (CIVIL)

Note:

1. The Contractor shall obtain prior approval from the Engineer-in-charge before placing order for any specific material or engaging any of the specialized agencies. The Contractor shall make a detailed submittal with catalogues and highlighted proposed specifications, as well as full details of the works proposed to be executed by the specialized agency, as specified.

2. Wherever applicable, the Engineer-in-charge may approve any material equivalent to that specified in the tender subject to proof being offered by the Contractor for equivalence to his satisfaction.

3. Unless otherwise specified, the brand / make of the material as specified in the particular specifications and in the list of approved materials attached in the tender, shall be used in the work.

1	CEMENT	ACC, ULTRA TECH, J. P. CEMENT, VIKRAM, SHREE CEMENT, BIRLA SHAKATI, CEMENT CORPORATION OF INDIA, VASAVDUTTA.
2	WHITE CEMENT	J.K., BIRLA
3	READY MIX CONCRETE	SKYWAY, A.C.C., ULTRA TECH, NUVOCO (LAFARGE),RMC READY MIX , GODREJ
4	SUPERPLASTICIZERS / ADMIXTURE	MC BAUCHEMIE, SIKA, FOSROC, BASF, ASIAN LABORATORIES
5	WATERPROOFING COMPOUND	PIDILITE, STRUCO EXCEL, CICO, FOSROC
6	REINFORCEMENT STEEL (TMT Fe 500)	SAIL, TATA STEEL, RINL, JINDAL STEEL & POWER LTD., JSW STEEL LTD.
7	STRUCTURAL STEEL	TATA STEEL, SAIL, RINL, JINDAL.
8	CONCRETE BLOCKS	CONWOOD, GURJARI, HINDUSTAN, LOK GROUP, SAI BLOCK, VED PMC LTD.
9	AAC BLOCKS	AEROCON, SIPOREX, ULTRA TECH, ECOLITE, HIL Ltd.
10	FRD FRAME & SHUTTERS	SUKRI, KENWOOD, ANCHOR, KUTTY

CORRECTIONS - NIL OMISSIONS - NIL INSERTIONS - NIL

EE (C) EE(E)

11	CALCIUM SILICATE BOARD	STARPAN, HILUX, AEROLITE, PROMAT
12	HINGES FOR FIRE RATED DOORS	DORMA, I.R (INGERSOL RAND), ASSA ABLOY
13	INTUMESCENT STRIPS	PROMAT, PEMKO, INTUMEX, ASTROFLAME
14	FLUSH DOORS	KENWOOD, ANCHOR, KUTTY, GREENPLY,DURO,CENTURY,SWASTIK, A1 TEAK
15	S.S. HARDWARE LIKE MORTICE LOCK WITH PAIR OF HANDLES, RECESS HANDLE FITTINGS, FLOOR SPRING, DOOR CLOSER, TOWER BOLT, FLOOR DOOR STOPPER	DORMA, GMBH & CO., KG HAFLE INDIA (P) LTD. D.LINE, CARL LF, INTERNATIONAL, GEZE, DORSET, KICH
16	PLYWOOD	ANCHOR, ARCHID, KITPLY, GREEN PLY, CENTURY
17	ROLLING SHUTTERS & GRILLS	STANDARD, SWASTIK, SHUBDHWAR
18	GALVANISED / STAINLESS STEEL ANCHOR FASTNER	HILTI , FISCHER, OBO
19	GALVANISED NUT BOLT, STEEL STUD ANCHORS / SS SCREWS	KUNDAN, ARROW
20	STAINLESS STEEL	SALEM STEEL, JINDAL OR EQUIVALENT
21	S. S. HANDLES	DORMA, KICH, HAFELE, DORSET
22	DOOR STOPPER / INDICATOR BOLT / PUSH PLATE	DORMA, KICH, HAFELE, MAGNUM
23	VITRIFIED TILES	KAJARIA, H & R JOHNSON, SOMANY, NITCO, SUNHEARRT
24	COMPOSITE MARBLE	NITCO, CLASSIC MARBLE, EURO, ASIAN
25	CERAMIC TILES	KAJARIA, H & R JOHNSON, SOMANY, NITCO

CORRECTIONS - NIL OMISSIONS - NIL INSERTIONS - NIL

EE (C) EE(E)

26	GLASS MOSAIC TILES	BISAZZA, ITALIA, PALLADIO
27	POLYMER MODIFIED CEMENTITIOUS GROUT / CEMENT ADHESIVE / EPOXY GROUT	ARDEX ENDURA, LATICRETE, ACC, AEROCON, ULTRATECH
28	WOODEN LAMINATE FLOORING	ACTION TESA, ARM STRONG, KRONOSWISS, PERGO, PARADOR
29	WOOD PLASTIC COMPOSITE (WPC) FLOORING	EGO, EBACO, HEM INTERIOR (WPC DECK)
30	PVC FLOORING	LG OR EQUIVALENT
31	GYPSUM BOARD / GLASS REINFORCED GYPSUM BOARD FALSE CEILING	GYPSUM BOARD OF ST. GOBAIN GYPROC INDIA GYPSUM / BORAL WITH FRAMING, DIAMOND WITH FRAMING
32	SALON SLATS PLUS FALSE CEILING	ANUTONE OR EQUIVALENT
33	METAL FALSE CEILING, METAL PANEL WITH TECHNICAL PANEL FALSE CEILING,ACOUSTICAL CLOUDS FALSE CEILING, WOODWORK CEILING PANELS FALSE CEILING, MINERAL FIBRE CEILING SYSTEM	ARMSTRONG, HUNTER DOUGLAS, INTERARCH.
34	ALUMINIUM ALLOY SHEET	KALZIP OR EQUIVALENT
35	ZINCALUME PROFILE SHEET	TATA BLUE SCOPE, PENNAR, CRIL (COLOR ROOF INDIA LTD).
36	READY MIXED CEMENT PLASTER	WALPLAST, ULTRA TECH
37	GYPSUM LIGHT WEIGHT PLASTER	GYPROC OR EQUIVALENT
38	PAINTS	ICI DULUX, ASIAN PAINTS, BERGER PAINTS, NEROLAC
39	ACRYLIC TEXTURE PLASTER	ASIAN PAINTS, SPECTRUM PAINTS, HERITAGE ICI DULUX, NEROLAC
40	PAVER BLOCKS / TACTILE TILE	VYARA, SUPER, JOHNSON

CORRECTIONS - NIL OMISSIONS - NIL INSERTIONS - NIL

EE (C) EE(E)

41	C. P. FITTINGS	JAQUAR, KOHLER, ROCA,
42	SANITARY WARES	JAQUAR, KOHLER, ROCA, CERA
43	S. S. SINK	NIRALI, DEEPALI, FUTURA, CERA, DIAMOND
44	S. S. GRATINGS	CHILLY, CAMRY,
45	FLOAT GLASS MIRROR	MODIGUARD, SAINT GOBAIN
46	C. I. PIPES	NECO, SKF, KAPILANSH, RPMF
47	P.V.C RAIN WATER PIPE	SUPREME, ASTRAL, KISAN, FINOLEX, PRINCE
48	TOILET MODULAR CUBICALS	MERINO BY BESCO , MATRIX CUBICLE SYSTEM, JAGUAR
49	G.I. PIPES	SAIL, TATA, JINDAL (HISSAR)
50	S S PRESS FIT PIPES & FITTINGS	J - PRESS OR EQUIVALENT
51	VALVES	ZOLOTO, LEADER, KIRLOSKAR, ADVANCE, AUDCO,
52	NP2 CLASS, R.C.C. PIPES	JAIN SPUN PIPE, K. K. SPUN PIPE, THE INDIAN HUME PIPE CO. LTD., PATEL HUME PIPES
53	S. F. R. C. COVERS	K. K. SPUN PIPE, JAIN SPUN PIPE, S. S. INDUSTRIES
54	MELAMINE POLISH	ASIAN PAINTS, PIDILITE INDUSTRIES, ICI DULUX.
55	HIGH PRESSURE LAMINATES	FORMICA, MERINO, GREENLAM, CENTURY, ARCHID.
56	BALL BEARING HINGES / TOWER BOLT	MAGNUM, DORMA, KICH
57	WOODEN ADHESIVE	PIDILITE, NATIONAL
58	ALUMINIUM EXTRUSION SECTIONS	JINDAL ALUMINIUM LTD., MAAN

CORRECTIONS - NIL OMISSIONS - NIL INSERTIONS - NIL

EE (C) EE(E)

		ALUMINIUM LIMITED, INDO ALUSYS INDUSTRIES LIMITED (FORMERLY MAHAVIR ALUMINIUM), BHORUKA ALUMINIUM LTD. (YKK), SAPA PROFILES INDIA LTD., GLOBAL ALUMINIUM PVT. LTD., MAA ALUMINIUM (I) PVT .LTD.
59	ANODIZING	LAKSHMI ANODISERS, AURA ARCHITECTURAL COATINGS, ALUFIN, BHORUKA, TALCO EXTRUTION
60	FLOAT ANNEALED GLASS	SAINT GOBAIN, ASAHI GLASS, EMIRATES GLASS, GUARDIAN GLASS (SUNGUARD), HNG, MODI GUARD
61	REFLECTIVE SOFT COATED / LOW E GLASS	SAINT GOBAIN, ASAHI GLASS, EMIRATES GLASS, GUARDIAN GLASS (SUNGUARD)
62	GLASS PROCESSER	SAINT GOBAIN, ASAHI GLASS, EMIRATES GLASS, GUARDIAN GLASS (SUNGUARD), SEJAL, GLASSTECH, FUSO, FG, GSC, NSD, SCHOTT.
63	FRICTION HINGES AND LOCKS	COTSWOLD, GIESSE, ALUALPHA
64	SPIDER FITTINGS	DORMA, HAFELE , DEFINE
65	FLOOR SPRING, PATCH FITTING, PIVOT AND LOCK (FOR CURTAIN GLAZING)	DORMA, HAFELE, DEFINE
66	ROCK WOOL	VETROTEX INDUSTRIES PVT. LTD., UP TWIGA, ROCK WOOL INDIA LTD.
67	ALUMINIUM COMPOSITE PANEL	ALUDECOR, EUROBOND, ALSTRONG, ALUCOBOND, MAPL
68	PVDF COATING	AURA ARCHITECTURAL COATINGS, M. J. COATERS PVT. LTD., S P ARCHITECTURAL COATINGS PVT LTD., AMECO, RADIANT ANODISERS PVT. LTD.
69	EPDM	AMEE RUBBER INDUSTRIES PVT. LTD., BOHRA RUBBER, OSAKA.

CORRECTIONS - NIL OMISSIONS - NIL INSERTIONS - NIL

EE (C) EE(E)

70	ALL TYPES OF SILICONE	DOW CORNING, GE, WACKER
71	SPACER TAPE / BACKER ROD	NORTON, BOW, AASTHA
72	GALVANIZATION	JENCO GROUP, SADHANA ENGINEERING CORPORATION OF STEELITE ENGINEERING LTD.
73	HYDROPHOBIC COATING	DUPONT, DOW CORNING, EVERCRETE, AQUAMIX
74	GLASS FIBER STRAND	SAINT GOBAIN, NIPPON ELECTRIC GLASS CO. LTD, STERLITE
75	AUTOMATIC SWING DOOR OPERATING SYSTEM	DORMA OR EQUIVALENT
76	INTUMESCENT FIRE RETARDENT PAINT	AKZONNOBEL, NEWKEM
77	STAINLESS STEEL PIPES FOR RAILING	MADE OF JINDAL, SAIL OR EQUIVALENT SHEET
78	COUPLER (MECHANICAL SPLICE /PARALLEL THREAD COUPLER)	DEXTRA, ISHITA
79	FIRE RATED GLASS	SAINTGOBAIN, MODI SCHOTT, SEZAL, PILKINTON
80	S.S PLUMBING PIPES	TATA STEEL, JINDAL STEEL
81	CPVC PIPES	FINOLEX, SUPREME, RAKSHA, ASTRAL, PRINCE, ASHIRWAD
82	HDPE PIPES	RELIANCE, JAIN PIPES, ORIPLAST, SUPREME

Note:- The above makes are subjected to the compliance of make in India Norms.

CORRECTIONS - NIL OMISSIONS - NIL INSERTIONS - NIL

EE (C) EE(E)

LIST OF SPECIALISED AGENCIES:

1	WATERPROOFING WORK	A. A. NAYAK Constructions Pvt. Ltd., NINA Concrete Systems Pvt. Ltd., LIKPROOF INDIA PVT. LTD., MODERN WATERPROOFING CO, INDIA WATERPROOFING CO.
2	PLUMBING SANITARY WORKS	SHREE KHODIYAR SANITATION, D. S. GUPTA, UJJWAL ENTERPRISES, CANTER, JK INFRA,
3	CURTAIN GLAZING / STRUCTURAL GLAZING	AJIT INDIA PVT. LTD., INNOVATORS FACADE SYSTEMS PVT. LTD., ALUMILITE ARCHITECTURAL PVT. LTD, GLASSWALL SYSTEMS, AZAD FAÇADE DESIGNING & CONTRACTING, ALUMAYER INDIA PVT. LTD., STEEL ARTS
4	STAMPING OVER CONCRETE	NINA, HICRETE, LAFARGE, STONECRETE

GUARANTEE BONDS
ANNEXURE-I

GUARANTEE TO BE EXECUTED BY THE CONTRACTOR FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF STONE WORK/ TILE WORK.

The agreement made this..... day of ..... Two Thousand..... between .....S/o .....(hereinafter called the GUARANTOR on the one part) and the President of India (hereinafter called the Government on the other part)

WHEREAS THIS agreement is supplementary to a contract (Hereinafter called the Contract) dated ..... and made between the GUARANTOR ON THE ONE PART AND the Government on theother part whereby the contractor inter alias undertook to render the work in the said contract structurally stable , workmanship, finishing and use of sound materials.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the affect that the said work will remain structurally stable and guaranteed against faulty workmanship, finishing and materials.

NOW THE GUARANTOR hereby guarantee that work executed by him will remain structurally stable after the expiry of maintenance period prescribed in the contract for the minimum life of five years to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

The decision of the Engineer-in-Charge with regard to nature and cause of defect shall be final.

During this period of guarantee, the guarantor shall make good all defects to the satisfaction of the Engineer-in-Charge calling upon him to rectify the defects failing which the work shall be got done by the Department by some other contractor at the Guarantor's cost and risk. The decision of the Engineer-in-Charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to make good all the defects, commits breach there under, then the guarantor will indemnify the principal and his successor against all loss, damage, cost expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and or cost incurred by the Government, the decision of the Engineer-in-Charge will be final and binding on both the parties.

IN WITHNESS WHEREOF these presents have been executed by the obligator.... ..... and ..... by ..... for and on behalf of the President of India on the day, month and year first above written.

SIGNED, sealed and delivered by OBLIGATOR in the presence of:-

1 ..... 2 .....
. .

SIGNED FOR AND BEHALF OF THE PRESIDENT OF INDIA BY..... in the presence of :-

1 ..... 2 .....
. .

ANNEXURE-II

GUARANTEE TO BE EXECUTED BY THE CONTRACTOR FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF WATER-PROOFING WORKS.

The agreement made this..... day of ..... Two Thousand..... between .....S/o .....(hereinafter called the GUARANTOR on the one part) and the PRESIDENT OF INDIA (hereinafter called the Government on the other part)

WHEREAS THIS agreement is supplementary to a contract (Hereinafter called the Contract) dated ..... and made between the GUARANTOR ON THE ONE PART AND the Government on the

other part whereby the contractor inter alia undertook to render the building and structures in the said contract completely water and leak-proof.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the affect that the said work will remain water and leak proof, for Ten years from the date of giving water proofing treatment.

NOW THE GUARANTOR hereby guarantee that work executed by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be Ten years to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

The decision of the Engineer-in-Charge with regard to nature and cause of defect shall be final.

During this period of guarantee, the guarantor shall make good all defects and in case of any defect being found render the building water proof to the satisfaction of the Engineer-in-Charge calling upon him to rectify the defects failing which the work shall be got done by the Department by some other contractor at the Guarantor's cost and risk. The decision of the Engineer-in-Charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing or commits breach there under, then the guarantor will indemnify the principal and his successor against all loss, damage, cost expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and or cost incurred by the Government, the decision of the Engineer-in-Charge will be final and binding on both the parties.

IN WITHNESS WHEREOF these presents have been executed by the obligator..... and ..... by ..... for and on behalf of the PRESIDENT OF INDIA on the day, month and year first above written.

SIGNED, sealed and delivered by OBLIGATOR in the presence of :-

1 ..... 2 .....
. .

SIGNED FOR AND BEHALF OF THE PRESIDENT OF INDIA BY..... in the presence of
:-

1 ..... 2 .....
. .

ANNEXURE-III

GUARANTEE TO BE EXECUTED BY THE CONTRACTOR
FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF SANITARY INSTALLATIONS / WATER SUPPLY / DRAINAGE WORK AND ALUMINIUM WORK

The agreement made this..... day of ..... Two Thousand..... between .....S/o .....(hereinafter called the GUARANTOR on the one part) and the PRESIDENT OF INDIA (hereinafter called the Government on the other part)

WHEREAS THIS agreement is supplementary to a contract (Hereinafter called the Contract) dated ..... and made between the GUARANTOR ON THE ONE PART AND the Government onthe other part, whereby the contractor inter alia, undertook to render the work in the said contract structurally stable, leak proof and sound material, workmanship, anodizing, colouring, sealing etc.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the affect that the said work will remain structurally stable, leak proof and guaranteed against faulty material and workmanship, defective anodizing / Powder coat colouring and finishing for ……. years from the date of completion of work.

NOW THE GUARANTOR hereby guarantee that work executed by him will be free from any leakage, seepage, cracks in pipes and guaranteed against faulty material and workmanship, defective galvanizing for five years to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

The decision of the Engineer-in-Charge with regard to nature and cause of defect shall be final. During this period of guarantee, the guarantor shall make good all defects and in case of anydefect to satisfaction of Engineer-in-Charge at his cost and shall commence the work for such rectification within seven days from the date of issue of the notice from the Engineer-in-Charge calling upon him to rectify the defects failing which the work shall be got done by the Department by some other contractor at the guarantor's cost and risk. The decision of the Engineer-in-Charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to make good all defects or commits breach there under, then the guarantor will indemnify the principal and his successor against all loss, damage, cost expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and or cost incurred by the Government, the decision of the Engineer-in-Charge will be final and binding on both the parties.

IN WITHNESS WHEREOF these presents have been executed by the obligator..... and ..... by

..... for and on behalf of the PRESIDENT OF INDIA on the day, month and year first above written.

SIGNED, sealed and delivered by OBLIGATOR in the presence of :-

1. ..... 2. .....

SIGNED FOR AND ON BEHALF OF THE PRESIDENT OF INDIA BY.....

1. in the presence of:-..... 2. .....

ANNEXURE-IV

FORM OF PERFORMANCE SECURITY / BANK GUARANTEE BOND

In consideration of the President of India (hereinafter called "the Government") having agreed under the terms and conditions made between _____ and_____{hereinafter called "the said contractor(s)"} for the work

Construction of New Administrative Cum Academic Building (G+6) with Auditorium and Director's Bungalow (G+1) (New Infrastructure Development Project) for IIPS at Deonar, Mumbai including water supply, sanitary installation, electrical installations, lifts, fire alarm, PA System & fire fighting system, electric substation, DG sets, CCTV, EPBAX, Audio & Video conference system, STP, water pumps, solar water heating & power generation system, VRF / VRV air-conditioning system, UPS, mechanical ventilation system, BMS, Exit & LED Sign Boards, external development works on Engineering, Procurement and Construction (EPC) basis (hereinafter called "the said agreement") having agreed to production of an irrevocable Bank Guarantee for Rs._____ (Rupees _____ only) as a security/guarantee from the contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said agreement,

We _____(hereinafter referred to as "the Bank")

(indicate the name of the Bank)

hereby undertake to pay to the Government an amount not exceeding Rs._____/- (Rs_____ only) on demand by the Government.

2. We _____ do hereby undertake topay the amounts due and
(indicate the name of the Bank)

payable under this Guarantee without any demure, merely on a demand from the Government stating that the amount claimed is required to meet the recoveries due or likely to be due from the said contractor (s). Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the bank under this Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs._____/-(Rs._____ only).

3. We, the said bank further undertake to pay to the Government any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal.The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the contractor(s) shall have no claim against us for making such payment.

4. We_____ further agree that the guarantee herein contained (indicate the name of the Bank)

Shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of the Government under or by virtue of the said agreement have been fully paid

and its claims satisfied or discharged or till Engineer-in-Charge, on behalf of the Government, certifies that the terms and conditions of the said agreement have been fully and properly carried out by the said contractor(s) accordingly discharges this guarantee.

5. We (indicate the name of the Bank) further agree with the Govt. that, the Govt.
shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Government against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said contractor(s) or for any forbearance, act of omission on the part of the Government or any indulgence by the Government to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

This guarantee will not be discharged due to the change in the constitution of the Bank or the contractor(s).

6. We_____ lastly undertake not torevoke this guarantee
(indicate the name of bank)
except with the previous consent of the Government in writing.

This guarantee shall be valid up to_____ unless extended on demand by Government. Notwithstanding anything mentioned above, our liability against this Guarantee is restricted to Rs._____/- (Rs._____ only) and unless a claim in writing is lodged with us within six months of the date of expiry or the extended date of expiry of this guarantee, all our liabilities under this guarantee shall stand discharged.

Dated the _____ day of_____

For_____
(Indicate the name of the Bank)

PART – VI

Electrical Works

Name of Work:- Construction of New Administrative Cum Academic Building (G+6) with Auditorium and Director's Bungalow (G+1) (New Infrastructure Development Project) for IIPS at Deonar, Mumbai including water supply, sanitary installation, electrical installations, lifts, fire alarm, PA System & fire fighting system, electric substation, DG sets, CCTV, EPBAX, Audio & Video conference system, STP, water pumps, solar water heating & power generation system, VRF / VRV air-conditioning system, UPS, mechanical ventilation system, BMS, Exit & LED Sign Boards, external development works on Engineering, Procurement and Construction (EPC) basis.

Scope of Work, User Requirements and Technical specifications:

Scope:

The scope of work is briefly defined under chapter Part-II, Technical Bid (Section-I),

GENERAL CONDITIONS FOR ALL E&M PACKAGES

1. The agency must study various CPWD specifications; get themselves acquainted with site and site conditions, provision for internal & electrical installations, lifts, fire alarm & PA System, fire fighting system, electric substation, DG sets, CCTV, EPBAX, STP, water pumpsets, solar power generation & water heating system, VRF/VRV air-conditioning system, UPS, BMS, Exit signages & LED Sign boards for New Administrative cum Academic Building & Auditorium and Director Bunglow at IIPS Govandi St. Road, Deonar, Mumbai in local byelaws and additional conditions carefully.

   The work shall be executed in close co-ordination with the progress of building work.

2. The work shall be carried out in the following order of preference :

(i) Indian Electricity rules 2005 & Indian Electricity act 2003 amended up to date.

(ii) Additional Technical specifications and list of acceptable makes attached.

CPWD General specifications for Electrical works Part-I (Internal)-2013, Part II (External) - 1994 amended up to date,CPWD general specifications for electrical works Part – III (Lifts and Escalators) – 2003,CPWD general specifications for electrical works Part – IV(Sub stations) – 2013, Local Fire Regulations, CPWD general specifications for electrical works Part – V (Wet riser & sprinkler system) – 2006, CPWD general specifications for airconditioning / HVAC works – 2017, CPWD general specifications for electrical works Part – VI Fire Detection and Alarm System 2018, CPWD general specifications for electrical works Part – VII D. G. Sets 2013, National electrical code 2011 amended up to date and Relevant sections of relevant IS codes of latest edition and CPWD special publications available on CPWD website.

The technical specifications are to be read in conjunction with above and in case of variations technical specifications of tender document shall apply. Nothing extra shall be paid on account of additional features in the technical specifications as the same to be read along with schedule of quantities for the work.

(Note: The higher specifications / stringent conditions of CPWD specifications or NBC – 2016 shall be followed).

(iv) Relevant BIS standards as modified up to date.

(v) Sound Engineering practice as approved by the Engineer – in – charge.

Any additional item of work, if taken up subsequently, shall also confirm to the relevant specifications mentioned above.

3. All the equipments/materials shall be delivered with (i) Manufacturer´s test certificate, (ii) Manufacturer´s technical catalogues and Installation / Instruction (O&M), manuals, invoice/ bill/ challane to verify genuineness of materials.

4. Scaffoldings & any other T & P required for execution, testing and commissioning of work shall be arranged by the contractor and is included in the cost of work tendered by the contractor.

5. The design layout plans / drawings / other documents pertaining to E & M services shall have to be submitted for approval and got proof checked by an institute of repute as defined /mentioned in the bid-document within the time period as specified in the table of mile stone.

6. Inspection before Dispatch: All routine tests shall be conducted before dispatch of equipments. No equipment shall be dispatched out from the manufacturer's premises before such tests are conducted and test result recorded. These test certificates shall be given along the supply of equipments. The Engineer In-charge shall, if he so desires inspect and witness the pre-delivery tests. For this purpose, the agency shall give 15 day advance notice. Agency shall arrange for inspection of the department. Department shall bear expenses of its officials for inspection as far as traveling, boarding and / lodging is concerned. However, the inspection shall be done at the discretion of the department without any cost implication but ROUTINE TEST & TYPE TEST Certificates shall have to be submitted for equipments. Prior to dispatch, all equipments shall be adequately protected & insured for the whole period of transit, storage and erection against corrosion and incidental damages etc. from the effect of vermin, sunlight, rain, heat and humid climate.

7. PROCEDURE FOR APPROVAL OF MATERIALS, SHOP FLOOR DRAWINGS AND COMMENCEMENT OF WORK:

Within the time specified in table of milestone the contractor shall submit following documents for approval.

(i) List of makes & Model numbers of all items of equipments and accessories each Sub head of work / package.

(ii) Catalogues of the equipments to be supplied.

(iii) Shop floor drawings of each packages/ Sub work separately for approval.

It is the responsibility of the tenderer to get the makes, models and shop floor drawings approved by the department before placing of order.

8. Insurance: The agency shall include storage cum erection insurance including third party insurance right from the storage to commissioning and handing over of various equipments. In insurance, the beneficiary shall be Engineer -In-charge at the cost of the agency. All insurance which the agency is required to enter into under the contract shall be affected from any authorized general insurance company and the agency shall produce the policies of insurance. In case of any delay in ITC & handing over, the insurance cover will be suitably extended by the contractor at his own cost.

9. Remedy of failure to insure: If the agency fails to effect and keep in force the insurance referred to in the preceding sub-clause the department may affect and keep in force any such insurance and pay such premium as may be necessary for that purpose and from time to time deduct the amount, so paid by the department, from any money due or which may become due to bids or recover the same as debit from the agency's bill.

10. Quality of material and workmanship: All parts of the equipment shall be of such design, size and material so as to function satisfactorily under all rated conditions of operation. All components of the equipments shall have adequate factor of safety. The work of fabrication and assembly shall conform to sound engineering practice and on the basis of "Fail Safe Design". The mechanical parts subject to wear and tear shall be easily replaceable type. The construction of the equipments shall be such as to facilitate easy operation, inspection, maintenance and repairs. All connections and contacts shall be designed to minimize risk of accidental short circuits caused by animals, birds and vermin etc. All identical items and their component parts should be completely interchangeable including spare parts.

11. Inspection and testing at site :

    i) The installation shall be subject to necessary inspection during every stage of erection, by the Engineer In-charge or his authorized representative. The successful bidder shall provide all facilities and assistance for the purpose.

    ii) The completed installation shall be inspected and tested by the Engineer-in charge in the manner as will be laid down by him, in consultation the agency.

    iii) All instruments and facilities necessary for the tests shall be provided by the agency.

12. Completeness of work :

    i) The installations shall be completed in all respects and put in to operation even if / even when certain details have not been mentioned / left out in these specifications. Any discrepancy may be brought out in pre-bid meeting.

    ii) All E&M services such as internal & electrical installations, lifts, fire alarm & PA System, fire fighting system,electric substation, DG sets, CCTV, EPBAX, STP, water pumpsets, solar power generation & water heating system, VRF/VRV air-conditioning system, UPS, BMS, Exit signages & LED Sign boards etc shall be declared as

completed after completion of successful trial run of 1 month or completion of whole work whichever is later. However, maintenance of these installations during the maintenance period of 24 months shall be carried out by the agency at his own cost. Defects Liability Period (DLP) / Warranty period of all works / machine / equipment shall commence from actual date of completion of complete work (project).

iii) All electrical & mechanical fittings / fixture / appliances, to be provided for the work, where BEE certification is available should have 5-star rating (of BEE). Since, the proposed construction is for GREEN PLUS GHAR RATING, all fittings and fixtures of minimum requirements required for that rating shall be provided.

iv) All low voltage (LV) Cables/Wires shall be routed through dedicated LV Shaft to the control room

The CPWD specifications are available at CPWD website "www.cpwd.gov.in". The department shall not be responsible for the lack of knowledge and also the consequences thereof to the Contractor. The information and data mentioned in the tender document have been furnished in good faith and for general information and guidance only. The Engineer-in-Charge in no case shall be held responsible for the accuracy thereof and / or interpretations or conclusions drawn there from by the Contractor and all consequences shall be borne by the Contractor and no claim, whatsoever, shall be entertained from the Contractor, if the data or information furnished in tender document is different from data / drawing after Preparationof architectural drawings, design and approved for construction. It is presumed that the Contractor has satisfied himself for all possible contingencies, situations, bottlenecks and acts of coordination, which may be required between different agencies.

13. INCIDENTAL CHARGES: All incidental charges of any kind including cartage, storage, wastage and safe custody of material etc. shall be borne by the Contractor.

14. QUALITY ASSURANCE: The Contractor shall make available, on request from the Department for record, copies of challans, cash memos / Invoices, receipts and other certificates, if any, vouchers towards the quantity and quality of various materials procured and the same shall be kept in record. These shall also provide information for the name of the manufacturer, manufacturer's product identification, manufacturer's instructions, warning, date of manufacturing and test certificates from manufacturers for the product for each consignment delivered at site, shelf life, if any, for the department to ensure that the material have been procured from the approved source and of the approved quality, as directed by the Engineer-in-Charge. Day to day account of receipt of such material shall be maintained at site of work and shall be regulated by the department. All materials as per TPQA guidelines shall be tested from approved laboratory/test house, all samples required for testing shall be submitted and charges towards testing shall be paid by the contractor. Nothing extra shall be payable on this account.

15. STORAGE OF MATERIALS: Storage and safe custody of all materials shall be the sole responsibility of the Contractor. Nothing extra shall be payable on this account.

16. QUALITY CONTROL AND TESTING OF MATERIALS:

(i) All the material to be used on works shall bear ISI certification mark unless otherwise the make is specified in the item or special conditions appended this tender document. In case ISI mark material or the materials mentioned in the tender documents are not available, as per opinion of Engineer-in-charge, which shall be final and binding, the material to be used shall conform to CPWD specifications applicable in this tender or IS Code. In such cases Engineer-in-charge shall satisfy himself about the quality or such material and give his approval in writing. Only articles classified as first quality by the manufacturers shall be used unless otherwise specified. All material not having ISI mark shall be tested as per relevant ISI specification. The Engineer in charge may relax the condition regarding testing if the quantity of the materials required for the work is small. In all cases of use of ISI marked materials proper proof of procurement of materials from authentic manufacturers shall be provided by the contractor to the entire satisfaction of Engineer-in-charge. All materials equivalent to the one specified should be got approved by the Engineer-in-charge before using the said materials in the work.

(ii) If the department desires to send any samples of materials for testing in a accredited laboratory, the Contractor at his own expense shall supply all materials, labour for preparing and testing samples as required by the Engineer-in-Charge. The testing shall be carried out in the presence of the representative of the Engineer- in- Charge. The transportation and testing charges shall also be borne by the contractor.

17. No foreign exchange shall be made available by the department for importing (purchase) of equipments, plants, machinery, materials of any kind. No delay and no claim of any kind shall be entertained from the Contractor on account of variation in the foreign exchange rate and/or any Custom duties / charges or any other taxes & levies.

18. NO WAIVING OF LEGAL RIGHTS AND POWERS :The Engineer-in-Charge shall not be precluded or stopped from taking any measurements, and framing of estimates or detaining any certificates made either before or after the completion and acceptance of the work and payment, from showing the true amount and character of the works performed and materials Furnished by the Contractor and from showing that any such measurements, estimates or certificates untrue or incorrectly made and that Engineer-in-charge shall not be precluded or stopped from recovering from the Contractor such damages as it may be sustained by reasons of his failure to comply the terms and conditions of the contract.

19. The tenderers shall take into account the element of wastage(s) those are likely to be there in all elements of the work and quote his price, considering the same. The tenderers shall study all the items from the point of view of wastage(s), which are likely to take place.

20. Power supply required for construction, testing & commissioning shall have to be arranged by the bidder at his own costs. Water required for testing of equipments is also in the scope of agency.

21. The description of E &M service & specification are given in general but they are not exhaustive i.e. does not mention all the incidental works required to be carried out for complete execution of the item of work. The work shall be carried out, all in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and/ or described in the specifications, provided that the same can be reasonably inferred there from. There may be several incidental works, which are not mentioned in the contract document/specifications but will be necessary to complete the item in all respect. All these incidental works/ costs which are not mentioned, but are necessary to complete the work shall be deemed to have been included in the overall amount quoted by the contractor for various components of work. No adjustment of rates shall be made for any variation in quantum of incidental works due to variation/change in actual working drawings. Also, no adjustment of rates shall be made due to any change in incidental works or any other deviation in such element of work (which is incidental to the items of work and are necessary to complete such items in all respects) on account of the directions of Engineer-in-charge .Nothing extra shall be payable on this account.

22. The scope of works also covers the preparation of layout plans, drawings for E & M schemes and approval of the same from the respective local bodies Fire Officer/Lift Inspector/CFO/CEA etc. before the commencement of work. During execution, if the local bodies etc. require a modification, the same shall be executed without any extra cost. Finally, after execution, approvals / NOCs / clearances from local bodies etc. shall be the responsibility of successful bidder for which nothing extra is payable. In case any modification / extra work is required by the local bodies necessary for approvals / NOCs / clearances, the same shall be got executed and nothing extra shall be paid on this account. All statutory fees / charges required for obtaining clearances from Fire Officer/Lift Inspector/CEA / Local Bodies shall be borne by the contractor.

23. <u>SUPERVISION OF WORK</u>:
The Contractor shall depute experienced Site Engineers & skilled workers as required for the work as per the documents required in technical bids. He shall submit organization chart along with details of Engineers and supervisory staff. It shall be ensured that all decision making powers shall be available to the representatives of the Contractor at site itself to avoid any likely delays on this account. The Contractor shall also furnish list of persons for specialized works to be executed for various items of work. The Contractor shall identify and deploy key persons having qualifications and experience in the similar and other major works, as per the field of their expertise. If during the course of execution of work, the Engineer-in-Charge is of the opinion that the deployed staff is not sufficient or not well experienced; the Contractor shall deploy more staff or better-experienced staff at site to complete the work quality and in stipulated time limit.

ELIGIBILITY CRITERIA FOR MAIN AGENCY WITH RESPECT TO ASSOCIATED ELECTRICAL AGENCY TO BE ENGAGED BY MAIN CONTRACTOR FOR EXECUTING THE ELECTRICAL SUB-HEADS

1. After award of work and before the first milestone, the main contractor will have to submit Name (s) of the proposed associate contractor (for each of the E&M works), who fulfill the set eligibility criteria for the relevant sub-head ending last day of previous month of submission or date of 1st mile stone. The documents will have to be submitted in detail as required, which will be checked as per NIT for approval of the associate contractors. It will be essential that proposed electrical associate agency qualify the eligibility criteria for sub- head given in NIT.

2. The department reserves the right to allow the main firm to submit additional Documents /additional names of the associates in case of the deficiencies in documents or in case of no associate getting qualified in respect of certain subheads. The same will have to be complied with the main contractor within the time allowed. The decision of the department shall be firm & binding on the intending bidders.

3. The main firm should submit the willingness from eligible electrical contractors to get associated with them for execution of the electrical component of works in wholesome manner and as per the conditions set out in the MOU to be entered into, between the one who is awarded the work and the associated eligible electrical contractor.

4. In support of the eligibility conditions of the proposed associated electrical contractor, copy of their registration documents, Electrical Contractor's License, GST documents, eligibility documents by competent authority shall have to be submitted. The credentials for work experience submitted by associate contractor shall be for work executed by him in Central/state Government, Government undertaking, autonomous bodies. Such associate electrical contractor will certify that they are not debarred as on the day of application for sale of tender.

5. In event of the concerned E&M agency not performing satisfactorily or failure of associate/sub-contractor to complete the E&M work, the main contractor on the written direction of the department, shall remove the Associate/sub-contractor deployed on the work and shall submit name of new associate who fulfills the conditions mentioned in NIT to execute the leftover work without any loss of time or variation in cost to the department in this regard. Such associates shall also enter into Agreement with the main tenderer and shall meet all the guarantee for the equipments already supplied for which payment has been released by the department in part. If any equipment supplied for the work, during the currency of the earlier Associate/sub-contractor and paid partly by the department, becomes redundant /not in a position to be installed and commissioned and put to beneficial use due to change in agency for execution of E&M work, the main contractor shall be liable for replacement of the equipment(s) at no cost to Department, No change of Electrical Contractor will be allowed without prior approval of the **SE cum PD, Mumbai Project Circle-II.**

6. Executive Engineer (E) shall be the Engineer-in-charge as far as for all electrical & mechanical services/ works are concerned.

7. The main contractor shall be responsible and liable for proper and complete execution of the Electrical work and ensure coordination and completion of both civil and electrical work.
8. The main contractor has to enter into agreement with contractor(s) associated by him for execution of E&M subheads. Copy of such agreement shall be submitted to EE(C) in charge of work. In case of change of associate contractor, the main contractor has to enter into agreement with the new contractor associated by him.

9. The associate or sub-contractor shall attend the inspection of the work by the Engineer-in- charge of E&M works as and when required. The agencies executing the electrical work should have valid license for LT/HT as applicable and as described in eligibility criteria.

10. Verifiable completion certificates of the work eligibility documents as the case may be, duly attested by the applicant shall be submitted. Valid Electrical Contractor's license, as the case may be, duly countersigned by the applicant as well as signed by the associate contractors shall also be submitted. Self attested GST documents in respect of the associated agencies as well as signed by associate firms shall be submitted.

11. For components of E&M works, the eligibility criteria for specialized agencies to be associated by the main contractor after award of work will be as detailed below:

For the different E&M subheads, the main contractor will have to engage the associate electrical contractor/specialized agency in the field after award of work as per following:-

(a) The main firm should either himself meet the eligibility conditions for the respective E&M packages or otherwise he will have to associate an agency meeting the eligibility requirements given below. They will have to submit willingness certificate for each of the component of the Electrical work for Associate agencies by clearly indicating the applicable component of the work.

(b)

(c) The firm should have successfully completed similar works during the last 7 years ending up to previous day of last date of submission of tender for each sub heads.

(d) The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion to the last date of submission of bid.

NOTE: For the purpose of eligibility criteria only, sub-head wise total cost is given as below which is rough cost and should not be used or interpreted for any other purpose.

Sl. No.	Name of Sub- Head	App. Cost in Cr.	Eligibility criteria	Similar Work
1	Internal & External Electrification. (Area / fascade lighting)	8.88	3 similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One work of value not less than 80% of component cost.	Providing Internal & External EI Work

2	Fire Fighting & Sprinkler System	2.62	3 similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One work of value not less than 80% of component cost.	Providing Fire Fighting System with Wet Riser & Sprinkler System
3	Fire Alarm System with PA System	1.17	3 similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One work of value not less than 80% of component cost.	Providing automatic addressable fire alarm with PA System
4	Lifts	1.99	The work shall be got executed by the OEM of lift of accepted makes, who fullfils the eligibility criteria as specified in package 4 (Lifts)	
5	Elelctrical Sub-station	3.07	3 similar works each of value not less than 40% of component cost with capacity of individual transformer being 80% of individual capacity (1600KVA) rounded off to next higher value or more / 2 similar works each of value not less than 60% of component cost with capacity of individual transformer being 80% of individual capacity(1600KVA) rounded off to next higher value or more/ One similar work each of value not less than 80% of component cost with capacity of individual transformer being 80% of individual capacity(1600KVA) rounded off to next higher value or more	Pdg. Substation equipments like Transformer, HT VCB Panel/ LT panel, APFC Panel, Bus trunking etc., having minimum one no. transformer of 1600 KVA or more
6	D. G. set	0.81	3 similar works each of value not less than 40% of component cost with capacity of individual D. G. set being 80% of individual capacity (320KVA) rounded off to next higher value or more/ 2 similar works each of value not less than 60% of component cost with capacity of individual D. G. set being 80% of individual capacity(320KVA) rounded off to next higher value or more /One similar work each of value not less than 80% of component cost with capacity of individual D. G. set being 80% of individual capacity(320KVA) rounded	Pdg. D. G. set and equipments like AMF panel, Bus trunking etc., having min. one no. D. G. Set of 320 KVA or more

			off to next higher value or more	
7	CCTV Surveillance System	0.46	3 similar works each of value not less than 40% of component cost OR 2 similar works each of value not less than 60% of component cost OR One similar work each of value not less than 80% of component cost	As per respective specialized work
8	Integrated BMS	0.59	3 similar works each of value not less than 40% of component cost OR 2 similar works each of value not less than 60% of component cost OR One similar work each of value not less than 80% of component cost	As per respective specialized work
9	Sewage Treatment plant	1.86	3 similar works each of value not less than 40% of component cost with capacity of 80KLD or more OR 2 similar works each of value not less than 60% of component cost cost with capacity of 80KLD or more OR One similar work each of value not less than 80% of component cost with capacity of 80KLD or more.	As per respective specialized work
10	VRF/VRV Air Conditioning system & ventilation system	4.23	3 similar works, each of value not less than 40% of component cost with individual work of total capacity 80% of individual capacity(780 HP) rounded off to next higher value or more/ 2 similar works, each of value not less than 60% of component cost with individual work of total capacity 80% of individual capacity (780 HP) rounded off to next higher value or more / One similar work each of value not less than 80% of component with individual work of total capacity 80% of individual capacity(780 HP) rounded off to next higher value OR more	Pdg. VRF/VRV System and other Equipments like AHUs, ducting, piping etc, having min. individual work of total capacity 780 HP
11	UPS	0.64	3 similar works each of value not less than 40% of component cost with capacity of individual UPS set being 120 KVA or more / 2 similar works each of value not less than 60% of component cost with capacity of individual UPS set being 120 KVA or more/ OR One similar work each of value not less than 80% of component cost with capacity of individual UPS set being 120 KVA OR more.	As per respective specialized work

12	Solar PV Power Generation system	0.32	3 similar works each of value not less than 40% of component cost with capacity of individual system being 24 KWp or more/ 2 similar works each of value not less than 60% of component cost with capacity of individual system being 24 KWp or more/ One similar work each of value not less than 80% of component cost with capacity of individual system being 24 KWp or more	Pdg. Solar photo voltaic Power Generation system and equipments like P. V. module, AC/ DC DB/ LT panel, Net meter etc., having minimum one system of 24 KWp or more
13	Solar Water Heating system	0.029	3 similar works each of value not less than 40% of component cost with capacity of individual system being 800 LPD or more / 2 similar works each of value not less than 60% of component cost with capacity of individual system being 800 LPD or more / One similar work each of value not less than 80% of component cost with capacity of individual system being 800 LPD or more	Pdg. Solar Water Heating system and equipments like collector, tank etc., having minimum one system of 800 LPD or more
14	IP EPBAX System	0.053	3 similar works, each of value not less than 40% of component cost OR 2 similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost	As per respective specialized work
15	Exit signages & Electrical LED sign board	0.11	3 similar works each of value not less than 40% of component cost OR 2 similar works each of value not less than 60% of component cost OR One similar work each of value not less than 80% of component cost	Pdg. Electrical LED sign board
16	Audio Video, conference and stage lighting	0.95	3 similar works each of value not less than 40% of component cost OR 2 similar works each of value not less than 60% of component cost OR One similar work each of value not less than 80% of component cost	Pdg. Audio Video Work

The Contractor is also be eligible to carry out any or all of these works without associating any specialized agency provided:

(a) Contractor fulfills the prescribed eligibility criteria respectively for these work(s).

OR

(b) Contractor directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.

FORM – 'K'

WILLINGNESS CERTIFICATE FROM CONCERNED COMPETENT ELECTRICAL CONTRACTOR (Separate for each sub head of E&M work)

Name of Work: Construction of New Administrative Cum Academic Building (G+6) with Auditorium and Director's Bungalow (G+1) (New Infrastructure Development Project) for IIPS at Deonar, Mumbai including water supply, sanitary installation, electrical installations, lifts, fire alarm, PA System & fire fighting system, electric substation, DG sets, CCTV, EPBAX, Audio & Video conference system, STP, water pumps, solar water heating & power generation system, VRF / VRV air-conditioning system, UPS, mechanical ventilation system, BMS, Exit & LED Sign Boards, external development works on Engineering, Procurement and Construction (EPC) basis.

I hereby give my willingness to work as asssssociate contractoe for electrical / specilized work (……..) of the above mentioned work. I will execute the work as per specifications and conditions for the agreement and as per direction of the Engineer-in-charge. Also I will employee full time technically qualified supervisor for the works.

I will attend inspection of officers of the department as and when required.

Dated:

Signature of Main Contractor	Signature of Associate Electrical Contractor
Address:	Registration detail Address:
Telephone:	Telephone:
FAX:	FAX:
e-mail:	e-mail:

MEMORANDUM OF UNDERSTANDING [M.O.U] BETWEEN
(Separate for each sub head of E&M work)

1] M/S [Name of the firm with full address]

[Henceforth called the main contractor]

And

2] M/S [Name of the firm with full address]

[Henceforth, called Associated Electrical Contractor or Electrical Contractor]

For the execution of Electrical Work: Construction of New Administrative Cum Academic Building (G+6) with Auditorium and Director's Bungalow (G+1) (New Infrastructure Development Project) for IIPS at Deonar, Mumbai including water supply, sanitary installation, electrical installations, lifts, fire alarm, PA System & fire fighting system, electric substation, DG sets, CCTV, EPBAX, Audio & Video conference system, STP, water pumps, solar water heating & power generation system, VRF / VRV air-conditioning system, UPS, mechanical ventilation system, BMS, Exit & LED Sign Boards, external development works on Engineering, Procurement and Construction (EPC) basis.

.

Name of sub-work: ……

We state that M.O.U between us will be treated as an agreement and has legality as per Indian Contract Act [amended upto date] and the department [CPWD] can enforce all the terms and conditions of the agreement for execution of the above work. Both of us shall be responsible for the execution of work as per the agreement to the extent this MOU allows. In case of any dispute, either of us will go for mediation/arbitration by the SE Cum PD,MPC – II,CPWD Mumbai. Any of us may appeal against the mediation/arbitration to the SE Cum PD,MPC – II, CPWD, Mumbai. His decision shall be final and binding on both of us.

We have agreed as under:

1. The main contractor / specialized associate agency will execute all works in the wholesome manner as per terms and conditions of the agreement. The main contractor shall be paid as per standard procedure followed by the department as per agreement terms and conditions. Any type of internal transaction between the Associate contractor and the main contractor shall be as per their convenience and mutual understanding without involving the department.
2. The main contractor shall be liable for disciplinary action if he / Associate contractor failed to discharge the action[s] and other legal action as per agreement.
3. All the machinery and equipments, tools and tackles required for execution of the

electrical works, as per agreement, shall be the responsibility of the main contractor.
4. The site staff required for the electrical / mechanical work shall be arranged by the main contractor as per terms and conditions of the agreement.

i) Site order book maintained for the said work shall be signed by the main contractor as well as by the Engineer of the Associated Contractor and by Associated Contractor himself.

ii) All the correspondence regarding execution of the electrical /mechanical work shall be done by the Department with the Associated Contractor with a copy to the main contractor. In case of non-compliance of the provisions of agreement, the main contractor, as well as the associated contractor shall be responsible. The action under clauses 2 and 3 shall be initiated and taken against the main contractor.

5. Name of the Sub Head / Package:--

Signature of main contractor	Signature of associated electrical contractor
Name :	Name :
Address :	Address :
Date:	Date :
Place:	Place:

COUNTERSIGNED

EXECUTIVE ENGINEER

PACKAGE - 1 (Internal & External Electrification works)

SCOPE OF WORK includes:

Designing, planning, supplying, installation, testing and commissioning of all internal & external electrical works for Administrative cum Academic building, Auditorium and Director Bungalow as follows :

1. Point wiring,
2. Circuit / submain wiring .
3. Power wiring.
4. Telephone, LAN wiring.
5. TV cabling
6. SITC of LED type Luminaires, fans, exhaust fans, bells, power plugs, TV sockets, RJ 45 LAN sockets, RJ 11 sockets, DBs, Panels etc.
7. All necessary cabling / sub- main between Main panel to different panels, DBs, sub DBs etc.
8. Earthings.

The work shall be generally carried out in accordance with tender conditions and the following specification and rules.

a) CPWD General Specification for electrical works Part I Internal 2013 as amended up to date.
b) CPWD general specification for electrical works Part II External 1994 as amended up to date.
c) CPWD general specification for electrical works Part IV Sub-Station 2013 as amended up to date.
d) Indian Electricity Act 2003 amended up to date.
e) National Electrical Code. 2017 amended up to date.
f) Indian Electricity Rule 2005 amended up to date.
g) National Building Code 2016 as amended up to date
h) GREEN AND GHAR RATING and Barrier Free And Accessibility norms.

Note: The following information given is indicative only. Execution shall be carried out as per functional requirement and design approved by engineer-in-charge.

Internal Electrical Installation :-

1.1 All internal electrical works shall be carried out with GI conduit in recess / surface. All switches, sockets, Telephone socket, TV socket, Data sockets, stepped type electronic fan regulators, bell push, MCB control socket outlet and accessories along with matching mounting boxes shall be of modular type. All modular accessories shall be of same make & model.

1.2 Required illumination level for general lighting shall be achieved as per CPWD General specification for Electrical part-I -2013/NBC-2016/IS guidelines. Wherever range of illumination for space is mentioned, higher side of Lux level shall be taken for design purpose.

1.3. Arrangement of luminaries in various areas of buildings shall be done as per list attached. Light points with Special fittings for murals as per requirement and designed approved by Engineer- in- charge.

1.4 Ceiling fans (BLDC type) shall be provided in all areas. The size of ceiling fans shall be 1200 / 1400 mm BLDC type with remote & regulator on switch. Optimum size and number of ceiling fans for rooms of different size shall be as per provision laid down in CPWD specifications for Internal E.I. work – 2013. Minimum air delivery and service value shall be as per ECBC norms. Wherever ceiling fan is not feasible, cabin fans shall be provided. (Generally in cabins, waiting lobby etc)

1.5 Heavy duty Metallic exhaust fan with louvers as per the requirement of ventilation shall be provided in lift machine room, Fire fighting pump room & substation etc. The number of exhaust fan/ventilation fan shall be calculated on the basis of number of air changes required as per NBC 2016 norms. However minimum size of exhaust fan shall not be less than 380 mm sweep. Suitable size of fresh air fan/exhaust/ventilation fan shall be provided in pantries/kitchen/ toilet. The suitable size of ventilation fan, jet fan shall be provided for mechanical force ventilation as per design.

1.6 Minimum size of copper conductor for power wiring/light plug wiring shall be 4 Sq mm PVC insulated multi strand with FRLS copper conductor cable and for light/fan points/exhaust fan/call bell point - wiring shall be done with 1.5 sq mm PVC insulated multi strand FRLS copper conductor cable.

1.7 Wiring for Intercom / Telephone shall be terminated in suitable size of G.I. Junction box and RJ-11 socket (for analogue phone) & RJ45 socket (for Ip phone). All the other end of wiring shall be terminated in krone box at each floor and in the EPABX room. The wiring shall be suitably tagged/marked mentioning the location of each point. Wiring for both analogue & IP phone shall be done with cat-6 armoured/ unarmoured UTP 4 pair cable as required.

1.8 GI Metal floor trunking (Race ways) for drawing LAN cables /power cables shall be done for all computer outlets. GI Metal trunking shall have separator in between power cable & LAN cables.

1.9 Floor trunking shall be made up of minimum 1.6 mm thick Pre-Galvanised / Hot dipped G.I sheet (minimum 275 GSM) including junction box of suitable size, Couplers, Jointing sleeves, floor fixing supports complete with cover as required. Size of the same shall be as per requirement as per approval of engineer in charge.

1.10 For CCTV, Cat-6 UTP, 4 pair unarmoured / armoured cable in indoor / outdoor application shall be provided as per the design and to be terminated in G.I. Junction box & wiring for cable TV with coaxial cable RG-6 grade, 0.7 mm solid copper conductor PE insulated with fine tinned copper braided & protected with PVC sheath shall be provided as per design. The wiring and conduit route plan/drawings shall be submitted by the contractor and shall be got approved from the Engineer-in-charge.

1.11 To facilitate drawing of wires, 18 SWG GI fish wire shall be provided in recessed conduit .i.e. Conduits laid for other services, like PA system etc., where wiring is not done along IEI works,fish wire shall be invariably drawn.

1.12 All lights in toilet, cabins, class room, meeting, conference room & storage space shall be controlled by motion sensors / occupancy sensors/ day light sensors. Configuration tool for sensor programming shall also be provided as per requirement of client. There shall be arrangement of bypass switch so that in case of failure of sensor, the light can be operated after by passing the sensor.

1.13 All exit signages in staircases, exit path and in critical areas shall be on UPS DB.

1.14 In parking areas, staircase areas, corridors, big halls etc. no switch for individual light control is to be provided all such point shall be executed on looping basis and shall be group controlled by MCB/switch from DB. In these areas Light controls shall be provided in such a manner to switch ON/OFF general lighting as per requirement /bay or section wise.

1.15 All suspended light fittings shall use suspension GI wire and assembly either supplied by Light fitting manufacturer or by their recommended OEM.

1.16 Inside the lift shaft there shall be arrangement of one light point with LED Bulk head fittings of suitable rating (minimum 800 lumens) shall be provided at each floor level end. All light points shall be in individual controlled and wired with 1.5sq mm FRLS copper conductor cable. 15 amp 6 pin power plug shall also be provided at all floors with 4 sq mm FRLS copper wiring.

1.17 Essential & non-essential 3 phase VTPN/horizontal TPN DBs shall be provided separately. Incomer for VTPN DB shall be MCCB / MCB of suitable rating & breaking capacity. The size of both type of DBs shall be as per the requirement of number of circuits connected from the DBs. In addition spare for another 2 nos. Circuits shall also be considered in each DB. All distribution boards shall be double door type with RCBO of 300 MA sensitivity of suitable rating as incomer & outgoings shall be suitable rating SP MCB /TP MCB

1.18 The rupturing capacity of the MCB's shall be 10 KA. The MCB's shall be ISI marked & the rupturing capacity of MCCBs shall be as per design of fault level, but shall not be less than 25 KA & the rupturing capacity of ACBs shall be as per design of fault level, but shall not be less than 50 KA.

1.19 The Make of MCB, RCCB, RCBO etc. shall be of the same as that of MCB DB

1.20 LT panel shall be cubicle modular type with IP 42 protection class and fabricated from CPRI approved fabricator from 2 mm thick CRCA sheet powder coated with 7 tank process and shall be equipped with suitable rating of 4 pole MCCBs/ACBs, as incomer/outgoing , Bus bars, suitable size of 2 nos. copper earth strips, digital type Multi function meter to measure parameters like current, voltage, frequency, wattage, power factor, KWH, KVA, phase angle etc. as per drawing approved by Engineer – in –

charge. Each outgoing shall be with suitable rating multifunction meter with RS485 port & control MCB. Floor Panels if required in building shall be provided for essential and non-essential. Incomer of essential panel shall be connected with DG set Supply and incomer of non-essential panel shall be connected with main/primary supply. Incomer, outgoing, bus bar, indicating instruments etc shall be designed as per maximum load and shall be got approved from Engineer-in-charge.

1.21 **Main LT panel shall feed :**

1. DG AMF panel.
2. APFC panel
3. HVAC - VRF system panel.
4. Non essential Rising Main - 2 nos. i.e 1 no. for each wing.
5. Backup for solar water heating system

Essential panel shall feed :

1.Essential rising main (for all Lighting & power loads) - 2 nos. i.e 1 no. for each wing.
2. Ventilation system.
3.Pressurisation panel.
5.Lift power & light panel.
6. AHU's
7.Pump set panel.
8.Fire fighting panel
9.UPS panel.

UPS panel shall feed UPS rising main & in turn it shall feed :

1. All computer loads
2. EPABX system
3. CCTV
4. Fire alarm System
5. Server
6. IBMS workstation & all DDCs.
7. Audio- Video System
8. Video Conferencing

1.22 MCCB, if used as incomer then it should have inbuilt earth fault protection and time delay. Separate earth leakage modules are not acceptable.

1.23 The breaking capacity of MCCB for all types of panel boards except DBs shall be as per fault level of that location. The rated service breaking capacity should be equal to rated ultimate breaking capacities (Ics=100% Icu). Where Ics is service breaking capacity and Icu is ultimate breaking capacity and they should be of approved make. MCCBs above 200A shall be provided with micro-processed based with suitable fault level with adjustable O/L, S/C, protection and up to 200A with Thermal Magnetic release of suitable fault level having adjustable settings for O/L and S/C. The breaking capacity of MCCB shall be minimum 25 KA up to 100 A & 35KA for ratings more than 100 A and upto 200A, 50KA for rating more than 200A up to 800 A, 60 KA for ratings above 800 A. The ACB/MCCB shall be same make of approved company.

1.24 All Electrical panel having incomer above 63A, shall be fabricated from System integrator/channel partner of the ACB/MCCB manufacturer, CPRI approved and strictly as per CPWD specifications. The drawing of panel boards must be got approved from Engineer – in – charge before fabrication work. The panel board shall consist of 4 pole MCCB of suitable rating & KA as per fault level as incomer & actual required nos. of outgoings with 20% spare outgoings feeders having 4 strip copper bus bar [The cross section of Bus bar shall be considered so that current density is 160 Amp/sq.cm (1000 Amp/sq inch)] & shall be adopted with 100% neutral, digital type multifunction meter with RS 485 port for remote monitoring through SCADA/BMS on Ethernet, selector switches, LED type indication lamps etc as per standard sound engineering practice. The capacity of 20% spares out going feeder shall be decided by the engineer-in-charge as per requirement.

1.25 Wires used shall be FRLS type, Cables – FRLS XLPE/PVC insulated PVC sheathed armoured cable.

1.26 All Cables in Parking area, Plant / Pump Rooms, Electrical Room, AHU room, LV rooms, Shafts shall be laid on cable trays and approx. **25% capacity** of all such cable trays shall remain unused as future provision.

1.27 Such cable tray on Parking area, Plant / Pump Rooms, Electrical Room, AHU room, LV Rooms, terrace area shall be steel wire mesh type & follow below Specifications.

a) Steel wire mesh (SS 304) Cable trays to be provided. Planning of cable tray and support system may be prepared using suitable software of the OEM of cable tray. Special attention shall be paid toward hanging / suspension support system. The support system shall also be provided by cable tray manufacture as per recommendation of OEM of cable trays.

b) Proper factory made TEE, Bend, elbows , cross, joints and other accessories shall be used

1.28 Cable trays above false ceiling on all other places shall be Perforated Hot Dipped Galvanised Iron (galvanisation thickness i.e average mass of Zinc coating shall not be less than 65 microns for 2 mm thick & 50 microns for 1.6 mm thick as per IS standard) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I.suspenders including G.I. bolts & nuts, etc. as required. Suitable size as per site conditions shall be used with thickness 1.6 mm for cable trays with width≤ 300 mm & thickness 2 mm for cable trays with width > 300mm.

1.29 Rising mains: Upward transmission of power inside the buildings shall be done through rising main. The Rising mains shall be provided separately for essential, non essential & UPS separately for each.

Essential rising main shall feed

1. All lighting load
2. All essential power load
3. All AHUs - For auditorium.

Non essential rising main shall feed

1. All non essential power load.

UPS rising main shall feed

1. All computer load.
2. CCTV
3. BMS control.
4. EPABX system
5. Fire alarm system, Server
6. IBMS workstation & all DDCs.
7. Video Conferencing

Rising main shall be sandwich type rising mains with Copper busbar for use on 3 phase 4 wire 415 V, 50Hz A.C. supply with GI/CRCA enclosure having IP-54 rating after fixing the tap off boxes and all accessories, made of 1.6mm thick steel sheet duly powder coated in convenient sections complete with 4 Nos. copper bus bars having current density of 160 A/ sq. cm at nominal current rating, necessary joints & expansion joints, fire barrier at each floor, provision of tapping at every meter, continuous earthing with 2 Nos. copper strip of not less than 20 x 3 mm upto 400 Amp & 20 x 5 mm for higher capacity (one on each side) including, G.I. clamping brackets, angle iron bracket, steel fasteners, connecting to earthing system etc i/c all accessories i.e. adopter box, cable end box, tap-off box with suitable rating MCCB. The minimum size of the section of bus bar shall be as per CPWD specifications for work part I Internal 2013 and General specifications for Electric sub station part IV 2013.

1.30 Rating of rising mains shall be decided as per maximum load of the building and **20% future expansion** and shall got approved by Engineer – in –Charge. Rising mains shall be conforming to IS 8623/ IEC 60439 as amendment up to date & shall have future provision by providing minimum 25% extra tap off boxes with suitable rating of MCCB as per approval by Engineer in charge.

1.31 After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2013 & Indian Electricity Rules 2005, shall be recorded and submitted to the department.

1.32 For accommodating various size of cables incoming to the building, medium class G.I. pipe of suitable size shall be provided.

1.33 Earthing: Copper plate earthing system comprising of earth electrode, earth conductor, earth bus, protective conductor etc for building shall be as per provision laid down in CPWD specifications part – I, 2013. Earthing system should be designed such as to maintain earth resistance as specified in CPWD specifications. Earth resistance shall be checked / tested in harsh climatic conditions. Minimum earthing sets shall be considered as follows:-

1. DG set - 2 nos. for Neutral earthing for each DG set + 2 Nos. for Body earthing.
2. Transformer – 2 nos. for Neutral earthing for each transformer + 2 Nos. for Body earthing.

3. HT panel – 2 sets. (Additional earthing as per requirement of local power supply company for HT metering unit – Kiosk etc.)
4. LT panel- 2 sets
5. Lift - 2 sets for each lift bank.
6. UPS – 2 sets for Neutral earthing for each UPS set + 2 Nos. for Body earthing. (Additional Earthing for isolation transformer as required.)
7. Rising Main - 2 sets for Essential Rising Main and Non- essential R.M + 2 sets for UPS R.M. for each Electrical Shaft
8. Lightening arrestor- 4 sets.
9. STP – 2 sets
10. FFS pumps & domestic pumps - 2 sets.
11. VRF A/C system - 2 sets.
12. Solar PV generation + solar water heater- 4 sets

Note :- If required additional earthsets shall have to be provided as per actual site / equipment requirements.

1.34 Following minimum provision is to be taken in to consideration during designing :

a) Call bell system and LED Indicator type (red/green light to indicate availability of officer) for each senior officer room, as directed by Engineer in charge, shall be provided.

b) Power, LAN & TV point

Sl. No	Location	6 A plug / 16A Plug	Computer socket outlet (Combination of 1 No. 16A switch and 3 No. 6A socket)	TV power outlet (Combination of 2 No. 6A switch and 2No. 6A socket)	Telephone Outlet (RJ 11)	Provision for LAN Outlet (RJ 45)	TV socket outlet	Remarks & Other Requirements
1	Cabin of Director / Registrar/ Finance Officer/ Assistant Registrar / Group AB offices	3 Nos.	2 Nos.	1 No.	1 No.	3 Nos.	1 No.	Computer outlet shall be connected to UPS. RJ -11 for Directline. RJ45 – 3nos. i.e 2 Nos.for internet & 1 no. for IP phone.
2	Cabin of Director / Registrar	2 Nos.	2 Nos.	1 No.	1 No.	3 Nos.	-----	.....do.....

	Personal staff / Academic section/ Reception / Ground floor office							
3	Classrooms / Recreation / Service center	2 Nos.	1No.	-----	1 No	1 No		Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 – 1 no. for internet.
4	Professor room (Faculty) / Spare room/ Record room	1 No.	1No.	-----	1 No	1 No		Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 – 1 no. for internet.
5	Meeting rooms	4 Nos.	2 Nos.	-----	1 No.	3 Nos.	-----	Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 – 3 nos. for internet.
6	Conference Halls / Halls (1st floor)	6 Nos.	3 Nos.	-----	1 No.	4 Nos.	-----	Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 – 4 nos. for internet.
7	Account Section	6 Nos.	4 Nos.	-----	3 Nos.	4 Nos.	-----	Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 – 4 nos. for internet.
8	Exhibition Area	6 Nos.	2 Nos.	-----	1 No.	2 Nos.	-----	Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 – 2 nos. for

								internet.
9	Project Center & Research Center	15 Nos.	15 Nos.	-----	4 Nos.	15 Nos.	-----	Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 for internet.
10	Server Room	04 Nos.	1 No.	-----	1 No.	1 No.	-----	Additional 02 Nos. 3 phase 32A industrial socket outlet points to be provided.
11	Computer lab (30 capacity)	4 Nos.	30 Nos.	-----	1 No.	30 Nos.	-----	Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 for internet.
12	Computer lab (60 capacity)	4 Nos.	60 Nos.	-----	1 No.	60 Nos.	-----	Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 for internet.
13	Video conferenci ng room	4 Nos.	6 Nos.	1 No.	1 No.	6 Nos.	-----	Computer outlet shall be connected to UPS. RJ -11 for intercom. RJ45 for internet.
14	Smart open halls (for PHD students and project staff)	10 Nos.	As per actual require ment	-----	2 Nos.	As per actual requir ement	------	At 6th floor both wings.
15	Pantry	6 Nos.	-----	-----	1 No.	-----	-----	
16	Canteen	7 Nos.	1 No.	-----	1 No.	1 No.	-----	
17	House keeping	1 No.			1 No.			
18	Corridor / lobby/	One no for			One no for 100	One no for		

	/common area	50 sq.mtr			sq.mtr	100 sq.mtr		
19	Service/ Utility Areas such as							
20	Elect. substation	10 Nos.			1 No.			
21	Fire Fighting Pump Room	2 Nos.			1 No.			
22	UPS Room (Proposed)	2 Nos.			1 No.			
23	AHU Room	1 No.	1 No.		1 No.	1 No.		
24	BMS Room (Proposed)	3 Nos.	1 No.	-----	1 No.	3 Nos.	-----	
25	Fire Control room	4 Nos.	1 No.	1 No.	2 Nos.	3 Nos.		
26	Lift Machine Room	2 Nos. each			1 No.			

Auditorium :-

Wiring with required size of FRLS PVC insulated copper conductor wire in G. I conduit as per design approved by department including stage lighting, Audio- Video systems including MCB DB's. LED foot lights minimum 06 Nos. in each row shall be considered alongwith Entrance / Exit signages, decorative wall lights, Dimmable downlighters / LED fittings in Auditorium. Acoustic insulation for walls and underdeck insulation for ceiling. Air circulating fans minimum 600 mm sweep as per air changes required shall be provided in Auditorium. Fire extinguishers auditorium – inside (stage, Male, female Green room, Operator room, AHU room, Stair case, Entrances shall be considered.)

DIRECTOR BUNGALOW :-

The Director bungalow shall have Internal Electrical installations as per Yardstick mentioned in DPAR 2019.
The design shall include circuit wiring, sub main wiring, 6 Amp plug points,16 Amp plug points, modular MCB controlled socket outlets, USB port, LAN sockets, computer outlets, MCB DBs with MCB, LED batten fitting, downlighters, decorative wall brackets, modular chimney for kitchen, weather proof outdoor LED type luminaires at terrace, geysers - 3 nos. and Split air conditioners – 3 nos. Area lighting comprising of bollard fittings including external service connection, deposit charges and metering arrangement etc. Type & capacity of Geysers shall be decided by Engineer-in-charge.

Minimum requirement of solar panel water heating system is 300 LPD at 60^{o} for Director Bungalow alongwith a backup electric source to heat up the water in case of cloudy weather.
G.I plate earthing - 2 Nos. for E. I and 2 Nos. for Solar water heating system.

c) VALUES OF ILLUMINATION AND TYPE OF LIGHTING FIXTURE :-

Sr. No.	Area / Space	Range of Average Illumination in Lux	Type of Lamps/ Luminaries preferred	Required CCT	Remarks
1	Lift Lobby	150-200-300	Surface / recessed type LED Down lighter. With IP 20 housing	5000 K to 6500 K	Surface / recessed type LED Down lighter
2	Lifts car	150	recessed LED Down lighters	4000 K	recessed LED Down lighters
3	Lift shaft		LED bulk head fitting with IP 65 rating minimum 800 lumens	5000 K to 6500 K	LED Bulkhead of minimum 800 lumen out put
	Lift machine room	200	4 ft LED batten	6000 K +- 500 K	Illumination level as per CPWD specification for lifts, 4 ft LED batten with minimum 3200 lumens
	Office area, cabins, Big halls, canteen etc	300-500-750	Linear Recess suspended type luminaire1200 mm/2400mm/ 3600mm + LED down lighters	5500 K to 6500 K	luminaire with wave type PMMA drop down diffuser with minimum lumen output 3200 lumens.
	Work station	300-500-750	Recess type 2'x2'LED backlit lumens	5500 K to 6500 K	
7	Corridor, Passage way, Stairs case	50-100-150	Surface / recessed type LED Down lighters	3500 K to 4000 K	Surface / recessed type LED Down lighters
8	Toilet areas	50-100-	Surface / recessed type	3000 K to	

		150	LED Down lighters& LED miror light above mirror	3500 K	
9	Conference room	300-500-750	Linear Recess suspended type luminaire1200 mm/2400mm/ 3600mm long with DALI dimmable driver. Recess type 2' x 2' LED backlit luminaire	5500 K to 6500 K	
10	Service/ Utility Areas such as Electrical, sub station Room, fire fighiting room, Pump Room, UPS,AHU room, etc.	100-150-200	Surface/Industrial type 4 ft LED fitting with IP 65	5500 K to 6500 K	Industrial Surface 4 ft LED luminaire with IP 65
11	Guest room, VIP suite	300 LUX	Recess type 2'x2'LEDbacklit luminaire & recessed type LED Down lighters		
12	Compactor room	300 LUX	Surface 4 ft LED fitting		
13	Car Parking area	50	Industrial type 4 ft LED batten IP 65	5500 K to 6500 K	
14	Open car parking	50	LED post top lantern	5800 k	LED post top lantern
15	Ramp and corners	50	Outdoor pathway light in recess and bollard		Outdoor pathway light in recess and bollard
16	Entrance and exits of car parking	50-100-150	LED post top lantern ring type luminaire IP 65	3000 K to 3500 K	LED post top lantern ring type luminaire
17	Gate lighting	50	LED post top lantern with IP65		LED post top lantern

18	Garden in podium, Water Bodies & Landscape lighting	Aesthetical Considerat ion	LED post top lantern, bollard as aesthetically required with IP 65 rating		LED post top lantern, bollard as aesthetically required

Note: The above details are for general guidelines, however as per site conditions requirements could be changed and same shall be considered while finalising luminaires/fittings.

1.36 Electric signage:- Electric signage shall be provided with integral battery capacity of 30 minutes & bicoloured LED status indicator & should visible from 40 mtrs, to indicate Exit, staircase location, toilet location, handicapped toilet location, lift location etc.

1.37 Lightening Arrestor:-Lightning conductor shall be provided for building as per CPWD General Specifications for Electrical Works Part-I (Internal)- 2013. Lightening Arrestor system shall comprise of :

a) Connections of lightning arrestors / Air terminal with earth pits shall be done with suitable size of copper strip including testing clamps as per CPWD General Specifications for Electrical Works Part-I (Internal)- 2013.

b) Copper plate earth sets – 2 Nos. per lightning conductor with connections shall be provided.

1.38 Aviation obstruction lights (LED Type), if required by local bye laws, shall be provided.

1.39 The technical specification of LED fittings are enclosed below. All the LED fittings i/c driver shall be under the comprehensive warranty of 5 years from the date of completion of work.

Note For LED bulbs/Fittings:

All LED bulbs/fittings shall be guaranteed for a period of 5 years. 10% of LED Light component amount will be with held from the payment of the contractor as guarantee, amount which will be released after five years of successful performance of LED lights. For this purpose amount of LED Light component will be considered as 50 Lacs.

1.40 Completion plan and completion certificate shall be submitted as per chapter 1/ Pt. 1.26 of CPWD General Specifications for Electrical work Part – I Internal 2013.

NOTE:- Passive & active components of computer data networking i.e Cat-6 cabling along with network including SITC of metal trunking, modular switch, sockets, RJ45 socket of LAN system are included in the scope of work.

2. External electrical installation.

2.1 Distribution of electric power to land scapping, area and fascade lighting etc. and gate lights shall be with FRLS XLPE insulated and PVC sheathed aluminium conductor armored UG cable of 1100 V (ISI marked) with loop earthing.

2.2 The cables shall be laid direct in ground, pipe, closed or open duct, cable trays or on surface of wall etc. depending upon the site conditions and as per direction of Engineer-In-charge. Tagging of cables on both ends of each circuit of compound lighting and gate lights shall be done.

2.3 Lighting luminaries for land scapping, area and fascade be of LED type as specified in bid documents. LED bollards/gate light fittings around Director Bunglow shall be considered. Land scapping, area and fascade and bollard lighting for Administrative cum Academic Building shall be considered.

2.4 All lights of land scapping, area and fascade shall be controlled by astronomical time switch. There shall be arrangement of bypass switch so that in case of failure of time switch, the lights can be operated after bypassing the same.

2.5 GI pipe of suitable size for protection of UG cables shall be used for road crossing, entry in to buildings and paved areas as per direction of Engineer-in-charge.

2.6 After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2013 and CPWD General Specifications Part-II (External)-1994 shall be recorded and submitted to the department. The results shall be within the permissible limits.

1. TECHNICAL SPECIFICATION OF Surface Mounted LED DOWNLIGHTERS

Sr.No.	Parameters	Technical specifications
1	Light Source	SMD LED Chip
2	LED Make	NICHIA/ OSRAM/ SEOUL/ PHILIPS LUMILEDS/ LEDNIUM/ CREE
3	Lighting Wattage/ Type	≤15 W
4	Colour Temperature	6000K(+_500K) COOL WHITE,4000K(+/-200K) & 2700K to 3000K for warm light
5	LED Chip Wattage	<1w
6	Ingress protection level	IP - 20
7	Min Lumen	1500
8	Min Efficacy (lm/Watt)	100
9	CRI(Typical)	Not less than 80
10	Beam Angle	Not less than 120
11	Junction temp	Minimum 85° C
12	LED Chip Efficacy	Minimum 135 Lm/W
13	Harmonics	Max 15%
14	EMC	CISPER 15 / IEC 61000-4-3

15	Lumen Maintenance at 85º C and LED Life	Minimum 70% up to 50,000 hrs (indoor application) and Life Expectancy 50,000 hrs for LED
16	Power Factor	Minimum 0.95 at full load / 230 Vac
17	Life Expectancy of Driver	Minimum 30,000 hrs
18	Rated Voltage	220 – 240 V
19	Operating Voltage	180 – 260 V
20	Surge Protection	2.5kV L N for Indoor Lighting
21	Working Temperature	-15 to +50º C
22	Product Housing OP Temperature	-5 to +50º C
23	Outer Body Luminaire Temperature	Max upto 70º C (with +-3º C) at ambient temperature
24	Working Humidity	10%- 90% RH
25	Luminaries Efficacy	>100 Lm/W
26	Driver Efficiency	>85 %
27	LED Life Span and Luminaire Photometric Data	IESNALM79 and IESNALM80 respectively
28	Housing Material	Die cast Aluminium / Extruded Aluminium
29	Temperature Cycling Test and Supply Voltage Switching Test	1) Product shall be subjected to 10º C for 1 hr then switch to 50º C for 1 hr – Total 5 cycle 2) 30 Sec On & 30 Sec Off At the end of test as per (1) & (2), no visual damage shall be observed and lamp shall alight for more than 15 min after test.
30	Accelerated Operational Life Test	Product shall be operated continuously for 6000 hrs. Test has to be conducted at 45º C. At the end of test, no visual damage shall be observed and lamp shall alight for more than 15 min after test.
31	Standard Warranty	5 years
32	LED Life Hours	Minimum 50,000 hrs with L 70 Life
33	LM79 Test Certificate for Lumens	LM79 Test Certificate
34	Environmental Consideration	ROHS Complaint

2. TECHNICAL SPECIFICATION OF Recess Mounted 2 ft x 2 ft LED backlit Luminaries

Sr.No.	Parameters	Technical specifications
1	Light Source	SMD LED Chip
2	LED Make	NICHIA/ OSRAM/ SEOUL/ PHILIPS LUMILEDS/ LEDNIUM/ CREE
3	Lighting Wattage/ Type	≤32 W
4	Colour Temperature	6000K(+_500K) COOL WHITE, 4000K(+/-200K) & 2700K to 3000K for warm light
5	LED Chip Wattage	<1w
6	Ingress protection level	IP - 20
7	Min Lumen	3200

8	Min Efficacy (Im/Watt)	100
9	CRI(Typical)	Not less than 80
10	Beam Angle	Not less than 120
11	Junction temp	Minimum 85° C
12	LED Chip Efficacy	Minimum 135 Lm/W
13	Harmonics	Max 15%
14	EMC	CISPER 15 / IEC 61000-4-3
15	Lumen Maintenance at 85º C and LED Life	Minimum 70% up to 50,000 hrs (indoor application) and Life Expectancy 50,000 hrs for LED
16	Power Factor	Minimum 0.95 at full load / 230 Vac
17	Life Expectancy of Driver	Minimum 30,000 hrs
18	Rated Voltage	220 – 240 V
19	Operating Voltage	180 – 260 V
20	Surge Protection	2.5kV L N for Indoor Lighting
21	Working Temperature	-15 to +50º C
22	Product Housing OP Temperature	-5 to +50º C
23	Outer Body Luminaire Temperature	Max upto 70º C (with +-3º C) at ambient temperature
24	Working Humidity	10%- 90% RH
25	Luminaries Efficacy	>100 Lm/W
26	Driver Efficiency	>85 %
27	LED Life Span and Luminaire Photometric Data	IESNALM79 and IESNALM80 respectively
28	Housing Material	Die cast Aluminium / Extruded Aluminium
29	Temperature Cycling Test and Supply Voltage Switching Test	1) Product shall be subjected to 10º C for 1 hr then switch to 50º C for 1 hr – Total 5 cycle 2) 30 Sec On & 30 Sec Off At the end of test as per (1) & (2), no visual damage shall be observed and lamp shall alight for more than 15 min after test.
30	Accelerated Operational Life Test	Product shall be operated continuously for 6000 hrs. Test has to be conducted at 45º C. At the end of test, no visual damage shall be observed and lamp shall alight for more than 15 min after test.
31	Standard Warranty	5 years
32	LED Life Hours	Minimum 50,000 hrs with L 70 Life
33	LM79 Test Certificate for Lumens	LM79 Test Certificate
34	Environmental Consideration	ROHS Complaint

3. TECHNICAL SPECIFICFICATION FOR LED Linear (Suspended/ recessed) Luminaire

Sr.No.	Parameters	Technical specifications
1	Light Source	SMD LED

2	LED Make	NICHIA/ OSRAM/ SEOUL/ PHILIPS LUMILEDS/ LEDNIUM/ CREE
3	Lighting Wattage/ Type	≤18W, ≤22W,≤28W (4ft) ≤38W, ≤44W, ≤56W (8ft)
4	CCT	6000K(+_500K) COOL WHITE, 4000K(+/-200K) for Neutral White
5	Lighting Type	100% Down light; 70% Down light, 30% up light
6	Minimum efficacy (Lm/ Watt)	100
7	LED Chip Wattage	<1w
8	Lamp Housing	Extruded Aluminium
9	Ingress protection	IP-20 class protection
10	Driver Efficiency	>85
11	Luminaries Efficacy	>110
12	CRI(Typical)	>80
13	SDCM	<5
14	Junction temp	Minimum 85° C
15	LED Chip Efficacy	Minimum 135 Lm/W
16	Harmonics	Minimum ≤10%
17	Power Factor	Minimum 0.95 or more (leading acceptable)
18	Life Hrs.	Minimum 50000hrs with L- 70B50
19	Operating Voltage	120-270VAC
20	Operating Temp	0 to 45deg. C
21	Working Humidity	10%- 90% RH
22	Surge Protection	2.5kV

4. Technical specification of LED Tube Light Fixture and Batten (IP20)

Sr.No.	Parameters	Technical specifications
1	Light Source	SMD LED Chip
2	LED Make	NICHIA/ OSRAM/ SEOUL/ PHILIPS LUMILEDS/ LEDNIUM/ CREE
3	Lighting Wattage/ Type (Minimum)	≤20 W
4	Colour Temperature	6000K(+_500K) COOL WHITE,4000K(+/-200K) & 2700K to 3000K for warm light
5	LED Chip Wattage	<1w
6	Ingress protection level	IP - 20
7	Min Lumen	2000
8	Min Efficacy (Im/Watt)	100
9	CRI(Typical)	Not less than 80
10	Beam Angle	Not less than 120
11	Junction temp	Minimum 85° C
12	LED Chip Efficacy	Minimum 135 Lm/W
13	Harmonics	Max 15%
14	EMC	CISPER 15 / IEC 61000-4-3

15	Lumen Maintenance at 85º C and LED Life	Minimum 70% up to 50,000 hrs (indoor application) and Life Expectancy 50,000 hrs for LED
16	Power Factor	Minimum 0.95 at full load / 230 Vac
17	Life Expectancy of Driver	Minimum 30,000 hrs
18	Rated Voltage	220 – 240 V
19	Operating Voltage	180 – 260 V
20	Surge Protection	2.5kV L N for Indoor Lighting
21	Working Temperature	-15 to +50º C
22	Product Housing OP Temperature	-5 to +50º C
23	Outer Body Luminaire Temperature	Max upto 70º C (with +-3º C) at ambient temperature
24	Working Humidity	10%- 90% RH
25	Luminaries Efficacy	>100 Lm/W
26	Driver Efficiency	>85 %
27	LED Life Span and Luminaire Photometric Data	IESNALM79 and IESNALM80 respectively
28	Housing Material	Die cast Aluminium / Extruded Aluminium
29	Temperature Cycling Test and Supply Voltage Switching Test	1) Product shall be subjected to 10º C for 1 hr then switch to 50º C for 1 hr – Total 5 cycle 2) 30 Sec On & 30 Sec Off At the end of test as per (1) & (2), no visual damage shall be observed and lamp shall alight for more than 15 min after test.
30	Accelerated Operational Life Test	Product shall be operated continuously for 6000 hrs. Test has to be conducted at 45º C. At the end of test, no visual damage shall be observed and lamp shall alight for more than 15 min after test.
31	Standard Warranty	5 years
32	LED Life Hours	Minimum 50,000 hrs with L 70 Life
33	LM79 Test Certificate for Lumens	LM79 Test Certificate
34	Environmental Consideration	ROHS Complaint

5. Technical specification of led Waterproof Batten (IP65)

Sr.No.	Parameters	Technical specifications
1	Light Source	SMD LED
2	LED Make	NICHIA/ OSRAM/ SEOUL/ PHILIPS LUMILEDS/ LEDNIUM/ CREE
3	Lighting Wattage/ Type	≤18W, ≤36W
4	CCT	6000K(+_500K) COOL WHITE, 4000K for Neutral White
5	Lighting Type	100% Downlight; 70% Downlight, 30% uplight
6	LED Chip Wattage	<1w

7	Lamp Housing	Polycarbonate
8	Ingress protection	IP-65 class protection
9	Driver Efficiency	>85
10	Luminaries Efficacy	>110
11	CRI(Typical)	>80
12	SDCM	<5
13	Junction temp	Minimum 85° C
14	LED Chip Efficacy	Minimum 135 Lm/W
15	Harmonics	Minimum ≤10%
16	Power Factor	Minimum 0.95 or more (leading acceptable)
17	Life Hrs.	Minimum 50000hrs with L- 70B50
18	Operating Voltage	120-270VAC
19	Operating Ambient Temp	0 to 45deg. C
20	Working Humidity	10%- 90% RH
21	Surge Protection	2.5kV

6. Technical specification of led Post Top

Sr. No.	Parameters	Technical specification
1	Lighting Wattage/ Type	30 W to 65 W Post Top LED Luminaire (As per design requirement)
2	Luminaire Efficacy	≥80 Lm/w
3	CCT	3000 K to 6000K (As per design requirement)
4	Ingress Protection	≥IP65 (For outdoor application)
5	Lamp Housing	Die Cast Aluminum body with high quality diffuser
6	Mechanical Impact Protection	IK07

8. Technical specification of LED Bollard

Sr. No.	Parameters	Technical specification
1	Lighting Wattage/ Type	7 to 10 Watt (As per design requirement)
2	Luminaire Efficacy	≥100 Lm/w
3	CCT	3000 K to 6000K (As per design requirement)
4	Ingress Protection	≥IP65 (For outdoor application)
5	Lamp Housing	Aluminum Die cast body /MS housing

9. TECHNICAL SPECIFICATION OF Surface/Wall Mounted LED Bulkhead Fixture

Sr.No.	Parameters	Technical specifications
1	Light Source	SMD LED Chip

2	LED Make	NICHIA/ OSRAM/ SEOUL/ PHILIPS LUMILEDS/ LEDNIUM/ CREE
3	Lighting Wattage/ Type	10 W
4	Colour Temperature	6000K(+_500K) COOL WHITE & 2700K to 3000K for warm light
5	LED Chip Wattage	<1w
6	Ingress protection level	IP - 65
7	Min Lumen	1000
8	Min Efficacy (Im/Watt)	100
9	CRI(Typical)	Not less than 80
10	Beam Angle	Not less than 120
11	Junction temp	Minimum 85° C
12	LED Chip Efficacy	Minimum 135 Lm/W
13	Harmonics	Max 15%
14	EMC	CISPER 15 / IEC 61000-4-3
15	Lumen Maintenance at 85º C and LED Life	Minimum 70% up to 50,000 hrs (indoor application) and Life Expectancy 50,000 hrs for LED
16	Power Factor	Minimum 0.95 at full load / 230 Vac
17	Life Expectancy of Driver	Minimum 30,000 hrs
18	Rated Voltage	220 – 240 V
19	Operating Voltage	180 – 260 V
20	Surge Protection	2.5kV L N for Indoor Lighting
21	Working Temperature	-15 to +50º C
22	Product Housing OP Temperature	-5 to +50º C
23	Outer Body Luminaire Temperature	Max upto 70º C (with +-3º C) at ambient temperature
24	Working Humidity	10%- 90% RH
25	Luminaries Efficacy	>100 Lm/W
26	Driver Efficiency	>85 %
27	Mechanical Impact Protection	IK08
28	LED Life Span and Luminaire Photometric Data	IESNALM79 and LESNALM80 respectively
29	Housing Material	Diecast Aluminium / Extruded Aluminium
30	Temperature Cycling Test and Supply Voltage Switching Test	1) Product shall be subjected to 10º C for 1 hr then switch to 50º C for 1 hr – Total 5 cycle 2) 30 Sec On & 30 Sec Off At the end of test as per (1) & (2), no visual damage shall be observed and lamp shall alight for more than 15 min after test.
31	Accelerated Operational Life Test	Product shall be operated continuously for 6000 hrs. Test has to be conducted at 45º C. At the end of test, no visual damage shall be observed and lamp shall alight for more than 15 min after test.
32	Standard Warranty	5 years

33	LED Life Hours	Minimum 50,000 hrs with L 70 Life
34	LM79 Test Certificate for Lumens	LM79 Test Certificate
35	Environmental Consideration	ROHS Complaint

10. TECHNICAL SPECIFICATION OF Recess Mounted Circular/Square LED Downlighters

Sr.No.	Parameters	Technical specifications
1	Light Source	SMD LED Chip
2	LED Make	NICHIA/ OSRAM/ SEOUL/ PHILIPS LUMILEDS/ LEDNIUM/ CREE
3	Lighting Wattage/ Type	15-18 W
4	Colour Temperature	6000K(+_500K) COOL WHITE & 2700K to 3000K for warm light
5	LED Chip Wattage	<1w
6	Ingress protection level	IP – 20
7	Min Lumen	1700
8	Min Efficacy (Im/Watt)	100
9	CRI(Typical)	Not less than 80
10	Beam Angle	Not less than 120
11	Junction temp	Minimum 85° C
12	LED Chip Efficacy	Minimum 135 Lm/W
13	Harmonics	Max 15%
14	EMC	CISPER 15 / IEC 61000-4-3
15	Lumen Maintenance at 85º C and LED Life	Minimum 70% up to 50,000 hrs (indoor application) and Life Expectancy 50,000 hrs for LED
16	Power Factor	Minimum 0.95 at full load / 230 Vac
17	Life Expectancy of Driver	Minimum 30,000 hrs
18	Rated Voltage	220 – 240 V
19	Operating Voltage	180 – 260 V
20	Surge Protection	2.5kV L N for Indoor Lighting
21	Working Temperature	-15 to +50º C
22	Product Housing OP Temperature	-5 to +50º C
23	Outer Body Luminaire Temperature	Max upto 70º C (with +-3º C) at ambient temperature
24	Working Humidity	10%- 90% RH
25	Luminaries Efficacy	>100 Lm/W
26	Driver Efficiency	>85 %
27	LED Life Span and Luminaire Photometric Data	IESNALM79 and LESNALM80 respectively
28	Housing Material	Die cast Aluminium / Extruded Aluminium
29	Temperature Cycling Test and Supply Voltage Switching Test	1) Product shall be subjected to 10º C for 1 hr then switch to 50º C for 1 hr – Total 5 cycle 2) 30 Sec On & 30 Sec Off At the end of test as per (1) & (2), no visual

		damage shall be observed and lamp shall alight for more than 15 min after test.
30	Accelerated Operational Life Test	Product shall be operated continuously for 6000 hrs. Test has to be conducted at 45º C. At the end of test, no visual damage shall be observed and lamp shall alight for more than 15 min after test.
31	Standard Warranty	5 years
32	LED Life Hours	Minimum 50,000 hrs with L 70 Life
33	LM79 Test Certificate for Lumens	LM79 Test Certificate
34	Environmental Consideration	ROHS Complaint

11. TECHNICAL SPECIFICATION OF LED Industrial Luminaries with 2 Nos. LED Tube

Sr.No.	Parameters	Technical specifications
1	Light Source	SMD LED Chip
2	LED Make	NICHIA/ OSRAM/ SEOUL/ PHILIPS LUMILEDS/ LEDNIUM/ CREE
3	Lighting Wattage/ Type	36-40 W
4	Colour Temperature	6000K(+_500K) COOL WHITE & 2700K to 3000K for warm light
5	LED Chip Wattage	<1w
6	Ingress protection level	IP - 54
7	Min Lumen	3600
8	Min Efficacy (Im/Watt)	100
9	CRI(Typical)	Not less than 80
10	Beam Angle	Not less than 120
11	Junction temp	Minimum 85° C
12	LED Chip Efficacy	Minimum 135 Lm/W
13	Harmonics	Max 15%
14	EMC	CISPER 15 / IEC 61000-4-3
15	Lumen Maintenance at 85º C and LED Life	Minimum 70% up to 50,000 hrs (indoor application) and Life Expectancy 50,000 hrs for LED
16	Power Factor	Minimum 0.95 at full load / 230 Vac
17	Life Expectancy of Driver	Minimum 30,000 hrs
18	Rated Voltage	220 – 240 V
19	Operating Voltage	180 – 260 V
20	Surge Protection	2.5kV L N for Indoor Lighting
21	Working Temperature	-15 to +50º C
22	Product Housing OP Temperature	-5 to +50º C
23	Outer Body Luminaire Temperature	Max up to 70º C (with +-3º C) at ambient temperature
24	Working Humidity	10%- 90% RH
25	Luminaries Efficacy	>100 Lm/W
26	Driver Efficiency	>85 %
27	LED Life Span and Luminaire	IESNALM79 and LESNALM80 respectively

	Photometric Data	
28	Housing Material	Die cast Aluminium / Extruded Aluminium
29	Temperature Cycling Test and Supply Voltage Switching Test	1) Product shall be subjected to 10º C for 1 hr then switch to 50º C for 1 hr – Total 5 cycle 2) 30 Sec On & 30 Sec Off At the end of test as per (1) & (2), no visual damage shall be observed and lamp shall alight for more than 15 min after test.
30	Accelerated Operational Life Test	Product shall be operated continuously for 6000 hrs. Test has to be conducted at 45º C. At the end of test, no visual damage shall be observed and lamp shall alight for more than 15 min after test.
31	Standard Warranty	5 years
32	LED Life Hours	Minimum 50,000 hrs with L 70 Life
33	LM79 Test Certificate for Lumens	LM79 Test Certificate
34	Environmental Consideration	ROHS Complaint

PACKAGE - 2 FIRE FIGHTING SYSTEM (WET RISER & SPRINKLER)

Designing, planning, supplying, installation, testing and commissioning of Wet Riser & Sprinkler System confirming to CPWD specifications Part- V (Wet Riser & Sprinkler System 2006) for Administrative cum Academic Building & Auditorium as per following :

Fire Fighting System:

DESIGN CRITERIA FOR WET RISER SYSTEM AND SPRINKLER SYSTEM
The Design of wet riser system and sprinkler system shall meet the requirement of NBC 2016 and requirement of Mumbai fire Brigade. This sub head covers all requirements except construction of underground tank. There shall be following minimum installations in the pump house:-

1) Horizontal Split Casing Main Electric Driven Fire Hydrant Pump 2850 LPM at 88 mtr. Head - 1 set
2) Diesel Engine Driven Fire Pump 2850 LPM at 88 mtr. Head - 1 set
3) Horizontal Split Casing Main Electric Driven Sprinkler Pump 2850 LPM at 88 mtr. Head -1 Set
4) Horizontal Type Electric Driven Jockey Pump 200-300 LPM at 88 mtr. Head for Hydrant System-1Set
5) Horizontal Type Electric Driven Jockey Pump 200-300 LPM at 88 mtr. Head for Sprinkler System-1 Set
6) Horizontal Type Electric Driven Booster/Terrace Pump 900 LPM at 35 mtr. Head for Sprinkler Hydrant-2 set
7) Air vessels for sprinkler and wet riser system independently.
8) Electrical panels for Fire Fighting Control system.
9) The number of pumps and capacity of the pump will be calculated as per the NBC 2016 and as per requirement of Chief Fire officer, Mumbai Fire Brigade.
10) The tentative location of External fire hydrants shall be marked in the drawing submitted by the Agency and shall be got approved by Engineer in charge and as per requirement of CFO Mumbai Fire Brigade.
11) The provision of Four way fire brigade connection shall be made as per the provision of NBC 2016.
12) The separate ring mains for external hydrants shall be laid and appropriate number of external hydrant shall be provided as per the guidelines of NBC 2016 and CPWD Specification.
13) The distribution pipe and range pipe in the sprinkler system shall be laid as per the relevant IS code and CPWD Specification Part V (Wet Riser & Sprinkler system) 2006.
14) The provision of sleeves in the beams shall be kept for running the distribution range pipe to utilize the space available above the false ceiling.
15) The zoning of sprinkler system on each floor shall match with fire zone approved by CFO, Mumbai fire Brigade.
16) Each Sprinkler zone shall cover one floor with required one flow switch at Main Header.
17) Different types of fire extinguishers shall be provided in all the floors as per the guidelines of NBC 2016.

18) All the staircase area, lift lobbies at each floor of main building & Auditorium, Lift Machine Room, electrical Panel room, lift machine rooms, Sub Station room, Canteen, HT Room, UPS Room, AHU Room, BMS Control Room, STP Room, Pump Room shall be provided at minimum 1 No. of 4.5 KG capacity CO2 cylinders and 1 No. 6Kg ABC type Fire extinguisher at all above places or as per decision of Fire authority/Engineer-in-charge, Auditorium (Inside -stage, Male, female Green room, Operator room, AHU room, Stair case, Entrances etc) and 45 Kg Trolley mounted 1 No. each in Sub station room and HT Room. If required additional extinguishers shall be considered as per NBC 2016 & CFO, Mumbai.
19) Trolly mounted CO2 cylinder of 45 KG with all accessories shall be provided in sub station minimum two nos. (1 no H.T. Room & 1 No. L.T. Panel Room).
20) All Fire Shaft of each floor with door and glass shall be provide the following accessories.

The fire door design shall be approved form Engineer-in-Charge.

a) M.S Hose Reel Drum with 20mm dia. RRL Hose Reel of 36 mtr. Long, GM / brass Nozzle
and Control valve.
b) M.S. Hose Cabinet with 63mm dia. Hose Pipe Type-B having male, Female coupler with G M / brass branch pipe 63 mm dia.
c) Landing Valve as per IS 5290- Double Headed Gun Metal Valve.

21) In External Hydrant

a) M.S. hose cabinet box with Double headed gun metal valve with 63 mm dia hose pipe Type-B having Male, Female coupler with G.M. branch pipe 63 mm dia.
b) In addition to that one no. M.S. Hose cabinet box with single Headed gun metal valve, 63mm dia. Hose pipe Type B having male, female coupler with G.M. branch pipe shall be provided at Terrace as required.
c) Suitable No. of M.S. Hose Reel drum with 20mm dia RRL Hose reel of 36 mtr long, GM / brass Nozzle and control valve shall be provided at terrace floor.

22) Drain arrangement with valves and 80 mm dia. GI riser in each shaft.
23) Earthing & Loop earthings for pump sets & panel as per CPWD specifications.
24) Drain pit / traps of suitable size in pump house i/c providing suitable capacity of drain pump & necessary piping work as required.

Scope of Work:

1.1. Complete Fire Fighting System Works and all equipments like Pumps, Piping, supports, firefighting accessories, specifications shall be as per CPWD Specifications Part-V Wet Riser and Sprinkler System(2006) and guidelines of the National Building Code-2016,relevant BIS Codes and requirements of the Chief fire officer, Mumbai Fire Brigade.
1.2. Additional requirements and specifications over and above mentioned work as listed down in the subsequent sections in this document. The contractor shall adhere to all below mentioned specifications.
1.3. Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven fire pumps, wet riser, fire hydrant system / fire extinguishers as required by the drawings submitted by the agency and duly approved by the Engineer-in-charge.

Hydraulic Calculations

The tenderer shall be responsible for providing fully detailed hydraulic calculations of sprinkler and hydrant system to comply with CPWD Specifications, NBC-2016, Relevant BIS Codes, NFPA Standards and as per the requirement of CFO, Mumbai Fire Brigade.

System Description

System shall be designed as per CPWD specifications and guidelines of the National Building Code-2016; relevant BIS codes, as per the requirements of the CFO, Mumbai Fire Brigade and as per GFC submitted by the Agency and shall got approved by the Engineer-in-Charge.

Fire Pumps, Motors, Engine And Accessories:

1. Electric Driven Main Fire Pump

a. Horizontal type, multistage, centrifugal, split casing pump of cast iron body and bronze impeller with stainless steel shalf, mechanical seal to ensure a minimum pressure of 3.5 kg/sq.cm. at highest and farthest outlet at **specified flow of 2850 LPM at 88 Metres head** conforming to IS 1520. (The pump should be capable of delivering 150 % rated discharge at a head not less than 65% of the rated head)
b. Suitable HP SQ cage induction motor, TEFC, synchronous speed 1500 RPM, suitable for operation on 415 volts, 3 phase 50 Hz. AC with IP 55 protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS-325
c. M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.
d. Suitable cement concrete foundation duly plastered and angle iron frame of size 35 mm x 35 mm x 3 mm on top edges of foundation with anti vibration pads.

2. Diesel Driven Fire Pump –

a. Horizontal type, multistage, centrifugal pump of cast iron body and bronze impeller with stainless steel shaft, mechanical seal to ensure a minimum pressure of 3.5 kg/sq.cm. at highest and farthest outlet at **specified flow of 2850 LPM at 88 metres head** conforming to IS 1520.The pump should be capable of delivering 150% rated discharge at a head not less than 65% of the rated head.
b. Suitable HP, 1500 RPM water cooled with radiator diesel engine conforming to relevant BS & IS standard complete with auto starting mechanism 12/24 Volts electric starting equipment, Diesel Tank, exhaust pipe extended minimum 1 m outside pump house or as per actual requirement at site. duly insulated with 50 mm. thick glass wool with 1.0 mm thick aluminium sheet cladding, residential silencer, instruments and protection as per specification, stop solenoid for auto stop in the event of fault with audio indication, painted with post office red colour etc. as reqd.
c. M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.
d. Suitable cement concrete foundation duly plastered and angle iron frame of size 35 mm x 35 mm x 3 mm on top edges of foundation with anti vibration pads.

3. Electric driven Jockey Pump for Hydrant System –200-300 LPM

a. Horizontal type, multistage, centrifugal pump of cast iron body and bronze impeller with stainless steel shaft, mechanical seal and flow of **200-300 LPM at 88 metre head** (Negative Suction) 5m NPSH conforming to IS:1520.
b. Suitable HP SQ cage induction motor TEFC type suitable for operation on 415 volts, 3 phase 50 HZ. AC with IP 55 class of protection for enclosure,horizontal foot mounted type with Class-'F insulation, conforming to IS : 325.
c. M.S.fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.
e. Suitable cement concrete foundation duly plastered and angle iron frame of size 35 mm x 35 mm x 3 mm on top edges of foundation with anti vibration pads.

4. Electric driven Terrace Pump for sprinkler and Hydrant – 900 LPM

a) Horizontal multi stage split casing centrifugal end suction type pump of cast iron body and bronze impeller with Stainless steel shaft mechanical seal and flow of **900 LPM** at **35 m head** conforming to IS : 1520
b) Suitable HP squirel cage induction motor TEFC type suitable for operation on 415 V 3 phase 50 Hz AC supply with IP 55 degree of protection for enclosure horizontal foot mounted type with Class F insulation conforming to IS : 325
c) M.S.fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.
d). Suitable cement concrete foundation (1:2:4) duly plastered and angle iron frame of size 35 mm x 35 mm x 3 mm on top edges of foundation with anti vibration pads.

All Pump shall be capable of discharge not less than 150% of rated discharge at a head of not less than 65 % with rated head. The shut off head shall not exceed 120% of rated head.

2.1 HYDRANT SYSTEM DESCRIPTION:

2.2 The Hydrants System shall consist of one main electric pump of suitable capacity Motor, standby diesel engine driven pump of suitable capacity and jockey pumps of suitable capacity and Terrace pump of suitable capacity with suitable capacity Motor.
An underground tank / sump for Hydrants & Sprinkler System of required capacity as per NBC-2016 for this type of project shall be provided. The system shall be complete with all required accessories including valves, strainers, special fittings, instrumentation, control panels and any other components required to complete the system in all respects.
2.3 The Hydrant system shall be kept pressurized all the times.
2.4 In the event of fire when any of the hydrant valves in the network is opened, the resultant fall in the pressure shall start the jockey pump first through pressure switch automatically. In case jockey pump fails to maintain the pressure hydrant pump shall start at the preset pressure. In case of failure the Main pump the diesel standby pump shall start.

2.5 The hydrant risers shall be terminated with air release valve at the highest points to release the trapped air in the pipe work.

2.6 To provide for an air cushion for counteracting pressure surges/ water hammer, an air vessel shall be furnished in the pump room near the fire pumps. The air vessel shall normally be kept partly full of water.

2.7 One No. four way Fire Brigade Inlet Connections shall be provided for filling of Underground Fire tank in case of emergency and in addition one no. four way Fire Brigade connection shall be made to each internal Fire riser in case fire pumps fail to start.

3.0 SPRINKLER SYSTEM DESCRIPTION:

3.1 The automatic sprinkler system will be installed to protect the entire building – Administrative cum Academic building and auditorium as per NBC 2016 & CFO, Mumbai requirement with permitted exception e.g. electrical switch room, power transformer and DG room as identified. There is a separate sprinkler pump of required capacity in the pump house to be provided and other than that Hydrant Pump and Diesel Engine shall also support the sprinkler system.

3.2 The Sprinkler System shall be fed both from an underground tank and also from the overhead tank.

3.3 Installation control valve shall be provided for alarming incase of fire. Installation control valve comprising of main stop valve, alarm valve with accessories, strainer and water motor gong.

3.4 For the sprinkler system the building shall have a riser of 150 mm dia. tapped on each floor to feed the sprinkler system. On each floor, at the tapping from the sprinkler riser, there shall be butterfly valve of suitable diameter and flow switch. The flow switch shall be connected to the Annunciation Panel through electrical cables.

4.0 DIESEL ENGINE:

4.1 General:

4.1.1 The engine rating shall be decided considering the de-rating factors which are based on Site conditions as per BS : 5514.

4.1.2 The diesel engine shall be of multi cylinder type four/six stroke cycle with mechanical (airless) injection, cold starting type.

4.1.3 The Engine shall be turbo-charged and water cooled.

4.1.4 The Engine shall be capable of operating continuously on full load at the site elevation for a period of 8 hours.

4.1.5 The Engine shall be provided with an adjustable governor to control the Engine speed within 10% of its rated speed under any condition of load upto the full load rating.The governor shall be set to maintain rated pump speed at maximum pump load.

4.1.6 The Engine shall be provided with an in-built tachometer to indicate R.P.M of the Engine.

4.1.7 Engine, after correction for altitude and ambient temperature, shall have bare engine horse power rating equivalent to the higher of the following two values :-

a) 20% in excess of the maximum brake horse-power required to drive the pump at its duty point.

b) The brake horse power required to drive the pump at 150% of its rated discharge with atleast 65 % of rated head.

4.1.8 The coupling between the Engine and pump shall allow each unit to be removed without disturbing the other.

4.1.9 All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or damaged to parts.

4.1.10 The engine shall have 10 % overload capacity for 1 hour in any period of 12 hours continuous run.

4.2 STARTING:

4.2.1 The engine shall be capable of both automatic and manual start. Generally the engine shall start automatically, but in case of failure of the auto-start system the engine shall be capable of manual start.

4.2.2 Provision shall be made for two separate methods of Engine starting viz.

4.2.3 a) Automatic starting by means of a battery powered high torque D.C. electric starter motor incorporating the axial displacement type of pinion, having automatic repeat start facilities initiated by a drop in pressure in the hydrant and sprinkler pipe line installations.

b) Manual starting by Electric Starter motor

Note: The starter motor used for automatic starting may also be used for manual starting provided there are separate batteries for manual starting.

4.2.4 Engine shall be able to start without any preliminary heating of combustion chamber, manual cranking mechanism shall also be provided. All controls/mechanisms, which have to be operated in the starting process, shall be within easy reach of the operator.

4.2.4.1 The high torque D.C motor charged by battery shall initiate automatic start of diesel engine. The battery shall hold adequate retainable charge to provide the starting of the diesel engine. Starting power will be supplied from storage batteries. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. Battery shall be lead acid / as per OEM standard (sealed maintenance free type of 12V, 25 plate, 180 Ah capacities.)

4.2.5 The battery banks shall be used for no other purpose other than starting of the engine and shall be fully charged at all times with provision for trickle & boost chargers. After start of the engine the charger shall be disconnected. The battery being fed from the engine alternator.

4.3 An over speed shutdown device to shutdown the engine at speed approximately 20% above rated engine speed with manual reset, so that the automatic engine controller will indicate an over speed signal until the device is manually reset to normal operating position.

4.4 Fuel System:

4.4.1 The diesel engine shall be suitable to run on High Speed Diesel (HSD), the tank

provided being enough to hold the volume required for 8 hours (minimum) continuous operation on full load. The tank shall be of MS sheet of 3.0 mm thickness.

4.4.2 The fuel tank shall be of welded steel construction to relevant Indian Standard. The tank shall be mounted above the Engine fuel pump to give gravity feed or as recommended by the manufacturer. The tank shall be fitted with an indicator showing the level of the fuel in the tank at higher level.

4.5 Cooling System:

4.5.1 The engine shall be radiator water cooled with cooling water drawn from the discharge side of the pump and with pressure reducing valve, strainer and all necessary accessories.

4.6 Oil Pressure Gauge: The engine shall be provided with oil pressure gauges indicating lubricating oil pressure.

4.7 Temperature Gauge: The engine shall be provided with a temperature gauge to indicate cooling water temperature.

4.8 Automatic Control Wiring :

All connecting wires for automatic controllers shall be harnessed or flexibly enclosed, mounted on the engine and connected in an engine junction box to terminals numbered to correspond with numbered terminals in the controller, for ready wiring in the field between the two/sets of terminals.

4.9 Engine Exhaust Pipes:

4.9.1 The exhaust pipe shall be galvanized G I pipe and sized in accordance with the manufacturer's recommendations. The exhaust pipe shall be insulated with 50 mm of fiber glass / glass wool with 1.0 mm thick aluminium sheet cladding for its entire length and to be left outside the building extended 1 mtr. or as per actual requirement at site.

A stainless steel flexible connection shall be provided between the engine exhaust outlet and the exhaust pipe. An exhaust silencer shall be provided as required to satisfy the acoustic requirements.

4.10 Installation: Installation of the Diesel Engine shall be carried out exactly as per manufacturer recommendation.

4.11 Foundation and Anti Vibration Mounting:

4.11.1 Foundation: The foundation shall be constructed as per the requirement of Diesel Engine Manufacturer.

4.11.2 The engine shall be provided with inlet filter and silencer, outlet muffler, expansion joints, dampers etc. as necessary for efficient operation. Intake air shall be taken from inside the building in which the engine is located, but the exhaust shall be discharged into the air at location as desired by the employer.

4.11.3 Suitable vibration mounting duly approved by Engineer-in- charge shall be approved for mounting the units so as to minimize transmission of vibration to the structure. The contractor shall provide all accessories, fittings and fixtures necessary and required

for a complete operating engine set.

4.12 Instrumentation:

4.12.1 The diesel engine shall be provided with instrumentation as under:.

4.12.1.1 Engine Instruments and Standard Control Panel:

It shall be complete with required connections and comprising of following items:

a) Inlet and outlet water temperature gauge (dial type) with key.
b) Lubrication oil pressure gauge.
c) Lubrication oil temperature gauge.
d) Automatic start stop device (push button type).
e) Auto /Manual Selector switch shall also be provided.
f) Manual: the Engine can be manually operated by means of Push Buttons.
g) Start Stop and failure control device.
h) Start key for manual starting.
i) Stop Push Button for manual stopping of engine.
j) Starting failure indication by lamp and horn unit.
k) Engine temperature control with failure indication by red lamp indication.
l) Engine temperature 'very high' indication by audio alarm and automatic stopping of engine.
m) Engine set is 'running' and 'in operation' indication by green lamp.
n) Mains supply available indicated by yellow lamp.
o) Push Button for Audio Alarm reset.
p) Push Button Failure indication by lamps.
q) The Panel shall also have an auto/manual/test/off selector switch.

5.0 CODES AND STANDARDS FOR PUMPS, MOTORS AND DIESEL ENGINE:

5.1 PUMPS:

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

a) IS: 1520 Horizontal centrifugal pumps for clear, cold and fresh water.
b) BS: 599 methods of testing pumps.
c) PTC: 8 ASME Power test Codes – Centrifugal Pumps. 7.2MOTOR

5.2.1 The following codes shall be applicable for the motor :-

a) IS: 325 Induction motor, three – phase.
b) IS: 900 code of practice for induction motors, installation and maintenance.
c) IS: 7816 guide for testing insulation resistance of rotating machines.
d) IS: 4029 guide for testing three phase induction motor.
e) IS: 3043 code of practice for earthing.
f) 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.

6.1 SETTING OF PRESSURE SWITCHES/OPERATING CONDITIONS FOR FIRE PUMPS:

6.2 The fire pumps shall operate on drop of pressure in the mains as given under clause below. The pump operating sequence shall be arranged in such a manner to start the pump automatically but should be capable of being stopped manually by stop push buttons only.

6.2.1 It is thus to be noted that Jockey Pumps shall start and stop automatically through pressure switches. Jockey Pump shall stop when main pumps start as specified. Diesel Engine driven fire pumps shall start automatically when pressure drop below the specified limits, and failure of Main Hydrant pump/Sprinkler pump but stopping shall be manual.

7.1 INTERLOCKING AND CONTROL PANEL:

7.1.1 The System has been designed for operation automatically so that as and when water is drawn from the system through any hydrant/sprinkler, the pumps will operate automatically and feed water into the system. However once a Fire Pump start working, it will be stopped only manually (except jockey pump).

7.1.2 Facility shall also be provided for manual operation. A selector switch for auto/manual selection shall be provided for each pump.

7.1.3 The Control system shall be designed to provide the following sequence of operation:

a) The Pressurization Pump shall maintain pressure in the system and shall operate only on account of minor pressure drop. In case of the sudden major pressure drop i.e. below the specified pressure i,e,(3.5Kg/cm2) in the system the Pressurization Pump shall stop and the Main Hydrant pump/Sprinkler pump shall start and shut down when the system pressure reaches the pre set value. Both limits shall be adjustable.

b) The Diesel Engine driven Fire Pump will start on sudden major pressure drop, only in case of power supply of Main Electric hydrant Pump / main sprinkler pump is not available or within a pre-set time the Main Hydrant Pump/ Main Sprinkler Pump fails to start or fail during the operation. No other pump will be working when Diesel Engine Driven Fire Pump is in operation. Audio-Visual Alarm shall be available to indicate the failure of Main Electric Hydrant Fire Pump/Sprinkler Fire pump.

c) A three attempts starting facility will be provided for diesel pump.

d) If within a pre-set time, the Diesel Engine Driven pump also fails to start or fails to develop pressure, the Diesel Engine Driven pump shall also be shut down and locked out. An audio visual alarm indication shall be given at the control panel.

e) Only one pump will be working at a time in auto mode. In manual mode more than one pump can be started.

f) Water level in UG and terrace tanks shall be monitored and in case of low water level, pumps connected with the tank shall not operate (even on manual mode) or stop operation as the case may be. An audio-visual alarm shall be given at the control panel.

g) The System Controller shall be designed to operate the fire pumps with interlocking and fault indication as brought out above Annunciation window provided in the panel shall indicate following faults:

i) Low water level in UG Tank

ii) Low water level in Terrace Tank

iii) Main Hydrant Pump/Main Sprinkler Pump failed to start

iv) Main Hydrant Pump/Main Sprinkler Pump Main pump failed during operation

v) Diesel Pump failed to start

vi) Diesel Pump failed during operation

vii) Supply to Main hydrant/ Main Sprinkler pump failed

viii) Supply to pressurization pump failed
ix) Supply to terrace pump failed

8. Suitable sensors, differential pressure switches, monitors etc. shall be provided at respective location. The control system shall be operational on 12/24 Volt supply.

9 PIPE, FITTINGS, VALVES, SUPPORTS AND OTHER ACCESSORIES:

9.1 Pipes, Fittings & Supports:

9.1.1 General:

a) All materials shall be new of the best quality conforming to the specifications and subject to the approval of the Engineer in charge.

b) Pipes and fittings shall be fixed truly vertical, horizontal as required in a neat workman like manner.

c) Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall no cause obstruction in shafts, passages etc.

d) Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified as per CPWD specification. Only approved type of anchor fasteners shall be used in RCC ceilings and walls.

e) Valves and other accessories shall be so located that they are easily accessible for Operations, repairs and maintenance.

9.1.2 ISI marked Pipes and fittings of following types (depending upon the design & drawing submitted by the Agency and shall be got approved by the Engineer in charge) and ISI marked only shall be used as per requirement of CFO Mumbai Fire Brigade.:

Type of Pipe / (dia)	**Size**	**Grade**	**Ends/Fitting**	**Code**
G.I/ Galvanised Pipes	Upto 150 mm dia	Heavy duty “C” Class	Screwed/Bevel,Butt welded 3 layers forms /screwed for Galvanised	IS: 1239 (Part I)
G.I./Galvanised Fittings	- do-	Heavy grade	MS/Galvanised Forged,Screwed ends	IS: 1239 (Part II)
MS/ Pipes	200mm dia & above	6.35 mm wall thickness up to 250 mm	Bevel, Butt welded, 3 layers for MS/ screwed for Galvanised	IS: 3589
MS/Galvanised Fittings	-do-	Schedule 40	-do-	IS: 3589

10.1 The piping system and components shall be capable of withstanding 150% of the working pressure including water hammer effects and test pressure upto 10 kg/cm2 as per specification.

10.1.1 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.

11.1.1 Flange thickness shall be as per table below IS: 6392 – 1971 and CPWD General Specification for Electrical Work Part-V (Wet Riser &Sprinkler System)2006

11.1.2 For tappings of 50 mm/40mm/32mm/25mm from headers, half socket connections with one side threading shall be employed. The half socket shall be welded at the centre of the header, either on the side or on the top.

11.1.3 Wherever two horizontal headers are to run side by side, the two headers shall be located at different levels, if possible, so as to avoid unnecessary bends at tapping off from the headers. Accordingly, the supports shall also be staggered to support pipes at two levels.

11.2 Pipe Support:

11.2.1 All pipe clamps and support shall be G.I.

11.2.2 Pipe shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanised nut and bolts. The size/diameter of the anchor fastener and the clamp shall be suitable to carry the weight of water filled pipe and dead load normally encounted.as per relevant Specification / IS Code.

11.2.3 While all piping shall have clevis type hanger supports from the ceiling with fasteners, for pipe headers of 100 mm dia and above, additional wall/column mounted supports shall be taken. Clevis type hanger supports shall be at 3.0 m intervals and at every turn, at both ends. MS angle supports at wall and columns shall be at 10 m intervals. The angles shall be cut by gas cutter and evened out by grinder. All welding to angles shall also be cleaned by grinder. Angles shall not be less than 40 x 40 x 6 mm size.

11.2.4 For fixing clevis hanger and angle support, only dash fasteners shall be used. Exposing of steel reinforcement and welding to them shall not be permitted except in exceptionable circumstances.

11.2.5 Pipes in vertical shafts shall have MS angle brackets at every floor level. The bracket shall be mounted behind the pipe. A base plate of 50 wide x 6 mm thick shall be welded to the bracket. The base plate shall be fixed to the wall by means of fasteners, GI ‘U’ clamps shall be used to fix the pipe to the bracket.

11.2.6 Each riser shall also be anchored to the floor slab with MS angles mounted on the slab.The angles shall be 40mm x 40mmx 6mm size, one mounted before the pipes and the other after the pipes. Extra cleat pipe pieces shall be welded to the pipes at this point which shall be welded to the angle iron support.

11.2.7 Wherever angle type supports are being used, profiled packing materials or wood or materials as approved by the Engineer shall be used. The packing materials shall be at least 25 mm thick and tight fitted with the pipe.

11.3 Hose Reel:

11.3.1 Wall mounting the swinging type first aid hose reel with drum shall be provided conforming to IS: 884-1985.

11.3.2 The rubber tubing shall be 20 mm dia high pressure rubber hose 36.0 mtr. long as per IS : 444 with gunmetal shut off nozzle having 6.5 mm dia orifice and control valve, shut off valve of approved make. The wall mounted bracket shall be fixed by means of fasteners. The hose reel shall have a gun metal nozzle.

11.3.3 The hose reel shall be connected directly to the riser by means of 25 mm dia GI pipe with threaded bends, union & one no. ball valve.

11.3.4 The drum can swing up to 180 degree.

11.4 Hose Cabinets:

11.4.1 Hose cabinet shall be fabricated from 16 gauge MS powder coated sheet of fully welded construction with hinged single/double door partially glazed door with suitable locking arrangement, stove enameled fire red paint with 'Fire Hose' written on it prominently. Glass panels shall be 4 mm thick.

11.4.2 The hydrant cabinet shall hold double headed GM hydrant, 2 nos. Hoses and 1 no. GM branch pipe and 1 no. Butterfly valve.

11.4.3 The cabinet shall have two pipe studs of 200 mm dia in MS with base which shall be fixed to the back of the cabinet and shall be used to hold the RRL hose.

11.5 RRL Hoses:

11.5.1 The hoses for the internal and external hydrant system should be rubber impregnated woven jacketed type conforming to IS:636 Type-A Re inforced rubber lined. Each fire hose shall be provided with quick coupling, branch pipes, nozzles, spanners etc.

11.5.2 Hose pipes of all types shall be capable of withstanding an internal water pressure of not less than 42 Kg/Sq.cm without bursting. It must also withstand a pressure of 25 Kg/Sq.cm without undue leakage or sweating.

11.5.3 Each hose shall be fitted with instantaneous spring lock type couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanised mild steel wires and leather bands.

11.6 Branch Pipes and Nozzle : Gun metal / brass Standard Branch Pipe shall be used conforming to IS : 903 with Gun metal / brass nozzle of 20 mm (nominal internal dia) to fit standard instantaneous type 63mm dia hose coupling. Suitable spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various components like branch pipes, nozzles, quick coupling ends.

11.7 Hydrant Valve:

11.7.1 Gun Metal Hydrant valve shall be of oblique pattern provided as per IS: 5290 complete with hand wheel, quick coupling connection, spring and blank cap and chain.

11.7.2 The hydrant shall have flanged inlet of 100 mm dia and 63 mm female instantaneous type outlet. The hydrant shall have a rubber plug with chain fixed to the Main body of the Hydrant.

11.8 Pressure Switch:

11.8.1 The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by lines pressure. The Pressure switch shall be diaphragm type, it shall be suitable for line pressures upto 15 kg/cm2.

11.8.2 The switch shall be suitable for consistent and repeated operations without change in values.

11.8.3 The enclosure shall be of aluminium and pressure element and wetted parts shall be of stainless steel.The switch shall be snap acting type with 1 no. NO/NC contact.

11.9 **Air Vessel**:

11.9.1 The air vessels 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.

11.9.2 Air vessel shall be fabricated from MS sheet conforming to IS: 2002 grade 2A having 8 mm thickness shell with 10 mm thick dished ends and suitable supporting legs with M.S. Plate size 75mmx75mmx5mm at bottom. It shall be provided with a 80 mm dia/100 mm dia flanged connections from pump, one 25 mm drain with ball valve and 15 mm sockets for pressure gauge and pressure switches. The air vessel shall be hydraulically tested to 25 kg/cm2 pressure for 30 minutes.

11.9.3 The pressure vessel shall be provided for hydrant and sprinkler system. The pressure switches shall be mounted on the drain end of each air vessel. The air vessel shall also be provided with safety valve mounted at the top. The presser vessel shall be supplied of size 250 mm dia x 1200 mm height.

11.10 Fire Department Connections:

11.10.1 Fire Brigade Inlet (4 Way) to Hydrant Ring/Hydrant Riser:

Gun Metal four way fire brigade tank filling connection having 63 mm dia instantaneous type inlet and 150 mm dia flange outlet conforming to IS : 904 with blank cap and chain with necessary 150 mm dia GI (heavy duty pipe) and flanges, nuts and bolts etc. alongwith non return valve and butter fly valve.

The inlet assembly shall be in glass fronted wall box and size of wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken.

Each box shall have fall of 25 mm toward the front at its base and shall be glassed with wired grass with “FIRE SUPPLY TO TANK” painted on the inner face of the glass in 50 mm size block letter.

Each such box shall be provided with a steel hammer with chain for breaking the glass.

Under Ground Tank Filling for Fire Brigade Connection:

Gun Metal four way fire brigade tank filling connection having 63 mm dia instantaneous type inlet and 150 mm dia flange outlet conforming to IS : 904 with blank cap and chain with necessary 150 mm dia GI (heavy duty pipe) and flanges, nuts and bolts etc.

The inlet assembly shall be in glass fronted wall box and size of wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken. Each box shall have fall of 25 mm toward the front at its base and shall be glassed with wired grass with "FIRE SUPPLY TO TANK" painted on the inner face of the glass in 50 mm size block letter. Each such box shall be provided with a steel hammer with chain for breaking the glass.

The inlets shall be provided with ABS quality plastic blank caps with chain.

11.11 Valves:

11.11.1 Sluice Valves: PN1.6

11.11.1.1 Sluice valve of of size 150mm dia (NB) and above shall be flanged type with cast iron body. The spindle, wall seat and wedge nuts shall be of bronze. They shall generally have non-rising spindle and shall be of the particular duty and design called for. All sluice valves will be provided with supervisory switch & PN 1.6 rating.

11.11.1.2 The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fibre gasket. Sluice valves shall conform to Indian Standard IS: 14846: 2000 and IS: 2906. Sluice valves for water works purposes suitable for seat test pressure of 16 Kg/Sq.cm. & PN 1.6

11.11.2 Butterfly Valve:

11.11.2.1 The butterfly valve PN 1.6 shall be suitable of size 32mm to 150mm dia (NB) for water works and tested to minimum of 15 Kg/Sq.cm pressure.

11.11.2.2 The body shall be of cast iron to IS: 210 in circular shape and of high strength to take the water pressure of 16 Kg/Sq.cm. The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.

11.11.2.3 The valve seat shall be of high grade elastomer or nitrile rubber. The valve in its closed position shall have complete contact between the seat and 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 EN 8 grade carbon steel.

11.11.2.4 Butterfly valve shall be of best quality conforming to IS: 13095 of class specified.

11.11.2.5 The valves shall be supplied with manual gear operated opening/closing by lever.

11.11.2.6 The valves shall be supplied with supervisory switch.

11.11.3 Gun Metal Valves:PN1.6

11.11.3.1 Gun metal valves shall be used for smaller dia pipes, and for threaded connection.

The valves shall bear certification as per IS: 778-1984 and shall be rated to 16 Kg/Sq.cm pressure.

11.11.3.1.1 The body and bonnet shall be of gun metal to IS : 318. The steam gland and gland nut shall be forged brass to IS: 319. The hand wheel shall be of cast iron to IS: 210.

11.11.3.2 The hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall non rising type.

11.11.3.3 All valves shall be approved by the Authority Representative before they are allowed to be used on the work.

11.11.4 Non-Return Valve: PN 1.6

11.11.4.1 Non-return valves shall be cast iron dual plate type. An arrow mark in the direction of flow shall be marked on the body of the valve. The valve shall bear IS: 5312 certification.

11.11.4.1 The valve shall be of cast iron body and cover. The internal flap in the direction of water shall be of cast iron and hinged by a hinge pin of high tensile brass of stainless steel. Cast iron part shall be as per IS : 210.

11.11.4.2 The gasket shall be of high quality rubber and flap seat ring of leaded gunmetal. At high pressure of water flow the flapper shall sit tightly to the seat. The valve shall be capable of handling pressure up to 15 Kg/Sq.cm.

11.11.5 Air Valves:

11.11.5.1 Provide 25 mm dia screwed Gun metal ball valve shall be provided on all high points in the system.

11.11.6 Drain Valve:

11.11.6.1 Drain Valve of size not less than 65mm dia GM Ball valve shall be provided in Sprinkler Drain line.

11.11.6.2 Air valves shall be provided at low points of all water riser and mains to ensure that all sections of pipe works and plant can be drained.

11.12 Pressure Gauge:

Pressure gauge shall be provided near all connections to hydrant system and isolation valves of sprinkler system and where required. Pressure gauge shall be stainless steel 150 mm dia gunmetal Bourden type with a scale range from 0 to 15 Kg/cm2 and shall be constructed as per IS 3624. Each pressure gauge shall have a siphon tube connection with ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability.

11.13 Pendent /Upright/Side wall Type Sprinkler :

11.13.1.1 Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly, yoke and the deflector. The sprinkler shall be of approved make and type with 15 mm nominal dia outlets.

11.13.1.2 The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches at 68 C.

11.13.2 The nominal bore shall be 15 mm dia and colour of liquid shall be Red.

11.13.3 The Sprinkler head shall bear approval of UL/FM.

11.14 Installation Control Valve for Sprinkler:

The installation control valve shall be double seated clapper type check valve. The body and cover shall be made from cast iron to IS: 210 grade FG- 200. The seat and seat clamp shall be made from bronze to IS: 318, LTB II grade. The sealing to the seat shall be neoprene gasket. The hinges pin and ball shall be from stainless steel.

11.14.1.1 It shall be vertically mounted and the direction of water travel shall be indicated on the surface. It shall be rated to 12 kg/cm2 and tested to 25 kg/cm2 pressure. A by- pass check valve shall be fitted to adjust minor and slow variations in water pressure for balancing so as to avoid any false alarm.

The valve shall also be provided with a test control box. The box shall house a lever to test and operate the Isolation Control Valve. A Steel strainer shall also be provided at the point of water supply to the alarm gong. A retarding chamber shall also be provided. The chamber shall be able to balance the water pressure in case of water line surges.

11.14.1.2 Each installation control valve shall have two sets of pressure gauges with Gun metal ball valve type shutoff.

11.14.2 Suitable size flexible pipe shall be provided for recessed rosette sprinkler.

Flexible drop of metallic pipe:

Flexible drop UL listed 25mm dia. Stainless steel metallic pipe of length 1000mm to 1500mm as per requirement of fire conditons alonqwith accessories as required.

11.15 Flow Switch:

Flow switch shall have a paddle made of flexible material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/pipe through a connecting socket. The switch shall be potential free in either NO / NC operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation panel. The seat shall be of stainless steel. The flow switch shall have IP: 55 Protection. It should operate even with the flow of one Sprinkler bursting

11.16 Fire Man's Axe:Fire man's axe for fire fighting purpose shell be used conforming to IS:926 – 1985

11.17 Painting:

All hydrant pipes shall be finished with post office red colour paint. All M.S/G.I.. pipes shall first be cleaned thoroughly before application of primer coat. After application of 2 coats of Red oxide primer, two coats of enamel paint shall be applied.Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO 1" etc.

11.18 Testing:

11.18.1 All piping in the system shall be tested to hydrostatic pressure of 10 Kg/Sq.cm without drop in pressure for atleast 24 hours during laying of pipes & after completion of work.

11.18.2 Rectify all leakages, make adjustments and retest as required and directed.

12.1 The following codes and standards and their subsequent modifications shall apply

for the design, manufacture, shop testing, erection, fabrication at site, resting and trial operation of piping, valves and specialties requirements:

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

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

12.1.3 IS: 778 : Copper alloy gate, globe and check valve for water work purposes.

12.1.4 IS: 14846 : Sluice valves for water –works purposes (50 mm to 1200 mm).

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

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

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

12.1.8 IS: 388 : Hose tubing.

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

12.1.10 IS: 5290 : landing Valves.

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

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

13.1 FIRE EXTINGUISHERS:

Portable Fire Extinguisher : Type and Location as per Fire Authority shall be provided minimum 2 Nos. at each floor staircase, 2 Nos. at each Lift Lobby, 2 Nos in each Lift Machine Room, 2 Nos. in UPS Room, 1 No. in each AHU Room, 2 Nos. in HT room, 2 Nos. in STP Room, 2 Nos. in BMS Room, 2 Nos. in Pump Room, 2 Nos. in Sub station room, Director Bungalow, Auditorium (Inside -stage, Male, female Green room, Operator room, AHU room, Stair case, Entrances etc) and 45 Kg Trolley mounted 1 No. each in Sub station room and HT Room. Portable Fire appliances as mentioned below :-

a) ABC Dry Powder fire extinguisher IS : 15683 – 2006 :- 6 Kg & 9 kg capacity .

b) CO2 Gas Fire extinguisher IS 15683 – 2006 :– 4.5 Kg capacity.

c) Fire bucket 4 Nos. as per IS 2546 shall be installed at following places :-

i) Sub station Room and Fire Fighting Pump House.

1) **Exit sign Boards** (Photo luminescent type) suitably visible from the distance of 10 – 15 mtr during darkness/ smoke in the building, so as to help the users to enable them to locate exits in the event of emergency evacuation, when the light goes off. It should glow strongly. These boards are to be placed on wall/ceiling suspended with S. S. Chains at all sections, stairs, lift lobbies and all possible places in all floors including basements etc. in the building to facilitate evacuation at all possible locations (Size not less than 400 mm x 500 mm). The same should be in compliance to the NBC-2016 and local fire authority requirements. The firm will submit the proposal for the complete complex including the buildings for approval of the department and do procurement and installation as approved.

The firm will submit the proposal for display screen, complying to the specifications given below, for approval of the department and do procurement and installation as approved.

1) Fire safety SS (grade:304) metal plates with inscription in Hindi and English (separate Two plates) of size 600 mm x 400 mm at each floor in each lift lobby and

holding area.

2) Electrical Safety Precaution plates at each floor in each lift lobby and holding area made out of SS (grade: 304).

14.1 HANDING OVER:

14.2 All commissioning and testing shall be done by the contractor to the satisfaction of the Engineer in charge, and the job handed over to the user Department.

14.3 Contractor shall also handover, to the Engineer in charge, all maintenance & operation manuals and all other items as per the terms of the contract to the Department.

15.1 GUARANTEE:

15.2 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

15.3 The warranty shall be valid for a period of Two year from the date of commissioning and handing over to user department.

15.4 The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer in charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

15.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Project Director.

16 Inspection by Local Fire officer :- After completion of work and testing to the entire satisfaction of Engineer – in- charge, the installation shall be offered for inspection by Chief Fire Officer or his representative. Testing as desired by the Fire Officer shall be carried out. The contractor will extend all help including manpower during testing. The observation of Chief Fire Officer which are a part of agreement shall be attended by the contractor. The building will be issued NOC for occupation only when all the safety provisions i/c Fire Fighting work are complete to the satisfaction of the Fire Officer.

16.1 TECHNICAL DATA (to be submitted by the firm to whom work is awarded,after the award of work as per the time schedule set)

16.2 Diesel Engine Driven Fire Pump :

Quantity	
Make	
Model	
Fluid Handled	
Type	
Suction	
Delivery	
Impeller Type	
Coupling	

Base Plate with Foundation Bolt	
No. of Stage	
Flow Rate (m3/hr)	
Total Head (m)	
Speed of Pump (RPM)	
Efficiency at rated duty point	
Material of construction (MOC)	
Casing material	
Impeller material	
Shaft material	
Shaft sleeve	
Casing Ring	
Impeller Ring	

16.3 Engine for Diesel Pump:

Quantity	
Make	
Model	
Horse Power	
Engine	
RPM	
Engine over speed setting	
Operating Cycle	
Number of Cylinder	
Accessories	
Dynamically balanced fly wheel	
Flexible coupling and coupling guard	
Electrical standing equipment and starting system	
Governer	
Fuel pump and water pump	
Lubricating oil pump	
Fuel, Air and Lubrication Oil Filter	
Instrument and Protection Device complete as per Engine Model	
Lubricating oil pressure	

High Cooling Water Temperature	
High Lubricating Temperature	
Engine Cooling and Oil System	
Capacity of Diesel Tank	
Detail of Batteries	
Battery Charger	
Other necessary accessories as per Model No in order to make the Diesel Engine Functional	

16.4 Electrical Motor Driven Fire Pumps:

Description	Fire Hydrant Pump	Sprinkler Pump	Jockey Pump	Water Curtain
Quantity				
Make				
Model				
Fluid Handled				
Type				
Suction				
Delivery				
Impeller Type				
Coupling				
Base Plate with Foundation Bolt				
No. of Stage				
Flow Rate (m3/hr)				
Total Head (m)				
Speed of Pump (rpm)				
Efficiency at rated duty point				
Material of construction (MOC)				
Casing material				
Impeller material				

Shaft material				
Shaft sleeve				
Casing Ring				
Impeller Ring				

16.5 Electric Motor For Main Fire Pumps :

Description	Fire Hydrant Pump	Sprinkler Pump	Jockey Pump	Water Curtain
Make				
Model				
Type of Motor				
Horse Power				
Valtage (V)				
Full Load Amps – A				
Speed of Motor				
Enclosure				
Mounting				
Class of Insulation				
Ambient Temperature/ Temp in				
Degree				
Starting Temperature as % of full temp				
Efficiency at 100% load efficiency at 75% load				
Type ofrotating movement				
Coupling				
Type of lubrication				
Frequency				
Make and type of starter				

LIST OF IS CODES (Relating to Fire Fighting works)

The following codes and Indian Standards shall be applicable with amendments up to date.

CODE OF PRACTISE

Code of practice for fire safety of building (general) fire-fighting equipment and maintenance. - IS : 1648

Code of practice for installation of internal fire hydrant in multistoried buildings.- IS : 3844

Recommendations for providing first aid and fire fighting arrangements in public buildings. - IS : 2217

Code of practice for the selection, installation and maintenance of portable first aid and fire appliances - IS : 2190

National building Code.

FIRE FIGHTING APPLIANCES

External fire hydrants.	-	IS : 5290
Internal landing valves.	-	IS : 5290
2 & 3 way suction collecting heads.	-	IS : 904
First aid hose reels.	-	IS : 884
Dunlop high pressure rubber pipe.	-	IS : 5132

HAND A PPLIANCES

Specification for portable CO2 fire extinguisher. - IS : 2878

Specifications for portable chemical fire extinguisher foam type – IS : 933

PIPING AND VALVES

MS tubes up to 150 mm	–	IS : 1239 (Part –I)
MS tubes 200 mm above	–	IS : 3589
G.I. Pipes	–	IS : 1239 (Part I)
C.I. double flanged sluice valves class I	–	IS : 780
C.I. double flanged non return valves	–	IS : 5312

PUMPS AND MOTORS

Centrifugal pump	–	IS : 1520
Electrical motors	–	IS : 7538

PUMPS AND VESSELS

Specification for horizontal centrifugal pumps for clear cold fresh water – IS : 1520

Steel plates for pressure vessels for intermediate and high temperature service including boilers – IS : 2002

Code for unfired pressure vessels – IS : 2825

Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining – IS : 4682 (Part 1)

Specification for sewage and drainage pumps – IS : 5600

Specification for submersible pump sets for clear, cold, fresh water – IS : 8034

Specification for horizontal centrifugal self priming pumps - IS:8418

PACKAGE - 3 FIRE ALARM WITH PA SYSTEM

Intelligent Analogue Addressable Fire Alarm System

1 Scope of work

Fire detection and alarm system with PA system complete as required for Administrative cum Academic building and auditorium & Director Bungalow under the law, Mumbai fire Brigade and NBC 2016. The Contractors' scope of work will include all items of work as per these specifications, terms and conditions of contract etc.

Designing, planning, supplying, installation, testing and commissioning of Intelligent addressable fire alarm system & PA System confirming to CPWD specifications part- VI (Fire Detection & Fire Alarm System 2018) for Administrative cum Academic Building & Auditorium and Director Bungalow as per following :

This shall include, the following:-

a) Addressable Beam Detectors.
b) Analogue Addressable Thermal Detectors.
c) Analogue Addressable Optical /Thermal type Multi sensor Smoke Detectors
d) Analogue Addressable Duct Detectors
e) Addressable Manual Call Points (Resetting Type)
f) Microprocessor Based Modular Intelligent Analogue Addressable Main Fire Alarm Control Panel for connecting and monitoring the Fire Detectors and other devices.
g) 4 nos. Microprocessor Based Intelligent Analogue Addressable Repeater Panel. Minimum one no. per two floors and one no. Repeater panel shall be provided in the Security cabin.
h) Low /High Intensity Hooters activated from the Fire Panel.
i) Providing suitable compatibility in the Main Fire Alarm Control Panel for the Public Address System.
j) 2x1.5 sqm Fire Survival multi core armored cable (600/1000)V Copper Conductor cable for connection to all the detectors & devices with Fire alarm Panel.
k) All other works associated with above items as per specifications, and conditions of contract and as per the requirements of CFO Mumbai Fire Brigade.
l) Fire Fighter's talk back system
m) PA system for complete building & auditorium including with speakers, wiring and accessories.
n) Fire command station with printer.
o) Integration of Fire dampers (Supplying Air & Return Air) & ventilation fans, pressurization of lift Shaft and Lift Lobby, staircase pressurization fan.
p) Getting necessary approval from local bodies and authority of Chief fire officer before commencement of work and after completion of the work.
q) All other works associated with above items as per specifications, and conditions of contract and the Mumbai Fire Brigade requirements

2 General Specifications & Design concept

1.1 The works shall be executed as per CPWD's General specification for Electrical Works, Part-I(Internal-2013); Part-II(External)-1995; Part-V(Wet Riser and Sprinkler System - 2006) for Fire Fighting Installation, Part-VI (Fire Detection & Fire Alarm System) 2018 IE Rules, BIS/IEC, Indian Standard amended up to date and as per direction of Engineer-in-charge.

The additional specification/conditions are applicable.

This scope of work shall cover the Design, Supply, Erection, Testing, and Commissioning of Intelligent Analogue Addressable Fire Alarm Systems which shall be modular and expandable type. The system is to be designed, installed, tested, commissioned and shall be got approved by a local Chief Fire officer Mumbai fire Brigade and providing functional and efficient solutions to the needs of the Engineer in charge.

Final Inspection & Testing

Final inspection & testing will be done by the Engineer-in-Charge or his representative as per details indicated in Appendix-IV & V under "Installation, testing & commissioning" of (General specification for electrical works Part – VI -Fire Detection & Fire Alarm System) 2018.

The installation will be offered for inspection to local body (Chief Fire Officer), The contractor will extend all help including test facilities to the representative of Chief Fire Officer. In case contractor fails to make desired facilities available during inspection, the department reserves the right to provide the same at the risk & cost of the contractor. The observation of Chief Fire Officer which are a part of agreement shall be promptly attended by the contractor. The installation will be accepted by the department only after receiving clearance from Chief Fire Officer.

1.2 The OEM of IAAFAS shall have an in-place support facility in India equipped with Competent Support Staff, Spare Parts Inventory and all the necessary Test and Diagnostic Equipment to provide support within 24 hours of any breakdowns.

1.3 All system components and sub-systems are to be fault tolerant and provide satisfactory operation without damage at ± 10% of the rated voltage and at ± 3 Hz variation in line frequency.

1.4 TECHNICAL DATA and Drawings : The contractor shall submit:-

(a) Comprehensive technical information for all the equipment and materials.

(b) Technical Catalogues and Type Test certificate of all equipment and accessories.

(c) SLD for various systems and sub systems shall be provided for approval of the Engineer in charge before execution of work

1.5 The Fire Alarm system shall comply with latest requirements **of EN54/VDS/UL** standard. In general the system and all other components shall have **EN54/VDS/UL Approval**.

2.1 INTELLIGENT ANALOG ADRESSABLE FIRE ALARM PANEL.

This refers to the microprocessor-based panel that shall be connected to the various detectors sensors/devices by means of 2 wire loops. The Intelligent Analog Addressable FACP shall be able to supervise individual detectors for proper performance as well as to give pin point location of Fire or Fault Alarm and initiate Alarms . The panel shall also have the provision through volt-free contact to activate an Auto-Dialer to dial selected phone numbers in case of fire. **THE PANEL shall be BMS compatible with open protocol system having hardware of BACNET/Modbus.**

2.2 LOOP

A loop shall mean a 2-wire circuit connecting minimum 252 Addressable Devices/detectors, which shall include minimum 150 Detectors. The Detectors shall have built-in short circuit isolators or additional isolator shall be provided after every 15 devices.

2.3 ADDRESSABLE DEVICES

This term indicates the complete group of addressable devices such as Sensors or Detectors, Manual Call Stations, Hooters, Addressable Output / Input Relays, Modules etc.

2.4 SENSORS OR DETECTORS

The Sensors or Detectors shall be Multi sensor Analogue Addressable type. The chamber should be easily removable for the purpose of easy maintenance. The address programming shall be done through the **decade switch/ rotary switch** in the Detector or auto addressing. The Detectors shall have a common base to allow easy interchange of various types of Detectors.

2.5 One Loop shall be connected maximum two floor only.

2.6 Addressable A n a l o g u e Smoke, detectors, Heat detectors and Multi sensor Detectors: The detectors shall provide electronic address-setting by means of configuration software. The area covered by each detector shall be as per EN – 54/VDS/UL guidelines. Each detector shall have either **in built fault isolation unit or external isolation after not more than 15 devices**. Detector shall be programmable for all 3 type of sensing, and shall self adjust depending upon environment. **The whole idea of providing such detectors is to reduce false alarm due to dust in normal areas and due to light smoke in smoky areas**.

2.7 MANUAL CALL STATION

The Manual Call Station shall be addressable type with Input Modules to define the address for each station. The function shall be similar to that of conventional Manual Call Point and should be resettable without replacing the glass.

2.8 OUTPUT MODULE(RELAY MODULE/CONTROL MODULE)

Output module shall mean Addressable points from the Intelligent Addressable Analogue Fire Alarm control panel. Any module shall operate two relay outputs powered from the loop and preferably consuming single address on the loop. The system shall also be able to handle separate modules to interface the speakers of the Public Address System.

2.9 INPUT MODULE

The input modules shall be of dual/single channel type. The dual channel module shall be selectable for Normally Open or Normally Close by a **2 bit DIL/DIP switch**.

3 . 0 FAULT ISOLATOR

This unit (required to be provided without any additional payment, in case of devices without inbuilt isolator) shall be placed on the loop preferably after not more than every 15 devices in case of external isolator and shall be able to isolate electrical short circuit in the wiring. All the other detectors shall remain functional because of the Class A wiring of the loop. The isolator shall not utilize an address and shall be built into the detector base wherever required.

3.1 SOUNDERS/HOOTERS

Each sounder shall be **Loop powered and addressable type or external type powered from additional wiring**. The sounders shall derive power either from Loop itself. Some big hooters may derive power from external 24VDC Source. It shall be capable of being directly mounted on the wall/ceiling or along with the detector. The sounder shall have an output of at least 90 db at 1 mtr distance. The sounder shall be programmed to activate in event of an alarm from a single detector/device or a group of detectors/ devices.

(i) The frequency of sound from sounders shall lie in the 500-1000 Hz band. The sound level shall be at least 65dB (A) or 5dB (a) above or any other noise likely persists for a period longer than 30 second at any part of the building sounders with a level greater than 120 dB (A) shall not be provided.
(ii) The sound shall be continuous although the frequencies and amplitude may vary and of the same characteristics from the fire alarm sounders in a building. Coded fire alarm signaling from sounders shall not be provided which may cause hearing damage.
(iii) 'Fault alarm' and 'Fire alarm' in a panel sounder shall be distinctly different.
(iv) The sounder shall be with IP 54 protection category.
(v) It shall conform to EN/NFPA/Indian standards.
(vi) The volume of sounders can be adjusted from the fire detectors control panel. Minimum three volume setting from fire alarm control panel shall be available. The strobe cum hooter are two wire devices that offer tone choices of either continuous horn or temporal tone when constant voltage from fire alarm control panel is applied. Each tone has minimum three volume levels that can be selected for
installation.
(viii) The strobe cum hooter installed at entrance of building should have three tones programmable from the fire detector control panel so that at least one of these tones can be selected to comply with at least 110dB (A) frequency range of 440Hz to 2850 Hz. The Volume should be adjustable from control panel.
(ix)The strobe should have a light intensity from 15 cd to 110 cd.

4. <u>Design, Installation/Execution, Performance TESTING and Approvals</u>

4.1 The Contractor shall execute the work on the basis of working drawings, prepared by contractor and approved by department. All Variations, i.e. additions, omissions or substitutions necessitated at anytime for any reason whatsoever, shall be deemed to have been accepted by the Contractor as not vitiating the performance based nature of this contract. If any such variations, irrespective of whether such variations are intended to be executed by other agencies employed by the Engineer-in-charge, have any bearing on the performance of this Contract, the same shall immediately be brought to the notice of Engineer-in-charge by the Contractor in writing. In any case the Contractor shall have to guarantee for due and proper performance of the system as per guidelines CFO and satisfaction of Engineer in charge.

4.2 All fire detection and alarm system devices, control panels and remote Annunciators shall be flush mounted or surface mounted as per direction given by E-in-C. Manual call boxes shall be suitable for surface mounting or semi-flush mounting and shall be installed at a height of not less than 1,000 mm, or from the finished floor level

4.3 Installation shall be in accordance with the IS 2189, NEC, NFPA 72, EN 54, local and state codes and as shown on the approved working drawings, and as recommended by the equipment manufacturer. The installation shall be carried out using proper Equipment/ Materials complying with applicable standards in a workmanship like manner. Engineer-in- charge reserves the right to reject any part of installation having poor workmanship.

4.4 All minor Masonry, Carpentry and Civil works such as cutting / opening in Masonry Walls/ Internal Partitions, Chasing on Walls, etc. and making good the same to match existing surface shall be done by the Contractor, wherever asked for by the Engineer- in-charge or his authorized representative. Nothing extra shall be paid on this account.

4.5 All fire detection and alarm system devices, control panels and remote Annunciators shall be flush mounted or surface mounted as per instructions of the Engineer-in-charge.

All equipment shall be tested at manufacturer's Works **as per latest relevant BIS specifications** or in the absence of IS specification approved testing methods shall be followed and Test Certificates/ Reports submitted to the Engineer-in-charge. The contractor shall intimate in advance the probable date of such tests to the Engineer-in-charge to enable their representatives to witness the tests if they so desire. But under no circumstances shall this absolve the Contractor of his responsibility for Performance of the Equipment or System.

4.6 In addition to the above, all equipment and systems shall be tested after installation as required by various statutory authorities, certifying agencies and as required by various sections of these specifications.

4.7 The Contractor shall take full responsibility for proper operation of the entire system including debugging and proper calibration of each component and sub-system.

4.8 The Contractor shall leave necessary provisions required for fixing instruments, multi meter, etc. for testing the installation even if these are not shown on the drawings. All such instruments, services etc. needed for the tests shall be arranged by the Contractor at his own cost.

4.9 **It is the sole responsibility of Contractor to obtain all the necessary approvals from the statutory authorities, prior to, during or after installation as required including all fees and statutory payments. All tests specified herein-after and witnessed/ approved by Engineer-in-charge, may be deemed to be invalid at the option of Engineer-in-charge, if the requisite, final and unconditional approvals from the concerned statutory authorities are not obtained by the Contractor.**

4.10 The Contractor shall intimate in writing to Engineer-in-charge as and when individual components of the installation are ready for tests required for further progress of erection. All such tests shall be carried out as per these specifications and/ or as directed by Engineer-in-charge and recorded in the presence of Engineer-in-charge or his authorized representatives.

4.11 On completion of erection, the contractor shall thoroughly clean all the equipment, inspect and check the entire installation for correctness and completeness and furnish a detailed report on all components of the installation to Engineer-in-charge.

4.12 The Contractor shall intimate in writing to Engineer-in-charge, the proposed date of initial start up

4.13 The Contractor shall, on approval of Engineer-in-charge, proceed with necessary pre- commissioning activities and tests and put the installation initial operation and start-up during which preliminary adjustments and addressing shall be carried out.

4.14 Based on preliminary observations during the initial operation described above, necessary modifications/ repairs/ replacements/ etc. if any shall be carried out by the Contractor to the entire satisfaction of Engineer-in-charge. On successful completion of initial operation, the Contractor shall proceed with trial runs.

4.15 Not with standing approval of tests or equipment or materials by Engineer-in-charge etc., up to the tests in static state as described here-in above, the Contractor shall be required to perform site tests to prove correctness of ratings and performance of equipment and materials supplied and installed by him, in normal operating condition.

4.16 All equipment shall be capable of performing the duties specified in these specifications without damage, distortion or failure of any component.

5 Performance Tests and Demonstration:

5.1 The performance of various equipments individually shall not be less than quoted ratings and consumption of power shall not exceed the ratings quoted by the tendered, when tested in normal operating condition. Otherwise the equipment / material are liable for rejection.

5.2 All test instruments shall be calibrated for accuracy prior to taking the performance tests. The Contractor shall completely check out, calibrate and test all connected hardware and software to ensure that the system performs in accordance with the approved specifications and sequences of operations submitted.

5.3 At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect. This demonstration shall consist of the following:

a) Display and demonstrate each type of data entry to show site specific customizing capability.

b) Demonstrate parameter changes.

c) Demonstrate scan, update and alarm responsiveness.

5.4 Failing satisfactory performance of equipment and/ or overall installation after rectification etc. as stated above, the Engineer– in-Charge, at his sole discretion, reserves the option of charging liquidated damages for such non-performance or demand supply and installation of new installation all at no extra cost to Engineer-in- Charge or demand for full refund of all "On Account" payments made to the Contractor for that part of the work which has failed to perform, and the Contractor shall be obliged to do so as directed by the Engineer-in-Charge.

6 TRAINING & HANDING OVER

6.1 Training by the Contractor shall utilize product manuals, manual prepared by contractor, and as-built drawing and the on-line help utility. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

6.2 Operator training shall include:

a) Sequence of Operation review
b) Sign ON - Sign OFF
c) Selection of all displays and reports
d) Commanding of points, keyboard
e) System initialization
f) Trouble shooting of sensors (determining faulty sensors)
g) Password modification

6.3 Supervisor training shall include:

a) Password assignment/modification
b) Operator assignment/modification
c) Operator authority assignment/modification
d) Point disable/enable
e) Terminal and data segregation/modification
f) Sequence of Operation.

6.4 The following manuals shall be provided at the time of Handing over:

(a) An Operator's Manual shall contain graphic explanations of keyboard use for all operator functions specified under Operator Training.

(b) Computerized printouts of all data file layouts including all point processing programming details, flowcharts, etc.

6.5 On completion of works **"As Built" drawings** for completed installation shall be prepared by the Contractor and (5) Five copies of the same will be supplied to the Engineer-in-Charge. In addition, (5) Five sets of all Operation Manuals, Technical Literature for the various components of equipment, Controls and Accessories installed, Recommended Spares and Services Manuals will be supplied by the Contractor to the Engineer-in-charge.

7 GUARANTEE

7.1 The contractor shall waranty the entire Intelligent Analogue Addressable Fire Alarm system installation as per specifications both for components and for system as a whole. All equipment shall be guaranteed for **Two year from the date of handed over to the User Department** against unsatisfactory performance or breakdown due to defective design, manufacture and/or installation. The installation shall be covered by the conditions that the whole installation or any part thereof found defective within two years from the date of completion of the work shall be replaced or repaired by the contractor free of cost as decided by the Engineer-in-Charge.

7.2 The guaranty shall cover the following:-

a) Quality, strength and performance of materials used.

b) Safe mechanical and electrical stress on all parts under all specified conditions of Operation.

c) Satisfactory operation during the guarantee period.

7.3 Labour to trouble shoot, repair, reprogram or replace system components shall be furnished by the contractor at Defect Liability Period at Free of Cost.

7.4 All corrective software modifications made during guarantee period shall be updated on all user documentation.

8. BASICS OF DESIGN

An Intelligent Modular/ Expandable Fire Alarm System Intelligent Analogue Addressable Fire Alarm system shall be provided to effect total control over the life safety services required in the building.

The system shall be provided with Addressable fire alarm initiating, annunciating and control devices.

The addressable and intelligent system shall be such that smoke detectors, thermal/Heat detectors manual call points, etc., can be identified with point address.

The FAS shall be able to recognize normal and alarm conditions, below normal sensor values that reveal trouble condition, and above normal values that indicate either a alarm condition or the need of maintenance.

Read-out or address an actual detector location. The operator shall also be able to adjust alarm and alarm thresholds and other parameters for the smoke sensors.

Provide a maintenance/pre-alert/fault alarm capability at smoke sensors to prevent the detectors from indicating a false alarm due to dust, dirt etc.

Provide alarm verification of individual smoke sensors. Systems that perform alarm verification on a zone basis shall not be acceptable. Alarm verification shall be printed on the printer at the Control Station's printer to enhance system maintenance and identify possible problem areas.

Provide local numeric point address and LED display of device and current condition of the point.

Each detector shall use state-of-the-art Microprocessor Circuitry with error, detector self-diagnostics and supervision programs. The number of detectors and location shall confirm to relevant standards but not less than the covered area of each detector **25 to 30-sq. meter area at 4m height and average density of detectors in whole building shall not be less than 28 sqmtr./detector** .Addressable intelligent optical detectors shall be used. The detectors shall give the visual and audible alarm at the respective control Panel. The panels shall be located in the respective ground floor control rooms. The detection of the fire shall be taken at the detector level.

Multi-Criteria Detectors shall be provided where by the system logic activation is based on any three inputs from the detector i.e. smoke, fixed heat or rate of rise heat.

Provide outputs that are addressable, i.e. outputs shall have point address. The operator shall be able to command such points manually or assign the points to Logical Point Groups (Software Zones) for pre-programmed operation.

In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.

a) The System Alarm LED on the main fire alarm control panel shall flash.

b) A local sounder shall be sounded.

c) The LCD display on the main fire alarm control panel shall indicate all information associated with Fire Alarm condition including the type of alarm point and its location within the premises.

d) Printing and history storage equipment shall log the information associated with the Fire Alarm Control Panel condition, along with the time and date of occurrence.

e) All system output programs assigned via control-by-event programs that are to be activated by a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated. The 2cx1.5 sqmm Fire survival multicore copper armoured cables shall be used from detectors to the alarm panel confirming to the relevant IS and from reputed manufacture.

The system should be able to detect any type of smoke, fire and heat in the respective site/area.

9.0 DETAILED DESCRIPTION OF THE SYSTEM AND COMPONENTS OF FIRE ALARM

9.1 CONTROL PANEL (FACP)

The Intelligent Analogue Addressable Fire Alarm Control Panel shall be networkable type.

IAAFACP shall have its own microprocessor, software and memory. Panel may have hot/cold redundancy CPU. Either hot standby CPU or degraded mode CPU alongwith cold standby CPU shall be provided. In the event of failure of the central or communication breakdown between the central station and the FACP, the FACP shall automatically operate on stand-alone mode without sacrificing any functions. The networking should be peer to peer type wherein all information is available on all the panels. The panel should be modular microprocessor based in nature and should be **expandable up to 10 loops with each loop capable of minimum up to 250 or as per OEM standard No of loop of panel shall be as per design.**

FACP shall supervise detection circuits and shall generate an alarm in case of abnormal conditions. FACP shall provide general purpose inputs for monitoring such functions as low battery or AC power failure. FACPs shall provide tamper protection and commendable outputs, which can operate relays or logic level devices. Smoke detectors shall be powered using the FACP-based smoke detection circuits. FACPs shall provide for resetting smoke detectors, fault-isolation and sensor loop operation. It shall be possible to mix different fire devices within the same FACP to optimize field wiring.

It shall be possible for the panel to have a loop length for connecting different devices **offering up to 1.2 km Loop length** of devices from the panel.

FACPs shall provide monitoring and control of multiple floors or areas. FACPs shall meet the following requirements to assure the integrity and reliability of the system:

a. The FACP shall be UL/EN-54/**Vds listed** independently as a fire alarm control panel.
b. The FACP should have **integrated power distribution module** and fixed cabling done internally to guarantee a clear and tidy cable feed.
c. The panel should have a **LCD touch screen Megapixel screen** with white background lighting and keypad. The display should enable a flexible design of the operating menu with variable keys and message windows.
d. FACP should have menu Based operation.
e. All materials and components used in the panel are specified as per UL/EN-54/**Vds Certification**.
f. The panel should have a 230V AC power supply unit in plug-in design with rack and panel

connector is a 24VDC/6A single output power supply. The module should be protected against overvoltage and reverse polarity. The output voltage is monitored and regulated externally.

g. LCD display at the FACP shall be provided to indicate point in alarm or trouble.
In such systems, means for manually scanning the points in trouble shall be provided and a trouble and alarm LED shall be used to indicate that there are points in alarm/trouble. The alarm/trouble LED shall only extinguish when all alarm/troubles are cleared from the loop.

h. It shall be possible to command test, reset and alarm silence from the FACP.
FACP should have freely configurable detector zone displays.

i. FACP should have a programmable software timer for automatic switching of day operation mode to night operation mode, switching of mode of operation of automatic multi-criteria fire detectors

j. FACP one freely programmable key switch with 2 switch positions for code mode, day operation, switch-off and reset

k. FACP modules encapsulated for rugged handling as EMC protection for electronics**.**

l. Programming & logging in of all panels in network is possible from any panel.

m. FACP should have at least **4000 history logs**.

n. The fire panel must display the mixed operation of bidirectional, digital data transmission between detector and control panel for uniform switching of fire peripherals via a two-wire stub and/or loop topology in a local security network (LSN) and direct current line technology (conventional zone direct connection of a stub line to a loop at any location without additional interfaces.

o. graphics-capable touch screen with white background lighting and screen size of at least 14.5 cm for display and operation of alarm messages, malfunctions, switching and control procedures and plain text displays of customer-specific data such as location data
programmable software timer for automatic switching of day operation mode to night operation mode, switching of mode of operation of automatic multi-criteria detectors
individual detector and detector zone switch-off output of stored messages in plain text on touch screen.

p. linking of detector information for generating switch commands, e.g. to Panels, as well as activation of monitored LSN control elements

q. one freely programmable key switch with 2 switch positions for code mode, day operation, switch-off and reset

r. The FACP shall have Drift Compensation facility to compensate for environment.

s. The display on FACP shall provide indication for AC Power, System Alarm, System Trouble/Security Alarm, Display Trouble and Signal Silence. This would mean that in the event of change of any logic, detector / zone sequence alteration, the operator can initiate these by use of the LCD touch pad & alpha-numeric keys on the FACP panel to reconfigure the above parameters.

The fire alarm panel shall operate 240V± 10% 50Hz. The FDAS shall also be provided with a dedicated stand by power supply system (battery and charger) capable of maintaining the system for a period of 24 hours after which sufficient battery shall remain to provide full load operation for at least 30 minutes in line.

9.2 DETECTORS & ADDRESSABLE DEVICES

General features common to all detectors:

Built-in-response indicator: Each detector shall incorporate indicator “LED” at the detector which shall blink in normal condition and glow steady on actuation of the detector to locate the detector which is operated while on fire. The detector shall not be affected by the failure of the response indicator lamp. The Led **should be visible from a 360 deg view**

Maintenance: All detectors shall be fitted either with plug-in system or bayonet type connections only, from the maintenance and compatibility point of view.

Construction: The components of the detectors must not be damaged by static over voltage.

9.3 Addressable Duct Detector

Addressable automatic fire detector for monitoring of ventilation ducts which can perform alarm pattern analysis (pattern comparison of fire characteristics), with even response sensitivity for all fires with smoke development. For installation in special housing, such that the trigger display remains visible after installation.

Evaluation of characteristics according to signal increase rate and signal strength. There is a significant reduction in deceptive alarms where detection equipment is constant. Features:

Contamination detection

Detector remote inquiry Self-monitoring

Automatic addressing

Additional manual addressing for the use of existing networks with stub branches

Integrated isolators at input and output so that all elements in the loop maintain operational availability, even if there is a short circuit. This means that no cable is required to maintain functionality.

Special Housing for accommodating a special detector that detects smoke in ventilation ducts, with input and output for air sample extraction, streamlined connection pipes for optimum air flushing of the detector, with dust-proof connection board for the loop outside the air flow, with air intake and exhaust pipe, seals and the required installation material Features:

Air intake and exhaust pipe, extendable up to 3m.

Detector's trigger display visible when housing is closed

Simple mounting to ventilation duct via expanding nuts (supplied)

Filter in air intake and exhaust route

Cover can be monitored when housing is open

9.4 Addressable Manual Stations

Addressable manual stations shall be provided to connect to the Fire Alarm Control Panel loops. The manual stations shall on command from the Control Panel send data to the panel representing the state of the manual station. Stations shall be suitable for surface mounting or semi flush mounting.

9.5 Addressable Monitor Modules

9.5.1 Programming of the input normal state "open" or "closed" independently selectable for each input.

- Pulse contact monitoring for detection of high resistance contacts.
- Monitoring of contacts for "open" and "closed" states on lines.
- For flush mounting in standard electrical boxes.
- Addressing of interface either automatically or via code switch (allowing unique assignment of installation location to address)

9.6 Addressable Control Module :

- Output should electrically isolated from loop.
- Owner supply to interface via two-wire line (line supply)
- Addressing of interface either automatically or via code switch (allowing unique assignment of installation location to address)

9.7 Addressable Sounder Base

- The Addressable Sounder Base shall be compatible with the Fire detection and alarm panel offered.
- It shall be Ceiling mounted or wall mount type.
- It shall be microprocessor based intelligent, addressable type .
- It shall work at the same operating voltage of detectors.
- It shall generate audio alarm on command from the fire detection and alarm panel.
- It shall be able to carry out self diagnosis and automatic device mapping.
- It shall be able to withstand ambient temperature upto 50 deg.C.
- It should be able to generate **multi tone tones.**

9.8 Technical specifications

i) Operating voltage 15 V DC. 33 V DC
ii) Current consumption < 5 mA at maximum sound pressure level
iii) Maximum sound pressure level is 90 dB(A) according to EN54-3
iv) Multi tone programmable from the fire detector control panel
v) Frequency range of 450 Hz to 2 900 Hz
vi) Various signals for pre-alarm and alarm
vii) Protection category according to DIN 60529: min IP 42
viii) Operating temperature range min -25°C to +85°C

9.9 Flasher

The flasher should have flexibility to accept detector base or Sounder base with no additional cabling or power supply, synchronized flash rate of 1Hz.

9.10 Response Indicators

Remote Response Indicator shall be installed outside the areas normally kept closed to identify the detectors response even if the room is locked. These indicators shall be able to indicate the status of the corresponding detectors in these areas.

9.11 PC based Graphical user interface

The system shall be provided with a PC based Graphical user interface. It shall comprise of hardware and software i.e. GUI hardware: Listed below are the specification of the hardware of PC Hardware Description

COM port : Max. 4 (one COM port per control panel)
Inputs: USB/LPT, CD-ROM, 3.5" disk drive
CPU :min. 2 GHz
RAM: 4 GB (server), 2 GB(client)

Hard drive memory : 160 GB
Network card :100 Mbit
Printer:- Laserjet

9.12 Software Description

a) Operating system :Windows 10
b) Internet Explorer : Version 8.0
c) Software: A brief description of the GUI is given below.
d) It shall display the plant layouts with building, floor, zone and location details.
e) It shall display the alarm status of the detectors, manual call points
f) It shall check, display and log the health of different components in the system.
g) It shall be able to generate and print alarm status reports, fault status reports.
h) It shall have facility for alarm acknowledgement, reset and test functions.
i) It shall communicate with the fire detection and alarm panel via RS-232/RS- 485 serial port or Ethernet port.
j) It shall facilitate the programming of the fire detection and alarm panel and other components.
k) It shall be possible to program and display different messages of normal, fault and alarm conditions
l) A back up CD with the FACP software and all the data in the system as per final configuration/ programming of the FACP panel and all system components shall be provided to the department at the time of handing over.

9.13 CABLING

All fire alarm system wiring must be as specified here in:-

Wiring shall be in accordance with local, state and national codes (NBC of India, IS 2189, NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 1.5 Sq. mm for initiating device circuits and signaling line circuits, for notification appliance circuits.
The Cables used shall be annealed tinned copper conductor of size 2cx1.5 sqmm Fire survival multicore armoured cable. (600 / 1000 V)

9.14 : Fire Fighter's Phone system: Complete in all respects shall be provided with phone at all landings of Fire staircase. It will have battery back up of 8 hours.

9.15 : PA system

General

1. Seamless Integrated PA with fire alarm system shall be provided. System shall be in accordance with latest NFPA guidelines and NBC requirement for evacuation system as per EN 54.
2. PA system may be Analogue or digital type. System shall act either in Auto or Manual Mode.
3. PA system shall be selective for announcements at: Floor wise, Building Wise, Basement wise in Automation mode.
4. Automatic announcement system in fire affected Zone shall be provided
5. Pre recorded standard announcement messages shall be stored in memory for auto

announcement. System shall be capable to record fresh messages also for future use.

9.16- Speakers:

1. All speakers shall operate on 25 VRMS or with field selectable output taps from 1.5 to 6.0 Watts. (1.5watt-30watt-6.0watts)
2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
4. The back of each speaker shall be sealed to protect the speaker cone from damage and Dust.

9.17 Programmable Electronic Sounders:

1. Electronic sounders shall operate on 24 VDC nominal.
2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.
3. Shall be flush or surface mounted as shown on plans.

9.18 DIGITAL AMPLIFIER

Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:

a. The digital amplifier shall automatically broadcast the stored audio message.

b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.

c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.

d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.

e. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of at least 16 or 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

f. Suitable No. of Amplifier with suitable wattage to cater all the speaker load shall be design and shall be provided.

9.19 Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The System Alarm LED shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. The 640-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

4. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
6. The audio portion of the system shall sound the proper audio signal (consisting of tone, voice, or tone and voice) to the appropriate.

PACKAGE - 4 – Lifts

1. Eligibility Criteria of Specialized agency for lifts

Agency should have

1. Average Annual financial turnover in India for immediate last three consecutive financial years shall not be less than Rs. 200 Crores.
2. The firm shall have in India:
   - I. Manufacturing and testing facility.
   - II. Research & development centre and
   - III. Dedicated training centre to trains its personnel.
3. Manufacturing experience of the manufacturer shall not be less the 15 years.
4. Domestic production capacity of the factory in India shall not be less than 2000 lifts per annum.
5. The manufacturer shall have service centers in 25 nos. towns/ cities including at least 15 nos. state capitals in India.
6. Testing tower in India shall be available with travel height not less than:
   - I. 12 meters for requirement of lifts speed up to 1.5 meter/second and
   - II. 20 meters for requirement of lifts speed above 1.5 meter/second with facility of testing at least 2 lifts simultaneously.
7. The manufacturer shall furnish and undertaking regarding availability of spares for the entire life of the lift i.e. 15 to 20 years.
8. The lifts including safety features and testing shall conform to relevant updated Indian Standers.
9. Quality standards shall conform to IS/ISO-9001:2015.
10. The fire rating of car door and landing door shall be as per National Building Code-2016.
11. i) The down time of installed lifts, which are being maintained by the manufacturer, shall not be more than 8 hours (average) in case of minor faults and 7 days (average) in case of major faults in last one year. The data to be considered shall be for last financial year.

    ii) Application shall have to submit details of service level agreement (SLA) consisting of Toll free number, E-mail id for loading complaints etc.

2. Designing, planning, supplying, installation, testing and commissioning of 4 Nos. 16 passenger lift as per following specifications. The work shall be executed as per CPWD's specification, Part-III (Lifts & Escalators)-2003, IE Rules, Bombay Lift Act, Indian Standards amended up to date and as per direction of Engineer-in-Charge. The additional specifications are to be read with above standard and specifications in case of any variations in specifications given in the tender shall apply.

Sl. No.	Type of Lift	Passenger Lift	Fire Lift
1	Type of lift	Passenger Lift	Passenger Lift
2	Number of lift required	3 Nos.	1 No.
3	Load: number of Persons	16 Passengers (884 Kg)	16 Passengers (884 Kg)
4	Rated Speed	1.5 mps	1.5 mps
5	Number of floors Served	G + 6 upper floors	G + 6 upper floors
6	Type of operation	Micro processor based duplex selective collective with/ without attendant for 2 nos. Lift on each bank.	Micro processor based duplex selective collective with/ without attendant for 2 nos. Lift on each bank.
7	Potential free Contacts	Potential free contacts, in each floor and RS 485/Modbus card in the controller shall be provided for monitoring position, up and down movement of the lift etc which can be used for building automation system.	Potential free contacts, in each floor and RS 485/Modbus card in the controller shall be provided for monitoring position, up and down movement of the lift etc which can be used for building automation system.
8	Clear inside size of lift car	As per standard design of manufacturer subject to Minimum 2.60 sq.mtr	As per standard design of manufacturer subject to Minimum 2.60 sq.mtr
9	Car entrance door		
(a)	Size	(i) Minimum Height – 2000 mm (ii) Minimum Width - 1000 mm.	Minimum Height – 2000 mm Minimum Width- 1000 mm.
(b)	Type of doors	Centre opening automatic power operated doors. Stainless Steel (SS 304) 1.5 mm thick with honey comb finish with multi beam sensor	Centre opening automatic power operated doors. Stainless Steel (SS 304) 1.5 mm thick with honey comb finish with multi beam sensor
(c)	Car open in front only	Yes	Yes
(d)	Fire resisting rating	Shall have fire resistance rating of one hour.	Shall have fire resistance rating of one hour.
10	Construction design and finish of car body work	CPWD General Specification for Electrical Works Part-III (Lifts & Escalators)-2003	CPWD General Specification for Electrical Works Part-III (Lifts & Escalators)-2003
(a)	Interior Finish		
(i)	Panels	Shall be Stainless Steel(SS 304) 1.5 mm thick with honey comb finish	Shall be Stainless Steel(SS 304) 1.5 mm thick with honey comb finish
(ii)	Flooring	Shall be granite tiles	Shall be granite tiles
(iii)	Ceiling	Stainless Steel SS304 mirror finish.	Stainless Steel SS304 mirror finish.
(iv)	Lighting	Shall be 'LED' lights with illumination level of minimum	Shall be 'LED' lights with illumination level of

		150 Lux	minimum 150 Lux
(v)	Ventilation	Shall be cross flow Blower/fan with louver – minimum - 2 nos.	Shall be cross flow Blower/fan with louver – minimum -2 nos.
11	Type of signal system shall be provided	(i) Digital floor position indicator in the car and at all landings TFT type in all 4 Nos lifts.	
		(ii) Travel direction indicator in the car and at all landings (to be provided in car operating panel & at landing operating panels) in all 4 Nos lifts.	
		(iii) Gongs & Visual indication on all landings for pre arrival of the car for two or more cars	
		(iv) Overload Warning audio and Video Indicator inside the car (lift should not start on overload) in all 4 Nos lifts.	
		(v) Battery operated alarm bell and Emergency light shall be provided in all 4 Nos lifts.	
		(v) Car operating panel with fade proof Luminous buttons in car and with intercom shall be provided in all 4 Nos lifts.	
		(vi) Luminous hall Buttons at all landings and inside car with Braille language signage.	
		(vii) Firemen's switch at ground floor	
12	Landing entrance		
(i)	Location of landing entrance in different floors	All doors on the same side shall be provided in all 4 Nos lifts.	
(ii)	Type of doors	Horz. Sliding Centre opening automatic power operated doors shall be provided in all 4 Nos lifts.	
(iii)	Fire resistant rating of the doors	Shall have fire resistance rating of one hour shall be provided in all 4 Nos lifts.	
(iv)	Lift in use/lift out of order sign	Lift out of order indication shall be in-built with floor Position indicator in all 4 Nos lifts.	
	Electric supply	(i) Power 415 Volts, AC, 3phase 50 HZ 4 wire system	
		(ii) Lighting 230 V AC 50Hz	
		The entire lift equipment should be suitable for operation at +10% to -10% of the rated supply voltage	
13	Is neutral wire available for control circuit	Yes	
14	Emergency supply	Suitable maintenance free battery and inverter power pack with necessary contactors for operating light in the lift car, Alarm bell and communication equipment shall be provided in all 4 Nos lifts.	
15	Intercom System in all 4 Nos lifts	Inter communication shall be provided for communication between the lift car, respective machine room & lift lobby/control room. Note: Intercom in lift car shall be press & speak type.	
16	Automatic rescue device ARD shall be provided in all 4 Nos lifts as per following	(i) ARD should monitor the normal power supply in the main controller and shall activate Rescue operations within ten seconds of normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor the elevator will detect the zone and stop. After the elevator has stopped, it	

		automatically opens the doors and parks with door open. After the operation is completed by the ARD the elevator is automatically switched over to normal operations as soon as normal power supply restores.
		(ii) In case the normal supply restores during ARD in operation the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing it will automatically be switched to normal power operation in all 4 Nos lifts.
		(iii) All the lift safeties shall remain active during the ARD mode of operation in all 4 Nos lifts.
		(iv) The battery capacity should be adequate so as to operate the ARD at least seven times a day. Provided the duration between usage is at least 30 minutes. Dry maintenance free batteries.
17	Levelling accuracy	±5mm at all load condition for all 4 Nos Lifts.
18	Speed variation	±1% rated speed for all 4 Nos Lifts.
19	Voice announcement system	Voice announcement system car to announce the position of the elevator in the hoist way as the car passes or stops at a floor served by the elevator shall be provided in all 4 Nos lifts.
20	Braille switching system	Braille switching system in car panel and each landing floor shall be provided in all 4 Nos lifts.
21	A hand rail	A hand rail at a height of 900 mm above floor level to be fixed on the full length at all three sides of the lift car shall be provided in all 4 Nos lifts..
22	Door Close Safety	Full height Infrared light curtain door safety shall be provided in all 4 Nos lifts.
23	BMS compatibility	Potential free contacts for each floor position and up & down movement of lift shall be provided in the controller which can be used for Building Automation System.

All statutory payments/fees for obtaining permission and lift license from Lift Inspector, Govt. of Maharashtra shall be borne by the contractor.

The testing of Lift installations shall be carried out in accordance with General Specifications for Electrical works (Part – III Lift and Escalators 2003 Section – IV testing of lift installations and Appendix – III).

PACKAGE - 5 Electrical Sub-Station

1. Scope of work

1.1 The scope of work covers Planning, Design, Supply, Installation, Testing & Commissioning of Substation Equipment & working out the power requirement of buildings under construction, including existing buildings, design the sub-station equipments & LT distribution in accordance with General Specifications for Electrical works (Part – IV Substation 2007. SITC of sub-station equipments and feeding of essential and non – essential power supply through LT cables / Bus duct & Rising main to buildings being constructed in this contract.

1.2 HT service connection is to be obtained from local Electric supply company who will also be providing metering arrangement. The contractor should organize his work in such a manner as to synchronize the installation & commissioning of substation equipment with that of supply company. The contractor shall make liaisoning with the local supply company i/c making payment of energy charges, deposit charges, service connection charges payable and all allied charges required for release of supply alongwith HT cable from tapping point of supply company, Kiosk metering unit etc. The contractor shall arrange to obtain necessary power connection approvals from statutory bodies including fees payable for the same, necessary permission from local bodies.

Sr. No.	Types of load	Rating to be taken for Calculation	Remarks
1	Lighting load (Main building)	As per design	
2	Fan load	30 W per fan	
3	AC load	TR X0.95	Given formulae, is significance for the calculation of substation capacity not for any other means. AHU load for auditorium building shall be considered.
4	Lifts	Quantity and Rating of lift	
5	FF main, Sprinkler, jockey pump & Hydrant Jockey Pump	Quantity and Rating of pumps	
6	Water supply pump	…do….	
7	Computer outlet (450 Nos.)	200 W per outlet	
8	Power outlet	500 W per outlet	
	Auditorium special lighting + AHU	As per Design & capacity of AHU	
9	STP load	Rating of STP	
10	Ventilation fan load & miscellaneous load	Rating of equipment.	
11	Server load	25 KW	

12	Existing buildings load	211 KW	
13	Proposed Hostel building (Phase- II)	100 KW	
14	Solar Heater (Power Backup)	20 KW	
15	Street light and land scapping	10 KW	
	Total load		

A) Calculation of capacity of sub station shall be carried out on the basis of the following criteria:

Consider Diversity factor 0.8 & loading of transformer 80%, Power factor 0.85.

After adding, as above, add 20% for future load expansion and then select next available standard rating. However minimum capacity of sub station including stand by (100%) shall not be less than 3200 KVA. However the capacity of transfomers selected shall be such that the fixed losses in no load hours shall be minimum and with suitable synchronization arrangement for the transformers and should be as per requirement of local supply companies.

2. Technical Details of equipments :

2.1 HT Panel

1. Incomer :- 1 no. (having capacity as per transformer design) VCB Horizontal draw-out type.
2. Outgoing:- (Quantity & capacity as per transformer design) VCB Horizontal draw-out type.
3. Type of Breaker : VCB
4. Breaking capacity of breaker : 26.3 KA for 1 Sec. at 11 KV .
5. 1 no. Microprocessor based relay with Overload, earth leakage & short circuit protection at
6. Incomer & all outgoings.
7. Other accessories:- CT / PT / Relay / Auxiliary relay/ master trip Relay / Bus bar / Ammeter / voltmeter / trivector meter/ Power factor meter / various indication lamps / terminal blocks etc as required for HT panel shall be as CPWD specifications and various IS codes. (CT shall be of 0.5s class for metering and 5P10 class for protection)
8. All the incoming & outgoing breakers should be capable of giving status & command of ON,OFF & trip on BMS. All load managers, meters in the panel shall be BMS compatible with RS 485 port.

2.2 Transformer

1. Rating (KVA) :- As per design but total capacity of substation not less than 3200 KVA i/c 100 % stand by.
2. No load Voltage ratio (KV) :- 11 KV/433V
3. Vector Group:- Dyn11
4. Type :- Cast resin Dry type
5. Winding type: copper wound

6. Insulation:- F
7. Tapping range on HV side :- +/- 2.5%,+/-5%, +/-7.5. Tap changer
8. Other specification :- Transformer shall comply with IS 11171:1985
9. Losses :- Having maximum losses at 50% and Full Load as per table of ECBC 2017 code.
10. Other criteria like, various indicators, % impedance, tap changer, cable end box and other accessories shall comply with the latest CPWD specifications for electrical works.

2.3 Main L.T. Panel

1. Incomer:- Quantity and capacity as per design of transformer- Each 4P, ACB , 50 KA (Ics=100%Icu=Icw) and with standing capacity of EDO type and with Microprocessor based (with overload / Earth fault protection / shunt trip with under voltage releases) , BMS compataible hardware and software like RS 485/ potential free contacts / Modbus / Bacnet card and control MCB –etc as reqd.
2. Bus bars : Suitable capacity as per design, TPN tinned Copper Busbar suitable for 50KA for 1 sec.
3. Bus coupler : Quantity and capacity as per design of transformer - Each 4P, ACB, 50 KA (Ics=100%Icu=Icw), EDO type and with Microprocessor without release -1 set
4. Outgoings: Nos of outgoing ACBs/MCCBs shall be as per design and requirements.
   MCCBs shall preferably be used for loads of upto 400 Amp.

For future use minimum 20% spare switchgear /MCCB may be kept. Rating shall be provided as per decision of Engineer-in-charge. In addition to above there shall be minimum 20% space/compartment without switchgear shall also be provided for future requirement.

5. Other criteria like protection, electrically & mechanically interlocking, cable termination, internal wiring, selector switches, multifunction meters etc shall be considered as per CPWD specifications.
6. Suitable syncronization arrangement shall be made as per designed and quantity of transformers.
7. Multifunction meter shall be provided at all outgoings.
8. All the incoming & outgoing breakers should be capable of giving status & command of ON, OFF & trip on BMS. All load managers, meters in the panel shall be BMS compatible with software and Hardware like RS 485/ potential free contacts / Modbus / Bacnet card and control MCB –etc as reqd shall be provided.
9. 4P high protection 70 KA surge protectors for all incomers line alongwith necessary HRC fuses.

2.4 Essential L.T. Panel

1. Incomer:- 1 no. capacity as per actual load calculations - 4P, ACB , 50 KA (Ics=100%Icu=Icw) EDO type microprocessor based with overload , short circuit & earth fault protection.
2. Bus bars : Suitable capacity as per design, TPN tinned Copper Busbar suitable for 50KA for 1 sec.
3. Outgoings : Nos. of outgoing ACBs/MCCBs shall be as per design and requirements. MCCBs should preferably be used for loads be upto 400 A.
4. Essential LT panel outgoing shall feed

a) Lighting load.
b) Fan load.
c) Lift load.
d) Jockey pump, Hydrant pump & sprinkler pump.
e) Water supply pump sets.
f) Computer outlet and server.
g) AHU load.
h) Compound lighting.
i) Auditorium lighting, Audio - Video Load, stage lighting.

5. For future use minimum 20% spare switchgear shall be provided. Rating as per decision of Engineer in charge. In addition there shall be minimum 20% space/compartment without switchgear for future use also may be considered.
6. Other criteria like protection, electrically & mechanically interlocking cable termination, internal wiring, selector switches, multifunction meters etc shall be as per CPWD specifications.
7. Multifunction meter shall be provided at all outgoings
8. All the incoming & outgoing breakers should be capable of giving status & command of ON, OFF & trip on BMS. All load managers, meters in the panel shall be BMS compatible with software and Hardware like RS 485/ potential free contacts / Modbus / Bacnet card and control MCB –etc as reqd shall be provided.

UPS Panel

Distribution panel for UPS Incoming :-

1. Incomer:- 1 no. capacity as per actual load calculations - 4P, MCCB/ ACB , 50 KA (Ics=100%Icu=Icw) with overload , short circuit & earth fault protection.
2. Bus bars : Suitable capacity as per design,TPN tinned Copper Busbar suitable for 50KA for 1 sec.
3. Outgoings : Nos. of outgoing MCCBs shall be as per design and requirements. MCCBs should preferably be used for loads be upto 400 A.

UPS outgoing panel :-

UPS outgoing panel with synchronization arrangement and necessary switch gears which shall feed :

a) UPS Rising mains (computer loads, EPABX system, CCTV & Access control, Fire alarm System, Server, IBMS workstation & all DDCs, Audio- Video System, Video Conferencing.

4. For future use minimum 20% spare switchgear shall be provided. Rating as per decision of Engineer in charge. In addition there shall be minimum 20% space/compartment without switch gear for future use also may be considered.
5. Other criteria like protection, electrically & mechanically interlocking cable termination, internal wiring, selector switches, multifunction meters etc shall be as per CPWD specifications.
6. Multifunction meter shall be provided at all outgoings

9. All the incoming & outgoing breakers should be capable of giving status & command of ON, OFF & trip on BMS. All load managers, meters in the panel shall be BMS compatible with software and Hardware like RS 485/ potential free contacts / Modbus / Bacnet card and control MCB –etc as reqd shall be provided.

2.5 APFC Panel

APFC panels :- Quantity and capacity as per design of transformer

Type:- Thyristor type switching

Capacity : Designed capacity to maintain overall P.F. of the system between 0.98 to 1.00

Type of capacitor:- APP type shunt capacitor 14% D-tuned harmonic filter with current limiting device discharge register.

Incomer : As per design - Microprocessor based ACB / MCCB as per of designed capacity in each panel.

Bus bar : As per incomer capacity - TPN tinned Copper Busbar suitable for 50KA for 1 sec

Other accessories and metering instruments i.e Multifunction meter with display parameters of Voltage, Amphere, KW, KWH, KVA, Frequency, PF, Phase angle and LED cluster indicating lamps , power factor digital meter, APFC relay minimum 11 step, 24 V DC Shunt trip coil, Three Phase Under voltage relay, Three Phase Over voltage relay, ON /OFF push button with controlling MCB, Digital Ammeter with selector switch with CTs, ON/OFF/TRIP indicating lamps etc shall be as per CPWD specifications and available IS codes. 2 amp MCB shall be used for protection of indication lamps / Meters etc.

There shall be minimum 20% space/compartment for future enhancement of capacity use also may be considered.

All the incoming & outgoing breakers should be capable of giving status & command ON;OFF & Trip with providing BMS compatible, software and hardware like RS 485/ potential free contacts / Modbus / Bacnet card and control MCB –etc as reqd shall be provided.

2.6 BUS TRUNKING

Sandwich type bus ducting with Copper bus bar for use on 3 phase 4 wire 415 V, 50Hz A.C. supply with GI/CRCA enclosure **having IP-54 rating after fixing the tap off boxes and all** accessories, made of 1.6mm thick steel sheet duly powder coated in convenient sections complete with 4 Nos. copper bus bars having current density of 160 A/ sq. cm at nominal current rating sandwich construction with inner layer of glass MICA and outer layer of polyester necessary joints & expansion joints, fire barrier etc. & earthing with suitable size 2 nos. copper strip. The minimum size of the section of bus bar shall be as per CPWD specifications for work part I Internal 2013 and General specifications for Electric sub station part IV 2013.

2.7 MCCB: MCCBs should preferably used for loads below 400 Amperes.

a) **All rating of MCCB shall be of 50 KA(Ics= 100%Icu) at 433 V short circuit current rating & should be microprocessor base type** with inbuilt adjustable protections against Over Load (L) and Short Circuit (S), earth fault protection and time delay. Separate earth leakage modules are not acceptable.

b) All MCCBs shall be provided the Rotary Operating Mechanism. The ROM shall be

door interlock & padlock facility.

c) MCCB should have Spreader links & Phase barriers as standard feature

2.8 ACB :

From 400 ampere and above ACB shall be used, These should have 50 KA (Ics= 100%Icu, Icw) short circuit current rating with microprocessor based overload, short circuit, earth fault protection at 415 V, 50 Hz. It Shall be EDO type, 100% neutral, minimum 50KA breaking capacity, with Numeric relay, Navigator for selection of parameter, Big size display of parameters, Shall have communication module with MODBUS protocol, built in CT, metering module , Password protection in releases for setting parameters, Test button for self diagnostic.

3. Additional Specifications of Equipments.

3.1 HIGH VOLTAGE PANEL

a) These specifications cover the detailed requirements for supply, installation, testing and commissioning of High Voltage Panels.

b) VACUUM CIRCUIT BREAKER

c) H.V. PANEL

d) The panel board shall be of indoor type, having the incoming sectionalisation and outgoing switch gears as per IS 13118-1991 of VCB, IEC 62271-100 for brakers and –200 for panels / IS 3427 of switch board. The degree of enclosure protection shall be IP-54.

e) The HV Panel manufacturer must possess all type test certificates as per IS : 13118-1991, IEC 62271-100 and 200.

f) All panel shall be subject to routine tests as per IS : 13118-1991, IEC 62271-100 and 200 at the works of the manufacturer before delivery.

g) Detailed requirements shall be in accordance with the specification.

h) Rating: All panels assembled to form a board shall be suitable for the nominal operation voltage and rupturing capacity as specified. They should be rated as specified with a minimum of 630 Amps. and suitable for operation of 11KV, 3 Phase 50 Hz system. Type test certificate for the breaking capacity of the panel shall be supplied. A circuit breaker for a given duty in service is best selected by considering the individual rated values required by load conditions and fault condition.

i) Type: The HV panel board shall be metal clad, indoor, floor mounting, free standing type. It shall be totally enclosed dust, damp and vermin proof.

j) General Construction: Separately earthed compartments shall be provided for circuit breaker, bus bars, relay & instrument, CT&PT and cable boxes, fully and effectively segregating these from one another so that fault in any one compartment do not cause damage to equipment (s) in other compartment (s).

The housing shall be of bolted construction to ensure compact and rigid structure, presenting a neat and pleasing appearance. The sheet steel used should not be less that 2mm thick.

The panels shall be bolted together to form a continuous flush front switch gear suitable for front operation of board and for extension at both ends.

k) General Design Aspects: The HV panel board shall be designed such that the switchgear, instruments. Relays, bus bars, small wiring etc. are arranged and mounted with due consideration for the followings:-

i) Facility for inspection, maintenance and repairs of testing terminals and terminal boards for ease of external connection.
ii) Minimum noise and vibrations.
(a) Risk of accidental short circuits and open circuits.
(b) Secured and vibration proof connections for power and control circuits.
iii) Risk of accidental contact and danger to personnel due to live connection.
iv) Mountings at approachable height.

BATTERY CHARGER and PANEL with Batteries:

Automatic Battery charger panel comprising of self contained Float cum Boost charged rated at 30V DC with 100AH capacity suitable for 30V 100AH Low maintenance Tubular type Lead Acid / Dry type Battery system. The Panel shall be CPRI approved and as per CPWD specifications.

3.2 VACUUM CIRCUIT BREAKER

3.2.1 General arrangements: The circuit braker panels shall be complete with the followings:
(a) Racking in / racking out mechanism.
(b) Isolating plugs and sockets.
(c) Mechanical inter-locks and safety shutters.
(d) Mechanical ON / OFF indicator.
(e) Minimum of 4 NO and 4 NC auxiliary contacts directly operated by the circuit breaker. Additional NO & NC contacts can be provided with auxiliary contactors.
(f) Anti condensation space heaters suitable for operation on 240V, 1 Phase 50 Hz A.C. for each panel wherever specified.
(g) Suitable tripping arrangement.
(h) Mechanical counter to assess the total number of operations of the breaker (if asked for specifically).

Type: The circuit breaker shall be of horizontal isolation, horizontal draw out pattern.

3.2.2 **Breaker Truck**: The breaker carriage shall be fabricated from steel, providing a sturdy vehicle for the circuit breaker and its operating and tripping mechanism. The carriage shall be mounted on wheels, moving on guides, designed to align correctly and allow easy movement of the circuit breaker and for removing the carriage for inspection and maintenance purposes. Vacuum interrupters shall be hermetically sealed and shall be designed for minimum contact erosion, fast recovery of di-electric strength, maintenance free vaccum interrupter, suitable for auto-reclosing. The drive mechanism shall preferably be provided with facility for pad locking at any position namely, “Service”, “Test” and “Fully isolated”. It should be possible for testing the circuit breaker for its operation without energizing the power circuit in the “Testing” position. The contacts shall be made only after the breaker is inserted into service position. Interlocking should prevent contacts from being disconnected if circuit breaker is tried to be moved from service position.

3.2.3 **General Features**: Single break contacts are provided in sealed vacuum interrupter.

Rating: The circuit breakers shall be continuously rated as specified with a minimum rated current of 630 amps. with voltage rating and braking capacity as specified.

3.2.4 **Operating Mechanism**: The operating mechanism shall be one of the following as specified:-

Manually operated spring charged / motor wound spring charged with both mechanical and electrical release for closing. The operating mechanism shall be trip free.

3.2.5 External auxiliary supply shall be made available for charging motors & heaters operation.

3.3 BUS BAR SECTION

3.3.1 General Requirement: The switch board shall be single bus bar pattern with air insulated encapsulated bus bars housed in a separate compartment, segregated from other compartments.

Material: The bus bars shall be of high conductivity electrolytic copper rated as specified with a minimum rated current of 630 amps. The bus bars shall be sized for carrying the rated and short circuit current without over-heating. Maximum bus bar temperature shall not exceed 95 degree C.

3.4 CURRENT TRANSFORMER

3.4.1 General Requirements: Accommodation shall be provided in the circuit breaker panel to mount one set of three numbers dual core dual ratio CTs for metering and protection purposes. Access to the CTs for cleaning, testing or changing shall be from the front, back or top of the panel.

3.4.2 **Rating:** CT's shall be Dual core & dual ratio 100/50/5/5 CTs of suitable burden (but not less than 15 VA) with 5 amps. secondary.

Note: CT ratio shall be compatible with the loading pattern on HV side.

The CTs shall conform to relevant Indian standards. The design and construction shall be robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block which will be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5 P 10 of IS 2705-Part-III-1992.

The metering CTs shall conform to the metering ratio and accuracy class 0.5 of IS 2705-1992 for incomer and class 1 for outgoing panels.

3.5 VOLTAGE TRANSFORMER

3.5.1 General Requirements: A voltage transformer of burden not less than 100 VA and proper ration as specified shall be provided at the incoming panel. The accuracy class for the VT shall be class 0.5 as per IS 3156 parts I to III for incomer and class 1 for outgoing panels.

The transformer shall be of cast epoxy resin construction. It shall be fixed / withdraw able type. HRC fuses / MCBs shall be provided on both HV and LV sides.

3.6 PROTECTION AND TRIPPING ARRANGEMENT

3.6.1 Protection: The relays shall be microprocessor based numerical relays with O/L, E/F and S/C protection.

Tripping relay shall be used for tripping signal to the shunt trip coil of circuit breaker operating on 24V / 30 V DC supply / power pack / 110V VT supply.

The Relays shall be microprocessor based numerical relays with O/L, E/F and S/C protection Tripping relay shall be used for tripping signal to the Shunt Trip Coil of Circuit Breaker operating on 24 V/ 30 V D C supply / Power pack / 110 V VT supply.

Note: - 24V/ 30V DC shall be provided through 2 No. SMF batteries of 12/ 15 volts of minimum 26 AH capacity with a battery charger as per recommendation of the manufacturer both for protection as well as indications.

Alternatively Power Pack converters fed through PT/ 230V externally could be provided with 2 Nos., 12/ 15 volt, 7 AH SMF batteries (Power pack with condenser/ capacitor backup are also available which do not need batteries, these should not be used) for tripping. In cases where tripping is fed through PT, VA burden of PT shall be suitably increased (say 200 VA) as recommended by the manufacturer depending upon the number of panels and connected controls. In addition external 24 volt / 30 volt DC supply shall be provided for indications etc. through 2 No. SMF batteries of 12/ 15 volts of minimum 26 AH capacity with a battery charger as per recommendation of the manufacturer.

3.6.2 **Relays:** over current relays shall have adjustable setting for current from 50% to 200% and earth fault from 10% to 40% or 20% to 80%. These should be of manual reset type. All relays shall have a LED indicator which will indicate operation for each function. It shall be possible to reset it only by manual operation. The number and types of relays shall be as specified.

3.7 SMALL WIRING

The small wiring shall be carried out with minimum 1.5 sq.mm FRLS/HFFR insulated copper conductor cables. CT wiring shall be done with minimum 2.5 sq.mm wires with colour code: RYB, Gray for auxiliary DC circuits and black for auxiliary AC circuits. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification tags shall be fitted to all wire terminals to render identification easy and to facilitate checking in accordance with IS 375. Necessary terminal block and cable entries shall be provided for RTD relay wiring, power supply etc.

3.7.1 METERING INSTRUMENT, PANEL ACCESSORIES (DIGITAL)

3.7.2 **Metering** : Energy metering shall be done on all the feeders .

3.7.3 **Voltage selection scheme**: where as bus coupler is incorporated and only one income feeder (out of two available) is intended to be operated at a time, a VT transfer relay shall be incorporated to provide necessary potential for metering. This will be necessary when energy metering is done on individual feeders or where VT supply is used for trip circuits. Alternatively PTs shall be provided on both the bus sections (incomers) with individual metering on each incomer.

3.7.4 **Instrument Panels:** The instrument panel shall form part of the housing. relays, meters and instruments shall be mounted as per general arrangement drawings to be submitted by the tenderer. They shall be preferably of flush mounting type at a maximum height of 1800mm.

4. INSTRUMENTATION:

(a) A voltmeter of class 1.5 accuracy as per IS-1248 shall be provided at each incomer panel, with selector switch. The instrument shalf be calibrated for the ranges specified.

(b) Energy meters of class 1.0 conforming to IS 722 (Part-IX) and power factor meter of class of accuracy of 2 shall be provided, if specified.

(c) Ammeter of specified range of class 1.5 accuracy as per IS-1248 shall be provided at both incomer and outgoing panels along with necessary selector switches.

(d) The panel assembly shall also take care of the following requirement:

(i) Lamp indication shall be proved to indicate ON/OFF (by red/green respectively) of switch gear.

(ii) Panel illuminating lamp.

(iii) Mechanical indication for spring charged status. If possible an indicating lamp could be provided.

(iv) Lamp indicating tripping at fault status.

(v) Healthy trip supply shall be indicated by clear lamp.

(vi) Separate fuses / MCBs shall be provided for lamps, heaters, voltmeters and other instrumentation etc. on each panel.

(vii) Anti-condensation space heaters shall be provided and shall be suitable for operation on 240V, 1 Phase, 50 Hz A.C. for each panel if specified.

(viii) Where there is more than one incomer and bus sections, these shall be castle key interlocked as per interlocking scheme as specified.

4.1.1 **CABLE BOXES**

Cable boxes shall be situated in a compartment at the rear / side of the housing as specified.

4.1.2 **Cable entry**: Provision for top (bus ducts preferred for top entry) / bottom or such other side entry shall be made as per requirement with sufficient head room for cable termination. 3mm thick removable gland plate shall be provided for cable termination.

4.1.3 **Earthing:** The earthing of the breaker body and moving portion shall be so arranged that the earthing of the non-current carrying structure to the frame earth bar is completed well before the main circuit breaker plugs enter the fixed house sockets.

The entire panel board shall have a common tinned copper earth bar of suitable section with 2 earth terminals for effectively earthing metallic portion of the panels. The frame earthing of panel shall be in accordance with section 7 of PART IV CPWD specifications.

4.1.4 **Installation**: The installation work shall cover assembly of panels lining up, grouting the units etc. in the case of multi panels switch boards after connecting up the bus bar all joint shall be insulated with HV insulation tape or with approved insulation compound. A

common earth bar shall be run preferably at the back of the switch indications & metering connections and wirings shall be completed. Where trip of the batteries. All relay instruments and meters shall be mounted and connected with appropriate wiring. Calibration checks of units as necessary and required by the licensee like CTs, VTs energy meters etc. shall be completed before pre-commission checks are undertaken.

5. TESTING AND COMMISSIONING

Procedure for testing and commissioning of relay shall be in general accordance with good practice.

Commissioning checks and tests shall include in addition to checking of all small wiring connections, relays calibration and setting tests by secondary injection method and primary injection method. Primary injection test will be preferred for operation of relay through CTs. Before panel board is commissioned, provision of the safety namely fire extinguishers, rubber mats and danger board shall be ensured. In addition all routine megger tests shall be performed. Checks and test shall include following.

(a) Operation checks and lubrication of all moving parts.
(b) Interlock function checks.
(c) Continuity checks of wiring, fuses etc. as reqd.
(d) Insulation tests.
(e) Trip test and protection gear tests.
(f) The complete panel shall be tested with 5000V megger for insulation between poles and poles to earth. Insulation test of secondary of CTs and VT to earth shall be conducted using 500V megger.
(g) Any other tests as may be required by the Licensee / Inspector shall be conducted.
(h) Where specified, the entire switch board shall withstand high voltage test after installation.
(i) Any other test required by the consignee / inspecting officer.

5.1.1 SANDWICH BUS BAR TRUNKING

5.1.2 Manufactured Units

5.1.3 General

The busbar trunking system shall be copper **conductor with sandwich construction**. All busbar trunking products and fittings (straight length, elbow, tees, flanged ends, cable tap box and circuit breaker, etc.) shall be in accordance with **IEC 60439:2005 or UL857** and from **the same manufacturer** as the busbar trunking system. The degree of protection of the busbar trunking system should be **IP54** in accordance to IEC 60529.

5.1.4 Rated operation voltage of the busbar trunking shall be **1000V**, 3 Phase, 4 or 5 Wire with **50% capacity continuous integral/internal earth busbar**. The neutral conductor should have the same cross-sectional area as the phase conductor. The earth busbar must be one **continuous piece** without bolting on housing.

5.1.5 The electrical contractor shall be responsible for routing the busbar trunking to coordinate with the other agencies.

5.2 Certificate

a) The busbar of full range and each rating, should pass full type tests specified in IEC 60439:2005. The certificate shall be issued by an international independent testing authority (e.g. ASTA, KEMA, UL).

b) A product safety mark (e.g. **KEMA-KEUR, ASTA DIAMOND, UL**) should be on the product offering a visible assurance to all of full product safety testing, factory inspection and ongoing surveillance under independent authority to ensure the ongoing safety of product.

c) The busbar trunking system should pass seismic tests with actual physical product and being certified complying with **UBC seismic Zone 4** condition by an international recognized earthquake research body, e.g. Asian Pacific Network of Centres for Earthquake Engineering Research (**ANCER**).

5.3 Short Circuit Ratings and Tests

5.3.1 The whole busbar trunking system shall be capable of withstanding the short circuit of the electrical installation without damaging the electrical, mechanical and thermal stress under fault condition at a service voltage of 1000 V 50 Hz. The minimum rated insulation voltage shall be 1000 V.

5.3.2 The minimum certified short circuit ratings of the busbar trunking shall be as follows:

Rating	kA /1 sec.	kA Peak	Rating	kA / 1 sec.	kA Peak
800 A	40	84	2500 A	75	165
1000 A	50	105	3200 A	90	198
1250 A	50	105	4000 A	100	220
1600 A	60	132	5000 A	120	264
2000 A	60	132	6000 A	120	264

5.4 Basic Construction

5.4.1 **Housing**

The busbar trunking housing shall be constructed of code gauge steel /GI / Aluminium to reduce hysteresis and eddy current losses and shall be provided with a suitable protective finish of ANSI 49 grey epoxy paint.

5.4.2 The busbar trunking housing shall be totally enclosed non-ventilated for protection against mechanical damage and dust accumulation and it shall pass at least 500 hours salt spray test to ensure the anticorrosion ability.

5.4.3 The totally enclosed housing shall be manufactured by the busbar trunking manufacturer. Modifications of busbar trunking to make it totally enclosed by other than the busbar trunking manufacturer voids the manufacturer's warranty. Busbar trunking so modified is unacceptable without the written undertaking of the manufacturer.

5.5 Busbars

5.5.1 Busbars shall be of copper with copper cladding utilizing Molecular Fusion technology and the size of Busbar shall be as per the CPWD specifications.

5.5.2 There shall be **no bolts passing through the busbars of the busway**.

5.5.3 Each busbar shall be insulated with **Class B rated (130 deg. C)** polyester **mylar** film from **Dupont/ eqv**. Epoxy insulation is not allowed.
5.5.4 The temperature rise at any point of the busbar trunking enclosure shall not exceed **55 degree Centigrade** rise above ambient temperature when operated at rated current.

5.6 Joint
5.6.1 The busbar trunking joint shall be of the **one-bolt type** which utilizes a high strength steel bolt(s) and **Belleville washers** to maintain proper pressure over a large contact surface area.
5.6.2 The bolt shall be torque indicating and at earth potential.
5.6.3 The bolt shall be **two-headed** design to indicate when proper torque has been applied and require only a standard long handle wrench for proper connection.
5.6.4 Access shall be required to only one side of the busbar trunking for tightening joint bolts.
5.6.5 It shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a busbar trunking length without disturbing adjacent busbar trunking lengths.

5.7 Support of busbar Trunking
5.7.1 Hanger spacing shall not exceed manufacturer's recommendations.
5.7.2 Indoor feeder and plug-in busbar trunking shall be approved for hanger spacing of up to 3 meters for horizontally mounted run and 4.88 meters for vertically mounted runs. Outdoor feeder busbar trunking shall be approved for spacing of up to 1.5 meters for horizontally or vertically mounted runs.

5.8 Voltage drop
5.8.1 The voltage drop (input voltage minus output voltage) specified shall be based on the busway operating at full rated current and at stabilized operating temperature in 30 degree Centigrade ambient.
5.8.2 The three-phase, line to line voltage drop shall not exceed 3.4 volts per hundred feet at 40% power factor concentrated load which may exist during motor starting.
5.8.3 The line-to line voltage drop shall not exceed 4.1 volts per hundred feet at the load power factor which produces maximum voltage drop in the busway.

5.9 REFERENCE Standard

The low-voltage plug-in bus way up to 5000 Ampere, 1000 V AC and protection devices in this specification are designed and manufactured according to latest revision of the following standards (unless otherwise noted).

5.9.1 **IEC 60439-2 ed.3.1: 2005**

14 type tests in accordance with this standard.
(i) Verification of temperature rise limits 8.2.1
(ii) Verification of dielectric properties 8.2.2.
(iii) Verification of short circuit strength 8.2.3.
(iv) Verification of the effectiveness of the protective circuit 8.2.4

(v) Verification of clearances and creepage distances 8.2.5
(vi) Verification of mechanical operation 8.2.6
(vii) Verification of the degree of protection 8.2.7
(viii) EMC tests (7.10, Annex H)
(ix) Verification of the resistance of insulating materials to abnormal heat and fire 8.2.9
(x) Verification of the electrical characteristics of the busbar trunking system 8.2.13
(xi) Verification of structural strength 8.2.10
(xii) Verification of crushing resistance 8.2.12
(xiii) Verification of resistance to flame propagation 8.2.14
(xiv) Verification of fire resistance in building penetration 8.2.15

5.9.2 Other reference standards

(i) ANSI/IEEE C37.23, Metal-Enclosed Bus and Calculating Losses in Isolated-Bus
(ii) ANSI/NEMA BU 1, Bus ways
(iii) ANSI/NEMA KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts)
(iv) ANSI/NFPA 70, National Electrical Code
(v) CSA C22.2 No. 27, Bus ways
(vi) NEMA AB 1, Molded Case Circuit Breakers and Molded case Switches
(vii) NEMA BU1.1, General Instructions for proper Handling, Installation, Operation and Maintenance of Bus way rated 600Volts or less.
(viii) NEMA ICS 2, Industrial Control and Systems: Controllers, Contactors and Overload Relays, Rated Not More Than 2000Volts AC or 750Volts DC.

5.10 SYSTEM DESCRIPTION

5.10.1 The low-voltage plug-in bus way 225 to 5000 Ampere, 1000 V AC shall be totally enclosed, low-impedance system.
5.10.2 Material and installation shall comply with all applicable codes, recommended practices and standards of ANSI, IEEE, NEMA, UL, CSA, KEMA and ASTA. All bus way components shall be UL listed. Arrangements, details and location shall be indicated in drawings. Bus way shall be tested and conform to Seismic Zone 4 requirements.
5.10.3 Short circuit rating of fittings with protective devices shall be equal to the lower short circuit rating of the protective device or the bus way. Short circuit rating of bus way plugs equals the rating of the fuses or circuit breaker used in the plug.

5.11 OPERATION AND MAINTENANCE

Manufacturer shall provide copies of installation, operation and maintenance procedures to owner in accordance with general requirements. Submit operation and maintenance data based on factory and field testing, operation and maintenance of specified product.

5.12 QUALITY ASSURANCE (QUALIFICATIONS)

5.12.1 Manufacturer shall have specialized in the manufacture and assembly of low-voltage plug-in bus ways.
5.12.2 Low-voltage plug-in bus way shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Article.
5.12.3 Manufacturer’s Certificate of ISO 9000 Compliance.

5.12.4 Installer's Certificate of ISO Compliance.
5.12.5 Installer has specialized in installing low voltage plug-in bus way with [minimum 3 years documented experience].

5.13 INSTALLATION
5.13.1 Install as per manufacturer's instructions.
5.13.2 Install required safety labels.

5.14 FIELD QUALITY CONTROL

Inspect installed bus ways for anchoring, alignment, grounding and physical damage. Check tightness of all accessible mechanical and electrical connections with calibration torque wrench. Minimum acceptable values are specified in manufacturer's instructions. Insulation resistance of bus ways may be measured using [500, 1000, 2500] VDC Meggar. Check phase to phase, phase to ground values. Individual lengths should be at least 3 mega ohm. Entire run should be at least 1 mega ohm. Divide runs over thirty meters long.

5.15 MV Panel

5.15.1 The panel shall be indoor type having incoming sectionalization and outgoing switchgear as specified. The design shall be cubical type. Panel shall be suitable for operation on 433 Volts, 3 Phase, 50Hz, 4 wire system. The degree of enclosure protection shall be IP 42 as per IS: 13947 (Part-I).All switchgears shall be fully rated at an ambient of 40^0 C.

5.15.2 **General Construction**

The switchboard shall be floor mounted; free standing totally enclosed bolted construction and extensible type. The switchboard shall be dust & vermin proof and shall be suitable for the climate conditions as specified. The design shall include all provisions for safety of operation and maintenance personnel. The general construction shall conform to IS:8623/1993 for factory assembled switch board.

5.16 Cubical Type Panels

5.16.1 Cubical type panels shall be fabricated out of sheet steel not lees less 2.0 mm thick. Wherever necessary, such sheet steel members shall be stiffened by angle iron framework. General construction shall employ the principle of compartmentalization and segregation for each circuit. Unless otherwise approved, incomer and bus section panels or section shall be separate and independent and shall not be mixed with sections require for feeders. Each section of the rear accessible type panels shall have hinged access doors at the rear. Overall height of the panel shall not exceed 2.4 meters. Operating levers, handle etc. of highest unit shall not be higher than 1.7 meters. Multi-tier mounting of feeder is permissible. The general arrangement for multi tier construction shall be such that the horizontal tiers formed present a pleasing and aesthetic look. The general arrangement shall be approved before fabrication. Cable entries for various feeders shall be either from top or bottom. Through cable alleys located in between two circuit sections, either in the rear or in the front of the panel. All cable terminations shall be through gland plates. There shall be separate gland plate for each cable entry so that there will not be dislocation of already wired circuits when new feeders are added. Cable entry plates shall therefore be sectionalized. The construction shall include necessary cable support for clamping the cable in the cable alley or rear cable chamber.

5.16.2 **Bus Bar and Connections**

The bus bars shall be of Copper of high conductivity electrolytic quality and of adequate section. Current density shall not exceed 160 amps/Sq. cm. The bus bar system may comprise of a system of main horizontal bus bars and ancillary vertical bus bars run in bus bar alleys on either side of which the circuit could be arranged with front access cable entries. In the case of rear access, horizontal bus system shall run suitably either at the top or bottom. All connections to individual circuits from the bus bar shall preferably be solid connections; however flexible connections shall also be permitted as per recommendations of the Panel Manufacturer. All bus bars and connections shall be suitably sleeved / insulated in approved manner.

5.16.3 **Incomer / Termination**

Incomer termination shall be suitable for receiving bus trunking / underground cables. Cable terminations shall invariably be though terminal blocks (Polyamide or superior) or brought out solid terminals.

5.16.4 **Instruments**

All Multifunction meter shall be flush mounted of required size shall be protected with MCB.

5.16.5 **Indicating Lamps**

On all the incomers of M.V panels, ON/OFF indicating LED lamps shall be provided and shall be suitable for operation on AC supply. Phase indicating LED lamps shall be associated with necessary ON/OFF toggle switch.

5.16.6 **Small Wiring**

All small wiring for Controls, Indication etc. shall be of with suitable FRLS/HFFR (halogen free fire retardant) copper conductor cables. Wiring shall be suitably protected within switchboard. Runs of wires shall be neatly bunched, suitably supported and clamped. Means shall be provided for easy identifications of the wires. Where wires are drawn through steel conduits, the works shall conform to CPWD General Specifications for Electrical work (Par I – Internal) – 2005 and IS:732 as the case may be. Identifications ferrules shall be used at both ends of the wires. All control wiring meant for external connections are to be brought out of terminal board

5.17 Operational requirement

The indoor type MV panel shall conform to the following:

(a) The panel shall comprise of incomers, outgoing feeders and bus coupler as specified. The incomer shall be either a double break / contact repulsion MCCB or an Air Circuit Breaker. The bus coupler shall be either a circuit breaker or a double break / contact repulsion MCCB as specifies. The outgoing feeders shall be circuit breakers/MCCBs as specified.

(b) Bus bars for phase and neutral shall have a rating as per CPWD specification.

(c) The entire switch panel shall be cubical type generally conforming to IS:8623/1933 for factory assembled switch board.

(d) The incomer panel shall be suitable for receiving MV cable of size specified either form top or from bottom.

(e) All incoming AIRCIRCUIT BREAKER/MCCB shall have suitable adjustable tripping current and the time delay settings.

(f) The entire panel shall have a common earth bar of size as specified with two terminals for earth connections.

5.18 Rating and Requirements

5.18.1 **MCCB**

All MCCBs shall be current limiting type with features of load line reversibility and suitable for Horizontal/Vertical mounting without any de-rating. Beyond 300Amps capacity MCCBs shall have positive isolation and preferably double break/Contact repulsion & double insulation features. The MCCBs shall invariably be used with terminal spreaders.

5.19 Test at manufacturers works

All routine tests shall be carried out and test certificates produced to the department.

5.20 Installation

The installation work shall cover assembly of various sections of the panels lining up, grouting the units etc. In the case of multiple panel switchboards after connecting up the bus bars etc., all joints shall be insulated with compound. A common earth bar shall be run inside at the back of switch panel connecting all the section for connection to frame earth system. All protection and other small wirings for indication etc. shall be completed before calibration and commissioning checks are commenced. All relays, meters etc. shall be mounted and connected with appropriate wiring.

5.21 Testing and commissioning

Commissioning checks and tests shall include all wiring checks and checking up of connections. Relay adjustment/setting shall be done before commissioning in addition to routine Megger tests. Checks and tests shall include the following:

(a) Operation checks and lubrication of all moving parts.

(b) Interlock function checks.

(c) Continuity checks of wiring, fuses etc. as required.

(d) Insulation test: When measured with 500V Megger the insulation resistance shall not be less than 100 mega ohms.

Trip tests and protection gear test.

5.22 THYRISTOR SWITCH APFC LT CAPACITOR PANEL

Design, manufacture, supply, erection, testing and commissioning of indoor type power correction capacitor banks for power factor improvement as per specification given below:

5.23 Rating: Capacitor units as per design but not less than 210 KVAR of each panel

5.24 Enclosure:

The panel shall be indoor type, free standing, and floor mounting with **IP42** degree of protection. It shall be completely made of 2mm thick CRCA sheet steel. The enclosure shall have sturdy support structure with angle supports as necessary and shall be finished with powder coating in the approved colour shade/s. The thickness of powder coating

should be minimum 60-80 microns. Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided as a necessary. The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors. The enclosure is to be suitable sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

5.25 General

a. System should be capable of real time cycle/Dynamic control.
b. PF control from 0.98 Lead to 0.95 Lag.
c. Thyristors switched
d. No spikes and transient free system

5.26 System configuration & Features

a. The system has to use Electronic thyristors switching. The connection and disconnection should occur when the voltage across thyristor is “Zero”. This ensure smooth connection, which avoids transient’s effect typically created by electro mechanically switched compensation systems.
b. Use of Solid State Relay as switching device is strictly prohibited.
c. Banking shall be designed.

5.27 Capacitors

a. The capacitor shall comply with the following standard (and their latest amendments : IS: 13340/IEC 831.1&2)
b. **The capacitor shall be ISI/IEC marked.**
c. **Capacitor voltage must be rated @ 550 V for system voltage at 415/440 V**
d. Capacitor type HA type resin bonded low loss terminal less without oil capacitor should be housed in a cylindrical aluminum can to assure better heat dissipation and compact size.
e. The impregnation shall be non PCB biodegradable type or Inert gas, so as not to have any degenerated properties and shall be non-oxidizing.
f. **Over current: 1.4*In.**
g. Total watt – losses excluding discharge resistors < 0.2W/KVAR
h. Inrush handling capacities shall not be less than 200* In
i. The entire capacitor unit shall be provided with high value fast discharge resistor, which shall discharge the capacitors within few seconds. The design shall be modular type for the simple mechanical assembly, no extra accessories/metal part to be required. Unit must be free standing.
j. Life expectancy should be 200000(two lacs) hours at D class (temperature range -25 degree C +70 degree C and annual average temperature of 35 deg. C.)

5.28 Detuned filter

a. The aluminium conductor used either have dual coat enamel insulation or are provided with insulation of nomex paper, capable of withstanding temperature exceeding 180 deg.C.
b. H- class insulation.

c. Vacuum impregnated.
d. Tolerance of inductance should not be more than 5%.
e. For the temp, protection a Temp sensor should be there.

5.29 System – Controller (APFC Relay)

a. The relay should have a microprocessor based sensing having three phase measurement and thyristorized output.
b. The relay should have a LED display panel and minimum current sensitivity of 40 mA.
c. It should have RS 232 port interface protocol or RS 485 port with MODBUS.
d. All measurement should be made with 0.5 class accuracy.
e. Load V, I and capacitor current THD measurement with ODD harmonic coefficient upto 19^{th} harmonic, Neutral current analysis too.
f. Upto 12 output bank control.
g. Protection to be provided for :-

1. Over/under voltage
2. Capacitor over/ under current / Thd
3. Over/ under frequency
4. Load unbalanced
5. Over temperature

5.30 Switching Module

a. Thyristorised Switching Module (TSM) should be fast electrically controlled, self observing thyristors switch for capacitive load and it should be capable to switch capacitors within few milli second (20 m sec) as often as required.
b. Reaction time shall be 7-10 milli seconds and PIV of 1100 V to take care of system voltage, voltage due to crest factor and switching transients across the SCR.
c. All intelligence needed should be offered within thyristors itself.
d. Permanent self controlling of Voltage parameter, phase sequence, capacitor out put.
e. Super fast semiconductor fuses of suitable ratings shall be used for the protection of Thyristorized switching module (TSM).
f. Fast discharge resistance shall be provided with each set of capacitors,
g. Maximum ambient temp. : 45 deg-C.
h. The TSM module should be protected against high temperature by the help of in built thermal cut outs, which ensures disconnection at high temperature and restores when the temperature becomes normal.
i. The TSM modules shall be naturally cooled with heat sinks of special aluminium alloys.

5.31 Compartments

a. The switching module and high speed fuses shall be placed on the front plate.
b. The capacitors, reactors and discharge module shall be placed behind.
c. The APFC modules shall be complete with all capacitors / reactors /HRC fuses and switching devices connected with cables of suitable sizes.
d. The compartment should ensure proper heat dissipation.

The APFC Panel shall be type tested by <u>ERDA/CPRI</u>

6. Cable work

6.1 11KV grade XLPE insulated PVC sheathed armoured aluminum cable shall be 3 core earthed of sizes.

6.2 All control wire shall be 650 grade copper conductor HFFR or FRLS PVC insulated conforming to IS : 1554 Part-I. The min. size of control wire shall be 1.5 sq.mm.

6.3 JOINTING FOR 11 KV GRADE CABLE GLANDS

Jointing work shall be carried out only by licensed experienced cable jointer and shall be in accordance to CPWD General Specifications for Electrical works – Part-II (External) 1994 amended upto date.

6.4 EARTHING For 11 KV GRADE CABLE GLANDS

All HV cable glands shall be connected to the earth with 2 Nos. 38.6 mm copper or equivalent G. I. conductors.

6.5 INSTALLATION

All joints shall be riveted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contract to iron or steel. Bolts, nuts, washer etc. shall be cadmium plated, main earth bars shall be spaced sufficiently on the surface to which they are fixed such as walls or the side trenches to allow for ease of connections. Copper earhting shall not be fixed by ferrous fittings. The earthing shall suitably be protected from mechanical injury by galvanized pipe wherever it passes through wall and floor. The portion within ground shall be buried at lease 60 cm deep. The earthing lead shall be securely bolted and soldered to plate or pipe as the case may be. In the case of plate earthing the lead shall be connected by means of a cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts nuts and washers shall be galvanized.

7. EARTHING SYSTEM

7.1 SCOPE

This section covers the general requirement of the earthing system for Sub-Station installation.

7.2 SYSTEMS

Earhting system shall comprise earth electrodes in accordance with clause 8.2.1 of General specifications for Elect. Works (Par I Internal) 2005. For every additional transformer 2 more separate and distinct earth electrodes shall be provided for neutral earthing. The body earthing for transformers, HV & MV panels shall be done to a common earth bus connected to two separate and distinct earth electrodes.

Note: For a single transformer Sub-Station, the total number of earth electrodes shall be 4 (2 for neutral and 2 for connection to a common earth bus for body earthing). For a two transformer sub-station total number of earth electrodes shall be 6 (4 for neutral earthing, two each for two transformers, and 2 for connecting to a common earth bus for body earthing)

7.3 ELECTRODES

The earth electrodes shall be as per CPWD General Specification for Elect. Works (Part-I Internal) 2005.

7.4 LOCATION OF EARTH ELECTRODES

Normally an earth electrode shall not be situated less than 1.5 m from any building. Care shall be taken that the excavation of earth electrode may not affect the column

footings or foundation of the building. In such cases electrodes may be farther away from the building.

The location of the earth electrode will be a place where the soil has reasonable chance of remaining moist. As far as possible, entrances, pavements and road ways, are to be definitely avoided for locating the earth electrode.

7.5 WATERING ARRANGEMENTS

Method of watering arrangement shall comply with CPWD General specifications.

7.6 SIZE OF EARTH LEAD

The recommended sizes of copper earth bus lead in case of sub-station shall be accordance with clause 8.2.2 of general specification for electrical works (Part –I Internal) 2005 amended upto date. The minimum size of earth lead shall be 2.5 mm x 5 mm copper or equivalent GI Strip.

7.7 INSTALLATION

All joints shall be riveted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contract to iron or steel. Bolts, nuts, washer etc. shall be cadmium plated, main earth bars shall be spaced sufficiently on the surface to which they are fixed such as walls or the side trenches to allow for ease of connections. Copper earhting shall not be fixed by ferrous fittings. The earthing shall suitably be protected from mechanical injury by galvanized pipe wherever it passes through wall and floor. The portion within ground shall be buried at lease 60 cm deep. The earthing lead shall be securely bolted and soldered to plate or pipe as the case may be. In the case of plate earthing the lead shall be connected by means of a cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts nuts and washers shall be galvanized.

7.8 TESTING

After installation, the tests as specified in CPWD General Specification for Electrical Works (Part-I Internal) 2013 shall be carried out and results recorded.

8. SAFETY REQUIREMENTS

8.1 Insulation mats Insulation mats conforming to IS : 15652-2006 shall be provided in front of main switch board as well as other control equipments as specified.

8.2 Danger Plate Danger plate shall be provided on HV and MV equipments. MV danger notice plate shall be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous enamelled white on both sides and with the description in single red colour on front side as required. Notice plates of other suitable materials such as stainless steel, brass or such other permanent nature material shall also be accepted with the description engraved in single red colour.

8.3 Fire Buckets Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand.

COMMERCIAL AND ADDITIONAL CONDITIONS - SUB STATION

1. Specification:- The work shall be executed as per CPWD's general specification for Electrical Works, Part-I-2013, Part-II-1994 (External) & Part-IV-2013 for Sub-Station.

Indian Standards amended upto date and as per direction of Engineer-in-Charge. The additional specifications are to be read with above and in case of any variation, specifications given in this the tender shall apply.

2. Storage:- Responsibility for storage space for execution of work shall be of main contractor.

3. Power & Water Supply:- Responsibility for supply of power & water for execution of work shall be of main contractor.

4. Indemnity:- The successful tenderer shall at all times indemnify the department, consequent on this works contract. The successful tenderer shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause and the contractor shall be responsible for any accident or damage incurred or claims arising three from during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer in so far as the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would bemade to the successful tenderer on account of the above.

5. Insurance and Storage: - All consignments are to be duly insured upto the destination from warehouse at the cost of the contractor. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

6. Inspection by CEA:- After completion of the work, the contractor will offer the same for inspection of Central Electricity Authority. The contractor will extend all help including test facilities to the representative of Central Electricity Authority. In case the contractor fails to make desired facilities available during inspection, the department reserve the right to provide the same at the risk & cost of the contractor. The observation of Central Electricity Authority which are a part of agreement will be attended by the contractor promptly. The installation will be commissioned only after receiving clearance from Central Electricity Authority. All statutory payments including Inspection fees of Central Electricity Authority will be borne by the Contractor.

7. The material required to be used in the work shall be got approved from the Engineer-in-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.

8. Contractor shall preserve the copies of invoices, test certificates, gate passes etc. to prove the genuineness of material/purchases. The responsibility of procurement, genuine material of specialized works shall rest with the contractor.

9. Liasoning with local power supply company for release of HT supply i/c all arrangements.

PACKAGE – 6 - Diesel Generating Set

Scope of work:

Scope of work includes design, planning, supply, installation, testing and commissioning of silent type DG set in accordance with CPWD General Specifications for Electrical Works (Part-VII DG Sets 2013).

1. The minimum capacity of the DG set shall be 2 X 380 KVA.
2. All lighting, fan, lifts, data power load & water supply pump load, Auditorium load - AHU load, ventilation/pressurisation system, fire fighting load including load on UPS shall be considered as essential load.
3. The DG sets will be kept in the area specified on suitable foundation and shall be connected with 3½ core X suitable size of FRLS copper armoured cables to the AMF & essential panel. The incomers of the panels shall be properly electrically & mechanically interlocked with each other and with coupler to ensure that no short circuit should occur.
4. The AMF panel shall have suitable size of 4 P microprocessor based ACBs with minimum 50 KA (Ics=100% Icu = Icw) or higher as per design of fault level with all earth fault, short circuit and overload protection.
5. 3½ core X suitable size of FRLS XLPE/PVC insulated, PVC sheathed power copper cables shall be provided for connection between D.G. sets and AMF panel, AMF panel to essential panel including necessary control cabling as per recommended sizes.
6. Automatic mains failure panel with all features shall be provided for the D.G. set.
7. Suitable size cement concrete foundation as per OEM / CPWD specifications after approval of Engineer- in- charge.
8. The DG set shall be silent type with acoustic enclosure and as per CPCB norms.
9. The height of the exhaust pipe shall be as per CPWD specification and CPCB norms. All M.S. Pipes for exhaust lines shall be conforming to relevant IS. The runs forming part of factory assembly on the engine flexible connections up to exhaust silencer shall be exclusive of exhaust piping item. The work include necessary cladding of exhaust pipe work using 50 mm thick Loosely bound resin (LBR) mattress/ mineral wool/ Rockwool, density not less than 120 kg/m^3 and aluminium cladding (0.6 mm thick) for the complete portion. The exhaust pipe work includes necessary supports, foundation etc.
   The supporting MS structure of suitable size shall also be provided which is included in the scope of work.
10. The generating set and all associated equipments control and switch gear and switch gear panels must be earthed before the set is put into operation.

    Four numbers earth sets for each DG Sets are required as under:

    - 2 earthing sets for Genset/ control panel body.
    - 2 earthing sets for neutral.

    In case there are more than one DG Set in one location, independent two nos. neutral earthing shall be provided for each DG set. However, two nos. earthing sets shall be common for the body earthing of DG Sets, Control Panel, AMF Panel.

11. Approval/clearance of the complete installation shall be obtained by the contractor from CPCB/state pollution Control Boards/ Local Bodies/ Central Electricity Authority (CEA)/other licensing authorities wherever required. Necessary application for approvals shall be made by department but statutory payments /fees, as applicable shall be paid by the contractor.

12. Brief technical details of 380 KVA silent DG set – Silent type' Diesel Generating set along with having Prime Power Rating of 380 KVA, 415 Volts at 1500 RPM, 0.8 lagging power factor at 415V suitable for 50 Hz, 3 phase system and consisting of the followings:
    i. Synchronous alternator- rated at 380 KVA, 415 volts at 1500 RPM, 3 phase 50 Hz, AC supply with 0.8 lagging power factor at 40 degree C, 50% RH 7 at 1000 mtr MSL. The alternator shall be having SPDP enclosure, brushless, continuous duty, self-excited and self-regulated through AVR conforming to IS : 4722/BS 2613 suitable for tropical conditions and with class- F/H insulation.
    ii. Diesel Engine – 4 stroke water cooled, electric start with turbo chargers of suitable BHP at 1500 RPM suitable for above output of alternator at 40 degree C, 50% RH & at 1000 mtr MSL and conforming to BS 5514, BS 649, IS10000,capable of taking 10 % over loading for one hour after 12 hours of continuous operation at full load. The engine will be fitted complete with all required accessories as below.
        a. Start-stop switch with key
        b. Water temperature indication
        c. Lubrication oil pressure indication
        d. Lubrication oil temperature indication
        e. Battery charging indication
        f. RPM indication
        g. Over speed indication
        h. Low lub. Oil trip indication
        i. Engine Hours indication
        j. BMS compatible software & hardware like Bacnet/Modbus card shall be provided
    iii. Engine mounted Instrument Panel shall be as per manufacturer standard with digital display for indication of various parameters etc.
    iv. Both the engine and alternator shall be mounted on suitable base frame made of MS channel with necessary reinforcement which shall be installed on suitable cement concrete foundation and vibration isolating arrangement as per recommendation of manufacturer.
    v. Daily service fuel tank of minimum 500 ltrs capacity fabricated out of 3 mm thick MS sheet complete with all standard accessories and fuel piping between fuel tank and diesel engine with GI heavy duty (class 'C') pipes of suitable dia. complete with valves, level indications & accessories etc. as required as per specifications.
    vi. Dry exhaust system with residential type exhaust silencer with catalytic converter shall be provided.
    vii. 12V/24V DC starting system with suitable nos. of batteries (25 plates, 180 Amp. Hour capacity lead acid type) or as per OEM standard shall be provided.
    viii. Acoustic and weather proof enclosure (to limit overall noise level to 75 dB (A) at a distance of 1 mtr. from the enclosure) as per CPCB norms with arrangement for fresh air intake for cooling of the engine & alternator, suitable extraction fan discharging hot air in to the atmosphere as per specification shall be provided.
    ix. AMF panel with bypass system complete with relays, timers, set of CTs for metering & protection and multi function meter to indicate currents, phase, and line voltages, frequency, KVA, power factor, KWH & provision for overload, short circuit, restricted earth fault, under voltage control, control cabling from AMF panel to diesel engine and elsewhere if required, all complete and inter locking including the following:

a. 2 Nos. 4 pole ACB 630 A minimum 50 KA or higher as per design of fault level with microprocessor based with short circuit, overload & earth fault protection.(one no for mains & one no for DG Set)
b. Auto/Manual/Test/Off selector switch
c. 2 Nos. over voltage relay, 2 Nos. reverse power relay and 2 Nos. under voltage relay.
d. 3 Sets of current transformers accuracy for protection and 15 VA class-I for metering.
e. Multifunctional meter shall indicate current voltage frequency power factor, KWH Phase, KVARH, KVA and all other parameters as required.
f. Indicating lamps for load on mains and load on set shall be provided.
g. Fuse for instruments, terminal blocks, push buttons, control switches etc. as required.
h. Control system equipments and components both for automatic operation on main failure and as well as for manual operation.
i. Battery charger, complete with transformer/rectifier, D.C. voltmeter and ammeter, selector switch for trickle, off and boost and current adjustment.
j. Main supply failure monitor
k. Supply failure timer
l. Restoration timer
m. Control unit with three impulse automatic engine start/stop and failure to start lockout.
n. Impulse counter with locking and reset facility.
o. ON/OFF/Control circuit switch with indicator
p. Audio/Video annunciation for
   (i) High water temperature
   (ii) Low lubricating oil pressure
   (iii) Engine over speed
   (iv) Engine fails to start
   (v) Full load/maximum load warning
q. PLC compatibility and required nos. of Input/ Output terminals points should be provided in the AMF control panel.

Synchronization of DG sets :-

Synchronization of DG sets as required in both Auto & Manual mode (as per decision by Engineer-in-charge) and comprising of running of DG set in parallel i.e. their synchronization on common bus bar, auto load sharing and auto load management.

PLC PANEL

Operation of DG sets shall be monitored and controlled by PLC panel i.e. Programmable logic controller based logic panel. In case of mains failure, this logic panel shall control auto changeover from mains to DG Sets supply and interlocking of ACBs, auto synchronizing and auto load management functions along with annunciation for alternator control and protection.

The logic panel shall be provided with a total manual over ride facility. There shall be Smooth transfer of DG set operation from PLC to manual system & vice versa without any interruption/tripping. The logic panel shall be complete with all Auxiliary Relays, Timers, Contactors, Programmable logic controller, control wiring, interconnections etc. with 2.5 sq.mm. PVC insulated, 1.1 KV grade copper conductor wires.

The system should also have inbuilt protection other than external relays in synchronization panel for Back up Protection.

COMMERCIAL AND ADDITIONAL CONDITIONS- DG SETs

1. Specification-: The work shall be executed as per CPWD's general specification for Electrical Works part-I(2013) & Part-II (1994) & Part-VII (2013) for DG Set Work, IE Rules, Indian Standards amended up to date and as per direction of Engineer-in-Charge. The additional specifications are to be read with above and in case of any variations, specifications given in the tender shall apply.
2. Inspection by CEA-: After completion of the work, the contractor will offer the same for inspection of Central Electricity Authority if required. The contractor will extend all help including test facilities to the representative of Central Electricity Authority. In case the contractor fails to make desired facilities available during inspection, the department reserve the right to provide the same at the risk & cost of the contractor. The observation of Central Electricity Authority which are a part of agreement will be attended by the contractor promptly. The installation will be commissioned only after receiving clearance from Central Electricity Authority. All statuatory payment including inspection fees of Central Electricity Authority will be borne by the contractor.
3. The material required to be used in the work shall be got approved from the Engineering charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.
4. Contractor shall preserve the copies of invoices, test certificates, gate passes etc. To prove the genuineness of material/purchases. The responsibility of procurement, genuine material of specialized works shall rest with the contractor.
5. The contractor shall offer inspection call at factory premises before dispatch of DG set to carry out test as per CPWD specification & fuel charge & other charges of testing of DG set for 13 hours shall be borne by the agency. To & fro journey fare of the CPWD officers for inspection of DG set shall be borne by the department.
6. The contractor shall submit the following after award of work:
   (i) Submission of GA drawing of DG set for approval within 3 month after award of work. Lay out drawings of the equipments to be installed including control cables, fuel/ lube oil pipes and supports/ structure for exhaust piping, Chimney and bus ducts/ cable trays.

   (ii) Electrical wiring diagrams from engine-alternator set to Electrical control panel, Electrical control panel to essential LT board including the sizes and capacities of the various electrical/ control cables and equipment.

   (iii) Dimensioned drawings of Acoustic enclosure/ Engine-Alternator set and Electrical control panel.

   (iv) Drawings showing details of supports for pipes, chimney cable trays, ducts etc.

   (v) Written commitment from OEM/OEA to supply the DG Sets and delivery schedule as per requirement of department.

   (vi) Certificate from OEM/OEA or authorized service provider of engine manufacturer of satisfactory installation and commissioning of DG Set after completion of the work.

(vii) The defect liability period shall be reckoned from the date of handing over of the installation to the department.

(viii) An undertaking that mandatory free service shall be carried out during the Defect liability period as per this agreement by the authorized service provider of engine manufacturer.

INSPECTION AND TESTING

The successful tenderer will arrange staff/fuel/POL for test run at his cost.

Inspection and Testing of DG sets of capacity more than 200 KVA

For DG sets of capacity more than 200 KVA, testing shall necessarily be carried out at factory/ manufacturer premises in presence of representative of the Department.

For testing, following procedure will be followed: All major items/ equipments i.e. engine & alternator in assembled condition, associated electrical control panels etc. shall be offered for inspection and testing at factory/ manufacturers works. The successful tenderer shall give a notice of minimum two weeks for carrying out such tests. The Engineer-in-charge/ or his authorized representative shall witness such inspection & testing at mutually agreed date. The cost of the representative's visit to the factory will be borne by the Department.

The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make arrangements for the same.

DG set will be tested on load of unity power factor for the rated KW rating. During testing, each of the D.G. sets covered under scope of work, shall be operated for a period of 12 hours on the rated KW at DG set's KW rating including one hour on 10% overload after continuous run of the 12 Hours. During testing all controls/ operations safeties will be checked and proper record will be maintained. Any defect/ abnormality noticed during testing shall be rectified. The testing will be declared successful only when no abnormality/ failure is noticed during the testing. The DG set will be cleared for dispatch to site only when the testing is declared successful by authorised representative/ Engineer-in-Charge.

Copies of all documents of routine and type test certificates of the equipment, carried out at the manufacturers premises shall be furnished to the Engineer-in-charge and consignee

Drawings/Documents to be furnished on completion of Installation

Two sets of the following laminated drawings shall be submitted by the contractor while handing over the installation to the Department. One set shall be laminated on a hard base for display in the DG set room/room where AMF panel is installed and another set shall be handed over to User department. In addition, drawings will be given on Compact Disc (CD):

(a) DG set installation drawings giving complete details of all the equipments, including their foundations.
(b) Line diagram and layout of all electrical control/AMF panels giving switchgear ratings and their disposition, cable feeder sizes and their layout.

(c) Control wiring drawings with all control components and sequence of operations to explain the operation of control circuits in AMF panel/PCC.

(i) Manufacturer's technical catalogues of all equipments and accessories.

(ii) Operation and maintenance manual of all major equipments, detailing all adjustments, operation and maintenance procedure.

AFTER SALES SERVICES

The contractor shall ensure adequate and prompt after sales service free of cost during guarantee period (01 year) in the form of maintenance, spares and personnel as and when required.

PACKAGE - 7 CCTV SURVEILLANCE SYSTEM

SCOPE OF WORK

Designing, Planning, Supplying, Installing, Testing & Commissioning of the CCTV Surveillance system shall be provided for the security system in the Administrative cum Academic Building and Auditorium as per following:

A) CCTV & SURVEILLANCE SYSTEM

(i) Minimum 1 number Dome Camera shall be provided at each Lift Lobby in each floor [2 Nos. lift lobbies (G+6th floor)] as per design.

(ii) Minimum 1 number Dome Camera shall be provided at all staircases, entrance lobby / front / rear internal corridor in each floor [G+6th floor – 2 nos. staircases and 1 no. each at entrance lobby / corridor.] as per design.

(iii) Minimum 1 number Dome Camera shall be provided at all internal corridors for both wings in each floor [G+6th floor] as per design.

(iv) Minimum 1 number Dome camera shall be provided in Entrance foyer, reception, conferrence halls (Ground floor), halls (First floor), Server Room, BMS room, ICT & data center, class room, computer labs as per design. The classroom with 2 Nos. entrances shall have 2 Nos. dome camera.

(v) Minimum 2 numbers Dome camera shall be provided in Canteen, exhibition area at Ground floor as per design.

(vi) Minimum 1 number Dome camera shall be provided in entry & exit of auditorium and staircase [G+1th floor – 2 nos. per staircase] as per design.

(vii) Minimum 3 numbers Dome camera shall be provided inside auditorium at Ground floor as per design.

(viii) Minimum 1 number Bullet cameras shall be provided at 2 Nos. entrance passages (each) ground floor to main building and vehicle entrance, vehicle exits gate.

(ix) Minimum 2 numbers Bullet cameras shall be provided at Terrace floor each to cover all the areas as per design.

(x) Minimum 4 numbers PTZ cameras shall be provided at suitable places around the periphery of building to cover the entire campus of the building.

The above are minimum requirements, but additional cameras shall be considered as per site requirements for covering all common areas within the design & scope of work.

The hardware required for the system including Servers , NVR ,Workstations, Monitors, CAT-6 Patch Cable to connect the camera to nearest POE enabled LAN Network switches, Cat-6 armoured copper Cables, connectors, conduits, power supplies etc. will be in the contractor's scope. Details of specification of IP back bone is given in the subhead of Local area network. Backbone upto core switch and rack in CCTV control room is taken in the scope of LAN subhead. **The complete LAN networking, for the CCTV should be separate and exclusively for CCTV system only and not mixed with other LAN system. The proposal shall be designed to ensure it.**

It will be the responsibility of the contractor /bidder to make the entire system fully functional as per the specifications. Contractor /bidder shall consider all the equipments, devices required to make the system functional if not mentioned herewith.
Suitable height Octagonal GI poles for outdoor CCTV cameras alongwith cabling, foundation shall be considered in the scope of work.

The Vendor shall supply and install an IP based Camera CCTV system with the objective to provide high degree of Electronic surveillance system. It is also essential to have recorded images to be stored at least for 30 days @ 2MP 30fps of all critical areas to facilitate investigations of a reported case. Bidder must offer the System with 30 days of Storage @ 2MP 30fps in RAID-5 with 20% Buffer capacity. (Bidder must calculate the storage capacity considering 1.7TB per camera for 30days).

The project is on design and build basis and must cover the entire premises. Building's Main Entry & Exit, entry & exit gates, Critical Areas, all Lift Lobbies, staircase, entrance corridors of all floors, canteen area, Reception area, class rooms, conference room, meeting rooms, ICT & data center, Ground floor car parking area i/c driveway, server room, BMS room, Terrace floor, Auditorium & campus of the building etc shall be fully covered along with any other critical area as per the requirement of client as a minimum.

The bidder is free to suggest/consider any other critical area under surveillance.

The Camera should have ONVIF Profile S & G Compliance. All equipments and materials used shall be standard components thoroughly tested and proven in actual use, that are regularly manufactured and used in the system.

Bidder shall calculate the camera quantity as per the scope of work and full coverage requirement. All the backend system must be designed as per the minimum specification given below.

For Camera Monitoring and Control, minimum 55inch Full HD Monitor shall be considered. All the cameras shall be live on using multiple monitors. One monitor shall have not more than 54 camera 9x6 Grid. Minimum Two Monitors can be used in on one workstation in Dual Monitor Mode. Minimum 05 concurrent workstation license shall be offered and number of Workstation and Monitors shall be decided by the Engineer-in-charge as per actual site requirements.

Following Technical Specifications to be complied for the CCTV system

A.	**2 MP Dome Camera**	
S. No	**Features**	**Specifications**
1	Form factor	IP based motorized Dome Camera
2	Image Sensor	1/2.8" CMOS
3	Day/ Night Operation	Yes, with IR

4	Minimum Illumination	Color 0.001 lux
5	Lens	3 - 9 mm, Megapixel Lens with remote zoom and focus
6	Automatic Electronic Shutter	1/66500 to 1 sec
7	Image Resolution	2 MP
8	Compression	H.264(Main Profile), MJPEG Video compression
9	Frame Rate and Resolution	2 MP (1920 X 1080) @ 30 FPS
10	Simultaneous Stream	Minimum 3 streams should be configurable at 1920 X 1080 @ 30 fps simultaneously
11	White Balance	Auto
12	Video Streams	Three Stream supportable, all stream should be H.264/H.265 – Independent Configuration
13	Video quality view	Video compression type (H.264 MJPEG) and bit rate of each stream should be viewable on home screen
14	Image Setting	Saturation, Brightness, Contrast, Sharpness, Hue adjustable
15	Two-way audio	Line in / Line Out
16	Audio Compression	G.711 / G.726 / AAC
17	Iris	P iris/DC- Iris
18	Wide Dynamic Range	120 dB or better
19	IR	Up to 30 mtr IR distance
20	Alarm	1 x Input & 1 x output
21	Edge Video Content Analytics	Camera should have in-built Edge Bases Analytics, Abandoned Object, Intrusion Detection, Tampering, Wrong Direction, Loitering Detection, Object Counting, Stopped Vehicle, Object Removal
22	Storage backup on network failure	Camera should support network failure detection, Camera should have the capability to start the recording automatically on SD card in case of connectivity between camera and NVR/Storage device goes down upto 128 GB. (to be checked)
23	Network Interface	RJ-45, 10/100Mbps Ethernet
24	Edge Storage	Built in SD card slot with support up to 128 GB SD card
25	Protocols	IPv4/v6, TCP/IP, UDP, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP, PPPoE, UPnP, IGMP, SNMP, QoS, ONVIF
26	Security	HTTPS / IP Filter / IEEE 802.1X Cyber Security Chipset
27	Video Output	1 X BNC
28	Enclosure	IP 65 weather proof,
29	Vandal Resistant	IK 10
30	Power	POE / 12 V DC /24 V AC
31	Operating Temperature	-30 ℃ to 50 ℃
32	Operating Humidity	Humidity 10%–90%

33	Certification	UL, CE, FCC, RoHS
34	ONVIF	ONVIF Profile S & G Profile compliant
35	Supported Web Browser	Internet Explorer (7.0+) / Firefox / Safari/Chrome

B.	**2 MP Bullet Camera**	
Sl.	**Features**	**Specifications**
1	Form Factor	IP based motorized Bullet Camera
2	Image Sensor	1/2.8" CMOS
3	Day/ Night Operation	Yes, with IR
4	Minimum Illumination	Color 0.001 lux
5	Lens	3 - 9 mm Megapixel Lens with remote zoom and focus
6	Automatic Electronic Shutter	1/66500 to 1 sec
7	Image Resolution	2 MP
8	Compression	H.264(Main Profile), MJPEG Video compression
9	Compression profile	Should support H.264 baseline, Main profile, and high profile
10	Frame Rate and Resolution	2 MP (1920 X 1080) @ 30 FPS
11	Simultaneous Stream	Minimum 3 streams should be configurable at 1920 X 1080 @ 30 fps simultaneously
12	White Balance	Auto
14	Field of View	36 º to 106 º
15	Noise Reduction	Digital Noise Reduction 2D / 3D DNR
16	Zoom	4x optical Zoom, 10x Digital Zoom
17	Digital PTZ	Camera should support digital PTZ
18	Video Streams	Quad Stream supportable, all stream should be H.264
19	Video quality view	Video compression type (H.264/MJPEG) and bit rate of each stream should be viewable on home screen
20	Image Setting	Saturation, Brightness, Contrast, Sharpness, Hue adjustable
21	Two-way audio	Line in / Line Out
22	Audio Compression	G.711 / G.726 / AAC
23	Iris	P iris/DC- Iris
24	Wide Dynamic Range	120 dB or better
25	IR	Up to 40 mtr IR distance
26	Alarm	1 x Input & 1 x output
27	Edge Video Content Analytics	Camera should have in-built Edge Bases Analytics, Abandoned Object, Intrusion Detection, Tampering, Wrong Direction, Loitering Detection, Object Counting, Stopped Vehicle, Object Removal

28	Storage backup on network failure	Camera should support network failure detection, Camera should have the capability to start the recording automatically on SD card in case of connectivity between camera and NVR/Storage device goes down
29	Edge Storage	Built in SD card slot with support up to 128 GB SD card
30	Network Interface	RJ-45, 10/100Mbps Ethernet
31	Protocols	IPv4/v6, TCP/IP, UDP, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP, PPPoE, UPnP, IGMP, SNMP, QoS, ONVIF
33	Security	HTTPS / IP Filter / IEEE 802.1X Cyber Security Chipset
35	Video Output	1 X BNC
36	Image Rotation	Normal, Mirror, 90 deg clockwise, 90 deg anti clockwise, 180 deg rotate
37	Privacy Masks	Up to 5 privacy masks
38	Audio Transmission mode	Full Duplex, Half Duplex, Simplex
39	Enclosure	IP 67 weather proof, IK 10
40	Power	POE / 12 V DC /24 V AC
41	Operating Temperature	-30 ℃ to 60 ℃
42	Operating Humidity	Humidity 10%–90%
43	Certification	UL, CE, FCC, RoHS
44	ONVIF	ONVIF Profile S and G
45	User accounts	20
46	Supported Web Browser	Internet Explorer (7.0+) / Firefox / Safari/Chrome
47	Certification	UL, CE, FCC

C.	**PTZ CAMERA**	
Sl.	**Features**	**Specifications**
	Form Factor	IP based motorized PTZ camera
1	Certifications	UL ,CE,FCC
2	Compatibility	ONVIF profile S , G and Q
3	Sensor	1/2.8" CMOS
4	Resolution	2 MP (1920 x 1080)
5	Multiple Stream	Three Stream
6	Frame Rate	upto 30 fps @ 2MP
7	Focal Length	4.3-129 mm
9	Optical Zoom	30X
10	Digital Zoom	16X or better
11	Focus	Auto (Motorized)
12	WDR	120 dB
13	Noise Reduction	2D / 3D
14	Shutter Speed	1/15000 sec.
15	IR	Inbuilt IR , IR distance upto 100 mtr

16	Illumination Adjustment	IR illumination adjustment by zoom ratio with inbuilt IR LEDs
18	Min Illumination	0.05 @ F1.6 – F1.4(Color)
19	Iris	P iris/DC-Iris
20	Edge Video Content Analytics	Camera should have in-built Abandoned Object, Intrusion Detection, Tampering, Wrong Direction, Loitering Detection, Object Counting, Stopped Vehicle, Object Removal
21	Storage backup on network failure	Camera should support network failure detection , Camera should have the capability to start the recording automatically on SD card in case of connectivity between camera and NVR/Storage device goes down
22	Edge Storage	Built in SD card slot with support upto 128 GB SD card
23	Video Compression	H.264(Main Profile), MJPEG Video compression
24	Privacy Mask	upto 20 privacy zones
25	PTZ	Pelco D, Pelco P, DSCP Protocol Support
26	Audio	2 Way audio
27	Audio Compression	G.711 / G.726 / AAC
28	PAN	360 °endless , Manual speed 0.1°~ 200°/s , preset speed 9°~ 250°/s
29	Tilt	-20°~ 200°, Manual speed 0.1°~ 200°/s , Preser speed 7°~ 200°/s , Auto flip
30	Presets	200
31	PTZ Operation	8 sequence
32	Speed by zoom	On / Off (Pan and tilt speed proportional to zoom ratio)
33	Home Function	Preset / Sequence / Auto pan / Cruise
34	Calibration	Auto(On/Off)
35	Resume after power loss	Supported zero downtime power switching
36	Protocols	IPv4/v6, TCP/IP, UDP, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP, PPPoE, UPnP, IGMP, SNMP, QoS, ONVIF, ARP
37	Security	HTTPS / IP Filter / IEEE 802.1x
38	Alarm	2 Input & 2 Output
39	Alarm response	Preset / Sequence / Auto Pan / Cruise
40	BNC	1 X BNC
41	Ethernet Interface	1 X RJ 45
42	Supported Web browser	Internet Explorer (10.0+) / Firefox / Safari/Chrome
43	Weather Proof	IP 66 , IK 10
44	Operating Temperature	40℃ ~ 50℃
45	Power Supply	802.3at (PoE) AC 24V/48 V / DC 12V/24

Network Video recorder NVR with storage
General Characteristics:
The IP Video Management Appliance shall be a RAID-5 protected all-in-one recording, viewing and management solution for network surveillance systems for all channels / cameras as per requirements.
Software updates shall be available free of charge during the product warranty period. The software installed on the IP Video Management.
The IP Video Management Appliance shall utilize “enterprise-rated” hard drives in a fault tolerant RAID-5 configuration.
The IP Video Management Appliance shall be a pre-configured and pre-installed video management solution support minimum up to 264TB (44x6 TB/33 x 8 TB) of gross storage capacity.
The IP Video Management Appliance shall have minimum 178 TB of net capacity storage.
The IP Video Management Appliance shall have bandwidth of 475 Mbit/s.
The IP Video Management Appliance shall have remote monitoring via a desktop application or a Web browser.
Functions:
The IP Video Management Appliance shall offer an energy-efficient hot-swap redundant power supply.
The IP Video Management Appliance shall offer hot-swap SATA-II hard drives providing up to minimum 220TB of gross storage capacity.
The IP Video Management Appliance shall come pre-installed and pre-configured with all necessary software.
The IP Video Management Appliance shall utilize Windows Storage Server 2012 R2, 64‑bit.
The IP Video Management Appliance shall offer Disk on Module (DoM); a solid-state, non-volatile memory module that contains a backup image of all system software needed to a full system recovery.
Access to Video
The IP Video Management Appliance shall deliver high-quality HD video despite low or limited bandwidth connections.
The IP Video Management Appliance shall have Dynamic Transcoding technology that retrieves data and subsequently decodes and decompresses the data stream to a lower bit stream.
The IP Video Management Appliance shall instantly enhance the video detail to full HD quality when the video is paused.
Management
The IP Video Management Appliance shall come with the VMS management

application pre-installed and pre-licensed.
The IP Video Management Appliance shall have Microsoft System Centre Suite built-in.
The IP Video Management Appliance shall allow operators to use one central tool for configuration and operations management.
Health Monitoring
The IP Video Management Appliance shall provide SNMP, Remote Desktop and HTTP monitoring support.
The IP Video Management Appliance shall offer high-availability hardware, embedded design, and system wide monitoring.
Processor
The IP Video Management Appliance shall contain an Intel Xeon Processor E3-1275 V3 (8M Cache, 3.5 GHz) processor.
The IP Video Management Appliance processor shall contain one (1) socket.
The IP Video Management Appliance processor shall feature a 8 MB Intel Smart Cache memory.
The IP Video Management Appliance processor shall include ECC Un buffered memory protection.
The IP Video Management Appliance processor shall contain a 1600 MHz maximum front side Bus.
Memory
The IP Video Management Appliance shall have 8 GB, DDR3-1666 ECC UNB (1 x 8 GB) of memory installed.
Storage
The IP Video Management Appliance shall contain 16 Trays/12 Trays 3.5” SATA storage trays.
The IP Video Management Appliance shall have SATA-3, 7200 RPM, 64 MB, 3.5“, RAID-5 Configuration hard drives installed.
The IP Video Management Appliance shall have 8 ports LSI 3108 SAS3 controller SAS RAID Card.
The IP Video Management Appliance shall include an AMD Fire Pro W4100; 4 x Mini Display Port graphics card.
Power Supply: 1200 W ,Redundant
USB Ports: Front: 2 USB 2.0 ports Rear: 2 USB 2.0 ports, 2 USB 3.0 ports
Network: Dual Intel i210AT Gigabit LAN (teamed) 1 IPMI BMC port

Full HD 55 Inch Monitor :

Features	Description
Screen Size	55-inch

Panel Type	IPS Panel/D-LED
Aspect Ratio	16:09
Number of Pixels (H xV)	1,920 x 1,080 Pixels
Contrast Ratio 1200:1	1200:1
Response Time	12.0 MS
Viewing Angle	178° / 178°
HDMI input	HDMI Type A Connector x 2
DVI-D In/Audio In (L / R)	DVI-D 24-pin x 1/Stereo Mini Jack (M3) x 1
PC In/Audio In (L/R)	Mini D-sub 15-pin x 1/Stereo Mini Jack (M3) x 1 (Shared with DVI-D In)
Audio Out	Stereo Mini Jack (M3) x 1
Built-in Speaker	10W (5W+5W) or better
Power Requirements	110-127/220-240 V AC, 50/60 Hz
Power Consumption	125W Approx.
Operating Environment	Temperature: 0℃ to 40 ℃ (32 ℉ to 104 ℉)
	Humidity: 20 % to 80 % (Non Condensation)

8 Port Industrial grade switch for CCTV Network :

SI. NO.	Features	Specifications
	Interface	8 x 10/100/1000Base-T Ports POE + 2 x Gigabit SFP Slots + 1 Console Port
	Network Protocols	IEEE802.3 10BASE-T; IEEE802.3i 10Base-T;IEEE802.3u;100Base-TX/FX;IEEE802 3ab 1000Base-T; IEEE802.3z 1000Base-X; IEEE802.3x;IEEE802.3af, IEEE802.3at
	PoE Specification	PoE Standard: IEEE802.3af/ IEEE802.3at
		PoE ports: 1-8 ports support PoE+
		Available PoE Power 240 W
	Performance Specification	Bandwidth: 20Gbps
		Jumbo Frames:9216 Bytes
		Packet Forwarding Rate:14.88Mpps
		MAC Address Table: 8K
	Forwarding Mode	Store-and-Forward
	Protection	Lightening protection, IP40 protection
	Power Supply	Dual DC Input - 48 ~ 57 VDC
	Carrier Ethernet	1588v2 PTP
		OAM (IEEE802.3ah)
		CFM (IEEE802.1ag)
		PM (ITU-T Y.1731)
		ELPS (ITU-T G.8031)
		ERPS (ITU-T G.8032)
		Rapid-Ring ,Self recover time in < 20ms

PACKAGE – 8 INTEGRATED BUILDING MANAGEMENT SYSTEM

Designing, Planning, Supplying, Installation, Testing, Commissioning of IBMS for controlling & Monitoring of VRF/VRV AC equipments and monitoring of sub-station equipments, lifts, fire alarm, wet riser & sprinkler equipments, S.T.P., DG Set, Solar PV generation System, Water Supply Pumps, UPS and all main LT Panels etc. as per given below scope of work.

A) The work shall be executed as per CPWD General specification.

The scope of BMS in the tender are as follows

1. VRF/VRV AC (Low & High Side) Monitoring and Control.
Outdoor units
Outdoor units ON/OFF status.
Outdoor units run status.
Outdoor units temperature.

2. Indoor units.
Indoor units ON/OFF status.
Indoor units run status.
Indoor air temperature

a. Air Handling unit & Ceiling suspended Unit.

1. AHU/CSU Auto / Manual status
2. AHU/CSU run status
3. AHU/CSU Pre filter status
4. VFD Speed Feedback / control
5. VFD Trip Status
6. Duct pressure monitoring
7. Return air temperature
8. Motorised 2 way Valve status and modulation
9. CO2 Sensor on Return Air
10. Fresh Air Damper Status & Control, Modulation
11. Supply air temperature & humidity sensor
12. Fire Damper Status

b. HRW unit

1. HRW fan unit ON/OFF status.
2. HRW fan unit run status.
3. HRW fan unit Trip status.

3. Pressurization fans.

1. Fan ON/OFF
2. Fan run status monitoring.
3. Fan Auto / Manual status.
4. VFD Modulation/Feedback.

4. STP

1. Fan ON/OFF
2. Fan run status
3. Fan Auto / Manual status
4. Filter Status

5. HT/LT PANEL

1. HT breaker ON/Off status
2. HT panel Breaker Trip status
3. Main LT breakers ON/Off status
4. Main LT panel Breakers Trip status
5. Bus coupler ON/Off status

6. Wet Riser & Sprinkler System

1. Jockey Pump sprinkler run status
2. Sprinkler Pump run status
3. Sprinkler Pump ON /OFF Status
4. Sprinkler Pump Trip Status
5. Jockey Pump hydrant run status
6. Hydrant Pump Run Status
7. Hydrant Pump ON /OFF Status
8. Hydrant Pump Trip Status
9. Booster Pump Run Status
10. Booster pump ON /OFF Status
11. Booster pump Trip Status

7. UG WATER TANK

1. Fire tank low, medium & high level monitoring
2. Raw water tank low, medium & high level monitoring
3. Treated water tank low, medium & high level monitoring
4. Flushing water tank low, medium & high level monitoring

8. OH FIRE WATER TANK

1. OH Fire tank low, medium & high level monitoring

9. Domestic PUMP

1. Domestic pumps run status
2. Domestic pumps on/off status
3. Domestic pumps Trip status
4. flushing pumps run status
5. flushing pumps on/off status
6. flushing pumps Trip status.

11. Integration of following systems through Bacnet over IP/Modbus RTU protocol

i) Lifts -4 nos

ii) Fire Alarm System
iii) All Transformers
iv) ALL Load Managers(Meters)
v) All Multifunction meter
vi) All UPS
vii) DG sets
viii) Ventilation fans system
ix) VRV/VRF unit.

1.1 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

IBMS Integrated Building Management System
GUI Graphical User Interface
POT Portable Operator's Terminal
DDC Direct Digital Controls
LAN Local Area Network
PICS Product Interoperability Compliance Statement
SQL Structured Query Language

1.2 ARCHITECTURE:

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet, and Modbus technology communication protocols in an interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, BACnet TCP to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet at all levels.

C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. **Components or controllers requiring "polling" by a Master / Global / Host to pass data shall not be acceptable**.

D. Structured Query Language (SQL) or Java Database Connectivity (JDBC) or ORACLE compliant server database is required for all system database parameter storage. This data shall reside on a server for all database access. **Systems requiring proprietary database and user interface programs shall not be acceptable**.

Two (2) level hierarchical topology is required to assure fast system response times and to manage the flow and sharing of data.