MAHARASHTRA METRO RAIL CORPORATION LIMITED

(Nagpur Metro Rail Project)

Dt.25.07.2019

Name of Work: Construction of Balance Work of Seven Numbers Elevated Metro Stations (Automotive Square, Nari Road, Indora Chowk, Kadvi Chowk, Gaddi Godam Station Kasturchand Park and Zero Mile) including E&M Works and PD Area Balance Works excluding Viaduct in Reach-2 for Nagpur Metro Rail Project.

Tender No.N1C-39/2019, Dt.05.07.2019, **Portal No.189**

Corrigendum-III

Reply to Pre-Bid Queries

Sr. No	Clause No.	Bid Condition	Bidder's Queries	Maha-Metro Reply
1	N1C-39/2019	Date and Time of submission of Tender : Online submission up till 16:00 Hrs. on 06/08/2019 at Maha Metro's e-tender portal	We request to postpone the date of submission at least by two weeks.	Cannot be acceded to
2	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-A, Contract Data, Item No. No. 5	Time of Completion: 16 months	Considering the volume of work and involvement of several special job with longer lead time , we request you to revise the completion period to minimum 22 months.	Tender condition prevails
3	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-A, Contract Data, Item No. No. 6	Defect Liability Period: 16 months reckoned from taking over the assets.	We request you to revise the Defect Liability Period to 12 months from handing over the assets.	Accepted
4	Financial Bid & Bill of Quantities Schedule A, G03	Traffic Signals, Signage's and other Traffic aids. This shall include item no 1(i) to 1 (vii)	In Item description 1(vii) not found. Please clarify.	G03 Traffic signals, Signage item includes only 1(i To vi) and stands amended accordingly..
5	Financial Bid & Bill of Quantities & Part-3 Condition of Contract Schedule A, G01,	Provide furnished site office as per drawing and specifications for the use of site Engineer and his supporting staff; at	Quantity mentioned under Item no. 6. of G0I of Schedule A is 91.67 Sqm but in Part-III, Section IX, Annexure -IX-D under	• Site office as mentioned in schedule A admeasuring 91.67 Sqmt. is prevailed

MAHARASHTRA METRO RAIL CORPORATION LIMITED NAGPUR METRO

	Item No.6 & Part-III, Section IX, Annexure -IX-D	least at two locations; as per specification	the head of "Site Office and Office Equipment's" minimum requirement is 150 Sqm. Please clarify.	• PCC, S.NO.92 ,Site office for Employer and Annexure-IX-D, requirement of 150 Sqmt site office stands deleted
6	Financial Bid & Bill of Quantities Schedule C, T05, Item No.5.8	Supplying and Installation of roofing with colour coated Galvalume substrate.	In the Item Specification, total thickness of the sheet with coating mentioned as 0.68 mm with a bare thickness of 0.5 mm thick but weight mentioned as 4.12 Kg/Sqm. With 4.12 Kg/Sqm weight the sheet thickness comes with coating as 0.58 mm having 0.5 mm bare thickness. Please clarify.	The bare thickness is 0.50mm and total thickness with coating is 0.58mm with 4.12Kg/Sqm weight.
7	Part-3 Condition of Contract Part-III, Section IX, Annexure -IX-C	Key Dates	Key dates are showing 110 weeks completion times with different milestone description and having different station names. Kindly clear	The completion period is 16 months and corrected Key date sheet is attached. Refer: **Annexure A**
8	Financial Bid & Bill of Quantities Important Notes to Bidders	The Bidder should quote his percentage rate against each item of schedule "A" to "G" in the "Financial Bid" or commercial envelope of e-tender portal of MAHA-METRO	Instruction to bidder says to quote his percentage rate against each item of the schedule "A" to "G" seems to be contradictory with the format given to quote the contractor his percentage rate against each schedule. Kindly clarify.	Read as: Bidder has to quote percentage below/at par/above on all schedules A to G
9	Particular Specification Section VII-B Content of Specification	Structural Specification	Structural Specification is not available in the contract volume though it is shown in the index page. Please clarify where to find the structural specification.	The structural specifications is attached and refer as: **Annexure B**
10	Financial Bid & Bill of Quantities Item No. T03, 3.1 of Schedule C	Item of reinforcement specifies only that lap is not payable for reinforcement work. But it is silent in regards to chairs and spacers for reinforcement works.	Kindly clarify chairs and spacers for reinforcement work are payable or not.	It is clarified that chairs and spacers for reinforcement works are not payable.
11	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part -A, Contract Data, Clause No. 39 and Part-	Repayment of Mobilization Advance	Clause No. 37 of Contract Data under Section IX- Particular Condition of Contract specifies that Mobilization advance recovery should start after 20% of certified Interim payments wherever	Clause No.47 of part B ,Specific provision under section 9 stands modified as "Particular Condition of Contract specifies that it should start after **20%** of certified

	B, Specific Provisions, Clause No. 47		Clause No. 47 of Part-B, Specific Provision under Section IX- Particular Condition of Contract specifies that it should start after 30% of certified Interim payments. Please clarify which one should prevail.	Interim payments".
12	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-B, Specific Provisions, Clause No. 45	Price Variation	1) Steel & Cement percentage components seems to be not in the line of the volume of scope of work for steel and cement. requested to modify the component in line with the BOQ cost.	Tender conditions prevail.
13	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-B, Specific Provisions, Clause No. 45	Price Variation	1) Major Materials for this contract are Finishing & MEP Materials which are not found covered at all under the head of "Other materials, machinery, machine tools component" as the index is to be governed by "Manufacture of Machinery and Equipment's" as published in RBI Bulletin. Requested to modify the indices and to incorporate the finishing materials.	Tender conditions prevail
14	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-B, Specific Provisions, Clause No. 45	Price Variation	1) Labour Indices: RBI Bulletin stopped its indices publication for "Consumer price index numbers for industrial workers" in Oct'2012. Last publication was upto Sep'2012. Please clarify which indices are to be considered against labour.	RBI bulletin is available. Hence no change in tender conditions.
15	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-B, Specific Provisions, Item No. 41(Clause No 13.3.1, new sub clause)	Employer's variation & Variation and variation procedure(Additional Items of work)	Extra Items to be operated first with latest CPWD SOR/USSOR-Indian Railways. If extra items are not covered in CPWD SOR/USSOR-Indian Railway then market rate analysis is to be done with accordance to the guide line stipulated in Part-2 b) stating" The contractor shall furnish sufficient information in terms of rate and prices of the work,	Please refer PCC S.No.43 Sub clause(New sub clause) 13.3.3

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

			equipment/components manufactured by the contractor or sourced from the vendor/subcontractors such as: estimated man-hours, man-hours rate for manufactured item, design cost, basic rate of materials, sub-assemblies, taxes, duties, overhead and profit and inflation rate, so as to establish the reasonableness of the variation price" 1. The definition of overhead is not included in the contract. Kindly clarify the different components should come under overhead. 2. Percentage of overhead is not mentioned in the clause. Kindly clarify which % should be taken into consideration.	
16	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-B, Specific Provisions, Item No. 43(Clause No 13.3.3, new sub clause)	Variation in Bill of Quantities	The Clause no. ii.e) under Variation in the Bill of Quantities leads the contract to vary upto colossal percentage without adjusting the rate as approximately 98% items comes under this head. Hence requested to mention the upper cap limit of total variation notwithstanding the prevailing clause limits based on the agreed contract price.	Tender condition prevails
17	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-B, Specific Provisions, Item No. 43(Clause No 13.3.3, new sub clause)	Variation in Bill of Quantities	Procedure of finalization of rate comprise of only 20% overhead, profit and corporate taxes over the base amount as per clause no g.v). It is requested to enhance the percentage of profit and overhead and corporate taxes to 30% on the basic cost as project of this nature has substantial in build subsidiary cost..	Tender condition prevail
18	Corrigendum-I Item No 6 (Equipment), Serial No.2	Fully Automatic computerised batching Plant (2 Nos. of 30 Cum)	As the concrete quantity is not substantial as per BOQ and	Fully Automatic computerised batching Plant (1 Nos. of 30 Cum)

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

			approximately 16000 cum, one batching Plant seems to be enough to cater the requirement. Please clarify.	
19	Corrigendum-I Item No 6 (Equipment), Serial No.3 &4	Concrete Pump: 6 Nos. Boom Placer :2 Nos	As the concrete quantity is not substantial as per BOQ and approximately 16000 cum, 1 Nos Concrete pumps and 1 No Boom Placer seems to be sufficient for the Project. Please clarify.	Concrete Pump: 3 Nos. Boom Placer :2 Nos
20	Corrigendum-I Item No 6 (Equipment), Serial No.5	Cranes and road Cranes in site/casting yard with suitable capacity: 5 Nos.	As the concrete quantity is not substantial as per BOQ and approximately 16000 cum & Casting yard not required, 2 Nos crane of suitable capacity seem to be sufficient for the Project. Please clarify.	Cranes and road Cranes in site/casting yard with suitable capacity: 3 Nos.
21	Corrigendum-I Item No 6 (Equipment), Serial No.6	Cranes and road Cranes of suitable capacity for launching and erection: 5 Nos.	As launching of girders are not included in the BOQ scope Launching Crane seems to be not required. Please clarify.	Cranes and road Cranes of suitable capacity for erection of PEB structure etc : 2 Nos.
22	Corrigendum-I Item No 6 (Equipment), Serial No.7	Gantry of Suitable Capcity in Casting Yard: 2Nos.	As precast girders are not included in the BOQ scope Gantry of suitable capacity seems to be not required. Please clarify.	Accepted.
23	Corrigendum-I Item No 6 (Equipment), Serial No.8	Minimum Nos. of Precasting Bed (Typical): 5Nos.	As precast girders are not included in the BOQ scope Precast Bed seems to be not required. Please clarify.	Accepted.
24	Corrigendum-I Item No 6 (Equipment), Serial No.9	Transit Mixers: 12Nos.	As the concrete quantity is not substantial as per BOQ and approximately 16000 cum & 5 Nos Transit Mixer seem to be sufficient for the Project. Please clarify.	Transit Mixers: 6 Nos.
25	Corrigendum-I Item No 6 (Equipment), Serial No.9	Trailers for carrying girders 75/200 MT respective capcity: 8Nos.	As precast girders are not included in the BOQ scope Trailers for carrying girders 75/200 MT respective capacity seem to be not required. Please clarify.	Trailers for carrying components of PEB structure etc. : 2Nos.
26		Use of flyash	Is utilization of flash is permitted? If Permitted please provide list of structures where flash can be used with	The details regarding Flyash is available in tender, clause no 3.2, Part-2, work requirement, section

NAGPUR METRO

			maximum percentage of flash utilization as per Codal requirement.	VII-B, particular specification-structural. The use of well graded flyash from an approved source may be permitted subject to satisfying the design criteria and requirement of mix design in pilecap/raft, pier, columns, beams, slabs excluding PSC girders. The maximum allowable content of flyash or flyash + micro silica/silica fume shall be limited to 150kg/Cum of concrete mix and the details are available in tender specification.
27	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-B, Specific Provisions, Item No. 1(Subcluase 1.5 Priorty of documents)	The Documents forming the contract taken as mutually explanatory to one another. For the purpose of interpretation, the priority of documents shall be in accordance with the following sequence: a) the Contract Agreement (If any). b) the Letter of Acceptance c) the Letter of Tender. d) the Particular Conditions- Part A e) the Particular Conditions- Part B f) these General Conditions g) the Specifications. h) the Drawings i) the Schedule	We think i) Schedule should be merged with a) the Contract Agreement (if any). Ply Clarify.	Accepted price Schedule is part of LOA which would be issued to the successful bidder.
28		Tender Drawings	As the attached Tender drawings are not completely readable, please provide autocad drawings.	Cad file is attached as corrigendum III

29		Drawings	To enable the contractor to plan work within time requested to provide contractor drawings at least 45 days earlier before commencement of any activity as per the agreed base line programmer.	The drawings shall be provided progressively. We confirm that availability of construction drawings prior to Schedule activities station wise as per baseline programme of contractor.
30		Design Approval	In case of any substantial delay in approval of design data/Construction Methodology, then suitable time and cost compensation to be provided as per mutual agreement.	EOT shall be considered without any monetary compensation.
31	Financial Bid & Bill of Quantities Important Notes to Bidders. Sl. No.3	A separate template in the financial section of the e- tender portal has been provided for details of taxes/duties/levies etc included in the schedules (For Schedule A to C and G) which the Bidder shall duly fill up and submit	As the Present Tax structure comprises with GST is it required to submit it separately? Please Clarify.	The said template stands deleted
32	Part-3 Condition of Contract & Contract Form Section-IX, Particular Condition of Contract, Part-B, Specific Provisions, Serial No. 3 Subcluase 2.1	Right of Access to the site: If the contractor suffers delay from failure on the part of the Employer to Grant right of access to or possession of the site the contractor shall give the notice to the Engineer in a period of 28 days of such occurrence. After receipt of such notice the Engineer shall proceed to determine any extension of time to which the the Contractor is entitled and shall notify the Contractor accordingly. For any such delay for handing over the site the Contracor will be entitled with reasonable extension of time and no monetary claim whatsoever shall be paid or entertained on this account.	We request you to modify the clause for suitable time and cost compensation to be provided to Contractor as per mutual agreement in case of any substantial delay to get the access of the site.	EOT shall be considered without any monetary compensation.
33	Stone and Granite works and tile works Item no.2.0, 3.0,	Stone and Granite works and tile works	As the stones and flooring tiles costs vary over a wide range, your are hereby	Accepted rates are applicable for all shades & colors of granite/tile.

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

	Schedule D		requested that the basic rate be provided for stones and flooring tiles and price variation be paid based on the diffrence between actual purchase price and basic rates.	
34	Reinforcement Part-2: Work Requirement Section VII-B: Particular Specification-Structural, Page no. 89	Only TMT reinforcing bars of grade Fe500 (0.2% proof stress / yield stress not less than 500 MPa) confirming to IS:1786 – 1985 shall be supplied and used as reinforcement steel for the permanent work	BOQ specifies that Fe 500 D steel be used, whereas specification specifies that TMT Fe 500 steel be used. Kindly clarify.	As per BoQ, Fe 500D steel to be used.
35	Structural Steel Works Item no. T04, Schedule C	STRUCTURAL STEEL - PEB / AT SITE as required	Kindly specify the grade of the structural steel to be used.	The details are given in design criteria for pre-engineered structures at para E1 of Part 2, Work requirement, Annexure VII-a, DBR (Stations). All structural components other than purlins and side cladding runners shall be made from Hot Rolled Sections and plates with Grade-B having a minimum yield stress of 250 (Grade Fe410WB) M Pa, conforming to IS: 2062.
36	Tender Security E tender notice	he total security amount shall be a total of INR 1.13 Crores submitted as below: (a) INR 23 lakh by RTGS/NEFT/Credit Card Online as per procedure in E-tender Portal. (b) INR 90 lakh in form of Bank Guarantee, as per procedure given in bid documents.	We request you to kindly accept total EMD in the form of bank guarantee.	Tender condition prevails
37	SECURED ADVANCE	There is no clause in the tender.	We request you to pay us secured advance @ 90% of value of materials brought at site.	Cannot be acceded to.
38	Liquidated damages Part III: Condition of Contract, Section-	The total amount of Liquidated Damages and penalties on all Key Dates summed	Kindly reduce the ceiling of maximum liquidated damages to 5% of the contract	Cannot be acceded to

MAHARASHTRA METRO RAIL CORPORATION LIMITED ★ NAGPUR METRO

	IX, Annexure-IX-C	up including KD related to taking over on completion of entire work shall be 10% of the total Contract Value.	as practiced by most of the government organizations. Also, incorporate an equitable clause for incentive for early completion.	
39	Land for Casting yard, batching plant, labour hutments etc. PART-2: Work Requirements Section VII-A: General Specifications	However successful bidder has to obtain all statutory permission NOC, clearance pertain to their plant, yards, other temporary works/structures, establishments, hutments and others allied work of their own use.	Kindly provide 10 acre land for Casting yard, batching plant, labour hutments etc. at free of cost	Tender conditions prevail
40	Due date of submission Page no. 1, E tender notice	Online submission is due by 06/08/2019 in MMRCL's e-tender portal.	The tender involves various specialized agencies for which rates are required to be invited from specialized agencies. These rates re rqeuired to be negotiated further to optimize the price. Therefore it is hereby requested the due date of submission be kept at 1 month after the issuance of clarification.	Cannot be acceded to:
41	2.1 PCC Rights of Access to the Site	Third para of Clause 2.1 PCC Rights of Access to the Site: ".....For any such delay in handing over of site, Contractors will be entitled to only reasonable extension of time and no monetary claims whatsoever shall be paid or entertained on this account...."	In case of delay in providing access to and possession of work areas/Site by the Employer to the Contractor, the contractor will incur losses in terms of additional cost and time. Therefore, it is requested to modify third para of Clause 2.1 as given below in order to avoid speculative bidding and potential increase in the Contract Price: The Employer shall grant the Contractor right of access to, and /or possession of, the Site progressively for the completion of Works. Such right and possession may not be exclusive to the Contractor. The Contractor will draw/modify the schedule for completion of Works according to progressive possession/right of such	Cannot be acceded to.

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

			sites. If the Contractor suffers delay as a result of a failure by the Employer to give any such right or possession within such time, the Contractor shall give notice to the Engineer and shall be entitled to: (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and (b) payment of any such Cost , which shall be included in the Contract Price, under Sub-Clause 20.1.	
42	2.1 PCC Rights of Access to the Site	The Access Dates shown in the Works Requirements are for planning purposes only.	It is requested to provide the site access dates/schedule so that activities in the tender programme can be planned accordingly.	Refer Particular conditions of contract, Section IX, Clause 2.1 at Sr. no 3
43	8.9 PCC Consequences of Suspension	Entire PCC Clause 8.9 Consequences of Suspension	In case works are suspended on account of Engineer's/Employer's instructions, the contractor would thereby incur additional cost. Such additional cost shall be payable to the Contractor which shall be determined by the Engineer. Hence, it is requested to retain GCC Clause 8.9 Consequences of Suspension in its entirety.	Cannot be acceded to.
44	14.2.1 PCC Interest in case of delay in repayment of Advances	First para of Clause 14.2.1 PCC Interest in case of delay in repayment of Advances: Should there be delay in the progress and completion of work, as a result of which it is not possible to recover the advance and interest thereon, before the date of completion stipulated in the Contract, then the interest to be charged from the Contractor on the remaining	The works may get delayed for reasons attributable to the Employer and beyond the control of the contractor. In such an eventuality the contractor should not be unnecessarily penalised by way of increased burden of interest for no defaults on its part. Accordingly, we seek the modification as stated:	Tender conditions prevail

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

		portion of the advance beyond the original completion date specified in the Contract, shall be the State Bank of India Base Rate plus 3% per annum or 12% per annum whichever is higher upto date of actual recovery affected by MAHA-METRO.	Should there be delay in the progress and completion of work **on account of delays attributable to the Contractor which is to be established by the Employer in terms of the contract**, as a result of which it is not possible to recover the advance before the original date of completion stipulated in the contract then interest to be charged from the contractor on the remaining portion of the advance beyond the original completion date specified in the Contract shall be equal to State Bank of India's Marginal Cost of fund based lending rate (MCLR) applicable for the tenure of 01 year prevailing on the original completion date specified in the Contract plus 3% penal interest per annum. **In case where the contractor is entitled to extension of time for completion pursuant to Clause 8.4, which shall not be unreasonably withheld by the Employer, the recovery of advances shall be made without levy of any interest in the extended period.**	
45	20.9 PCC Arbitration	Entire Clause 20.9 PCC Arbitration	Please confirm that inline with various Sections of the Arbitration and Conciliation Act 1996 (amended), the panel of Arbitrators which will be provided by the Employer will not consist of persons having any past or present business relationship with MAHA-METRO.	Tender Conditions prevail
46	2.1.2 (xxix) Viaduct Employer's Requirements - Functional	The contractor has to get necessary permission/ NOC from the railway, road and other concerned regulatory authorities for block and working in such	Maha- Metro being an government entity is in a better position to obtain permission/NOC from railways and other concerned regulatory authorities for	Tender conditions prevail

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

		locations. Maha-Metro will assist for getting them permission from concerned regulatory authorities for working in such locations.	block hence it is requested to shift the obligation of obtaining such permissions from contractor to Employer.	
47	NIT	Current submission date is 16:30 hrs on 06.08.2019	As several inputs are still required from suppliers/sub-contractors for preparation of estimate, we request you to extend bid submission date by 15days ie 16:30 hrs on 20.08.2019.	Cannot be acceded to.
48	Part 4	Financial Bid and bill of Quantities Corrigendum II i)Revised Abstract of Amount for all Schedules ii)Revised Schedule F	----------	Refer Corrigendum III i) **Re-Revised Abstract of all Schedules** ii) **Re-Revised Schedule F**

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

25/7/2019

ED(Procurement)
Maha-Metro

ANNEXURE-A

Annexure-IX-C

CONTRACT KEY DATES AND COMPLETION DATE

The Contractor shall prepare and submit his detailed Programme of Work so as to achieve key dates of various activities on time. The Contractor shall complete the work in a phased manner by fixing priorities to different stretches of work to give access to the other interfacing contractors as per the requirement of project from time to time and as per the key dates (mile stones) indicated below:

The Contractor will be required to achieve the following Key Dates (KD) to be calculated from the commencement date of Work

[All numbers refer to weeks from Commencement Dates of the Works]

(i) **FOR STATIONS**

Key Dates	Time to achieve (in weeks from date of issue of notice to proceed)	Description of Stage
Key Date 1	6	Completion of roadwidening, Erection of Barricades, barricading for at least 2 stations and start the piling work.
Key Date 2	8	Completion of road widening, Erection of Barricades, barricading for remaining stations.
Key Date 3	20	Completion of piling work of two stations including pile cap/foundation work in off road area.
Key Date 4	22	Completion of piling work, pile cap/foundation work in remaining stations.
Key Date 5	27	Completion of slab up to concourse level of two stations.
Key Date 6	34	Completion of slab up to concourse level of remaining stations.
Key Date 7	40	Completion of slab up to platform level of two stations with lift shaft and escalator pit.
Key Date 8	42	Completion of Platform level slab of remaining stations with lift shaft and escalator pit.
Key Date 9	64	(a) Completion of operational rooms i.e. Signaling room, Telecommunication room, ASS, and UPS Room including MEP works, roofing structure with roofing of two stations.
	66	(b) Completion of operational rooms i.e. Signaling room, Telecommunication room, ASS, and UPS Room including MEP works, roofing structure with roofing of two stations.
Key Date 10	69	Completion of TOM room & flooring with required cutting for raceways for fixing AFC for all stations.

MAHARASHTRA METRO RAIL CORPORATION LIMITED NAGPUR METRO

Key Date 11	**70**	Completion of works as a whole of all stations including PD area.

Note: -

1. Contractor shall interface and maintain a close liason with other agencies working for this project like viaduct contractors, track work contractors, electrical contractors, etc. for the timely availability of the access to ensure adherence to the key dates. In the case the Contractor finds that there is slippage and likely Key Dates may not be adhered to the Contractor shall inform the Employer in well advance for the likely delays in access to site.
2. The achievement of a Key date shall be subject to issue of "No Objection" from the Employer's representatives upon notice of completion of each KD by contractor.
3. Failure to meet any key date of station, Liquidated Damages (LD) will be imposed at a rate of 0.05% of the accepted contract amount per week delay after key date.
4. L.D is subjected to a maximum of 10% of accepted contract amount.
5. Any imposition of LD on account of delay in Key Date will be waived and LD amount if deducted will be returned (without interest) provided the Contractor is able to complete next key dates.
6. The Penalties levied for not achieving the intermediate key dates are non-refundable even if work as a whole in completed in time.
7. The Penalties against KD-1 to KD-4 are applicable for each station separately and will be in addition to LD to be levied as per clause 8.5 of GCC and Bidding form & Appendix to form of bidding.
8. These penalties shall not relieve the Contractor from his obligation to complete the works or from any other obligations and liabilities under this contract.
9. A 7 day week calendar shall be adopted for various (Work) programme schedules for scheduling purposes.
10. For Project purposes, the presentation shall be in "Week" units.

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

ANNEXURE-B

PARTICULAR SPECIFICATION – STRUCTURAL

1 GENERAL

1.1 General

1.1.1 These Specifications contained herein shall be read in conjunction with other tender documents.

Generally the work shall be carried out as per the latest edition of "Specifications for Road and Bridge works" of Ministry of Road Transport & Highways (MORTH) as published by Indian Roads Congress and CPWD specifications – 1996 / 2002 with correction slips & amendments up to date to the extent they are applicable to the works covered under scope of works. However, the provisions of MORTH specifications take precedence over CPWD specifications. Further the specifications contained herein will supersede the provisions of the MORTH & CPWD specifications to the extent of their applicability.

1.1.2 The Work shall be carried out in accordance with the "Good for Construction" drawings and designs as would be issued to the Contractor by the Engineer duly signed and stamped by him. The Contractor shall not take cognisance of any drawings, designs, specifications, etc. not bearing Engineer's signature and stamp. Similarly the Contractor shall not take cognisance of instructions given by any other authority except the instructions given by the Engineer in writing.

1.1.3 The work shall be executed and measured as per metric units given in the Schedule of Quantities, drawings etc. (FPS units where indicated are for guidance only).

1.1.4 Absence of terms such as providing, supplying, laying, installing, fixing etc. in the descriptions does not even remotely suggest that the Contractor is absolved of such providing, supplying etc. unless an explicit stipulation is made in this contract. The Employer / Engineer shall bear no costs of materials, labour, equipment, duties, taxes, octroi, cess, royalties etc.

1.1.5 The specifications have been divided into different sections / sub-heads for convenience only. They do not restrict any cross-references. The Contractor shall take into account inter-relations between various parts of works/trades. No claim shall be entertained on the basis of compartmental interpretations.

1.1.6 The classification of various items of works for purposes of measurements and payments shall be as per Bills of Quantities (BOQ). Except where distinguished by BOQ, the rates apply to all heights, depths, leads, lifts, sizes, shapes and locations. They also cater for all cuts and wastes. No height wise / floor wise separation shall be made for the rates. Likewise all heights of centring, shuttering, staging, formwork

and scaffolding, launching trusses and other launching methods are covered by the quoted rates including multi stage propping for heights greater than one lift / floor as per drawings.

1.1.7 Reference to the Standard Codes of Practice

1. The contractor shall make available at site all relevant Codes of practice as applicable.

2 Legend:

ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
BS	British Standard
CPWD	Central Public Works Department
DIN	Deutsches Institut für Normung e.V.
IRC	Indian Road Congress
IRS	Indian Railway Standards
IS	Indian Standards
JIS	Japanese Industrial Standard
MORTH	Ministry of Road Transport and Highways
UIC	International Union of Railways
IRCEM	Institution de RetraiteComplementaire des Employes de Particular

1.1.8 Contractor to Provide

The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, except for the items specified in the Bill of Quantities the cost being held to be included in the Contract Rates

1. General works such as setting out, site clearance before setting out and on completion of works. All weather approach roads to the site office should also be constructed and maintained in good condition.
2. All labour, materials, plant, equipment and temporary works, overhead charges as well as general liabilities, obligations, insurance and risks arising out of GCC, required incompletion and maintenance the works to the satisfaction of the Engineer.
3. Adequate lighting for night works, and also at other times whenever and wherever required by the Engineer.

4. Continuous & Rigid temporary fences, barricades/hoardings on both sides of the site occupied by the contractor including, guards, lights and protective work necessary for protection of workmen, supervisors, engineers, General public and any other persons permitted access to the site as approved by the Engineer. Contractor shall provide proper signage as directed.

   All fences, barricade/hoardings shall be as per approved drawings and painted with colour shades as specified by the Engineer. The barricading/hoardings should be of adequate height to ensure visual obstruction of work from public view.
5. All equipment, instruments, labour and materials required by the Engineer for checking alignment, levels, slopes and evenness of surfaces measurements and quality etc.
6. Design mixes and testing them as per relevant clauses of specifications giving proportion of ingredients, sources of aggregates and binder along with accompanying trial mixes. Test results to be submitted to the Engineer for his approval before adoption on works.
7. Method Statements, for each main activity of the work (temporary and permanent) to be executed detailing the purpose, scope, resources required, sequence / procedure of execution, persons responsible, time frame, safety requirements & measures, risk analysis, Inspections, and Test Procedures along with standard values / acceptable criteria etc. duly approved by the Engineer before start of that particular activity at site.
8. Contractor shall also prepare / approve and make available to the Site Engineer the work procedure for each sub-activity to be done at the site, detailing the procedure / process to be followed including work sequence, safety measures, to be followed, level of quality to be maintained, type of material to be used, type of finishing required and responsibility assigned etc.
9. Preparation and compliance with provision of a quality assurance control programme as per Appendix II of Special Conditions of Contract.
10. Prepare and submit Standard Quantities for the purpose of billing based on the approved drawings.
11. Safe guarding the environment as per Section V- Eligibility criteria and Social & Environment Responsibility.
12. Cost of safety measures and requirements of site safety plan as per Appendix VI of Special Conditions of Contract.

13. A testing laboratory as specified by the Engineer equipped with the following minimum apparatus, materials and competent trained staff required for carrying out tests, as specified in the relevant sections of the specifications/Codes:-
    i. 1 Set of standard sieves for testing grading of sand with mechanical sieve shaker.
    ii. Sieves with openings respectively of 4.75mm, 10mm, 20mm, 25mm, 30mm for testing and grading of aggregates.
    iii. Weighing Balance of capacity up to 10 Kg. reading up to 5 gm.
    iv. Electric Thermostat controlled oven and pans for drying of sand and aggregates.
    v. Glass measuring flasks of 1/2, 1 litre& 2 litre capacity.
    vi. Flask for determining moisture content of sand.
    vii. Slump cone with rod and V B Apparatus, flow table to measure slump or DIN Specifications (separate sets for laboratory and at Site).
    viii. Apparatus to measure permeability of concrete as per Appendix 1700/II of MORTH Specifications.
    ix. Minimum 24 Nos. steel moulds for 150mm x 150mm x 150mm concrete test cubes. It may be necessary to provide more steel cube moulds depending upon concreting programme.
    x. 25mm dia. vibrator for compaction of concrete in test cubes and also vibrating table.
    xi. Concrete cube testing machine of 200 tonnes capacity with 3 dial gauges electrically operated.
    xii. Work benches, shelves, desks, sinks and any other furniture and lighting as required by the Engineer.
    xiii. Abrasion, Flakiness & Impact testing Equipment for testing coarse aggregates.
    xiv. Silt Testing Equipment.
    xv. Any other equipment specified by Engineer.

1.1.9 Quality Assurance & Quality Control

i. The work shall conform to high standards of design and workmanship, shall be structurally sound and aesthetically pleasing. The Contractor shall conform to the Quality standards prescribed, which shall form the backbone for the Quality Assurance and Quality Control system.

ii. At the site, the Contractor shall arrange the materials, their stacking/storage in appropriate manner to ensure the quality. The Contractor shall provide all the necessary equipment and qualified manpower to test the quality of materials, assemblies etc., as directed by the Engineer. The tests shall be conducted at specified intervals and the results of tests properly documented. The cost of all such testing shall be included in the quoted rates and nothing extra shall be paid for in this regard. In addition the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of the surfaces.

iii. Testing of Materials

(a) The Engineer shall be free to carry out such tests as may be decided by him at his sole discretion, from time to time, in addition to those specified in this document as per provisions of Clause 48 of General Conditions of Contract. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples, or for the collection of the samples. The test shall be conducted at the Site laboratory that may be established by the Contractor or at any other Standard Laboratory having NABL certification.

(b) The Contractor shall transport the samples to the laboratory for which nothing extra shall be payable. In the event of the Contractor failing to arrange transportation of the samples in proper time the Engineer shall have them transported and recover two times the actual cost from the Contractor's bills.

(c) All testing shall be performed in the presence of Engineer or his authorised representative. Testing may be witnessed by the Contractor or his authorised representative if permitted by the Test House. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

(d) Cost of all such tests shall be borne by the Contractor and nothing extra shall be payable on this account.

iv. The Engineer shall have the right at all times to inspect all operations including the sources of materials, procurement, its transportation, layout and storage of materials, all equipment including the concrete batching and mixing

equipment, and the quality control system. Such an inspection shall be arranged and the Engineer's approval obtained prior to starting of the particular item of work. This shall however, not relieve the Contractor of his responsibilities. All materials which do not conform to these specifications shall be rejected. In the event of contractor not being able to arrange the material conforming to these specifications or in the event of failure of the contractor to get the sources approved within the agreed schedule submitted by contractor, the Engineer shall have the powers to cause the Contractors to purchase and use such materials from any particular source, as may, in the Engineer's opinion, be necessary for the proper execution of work. Nothing extra shall be payable to the contractor on this account.

v. Dimensions

1 Figured dimensions on drawings shall only be followed and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others at tender stage where as those mentioned in the construction drawings supersedes all others. All dimensions shall be checked at site prior to execution.

2 The dimensions where stated do not allow for waste, laps, joints, etc., but the Contractor shall provide at his own cost sufficient labour and materials to cover such waste, laps, joints, etc.

3 The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

1.1.10 Setting out of Works

The Contractor shall set out the Works indicated in the Conditions of Contract. The Contractor shall provide suitable stones with flat tops and build the same in concrete for temporary bench marks. All the pegs for setting out the Works and fixing the levels required for the execution thereof shall, if desired by the Engineer, likewise be built in masonry at such places and in such a manner as the Engineer may direct. The Contractor shall carefully protect and preserve all bench marks and other marks used in setting out the works. The contractor will make overall layout of complete work

and get it checked from engineer. The cost of all operations of setting out including construction of bench marks is deemed to be included in the quoted rates as per Bill of Quantities.

(a) All the survey work except levelling shall work shall be carried out using total stations with one second accuracy. The levelling work shall be carried out using Auto level.

(b) The triangulation points given by Employer/Engineer before start of work shall be maintained during execution and handed over back to Employer/Engineer after completion of work.

1.1.11 Materials

1 Source of Materials

It shall be the responsibility of the contractor to procure all the materials required for construction and completion of the contract. The contractor shall indicate in writing the source of materials well in advance to the Engineer, after the award of the work and get it approved from the Engineer before commencing the work. If the material from any source is found to be unacceptable at any time, it shall be rejected by the Engineer.

2 Quality

All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed hereafter, or where tests are not laid down in the specifications, with the requirements of the latest issues of the relevant Indian & other Standards.

3 Sampling and Testing

All materials used in the works shall be subjected to inspection and test in addition to test certificates. Samples of all materials proposed to be employed in the permanent works shall be submitted to the Engineer at least 45 days in advance for approval before they are brought to the site.

Samples provided to the Engineer for their retention are to be labeled in boxes suitable for storage. Materials or workmanship not corresponding in character and quality with approved samples will be rejected by the Engineer.

Samples required for approval and testing must be supplied sufficiently in advance in required quantity and number to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected

further samples may be required. Delay to the works arising from the late submission of samples will not be acceptable as a reason for delay in completion of the works.

Materials shall be tested before leaving the manufacturer's premises, quarry or source, wherever possible. Materials shall also be tested at site and they may be rejected if not found suitable or in accordance with the specifications, notwithstanding the results of the tests at the manufacturer's works or elsewhere or test certificates or any approval given earlier.

The contractor will bear all expenses for sampling and testing, whether at the manufacturer's premises at source, at site or at any testing laboratory or institution as directed by the Engineer subject to the provisions of Clause 1.1.9 above. No extra payment shall be made on this account.

4 Dispatch of materials

Materials shall not be dispatched from the manufacturer's works to the site without written authority from the Engineer.

5 Test certificates

All manufacturer's certificates of test, proof sheets, etc showing that the materials have been tested in accordance with the requirement of these specifications and of the appropriate Indian Standards are to be supplied free of charge on request to the Engineer.

6 Rejection

Any materials that have not been found to conform to the specifications or otherwise not acceptable to the Engineer will be rejected forthwith and shall be removed from the site by the Contractor at his own cost within three days or as instructed by the Engineer.

1.1.12 Storing of Materials at site

All materials used in the works shall be stored on racks, supports, in bins, silos, goodowns, under cover etc. as appropriate to prevent deterioration or damage from any cause whatsoever to the entire satisfaction of the Engineer.

The storage of materials shall be in accordance with IS 4082 "Recommendation on stacking and storage or construction materials on site" and as per IS 7969 "Safety code for handling and storage of building materials".

The materials shall be stored in a proper manner at places at site approved by the Engineer. Should the place, where material is stored by the Contractor, be required

by the Employer for any other purpose, the Contractor shall forthwith remove the material from that place at his own cost and clear the place for the use of the Employer with in the time as communicated by the Engineer and at no extra cost to the Employer.

1.1.13 Water

1 Water from approved source

Potable water only shall be used for the works. Contractor shall have his own source of water required for the works including curing duly approved by Engineer. However, the contractor will have to obtain necessary permission for use of such water, if any, from concerned authorities. The water shall be free from any deleterious matter in solution or in suspension and be obtained from an approved source. The quality of water shall conform to IS 456.

Recycled water may be used with prior permission of the Engineer-in-Charge if the quality of recycled water conforms to IS-456 and shall be free from deleterious matter.

2 Storage

The Contractor shall make his own arrangements for storing water, if necessary, in drums or tanks or cisterns, to the approval of the Engineer. Care shall be exercised to ensure that water is not contaminated in any way.

3 Testing

Before starting any concreting work and wherever the source of water changes during the currency of works, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete and other works including curing for approval of the Engineer. No water shall be used until tested and found satisfactory.

4 Cost of arranging, storing and testing of water shall be deemed to be included in the quoted rates in the Bill of Quantities and nothing extra shall be payable in this regard.

1.1.14 Cement:

The grade of cement shall be as specified and confirming the relevant IS code and shall be purchased from the approved manufacturers.

Separate go-downs shall have to be provided for different grades of cement. The fresh cement should be used. The cement older than 3 months will not be allowed to use at

site. The cement should be stored in a water tight shed and on wooden planks giving sufficient gaps between walls floors and cement piles.

The actual issue and consumption of cement in works shall be regulated and proper accounts maintained as provided in the relevant clause of the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in relevant clause of the contract and shall be governed by conditions laid therein.

Cement (OPC of 43/53 grade and Portland Slag Cement (PSC) as specified in documents in paper bags or any suitable packing shall be arranged by the contractor.

1.1.15 Coarse Aggregate:

Coarse aggregate in size and quality shall be conforming to the relevant IS code and as specified in the documents.

The nominal maximum size of aggregate (MSA) to be used in RCC and PSC work shall be 20mm. The other requirement shall be as per CPWD specification.

The aggregate shall be stored in such a way as to prevent mixing with foreign materials. Different sizes of coarse aggregate shall be stored in separate stock piles sufficiently away from each other in order to prevent intermixing the materials at the edges of the stock piles.

1.1.16 Fine Aggregate:

The quality, tests and acceptance criteria for fine aggregates shall be same as per CPWD specifications. The fine aggregate shall conform to Zone II or Zone III of CPWD specifications as per requirement of trial mix design (or any combination of the two as approved by Engineer and the decision of Engineer in this respect shall be final). The silt content of fine aggregate used for trial mixes shall be recorded & the silt content in fine aggregate used shall neither exceed 8% nor 1% more than that of the fine aggregate used in the trial-mix.

1.1.17 Other Materials:

All other materials not specifically mentioned above shall be of best quality and shall conform to manufacturer's specification. Wherever, no specific code of practice of IRS/IRC/BIS is applicable, the decision of Engineer shall be final and binding.

1.1.18 Workmanship

1 All works shall be true to level, plumb and square and the corners, edges and rises in all cases shall be unbroken and neat.

2 Any work not to the satisfaction of the Engineer or his representative will be rejected and the same shall be rectified, or removed and replaced with work of the required standard of workmanship at no extra cost.

1.1.19 Load testing on Completed Structures

1.1.19.1 During the period of construction or within the defect liability period the Engineer may at his discretion order the load testing of any completed structure or any part thereof if he has reasonable doubts about the adequacy of the strength of such structure for any of the following reasons :

a) results of compressive strength on concrete test cubes falling below the specified strength.

b) premature removal of formwork.

c) inadequate curing of concrete.

d) over loading during the construction of the structure or part thereof.

e) carrying out concreting of any portion without prior approval of the Engineer.

f) honey-combed or damaged concrete which in the opinion of the Engineer is particularly weak and will affect the stability of the structure to carry the design load, more so in important or critical areas of the structure.

g) any other circumstances attributable to alleged negligence of the contractor which in the opinion of the Engineer may result in the structure or any part thereof being of less than the expected strength.

1.1.19.2 All the loading tests shall be carried out by the contractor strictly in accordance with the instructions of the Engineer, IS:456 and as indicated hereunder. Such tests shall be carried out only after expiry of minimum 28 days or such longer period as directed by the Engineer.

1.1.19.3 The structure shall be subjected to a super-imposed load equal to the specified superimposed load assumed in the design. This load shall be maintained for a period of 24 hours before removal. During the test, struts strong enough to take the whole load shall be placed in position leaving a gap under the members as directed. The deflection due to the superimposed load shall be recorded by sufficientnumber of approved deflectometers capable of reading up to 1/500 of a cm and located suitably under the structure as directed by the Engineer.

The structure shall be deemed to have passed the test if the maximum deflection at the end of 24 hours of loading does not exceed the deflection given by the following expressions:

$D = 0.001\ L^2/25\ T$, where,

D = max deflection due to imposed load only

L = span of the member under load test (the shorter span in case of slabs). The span is the distance between centres of the supports or the clear distance between the supports plus the depth of the member, whichever is smaller. In case of cantilever, this shall be taken as twice the distance from the support to the end and deflection shall be adjusted for movement of the support.

T = depth of member.

If within 24 hours of the removal of the superimposed load, the structure does not recover at least 75% of the deflection under the superimposed load, the test loading shall be repeated after a lapse of 72 hours. If the recovery after the second test is less than 80% of the maximum deflection shown during the second test, the structure shall be considered to have failed to pass the test and shall be deemed to be unacceptable.

1.1.19.4 In such cases the portion of the work concerned shall be taken down or cut out and reconstructed to comply with the specifications. Other remedial measures may be taken to make the structure secure at the discretion of the Engineer. However such remedial measures shall be carried out to the complete satisfaction of the Engineer.

1.1.19.5 All costs involved in carrying out the test ordered on the grounds as mentioned in Cl. 1.1.20.1 (a) to (g) above, (except load and integrity test for piles) and other incidental expense thereto shall be borne by the contractor regardless of the result of the test. In case of failure of the test the contractor shall take down or cut out and reconstruct the defective work or shall take the remedial measures, as instructed, at his own cost.

If the load testing is instructed on any ground other than mentioned in para a) to g) of clause 1.1.20.1 above, then the cost of the same shall be reimbursed if the test results are found to be satisfactory.

1.1.19.6 In addition to the above load tests, non-destructive tests on various elements (except on piles) such as core test and ultrasonic pulse velocity test shall be carried out by the contractor at his own expense if so desired by the Engineer. However, non-destructive testing of piles will be paid as per BOQ. Such tests shall be carried out by

an agency approved by the Engineer and shall be done using only recommendedtesting equipment. The acceptance criteria for these tests shall be as specified by the testing agency or good engineering practice and as approved by the Engineer.

1.2 Preliminary Work

1.2.1 Survey Work

The said work involves at the very start of work taking-over of reference point from the Engineer, establishment of control points, triangulation points, bench marks, grid layout for all the piers and other structures maintaining horizontal and vertical control within the permissible limits, incorporating changes (if any), submission of full data in the tabulation form and survey drawings. The item islump sum and shall be including setting and layout of various works during the progress of work and matching of the station area track alignment with the alignment of the approaches at station ends and incorporating the changes (if any). The payment for the item shall be on pro-rata basis and will be spread over the duration of the contract.

1.2.2 Barricading

The work covers barricading for the work done along the median and areas affecting road traffic. Barricading for the other areas like casting yard, batching plant, storage and other working area shall be done at own cost by the contractor. The detailed scope of work is as follows:

i) Providing and installing the barricade of the design and type as shown in the typical sketch furnished as per the approved plan firmly to the ground and maintaining it during the during the progress of work.

ii) Providing adequate road safety devices. A tentative list given hereunder identifies minimum items, which may be required. However, actual numbers required will be as per approved plan by the Engineer and clearance from the traffic department, Nagpur. The contractor shall not be paid extra for any addition to this list if required during the execution of works.

iii) Dismantling of barricading and other temporary installations from the site and cleaning the site as per direction of Engineer upon completion and acceptance of work.

1.2.3 Tentative Road Safety Devices are mentioned below:

S.No.	Brief Description
1.	Supply of Red portable traffic cones of 750 mm height with white reflective tape bands on min. 100 mm width all around
2.	Hazard warning light flasher with rechargeable. Maintenance free battery & Charging system
3.	Safety light island post with 11 nos. parallel reflector
4.	Red reflective arrow fitted on enamelled mild steel board of 360 x 220 mm size
5.	Traffic Triangular Tripod made of fluorescent cloth fitted on steel frame
6.	Retro-reflective tape (I) 50 mm width
7.	Fluorescent Jackets with reflective tape all around
8.	Yellow reflective cat eyes of size 115 x 11 x 22 mm made of ABS material having 19 glass beads on each side.
9.	Metal Tubular Delineator of 610 mm height with reflective tapes
10.	Retro-reflective arrows diversion board 450 x 900 mm with crystal clear protective transparent coat to avid damage on 14 gauge Mild Steel sheet with and without pole
11.	Retro-reflective “Men at work” triangular board of size 900 mm with crystal protective transparent coat to avoid damage on 14 gauge Mild steel board with and without poles
12.	Retro-reflective board for “Go Slow Work in progress” of size 1200 x 750 mm with crystal clear protective transparent coat to avoid damages to the Mild Steel sheets with and without pole.
13.	Retro-reflective advance direction sign cum Diversion Boards of size 1200 x 900 mm with crystal clear protective transparent coat to avoid damage to the 14 gauge Mild Steel sheet with and without pole.
14.	Retro-reflective speed limit circular sign Boards of 600 mm Diameter with crystal clear protective transparent coat to avoid damage to the 14 gauge sheet (without pole).
15.	‘SORRY FOR INCONVENIENCE’ Retro-reflective Boards of size 900 x 300 mm size with crystal clear protective transparent coat to avoid damage to the 14 gauge Mild Steel Sheet (without pole).
16.	HAZARD MARKERS (Yellow & Black) must be put all over the construction sites. This Retro-reflective board is of size 300 x 900 mm with crystal clear protective

	transport coat to avoid damage and the 14 gauge Mild Steel Sheet with or without pole.
17.	'CAUTION' tape which is normally yellow tape of special Polythene Material having 75 mm width `CAUTION' is written all over with Black colour in rolls of 300 metres.

Measurement

The barricading including all the required safety devices as listed under the above table shall be measured in running metre up to two decimal places.

(Payment of the item shall be made on monthly basis over contract period. Payment shall be deducted for the period during which the barricading and arrangements for traffic diversion are not satisfactory to the Engineer. The payment and deduction (if any) for the item shall be on pro-rata basis.

1.2.4 Supply of Progress Photographs and Album

The work covers the supply of colour photographs along with negatives in an album to serve as a permanent record of various stages/facets of work needed for an authentic documentation as approved by the Engineer.

The photographs shall be of acceptable quality and they shall be taken by a professionally competent photographer will camera having the facility to record the date of the photographs taken in the prints and negative. The camera reel, type and quality of photo paper shall be of standard make approved by the Engineer. Each photograph in the album shall be suitably captioned and dated.

The frequency, time and extent of coverage for each work shall be as decided by the Engineer. The rate for the supply of record photographs shall include the cost of taking the photographs, developing and obtaining the colour prints, cost of albums, mounting and captioning the photographs.

The photographs and materials including negative shall form a part of the records of NMRCL and the prints cannot be supplied to anybody else or published without the written permission of NMRCL.

1.2.5 Supply of Video Cassette of Works

The work consists of taking video film of important activities of the works as directed by the Engineer during the currency of the project and editing them to a video film of the duration as indicated in the item. The cassette shall be of approved make and of specified duration. It shall contain narration of the activities in English by a

competent narrator. The edition of the film and script of the narration shall be approved by the Engineer.

1.2.6 Transplantation of Trees

The item shall be carried out as per the approved plan by the Engineer after the identification of the trees to be transplanted. The actual number of trees shall be finalised after the necessary clearances by the concerned departments. The item is complete and including all expenditures for carrying out all operations i.e. excavation, watering, feeding of chemicals, back filling, lifting of trees by crane and transporting to the designated site where it is to be transplanted and all necessary care to be taken for the specified initial period till the tree gets settled at new site and up to the full satisfaction of the Engineer.

Measurements

The item shall be measured in numbers according to size of the tree as specified in the item and the full payment shall be released only when the item is executed fully as per the Scope of Work detailed out in the approved plan for transplantation of trees.

The rate shall include all required operations during the transplantation and specified duration afterwards, clearances from the concerned authorities.

1.2.7 Site office for Engineer and Other Supervisory Staff

The work covers the construction and provisions of furnished site office accommodation for the supervisory staff of engineer and maintaining the same.

The contractor shall arrange to provide fully furnished office accommodation constructed as shown in drawings. Work includes providing electric supply, all electric items, like lights, fans, complete wiring, providing water supply including all pipes, fittings, tanks, valves etc. complete, septic tank, drains, internal surface roads etc. complete as shown in the drawings.

The contractor shall provide the Office accommodation within 1 month from the date of issue of the acceptance letter.

The site office with all services, furniture and fittings shall be the property of the employer. The land for the site office shall be provided by the Engineer and the location shall be indicated in the drawing.

The contractor shall arrange to maintain the site office including day to day upkeep of the building and the surroundings, attending to repairs to various parts of the building, furniture, fittings, office equipment and the connected services as and when necessary, including periodic white/colour washing, painting etc.

The contractor shall arrange to provide uninterrupted supply of electricity and water for the office building. In case of failure of main power/water supply, alternate source shall be provided.

1.2.8 Providing and maintaining Radio Communication

The work covers provision of maintenance of wireless communication system with necessary mobile/base transceivers and other accessories:

The System shall consist of the following

(i) Hand held radio sets - 4 nos.

The contractor shall arrange to obtain all necessary statutory approvals from various govt. departments and also fulfill requirements for operating the wireless system.

The contractor shall arrange to maintain the entire wireless system including all accessories, spares etc. in satisfactory working conditions.

The payment will be made on monthly basis and commence after commissioning of the system. The system should be commissioned by the contractor within three months of date of issue of acceptance letter.

If the contractor fails to maintain the system as required, a sum of Rs. 5,000/- per month or part thereof will be debited to the contractor and also for the month(s) during which the Contractor fails to carry out the required maintenance shall not be measured for the payment.

If the Contract works are not completed with the stipulated period of within the granted extended time of completion the maintenance shall be carried out by the contractor at his own cost and as such no payment shall be made for the same. In case of any failure of contractor to do so, an amount of Rs. 6000/- per month or part there of shall be debited to the contractors account.

1.3 Structural Work

1.3.1 Unless otherwise specified, only controlled concrete with design mix and weigh batching is to be used for the work.

1.3.2 Minimum cement content for various grades / elements of concrete as specified in MORTH Specifications in CPWD specification 1996 / 2002 is purely from durability point of view. Larger content of cement shall have to provided if demanded by mix design or as per the requirement of relevant codes.

1.3.3 Provision of cement slurry to create bond between plain / reinforced concrete surface and subsequent applied finishes shall not be paid extra.

1.3.4 Mix design using smaller aggregates of 10mm down shall also be done in advance for the use in the junction having congested reinforcement.

1.3.5 Procedure of mixing the admixtures shall be strictly as per the manufacturer's recommendations or as directed by the Engineer.

1.3.6 All the water tanks and other liquid retaining concrete structures shall undergo hydro-testing.

1.3.7 Special benches shall be provided at site for stacking reinforcement bars of different sizes.

1.3.8 Formwork for beams of RCC works shall be designed in such a way that the formwork of the adjacent slabs can be removed without disturbing the props / supports of the beams.

1.3.9 Wherever there are tension / suspended concrete members which are suspended from upper level structural members, the shuttering / scaffolding of such members at lower level shall have to be kept in place till the time the upper level supporting members gain minimum required strength. Cost of such larger duration of keeping in place the shuttering/scaffolding shall be deemed to be included in the price quoted for respective structural members.

1.3.10 The Contractor shall incorporate seismic considerations of anchoring and isolation in the design and detailing of the finishes as directed by the Engineer. The element to be anchored shall have its motion suitably restrained whilst at the same time it shall be suitably isolated so as not to be affected by the deformations/ vibrations of the building during Construction.

1.3.11 Formwork shall be provided for full height at all locations. Special precautions for such tall formwork shall be taken to ensure its safety. Extra costs for providing such formwork shall be deemed to have been included in the prices quoted against relevant items.

1.3.12 The contractor shall carry out expeditiously and without delay the following works with in the mobilization period itself:

a. Identify and get approved the sources of various major constitution materials.

b. Material testing and mix designs of concrete as contemplated in the specifications.

c. Setting up of full-fledged site laboratory as per the requirements of these specifications.

d. Setting up concrete batching & mixing plant.

e. Site office for the use of the Engineer's staff.

f. Contractor's site office setup.

g. Casting yard with complete facilities.

h. Any other pre-requisite items required for final execution.

1.3.13 Casting yard shall have following minimum facilities:

a. Casting beds as required.

b. Sets of form work / moulds as required.

c. All handling facilities for precast elements.

d. Curing arrangements as required.

e. Stacking arrangements for material and precast elements.

f. Storing arrangement of materials.

g. Proper drainage and all weather approach roads.

1.3.14 The load testing of spans / piles etc. shall be done using certified and calibrated dial gauges only. Use of levelling instruments for measuring deflections shall not be allowed

1.4 Sub-Contractor

Works as listed below and those dealing with proprietary materials/ products may be carried out by the Contractor through the Sub-Contractors as may be approved by the Engineer in writing. All sub-contractors shall satisfy the specifications/requirements for their specific works. The Sub-Contractors must be firms of repute and long standing, having adequate experience and complete facilities to carry out all items of work required for completion as per Specifications and expected quality to the satisfaction of the Engineer. The Sub-Contractor must also have personnel experienced in preparing shop drawings. All such works shall be carried out under the direct supervision of the manufacturers of the proprietary materials/ products or their trained and accredited licensee.

(a) Fire fighting / safety equipment/accessories and setup

(b) Landscaping

(c) Waterproofing

(d) Caulking & Sealants

(e) Painting and Polishing (where proprietary product or material or a specialised process/ technique is required)

(f) Roof sheeting

(g) Structural Glazing / cladding

1.5 Guarantees and Building Maintenance for Finishes:

The Contractor shall guarantee and undertake to maintain and rectify the various components of the Civil Works for their successful performance for the periods as specified below. The Contractor shall indemnify the Engineer for a similar period against any damage to property and injury to persons on account of any defective work or maintenance carried out by the Contractor. The format and text of the Guarantee and the Indemnity Bond shall be as followed in CPWD or as approved by the Engineer.

a. External/Internal cladding of Stone, Marble and Granite shall be guaranteed for 5 years.

b. All Fire Rated Door sets shall be guaranteed to remain integral and absolutely stable in the event of a fire. All moving parts of the Fire Rated Door sets shall be guaranteed to give trouble free service for 5 years and the finish shall be guaranteed to last for at least 5 years.

c. Waterproofing for basements (which include raft, retaining walls, and expansion/separation joints in retaining walls) and roofs shall be guaranteed for 15 years. The waterproofing shall include all allied works on the roof such as concrete screed and the China Mosaic roof finish/ stone cladding on the parapet between which the waterproofing treatment shall be sandwiched.

d. Waterproofing for the other areas such as toilets, kitchens, chhajjas etc. shall be guaranteed for 15 years. The waterproofing shall include all allied works on the slab etc. such as concrete/ mortar screeding, if any, floor finish between which the waterproofing treatment shall be sandwiched.

e. The manufacturer / Supplier / fabricator/ contractor of the roofing system shall give a guarantee for 15 years with regarding to its composition, surface and tensile strength.

1.5.1 Responsibility for Shop drawings, Samples and Mock-ups:

Approval of shop drawings, samples and mock-ups for the various components shall not absolve the Contractor of his responsibility of completing the work to the specifications, standards, tests for performance and guarantees given in these documents and to a quality of finish as desired by the Engineer.

1.5.2 Cleaning:

Surfaces on which finishes are to be provided shall be cleaned with water jets or oil free compressed air or power tools with wire brushes and detergents all as approved by the Engineer.

1.5.3 Expansion bolts/ fasteners:

1 Unless specified otherwise all expansion bolts/ fasteners shall be fabricated from austenitic stainless steel sheet, strip or plate conforming to ASTM A 240 Gr 304 or bar to ASTM A 479 Gr 304 of approved make and design. The material of the bolt shall not cause any bimetallic corrosion with the reinforcing bars of the RCC/ brickwork or with any other fixings or doors or windows or skylights etc.

2 For steel backings the fasteners shall be prevented from contact with other metals which would lead to bimetallic corrosion.

3 For brick masonry backing the sleeves of the expansion bolts shall be fixed in wedge shaped pockets having an area of 75mm x 75mm at the surface and 100mm x 100mm at the inner surface and shall be 125mm deep. The wedge could also be as a truncated cone of 75mm dia. / 100mm dia. The dimensions shall be reviewed by the Engineer during execution of the work. The wedge shall be filled with PCC 1:1:2 (1: Cement, 1: Sand and 2: Coarse Aggregate) mixed with non-Shrink Compound in the proportion as recommended by the manufacturer.

4 The holes drilled for the expansion fasteners shall be cleaned of all ground material, dust, etc. before inserting the expansion sleeves.

5 All expansion bolts fixed into soffits shall be bonded to the backing with epoxy/ polyester resin of approved make.

6 All expansion bolt fixings shall be tightened in accordance with the recommended torque figures by the manufacturer. Where such values are not available the Contractor shall test at least 6 samples to determine the safe torque values. All bolts shall be tightened using torque spanner/ wrenches. All bolts shall be checked 24 hours (minimum) after installation and retightened if necessary.

1.5.4 No walls, terraces shall be cut for making any opening after water proofing has been done without written approval of the Engineer. Cutting of water proofing when authorised by the Engineer in writing shall be done very carefully so that no other

portion of the water proofing is damaged. On completion of the work at such places, the water proofing membrane shall be made good and ensured that the opening / cutting is made fully water proof as per specifications and details of water proofing approved by the Engineer at no extra cost. No structural member shall be cut or chased without the written permission of the Engineer.

1.5.5 Provision of grooves in plaster, drip courses etc, if directed, at junction of walls-ceilings, columns-walls, frames-plaster and such other generally typical locations shall not be paid extra, including grooves in concrete, masonry, stonework.

1.6 Applicable Codes, Standards & Publications For Structural & Architectural Work

The important Codes, Standards and Publications to Contract are listed here under :

A	**General**
IS:875 (Part 3)	Code of practice for design loads (other than earthquake) for buildings and structures
IS:1322	Bitumen felts for water proofing and damp-proofing
IS:1893	Criteria for earthquake resistant design of structures
IS:2572	Code of Practice for construction of hollow concrete block masonry
IS:3414	Code of practice for design and installation of joints in buildings
IS:6408 (Parts 1,2)	Recommendations for modular co-ordination in building industry – tolerances
IS:10958	General check list of functions of joints in building
IS:11817	Classification of joints in buildings for accommodation of dimensional deviations during construction
IS:11818	Method of test for laboratory determination of air permeability of joints in buildings
IS:12440	Precast concrete stone masonry blocks
CPWD	Specifications 1996.
BS:476 (Part 7)	Method for classification of the surface spread of flame of products
BS:476 (Part 20)	Method of determination of the fire resistance of elements of construction (general principles)

BS:476 (Part 22)	Methods for determination of the fire resistance of non-load bearing elements of construction
BS:5215	Specification for one-part gun grade polysulphide-based sealants
BS:5606	Guide to accuracy in building
BS:6093	Code of practice for the design of joints and jointing in building construction
BS:8200	Code of practice for the design of non-load bearing external vertical enclosure of building
ASTM C 332	Specification for light weight aggregate for insulating concrete
SP 7	National Building Code of India
SP 23 (S&T)	Hand Book on Concrete Mixes
B	**Bitumen**
IS:702	Industrial Bitumen
IS:3384	Specification for bitumen primer for use in waterproofing and damp-proofing
C	**Building Construction Practices**
IS: 1838 Parts I and II.	Specifications for preformed fillers for expansion joint in concrete pavements and structures.
IS:1946	Code of Practice for use of fixing devices in walls, ceilings, and floors of solid construction.
IS:6509	Code of Practice for installation of joints in concrete pavements.
IS:11134	Code of Practice for setting out of buildings.
IS:11433	Parts I and II. Specifications for one part Gun grade polysulphide based joint sealant.
IS:12200	Code of Practice for provision of water stops at transverse contraction joints in masonry and concrete dams
D	**Cement**
IS:269	33 grade ordinary Portland cement
IS:455	Portland Slag Cement
IS:650	Specification for standard sand for testing cement.

IS:1489 (Part 1)	Portland pozzolana cement: Flyash based
IS:1489 (Part 2)	Portland pozzolana cement: Calcined clay based
IS:3535	Method of Sampling Hydraulic Cements
IS:4031	(Parts 1 to 13) Methods of physical tests for hydraulic cement.
IS:4032	Method of chemical analysis of hydraulic cement.
IS:6925	Methods of test for determination of water soluble chlorides in concrete admixtures.
IS:8042	White Portland Cement
IS:8112	Specification for 43 grade ordinary Portland cement.
IS:12269	Specification for 53 grade ordinary Portland cement.
IS:12330	Specification for sulphate resistant Portland cement.
E	**Concrete**
IS:456	Code of practice for plain and reinforced concrete.
IS:457	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS:460 (Parts I to III)	Specification for Test Sieves
IS:516	Methods of test for strength of concrete.
IS:1199	Methods of sampling & analysis of concrete.
IS:1200	Method of measurement of building and civil engineering
IS:1343	Code of practice for prestressed concrete
IS:1607	Method of Test Sieving
IS:2386	Parts I-VIII. Methods of tests for aggregates for concrete.
IS:2430	Methods of Sampling of Aggregates of Concrete
IS:2438	Specification for roller pan mixer
IS:2514	Specification for concrete vibrating tables
IS:2571	Code of practice for laying in-situ cement concrete flooring
IS:2645	Specifications for integral cement water proofing compounds
IS:2722	Specifications for portable swing batchers for concrete (double bucket type)
IS:2770	Methods of testing bond in reinforced concrete part I pull

	out test
IS:3025	Methods of sampling and test (physical and chemical) for water & waste water
IS:3370	Code of practice for concrete structures for storage of liquids
IS: 3935.	Code of practice for composite construction
IS:4326	Code of practice for earthquake resistant construction of building
IS: 6925.	Methods of test for determination of water soluble chlorides in concrete Admixtures
IS:7242	Specifications for concrete spreaders
IS:7251	Specifications for concrete finishers
IS:7861	Parts I & II. Code of practice for extreme weather concreting.
IS:7969	Safety code for handling and storage of building materials
IS:8989	Safety code for erection of concrete framed structures
IS:8142	Methods of test for determining setting time of concrete by penetration resistance
IS:9103	Specifications for admixtures for concrete
IS:9013	Method of making, curing and determining compressive strengths of accelerated cured concrete test specimens
IS:9284	Method of test for abrasion resistance of concrete
IS:10262	Recommended guidelines for concrete mix design.
MORTH	Specifications for Road and Bridge Works, Ministry of Road Transport and Highways (Roads Wing)
IRS	Concrete Bridge Code
IRC 21-2000	Standard Specifications and Code of Practice for Road Bridges Section III – Cement Concrete (Plain & Reinforced)(First Revision)
IRC:18-2000	Design criteria for Prestressed Concrete Road Bridges (Post –Tensioned Concrete)
ASTM - C - 94	Ready Mix Concrete
IS 4926:2003	Ready Mixed Concrete – Code of Practice
ASTM – C -	Specifications for Silica Fume for use in Hydraulic Cement

1240	and Mortar
F	**Construction Plant and Machinery.**
IS:1791	Specification for batch type concrete mixers.
IS:2505	General requirements for concrete vibrators: Immersion type.
IS:2506	General requirements for screed board concrete vibrators.
IS:3366	Specification for pan vibrators.
IS:3558	Code of Practice for use of immersion vibrators for consolidating concrete.
IS:4656	Specifications for form vibrators for concrete.
IS:4925	Specification for concrete batching and mixing plant.
IS:11993	Code of Practice for use of screed board concrete vibrators.
G	**Formwork**
IS:4990	Specifications for plywood for concrete shuttering work.
IRC:87	Guidelines for the design and erection of false work for road bridges.
IS:806	Code of practice for use of steel tubes in general building construction.
IS:1161	Specification of steel tubes for structural purposes.
IS:1239	Specification for mild steel tubes. Tubulars and other wrought steel fittings.
H	**Gypsum and Gypsum Board**
IS:2095	Gypsum plaster boards
IS:2542 (Part 1/Sec 1 to 12)	Methods of test for gypsum plaster, concrete and products: plaster and concrete
IS:2542 (Part 2/Sec 1 to 8)	Methods of test for gypsum plaster, concrete and products: Gypsum products
IS:2547 (Part 1)	Gypsum building plaster: Excluding premixed lightweight plaster
IS:2547 (Part 2)	Gypsum building plaster: Premixed lightweight plaster
I	**Handling and Storage**
IS:4082	Recommendation of Stacking and Storage of construction materials

IS:8348	Code of practice for stacking and packing of stone slabs for transportation
J	**Instruments For Testing Cement and Concrete**
IS:5513	Specification for vicat apparatus.
IS:5514	Specification for apparatus used in Le-Chaterlier test.
IS:5515	Specification for compaction factor apparatus.
IS:7320	Specification for concrete slump test apparatus.
IS:7325	Specification for apparatus to determine constituents of fresh concrete.
IS:10080	Specification for vibration machine.
IS:10086	Specification for moulds for use in tests of cement and concrete.
IS:10510	Specification for vee-bee consistometer.
K	**Joint Fillers**
IS:1838 (Part 1)	Preformed fillers for expansion joint in concrete pavements and structures (non-extruding and resilient type): Bitumen impregnated fibre
L	**Paints and Coatings**
IS:102	Ready mixed paint, brushing, red lead, non-setting, priming
IS:109	Ready mixed paint, brushing, priming, plaster, to Indian Standard Colour No. 361 and 631 white and off white.
IS:347	Varnish, shellac, for general purpose.
IS:2074	Ready mixed paint, air drying, red oxide-zinc chrome, priming
BS:6496	Specification for powder organic coatings for application and stoving to aluminium alloy extrusions, sheet and preformed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and preformed sections coated with powder organic coatings
BS:EN:10152	Specification for electrolytically zinc coated cold rolled steel flat products. Technical delivery conditions
ASTM A 164-71	Specification for electrodeposited coatings of zinc on steel

M	**Pigment for Cement**
BS:1014	Specification for pigments for Portland cement and Portland cement products
N	**Reinforcement & Structural Steel**
IS:280	Mild steel wire for general engineering purposes
IS:432	Part I. Mild steel and medium tensile steel bars. Part II Hard drawn steel wire.
IS:814	Parts I & II. Electrodes for metal arc welding of structural steel.
IS:815	Classification coding of covered electrodes for metal arc welding of structural steels
IS:816	Code of Practice for use of metal arc welding for general construction in mild steel.
IS:1566	(Part I) Specifications for hard-drawn steel wire fabric for concrete reinforcement.
IS:1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS:2502	Code of Practice for bending and fixing of bars for concrete reinforcement.
IS:2629	Recommended practice for hot-dip galvanising of iron and steel.
IS:2751	Code of Practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS:4759	Hot-dip zinc coating on structural steel and other allied products.
IS:5525	Recommendations for detailing of reinforcement in reinforced concrete works
IS:9417	Recommendations for welding cold-worked steel bars for reinforced concrete construction.
IS:14268	Uncoated stress relieved low relaxation steel class 2 for Pre-stressed concrete
IS:226	Structural steel (Standard Quality)
IS:800	Code of practice for use of structural steel in general

	building construction.
IS:813	Scheme of symbols for welding.
IS:814	Covered electrodes for metal arc welding of structural steel. (Part I & Part II)
IS:816	Code of practice for use of metal arc welding for general construction in mild steel.
IS:822	Code of practice for inspection of welds.
IS:961	Structural steel (High Tensile)
IS:1024	Code of practice for use of welding in bridges and structures subject to dynamic loading.
IS:1161	Steel tubes for structural purposes.
IS:1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
IS:2062	Structural steel (Fusion welding quality)
IS:3757	Specification for high tensile friction grip bolts.
IS:5624	Specification for foundation bolts.
IS:3600	Code of practice for testing of fusion welded (Part I) joints and weld metal in steel.
IS:4923	Hollow steel sections for structural use.
IS:6227	Code of practice for use of metal arc welding in tubular structure.
IS:801	Code of practice for use of cold formed light gauge steel structural members in general building construction.
IS:811	Specifications for cold formed light gauge structural steel sections.
IS:8500	Structural Steel Micro alloyed (Medium and high strength qualities)
IS:8910	General requirements of supply of weldable structural steel
IS:9595	Recommendations for metal arc welding of carbon & carbon-Manganese steels
IS:7205	Safety Code for erection of Structural Steel Works
O	**Aggregates**
IS:383	Coarse and fine aggregates from natural sources for

	concrete.
P	**Scaffolding**
IS:2750	Specification for steel scaffoldings
IS:3696 (Part 1)	Safety Code of scaffolds and ladders: Scaffolds
IS:3696 (Part 2)	Safety Code of scaffolds and ladders: Ladders
IS:4014 (Part 1)	Code of practice for steel tubular scaffolding: Definition and materials
IS:4014 (Part 2)	Code of practice for steel tubular scaffolding: Safety regulations for scaffolding
IRC:87	Guidelines for the design and erection of falsework for road bridges
Q	**Sealants**
IS:10959	Glossary of terms for sealants for building purposes
IS:11433 (Part 1)	One part grade polysulphide base joint sealant: General requirements
IS:11433 (Part 2)	One part grade polysulphide base joint sealant: Methods of test
IS:13055	Methods of sampling and test for anaerobic adhesives and sealants
BS:5889	Specification for one part gun grade silicone-based sealants.
R	**Wood**
IS:303	Plywood for General Purposes
IS:848	Synthetic resin adhesives for plywood (phenolic and aminoplastic)
IS:1141	Seasoning of Timber - Code of Practice
IS:1328	Veneered decorative plywood
IS:1659	Block Boards
IS:2046	Decorative thermosetting synthetic resin bonded laminated sheets
IS:2202 (Part 1)	Wooden flush door shutters (solid core type): Plywood face panels
IS:2202 (Part 2)	Wooden flush door shutters (solid core (type): Particle face panels and hardboard face panels

S	**Bearings**
IRC:83Part-II	Standard specifications and code of practice for road bridges Elastomeric Bearings
IRC:83 Part-III	Standard specifications and code of practice for road bridges
T	Pot Bearings
IS 4985	**UPVC Pipe For Drainage**
U	Unplasticized PVC Pipes for portable water supplies
IS :2911	PILING
PART-I	Bored Cast in-situ Concrete Piles
IRC:78	Standard specifications and code of practice for road bridges Foundation And Substructure
V	All Indian Railway Standards
W	MOST Specifications for Road and Bridge works (latest Revision)
X	CPWD Specifications (latest Revision)

1.7 Temporary Work

1.7.1 All designs for temporary work shall conform to and comply with all the requirements given in the latest editions of the relevant Indian Standard specifications and codes of practice and other technical Specifications as detailed in this tender.

1.7.2 For all work for which the contractor has to submit design for approval of the Employer, the same shall be got prepared by the contractor from approved consultants who are specialised in this field. For particular item of scaffolding, staging and shuttering, use of any proprietary method of staging should be supplemented with proper designs of such system after getting approval from the Engineer.

1.7.3 The contractor shall assess with due care the supplementary site investigations needed to verify all topographical, hydrological and other site data indicated in the tender and also collect such additional site data/geo-technical data as may be necessary for doing the job and safety of structure.

1.7.4 The Engineer at his discretion may order any supplementary site geo technical investigation after award of the contract for verification and evaluation of any relevant data including geo technical data, and no claim for extra payment on this account of variation of site data so evaluated shall be tenable subject to other relevant provisions of the tender elsewhere.

2 EARTHWORK

2.1 These specifications shall be read in conjunction with the MORTH and CPWD specifications 1996/2002 with latest edition and correction ships upto date and other relevant specifications described in the section 1 of these specifications.

2.2 Results of the sub-surface investigations conducted at the Project Site are enclosed with the tender document. This information about the soil and sub-soil water conditions is being made available to the Contractor in good faith and the Contractor is advised to confirm / obtain details independently as may be considered necessary by him before quoting rates in the tender.

No claim whatsoever on account of any discrepancy between the sub-surface conditions that may be actually encountered at the time of execution of the work and those given in these Tender Documents shall be admissible to the Contractor under any circumstances whatsoever.

2.3 Excavation of rock may be carried out by chiselling, jack hammers, crowbars, wedging and using cutting machine or by any other method approved by the Engineer. Use of non-explosive demolition compounds shall also be permitted.

Open blasting is not permitted for the works under scope of this contract but at discretion of the Engineer, Controlled blasting may be permitted only in very special cases where all alternative methods have failed to achieve the satisfactory results. The Blasting, if permitted, shall be carried out with in the pre-defined fixed period to be decided in consultation with Traffic Police and approved by Engineer. Contractor shall be responsible for arranging and implementing an effective & approved system for informing the timing of the blasting to the Public including blowing a Siren on a regular basis. Contractor shall take all necessary precautions to prevent flying of blasted stones outside the excavation pit and damage to adjacent structures etc by controlling spacing and quantity of explosive charge and covering the sufficient area of blasting by steel plates loaded with adequate number of sand bags.

All operations of controlled blasting shall be carried out under the supervision of a responsible, authorised, competent and experienced blasting agent / foreman. Contractor shall be responsible for any damage arising out of blasting operation to the Employer/Engineer, workmen, public or any property. Contractor shall obtain all necessary permission from Traffic Police and other concerned authorities for blasting as required. Non-granting of permission for blasting by concerned authorities will not be considered as reason for delay or any claim thereof.

2.4 Excavation for all works and for materials required for filling shall be to the exact width, length and depth shown on the drawings or as directed by the Engineer. Where the nature of soil or the depth of the trench and season of the year, do not permit vertical sides, the contractor at his own expense shall put up the necessary shoring, strutting, planking or any other approved protection measures with due regard to the safety of personnel and works and to the satisfaction of the Engineer.

The construction barricading/fence in general will have a maximum width of 8.0m (outside to outside of barricading). This can be increased at specific locations with prior approval of Engineer. The Contractor shall submit method statements for approval of Engineer demonstrating how this will be achieved at site. If required, driving of rolled section / sheet pile of suitable size into the soil shall be done to retain earth as directed by Engineer. Measurement of plan area of excavation for payment shall be permitted only up to the end of PCC under foundations.

If excavation is carried out to greater depth than required beyond the level specified, for any reason whatsoever, such volume shall be made good by filling with PCC M10 having coarse aggregates 40 mm and below, graded, and brought to level to receive the levelling course below foundations. If excavation is carried out to greater width and length, such extra width and length shall be filled in by well consolidated earth / sand or if the Engineer thinks it is necessary for the stability of the work, by masonry or concrete as he may direct. No extra payment will be made on this account.

Propping shall be undertaken when any foundation or stressed zone from an adjoining structure is within a line of 1 vertical to 2 horizontal from the bottom of the excavation.

All excavations shall be carried out in conformity with the directions laid hereunder and in a manner approved by Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilised as decided upon, beforehand.

2.5 The last 200mm depth of excavation shall be done not earlier than 36 hours before laying the levelling course below foundations.

2.6 The Contractor shall make provision for all shoring, de-watering, dredging, bailing out or draining water whether subsoil or rain or other water and the excavation shall be kept free of water while concrete work is in progress and until the Engineer considers the work well set (Refer IS:3764 Safety Code for Excavation Work). The

sides of trenches shall be kept vertical and the bottom level throughout or properly stepped as directed by the Engineer. No extra payment shall be made on this account.

2.6.1 De-watering shall be carried out by suitable means with adequate stand-by arrangements as may be approved by the Engineer. The level of ground water shall be maintained at least 300mm below the lowest level of excavation during the laying of foundations. The Contractor shall be deemed to have satisfied himself with regard to feasibility of all aspects of de-watering including site constraints due to existing structures. Though the method of de-watering is left to the contractor, he shall be required to submit method statement of de-watering scheme including requisite justifications to the Engineer and seek his prior written approval.

Approval of the Engineer however shall not relieve the contractor of the responsibility of adequacy and appropriateness of de-watering and protection arrangements for the quality and safety of the work. The contractor shall satisfy the Engineer as to the capacity of the drains or disposal site to take the required quantity and flow of water to be pumped out at various stages of excavation. The Contractor shall obtain necessary approvals of local bodies for discharging and disposal of the pumped out water. All the de-watering pumps shall therefore also have dedicated D.G. Power supply which shall start automatically in case of failure of electrical supply. Monitoring of water table shall be done using electronic probes or by other suitable methods.

2.7 The Contractor shall erect and maintain during progress of works temporary fences/ barricading around the work area with all safety measures. The dangerous excavations, excavations near habitations, public movement areas and all works along the roads, shall be, provided with proper caution signs and marked with red lights, reflectors at night to avoid accidents. The contractor shall take all adequate protective measures to see that excavation operations do not affect or damage adjoining structures. Payment for the same shall be made at the quoted rates for the items in the BOQ and nothing extra shall be payable.

2.8 Excavation material required for filling shall be stacked or dumped where indicated by the Engineer. Excavated material not required for filling and any surplus material shall be removed and spread on the site anywhere within the premises and as directed by the Engineer or carted away from the site as directed by the Engineer. Dumping of this surplus material shall be in an environmental friendly manner using dumper with tarpaulin or suitable cover, placer etc. and according to the levels/grades as indicated

by the Engineer. Levelling and Compaction, if required, at the dumping ground shall also be carried out. The cost of such removal and spreading shall be borne by the Contractor and deemed to be included in the Contract Rates. Necessary approval from the local authorities for carting and dumping surplus material is to be obtained by the contractor at his own cost.

2.9 The Contractor shall notify to the Engineer when the excavation is completed and no base or Concrete or Masonry shall be laid until the Engineer has inspected and approved of the soil conditions obtained for each individual footing or the full raft area.

2.10 The Contractor shall ensure the stability of the excavation so that the surrounding ground and all adjoining structures and plants will be safe against settlement, subsidence and damage and that there is no risk of injury to personnel.

2.11 In case any underground structures/ utilities that need to be protected (like underground sewer lines etc.) are encountered, the Contractor shall bring the same to the notice of the Engineer immediately and shall take all such steps as the Engineer may instruct for protection of such structures. Such protective measures shall be done at the Contractor's cost If any damage occur to such structures/utilities which were required to be protected during execution, the same shall be made good by contractor at his own cost otherwise client will arrange to make it good at the risk and cost of Contractor.

2.12 The Contractor is free, within the framework of rules and regulations of the local authorities, to deal with the surplus earth in any manner suitable to him. The Contractor may dispose-off the surplus earth from the project site to a place/ places as may be permitted by the Engineer/ appropriate authority/ body. The transportation of the surplus earth shall be done by mechanical means only. The Contractor shall at his own cost obtain necessary clearances/ permissions statutory or otherwise needed for the purpose. Dumpers may be used for transporting slushy, material excavated from pile boring / well boring / pile cap / Open Foundation with precautions for non-spillage of muck.

2.13 In case earth is used for backfilling in foundation and plinth, it shall be got approved from the Engineer. In the foundation the backfilling shall be done in layers not more than 200mm thick and shall be thoroughly watered and consolidated by approved method. The rate for backfilling in foundation using earth is deemed to have been

included in the excavation rate even when dewatering may be required to be carried out.

2.14 In case sand is used for backfilling in foundation and plinth, it shall be got approved by the Engineer. In the foundation the backfilling shall be done in layers not more than 200mm thick and shall be thoroughly watered and consolidated by approved method. The rate for backfilling using sand in foundation is deemed to have been included in the excavation rate.

2.15 For open foundation resting on rock, if sound rock is located at shallow depths, the contractor is required to cut the rock (of all type or strength) to a depth so that open foundation with a minimum earth cushion of 500mm can be accommodated.

2.16 Measurements & Payment

Payment for excavations in soil and/or rock, including providing and installing shoring / strutting, dewatering, pumping and bailing out water shall be made as per the quoted rate of the respective items of excavation as specified in BOQ. However unless stated otherwise, the quoted rates for concrete in foundation (upto ground level) shall be deemed to include the cost of shoring, strutting, dewatering and backfilling using earth or sand wherever required with compaction of the same.

Measurements of excavation shall be solid measurements or actual volume of the materials prior to its removal. Measurements shall be of the exact length, width as indicated in the drawings and depth, measured vertically according to the Engineer's drawing or his instruction. No separate payment shall be made for shoring, dewatering, dredging, bailing, extra excavation required for side slopes and/or benching, ramps, space for providing side shutters and props etc.

The measurements for the removal of the excavated material shall be recorded at site of work before it is loaded in trucks and admissible deductions, if any, shall be made depending upon the type of material.

For excavation of existing road maximum limit of measurement for payment shall be from the existing ground level to the bottom of rubble soling. Measurement shall be those for the minimum works as ordered/plan dimensions as shown in the drawing and actual depth measured at site. All excavation shall be measured net and rate shall not allow for any additional for working space.

The measurement for backfilling shall be based on actual difference of levels before filling and after levelling.

3 STRUCTURAL CONCRETE: PLAIN, REINFORCED & PRESTRESSED

These specifications shall be read in conjunction with the MORTH and CPWD specifications 1996/2002 with correction ships / amendments upto date, and other relevant specifications described in the Section 1 of these Specifications.

3.1 Materials

Before bringing to the site, all materials for concrete including their source shall be approved by the Engineer. All approved samples shall be deposited in the office of the Engineer before placing orders for the materials with suppliers. The materials brought on to the works shall conform in every respect to the approved samples.

In case of change in type and/or source of any approved material, the contractor shall inform the Engineer and fresh samples shall be deposited with Engineer. Prior approval of Engineer will have to be obtained before using such material at site. The contractor shall check fresh consignment of materials as it is brought on to the works to ensure that they conform to the specifications and/or approved samples.

The Engineer shall have the option to have any of the materials tested at any time to find out whether they are in accordance with specifications at the contractor's expense. All bills vouchers and test certificates which in the opinion of the Engineer are necessary to convince him as to the quality of materials or their suitability shall be produced for his inspection when required.

Any material which has not been found to conform to the specifications and not approved by the Engineer shall be rejected forthwith and shall be removed from the site by the contractor at his own cost within the time stipulated by the Engineer. In the event of contractor not being able to arrange the material conforming to specifications or in the event of failure of the contractor to get the sources approved within the agreed schedule submitted by contractor, the Engineer shall have the powers to cause the Contractors to purchase and use such materials from any particular source, as may, in the Engineer's opinion, be necessary for the proper execution of work. Nothing extra shall be payable to the contractor on this account.

Contractor shall also ensure that all constituents of exposed concrete shall be taken from same sources to achieve a uniform colour and texture.

3.1.1 Cement

3.1.1.1 The cement used shall be of the following types:

a) 43 grade Ordinary Portland Cement conforming to IS: 8112.

b) 53 grade Ordinary Portland Cement conforming to IS:12269.

For piling and foundation work, type of cement shall be as mentioned in section S-08 on Pile Foundations.

3.1.1.2 Whenever possible all cements of each type shall be obtained from one constant source throughout the contract. Cement of different types shall not be mixed together. Different brands of cement, or the same brand of cement from different sources, shall not be used without prior approval of the Engineer.

3.1.1.3 Packaged cement shall be delivered to the site in original sealed bags which shall be labelled with the weight, name of manufacturer, brand and type including date of manufacture. Cement received in torn bags shall not be used.

Contractor may obtain cement in bulk and store it in suitable silos of adequate capacity. Each type of cement shall be stored in a separate silo and it shall be ensured, that cements of different quality are not mixed up.

3.1.1.4 All cement shall be fresh when delivered. Cement older than 3 months from the date of manufacture shall not be used.

3.1.1.5 In fair faced elements, the cement used in the concrete for any complete element shall be from a single consignment. All cement for exposed concrete shall be from the same approved source and uniform in colour.

3.1.1.6 With each and every delivery of cement consignment, the contractor shall provide manufacturer’s certificate that the cement conforms to the relevant Indian standard. The contractor shall provide complete facilities at site for carrying out the following tests:

a) Setting time by Vicat's apparatus as per IS:4031 and IS:5513.

b) Compressive strength of cement as per IS: 4031, IS:650, IS:10080.

3.1.1.7 Total chloride content in cement shall in no case exceed 0.05 % by mass of cement. Also, total sulphur content calculated as sulphuric anhydride (SO3), shall in no case exceed 2.5% and 3.0% when tri-calcium aluminate per cent by mass is upto 5% or greater than 5% respectively.

3.1.2 Aggregates

Aggregates from natural sources shall be in accordance with IS:383. The contractor shall submit to the Engineer certificates of grading and compliance for all consignments of aggregate. In addition at site from time to time, the contractor shall allow for carrying out such tests and for supplying test records to the Engineer. The aggregates shall be procured from approved sources only as directed by the Engineer from time to time.

For fair faced concrete, the contractor shall ensure that aggregates are free from iron pyrites and impurities, which may cause discoloration. Aggregates shall be stored on paved areas in different compartments according to their nominal size.

3.1.2.1 Fine Aggregates

The contractor shall provide complete facilities at site for determining grading of aggregates by sieves as per IS:383, IS:460, IS:1607, and IS:2386.

The fine aggregate shall be river sand, pit sand, stone dust or other approved sand subject to their conformity to the specifications. It shall be free from clay, loam, earth or vegetable matter and from salt or other harmful chemical impurities. It shall be clean, sharp, strong,angular and composed of hard siliceous material.

The grading of fine aggregate when determined as described in IS:2386 (part I), shall be within the grading zones I, II, III. The contractor shall provide complete facilities at site for carrying out the following tests:

A) Proportion of clay, silt and fine dust by sedimentation method as per IS:2386 part II.

B) Moisture content in fine aggregate as per IS: 2386 Part III.

C) Bulk density/Bulkage.

3.1.2.2 Coarse Aggregates

The coarse aggregate shall be crushed stone.

Coarse aggregate obtained from crushed or broken stone shall be angular, hard, strong, dense, non-porous, durable, clean and free from soft, friable, thin plate, elongated or flaky pieces and any deleterious material.

Except where it can be shown to the satisfaction of the Engineer that a supply of properly graded aggregates of uniform quality can be maintained over the said period of the works, the grading of aggregates shall be controlled by obtaining the coarse aggregates in different sizes and blending them in correct proportions as and when required.

All coarse aggregates shall conform to IS:383 and tests for conformity shall be carried out as per IS:2386,Parts I to VIII.

The maximum size of coarse aggregates shall be such that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of formwork. Unless otherwise permitted by the Engineer the nominal maximum size shall not exceed 20 mm.

3.1.3 Water

3.1.3.1 Water used in the works shall be potable water and free from deleterious materials. Water used for mixing and curing concrete as well as for cooling and/or washing aggregate shall be fresh, clean and free from injurious amounts of oil, salts, acids, alkali, other chemicals and organic matter.

3.1.3.2 Water shall be from the source approved by the Engineer and shall be in accordance with clause 5.4 of IS: 456. However, chloride content in water shall not exceed 500 mg/litre.

3.1.3.3 Whenever the source of water changes, the water shall be tested for its chemical and other properties or impurities to ascertain its suitability for use in concrete with approval of the Engineer. No water shall be used until tested and found satisfactory. Cost of all such Tests shall be borne by the contractor.

3.2 Blending Of Aggregates

In order to obtain optimum workability, individual aggregates of nominal size 20mm, 10mm, 4.75mm and 2.36mm will be blended in such a way that the grading curve for all in aggregates will be a smooth curve from size 0.15mm to 20mm falling within the established envelope grading curve. Contractor shall establish envelope grading curve for each grade of concrete for given maximum size of aggregates and get it approved by Engineer before finalising the mix design.

3.3 Admixtures

3.3.1 Chemical admixtures are not to be used until permitted by the Engineer. In case their use is permitted, the type, quantity/dosage and method of use of any admixture proposed by the Contractor shall be submitted to the Engineer for approval. The minimum cement content specified shall not be reduced on account of the use of the Admixtures.

3.3.2 The contractor shall further provide the information concerning each admixture to the Engineer as per para 1012.1 of MORTH Specifications.

3.3.3 In reinforced concrete works, the chloride content of any admixture used shall not exceed 2 percent by weight of the admixture as determined in accordance with IS:6925 and the total chloride and sulphate contents in concrete mix shall not exceed 0.15 and 4.0 percent respectively by weight of cement.

3.3.4 The admixtures when used shall conform to IS:9103. The suitability of all admixtures shall be verified by trial mixes.

3.3.5 The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances.

3.3.6 Retarding admixtures when used shall be based on lingosus-Phonates with due consideration to clause 5.2 and 5.3 of IS:7861.

3.4 Batching Plants, Mixers and Vibrators

3.4.1 Unless otherwise specified in the schedule of items, for all structural concreting work the Contractor shall provide automatic weigh-batching plant of suitable capacity. The plant used shall conform to IS:4925. The batching plants should have printing facilities to printout records of each batch in the format approved by the Engineer.

3.4.2 The Contractor shall provide Concrete mixers (IS:1791 – Batch type concrete mixers, IS:2438 – Roller Pan Mixer) and Vibrators (IS:2505 – Concrete Vibrators Immersion Type, IS:2506 – Screed board concrete vibrators, IS:4656 – Form Vibrators for Concrete) supplied by recognized manufacturers.

3.5 Grade of Concrete

The concrete is designated as follows:

Concrete M 25 / 20

The letter M refers to the mix

The number 25 represents the characteristic compressive strength of 15cm cubes at 28 days in MPa (Mega Pascals : 1 MPa : 10 kg/cm^2 approximately). M25 concrete thus has a characteristic strength of 250 kg/cm^2. Other mix design will also be denoted in same way.

The number 20 represents the nominal size of the coarse aggregates in mm.

3.6 Mix Design

It is the complete responsibility of the Contractor to design the concrete mixes by approved standard methods and to produce the required concrete conforming to the specifications and the strength, workability requirements approved by the Engineer.

Mix Design once approved must not be altered without prior approval of Engineer. However, should the contractor anticipate any change in quality and/or change in source of future supply of materials than that used for preliminary mix design, he should inform the Engineer quite in advance and bring fresh samples sufficiently in advance, to carry out fresh trial mixes. Design mix will indicate by means of graphs and curves etc., the extent of variation in the grading of aggregates which can be allowed.

Limits of Water and Cement Contents

Maximum water/cement ratio

a)	For RCC members including piles	-	0.40
b)	For PSC members	-	0.40

Cement Content

Notwithstanding to the stipulations in any code, Cement content in concrete shall not be less than 380 kg/ cum for RCC work and 400 kg/ cum for PSC work under normal exposure. In case of piling work minimum cement content shall be as specified under the section "Pile Foundations". However, maximum cement content shall be limited to 540 kg/ cum of concrete. Ordinary Portland Cement (OPC) of 43 and 53 grade conforming to IS: 8112 and IS: 12269 respectively shall be used. For pre-stressed concrete, cement conforming to OPC 53 grade cement shall be used. However for nominal mixes, CPWD specifications will be followed. "Cement" means Ordinary Portland Cement and excludes the additions as mentioned in para 5.2 of IS 456.

As regards trial mixes, acceptance criteria, acceptance specification, lot size, sampling and testing and sampling size for piling work, PSC girders (cast-in-situ and pre-cast post-tensioned) and general work, the requirement of the relevant codes, standards and directions of the Engineer shall be followed.

3.7 Additional Tests for Concrete

As frequently as the Engineer may require, additional tests shall be carried out of concrete in addition to mandatory test specified in MORTH Specifications, CPWD specifications 1996/ relevant IS Code.

3.7.1 Permeability test for Concrete:

The concrete will be verified for permeability by the following procedure and shall confirm to IS:3085-1965 – 'Permeability of Cement Mortar & Concrete'. Section 1716.5 of MORTH Specifications and DIN 1048.

1 The Engineer shall select random batches of concrete for examination at his discretion and sampling will generally be done at the point of discharge from the mixer and at placing point.

2 From the batches thus selected two concrete cylinders shall be made in accordance DIN 1048.

3 At least two cylinders shall be made on each day's concreting until 60 cylinders have been made for each grade of concrete.

4 All cylinders shall be made, cured, stored, transported and tested in accordance with clause 1716.5 of MORTH Specifications. The tests shall be carried out in a laboratory having NABL certification.

5 Test Procedure

The permeability of concrete will be verified by the following procedure:

i. Prepare a cylindrical test specimen 150 mm dia. and 160mm high.

ii. After 28 days of curing, test specimen will be fitted in a machine such that the specimen can be placed in water under pressure up to 7 bars. The typical machine shall be similar to one shown in Appendix 1700/II of MORTH.

iii. At first a pressure of one bar is applied for 48 hours, followed by 3 bars for 24 hours and 7 bars for next 24 hours.

iv. After the passage of the above period, the specimen is taken out and split in the middle by compression applied on two round bars on opposite sides above and below.

v. The water penetration in the broken core is measured with scale and the depth of penetration assessed in mm (max permissible limit 25 mm).

6 Acceptability Criteria

The concrete shall pass the permeability test if it is properly compacted and is not considered permeable when tested as above.

No extra payment shall be made for this test and cost of the same should be included in the quoted rate for concrete work.

3.8 Batching Of Concrete Ingredients

Unless permitted by the Engineer, all concreting shall be produced in computerised automatic weigh batching plant having printing facilities to print out records of each batch and installed at site. Under exceptional circumstances Ready Mixed Concrete (RMC) manufactured in computerised automatic weigh batching plant (as per specifications described above) by the approved agencies using the constituent materials from approved sources and approved mix design may also be used with prior approval from Engineer. Nothing extra shall be paid for such RMC used in the work including transportation, placing in position etc. However, in such cases the RMC production & transportation will have to be directly supervised by the qualified personnel of the contractor.

3.9 Placing Temperatures

During extreme hot or cold weather, the concreting shall be done as per procedures set out in IS:7861, Parts I & II.

The placing temperature of concrete shall be as low as possible in warm weather and care shall be taken to protect freshly placed concrete from overheating by sunlight in the first few hours of its laying. The time of day selected for concreting shall also be chosen so as to minimise placing temperatures. In case of concreting in exceptionally hot weather the Engineer may at his discretion specify the use of ice either flaked and used directly in the mix or blocks used for chilling the mixing water. In either case, the Contractor shall not be paid extra for cost of ice, additional labour involved in weighing and mixing etc. All salt and saw dust shall be removed from ice before use. Quality of water used for making ice shall confirm to IS:456.

3.10 Transporting, Placing, Compacting And Curing

Transporting, placing, compacting and curing of concrete shall be in accordance with IS: 456.

3.10.1 Transporting

The method of transportation used should efficiently deliver the concrete to the point of placement without significantly altering its desired properties with regard to water-cement ratio, slump, segregation and homogeneity.

The mix after discharging from the automatic computerized weigh batching plant/mixer shall be transported by agitating transit mixers, buckets, pumps etc. or as approved by the engineer without causing segregation and loss of cement slurry and without altering its desired properties with regard to water cement ratio, slump, air content, cohesion and homogeneity. It should be ensured that the concrete is moved to its final destination before it attains the initial set.

The revolving-drum truck bodies of approved make shall be used for transporting the concrete. The number of revolutions of mixing, speed, during transportation, and prior to discharge shall be specified and agreed upon. Reliable counters shall be used on revolving-drum truck units. Standard mixer uniformity tests, conforming to ASTM standards C 94 “Standard Specifications for Ready Mix Concrete”, shall be carried out to determine whether mixing is being accomplished satisfactorily.

3.10.2 Water, Admixtures and Slump

The amount of water required for proper concrete consistency shall take into account the rate of mixing, length of haul, time of unloading, and ambient temperature conditions.

Additions of water to compensate for slump loss should not be resorted to nor should the design maximum water-cement ratio be exceeded. Additional dose of retarder be used to compensate the loss of slump at contractor's cost, when permitted by Engineer. Retempering water shall not be allowed to be added to mixed batches to obtain desired slump.

3.10.3 Placing

The method of placing shall be such as to prevent segregation by providing windows in the formwork for pouring concrete or by Tremie pipe. The thickness of horizontal layers shall not exceed 300mm. High velocity discharge of concrete causing segregation of mix shall be avoided. The concrete shall be placed in the forms gently in such a way that the segregation does not take place. The concrete shall not be dropped from a height exceeding 2.0m. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow each other close enough to ensure that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken initial set.

For piers and pier heads, portal columns, concreting is to be carried out in single stage i.e in first stage concreting will be from kicker to just below pier head bottom and second stage of concreting will be pier head including shear key and cross girder (for all heights by using tremie/ pumps at the rate not more than 1.5m / hror as approved by the Engineer).

Concreting of any portion or section of the work shall be carried out in one continuous operation and no interruption of concreting work will be allowed without approval of the Engineer.

3.10.4 Compaction

Internal (needle) and surface (screed board) vibrators of approved make shall be used for compaction of concrete.

Internal vibrators shall be used for compaction of concrete in foundations, columns, buttresses arch section, slabs etc., and if required surface vibrators shall also be used. Depending on the thickness of layer to be compacted, 25 mm, 40 mm, 60 mm and 75

mm dia. internal vibrators will be used. The concrete shall be compacted by use of appropriate diameter vibrator by holding the vibrator in position until:

i. Air bubbles cease to come to surface.

ii. Resumption of steady frequency of vibrator after the initial short period of drop in the frequency, when the vibrator is first inserted.

iii. The tone of the vibrated concrete becomes uniform.

iv. Flattened, glistening surface, with coarse aggregates particles blended into it appears on the surface.

v. After the compaction is completed, the vibrator should be withdrawn slowly from the concrete so that concrete can flow in to the space previously occupied by the vibrator. To avoid segregation during vibration the vibrator shall not be dragged through the concrete nor used to spread the concrete. The vibrator shall be made to penetrate, into the layer of fresh concrete below if any for a depth of about 150mm. The vibrator shall be made to operate at a regular pattern of spacing. The effective radii of action will overlap approximately half a radius to ensure complete compaction.

vi. To secure even and dense surfaces free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic.

vii. A sufficient number of standby vibrators shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.

viii. Form vibrators whenever used shall be clamped to the sides of formwork and shall not be fixed more than 450 mm above the base of the new formwork and concrete shall be filled not higher than 230mm above the vibrator. The formwork must be made specially strong and watertight where this type of vibrator is used.

Care must be taken to guard against over vibration especially where the workability of the concrete mix is high since this will encourage segregation of the concrete.

ix. Plain concrete in foundations shall be placed in direct contact with the bottom of the excavation, the concrete being deposited in such a manner as not to be mixed with the earth. Plain concrete also shall be vibrated to achieve full compaction.

x. Green concrete shall be protected from the direct sun light and hot winds as per the methods approved by Engineer. Such method should be got approved from the Engineer before start of concreting operations.

Concrete placed below the ground shall be protected from falling earth during and after placing. Concrete placed on ground containing deleterious substances shall be kept free from contact with such ground and with water draining therefrom during placing and for a period of seven days or as otherwise instructed thereafter. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, abrasion, vibrations, deleterious ground water, mixing with earth or other materials, and other influences that may impair the strength and durability of the concrete.

3.10.5 Field Control

Sampling at both, truck discharge and point of final placement shall be employed to determine if any changes in the slump and other significant mix characteristics occur. However, for determining strength of concrete, cubes shall be taken from the placement end of line.

3.10.6 Curing

i. Curing of concrete shall be complete and continuous using potable water free from chlorides and sulphates water that is free of harmful amounts of deleterious materials that may attach, stain or discolour the concrete as per IS 456. Minimum wet curing will be for seven days by ponding water followed by moist curing by spraying water which shall be maintained up to a total period of at-least 21 days from the date of casting.

ii. Immediately after compaction and completion of any surface finishes the concrete shall be protected from the evaporation of moisture by means of polythene sheathing, wet hessian or other material kept soaked by spraying. As soon as the concrete has attained a degree of hardening sufficient to withstand surface damage moist curing shall be implemented and maintained for a period of at least 15 days after casting.

iii. Method of curing and their duration shall be such that the concrete will have satisfactory durability and strength and members will suffer a minimum distortion, be free from excessive efflorescence and will not cause undue cracking in the works by shrinkage.

iv. Steam curing with approved methodology can be adopted if required, for precast segments. No extra payment will be made for adopting steam curing.

v. Water based curing compounds may be permitted with specific approval of Engineer. However it is required to be proved that by using such curing compound, the concrete shall not have less strength than concrete cured by water curing. It shall not leave any discolouration on the structural concrete. It shall be applied as per the provisions of clause 1713.3 of MORTH specifications. No extra payment will be made for the same.

3.11 Construction Joints

Construction joints in all concrete work shall be made as directed by the Engineer. Where vertical joints are required, shuttering shall be fixed as directed To ensure that the concrete does not take natural slope.

Before fresh concrete is placed against a vertical joint, the old concrete shall be chipped, cleaned and moistened.

No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning them. When a horizontal construction joint is formed, provision shall be made for interlocking with the succeeding layer by the embedment of saturated wooden blocks or wooden strips bevelled on four sides to facilitate their removal. Prior to the next pour the wooden pieces shall be loosened and removed in such a manner as to avoid injury to the concrete.

Construction joints in concrete walls and slabs for liquid retaining structures shall be prepared in a similar manner to normal construction joints. If use of metal, rubber or plastic water stops is specified, this shall be cast into joints. Measures shall be taken by the Contractor to ensure that no displacement or distortion of water stops takes place during placing of concrete. The construction joints shall ensure proper bond and leak proof joint.

3.12 Cracks

If cracks, which in the opinion of the Engineer may be detrimental to the strength of the construction, develop in concrete construction, the Contractor at his own expense shall test the structure as specified in clause 1.1.16 of 'Loading Tests' of these Specifications. If under such test loads the cracks develop further, the Contractor shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto.

If cracks develop in the concrete construction, which in the opinion of the Engineer, are not detrimental to the stability of the construction, the Contractor at his own expense shall grout the cracks with neat cement grout or with other composition as directed by Engineer and also at his own expense and risk shall make good to the satisfaction of the Engineer all other works such as plaster, moulding, surface finish, which in the opinion of the Engineer have suffered damage either in appearance or stability owing to such cracks. The Engineer's decision as to the extent of the liability of the Contractor in the above matter shall be final and binding.

External crack width shall be restricted to 0.2mm on all viaduct structures. If crack width is more than 0.2mm or in the opinion of Engineer may be detrimental to concrete construction, the contractor should test the structure at his own expense.

3.13 Defective Concrete

Should any concrete be found honeycombed or in any way defective, such concrete shall be cut out partially or wholly by the Contractor and made good at his own expense. If Engineer feels that repaired structure will not be having same strength or shape or uniformity with other exposed surface as original desired structure / original structure, the same shall be rejected by Engineer and required to be dismantled and disposed-off by contractor at his own cost, as instructed by Engineer. Decision of the Engineer shall be final binding in this regard.

3.14 Exposed Faces, Holes and Fixtures

On no account shall concrete surfaces be patched or covered up or damaged concrete rectified or replaced until the Engineer or his representative has inspected the works and issued written instructions for rectification. Failure to observe this procedure will render that portion of the works liable to rejection.

Holes for foundation or other bolts or for any other purposes shall be moulded, and steel angles, holdfasts or other fixtures shall be embedded, according to the drawing or as instructed by the Engineer.

3.15 Finishes

Unless otherwise instructed, the face of exposed concrete placed against formwork shall be rubbed down immediately on removal of the formwork to remove irregularities. The face of concrete for which formwork is not provided other than slabs shall be smoothed with a float to give a finish equal to that of the rubbed down face, where formwork is provided. The top face of a slab which is not intended to be covered with other materials shall be levelled and floated to a smooth finish at the

levels or falls shown on the drawings or as directed. The floating shall be done so as not to bring an excess of mortar to the surface of the concrete. The top face of a slab intended to be surfaced with other material shall be left with a spaded finish. Faces of concrete intended to be plastered shall be roughened by approved means to form of a key.

3.16 Concrete for Flooring on Grade

Concrete for flooring on grade shall be placed in alternate bays not exceeding more than 4m x 4m or as specified in the drawings including forming the joints or adjacent bays. The stiff mix shall be thoroughly vibrated and finished to receive the floor finish.

3.17 Grouting Of Base Plates & Bolt Holes

3.17.1 Mixing

Dry grout should be mixed in a mechanical mixer: the conventional 200/400-litre capacity concrete mixer can be used to mix four bags of dry grout; alternatively, paddle type mortar mixers can be used. The quantity of grout to be mixed at one time should not exceed that amount which can be placed in approximately 10 to 15 minutes.

3.17.2 Batching

Batching of grout by fraction of a bag is not allowed. The quantity of mixing water should be the minimum commensurate with workability, compaction, and filling of the grout in all corners and crevices. Mixing should be done for a minimum of three minutes to obtain a fluid grout of uniform consistency.

3.17.3 Cleaning and preparation of the surface

The base concrete should be clean and strong, and its surface should be properly hacked; all dust should be removed by suction or compressed air. The surface should be thoroughly wetted with water for several hours. Before the grout is poured, all free water should be removed and the flat surfaces coated with a thin cement slurry.

3.17.4 Restraint

Heavy back-up blocks of timber or concrete should be fixed on all sides of the base plate to prevent escape of the grout, when poured through the openings provided in the base plate. Adequate restraint must be ensured on all the sides for a period of 7 days to obtain effective expansion and shrinkage compensation.

3.17.5 Curing

The grout should not dry out where external restraint is provided in the form of form-work, the top opening and all stray openings should be covered with wet sack for at least 7 days.

3.17.6 Placing and Compaction

The grout should be placed quickly and continuously either through the holes in the base plates or from one side only to ensure complete filling without entrapment of air. Grout should be properly spread and compacted by rodding. Excessive vibration should be avoided.

Below the bed plates, the grout should be compacted using long pieces of doubled-over flexible steel strapping or chains. The forward and backward movement of the strap or chain will assist in the flow of the grout into place. Steps must be taken to keep the grout in full contact with the underside of the bedplate until the grout sets; maintaining a small head of fresh grout in the forms.

3.17.7 Shrinkage Compensated Grout

Shrinkage compensated grout or non-shrinkable grout of Associated Cement Companies Limited or any other approved manufacturer (Fosroc, Roff, Sikka, etc) should be used. The batching shall be as per the manufacturer's specifications, other procedures being as above.

3.18 Pre-Cast Concrete

The provision in this section shall be considered supplementary to general provisions for reinforced concrete works.

3.18.1 Handling and Storage

The pre-cast units shall be stored as directed by the Engineer. The area intended for the storage of pre-cast units should be surfaced in such a way that no unequal settlement can occur.

To prevent deformation of slender units, they should be provided with supports at fairly close intervals and should also be safeguarded against tilting. Lifting and handling positions should conform to the Engineer's directions and drawings. In addition, location and orientation marks should be put on the members, as and where necessary. During erection the precast units should be protected against damage caused by local crushing and chafing effects of lifting and transport equipment.

3.18.2 Temporary Supports and Connections

Temporary supports provided during erection should take into account all construction loads likely to be encountered during the completion of joints between any combination of precast and in-situ concrete structural elements. The supports should be arranged in a manner that will permit the proper finishing and curing of any in-situ concreting and grouting associated with the precast member being supported when the gaps of joints have to be filled with concrete or mortar. They should first be cleaned and faces of the joints should be wetted. The mixing, placing and compacting of cement and mortar should be done with special care. Mortar of a dry consistency should be in the proportion of 1:1½ (1 part of cement to 1½ parts of sand) and should be placed in stages and packed hard from both sides of the joint.

3.18.3 Tolerances

The following tolerances apply to finished precast products at the time of placement in the structure. The forms must be fabricated / constructed to give a casting well within these limits:

1 Overall dimensions of members should not vary by more than + 6mm per 3m length with a maximum variation of + 20mm.

2 Cross-sectional dimensions should not vary by more than the following:

+ 3mm for sections less than 150mm thick

+ 4mm for sections over 150mm & less than 450mm

+ 6mm for sections over 450mm to 1000mm

+ 10mm for sections over 1000mm

3 Deviation from straight line in long sections should not be more than + 6mm up to 3m, + 10mm for 3m to 6m, + 12mm for 6m to 12m.

3.19 Additional Specifications For Pumped Concrete

3.19.1 Coarse Aggregates

The maximum size of coarse aggregate shall be limited to one-third of the smallest inside diameter of the hose or pipe used for pumping. Provision shall be made for elimination of over-sized particles by screening or by careful selection of aggregates. To obtain proper gradation it may be necessary to combine and blend certain fractional sizes of aggregates. Uniformity of gradation throughout the entire job shall be maintained.

The quantity of coarse aggregate shall be such that the concrete can be pumped, compacted and finished without difficulty.

3.19.2 Fine aggregates

The gradation of fine aggregate shall be such that 15 to 30 percent should pass the 0.30 mm screen and 5 to 10 percent should pass 0.15 mm screen so as to obtain pumpable concrete. Sands, which are deficient in either of these two sizes, should be blended with selected finer sands to produce these desired percentages. With this gradation, sands having a fineness modulus between 2.4 and 2.8 are generally satisfactory. However, for uniformity, the fineness modulus of the sand should not vary more than 0.2 from the average value used in proportioning.

3.19.3 Pumping of concrete

Only approved pumping equipment, in good working condition, shall be used for pumping of concrete. Concrete shall be pumped through a combination of rigid pipe and heavy-duty flexible hose of approved size and make. The couplings used to connect both rigid and flexible pipe sections shall be adequate in strength to withstand handling loads during erection of pipe system, misalignment, and poor support along the lines. They should be nominally rated for at least 3.5 Mpa pressure and greater for rising runs over 30 m. Couplings should be designed to allow replacement of any section without moving other pipe sections, and should provide full cross section with no construction or crevices to disrupt the smooth flow of concrete.

All necessary accessories such as curved sections of rigid pipe, swivel joints and rotary distributors, pin and gate valves to prevent backflow in the pipe line, switch valves to direct the flow into another pipe line, connection devices to fill forms from the bottom up, extra strong couplings for vertical runs, transitions for connecting different sizes of pipe, air vents for downhill pumping, clean-out equipment etc, shall be provided as and where required. Suitable power controlled booms or specialized crane shall be used for supporting the pipe line.

3.19.4 Planning

Proper planning of concrete supply, pump locations, line layout, placing sequence, and the entire pumping operation for a particular pour shall be made and got approved. The pump should be as near the placing area as practicable, and the entire surrounding area shall have adequate bearing strength to support concrete delivery pipes. Lines from pump to the placing area should be laid out with a minimum of bends. For large placing areas, alternate lines should be installed for rapid

connection when required. Standby power and pumping equipment should be provided to replace initial equipment, should breakdown occur.

The placing rate should be estimated so that concrete can be ordered at an appropriate delivery rate.

As a final check, the pump should be started and operated without concrete to be certain that all moving parts are operating properly. A grout mortar should be pumped into the lines to provide lubrication for the concrete, but this mortar shall not be used in the placement. When the form is nearly full, and there is enough concrete in the line to complete the placement the pump shall be stopped and a go-devil inserted and shall be forced through the line by water under pressure to clean it out. The go-devil should be stopped at a safe distance from the end of the line so that the water in the line will not spill into the placement area. At the end of placing operation, the line shall be cleaned in the reverse direction.

3.20 Additional Specifications for Concrete M60 And Above

3.20.1 Any of the following shall be permitted to be used as part replacement of Ordinary Portland Cement with the approval from Engineer

- Microsilica / silica fume
- Fly Ash
- Granulated Slag

However the cement content excluding any mineral admixtures shall not exceed 450kg / cum except with the prior approval from Engineer

Also cement contents + binder should not be less than 380kg / cum of concrete

The water / (cement + binder) ratio should generally not exceed 0.33, but in no case more than 0.40.

3.20.2 In order that the performance of the completed structure be consistent with the requirements and assumptions made during planning and design, stringent quality assurance measures shall be taken. The methods and procedures of Quality System shall follow the guidelines contained in IRC:SP:47 – 1998. Q-4 class of Quality Assurance shall be adopted for the ‘Materials’ and ‘Workmanship’ items.

3.20.3 The temperature of concrete at the time of placement shall not exceed 30□ C. The temperature of concrete at the mixing stage should be lower, to allow for rise in temperature during transport. When considerable distance of transport is involved,

particular attention should be paid to ensure retention of slump as targeted for placement

3.20.4 Use of Microsilica / silica fume

(a) Mineral admixture in the form of microsilica or condensed silica fume shall be permitted in the design mix. It shall comply with ASTM C 1240 "Specifications for Silica Fume for use in Hydraulic Cement Concrete and Mortar". It shall be obtained from proven, reliable and approved manufacturer/supplier to the satisfaction of the Engineer.

(b) Adequate and complete dispersal of the micro silica during the concrete mixing shall be ensured.

(c) When microsilica is used in powder form the contractor shall take all precautions against potential health hazards during handling of the material.

(d) Chilled water and/ or ice shall be used in the concrete mix depending on the ambient temperature, dimensions of the concrete element, rate of pouring and design mix constituents.

(e) Special profuse curing arrangements shall be made for dissipation of the heat of hydration. The water curing shall be continued for a period of 21 days.

(f) The concrete design mix and arrangement for mixing, transportation, and curing of concrete shall be subject to the approval of the Engineer.

3.20.5 Use of Fly Ash

a) Use of well-graded Fly Ash from an approved source may be permitted subject to satisfying the design criteria and requirement of mix design. Combination of microsilica / silica fume and fly ash may also be used to improve upon the durability of concrete and getting the early strength as required. However, the contents of fly ash or fly ash + microsilica / silica fumes in the mix shall not be more than 35% of the total cementatious material (cement + fly ash or Cement + fly ash + microsilica / silica fumes as the case may be). The maximum allowable content of the fly ash or fly ash + microsilica / silica fume shall be limited to 150 kg per cum of concrete mix.

b) Saving in the cement contents due to this vis a vis the mix design without the using Fly Ash shall be passed on to the Employer

c) Fly Ash shall be conforming to IS: 3812 (Part – 1):2003 and IS: 269-1989. Contractor shall have to make sure of availability of Fly Ash of consistent quality and in required quantity.

d) The physical requirements for Fly Ash are as under:

S.No	Characteristics	Requirement
1	Fineness-specific surface in m3/kg by Blaine's permeability method, (minimum)	320
2	Particles retained on 45 microns IS sieve (wet sieving) in percent, (maximum)	34
3	Lime reactivity – Average compressive strength in N/mm^2 (minimum)	4.5
4	Compressive strength at 28 days in N/mm^2 (minimum)	Not less than 80 percent of the strength of corresponding plain cement mortar cubes
5	Soundness by autoclave test – Expansion of specimen in percent (maximum)	0.8

e) Source of Fly – Ash

To ensure the good quality of fly ash for use in concrete, the following sources of ash should be avoided:

i. Ash from plants burning different coal or blends of coal
ii. Ash from plants burning other fuels (wood chips, tyres trash) blended with coal
iii. Ash from start-up or shut down phases of operation
iv. Ash from plants not operating at a "Steady State"
v. Ash that is handled and stored using a wet system
vi. Unprocessed ash from power plant without electrostatic precipitator (ESP)

f) Drying and Conditioning of Fly Ash

When used in as a partial replacement for Portland cement in ready mix concrete, fly ash must be in dry form and as such requires no processing, provided above source control is maintained.

g) Quality Control

Fly Ash in concrete should be as consistent and uniform as possible. Fly Ash to be used in concrete should be monitored by quality assurance/quality control (QA/QC) programmed on lot basis. These procedures include performing tests for fineness by wet sieving at 45-micron sieve and loss on ignition (LOI) so that the consistency of a Fly Ash source can be certified.

Contractor shall have to evolve a suitable mix design on Fly Ash or fly ash + microsilica / silica fume (as the case may be) for the specified compressive/flexural strength and also demonstrate the suitability of the mix by field tests.

Concrete mixes are designed by selecting the proportions of the mix components that will develop the required strength, produce a workable consistency concrete that can be handled and paved easily, and attend sufficient durability under exposure to in service environmental conditions. Procedures for proportioning Fly Ash or fly ash + microsilica / silica fume (as the case may be) concrete mixes differ slightly from those called conventional concrete mixes.

One mix design approach commonly used in proportioning Fly Ash or fly ash + microsilica / silica fume (as the case may be) concrete mixes is to use mix design with all Portland Cement. Increase the total cementatious materials content (normally by 12%) remove some of the Portland Cement and then add Fly Ash or fly ash + microsilica / silica fume (as the case may be) to compensate for the cement removed. Also, water content should be reduced by 5%. The ACI mix proportioning guidelines recommend a separate trial mix for each 5% increment in the replacement of Portland cement by Fly Ash.

When Fly Ash is used as a separately batched material, trial mixes should be made using a water (cement + fly ash) W/C + F) ratio, sometimes referred to as the water cementitious ratio, instead of the conventional W/C ratio.

Also relaxation shall be given in such cases from 28 days strengths as 56 days strength shall also be tested for compliance. Minimum cement content should be 250 kg per cum. of concrete.

h) It shall be the responsibility of the contractor to procure and to transport and to store the Fly Ash to batching plant site. Contractor may also have to make necessary modifications in the batching plant to enable use of Fly Ash in the concrete mix.

i) Fly Ash handling and Storage

When Fly Ash is used as cementatious material, the contractor should handle Fly Ash in the same manner as Portland cement, except that Fly Ash must be stored separately from the Portland cement. Loading, transportation, unloading including handling of the Fly Ash shall be done in eco-friendly manner so as not to pollute / degrade the atmosphere. The safety of the persons handling the Fly Ash should be ensured as per the approved norms.

j) Curing

Slower strength development of concrete containing Fly Ash may require that the moisture is retained in the concrete for a longer period of time than what is normally required for conventional concrete. Proper application of a curing compound should retain moisture in the concrete for sufficient period of time to permit strength development. Normal curing practices should be adequate for concrete containing Fly Ash.

Scheduling of pavement construction should allow adequate time for the desired or specified gain prior to the placement of traffic loads.

3.21 Testing Concrete Structures for Water Tightness & Acceptance Criteria

3.21.1 Underground Tanks, Pump Rooms and Sumps

In the case of structures whose external faces are submerged and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hours over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the water tightness of the structure.

A structure shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

3.21.2 Roofs

The roofs of liquid-retaining structures shall be water-tight and shall be tested on completion by flooding the roof with water to a minimum depth of 25 mm for 24 hrs. Where it is impracticable, because of roof falls or otherwise, to contain a 25 mm depth of water, the roof shall have water applied by a continuous hose of sprinkler system to provide a sheet flow of water over the entire area of the roof for not less than 6 hrs. In either case the roof shall be considered satisfactory if no leaks or damp patches show on the soffit. Should the structure not satisfy either of these tests, then after completion of the remedial work it should be re-tested in accordance with this clause. The roof insulation and covering should be completed as soon as possible after satisfactory testing.

3.21.3 Contractor shall give warranty for leak tightness of joints for 10 years.

3.22 Measurement

Measurement shall be made for the finished volume of reinforced cement concrete (excluding lean concrete) only. All linear dimensions shall be measured correct to 1cm & restricted to design dimensions, and the volume calculation will be correct to two decimal places in cubic metres.

No deduction shall be made for volume of steel embedded in concrete or for voids not exceeding 0.03 cum in volume.

In case of pile caps, the quantity of concrete of piles, which has gone into the pile caps, shall not be deducted.

4 FORM WORK

4.1 General

These specifications shall be read in conjunction with the MORTH specifications and CPWD specifications 1996/2002 with correction slips/amendments upto date, and other relevant specifications described in the section 1 of these specifications.

4.2 Materials

Formwork shall be of timber, plywood (including marine plywood), steel or any other suitable material capable of resisting damage to the contact faces under normal conditions of erecting forms, fixing steel and placing concrete. The selection of materials suitable for formwork shall be made by the Contractor based on the quality consistent with the specified finishes and safety. For designated areas prominently in public view like piers, piers caps, portals, viaduct (cast-in-situ or pre-cast), parapet, columns etc., only steel shuttering shall be used. The material shall be approved by the Engineer before erected at site. However, the entire responsibility of planning, designing, erecting, dismantling, shifting and safety of false work lies with the contractor.

All formwork and formwork supports (centring, props, scaffolds, ladders etc.) shall be in structural steel only and preferably of pipes conforming to IS:806, IS:1161, IS:1239, IS:2750. Wooden ballies shall not be permitted as props/formwork supports. All props shall be properly braced using x & k bracings. Ladders to be used at site should have treads and shall be fabricated from structural steel. Wooden / bamboo / aluminium / pipe ladders shall not be permitted.

4.2.1 Timber

Timber used for formwork shall be easily workable with nails without splitting. It shall be stable and not liable to warp when exposed to sun and rain or wetted during concreting.

4.2.2 Plywood

Plywood used for formwork shall be minimum 12 mm thick. Shuttering quality plywood complying with IS:4990 and of make approved by the Engineer. Suitable stiffeners and walers shall be provided depending on the shuttering design.

4.2.3 Steel

Steel formwork shall be made of minimum 4 mm thick black sheets stiffened with angle iron frame made out of M.S. angles 40 mm x 6 mm supported at suitable spacing.

Design & Drawings

All temporary works such as formwork, falsework, staging, launching girder, cantilever form traveller scheme etc. shall be designed by the Contractor. The permissible stresses in materials of formwork, falsework, staging, launching girder& cantilever form traveller shall be same as for permanent structure. All calculations and drawings of the same including construction sequence shall be checked and verified by independent agency appointed by contractor. Only after the checking of the same, the calculations and drawings (along with soft copy in CD ROM) shall be submitted to Engineer for approval well in advance of work.

All temporary works shall be also inspected by the independent agency and independent report shall be submitted to Engineer. All temporary works shall be robust, safe and constructed such a way that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position and level subject to specified tolerance. It is the responsibility of the Contractor to obtain the results required by the Engineer, whether or not some of the work is sub-contracted. Approval of the temporary works by the Engineer shall not diminish the Contractor's responsibility for the satisfactory performance of the same, nor for the safety and co-ordination of all operations.

For pier formwork, it shall be ensured that total deflection (taking account of combined deflection of plate, stiffners, walers or any other supporting arrangement) shall not be more than 3mm.

All the formwork, launching truss and cantilever form traveller and other selected temporary works shall be tested for the load including factor of safety for which the truss/formwork is designed before use in works at no extra cost

The design of false work should be such as to facilitate easy and safe access to all parts for proper inspection.

Methodology for removal of form should be planned as a part of total form work design process.

In case of pre-stressed concrete work, careful consideration shall be given to re-distribution of loads due to pre-stressing.

4.3 Formwork for Exposed Concrete Surfaces

The facing formwork, unless indicated otherwise in drawings, or specifically approved by the Engineer in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure:

1. Plain slab soffit, and sides of beams, girders, joists and ribs and side of walls, fins, parapets, pardis, sun-breakers, etc shall be made with:
    a. Steel plates not less than 4mm thick of specified sizes stiffened with a suitable structural framework and fabricated true to plane
    b. Timber planks of 20mm actual thickness and of specified surface finish, width and reasonable length,
    c. Plywood not less than 12mm thick (IS:4990 - Specification for Plywood for Concrete Shuttering Work) stiffened with a suitable timber frame work or 3mm thick plywood with a 20mm timber plank backing, of specified sizes stiffened with a suitable timber framework and bracing. At joints 6mm/10mm sponge to be provided.
2. Bottoms of beams, girders and ribs, sides of columns shall be made with
    a. Steel plates not less than 5mm thick of specified sizes stiffened with a suitable structural framework, and fabricated true to plane
    b. Timber planks of 35mm actual thickness and of specified surface finish, width and reasonable length,
    c. Plywood not less than 12mm thick (IS:4990), of specified sizes stiffened with a suitable timber framework.
3. For Precast segments, piers, pier heads, portals etc. suitable steel form work is to be used unless otherwise specified by Engineer.

4.4 Formwork for Sloped Surfaces

1. Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration, inspection and finishing of the concrete.
2. The formwork shall be built in such a way so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 2 horizontal:1 vertical shall be formed as required herein.

4.5 Formwork for Curved Surfaces

1. The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form lumber shall be built up of laminated splices cut to make tight, smooth form surfaces.

2. After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be dressed to the specified curvature.

4.6 Erection of Formwork

The following shall apply to all formwork:

1. To avoid delay and unnecessary rejection, the Contractor shall obtain the approval of the Engineer for the design of forms and the type of material used before fabricating the forms. (Ref. ACI 347 Formwork for Concrete or equivalent I.S. Code).
2. All shuttering planks and plates shall be adequately backed to the satisfaction of the Engineer by a sufficient number and size of walers or framework to ensure rigidity during concreting. All shutters shall be adequately strutted, braced and propped to the satisfaction of the Engineer to prevent deflection under deadweight of concrete and superimposed live load of workmen, materials and plant, and to withstand pouring rate and vibration.
3. Vertical props shall be supported on wedges or other measures shall be taken so that the props can be gently lowered vertically during removal of the formwork. Props for an upper level shall be placed directly over those in the level immediately below, and the lowest props shall bear on a sufficiently strong area. Care shall be taken that all formwork is set plumb and true to line and level or camber or better where required and as specified by the Engineer.
4. Provision shall be made for adjustment of supporting struts where necessary. When reinforcement passes through the formwork care should be taken to ensure close fitting joints against the steel bars so as to avoid loss of fines during the compaction of concrete.
5. If the formwork is held together by bolts, these shall be so fixed that no iron will be exposed on surfaces against which concrete is to be laid and within the concrete cover to the steel reinforcement. In any case wires shall not be used with exposed concrete formwork. The Engineer may at his discretion allow the Contractor to use tie-bolts running through the concrete and the Contractor shall decide the location and size of such tie-bolts in consultation with the Engineer. The tie bolts shall be so designed that their removal on de-shuttering does not leave any embedment with in the concrete cover to steel reinforcement. Holes left

in the concrete by these tie-bolts shall be filled by the concrete repair material and the methodology as approved by the Engineer at no extra cost.

6. Provision shall be made in the shuttering for beams, columns, and walls for a port hole of convenient size so that all extraneous materials that may be collected could be removed just prior to concreting.
7. Formwork shall be so arranged as to permit removal of forms without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails.

   The formwork for beams and slabs shall be so erected that forms on the sides of the beams and the soffit of slabs can be removed without disturbing the beam bottoms or props under beams.
8. Surfaces of forms in contact with concrete shall be oiled with a mould oil of approved quality form releasing agent. If required by the Engineer the contractor shall execute different parts of the work with different mould oils to enable the Engineer to select the most suitable. The use of mould oil which results in blemishes of the surface of the concrete including diesel, burnt oil and any other lubricating oil shall not be allowed. Mould oil shall be applied before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in position. The formwork shall be kept thoroughly wet during concreting and the whole time that is left in place,. Nothing extra shall be paid to contractor for oiling the moulds.
9. Immediately before concreting is commenced, the formwork and other related arrangements shall be carefully examined to ensure the following :
   a. Removal of all dirt, shavings, sawdust and other refuse by brushing, washing and compressed air / vacuum cleaning.
   b. The tightness of joints between panels of sheathing and between these and any hardened core.
   c. The correct location of tie bars, bracing and spacers, and especially connections of bracing.
   d. Adequate cover blocks are in place
   e. Straightness and plumbness of the form work
   f. Side supports / restraints for the form work are enough and robust
   g. Construction joint (wherever applicable) is properly prepared
   h. That all wedges are secured and firm in position.

i. That provision is made for traffic on formwork not to bear directly on reinforcing steel.
j. Pouring platform along with its approach from ground is robust and safe for workers movement.
k. Arrangement for vibrators for compaction of concrete
l. Sequence of concrete pouring is well defined and is agreed upon by the Engineer and is explained to concrete pouring team
m. The Pouring area is well lit.
n. Curing arrangements are well planned and agreed upon by the Engineer.
o. The green concrete protection measures from sun & rain etc. are in place.

10. The Contractor shall obtain the Engineer's approval for dimensional accuracies of the work and for the general arrangement of propping and bracing. (IS:3696 - Safety Code of Scaffolds and Ladders, IS:4014 Steel Tubular Scaffolding I & II). All scaffolding and staging shall be either of steel tubes or built up section of rolled steel with adequate bracing at several levels in each perpendicular direction connecting each prop. In addition to this diagonal bracing should be provided in elevation ideally at 45 degrees or between 30 and 60 degree. The Contractor shall be entirely responsible for the adequacy of propping, and for keeping the wedges and other locking arrangements undisturbed through the de-centring period. (IS:8989 Safety code for erection of concrete framed structures)
11. Formwork shall be continuously watched during the process of concreting. If during concreting any weakness develops and formwork shows any distress the work shall be stopped and remedial action as directed by the engineer shall be taken..
12. Staging for portal girder and cross girder (in station zone) shall be in the form of portal frame. It shall be ensured that minimum two lanes of traffic with a restricted height of 4.5m can ply underneath it with adequate protection to portal legs from moving traffic.

4.7 Concrete Finishes

This section deals with the surface of concrete on which forms had been fixed while concreting.

4.7.1 Formed Surface

Allowable deviation from plumb or level and from the alignment profile, grades and dimensions shown on the drawings is defined as "tolerance" and is to be distinguished

from irregularities in finishes as described herein. Tolerances in concrete construction are specified elsewhere.

The classes of finish and requirements for finishing of concrete surface shall be as shown on the drawings or as hereinafter specified. In the event of finishing not being definitely specified herein or in the drawings, finishes to be adopted shall be as directed by the Engineer.

Completed concrete surface shall be tested, where necessary to determine whether surface irregularities are within the limits specified hereinafter.

Surface irregularities are classified as "Abrupt" or "Gradual". Offsets caused by displaced or misplaced form sheathing, or form sections or by loose knots or otherwise defective timber form will be considered as abrupt irregularities, and shall be tested by direct measurements. All other irregularities shall be considered as gradual irregularities and will be tested by use of template, consisting of a straight edge or the equivalent thereof for curved surfaces. The length of the template shall be 150 cm for testing of formed surfaces and 300 cm for testing of unformed surfaces.

The classes of finish for formed concrete surfaces are designated by one of the symbols F1, F2, F3 and F4. Unless otherwise specified or indicated on drawings, these classes of finish shall apply as follows:

Finish F1: This finish applies to surfaces where roughness is not objectionable, or surface that will otherwise be permanently concealed. Surface treatment shall be the repair of defective concrete, correction of surface depressions deeper than 25 mm and filling of tie rod holes. Form sheathing will not leak mortar when concrete is vibrated. Forms may be manufactured with a minimum of refinement.

Finish F2: This finish is required on surfaces permanently but not prominently exposed to public view for which other finishes are not specified except F1. Forms shall be manufactured in a workmanlike manner to the required offsets or bulges. Surface irregularities shall not exceed 5mm for abrupt and 8mm for gradual irregularities measured with a 1.5 m template.

Finish F3: This finish is required for coarse textured concrete surfaces intended to receive plaster, stucco or wainscoting. Surface irregularities shall not exceed 5mm for both abrupt and gradual irregularities.

Finish F4: This finish is designated for surfaces prominently exposed to public view where appearance is also of special importance. This shall include piers of bridges, viaducts, beams, parapets, railings and decorative features on the structure and on the

bridges. To meet with requirements for F4 finish, forms shall be manufactured in a skilful, workmanlike manner, accurately to dimensions. There should be no visible offsets, bulges or misalignment of concrete. At construction joints, the forms shall be rightly set and securely anchored close to the joint. Abrupt and gradual irregularities shall not exceed 3mm. Irregularities exceeding this limit shall be reduced by grinding to a level of 1:20 ratio of height to length. Jute bag subbing or sand blasting shall not be used.

4.7.2 Unformed Surfaces

The classes of finish for unformed surfaces are designated by symbols U1, U2, U3 and U4. Unless otherwise specified or indicated on drawings, these classes of finish shall apply as follows:

Finish U1: This finish applies to unformed surfaces that will be concealed permanently or otherwise where a screeded surface finish meets the functional requirements. Finish U1 is also used as the stage of finishes for U2 and U3. Finishing operations shall consist of sufficient levelling and screeding to produce an even uniform surface. Surface irregularities shall not exceed 10mm.

Finish U2: This is floated finish, and used on all outdoor, unformed surfaces. Finish U2 is also used as the second stage of finish for U3. Floating to be performed manually or mechanically on stiffened screed surface shall be minimum to produce textured surface. If finish U3 is to be applied, floating shall be continued till a small amount of mortar without excess water is brought to the surfaces so as to permit effective trowelling. Surface irregularities shall be removed as directed by the Engineer.

Finish U3: This is a trowelled finish and shall be used for tops of parapets, etc prominently exposed to view. When the floated surface has hardened sufficiently, steel trowelling shall be started. Steel trowelling on hardened, floated surface shall be performed with firm pressure to produce a dense uniform surface free from blemishes and trowel marks and having slightly glossy appearance. Surface irregularities shall not exceed 5mm.

Finish U4: This is a steel-trowelled finish, similar to finish U3, except that light surface pitting and light trowel marks such as obtained from the use of machine trowelling will be acceptable, provided that surface irregularities do not exceed the limits specified for finish U3.

Unformed surfaces which are nominally level shall be sloped for drainage as shown on drawings or as directed by Engineer unless the use of other slopes or level surface is indicated on drawings. Narrow surface such as tops of parapets, walls and kerbs shall be sloped approximately 1cm per 30cm of width. Broader surface such as roadways, platform and decks, shall be sloped approximately half centimetre per 30cm of width. Finishes of floor and roof slabs shall be sloped, if required, by the Engineer.

4.8 Exposed Concrete Work

Exposed concrete surfaces shall be smooth and even, originally as stripped without any finishing or rendering. Where directed by the Engineer, the surface shall be rubbed with carborundum stone immediately on striking the forms. The Contractor shall exercise special care and supervision of formwork and concreting to ensure that the cast members are made true to their sizes, shapes and positions and to produce the surface patterns desired. No honeycombing shall be allowed. Honeycombed parts of the concrete including the other surface defects in the concrete shall be removed by the Contractor as per the methods, which do not affect the strength of adjoining Concrete and as approved by the Engineer.

Part of defective concrete thus removed shall be re-cast using fresh concrete of same grade or approved quality concrete repair material depending upon the size, location, thickness of the defective concrete and structural behaviour of the member having defective concrete as instructed by the Engineer without extra cost,. For the purpose the Contractor shall prepare a comprehensive work procedure and get it approved from the Engineer. Nothing extra shall be paid for repair of the concrete. Contractor shall ensure that no air bubbles are formed on the exposed surface. Concrete pouring sequence, vibration methodology etc. shall be planned to avoid air bubbles. All materials, sizes and layouts of formwork including the locations for their joints shall have prior approval of the Engineer.

4.9 Age of Concrete at Removal of Formwork

In accordance with CPWD Specifications 1996 / 2002 or IS:456. The Engineer may vary the periods specified if he considers it necessary. Immediately after the forms are removed, they shall be cleaned with a jet of water and a soft brush.

4.10 Stripping Of Formwork

The work of form work removal should be planned and a definite scheme of operation worked out. Formwork shall be removed carefully without jarring the concrete, and

curing of the concrete shall be commenced immediately. Concrete surfaces to be exposed shall, where required by the Engineer, be rubbed down with carborundum stone or bush-hammer to obtain a smooth and even finish. Where the concrete requires plastering or other finish later the concrete surface shall be immediately hacked lightly all over using approved methods and as directed by the Engineer. No extra charge will be allowed to the Contractor for such work on concrete surfaces after removal of forms.

4.11 Reuse of Forms

The Contractor shall not be permitted reuse of timber facing formwork brought new on the works for more than 5 times for exposed concrete formwork and 8 times for ordinary formwork. 5 or 8 uses shall be permitted only if forms are properly cared for, stored and repaired after each use. The Engineer may at his absolute discretion order rejection of any forms he considers unfit for use for a particular item irrespective of no of times the shuttering has been used and order removal from the site of any forms he considers unfit for use in the Works. Used forms brought on the site will be allowed proportionately fewer uses depending upon its condition and as decided by the Engineer. Use of different quality boards or the use of old and new boards in the same formwork shall not be allowed. If any other type of special or proprietary form work is used, the number of times they can be used will be determined by the Engineer.

4.12 Formwork for Precast/ Prestressed Concrete

1. The provisions in this section shall be considered supplementary to the general provisions stated above and additional Technical Specifications for precast segments. Precast concrete members and panels shall be made in accurately constructed moulds, on a properly prepared casting bed. All aspects of the making, curing and erection of precast units shall be subject to the approval of the Engineer.

   The contractor shall submit detailed drawings of formwork for the approval of the Engineer. Finishing with cement mortar shall not be allowed.

2. The formwork should be so designed that it does not restrain the shrinkage movement and possible shortening due to pre-stress of the concrete. The formwork shall be of sturdy construction with special considerations to shutter vibrators when used. All edges and joints of the formwork should be designed and sealed so that no cement grout can escape and there is no wedging or keying to the concrete. The effect of curing on the formwork should be given special consideration. Depending on care,

curing, erection and maintenance of the formwork after stripping, the following number of uses can be made with different types of formwork.

Plywood with timber backed formwork - As per satisfaction of Engineer

Steel moulds -do-

Number of uses of shuttering to be as per approval of the Engineer

In case concrete moulds can be satisfactorily provided by the contractor, the Engineer's approval shall be obtained before use on the works.

3. Stripping

As soon as the pre-cast units have attained sufficient strength, the formwork shall be stripped. The pre-cast unit shall be lifted uniformly out of the formwork without being subjected to tilting or restraint effects.

4.13 Special Architectural Finishes

Special approved architectural finishes like grooves, logos, engravings/projections in inset and out set as per the approved design shall be provided by fixing monolithic rubber forms or any other approved material fixed on the entire surface of the form work. The shore hardness of the rubber shall be 600 ± 5A to ensure strength, flexibility and elasticity. The rubber shall be cold cured (preferably polyurethane based) and fixed to the formwork under controlled conditions in shade and air temperature not exceeding 280 C.

The form liners should be shrinkage free, solvent free and should be impervious to abrasion by Concrete, resistant to concrete pressure and heat resistant upto 700 C dry heat. Formwork liner fixation should be factory made under close tolerances and stage inspections.

4.14 If proprietary system of formwork is used, detailed information as given in Annexure 4.1 herein shall be furnished to Engineer for approval before use.

4.15 Measurement

Unless stated otherwise, the rate for concrete in plain concrete, reinforced concrete or in prestressed concrete shall be deemed to include the cost of all formwork / shuttering, staging, launching etc.

ANNEXURE 4.1

INFORMATION TO BE SUPPLIED BY MANUFACTURERS OF PROPRIETARY SYSTEMS OF FORM WORK

1. GENERAL

1.1 The information which the manufacturer is required to supply shall be in such detail as to obviate unsafe erection and use of equipment due to the intention of the manufacturer not having been made clear or due to wrong assumptions on the part of the user.

1.2 The user shall refer unusual problems of erection/assembly not in keeping with intended use of equipment, to the manufacturer of the equipment.

2. INFORMATION REQUIRED

2.1 The manufacturers of proprietary systems shall supply the following information;

a. Description of basic functions of equipment.

b. List of items of equipment available, giving range of sizes, spans and such like, with manufacturer's identification number or other references.

c. The basis on which safe working loads have been determined and whether the factor of safety given applies to collapse or yield.

d. Whether the supplier's data are based on calculations or tests. This shall be clearly stated as there may be wide variations between results obtained by either method.

e. Instructions for use and maintenance, including any points which require special attention during erection, especially where safety is concerned.

f. Detailed dimensional information, as follows :

i. Overall dimensions, depths and widths of members.

ii. Line drawings including perspectives and photographs showing normal uses.

iii. Self-weight.

iv. Full dimensions of connections and any special positioning and supporting arrangements.

v. Sizes of members, including tube diameters and thicknesses of material.

vi. Any permanent camber built into the equipment.

vii. Sizes of holes and dimensions giving their positions.

viii. Manner of fixing including arrangements for sealing joints.

ix. Method of de-stripping, storing & shifting.

g. Data relating to strength of equipment as follows:

i. Average failure loads as determined by tests.

ii. Recommended maximum working loads for various conditions of use.

iii. Working resistance moments derived from tests.

iv. Working shear capacities derived from tests.

v. Recommended factors of safety used in assessing recommended loads and deflections based on test results.

vi. Deflections under load together with recommended pre-camber and limiting deflections.

vii. If working loads depend on calculations, working stresses should be tested. If deflections depend on theoretical moments of inertia or equivalent moments of inertia rather than tests, this should be noted.

viii. Information on the design of sway bracing against wind and other horizontal loadings.

ix. Allowable loading relating maximum extension of bases and/or heads.

x. Any restrictions regarding usage of any component or full assembly with regard to spans, heights and loading conditions.

5 REINFORCEMENT

5.1 General

These specifications shall be read in conjunction with the MORTH specifications and CPWD specifications 1996/2002 with correction ships / amendments upto date, and other relevant specifications described in the section 1 of these specifications.

Any steel specified for reinforcement shall conform in every respect to the latest relevant Indian Standard Specifications and shall be of tested quality under the ISI Certification Scheme.

All reinforcement work shall be executed in conformity with the drawings supplied and instructions given by the Engineer and shall generally be carried out in accordance with the relevant Indian Standard Specifications IS:2502- Bending and Fixing of Bars for Concrete Reinforcement.

Only TMT reinforcing bars of grade Fe500 (0.2% proof stress / yield stress not less than 500 MPa) confirming to IS:1786 – 1985 shall be supplied and used as reinforcement steel for the permanent work

The reinforcement steel shall be from primary producers and no re-rolled steel shall be supplied and used. The contractor will produce copy of original challan / voucher as a proof of having purchased the steel reinforcement from approved manufacturers or their authorised distributors.

The steel reinforcement shall be brought to the site in bulk supply of 10 tonnes or more as decided by the Engineer. All reinforcement shall be stored horizontally above ground level on platforms, skids or other approved supports, clear of any running or standing water. Proper drainage of platform shall be provided. Steel reinforcement shall be stored in such a way as to avoid distortion and prevent deterioration by corrosion. Bars of different diameters shall be stored separately. A record shall be kept of the batch numbers of reinforcement deliveries in such a form that the part of works in which particular reinforcement is used can be readily identified.

5.2 Inspection & Testing

Every bar shall be inspected before assembling on the works and any defective, brittle, excessively rusted or burnt bars shall be removed. Cracked ends of bars shall be cut out.

No work shall be commenced without the Engineer’s approval of the bar bending schedule.

Manufacturer's test Certificate shall be supplied for each lot of supply brought at site of work by the contractor.

Specimens sufficient for three Tensile Tests for each different size of bar for each consignment delivered shall be sampled and tested by the Contractor before use at site. Test results shall be duly supported by Graph. Batches shall be rejected if the average results of each batch are not in accordance with the relevant specifications / codes and the rejected steel shall be removed from the site of work by the contractor at his own cost within a week's time from the written order from the Engineer.

5.3 Bar Bending and Bar Bending Schedule

All bars will be carefully and accurately bent by approved means in accordance with IS: 2502, and relevant drawings. It shall be ensured that depth of crank is correct as per the bar cutting and bending schedule. Bent bars are not straightened for use in any manner that will injure the material.

Prior to starting bar bending work, the Contractor shall prepare bar bending schedule from the structural drawings supplied to him and get the same approved by Engineer. Any discrepancies and inaccuracies found by the Contractor in the drawings shall be immediately reported to the Engineer whose interpretation and decision there to, shall be final.

5.4 Lapping & Couplers

As far as possible, bars of the maximum length available shall be used. Laps shown on drawings or otherwise specified by the Engineer will be based on the use by the Contractor of bars of maximum length. Payment for reinforcement shall be made only for reinforcement shown in such drawings and such laps. In case the Contractor wishes to use shorter bars, laps / mechanical couplers shall be provided at the Contractor's cost in the manner and at the locations approved by the Engineer. However use of mechanical couplers shall be subject to acceptance of the quality and test results by the Engineer.

Welding in lieu of lap is not permitted unless specified in the drawings or as instructed by the Engineer.

5.5 Spacing, Supporting And Cleaning

All reinforcement shall be placed and maintained in the positions shown on the drawings.

The Contractor shall provide approved types of supports for maintaining the bars in position and ensuring required spacing and correct cover of concrete to the

reinforcement as specified on the drawings. Cover blocks of required shape, size and strength M.S. Chairs and spacer bars shall be used to ensure accurate positioning of reinforcement.

Cover blocks shall be cast well in advance and shall consist of approved proprietary pre-packaged free flowing mortars (Conbextra HF of Fosroc or equivalent) having the strength same as that of concrete for the member for which they are to be used. They shall be circular in shape for side cover and square for bottom cover. Cover blocks shall be cast and compacted using plate vibrator or any other approved method and shall be cured so as to achieve the desired strength. The cost of cover blocks and chairs/spacers shall be deemed to have been included in the rates.

Bars must be cleaned before concreting commences of all scale, rust or partially set concrete which may have been deposited there during placing of previous lift of concrete. Any reinforcement which is certified as corroded by the Engineer shall be removed from the site.

The HYSD bars shall be provided using cement and inhibitor using following procedure:

a) Cleaning of steel by wire brush for dust and rust.

b) Apply one coat of Cement slurry [1 kg cement & 600 cc of inhibitor solution (Patent No. 109784/67)] by dipping or brushing. Allow it to dry for 24 hours in shade. The water is not to be used. The inhibitor solution is prepared in ionised water

No extra payment shall be made for the same.

18 Gauge G.I. wires shall be used for binding reinforcement as well as for tying cover blocks with reinforcement.

5.6 Welding

1. Wherever specified all lap and butt welding of bars shall be carried in accordance with IS:2571. Only qualified welders duly tested and certified by the contractor shall be permitted to carry out such welding.
2. For cold twisted reinforcement welding operations must be controlled to prevent supply of large amounts of heat larger than that can be dissipated. The extreme non twisted end portion shall be cut off before welding. Electrodes with rutile coating should be used.
3. Bars shall be free from rust at the joints to be welded.
4. Slag produced in welding after each run should be chipped and removed by brush.

5. Electrode should not be lighted by touching the hot bar.
6. The welding procedure shall be approved by the Engineer and tests shall be conducted to prove the soundness of the welded connection.

5.7 Provision of Future Cathodic Protection for Corrosion Control:

In order to provide Cathodic Protection in future, all reinforcement shall be tack welded using electrodes compatible with the types of bars at the specified intervals in the drawings. As a guideline, all reinforcing bars shall be tack welded at each ends or at a distance not more than 6m along length to the bars intersecting in other direction. The tack welding shall be checked for the electrical continuity before concreting. This shall be measured and paid separately.

5.8 Measurement

The measurement shall be done by weight in MT based on bar bending schedule using the standard sectional weight of various bars as indicated below:

S. No.	Bar Dia (mm)	Standard sectional weight in Kg. / m
1	6	0.222
2	8	0.395
3	10	0.617
4	12	0.888
5	16	1.578
6	18	2.000
7	20	2.466
8	22	2.980
9	25	3.854
10	28	4.830
11	32	6.313
12	36	7.990
13	40	9.864
14	45	12.49

Payment of reinforcement steel shall be made for the length of the reinforcement bars of different diameter as per approved bending schedule (to be prepared by the contractor on the basis of approved drawing) including authorised chairs / spacer bars, lap/butt welding wherever required as per Clause 5.4. However, if standard laps are provided, they will be measured separately for the length shown in the drawing or for

measured length of bars. In case the actual reinforcement provided in any member is less than the quantity calculated based on drawings/ bar bending schedule (with the approval of engineer), the same shall be adjusted for the purpose of payment.

Payments shall not be made for butt welding and reinforcement bars used for lifting, hooks, handling, etc., as cost towards these is deemed to be included in the accepted rate of the item.

6 PRESTRESSING

Structural concrete containing prestressed steel reinforcement to introduce precompression is termed as prestressed concrete.

6.1 General

The prestressed concrete work shall generally conform to IS:1343 "Code of Practice for Prestressed Concrete" and Section 1800 of MOST Specifications. The Concrete, Formwork and Non- tensioned reinforcement shall conform to relevant clauses in Section 3, 4, and 5 of this specification. The work shall be carried out in accordance with the drawing and these specifications or as approved by the Engineer.

The prestressing steel shall be Uncoated stress relieved low relaxation seven-ply strand conforming to IS: 14268. All prestressing steel shall be free from splits, harmful scratches, surface flaws, piping and other surface defects likely to impair its use in prestressed concrete. The prestressing steel shall be stored in a manner such that they do not come in contact with dirt, water, greasy and other harmful materials. The contractor shall furnish the test certificate for each bundle of strands bought if required by the Engineer, he shall get tested at his cost samples of strands in specified bundles in an approved laboratory.

Site for casting yard shall be the choosing of the contractor. If the land is made available NMRCL the same shall be on an agreed rental basis.

The precast pretensioned elements shall be cast by the Contractor in the precasting yard. After 28 days of casting, the girders shall be transported to site and erected at appropriate position by the Contractor. The Tenderers are advised to visit the station sites as well as site of proposed precasting yard and assess the physical condition of the route for transportation of the elements. The Department shall allocate the premises of precasting yard for a specific period to the successful bidder on "as is where is" basis.

Concrete and untensioned steel for the construction of prestressed concrete members shall conform to the requirements of sections respectively in so far as therequirements of these Sections apply and are not specifically modified by requirements set forth herein.

Contractor shall ensure that different components of prestressing such as jacks, bearing plates, wedges, anchorages, strands and HDPE ducts are compatible to one another and the same shall be exchanged in between all the suppliers to ensure the same.

6.1.1 Scope of Work:

The general scope of work will include:

i. Providing and placing cement concrete with all ingredients and admixtures if and as required.

ii. All arrangements needed to keep the reinforcement bars, pretensioned strands and sheathing in position with due spacing & cover blocks

iii. Providing steel shuttering, staging, scaffolding, erection & eventual removal.

iv. Providing and placing in position and fixing permanent specialised bearings with the super structure, with their anchor bolts as per detailed specifications/instructions as stipulated, supplemented by manufacturer's specifications and directions of Engineer including grouting of holes etc. if any, with suitable grouts as approved by the Engineer.

v. Installation of expansion joints in stages over the viaduct deck as per approved drawings and as per manufacturer's specifications/directions of Engineer.

vi. Fixing/embedding all necessary electrical or other fixtures which shall be supplied by the dept. free of cost at site.

vii. Providing and mixing cement concrete with all ingredients and admixtures if and as required.

viii. Casting, curing, with steam/water as necessary, stacking at casting yard including all handling, rehandling and interim storage operations as required for precast girders.

ix. Loading at casting yard, transportation to site in accordance with the prevailing traffic rules and regulations, unloading and stacking at site for precast girders.

x. Provision of necessary & suitable packing to maintain the required gap between precast girders.

xi. Protection of reinforcement, required to be left for Integration of the precast unit with top deck slab cast in place and bending the reinforcement to required shape after precasting& till their embedment in concrete.

xii. Transporting precast girder to the location of placement, hoisting & placing in correct position, including all handling operations.

xiii. The operation of placing precast I-girders over brackets/pier arms on teflon/neoprene pads/tar paper including the cost of all operations involved, appropriate setting of superstructure.

xiv. Fixing/embedding any fixture supplied by the Employer.

xv. The handling, carriage and storage of HT strands as per manufacturer's specification.

xvi. The H.T. strands will be procured by the Contractor. The extra pieces of HT strands cut after the stressing of the cable will be the liability/property of the Contractor.

xvii. Cost of all other items of materials, plants and equipment and works (not specifically excluded above) for proper prestressing operation of the strands in accordance with the provisions contained elsewhere in the tender documents will be included in the cost of this item.

xviii. Providing/supplying and operating etc. of jacks and power pumps for prestressing, recording of data, tabulating the same in necessary formats for submission. The item will also include corrective measures that may be necessary and required by the Engineer.

6.2 Materials

6.2.1 Sheathing

All prestressing sheathing ducts shall be in the form of corrugated HDPE ducts (102mm ID for 19K15, 85mm ID for 12K15 & 19T13 etc) conforming to IRS Concrete Bridge Code-1997 (Addendum & corrigendum Slip No.5 Dated 19.11.2001 with modifications as stated below). The material for the ducts shall be high-density polyethylene with more than 2 percent carbon black to provide resistance to ultra-violet degradation and shall have the following properties:

Density (IS: 2350)	0.94 – 0.96 g/cm^3 at 230C
Tensile Strength at yield (BS EN ISO 527-3)	20-26 N/mm^2
Shore Hardness D (BS EN ISO 2039-1)	3 sec –60 min 15sec –58min
Elongation at Yield (BS EN ISO 527-3)	7 % (min)
Melt Flow Index (MFI) (IS:2530)	0.4 - 0.6 g / 10 minutes (Temperature 190° C under a mass of 5 kg.)
Charpy Impact strength of notched specimen (BS EN ISO 179)	
At 23° C	10 kJ/m^2
-40° C	4 kJ/m^2
Coefficient of Thermal Expansion for	1.50 x 10^{-4} / ^{o}C

20^0C – 80^0C (DIN 53 752	
Environmental Stress Crack Resistance (ASTM D-1693) at 70^o C	192 Hrs

The thickness of the wall shall be 2.3 ± 0.3mm as manufactured and minimum 1.5mm after loss in the compression test, for duct size upto 160mm OD.

The ducts shall be corrugated on both sides. The duct shall transmit full tendon strength from the tendon to the surrounding concrete over a length not greater than 40 duct diameters. Material and formulation of sheathing ducts shall conform to test and acceptance criteria of Appendix 1B of IRC:18-2000.

These ducts shall be joined by adopting any one or more of the following methods, as convenient to suit the individual requirements of the location, subject to satisfactory pressure tests, before adoption.

- Screwed together with male and female threads
- Joining with thick walled HDPE shrink couplers with glue. This can also be used for connection with trumpet, etc.
- Welding with electro-fusion couplers.

The joints shall be able to withstand an internal pressure of 0.5 bars for 5 minutes as per water loss test procedure given in Appendix-B of IRS Concrete Bridge Code-1997 (Addendum & corrigendum Slip No.5 Dated 19.11.2001).

The initial acceptance tests such as bond test , compression test are required to be performed as acceptance criteria for system. In addition to above, friction test as given in FIB bulletinNo-7 are also required to be performed as acceptance criteria. Test conducted by supplier in the past shall not be regarded as acceptance criteria.

The routine test such as workability test, transverse load rating test, tension load test and water loss test shall be applicable for both post threading and pre – threading system of cables. Loads to be imparted on the 102mm ID sheathing during transverse load rating test and tension load test shall be extrapolated from values given for smaller dia sheathing. At least 3 samples for one lot of supply (not exceeding 3000 metre length) shall be tested.

6.2.2 Anchorages

6.2.2.1 Anchorages shall be procured from authorised manufacturers only. Anchorages shall conform to BS:4447.

Load transfer test and anchorage efficiency shall be conducted as defined in FIP-1993. Engineer in-charge shall select at random, the required anchorage / wedges sample from completed lots for testing by the manufacturer. The concrete unit of required size/R/F will be made by contractor using same design mix of concrete which will be required for the load transfer test . The load transfer test shall be conducted at the strength of concrete at which stressing are proposed in the drawings.

No damaged anchorages shall be used. Steel parts shall be protected from corrosion at all times. Threaded parts shall be protected by greased wrappings and tapped holes shall be protected by suitable plugs until used. The anchorage components shall be kept free from mortar and loose rust and any other deleterious coating.

After completion of pre-stressing and grouting of cable in PSC girders, the extra length pre-stressing strands projecting outside the anchorage are required to be cut at the anchor end and anchor end is to be sealed.

6.2.2.2 Swages of prestressing strand shall develop strength of at least 95 per cent of the specified breaking load of the strand.

6.2.2.3 Untensioned Steel reinforcement, around anchorages shall be furnished by prestressing system supplier. Requirement of the same should be job specific and based on edge distance of anchorage and strength of concrete at the time of stressing of cables as defined in drawings. The same R/F shall be provided in unit required for load transfer test.

Minimum 3 tests each are required to be conducted for load transfer test and anchorage efficiency test. The manufacturer shall complete the required testing and determine compliance the result with FIP-1993 recommendations before transporting the lot to site.

6.2.3 Prestressing Steel

Uncoated stress relieved low relaxation steel conforming to IS: 14268, class – 2 shall be used. Nominal dia. shall be 15.2 mm with minimum breaking strength of 260.7 KN and minimum 0.2 % proof load of 234.6 KN. Various tests as recommended in IS: 14268 shall be conducted before transporting the lot to site. Apart from 1000 hrs relaxation test conducted by manufacturer, at least two such tests are required to be conducted by independent agency in the beginning of the project.

6.2.3.1 Prestressing Strands/Wires Storage

All high tensile steel for prestressing work shall be stored about 30cm above the ground in a suitably covered and closed space to protect it from dampness. It shall

also be invariably wrapped in gunny cloth or tar paper or any other suitable material, as per approval of Engineer. Even if it is to be stored in an area at the site for the short time during transportation it shall be suitably covered. Protection during storage and repacking or application of washable protective coating to the H.T. steel shall be given by the contractor at no extra cost if the packing of H. T. Strand/wire during unloading and storage / handling in the stores gets damaged.

The objectives are to keep the materials clean and free from detrimental corrosion and mechanical damage. Storage facilities and procedures for transporting material on site shall not permit tendons to be kinked or notched.

Stock piling of H. T. Steel on the work site shall not be allowed any time, specially before and during the monsoon.

Strand shall be stored in large diameter coils. The internal diameter of the coil generally

Engineer-in-Charge or his authorized representative shall always have an easy access to the store-yard for inspecting the H. T. Wire/strands/Bars and satisfying themselves regarding the condition thereof. Any modification regarding storage suggested by Engineer shall scrupulously be followed by the contractor. During monsoon days, H.T wires/strands shall be kept in reasonable air tight store, if required by the Engineer, at no extra cost.

6.3 Testing of Prestressing Steel and Anchorages

All materials specified for testing shall be furnished free of cost and shall be delivered in time for tests to be made well in advance of anticipated time of use.

All strands to be transported to the site shall be assigned a lot number and tagged for identification purposes. Anchorage assemblies to be transported shall be like-wise identified.

All samples submitted shall be representative of the lot to be furnished and in the case of strand, shall be taken from the same master roll. The Contractor shall furnish samples of at least 5.0m length selected from each lot for testing. Also, two anchorage assemblies, complete with distribution plates of each size or type to be used, shall be furnished alongwith short lengths of strands as required.

All equipment must be used in accordance with the specification of the manufacturer and must at all times be maintained in good condition.

The type of jack used should correspond with the type of strand used. It must also be checked that the jacks have the necessary stroke for the stressing of the strands/wires

on the particular job. Pressure tests on jacks must be executed with pressures 10% higher than the maximum operating pressure. The combined jack and pump system should be checked for correct behaviour.

6.4 Workmanship

6.4.1 Concreting for Precast Girders

Unless otherwise mentioned hereunder, the concrete shall be prepared, mixed and placed in position in accordance with the particular specifications given earlier. The Contractor shall maintain a record of the proportions of mix at the batching plant and produce the same for checking by Engineer in Charge whenever required.

The contractor shall take care in placing reinforcement cage so that cables/strands are not disturbed and the minimum cover as recommended in the drawing is available.

The reinforcement protruding at the ends of each girder shall be bent to the shape so as to match with the reinforcement of end cross diaphragm. The protruding reinforcement shall be coated with cement wash. Finished concrete shall have rough finish on top for proper bond with cast in situ top slab at site.

6.4.2 Forms for Precast Prestressed Girders

The pre-tensioned girders shall be cast at casting yard. The contractor shall clean, thoroughly, the steel forms of all dirt, mortar and other matter such as chips, blocks etc. prior to using them. The contractor shall check the accuracy of alignment and rectify the inconsistencies, if any, of the forms and steel casting bed. Contractor shall also take care of bulkheads including positioning of jacks which may become necessary to suit the design requirement of the precast girders or as instructed by Engineer in Charge.

6.4.3 Cleaning

Tendons shall be free from loose rust, oil, grease, tar, paint, mud or any other deleterious substance.

Cleaning of the steel may be carried out by immersion in suitable solvent solutions, wire brushing or passing through a pressure box containing carborundum powder. However, the tendons shall not be brought to a polished condition.

6.4.4 Straightening

High tensile strand shall be supplied in coils of sufficiently large diameter such that tendons shall retain their physical properties and shall be straight as it unwinds from the coil. Tendons of any type that are damaged, kinked or bent shall not be used.

The packing of prestressing strand shall be removed only just prior to making of cable for placement. Suitable stands shall be provided to facilitate uncoiling of strands without damage to steel. Care shall be taken to avoid the possibility of steel coming into contact with the ground.

6.4.5 Post-Tensioning

Prestressing tendons shall be accurately located and maintained in position, both vertically and horizontally, as per drawings.

Tendons shall be so arranged that they have a smooth profile without sudden bends or kinks.

Pull-in or push-in of the prestressing strands shall be mechanised,

The location of prestressing cables shall be such as to facilitate easy placement and vibration of concrete in between the tendons.

Sheathing shall be placed in correct position and profile by providing suitable ladders and spacers. Such ladders may be provided at intervals of approximately 1.0 m. Sheathing shall be tied rigidly with such ladders/spacer bars so that they do not get disturbed during concreting.

The method of supporting and fixing shall be such that profile of cables is not disturbed during vibrations, by pressure of wet concrete, by workmen or by construction traffic.

Each anchorage device shall be set square to the line of action of the corresponding prestressing tendon and shall be positioned securely to prevent movement during concreting.

The anchorage devices shall be cleaned to the satisfaction of the Engineer prior to the placing of concrete. After concreting, any mortar or concrete, which adheres to bearing or wedging surfaces, shall be removed immediately.

6.4.6 Cutting

Cutting and trimming of wires or strands shall be done by suitable mechanical or flame cutters. When a flame cutter is used, care shall be taken to ensure that the flame does not come in contact with other stressed steel. The location of flame cutting of strand shall be kept beyond 75 mm of where the tendon will be gripped by the anchorage or jacks.

In post-tensioning, the ends of prestressing steel projecting beyond the anchorages shall be cut after the grout has set.

6.4.7 Protection of Prestressing Steel

Prestressing steel shall be continuously protected against corrosion, until grouted. 'The corrosion protector shall have no deleterious effect on the steel or concrete or on the bond strength of steel to concrete. Grouting shall conform to these specifications or as directed by the Engineer. The prestressing steel of the end block will also be protected against corrosion by the method approved by the Engineer. Nothing extra shall be paid for the same

6.4.8 Sheathing

The joints of all sheathings shall be water-tight. Special attention shall be paid to the junction at the anchorage end, where the sheathing must tightly fit on the protruding trumpet end of anchorage and thereafter sealed preferably with adhesive water proof tape as per approved manufacturer.

The sheathing and all joints shall be water-tight. Any temporary opening in the sheathing shall be satisfactorily plugged and all joints between sheathing and any other part of the prestressing system shall be effectively sealed to prevent entry of mortar, dust, water or other deleterious matter. Sheathing shall be neatly fitted at joints without internal projection or reduction of diameter.

Enlarged portions of the sheathing at couplings or anchorages shall be of sufficient length to provide for the extension of the tendons.

6.4.9 Grout Vents

Grout vents of at least 20 mm diameter shall be provided at both ends of the sheathing and at all valleys and crests along its length. Additional vents with plugs shall also be provided along the length of sheathing such that the spacing of consecutive vents do not exceed 20m. Each of the grout vents shall be provided with a plug or similar device capable of withstanding a pressure of 1.0 MPa without the loss of water, air pressure or grout.

6.4.10 Anchorages

All bearing surfaces of the anchorages shall be cleaned prior to concreting and tensioning.

Anchor cones, blocks and plates shall be securely positioned and maintained during concreting such that the centre line of the duct passes axially through the anchorage assembly.

The anchorages shall be recessed from the concrete surface as per drawings.

After the prestressing operations are completed and prestressing strands are cut, the surface shall be painted with two coats of epoxy of suitable formulation having a dry film thickness of 80 microns per coat and entire recess shall be filled with concrete or non-shrink/pre-packaged mortar or epoxy concrete.

6.5 Post-Tensioning

Tensioning force shall be applied in gradual and steady steps and carried out in such a manner that the applied tensions and elongations can be measured at all times. The sequence of stressing, applied tensions and elongations shall be in accordance with the approved drawing or as directed by the Engineer.

It shall be ensured that in no case, the load is applied to the concrete before it attains the strength specified on the drawing or as stipulated by the prestressing system supplier, whichever is more.

After prestressing steel has been anchored, the force exerted by the tensioning equipment shall be decreased gradually and steadily as to avoid shock to the prestressing steel or anchorage.

The tensioning force applied to any tendon shall be determined by direct reading of the pressure gauges or dynamo-meters and by comparison of the measured elongation with the calculated elongation. The calculated elongation shall be invariably adjusted with respect to the modulus of elasticity of steel for the particular lot as given by the manufacturer.

Parallel measurement of prestressing force by load cell in combination with direct reading of pressure gauge shall be preferred. In any case such parallel measurements by load cell shall be made for at least 10% of the cables stressed during any tensioning operation

The difference between calculated and observed tension and elongation during prestressing operations shall be regulated as follows:

a) If the calculated elongation is reached before the specified gauge pressure is obtained, continue tensioning till attaining the specified gauge pressure, provided the elongation does not exceed 1.05 times the calculated elongation. If 1.05 times the calculated elongation is reached before the specified gauge pressure is attained, stop stressing and inform the Engineer.

b) If the calculated elongation has not been reached at the specified gauge pressure, continue tensioning by intervals of 5kg/sq. cm until the calculated

elongation is reached provided the gauge pressure does not exceed 1.05 times the specified gauge pressure.

c) If the elongation at 1.05 times the Specified gauge pressure is less than 0.95 times the calculated elongation, the following measures must be taken, in succession, to determine the cause of this discrepancy:

i) Check the correct functioning of the jack, pump and leads.

ii) De-tension the cable. Slide it in its duct to check that it is not blocked by mortar which has entered through holes in the sheath. Re-tension the cable if free.

iii) Re -establish the modulus of elasticity of steel for the particular lot from an approved laboratory. Contractor may suggest other remedial measure for approval of the Engineer.

If the required elongation is still not obtained, further finishing operations as cutting or sealing, should not be undertaken without the approval of the Engineer.

d) When stressing from one end only, the slip at the end remote from the jack shall be accurately measured and an appropriate allowance made in the measured extension at the jacking end.

A complete record of prestressing operations along with elongation and jack pressure data shall be maintained in the format given in Appendix 1800/II of MOST Specification.

e) Any breakage of individual strand / groups of strands during tensioning shall require immediate destressing of all strands and replacement of the all the strands by fresh strands.

6.6 Sequence of Operations for Pretensioned Girders

For pretensioned girders of standard length, the sequence of operation, starting from erection of formwork, shall be as follows:

i) Erection of formwork

ii) Placement of reinforcement cage.

iii) Threading of H.T. strands from movable bulkhead to fixed anchor through individual casting beds, end shuttering and reinforcement cages. De bonding tubes are to be placed in position for strands to pass through. The debonding tubes shall be 25 mm internal dia., hollow,

rigid HDPE pipes and the same shall be provided as per detailed drawings/approval of Engineer-in-Charge without any extra cost.

iv) Removal of initial slackness in the strands by using J 20monostrand jack or equivalent upto 20 KN force.

v) Complete the balance prestressing by using mono-strand jacks of desired capacity and lock individual strands. Locking plate to be inserted between the movable bulkhead and fixed bulkhead. Mark individual strands for checking the slip of strands.

vi) Seal the ends of de bonding tubes and close the formwork to correct dimension.

vii) Pour concrete. Keep test cubes in the same environment as that of the girder concrete.

viii) Allow concrete to set for 3 4 hours before steam curing is started.

ix) Once steam curing is over as per direction of Engineer-in charge, remove covers and allow the girders to cool to ambient temperature. Test the cubes for determining compressive strength of concrete in girders.

x) If adequate compressive strength is obtained, release the strands and check the slip of strands.

xi) Cut the strands, remove the formwork and lift the girders to inspection bay for removal of end plate and bending of projected bars.

xii) Cut the projected strands from girder ends and apply epoxy coating to strands. Mark the girders.

xiii) Transfer the girders to curing bay for wet curing.

xiv) Arrange for stacking, local handling and transportation to site.

6.7 Grouting Of Prestressed Tendons

Prior to grouting, all cables shall be tested with water pressure of 0.3 MPa for approximately 3 minutes, to investigate leakages and connectivity of ducts. Where directed by the Engineer, the Contractor shall perform full scale site test to determine the adequacy of grout mix, equipment and grouting method. The Contractor shall submit a method statement detailing the test procedure.

All other aspects of grouting of cables shall be governed by MORTH Specifications. A record of grouting operations shall be maintained in the format as given in Appendix 1800/IV of MORTH Specifications.

6.8 Supervision

All prestressing and grouting operations shall be undertaken by trained personnel only. A representative of supplier of the prestressing system shall be present during all tensioning and grouting operations and shall ensure, monitor and certify their correctness.

6.9 Tensioning Equipment

i. All tensioning equipment shall be procured from authorised manufacturers only and be approved by the Engineer prior to use. Where hydraulic jacks are used, they shall be power-driven unless otherwise approved by the Engineer. The tensioning equipment shall satisfy the following requirements:

ii. Jack & pump shall be got calibrated from a laboratory having NABL certification prior to use and then at intervals not exceeding 3 months.

iii. As one pair of pre-stressing tendon is generally stressed simultaneously, the equipment used should be able to work in tandem.

iv. The means of attachments of the prestressing steel to the jack or any other tensioning apparatus shall be safe and secure.

v. Before initial use & subsequently at suitable intervals the prestressing equipment shall be checked to determine any variation from normal values during use. So far as these variations depend upon external influence (e.g. temperature in case of oil jacks) they shall be taken in to account

vi. The tensioning equipment shall be such that it can apply controlled total force gradually on the concrete without inducing dangerous secondary stresses in steel, anchorage or concrete; and

vii. Means shall be provided for direct measurement of the force by use of dynamo-meters or pressure gauges fitted in the hydraulic system itself to determine the pressure in the jacks. Facilities shall also be provided for the linear measurement of the extension of prestressing steel to the nearest mm and of any slip of the gripping devices at transfer.

All dynamo meters and pressure gauges including a master gauge shall be calibrated by an approved laboratory immediately prior to use and then at intervals not exceeding 3 months and the true force determined from the calibration curve.

Pressure gauges shall be concentric scale type gauges accurate to within two per cent of their full capacity. The minimum nominal size of gauge shall be 100 mm. The gauge shall be so selected that when the tendon is stressed to 75 per cent of its

breaking load, the gauge is reading between 50 percent and 80 percent of its full capacity.

Suitable safety devices shall be fitted to protect pressure gauges against sudden release of pressure.

Provision shall be made for the attachment of the master gauge to be used as a check whenever requested for by the Engineer.

6.10 Safety Precautions during Tensioning

Care shall be taken during tensioning to ensure the safety of all persons in the vicinity. Jacks shall be secured in such a manner that they will be held in position, should they lose their grip on the tendons.

No person shall be allowed to stand behind the jacks or close to the line of the tendons while tensioning is in progress.

The operations of the jacks and the measurement of the elongation associated operations shall be carried out in such a manner and such a position that the safety of all concerned is ensured.

A safety barrier shall be provided at both ends to prevent any tendon, which might become loose from recoiling unchecked.

During actual tensioning operation, warning sign shall be displayed at both ends of the tendon.

After prestressing, concrete shall neither be drilled nor any portion cut nor chipped away nor disturbed, without express approval of the Engineer.

No welding shall be permitted on or near tendons nor shall any heat be applied to tendons. Any tendon which has been affected by welding, weld spatter or heat shall be rejected.

6.11 Tolerances

Permissible tolerances for positional deviation of Prestressing tendons in cast-in-situ construction shall be limited to the following

a) Variation from the specified horizontal profile : 5 mm
b) Variation from the specified vertical profile : 5 mm
c) Variation from the specified position in member : 5 mm

6.12 Tests and Standards Of Acceptance

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

6.13 Quality Control and Testing Materials

The contractor shall carry out all tests of materials in order to guarantee the specified quality in accordance with the relevant clauses of this specification.

6.13.1 Curing of Precast Girders

The pre tensioned girders shall be subjected to steam curing. Temperature gradients within the elements must be minimised as curling, warping and similar defects may be introduced into the concrete by differential thermal movement. The contractor shall maintain steam curing record of the girder in an approved proforma. For the observations of temperature, thermocouples, thermistors, immersion thermometers etc. shall be used by the contractor.

The contractor shall observe the following precautions during steam curing process:

i) Rate of rise of temperature in the concrete does not exceed 15 C/hour in the first 3 hours.

ii) Thereafter, the rate of rise and fall of temperature of concrete does not exceed 35 C/hour.

iii) The temperature of concrete does not exceed 80 C.

In order to avoid thermal cracking, exposure to ambient temperature should not take place while the temperature of the concrete is more than 40oC above ambient temperature.

Wet curing of the above element shall continue constantly for a period of 14 days, after the steam curing is over.

6.13.2 Marking of Precast Elements

Precast Elements shall be marked immediately after removing the side forms with paint of approved quality. The elements shall be marked at minimum four places on outer faces of webs and at the ends with the following details:

i) Girder Number.

ii) Date of casting the girder.

6.13.3 Tests of Precast Pretensioned Elements

One unit of each type of precast element shall be load tested upto to failure but its quantity shall not be measured for payment.

Prior to carrying out load tests, if required, the contractor shall submit arrangement of testing, loading etc. and shall carry out any modifications, if needed, on the existing

testing arrangement to the satisfaction of Engineer in Charge at no extra cost. The contractor shall submit a report containing test results and observations etc. to the department.

6.13.4 Handling, Stacking, Transportation and Placing of Precast Element

All aspects of casting, pretensioning,handling, transportation and erection shall be proposed by contractor in detailand method of statements to be submitted by contractor for approval of engineer. Detailed fabrication drawings of each element to be submitted by contractor for approval of engineer.

Handling of precast members shall be allowed only after the same have attained the specified strength. Minimum concrete strength at transfer for precast pretensioned member shall be 35Mpa and for post-tenisoned members it shall be 40Mpa. Minimum age of precast elements is 28 days at the time of incorporation in the structure.

The members shall be lifted only from the positions specified for this purpose. Precast members are to be lifted, stacked and/or handle such that self-weight is mobilized and supports are located within 500mm from each end. Lifting inserts are to be proposed by the contractor for approval of engineer. Precast elements will have projecting reinforcement for composite action with cast-in-situ elements. They will also have steel embedments of various types for connection to other structural elements.

For precast pretensioned members arrangements would be required for debonding of strands for part length towards end of members. All exposed edges of precast elements should have chamfers of 10mm x 10mm. All necessary safety precautions will be taken to avoid any accident and damage during handling of the precast units. Special precautions areto be taken during and after erection for stability of the precast elements.

The contractor shall submit detailed plan showing stacking of precast elements at casting yard and at site and shall obtain approval of the Engineer in Charge.

The precast girders shall be stacked on timber or any other suitable supports provided over the firm ground/base. The girders shall be placed side by side on these supports. The girders shall be stacked not more than three in a layer keeping adequate gap between the layers to avoid damage to protruding reinforcement of girders. In no case the layers shall be placed in cross directions to each other. Care shall be taken to avoid any undue loading of girders during stacking.

The girders shall be transported in an upright position and points of support and the direction of reaction with respect to the girders shall approximately be the same

during storage as when the girder is placed in final position. The transportation and placing of precast units to position shall be done during night unless otherwise permitted by the Engineer in Charge.

The contractor shall obtain necessary permission from the concerned department for transporting the precast girders. Mode of transportation, proposed by Contractor, shall be got approved from the Engineer in Charge before commencing the transportation operation. Proper precautions should be taken during handling of precast units during transportation and all traffic safety measures taken. The contractor shall be required to execute all handling and re-handling of girders including interim storages etc., till these are finally erected, within his quoted rate.

Contractor can plan the activities in advance to reduce such handling if practicable. The Contractor shall ensure the security of all personnel by avoiding any risk of instability of the members or of the lifting or handling equipment, avoid any unexpected stress and excessive deformation, eliminate every risk of deterioration capable to alter the aspect or the durability of the structure. Care shall be taken to avoid any thermal shock during storage.

When placing the precast units in position, care should be taken to place the right unit in the right position with minimum handling of units. Care should also be taken to prevent any damage to the precast units. Units damaged by improper storing or handling/ rehandling shall be replaced by the contractor at his own expense. The methodology proposed by the Contractor for placing these units, shall be got approved from the Engineer in Charge, before commencement of the work. The rate for the reinforcement in the girders shall also include cutting of temporary handles (rebar), if required. The contractor shall prepare and submit a plan for each span indicating the location and girder number of each girder.

6.13.5 Shop drawings and design calculations for construction procedures

The contractor shall submit according to a schedule, complete details and information concerning the method, materials, equipment and procedures he proposes to use. These shall be called “Method statements”. Method Statements shall be submitted sufficiently in advance of the start of superstructure filed construction operations, so as to allow the Employer’s Representative adequate review period, which shall not be less than 30 days. The submittals shall invariably include step-by-step casting, lifting, curing, stacking, transportation and erection procedure. The contractor’s Method

Statements shall also include all calculations, drawings and information as may be relevant. The following points are specifically highlighted.

- Accommodating block-outs, openings and protrusions. Protruding re-bars may be needed (track starter rebars, for example). Anchorages and inserts for OHE poles, Signalling equipment and cable routing supports shall also be included where needed in precast beams.

- Adjusting to changes in girder length, curve, inclination and camber as shown in Detailed Design Drawings issued by Employer.

- Adjusting the profile to take into account design camber values

- Stripping without damage to the concrete

-The design shall provide a tapered portion at both end for bearing of electrometric bearing.

- Forms shall not be removed until the concrete has attained adequate strength. Care should be exercised in removing the forms to prevent spalling and chipping of the concrete.

- All side, bottom and end forms for precast beams shall be constructed of steel.

- Forms shall be of sufficient thickness, with an adequate external bracing and stiffeners, and shall be sufficiently anchored to withstand the forces due to placement and vibration of concrete.

No tie bolt is permitted for casting of precast beam. Joints in the forms shall be designed and maintained for mortar tightness. The grade and alignment of forms shall be checked each time they are set and shall be maintained during the casting of concrete.

6.13.6 Post Tensioned Cross Girder

Precast post-tensioned girders are to be lowered gradually as proper alignment is necessary so that prestressed bars already threaded into the pier cap and the part of it that is projecting out are properly threaded into the duct specified for each bar in the cross girder. Cranes for lifting and placing of girders shall have a capability of lowering the girders at a rate of 25mm per minute. In case two cranes are proposed to be used for a single component, their movement has to be synchronised.

High tensile bar anchor system and components are to be complied and tested in accordance with requirements of BS:4486, ASTM T22-88 and IS:2090. The system shall comply with, “Recommendations for Acceptance and Application of Post-

Tensioning Systems," of FIP. High tensile threaded bars shall be such as manufactured by Macalloy and Dywidag System.

6.14 Measurements for Payment

Prestressed Concrete shall be measured in -cubic metres based on theoretical cross-sectional area and length. The volume occupied by mild steel reinforcement / HYSD bars; high tensile steel, sheathing and anchorages shall not be deducted.

Measurement for transportation of precast member/segment shall be measured in tonnes based on standard density of concrete equivalent to 2.4 t/cum including the weight of rebars, sheathing ducts, embedments etc.

High tensile (prestressing) steel shall be paid for separately and measured as actually incorporated in finished work i.e. end of live end wedges to dead end wedges. (The rate shall include its length including additional length of cables for attaching jacks or additional length at dead end).

From the length so measured its weight shall be calculated in tonnes on theoretical basis based on the standard weight per m length and paid for.

Actual length of sheathing provided in permanent works shall be measured and paid for separately. All the accessories required for grouting operations, protection of sheathing, couplers for sheathing, samples for testing including testing shall all be deemed to be included in the item of sheathing and shall not be paid for separately.

Actual numbers of anchorages used shall be measured and paid for separately. Making of recess and filling the same, protection by painting with epoxy and furnishing samples for testing including testing shall all be deemed to be included in the item of anchorages and shall not be paid for separately. The rate shall also include payments, if any to be made to the supplier of the prestressing system who has to monitor, ensure and certify the correctness of all the arrangements/operations.

6.15 Rate

The contract unit rate for cast-in-situ / precast prestressed concrete shall cover the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as per directions of the Engineer, curing and other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to specifications. The contract unit rate shall also include the cost of making, fixing and removing of all centring and forms required for the work unless otherwise specified in the Contract. The shuttering shall have to be of steel plates and arrangement has to be designed and

provided to ensure that there is no obstruction to traffic during construction. Design calculations shall be submitted for approval for all temporary construction which may be required to complete the work.

For precast concrete members, the rate shall include the cost of all items as mentioned above and materials, labour, tools and plants required for casting bed, curing (water or steam), handling equipment, steel moulds, transportation of elements within casting yard (i.e. to curing tank or stacking yard etc.). However, the cost of transporting the segments from casting yard to launching site, launching arrangements, application of epoxy including temporary bar prestressing etc. will be paid separately as per BOQ.

The contract unit rate for high tensile steel shall cover the cost of all items as mentioned above including material, labour, tools and plant including plant required for manufacturing, placing, tensioning, anchoring and grouting the high tensile steel in the prestressed concrete as shown on the drawings and as per specifications herein above or as directed by the Engineer.

7 STRUCTURAL STEEL WORKS

7.1 These specifications shall be read in conjunction with the CPWD specifications 1996 and other relevant reference specifications described in the section 1 of these specifications.

The Contractor will provide all materials and equipment required to complete the works in every respect, whether such materials are required as part of the permanent structures or temporary for fabrication or erection or maintenance including specifically structural steel plates, flats, bars, welding rods, rivets, bolts and nuts, paint, welding sets in the shop and at site, all workshop facilities, derricks, cranes, pulley blocks, wire ropes, hemp or manila ropes, winches, erection cleats and temporary braces or supports and all other materials required to deliver the Works complete in every respect.

All labour required for fabrication and erection for any cleaning, making good, rectifying, hauling, and painting for any other ancillary work required to complete fabrication and erection.

The Contractor shall observe all safety requirements for erection of structural steelwork as covered in IS:7205.

7.2 Drawings:

7.2.1 The Engineer will supply to the Contractor profile drawings showing sizes of all structural members and typical connection details.

7.2.2 Should there be any discrepancy in the drawings the Contractor is to refer the matter to the Engineer. The Contractor shall further provide a drawing showing the accurate setting out to line and level of all the anchor bolts intended for the work in sufficient time for their inclusion in the work so as to maintain the building program.

7.2.3 The Contractor is to prepare all the necessary fabrication shop drawings and these shall be submitted to the Engineer in duplicate and be approved by him before fabrication is commenced. All such drawings shall show the dimensions of all parts, method of construction, welding and bolting. A further set of all approved fabrication drawings shall be supplied by the Contractor for use of the Engineer as required.

7.2.4 Approval by the Engineer of drawings or any other particulars submitted by the Contractor shall not relieve the Contractor of full responsibility for any discrepancies, errors or omissions therein. The Contractor shall at his own expense supply such additional copies of his working drawings as are required for the use of the interested parties.

7.3 Material:

7.3.1 Structural Steel

All structural steel shall be of tested quality and shall conform to one of the following standards:

IS:226 Structural steel (Standard Quality)

IS:2062 Structural steel (Fusion welding quality)

IS:961 High Tensile Structural Steel (Ordinary)

IS:1161 Steel Tubes for Structural purposes

IS:4923 Hollow Steel Sections for Structural use

The Contractor shall supply to the Engineer copies of the manufacturer certificate that the steel brought to the site for incorporation in the works is of a quality fully complying with the specification. If required by the Engineer, the Contractor shall arrange for testing of the steel samples as per IS:1608 - 1599.

7.3.2 Welding Electrodes:

Welding electrodes used for the works shall conform to IS:814/latest and shall be supplied by manufacturer approved by the Engineer and shall be of the grade approved by the Engineer. All Electrodes shall be kept under dry conditions. Any electrode which has part of its flux coating broken away or is damaged shall be rejected.

7.3.3 Bolts and Nuts:

Bolts and nuts used for the works shall unless otherwise specified be black bolts and nuts supplied by manufacturer approved by the Engineer and shall conform to IS:1367.

For the truss hot-dip galvanized (@ 300gm/sqm) bolt sleeve of mild steel grade 'B' conforming to IS:2062 and 4 dia 12mm anchor bars welded to same as per detailed drawing and instruction of the Engineer shall be provided. The length and diameter of sleeve shall be 300mm and 60mm respectively. The sleeve shall receive hexagon head bolt IS:1363 (part –I) –ISO 4016-M20x90-8.8. Hexagon head bold shall be provided with galvanized spring washer as per the detailed drawing and instruction of the Engineer.

7.3.4 Washers

Plain washers shall be made of mild steel conforming to IS:5369 (1975), unless otherwise specified. One washer shall be supplied with each bolt and, in case of special types of bolts, more than one washer as needed for the purpose shall be

supplied. An additional double coil helical spring washer, conforming to IS:6755 (1980), shall be provided for bolts carrying dynamic or fluctuating loads and those in direct tension. Tapered washers, conforming to IS:5372 (1975) and IS:5374 (1975), shall be used for channels and beams respectively wherever required.

7.3.5 For all other material required for the works, the approval of the Engineer shall be obtained by the Contractor prior to the use of the material in the works.

7.4 Workmanship and Fabrication:

7.4.1 For all the works, workmanship shall be of first class quality, throughout, in conformity with IS:800-latest, and true to line, level and dimension as shown in the drawings or instructed by the Engineer.

7.4.2 All parts assembled for bolting shall be in close contact over the whole surface and all bearing stiffeners shall bear tightly at top and bottom without being drawn or caulked. The component parts shall be so assembled that they are nottwisted otherwise damaged as specified cambers if any shall be provided. Drilling done during assembling shall not distort the metal or enlarge holes. The butting surfaces at all joints shall be so cut and milled so as to butt in close contact throughout the finished joints.

7.4.3 Cutting shall be done automatically. Hand flame cutting will not be permitted.

7.4.4 The edges and ends of all cut/sheared flange plates, web plates of plate girders, and all cover plates, and the ends of all angles, tees, channels and other sections forming the flanges of plate girders, shall be planed/ground.

7.4.5 Holes for bolts shall be drilled to confirm to clause 10 of IS:7215 (1974). Punching of holes will not be permitted. All drilling shall be free from burrs. No holes shall be made by gas cutting process.

7.4.6 All welding for the works shall be carried out by first class welders and shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323 and IS:9595. The Engineer may at his discretion order periodic tests of the welder and/or of the welds produced by them. All such test shall be carried out by the Contractor at his cost.

7.4.7 Safety requirements should conform to IS: 7205, IS: 7273 and IS: 7269 as applicable and should conform to safety, economy and rapidity.

7.4.8 As much as possible shall be welded in shops. The pieces shall be manipulated to ensure down hand welding for all shop joints as far as possible. All parts to be welded shall be arranged so as to fit properly on assembly. After assembly and before

the general welding is to commence the parts are to be tack welded with small fillet or butt welds as the case may be. The tack welding must be strong enough to hold the parts together but small enough to be covered by the general welding. The welding procedure shall be so arranged that the distortion and shrinkage stresses are reduce to a minimum.

7.4.9 All joints required in structure to facilitate transport or erection shall be shown on the drawings or as specified by the Engineer. Should the Contractor need to provide joints in locations other than those specified by the Engineer he shall submit his proposals and obtain the prior sanction of the Engineer for such joints. The lengths of structural shall be the maximum normally available in the market jointing of shorter length in order to make up lengths required shall not be permitted.

7.4.10 Each piece of steel work shall be marked distinctly before delivery, indicating the position and direction in which it is to be fixed. Three copies of a complete marking plan are to be supplied to the Engineer before erection commences.

7.4.11 In the case of welded fabrication any distortion remaining in the member after welding operations are completed shall be rectified by and/or at the expense of the Contractor to the approval of the Engineer.

7.4.12 All members of trusses and lattice girders shall be straight throughout their length, unless shown otherwise on the drawings, and shall be accurately set to the lines shown on the drawings. Sheared edges of gussets or other members to be straightened and dressed where necessary.

7.4.13 Templates and jigs used throughout the work shall be all steel. In cases where actual materials have been used as templates for drilling similar pieces, the Engineer shall decide whether they are fit to be used as parts of the finished structure.

7.4.14 Apart from the requirements of welding specified under the above sub clauses, sections above, the Contractor shall ensure the following requirements in the welded joints.

i) Strength-quality with parent metal.

ii) Absence of defects

iii) Corrosion resistance of the weld shall not be less than that of parent material in an aggressive environment.

7.4.15 No gasket or other flexible material shall be placed between the holes. The holes in parts to be joined shall be sufficiently well aligned to permit bolts to be freely placed

in position. Driving of bolts is not permitted. The nuts shall be placed so that the identification marks are clearly visible after tightening. Nuts and bolts shall always be tightened in a staggered pattern and, where there are more than four bolts in any one joint, they shall be tightened from the centre of the joint outwards.

7.5 Testing of Welds:

1 Butt welds - Radiographic testing of 5% of welds as per IS 1182.

2 Fillet welds - Ultrasonic testing of 5% of welds.

3 All welded connections shall be inspected as per IS:822

4 All welds shall be tested by "dye penetration test" as per current practices.

5 Agency for testing of weld shall be approved by the Engineer prior to testing.

6 Defected welds shall be repaired or replaced as decided by the Engineer. The repaired or replaced welds shall be tested using the same methods as above. Additionally, when defective welds are found, the cause of the defective welding shall be determined and the contractor shall institute immediate corrective action.

7 No extra payment shall be made for the tests indicated above.

7.6 Protection of Steel Works (IS:8629):

a) Sand blasting where specified shall be carried out in accordance with IS:1477.

b) Painting work shall be carried out in accordance with IS:8629 (Parts I to III). Painting shall be applied under the temperature requirement specified by the manufacturer.

c) The steel work, prior to delivery, shall be cleaned form scale, rust, dirt and grease etc., but means of chipping, scraping and wire brushing using skilled operators as described in the painting systems below. The cleaning shall proceed each day over the extent of surfaces which can be painted on that day. The paint shall be applied by brushing or spraying as per approval of the Engineer.

d) Paint brushes round/oval and flat shall be conforming to IS:487 and IS:384 codes respectively, if painting with brushing is approved by Engineer.

e) The spraying equipment shall be compatible with the paint material, fitted with necessary gauges and controls and approved by the Engineer.

f) Site weld locations shall be left free from paint within 50mm of the weld position, and contact surfaces in connection using High Strength Friction Grip Bolts shall not be painted. Immediately after completion of erection all

damaged paint shall be scraped off and made good to the approval of the Engineer.

g) The Steelwork specialist shall also clean down and apply one coat of primer to all site bolts, site bolted connections and site weld locations and the paint work generally shall be left in sound condition for any subsequent painting.

h) All paints and primers shall be of best quality and in original sealed containers as packed by the paint manufacturer conforming to the relevant Indian Standards and shall be procured directly from the manufacturers. All paint to be used shall be stored under cover in such conditions as will preserve it from extreme of temperature and the paint shall be used and applied strictly in accordance with the manufacturer's instructions.

i) In addition, the following specification shall apply to the shop painting of contact and inaccessible surfaces:

a. Surfaces to be painted shall be thoroughly cleaned from scale, rust, dirt, grease etc. by means of sand/grit/shot blasting or other equivalent means.

b. Surfaces which are to be brought permanently into close contact or made inaccessible either in the shops or upon erection shall, after cleaning, be given two coats of Red Lead Priming Paint. The surfaces shall be brought into contact while the paint is still wet.

c. Contract surfaces in connection using High Strength Friction Grip bolts shall not be painted or oiled and shall be free from dirt, loosed scale, burrs, pits and any other defects which would prevent the solid seating of the parts and would interfere with the development of friction between them.

d. All enclosed surfaces of box members shall be completely sealed by oilingor by coating with approved bitumen paint and all such members and tubes shall have their ends closed by suitable plates welded in position.

j) Surfaces in contact during shop assembly shall not be painted. Surfaces which cannot be painted, but require protection, shall be given a rust inhibitive grease conforming to IS:958 (1975), or solvent deposited compound conforming to IS:1153 (1975) or IS:1674 (1960), or treated as specified in the drawings.

k) Surfaces to be in contact with concrete shall not be painted.

Contractor shall decide such rates accordingly to the definitive paints selected by him for ensuring the specified DFT in Table.

m) The Contractor shall take all precautions to prevent dust and dirt coming in contact with freshly painted surfaces or with surface being painted. The second coat of paint shall only be applied when the first coat has dried.

n) Surfaces not in contact but inaccessible after shop assembly shall receive the specified protective treatments before assembly.

o) Exposed machined surfaces shall be adequately protected.

p) A uniform film thickness of paint is to be ensured throughout the work.

q) Surfaces, which have not been shop coated, but require surface treatment shall be given necessary surface preparation and coats at site as specified in the painting system.

7.7 Quality Control & Testing Requirements

7.7.1 General

7.7.1.1 Scope of Specification

The scope of work of these specifications is to establish the norms for ensuring the required Quality Control through established the norms of the welded structural steelwork.

7.7.1.2 Codes/ Standards

Relevant IS codes for tolerance and tests of welding procedures as specified in the specification for Structural Steelwork.

7.7.1.3 Submittals

The contractor shall submit the following:

- Proposed overall schedule for documentation of calculations, shop drawings, plan/ procedures and records, submission of procedure of fabrication.
- The contractor shall himself inspect all materials, shop work and field work to satisfy the specified tolerance limits and Quality norms before the same are inspected by Engineer or his authorised representative.

7.7.2 Products

Not applicable

7.7.3 Execution

7.7.3.1 Tolerances

The contractor shall through appropriate planning and continuous measurements in the workshop and erection at site ensure that the tolerance specified is strictly adhered to.

7.7.3.1.1 Dimensional & weight tolerance

The dimensional and weight tolerance for rolled shapes shall be accordance with IS: 1852. The acceptance limits of straightness for rolled or fabricated members as per IS: 7215 are:

Struts and columns: L/1000 or 10 mm whichever is smaller

Where L is the length of finished member

A limit for distortion in transverse direction from the true axis of plate and box girder shall not be more than L/1000 where L is the length of diagonal of profile.

Tolerance in specified camber of members shall be 3 mm in 12 m length

Tolerance in specified lengths shall be as follows:

- Column finished for contact bearing ± 1 mm
- Other members (cols.) up to and over 10 m ± 5 mm
- Including 10 m L/2000 subject to max of ± 8 mm
- Other members (beams) up to 12 m ± 3 mm
- Over 12 L/4000 subject to max of ± 5 mm

7.7.3.1.2 End of members

Beam to beam and beam to column connection – Where the abutting parts are to be joined by butt welds, permissible deviation from the squareness of the end is:

- Beam up to 600 mm in depth : 1.5 mm
- Beam over 600 mm in depth : 1.5 mm for increase in depth of every 600 mm subjected to max of 3 mm.

Where abutting parts are to be joined by bolting through cleats or end plates, the connections require closer tolerance, permissible deviation from the squareness of the end is:

- Beam up to 600 mm in depth 1 mm per 600 mm of depth subject to a max of 1.5 mm.

For full bearing, two abutting ends of columns shall first be aligned to within 1 in 1000 of thecombined length and then the following conditions shall be met:

a) Over atleast 80% of the bearing surface the clearance between the surfaces does not exceed 0.1 mm
b) Over the remainder of the surfaces the clearances between the surfaces does not exceed 0.3 mm

Where web stiffeners are designed for full bearing on either the top flange or the bottom flange or both, atleast half the stiffener shall be in positive contact with the flange. The remainder of the contact face could have a max. gap of 0.25 mm

Acceptable deviation from the specified overall depth as per IS: 7215 (1974) is:

- Up to and including 1000 mm : 1.0 mm
- Over 1000 mm : 2.0 mm

7.7.3.1.3 Web Plates

An acceptable deviation from flatness in girder webs in the length between the stiffeners or in a length equal to the girder depth shall be:

Up to 500 mm depth : 0.5 mm

Over 500 mm & including 1000 mm : 1.0 mm

Over 1000 mm : 2.0 mm

7.7.3.1.4 Flange Plates

A reasonable limit for combined warpage and tilt on the flanges of a built-up member is 1/200 of the total width of flange or 2 mm whichever is smaller measured with respect to centreline of flange.

Lateral deviation between centreline of web plate and centreline of flange plate at contact surfaces measured as the difference between diagonals of nominal length of L shall not be greater than L/1000.

7.7.3.1.5 End Milling

Column ends bearing on each other or resting on base plates and compression joints designed for bearing shall be milled true and square to ensure proper bearing and alignment. Base plates shall also have their surfaces milled true and square.

7.7.3.2 Quality Control

In order to exercise proper control of the quantity of the welding, Contractor shall enforce methods of control as tabulated below:

Purpose	Control Subjects	Methods of Control
1. Control of welding materials and basic metal quality	Quality control of electrode, welding wire, flux and protective gases	Weldability test to determine the technological properties if materials. Mechanical test of weld metal Metalographical investigations of welds macro-structure and microstructure Checking of weld metal resistance for intercrystalline corrosion. Study if weld metal solidity by physical control methods
2. Checking of welders qualifications	Welding of specimens for quality determination	Mechanical tests, metalographical investigation & checking of welded joints by physical control methods
3. Control of welded joint quality	Control of assembly accuracy and technological welding process	Checking of assembly quality &centering of welded members Checking of welding equipment condition. Checking correctness of welding procedure. Visual examination of welds.

7.7.3.3 Tests & Testing Procedures

Agency for testing of weld shall be approved by the Engineer prior to testing.

7.7.3.3.1 Visual Examination

The contractor shall conduct visual examination and measurement of the external dimensions of the weld for all joints. Before examining the welded joints, areas close to it on both sides of the weld for a width not less than 20 mm shall be cleaned of slag and other impurities. Examination shall be done by a magnifying glass which has a magnification power of ten (10) and measuring instrument which has an accuracy of ±0.1 mm or by weld gauges. Welded joints shall be examined from both sides. The contractor shall examine the following during the visual checks.

i. Correctness and shape of the welded joints
ii. Incomplete penetration of weld metal
iii. Influx
iv. Burns
v. Unwelded craters
vi. Undercuts
vii. Cracks in welded spots and heat affected zones
viii. Porosity in welds and spot welds
ix. Compression in welded joints as a result of electrode impact while carrying out contact welding
x. Displacement of welded element

The contractor shall, document all data as per sound practices

7.7.3.3.2 Mechanical test

The contractor shall carry out various tests to determine weldability, metal alloyability, nature of break, correct size and type of electrodes, degree of pre-heat and post-heat treatment. The type, scope and sample of various mechanical tests shall be determined in agreement with the purchaser. The number of tests conducted shall depend on the result obtained to satisfy the engineer that the correct type and size of electrode, degree of pre-heating and post- heating and weldability of metal are being followed.

7.7.3.3.3 Dye Penetration Test

All welds shall be tested by "Dye Penetration test" as per current practices

7.7.3.3.4 Radiography test

Radiography test shall be conducted by the contractor to determine gas inclusion (blow holes, hollows) slag inclusion, shallow welds and cracks for 25 % length all butt joints.

Before conducting the examination the welded joints shall be cleaned of slag and scales and visually examined. The welds shall be marked into separate portions depending on the length of photograph. The length of photograph shall be such as to ensure that there are no distortions and shall reveal the defect correctly. The length shall not be more than 0.75 of the focal distance and the width of the photograph would depend on the width of the welded joint plus 20 mm on either side of the weld. The cassette with the film shall be protected by sheet of lead or equivalent of proper thickness against incidental, diffused and secondary radiation.

The direction of the ray with relation to the film shall be as specified hereunder. Welds of butt joints without edge slopes with edge processing shall be examined by central ray directed at right angles to the weld.

In special cases examination of welds with inclined rays directed along edge slopes may be permitted by the Engineer.

Lap joints shall be examined by directing rays at 45 degree to the bottom plate. Welds in T-joints without any edge preparation shall be examined by rays directed at 45 degree to the weld. Angle welds in lap and tee-joints shall be examiner by the rays in opposite direction i.e. the film will be on the side of the weld. Weld in angle joints shall be checked by directing ray along the bisector of the angle between the welded elements. Opposite directing of the ray and location of the film may also be permitted by the Employer.

7.7.3.3.5 Ultrasonic Test

Ultrasonic test shall be conducted by the contractor to detect gas inclusion 9pores), slag inclusion, shallow welds, cracks, lamination and friability etc. Prior to starting of ultrasonic test the welded joint shall be thoroughly cleaned of slag and other material. Surface of the basic metal adjacent to welded joint on both sides shall be mechanically cleaned by the grinder or a metal brush to provide metal adjacent to welded joint on both sides shall be mechanically cleaned by the grinder or a metal brush to provide the contact of the whole ultrasonic probe surface with surface of basic metal. The width of the clean surface shall be as directe4d by the Engineer. The welded joint then shall be covered with a thin coat of transformer oil, turbine or machine oil to ensure acoustic contact. The joints so treated shall be marked and the marks shall be entered in to the documentation, subsequent to this, ultrasonic test shall be carried out as directed by the Engineer. At least 50% of weld shall be tested by ultrasonic testing

7.8 Erection & Site Work:

7.8.1 The Contractor shall be responsible for checking the alignment and level of foundation and correctness of foundation bolt centres, well in advance of starting erection work, and shall be responsible for any consequences for non-compliance thereof. Discrepancies if any shall immediately be brought to the notice of the Engineer for his advice.

7.8.2 The structure should be divided into erectable modules as per the total scheme. This should be pre-assembled in a suitable yard/platform and its matching with members of the adjacent module checked by trial assembly before erection.

7.8.3 Immediately prior to erection any rust in the paint area shall be removed by power wire brushing to a standard equivalent to SA3.

7.8.4 During erection the rough handling of fabricated materials such as bending, straining or pounding with sledges shall be avoided. Any damage to the structure during transportation or erection shall be immediately rectified by the Contractor at his own cost. The straightening of bend edges of plates, angles and other sections shall be done by methods which will not cause fracture.

7.8.5 Following the completion of the straightening, the surface of the member shall carefully be inspected for damage and got approved by the Engineer before further use.

7.8.6 The Contractor shall be responsible for accurately positioning, leveling and plumbing of all steelwork and placing of every part of the structure in accordance with the approved drawings and to the satisfaction of the Engineer. All stanchion base, beam and girder bearings etc. shall be securely supported on suitable steel packs. All reference and datum points shall be fixed near the work site for facilitating the erection work.

7.8.7 All equipment used by the Contractor shall be sufficient for the purpose and for the erection of the steel work, in the time specified in the contract. Any lifting or erecting machinery shall be to the approval of the Engineer and shall be removed from the site if he considers such appliances dangerous or unsuitable for their functions. The approval of the Engineer shall not relieve the Contractor of the responsibilities for the loads to which the erection equipment shall be called upon to carry. Adequate arrangement shall be made to resist wind loads and lateral forces arising at the time of erection.

7.8.8 The Contractor is entirely responsible for the stability of the structure during erection and shall arrange that sufficient tack bolts, braces or guy ropes are used to ensure that work will remain rigid until final bolting, rivetting or welding is completed. The Contractor shall supply and fix, without extra charge, any temporary bracing which may be necessary.

7.8.9 All steelwork shall be erected in the exact position as shown on the drawings. All vertical members shall be truly vertical throughout and all horizontal members truly

horizontal, fabrication being such that all parts can be accurately assembled and erected. No permanent bolting, welding or grouting shall be done until proper alignment has been obtained and checked by the Engineer.

7.8.10 At stanchion splices and at other positions where concrete cover to the steel is liable to be restricted, bolts will be placed with their heads on the outside of the members.

7.8.11 All field assembly bolting and welding shall be executed in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only. Where steel has been delivered painted the paint shall be removed before field welding for a distance of at least 50mm on either side of the joints. The number of washers on permanent bolts shall not be more than two for the nut and one for the bolt head.

7.9 Rectification of damaged materials:

Any error in shop work which prevents the proper assembly and lifting up of the parts by moderate use of drift pins or reaming or cutting shall be immediately reported to the Engineer and his approval of the method of rectification obtained in writing. Wrongly fabricated material whose erection in the field necessitates extra work shall be the responsibility of the contractor. The entire costs of such operation including the replacement of defective members, if required, shall be borne by the contractor.

7.10 Inspection:

7.10.1 The contractor shall inform the Engineer of the progress in fabrication and as to when individual pieces are ready for inspection. All gauge templates necessary to satisfy the Engineer shall be supplied by the contractor. The Engineer may at his discretion check the results obtained at the contractor's works by independent tests and should the material so tested be found unsatisfactory, the cost of suchtests shall be borne by the contractor.

7.10.2 Structural steel and components viz. bolts, nuts, washers, welding consumables, etc. should be tested for mechanical and chemical properties as per the requirement of the relevant IS or any other specified codes/standard.

7.10.3 During Inspection, the component/member shall not have any load or external restraint.

7.11 Grouting of steel bases:

Before grouting of stanchion bases, the contractor shall take the following action:

a. Inform the Engineer.

b. Clean all holes, openings, recesses and the top of foundations of all dirt, mud, water, oil or other extraneous matter.

c. A frame shall be placed in position around the base plate with a provision for placing or injecting grout.

d. The contractor shall provide screed bars or mild steel flats and fix them in mortar.

e. Holes shall be provided on the stanchion bases for escape of air.

7.11.1 Grouting of steel beams, steel stanchions, bases and bearings and encasement of steelwork will be carried out by the contractor after the steelwork has been finally aligned and leveled and approval of the Engineer obtained.

7.11.2 The bolt sleeves shall be grouted as a separate operation using neat cement grout of a creamy consistency, which shall be poured in so as to completely fill the holes. "Non-shrink" cements, additives of approved makes shall be used for all grouting operations.

7.11.3 The space between the top of the foundations and the underside of the base plate shall be completely filled with a mix 1:2 cement sand mortar and finished flush with edge of the base plate, either:

a. Mixed as a stiff mortar well rammed into place from all sides.

b. Mixed as thickly as possible consistent with fluidity and poured under a suitable head and tamped until the space has been properly filled.

7.12 Holding down and Anchor bolts:

7.12.1 The holding down and anchor bolts should conform to the requirements laiddown in IS:5624 or as directed by the Engineer.

7.12.2 Installation: Individual bolts in groups of holding down bolts shall be positioned accurately within a tolerance of +6mm. The bolts shall be set vertically to a tolerance of not more than 1 in 250.

7.12.3 During the casting of concrete the contractor shall ensure that space between the bolt and sleeves is kept clean after removal of shuttering. The contractor shall provide and fix timber plugs to maintain this space in a clean condition. The projecting threads of bolts shall be protected by approved wrapping materials.

7.12.4 Grouting of bolt tubes shall be carried out after the steelwork or equipment have been aligned, plumbed and leveled.

7.13 Tolerances:

7.13.1 All tolerances shall be in accordance with IS:7215 unless otherwise specified.

7.13.2 The maximum deviation for line and level shall be + 3.0mm for any part of the structure including for location of column centres.

7.13.3 The maximum deviation from plumb for columns shall be +3.0mm in 10.0m height subject to a maximum of +6.0mm in a total height of 30.0m.

7.13.4 The deviation at the centre of the upper chord member from vertical plane running through the centre of the bottom chord shall not be more than 1/1500 of span but in no case more than 10.0mm. The lateral displacement of top chord at centre of span form vertical plane running through centre of supports shall not be more than 1/250 of the depth of truss but in no case more than 20.0mm.

7.14 Mode of measurement:

7.14.1 The pricing must include for all rolling margins, extras for length and size, allowance for waste, complete fabrication, delivery and erection, and caulking the gap between base plate and foundation, and painting as specified in the item. Unless otherwise specified, the final coats of paints, however, will be measured and paid separately on the basis of tonnage fabricated and erected.

7.14.2 Any temporary strutting, tying or anchor bolts, black bolts, fasteners, welding required to withstand the stresses of erection and carrying of plant are to be included in the price.

7.14.3 The payment for the steelwork will be for the weight of the steelwork actually erected, i.e. plates, rolled sections, shear connections, cleats, splice plates.

7.14.4 Dimensions of the steelwork will be taken correct to 1 mm and the net weight of metal in the fabricated structure on the basis of unit weight of the steel used in the works approved by the Engineer worked out on site or from the actual shop working drawings as decided by the Engineer. In calculating the weights of gusset plates, payment will be made for the least enclosing parallelogram or triangle. For structural sections the weight will be calculated on lengths actually used with no deduction for splay cut or mitred end. In case of imported sections, the weights chargeable shall be the weight according to the relative standards of the country of origin. Full weight of the bolts and nuts will be paid for as per Indian Standard Codes weights without any deduction for shanks, etc. No account shall be taken of the weight of weld in calculating the weight of steelwork. Erection packing plates bedded in mortar and wedges shall not be measured but shall be included in the rates. No deduction shall be made for openings less than 0.1m2 in area measured in plane for bolt holes. The

weight of sheet steel, plate, strips and rolled sections shall be taken from relevant Indian Standards.

7.14.5 Unless otherwise specified, foundation and anchor bolt assemblies shall be measured separately including nuts and washers.

7.14.6 The structural work which is temporary in nature and/or which is required for erection purposes shall not be measured.

8 PILE FOUNDATIONS

8.1 General

The piles shall be cast-in-situ reinforced concrete piles according to the approved drawings and specifications. The method of construction shall be with hydraulic drilling rigs with casing and/or bentonite slurry as decided by the Engineer.

The average basic length of the piles mentioned in the drawings is tentative. The final length of the pile shall be decided by the Engineer on the basis of resistance actually observed during initial load test at site. It will be the responsibility of the Contractor to ensure by subsequent routine load tests that the installed length of piles is able to carry the specified safe load and the resulting deflections shall be within permissible limits. In case of failure of any pile in routine load test, the remedial measures shall be provided by the Contractor as directed by the Engineer.

8.1.1 Piling plant and Methods

Suggested method for piling is cast in situ-bored piles with hydraulic drilling rigs using partial depth casing by oscillator or vibro hammer arrangement,with or without bentonite and equipments and methodology suitable for the purpose. Bailer and chisel method shall not be used except for socketting of the piles in rock.

1. Not less than 2 weeks before any piling work is commenced the Contractor shall submit to the Engineer for approval full details of his proposed piling plant, bentonite mixing, handling, transporting and disposal scheme and detailed method statements for carrying out the Works.

   Details of casings and concreting methods in respect of bored cast in place concrete piles are to be provided.
2. The Contractor shall not commence any piling until the plant and methods which he proposes to use including bentonite mixing, handling, transporting and disposal scheme have been approved by the Engineer but such approval shall not relieve the Contractor from any of his obligations and responsibilities under the Contract. If for any reason the Contractor wishes to make any change in the plant and methods of working which have been approved by the Engineer, he shall not make any such change without having first obtained the Engineer approval thereof.
3. List and nos. of equipment& accessories proposed to be used for the present job shall be submitted along with the bid and these should not be less than the list submitted for P.Q. tender. However, Contractor is bound to increase the

plant & machinery to complete the work within the stipulated completion period.

8.1.2 Records

The Contractor shall keep complete records of all data required by the Engineer covering the fabrication; driving and installation of each pile and shall submit two signed copies of these records to the Engineer not later than noon of the next working day after installation of the piles.

The following data shall be recorded during install align of pile along with any other relevant data as directed by the Engineer.

i) Sequence of installation of piles
ii) Dimensions of the pile, including reinforcement details and mark of the pile.
iii) Depth bored and founding level along with a bore log indicating nature of stratum
iv) Method of cleaning bottom of hole at founding level before commencing the concreting.
v) Time taken in concreting
vi) Cut-off level/working level/RL of top of concrete
vii) No. of cement bags consumed. Slump of concrete.
viii) Details of insertion and taking out of tremie pipes i.e., their number, length and sequence.
ix) Actual sounding before commencing the concrete.

8.1.3 Programme and Progress Report

1. The Contractor shall inform the Engineer each day of the programme of piling for the following day and shall give adequate notice of his intention to work outside normal hours and at weekends, where approved.
2. The Contractor shall submit to the Engineer on the first day of each week, or on such other date as the Engineer may decide, a progress report showing the rate of progress to that date and progress during the previous week or period of all main items of piling works, as required by the Engineer.

8.1.4 Setting Out

The Contractor shall establish and maintain permanent datum level points, base lines and grid lines to the satisfaction of the Engineer and shall set out, with a suitable identifiable pin or marker, the position of each pile. The setting out of each pile shall

be agreed with the Engineer at least 8 working hours prior to commencing work on a pile and adequate notice for checking shall be given to the Engineer

Notwithstanding such checking and agreement, the Contractor shall be responsible for the correct and proper setting out of the piles and for the correctness of the positions, levels, dimensions, and alignment of the piles.

8.1.5 After all piles are cast in a pile cap and weak concrete is chipped out, the Contractor shall submit the drawing showing the exact location of piles with respect to the column centre line.

8.1.6 Disturbances and Noise

1. The Contractor shall carry out the piling work in such a manner and at such times as to minimise noise, vibrations and disturbance.
2. The Contractor shall take precautions adequate enough to avoid damage to existing services and adjacent structures. Fig.1 of IS:2974 (Part 1) - 1969 may be used as a guide for studying qualitatively the effect of vibration on persons and structures. In case of deep excavation adjacent to buildings/structures, proper shoring or other suitable arrangement shall be done to guard against the lateral movement of soil stratum or releasing the confining soil stress. Any such damage if caused shall be repaired by the contractor at his own cost to the entire satisfaction of the Engineer.
3. The Contractor shall ensure that damage does not occur to completed piling works and shall submit to the Engineer for approval his proposed sequence and timing for driving or boring piles having regard to the avoidance of damage to adjacent piles.

8.1.7 Obstructions

If during the execution of the Works the Contractor encounters obstructions in the ground, he shall forthwith notify the Engineer accordingly, submit to him details of proposed methods for overcoming the obstruction and proceed according to the Engineer’s instructions.

8.2 Scope of Work

8.2.1 These specifications cover the works of providing pile foundations. Work included consists of all necessary services and furnishing of all labour material, tools, plant, equipment and related items for the full and satisfactory performance of the contract, conforming to these specifications and as shown in the Contract Drawings or reasonably implied therein or any authorised conditions or alterations thereof.

8.2.2 The tenderer is advised to visit the site and familiarise himself with the conditions at site. The Engineer shall not be held responsible for the accuracy of the soil data, furnished in good faith with the tender.

8.2.3 The construction of piles shall be in accordance with the following Indian Standard Codes of Practice for Design and Construction of Pile Foundations:

8.2.4 IS:2911-1979 Part I Section 2 Bored Cast in-situ Concrete Piles Or IRC:78 Standard specifications and code of practice for road bridges Foundation And Substructure

8.2.5 With the tender, the Contractor shall submit the detailed method of construction to be adopted. For cast-in-situ concrete piles, the Contractor shall indicate the methods he proposes to concrete the piles in order to prevent necking of piles.

8.2.6 The Contractor shall quote rates as detailed in the Bill of Quantities and Rates. In particular:

a. For piles, the rate quoted shall be for 'per metre length of pile' .The actual length of piles will be determined from site conditions and load test results after work begins.

b. In case the load tests and actual site conditions reveal that the piles proposed do not, in the opinion of the Engineer provide a satisfactory and economical foundation, the Engineer at his sole and absolute discretion shall have the powers to revise the pile layout.

8.2.7 The items of work to be carried out in piling will generally be:

a. Boring/drilling including provision of temporary casing (including its withdrawal) empty boring, & bentonite slurry, if required.

b. Supplying, fabrication, tying and placement of all reinforcement.

c. Casting of concrete piles as per specifications.

d. Integrity and Load testing of piles.

8.3 Materials

8.3.1 General

Unless otherwise specified in this section all materials shall conform to the requirements specified in separate sections for Concrete, Formwork and Reinforcement.

8.3.2 Cement

The cement to be used for piling and all foundation work shall be conforming to following Indian Standard Specifications:

IS:455 Specification for Portland slag cement

Cement shall be free from lumps and caking.

8.3.3 Concrete Mix Design

The concrete shall generally be of grade M35. The maximum size of coarse aggregate shall not exceed 20mm. For cast-in-situ piles concrete with a slump of 150 to 175mm (consistent with the method of concreting) will be required. Minimum cement content for design mix shall not be less than 400 kg/m3 of concrete in piling. For piling, qty. of cement to be used shall be as per the design mix or the minimum cement content whichever is greater.

The contractor shall submit mix design calculations and get the same approved by the Engineer well before the starting of boring of piles and carry out adequate numbers of tests to ensure the minimum specified strength as indicated in drawings.

8.3.4 Concrete cube tests

Concrete cubes shall be cast, tested and evaluated as specified in Section 3.

8.3.5 Reinforcement

a. The reinforcement shall conform to the requirements specified in Section 5 extending for the full length of the pile and shall project 60 times bar diameters above the cut off level or as specified in the drawing. Only circular concrete cover blocks threaded on to the helix shall be used for ensuring the specified cover.

b. Joints in main longitudinal bars will be permitted only where, in the opinion of the Engineer, each bar cannot be supplied in one complete length. Where permitted, staggered joints shall be provided at agreed centres, designed to develop the full strength of the bar across the joint, provided with adequate extra links or stirrups in position from those of adjacent longitudinal bars, all to the approval of the Engineer.

c. All main longitudinal bars shall be tack welded at lapping and to the pile cap reinforcement. The last circle of helical stirrups at each end shall be welded to main longitudinal bars Nothing extra shall be payable on account of this. Any extra tack welding required for handling and lowering of cage in borehole shall also be done by the contractor at no extra cost.

8.3.6 Casings and Tremie Pipes

The casings and tremie pipes shall be in mild steel. The temporary casing plates and permanent liners shall have adequate wall thickness and strength to withstand driving stresses, stresses due to soil pressure, etc. Without damage or distortion all joints shall

be water tight. The internal diameter of the casing shall not be less than the nominal diameter of pile.

8.4 Cast In-Situ Bored Piles

8.4.1 General

a. Diameters of the piles shall be the concrete shaft diameters and shall not be less than the diameters specified in the drawing.

b. These shall be formed by boring to the founding strata specified on the drawings or as directed at site. The sides of the boring shall be prevented from collapse by one of the following methods:

- Providing permanent mild steel liner (cased pile)
- Providing removable mild steel casing (uncased pile)

c. Piles shall be constructed in a sequence approved by the Engineer. During boring, the Contractor shall, where required by the Engineer, take soil, rock or ground water samples and transport them to an approved testing laboratory or carry out soil tests as directed.

d. The method adopted shall be chosen giving due consideration to the subsoil data, ground water conditions and to the other relevant conditions at site as well as to the presence of adjacent structures.

e. The bottom of the steel lining shall be sufficiently in advance of the boring tool so as to prevent settlement of outside soil and formation of cavities.

f. Removable mild steel casings shall be used, only with extreme caution. Individual casings shall be joined together by screwing or any other approved method and not by direct butting with external lug connections. The inner surface of casings shall be smooth and free of all internal projections.

8.4.2 Boring

a. Boring shall be done using Rotary hydraulic drilling rigs with oscillator arrangement/ equipment and methodology suitable for different kinds of strata encountered.

b. As a general guideline, size of cutting tool shall in no case be less than the diameter of the pile minus 75mm. However the size of cutting tool shall be chosen by contractor depending on the type of substrata and equipment employed by contractor so that executable pile shall not have diameter less than nominal diameter of pile as specified in drawing. The contractor shall also ensure that there is no reduction in poured concrete quantities. These calculations shall be based on consumption of concrete poured in bore (as recorded in pour log) and actual concrete required in bore on

theoretical basis i.e. based on nominal diameter of pile and actual bore hole length (based on actual sounding of founding level). More than 5% reduction in consumption of poured concrete quantities in pile may be rejected. In general, piling shall be done by using hydraulic rig with temporary liner. Use of liner for top 6 metres from ground level or upto depth having N. value = 10 or more depth, (to protect loose soil falling in bore hole) as directed by Engineer, is essential. No extra payment shall be made to the contractor for using temporary liner, over the item of piling as in BOQ.

c. Use of drilling mud in stabilising sides of the pile borehole may also be necessary together with temporary or permanent casing wherever sub soil and ground water conditions are likely to cause mud flows or instability of pile bore or sand boiling. However, this will be permitted only when deemed necessary by the Engineer. In such situations the properties of bentonite used & quality control shall be as per requirement given below.

Fresh Bentonite slurry shall satisfy the following properties at all times:

- Mud density shall not exceed 1.05 g/cc
- pH value 9 to 11.5
- Marsh Cone viscosity 30-40 seconds
- The sand content of Size > 0.075mm shall not be more than 1 percent.
- Liquid limit of bentonite shall not be less than 400 percent.
- Bentonite shall be saturated for minimum 24 hours before use.

When using bentonite mud, flushing shall be done with fresh bentonite slurry after lowering of reinforcement cage and tremie. The bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning / flushing methodology shall be submitted and got approved by the Engineer prior to commencement of piling.

Where mud flow conditions exist or the aggressive action of ground water is to be avoided, or in the case of piles built in flowing water or in cases where significant length of piles could be exposed due to scour – the casing should be left permanently in the ground and the permanent liners will be paid separately as per BOQ.

The quantum of steel required in permanent liners from the cut off level downwards shall be measured as per drawing. Though the liner might have been provided right from the level of the working platform on practical

considerations, the length of the permanent liner above the cut-off level has to be necessarily removed for facilitating chipping of the top portion of the pile and for interlacing its reinforcement bars into the capping slab. There is however, no objection if the surplus pieces (if cut and removed carefully and then found reusable) are joined and are rewelded to required length for reuse in the same contract on some of the other piles. No claim / compensation shall be entertained for such cut pieces if they cannot be reused by the Contractor in the aforesaid manner.

d. Pumping from a bore hole shall not be permitted unless a casing has been driven into a stable stratum which prevents flow of external ground water from other strata in significant quantities.

e. In case of end bearing piles founded on rock, cutting of rock by hydraulic rig using diamond bits / conventional winches with chiseling will be resorted to. Scheme adopted shall be such that noise and vibration parameters specified in tender document /Environment manual are not violated. Drilling in rock shall be carried out by hydraulic rig using diamond bits. No extra payment shall be entertained for socketing in rock except as specified in BOQ.

f. On completion of boring, loose disturbed or remoulded soil shall be removed from the base of bore.

Penalty on mishandling of bentonite

Mishandling of bentonite (like splashing of bentonite outside specified width of barricading or non-cleaning of tyres of dumpers and transit mixers before leaving the piling site thereby making the road dirty etc.) is strictly prohibited . Noncompliance of same shall attract a penalty as follows:

I. On first observation – Rs one lac

II. On Second observation – Rs two lacs

III. On third and each subsequent observation – Rs three lacs

8.4.3 Concreting

a. Prolonged delays in the commencement of concreting after the completion of the boring shall not be permitted. The time interval between the completion of boring and placing of concrete shall not exceed 6 hours.

b. The concrete shall have a minimum slump of 150mm . Suitable precautions shall be taken for prevention of segregation. Internal vibrators shall not be used unless the

Contractor is satisfied that segregation will not result because of vibration and unless the method of use has been approved by the Engineer.

c. The concrete for piles underwater or in drilling mud shall be placed with a tremie pipe. The tremie pipe shall not be less than 200mm diameter for 20mm aggregate. The joint between the hopper and tremie pipe as well as the joints in the tremie pipe shall be water tight and the tremie pipes shall be thoroughly cleaned after each use. .

   It is essential that the water level within the pile bore be in equilibrium before commencement of concreting.

d. The Contractor shall ensure that heavily contaminated drilling mud has not accumulated at the base of boring since this could impair free flow of concrete from the tremie pipe.

e. If the specific gravity of the drilling mud at the base of the bore exceeds 1.20 the placing of concrete shall not proceed.

f. The first charge of concrete shall be placed in the hopper over a sliding plate of the bottom of the hopper. The charge should be adequate in volume to ensure flushing action to prevent mixing of water or drilling mud and concrete.Alternatively floating plugs of approved specification may be used before the first charge of concrete.

g. The tremie pipe shall at all times penetrate the previously placed concrete for minimum depth of 2 m as a precaution against accidental withdrawal. The tremie pipe shall not be withdrawn until the completion of concreting. At all times a sufficient quantity of concrete shall be maintained within the pipe to ensure that the pressure from it exceeds that from the seepage water.

h. Spot measurements shall be taken at suitable intervals to check that the tremie pipe has an adequate penetration into previously placed concrete.

i. Concreting of the pile shall be in one single and continuous operation. In case of long piles of large diameter, large size mixers or more number of mixers shall be used so that the entire concreting operation is completed in not more than two hours.

j. The top of concrete in a pile shall be brought above the cut-off level since the top concrete is loose and is weak because of contamination with water/drilling mud. This ensures good concrete at the cut-off level.

k. Cut off level (COL)

   Cut off level of piles (50mm inside the pile cap) shall be as indicated in working drawings or as indicated by Engineer.

The top of concrete in pile shall be brought above the cut off level to remove all laitance & weak concrete and to ensure good concrete at cut-off level.

In case of concrete being placed by tremie method and pile cut off level being less than 1.0meter below the ground level, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 meter below working level then concrete shall be cast to a minimum of one meter above COL. Before concreting contractor shall obtain the approval of the Engineer of the height above COL up to which the concrete is to be cast.

In the circumstances where COL is below ground water level, the need to maintain a pressure should be observed & accordingly length of extra concrete above COL shall be determined by the Contractor and approval of Engineer obtained before concreting.

Any defective concrete in the head of the completed pile shall be cut away and made good with new concrete.

l. When a casing is being extracted, sufficient quantity of concrete shall be maintained within the bore to ensure the pressure from external ground water and soil is adequately exceeded by the pressure of concrete. Otherwise necking of the pile may result.

m. No concreting shall be placed in the bore once the bottom of the casing has been lifted above the top of concrete.

n. While concreting the pile, the overflowing bentonite slurry from pile should be carefully pumped out to a water tight container/tank so that it does not spill over. The contaminated bentonite should be disposed-off as per the methodology approved by the Engineer.

o. After each pile has been cast any empty bore shall be protected by putting steel cage/Jali over it and carefully backfilled as soon as possible with approved materials.

p. Complete boring and concreting records shall be submitted to the Engineer for each pile. The records shall include the duration of concreting, tremie lengths (individual and cumulative), tremie pipe lengths removed, theoretical sounding, actual sounding ,actual lengths of pile concreted and the volume of concrete placed, cut off level , founding levels etc. For piles with temporary casings records of sequence of casing withdrawal and levels of concrete before and after withdrawal shall also be included in the reports.

8.5 Alignment of Piles

8.5.1 Piles shall be installed as accurately as possible according to the drawings either vertically or to the specified batter. All deviations will be measured at the cut off level of the piles. The deviation from the true axis shall not be more than 1.5% for vertical piles and 4% for raker piles. Piles should not deviate in location by more than 75mm when used in groups. For single or two piles used under piers / columns, deviation shall not be more than 50mm.

8.5.2 The Contractor shall maintain a record of actual pile locations in the form of a drawing and submit the information to the Engineer at suitable intervals.

8.6 Pile Cap

Pile caps shall be of reinforced concrete. A minimum offset of 200mm shall be provided beyond the outer faces of the outer most piles in the group. If the pile cap is in contact with earth at the bottom, a leveling course of minimum 75 mm thickness of PCC of grade M15 shall be provided or as shown in the drawings.

The attachment of the pile head to the cap shall be adequate for the transmission of loads and forces. A portion of pile top may be stripped of concrete and the reinforcement anchored into the cap. Manual chipping may be permitted after three days of pile casting while pneumatic tools for chipping shall not be used before seven days after pile casting. The top of pile after stripping shall project at least 50mm into the pile cap. Concreting of the pile cap shall be carried out in dry conditions. Nothing extra will be paid for dewatering, etc. for carrying out pile cap excavation or providing concrete leveling course on building up pile cap and further substructure. Cost of all the operations and tools required for making the pile in dry condition is deemed to be included in the item.

The excavation area for the Piling / Pile cap shall be back filled and compacted and restored immediately but not later than 7 days after casting of the pile cap. Similarly the road surface should be repaired immediately after casting of column or completion of launching of superstructure (as the case may be but not later than 2 weeks). The payment for the same shall be made as per BOQ. If the area is not back filled and/or road surface is not repaired, with in the time frame as above, penalty will be imposed as decided by the Engineer.

8.7 Testing Of Piles

8.7.1 The load tests shall be in accordance with the Indian Standard Code of Practice for Design and Construction of Pile Foundations IS 2911 (Part IV) Load Tests on Piles.

For initial load test, test load will be 2.5 times the theoretical designed capacity of pile. For initial load, test arrangement to be designed shall also cater for additional 25% above test load and nothing extra will be paid on this account. The payment shall be made based on relevant item included in BOQ on test load only. Permissible stresses in test arrangement (steel truss or plate girder) to cater for test load plus additional 25% load shall be within permissible stresses as per IS:800 (as for permanent structure). For test frame, steel of Grade –B conforming to IS:2062 shall be used.

8.7.2 Engineer will decide the locations and no. of initial load tests to be performed in different zones depending on variation in substrata but minimum two initial load tests are required to be done for different types of strata. The contractor shall undertake test piles required for initial pile load test in the initial stages of work using the same methodology and equipment's which will be subsequently used for working piles. These tests shall be undertaken well in advance of working pile. No working pile would be allowed to be undertaken till initial pile load tests have been satisfactorily completed. Non-granting of permission for pile/ pile cap by Engineer in such respect will not be considered as reason for delay or any claim thereof. The test arrangement to be employed shall be of nature which is quick to install and remove and easily transferable. Sufficient no. of test arrangement and resources will be required to be mobilized by contractor so as to conduct required no. of initial load tests simultaneously. Vertical cyclic loading tests shall be carried out where specially needed and specified for separation of skin friction and point bearing components of the load carrying capacity of the piles.

8.7.3 Routine tests are performed as a check on the load carrying capacity and settlements of the pile foundations. At least one routine test shall be performed for every 100 piles unless otherwise specified by the Engineer.

8.7.4 Before commencing the load test the contractor shall prepare the work procedure for the same and shall make it available at site.

8.7.5 The Contractor shall give the Engineer at least 48 hours' notice of the commencement of construction of these piles which are to be subjected to Initial Tests.

8.7.6 The load tests shall not normally be conducted unless the concrete is at least 28 days old. However in special circumstances, permission can be given by Engineer for prior testing.

8.7.7 All testing shall be done under the direction of experienced personnel conversant with the equipment and the testing procedure.

8.7.8 Before the commencement of the tests all the particulars regarding the test pile including boring data and concrete cube strengths shall be made available at site and shall form a part of the test report.

8.7.9 On completion of each load test the Contractor shall submit a report of the load test which shall include the following information.

a. Description of soil conditions, ground water table, actual boring and installation records, concrete cube test results.
b. Method of load application
c. Load settlement readings during loading and unloading
d. Time load-settlement curve
e. All other observations relevant to the test being conducted.

8.7.10 This Dynamic Integrity test using pile driving analyser or approved equivalent for pile integrity shall be performed on the sample of piles selected by the Engineer. The top of the pile shall be made accessible, chipped off up to hard concrete, levelled by trimming it back as far as practicable. The reinforcing bars of the piles tested shall be bent sideways. The test shall be performed after removal of bad/ weak concrete at top so that the wave propagation is steady through hard concrete. The test shall be carried out at minimum 3 locations on each pile in such a way that the entire cross section of the pile is evenly covered. The test shall be conducted with a minimum age of concrete of 15 days. A specialist approved agency shall be employed for the test and the tests shall generally be as per recommendations of the agency unless otherwise directed by the Engineer. A complete report indicating the graphical display of wave propagation under each flow shall be submitted along with interpretation of results showing discontinuities, cross-sectional changes or material changes if any. The results are to be co-related with Site data.

8.7.11 Various utilities/services are running parallel to or crossing the viaduct alignment at different locations. Known utilities enroute have been identified, listed and marked on the GAD. The contractor shall take care that all necessary precautions shall be taken for preventing any damage to it during piling / casting of pile cap. The contractor shall carryout trial probes and trial pits down to depths decided by the Engineer with the objective of locating underground utilities well in advance of the piling. The locations shall be decided by the Engineer after consultation with the contractor.

8.7.12 Any damage done to the utilities / services (charted or un-charted) during piling/casting of pile cap or due to any of the contractor's operations, shall be made good by the contractor at his own cost. Any demurrage / penalty levied by the utility agency in this regard will also be payable by the contractor and no claim in this regard shall be entertained by Engineer/Employer.

8.7.13 As the work is to be carried out in urban areas, load test by kentalage method is not permitted

8.8 Defective Piles

8.8.1 The Engineer reserves the right to reject any pile which in his opinion has not been constructed in accordance with the specifications.

8.8.2 The Contractor will not be paid for rejected piles. The increase in cost of the pile caps, tie beams and other measures adopted for strengthening as a result of rejection of defective piles shall be borne by the Contractor.

8.9 Mode of Measurement Of Piles

8.9.1 Piles with casing pipe / Temporary Liners

1. The Contractor shall be paid for the length of each pile as measured from the theoretical founding level (as per drawing) or as per actual whichever is less to the point of the vertical cut-off level. The Contractor's rate shall include all items of work including all temporary/permanent arrangements for boring including usage of Bentonite, chiseling as specified / required, concreting, handling, form-work and grouting for precast piles, including chipping of top weak concrete, cutting off the MS liner / casing as necessary, removal of excavated earth, chipped concrete, casing / liners and bentonite slurry away from site including its treatment & final disposal, and all other items of work for the satisfactory completion of the pile foundations. Reinforcement shall be measured and paid separately.
2. Pile load tests initial and routine shall be measured separately and paid for separately.
3. Each pile integrity test shall be measured and paid for separately.
4. The quoted rate should include costs of tools and plants, cutting, welding MS liner, cutting shoe etc. complete.

Attention is also drawn to Para 8.4 2 (c) above.

8.9.2 Piles with Permanent Liners

The quantity of piles with permanent steel liners required for the job shall be measured as per specifications / detailed in para A above and paid for separately as per the relevant item of BOQ.

Attention is also drawn to Para 8.4 2 (c) above.

8.10 As-Built Drawings

On completion of the work, the Contractor will submit a plan showing the exact location and length of each pile as constructed at site, as well as dates of concreting, cube test results etc. The original tracings of these drawings along with soft copies shall be submitted to the Engineer.

9 ROOF SHEETING

9.1 General:

The roofing material shall consist of single skin crimp curved profiled sheeting made up of either of the below mentioned materials:

- High tensile SMP galvalume steel
- Modified polyester coated GI sheet
- Powder Coated MS sheet
- Aluminium/Aluminium Alloy sheets
- Zincalume sheets

The profile and length of sheets shall be commensurate with the design and site requirements and pre-coated with approved colour.

The contractor shall prepare shop drawings based on the drawings supplied by the Engineer. These shall be submitted in five sets sufficiently in advance to the Engineer for approval. All manufacturers shall be ISO 9001:2000 accredited.

9.2 Steel Material

- High tensile SMP galvalume steel

  The base material of sheet shall be galvalume high tensile cold rolled steel as per AS 1397, coating class AZ 150 (min. 150 gm/m2 zinc aluminium alloy coating mass, total of both sides) and having a yield strength not less than 550 Mpa.

- Modified polyester coated GI sheet

  The material shall be 0.60 mm TCT (Total Coated Thickness) modified polyester coated Galvanised steel. The sheets shall have a hot-dip metallic coating of Zinc (180 gms/Sq.M. zinc. Coating mass total on both sides) and have a yield strength not less than 240 MPa as per relevant IS codes.

- Powder Coated MS sheet

  The material shall be 0.60 mm TCT (Total Coated Thickness) powder coated mild steel. The sheets shall have a yield strength not less than 240 Mpa as per relevant IS codes.

- Aluminium/Aluminium Alloy sheets

  The External sheet shall be 65/400 profile straight sheets or tapered sheets Aluminium Alloy: EN AW-3004-AIMn1Mg1 (as per DIN 1725)with minimum ultimate tensile strength of 225 N/mm² and 0.2% Proof stress - min

200 N/mm² modulus of elasticity - 70,000 N/mm². Profile reference shall be 65/400 with min 65mm standing seam; 400mm cover width and nominal thickness/gauge: 0.9mm.

The roofing system shall comply to the British Board of Agreement and be certified as CLASS 1 roofing by Factory Mutual Research Corporation.

9.2.1 Profile

Trapezoidal profile with minimum depth of 30/40 mm with 3 small ribs at the centre to stiffen the profile. The profile shall have the seam and rib height as per the material used, thickness, purlin spacing and profile of the sheeting.

9.3 Coating/ Finishing

- High tensile SMP galvalume steel

  The sheet shall have silicon modified polyester (SMP) coating of approved colour of total thickness of 35 microns exterior coat of SMP over 5 microns polyester back coat over 5 micron primer coats on both surfaces including sides and end laps.

- Modified polyester coated GI sheet

  The sheet shall have modified polyester coating of approved colour of total thickness of 35 microns comprising of 20 microns exterior coat of modified polyester coating over top surface and 5 micron polyester backer coat over 5 micron primer coats on both surfaces

- Powder Coated Mild Steel Sheet

  The sheet shall have powder coating of approved colour of total thickness of 35 microns on both surfaces.

- Aluminium /Aluminium Alloy sheeting

  The outer sheet shall have PVF 2 coat system (non-clad 3004 type) or stucco embossed and colour as per requirements and specifications. The fluorocarbon (PVF2) coating system shall have 2 coats. The first coat shall be of inhibitive primer, with a dry film thickness averaging 5-7□m. Second coat shall have Fluorocarbon colour coat, with a minimum dry film thickness of 20 □m.

  The exterior finish coat shall be PVF2 paint system containing at least 70% of PVF2 resin in dry paint film, as required by approved licensed coating formulate. The finish coat shall have a dry film thickness of 0.020mm. The

paint finish system shall have mica particles to achieve its unique appearance, which result in a visual effect known as geometric metamerism.

In order to minimise appearance differences; all requirements shall be processed in one production run using the same batch of paint.

Standard colours will have a nominal gloss level of 20 to 35% (60o) - subject to choices of colours. A Backing Coat of nominal thickness of 0.005mm with standard colour coating. The coated finish for flashing and roofing sheet shall have the following properties:

- Humidity Resistance Blistering tested accordance to ASTM D 2247 (3000 Hours) with no blistering.
- Acid Salt Spray tested accordance to ASTM B117 (3000 Hours) with no creepage sighted.
- Formability of 0T to 2T, tested accordance to ASTM D4145.
- Pencil hardness conforming to ASTM D3363 with HB to 2T hardness grading.
- Reverse Impact tested accordance to ASTM D2794, with no loss of adhesion.
- Flame test tested to ASTM E84. Class A coating
- Specular gloss of 20 - 35%, measured at 60o and tested in accordance to ASTM D523.

9.4 Fixing

If slope of roof is less than 15 degree, the end lap on roof shall be minimum 225mm and single length sheets with joint sealed with double sided self-sticking tapes fixed between two sheets are recommended.

The contractor shall ensure that panel erector is familiarised with erection procedure and all the supporting members are straight, level, plumb and true (according to AISC) before starting panel erection. Panels shall be erected according to approved shop drawings. The indicative installation procedure is given below. It shall be suitably adapted based on the cladding/roof system adopted.

- Cut sheets and flashings to give clean true lines, with no distortion. Remove burrs and any lubricant.
- Cut openings in sheets for outlets, vent pipes, flues, etc. to the minimum size necessary and as per the cladding manufacturer’s recommendations.

- The sheets shall be laid starting from the eaves, or from bottom upward in case of cladding (IS:3007). The sheets shall be laid from the end of the building away from prevailing wind so that exposed edges face down wind.
- Ensure that ends of sheets, and end laps are fully supported with fixings at top of lap.
- Ensure that raking cut edges at hips and valleys are fully supported.
- Remove dust and any other foreign matter before finally fixing sheets into position.
- Protect sheets adequately during fixing and up to Practical Completion against mechanical damage and disfigurement. Rectify any defects as quickly as practicable to minimise damage and nuisance.

Fasteners

- Sheets shall be crest fixed to roof purlins with no. 12-14 x 55 mm long polymer coated galvanised hex head self-drilling screws with integral washers and EPDM seals (four fasteners per support) per sheet.
- Or drill all holes and install fasteners perpendicular to the surface of the cladding. Position fasteners at regular intervals in straight lines, centred on support bearings.
- Locate fasteners centrally within holes that are oversized.
- Install fasteners to correct tightness using any special tools recommended by the fastener manufacturer. When used, screw guns must be fitted with depth sensitive devices and used at the correct speed.
- Check fastenings on completion and adjust as necessary to ensure that they are watertight and sheeting is secure but not buckled or distorted.
- Paint all cut edges to match face finish.

FIXING OF STANDING SEAM SHEETS

- Standing Seam sheets to be installed by mechanically seaming sheets to support clips with electrically operated zipping machine.
- Only roofing contractors approved by the manufacturers should be employed to install Standing Seam roofing system.

STRUCTURAL MOVEMENT JOINTS

- Leave space between sheets to coincide with structural movement joints.
- Fix movement joint cover to sheets on one side only.

- Movement joint flashing details to be in accordance to cladding manufacturers recommendations.

9.4.1 Jointing Detail:

Trapezoidal profile with atleast one corrugation for side lap.

9.5 Accessories

The specification for capping, flashing and trims materials shall be same as that for sheeting and shall be factory formed to required shape and profile based on shop drawings. Depending on the cladding system adopted and the suitability, the accessories mentioned below shall be used.

- Extruded aluminium alloy: EN AW-6061 halters, 85mm long fixed to galvanised steel purlins, 2mm thick, with 25mm long 6.3mm dia stainless steel self-tapping fasteners
- Polyamide thermal barrier pads fixed to halter base
- Pressed aluminium alloy channel verge cap
- Pressed aluminium alloy ridge support
- Aluminium alloy Z section ridge closure
- Pressed aluminium alloy drip angle 40 x 60mm
- The aluminium clip shall be manufactured from extruded Aluminium Alloy 6061T6 with a ultimate tensile strength of not less than 340 MPa and elongation not more than 16% when tested according to ASTM B 557: 1981.
- Stainless steel self-tapping screws complete with stainless steel/EPDM bonded washers – thread type, length to suit construction detail. A minimum of 2 numbers of fixings per halter should be used.

9.6 Gutter

9.6.1 Material description:

Outer skin: 2.0mm aluminium, plain mill finish or galvalume, GI or MS powder coated sheet as per the cladding system adopted as per the specifications mentioned above.

9.6.2 Special requirements

- Gutter shall be supported by colour matched 2mm thick GI support brackets at every meter and butt jointed at (maximum) every 3 meters.
- Gutter fixings: stainless steel bolts, nuts, stainless steel & EPDM washers.

- Gutter sealing: All joints to be sealed with suitable sealant and water flow area shall be lined with waterproofed using suitable material.

9.7 Measurement

The sheets including special accessories such as gutters, north light curves, flashings, trims, etc. shall be measured and paid per sqm area.

No separate payment will be made for laps of sheets and accessories, bolts, nuts, washers, whitewashing, adjustable bolts and supports for gutters and other fixtures. These are assumed to be included in the quoted rates.

9.8 Warranty Period

The manufacturer / Supplier / fabricator/ contractor of the roofing system shall give a guarantee for 15 years with regarding to its composition, surface and tensile strength.

10 MISCELLANEOUS

10.1 Bearings

10.1.1 General

This work shall consist of design supply and fixing in position of bearings for bridge / viaduct girders in accordance with details shown on drawings and to the requirements of these Specifications, Codes and Standards quoted therein and as directed by Engineer.

10.1.1.1 Bearing plates, assemblies and other expansion or fixed devices shall be constructed in accordance with details shown on drawings.

When bearing assemblies or plates are shown on drawings to be placed (not embedded) directly on concrete, the concrete bearing area shall be constructed slightly above grade and shall be finished by grinding.

10.1.1.2 It shall be ensured that the bearings are set truly level and in exact position as indicated on drawings so as to have full and even bearing on the seats. This shall be checked with spirit level in both directions. Thin epoxy mortar pads (not exceeding 5 mm) may be made to meet with this requirement.

It shall be ensured that the bottoms of girders to be received on the bearings are plane at the location of these bearings and care shall be taken that the bearings are not displaced while placing the girders.

10.1.1.3 When elastomeric bearing pads or preformed fabric pads are to be provided, the concrete surfaces on which pads are to be placed shall be wood float finished to a level plane, which shall not vary by more than 1.5 mm from a straight edge placed in any direction across the area.

10.1.2 Scope of Work

The scope of work will include:

i) Rendering necessary assistance/coordinate with the manufacturer with regard to placement/fixing of said bearings. The contractor shall ensure that these bearings are installed in accordance with the specification of the manufacturers so that the bearings perform in the desired manner, in accordance with the forces/ displacements/ rotations for which these bearings have been designed. The contractor shall liaise with the agency and will be responsible for design etc. The contractor shall furnish adequate and proper installation details for these bearings while submitting his design and detailed Engineering Drawings. The design criteria, specifications etc. as mentioned in tender documents are mandatory and no deviation to the same shall be permitted unless otherwise directed by the Engineer.

ii) The contractor shall supply all the bearings in suitable packed condition (for its proper transportation and storage before placement in position) at project site to be identified by the Engineer. The price for such bearings (quoted in Schedule of Quantities) shall include all the accessories/holding down bolts/fixing arrangements (excepting reinforced concrete work in piers and girders, and finishing the surfaces of the pedestal) including grouting of holes with epoxy etc., as required.

A. POT BEARINGS

A.1 Material specifications of Pot bearing

The material such as PTFE (Poly Tetra Fluoro Ethylene) and lubrication to be used in Pot bearing should conform to BS:5400 Part-9.2 & BS:3784. The confined elastomer to be used shall conform to IRC:83 with a minimum IRHN of 60 +/- 5. The stainless steel shall conform to AISI: 304. The Pot base,saddle & top plate shall be of Cast steel conforming to IS:1030 Gr 280-520 W. Structural steel shall conform to grade A IS:2062-1992. The POT cylinder shall be made up of cast steel. If POT cylinder is to be made of mild steel, then it shall be made of Mild Steel conforming to Grade A of IS: 2062 – 1992 and without welding, duly certified as lamination free steel from SAIL/TISCO. No building up of thickness shall be permitted for POT cylinder. The anchor bolts shall conform to IS: 1364. All welding will be done by manual arc process and as per approved drawing shall conform to IS:816 & IS:9595 with electrode as per IS:814. Pre-healing and post weld stress relieving shall be done as per

IS: 9595. Painting on non-working surface of bearing shall be as per MOST specification, cl 2006.4.5. The mating surface of Piston and cylinder shall be hardened to 350BHN (Min).

A.1.1 ELASTOMER –Only the required type of chloroprene viz. Neoprene – WRT, Bayprene 110 or equivalent as specified in IRC: 83(Part-II) – 1987 shall be used in the manufacture of bearings. The Chloroprene shall either be imported directly from the manufacturers or purchased from their authorised agent in India and shall give a certificate to this effect to the department and the same shall be verified from the documents of purchase. Only fresh chloroprne which has been produced not earlier than one year shall be permitted for manufacture of bearings. No reclaimed rubber or vulcassired wastes shall be used.

A.1.1.1 The confined elastomer inside the POT will have the following properties as per Clause 2006.3(c) of MOST Specifications for Roads and Bridges which is reproduced below (Test method as per IS: 3400).

(a)	Hardness IRHD	50+5	
(b)	Tensile strength (minimum)	15.5 Mpa	
(c)	Elongation at break (minimum)	400%	
(d)	Compression set (maximum)	35%	
(e)	Accelerated ageing (maximum Change from initial value)		
	(i) Hardness	(+)	15 IRHD
	(ii) Tensile Strength	(-)	15%
	(iii) Elongation at Break	(-)	40%

Other specifications as given in IRC-83 (Part II) for elastomeric bearings will be followed.

A.1.1.2The elastomer for guide-stopper bearing shall be of synthetic rubber (Chloroprene) and shall conform to all the properties specified in clause 915.2 of IRC: 83 (Part – II) – 1987.

Laminates of mild steel conforming to IS: 226 shall only be permitted to be need. Use of any other materials like fibre glass or similar fabric as laminates shall not be permitted.

A.1.2. Accessories other than those mentioned below will be as per IS:2062 – 1992.

(a) Sealing ring for POT – Metallic (brass).

(b) Wiper seal – elastomer as per IRC: 83 (Part - II) - 1987.

(c) Dust seal – elastomer as per IRC: 83 (Part II) - 1987.

Guide stop bearings shall be fabricated as per tolerances in Table 2 of IRC:83 (Part-II)-1987.

Design of the bearing and all accessories shall be the responsibility of the Contractor and got approved from the Engineer.

A.2. Permissible stresses in steel component of Pot bearing

The entire design requirement for Pot bearing as specified in IRC:83 Part-III has to be fulfilled with following modifications.

(a) No increase in permissible stresses in any material of bearing or bearing stress between concrete and bearing is permitted in seismic condition.

A.3. Permissible bearing stresses in concrete

The allowable bearing stresses in concrete as defined in IRC:83 Part-III has to be followed with following modifications.

(a) No increase in permissible bearing stress between concrete and bearing is permitted in seismic condition.

A.4 Anchor sleeve

All the part of bearing such as anchor sleeves embedded in concrete shall be hot dip galvanized @ 300gm/ m^2. The anchor sleeves have to be designed taking account of difference in elasticity of steel of sleeve and concrete. The effect of shifting of center of rotation of sleeve should be also taken into account

A.5. The contractor shall furnish along with tender documents in technical bid , the name of the manufacturer of bearings , his qualifications with all details including proof of satisfactory performance, certification and testing facilities of the bearing he proposes to use . Products of reputed manufacturers shall only be used.

A.6 The Bearings shall be measured in numbers according to their capacities. For this purpose Fixed type POT bearings, Free sliding type POT-cum-PTFE bearings, Guided sliding type POT-cum-PTFE bearings, Free or Guided PTFE Sliding Assembly, Pin Bearings or Metallic Guided bearings shall be counted separately. The rate shall include the cost of supplying, fixing, sampling and testing as required and confirming to the specifications

A.7 Testing of Pot Bearing

A.7.1 Proof Load Test

A test bearing shall be loaded to 150% of the bearing's rated design capacity and simultaneously subjected to a rotational range of 0.02 radians or design rotation, whichever is greater, for a period of one hour.

The bearing will be visually examined both during the test and upon disassembly after the test. Any resultant visual defects, such as extruded or deformed elastomer or PTFE, damaged seals, or cracked steel, shall be cause for rejection.

During the test, the steel bearing plate and steel piston shall maintain continuous and uniform contact for the duration of the test. Any observed lift-off will be cause for rejection.

All bearings will be applied with a vertical load perpendicular to the plan area of the bearings and on approved system duly approved by Engineer, to subject the bearings to rotation. The minimum load at which the required rotation is achieved is to be determined and this value should be less than the minimum design vertical load as tabulated in the drawing.

For guide-stopper bearing, test on specially molded test pieces shall be conducted as per clause 918.4.1.2. of IRC : 83 (Part – II) – 1987 which shall be compared with Test pieces from test bearings. The variation shall be within limits specified herein.

A.7.2 Sliding Coefficient of Friction

For all guided and non-guided expansion type bearing, the sliding coefficients of friction shall be measured at the bearing's design capacity.

The sliding coefficient of friction shall be calculated as the horizontal load required maintaining continuous sliding of one bearing, divided by the bearing's vertical design capacity.

The test result will be evaluated as follows:-

(a) The measured sliding coefficients of friction shall not exceed 3%.

(b) The bearing will be visually examined both during and after the test. Any resultant visual defects, such as bond failure, physical destruction, cold flow of PTFE to the point of debonding, or damaged components shall be cause for rejection.

A.8 Sampling and Testing

A.8.1 Lot Size

Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria.

(a) A lot shall not exceed a single contract or project quantity;

(b) A lot shall not exceed 25 bearings;

(c) A lot shall consist of bearings of the same type regardless of load capacity. Bearing types shall be fixed or expansion bearings types . Guided and non-guided expansion bearing shall be considered a single type.

A.8.2 Sampling and testing requirements

The manufacture shall furnish the required number of samples to perform testing in accordance with Table Given below:

Test	Sample Required
Proof load	One production bearing per lot
Coefficient of Friction	One production bearing per lot
Physical Properties of elastomeric rotational elements	One elastomeric element per lot
Physical properties of PTFE sheet	One 10" x 15" sheet of PTFE material per project

A minimum of thirty (30) days shall be allowed for inspection, sampling and testing of production bearings and component materials.

All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

The manufacturer shall select, at random, the required sample bearing(s) from completed lots of bearings for testing by the manufacturer. He shall complete the required testing and determine compliance with this specification before submitting the lot(s) for inspection, sampling, and acceptance consideration.

The Engineer shall select, at random, the required sample bearing(s) from completed lots of bearings.

Necessary test certificates for all raw material shall be furnished by manufacturer .Test specified in IS:1030 for cast steel shall be performed . Casting shall be ultrasonically got tested by approved testing agency.

A.9 Fabrication Details

The Contractor shall provide the Engineer with written notification thirty (30) days prior to the start of bearing fabrication. This notification shall include all the information shown on the shop drawings which are required as explained in subsequent section.

The finish of the mold used to produce the elastomeric rotational element shall conform to good machine shop practice.

All steel surfaces exposed to the atmosphere, except stainless steel surfaces and metal surfaces to be welded, shall be shop painted in accordance with the Contract Plans. Prior to painting, the exposed steel surfaces shall be cleaned in accordance with the recommendations of the coating's manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating approved by the Engineer, if the time of exposure before welding takes place is to exceed three months, the coating shall be removed at the time of welding. No painting will be done to these surfaces prior to the completion of welding.

Stainless steel sheet shall be attached to its steel substrate with an approved epoxy to ensure complete contact and then sealed with a continuous seal weld.

The steel piston and the steel pot shall each be machined from a solid piece of cast steel.

The outside diameter of the piston shall be no more than 1mm less than the inside diameter of the pot at the interface level of the piston and elastomeric rotational element. The sides of the piston shall be bevelled to facilitate rotation. Except as noted all bearing surfaces of steel plates shall be finished or machined flat in accordance with tolerance given below:

Tolerances:-

Manufacture tolerance shall be as per IRC:83 Part-III and BS:5400,section 9.2 shall be followed subject to following modification .

(a) Plan Dimension: -0 to +5mm

(b) Overall height: -0 to +3 mm

(c) Height of any steel component

(i) Machined -0 to 0.5mm

(ii) Unmachined class 2 of IS:4897

(d) Stainless steel sliding surface

a. Flatness 0.0004L, where L= lengthin directionof measurement

b. Surface Finish Ra shall be less than or equal to 0.25 pm as perIS: 3073

All the measurements will be taken using dial / height gauges, verniercalipers, surface finish measurement instrument etc. has to be arranged by manufacturer at the workshop.

Every bearing shall have the Project Identification Number, Lot Number, and individual bearing number indelibly marked with ink on a side that will be visible after erection.

After assembly, bearing components shall be held together with steel strapping, or other means, to prevent disassembly until the time of installation. Packaging shall be adequate to prevent damage from impact as well as from dust and moisture contamination during transportation and storage.

A.10 Shop Drawings

Along with detailed design of different types of bearing, shop drawings shall be submitted .The shop drawings shall contain the following information, which is necessary for proper design and detailing of the bearings.

Quantity, type (fixed, guided expansion, non-guided expansion), and location of all bearing units.

A table containing maximum and minimum vertical and horizontal loads, design rotation requirements, and magnitudes and directions of movements.

Allowable contact stresses, maximum dimensions, and anchorage requirements at the bearing interfaces; grades, bevels, and slopes at all bearings; and allowable coefficients or friction of all sliding surfaces.

The painting system to be used on the steel components to guard against corrosion.

Any special consideration such as earthquake requirements, uplift details, or temporary attachments.

Installation scheme of pot bearing

The Contractor shall submit detailed shop drawings in conformance with the applicable requirements.

A.11 Measurements

The bearings will be counted in numbers alongwith bolts & washers.

B. ELASTOMERIC BEARINGS

The term “bearing” in this case refers to an elastomeric bearing consisting of one or more internal layers of elastomer bonded to internal steel laminates by the process of vulcanisation. The bearing shall cater for translation and/or rotation of the superstructure by elastic deformation.

B.1 Raw Material

The raw material shall confirm to the requirements laid down in clause 2005.1 of MORTH specifications.

Chloroprene (CR) only shall be used in the manufacture of bearing.

Grades of raw elastomer of proven use in elastomeric bearings, with low crystallization rates and adequate shelf life (e.g. Neoprene with low crystallization rates and adequate shelf life (e.g. Neoprene WRT, Bayprene 110 Skyprene B- and Denka S-40V) shall be used.

No reclaimed rubber or vulcanized wastes or natural rubber shall be used.

The raw elastomer content of the compound shall not be lower than 60 per cent by its weight. The ash content shall not exceed 5 percent (as per tests conducted in accordance with ASTM D-297, sub-section 10).

EPDM and other similar candidate elastomers for bridge bearing use shall not be permitted.

B.2 Properties

The elastomer shall conform to the properties specified in Clause 4.3.1 of the IRICEN publication titled "Bearings for Railway Bridges" and those specified in Table 2000-1 of the publication titled "Specifications for Road and Bridge Works", published by IRC on behalf of MORTH (Roads Wing).

The design, drawings, detailed method statement for installation & replacement of the bearings including its accessories shall be the responsibility of the Contractor. The design shall be got checked and certified by approved independent agency before submitting to the Engineer for approval

B.3 Fabrication and Tolerances

Fabrication and Dimensional tolerances shall be governed by the specifications laid down in Clause 4.3.2 of the IRICEN publication & Clause 2005.2 of the MORTH specifications mentioned above.

B.4 Acceptance Specifications

For inspection and testing requirement Clause 4.4 of the above mentioned IRICEN publication shall be referred with modifications of lot size as mentioned below:-

Sampling testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria.

(a) A lot shall not exceed a single contract or project quantity;

(b) A lot shall not exceed 50 bearings;

(c) A lot shall consist of bearings of the same type regardless of load capacity.

Accepting and testing requirements shall also conform to the specifications laid down in Clause 2005.3 of the referred MORTH specifications.

In addition to tests mentioned above, all bearings shall also be weighed actually and compared with the theoretical weight.

All bearings shall carry a warrantee of not less than 15 years in an approved format. The contractor shall be responsible for immediate repair or replacement of the bearings in case of failure / distress to the satisfaction of the Owner at not extra cost to the Owner within the warrantee period.

Criteria for Selection of bearing manufacturer shall conform to requirement of MOST letter No-RW/NH-34057(1) / 95-(S & R) dated 2nd November,2000. It is necessary that all manufacturers of all elastomeric bearings shall have in house facilities for carrying out Infrared Spectro-Photometry as per ASTM D-3677.

B.5 Design

The design of elastomeric bearings shall be as per the guidelines laid down in the UIC 772 R. Alternatively, design can also be made with latest version of Euronorm prEN1337-3 Part 3.

The design, drawings and detailed method statements for installation and replaceability of the bearings shall be checked and certified by approved independent agency before submitting to the Engineer for approval.

B.6 Storage and Handling

Each elastomeric bearing shall be clearly labelled or marked. The bearing shall be wrapped in a cover. They shall be packed in timber crates with suitable arrangement to prevent movement and to protect corners and edges.

Care shall be taken to avoid mechanical damage, contamination with oil, grease and dirt, undue exposure to sunlight and weather to the bearings during transport and handling prior to and during installation.

B.7 Installation

Installation procedure shall conform to the guidelines listed in Clause 4.5 of the IRICEN publication and Clause 2005.6 of the MORTH specifications. Cost of Non-shrink grout above and below the bearing should be included in the cost of providing and installation of bearing as per BOQ.

B.8 Measurement

Measurement shall be done in cu.cm correct to two decimal places. All linear dimensions required to arrive at volume of elastomer shall be measured correct to a mm. Payment shall be made for the volume of bearing as per design.

C. SHEAR KEY DEVICE

C.1 General Description of the System

C.1.1 General

The shear key is made of concrete cast in place in second pour after concrete decks are assembled.

The shear keys shall take all horizontal loads (longitudinal and transverse).

It is equipped with a system of fixation with high strength bars to one end of the deck, and with 5 vertical bearings taking the transverse horizontal loads and the rotations.

C.1.2 Description of the proposed system

The system of fixation of the shear key to the deck is performed by high strength tensile bars installed on only one horizontal layer.

The system shall satisfy with the two main following requirements:

- Construction easiness
- Maintenance easiness

The high strength tensile bars shall have a good resilience and a good resistance to fatigue because due to the rotation of the deck and the braking/acceleration loads the bars are almost continuously loaded.

The elastomeric bearings shall be of sufficient quality to avoid premature ageing. All the external surfaces shall be made of polychloroprene.

C.2 Materials characteristics

C.2.1 High tensile bars

Quality of steel: the quality of the raw material steel shall be according to the DIN EN 10083-1 or equivalent. The chemical composition shall be such as to guarantee the following mechanical characteristics:

- Yield stress Fy >1050 MPa
- Tensile stress Fu >1200 MPa
- Elongation at breaking >10%
- Resilience at 20°C > 50 Joules;

The threading of the bars shall be made by rolling method (cold plastic deformation of the metal between two dies). The threads shall have a triangular profile H7 according to ISO 262 - NFE 03014 and 03053.

The tolerance of the length of the bars is +/- 5mm

Diameters of bars: the stress in the bar will not exceed 0.85 Fu. The following U.T.S of bar are contemplated, but may be adjusted during detailed design phase: U.T.S of bars is 1420 kN, 1300 kN, 1120 kN, 1000 kN, 900 kN.

Due to the repetitive loading that will be applied to the bars, some tests shall be carried out to demonstrate the fatigue resistance of the bars. The test criteria shall be as follows:

- mean stress : 0.57 Fy
- stress range : +/- 0.03 Fy
- millions cycles
- after 4 million cycles, no breaking at less than 0.80 Fy.

Ultimate tensile strength test shall be conducted at manufacturers or any other approved independent laboratory in presence of Employer's Representative in charge, same test conducted in the past will not be considered.

C.2.2 Other materials

The repartition plates shall be of S355 JO steel quality or equivalent, and each shall include an injection pipe.

The bars end shall be equipped with a protection cap filled up with grease and fixed on repartition plate by threading.

The nuts at the bars ends shall be spherical in order to ensure that the tensioning is well axed.

Sheaths shall be made with 2 mm thick steel / 5 mm thick HDPE pipe.

The injection product shall be wax / high-density grease in order to provide a good time-resistance and to provide flexibility under the deck rotations. The product shall be equivalent as for use for protecting stay cables or tension rods.

C.2.3 Elastomeric bearings system

On the movable side of deck, one sliding elastomeric bearing shall be installed longitudinally on each side of the shear key. This sliding elastomeric bearing shall be made of one laminated elastomeric pad and of one sliding plate.

On the fixed side of deck, one laminated elastomeric bearing shall be installed longitudinally on each side of the shear key. In addition, at the interface between the shear key, one laminated elastomeric with adequate recesses to allow for replacement without taking out the high tensile bars shall be installed transversally.

These elastomeric bearings shall be made of polychloroprene, and manufactured according to Euronorm EN 1337-3 or equivalent.

The sliding plate shall be PTFE, with elongation at break >300% and tensile strength from 29 to 40 MPa.

C.3 Corrosion Protection

C.3.1 High tensile bars

The protection against corrosion of the high tensile bars shall be performed by using wax/ high-density grease injected in tube. So, the bars will be protected against corrosion only for the time of transportation and storage by means of sprayed oil or equivalent system.

C.3.2 Other materials

The upper repartition plate and the protection cap shall be sandblasted and shall receive 3 layers of coating.

The articulation room, the coupler and the lower ring shall be sandblasted and shall receive 3 layers of coating and a petrolatum tape.

The articulation room and the upper protection cap shall be filled up with grease.

C.4 Transportation & Storage

The bars and the accessories shall be transported in wooden cases and in containers, or equivalent.

The bar threading shall be temporarily protected against shocks by a greased tape and a steel ring, or equivalent. The protection of the threads shall be taken off only right before the installation of the bars.

The bars and accessories shall be carefully stored in the jobsite in the following conditions:

They shall be protected from rain, and the storage room shall have ventilation.

If the bars have to be kept stored for a long time, it will be necessary to protect them with a layer of solvable oil or equivalent in order to protect them against corrosion.

Before installation of the bars, if there is some corrosion, they shall be cleaned up. Acceptance of the bars shall be subject to CMRL approval.

C.5 Installation Procedure

The installation procedure is proposed as follows. Alternate methods can be submitted by the contractor, subject to CMRL approval.

1. Shear Key is poured before precast concrete deck segments are installed .The span must be assembled on higher level to avoid conflicts with already built concrete key.
2. Superstructure should have recess of 20mm for grouting by non-shrinkage grout at later stage
3. Erect the superstructure on temporary bearings/jacks with sliding surface at top at both ends
4. Provide some arrangement to prevent deck sliding (e.g. under seismic load).
5. Move the girder by hand screwing/jacking bar be nearly 20mm
6. At this stage vertical faced elastomeric pad is in position (resting on tubes)
7. Replace the temporary bearing with the permanent elastomeric bearing
8. Grout the gap between the girder (with hacked surface at grouting location) and the elastomeric bearing
9. Bar stressing
10. Wax injection and capping

Notes:

a) The bars are installed after alignment check, and the bars are installed inside the spherical nut at movable end. Then the bars are prestressed with jack. The bars are tensioned step by step (50% one bar, then 50% the other, then the remaining 50%).

b) Injection is then made from the movable end, with heated wax through injection tube.

C.6 Maintenance Procedure

The system shall be such that any device can be replaced without any destruction of concrete part of the structure.

The system shall be such that the maintenance procedures described below can be undertaken.

a) Lateral elastomeric bearings

For the lateral vertical bearings, a theoretical gap of 2mm shall be provided on each side of the shear key. If it is needed to change one or all of these lateral bearings, then, as the deck will not be in contact on each side at a time, the lateral bearings on the non-compressed side are taken out first. First the sliding plate is taken out, then the elastomeric bearing. Then the deck may need to be translated laterally to take out the elastomeric bearings on the compressed side. For this, steel angles can be split in the concrete on each side of the elastomeric bearings to provide support for jacks or threaded bars. The needed force to distort the neoprene bearings supporting the deck will be calculated.

b) Transversal elastomeric bearings

Thanks to the opening on the bearing, it will only be necessary to un-stress temporarily the tie-bars to take out the bearings and replace it.

c) Prestressed tie-bars

Bars will be un-stressed, then simply taken out thanks to the device provided at the movable end. Bars will be taken out easily because the connection between the spherical nut and the protection cap will not allow the spherical nut to turn. The wax product will come out with bar. New bars are introduced as per first installation, then tensioned and wax is injected.

10.2 Expansion Joints

10.2.1 Scope of Work

The scope of work will include:

i) Preparation of detailed engineering and installation drawings, supply and supervision during fixing of strip seal/compression seal expansion joints conforming to specifications. The expected expansion/contraction of the superstructure at the location of expansion joints are shown in relevant drawings.

ii) Design, manufacture, providing and seating of expansion joints by the specialised agency and approved by the Engineer.

iii) Necessary technical supervision for installation of each and every expansion joint during different stages of installation including rectification of any deficiency or defect attributable to fixing and installation will be provided by the manufacturer/supplier.

iv) The expansion joint shall be provided for the full width of viaduct including the railing.

v) Leak tightness of all joints shall be ensured which shall also carry a warranty of 10 years from the contractor.

10.2.2. The expansion joints provided over elevated structure decks should be so designed as to be compatible with the bearings wherever provided where the structure passes through stations, specially designed completely waterproof expansion joints should be provided.

10.2.3. The contractor shall submit design and drawing of compression seal expansion joints based on design criteria mentioned under "scope of Work" to the Engineer for approval. The design of expansion joint shall be done as per Revised Highways "Interim Specification for expansion joint" issued by Ministry of Road Transport vide No. RW/NH – 34059/1/96 – S & R dated 30th November 2000, IRC Codes and MOST Specification for Roads and Bridges and Sound Engineering practices.

Any modification to the design and drawings submitted by the Contractor, if suggested by the Engineer, shall be incorporated without any reservations. The design and drawings including changes approved by the Engineer shall form basis of execution and the Contractor shall undertake all necessary action for ensuring execution of work on that basis.

For design, manufacture, testing and supply of strip seal/modular strip seal expansion joints, following will be followed in order of preferences.

(a) Details in this chapter and elsewhere in tender documents.

(b) "Revised Interim Specifications for expansion joints" issued by MOST vide No. RW/NH – 34059/1/96/ S & R dtd.30.11.2000.

(c) IRC Codes and MOST specifications for Roads and bridges published by Indian Road Congress.

(d) Sound Engineering Practice (Decision of Engineer will be final in this case) which shall include specialized literature as decided by Engineer-in-Charge.

STRIP SEAL ELEMENT SPECIFICATION

Sealing element is made of chloroprene and must be extruded section. The working movement range of the sealing element shall be 70mm.

Property	**Specified Value**
Hardness*	
DIN 53505	63+ /-5 Shore A
ASTM D 2240 (Modified)	55 +/- 5 Shore A
Tensile Strength*	.
DIN 53504	Min 11 MPa
ASTM D 412	Min 13 .8Mpa
Elongation at fracture*	
DIN 53504	Min 350 per cent
ASTM D 412	Min 250 per cent
Tear Propagation Strength	
Longitudinal	Min 10 N/mm
Transverse	Min 10 N/mm
Shock elasticity	Min 25 per cent
Abrasion	Min 220 Cu.mm
Residual Compressive Strain	
(22h/70 deg C/30 per cent Strain))	Max 28 per cent
Aging in hot air	
(14days/70 deg C)	
Change in hardness	Max + 7 Shore A
Change in tensile strength	Max –20 per cent
Change in elongation at fracture	Max - 20 per cent
Ageing in Ozone	
(24 h/50 pphm/25 deg	
C/20 per cent elongation)	No cracks
Swelling behaviour in Oil (168h/25 deg. C)	
ASTM Oil No. 1	
Volume Change	Max + 5 per cent
Change in hardness	Max –10 Shore A
ASTM Oil No. 3	
Volume Change	Max + 25 per cent
Change in hardness	Max –20 Shore A
Cold Hardening Point	Max –35 deg C

*Only one set of specification viz. ASTM or DIN shall be followed depending on the source of supply.

10.2.4. Building Expansion Joints

Specialised expansion joints consisting of aluminium extrusions and / or elastomer suited to building applications shall be used. These will be provided for covering the structural gap at expansion joints along the horizontal faces of slabs and beams, vertical faces of retaining walls, etc. Necessary block-outs as per the manufacturer's recommendations shall be provided in the structure which shall be filled in the approved manner after placing the expansion joints.

The base of the expansion joint assembly shall be fixed onto the concrete base using anchor fasteners as per manufacturer’s specifications. All aluminium in contact with concrete shall have zinc chromate finish. The joint assembly shall be capable of accommodating the specified movement without loss of cover. The expansion joint cover assemblies shall withstand a minimum 500lb point load without damage or permanent deformation.

Only proprietary imported expansion joints from reputed manufacturers such as those manufactured by M/s Watson Bowman Acme supplied by Sanfield India Ltd and those manufactured by M/s c/s expansion joint and supplied by Z-Tech India Pvt Ltd and other MORTH approved manufacturers shall be used.

10.2.5. Fabrication (Pre-installation)

(a) The strip seal joint system and all its component parts including anchorages shall be supplied by the manufacturer /system supplier.

(b) The width of the gap to cater for movement due to thermal effect, prestress, shrinkage and creep, superstructure deformations (if any) and sub-structure deformations (if any) shall be determined and intimated to the manufacturer. Depending upon the temperature at which the joint is to be installed, the gap dimension shall be preset.

(c) Each strip seal expansion joint system shall be fabricated as a single entity unless stage construction or excessive length prohibits monolithic fabrication. It shall fit the full width of the structure as indicated on the approved drawing. The system shall be pre-set by the manufacturer prior to transportation. Presetting shall be done in accordance with the joint opening indicated on the drawing.

(d) The finally assembled joint shall then be clamped and transported to the work site.

10.2.6. Handling and Storage

(a) For transportation and storage, auxiliary brackets shall be provided to hold the joint assembly together.

(b) The manufacturer/supplier shall supply all the materials of strip seal joints including sealants and all other accessories for the effective installation of the jointing.

(c) Expansion joint material shall be handled with care. It shall be stored under cover on suitable lumber padding.

10.2.7. Supply/Installation:

Components of expansion joint such as edge beam and strip seal shall be imported from the specified foreign manufacturer / collaborator to ensure quality and performance. The joint shall be supplied and installed only by the MORTH approved manufacturer. Contractor shall furnish a warranty of trouble free performance for at least ten years and free rectification of defects / replacement, if any, during this period.

The joints shall be installed by the manufacturer/supplier (only MORTH Approved) or their authorised representative who will ensure compliance to the manufacturer's instructions for installation.

Taking the width of gap for movement of the joint into account, the dimensions of the recess in the decking shall be established in accordance with the drawings or design data of the manufacturer. The surfaces of the recess shall be thoroughly cleaned and all dirt and debris removed. The exposed reinforcement shall be suitably adjusted to permit unobstructed lowering of the joint into the recess.

The shuttering in the recess will be provided in such a way that dimensions in the joint drawing are maintained. The formwork shall be rigid and firm.

Immediately prior to placing the joint, the presetting shall be inspected. Should the actual temperature of the structure be different from the temperature provided for presetting, correction of the presetting shall be done. After adjustment, the brackets shall be tightened again.

The joint shall be lowered in a pre-determined position. Following placement of the joint in the prepared recess, the joint shall be levelled and finally aligned and the anchorage steel on one side of the joint welded to the exposed reinforcement bars of

the structure. Upon completion, the same procedure shall be followed for the other side of the joint. With the expansion joint finally held at both sides, the auxiliary brackets shall be released, allowing the joint to take up the movement of the structure.

High quality concrete shall then be filled into the recess. The packing concrete must feature low shrinkage and have the same strength as that of the superstructure, but in any case not less than M40 grade. Good compaction and careful curing of concrete is particularly important. After the concrete has cured, the movable installation brackets and shuttering still in place shall be removed.

The neoprene seal shall be field installed in continuous length spanning the entire carriageway width to ensure proper fit of seal and enhance the ease of installation dirt, spatter or standing water shall be removed from the steel cavity using a brush, scrapper or compressed air. The seal shall be installed without any damage to the seal by suitable hand method or machine tools.

The deck surfacing shall be finished flush with the top of the steel sections. The horizontal leg of the edge beam shall be cleaned beforehand. It is particularly important to ensure thorough and careful compaction of the surfacing in order to prevent any premature depression forming in it.

10.2.8. Acceptance Criteria:

(i) All steel elements shall be finished with corrosion protection system.

(ii) For neoprene seal, the acceptance test shall conform to the requirements stipulated in Table-1. The manufacturer/supplier shall produce a test certificate conducted in a recognized laboratory, in India (having NABL certification) or abroad.

(iii) The manufacturer shall produce test certificates indicating that anchorage system had been tested in recognized laboratory having NABL certification to determine optimum configuration of anchorage assembly under dynamic loading.

(iv) Prior to acceptance, 25 percent of the completed and installed joints, subject to a minimum of one joint, shall be subjected to water tightness test. Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25mm above the highest point of deck. The width of ponding shall be at least 50mm beyond the anchorage block of the joint on either side. The depth of water shall not fall below 25mm anytime during the

test. A close inspection of the underside of the joint shall not reveal any leakage.

(v) As strip seal type of joint is specialized in nature, generally of the proprietary type, the manufacturer shall be required to produce evidence of satisfactory performance of this type of joint.

10.2.9. Test and Standards of Acceptance

The materials shall be tested in accordance with these specifications and shall meet the prescribed criteria. The manufacturer/supplier shall furnish the requisite certificates from the recognized testing laboratory in India having NABL Certification or abroad.

10.2.10. Mode of Measurement

The measurement for expansion joints as a finished work shall be in running meters nearest to a centimetre.

10.2.11. Rates

The contract unit rate shall include the cost of all materials , labour , equipment, cost of transportation (overseas as well as with in country), cost of testing including cost of test samples and other incidental charges for fixing the joints complete in all respects as per specifications

10.3. Sealants

10.3.1. General

Joint sealing compounds shall seal joints in concrete against the passage of water, prevent the ingress of grit or other foreign material and protect the joint filler. The compound shall have good extensibility and adhesion to concrete surfaces and shall be resistant to flow and weathering.

Approved Sealant where specified on the drawings shall be provided strictly in accordance with the manufacturer's written instructions, such joints shall be formed to the correct dimensions, thoroughly cleaned and treated with recommended primer strictly in accordance with the manufacturer's written instructions prior to sealing. Wherever width of gap to be sealed is wide enough to necessitate the use of backer rod, the same shall be provided at no extra cost. The contractor shall use only competent personnel experienced in the application of sealant for such work.

Where specified in the drawings, silicon/poluurithane/ polysuphide based sealants shall be of an approved manufacture. The treatment of the joint and the use of sealing

compound shall be strictly in accordance with the manufacturer's written instructions. The entire work shall be carried out as per IS:3414, IS:6509, IS:11433.

Sealants shall be as follows:

Silicon sealant shall be one part gungrade type with minimum movement capability of ±25% and elongation at break of 450% confirming to BS 5889 or TTS 001543A. This Sealant shall be of approved color and shall be nonstaining to the parent concrete surface.

10.3.2. Ancillary Materials

The Contractor shall provide all ancillary materials such as cleaning solutions, epoxy mortar, primer, tool cleaner, bond breaker type, filler boards, back up material, backing rods, polyethylene foam, masking tapes, sealant slot former etc.

10.3.3. Primer

Primer for sealants shall only be as recommended by the sealant manufacturer, Primer shall have been tested for compatibility and durability with the sealant to be used and on samples of the surfaces to be selected.

10.3.4. Backdrop Material

Backdrop material shall be an expanded polyethylene of nominal density 35 kg/cum as recommended by the sealant manufacturer. It shall be of non-absorbent and non-staining material compatible with the sealant used. Tube or rod stock shall be rolled into the joint cavity.

10.3.5. Bond-preventive Materials

Bond-preventive materials shall be pressure-sensitive adhesive polyethylene tape or aluminium foil.

10.3.6. Equipment

The Contractor shall inter alia provide the following plant and equipment for the work.

T-paddle, follower plate, solid barrel gun, plastic nozzle, wire brush, heavy duty 500 rpm electric drill, palette knife, masking tape and paint brush for priming etc.

10.3.7. Working Life

Care shall be taken to ensure that material with adequate shell life is provided. Material whose shell life is over shall not be used in the works and shall be removed from the site forthwith. Depending on the storage, temperature and humidity, only one unit shall be drawn from the storage.

10.3.8. Curing Period

No portion of the work where sealant has been applied shall be allowed to be submerged or be wetted by any liquid for a period of 7 days after application of the sealant. This period may be modified depending on the temperature and humidity prevalent at the time.

10.3.9. Environmental Requirements

The ambient temperature shall be within the limits as given by the manufacturer, when the sealants are applied. The work shall not be carried out in a dusty atmosphere or when it is raining or when the humidity is high.

Sealants shall not be applied when the ambient temperature is below 4 degree C. When the ambient temperature is below 10 degree C but greater than 4 degree C, the sealant containers shall be stored for some hours at 21 degree C, to ease mixing and application.

10.3.10. Delivery and Storage

Materials shall be delivered to the job site in the manufacturer's original unopened containers.

The containers shall include the following information on the label:

a) Name of supplier,
b) Name of material,
c) Formula,
d) Lot number,
e) Colour
f) Date of manufacture,
g) Mixing instructions
h) Shell life and
i) Curing time

Materials shall be carefully handled and stored to prevent contamination of foreign materials to exposure to temperatures exceeding 35 degree C.

10.4. Joints

The effective width to depth ratio shall be as per the table given below unless directed otherwise by the Engineer.

Surfaces	**Joint Width**	**Joint Depth**	
		Minimum	**Maximum**
For concrete masonry or stone:	6 mm	6 mm	6 mm
	Over 6 mm up to 12 mm	6 mm	Equal to width
	Over 12 mm	½ of width	½ of width

10.4.1. Surface Preparation

General

The surface of joints to be sealed shall be clean, dry, sound and free of all release agents, water repellents, laitance, oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale and other foreign substances. Oil and grease shall be removed with solvent and the surfaces shall be wiped with clean clothes.

10.4.2. Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil or other such materials, the materials shall be removed by sandblasting or wire brushing, Litance, efflorescence and loose mortar shall be removed from the joint cavity. The surfaces/edges shall be repaired with epoxy mortar to give smooth and even surfaces to correct lines and levels with a uniform gap for the length to be sealed.

10.4.3. Application

Masking Tape

Masking tape shall be placed on the finished surface on one or both sides of a joint cavity to protect adjacent finished surfaces from primer or compound smears. The masking tape shall be removed within 10 minutes after the joint shall be filled and tolled.

10.4.4. Bond-preventive materials

Bond-preventive materials shall be installed on the bottom of the joint cavity and other surfaces to prevent the sealant from adhering to the surfaces covered by the bond-preventive materials. The materials shall be carefully applied to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond-preventive materials.

10.4.5. Backstops

The back or bottom of joints constructed deeper than specified shall be packed tightly with an approved backstop material to provide a joint of the depth specified.

10.4.6. Primer

The primer shall be used in accordance with the manufacturer's instructions. The primer shall be applied to the joint surfaces to be sealed only and not spill over or be applied to surfaces adjacent to the joints.

10.4.7. Application of Sealant

The sealant shall be gun-applied with a nozzle of proper size to fit the width of the joint indicated and shall be forced into grooves with sufficient pressure to expel air and fill the groove solidly. The sealant shall be uniformly smooth and free of wrinkles.

The plastic nozzles shall be inserted on the gun and cut to appropriate size. The sealant shall be gunned into joints using an even trigger pressure. The nozzle shall be cleaned occasionally.

The sealant shall be pressed into joints with a wet spatula and tooled within five minutes of application. The jointly shall be tooled slightly concave after the sealant is installed. The tolled joint shall present a smooth and professional joint giving the desired finish and shape. The masking tape shall be removed immediately after tooling.

Application equipment shall be cleaned with a tool cleaner, recommended by the manufacturer, after wearing PVC or rubber gloves and whist the sealant is still in an uncured state.

10.4.8. Cleaning

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealing application as the work progresses. Sealant adhering to, porous surfaces shall be left until is just cured and then removed by abrasion or other mechanical means.

10.4.9. Measurement

Measurement shall be made in running metres correct to two decimal places.

10.5. Waterbars / Waterstops

Where waterbars/ waterstops are shown on the drawings, the joints shall incorporate PVC waterbar/ waterstop such as "Fixostop" or approved equivalent (conforming to IS:12200). The waterbars/ waterstops shall be complete with all the necessary moulded or prefabricated intersection pieces assembled with bends and butt joints in running lengths made by welding in an electrically heated jig. The fabrication

drawing made by the manufacturer shall be submitted by the Contractor for approval of the Engineer

Jointing and fixing of waterbars/ waterstops shall be carried out strictly in accordance with the manufacturer's instructions which should be enumerated in a detailed method statement and submitted for approval / comments of the Engineer. The following types of waterbars/ waterstops are proposd to be used in the Work.

(a) 'FIXOSTOP' Type 230 KD or equivalent – To be used at construction joint in base slab

(b) 'FIXOSTOP' Type 230 KV or equivalent – To be used at expansion joint in base slab

(c) 'FIXOSTOP' Type 240 RS or equivalent – To be used at construction joint in between wall and base slab

(d) 'FIXOSTOP' Type 240 H or equivalent – To be used at expansion joint in base slab

Waterbars/ waterstops shall be of approved and appropriate type obtained from approvedmanufacturers.

The waterbars/ waterstops shall be installed so that they are securely held in their correct position during the placing and compacting of the concrete. Necessary supporting devices to prevent sagging of the waterbars/ waterstops shall be provided.

Where reinforcement is present adjacent to waterbars/ waterstops, adequate clearance shall be left between the reinforcement and waterbars/ waterstops to facilitate compaction of the concrete.

Double headed nails maybe used in the edge of the waterbar/ waterstop outside the line of the external grooves for fixing purposes, but no other holes shall be permitted through the waterbar/ waterstop.

A representative of the manufacturer shall be present at site during the operations of installing, jointing and embedment of waterbar/ waterstop. He shall monitor and certify that the work is being carried out strictly as per specifications and recommended practices.

Waterbars/ Water stops shall be measured and paid for separately as per BOQ.

10.5.1. MEASUREMENT

Waterbars/ Waterstops shall be measured in running meters along the line they are to be laid. Laps and welding etc. shall not be measured separately. The length shall be taken in metres correct to two decimal places.

All wastages, laps and variations are deemed inclusive in the item rate quoted by the contractor and nothing extra is admissible on this account. Payment will be made only for the measured quantity incorporated in the work.

10.5.2. RATE

The rate quoted shall include the cost of materials all transportation etc. and labour involved in all the operations described above.

10.6. Compression Seal expansion Joint

Expansion joint type described here-after is the "Compression seal" type, but alternate designs can be proposed for approval of the Engineer (e.g. elastomeric omega-shape cover joint, or any other suitable joint type.)

10.6.1. Compression seal joint shall consist of steel armoured nosing at two edges of the joint gap suitably anchored to the deck concrete and a preformed chloroprene elastomer or closed cell foam joint sealer compressed and fixed into the joint gap with special adhesive binder.

10.6.2. Material

10.6.2.1.Steel Nosing: The steel nosing shall be of angle section ISA 100 x 100 conforming to weldable structural steel as per IS:2062. The thickness of legs shall not be less than 12mm. The top face of the angle shall be provided with Bleeder holes of 12mm diameter spaced at maximum 100mm centre so as to ensure that there are no voids in the concrete beneath the angle.

10.6.2.2. Anchorage: The anchorage steel shall conform to IS:2062 or equivalent. The steel nosing shall be anchored to the deck by reinforcing bars or anchor plates cast in concrete or a combination of anchor plates and reinforcing bars, anchor plates and anchor loops. This shall be achieved by passing transverse bars through the loops or plates.

The minimum thickness of anchor plates shall be 12mm. Total cross sectional area of bars on each side of the joint shall not be less than 1600sq mm per m length of the joint and the centre to centre spacing shall not exceed 250mm. The ultimate resistance of each anchorage shall not be less than 600 KN/m in any direction.

Corrosion Protection: All steel section shall be protected against corrosion by hot dip galvanising or any other approved anticorrosive coating with a minimum thickness of 100micron.

10.6.2.3.Joint Seal

The sealing element shall be a preformed continuous chloroprene or closed cell foam seal with high tear strength, insensitive to soil, gasoline and ozone. It shall have high resistance to ageing and ensure water tightness. The seal should be vulcanised in a single operation for the full length of the joint required for carriageway, kerbs and footpaths, if any. The seal shall cater for a horizontal movement up to 40mm and vertical movement of 3mm.

The physical properties of chloroprene/closed cell foam sealing element shall conform to the following:

(a) Chloroprene Seal

It shall be performed extruded multi-web cellular section of chloroprene of such a shape as to promote self-removal of foreign material during normal service operations. Chloroprene of joint seal shall conform to clause 915.1 of IRC:83 (Part-II) and satisfy the properties stipulated in Table 1 herein above strip seal element specifications of these specifications except in respect of the working movement range of the sealing element which shall be as specified in Cl G.2.4.1 above.

(b) Closed Cell Foam seal:

It shall be of preformed non-extruded non cellular section made from low density closed cell, cross linked ethylene vinyl acetate, polyethylene copolymer that is physically brown using nitrogen. The material shall possess properties as indicated in the Table 2 below.

Table-2

Properties of Closed Cell Foam Seal

Property	**Special Value**
(ii) Density	41.7 – 51.3 kg/cum
(iii)Compression set on 25 mm	50% compression samples (ASTM D 3575) for 22 hours at 23^0 C, 2 hour recovery; 13% set.
(iii) Working temperature	-70 to $+70^0$C.
(iv) Water Temperature absorptions (total Immersion for 3 months) (ASTM3575)	0.09766 kg/sqm
(v) Tensile strength	0.8 MPa
(vi) Elongation at break (ASTM D 3575)	195+/-20%

10.6.2.4. Lubricant cum Adhesive: The type and application of material used in bonding the preformed joint seal to the steel nosing and concrete shall be as recommended by the manufacturer/supplier of the seal system.

10.6.3. Handling and Storage

(i) The expansion joint material shall be handled with care and stored under cover.

(ii) All joint materials and assemblies shall be protected from damage and assemblies shall be supported to maintain true shape and alignment during transportation and storage.

10.6.4. Installation

10.6.4.1. The expansion joint shall be installed by the manufacturer/supplier or their authorised representative, who will ensure compliance of specified installation procedure and instructions.

10.6.4.2. The dimension of the joint recess and the width of the gap shall conform to the approved drawing.

10.6.4.3. Anchoring steel shall be welded to the main reinforcement in the deck maintaining the level and alignment of the joint.

10.6.4.4. Concreting of pocket/recess shall be done with great care using proper mix conforming to same grade as that of the deck concrete but no less than M30 grade in any case. The water-cement ratio shall not be more than 0.40. If needed, suitable admixtures may be used to achieve the workability. The width of pocket shall not be less than 300mm on either side of the joint. Care shall also be taken to ensure efficient bonding between already cast/existing deck concrete and the concrete in the joint recess.

10.6.4.5. At the time of installation, joint shall be clean and dry and free from spalls and irregularities, which might impair a proper joint seal.

10.6.4.6. Concrete or metal surfaces shall be clean, free of rust, laitance, oils, dirt, dust or other deleterious materials.

10.6.4.7. The lubricant cum adhesive shall be applied to both faces of the joint and joint seal prior to installation in accordance with the manufacturer's instructions.

10.6.4.8. The joint seal shall be compressed to the specified thickness for the rated joint opening and ambient temperature at the time of installation, which shall be between +05 to +35 degree C.

10.6.4.9. The joint seal shall be installed without damage to the seal. Loose fitting or open joints shall not be permitted.

10.6.5. Acceptance Criteria

10.6.5.1. All steel elements shall be furnished with corrosion protection system.

10.6.5.2. For the joint seal the acceptance test shall conform to the requirements stipulated in para above. The manufacturer/supplier of this type of joint shall produce a test certificate to this effect conducted in a recognized laboratory in India having NABL certification or abroad.

10.6.5.3. Prior to acceptance 25% of the completed and installed joints, subject to a minimum of one joint, shall be subjected to water tightness test. Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25mm above the highest point of deck. The width of ponding shall be at-least 50mm beyond the anchorage block of the joint on either side. The depth of water shall not fall below 25mm any time during the test. A close inspection of the underside of the joint shall not reveal any leakage.

10.6.6. Tests and Standards of Acceptance:

The materials shall be tested in accordance with these specifications and shall meet the prescribed criteria. The manufacturer/supplier shall furnish the requisite certificates from the recognised testing laboratory of India having NABL certification or abroad.

The work shall conform to these specifications and shall meet the prescribed standards of acceptance.

10.6.7. Mode of Measurement

The measurement for expansion joints as a finished work shall be in running meters nearest to a centimetre.

10.6.8. Rates

The contract unit rate shall include the cost of all materials (including cast–in-situ concrete), labour , equipment,cost of transportation (overseas as well as with in country), cost of testing including cost of test samples and other incidental charges for fixing the joints complete in all respects as per specifications. However the cost of covering plate over shear keys will be measured in MT and paid separately.

10.7. Railings

10.7.1. General

Prefabricated railing as per approved drawings & details shall be erected at site and shall extend all along the full length of the viaduct and as shown in drawing. Fixing arrangements with deck shall be incorporated as per approved design & drawings.

Railing on viaduct shall not be constructed until the centering / supporting arrangement form work / supporting arrangement for the span has been released and the span is self-supporting. For concrete and steel, specifications of the items of controlled concrete and reinforcement mentioned under relevant specifications shall be applicable.

Railing shall be carefully erected true to line and grade. Posts shall be vertical with a tolerance not exceeding 6 mm in 3 m. The pockets / blockouts left for posts shall be filled up with non-shrinkable mortar.

All edges and corners shall be straight and finished to true line and level. Forms shall either be of single width boards/ plates or shall be lined with suitable materials duly approved by Engineer. Form joints in plain surface will not be permitted. All mouldings, panel work and level strips shall be constructed according to the details shown in the drawings.

10.7.2. Metal Railings

10.7.2.1. General

All complete steel/ aluminium railing elements, terminal sections, posts, and other fittings shall be of shape, size and designation of approved material and make as given in the item of work or as directed by Engineer. In case of steel railing all these elements shall be galvanised or painted with an approved paint. If galvanised, all elements of the railings shall be free from abrasions, rough or sharp edges, and shall not be kinked, twisted or bent. If straightening is necessary, it shall be done by methods approved by Engineer.

Aluminium sections shall be of approved quality,and make and free from scratches, stains and discoloration.

The Contractor shall take every precaution against damage of the components during fixing in position.

Damaged galvanized surfaces shall be cleaned and regalvanised. Special care shall be taken to prevent staining of all products, rust, mortar, etc. before it is put into use.

10.7.2.2. Fixing

The railing shall be carefully adjusted prior to fixing in place to ensure proper matching at abutting joints, correct alignment and camber throughout their length.

Fixing shall be strictly as per fixing details shown in the drawings or as directed by Engineer.

If sections are not galvanised, railing shall be given one shop coat of paint and three coats of paint after erection.

All necessary holes, chases, etc., required in fixing shall be made by the contractor and made good after installation, without any extra charge.

10.7.3. Cast-In-Situ Railings

10.7.3.1. The portion of the cement concrete railing or parapet which is to be cast in place shall be constructed in accordance with the requirements for Cement Concrete described in the respective section of RCC. Forms shall either be of single width boards or shall be lined with suitable material duly approved by Engineer. Form joints in plane surfaces will not be permitted.

All mouldings, panel work and bevel strips shall be constructed according to details shown on drawings. All corners in the finished work shall be true, sharp and clean - cut and shall be free from cracks, spalls or other defects.

10.7.4. Precast Railings

Precast members for railings shall be of reinforced cement concrete to be constructed in accordance with the requirements of cement concrete described in respective sections of RCC and Pre-cast concrete. The precast members shall be removed from moulds as soon as practicable and shall be kept damp for a period of at least 14 days. During this period they shall be protected from sun and wind. Any precast member that becomes chipped, marred, or cracked before or during the process of erection and fixing shall be rejected.

10.7.5. Measurements for Payment

Railings shall be measured as per BOQ as finished work.

10.7.6. Rate

Contract unit rate shall include cost of all labour, materials, tools and plant required for doing the work complete in all respects in accordance with above specifications and as shown in the drawings or as directed by Engineer.

11 STRUCTURAL STEEL SPECIFICATIONS - PAINTING WORKS

11.1 General

- Scope of specification

  This Specification covers the scope of painting, methods for the surface preparation, application of paints and precautions to be taken for the painting of structural steel work. It covers the supply and delivery of all necessary materials, labour, scaffolding, tools, equipment and everything that is necessary for the job completion on schedule.

- Applicable Codes

  The following Specifications, Standards and Codes are included as part of this Specification. All standards and codes of practice referred to herein shall be the current editions during the currency of project including all applicable official amendments and revisions.

  In case of discrepancy between this Specification and those referred to herein, this specification shall govern. In case of discrepancy between Contract drawings and this specification, the Contract drawings shall govern.

  a). IS: 102 (1962) : Ready Mixed Paint, Brushing, Red lead, Non Setting, Priming.

  b). IS: 159 (1981) : Ready Mixed Paint, Brushing, Acid Resisting for Protection against Acid Fumes, Colour as Required.

  c). IS: 384 (1979) : Brushes, Paints and Varnishes, Flat.

  d). IS: 487 (1985) : Brush, Paint and Varnish i) Oval Ferrule Bound
  ii) Round Ferrule Bound.

  e). IS: 958 (1975) : Temporary Corrosion Preventive Grease, Soft Film, Cold Application.

  f). IS: 1153(1975): Temporary Corrosion Preventive, Fluid, Hard Film, Solvent Deposited

  g). IS: 1477(1971): Code of Practice for Painting of Ferrous Metals in Building.
  Part I –Pretreatment
  Part II -Painting

  h). IS: 1674(1960): Temporary Corrosion Preventive Fluid, Soft Film, Solvent Deposited.

  i). IS: 2074(1992): Ready Mixed Paints, Red Oxide -Zinc Chromate.

11.2 Products & Materials

- Paint
  1. All paint delivered to the fabrication shop shall be ready mixed, in original sealed containers, as packed by the paint manufacturers, and no thinners shall be permitted.
  2. Paint shall be stirred frequently to keep the pigment in suspension
- Storage of Paints
  1. LAN paints shall be stored strictly in accordance with the requirements laid down by the paint manufacturers The storage area shall be well ventilated and protected from sparks, flame, direct exposure to sun or excessive heat, preferably located in an isolated room or in a separate building.
  2. All paint containers shall be clearly labelled to show paint identification, date of manufacture, batch number, order number and special instructions in legible form. The containers shall be opened only at the time of use. Paints which have liveried, gelled or otherwise deteriorated during storage, shall not be used. Paints for which the shelf life specified by the supplier has expired shall not be used without inspection and approval by the Engineer-in-charge.
- Execution

  Paint System (High Performance Polysiloxane System) Sand blasting shall be carried out in accordance with IS: 1477

Painting work shall be carried out as follows:

Description	**Surface**	
Fabrication Shop	**External Surfaces**	**Internal Surfaces**
Surface Treatment	Abrasive Blast to SA2.5 (ISO 8501-1:1988). If oxidation occurs between blasting and application of paint, the surface shall be re blasted to the specified standard.	Abrasive Blast to cleaning to minimum SA 2.5 (Swedish Standard SIS 055900), Near-White blast cleaning.

1st Coat	Providing & applying two components high build Zinc Rich Epoxy Primer Poly amide cured with minimum volume Solids of approximately 60% and a product weight of 2.50 kg/liter, minimum recoat interval of not more three hours at 25 deg C. The primer can be like Interzinc 52 of International Paints or approved equivalents. **DFT-75 microns** The primer shall be applied by Conventional/Airless Spray only in Shop.	Surface Tolerant Epoxy with minimum Volume Solids of 80%, minimum overcoat interval of not more than 24 hours at 25 deg C and a product weight of 1.6kg/liter. The primer can be like Interseal 670 HS of international paints or approved equivalent **DFT-150 microns**
2no Coat	Providing and applying two component Hi Build Epoxy intermediate Coat pigmented with Micaceous Iron oxide with approximate Volume Solids of 80%, minimum re-coat interval of 6 hours at 25 deg C and a product weight of approximately 2 kg/liter- like Intergard 475 HS of international paint or approved equivalent. **DFT-150 microns** The coat shall be applied by Conventional/Airless Spray only in Shop	
Erection Site Touch up Primer	Power Tool Cleaning to ST 2 standards followed by Surface Tolerant Epoxy with minimum Volume Solids of 80%,minimum overcoat interval of not more than 24 hours at 25 deg. C and a product weight of approximately 1.6kg/ litre like Interseal 670 HS of International Paints or approved equivalent. This primer shall be applied as touch up wherever damages have occurred on account of welding or Transportation & Erection.(Stripe Coat)- The DFT shall not be included in the Total DFT of System **DFT-75** microns	

Finish Paint Providing and applying two components Hi Gloss Acrylic Polysiloxane Finish Paint with approximate Volume solids of 70%, The product shall hard dry in not more than 5 hours at 25 deg C and 50% R.H. like Interfine 878 of International Paints or approved equivalent. This product should exhibit Gloss Retention following 3000 hours to U.V-A florescent lamp when checked as per ASTM-523 **DFT-75 microns.**
The paint shall be applied by Conventional/Airless Spray only at site.

The total Average DFT of External Surface is 375 microns

The total Average DFT of Internal Surface is 150 microns

DFT measurements should be done in accordance with Specifications SSPC PA 2.

INTERNAL SURFACE =Internal surface are those which will become inaccessible after fabrication and are not prone to humidity and moisture from the atmosphere.

EXTERNAL SURFACE = All other surfaces which are prone to humidity and moisture from the atmosphere.

The following precautions must be taken:

a) After abrasive blast cleaning, the first undercoat (primer coat) should be applied well beforesurface deterioration.
b) Over coating intervals, application parameters shall conform to manufacturer's instructionmanual.
c) The DFT (Dry film thickness) shall be measured after completion of each coat.

- Surface Preparation

  All surfaces shall be cleaned of loose substances and foreign materials, e.g. dirt, rust, scale, oil, grease, welding flux etc so that the primer coat adheres to the original metal surface. The work shall be carried out in accordance with IS: 1477 (1971) (Part I). Any oil, grease, dust or foreign matter deposited on the surface after preparation shall be removed and care shall be taken to ensure that the surface is not contaminated with acids, alkalis or other corrosive chemicals. The primer coat shall be applied immediately after the surface preparation is completed.

  Before the application of any paint the surfaces to be treated shall be thoroughly cleaned freed from all scale, loose paint, rust and other deleterious

matters. Oil and grease shall be removed from the surface by washing with solvents or with a detergent solution before blast cleaning operation of metal polish with metal pellets. If any traces of oil or grease remain after blasting they shall be removed by solvent cleaning and the area will be re-blasted thereafter.

All welding areas shall be given special attention for removal of weld flux slag, weld metal splatter weld head oxides, weld flux fumes silvers and other foreign objects before blasting. If deemed necessary by the Engineer in Charge, acid washing and subsequent washing with clean water shall be used. Any rough seams will have to be ground and must be inspected and approved by the Engineer-in-charge before application of the coatings.

All structural steel to be painted shall be cleaned using blast cleaning in accordance with SA 2 1/2 Near-White Blast cleaning (equivalent Swedish Standard SIS 055900). For SA 2 1/2 the profile should be in the range of 40-70 microns and shall be measured with comparator. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are light stains in the form of spots or stripes. Finally the surface shall be cleaned with a vacuum cleaner or clean dry compressed air. The blast cleaning shall produce a surface roughness complying with the one specified by the paint manufacturer for the primer concerned. If, cleaned surfaces are rusted or are contaminated with foreign material before painting is accomplished they shallbe re-cleaned by the Contractor at his own expenses. Nothing extra shall be paid on this account.

- Mixing of paint

All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse pigments, before use and during application, to maintain homogeneity. All pigmented paints shall be strained after mixing to remove skins and other undesirable matters.

1. Dry pigments, pastes, tinting pastes and colours shall be mixed and/or made into paint so that all dry powders get wetted by vehicles and lumps and particles are uniformly dispersed.
2. Additives that are received separate such as curing agents, catalysts, hardeners etc. shall be added to the paint as per the manufacturer’s

instructions. These shall be promptly used within the pot life specified by the manufacturers and unused paint thereafter shall be discarded.

3. Thinners shall not be used unless essential for proper application of the paint. Where thinners are used, they shall be added during the mixing process and the type and quantity of thinner shall be in accordance with the instructions of paint manufacturer.

- Paint Application

General

- Paint shall be applied in accordance with the manufacturer recommendations, as supplemented by these Specifications. The work shall generally follow IS 1477 (1971) Part II. Prior approval of the Engineer-in-charge shall be taken in respect of all primers and/or paints, before their use in the works.
- Paint shall generally be applied by brushing except that spraying may be used for finish coats only when brushing may damage the prime coats. Roller coat or other method of paint application shall not be used unless specifically authorized.
- Paint shall not be applied when the ambient temperature is 10°C and below. For paints, which dry by chemical reaction the temperature, requirements specified by the manufacturer shall be met with. Also, paint shall not be applied in rain, wind, fog or at relative humidity of 80% and above or when the surface temperature is below dew point, resulting in condensation of moisture. Any wet paint exposed to damaging weather conditions shall be inspected after drying and the damaged area repainted after removal of the paint.
- Each coat of paint shall be continuous, free of pores and of even film thickness without thin spots. The film thickness shall not be so great as to detrimentally affect either the appearance or the service life of the paint.
- Each coat of paint shall be allowed to dry sufficiently before application of the next coat, to avoid damages such as lifting or loss of adhesion. Undercoats having glossy surface shall be roughened by mild sand papering to improve adhesion of subsequent coats. Successive coats of same colour shall be tinted. Whenever practical, to produce contrasts and helps in identifying the progress of the work.

Brush Application

- Proper brushes shall be selected for a specific work piece. Round or oval brushes which conform to IS: 487(1985) are better suited for irregular surfaces, whereas flat brushes which conform to IS: 384(1979) are convenient for large flat areas. The width of flat brushes shall not generally exceed 1.25mm.
- Paint shall be applied in short strokes depositing a uniform amount of paint in each stroke followed by brushing the paint into all surface irregularities, crevices and corners and finally smoothening or levelling the paint film with long and light strokes at about right angles to the first short strokes. All runs and sags shall be brushed out. The brush marks left in the applied paint shall be as few as practicable.

Spray Application

- The spraying equipment shall be compatible with the paint material and provided with necessary gauges and controls. The equipment shall be cleaned of dirt, dried paint, foreign matter and solvent before use.
- The paint shall be applied by holding the gun perpendicular to the surface at a suitable distance and moved in a pattern so as to ensure deposition of a uniform wet layer of paint. All runs and sags shall be brushed out immediately. Areas not accessible to spray shall be painted by brush or dauber.
- Water trap acceptable to Engineer-in-charge shall he furnished and installed on all equipment used in spray painting.

Shop Painting

- The painting system specified in Table shall be followed. Surfaces, which will be inaccessible after field assembly, shall receive the full-specified protective treatment before assembly.
- Surfaces in contact during shop assembly shall not be painted. Surfaces which cannot be painted but require protection shall be given a rust inhibitive grease conforming to IS:958-1975 or solvent deposited compound conforming to IS: 1153 (1975) or IS: 1674 (1960) or treated as specified in the drawing.
- The shop coats shall be continuous over all edges, including ends meant for jointing at site by bolting, except where the paint could be detrimental to

bolting. In such cases, no paint shall be applied within 50mm, and the unprotected surface shall be given a coat of corrosion inhibitive compound.

- The unpainted area shall be cleaned prior to welding. The welded joint shall be cleaned and deslagged, and immediately after covered by the same paint as has been used for the remaining surface.

Painting at Site

- Surfaces which will be inaccessible after site assembly shall receive the full specified protective treatment before assembly. Surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together while the paint is still wet. Damaged or deteriorated paint surfaces shall be first made good with the same type of coat as the shop coat. Where steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds, bolts and site rivets. Specified protective treatment shall be completed after erection. Protection of Paint work
- The Contractor shall provide measures as necessary to prevent damage to the work and to other property or persons from all cleaning and painting operations. Paint or paint stains, which result in other unsightly appearance on surfaces not designated to be painted, shall be removed or obliterated by the contractor at his cost.
- All painted surfaces that in the opinion of the Engineer-in-charge are damaged in anyway, shall be repaired by the contractor at his cost with materials and to a condition equal to that of the requirements specified in these specifications.
- Upon painted surfaces that in the opinion of any other work that would cause dust, grease or foreign materials to be deposited upon the painted surfaces, the painted surfaces shall be thoroughly cleaned.
- The areas for high-strength bolts shall be protected by masking tape against undercoat application at the fabrication shop. Immediately prior to erection any rust in the paint area shall be removed by power wire brushing to a standard equivalent to SA3.

11.3 STRUCTURAL STEEL WORK-ERECTION

11.3.1 General

11.3.1.1Scope of Specifications

This Specification covers the delivery to site, storage and erection of structural steelwork at site. This includes plant and equipment requirements, installation of fabricated steel work in position and grouting all complete as per drawings, specifications and other provisions of the Contract.

11.3.1.2Submittals

A. Ref. Specification for Structural Steelwork Erection-General (Clause 11.1.3 above)

B. The contractor shall submit for approval a full description of his proposed erection method including sequence of erection, use of temporary supports, connection details and erection camber diagram and design calculations covering various stages of erection process.

11.3.2 Execution

11.3.2.1Delivery, Storage & Handling

A. Before the shop assembly is dismantled, all members and sections shall be appropriately marked with paint or grooved with their identification numbers as detailed in shop drawings. The Contractor's representative shall be present during all the shop assemblies (wherever fabrication will be done) , its dismantling and marking operations.

B. The Contractor shall deliver the fabricated structural steel materials to site, with all necessary field connection materials, in such sequence as will permit the most efficient and economical performance of the erection work. As per scheduled programme, the Engineer may, at his discretion prescribe or control the sequence of delivery of materials.

C. Fabricated parts shall be handled and stacked in such a way-that no damage is caused to the components. Measures shall be taken to minimize damage to the protective treatment on the steelwork. All work shall be protected from damage in transit. Particular care shall be taken to stiffen free ends, prevent permanent distortion and adequately protect all machined surfaces. All bolts, nuts, washers, screws, small plates and articles shall be suitably packed and identified.

11.3.2.2Plant and Equipment

All erection tools and plant & equipment proposed to be used shall be efficient, dependable duly certified by independent third party and in good working condition, and the suitability and adequacy of such shall be determined by the Engineer. The Contractor shall, in his technical proposal submittal, specify the plant and equipment proposed by him for erection of structural steelwork at Site.

11.3.2.3Storage

Materials to be stored shall be placed on skids above the ground and shall be kept clean and properly drained

11.3.2.4Method and Sequence of Erection

The method and sequence of erection shall have the prior approval of the Engineer. The contractor shall arrange for the most economic method and sequence consistent with the drawings and Specifications and such information as may be furnished to him prior to the execution of the Contract. The erection of steelwork shall be planned so as to ensure safe-working conditions at all times. The Contractor shall be solely responsible for enhancing the safety of his construction activities at Site.

11.3.2.5Assembly & Erection

A. During erection, the members and sections shall be accurately assembled as shown in the approved shop drawings and by following the match marks. The material shall be carefully handled so that no section will be bent, broken or otherwise damaged. Hammering which will damage or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Splices and field connections shall have 50% of the holes filled with bolts and balance 50% with cylindrical erection pins before bolting with high-strength bolts. Filling-up bolts shall be of the same nominal diameter as the high-strength bolts, whereas the cylindrical erection pins shall be 1 mm or larger in diameter.

B. The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the Engineer and his approval of the method of correction obtained. The

contractor shall be responsible for all misfits, errors and injuries and shall make the necessary corrections and replacements.

C. The straightening of plates, angles, other shapes and built-up members, when permitted by the Engineer, shall be done by methods that will not produce fracture or other damages. Distorted members shall be straightened by mechanical means or, if approved by the Engineer, by the carefully planned and well supervised application of a limited amount of localized heat Each application will be subject to the approval of the Engineer.

D. The responsibility in respect of temporary bracing and guys shall rest with the Contractor until the structural steel is located, kept in plumb, leveled, aligned and grouted within the tolerances permitted under the Specifications, and the permanent bracing/framing system has been installed.

E. The temporary guys, braces, false work and cribbing shall not be the property of the Engineer/Employer and will be removed by the Contractor, with the approval of the Engineer, without any charge, once the permanent framing system has been installed to the satisfaction of the Engineer and when the temporary bracing, guys etc. can be removed without any potential danger/damage to the erected structure.

11.3.2.6Setting Out

A. Positioning and leveling of all steelwork, keeping in plumb and placing of every part of the structure, with accuracy, shall be in accordance with the approved drawings and to the satisfaction of the Engineer. The Contractor shall check the positions and levels of the anchor bolts etc. before concreting and ensure that they are properly secured against disturbance during pouring operations. The Contractor shall remain responsible for correct positioning and shall set proper screed bars to maintain proper level. No extra payment shall be made on this account.

B. No permanent field connections by bolting shall be carried out until proper alignment and guides for keeping in plumb have been attached.

11.3.2.7Field Bolting

A. Bolts shall be inserted in such a way that they remain in position under gravity, even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled all joint surfaces including those

adjacent to the washers shall be free of scales. They shall be free of dirt, loose scales, burns and other defects that would prevent solid seating of the parts.

B. Holes for turned bolts to be inserted in the field shall be reamed in the field. Alldrilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications.

C. All high tensile bolts shall be tightened to provide the required minimum bolt tension as per relevant Indian Standards / Specifications when all fasteners in the joint are tight,

D. The manufacture and use of high strength friction grip bolts shall comply with therequirements of IS.3757 (1985).

E. Load indicating bolts or washers may be used, subject to the approval of theEngineer.

11.3.2.8Holes, Cutting and Fitting

A. No cutting of sections, flanges, webs, and cleats, rivets, bolts, welds etc. shall bedone unless specifically approved and / or instructed by the Engineer.

B. The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contract, or directed by the Engineer. Wherever such work is specified, the Contractor shall obtain complete information as to size, location and number of alterations, prior to carrying out any work.

11.3.2.9Drifting

A. Correction of minor misfits will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes, as necessary, to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed

B. Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be brought to the attention of the Engineer, and approval of the method of correction obtained. The use of gas cutting torches at the erection site is prohibited

11.3.2.10Grouting

A. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water, and any accumulated water shall be removed.

Grouting shall be carried out under expert supervision, takings care to avoid air locks. Edges shall be finished properly.

B. Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally aligned and leveled. Immediately before grouting, the space under steel is thoroughly cleaned. Where packings are to be left in place, they shall be placed such that they are completely covered with grout.

C. The grout to be used shall be Non-shrink grout conbextra GP-2 of M/S Fosroc orequivalent.

D. All steel in foundations shall be solidly encased in Portland Cement Concrete ofminimum characteristic strength at 28 days as specified in the drawings, subject to a minimum of 35 N/mm2. A minimum cover of 100mm shall be provided to all steelwork where surrounding concrete is in contact with soil.

11.3.2.11Inserts andEmbedments

Various steel inserts and embedments are required under the contract to be fabricated, positioned and secured firmly into place inside the formwork prior to concrete being poured. There are also requirements of jointing, threading, bolting and welding inserts and embedments of different concrete and structural steel elements in order to establish structural continuity and connection. Great care shall be exercised by the contractor in executing all aspects of the work related to inserts and embedments, including tolerances, so that the final assembly of the concrete elements can meet satisfactorily the continuity and contiguity requirements intended in the structure.

11.3.2.12Painting after Erection

A. The surfaces required to remain unpainted at shop, shall be given a protective coating after the structure is erected, leveled, kept in plumb, aligned in its final position, and accepted by the Engineer. However, touch up painting, making good any damaged shop painting and completion of any unfinished portion of the shop coat shall be progressively carried out by the Contractor.

B. Painting shall not be done in frost or foggy weather, or when humidity is such asto cause condensation on the surfaces to be painted. Before, commencingpainting of steel, which is delivered unpainted, all surfaces to be painted shall bedried and thoroughly cleaned from all loose scale and rust.

C. Surfaces, which will be inaccessible after field assembly, shall receive the full-specified protective treatment before assembly. Bolts and fabricated steelmembers, which are galvanised or otherwise treated, shall not be painted.

D. The contractor shall be responsible for any damage caused to other componentsof the structure including the substructure. In particular, he shall take all necessaryprecautions to minimise concrete splash onto completed steelwork or rust stainingof concrete due to erected steel work and clean and/or repair all stains and otherdamages to completed work prior to tests on completion.

11.3.2.13Final cleaning up

Upon completion of erection, and before final acceptance of the work by the Engineer,the Contractor shall remove, free of cost, all falsework, rubbish and all temporary works,resulting from or in connection with the performance of his work.

11.4 ADDITIONAL SPECIFICATIONS FOR LAUNCHING

Truss launching for longer spans:

- Preferably no road traffic blocking will be used. Multiple day/night short blocks of 1h to 1h30 maximum are acceptable to ensure safety.
- Launching scheme shown in Tender drawings is suggestive only. Contractor has to provide his own proposed launching scheme and supporting calculations with the offer.
- Contractor has to provide principles of nose/truss connection details in tender.
- Truss design composite girder requirements will govern over nose/ launching equipment requirements.
- Contractor will submit and get approval from Engineer of the detailed design of the full launching equipment and scheme before starting the launching.
- Contractor will coordinate with Nagpur Traffic Police and Engineer before and during the launching contractor to develop detailed traffic diversion scheme.
- Tentative allowable bearing pressure for temporary supports foundation concrete blocks shall be assumed at 10 tonnes/sqm.
- For location of storage and fabrication yard relevant clause of N.I.T shall be '-referred. Contractor shall indicate and justify in tender the proposed total needed yard area for the purpose.

- Any necessary precaution by proper and secure fixing shall be taken by the contractor to prevent the fall of any object onto the road below during the whole erection period.
- A minimum 15m •clear width (4 lanes) shall be kept during the whole construction period. These lanes can be obtained as 4 or 2+2.

11.5 MODE OF MEASUREMENT

1 The unit rate shall include the following:

i. Erection of fabricated parts (fabrication and transportation of various parts / components including HSFG bolts/nuts / washers from workshop to storage yard will be done by approved sub-contractors)

ii. Receiving, unloading and keeping in safe custody and upkeep of all fabricated parts including HSFG bolts/nuts / washers at storage yard.

jjj. Loading, transportation and unloading of all fabricated structural steel materials including HSFG bolts/nuts / washers from site storage yard to erection site, handling, assembling, bolting, welding if necessary and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer.

iv. Tightening of HSFG bolts for the field erection of fabricated parts. However supply of HSFG bolts and its compatible nuts and washers will be arranged / supplied at the storage yard by approved sub-contractor.

v. Preparation of complete detailed erection drawings and detailed calculation based on suggested erection sequence and design drawings as given by Engineer or alternative scheme proposed by contractor and approved by Engineer.

vi. Preparation of complete detailed fabrication drawings for all temporary structures such as temporary nose, staging, temporary support, bracing required for all permanent and temporary structures.

vii. All tools, plants and equipment I machinery

viii. All other consumables including fuel and lubricants etc.

x. All safety and protection arrangements to be made at site I storage yards for road users, public, and workmen.

2 The payment for the erection work and above mentioned work will be Lump-sum.

3 The procurement and application of all coats of site paints on external surfaces after erection as specified will be measured in sqm and paid separately.

12 FIREPROOFING FOR STRUCTURAL STEEL

12.1 GENERAL

12.1.1 SUMMARY

Section Includes: Provide spray-applied standard fireproofing with primers, hard coats, sealers, and accessories as required for complete finished installation.

12.1.2 REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E 605 Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members.
4. ASTM E 736 Cohesion/Adhesion of Sprayed Fire-Resistive Material Applied to Structural Members.
5. ASTM E 859 Air Erosion of Sprayed Fire-Resistive Material Applied to Structural Members.
6. ASTM E 761 Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members.
7. ASTM E 759 Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members.
8. ASTM E 760 Effect of Impact on Bonding of Sprayed Fire Resistive Material Applied to Structural Members.
9. ASTM E 937 Corrosion of Steel by Sprayed Fire Resistive Material Applied to Structural Members.
10. British Standard (BS) 476: Fire tests on building materials and structures, Part 20:1987, Method for the determination of the fire resistance of elements of construction (general principles)
11. British Standard (BS) 476: Fire tests on building materials and structures, Part 21:1987 Methods for determination of the fire resistance of load-bearing elements of construction
12. British Standard (BS) 476: Part 4-11 Product Characteristics for Surface Spread of Flame, Non Combustibility tests.

13. International Standard Organisation (ISO) 834: Fire-resistance tests - Elements of building construction, Part 1 - 1999: General requirements

B. Underwriters Laboratories Inc. (UL):

1. Fire Resistance Directory.
2. Cementitious Mixture as identified by Underwriters Laboratories Inc. in latest edition of UL Fire Resistance Directory under category CHPX, Spray-Applied Fire Resistive Material.

12.1.3 SYSTEM DESCRIPTION

A. Performance Requirements: Provide fireproofing in density and thickness as required to achieve fire ratings for Type 1 Fire Resistive Construction.

1. Fire Resistance Ratings: Comply with required ratings based on tests in accordance with ASTM E119, BS 476 part 20 &21, AS 1530.3.
2. Dry Density: Density shall be in accordance with ASTM Standard E 605 or relevant BS standards. Minimum average density shall be in the range of 240-320 kg/m3, whichever is greater.
3. Deflection: Material shall not crack or delaminate from surface to which it is applied when tested in accordance with ASTM E 759, or Material Tested to BS476 Standards for Deflections up to L/30.
4. Bond Impact: Material subject to impact tests in accordance with ASTM E 760 shall not crack or delaminate from surface to which it is applied.
5. Bond Strength: Fireproofing, when tested in accordance with ASTM E 736, shall have minimum average bond strength of 9.6 kPa and minimum individual bond strength of 7.2 kPa and not less than 20 times fireproofing weight.
6. Air Erosion: Maximum allowable total weight loss of fireproofing material shall be .05 g/m2 when tested in accordance with ASTM E 859 or relevant BS standards.
7. Durability: The material shall be durable for a min time period of 50years and shall have a data of durability in no fire situations in various weather conditions and various corrosion resistance, deflections and vibration conditions over these years. The durability data should be from independent recognized testing laboratories.

8. Compressive Strength: Fireproofing shall not deform more than 10 percent when subjected to compressive forces of 57kPa when tested in accordance with ASTM E 761 or relevant BS standards.
9. Corrosion Resistance: Fireproofing applied to steel shall be tested in accordance with ASTM E 937 and shall not promote corrosion of steel.
10. Surface Burning Characteristics: Material shall exhibit following surface burning characteristics when tested in accordance with ASTM E 84 or BS 476 Part 4-11 for product tests:

a. Flame Spread: 25 or less.
b. Smoke Developed: 25 or less.

11. Mold Resistance: Materials to show resistance to mold growth, ASTM C665 or shall be classified as non-hazardous material.
12. Combustibility: Material shall be Non Combustible and tested to BS 476 Part 4-11. Material shall have maximum total heat release of 20 MJ/m2 and a maximum 125 kW/m2 peak rate of heat release 600 seconds after insertion when tested in accordance with ASTM E 1354 or relevant BS standards at radiant heat flux of 75 kW/m2 with use of electric spark ignition. Sample shall be tested in horizontal orientation.

12.1.4 SUBMITTALS

A. Product Data: Submit manufacturer's literature indicating characteristics, performance,and limitation criteria of fireproofing.

B. Thickness Schedule: Provide schedule indicating material to be used, building elementsto be protected with spray-applied fireproofing, hourly rating and material thicknessprovided and appropriate references

C. Samples: Submit samples of fireproofing, fireproofing with hard coat finish, andfireproofing with sealer.

Size: Submit nominal 300mm by 300mm samples.

Number: Submit minimum four samples, three of which will be retained by the Employer's Representative.

D. Test Reports: Submit manufacturer's certified laboratory test report indicating thecompliance with performance requirements.

1. Submit fire test reports of fireproofing application to substrate similar to conditions expected on Contract.

2. Submit reports of independent testing agencies indicating conformance to ASTM E119 and ASTM E84 or BS 476 Part 4-11, and System Test To BS 476 Part 20& 21 and complying with ASTME 119.

E. Certificates:

1. Submit manufacturer certification indicating installer is approved or licensed by manufacturer.
2. Submit manufacturer certification materials comply with The Contract and applicable code requirements.
3. Submit Certificate of Approval from Taiwan Ministry of Interior.

F. Manufacturer Field Reports: Submit manufacturer's representative's field report andcertification indicating system has been installed in accordance with manufacturerrecommendations and installation instructions.

12.1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm with minimum five years successful experiencemanufacturing products similar to those required for Contract.

B. Installer Qualifications: Firm with minimum five years successful experience installingproducts similar to those required for Contract in similar applications.

1. Installer shall be approved or licensed by manufacturer.

C. Regulatory Requirements: Comply with

1. Products, execution, and fireproofing thickness shall conform to applicable code requirements for required fire resistance ratings.

D. Mockups: Provide mock-up area at reviewed without objection by the Employer'sRepresentative. Replace unsatisfactory mock-ups. Mock-up will be used as a standardfor judging acceptability of work on Contract.

1. Apply mock-up no less than two weeks before scheduled application.

E. Pre-lnstallation Meeting: Convene not less than one week prior to commencing work of this Section.

1. Require attendance of parties directly affecting work of this Section.
2. Review installation procedures and coordination required with related work.

12.1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original packaging.

B. Store materials off the ground, under cover, and in dry location until ready for use.

1. Bags exposed to water before use are unacceptable and shall be discarded.

2. Use material prior to manufacturers listed expiration date where applicable.

12.1.7 SITE CONDITIONS

A. Apply fireproofing only when temperature of substrate material, surrounding air, and dew point are within manufacturer's specified range.

B. Provide ventilation in enclosed areas to receive fireproofing during and 24 hours after application to dry material.

C. Provide temporary enclosures to prevent spray from contaminating air.

D. Provide temporary barriers to prevent over spray.

12.2 PRODUCTS

12.2.1 MATERIALS

A. Fireproofing: Mill-mixed cementitious formulation for sprayed-on application meeting performance requirements specified and blended for even texture.

1. Manufacturers: Match Southwest Vermiculite Co., Inc./Type 5 Cementitious Fireproofing; W.R. Grace/Monokote MK-6; Albi Manufacturing Division, Stanchem, Inc./Duraspray; Carboline Corp./Pyrolite I; IsolatekIntemational/Cafco 300; LAF (India);. Lasarge (India); Keisca (India).

2. Fireproofing shall be tested to certify manufacturer's published bond strength for primed steel.

3. Provide fireproofing product that contains no asbestos.

B. Adhesive/Bonding Agent: Manufacturer's standard material used as requiredto enhance the bonding strength to substrate.

C. Metal Lath or Wire Mesh: lath with galvanized finish to provide mechanical bond toprimed steel structure.

D. Water: Clean, Potable.

E. Hard Coat: Provide manufacturer's standard hard-coat topping system or special hardsystem for applications subject to abuse.

F. Sealer: Provide manufacturer's standard material recommended for use on applicationsof sprayed-on fireproofing exposed to exterior and high humidity, applied topping orntegral system, Contractor's option.

12.2.2 MIXES

A. Mixing water shall be clean, fresh, and suitable for consumption and free from suchamounts of mineral or organic substances as would affect the set of the fireproofingmaterial.

B. Provide water with sufficient pressure and volume to meet fireproofing applicationschedule.

12.3 SOURCE QUALITY ASSURANCE

A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve substrate before application and to instruct applicator on product and application method to be used for each substrate.

12.4 EXECUTION

12.4.1 EXAMINATION

A. Surfaces to receive spray-applied fireproofing shall be provided free of oil, grease, paints/primers, loose mill scale, dirt, or other foreign substances that may impair proper adhesion of fireproofing to substrate.

B. Where necessary to ensure bonding to substrate clean surfaces to receive fireproofing.

12.4.2 PREPARATION

A. Comply with fireproofing manufacturer recommendations for preparation of substrates to receive fireproofing.

B. Prior to application of fireproofing, apply bonding agent to concrete substrates to receive fireproofing and to other substrates where recommended by fireproofing manufacturer.

C. Allow other trades to install clips, hangers, support sleeves and other attachmentsrequired to penetrate fireproofing, prior to application of fireproofing material.

D. Complete fireproofing installation prior to installation of ducts, piping, equipment, and other suspended items. Coordinate with work of other Sections.

E. Allow completion of placing concrete on floor and roof decking prior to application of fireproofing to underside of steel deck and supporting beams and joists.

F. Complete roofing applications and roof mounted equipment installation prior to application of fireproofing to underside of roof decking and supporting beams and joists.

1. Prohibit roof traffic upon commencement of fireproofing and until fireproofing material is dry.

G. Protect permanently exposed walls, floors, and special surfaces:

1. Protect concrete, masonry, and other surfaces subject to overspray and that will be exposed to view, with masking, drop cloths, and other coverings as required to prevent overspray from bonding to protected item.

H. Post appropriate cautionary signs in areas in contact with wet fireproofing material.

I. Erect barriers to prevent entry by non-fireproofing workers into fireproofing spray and mixing areas and other areas exposed to wet fireproofing material.

12.4.3 INSTALLATION

A. Install fireproofing in accordance with manufacturer recommendations and applicationinstructions and in accordance with requirements of applicable codes and fire ratingapproval numbers and as required to meet required fire ratings.

1. Equipment and application procedures shall conform to material manufacturer's application instructions.

B. Apply fireproofing in sufficient thickness and density to achieve required fire ratings.

C. Apply fireproofing over substrate, building to required thickness with as many passes or stages necessary to cover with monolithic blanket of uniform density and texture.

D. Hard Coat Application: Provide protective hard coat or hard system at surfaces subject to damage by abrasion and damage by vandalism.

E. Sealer Application: Provide exterior quality material or sealer at fireproofing exposed to exterior and to high humidity.

F. Perform patching and repairing of spray-applied fireproofing with same materials asrequired to match original fire ratings and appearance.

12.4.4 FIELD QUALITY ASSURANCE

A. Site Tests: Provide site testing to ensure applied thickness and density meet fire rating requirements and reviewed test reports.

1 Correct unacceptable work and pay for further testing required to prove acceptability of installation

2. Patch test areas as required to re-establish fireproofing integrity.

B. Inspection: Allow for independent field inspections as required by applicable authorities.

C. Manufacturer's Field Services: Provide services of a factory-authorized technical service representative to verify installation is in accordance with manufacturer recommendations and installation instructions.

12.4.5 CLEANING

A. After completion of fireproofing work, remove application equipment.

B. Remove excess and overspray, droppings, and debris.

C. Remove fireproofing from materials and surfaces not required to be fireproofed.

1. Surfaces in exposed areas shall be left clean of fire proofing, surfaces in concealed areas shall be left in a scraped clean condition.

12.4.6 PROTECTION

Protect applied fireproofing from damage by subsequent operations; repair damaged fireproofing before fireproofing is enclosed.

SN	Item	Description
1.	2 Layers Electrical Isolation Membrane	Heave duty, cold applied and self-adhesive membrane with minimum 200 micron 4 ply cross-laminated HDPE film and rubber bitumen compound - with manufacturer's standard primer suitable for the application
2	GRC Angle / Tee	Uncoated GRC angle with a volume resistivity of minimum 1.2 X 10^{10} ohm-cm, or equal and approved, 4.5 mm thick performed to filleted angle / tee shape as required. Angles and tee to be installed in standard lengths butt joint and fixed to structure by means of epoxy based adhesive or equivalent. Ensure **all** arises are smooth and unlikely to cause damage to the insulation membrane.
3.	Isolation Sealant	

SN	Item	Description
	Backer Rod	Performed, compressible, resilient, non-staining, non-waxing, non-extruding strips of flexible plastic foam of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance. Backing materials to be compatible with joint substrates, sealant, primers and other joint filters; and are approved for applications indicated by manufacturer. Minimum volume resistivity 5 X 10^{10} ohm-cm.
	Sealant	Elastomeric one component, non-flammable RTV silicone rubber. Minimum volume resistivity 5 X 10^{10} ohm-cm. 1000mm x 10mm x 20 mm, sample test, wet 125 Mega Ohms. Size of joints related to resistivity test, preferred dimension 6mm.
4	Platform Floors / walls clad in floor tiles	Tie to be not less than 20mm thick and have a volume resistivity of 1 x 10^{8} ohm-cm.
5	Isolation Grout	Isolation grout to be not less than 10mm depth with minimum volume resistivity 2 x 10^{8} ohm-cm.
6	Fixings	Fixings to substrate to be resin / chemical anchors compatible with substrate / isolation membrane. And to have full isolation washers and caps to bolts. Minimum volume resistivity 5 x 10^{1} ohm-cm.
7	Wire Mesh	2mm diameter wire in mesh sizes of 50 x 50 mm.

APPROVED MANUFACTURERS/SUPPLIERS

All materials and products shall conform to the relevant standard specification, BIS codes and other relevant codes etc. and shall be of make as approved by Engineer.

The list of approved makes for products and materials is given below. Other equivalent manufacturers may also be considered with prior approval of the Engineer, if found conforming to all standards. Such requests should be made with all documents to the Engineer at least 45 days before the material is required and any order shall be placed only after receiving the written approval of the Engineer.

	List of Approved makes	
S.No.	**Details of Materials/Products**	**Manufacturer's Name**

Name of the work: Construction of balance work of Seven numbers Elevated Metro Stations (Automotive square, Nari road, Indora Chowk, Kadvi Chowk, Gaddi Godam Station, Kasturchand Park and Zero mile) including E&M works and PD area balance works excluding viaduct in Reach-2 of Nagpur Metro Rail Project.

RE-REVISED ABSTRACT OF ALL SCHEDULES

Tender No.N1C-39/2019

Item	Description	Description of Schedule	Estimated Amount (Rs.)	Percentage Above/Below/At Par	Amount in Indian Rs.(INR)
SCHEDULE- A to G					
1	**SCHEDULE- A**	General Works of Stations	165,12,059		
2	**SCHEDULE- C**	Structural Works of Stations	6727,06,473		
3	**SCHEDULE- C1**	Structural Works of Stations NDSR items	73,14,985		
4	**SCHEDULE- D**	NDSR items for the Architectural Finishing Works, Parking works, Site development works etc and other Miscellaneous work	3678,91,083		
5	**SCHEDULE-D1**	Architectural & Site Development Works	2167,00,953		
6	**SCHEDULE- E**	Item for the Architectural Finishing Works, Parking works, Site development works, etc and other Miscellaneous work	212,16,397		
7	**SCHEDULE- F**	E and M work (Electrical, fire fighting with fire alarm system, HVAC system)	5866,78,538		
8	**SCHEDULE- F1**	Public Health Engineering	451,19,649		
9	**SCHEDULE- G**	DSR-2018 items (with latest amendment / Directives to the DSR-2018). The contractor has to carryout the works as per DSR-2018 varrious clauses,chapters and schedules covered in the DSR-2018.	975,00,000		
GRAND TOTAL (Rs.)			**20316,40,137**		
Amount in Words:					

MAHA-METRO

MAHARASHTRA METRO RAIL CORPORATION LIMITED NAGPUR METRO

Signature and Seal of Bidder

Name of Work: CONSTRUCTION OF Balance work of SEVEN ELEVATED METRO STATIONS (AUTOMOTIVE SQUARE, NARI ROAD, INDORA CHOWK, KADVI CHOWK, GADDI GODAM STATION, KASTURCHAND PARK AND ZERO MILE) INCLUDING E&M WORKS AND PD AREA BALANCE WORK EXCLUDING VIADUCT IN REACH-2 OF NAGPUR METRO RAIL PROJECT.

Tender No.N1C-39/2019

Re-Revised Summary of Schedule - F

Reach-2

	S. NO.	Description	AMOUNT (INR)
ELECTRICAL	E.01	L.T. PANELS	762,09,811.98
	E.02	DISTRIBUTION BOARDS	67,95,804.71
	E.03	MV CABLING, BUSDUCT AND TRAY	708,23,611.79
	E.04	INTERNAL WIRING & ACCESSORIES	183,45,269.79
	E.05	LIGHTING FIXTURES & FANS	355,54,359.68
	E.06	PROTECTIVE EARTHING	135,02,988.82
	E.07	LIGHTNING PROTECTION	50,73,910.78
	E.08	EXTERNAL LIGHTING	30,25,650.94
	E.09	UNINTERRUPTED POWER SUPPLY SYSTEM	-
	E.10	Safety and Other accessories	3,72,768.75
	E.11	BMS/SCADA for all system parameter of the panel	335,49,187.50
	E.12	VIA DUCT LIGHTING	-
	E.13	Mandatary Operational Spares for the Panels And safety items	22,36,612.50
	E.14	LIGHTING CONTROL SYSTEM	153,22,309.07
		TOTAL FOR ELECTRICAL	**2808,12,286**
FIRE FIGHTING	F.01	FIRE HYDRANT SYSTEM	381,25,490.29
	F.02	FIRE EXTINGUISHERS	33,46,787.73
	F.03	PANEL FLOODING SYSTEM	89,46,450.00
	F.04	FIRE ALARM SYSTEM	105,71,861.02
	F.05	Mandatary Operational Spares for the Panels And safety items	22,36,612.50
		TOTAL FOR FIRE FIGHTING	**632,27,201.54**
HVAC	H.01	EQUIPMENT & PIPING	302,45,798.97
	H.02	VENTILATION	98,634.71
	H.03	AIR DISTRIBUTION	2,53,039.91
		TOTAL FOR FIRE HVAC	**305,97,473.59**
		GRAND TOTAL FOR E&M SYSTEM -REACH-2	**3746,36,961.42**

ZERO MILE STATION

ELECTRICAL	ZE.01	L.T. PANELS	314,98,633.00
	ZE.02	DISTRIBUTION BOARDS	16,99,816.21
	ZE.03	MV CABLING, BUSDUCT AND TRAY	372,56,888.68
	ZE.04	INTERNAL WIRING & ACCESSORIES	159,59,062.46
	ZE.05	LIGHTING FIXTURES & FANS	164,19,709.41
	ZE.06	PROTECTIVE EARTHING	23,96,634.41
	ZE.07	LIGHTNING PROTECTION	13,48,045.00
	ZE.08	EXTERNAL LIGHTING	31,99,583.70
	ZE.09	UNINTERRUPTED POWER SUPPLY SYSTEM	24,88,136.00
	ZE.10	DIESEL GENERATOR	38,01,570.00
	ZE.11	BMS/SCADA for all system parameter of the panel	55,91,531.25
	ZE.12	Safety and Other accessories	62,128.13
	ZE.13	Mandatary Operational Spares for the Panels And safety items	3,72,768.75
	ZG.01	FACADE LIGHTING	321,91,384.00
		TOTAL FOR ELECTRICAL	**1542,85,891**
FIRE FIGHTING	ZF-01	FIRE HYDRANT SYSTEM	201,62,757.73
	ZF.02	FIRE ALARM SYSTEM	101,36,473.83
		TOTAL FOR FIRE FIGHTING	**30299231.55**
HVAC	ZA	EQUIPMENT & PIPING	183,68,536.69
	ZB	AIR DISTRIBUTION	70,66,985.00
	ZC	THERMAL INSULATION	7,12,532.00
	ZD	ELECTRICAL	13,08,400.00
		TOTAL FOR FIRE HVAC	**274,56,453.69**
		GRAND TOTAL FOR E&M SYSTEM -ZERO MILE STATION	**2120,41,576.24**
		GRAND TOTAL FOR E&M SYSTEM - REACH-2 & ZERO MILE STATION	**5866,78,537.66**
		Grand Total of Schedule-F Say	**58,66,78,538**

MAHA-METRO

Signature and Seal of Bidder

MAHARASHTRA METRO RAIL CORPORATION LIMITED
NAGPUR METRO

Name of Work: CONSTRUCTION OF Balance work of SEVEN ELEVATED METRO STATIONS (AUTOMOTIVE SQUARE, NARI ROAD, INDORA CHOWK, KADVI CHOWK, GADDI GODAM STATION, KASTURCHAND PARK AND ZERO MILE) INCLUDING E&M WORKS AND PD AREA BALANCE WORK EXCLUDING VIADUCT IN REACH-2 OF NAGPUR METRO RAIL PROJECT.

Tender No.N1C-39/2019 Dt.05.07.2019

Re-Revised BOQ FOR E&M SYATEM OF REACH-2 STATIONS & ZERO MILE

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
E	**General Notes for Electrical Works**												
1	The BOQ specified below include the latest relevent standards, specifications, **drawings (In conjuction with relevant Station drawings)** and the contractor is required to go through them as referred in tender document while quoting the rates. All the samples/ material intended to be used in the works shall be subject to approval before use as the Employer's representative may opt.												
2	The description as mentioned in BOQ, specifications, special conditions, GCC drawing and the conditions mentioned therein whichever is stringent shall be applicable, acceptable and complied with.												
3	Sub-letting of work by the contractor shall only be permitted in accordance with Special Conditions of Contract.												
4	The items indicating zero quantity can also be operated and variation clause shall be applicable as stipulated in GCC / SCC.												
5	Bus Bar Sizing calculations shall be submitted for approval of Employer or his representative.												
6	Contractor's shall quote resonably rates against each item of BOQ (both in word and figure)												
7	Auto,manual,bypass ,remote, local selector switch and interlocking arrangement shall be provided for the Panel boards wherever required.												
E.01	**L V SWITCHGEAR**												
E1.1	**Switch Boards/panels**												
	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty floor / wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with neoprene gaskets, fabricated from 2 mm thick CRCA sheets with dip coat priming and epoxi powder coated finish (minimum thickness 50 micron) suitable for 415 volts 3 phase 4 wire 50 Hz system to withstand symmetrical fault level of 50 KA at 415 V including interconnections, bonding to earth etc. and flush doors conforming to relevant IEC/IS (viz. IEC 60439, IS 8623 etc.) standard including the earth leakage protection complete as per specification & drawings as required and as given below. All internal wiring in the panels shall be carried out using high temperature FRLS wires.												
a)	The Switchboards shall be provided with detachable gland plates for entry of cables from the top/bottom as required.												
b)	All live accessible parts shall be shrouded and all equipment shall be finger touch proof. The busbars shall be insulated with heat shrinkable sleeves. SMC/DMC shrouds and busbar supports suitably spaced shall be used. Hinged doors with padlocking facility shall be provided on all outgoing feeders with switch handles lockable in OFF position.												
c)	The panel shall have tinned copper busbars with bar type feeder connections, spacers etc.and neutral busbar shall be of 50% capacity for busbar of above 200A rating and 100% otherwise.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
d)	Earthing all components, frame etc. to a common internal earth bar of minimum size 50 x 6 mm Copper .												
e)	All accessories & supporting structures such as channels, ISMC base frame, mounting brackets, lifting lugs, panel heaters, ventilation arrangement etc as required.												
f)	Each incomer and outgoing feeder shall be provided with multiple LED/neon type status indication lamps suitable for 230 V, AC as approved.												
g)	Space provision @ 15% for future expansion												
h)	The makes of components and accessories shall, to the extent practically feasible, be same for panels and boards for uniformity, standardisation and replaceability and shall be applicable to all panels/ boards under the scope of work.												
i)	Switchboard including interconnections, labeling, earthing,associated foundation / masonary work & erection etc. complete as required.												
j)	All MCCBs shall be current limiting type microprocessor based, rated for requisite specified Service short circuit breaking capacity (Ics suitable for isolation conforming to latest IEC947-2/IS13947-2 duly marked on MCCB, at operating voltage (Ue) of 415 V, insulation voltage (Ui) 750 V and with trip free mechanism, handle indicating ON/OFF/tripped position. The breaking capacity as mentioned shall be Ics values.												
k)	MCCBs shall be compact (As the Engineer may decide), suitably designed to provide protection of motors, cables, busbars to suit rated current, unbalanced power distribution as required and with front adjustable overload and short circuit releases and minimum electrical endurance of the order of 7000-8000 operation cycles (higher shall be preferred) for capacity of 100-250 amps.												
l)	All the MCCBs shall be provided with potential free contacts for connectivity to PLC in ESR/Pump Room for ON/OFF status and control, as required, from BMS workstation.												
m)	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 9/10 kA at 415 V AC, current limiting type lower powerloss appx 40 -70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for moter application duty, with minimum Electrical endurance of the order of 20000 operation cycles.												
n)	Panel/board design shall be compact and components / accessories of compact sizes be used to economies the room space available. Employer reserve the right to seek compact items inplace of larger ones												
o)	All incomer ACB's shall be provided with minimum 2 NO + 2 NC auxiliary contacts and all MCCBs shall be provided with 2 NO+ 2NC auxiliary contacts, and there should be provision to add min. 6 Auxlary contacts.												
p)	All 4-pole ACBs shall have fully rated neutral pole												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
q)	The panels shall be fitted with fire trace tube system. Payment for fire trace tube system shall be made under separate item. Scheme of fire trace tube system shall be got approved by Engineer before proceeding with manufacturing and assembly.												
r)	Various panels/boards as given below:												
1.1	**Main Distribution Board (MDB1 and MDB 2)**												
	Main Distribution Board (MDB)as per specifications & as per following details:	No.	1	1	1	1	1	1		6	19,34,017.05	21,75,769.18	130,54,615.11
A	**TRANSFORMER - I INCOMING**												
	1 no. 800 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase (red, yellow, blue) indicating lamps												
c)	Amber healthy trip indicating lamps												
d)	3 nos. cast resin current transformers of 1000/5 ratio with 15 VA Burden & Class 5P10 for protection and metering												
e)	3 nos. cast resin current transformers of 1000/5 ratio with 15VA burden and Class 1.0 for measurement												
f)	Microprocessor based release having variable range of overcurrent, short circuit and earth fault protection with time log facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.												
g)	230V AC or 24 V DC shunt trip coil												
h)	230V, AC Motor wound spring closing mechanism												
i)	Terminals to receive aluminium XLPE armoured cables												
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
B	**TRANSFORMER - II INCOMING**												
	1 no. 800 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase (red, yellow, blue) indicating lamps												
c)	Amber healthy trip indicating lamps												
d)	3 nos. cast resin current transformers of 1000/5 ratio with 15 VA Burden & Class 5P10 for protection												
e)	3 nos. cast resin current transformers of 1000/5 ratio with 15VA burden and Class 1.0 for measurement												
f)	Microprocessor based release having variable range of overcurrent, short circuit and earth fault protection with time lag facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.												
g)	230V AC or 24 V DC shunt trip coil												
h)	230V, AC Motor wound spring closing mechanism												
i)	Terminals to receive aluminium XLPE armoured cables												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
j)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.BMS interface terminal shall be separate												
	Auto,manual,bypass ,remote and local selector switch and interlocking arrangement												
C	**BUS COUPLER**												
	1 no. 800 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase (red, yellow, blue) indicating lamps												
c)	Amber healthy trip indicating lamps												
d)	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol.												
D	**BUSBAR**												
a)	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 800 A having a maximum current density of 1.2 A per sqmm suitable to with stand symmetrical fault level of 50 kA. at 415 V with necessary high temp PVC sleeving. The neutral busbar shall be of 50% capacity.												
b)	Two incomers & Bus coupler shall be electrically & mechanically interlocked such that only two breakers shall be switched ON at a time.												
E	**Metering**												
a)	2 sets (4 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Volt meter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size summation CTs connections as required for both incoming feeders.												
b)	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size summating CTs for above two incomer metering supporting SCADA/BMS connectivity												
F	**MDB1 OUTGOINGS(TYPE 1)**												
a)	2 no. 125 A, 415V, Ics = 50 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
b)	4 no. 63 A, 415V, Ics= 35 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
c)	3 no. 200 A, 415V, Ics= 35 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
d)	1 no. 100 A, 415V, Ics=35 kA, TP MCCB's and with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
G	**MDB1 OUTGOINGS(TYPE 2)**												
a)	3 no. 125 A, 415V, Ics = 50 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b)	3 no. 63 A, 415V, Ics= 35 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
c)	1 no. 400 A, 415V, Ics = 50 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
H	**MDB2 OUTGOINGS**												
a)	1 no. 400 A, 415V, Ics = 50 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
b)	2 no. 125 A, 415V, Ics= 35 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
c)	1 no. 100 A, 415V, Ics= 35 kA, TP MCCB's with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
d)	2 no. 63 A, 415V, Ics=35 kA, TP MCCB's and with variable overcurrent and short circuit releases, UVR & shunt trip each having 1 set of 3nos. phase indicating lamps (red, yellow, blue) & with heavy duty solid neutral link.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.BMS interface terminal shall be separate												
1.2	**Capacitor Panel**												
	Capacitor Bank Panel (75kVAR) as per specifications & as per following details:	No	2	2	2	2	2	2		12	2,85,689.97	3,21,401.22	38,56,814.60
A	**INCOMING**												
	INCOMER												
	Incoming from MDB with 125 A, 415V, Ics=50 kA, 4P,MCCB complete with variable overcurrent and short circuit releases												
	2 – set Red/Green ON/OFF indicating lamps												
	2 set of three phase indicating lamps (red, yellow, blue)												
	Amber healthy/ trip indicating lamps for above feeders U/V relay with shunt trip.												
	Direct Cable incoming												
a)	1 – set Red/Green ON/OFF indicating lamps												
b)	1 set of three phase indicating lamps (red, yellow, blue)												
c)	5-step automatic power factor correction relay to sense and monitor the system power factor and provide impulses for operation of 5 capacitor circuits with automatic switching over facility with manual override.												
B	**BUSBAR**												
a)	Electrolytic high conductivity copper three phase and neutral busbars rated at 160 A having a maximum current density of 1.2 A per sq mm suitable to with stand symmetrical fault level of 50 kA at 415 V. The neutral busbar is to be of 50% capacity.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
C	**OUTGOING UNITS**												
a)	2 nos. 100 A, 415V, 35 kA TP MCCB with fixed neutral and 100A, 3 pole Contactor for automatic switching of capacitor												
b)	3 nos. 63 A, 415V, 35 kA TP MCCB with fixed neutral and 63A, 3 pole Contactor for automatic switching of capacitor												
c)	2 nos. 25 kVAR, 415 V hermetically sealed metalised polypropylene capacitors in well ventilated enclosures complete as per specifications , application duty and as required												
d)	2 nos. 10 kVAR, 415 V hermetically sealed metalised polypropylene capacitors in well ventilated enclosures complete as per specifications , application duty and as required												
e)	1 nos. 5 kVAR, 415 V hermetically sealed metalised polypropylene capacitors in well ventilated enclosures complete as per specifications , application duty and as required												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.BMS interface terminal shall be separate												
1.3	**Essential Main distribution Board (EMDB) complete with automatic source transfer system as per specifications and as per following details**	No	1	1	1	1	1	1		6	9,91,434.54	11,15,363.86	66,92,183.17
	Automatic source transfer system suitable for the below												
A	**INCOMER (Normal supply)**												
a)	Incoming from MDB2 with 400 A, 415V, Ics=50 kA, 4P, motorised MCCB complete with variable overcurrent and short circuit releases for Normal supply												
b)	2 – set Red/Green ON/OFF indicating lamps												
c)	2 set of three phase indicating lamps (red, yellow, blue)												
d)	Amber healthy/ trip indicating lamps for above feeders U/V relay with shunt trip.												
B	**INCOMING FROM DG PANEL**												
	1 nos. 400 A, 415V, Ics= 50 KA, 4P, motorised MCCBs complete with variable overcurrent and short circuit releases												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase indicating lamps (red, yellow, blue)												
c)	Amber healthy trip indicating lamps for above feeders												
C	**BUSBAR**												
a)	Electrolytic high conductivity copper three phase and neutral busbars rated at 400 A having a maximum current density of 1.2 A per sq mm suitable to with stand symmetrical fault level of 50 kA at 415 V. The neutral busbar is to be of 50% capacity.												
b)	All incomers shall be interlocked electrically & mechanically with automatic source transfer system so that only one supply is switched on at a time and fail safe restoration.												
D	**Metering**												
a)	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size summating CTs for above two incomer metering supporting SCADA/BMS connectivity												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
E	**OUTGOING UNITS**												
a)	1 no. 200A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip having indication lamps to give status												
b)	3 nos. 100A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip each having indication lamps to give status												
c)	5 nos. 63A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases UVR & shunt trip each having indication lamps to give status												
d)	9 no. 32A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases UVR & shunt trip each having indication lamps to give status												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.4	**Main lighting panel (MLP) complete as per specifications and as per following details:**	No	1	1	1	1	1	1		6	3,09,891.77	3,48,628.25	20,91,769.47
A	**INCOMER**												
	1 no. 63A, 415V, Ics=35 kA, TP motorised MCCB with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip having indication lamps to give status												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase indicating lamps (red, yellow, blue)												
B	**BUSBAR**												
a)	Electrolytic high conductivity copper three phase and neutral busbars rated at 63 A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.												
C	**OUTGOING**												
	8 no. 32A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases UVR & shunt trip each having indicationlamps to give status												
D	**Metering**												
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size summating CTs for above two incomer metering supporting SCADA/BMS connectivity												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.5	**Emergency lighting panel (EMLP) as per specifications and as per following details:**	No	1	1	1	1	1	1		6	2,28,363.11	2,56,908.49	15,41,450.97
A	**INCOMER**												
	1 no. 63A, 415V, Ics=25 kA, TP motorised MCCB with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip having indication lamps to give status												
a)	1- set Red/Green ON/OFF indicating lamps												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b)	1- set of three White phase indicating lamps												
B	**BUSBAR**												
a)	Electrolytic high conductivity copper three phase and neutral busbars rated at 63A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 25kA at 415 V. The neutral busbar is to be of same size as phases.												
C	**OUTGOING**												
a)	6 nos. 32A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases UVR & shunt trip each having indication lamps to give status.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.6	**Power Panel as per specifications and as per following details:**	No	1	1	1	1	1	1		6	4,65,069.61	5,23,203.31	31,39,219.84
A	**INCOMER**												
	1 no. 125A, 415V, Ics=35 kA, TP motorised MCCB with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip having indication lamps to give status												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three White phase indicating lamps												
B	**BUSBAR**												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 125 A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same size as phases.												
C	**OUTGOING**												
	1 nos. 63A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip each having indication lamps to give status												
	7 nos. 32A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip each having indication lamps to give status												
D	**Metering**												
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps, Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.7	**Water pump Panel (WPP) as per specifications and as per following details**	No.	1	1	1	1	1	1		6	4,71,905.36	5,30,893.53	31,85,361.16

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Internal wiring in the Starters shall be done with FRLS PVC insulated cables of adequate size. Internal wiring, contactors, relay contacts, push button contacts should be rated not less than 2.5 Sqmm.												
A	**INCOMER**												
a)	1 no. 63 A ,415V, Ics=35 KA , TP MCCB with variable over current and short circuit releases												
b)	1- set Red/Green ON/OFF indicating lamps												
c)	1- set of three phase indicating lamps (red, yellow, blue)												
B	**BUSBAR**												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 63 A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 35kA. at 415 V. The neutral busbar is to be of same size as phases.												
C	**OUTGOING**												
a)	2 Nos. 32A, Ics = 35 KA, 415V, TP MCCB each with the following :												
a1)	2 nos. 7.5 HP/ 5.6 KW, Star Delta starter comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.												
a2)	1 – set Red/Green ON/OFF indicating lamps												
a3)	1 – set start stop push buttons.												
a4)	Auto / Manual selector switch.												
a5)	Amber healthy trip indicating lamps												
a6)	AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCB, suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
b)	2 Nos. 32A, Ics = 10KA, 415V, TP MCB each with following												
b1)	6 nos. 5.0 HP/ 3.75 KW, Star Delta starter comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.												
b2)	1 - set Red / Green ON/OFF indicating lamp												
b3)	1 - set start / stop puch buttons												
b4)	Auto / Manual selector switch.												
b5)	Amber healthy trip indicating lamps												
b6)	AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCB,suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
c)	2 Nos. 32A, Ics = 35KA, 230V, DP MCB each with following												
c1)	1 nos. 20 HP / 15 kW pump DOL starter with bimetallic over current relay with potential free contacts for remote monitoring and control.												
c2)	1 – set Red/Green ON/OFF indicating lamps												
c3)	1 – set start stop push buttons.												
c4)	Auto / Manual selector switch.												
c5)	Amber healthy trip indicating lamps												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
c6)	AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCB,suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
D	**Metering**												
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity												
E.	Presettable switching timer set for each pump												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.8	**Fire Pump Panel**												
	Fire pump panel (FPP) Type 1 as per specifications as per following details complete with automatic source changeover facility.	No.	1	1	1	1	1	1		6	4,96,526.87	5,58,592.73	33,51,556.38
	Internal wiring in the Starters shall be done with FRLS PVC insulated cables of adequate size. Internal wiring, contactors, relay contacts, push button contacts should be rated not less than 2.5 Sqmm.												
A	**INCOMER - I from EMDB (EMERGENCY supply)**												
	1 no. 200 A, 415 V, Ics=35kA, 4P, motorised MCCB with variable over current and short circuit releases having:												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase indicating lamps (red, yellow, blue)												
c)	Amber trip indicating lamps												
B	**INCOMER -II from DG set**												
	1 no. 200 A, 415 V, Ics=35 kA, 4P, motorised MCCB with variable over current and short circuit releases having:												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase indicating lamps (red, yellow, blue)												
c)	Amber trip indicating lamps												
C	**BUSBAR**												
a)	Electrolytic high conductivity copper three phase and neutral busbars rated at 200 A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of capacity as phases												
b)	Two incomers shall be interlocked electrically & mechanically with automatic source transfer system so that only one supply is switched on at a time.												
D	**OUTGOING**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a)	1 no. 200 A, Ics=35 kA, 415 V, TP MCCB with fixed neutral and with variable overcurrent and short circuit releases												
a1)	1 no. 100 HP/74.50 KW, **Star Delta starter** comprising 1 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.												
a2)	1 – set Red/Green ON/OFF indicating lamps												
a3)	1 – set start stop push buttons.												
a4)	Auto / Manual selector switch.												
a5)	Amber healthy trip indicating lamps												
a6)	AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCB, suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
b)	1 no. 32 A, Ics=35 kA, 415 V, TP MCCB with fixed neutral and with variable overcurrent and short circuit releases												
b1)	1 nos. 7.5 HP/5.6, **Star Delta starter** comprising 2 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.												
b2)	1 – set Red/Green ON/OFF indicating lamps												
b3)	1 – set start stop push buttons.												
b4)	Auto / Manual selector switch.												
b5)	1 no. of AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs, connections as required for incoming feeder and suitable selector for measuring other circuit current.												
E	**Metering**												
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size summating CTs for above two incomer metering supporting SCADA/BMS connectivity												
F	Auxiliary relay shall be provided which shall be activated by pressure switch for remote monitoring.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.9	**Escalator Power Panel as per specifications & Drawing and as per following details: (TYPE- 1)**	**No.**	**0**	**0**	**0**	**0**	**0**	**0**		0	3,42,611.48	3,85,437.92	-
A	**INCOMER**												
	1 nos. 160 A ,415V, Ics= 35 KA, TP motorised MCCB with variable over current and short circuit releases having:												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase indicating lamps (red, yellow, blue)												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
B	**BUSBAR**												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 160 A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same capacity as phases.												
C	**OUTGOING**												
a)	5 nos. 40A Ics=35 kA, 415V, TP MCCB with fixed neutral and with variable overcurrent and short circuit releases each having indication lamps to give status												
b)	Space for providing variable KWHr meter with required CT's/PT's for each of the outgoing feeder with locking arrangement.												
D	**Metering**												
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.10	**Escalator Power Panel Type 2 as per specifications & Drawing and as per following details: (TYPE 2)**	No	0	0	0	0	0	1		1	3,53,440.00	3,97,620.00	3,97,620.00
A	**INCOMER**												
	1 nos. 250 A ,415V, Ics= 35 KA, TP motorised MCCB with variable over current and short circuit releases having:												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase indicating lamps (red, yellow, blue)												
B	**BUSBAR**												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 250 A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same capacity as phases.												
C	**OUTGOING**												
a)	8 nos. 40A Ics=35 kA, 415V, TP MCCB with fixed neutral and with variable overcurrent and short circuit releases each having indication lamps to give status												
b)	Space for providing variable KWHr meter with required CT's/PT's for each of the outgoing feeder with locking arrangement.												
D	**Metering**												
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.11	**Escalator Power Panel Type 3 as per specifications & Drawing and as per following details: (TYPE 3)**	No	1	1	1	1	1	1		6	4,94,389.66	5,56,188.37	33,37,130.23
A	**INCOMER**												
	1 nos. 400 A ,415V, Ics= 35 KA, TP motorised MCCB with variable over current and short circuit releases having:												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three phase indicating lamps (red, yellow, blue)												
B	**BUSBAR**												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 400 A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 35kA at 415 V. The neutral busbar is to be of same capacity as phases.												
C	**OUTGOING**												
a)	14 nos. 40 A Ics=35 kA, 415V, TP MCCB with fixed neutral and with variable overcurrent and short circuit releases each having indication lamps to give status												
b)	Space for providing variable KWHr meter with required CT's/PT's for each of the outgoing feeder with locking arrangement.												
D	**Metering**												
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.12	**UPS output Panel Type-1 as per specifications and as per following details:**	No.	1	1	1	1	1	1		6	3,70,458.14	4,16,765.40	25,00,592.42
A	**INCOMER**												
	1 no. 63A, 415V, Ics=25 kA, TP motorised MCCB with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip having indication lamps to give status												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three White phase indicating lamps												
B	**BUSBAR**												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 63A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 25kA at 415 V. The neutral busbar is to be of same size as phases.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
C	**OUTGOING**												
a)	8 nos. 32A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases UVR & shunt trip each having indication lamps to give status.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.13	**UPS output Panel TYPE-2 as per specifications and as per following details:**	Set	1	1	1	1	1	1		6	2,03,682	2,03,682	12,22,091.43
A	**INCOMER**												
	1 no. 100A Ics=25 kA, DP motorized MCCB with variable overcurrent and short circuit releases, UVR & shunt trip having indication lamps												
a)	1- set Red/Green ON/OFF indicating lamps												
b)	1- set of three White phase indicating lamps												
B	**BUSBAR**												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 125A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 25kA at 415 V. The neutral busbar is to be of same size as phases.												
C	**OUTGOING**												
a)	12 nos. 32A, 240V, Ics=10 kA, DP MCB's												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.14	**DIESEL GENERATOR**												
	Supply, installation, testing and commissioning a complete system of 250kVA Prime duty type diesel generator sets to meet the load requirements for all essential loads as mentioned in these Specifications/Contract.		1	1	1	1	1	1		6	20,10,190.00	22,61,463.75	135,68,782.50
	The DG set emissions shall cofirm to the latest regulation of the Central Pollution Control Board (CPCB).												
	Installation Batteries with Stand, leads, cover and accessories.												
	990 Ltrs Day Tank fabricated out of 6mm thick sheet steel with secondary containment tank and with fitments and float level switches.												
	Drip Tray for fuel tank ,Drip Tray below engine crank case												
	The entire set shall be housed in soundproof enclosure mounted on suitable Rubber-in-shear type vibration mounts with 6mm static deflection for isolating the building floor. A nominal base concrete pad (if required) shall be provided over which the engine set with its own base frame and vibration mounts shall be mounted. Adopter Box for cable / bus duct termination with extension bus bars & 630 4P MCCB Isolator												
	Any other item not specifically mentioned but required for proper performance and safe working of the system.												
	The DG system shall be provided to interface with Station Management System (SMS)/Building Management system(BMS) for remote monitoring and management in Station Control Room and/or OCC room (if available) respectively.	No.											
	AMF PANEL												
	The AMF Panel should therefore comprise:												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	(i) 630A , 4 Pole MCCB with 4-pole contactor as main Incomer from AMF Panel, copper bus bar of adequate rating with one no. 4-pole ACBs as outgoing for Essential Power Panel 400A and Fire Pump Panel 250A, MCCB of adequate rating, duly interlocked.												
	(ii) Battery charger with normal and trickle charging facility and an isolating switch.												
	(iii) Over load and Earth Fault protection for the generator set.												
	DG Exhaust Pipe												
	Exhaust piping shall be fabricated from class 'B' MS pipes upto 150 mm dia conforming to IS 1239 of size suitable to limit backpressure to within permissible limit.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.15	**Synchronizing Panel for Solar power Intake**												
	Supply,Installation,Testing and commissioning of synchronizing panel comparising of	No	0	0	0	0	0	0		0	5,74,340.00	6,46,132.50	-
	INCOMER (Normal supply)												
	Incoming from MDB2 with 400 A, 415V, Ics=50 kA, 4P, motorised MCCB complete with variable overcurrent and short circuit releases for Normal supply												
	2 – set Red/Green ON/OFF indicating lamps												
	2 set of three phase indicating lamps (red, yellow, blue)												
	Amber healthy/ trip indicating lamps for above feeders U/V relay with shunt trip.												
	INCOMING FROM Solar PANEL												
	1 nos. 400 A, 415V, Ics= 50 KA, 4P, motorised MCCBs complete with variable overcurrent and short circuit releases												
	1- set Red/Green ON/OFF indicating lamps												
	1- set of three phase indicating lamps (red, yellow, blue)												
	Amber healthy trip indicating lamps for above feeders												
	BUSBAR												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 400 A having a maximum current density of 1.2 A per sq mm suitable to with stand symmetrical fault level of 50 kA at 415 V. The neutral busbar is to be of 50% capacity.												
	OUTGOING UNITS												
	1 no. 400A, 415V, Ics=35 kA, TP MCCB's with fixed neutral and with variable overcurrent and short circuit releases, UVR & shunt trip having indication lamps to give status												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	Addition/Deletion												
2.00	Adjustment rates for addition/deletion of supply & fixing of following including making of suitable holes/space in the panel/DBs and making good all external/internal finishes, terminations etc complete in all respect as required.												
a	Voltage Transduser	Set	0	0	0	0	0	0		0	8,131.00	8131.00	-

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b	Under & Over Voltage Relay	Set	0	0	0	0	0	0		0	34,151.00	34151.00	-
c	Multifunction Meter with CTs	Set	1	1	0	1	1	1		5	25,702.00	25702.00	1,28,510.00
d	Digital Load Manager with CTs	Set	0	0	0	0	0	0		0	25,701.00	25701.00	-
e	Electrical, Mechanical Interlock	Set	0	0	0	0	0	0		0	12,196.00	12196.00	-
f	Surge Protection Device	Set	0	0	0	0	0	0		0	36,235.00	36235.00	-
g	Micom Relay P127 with CT	Set	0	0	0	0	0	0		0	90,152.00	90152.00	-
h	Under & Over Voltage Release	Set	0	0	0	0	0	0		0	4,309.00	4309.00	-
i	Motor Mechanism 100A/160A	Set	3	3	3	3	3	3		18	34,964.00	34964.00	6,29,352.00
j	Motor Mechanism 250A	Set	2	2	2	2	2	2		12	31,646.00	31646.00	3,79,752.00
k	Motor Mechanism 400A/630A	Set	3	3	3	3	3	3		18	49,828.00	49828.00	8,96,904.00
l	Integral Type Digital Energy Meter with CTs	Set	0	0	0	0	0	0		0	41,390.00	41390.00	-
m	Copper Busbar	KG	0	0	0	0	0	0		0	764.00	764.00	-
n	Multiple LED/neon type indications	Nos	0	0	0	0	0	0		0	134.00	134.00	-
o	Astronomical digital timer	Nos	0	0	0	0	0	0		0	7,852.00	7852.00	-
p	Ammeter/Voltmeter (3.5 digit display)	Nos	0	0	0	0	0	0		0	1,202.00	1202.00	-
q	TP Contactor - 40/32 Amps	Nos	0	0	0	0	0	0		0	2,914.00	2914.00	-
r	Aux. Contact 1 NO + 1 NC for MCB	Nos	0	0	0	0	0	0		0	378.00	378.00	-
3	Adjustment rates for **addition/deletion** of compartmentalised switchgear in panels/switchboard of following rating including the supply, fabrication, extension, modification of the enclosure or in a separate enclosure, earthing ,basbar, other sub-systems, accessories etc complete as required and as per specifications and as specified in of item 1.0 above												
3.1	1 no. 800 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	Nos	1	0	0	0	0	0		1	2,75,578	275578	2,75,578.00
a	1- set Red/Green ON/OFF indicating lamps												
b	1- set of three phase (red, yellow, blue) indicating lamps												
c	Amber healthy trip indicating lamps												
d	3 nos. cast resin current transformers of 800/5 ratio with15 VA Burden & Class 5P10 for protection												
e	3 nos. cast resin current transformers of 800/5 ratio with 15VA burden and Class 1.0 for measurement												
f	Microprocessor based release having variable range of overcurrent, short circuit and earth fault protection with time lag facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.												
g	230V AC or 24 V DC shunt trip coil												
h	230V, AC Motor wound spring closing mechanism.												
i	Terminals to receive suitable rating bus duct/XLPE armoured cables												
j	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
3.2	630A, 415V, Ics=50 kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.	0	0	0	0	0	0		0	63,353	63353	-
3.3	630A, 415V, Ics=50 kA, TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps (red, yellow, blue)	No.	5	5	5	5	5	5		30	58,003	58003	17,40,090.00
3.4	400A, 415V, Ics=35 kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.	9	9	9	9	9	9		54	49,839	49839	26,91,306.00

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.5	400A, 415V, Ics=35 kA, TP, MCCB with variable over current and short circuit releases with heavy duty solid link and 1-set of three phase indicating lamps (red, yellow, blue)	No.	11	11	11	11	11	11		66	46,525	46525	30,70,650.00
3.6	250/200 A ,415V, Ics=35kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps	No.	0	0	0	0	0	0		0	43,377	43377	-
3.7	250/200 A ,415V, Ics=35kA, TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	5	5	5	5	5	5		30	39,417	39417	11,82,510.00
3.8	100/63 A, 415V, Ics=35 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	9	9	9	9	9	9		54	21,721	21721	11,72,934.00
3.9	Less than 63A to 40A, 415V, Ics=25 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.	11	11	11	11	11	11		66	21,721	21721	14,33,586.00
3.10	32A , 415V, Ics=35 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	Nos	10	10	10	10	10	10		60	12,417	12417	7,45,020.00
3.11	Electrical operating mechanism (Motorised mechanism) for all type of above MCCBs	Nos	0	0	0	0	0	0		0	12602	12602	-
3.12	40-63A FP MCB 9/10 kA	No.	1	0	0	0	0	0		1	4,515	4515	4,515.00
3.13	40-63A TP MCB 9/10 kA	No.	1	0	0	0	0	0		1	4,260	4260	4,260.00
3.14	40-63A DP MCB 9/10 kA	No.	1	0	0	0	0	0		1	1,380	1553	1,552.50
3.15	40-63A SP MCB 9/10 kA	No.	1	0	0	0	0	0		1	730	821	821.25
3.16	5-32A FP MCB 9/10 kA	No.	14	19	14	14	14	14		89	1,860	2093	1,86,232.50
3.17	5-32A TP MCB 9/10 kA	No.	1	0	0	0	0	0		1	1,380	1553	1,552.50
3.18	5-32A DP MCB 9/10 kA	No.	12	12	12	12	12	12		72	900	1013	72,900.00
3.19	5-32A SP MCB 9/10 kA	No.	1	0	0	0	0	0		1	410	461	461.25
3.20	16-32Amp DP RCCB, 30 mA	No.	1	0	0	0	0	0		1	3,480	3915	3,915.00
3.21	1000mA 4P RCCB/ELCB-MCB	No.	4	4	4	4	4	4		24	17,321	17321	4,15,704.00
													-
3.22	Supply, installation and testing of 63/40 Amp adjustable, TP MCCB with fixed neutral in sheet steel enclosure with incoming & outgoing cable box and ON indication lamp complete as required.	Nos	1	0	0	0	0	0		1	13,469	13469	13,469.00
3.23	Supplying installation testing and commissioning of 10/25/32A DP MCB in IP 54 rated surface/recessed box with the total unit having IP 54 ingress protection with incoming & outgoing cable box for AC indoor unit complete as required.	Nos	1	0	0	0	0	0		1	1,833	1833	1,833.00
2.24	Supplying installation testing and commissioning of 63 A 4P isolator MCCB in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection for AC Outdoor Units/Lifts/Escalators etc.	Nos	12	17	12	12	12	12		77	2,671	2671	2,05,667.00
3.25	Supplying installation testing and commissioning of 125 A 4P isolator MCCB in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection for Station UPS	Nos	2	2	2	2	2	2		12	4,758	4758	57,096.00
3.26	Supply, installation and testing of 4 way TPN sheet steel enclosure with incoming and outgoing cable, distribution board complete as required.	Nos	1	0	0	0	0	0		1	17230	17230	17,230.00

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.27	Supply, installation and testing of 200 amps 4 Pole Isolator in sheet steel enclosure with incoming and outgoing cable box and indication lamps complete as required.	Nos	2	2	2	2	2	2		12	19060	19060	2,28,720.00
3.28	Overload relay												
a	4 - 6 A	Nos	1	0	0	0	0	0		1	779	779	779.00
b	6 - 12A	Nos	1	0	0	0	0	0		1	779	779	779.00
c	9 - 15 A	Nos	1	0	0	0	0	0		1	1,001	1001	1,001.00
d	30 - 40 A	Nos	1	0	0	0	0	0		1	2,202	2202	2,202.00
e	40 - 65 A	Nos	1	0	0	0	0	0		1	2,258	2258	2,258.00
f	63 - 100 A	Nos	1	0	0	0	0	0		1	3,693	3693	3,693.00
3.29	100 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	Nos	3	3	3	2	2	2		15	141045	141045	21,15,675.00
3.30	75 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	Nos	0	0	0	0	0	0		0	141045	141045	-
3.31	50 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	Nos	2	2	2	1	1	1		9	42,961	42961	3,86,647.61
3.32	10/7.5 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	Nos	0	0	0	0	0	0		0	36,774	36774	-
3.33	Upto 5HP, **DOL starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	Nos	1	1	1	1	1	1		6	22,824	22824	1,36,942.10
3.34	Adjustment rates for addition/deletion of Power Contactor of following rating including the supply, fabrication, extension, modification of the enclosure or in a separate enclosure, earthing ,basbar, other sub-systems, accessories etc complete as required and as per specifications												
a	400 Amps 4 P Power Contactor	Nos	1	0	0	0	0	0		1	22,712	22,712	22,712.00
b	300 Amps 4 P Power Contactor	Nos	1	0	0	0	0	0		1	17,653	17,653	17,653.00
c	250 Amps 4 P Power Contactor	Nos	1	0	0	0	0	0		1	9,597	9,597	9,597.00
d	200 Amps 4 P Power Contactor	Nos	1	0	0	0	0	0		1	8,565	8,565	8,565.00
	SUB TOTAL L V SWITCHGEAR E.01												**762,09,811.98**
E.02	**DISTRIBUTION BOARDS**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty dead front wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with foamed-in neoprene gasketted hinged doors, fabricated from 2 mm thick CRCA with powder coated finish suitable for 415 V, 3-phase, 4 wire, 50 Hz system including suitably rated insulated copper busbars, interconnections, neutral bar assembly, phase segregating barriers, LED indicating lamps for incoming and outgoing feeders,15% spare space for future expansion, knockouts and gland plates for entry of cables and conduits, all internal wiring using high temperature FRLS wires, independant terminals for each phase, earthing terminals and including the cost of providing Master key lock on the door and pad locking facility on door as well as at incomer, bonding to earth etc. complete as per specification, drawings as required and as under:												
a)	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 9/10 kA at 415 V AC, current limiting type lower powerloss appx 40 -70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for moter application duty, with minimum Electrical endurance of the order of 20000 operation cycles.												
b)	Residual current circuit breaker (RCCB) conforming to IS 12640 shall be provided with 30 mA sensitivity and electrically connected rated current capacity MCB for short circuit and over load protection as required												
c)	All incomer MCBs of boards /panels shall be provided with NO/NC contacts as specified in specifications and drawings												
d)	The LDBs may be required to accommodate Dimming Control equipment mountable on DIN rail. Contractor should refer to relevant specifications and drawings in this regard and submit his scheme for approval by Engineer.												
e)	All the contactors shall be provided with potential free contacts for remote monitoring and control.												
f)	Various distribution boards as given below:												
1.1	**Lighting Distribution Boards (LDB) Type-1 as per specification and Drawing as per following details.**												
	One lighting distribution board (LDB) unit consisting of 3 compartments with respective incoming TPN MCBs, DP MCB RCCBs/ELCBs, set of contactors and outgoing SP MCBs each having indications for incoming & outgoing feeder status e.g. LDB is combination of LDB /N, LDB /G, LDB /U connected to incoming Supplies from Normal, DG set & UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:	Nos	4	4	4	4	4	4		24	1,54,964	154964	37,19,136.00
A	**Normal**												
	INCOMER												
a)	1 no. 40A TPN Contactor with astronomical digital timer												
b)	1 no. 40A TPN MCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	24 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
b)	3 nos. 32A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped from above contactor (non timer - controlled feeders).												
B	**DG**												
	INCOMER												
a)	1 no. 40A TPN Contactor with astronomical digital timer												
b)	1 no. 40A TPN MCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a)	24 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
b)	3 nos. 32A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped from above contactor (non timer - controlled feeders).												
C	**UPS**												
	INCOMER												
a)	1 no. 25A DP Contactor with astronomical digital timer												
b)	1 no. 25A TP MCB + ELCB/RCCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	10 nos. 10A/20A SP MCB arranged in a row and controlled by one no. 25A DP ELCB/RCCB with feeder ON indication lamps												
b)	4 nos. 10A/20A SP MCB arranged in a row and controlled by a 20A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped from above contactor (non timer -controlled feeders).												
	SCADA / BMS CONNECTIVITY Contactor & Timer shall be provided with necessary NO/NC potential free contact & should provide single point to communicate with BMS/SCADA.												
1.2	**Lighting Distribution Boards (LDB) Type-2 as per specification and Drawing as per following details.**												
	One lighting distribution board (LDB) unit consisting of 2 compartments with respective incoming TPN MCBs, DP MCB RCCBs/ELCBs, set of contactors and outgoing SP MCBs each having indications for incoming & outgoing feeder status e.g. LDB is combination of LDB /N, LDB /G/LDB /U connected to incoming Supplies from Normal, DG set / UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:	Nos	2	2	2	2	2	2		12	50,847	50847	6,10,164.00
	SCADA / BMS CONNECTIVITY Contactor & Timer shall be provided with necessary NO/NC potential free contact & should provide single point to communicate with BMS/SCADA.												
A	**Normal**												
	INCOMER												
a)	1 no. 40A TPN MCB												
b)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	24 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
B	**UPS**												
	INCOMER												
a)	1 no. 25A DP MCB ELCB/RCCB												
b)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder with feeder ON Indication LED Lamps												
a)	10 nos. 10A/20A SP MCB												
	SCADA / BMS CONNECTIVITY Contactor & Timer shall be provided with necessary NO/NC potential free contact & should provide single point to communicate with BMS/SCADA.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
1.3	**Lighting Distribution Boards (LDB) Type-3 as per specification and Drawing as per following details.**												
	One lighting distribution board (LDB) unit consisting of 2 compartments with respective incoming TPN MCBs, DP MCB RCCBs/ELCBs, set of contactors and outgoing SP MCBs each having indications for incoming & outgoing feeder status e.g. LDB is combination of LDB /N, LDB /G/LDB /U connected to incoming Supplies from Normal, DG set / UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:	Nos	1	1	1	1	1	1		6	1,17,067	117067	7,02,402.00
A	**Normal**												
	INCOMER												
a)	1 no. 40A TPN Contactor with astronomical digital timer												
b)	1 no. 40A TPN MCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	18 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
b)	3 nos. 32A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped with DP Contactor												
B	**DG**												
	INCOMER												
a)	1 no. 40A TPN Contactor with astronomical digital timer												
b)	1 no. 40A TPN MCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	9 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
b)	3 nos. 32A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped with DP Contactor												
1.4	**Vertical Power distribution boards (VDPN) TYPE-4 as per specification and as per following details.**	Nos	1	1	1	1	1	1		6	43,175	48,571.88	2,91,431.25
	One lighting/Power distribution board (LDB) unit with respective incoming TP MCCBs, outgoing TPN MCBs each having indications for incoming & outgoing feeder status as per specifications and as under:												
	INCOMER												
	1 no. 80 TP MCCB												
	1 set of (ON) indicating lamps.												
	OUTGOINGS with feeder ON Indication												
	8 Nos of 32 TPN MCB												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.5	**Lighting distribution boards (LDB/PDP) Type-5 as per specification and as per following details. (Adversement DB Concourse and Platform level)**	Nos	3	3	3	3	3	3		18	57,572	57,572	10,36,296.00

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	One lighting distribution board (LDB) unit with respective incoming TP MCBs, outgoing TP MCBs DP RCCB and outgoing SP MCBs each having indications for incoming & outgoing feeder status as per specifications and as under:												
A	**INCOMER**												
a.	1 no. 63A Ics =35kA TPN MCCB												
b.	1 set of (ON) indicating lamps.												
B	**OUTGOINGS with feeder ON Indication LED Lamps**												
	3 No. 32A TP MCBs												
a)	9 Nos of 10A/20A SPMCB arranged in three rows and each row controlled by one no. 32A DP ELCB with feeder (ON) indication lamps.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.6	**Lighting distribution boards (LDB/PDP) TYPE-6 as per specification and as per following details.**	Nos	2	2	2	2	2	2		12	36,365	36365	4,36,375.46
	One lighting distribution board (LDB) unit with respective incoming TP MCBs, DP RCCB and outgoing SP MCBs each having indications for incoming & outgoing feeder status as per specifications and as under:												
A	**INCOMER**												
a.	1 no. 40A TP MCB												
b.	1 set of (ON) indicating lamps.												
B	**OUTGOINGS**												
a)	18 Nos of 10A/20A SPMCB arranged in three rows and each row controlled by one no. 40A DP ELCB with feeder (ON) indication lamps.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	SUB TOTAL DISTRIBUTION BOARDS E.02												**67,95,804.71**
E.03	**LV POWER & CONTROL CABLES,CABLE TRAYS AND STEEL WORKS**												
3.1	**Cable Laying**												
3.1.1	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured, FRLSZH, **XLPE**, aluminium(AL) / Copper (CU) conductor cables on existing trays/walls/columns/ indoor/ trenches including the cost of supports with suitable clamps, saddles, hooks, bolts etc. and including the cost of proper dressing of cables, markers providing identification tags,earthing of glands armouring etc. complete as per specifications, as required and as below.												
	Note 1: All cables 25 sq.mm and above are AL conductor unless specified otherwise.												
a)	3.5 core 400 sq mm AL conductor	m	110	100	104	130	110	268		822	1,855.56	2,087.51	17,15,929.11
b)	3.5 core 300 sq mm AL conductor	m	375	375	375	375	375	375		2250	1,167.46	1,313.39	29,55,124.27
c)	3.5 core 240-sqmm AL conductor	m	70	70	70	70	70	63		413	857.00	857.00	3,53,941.00
d)	3.5 core 185-sqmm AL conductor	m	140	140	140	140	140	140		840	800.76	900.86	7,56,720.56

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
e)	3.5 core 150 sq mm AL. Conductor	m	70	70	70	70	70	70		420	526.00	526.00	2,20,920.00
f)	3.5 core 120-sqmm AL conductor	m	280	150	205	410	158	371		1574	554.46	623.77	9,81,808.27
g)	3.5 core 95 sq mm AL. Conductor	m	0	0	0	0	0	0		0	593.00	593.00	-
h)	4 core 95 sq mm AL. Conductor	m	200	200	200	200	200	200		200	430.00	430.00	86,000.00
i)	3.5 core 70-sqmm AL conductor	m	125	338	27	138	130	460		1218	402.04	452.29	5,50,892.57
j)	3.5 core 50 sq mm AL. Conductor	m	240	225	230	225	208	267		1395	331.35	372.77	5,20,012.41
k)	3.5 core 35-sqmm AL conductor	m	155	2720	1604	494	400	1625		6998	265.08	298.22	20,86,908.57
l)	3.5 core 25-sqmm AL conductor	m	1301	1500	465	150	697	225		4338	247.41	278.33	12,07,412.89
m)	4 core 16 sq mm CU Conductor	m	4000	4000	4000	4000	4000	4000		24000	618.52	695.84	167,00,040.00
n)	4 core 10 sq mm CU Conductor	m	2000	2000	2000	2000	2000	2000		12000	503.65	566.61	67,99,302.00
o)	4 core 6 sq mm CU Conductor	m	400	600	440	476	270	135		2321	342.40	385.19	8,94,036.14
p)	4 core 4 sq mm CU Conductor	m	350	350	350	350	350	350		2100	276.13	310.64	6,52,345.31
q)	3 core 6 sq mm CU Conductor	m	100	100	100	100	100	100		600	238.00	238.00	1,42,800.00
r)	3 core 4 sq mm CU Conductor	m	100	100	100	100	100	100		600	140.00	140.00	84,000.00
s)	2 core 16 sq mm AL. Conductor	m	250	250	250	250	250	250		1500	101.00	101.00	1,51,500.00
t)	2 core 50 sq mm Cu. Conductor	m	20	20	20	20	20	20		120	771.00	771.00	92,520.00
3.1.2	Cable jointing and termination of cable as per item 1.1 -including cost of supplying and fixing, crimping lugs, double compression brass glands, insulation tape etc. complete as per specifications and as required.												
a)	3.5 core 400 sq mm AL conductor	Nos.	10	10	10	10	10	10		60	3,283.95	3,694.45	2,21,666.94
b)	3.5 core 300 sq mm AL conductor	Nos.	14	14	14	14	14	14		84	2,841.16	3,196.31	2,68,489.67
c)	3.5 core 240-sqmm AL conductor	Nos.	3	3	3	3	3	3		18	2,379.21	2,676.61	48,179.06
d)	3.5 core 185 sqmm AL conductor	Nos.	8	8	8	8	8	8		48	1,640.27	1,845.30	88,574.33
e)	3.5 core 150 sq mm AL. Conductor	Nos.	2	2	2	2	2	2		12	1,268.45	1,427.00	17,124.05
f)	3.5 core 120 sqmm AL conductor	Nos.	12	12	12	12	12	12		72	1,261.56	1,419.25	1,02,186.35
g)	3.5 core 95 sq mm AL. Conductor	Nos.	0	0	0	0	0	0		0	821.35	924.02	-
h)	4 core 95 sq mm AL. Conductor	Nos	4	4	4	4	4	4		24	1,624.00	1,624.00	38,976.00
i)	3.5 core 70 sqmm AL conductor	Nos.	10	10	10	10	10	10		60	756.58	851.16	51,069.32
j)	3.5 core 50 sq mm AL. Conductor	Nos.	18	18	18	18	18	18		108	646.13	726.90	78,505.10
k)	3.5 core 35 sqmm AL conductor	Nos.	20	20	20	20	20	20		120	540.27	607.80	72,935.93
l)	3.5 core 25 sqmm AL conductor	Nos.	20	20	20	20	20	20		120	386.58	434.90	52,187.63
m)	4 core 16 sq mm CU Conductor	Nos.	50	50	50	50	50	50		300	375.53	422.47	1,26,741.38
n)	4 core 10 sq mm CU Conductor	Nos.	30	30	30	30	30	30		180	312.90	352.02	63,363.23
o)	4 core 6 sq mm CU Conductor	Nos.	10	10	10	10	10	10		60	265.08	298.22	17,892.90
p)	4 core 4 sq mm CU Conductor	Nos.	34	34	34	34	34	34		204	220.90	248.51	50,696.55
q)	3 core 6 sq mm CU Conductor	Nos.	12	12	12	12	12	12		72	1,236.00	1,236.00	88,992.00
r)	3 core 4 sq mm CU Conductor	Nos.	12	8	8	8	8	8		52	927.00	927.00	48,204.00
s)	2 core 16 sq mm AL. Conductor	Nos.	24	24	24	24	24	24		144	898.00	898.00	1,29,312.00
t)	2 core 50 sq mm Cu. Conductor	Nos.	2	2	2	2	2	2		12	990.00	990.00	11,880.00

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.1.3	Supply, laying testing and commissioning of 1.5 sqmm 1100 V grade, armoured, FRLSZ PVC insulated, FRLSZH PVC sheathed copper conductor cables on existing trays/walls/columns/ indoor/ trenches including the cost of supports with suitable clamps, saddles, hooks, bolts etc. and including the cost of proper dressing of cables and including the cost of providing identification tags etc. complete as per specifications, as required and as below.												
	Note : Termination of all control cables to be provided under the above item and as per schematic diagram including the cost of supplying and fixing crimping lugs, compression type brass glands, heavy duty ferrules, insulation tape etc. complete as per specifications and as required.												
a)	4 C x 1.5 sqmm	m	10	0	0	0	0	0		10	131.32	147.73	1,477.31
b)	5 C x 1.5 sqmm	m	10	0	0	0	0	0		10	165.67	186.38	1,863.75
c)	7 C x 1.5 sqmm	m	10	0	0	0	0	0		10	197.60	222.30	2,223.03
d)	8 C x 1.5 sqmm	m	10	0	0	0	0	0		10	209.58	235.78	2,357.76
e)	10 C x 1.5 sqmm	m	10	0	0	0	0	0		10	263.47	296.40	2,964.04
3.2	**Lighting and Power Bus bar (Addition and deletion)**												
	Ideal for all lighting and power demands up to 63 A Plug outlet covers (hinged and retained), cover tap-off outlets when not in use Feed units and end covers .												
a)	Lengths Rigid galvanised steel casing 3 m maximum distance between suspension brackets Conductors insulated with self-extinguishing plastic (IEC 60695-2-12 and V0 according to UL94) Standard tap-off outlets with captive IP 55 plug outlet covers Protection index IP 55 Impact resistance : IK 07 252	m	0	0	0	0	0	0		0	5,985.96	6,734.20	-
b)	End feed units Allow electrical powering of the LB PLUS busbar With terminals for the connection of stranded or solid copper wire cables Delivered with corresponding cable glands	Nos	0	0	0	0	0	0		0	2,530.91	2,847.27	-
c)	Centre feed units Centre feed units can be used to power the busbar from an intermediate point of the line, reducing the voltage drop at the end of the line and/or facilitating the installation when the power supply point is near the centre of the line Complete with all internal wiring One set of terminals feeds both left hand and right hand feed sections Supplied with both end caps	Nos	0	0	0	0	0	0		0	3,105.75	3,493.97	-
d)	Flexible joints Consists of a right hand and left hand unit Used to change direction, change level or overcome obstructions	Nos	0	0	0	0	0	0		0	8,863.17	9,971.06	-
3.3	**Cable Trays**												
3.3.1	Supply, fabrication & installation of perforated hot dipped galvanised double bended cable trays from 2 mm thick GI sheets continuously connected including horizontal and vertical bends, reducers, tees, and other accessories and duly suspended from the ceiling with 12 mm dia vertical GI rods supported by 40mm x 40 mm 5 mm GI angle etc. (or installed on wall supported on suitable brackets as required) complete as per specifications, as required and as below. Coloured cable tray shall be provided as per Engineer In-charge.The Cable Tray shall be provided with perforated removable cover.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Note: Trays shall be supported adequately at minimum 1 m distance from the building structure/ ceiling by means of painted/galvanized (as specified) MS structural members secured to the structure by dash fasteners or by grouting. This support should be capable of withstanding the weight equivalent of 3m length of the cables that can be laid in the trays. At turns the support has to be double and at both ends of the bend.												
a)	600 mm wide x 50 mm deep x 2mm thick	mtr	500	500	500	500	500	500		3000	1,651.00	1,651.00	49,53,000.00
b)	450 mm wide x 50 mm deep x 2mm thick	mtr	0	0	0	0	0	0		0	1,033.00	1,033.00	-
c)	300 mm wide x 50 mm deep x 2mm thick	mtr	737	1700	1900	1700	1145	1715		8897	994.05	1,118.31	99,49,570.71
d)	200mm wide x 50mm deep x 2mm thick	mtr	300	300	300	300	300	300		1800	662.70	745.54	13,41,967.50
e)	150mm wide x 50mm deep x 2mm thick	mtr	1752	1900	2150	1900	1410	2010		11122	607.48	683.41	76,00,879.07
f)	100mm wide x 50mm deep x 2mm thick	mtr	116	1450	700	300	565	217		3348	552.25	621.28	20,80,049.63
3.4	**CABLE LADDER**												
	Supply & installation of prefabricated, GI, ladder type cable tray conforming to M & E Specifications continuously connected including horizontal & vertical bends reducers, tees, coupling plate, nut bolts washers etc. The side runners shall be 100 x 20 x 2.5 mm and centre rungs shall be of size 30 x 15 x 2.5 mm with centre to centre distance of 250 mm, as required.												
a	900 mm wide x 2mm thick	m	65	70	70	70	65	65		405	994.05	1,118.31	4,52,914.03
b	600 mm wide x 2mm thick	m	60	60	60	60	60	60		360	828.38	931.92	3,35,491.88
c	450 mm wide x 2mm thick	m	50	50	50	50	40	40		280	552.25	621.28	1,73,958.75
d	300 mm wide x 2mm thick	m	0	0	0	0	0	0		0	953.08	1,072.22	-
3.5	***Raceways***												
	Supply, installation of sheet steel raceways /trunking , fabricated from 2.0 mm thick GI with minimum coating thickness 260 gm / sq. meter on both sides with removable cover plate complete with counter sunk cadmium plated brass screws, bends, tee-junctions, cross junction etc ,in floor and suspended from the ceiling with required support . Coloured Raceways shall be provided as per Engineer In-charge. Rendered electrially continous as approved and of following sizes.												
a)	100 x 100 MM	m	0	0	0	0	0	0		0	1,008.97	1,135.09	-
b)	100 x 50 MM	m	120	375	200	165	100	165		1125	1,767.20	1,988.10	22,36,612.50
c)	150 X 100 MM	m	0	0	0	0	0	0		0	2,098.55	2,360.87	-
d)	150 x 150 MM	m	0	0	0	0	0	0		0	682.63	767.95	-
e)	200 x 50 MM Raceway	m	100	100	100	100	100	100		600	2,935.35	2,935.35	17,61,209.49
3.6	**STEEL WORK**	kg	1500	1500	1500	1500	1500	1500		9000	138.06	155.32	13,97,882.81
	Supply, fabrication & installation, of fabricated GI steel work conforming to M & E specification and tender doct, to support GI cable trays, bus duct, light fixtures, conduit wirings, Bracket ,& other electrical works, as required.										-		
	SUB TOTAL LV POWER & CONTROL CABLES,CABLE TRAYS AND STEEL WORKS E.03												**708,23,611.79**
E.04	**INTERNAL WIRING & ACCESSARIES**												
	Whether explicitly stated in the schedules below or not, the following must be complied with:												
	For supply and installation, of conduits, cable trunking, raceway, flexible conduits and wiring,												
	Wires supplied must conform to relevant clauses of tender doct. And Specifications.												
	Wiring accessories must conform to relevant clauses of tender doct. And Specifications.												
	In case of any contradiction between BOQ and tender doct. And specifications, the strangest condition of the two will apply.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
4.1	Supply and laying of Lighitng Submains/circuit mains (3R x 2.5 Sqmm) in concealed or surface conduit system with GI conduits & 1100 V grade, multi strand copper conductor, FRLSZH-PVC insulated wires for phase, neutral & earth, shall include end termination. The conduits shall be complete with bends, JBs etc. The laying cost shall also include chipping works if necessary.												
a	Primary Point (13 meter)	Points	86	176	156	123	145	122		808	5,690.38	6,401.68	51,72,559.06
b	Secondary Point	Points	324	734	597	458	450	620		3183	2,001.35	2,251.52	71,66,598.50
4.2	Supply and laying of circuit wiring along with earth wire with the following size of FRLSZH PVC insulated copper conductor single core cable in GI conduit as required. Compete in all respect to the entire satisfaction of engineer-in-charge												
a	3 R of 1 c x 2.5 Sqmm	m	100	100	100	100	100	100		600	143.59	161.53	96,919.88
b	3R of 1 c x 4 Sqmm	m	0	0	0	0	0	0		0	204.59	230.16	-
c	3c x 2.5 Sqmm	m	0	0	0	0	0	0		0	150.70	169.53	-
											-		
4.3	Supply and laying of Power Submains/circuit mains (3R x 4 Sqmm)in concealed or surface conduit system with GI conduits & 1100 V grade, multi strand copper conductor, FRLSZH-PVC insulated wires for phase, neutral & earth, shall include end termination. The conduits shall be complete with bends, JBs etc. The laying cost shall also include chipping works if necessary.												
a	Primary Point (13 meter)	Points	77	135	104	78	101	97		592	6,185.20	6,958.35	41,19,343.20
b	Secondary Point	Points	29	98	40	36	65	93		361	2,926.93	3,292.79	11,88,697.42
											-		-
4.4	Supply and laying of circuit wiring along with earth wire with the following size of FRLSZH PVC insulated copper conductor single core cable in GI conduit as required. Compete in all respect to the entire satisfaction of engineer-in-charge										-		-
a	3R of 1 c x 4 Sq sqmm	Mtr.	100	100	100	100	100	100		600	193.29	217.45	1,30,469.06
b	4c x 6 SqMM	Mtr.	0	0	0	0	0	0		0	484.03	544.53	-
4.5	S&F suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing of 6/16A 1P+N+E water proof socket with switch as required.	Nos	0	0	0	0	0	0		0	2,049.95	2,306.20	-
4.6	S&F suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing of 6/16A 1P+N+E socket with switch as required.	Nos	90	106	87	71	75	82		511	607.48	683.41	3,49,222.19
4.7	S&F suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing of 32A 3P+N+E water proof socket with plug as required.	Nos	0	0	0	0	0	0		0	7,179.25	8,076.66	-
4.8	S&F suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing of 20A 1P+N+E socket as required for AC .	Nos	20	21	20	18	18	18		115	938.83	1,056.18	1,21,460.48
4.9	S&F of 32 A 4P isolators with box complete as required by the engineer	Nos	0	0	0	0	0	0		0	3,865.75	4,348.97	-
4.10	S&F of 63 A 4P isolators with box complete as required by the engineer	Nos	0	0	0	0	0	0		0	5,798.63	6,523.45	-
4.11	Supply & installation of following modular grid plat mounted switch/es and socket/s etc. on a suitable size mild steel electrogalvanized switch boxes complete in single or combination on prorata basis complete with the connections, earthing and testing as per specifications and as required:(Note the grid plate and MS BOX shall be selected suitably as per the requirement to fix the switches and sockets.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a	1 no. 6A modular switch	Nos	0	0	0	0	0	0		0	180	180.00	-
4.12	Supply installation testing and commissioning of Occupancy sensor based movement detector with a build-in switch suitable for recessed mounting at a height of 3m with detection pattern of 6m X 8m. The sensor should have an operating voltage range of 230VAC +/10%; 50/60Hz and should be able to take upto 6A of electrical load and should be able to provide the switch off delay from 1 minute to 30 minutes range. The sensor should be in compliance with EN/IEC 60669-2-1, IEC (EN) 60669-2-1, IEC (EN) 61547, IEC (EN) 55015 and IEC (EN) 55022, class B.	No.	0	0	0	0	0	0		0	3,467	3,467.00	-
4.13	Supply and installation of G.I conduits complete with G.I junction box,pull box,other accessories with G.I fish wires as specified and as shown below												
a	25 mm dia,1.6 mm thick	Mtrs	10	10	10	10	10	10		60	192	192.00	11,520.00
b	32 mm dia,1.6 mm thick	Mtrs	10	10	10	10	10	10		60	269	269.00	16,140.00
c	50 mm dia,2.0 mm thick	Mtrs	10	10	10	10	10	10		60	444	444.00	26,640.00
											-		
	SUB TOTAL INTERNAL WIRING & ACCESSARIES E.04												**183,45,269.79**
E.05	**INDOOR LIGHTING AND FANS**												
	Supply, installation, testing & commissioning of light fittings including all accessories e.g. ballast, HPF condensors, lamps, holders, surface/recess mounting arrangement etc. including necessary supports, accessories and hardware as per specifications & as required at site and as below:												
A	Luminaire minimum specifications and requirements												
a.	Luminaires should operate at +/-6% voltage fluctuation for continuous use to comply to IEC. PF > 0.95 for HF ballasts; for EM circuits PF > 0.85 with capacitor.												
b.	All the components including the internal wiring of the luminaries to be used shall be manufactured of material, which are of low smoke and zero halogen type. All luminaires shall be manufactured to relevant sections of IEC60598 or other approved international standards and the type tests for all luminaries shall be provided.												
c.	All internal wiring within the lighting fixtures shall be heat-resisting cables.												
	REFERRED STANDARDS FOR LED LIGHTING FIXTURES												
	IS: 513 Cold-rolled low carbon steel sheets and strips												
	IEC 60529 Classification of degree of protections provided by enclosures.												
	EN 55015, CISPR15 Limits and methods of measurement of radio disturbance characteristic of electrical lighting and similar equipment.												
	IEC 62031 LED modules for general lighting-Safety requirements												
	EN 61547 Equipment for general ighting purposes – EMC iimunity requiement.												
	EN 60929 Performance, AC supplied electronics ballast for tubular flourescent lamps perormance requirement.												
	IEC 60598-2-1 Fixed general purpose luminaries												
	IEC 60598-1 Luminaires - General requirement and tests												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	IEC 61000-3-2 Electro Magnetic compatibility (EMC) -Limits for Harmonic current emission -– (equipment input current = 16 Amps. per phase.												
	IEC 60068-2-38 Environmental Testing :Test Z- AD: composite temperature/humidity cyclic test												
	IEC 61347-2-13 Lamp control gear : particular requirements for DC or AC supplied electronic control gear for LED modules.												
	IS 10322 Specification for the luminaries												
	IS 4905 Method for random sampling												
	LM 79 LED luminair photometry measurement.												
	LM 80 Lumen Maintenance												
	IEC 62384 DC or AC supplied electronic control gear for LED modules performance requirements												
	IEC/PAS 62612 Self-ballasted LED lamps for general lighting services- Performance												
5.1	Supply, Installation, Testing & Commissioning of 38W LED Recess mounted Luminaire with 6500K color temperature having 50000 burning hours life with minimum 70% lumen maintenance, CRI should be greater than 80, system lumen output should be minimum 3500 lumens and efficacy >92 lm/W. Housing should made of CRCA with opal diffuser. Electronic Driver should be in-built with life of 50000 hours, power factor >0.9 with THD <10%. LED make should be from CREE / Nichia /Philips Lumileds / LG. System Consumption should be less than 38W. Similar to PHILIPS CAT no: RC380B G2 LED35S-6500 PSU OD WH	No	100	232	100	100	150	100		782	6,737.45	7,579.63	59,27,271.64
5.2	Supply, Installation, testing and commissioning of Surface mounted LED luminaire with Mid flux LED using efficient optics , System lumen efficacy > 80Lumen/Watt , System Luminous flux of >=3200 lumens, System Wattage <=43W with 50,000 hours burning life. Color rendering index > 70 and Color temperature 4000K. CRCA housing with high efficieny opal diffuser. Luminarie sealed from bottom. Inbuilt gear . Zero maintenance, Zero mercury. Driver Surge protection > 1.5kV. Electronic In-Built PF > 0.9 , THD < 10% , IEC Compliant for Safety , Performance & EMI. The type shall be of 2'x2'. EQUIVALENT TO PHILIPS CAT. No. SM365C LED-34-4000 PSE-OD or as per the approved make list	No	0	0	0	0	0	0		0	5,910.11	6,648.87	-
											-		
5.3	Supply, Installation, testing and commissioning of LED based luminaire enclosed in a CRCA housing with diffused optics. The luminaire shall be suitable for Wall / conduit/suspended/surface mounting. With a minimum system level lumen package of 3900 lumens should have a maximum system level wattage of 42W giving a system efficacy of >98 lm/W. The product is available in color temperatures of 6500K with CRI>80 and a system lifetime of 40,000 burning hours at 70 percent lumen maintenance. It has an electronicelectronic driver with a pf>0.95 and THD<=10%. The luminaire is IP 20 protected. Operating voltage range of 140-270 V AC. LED make should be from CREE/Nichia/Philips Lumileds/ LG. The diffuser shall be made of polycarbonate. The luminaire shall be with Short circuit and Over voltage cut off protection and Electrical Class I. Philips BN108C LED 40S PSU CDL WH	No.	100	467	68	207	130	309		1281	3,534.40	3,976.20	50,93,512.20
5.4	Supply, Installation, testing and commissioning of LED highbay symmetric beam luminaire with housing made of die-cast aluminium of system wattage not more than 72W. The luminaire shall be with dedicated optics to provide precise light distribution of symmetric beam angle. The luminaire shall be designed to meet its specifications on performance & lifetime at a design ambient temperature of 45 deg C. A specially designed heat management system to ensure luminous efficacy >=102 lm/ W for the system and ensure lumen depreciation upto 30% over 50k burning hours. The luminaire is designed to meet IP 65 classification and is compliant with relevant immunity, safety and performance and EMI standards. The system lumens shall not be less than 7200 lumens with 5700K CCT. The CRI shall be > 70. The luminaire shall be able operate from 190 - 270V AC, 50Hz with > 0.9 PF & THD <=20%. The luminaire shall have an in-built surge protection upto 3kV. The LEDs shall be of SMD type (not COB type). The luminaire shall be supplied with suitable suspended / surface mounting kit. Similar to Philips: BY400V LED72S CW SY PSU S2 FG WH – Surface.	No	30	45	30	30	30	30		195	19,881.00	22,366.13	43,61,394.38

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
5.5	LED based IP54 Light trunking system suitable for Suspended, surface-continuous or standalone mounting applications provided with slim extruded housing having width<75mm. With a minimum system level lumen package of 3900 lumens should have a maximum system level wattage of 42W. The LED used in the system shall be best in class ensuring system efficacy of at least 100 lumen/watt . Color rendering index (CRI) >80. The trunking system shall be available in single sections of up to 3M length to ensure continuity along the length of the platform. The electronic driver used in the fixture shall be a constant current type driver with power factor > 0.9 and THD < 10%.The CCT shall be 4000K. Similar to Philips: LL199X 1XDLED40-4000 PSE ODWH - IP54	No	125	128	125	125	125	125		753	8,283.75	9,319.22	70,17,371.72
											-		
5.6	Supply and Installation of Trunking system suitabe for the above Trunking based Luminaire,Housing shall be made of extruded aluminium with white poweder coating,the length of the trunking system shall be 3.5 to 3.6m the trunking system shall be supplied with necessary suspenstion rods and end caps TTX 199/03LED	No.	39	39	39	39	39	39		234	2,485.13	2,795.77	6,54,209.16
5.7	Supply, installation, testing and commissioning of LED round downlighter with > 1600 lumens with 4000K CCT. The optic shall be diffuser. The reflector shall be of polycarbonate and heat sink shall be of die-cast aluminium. The wattage of the luminaire shall be with not more than 18W. The efficacy of the downlighter shall be >88 lm / W. The luminaire shall be mounted using spring clip. The CRI of the luminaire shall be >80. The luminaire shall be with electronic driver with THD < 10% and PF > 0.9 . The driver shall comply to IEC 62384 , IEC 61347-2-13, IEC 61547, EMI- CISPR15 standards. Equivalent to Philips: DN394B LED16S-4000 PSU WH	No	18	37	16	20	12	23		126	3,534.40	3,976.20	5,01,001.20
5.8	Supply, installation, testing and commissioning of contemporary post top luminaire with system wattage not more than 36W and system lumens > 3400. The luminaire shall be with operating voltage 140-270V with PF > 0.9. The LED shall be of SMD type only with CCT 5700K CRI >70. The luminaire shall be with IP 66, IK 10 and Electrical protection Class I. The luminaire shall have an efficacy > 100 lm /W. The luminaire shall comply to IS 10322, IEC 60698. The light distribution shall be street lighting distribution. The housing shall be of die-cast aluminium with flat glass cover. The luminaire shall be with 0% ULOR. The pole height shall be 3m from FFL. The life of luminanire shall be > 50000 hours at L70. The luminaire manufacture shall submit LM79 and LM80 reports from NABL accredidated lab. The luminaire shall be supplied with square shaped pole of height > 3.0m. The base plate dimension shall be 300mm x 300mm with 4 nos of holes of dia 15mm. Equivalent to Philips BGP400 LED 35L CW MR FG S1 WITH BRACKET ZGP400 L TYPE LUMACUBE AND POLE ZGP400 3M POLE complete with pole & accessories	No	0	0	0	0	0	0		0	41,418.75	46,596.09	-
5.9	Supply, Installation, testing and commissioning of LED Flood light with system power not more than 70W High efficiency glass cover with Aesthetically Designed LM6 PDC housing with Black corrosion resistant polyester Powder coating, IP66 & IK≥07 with operating voltage from 140-270VAC, 50 Hz, with LED Life of 50000 Burning Hours @L70 with system efficacy not less than 95 Lumen/Watt for the light fixture. The system lumen shall be > 7000 lumens . The supplier shall provide LM80 and LM 79 test reports from NABL accredited LAB before supplying the luminaires . Equivalent to Philip: BVP120 LED70 CW FG S1 PSU GR	No	20	20	20	20	20	20		120	17,672.00	19,881.00	23,85,720.00
5.10	Supply, Installation, testing and commissioning of LED floodlight with LM6 Pressure die-cast aluminium Housing and High efficiency Glass cover. The system wattage shall be not more than 115W and system lumen output shall not be less than 10000 lumens.The Driver Efficiency : > 85% and Life L70, 50k Hrs. Color temp shall be 5700K. The luminaire shall be provided with Graduation disk for aiming and Suitable 'C' clamp mounting. The luminaire shall have an efficacy > 95lm /W. The luminaire shall be IP 65, Class I protected. The dimension of the luminaire shall not be more than 447 x 327 x 163mm (H x W x H). The luminaire shall not weigh more than 13kg. The supplier shall provide LM80 and LM 79 test reports from NABL accredited LAB before supplying the luminaires .PHILIPS: BVP410 LED 107 CW HE NB FG S3 XT	No	2	2	2	2	2	2		12	38,657.50	43,489.69	5,21,876.25

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
5.11	Supply, Installation, Testing & Commissionimg of Surface mounted Bulkhead LED with a system lumen output of 600 lumens and a system efficacy of 100 lumen/watt The luminarie shall be IP66 & IK09 rated and shall have a CRI of 70. The housing of luminarie is made of high pressure die cast aluminium with front cover made of polycarbonat diffuser. Similar to Philips WT202W LED 6S and must conform to ingress Protection Clasification of IP54	No.	10	10	10	10	10	10		60	1,557	1,557.00	93,420.00
	FANS										-		
5.12	Supply and installations of 230 V, 1-phase, 1440 RPM, sweep of appx. 400mm Bracket fan including mounting bracket, blades, starters & other standard accessories complete as required.	No.	5	5	5	5	5	5		30	1,879.22	2,114.12	63,423.64
											-		
5.13	Supplying and installations of 230 V single phase, 1400 mm sweep ceiling fans with electronic regulators including all standard accessories complete, mounting of regulator on grid plate & MS BOX etc. and suitable length down rod, duly painted, not exceeding minimum fan height of 2.4 m from floor as required and as below.	No.	10	10	10	10	10	10		60	2,209.00	2,485.13	1,49,107.50
											-		
5.14	Supply, installation, testing and commissioning of exhaust fan with fan guards on both sides, double ball bearings, class-E insulation, capacitor (pf 0.90 or better) complete with all other accessories as per IS 2312 and as required, of following sizes:										-		
a)	Size 450mm dia, 1400 rpm	No.	7	7	7	7	7	7		42	3,403	1,42,926	60,02,892.00
b)	Size 300 mm dia, 1400 rpm	Nos	3	3	3	3	3	3		18	8,590	1,54,620	27,83,160.00
	SUB TOTAL INDOOR LIGHTING AND FANS E.05												**355,54,359.68**
E.06	**PROTECTIVE EARTHING**												
6.1	**Earthmat**												
6.1.1	Supply, laying, testing and commissioning of 30 mm dia MS rod for earth mat grid conductor (at 500mm or deeper as per the final approved design as per the site condition) as per specifications including lap (of not less than 150mm) & cross weld joints and providing bitumin coat at every joint as required. Risers from earth mat to be brought out as per approved drawings and specifications. (Cost of risers not included in this item). Supply, laying, testing and commissioning of vertical earth electrodes of 20 mm dia MS rod, 3 m deep from	umpsur	1	1	1	1	1	1		6	3,42,395.00	3,85,194.38	23,11,166.25
	Note: In the above items description says the lump sum price however the contractor responsibility to arrive The resistance of the earth mat shall not be more than 1 Ohm												
6.3	Providing and making plate earthing station with 600mm x 600 mm x 3.15 mm **Cu** plate electrode , 15 mm dia G.I.watering pipe, CI funnel with wiremesh charcoal/coke , salt, all earth work, masonry enclosure with frame,hinged cover plate having locking arrangement,Disconnecting links, complete as required as per IS-3043-1987 for earthing.	No.	10	10	10	10	10	10		60	33,135.00	37,276.88	22,36,612.50
											-		
6.4	Supply, Installing,Testing and commissioning of 50mm dia ,3m length ,pipe in pipe Chemical earth electrode complete as required as per IS-3043-1987 for earthing.	No	10	10	10	10	10	10		60	13,806.25	15,532.03	9,31,921.88
6.5	Supply and laying,Testing and commissioning of copper/GI Strips/wire for interconnecting the earthing stations ,panels,DBs etc. of the following sizes in built up trenches /surface/wall/ground complete with holes & fixing,jointing / terminating accessories as per specifications & drawing as required. (Quantity shall be paid as per the actual measurement as executed, however direct measurement shall not excced the quantity indicated in drawing approved .												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
6.5.1	50 mm x 6 mm GI strip	m	4000	5000	4500	5500	4000	5500		28500	220.90	248.51	70,82,606.25
6.5.2	25 mm X 6 mm GI strip	m	1000	1000	1000	1000	1000	1000		6000	132.54	149.11	8,94,645.00
6.5.3	20 mm X 3 mm GI strip	m	0	0	0	0	0	0		0	115.97	130.47	-
6.5.4	50 x 6 mm Cu strip	m	0	0	0	0	0	0		0	2,264.23	2,547.25	-
6.5.5	8 SWG / 4 mm diameter, copper Wire	m	65	65	65	65	65	65		390	104.93	118.04	46,036.94
										0			
6.6	Supply, laying and testing of unarmoured, stranded copper conductor, Low Smoke Zero Halogen, green coloured cables of following sizes, conforming to BS 7211 and Section E02 of M & E Specifications, for earthing, including termination of the same by copper lugs at both ends.												
a	1 x 6 sq. mm	m	0	0	0	0	0	0		0	64.87	72.98	-
b	1 x 10 sq. mm	m	0	0	0	0	0	0		0	83.83	94.31	-
c	1 x 16 sq. mm	m	0	0	0	0	0	0		0	179.64	202.09	-
d	1 x 70 sq. mm	m	0	0	0	0	0	0		0	605.78	681.50	-
e	1 x 150 sq. mm	m	0	0	0	0	0	0		0	1,246.49	1,402.30	-
	Note-1: In case of non availability of any of the sizes mentioned above, next higher size available in market shall be provided at the same rate.												
	Note-2: No additional payment will be made for providing Main Earth Terminals (made out of GI/Cu strips from within the above sizes). The METs will required to be fixed on walls as required and will be required to be provided with 12/16/20mm holes for connections of individual equipments including of other contractors'.												
6.7	Extra for bituminous coating and hessian tape wrap or polyethylene faced hessian complete for buried 50mm x 6mm or 75mm x 6mm strip as per specifications and drawings as required.	m	0	0	0	0	0	0		0	74.85	84.21	-
6.8	Extra for GI / Electrolytic Copper test links/ termination With building pier continuity conductor including termination plate, nut& bolts,fixing/welding etc as per specifications and as required.	No	0	0	0	0	0	0		0	252.49	284.05	-
6.9	**Rubber Mat**												
	Supply & placing of ribbed surface rubber mat 12 mm thick and 900 mm width as required including cutting to required lengths, of approved make, with test certificates for L.T. panels.	No	0	0	0	0	0	0		0	1,877.65	2,112.36	-
	SUB TOTAL PROTECTIVE EARTHING E.06												**135,02,988.82**
E.07	**LIGHTNING PROTECTION**												
7.1	Supplying and laying of the stainless steel SS-304 air terminations, base plate & clamping of down Conductor complete with base plate, concrete coping fixing accessories and clamping with down Conductor as per specifications & drawing as required	set	12	12	12	12	12	12		72	1,871	1,871.18	1,34,724.84
7.2	Supplying and laying of the stainless steel SS-304 strip down conductor size 25 x 3 on surface/wall / parapet/ shaft complete with joints, bimetallic connectors, testing links & other fixing accessories and clamping/ connection with earth terminations as per specifications & drawing as required.	m	1500	1500	1500	1500	1500	1500		9000	331.35	372.77	33,54,918.75

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
7.3	Supplying and laying of the stainless steel SS-304 strip Earth terminations with burried conductor size 25 x 3 with bituminous coating and covered with PVC taping complete as per specifications & drawing as required.	m	500	500	500	500	500	500		3000	248.51	279.58	8,38,729.69
7.4	Earth terminations with 50 mm dia GI perforated pipe complete with 15mm GI watering pipe with funnel with wire mesh etc. complete as per specification and drawing as required.	No	20	20	20	20	20	20		120	5,522.50	6,212.81	7,45,537.50
	SUB TOTAL LIGHTNING PROTECTION E.07												**50,73,910.78**
E.08	**EXTERNAL LIGHTING**												
8.1	**Poles**												
8.1.1	9m Octagonal pole hot dip galvanised with top bottom dia 70/155 mm , thickess 3 mm , base plate 260 mm X 260 mm X 16 mm , with single arm bracket 1.5 m with foundation bolts excluding cables and other electrical accessories	No	5	5	5	5	5	5		30	20,700.35	23,287.89	6,98,636.85
8.1.2	9m Octagonal polem hot dip galvanised with top bottom dia 70/155 mm , thickess 3 mm , base plate 260 mm X 260 mm X 16 mm , with double arm bracket 1.5 m with foundation bolts excluding cables and other electrical accessories	No	1	1	1	1	1	1		6	20,433.25	22,987.41	1,37,924.44
8.1.3	7m Octagonal polem hot dip galvanised with top bottom dia 70/130 mm , thickess 3 mm , base plate 220 mm X 220 mm X 16 mm , with single arm bracket 1.5 m with foundation bolts excluding cables and other electrical accessories	No	5	5	5	5	5	5		30	17,388.02	19,561.52	5,86,845.52
8.1.4	7m Octagonal polem hot dip galvanised with top bottom dia 70/130 mm , thickess 3 mm , base plate 220 mm X 220 mm X 16 mm , with double arm bracket 1.5 m with foundation bolts excluding cables and other electrical accessories	No	1	1	1	1	1	1		6	18,492.79	20,804.39	1,24,826.35
8.2	**Luminaires**												
8.2.1	Supply, installation, testing and commissioning of LED Street light fixture - 70 watt with IP66 protected LM6 high pressure aluminium die cast housing capable of delivering a nominal system lumen output of 7200 lumens with a minimum system efficacy of 85 lumen/watt and a CRI greater than 70. The luminaire shall have a life class of 50,000 hours @ L70 and driver efficiency of >85%.(Similarto Philips Cat. No. BRP410 LED CW072 MR FG S1 PSU or equivalent)	No	10	10	10	10	10	10		60	14,082.38	15,842.67	9,50,560.31
8.2.2	Supply of 75mm dia HDPE pipe confirming to PN-4 boring of road channel area by using open trench method and laying of HDPE pipe properly continuously jointed restoring the surface where pitting is done ,to original position.	m	50	50	50	50	50	50		300	211.57	238.02	71,406.33
8.2.3	Supply and laying of 6 SWG wire along with the cable	m	200	200	200	200	200	200		1200	16.97	19.09	22,903.92
8.2.4	Providing and fixing thermo plastic poly carbonate pole boxex confirming to IP-65 degree of protection, along with 16A MCB and 5 way connector and 2 No. cable gland suitable for 4x25 sq.mm cable.	m	10	10	10	10	10	10		60	6,219.49	6,996.92	4,19,815.34
8.2.5	wiring for luminaries in existing poles with following sizes of unarmoured cu cables from pole box to each fittings.	m	10	10	10	10	10	10		60	188.62	212.20	12,731.88
	3x2.5 sq mm												
8.3	**High Mast**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
8.3.1	Supply, installation, Testing and Commissioning 20 m high area lighting High Mast of Wipro/Philips/GE/Thorn, suitable for **06 nos. 250W LED luminaires** complete with all standard accessaries like winches, latern carriage etc. including the cost of providing supplying and fixing 6 nos of IP65 rated 250W LED flood light luminaires with High efficiency, long life, high power LED- Chip On Board(COB) Technology with luminaire Lumen output> 22900lm, Luminaire efficacy>92lm//W, CCT- 5000K, 50000 burning hours as per L70 Criteria. Housing: Extruded Aluminium, Highly efficient & specially designed glass lens optics, Constant current-Constant voltage isolated mutistage LED driver with operating voltage ranges from 90V-305V AC. Operating power factor>0.95, THD<10%, Driver efficiency > 85%, Complete assembly with LED, Driver and accessories pre wired in driver compartment, best efficient heat dissipation system similar to Wipro Cat num LF07-272-060-50-XX with beam angles 60degrees. System should include Lightning Arrestor and others accessaries like phosper Bronz Gear, double drum, stainless steel wire ropes, suitable MCB wires/cables as required with alongwith the folowing accessaries as required as under : -20 m High Mast suitable for 6 Nos LF07-582-XXX-50-XX with lantern carriage excluding lightening arrestor, panel, cables & other electrical accessories like MCB etc. **The supplier shall provide LM80 and LM 79 test reports from NABL accredited LAB before supplying the luminaires.**	NO								0	4,69,412.50	4,69,412.50	-
a)	Suitable foundation for the Mast considering soil bearing capacity 10 Ton per Sqm, with base pedestal of approve design, incoporating a suitable cable looping box with terminal blocks MCB etc.												
b)	S.I.T.C. of Earth station of Pipe earthing as per IEEE 80 -2000, ans IS 3043 -1987, including duplicate earth connection to the mast with 25X3 mm size MS GI flate.												
c)	S.I.T.C. of suitable neon Aviation lights as required.												
8.4	Façade Lighting - Design, Supply, installation, Testing and commission of following Items for Façade Light												
8.4.1	12W PER METER 24V IP68 24v DC | 3.4 w/Ft | SMD 5050 Tri-chip | 160° Beam Angle LED Light SMD LED Chip Running Length Single feed: 10 meters / 32.81 feet Double feed: 20 meters / 65.62 feet Light Surface Square Profile 160° Lumen Maintenance 70,000 Hours L70 @ 25°C : 90,000 L50 @ 25° 50,000 Hours L70 @ 50° : 70,000 Hours L50 @ 50°C Electrical Input Voltage 24V DC Driver On Board Constant Current Power Consumption 7.2 watts per meter / 12 watts per meter / 2.19 watts per foot 3.66 watts per foot LED Count 108 per meter / 32.9 per foot Physical Materials Polyvinyl Chloride (PVC) LED Spacing 9.26 mm / .36 inches Cutting Length 83.3 mm / 3.28 inches (9 LEDs) 55.6 mm / 2.19 inches (6 LEDs) Package Size: 697 × 807 × 48 mm / 27.4 × 31.8 × 1.9 inches Weight/Meter: 325 grams / .72 pounds Thermal Management Cool to the Touch, Free Air Convection Fixture Connections Front & End Leader Cables Bend Tolerances IP Rated IP68 Factory Order / IP68 with Accessories. **(MAKE: CONNECT - GREENLED, INSTAPOWER, OSRAM, Schreder)**	Mtrs	0	0	0	0	0	0		0	24,304	24,304.00	-
8.4.2	IP65 protected Channel Light DIFFUSE 5000K WITH BACK PROFILE with integrated cablle alley for cable management with integrated IP rated cable connectors hidden within profile for additional protection from weather. Cross section of profile Silver anodized surface mounted aluminium profile 25 mm (W) x 20 mm (D) approx , with opal semi translucent sealed encapsulation, protection grade IP67, DC 24 V, 1000 lm/m, 20 W/m, warm white 3000K or neutral white 4000K or cool white 5000K, CRI>80Ra (optional RGB, RGBW, other CCT, red, blue, green), 700 LED/m, standard length 2000 mm. Excl. converter and end caps (on request). The support is made of an anodized extruded aluminium frame which makes it possible to first fix AWP3 or AWM3 to the wall/ceiling. **(MAKE: CONNECT-GREENLED, INSTAPOWER, OSRAM, Schreder)**	Mtrs	0	0	0	0	0	0		0	18,585	18,585.00	-

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
8.4.3	IP66 protected PATHFINDER IP66 3000K 10° Aluminium Die Cast 9W Body Hard anodized aluminium Finish Installation Housing box Power Supply Cables35 cm NS20N PCP 2x0,5 mm2 Power Supply24Vdc Power Consumption 9 Watt Lumen Output680lm Working Temperature-20°C +45°C Insulation ClassIII Weight535g. Choice of three colour emperatures as standard (2700K, 3000K and 4000K) and delivers 80CRI for excellent colour rendering, and with binning-free LEDs carefully selected from two-step Macadam's ellipse. PATHFINDER is Smart Shield protected against polarity inversion; an integrated super fast diode prevents accidental damage to the luminaire during installa on due to reverse polarity. Smart Shield protects against 'hot-plugging'. Fully integrated surge protection the constant- current driver and prevents damage to the LED die surface. **(MAKE: CONNECT, INSTAPOWER, OSRAM, Schreder)**	Nos	0	0	0	0	0	0		0	11,437	11,437.00	-
8.4.4	Recessed ceiling compact downlight 55925. Mid beam light distribution. LED 50 W, connected wattage 50W, 5000 lm, half beam angle 45°, colour temperature 3000 K. Colour rendering index (Ra) > 80.Overheating protection and an expected service life of at least 50,000 operating hours. 3 years warranty of availability of LED module and wear parts. Without power supply unit. Protection class IP 55, safety class III. Luminaire made of cast aluminium, aluminium and stainless steel, colour graphite. Safety glass, clear. Reflector made of pure anodised aluminium. With fixed connecting cableA05VV-F 2 x 0,5 qmm, length 0,5 m, with connector. For installation in suspended ceilings having a material thickness of 10-45 mm. **(MAKE: CONNECT, INSTAPOWER, OSRAM, Schreder, BEGA, SILL, HOFFMEISTER)**	Nos	0	0	0	0	0	0		0	17,156	17,156.00	-
8.4.5	SPIKE LED 24DEG beam angle IP rated 65 product fitted with Osram 700ma 18W 24DEG 3000/4000K CRI80+ NON DIM with led power supply built in Color tolerance: <MacAdam 4 SDCM. **(MAKE: CONNECT, INSTAPOWER, OSRAM, Schreder)**	Nos	0	0	0	0	0	0		0	14,296	14,296.00	-
8.4.6	LINEAR HANGING LIGHT DIRECT + INDIRECT 100% recyclable, extruded Acrylic tubular White LINEAR LENS Extruded, twin-layered, high-impact acrylic white and extra diffuse with minimal-to-no source visibility. MOUNTING SIZE – Suspended 1.5m. LED MED Medium-output, high performance LED HI High-output, high-performance LED 3000K CRI >80 4 Step MacAdam binning FINISH AL Standard, natural "Ultimate" aluminium VOLTAGE UNV Universal voltage LED Driver. NON - DIM (MAKE: CONNECT, INSTAPOWER, OSRAM, Schreder)	Nos	0	0	0	0	0	0		0	18,585	18,585.00	-
	SUB TOTAL EXTERNAL LIGHTING E.08												**30,25,650.94**
E.09	**UNINTERRUPTED POWER SUPPLY SYSTEM**												
9.1	Supply, Installation, Testing and Commissioning of **true parallel redundant 2 x 20 kVA, online, UPS** system suitable for providing power supply to emergency lighting at station & viaduct, Platform edge door and Computerised Control panel load of approved make, suitable for incoming 415 volts, 3 phase +10 % -20%, 50 Hz, supply and single phase output voltage, variation ± 1%, including transformer, rectifier/dual converter, static switch, inverter, filter, Bypass & static transfer switch for automatic switch over without giving any break of power, maintenance bypass switch, Micro processor/ software controlled annunciation,protection(including against input phase reverssal), and menu run diagnostic module,associated cabling and connections/ terminations, complete as per specifications and as required. **Note-1:** The price of above item is inclusive of a manual chnageover switch suitable for terminating 2 nos. of 4-core aluminium conductor armoured cables on the incoming side of UPS. The manual change over switch may be wall mounted in the UPS room. RS 485 port for display of ON/OFF status of UPS on BMS work station through MODBUS protocol is also included in the price. **Supply,** Installation, Testing and Commissioning of valve regulated lead acid-sealed maintenance free suitable for 30-minute-battery backup to the each UPS of item 9.1, Battery shall comply with relevant regulations & Battery racks shall be made of acid resistant material complete as per specifications & as required.	set								0	6,95,835.00	7,82,814.38	-
	SUB TOTAL UNINTERRUPTED POWER SUPPLY SYSTEM E.09												**-**

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
E.10	**Safety and Other accessories**												
10.1	Supply and fixing of the following safety equipments in Aux. Sub.Station/MDB room as per detailed descriptions given below and as per relevant IE rules & code of standard practice.												
a)	**1000 mm** wide 15 mm thick rubber matting (complying with I.S.S.) and suitable to withstand 11 kV in front of all panels in ASS building & MDB room as required of `Syntax' make.												
	Laminated standard shock treatment charts in English & Hindi in ASS, ESR, DG room and Pump room in each station.												
b)	**Danger** plate as per approved Style & sample written in English & Hindi for MV installations as required as per IE rules, IES and IS 2551 (latest) - 8 nos. per station	umpsur	1	1	1	1	1	1		6	55,225.00	62,128.13	3,72,768.75
c)	**2 nos.** per station First Aid Box Complete as approved by St. John ambulance or Indian Red Cross												
	4 nos. per station of 3-fire-buckets set each painted red with 'fire' written complete with sand filling, floor/wall mounting brackets/stand complete as per elevant IS and as required.												
d)	**One Tool** kit per station comprising 1 set of flat spanner (Taparia / Jalan), 1 set of box spanner, 1 no.												
	Hacksaw frame with 10 No. blades, 1 no. large, medium, small screw drivers, 1 no. insulated plier, 1 no nose												
e)	plier, 1 no. hand crimping tool upto 16 sq.mm, 1 no. digital multimeter, 1 no. test lamp and 1 no. tester. Screw driver set for all types of screw heads also to be provided												
	SUB TOTAL Safety and Other accessories E.10												**3,72,768.75**
E.11	**BMS/SCADA for all system parameter of the panel**												
11.1	The Specifications shall be read in conjuction with Manual of specifications and standards and Technical Specifacations.		1	1	1	1	1	1		6	49,70,250.00	55,91,531.25	335,49,187.50
	Supply, Installation, testing, commissioning, trainging and AMC of Biluding Management System PLC, Remote Processor, Siganl Interface wiring and cabling with field equipment interface and provision of supervisory control and monitoring for M&E SCADA contractor using standard protocol over Ethernet(Station LAN-Provided by Others(S&T Contractor)) as per specification and Tender clauses.												
11.2	**SOFTWARE - RPU Programming and Configuration Software(Rate included in item 11.1)(Complies to SIL-2)**												
	Programme software for RPU logic develolpment and debugging for use with												
	compatible Personal Computer with Licence to carry required engineering												
	and maintenance function with below marked minimum functions:												
	RPU Programming and Configuartion Functionality												
	RPU dignosis and data monitoring function locally.												
	RPU histroic data download function for record and fault segregation process.												
	RPU software interlock and logic development for process or data management												
	Communication and Integration mangement and configuration of I/Os fucntion												
a	The RPU shall be capable of fully stand-alone operation and shall be independent of any central computer for all specified control or communication applications. The software shall include all necessary routines and modules required to implement any control strategy and shall be user programmable. The programming language shall be English and shall use standard controls terminology.												
b	Input and Output point processing shall include:												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	(i) Continuous update of input and output values, conditions and status. All connected points are to be updated at a maximum of 5 second intervals, under worst conditions.												
	(ii) Analog to digital conversion of input values shall be carried out with at least 11 bit resolution with typically 40 dB series mode rejection @50 Hz. It shall be possible to calibrate the inputs by means of movable jumpers or links to suit the sensor type in use, to achieve a high accuracy reading.												
	(iii) Input reading shall be automatically checked to determine that the reading is within the sensor"s range and within the range of the input circuit, i.e. 0-10V or 4-20mA. Should this not be the case then an alarm status shall be indicated.												
	(iv) All sensor readings shall be in engineering or user-definable units. These units shall be calculated by the sensor scaling type assigned to each sensor.												
	(v) Each sensor shall have, in addition to the checks specified above, operator adjustable High and Low alarm limits. If the sensor reading is outside these limits then an alarm shall be generated. It shall be possible to delay these alarms by a user-defined amount so that spurious alarms are not reported.												
	(vi) All inputs shall be filtered to reject mains frequency interference. The mains frequency of 50 Hz shall be selectable in software.												
c	Each RPU is to be configured to run the control strategies called for in the sequence												
	of operation sections of this specification. Each RPU shall have the required software												
	modules available for arithmetic calculations, logical decisions and relational operators												
	necessary for the implementation of these control sequences.												
	(i) RPU data such as set points, sensor values, loop parameters etc., shall be available to												
	the operator for display and modification at the main supervisor, the portable												
	supervisor or the display panel.												
	(ii) The reschedule time of control loops shall be adjustable, in 5 second intervals.												
d	Each RPU shall provide five independent time zones, each of which shall have three												
	separate start and stop periods within each 24 hours.												
	(i) Unique time program shall be provided for each day of the week, plus a unique												
	holiday schedule. Each RPU time zone may be provided with unique time programs,												
	or they may be grouped and assigned a common time program as configured by												
	the operator.												
	(ii) For each time program, the main supervisor shall have a calendar available which												
	may be used to make simple modifications up to a year in advance. The calendar												
	shall allow these modifications to be permanent or to execute only once and then												
	return to the previous (permanent) schedule.												
	(iii) Calendar days which are intended to operate as Holidays shall also be definable												
	up to a year in advance.												
e	All control strategies shall be held in RAM, battery backed up for at least 2 years. All												
	data shall be available for review and modification from the main or portable supervisors.												
11.4	**Remote Processor Unit (RPU), It's Sub-components and Mounting Panel**												
	Remote Processor Unit (RPU) Modules should have (Digital Input, Digital Output,												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Analog Input and Analog Output Modules integrated to CPU module along with												
	other required interface or system module for integration of field signals;												
	should capable of standalone monitoring and control function irrespective to												
	server communication interface; should fully equiped with Power Supply module,												
	device protection and intrface terminals and wiring and other devices as required to												
	meet tender specification & functional requirment.												
	The contractor shall cross reference the RPU Panel and others to Housing Type as required.												
	A by-pass switch/s shall be provided to completely by-pass the RPU in the event of a total												
	failure of the Processor and associates equipment to enable the normal operation of												
	the equipment controlled by the RPU. Panels shall be fitted with a suitable pocket to contain												
	circuit diagrams and other relevant Definitive Design Drawings. An "as installed" set shall be												
	having. All wiring and equipment tagging as per most acceptable inernational standards and												
	metro practice.												
	CPU with onboard RS485port for profibus/mpi/Modbus communication.												
	Data and program backup without external battery. CPU shall have scan time of												
	not less than 0.1ms per 1k bit instruction and 5ms per 1k floating point instructions.												
	Micro-Memory Card												
	Power Supply Module with AC/DC converter as required.												
	Al Module of 8 Channel as per Signal list with necessary spare and redundant I/O consideration.												
	DI Module of 16 / 32 /64 Channel as per Signal list with necessary spare and redundant I/O consideration.												
	DO Module of 8 / 16 / 32 Channel as per Signal list with necessary spare and redundant I/O consideration.												
	AO Module of 8 Channel as per Signal list with necessary spare I/O consideration. (Minimum 1 Modules per panel)												
	Front Connector for Programming/console port (Serial RS232 / Ethernet) with portable computer communication BUS.												
	BMS Workstation / Server system interface provison in PLC communication Port (Ethernet TCP/IP Rj45 connector)												
	Field equipment serial RS485/Rs232 Port interface port (3 nos or as required to meet the functional and integration requirment												
	Active Bus Module for IO Modules (As applicable for DI module up to field cable interface TBs)												
	Active Bus Module for DO Modules (As applicable for DO module up to Relay control Board/ field cable interface TBs)												
	Active Bus Module for AI/AO Modules (As applicable for AI/AO module up to field cable interface TBs)												
	Mounting Rail and other cable containment for RPU panel different component mounting and Cable wiring.												
	RPU Required frameware, protocol and data point licence as required to meet the interface and programming requirement in ref to tender specification with provision of spare (i.e. spare of 50% of Total IO Point as future expansion requirement without any upgradation)												
	Bus cable for different module integration. Or as required for intermodule communication.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Interface Module and/ or integrator module with or without gateway for ethernet interface provision of M&E SCADA system.												
	Ethernet Module TCP/IP 10/100 MBPS												
	MODBUS/PROFIBUS/BACNET card as required												
	Terminal block 8 slots (as required for field cable interface and termnination)												
	16 channels Relay Board PCB Mounted type, plug in relays. (As per DO module)												
	Allowance for 30% Spare I/O Points Modules and expansion by 50% shall be possible by adding more I/O modules and software reconfiguration												
	Assorted connectors, pre-formed connecting cables, special terminal blocks, bus cables, taps, tap links, networking accessories consisting of patch Panels, Cat 5 patch cords etc.												
	Note:												
	All devices as required to meet tender specification & Operational requirment shall be provided for fully functioning of BMS system.												
	The RIO shall be designed in accordance with the IO signals given as per the IO												
	Summary Provided for stations.												
	All RPU Controller input modules served equipment from outside are												
	protected against voltage transients. All input/output modules are												
	galvanically separated from CPU & internal bus. It is protected against												
	short circuit and it is connected via separate terminal strip. PLCs shall												
	be designed by taking 20% of spares in I/O's signals with Mounting												
	cabinet.												
11.5	**Marshalling Cabinets**												
	Terminal blocks shall be designed and tested in complying with IEC 60947-7-1.												
	Terminal block shall have ability to receive unprepared conductors.												
	Terminal block shall be single terminal type. Each terminal shall be exchangeable												
	without dismounting adjacent terminals and also suitable for designative labeling.												
	Terminal blocks shall be of the rail-mounted type and shall be of screwless type												
	terminals 600V a.c. moulded block type with molded insulating barrier between terminals.	umpsur											
	Terminal connections shall be such that the conductors shall be connected with the												
	necessary maintained contact pressure. Terminals shall be so constructed that the												
	conductors can be clamped between suitable surface without any significant damage												
	either to conductors or terminals.												
	Terminal blocks shall have test probe facilities for connections of test leads and an												
	integral disconnecting device to facilitate testing.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	The rated cross-section of a terminal block shall be 0.5-2.5 mm2 of round copper												
	conductor. No terminal can carry more two conductors simultaneously connectable on												
	each incoming/outgoing side.												
	The spare terminating block in all MS shall be provided with capacity at least 20% of the												
	number of I/O points.												
	The Marshalling Cabinet shall be of 1.6 mm thick galvanized sheet steel with gray												
	colour epoxy and electrostatic powered coated. The protection class shall be IP 31.												
11.6	**ETHERNET SWITCHES**												
	Providing, Installing, Testing & Commissioning of industrial Ethernet Switches having the												
	following specifications to meet the functional and system requrment in a redundant												
	system architechure												
	1. Ethernet 10/100MBPS Switch												
	2. Network Protocol - IEEE 802												
	3. Data Protocol - Modbus over TCP/IP												
	4. Full or half duplex operation with flow control supported on all the ports												
	5. Reverse polarity protection												
	6. Industrial surge and Spike protection												
	7. IP 30 protection												
	8. Operating temperature 0 to 60 deg C												
	9. Storage temperature -40 to +85 deg C												
	10. Relative Humidity 10 to 95 % non condensing												
	11. UL listed equipment												
	12. 24AWG Cat 6 RJ 45 port and 6 fiber optic port												
11.7	**Integrators/ Modems/ Gateways/Protocol Converters**												
	Supply, installation, testing and commissioning of Integrators/ Modems/ Gateways/												
	Protocol Converters for Integration of standalone Systems with BMS (All software,												
	hardware required for integration with the specific standalone system with BMS shall be												
	supplied by respective contractor). The following Equipments with necessary												
	Data Points as mentioned below shall be considered for integration with individual PLC.												
	Uninterrupted Power Supply												
	Digital Power Meter .												
	DG Set												
	Lifts												
	Escalators												
	Water Meter												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Fire Alarm Panel												
	HV Panels												
	Fire Fighting systems and Panel flooding system												
	All the Panel boards incoming and out going breakaers												
	PHE systems												
	Systems not listed above but that requires BMS/SCADA to be considered.												
11.8	**Field Devices**												
	Pressure transmitters												
	Pressure transmitters shall have a linear output of 0-10V. Pressure transmitters shall be a												
	span of not greater than twice the s tatic pressure at maximum flow or differential												
	pressure at shutoff as applicable.												
	Water-Flow Meter												
	Water-flow measuring devices consisting of annular averaging pilot tube flow elements												
	having the following minimum Specifications. Select the Annular for the operating flow												
	range, pipe size and fluid temperature.												
	(i) Accuracy - 2%												
	(ii) Repeatability - 1.2%												
	(iii) Pressure Drop - 1.5 kPa maximum												
	(iv) Operating Temperature Range - 4^{o}C to 95^{o}C [140^{o}F to 203^{o}F]												
	(v) Operating Pressure Rating - 174 kPa [250 psig]												
	Level Switch												
	Wind Transmitter												
	Wind Speed & Direction Sensors												
	Temperature Sensors												
	Temprature and Humidity Sensors												
11.9	**Control Cable**												
	Supply and laying Control Cables with following specification including 25mm dia rigid												
	GI conduits as applicable for running cable from Cable try / Raceways to equipment panel or												
	required to be laid at open.												
	All control cable shall be suitable for installation in wet and dry locations. The conductor												
	shall be of soft or annealed strand uncoated copper wire.												
	The insulation shall be FRLS, PVC, insulated cables suitable for use on a copper												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	conductor with a maximum operating temperature not less than 70°C.												
	Fillers shall be used in the interstice of the multi-conductor cable where necessary to give												
	the complete cable a substantially circular cross section. Fillers shall be Polyvinyl												
	chloride (PVC) rod or Polyethylene (PE) materials.												
	The cable shall be helically wrapped over the filler and copper shielding with												
	non-hygroscopic Mylar or Polyester tape.												
	The shielding, for control cables, shall be annealed copper tape or suitable width and												
	shall be helically applied with a minimum 10% lap. The annealed copper tape shall be a												
	least 0.1mm thickness and substantially free from burrs.												
	For Analogue Signals and Data Communication												
	2 Twisted Pair 0.5 Sq mm copper Cable with Aluminium Schelding.												
	For Digital Signals												
	12 Core X 1.0 Sq. mm Copper, screened cable												
	05 Core X 1.0 Sq. mm Copper, screened cable												
11.10	**CAT5e CABLE - Data Cable**												
	Supply, Installation, testing and commissioning of CAT 5e cable with												
	25mm GI conduit & complying to Class 1E type Communication with												
	MODBUS, BACnet, Lontalk, ARCNET on RS 232/485 port to match the control system												
	requirement, thick 20mm dia Conduit shall be supported at regular intervals not												
	exceeding 2.5 m. on horizontal runs and 1.5 m. on vertical runs. as required at site.												
	etc. (For RPU panel internal Data commuication, Station LAN interface, etc..)												
	OPTICAL FIBRE CABLE - Communication Cable												
	Supply, Installation, testing and commissioning of 6 core single mode												
	OFC with all accessories necessary such as listed below:												
	i) 12Port fiber Patch cord Loaded with adapter Plates & Splice tray												
	ii) 24Port fiber Patch cord Loaded with adapter Plates & Splice tray												
	iii) SC-LC, Duplex OFC patch cord, 3mtrs, OM3												
	iv) SC-Style Pigtail, 50/125, Multimode, OM3, 1.5 meter												
	v) Line interface unit for Fo cable termination, supply, installation and connection												
	as required to meet functional requirment.												
	Note: The items indicated above are probable and main items.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	vendor to include all allied and implied items and required quantity												
	for station building management system as indicated in various areas of												
	BOQ.												
	Qunatity shall be as per detail design requirement or as to meet system operational and functional requirement as required by the client/cunsultant .												
	Make: Honeywell / Equivalent												
	SUB TOTAL BMS/SCADA for all system parameter of the panel E.11												**335,49,187.50**
E.12	**Via Duct Lighting**												
	Supply, Installation, Testing and commissioing of Via duct lighting with Light fitting, cable, BD, Cable tray and junction and all necessary accessories										217,21,825.97	244,37,054.22	-
12.1	Light Fixtures												
	Supply, Installation, testing and commissioning of LED Via Duct Light with system power not more than 20W High efficiency glass cover with Aesthetically Designed LM6 PDC housing with corrosion resistant polyester Powder coating, IP66 & IK 10 with operating voltage from 220-240VAC, 50 Hz, with LED Life of 50000 Burning Hours @L70 with system efficacy not less than 80 Lumen/Watt for the light fixture. The system lumen shall be >= 1600 lumens . The supplier shall provide LM80 and LM 79 test reports from NABL accredited LAB before supplying the luminaires . Philips: Philips Via Duct LED Luminaire												
12.2	Distribution Board												
	Outdoor type Vertical Power distribution boards (VDPN) IP65 rated as per specification and as per following details.												
12.3	INCOMER												
	1 no. 63A TP Contactor with with astronomic digital timer												
	1 no. 63 TP MCCB												
	1 set of (ON) indicating lamps.												
12.4	OUTGOINGS												
	8 Nos of 20 TPN MCB												
	SCADA / BMS CONNECTIVITY												
12.5	Cables	umpsur											
	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured, FRLSZH, **XLPE**, aluminium(AL) / Copper (CU) conductor cables on existing trays/walls/columns/ indoor/ trenches including the cost of supports with suitable clamps, saddles, hooks, bolts etc. and including the cost of proper dressing of cables, markers providing identification tags,earthing of glands armouring etc. complete as per specifications, as required and as below.												
	5 core 2.5 sq mm CU Conductor												
	5 core 4 sq mm CU Conductor												
	3.5 core 50 sq mm AL. Conductor												
12.6	Cable Termination												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Cable Joining and termination above cables including cost of supplying and fixing, crimping lugs, double compression brass glands, insulation tape etc. complete as per specifications and as required and any other Miscellaneous items required for to complete installation,testing and commissioning of Via duct lighting .												
12.7	Cable Trays												
	Supply, fabrication & installation of perforated hot dipped galvanised double bended cable trays from 2 mm thick GI sheets continuously connected including horizontal and vertical bends, reducers, tees, and other accessories and duly suspended from the ceiling with 12 mm dia vertical GI rods supported by 40mm x 40 mm 5 mm GI angle etc. (or installed on wall supported on suitable brackets as required) complete as per specifications, as required and as below. Coloured cable tray shall be provided as per Engineer In-charge												
a)	150mm wide x 50mm deep x 2mm thick												
	SUB TOTAL Via Duct Lighting E.12												**-**
E.13	**Mandatary Operational Spares for the Panels And safety items**		1	1	1	1	1	1		6	3,31,350.00	3,72,768.75	22,36,612.50
	R,Y,B Phase Indication lamp Led Type												
	Red / Green On, Off Indication lamp Led Type ,On,Off,trip Indication lamp Led Type												
	Amber trip Indication lamp Led Type												
	3Phase Digital Amp/Volt. Meter 96mm*96mm with inbuilt Selector Switch												
	Electronic Multifunction Meter 3Phase Class1.0 EM6400												
	CTs 1000/5A Cl 1.0 15VA, cast resin for measurement												
	CTs 1000/5A Cl 5P10 15VA, cast resin for protection												
	CTs 100/5A Cl 1.0 5VA, tapewound												
	230V AC or 24V DC shunt trip coil												
	230V AC motor wound spring close mechanism												
	Control MCB 6A SP 10kA MCB, 'C' Curve	umpsur											
	CTTB+Neutral Link												
	Power terminals ,Control Terminal Block,Neutral Link,Spreader Terminals												
	Shunt release,UV release												
	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
	Exhaust Fan 8" with Filter and Switch												
	Rotary Operating Handle												
	Control MCB 6A SP 10kA MCB, 'C' Curve,												
	Power Contactor 3Pole 9A 220V AC-3 Duty,Auxiliary Contact Block 2No+2NC												
	On, Off Push Button,Auto Manual Selector Switch												
	Single phase Preventor												
	Over current Relay												
	And not limited to the above and any other items necessay shall also be considered.												
	SUB TOTAL Mandatary Operational Spares for the Panels And safety items E.13												**22,36,612.50**
E.14	**Lighting Control System**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Supply, Installation ,Testing and commissioning of Lighting control panel to achieve 33%,66% and 100% on/off the lighting. The Lighting Control System shall be integrated with the E& M SCADA . Each lighting circuit from the lighting control panels (LCP) shall be controlled by the SCADA between the LCP and RTU.The Schedule for control and monitoring of lighting circuits and graphic of lighting control floor plan shall be from the E & M SCADA work station in SCR and OCC . The lighting control system configuration such as graphic, layout, setting, etc., shall be adjusted to harmonize with Architectural finishes. This is also applied to third party vendors interfaces with the system. The lighting control system shall comply with the following codes and standards: (1) IEEE 802 : Standard for Information Technology – Telecommunications and Information exchange between systems (2) IEC 60529/1989 : Degree of protection provided by enclosures (IP Code) (3) IEC 60255 : Electrical Relay (4) IEC 60364 : Electrical Installation of Buildings												
a)	LX Lighting Control Panels with encloser,24 Relay Spaces, Relays Ratings : 120, 277, and 347VAC 20 Amp Single Pole Input: 120/277/347VAC multi-tap transformer.	No	5	5	5	4	4	4		27	3,20,172.46	3,60,194.02	97,25,238.47
											-	-	-
b)	Power Supply for LX Panel Input: 120VAC Output: LON Protocol	No	4	4	4	4	4	4		24	72,278.48	81,313.29	19,51,518.96
											-	-	-
c)	LX Switches for Manual Override, 5 Switches, White Color	No	6	6	6	5	5	5		33	11,829.20	13,307.84	4,39,158.86
											-	-	-
d)	Graphic User Interface for LX Panel for Local Control	No	1	1	1	1	1	1		6	37,064.81	41,697.91	2,50,187.47
											-	-	-
e)	PC Integration Tool for remote controlling Panels Via IP Address Input: 120VAC	No	1	1	1	1	1	1		6	2,33,298.01	2,62,460.26	15,74,761.58
f)	Building Automation multi-protocol gateway (BACnet, Metasys N2 by JCI, and Modbus) for providing control and access to LX Network Lighting Control Panel system Input: 24VDC	No	1	1	1	1	1	1		6	1,66,003.04	1,86,753.42	11,20,520.50
g)	Power Supply for ProtoCessor Input: 100-240VAC, 1.5A Output: 24V, 1.5A	No	1	1	1	1	1	1		6	592.01	666.01	3,996.08
h)	Control Cable for LON Communication between Panels (100 Ft Reel)	No	1	1	1	1	1	1		6	12,827.66	14,431.12	86,586.73
i)	Surface Mounted Cabinet for LX Panel Accessories	No	7	7	7	5	5	5		36	4,205.94	4,731.68	1,70,340.41
	SUB TOTAL Lighting Control System E.14												**153,22,309.07**
	Grand Total-Electrical												**2808,12,286.29**
	SCHEDULE-F-FIRE FIGHTING & FIRE ALARM SYSTEM												
F.01													
A	**Hydrant Main Fire Pumps**												
1.0	Supply, installation,testing and commissioning of fire pumps, electrically driven generally as specified and shown in equipment schedule complete with:												
i)	all accessories												
ii)	vibration mounts												
iii)	test connection excluding starter panel												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
iv)	Civil foundation in R.C.C. 1:2:3 200 mm high and 150 mm projection allround base plate or as per pump manufacturer's recommendation.												
1.1	**Hydrant Main Fire Pumps**												
	Providing and fixing horizontal single stage, single outlet pumping set with bronze impeller, C.I. body and connected by a flexible coupling to a totally enclosed fan cooled induction motor mounted on a common M.S. structural base plate with RCC base (RCC by civil contractor) and with all pump accessories, including pressure switch, pressure guage (both with cut off ball valves) complete as per specifications. Motor to be suitable for 415V, 3-phase, 50 Hz AC supply (specifications as per fire fighting requirements and on the pattern of local authority approval) as per instruction and specifications.												
a	Capacity : 2280 lpm App.head : 70 m App. HP :60 HP	Set	0	0	0	0	0	1		1	4,08,000	4,08,000.00	4,08,000.00
b	Capacity : 2850 lpm App.head : 70 m App. HP :75 HP	Set	0	0	0	0	0	1		1	4,82,344	4,82,344.00	4,82,344.00
c	Capacity : 2280 lpm App.head : 90 m App. HP :75 HP	Set	3	3	3	3	0	0		12	5,24,001	5,24,001.00	62,88,012.00
d	Capacity : 2850 lpm App.head : 90 m App. HP : 100 HP	Nos	0	0	0	0	1	0		1	6,39,999	6,39,999.00	6,39,999.00
e	Capacity : 1800 lpm App.head : 90 m App.HP : 100 HP	Nos	0	0	0	0	1	0		1	3,25,952	3,25,952.00	3,25,952.00
1.2	**Fire Jockey Pumps**												
	Supplying, installing, testing, & commissioning of electric driven automatic pressurisation pump set consisting of the following.												
i)	Vertical mounted multi stage centrifugal Jockey pump.												
ii)	Squirrel cage induction motor suitable for 415 V, 50Hz, AC supply of the above pump with synchronous speed of 2900 RPM T.E.F.C type such as confirming to IP:55 and flexible coupling and coupling guard with the pump.											-	
iii)	Common bed plate of fabricated mild steel channel or cast iron type.											-	
iv)	Suitable cement concrete pump foundation of 1:2:4 ratio (1 cement : 2 fine aggregate : 4 coarse aggregate) with MS bolts, washers or as per pumpmanufacturer's recommedation.												
a	Capacity : 180 lpm, App.head : 70 m, HP : 7.5 HP	Nos	2	2	2	2	2	1		11	1,36,470	1,53,528.75	16,88,816.25
b	Capacity : 180 lpm, App.head : 90 m, HP : 10 HP	Nos	0	0	0	0	0	0		0	1,70,587	1,91,910.38	-
												-	-
1.3	**Supply and installation of pressure gauge panel (manifold) as per the requirement & Comprising:**	Set	1	1	1	1	1	1		6	17,513	19,702.13	1,18,212.75
	i) Pressure gauges												
	ii) Pressure switches with snubber ball valve and 2 x 1.5 sq mm copper conductor wiring to motor starter panel												
	iii) Water piping from system upto the gauge panel along with valves etc.and as required.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	iv) Sheet metal enclosure with glass paneling etc. as approved												
1.4	**Internal hydrants/landing valves generally as specified and all complete with:**	Set	11	11	11	11	11	11		66	51,812	51,812	34,19,592.00
	i) 63mm dia Single headed landing valve IS marked (Stainless steel)												
	ii) First aid hose reel with 25 mm dia, 45 m long thermoplastic hose as per IS 12585 rubber hose, ball valve, piping and 7-8mm nozzle as required												
	iii) 38mm synthetic hoses with 63mm instantaneous SS coupling, IS marked- 15 m x 2 lengths with suitable arrangement of connecting the hose pipe with coupling as required.												
	iv) branch pipe and nozzle IS marked (Stainless steel)												
1.5	**Hose cabinet as approved or as per site conditions with universal locking arrangement. Glazed with 5.5mm clear glass Powder coated Aluminium shutter door as appropriate with universal locking arrangement with aluminium grill of following sizes and types :**												
a	Size 1200 x 1500 in 2 mm thick stainless steel sheet	Set	0	0	0	0	0	2		2	27,642	27,642	55,284.00
b	Size 1500 x 1850 in 2 mm thick stainless steel sheet	Set	7	7	7	7	7	7		42	31,136	31,136	13,07,712.00
c	Size 2100 x 900 in 2 mm thick stainless steel sheet	Set	4	4	4	4	4	4		24	29,073	29,073	6,97,752.00
1.6	Hose cabinet door as approved or as per site conditions with universal locking arrangement. Toughen Glass of following sizes and types :												
a	Size 1200 x 1500 in 2 mm thick stainless steel sheet	Set						1		1	29,880	29,880	29,880.00
b	Size 1500 x 1850 in 2 mm thick stainless steel sheet	Set						1		1	34,120	34,120	34,120.00
c	Size 2100 x 900 in 2 mm thick stainless steel sheet	Set						1		1	32,057	32,057	32,057.00
1.7	**Supply, installation, testing and commissioning of external (yard) hydrants inclusive of :**	Nos	2	2	2	2	2	2		12	58,538.50	65,855.81	7,90,269.75
	i) MS Box cabinet of size 750 x 600 x 250 mm of 2mm thickness with 2 nos x 15M Length of 38mm dia synthetic hose with 1 no branch SS nozzle.												
	ii) 63 mm dia single headed landing valve IS marked.												
2.0	**PIPING FOR FIRE FIGHTING SYSTEM**												
2.1.1	Supply, fabricating, laying, testing, painting and commissioning external piping (UNDERGROUND) generally as specified using heavy class G.I. conforming to IS : 1239 & BS : 1387 with all fittings and complete with one protection layer of 4mm thick Pypkote												
	i) All pipes and all heavy grade fittings conforming to IS 1239 together with suitable joints, flanges, gaskets, bolts & nuts, washers, fittings, adapter pieces etc.including the support arrangements.											-	
a	150 mm nominal bore	Mtrs	114	114	114	114	114	114		684	2,290.51	2,576.83	17,62,549.06
b	100 mm nominal bore	Mtrs	87	87	87	87	87	87		522	1,538.62	1,730.95	9,03,556.78
c	80 mm nominal bore	Mtrs	70	70	70	70	70	70		420	1,114.55	1,253.87	5,26,625.32
2.1.2	Excavation upto hard murram as per general profiles and back filling	Cu.m	10	10	10	10	10	10		60	497.03	559.15	33,549.19
2.1.3	Making 1:2:4 cement concrete supports and thrust blocks generally as required and approved.	Cu.m	1	1	1	1	1	1		6	3,625.52	4,078.71	24,472.27

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
2.1.4	**Butterfly Valve (PN16)**												
	Supply and installation of Butterfly Valve with mating flanges generally as specified all complete.												
a	200 nominal bore	Nos	2	2	2	2	2	2		12	15,489	15,489	1,85,868.00
b	150 nominal bore	Nos	12	9	12	8	12	8		61	14,164.80	15,935.40	9,72,059.28
c	100 nominal bore	Nos	31	19	12	17	20	17		116	8,721.27	9,811.43	11,38,125.74
d	80 nominal bore	Nos	7	11	4	14	7	14		57	7,098.48	7,985.79	4,55,190.25
e	65 nominal bore	Nos	4	4	4	4	4	4		24	4,738	4,738	1,13,712.00
2.1.5	**Non Return Valve(PN16)**												
	Supply and installation of Non Return Valve with mating flanges generally as specified all complete.												
a	200 mm dia	Nos									25,500	25,500	-
b	150 mm dia	Nos	5	5	4	3	3	3		23	27,857.84	31,340.07	7,20,821.53
c	100 mm dia	Nos								0	6,008	6,008	-
d	80 mm dia	Nos	2	2	2	2	2	2		12	9,084.10	10,219.61	
2.1.6	**Supply, installation testing and commissioning of Flexible connectors (Expansion Bellow) as per specification complete in all respect. PN16**												
a	Size 80 mm	Nos	4	4	4	2	2	2		18	4,474	4,474	80,532.00
b	Size 100 mm	Nos	0	0	0	0	0	0		0	5,333	5,333	-
c	Size 150 mm	Nos	6	6	6	4	4	4		30	6,768	6,768	2,03,040.00
d	Size 200 mm	Nos	0	0	0	0	0	0		0	9,117	9,117	-
2.1.7	**Foot valve**												
	Supply and installation of Foot Valves with mating flanges generally as specified all complete.												
a	200 nominal bore	Nos	0	0	0	0	0	0		0	33,129.89	37,271.13	-
b	100 nominal bore	Nos	1	1	1	1	1	1		6	8,449.15	9,505.29	57,031.75
2.1.8	**Providing, fixing, testing & commissioning of cast Iron double flanged type `Y' strainer with SS 304 perforated metal removable basket including all fittings complete as required and suitable for system pressure.**												
a	Size 200 mm	Set	2	2	2	2	2	2		12	37,787	37,787	4,53,444.00
b	Size 100/150 mm	Set	3	3	3	2	2	2		15	22,615	22,615	3,39,225.00
2.2	**Internal Piping**											-	
	Supply, fabrication & laying heavy grade IS marked G.I piping conforming to IS : 1239 & BS : 1387 complete with fittings, pipe supports, clamps, painting of two coats of red enamel etc. including the support arrangements.												
a	200 mm nominal bore (6 mm wall thickness)	Mtrs	24	18	18	18	18	18		114	3,172.79	3,569.39	4,06,909.89
b	150 mm nominal bore	Mtrs	667	789	500	289	465	289		2999	2,181.28	2,453.94	73,59,356.11
c	100 mm nominal bore	Mtrs	350	231	662	250	291	250		2034	1,465.78	1,649.00	33,54,075.55
d	80 mm nominal bore	Mtrs	100	100	100	24	18	24		366	1,062.20	1,194.97	4,37,359.88
e	50 mm nominal bore	Mtrs	20	20	20	20	20	20		120	706.22	794.49	95,339.34
f	40 mm nominal bore	Mtrs	0	0	0	0	0	0		0	498.63	560.95	-

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
g	32 mm nominal bore	Mtrs	0	0	0	0	0	0		0	454.00	510.76	-
h	25 mm nominal bore	Mtrs	0	0	0	0	0	0		0	338.58	380.91	-
2.3	**Air vessel**												
	Supply, fabrication (as per code), installation, testing and commissioning of Air vessels 300mm diameter and 1000mm high with ball valve inlet/outlet valve drain, air release valve, valve air inlet etc. all complete.	Nos	2	2	2	1	1	1		9	68,520.42	77,085.47	6,93,769.24
											-		
2.4	**Pressure vessel**										-		
	Supply, fabrication (as per code), installation, testing and commissioning of Pressure vessels 450mm diameter and 1000mm high fabricated from 8-10mm M.S. plate with accessories inside painting with epoxy paint and outside with enamel.	Nos	0	0	0	0	0	0		0	76,286.43	85,822.24	-
											-		
2.5	**Fire Brigade Connection (2-way)**										-		
	Supply, installation, testing and commissioning fire brigade connection with 2 way 63mm valves inlets, stand post and 150 mm MS pipe for mounting the stand post etc. as specified all complete as approved on tank. The fire brigrade connection shall be provided in a suitable MS box having mesh doors with universal locking arrangement. ***Note:*** The drawings of the proposed arrangement shall be provided by the contractor for approval of employer's representative.	Nos	0	0	0	0	0	0		0	26,528.71	29,844.80	-
											-		
2.6	**Fire Brigade Connection (4-way)**										-		
	Supply, installation, testing and commissioning Siamese connection with 4-way 63-mm outlets with non-return valve and sluice valve etc. complete as required and approved including M.S. Cabinets with universal locking arrangement, M.S. welded mesh inside at road level cabinets. ***Note:*** The drawings of the proposed arrangement shall be provided by the contractor for approval of employer's representative.	Nos	3	3	3	3	3	3		18	61,969.35	69,715.52	12,54,879.40
2.7	**100 mm dia stainless steel Draw Out connection with foot valve for Fire Brigade.**	Set	1	1	1	1	1	1		6	6,839	6,839	41,034.00
2.8	**Air Release valve**												
	Supply, installtion, testing and commissioning of 25 mm dia Air Release valve with Ball valve to be fixed on top of Risers.	Nos	4	4	4	4	4	4		24	6,903	7,766.02	1,86,384.38
3.0	**SPRINKLER SYSTEM**												
a	Providing, fixing, testing and commissioning of UL listed Pendant / Upright type Sprinkler Head rated at 68 degree centigrade	Nos	0	0	0	0	0	0		0	179	179	-
b	Flexible dropper for sprinkler- 1000 mm length UL Approved	Nos	0	0	0	0	0	0		0	895	895	-
3.1	Providing & Fixing of installation control valve with turbine type automatic Alarm Gong to be connected with control valve, drain & test valve as per manufacturer's specifications complete as required.												
	a) 150 mm dia:	Nos	0	0	0	0	1	1		2	40,151	45,169.88	
3.2	Providing and fixing UL listed Flow Switch of 65/ 80 / 100 / 150 mm dia on Sprinkler Header complete with flexible full bore paddle, U clamp and NO / NC contact terminals	Set	0	0	0	0	0	1		1	7,624.50	8,577.56	8,577.56
	SUB-TOTAL FIRE HYDRANT SYSTEM F.01												**381,25,490.29**

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
F.02	**PORTABLE FIRE EXTINGUISHERS**												
	Supply and installation of portable fire Extinguishers as described below:												
2.1	9 litre capacity of water CO_2 type, IS marked, with discharge tube including clamps etc.	Nos	20	20	20	20	20	20		120	5,563.23	6,258.63	7,51,035.84
2.2	Carbon dioxide extinguisher conforming to IS with high pressure discharge tube, horn, control valve, IS marked including clamps etc.												
	4.5 kg capacity extinguisher	Nos	50	20	20	20	20	20		150	9,446.24	10,627.02	15,94,052.37
2.3	Mechanical foam type 9.0 liter capacity fire extinguisher (for DG room)	Nos	5	5	5	5	5	5		30	7,427.07	8,355.46	2,50,663.69
2.4	5 kg capacity of DCP(Dry Chemical Powder) fire extinguisher	Nos	20	20	20	20	20	20		120	5,563.23	6,258.63	7,51,035.84
	SUB-TOTAL PORTABLE FIRE EXTINGUISHERS F.02												**33,46,787.73**
F.03	**PANEL FLOODING - CO2 GAS BASED FIRE TRACE TUBE SYSTEM**												
	Supply, fixing, testing and commissioning of Polymer Tube Detection based CO2 System for Electrical Panels including AMF and Communication Panels,The exact quantity of the Panels shall be finalized during detail design stage. (Firetrace Tube Panel Protection System), consisting of the following components:		1	1	1	1	1	1		6	13,25,400.00	14,91,075.00	89,46,450.00
(a1)	CO2 Cylinder, 8 kg capacity, complete with all necessary CO2 Gas, fittings, support and accessories, connected with Valve (with manual release facility).												
(a2)	CO2 Cylinder, 4.5 kg capacity, complete with all necessary CO2 Gas, fittings, support and accessories, connected with Valve (with manual release facility).												
(b)	Filling Adapter	LS											
(c)	Outlet adapter												
(d)	End of Line adapter												
(e)	Pressure switch												
(f)	Flexible Polymer Detection Tube with all necessary fittings & supports.												
(g)	Master Control Unit for controlling each system, complete with pressure switches, buzzers and electronic hooters, including all necessary accessories + electrical wiring to make each entire system functional.												
(h)	Auto weight measuring Unit for Cylinders with automatic audio/visual alarm.												
	SUB-TOTAL PANEL FLOODING - CO2 GAS BASED FIRE TRACE TUBE SYSTEM F.03												**89,46,450.00**
	TOTAL For Fire Fighting												**504,18,728.02**
F.04	**FIRE ALARM AND DETECTION SYSTEM**												
	The Fire Alarm and Detection System specified herein, must conform to M & E Specifications, in addtion to the description given in respective items of BOQ, whether explicitly specified or not. In case of contradiction between M & E specification and description in BOQ, the most stringent of the condition will prevail.												
	All the items / parts mentioned in relevant clauses of the M & E specifications and not specifically mentioned in BOQ shall be deemed to be included in the quoted rates, unless specifically excluded.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	All the items not specifically mentioned here but necessary to make the system complete and suitable for desired application as per M & E Specifications and Drawings will be deemed to be included in the quoted prices												
4.1	Supply, Installation, Testing and Commissioning of 2 Loop Addressable Main Fire Alarm Control Panel (MFACP) complete with capacity to connect Devices & Detectors (in zoned manner) as per M & E Specifications & Drawings but not limited to the following:	Set	1	1	1	1	1	1		6	4,52,845.00	5,09,450.63	30,56,703.75
a	2 Loop Panel												
b	Repeator Driver Board												
c	Communication Board												
d	Software & Graphics												
e	PC with 21" TFT + **80** column Printer.												
f	Nicl. Batteries & Battery Charger.												
g	Amplifier card												
h	Provision for interfacing with other systems such as SCADA / BMS with all required Hardware & Software.												
4.2	Supply, Installation, Testing and Commissioning of Repeater Annunciator Panel with Mimic panel as per Specifications and Drawings.	Set	1	1	1	1	1	1		6	98,420.89	1,10,723.50	6,64,341.01
4.3	Supply, Installation, Testing & Commissioning of following Signal Initiating (Intelligent Analogue Addressable) devices complete with Detector Base etc. etc. complete as specified, required and as approved .												
4.3.1	Intelligent Addressable Multi Sensor Smoke Detector.	Nos.	105	150	95	80	94	95		619	2,673.99	3,008.24	18,62,102.92
	Rate of rise cum fixed Temperature thermister type Heat detector with mounting base complete as required												
4.3.2	Addressable Fault Isolator Base	Nos.	19	32	19	19	19	19		127	1,628.03	1,831.54	2,32,605.21
4.3.3	Addressable Fault Isolator	Nos.	19	32	19	19	19	19		127	3,147.83	3,541.30	4,49,745.50
4.3.4	Supply installation testing and commissioning of dust and vermin proof addressable analogue Manual Call Boxes to initiate audio visual alarm including the cost of mounting accessories complete as per specifications and as required.	Nos.	15	23	15	20	20	15		108	3,534.40	3,976.20	4,29,429.60
4.3.5	Supply, installation, testing and commissioning of Wall/ Ceiling mounting strobes for visual indication including the cost of mounting accessories complete as per specifications and as required.	Nos.	13	24	13	20	20	13		103	2,922.51	3,287.82	3,38,645.50
4.3.6	Addressable Loop Sounder 6.8 W.	Nos.	0	0	0	0	0	0		0	2,809.85	3,161.08	-
4.3.7	Response Indicator constructed from 16 guage MS stove / ABS plastic enamelled sheet with front 16 guage steel cover plate / ABS plastic complete as required.	Nos.	56	105	56	45	45	56		363	342.40	385.19	1,39,825.56
4.3.8	Intelligent Addressable Duct Detector.	Nos.	0	0	0	0	0	0		0	7,179.25	8,076.66	-

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
4.3.9	Supply, installation, testing and commissioning of Control Modules including the cost of mounting accessories complete as per specifications and as required.	Nos.	20	25	20	20	20	20		125	3,147.83	3,541.30	4,42,662.89
4.3.10	Supply, installation, testing and commissioning of Monitor Modules including the cost of mounting accessories complete as per specifications and as required.	Nos.	34	32	34	26	23	34		183	3,147.83	3,541.30	6,48,058.47
											-		-
4.3.11	Intelligent Addressable water Flow Monitoring Modules	Nos.	20	20	20	20	20	20		120	3,147.83	3,541.30	4,24,956.38
											-		-
4.3.12	High Temperature (min. 80 C degree trip) Heat detector	Nos.	2	2	2	2	2	2		12	3,147.83	3,541.30	42,495.64
											-		-
4.4	Supplying, Laying, Termination, Testing & Commisioning of Fire Survival Cables (confirming to BS: 7846 and Section E02, 35 of M & E specifications for perfomance requirements of Fire Survival Cables) armoured, 1 pair 2.5 sq.mm, screened / shielded, Copper conductor (one pair shielded and one pair unshielded) cable or Mineral Insulated cable complying the CWZ category.	Metre	0	0	0	0	0	0		0	78.42	88.22	-
											-		-
4.5	Supplying, Laying, Termination, Testing & Commisioning of Fire Survival Cables (confirming to BS: 7846 and Section E02, 35 of M & E specifications for perfomance requirements of Fire Survival Cables) armoured, 1 twisted pair 1.5 sq.mm, screened / shielded copper conductor cable or Mineral Insulated cable complying the CWZ category for looping of detection units etc.	Metre	2500	2500	2500	2000	2000	2000		13500	71.79	80.77	10,90,348.59
4.6	Fire Rated Material for Cut-outs Closing												
	Description of Work												
	All the Shaft and services openings in fire rated walls & floors are to be properly fire stopped with 2 hrs fire rated Insulation & integrity with PROMASTOP® **Mortar/**Cement . The system would involve providing and fixing of PROMASTOP® Cement with required thickness. Penetrations through walls and floors to be sealed with POMASTOP® **Mortar** as tested to BS: 476 Part 20 & AS 1530 part 4 to maintain the required fire rating of 4 hrs of the building element. Installation shall be done in accordance with the tested specification. **The system will have to be supported by a valid Test report of the complete system as per BS 476 part 20 issued by M/s.Promat International Asia Pacific Ltd.**	Sqm	10	10	10	10	10	10		60	12,499	12,499	7,49,940.00
	SUB-TOTAL FIRE ALARM AND DETECTION SYSTEM F.04												**105,71,861.02**
F.05	**Mandatary Operational Spares for the Panels**	LS	1	1	1	1	1	1		6	3,31,350.00	3,72,768.75	22,36,612.50
	TOTAL For Fire Alarm System												**128,08,473.52**
	TOTAL For Fire Fighting And Fire Alarm System												**632,27,201.54**
H.01	**VRV AIRCONDITONING SYSTEMS -EQUIPMENTS & PIPING**												
1.1	Supply, Installation, testing and commissioning of Air Cooled Variable Refrigerant Volume System suitable for R410A and 415 ± 10% , 50 Hz, AC supply. The unit shall consist of indoor units and external condensing units and other accessaries as listed below complete in all respects. The unit shall be fully charged with gas and oil.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
1.1.1	Outdoor Unit												
	Supply, installation, testing and commissioning of Modular type outdoor condensing units equipped with highly efficient scrol/hermetic type DC twin rotary compressors with digital/ invertor technology, special acryl precoated heat exchanger, low noise condenser fan with motor, auto check function for errors in display panel, auto address setting, as per specifications and capacities as mentioned below.(The unit shall be fully charged with gas and oil.Price shall include pressure testing).												
	The units shall be complete with necessary mounting frames												
	Capacity shall be as under												
a	26 HP (22TR Nominal Capacity)	Nos	0	0	0	0	0	0		0	7,23,668.40	8,14,126.95	-
b	24 HP (20TR Nominal Capacity)	Nos	0	0	0	0	0	0		0	6,65,218.26	7,48,370.54	-
c	20 HP (16TR Nominal Capacity)	Nos	0	0	0	0	0	0		0	6,17,901.48	6,95,139.17	-
d	18 HP (15TR Nominal Capacity)	Nos	3	3	3	3	3	3		18	6,06,768.12	6,82,614.14	122,87,054.43
e	6 HP (5TR Nominal Capacity)	Nos	0	0	0	0	0	3		3	4,07,759.31	4,58,729.22	13,76,187.67
1.1.2	Indoor Units												
	Supply, installation, tesing and commissioning of ceiling mounted duct type indoor units each complete with coil, pre-filter, etc. The units casing shall be of steel construction, wall mounted split type indoor units and 220 volt, 1 phase, 50 Hz, AC supply all as per specifications.												
	The capacities shall be as follows:												
a	Ceiling mounted duct type 3500 CFM - 6.0 TR Nominal Capacity	Nos	0	0	0	0	0	0		0	2,36,862.23	2,66,470.01	-
b	Ceiling mounted duct type 3200 CFM - 5.0 TR Nominal Capacity	Nos	0	0	0	0	0	0		0	77,098.52	86,735.84	-
													-
c	Ceiling mounted duct type 2800 CFM - 5.0 TR Nominal Capacity	Nos	0	0	0	0	0	0		0	77,098.52	86,735.84	-
													-
d	Ceiling mounted duct type 2500 CFM - 4.0 TR Nominal Capacity	Nos	0	0	0	0	0	0		0	71,114.34	80,003.63	-
													-
e	Ceiling mounted duct type 2400 CFM - 4.0 TR Nominal Capacity	Nos	0	6	5	0	0	0		11	71,114.34	80,003.63	8,80,039.96
													-
f	Ceiling mounted duct type 2300 CFM - 4.0 TR Nominal Capacity	Nos	6	0	1	3	0	6		16	71,114.34	80,003.63	12,80,058.12
													-
g	Ceiling mounted duct type 2000 CFM - 3.0 TR Nominal Capacity	Nos	0	2	3	6	9	3		23	76,402.68	85,953.02	19,76,919.35
													-
h	Ceiling mounted duct type 1600 CFM - 3.0 TR Nominal Capacity	Nos	0	1	0	0	0	0		1	76,402.68	85,953.02	85,953.02
													-

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
i	Wall mounted split type 2.0 TR Nominal Capacity	Nos	0	0	0	0	0	6		6	44,950.94	50,569.81	3,03,418.85
													-
j	Wall mounted split type 1.5 TR Nominal Capacity	Nos	3	0	3	3	3	3		15	42,306.77	47,595.12	7,13,926.74
													-
k	Wall mounted split type 1.0 TR Nominal Capacity	Nos	0	3	0	3	0	0		6	39,662.60	44,620.43	2,67,722.55
l	Ceiling mounted duct type - 2.5 TR Nominal Capacity	Nos	0	0	0	0	0	0		0	49,120	49,120	-
m	Ceiling mounted duct type - 2.0 TR Nominal Capacity	Nos	3	3	0	3	6	0		15	42,109	42,109	6,31,639.99
n	Ceiling mounted duct type - 1.5 TR Nominal Capacity	Nos	0	0	0	0	0	0		0	38,363	38,363	-
o	Ceiling mounted duct type - 1.0 TR Nominal Capacity	Nos	0	3	3	3	0	0		9	38,139	38,139	3,43,250.01
													-
1.1.3	Supply, installation, tesing and commissioning of Corded Remote controllers for operation of indoor units.	Nos	12	15	12	18	18	15		90	3,757.51	4,227.20	3,80,447.89
													-
1.1.4	Supply, installation, tesing and commissioning of Central Remote controller for complete system including all VRV indoor and outdoor units.	Nos	1	1	1	1	1	1		6	1,18,291.95	1,33,078.44	7,98,470.66
													-
1.1.5	Supply, installation, tesing and commissioning of Imported fittings Y-joints, T-joints, distributer and headers for all Indoor units at both the floors layout as per layout drawings.	Nos	17	17	17	17	17	17		102	11,411.69	12,838.15	13,09,491.43
													-
1.2	Refrigerant Piping												-
													-
	Supply,installation,testing and commissioning of Interconnecting refrigerant pipe work with elastomeric nitrile rubber**/**closed cell expanded polythene tubular insulation between each set of indoor & outdoor units as per specifications, all piping should be laid on Galvanised/Powder Coated tray supported by Galvanised M S Hangers & Clamps.												-
													-
a)	41.3 mm O.D. (insulation : 19 mm)	Rm	0	0	0	0	0	0		0	1,461.25	1,643.91	-
											-		-
b)	34.9 mm O.D. (insulation : 19 mm)	Rm	0	0	0	0	0	0		0	932.42	1,048.97	-
											-		-
c)	28.6 mm O.D. (insulation : 19 mm)	Rm	107	130	107	107	107	107		665	751.50	845.44	5,62,215.94
											-		-
d)	22.2 mm O.D. (insulation : 13 mm)	Rm	36	54	36	36	36	36		234	747.33	840.75	1,96,734.62
											-		-
e)	19.1 mm O.D. (insulation : 13 mm)	Rm	31	31	31	31	31	31		186	487.08	547.97	1,01,921.49
											-		-
f)	15.9 mm O.D. (insulation : 13 mm)	Rm	315	291	315	315	315	315		1866	400.80	450.90	8,41,379.40
											-		-
g)	12.7 mm O.D. (insulation : 13 mm)	Rm	36	144	36	36	36	36		324	313.13	352.27	1,14,135.89

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
											-		-
h)	9.5 mm O.D. (insulation : 13 mm)	Rm	264	155	264	264	264	264		1475	228.23	256.76	3,78,719.16
											-		-
i)	6.4 mm O.D. (insulation : 13 mm)	Rm	56	56	56	56	56	56		336	140.56	158.13	53,131.68
1.3	Control cum transmission wiring										-		-
a	Supply,installation,testing and commisioning of control cum transmission wiring of 2 core x 1.5 sqmm copper in suitable GI conduits between indoor and outdoor units.	Rm	1000	1000	1000	1000	1000	1000		6000	334.00	375.75	22,54,500.00
b	Supply,installation,testing and commisioning of contl cum transmission wiring of 2 core x 1.0 sqmm copper in suitable GI conduits between indoor and outdoor units.	Rm	1000	0	0	0	0	0		1000	164	164	1,64,000.00
1.4	Supply,installation,testing and commissioning of power cables from isolator MCB to outdoor unit.	Rm	0	0	0	0	0	0		0	584.50	657.56	-
1.5	DX wall mounted Split Unit												
1.5.1	Providing, fixing, testing and commissioning of Hi wall split unit air conditioing air cooled type with evaporator coil, fan and fan motor ,air cooled condenser with hermatically sealed recipcating compressor, condenser coil and complete with electrical Wiring as required (Voltage stablizers are not to be provided)												
	Note:Providing and fixing of M.S. angle iron frame work for outdoor unit including P.O. painting of the same is also included in the above scope. Contractor to submit design/Scheme for Iron frame and obtain approval of engineer-in-chage before proceeding further.												
a)	Nominal capacity 1.5 TR	Nos	6	7	6	3	6	0		28	62,625.15	70,453.29	19,72,692.23
1.5.2	Providing, fixing and testing of copper refrigerant piping of apppriate sizes duly insulated with nitrile rubber insulation of 9 mm thickness for all types of split AC units. The pipes plus nitrile rubber insulation are to be covered with PVC flexible conduits for protection.	Rmt	48	54	48	24	48	0		222	2,574.59	2,896.41	6,43,003.85
1.6	Condensate Drain Piping:												
	Providing, fixing and testing GI drain piping for condensate from indoor unit to nearest suitable drain system as per site conditions as per instructed at site engineer complete with all required fittings and pviding clean out plug at suitable location when required complete with 6mm thick elastomeric nitrile rubber insulation over GI pipe:												
a	40mm Dia.	RM	0	0	0	0	0	0		0	528.83	594.93	-
b	32mm Dia.	RM	0	0	0	0	0	0		0	431.42	485.35	-
c	25mm Dia.	RM	125	125	125	125	125	125		750	389.67	438.38	3,28,784.06
											-		
	TOTAL FOR EQUIPMENTS & PIPING H.01												**302,45,798.97**
H.02	**VENTILATION SYSTEM**												
	Supply, installation, testing and commissioning of following equipment .												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
2.1	Propeller type fan complete with motor suitable for 220±6% volt, 1 phase, 50 Hz AC supply, mounting frames and GI gravity louvers.												
a	Capacity 1500 CFM (2550CMH) wall mounted (exhaust fan)	Nos	0	0	0	0	0	0		0	9,045.86	10,176.59	-
b	Capacity 1350 CFM (2295CMH) wall mounted (exhaust fan)	Nos	0	0	0	0	0	0		0	7,654.19	8,610.96	-
c	Capacity 1300 CFM (2210CMH) wall mounted (exhaust fan)	Nos	0	0	0	0	0	0		0	7,654.19	8,610.96	-
d	Capacity 1200 CFM (2040CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	6,958.35	7,828.14	-
e	Capacity 1150 CFM (1955CMH) wall mounted (exhaust fan)	Nos	0	0	0	0	0	0		0	6,958.35	7,828.14	-
f	Capacity 1080 CFM (1836CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	6,958.35	7,828.14	-
g	Capacity 1000 CFM (1700CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	6,262.52	7,045.34	-
h	Capacity 960 CFM (1632CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	6,262.52	7,045.34	-
i	Capacity 920 CFM (1564CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	6,262.52	7,045.34	-
j	Capacity 900 CFM (1530CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	6,262.52	7,045.34	-
k	Capacity 800 CFM (1360CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	5,566.68	6,262.52	-
l	Capacity 650 CFM (1105CMH) wall mounted (exhaust fan)	Nos	0	0	0	0	0	0		0	5,566.68	6,262.52	-
m	Capacity 520 CFM (884CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	5,566.68	6,262.52	-
n	Capacity 500 CFM (850CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	4,175.01	4,696.89	-
o	Capacity 400 CFM (680CMH) wall mountde (supply fan)	Nos	0	0	0	0	0	0		0	4,175.01	4,696.89	-
p	Capacity 300 CFM (510CMH) wall mountde (supply fan)	Nos	3	3	3	3	3	3		18	3,479.18	3,914.08	70,453.40
q	Capacity 260 CFM (442CMH) wall mountde (supply fan)	Nos	3	3	3	0	0	0		9	2,783.34	3,131.26	28,181.32
													-
2.2	cabinet fan with centrifugal blower driven by motor. The motor shall be suitable for 220 Volts ±6% 1 Phase 50 HZ AC supply.												-
													-
a	Capacity 9300 CFM (15810 CMH) ceiling mounted (exhaust fan)	No	0	0	0	0	0	0		0	66,800.16	75,150.18	-
											-		-
b	Capacity 7440 CFM (12648 CMH) ceiling mounted (supply fan)	No	0	0	0	0	0	0		0	44,533.44	50,100.12	-
											-		-
c	Capacity 6000 CFM (10200 CMH) ceiling mounted (exhaust fan)	No	0	0	0	0	0	0		0	39,662.60	44,620.43	-
											-		-
d	Capacity 5000 CFM (8500 CMH) ceiling mounted (exhaust fan)	No	0	0	0	0	0	0		0	30,616.74	34,443.83	-
											-		-
e	Capacity 4800 CFM (8160 CMH) ceiling mounted (supply fan)	No	0	0	0	0	0	0		0	30,616.74	34,443.83	-
											-		-
f	Capacity 4000 CFM (6800 CMH) ceiling mounted (supply fan)	No	0	0	0	0	0	0		0	27,833.40	31,312.58	-
	TOTAL FOR VENTILATION H.02												**98,634.71**
H.03	**AIR DISTRIBUTION SYSTEM**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.1	Supplying, fabricating, installing and testing of factory fabricated G.I. Sheet metal ducts with flanges complete with supports, vanes, dampers, links, levers and quadrants etc. as per specifications and drawings. The rates shall include all materials of the duct and labour for suspension and supporting arrangement for plenums, ducts, complete with fire retardant flexible connection as required and specifications.												
a	0.63 MM (24 Gauge) for ac duct	Sqm	5	5	5	5	5	5		30	904.59	1,017.66	30,529.91
b	0.63 MM (24 Gauge) for ventilation duct	Sqm	0	0	0	0	0	0		0	904.59	1,017.66	-
3.2	Grilles and Dampers												
a	Providing and fixing, testing and commissioning of powder coated extruded aluminium section grills with dampers for supply air terminal.	Sq m	0	0	0	0	0	0		0	12,525.03	14,090.66	-
b	Providing and fixing, testing and commissioning of powder coated extruded aluminium section grills without dampers for exhaust air terminal.	Sq m	0	0	0	0	0	0		0	6,262.52	7,045.34	-
3.3	Providing, fixing, testing and commissioning of exhaust air/fresh air louvers with filter of powder coated extruded aluminium construction with bird screen, minimum 80 mm deep.	Sqm	0	0	0	0	0	0		0	10,437.53	11,742.22	-
3.4	Providing and fixing, testing and commissioning of 16 Ga GI Frame / 24 Ga GI aerifoil blades type volume control damper for duct complete with linkages,levers, fittings, supports, all accessories and any other item required to make the system complete.	Sqm	0	0	0	0	0	0		0	6,958.35	7,828.14	-
3.5	Providing and fixing of self adhesive Closed Cell Elastomeric Nitrile rubber 13mm thick insulation on duct complete as per the specifications.	Sqm	0	0	0	0	0	0		0	695.84	782.82	-
3.6	Supplying and fixing of accoustic lining of duct with fiber glass rigid board of density 48 kg/m3 sealed in fiberglass tissue paper and covered with 0.5mm perforated aluminium sheet & conforming to standard specification.	Sqm	0	0	0	0	0	0		0	904.59	1,017.66	-
3.7	Providing, fixing, testing and commissioning of supply and return air Diffusers as per specification and drawings including fixing frames of GI in False ceiling / Wall.												
a	Aluminium Diffuser without Damper	Sqm	5	5	5	5	5	5		30	7,417	7,417	2,22,510.00
	TOTAL FOR AIR DISTRIBUTION H.03												**2,53,040**
	Total For HVAC												**305,97,474**
											Grand Total- Reach-2		**3746,36,961**
	BOQ FOR ZERO MILE STATION												
ZE.01	**L.T. PANELS**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
1.1	Design, fabrication, assembling, wiring, supply, installation, testing and commissioning of Main LT panel/Main distribution panels/sub- distribution panels fabricated out of 3 mm thick for structural members and 2 mm thick for door and covers CRCA sheet steel in cubicle compartmentalised free standing floor mounted, dust and vermin proof with reinforcement of suitable size angle iron, channel T irons and/or flats wherever necessary. 16 gauge CRCA sheet steel shall be used for final distribution panels. Cable gland plates shall be provided on top as well as at the bottom of the panels. Panels shall, be treated with all anticorrosive process before painting as per specifications with 2 coats of zinc chromate primer and final approved shade of enamelled paint. 2 Nos. earthing terminals shall be provided for all distribution panels. Panels shall be suitable for 415V, 3 phase, 4 wire, 50 HZ supply system and with 15% spare space, lifting hooks shall also be provided in case of large panels. Approval shall be takeny (4) IEC 60364 : Electrical Installation of Buildings with zinc passivation shall be used in fabrication of panels.												
	The panels to confirm IP-43 for indoor & IP-55 for outdoor.												
Note:	RATING AND SWITCH BOARDS WILL BE DESIGNED AS PER ACTUAL												
	(NOTE: Unless not specified all incomers and outgoings ACBs/MCCBs of main LT panel shall be Microprocessor based with 485 communication port for BMS (Building Management system) connectivity through MODBUS protocol, as specified in TS 2.2.10)												
1.1	**MAIN LT PANEL**												
	SECTION - I												
	Incoming Air Circuit Breaker A' (Transformer-1)												
	4000A, 4 pole electrically operated (motorised) fully draw out type air circuit breaker with built in micro processor based release unit for short circuit, over current and earth fault protection with adjustable setting and with the following accessories :												
	Electronic energy meter of accuracy class-1 with 3 Nos 4000/5A, 15VA CTs to measure and display the following electrical quantities:												
	Real time												
	Total active energy (KWH/MWH)												
	Maximum Demand (KVA/MVA) (KW/MW)												
	Maximum Demand reset count												
	Instantaneous power factor												
	Eight time of a day energy												
	Current												
	Voltage												
	Frequency / Harmonics												
	0-500V digital voltmeter with selector switch with 6A MCB's - 1 Set												
	0-4000A digital ammeter with selector switch and 4000/5A, 15VA, CLASS 1, CT - 1 Set												
	Phase indicating lights and protected by 2A MCB's - 1 Sets												
	Breaker ON/OFF/TRIP indicating lights and push button -1 Set												
	24V, shunt trip coil - 1 Set												
	1 CT 4000/5A, 15VA, CL 5P10 consisting of												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Undervoltage Relay (27) - 1 set												
	Over voltage relay (59)- 1 Set												
	Over current Relay (51) - 1 set												
	Earth fault Protective Device (51N) 1 set												
	4000/5A,15VA, CLASS-1, CT on Y Phase for APFCR.												
	Auxiliary contacts required for necessary interlocking of breakers.												
	Bus Bars												
	5000A, TPN copper bus bars with heat shrinkable insulation sleeves 1Set												
	Outgoing												
	1250 amps TPN ACB draw out type (manually operated) 1 No												
	1000 amps TPN ACB draw out type (manually operated) 1 No												
	630 amps TPN (50 kA) MCCB 1 Nos												
	400 amps TPN (50 kA) MCCB 6 Nos												
	250 amps TPN (50 kA) MCCB 7 Nos												
	200 amps TPN (50 kA) MCCB 5 Nos												
	100 amps TPN (50 kA) MCCB 4 Nos												
	63 amps TPN (50 kA) MCCB 4 Nos												
	Bus Coupler-: Breaker "C												
	4000A, 4 pole electrically operated (motorised) fully drawotd type air circuit breaker with ON/OFF/TRIP indicating lamps &												
	SECTION= II												
	Incoming Air Circuit Breaker B' (Transformer-II)												
	4000A, 4 pole electrically operated (motorised) fully draw out type air circuit breaker, with built in micro processor based release unit for short circuit, over current and earth fault protection with adjustable setting and with the following accessories :												
	Electronic energy meter of accuracy class-1 with 3 Nos 4000/5A, 15VA CTs to measure and display the following electrical												
	Real time												
	Total active energy (KWH/MWH)												
	Maximum Demand (KVA/MVA) (KW/MW)												
	Maximum Demand reset count												
	Instantaneous power factor												
	Eight time of a day energy												
	Current												
	Voltage												
	Frequency / Harmonics												
	0-500V digital voltmeter with selector switch with 6A MCB's - 1 Set												
	0-4000A digital ammeter with selector switch and 4000/5A, 15VA,CLASS 1, CTs - 1 Set												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Phase indicating lights and protected by 2A MCB's - 1 Set												
	Breaker ON/OFF/TRIP indicating lights and push button - 1 Set												
	24V shunt trip coil - 1 Set												
	1 Ct 4000/5,15VA,CL5P10 consisting of												
	Under Voltage relay (27) - 1 Set												
	Over voltage relay(59) - 1 Set												
	Overcurrent Relay(51)- 1 set												
	Earth fault Protective Device (51N) - 1 set												
	4000/5A, 15VA, CLASS-1, CT on Y Phase for APFCR.												
	Auxiliary contacts required for necessary interlocking of breakers.												
	Bus Bars												
	5000A, TPN copper bus bars with heat shrinkable insulation sleeves 1Set												
	Outgoing												
	1250 amps TPN ACB draw out type (manually operated) 1 No												
	1000 amps TPN ACB draw out type (manually operated) 1 No												
	630 amps TPN (50 kA) MCCB 1 Nos												
	400 amps TPN (50 kA) MCCB 7 Nos												
	250 amps TPN (50 kA) MCCB 7 Nos												
	200 amps TPN (50 kA) MCCB 4 Nos												
	100 amps TPN (50 kA) MCCB 3 Nos												
	63 amps TPN (50 kA) MCCB 5 Nos												
	Red indicating light 230V (56 Nos.), Green indicating light 230V (56 Nos.), MCCB Aux. Contact Block T1-T6 (56 Nos.), MCB 6A SP 10KA (56 Nos.), CT 4000/5A CL-PS 15VA (08 Nos.)												
	Note -1. All outgoing feeders shall have suitable range of following (except capacitor feeders)												
	a. Digital electronic ammeter with selector swtich and CTs - 3 Nos												
	b. Phase indicating light protected by 2A MCB's - 3 Nos												
	2. All incoming / outgoing ACB and MCCB shall be 50 KA breaking capacity												
	3. The two incomer shall be interlocked elecrtically and mechanically operated ACBs with Automatic source transfer system. so that only one supply can be swithed ON at a time.												
	Main LT Panel as described above	Set							1	1	106,15,604.00	119,42,555	119,42,554.50
1.2	**Essential Power Panel (EPP)**												
	Incoming Air Circuit Breaker A'												
	1000 A, 4 pole electrically operated (motorised) fully draw out type air circuit breaker with built in micro processor based release unit for short circuit, over current and earth fault protection with adjustable setting and with the following accessories :												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Electronic energy meter of accuracy class-1 with 3 Nos. 1000/5A, 15VA CTs to measure and display the following electrical quantities :												
	Real time												
	Total active energy (KWH/MWH)												
	Maximum Demand (KVA/MVA) (KW/MW)												
	Maximum Demand reset count												
	Instantaneous power factor												
	Eight time of a day energy.												
	Current												
	Voltage												
	Frequency / Harmonics												
	0-500V digital voltmeter with selector switch with 6A MCB's - 1 Set												
	0-1000A digital ammeter with selector switch and 1000/5A, 15VA, CLASS 1CT - 1 Set												
	Phase indicating lights and protected by 2A MCB's - 1 Sets												
	Breaker ON /OFF /TRIP indicating lights and push button - 1 Set												
	1 CT, 1000/5A, 15VA, CL 5P10 consisting of												
	Under Voltage relay (27) - 1 Set												
	Over voltage relay (59) - 1 Set												
	Overcurrent Relay (51)- 1 Set												
	Earth fault protection device (51N)- 1 Set												
	Auxiliary contacts required for necessary interlocking of breakers.												
	Breaker control switch - 1 Set												
	Under Voltage release - 1 Set												
	Auto Manual selector switch - 1 Set												
	Voltage sensing relay & timer for auto change over.												
	24V shunt trip coil												
	Bus Bars												
	1250A, TPN copper bus bars with heat shrinkable insulation sleeves 1 Set												
	Outgoings												
	400 amps TPN (50 kA) MCCB 3 Nos												
	250 amps TPN (50 kA) MCCB 3 Nos												
	200 amps TPN (50 kA) MCCB 5 Nos												
	100 amps TPN (50 kA) MCCB 2 Nos												
	63 amps TPN (50 kA) MCCB 7 Nos												
	Bus Coupler												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	1 No. 1000A, 4 Pole ACB electrically operated drawout type with necessary potential free contacts for inter lockings and with breaker control switch, ON/OFF/TRIP indicating lamps with control MCB/s The two incomer shall be interlocked elecrtically and mechanically operated ACBs with Automatic source transfermer system. so that only one supply can be swithed ON at a time.												
	SECTION - II												
	Incoming Air Circuit Breaker B'												
	1000A, 4 pole electrically operated (motorised) fully draw out type air circuit breaker with built in micro processor based release unit for short circuit, over current and earth fault protection with adjustable setting and with the following accessories:												
	Electronic energy meter of accuracy class-1 with 3 Nos. 1000/5A, 15VA CTs to measure and display the following electrical quantities:												
	Real time												
	Total active energy (KWH/MWH)												
	Maximum Demand (KVA/MVA) (KW/MW)												
	Maximum Demand reset count												
	Instantaneous power factor												
	Eight time of a day energy												
	Current												
	Voltage												
	Frequency / Harmonics												
	0-500V digital voltmeter with selector switch with 6A MCB's - 1 Set												
	0-1000 A digital ammeter with selector switch and 1000/5A, 15VA,CLASS,1CTs - 1 Set												
	Phase indicating lights and protected by 2A MCB's - 1 Set												
	Breaker ON/OFF/TRIP indicating lights and push button - 1 Set												
	1 CT, 1000/5A, 15VA, CL 5P10 consisting of												
	Under Voltage relay (27) - 1 Set												
	Over voltage relay (59) - 1 Set												
	Overcurrent Relay (51)- 1 Set												
	Earth fault protection device (51N)- 1 Set												
	Auxiliary contacts required for necessary interlocking of breakers												
	Breaker control switch - 1 Set												
	Under Voltage release - 1 Set												
	Auto Manual selector switch - 1 Set												
	Voltage sensing relay & timer for auto changeover												
	24V shunt trip coil												
	Bus Bars												
	1250A TPN copper bus bars with heat shrinkable insulation sleeves - 1 Set												
	Outgoings												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	630 amps TPN (50 kA) MCCB 1 Nos												
	400 amps TPN (50 kA) MCCB 2 Nos												
	250 amps TPN (50 kA) MCCB 3 Nos												
	200 amps TPN (50 kA) MCCB 3 Nos												
	100 amps TPN (50 kA) MCCB 6 Nos												
	63 amps TPN (50 kA) MCCB 6 Nos												
	Note -1. All outgoing feeders shall have suitable range of following												
	a. Digital electronic ammeter with selector swtich and CTs - 3 Nos												
	b. Phase indicating light protected by 2A MCB's - 3 Nos												
	2. All incoming / outgoing ACB and MCCBs shall be 50 KA (1 sec) breaking capacity												
	Main Emergency Panel as described above	Set							1	1	41,86,263.00	47,09,546	47,09,545.88
1.3	**FIRE FIGHTING PANEL - FIRE PLANT ROOM**												
A.	**Incomer 2 No. each comprising of :**												
a.	400 amps 4 Pole motorized MCCB, minimum Ics = 50 kA with microprocessor release unit of Over current, Short Circuit, Ground Fault - 1 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size summating CTs for above two incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size summation CTs connections as required for both incoming feeders.												
d.	3 No. 400/5 amps cast resin current transformers with 15 VA Burden & Class 5P10 for protection and metering - 1 Set												
e.	3 No. 400/5 amps cast resin current transformers with 15 VA Burden & Class 1.0 for metering - 1 Set												
f.	Breaker ON / OFF / TRIP, Ready to close contact & indicating lights with control MCB - 2 Set												
g.	RYB Phase indicating light protected by 2 amps MCB's. - 2 Set												
h.	230 V AC Shunt trip coil. - 2 Set												
i.	RS-485 port for display of ON/OFF status of MCCB on BMS workstation through MODBUS protocol												
j.	Note: Contractor shall provide an earmarked terminal boards for SCADA and BMS signals as per specifications and requirements.												
k.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
i	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 600 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 50 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	4 No. 200A, 415V, TPN MCCB (motor duty) each outgoing comprises with following												
a	1 no. 100 HP/ 75 KW, star Delta starter comprising 1 Nos. TP contactor AC-3 duty, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control + 3 level liquid controller with following												
b	1 – set Red/Green ON/OFF indicating lamps												
c	1 – set start stop push buttons.												
d	Auto / Manual selector switch.												
e	Amber healthy trip indicating lamps												
f	AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP•45 models of MECO or equivalent with necessary Circuit MCB, suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
	Note: Contactor & overload relay shall be as per the type - 2 coordination chart												
ii.	2 No. 63A, 415V, TPN MCCB (motor duty) each outgoing comprises with following												
a	1 no. 15 HP/ 10 KW, Star Delta starter comprising 1 Nos. TP contactor AC-3 duty, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control + 3 level liquid controller with following												
b	1 – set Red/Green ON/OFF indicating lamps												
c	1 – set start stop push buttons.												
d	Auto / Manual selector switch.												
e	Amber healthy trip indicating lamps												
f	AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP•45 models of MECO or equivalent with necessary Circuit MCB, suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
	Note: Contactor & overload relay shall be as per the type - 2 coordination chart												
iii.	3 No. 40A, 415V, TPN MCCB (motor duty) each outgoing comprises with following												
a	1 no. 10 HP/ 7.5 KW, Star Delta starter comprising 1 Nos. TP contactor AC-3 duty, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control + 3 level liquid controller with following												
b	1 – set Red/Green ON/OFF indicating lamps												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
c	1 – set start stop push buttons.												
d	Auto / Manual selector switch.												
e	Amber healthy trip indicating lamps												
f	AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP•45 models of MECO or equivalent with necessary Circuit MCB, suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
	Note: Contactor & overload relay shall be as per the type - 2 coordination chart												
	Notes:-												
a	All meters shall be wired at one point for BMS compatibility.												
b	Both incoming breakers shall be electrically/ mechanically interlocked												
c	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												
d	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
e	Internal wiring in the Starters shall be done with FRLS PVC insulated cables of adequate size. Internal wiring, contactors, relay contacts, push button contacts should be rated not less than 2.5 Sqmm.												
	FIRE FIGHTING PANEL - FIRE PLANT ROOM described as above	Set.							1	1	7,42,860	7,42,860	7,42,860
1.4	**Water pump Panel (WPP) as per specifications and as per following details**												
	Internal wiring in the Starters shall be done with FR PVC insulated cables of adequate size. Internal wiring, contactors, relay contacts, push button contacts should be rated not less than 2.5 Sqmm.												
A	**INCOMER**												
a)	2 no. 125A ,415V, Ics=25 KA , TP MCCB with variable over current and short circuit releases												
b)	1- set Red/Green ON/OFF indicating lamps												
c)	1- set of three phase indicating lamps (red, yellow, blue)												
d)	Amber healthy trip inicating lamps for above feeders												
B	**BUSBAR**												
	Electrolytic high conductivity copper three phase and neutral busbars rated at 125 A having a maximum current density of 1.4 A per sq mm suitable to with stand symmetrical fault level of 25 kA. at 415 V. The neutral busbar is to be of same size as phases.												
C	**OUTGOING**												
a)	3no. 40A , Ics = 25 KA, 415V, TP MCCB(motor Duty) each with the following :												
a1)	3 nos. 10 HP/ 7.5 KW, Star Delta starter comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control + 3 level liquid level controller												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a2)	1 – set Red/Green ON/OFF indicating lamps												
a3)	1 – set start stop push buttons.												
a4)	Auto / Manual selector switch.												
a5)	Amber healthy trip indicating lamps												
a6)	1 no for each feeder AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCB, suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
b)	6 Nos. 20 A, Ics = 10KA, 415V, TP MCB(Motor duty) each with following												
b1)	6 nos. 2 HP/ 1.5 KW,DOL starter Star with bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.												
b2)	1 - set Red / Green ON/OFF indicating lamp												
b3)	1 - set start / stop puch buttons												
b4)	Auto / Manual selector switch.												
b5)	Amber healthy trip indicating lamps												
b6)	1 no for each feeder AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCB,suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
c)	3 Nos. 16 A, Ics = 10KA, 230V, DP MCB each with following												
c1)	1 nos. 1HP / 0.75 kW pump DOL starter with bimetallic over current relay with potential free contacts for remote monitoring and control.												
c2)	1 – set Red/Green ON/OFF indicating lamps												
c3)	1 – set start stop push buttons.												
c4)	Auto / Manual selector switch.												
c5)	Amber healthy trip indicating lamps												
c6)	1 no for each feeder AC operated, 3.5 Digit, independent Digital Ammeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCB,suitable size CTs and selector switch for current measurement on standby and main pumps including connections as required for incoming feeder and suitable selector for measuring other circuit current as required.												
D	**Metering**												
	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency & power factor conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and supporting SCADA/BMS connectivity												
E.	Presettable switching timer set for each pump												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	WATER PUMP PANEL - PLUMBING PLANT ROOM described as above	Set.							1	1	5,04,163	5,04,163	5,04,163
1.5	**MAIN LIGHTING PANEL (ASS Room)**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
A.	**Incomer 2 No. each comprising of :**												
a.	1 Nos. 200 amps TPN MCCB (35 kA) with release unit for SC and OL protection along with 1 Nos. 200 amps 4P AC3 duty Contactor - 1 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size summating CTs for above two incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's - 1 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 200 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 35 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	63 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status. - 2 Set												
ii.	40 Amps TPN MCCB with releases for SC and OL protection & shunt trip each having indication lamps to give status - 14 Set												
	Notes:-												
a.	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												
b.	All Outgoing feeders shall be provided with earth fault release.												
c.	Both the Incomers shall be electrically & mechanically interlocked with contactor based automatics chngeover system so that only one supply is switched on at a time.												
d.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	MAIN LIGHTING PANEL (ASS Room) described as above	Set.							1	1	5,59,326	5,59,326	5,59,326
1.6	**ESSENTIAL LIGHTING PANEL (ASS Room)**												
A.	**Incomer comprising of :**												
a.	100 amps TPN MCCB (35 kA) with release for SC and OL protections - 2 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size CTs for above incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's - 1 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 200 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 35 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	63 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 4 Set												
ii.	32 Amps TPN MCCB with releases for SC and OL protection & shunt trip each having indication lamps to give status - 12 Set												
	Notes:-												
a.	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b.	All Outgoing feeders shall be provided with earth fault release.												
c.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	ESSENTIAL LIGHTING PANEL (ASS Room) described as above	Set.							1	1	7,89,860	7,89,860	7,89,860
1.7	**POWER PANEL (ASS Room)**												
A.	**Incomer comprising of :**												
a.	125 amps TPN MCCB (35 kA) with release for SC and OL protections - 2 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size CTs for incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's - 1 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 200 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 35 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	63 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 10 Set												
	Notes:-												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a.	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												
b.	All Outgoing feeders shall be provided with earth fault release.												
c.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	POWER PANEL (ASS Room) described as above	Set.							1	1	4,65,069.61	5,23,203	5,23,203
1.8	**ESCALATOR POWER PANEL (ASS Room)**												
A.	**Incomer comprising of :**												
a.	400 amps TPN MCCB (35 kA) with Microprocessor release for SC, OL and E/F protections - 2 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size summating CTs for above two incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 2 Set												
e.	Phase indicating light protected by 2 amps MCB's - 2 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 600 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 35 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	63 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status. - 14 Set												
	Space for providing variable KWHr meter with required CT's/PT's for each of the outgoing feeder with locking arrangement.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Notes:-												
a.	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												
b.	All Outgoing feeders shall be provided with earth fault release.												
c.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	ESCALATOR POWER PANEL (ASS Room) described as above	Set.							1	1	4,94,389.66	5,56,188	5,56,188
1.9	**SUB VENTILATION POWER PANEL - 1 (Basement - 2)**												
A.	**Incomer comprising of :**												
a.	160 amps TPN MCCB (25 kA) with release for SC and OL protections - 2 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size CTs for incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's - 1 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 200 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 25 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
i.	63 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 5 Set												
ii.	40 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 11 Set												
	Notes:-												
a.	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												
b.	All Outgoing feeders shall be provided with earth fault release.												
c.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	SUB VENTILATION POWER PANEL - 1 (Basement - 2) described as above	Set.							1	1	4,56,830	4,56,830	4,56,830
1.10	**SUB VENTILATION POWER PANEL - 2 (Basement - 1)& SUB VENTILATION POWER PANEL - 5 (Street level)**												
A.	**Incomer comprising of :**												
a.	125 amps TPN MCCB (25 kA) with release for SC and OL protections - 2 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size CTs for incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's - 1 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 200 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 25 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	63 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 9 Set												
	Notes:-												
a.	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												
b.	All Outgoing feeders shall be provided with earth fault release.												
c.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	SUB VENTILATION POWER PANEL - 2 (Basement - 1), SUB VENTILATION POWER PANEL - 3 & 4 (Platform level) SUB VENTILATION POWER PANEL - 5 (Street level) described as above	Set.							4	4	5,78,040	5,78,040	23,12,160
1.11	**RETAIL & ADVERTISEMENT POWER PANEL - 2 (DB ROOM)**												
A.	**Incomer comprising of :**												
a.	200 amps TPN MCCB (35 kA) with release for SC and OL protections - 1 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size CTs for incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's - 1 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 300 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 35 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	100 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 2 Set												
ii.	63 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 2 Set												
iii.	40 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 10 Set												
	Notes:-												
a.	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												
b.	All Outgoing feeders shall be provided with Multifunction meter for V,A, KWHr, Hz, P with 3 No. 40/5 amps cast resin current transformers with 15 VA Burden & Class 5P10 for protection and metering and RS 485 communication port - 1 Set												
c.	All Outgoing feeders shall be provided with earth fault release.												
d.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	RETAIL & ADVERTISEMENT POWER PANEL - 2 (DB ROOM) described as above	Set.							1	1	3,75,683	3,75,683	3,75,683
1.12	**RETAIL & ADVERTISEMENT POWER PANEL - 1 (DB ROOM)**												
A.	**Incomer comprising of :**												
a.	125 amps TPN MCCB (35 kA) with release for SC and OL protections - 1 Set												
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size CTs for incomer metering supporting SCADA/BMS connectivity												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's - 1 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												
a	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 200 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 35 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	40 Amps TPN MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 27 Set												
	Notes:-												
a.	All outgoing breakers shall be minimum 25 kA rating with Icu = Ics.												
b.	All Outgoing feeders shall be provided with Multifunction meter for V,A, KWHr, Hz, P with 3 No. 60/5 amps cast resin current transformers with 15 VA Burden & Class 5P10 for protection and metering and RS 485 communication port - 1 Set												
c.	All Outgoing feeders shall be provided with earth fault release.												
d.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	RETAIL & ADVERTISEMENT POWER PANEL - 2 (DB ROOM) described as above	Set.							1	1	4,73,900	4,73,900	4,73,900
1.13	**UPS OUTPUT PANEL - 1 (UPS Room & Basement UPS Room)**												
A.	**Incomer comprising of :**												
a.	125 amps DP MCCB (25 kA) with release for SC and OL protections - 2 Set												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b.	1 No., 230V, AC operated integral type Digital meter with RS-485 port for measuring Amps ,Voltage, Energy, frequency, kWH, kVAH, maximum demand & power factor etc with TOD facility conforming to specifications, latest IEC/ EMC and EMI standards/criterion, with necessary Circuit MCBs and suitable size CTs for incomer metering supporting SCADA/BMS connectivity												
c.	1 sets (2 no.) of AC operated, 3.5 Digit, independent Digital Ammeter, Digital Voltmeter similar to SMP-45 models of MECO or equivalent with necessary Circuit MCBs and with suitable size CTs connections as required for incoming feeders.												
d.	ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's - 1 Set.												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												
a	Electrolytic high conductivity tinned copper single phase and neutral busbars rated at 200 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 25 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
i.	63 Amps DP MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 3 Set												
ii.	40 Amps DP MCCB with releases for SC and OL protections & shunt trip each having indication lamps to give status - 12 Set												
	Notes:-												
a.	All outgoing breakers shall be minimum 16 kA rating with Icu = Ics.												
b.	All Outgoing feeders shall be provided with ON/OFF/TRIP Indications and shall be protected by 2 amps SP MCBs.												
c.	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	UPS OUTPUT PANEL - 1 (UPS Room) described as above	Set.							2	2	2,43,973	2,43,973	4,87,946
1.14	**400 kVAR Capacitor Panel (ASS Room)**												
A.	**Incomer comprising of :**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a.	1000 amps 4 Pole Electrically operated fully draw out type air circuit breaker (50 kA) with over current, short circuit & earth fault protection releases, UVR & shunt trip each having indication lamps to give status etc. - 1 Set												
b.	Microprocessor APFC controller relay to sense and monitor the system power factor and provide impulses for operation of 5 capacitor circuits with automatic switching over facility with manual override. It shall continuously monitor all three phases and displays various Electrical Parameters like voltage, input current, capacitive current, KVA demand, KW, Power Factor, self diagnostic error code indication with printout facility of the above with RS 485 port. Controller should mounted on the front side of the panel. It shall have data logging for minimum 2 months, it shall provide output for maximum 8 stages.												
c.	Multifunction meter for V, Hz & A with CT's - 1 Set												
d.	Breaker ON / OFF / TRIP indicating lights with control MCB - 1 Set												
e.	Phase indicating light protected by 2 amps MCB's. - 1 Set												
f.	Amber healthy trip indicating lamps												
B.	**Bus Bar comprising of :**												
	Electrolytic high conductivity tinned copper three phase and neutral busbars rated at 1200 A having a maximum current density of 1.4 A per sqmm suitable to with stand symmetrical fault level of minimum 50 kA. at 415 V with necessary high temp PVC colour coded heat shrinkable sleeving. The neutral busbar shall be of same capacity as phases.												
C.	**Outgoing comprising of :**												
a.	100 kVAR Capacitor Bank - 1 Set each comprising of following:												
i)	250 Amps TPN MCCB - 1 Set												
ii)	250 amps or capacitor heavy duty 525 volts 50Hz contactors. - 1 Set												
iii)	"ON" /"OFF" push buttons and indicating lamps. - 1 Set												
iv)	100 kVAR, 525 volts hermetically sealed metalized polypropylene capacitors in well ventilated enclosures complete as per specifications, application duty and as required - 1 Set												
v)	7% Harmonic Filters, On/Off push button, Indicating lamps - 1 Set												
b.	50 kVAR Capacitor Bank - 4 Set each comprising of following:												
i)	125 Amps TPN MCCB - 1 Set												
ii)	125 amps or capacitor heavy duty 525 volts 50Hz contactors. - 1 Set												
iii)	"ON" /"OFF" push buttons and indicating lamps. - 1 Set												
iv)	50 kVAR, 525 volts hermetically sealed metalized polypropylene capacitors in well ventilated enclosures complete as per specifications, application duty and as required - 1 Set												
v)	7% Harmonic Filters, On/Off push button, Indicating lamps - 1 Set												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
c.	25 kVAR Capacitor Bank - 3 Set each comprising of following:												
i)	80 Amps TPN MCCB - 1 Set												
ii)	80 amps or capacitor duty 525 volts 50Hz contactors. - 1 Set												
iii)	"ON" /"OFF" push buttons and indicating lamps. - 1 Set												
iv)	25 kVAR, 525 volts hermetically sealed metalized polypropylene capacitors in well ventilated enclosures complete as per specifications, application duty and as required - 1 Set												
v)	7% Harmonic Filters, On/Off push button, Indicating lamps - 1 Set												
d.	12.5 kVAR Capacitor Bank - 2 Set each comprising of following:												
i)	40 Amps TPN MCCB - 1 Set												
ii)	40 amps or capacitor duty 525 volts 50Hz contactors. - 1 Set												
iii)	"ON" /"OFF" push buttons and indicating lamps. - 1 Set												
iv)	12.5 kVAR, 525 volts hermetically sealed metalized polypropylene capacitors in well ventilated enclosures complete as per specifications, application duty and as required - 1 Set												
v)	7% Harmonic Filters, On/Off push button, Indicating lamps - 1 Set												
	Notes:												
a.	All outgoing breakers shall be minimum 35 kA rating with Icu = Ics.												
b.	Heavy duty exhaust fans to be provided for cooling Capacitors & Filters.												
c.	LED indication for number of capacitor banks 'ON'.												
d.	LED indication of Power Factor lagging or leading.												
e.	APFC system shall comprise of following: i. Over Voltage ii. Voltage Imbalance iii. Earth Leakage												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	400 kVAR Capacitor Panel (ASS Room) described as above	Set.							2	2	17,16,734	19,31,326	38,62,652
	Addition /Deletion Items												
2	Adjustment rates for addition/deletion of supply & fixing of following including making of suitable holes/space in the panel/DBs and making good all external/internal finishes, terminations etc complete in all respect as required.												
a	Voltage Transduser	Set							1	1	8,131.00	8131.00	8,131.00
b	Under & Over Voltage Relay	Set							1	1	34,151.00	34151.00	34,151.00
c	Multifunction Meter with CTs	Set							1	1	25,702.00	25702.00	25,702.00

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
d	Digital Load Manager with CTs	Set							1	1	25,701.00	25701.00	25,701.00
e	Electrical, Mechanical Interlock	Set							1	1	12,196.00	12196.00	12,196.00
f	Surge Protection Device	Set							1	1	36,235.00	36235.00	36,235.00
g	Micom Relay P127 with CT	Set							1	1	90,152.00	90152.00	90,152.00
h	Under & Over Voltage Release	Set							1	1	4,309.00	4309.00	4,309.00
i	Motor Mechanism 100A/160A	Set							1	1	34,964.00	34964.00	34,964.00
j	Motor Mechanism 250A	Set							1	1	31,646.00	31646.00	31,646.00
k	Motor Mechanism 400A/630A	Set							1	1	49,828.00	49828.00	49,828.00
l	Integral Type Digital Energy Meter with CTs	Set							1	1	41,390.00	41390.00	41,390.00
m	Copper Busbar	KG							1	1	764.00	764.00	764.00
n	Multiple LED/neon type indications	Nos							1	1	134.00	134.00	134.00
o	Astronomical digital timer	Nos							1	1	7,852.00	7852.00	7,852.00
p	Ammeter/Voltmeter (3.5 digit display)	Nos							1	1	1,202.00	1202.00	1,202.00
q	TP Contactor - 40/32 Amps	Nos							1	1	2,914.00	2914.00	2,914.00
r	Aux. Contact 1 NO + 1 NC for MCB	Nos							1	1	378.00	378.00	378.00
3	Adjustment rates for addition/deletion of compartmentalised switchgear in above panels/board of following rating including the supply, fabrication, extension, modification of the enclosure or in a separate enclosure, earthing ,busbar, other sub-systems, accessories etc complete as required and as per specifications and as specified in of item 1.0 above												
3.1	1 no. 4000 A, 415V, 65kA, 4P draw out Electrically operated ACB complete with:	No.							1	1	4,50,700	4,50,700	4,50,700
a	1- set Red/Green ON/OFF indicating lamps												
b	1- set of three phase (red, yellow, blue) indicating lamps												
c	Amber healthy trip indicating lamps												
d	3 nos. cast resin current transformers of 4000/5 ratio with15 VA Burden & Class 5P10 for protection												
e	3 nos. cast resin current transformers of 4000/5 ratio with 15VA burden and Class 1.0 for measurement												
f	Microprocessor based release having variable range of overcurrent, short circuit and earth fault protection with time lag facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.												
g	230V AC or 24 V DC shunt trip coil												
h	230V, AC Motor wound spring closing mechanism.												
i	Terminals to receive suitable rating bus duct/XLPE armoured cables												
j	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
3.2	1 no. 1600 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	No.							1	1	3,71,000	3,71,000	3,71,000
a	1- set Red/Green ON/OFF indicating lamps												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b	1- set of three phase (red, yellow, blue) indicating lamps												
c	Amber healthy trip indicating lamps												
d	3 nos. cast resin current transformers of 1600/5 ratio with15 VA Burden & Class 5P10 for protection												
e	3 nos. cast resin current transformers of 1600/5 ratio with 15VA burden and Class 1.0 for measurement												
f	Microprocessor based release having variable range of overcurrent, short circuit and earth fault protection with time lag facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.												
g	230V AC or 24 V DC shunt trip coil												
h	230V, AC Motor wound spring closing mechanism.												
i	Terminals to receive suitable rating bus duct/XLPE armoured cables												
j	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
3.3	1 no. 1250 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	No.							1	1	3,39,687	3,39,687	3,39,687
a	1- set Red/Green ON/OFF indicating lamps												
b	1- set of three phase (red, yellow, blue) indicating lamps												
c	Amber healthy trip indicating lamps												
d	3 nos. cast resin current transformers of 1250/5 ratio with15 VA Burden & Class 5P10 for protection												
e	3 nos. cast resin current transformers of 1250/5 ratio with 15VA burden and Class 1.0 for measurement												
f	Microprocessor based release having variable range of overcurrent, short circuit and earth fault protection with time lag facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.												
g	230V AC or 24 V DC shunt trip coil												
h	230V, AC Motor wound spring closing mechanism.												
i	Terminals to receive suitable rating bus duct/XLPE armoured cables												
j	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
3.4	1 no. 1000 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	No.							1	1	2,98,545	2,98,545	2,98,545
a	1- set Red/Green ON/OFF indicating lamps												
b	1- set of three phase (red, yellow, blue) indicating lamps												
c	Amber healthy trip indicating lamps												
d	3 nos. cast resin current transformers of 1000/5 ratio with15 VA Burden & Class 5P10 for protection												
e	3 nos. cast resin current transformers of 1000/5 ratio with 15VA burden and Class 1.0 for measurement												
f	Microprocessor based release having variable range of overcurrent, short circuit and earth fault protection with time lag facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.												
g	230V AC or 24 V DC shunt trip coil												
h	230V, AC Motor wound spring closing mechanism.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
i	Terminals to receive suitable rating bus duct/XLPE armoured cables												
j	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
3.5	1 no. 800 A, 415V, 50kA, 4P draw out Electrically operated ACB complete with:	No.							1	1	2,75,578	2,75,578	2,75,578
a	1- set Red/Green ON/OFF indicating lamps												
b	1- set of three phase (red, yellow, blue) indicating lamps												
c	Amber healthy trip indicating lamps												
d	3 nos. cast resin current transformers of 800/5 ratio with15 VA Burden & Class 5P10 for protection												
e	3 nos. cast resin current transformers of 800/5 ratio with 15VA burden and Class 1.0 for measurement												
f	Microprocessor based release having variable range of overcurrent, short circuit and earth fault protection with time lag facility for each of the fault for achieving discrimination along with distinct fault indication through LED's.												
g	230V AC or 24 V DC shunt trip coil												
h	230V, AC Motor wound spring closing mechanism.												
i	Terminals to receive suitable rating bus duct/XLPE armoured cables												
j	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
3.6	630A, 415V, Ics=50 kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.							1	1	63,353	63,353	63,353
3.7	630A, 415V, Ics=50 kA, TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps (red, yellow, blue)	No.							1	1	58,003	58,003	58,003
3.8	400A, 415V, Ics=35 kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps (red, yellow, blue)	No.							1	1	49,839	49,839	49,839
3.9	400A, 415V, Ics=35 kA, TP, MCCB with variable over current and short circuit releases with heavy duty solid link and 1-set of three phase indicating lamps (red, yellow, blue)	No.							1	1	46,525	46,525	46,525
3.10	250/200 A ,415V, Ics=35kA, 4P, MCCB with variable over current and short circuit releases and 1-set of three phase indicating lamps	No.							1	1	43,377	43,377	43,377
3.11	250/200 A ,415V, Ics=35kA, TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.							1	1	39,417	39,417	39,417
3.12	100/63 A, 415V, Ics=35 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.							1	1	21,721	21,721	21,721
3.13	Less than 63A to 40A, 415V, Ics=25 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps	No.							1	1	21,721	21,721	21,721

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.14	32A, 415V, Ics=25 kA ,TP, MCCB with variable over current and short circuit releases with heavy duty solid neutral link and 1-set of three phase indicating lamps								1	1	12,417	12,417	12,417
3.15	Electrical operating mechanism (Motorised mechanism) for all type of above MCCBs	No.							1	1	12,602	12,602	12,602
3.16	40-63A FP MCB 9/10 kA	No.							1	1	4,515	4,515	4,515
3.17	40-63A TP MCB 9/10 kA	No.							1	1	4,260	4,260	4,260
3.18	40-63A DP MCB 9/10 kA	No.							1	1	1,380	1,553	1,553
3.19	40-63A SP MCB 9/10 kA	No.							1	1	730	821	821
3.20	5-32A FP MCB 9/10 kA	No.							1	1	1,860	2,093	2,093
3.21	5-32A TP MCB 9/10 kA	No.							1	1	1,380	1,553	1,553
3.22	5-32A DP MCB 9/10 kA	No.							1	1	900	1,013	1,013
3.23	5-32A SP MCB 9/10 kA	No.							1	1	410	461	461
3.24	16-32Amp DP RCCB, 30 mA	No.							1	1	3,480	3,915	3,915
3.25	1000mA 4P RCCB/ELCB-MCB	No.							1	1	17,321	17,321	17,321
3.26	Supply, installation and testing of 63/40 Amp adjustable, TP MCCB with fixed neutral in sheet steel enclosure with incoming & outgoing cable box and ON indication lamp complete as required.	No.							10	10	13,469	15,153	1,51,526
3.27	Supplying installation testing and commissioning of 10/25/32A DP MCB in IP 54 rated surface/recessed box with the total unit having IP 54 ingress protection with incoming & outgoing cable box for AC indoor unit complete as required.	Nos							1	1	1,833	2,062	2,062
3.28	Supplying installation testing and commissioning of 63 A 4P isolator MCCB in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection for AC Outdoor Units/Lifts/Escalators etc.	Nos							1	1	2,671	3,005	3,005
3.29	Supplying installation testing and commissioning of 125 A 4P isolator MCCB in IP 56 rated surface/recessed GI box with the total unit having IP 56 ingress protection for Station UPS	Nos							1	1	4,758	5,353	5,353
3.30	Supply, installation and testing of 4 way TPN sheet steel enclosure with incoming and outgoing cable, distribution board complete as required.	No.							1	1	17230	17,230	17,230
3.31	Supply, installation and testing of 200 amps 4 Pole Isolator in sheet steel enclosure with incoming and outgoing cable box and indication lamps complete as required.	No.							1	1	19060	19,060	19,060
3.32	Overload relay												
a	4 - 6 A	No.							1	1	779	779	779

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b	6 - 12A	No.							1	1	779	779	779
c	9 - 15 A	No.							1	1	1,001	1,001	1,001
d	30 - 40 A	No.							1	1	2,202	2,202	2,202
e	40 - 65 A	No.							1	1	2,258	2,258	2,258
f	63 - 100 A	No.							1	1	3,693	3,693	3,693
3.28	100 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.							1	1	141045	1,41,045	1,41,045
3.29	75 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.							1	1	141045	1,41,045	1,41,045
3.30	50 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.							1	1	42,961	42,961	42,961
3.31	10/7.5 HP, **Star Delta starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.							1	1	36,774	36,774	36,774
3.32	Upto 5HP, **DOL starter** comprising 3 Nos. TP contactor AC-3 duty Auto/Manual switch, Start Stop push button, bimetallic over current relays single phasing preventer and timer & with potential free contacts for remote monitoring and control.	No.							1	1	22,824	22,824	22,824
3.33	Adjustment rates for addition/deletion of Power Contactor of following rating including the supply, fabrication, extension, modification of the enclosure or in a separate enclosure, earthing ,basbar, other sub-systems, accessories etc complete as required and as per specifications												
a	400 Amps 4 P Power Contactor	No.							1	1	22,712	22,712	22,712
b	300 Amps 4 P Power Contactor	No.							1	1	17,653	17,653	17,653
c	250 Amps 4 P Power Contactor	No.							1	1	9,597	9,597	9,597
d	200 Amps 4 P Power Contactor	No.							1	1	8,565	8,565	8,565
	TOTAL FOR LV SWITCHBOARDS ZE.01												**314,98,633**
ZE.02	**DISTRIBUTION BOARDS**												
1	Supply, installation, testing & commissioning of front operated front access cubical type indoor duty dead front wall / recess/ surface mounting, totally enclosed dust and vermin proof (minimum protection IP 54) panels with foamed-in neoprene gasketted hinged doors, fabricated from 2 mm thick CRCA with powder coated finish suitable for 415 V, 3-phase, 4 wire, 50 Hz system including suitably rated insulated copper busbars, interconnections, neutral bar assembly, phase segregating barriers, LED indicating lamps for incoming and outgoing feeders,15% spare space for future expansion, knockouts and gland plates for entry of cables and conduits, all internal wiring using high temperature FRLS wires, independant terminals for each phase, earthing terminals and including the cost of providing Master key lock on the door and pad locking facility on door as well as at incomer, bonding to earth etc. complete as per specification, drawings as required and as under:												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a	MCBs shall conform to IEC898/IS 8828 (latest) and, with breaking capacity 9/10 kA at 415 V AC, current limiting type lower powerloss appx 40 -70% of the stipulated value and suitable for magnetic releases operating between 3 to 5 times rated current for normal power distribution application and 5 to 10 times rated current for moter application duty, with minimum Electrical endurance of the order of 20000 operation cycles.												
b	Residual current circuit breaker (RCCB) conforming to IS 12640 shall be provided with 30 mA sensitivity and electrically connected rated current capacity MCB for short circuit and over load protection as required												
c	All incomer MCBs of boards /panels shall be provided with NO/NC contacts as specified in specifications and drawings												
d	The LDBs may be required to accommodate Dimming Control equipment mountable on DIN rail. Contractor should refer to relevant specifications and drawings in this regard and submit his scheme for approval by Engineer.												
e	All the contactors shall be provided with potential free contacts for remote monitoring and control.												
f	Various distribution boards as given below:												
1.1	**Lighting Distribution Boards (LDB) Type-1 as per specification and Drawing as per following details.**												
	One lighting distribution board (LDB) unit consisting of 3 compartments with respective incoming TPN MCBs, DP MCB RCCBs/ELCBs, set of contactors and outgoing SP MCBs each having indications for incoming & outgoing feeder status e.g. LDB is combination of LDB /N, LDB /G, LDB /U connected to incoming Supplies from Normal, DG set & UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:	No.							5	5	1,54,964	1,54,964	7,74,820
A	**Normal**												
	INCOMER												
a)	1 no. 40A TPN Contactor with astronomical digital timer												
b)	1 no. 40A TPN MCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	24 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
b)	3 nos. 32A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped from above contactor (non timer - controlled feeders).												
B	**DG**												
	INCOMER												
a)	1 no. 40A TPN Contactor with astronomical digital timer												
b)	1 no. 40A TPN MCB												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	24 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
b)	3 nos. 32A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped from above contactor (non timer - controlled feeders).												
C	**UPS**												
	INCOMER												
a)	1 no. 25A DP Contactor with astronomical digital timer												
b)	1 no. 25A TP MCB + ELCB/RCCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	10 nos. 10A/20A SP MCB arranged in a row and controlled by one no. 25A DP ELCB/RCCB with feeder ON indication lamps												
b)	4 nos. 10A/20A SP MCB arranged in a row and controlled by a 20A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped from above contactor (non timer -controlled feeders).												
	SCADA / BMS CONNECTIVITY Contactor & Timer shall be provided with necessary NO/NC potential free contact & should provide single point to communicate with BMS/SCADA.												
1.2	**Lighting Distribution Boards (LDB) Type-2 as per specification and Drawing as per following details.**												
	One lighting distribution board (LDB) unit consisting of 2 compartments with respective incoming TPN MCBs, DP MCB RCCBs/ELCBs, set of contactors and outgoing SP MCBs each having indications for incoming & outgoing feeder status e.g. LDB is combination of LDB /N, LDB /G/LDB /U connected to incoming Supplies from Normal, DG set / UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:	No.							2	2	50,847	50,847	1,01,694
	SCADA / BMS CONNECTIVITY Contactor & Timer shall be provided with necessary NO/NC potential free contact & should provide single point to communicate with BMS/SCADA.												
A	**Normal**												
	INCOMER												
a)	1 no. 40A TPN MCB												
b)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	24 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
B	**UPS**												
	INCOMER												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a)	1 no. 25A DP MCB ELCB/RCCB												
b)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder with feeder ON Indication LED Lamps												
a)	10 nos. 10A/20A SP MCB												
	SCADA / BMS CONNECTIVITY Contactor & Timer shall be provided with necessary NO/NC potential free contact & should provide single point to communicate with BMS/SCADA.												
1.3	**Lighting Distribution Boards (LDB) Type-3 as per specification and Drawing as per following details.**												
	One lighting distribution board (LDB) unit consisting of 2 compartments with respective incoming TPN MCBs, DP MCB RCCBs/ELCBs, set of contactors and outgoing SP MCBs each having indications for incoming & outgoing feeder status e.g. LDB is combination of LDB /N, LDB /G/LDB /U connected to incoming Supplies from Normal, DG set / UPS respectively including a set of time switches as per specifications and as shown on Drawing and as under:	No.							1	1	1,17,067	1,17,067	1,17,067
A	**Normal**												
	INCOMER												
a)	1 no. 40A TPN Contactor with astronomical digital timer												
b)	1 no. 40A TPN MCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	18 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
b)	3 nos. 32A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped from above contactor (non timer - controlled feeders).												
B	**DG**												
	INCOMER												
a)	1 no. 40A TPN Contactor with astronomical digital timer												
b)	1 no. 40A TPN MCB												
c)	1 set of (ON) indicating lamps for each												
	OUTGOINGS feeder												
a)	9 nos. 10A/20A SP MCB arranged in three rows and each row controlled by one no. 32A DP ELCB/RCCB with feeder ON indication lamps												
b)	3 nos. 32A DP MCB + ELCB/RCCB with feeder ON indication lamps tapped from above contactor (non timer - controlled feeders).												
1.4	**Vertical Power distribution boards (VDPN) Type-4 as per specification and as per following details. (ViaDuct Socket)**								2	2	43,175	48,572	97,144
A	**INCOMER**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	1 no. 80 TP MCCB												
	1 set of (ON) indicating lamps.												
B	**OUTGOINGS**												
	8 Nos of 32 TPN MCB												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.5	**Lighting distribution boards (LDB/PDP) Type-5 as per specification and as per following details. (Adversement DB Concourse and Platform level)**	No.							3	3	57572	57,572	1,72,716
	One lighting distribution board (LDB) unit with respective incoming TP MCBs, outgoing TP MCBs DP RCCB and outgoing SP MCBs each having indications for incoming & outgoing feeder status as per specifications and as under:												
A	**INCOMER**												
a.	1 no. 63A Ics =35kA TPN MCCB												
b.	1 set of (ON) indicating lamps.												
B	**OUTGOINGS with feeder ON Indication LED Lamps**												
a)	3 No. 32A TP MCBs												
b)	9 Nos of 10A/20A SPMCB arranged in three rows and each row controlled by one no. 32A DP ELCB with feeder (ON) indication lamps.												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
1.6	**Lighting distribution boards (LDB/PDP) TYPE-6 as per specification and as per following details.**	Nos							12	12	36,365	36,365	4,36,375
	One lighting distribution board (LDB) unit with respective incoming TP MCBs, DP RCCB and outgoing SP MCBs each having indications for incoming & outgoing feeder status as per specifications and as under:												
A	**INCOMER**												
a.	1 no. 32A TP MCB												
b.	1 set of (ON) indicating lamps.												
B	**OUTGOINGS**												
a)	18 Nos of 10A/20A SPMCB arranged in three rows and each row controlled by one no. 40A DP ELCB with feeder (ON) indication lamps.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	TOTAL FOR DISTRIBUTION BOARDS ZE.02										**4,59,990**		**16,99,816**
ZE.03	**MV CABLING, BUSDUCT AND TRAY**												
3.1	Supply, laying, jointing, terminating, testing and commissioning of 1100 V grade, armoured / unarmoured, FRLSZH, **XLPE**, aluminium(AL) / Copper (CU) conductor cables on existing trays/walls/columns/ indoor/ trenches including the cost of supports with suitable clamps, saddles, hooks, bolts etc. and including the cost of proper dressing of cables, markers providing identification tags,earthing of glands armouring etc. complete as per specifications, as required and as below.												
	Note 1: All cables above 16 sq. mm are Al Conductor unless specified otherwise.												
a)	3.5 core 400 sq mm AL conductor	Mtrs							420	420	1,680	1,890	7,93,800
b)	3.5 core 300 sq mm AL conductor	Mtrs							2700	2,700	1,057	1,189	32,10,638
c)	3.5 core 240-sqmm AL conductor	Mtrs							300	300	857	857	2,57,100
d)	3.5 core 185-sqmm AL conductor	Mtrs							720	720	725	816	5,87,250
e)	3.5 core 150 sq mm AL. Conductor	Mtrs							540	540	526	526	2,84,040
f)	3.5 core 120-sqmm AL conductor	Mtrs							420	420	502	565	2,37,195
g)	3.5 core 95 sq mm AL. Conductor	Mtrs							540	540	593	593	3,20,220
h)	4 core 95 sq mm AL. Conductor	Mtrs							300	300	430	430	1,29,000
i)	3.5 core 70-sqmm AL conductor	Mtrs							2160	2,160	364	410	8,84,520
j)	3.5 core 50 sq mm AL. Conductor	Mtrs							1560	1,560	300	338	5,26,500
k)	3.5 core 35-sqmm AL conductor	Mtrs							13656	13,656	240	270	36,87,120
l)	3.5 core 25-sqmm AL conductor	Mtrs							2400	2,400	224	252	6,04,800
m)	4 core 16 sq mm CU Conductor	Mtrs							16560	16,560	560	630	104,32,800
n)	4 core 10 sq mm CU Conductor	Mtrs							4200	4,200	456	513	21,54,600
o)	4 core 6 sq mm CU Conductor	Mtrs							300	300	310	349	1,04,625
p)	4 core 4 sq mm CU Conductor	Mtrs							300	300	250	281	84,375
q)	3 core 6 sq mm CU Conductor	Mtrs							900	900	238	238	2,14,200
r)	3 core 4 sq mm CU Conductor	Mtrs							900	900	140	140	1,26,000
s)	2 core 16 sq mm AL. Conductor	Mtrs							1500	1,500	101	101	1,51,500
t)	2 core 50 sq mm Cu. Conductor	Mtrs							30	30	771	771	23,130
u)	1 core 95 sq.mm. Cu unarm.	RM							720	720	238	238	1,71,360
v)	1 core 50 sq.mm. Cu unarm.	RM							630	630	140	140	88,200

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.2	Cable jointing and termination of cable as per item 1.1 -including cost of supplying and fixing, crimping lugs, double compression brass glands, insulation tape etc. complete as per specifications and as required.												
a)	3.5 core 400 sq mm AL conductor	Nos							24	24	2,973	3,345	80,278
b)	3.5 core 300 sq mm AL conductor	Nos							48	48	2,572	2,894	1,38,907
c)	3.5 core 240-sqmm AL conductor	Nos							24	24	2,384	2,384	57,216
d)	3.5 core 185 sqmm AL conductor	Nos							24	24	1,485	1,671	40,097
e)	3.5 core 150 sq mm AL. Conductor	Nos							12	12	1,271	1,271	15,252
f)	3.5 core 120 sqmm AL conductor	Nos							24	24	1,142	1,285	30,839
g)	3.5 core 95 sq mm AL. Conductor	Nos							24	24	823	823	19,752
h)	4 core 95 sq mm AL. Conductor	Nos							24	24	1,624	1,624	38,976
i)	3.5 core 70 sqmm AL conductor	Nos							12	12	685	771	9,248
j)	3.5 core 50 sq mm AL. Conductor	Nos							36	36	585	658	23,693
k)	3.5 core 35 sqmm AL conductor	Nos							24	24	489	550	13,207
l)	3.5 core 25 sqmm AL conductor	Nos							108	108	350	394	42,525
m)	4 core 16 sq mm CU Conductor	Nos							300	300	340	383	1,14,750
n)	4 core 10 sq mm CU Conductor	Nos							252	252	283	319	80,316
o)	4 core 6 sq mm CU Conductor	Nos							252	252	240	270	68,040
p)	4 core 4 sq mm CU Conductor	Nos							252	252	200	225	56,700
q)	3 core 6 sq mm CU Conductor	Nos							72	72	1,236	1,236	88,992
r)	3 core 4 sq mm CU Conductor	Nos							72	72	927	927	66,744
s)	2 core 16 sq mm AL. Conductor	Nos							144	144	898	898	1,29,312
t)	2 core 50 sq mm Cu. Conductor	Nos							10	10	990	990	9,900
u)	1 core 95 sq.mm. Cu unarm.	No.							12	12	964	964	11,568
v)	1 core 50 sq.mm. Cu unarm.	No.							12	12	747	747	8,964
3.3	Supply, laying testing and commissioning of 1.5 sqmm 1100 V grade, armoured, FRLSZ PVC insulated, FRLSZH PVC sheathed copper conductor cables on existing trays/walls/columns/ indoor/ trenches including the cost of supports with suitable clamps, saddles, hooks, bolts etc. and including the cost of proper dressing of cables and including the cost of providing identification tags etc. complete as per specifications, as required and as below.												
	Note : Termination of all control cables to be provided under the above item and as per schematic diagram including the cost of supplying and fixing crimping lugs, compression type brass glands, heavy duty ferrules, insulation tape etc. complete as per specifications and as required.												
a)	2 C x 1.5 sqmm	RM							100	100	242	242	24,200

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b)	4 C x 1.5 sqmm	RM							100	100	119	134	13,388
c)	5 C x 1.5 sqmm	RM							100	100	166	187	18,675
d)	8 C x 1.5 sqmm	RM							100	100	198	223	22,275
e)	10 C x 1.5 sqmm	RM							100	100	210	236	23,625
f)	12 C x 1.5 sqmm	RM							100	100	264	297	29,700
3.4	Trunking made of roll-formed sheet steel in white polyster lacquer finish,11 conductors embeded in an integral conductor moulding. 5 mains power lines plus 2x2 conductors for integrating imergency lighting using two independently isolated circuits,plus 2 control-line conductors.Tool-free connection using electrical feed kit complete as required.Dimensions:4000x60x54 mm	Mtrs							10	10	3,171	3,171	31,710
3.5	**BUS DUCTS**												
3.5.1	Design, manufacture, testing at works, supplying, Installtion, testing and Commissioning of sheet steel structure Sandwitch type TPN "Al" bus duct having neutral cross section equal to phase, 50% Integral earth which is part of housing itself and class F/H insulation and enclosure will be of minimum 1.6 mm GI sheet steel epoxy powder coated paint with approved shade as per specification including suitable earthing conductor through out the length of bus duct. The bus bar will be of Aluminium with radialised edges. Individual sections will not be more than 3 meters long uniblock. One section will be connected to adjacent section by joint system operating by single bolt. Sub assembly should be removable without disturbing the adjacent bus bars. Rates shall be inclusive of all accessories i.e. bends, expansion joint, end feed box, Fire barriers inccluding all required necessary supports etc. as required.(Phase sequence shall be matched at both ends)												
a	1000 amps Sandwich Busduct with short circuit withstand of 50kA for one Sec.	RM							0	0	26,251	31,501	0
b	1600 amps Sandwich Busduct with short circuit withstand of 50kA for one Sec.	RM							0	0	24,000	28,800	0
c	2000 amps Sandwich Busduct with short circuit withstand of 50kA for one Sec.	RM							0	0	27,738	33,286	0
d	2500 amps Sandwich Busduct with short circuit withstand of 50kA for one Sec.	RM							0	0	36,300	43,560	0
e	4000 amps Sandwich Busduct with short circuit withstand of 65kA for one Sec.	RM							40	40	86,180	86,180	34,47,200
3.5.2	Design, manufacture, testing at works, supplying, Installation, Testing and Commissioning of flanged end Bimetallic flexible Termination with all accessories as required for the following rating of bus duct. The Flange End should be suitable for the Transformers and Panels:												
a	1000 amps	No.							0	0	49,252	59,102	0
b	1600 Amps	No.							0	0	25,775	30,930	0
c	2000 Amps	No.							0	0	31,625	37,950	0
d	2500 Amps	No.							0	0	41,013	49,216	0
e	4000 Amps	No.							4	4	1,69,811	1,69,811	6,79,244

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.6	Supply, fabrication & installation of perforated hot dipped galvanised double bended cable trays from 2 mm thick GI sheets continuously connected including horizontal and vertical bends, reducers, tees, and other accessories and duly suspended from the ceiling with suitable size vertical fully threaded G.I rods or suitable size G.I angles supported by 40mm x 40 mm x 5 mm GI angle etc. (or installed on wall supported on suitable G.I.brackets as required) complete as per specifications, as required and as below.as per Engineer In-charge. **Note: All cable tray, bends, tee, reducer, accessories etc shall be factory fabricated as approved by Engineer In-charge.**												
	Note: Trays shall be supported adequately at minimum 1 m distance from the building structure/ ceiling by means of painted/galvanized (as specified) MS structural members secured to the structure by dash fasteners or by grouting. This support should be capable of withstanding the weight equivalent of 3m length of the cables that can be laid in the trays. At turns the support has to be double and at both ends of the bend.												
a)	600 mm wide x 50 mm deep x 2mm thick	RM							500	500	1,651	1,651	8,25,500
b)	450 mm wide x 50 mm deep x 2mm thick	RM							500	500	1,033	1,033	5,16,500
c)	300 mm wide x 50 mm deep x 2mm thick	RM							3000	3000	900	1,013	30,37,500
d)	200 mm wide x 50 mm deep x 2mm thick	RM							140	140	600	675	94,500
e)	150 mm wide x 50 mm deep x 2mm thick	RM							2000	2000	550	619	12,37,500
f)	100 mm wide x 50 mm deep x 2mm thick	RM							0	0	500	563	0
g)	50 mm wide x 50 mm deep x 2mm thick	RM							0	0	296	296	0
3.7	Supply, & installation of prefabricated, GI, ladder type cable tray conforming to M & E Specifications continuously connected including horizontal & vertical bends reducers, tees, coupling plate, nut bolts washers etc. The side runners shall be 100 x 20 x 2.5 mm and centre rungs shall be of size 30 x 15 x 2.5 mm with centre to centre distance of 250 mm, as required.The rate shall include the supporting arrangement with suitable size fully threaded rod or G.I suitable size angles as required. **Note: All cable tray, bends, tee, reducer, accessories etc shall be factory fabricated as approved by Engineer In-charge.**												
a	900 mm wide x 2.5 mm thick	RM							100	100	900	1,013	1,01,250
b	600 mm wide x 2.5 mm thick	RM							100	100	750	844	84,375
c	450 mm wide x 2.5 mm thick	RM							100	100	500	563	56,250
d	300 mm wide x 2.5 mm thick	RM							100	100	495	557	55,688
e	150 mm wide x 2.5 mm thick	RM							100	100	490	551	55,125
7	Supply, installation of sheet steel raceways /trunking , fabricated from 2.0 mm thick GI with minimum coating thickness 260 gm / sq. meter on both sides with removable cover plate complete with counter sunk cadmium plated brass screws, bends, tee-junctions, cross junction tap-off boxes of adequate size etc ,in floor and suspended from the ceiling with required support . **Coloured Raceways shall be provided as per Engineer In-charge**. Rendered electrically continuous as approved and of following sizes.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a	100 x 100 mm raceway	RM							0	0	1,009	1,135	0
b	100 x 50 mm raceway	RM							100	100	1,600	1,800	1,80,000
c	150 X 100 mm raceway	RM							0	0	1,900	2,138	0
d	150 x 150 mm raceway	RM							0	0	683	768	0
e	200 x 50 mm raceway	RM							100	100	2,935	2,935	2,93,500
8	**Steel Works**												
	Supply, fabrication & installation, of fabricated GI steel work conforming to M & E specification and tender doct, to support GI cable trays, bus duct, light fixtures, conduit wirings, Bracket ,& other electrical works, as required.	kg							1500	1500	125	141	2,10,938
	TOTAL CARRIED TO SUMMARY OF MV CABLING BUSDUCT AND TRAY ZE.03										**5,73,143**		**372,56,889**
ZE.04	**INTERNAL WIRING & ACCESSORIES**												
	Whether explicitly stated in the schedules below or not, the following must be complied with:												
	For supply and installation, of conduits, cable trunking, raceway, flexible conduits and wiring,												
	Wires supplied must conform to relevant clauses of tender doct. And Specifications.												
	Wiring accessories must conform to relevant clauses of tender doct. And Specifications.												
	In case of any contradiction between BOQ and tender doct. And specifications, the stringent condition of the two will apply.												
4.1	Supply and laying of Lighitng Submains/circuit mains (3R x 2.5 Sqmm) in concealed or surface conduit system with GI conduits & 1100 V grade, multi strand copper conductor, FRLSZH-PVC insulated wires for phase, neutral & earth, shall include end termination. The conduits shall be complete with bends, JBs etc. The laying cost shall also include chipping works if necessary.												
a	Primary Point (13 meter)	Points							250	250	5,690.38	6,401.68	16,00,421
b	Secondary Point	Points							2300	2,300	2,001.35	2,251.52	51,78,503
4.2	Supply and laying of circuit wiring along with earth wire with the following size of FRLSZH PVC insulated copper conductor single core cable in GI conduit as required. Compete in all respect to the entire satisfaction of engineer-in-charge												
a	3 R of 1 c x 2.5 Sqmm	Mtrs							9750	9,750	143.59	161.53	15,74,948
b	3R of 1 c x 4 Sqmm	Mtrs							2400	2,400	204.59	230.16	5,52,389
c	3c x 2.5 Sqmm	Mtrs							100	100	150.70	169.53	16,953
4.3	Supply and laying of Power Submains/circuit mains (3R x 4 Sqmm)in concealed or surface conduit system with GI conduits & 1100 V grade, multi strand copper conductor, FRLSZH-PVC insulated wires for phase, neutral & earth, shall include end termination. The conduits shall be complete with bends, JBs etc. The laying cost shall also include chipping works if necessary.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
a	Primary Point (13 meter)	Points							210	210	6,185.20	6,958.35	14,61,254
b	Secondary Point	Points							420	420	2,926.93	3,292.79	13,82,972
4.4	Supply and laying of circuit wiring along with earth wire with the following size of FRLSZH PVC insulated copper conductor single core cable in GI conduit as required. Compete in all respect to the entire satisfaction of engineer-in-charge												
a	3R of 1 c x 4 Sq sqmm	Mtrs							8400	8,400	193.29	217.45	18,26,567
b	4c x 6 sqmm	Mtrs							3000	3,000	484.03	544.53	16,33,588
4.5	32A 3pin industrial socket outlet with 32A DP RCCB 30mA with MCB shall be standard powder coated MS sheet steel IP 55 enclosure, separately lockable	Each							30	30	9,249	9,249	2,77,470
4.6	S&F suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing of 6/16A 1P+N+E water proof socket with switch as required.	Pt.							10	10	2,049.95	2,306.20	23,062
4.7	S&F suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing of 6/16A 1P+N+E socket with switch as required.	Pt.							0	0	607.48	683.41	0
4.8	S&F suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing of 32A 3P+N+E water proof socket with plug as required.	Pt.							0	0	7,179.25	8,076.66	0
4.9	S&F suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing of 20A 1P+N+E socket as required for AC .	Pt							5	5	938.83	1,056.18	5,281
4.10	S&F of 32 A 4P isolators with box complete as required by the engineer	Pt							0	0	3,865.75	4,348.97	0
4.11	S&F of 63 A 4P isolators with box complete as required by the engineer	Pt.							0	0	5,798.63	6,523.45	0
4.12	Supply installation testing and commissioning of Occupancy sensor based movement detector with a build-in switch suitable for recessed mounting at a height of 3m with detection pattern of 6m X 8m. The sensor should have an operating voltage range of 230VAC +/10%; 50/60Hz and should be able to take upto 6A of electrical load and should be able to provide the switch off delay from 1 minute to 30 minutes range. The sensor should be in compliance with EN/IEC 60669-2-1, IEC (EN) 60669-2-1, IEC (EN) 61547, IEC (EN) 55015 and IEC (EN) 55022, class B.	No.							5	5	3,467	3,467	17,335
4.13	Supply and installation of GI conduiting complete with GI junction and pull boxes, GI fish wires as specified and as shown below.												
a	25 mm dia 1.6mm thick	M							1500	1500	192	192	2,88,000
b	32 mm dia 1.6mm thick	M							20	20	269	269	5,380

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
c	50 mm dia 2.0mm thick	M							10	10	444	444	4,440
4.14	Supply and providing of PVC cable trough complete with all fittings and accessories	RM							500	500	221	221	1,10,500
	TOTAL CARRIED TO SUMMARY INTERNAL WIRING AND ACCESSORIES ZE.04										**52,262**		**159,59,062**
ZE.05	**LIGHTING FIXTURES & FANS**												
1	**Lighting Fixtures**												
1	Supply, installation, testing & commissioning of light fittings including all accessories e.g. ballast, HPF condensers, lamps, holders, surface/recess mounting arrangement etc. including necessary supports, accessories and hardware as per specifications & as required at site and as below:												
	Luminaire minimum specifications and requirements												
a	Luminaires should operate at +/-6% voltage fluctuation for continuous use to comply to IEC. PF > 0.95 for HF ballasts; for EM circuits PF > 0.85 with capacitor.												
b	All the components including the internal wiring of the luminaries to be used shall be manufactured of material, which are of low smoke and zero halogen type. All luminaires shall be manufactured to relevant sections of IEC60598 or other approved international standards and the type tests for all luminaries shall be provided.												
c	All internal wiring within the lighting fixtures shall be heat-resisting cables.												
d	All light fixtures model no. specified are tentative and contractor shall ensure latest generation model no. shall be provided in case of any change in technical specification / obsolete model no. by light manufacturer at the time of installation.												
	REFERRED STANDARDS FOR LED LIGHTING FIXTURES												
	IS: 513 Cold-rolled low carbon steel sheets and strips												
	IEC 60529 Classification of degree of protections provided by enclosures.												
	EN 55015, CISPR15 Limits and methods of measurement of radio disturbance characteristic of electrical lighting and similar equipment.												
	IEC 62031 LED modules for general lighting-Safety requirements												
	EN 61547 Equipment for general lighting purposes – EMC immunity requirement.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	EN 60929 Performance, AC supplied electronics ballast for tubular fluorescent lamps performance requirement.												
	IEC 60598-2-1 Fixed general purpose luminaries												
	IEC 60598-1 Luminaires - General requirement and tests												
	IEC 61000-3-2 Electro Magnetic compatibility (EMC) -Limits for Harmonic current emission -– (equipment input current = 16 Amps. per phase.												
	IEC 60068-2-38 Environmental Testing :Test Z- AD: composite temperature/humidity cyclic test												
	IEC 61347-2-13 Lamp control gear : particular requirements for DC or AC supplied electronic control gear for LED modules.												
	IS 10322 Specification for the luminaries												
	IS 4905 Method for random sampling												
	LM 79 LED luminaire photometry measurement.												
	LM 80 Lumen Maintenance												
	IEC 62384 DC or AC supplied electronic control gear for LED modules performance requirements												
	IEC/PAS 62612 Self-ballasted LED lamps for general lighting services- Performance												
5.1	Supply, Installation, Testing & Commissioning of 38W LED Recess mounted Luminaire with 5700K colour temperature having 50000 burning hours life with minimum 70% lumen maintenance, CRI should be greater than 80, system lumen output should be minimum 3500 lumens and efficacy >100 lm/W. Housing should made of CRCA with PMMA diffuser and shall be with Electronic driver. The luminaire shall have life of 50000 hours, power factor >0.9 with THD <10%. LED make should be from CREE / Nichia /Philips Lumileds / LG. System Consumption should be less than 38W. Similar to **PHILIPS Cat Ref. RC380B G2 LED35S-6500 PSU OD WH or Equivalent.**	No.							155	155	6,737.45	7,579.63	11,74,843
5.2	Supply, Installation, testing and commissioning of Surface mounted LED luminaire with Mid flux LED using efficient optics , System lumen efficacy > 100 Lumen/Watt , System Luminous flux of >=3200 lumens, System Wattage <=43W with 50,000 hours burning life. Colour rendering index > 70 and Colour temperature 4000K. CRCA housing with high efficiency opal diffuser. Luminaire sealed from bottom. Inbuilt gear . Zero maintenance, Zero mercury. Driver Surge protection > 1.5kV. Electronic In-Built PF > 0.9 , THD < 10% , IEC Compliant for Safety , Performance & EMI. The type shall be of 2'x2'. EQUIVALENT TO **PHILIPS CAT. No. SM365C LED-34-4000 PSE-OD or as per the approved make list**	No.							10	10	5,910.11	6,648.87	66,489
											-		
5.3	Supply, Installation, testing and commissioning of LED based luminaire enclosed in a CRCA housing with diffused optics. The luminaire shall be suitable for Wall / conduit/suspended/surface mounting. With a minimum system level lumen package of 3900 lumens should have a maximum system level wattage of 42W giving a system efficacy of > 100 lm/W. The product is available in colour temperatures of 6500K with CRI>80 and a system lifetime of 40,000 burning hours at 70 percent lumen maintenance. It has electronic driver with a pf>0.95 and THD<=10%. The luminaire is IP 20 protected. Operating voltage range of 140-270 V AC. LED make should be from CREE/Nichia/Philips Lumileds/ LG. The diffuser shall be made of polycarbonate. The luminaire shall be with Short circuit and Over voltage cut off protection and Electrical Class I. **Similar to Philips BN108C LED 40S PSU CDL WH**	No.							100	100	3,534.40	3,976.20	3,97,620

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
5.4	Supply, Installation, testing and commissioning of LED highbay symmetric beam luminaire with housing made of die-cast aluminium of system wattage not more than 72W. The luminaire shall be with dedicated optics to provide precise light distribution of symmetric beam angle. The luminaire shall be designed to meet its specifications on performance & lifetime at a design ambient temperature of 45 deg C. A specially designed heat management system to ensure luminous efficacy >=102 lm/ W for the system and ensure lumen depreciation upto 30% over 50k burning hours. The luminaire is designed to meet IP 65 classification and is compliant with relevant immunity, safety and performance and EMI standards. The system lumens shall not be less than 7200 lumens with 5700K CCT. The CRI shall be > 70. The luminaire shall be able operate from 190 - 270V AC, 50Hz with > 0.9 PF & THD <=20%. The luminaire shall have an in-built surge protection upto 3kV. The LEDs shall be of SMD type (not COB type). The luminaire shall be supplied with suitable suspended / surface mounting kit. **Similar to Philips: BY400V LED72S CW SY PSU S2 FG WH – Surface.**	No.							70	70	19,881.00	22,366.13	15,65,629
5.5	LED based IP54 Light trunking system suitable for Suspended, surface-continuous or standalone mounting applications provided with slim extruded housing having width<75mm. With a minimum system level lumen package of 3900 lumens should have a maximum system level wattage of 42W. The LED used in the system shall be best in class ensuring system efficacy of at least 100 lumen/watt . Colour rendering index (CRI) >80. The trunking system shall be available in single sections of up to 3M length to ensure continuity along the length of the platform. The electronic driver used in the fixture shall be a constant current type driver with power factor > 0.9 and THD < 10%.The CCT shall be 4000K. **Similar to Philips: LL199X 1XDLED40-4000 PSE ODWH - IP54**	No.							120	120	8,283.75	9,319.22	11,18,306
											-		
5.6	Supply and Installation of Trunking system suitable for the above Trunking based Luminaire, Housing shall be made of extruded aluminium with white powder coating, the length of the trunking system shall be 3.5 to 3.6m the trunking system shall be supplied with necessary suspenstion rods and end caps. **Equivalent to TTX 199/03LED**	No.							40	40	2,485.13	2,795.77	1,11,831
5.7	Supply, installation, testing and commissioning of LED round downlighter with > 1600 lumens with 4000K CCT. The optic shall be diffuser. The reflector shall be of polycarbonate and heat sink shall be of die-cast aluminium. The wattage of the luminaire shall be with not more than 18W. The efficacy of the downlighter shall be >100 lm / W. The luminaire shall be mounted using spring clip. The CRI of the luminaire shall be >80. The luminaire shall be with electronic driver with THD < 10% and PF > 0.9 . The driver shall comply to IEC 62384 , IEC 61347-2-13, IEC 61547, EMI- CISPR15 standards. **Equivalent to Philips: DN394B LED16S-4000 PSU WH**	No.							410	410	3,534.40	3,976.20	16,30,242
5.8	Supply, installation, testing and commissioning of contemporary post top luminaire with system wattage not more than 36W and system lumens > 3400. The luminaire shall be with operating voltage 140-270V with PF > 0.9. The LED shall be of SMD type only with CCT 5700K CRI >70. The luminaire shall be with IP 66, IK 10 and Electrical protection Class I. The luminaire shall have an efficacy > 100 lm /W. The luminaire shall comply to IS 10322, IEC 60698. The light distribution shall be street lighting distribution. The housing shall be of die-cast aluminium with flat glass cover. The luminaire shall be with 0% ULOR. The pole height shall be 3m from FFL. The life of luminaire shall be > 50000 hours at L70. The luminaire manufacture shall submit LM79 and LM80 reports from NABL accredited lab. The luminaire shall be supplied with square shaped pole of height > 3.0m. The base plate dimension shall be 300mm x 300mm with 4 nos of holes of dia 15mm. Equivalent to **Philips BGP400 LED 35L CW MR FG S1 WITH BRACKET ZGP400 L TYPE LUMACUBE AND POLE ZGP400 3M POLE complete with pole & accessories**	No.							10	10	41,418.75	46,596.09	4,65,961

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
5.9	Supply, Installation, testing and commissioning of LED Flood light with system power not more than 70W High efficiency glass cover with Aesthetically Designed LM6 PDC housing with Black corrosion resistant polyester Powder coating, IP66 & IK≥07 with operating voltage from 140-270VAC, 50 Hz, with LED Life of 50000 Burning Hours @L70 with system efficacy not less than 100 Lumen/Watt for the light fixture. The system lumen shall be > 7000 lumens . The supplier shall provide LM80 and LM 79 test reports from NABL accredited LAB before supplying the luminaires . **Equivalent to Philip: BVP120 LED70 CW FG S1 PSU GR**	No.							25	25	17,672.00	19,881.00	4,97,025
5.10	Supply, Installation, testing and commissioning of LED floodlight with LM6 Pressure die-cast aluminium Housing and High efficiency Glass cover. The system wattage shall be not more than 115W and system lumen output shall not be less than 10000 lumens. The Driver Efficiency : > 85% and Life L70, 50k Hrs. Colour temp shall be 5700K. The luminaire shall be provided with Graduation disk for aiming and Suitable 'C' clamp mounting. The luminaire shall have an efficacy > 100lm /W. The luminaire shall be IP 65, Class I protected. The dimension of the luminaire shall not be more than 447 x 327 x 163mm (H x W x H). The luminaire shall not weigh more than 13kg. The supplier shall provide LM80 and LM 79 test reports from NABL accredited LAB before supplying the luminaires **.Similar to PHILIPS: BVP410 LED 107 CW HE NB FG S3 XT**	No.							10	10	38,657.50	43,489.69	4,34,897
5.11	Supply, Installation, Testing & Commissionimg of Surface mounted Bulkhead LED with a system lumen output of 600 lumens and a system efficacy of 100 lumen/watt The luminarie shall be IP66 & IK09 rated and shall have a CRI of 70. The housing of luminarie is made of high pressure die cast aluminium with front cover made of polycarbonat diffuser. Similar to Philips WT202W LED 6S and must conform to ingress Protection Clasification of IP54	No.							50	50	1,557	1,557	77,850
5.12	Supply, Installation, testing and commissioning of 4ft linear recess mounted light fixture with a system efficacy of at least 110lm/W and nominal system lumen output of 2600lumens. CRI greater than 80, SDCM<5 and the fixture CCT shall be available in 4000 as well as 6500K. The luminaire shall have a total harmonic distortion factor of not more than 10% and power factor of at least 0.9. The width of the fixture shall not be more than 60mm. The fixture shall have an extruded aluminium housing with an anodized finish and high efficiency extruded polycarbonate diffuser. Heat sink to be made of CRCA. Operating voltage range of 140- 270V AC with an inbuilt surge protection of 2.5kV. The thickness of the luminaire wall shall be 1.7mm and width of the fixture shall not be more than 60mm. The luminaire shall have Class B serviceability and a life class of at least 50k hours at L70B50. The luminaire shall be available in options of continuous as well as standalone versions. It should also have options of fixed output as well as DALI dimmable versions. LM79 and LM80 reports to be available **similar to Philips RC780B LED 26S**	No.							370	370	10,619	10,619	39,29,007
5.13	Supply, installation, testing and commissioning of LED round downlighter with > 1600 lumens with 4000K CCT. The optic shall be diffuser. The reflector shall be of polycarbonate and heat sink shall be of die-cast aluminium. The wattage of the luminaire shall be with not more than 18W. The efficacy of the downlighter shall be >100 lm / W. The luminaire shall be mounted using spring clip. The CRI of the luminaire shall be >80. The luminaire shall be with electronic driver with THD < 10% and PF > 0.9 . The driver shall comply to IEC 62384 , IEC 61347-2-13, IEC 61547, EMI- CISPR15 standards. **Equivalent to Philips: SM251C LED15S- 4000 PSU WH**	No.							180	180	1,508	1,508	2,71,440
5.14	Supply, installation, testing and commissioning of LED round downlighter with > 1200 lumens with 4000K CCT. The optic shall be diffuser. The reflector shall be of polycarbonate and heat sink shall be of die-cast aluminium. The wattage of the luminaire shall be with not more than 12W. The efficacy of the downlighter shall be >100 lm / W. The luminaire shall be mounted using spring clip. The CRI of the luminaire shall be >80. The luminaire shall be with electronic driver with THD < 10% and PF > 0.9 . The driver shall comply to IEC 62384 , IEC 61347-2-13, IEC 61547, EMI- CISPR15 standards. **Equivalent to Philips: SM250C LED12S- 4000 PSU WH**	No.							10	10	1,141	1,141	11,410

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
5.15	Supply, Installation, Testing & Commissioning of LED Wall mounted linear batten fixture (1200mm length approx.), Aluminium housing, high optically efficient translucence diffuser complete with driver, PF>0.9, THD<20%, rated life of L-70@ 50,000 hours having minimum system lumen output of 2000 Lumens and system efficacy of minimum 100 Lumens / watt with CRI ≥ 80. **Similar to PHILIPS BN108C LED 20S PSU**	No.							1010	1010	1,049	1,049	10,59,272
	Fans												
5.16	Supply and installations of 230 V, 1-phase, 1440 RPM, sweep of appx. 400mm Bracket fan including mounting bracket, blades, starters & other standard accessories complete as required.	No.							10	10	1,879	1,879	18,790
5.17	Supplying and installations of 230 V single phase, 1400 mm sweep ceiling fans with electronic regulators including all standard accessories complete, mounting of regulator on grid plate & MS BOX etc. and suitable length down rod, duly painted, not exceeding minimum fan height of 2.4 m from floor as required and as below.	No.							10	10	2,000	2,000	20,000
5.18	Supply, installation, testing and commissioning of exhaust fan with fan guards on both sides, double ball bearings, class-E insulation, capacitor (pf 0.90 or better) complete with all other accessories as per IS 2312 and as required, of following sizes:												0
a)	Size 450 mm dia, 1400 rpm	Nos							0	0	3,403	3,403	0
b)	Size 300 mm dia, 1400 rpm	Nos							0	0	8,590	8,590	0
3	**Lighting Control System**												
a	Supply, Installation ,Testing and commissioning of Lighting control panel to achieve 33%,66% and 100% on/off the lighting. The Lighting Control System shall be integrated with the E& M SCADA . Each lighting circuit from the lighting control panels (LCP) shall be controlled by the SCADA between the LCP and RTU.The Schedule for control and monitoring of lighting circuits and graphic of lighting control floor plan shall be from the E & M SCADA work station in SCR and OCC . The lighting control system configuration such as graphic, layout, setting, etc., shall be adjusted to harmonize with Architectural finishes. This is also applied to third party vendors interfaces with the system. The lighting control system shall comply with the following codes and standards: (1) IEEE 802 : Standard for Information Technology – Telecommunications and Information exchange between systems (2) IEC 60529/1989 : Degree of protection provided by enclosures (IP Code) (3) IEC 60255 : Electrical Relay (4) IEC 60364 : Electrical Installation of Buildings												0
b	LX Lighting Control Panels with encloser,24 Relay Spaces, Relays Ratings : 120, 277, and 347VAC 20 Amp Single Pole Input: 120/277/347VAC multi-tap transformer.	No							4	4	2,89,880	3,26,115	13,04,460

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
c	Power Supply for LX Panel Input: 120VAC Output: LON Protocol	No							4	4	65,440	73,620	2,94,480
d	LX Switches for Manual Override, 5 Switches, White Color	No							10	10	10,710	12,049	1,20,488
e	Graphic User Interface for LX Panel for Local Control	No							4	4	33,558	37,753	1,51,011
f	PC Integration Tool for remote controlling Panels Via IP Address Input: 120VAC	No							4	4	2,11,225	2,37,628	9,50,513
g	Building Automation multi-protocol gateway (BACnet, Metasys N2 by JCI, and Modbus) for providing control and access to LX Network Lighting Control Panel system Input: 24VDC	No							4	4	1,50,297	1,69,084	6,76,337
h	Power Supply for ProtoCessor Input: 100-240VAC, 1.5A Output: 24V, 1.5A	No							4	4	536	603	2,412
i	Control Cable for LON Communication between Panels (100 Ft Reel)	No							4	4	11,614	13,066	52,263
j	Surface Mounted Cabinet for LX Panel Accessories	No							4	4	3,808	4,284	17,136
	TOTAL CARRIED TO SUMMARY LIGHTING FIXTURE AND FANS ZE.05										**9,56,928**		**164,19,709**
ZE.06	**PROTECTIVE EARTHING**												
6.1	**Earthmat**												
6.1.1 6.1.2 6.2	Supply, laying, testing and commissioning of 30 mm dia MS rod for earth mat grid conductor (at 500mm or deeper as per the final approved design as per the site condition) as per specifications including lap (of not less than 150mm) & cross weld joints and providing bitumin coat at every joint as required. Risers from earth mat to be brought out as per approved drawings and specifications. (Cost of risers not included in this item). Supply, laying, testing and commissioning of vertical earth electrodes of 30 mm dia MS rod, 3 m deep from earth mat including weld joints with earth mat as per approved drawings and specifications. The weld joints to be provided with bitumin coats. Providing and making plate earthing station including the cost of 600 mm x 600 mm x 6.3 mm G. I. plate electrode, 15 mm dia G.I.watering pipe, CI funnel with wiremesh charcoal/coke , salt, all earth work, masonry enclosure with frame,hinged cover plate having locking arrangement,Disconnecting links, complete as per IS 3043:1987 for earthing.	Lumpsum							1	1	3,42,395.00	3,85,194.38	3,85,194

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
6.3	Providing and making plate earthing station with 600mm x 600 mm x 3.15 mm Cu plate electrode, 50 mm dia G.I. watering pipe, CI funnel with wiremesh charcoal/coke , salt, all earth work, masonry enclosure with frame, hinged heavy duty RCC top cover plate having locking arrangement,Disconnecting links, complete as per IS 3043:1987 for earthing.	No.							10	10	33,135.00	37,276.88	3,72,769
											-		
6.4	Supply, Installing,Testing and commissioning of 50mm dia ,3m length ,pipe in pipe Chemical earth electrode complete as required as per IS 3043-1987 for earthing.	No.							0	0	13,806.25	15,532.03	0
6.5	Supply and laying,Testing and commissioning of copper/GI Strips/wire for interconnecting the earthing stations ,panels,DBs etc. of the following sizes in built up trenches /surface/wall/ground complete with holes & fixing,jointing / terminating accessories as per specifications & drawing as required. (Quantity shall be paid as per the actual measurement as executed, however direct measurement shall not exceed the quantity indicated in drawing approved .												
a	75 mm x 6 mm GI strip	RM							2000	2000	322	322.00	6,44,000
b	50 mm x 6 mm GI strip	RM							1000	1000	220.90	248.51	2,48,513
c	25 mm x 6 mm GI strip	RM							5000	5000	132.54	149.11	7,45,538
d	20 mm x 3 mm GI strip	RM							100	100	115.97	130.47	13,047
e	50 x 6 mm Cu strip	RM							100	100	2,264.23	2,547.25	2,54,725
f	8 SWG / 4 mm diameter, copper Wire	RM							1000	1000	104.93	118.04	1,18,043
6.6	Supply, laying and testing of unarmoured, stranded copper conductor, Low Smoke Zero Halogen, green coloured cables of following sizes, conforming to BS 7211 and Section E02 of M & E Specifications, for earthing, including termination of the same by copper lugs at both ends.												
a	1 x 6 sq. mm	RM							0	0	64.87	72.98	0
b	1 x 10 sq. mm	RM							0	0	83.83	94.31	0
c	1 x 16 sq. mm	RM							0	0	179.64	202.09	0
d	1 x 70 sq. mm	RM							0	0	605.78	681.50	0
e	1 x 150 sq. mm	RM							0	0	1,246.49	1,402.30	0
	Note-1: In case of non availability of any of the sizes mentioned above, next higher size available in market shall be provided at the same rate.												
	Note-2: No additional payment will be made for providing Main Earth Terminals (made out of GI/Cu strips from within the above sizes). The METs will required to be fixed on walls as required and will be required to be provided with 12/16/20mm holes for connections of individual equipments including of other contractors'.												
6.7	Extra for bituminous coating and hessian tape wrap or polyethylene faced hessian complete for buried G.I/Cu strips as per specifications and drawings as required.	RM							0	0	74.85	84.21	0

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
6.8	Extra for GI / Electrolytic Copper test links/ termination With building pier continuity conductor including termination plate, nut& bolts,fixing/welding etc as per specifications and as required.	No.							0	0	252.49	284.05	0
	TOTAL CARRIED TO SUMMARY PROTECTIVE EARTHING ZE.06										**52,610**		**23,96,634**
ZE.07	**LIGHTNING PROTECTION**												
1	Providing and fixing of stainless steel SS-304 air terminations, base plate and clamping of down conductor complete with base plate, concrete coping, fixing accessories and clamping with down conductor etc. complete as required as per specifications.	No.							20	20	1,871	1,871	37,420
2	Supplying and laying of the stainless steel SS-304 strip down conductor size 25 x 3 on surface/wall / parapet/ shaft complete with joints, bimetallic connectors, testing links & other fixing accessories and clamping/ connection with earth terminations as per specifications & drawing as required.	RM							2200	2200	300	337.50	7,42,500
3	Supplying and laying of the stainless steel SS-304 strip Earth terminations with burried conductor size 25 x 3 with bituminous coating and covered with PVC taping complete as per specifications & drawing as required.	RM							1800	1800	225	253.13	4,55,625
4	Earth terminations pit as per IS 3043 with 50 mm dia GI perforated pipe complete with funnel, Wire mesh, Masonary Chamber with Heavy duty cover etc. complete as per specification and drawing as required.	No							20	20	5,000	5,625.00	1,12,500
	TOTAL CARRIED TO SUMMARY LIGHTNING PROTECTION ZE.07										**7,396**		**13,48,045**
ZE.08	**EXTERNAL LIGHTING**												
1	**Poles**												
8.1.1	9m Octagonal pole hot dip galvanised with top bottom dia 70/155 mm , thickess 3 mm , base plate 260 mm X 260 mm X 16 mm , with single arm bracket 1.5 m with required concrete foundation including foundation bolts,nuts and accessories.The rate shall inclusive of 2x40 mm dia G.I pipe for cable looping excluding cables and other electrical accessories	No.							5	5	20,700.35	23,287.89	1,16,439
8.1.2	9m Octagonal polem hot dip galvanised with top bottom dia 70/155 mm , thickess 3 mm , base plate 260 mm X 260 mm X 16 mm , with double arm bracket 1.5 m with required concrete foundation including foundation bolts,nuts and accessories.The rate shall inclusive of 2x40 mm dia G.I pipe for cable looping excluding cables and other electrical accessories	No.							5	5	20,433.25	22,987.41	1,14,937
8.1.3	7m Octagonal polem hot dip galvanised with top bottom dia 70/130 mm , thickess 3 mm , base plate 220 mm X 220 mm X 16 mm , with single arm bracket 1.5 m with required concrete foundation including foundation bolts,nuts and accessories.The rate shall inclusive of 2x40 mm dia G.I pipe for cable looping excluding cables and other electrical accessories	No.							5	5	17,388.02	19,561.52	97,808

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
8.1.4	7m Octagonal polem hot dip galvanised with top bottom dia 70/130 mm , thickess 3 mm , base plate 220 mm X 220 mm X 16 mm , with double arm bracket 1.5 m with required concrete foundation including foundation bolts,nuts and accessories.The rate shall inclusive of 2x40 mm dia G.I pipe for cable looping excluding cables and other electrical accessories	No.							5	5	18,492.79	20,804.39	1,04,022
8.1.5	Ornamental Cast iron Pole with double arm bracket, of total height 3500mm nominal above the foundation top level fabricated with cast iron embellishment, joints, column sections etc re-inforced internally with a pipe inside. The bottom column should have accommodation to mount MCB, Bakelite sheet and connector. The pole shall be painted with polyurethane paint of approved colour finish with supply of Foundation bolt M16*600. Similar to BAJAJ Make : ALEXANDER 3.5 M or equivalent	No.							10	10	59,256	59,256	5,92,560
8.1.6	Supply, installation, testing and commissioning of Decorative Light 40W LED Luminaire which shall be black painted Die cast aluminium pole cap with top mounting arrangement for post top having optical compartment tightness level shall be IP65 The LED color temp shall be 5700 K. Two fittings required on each Edgar Pole. Similar to BAJAJ MAKE:- GLORILILLY 40W LED or equivalent.	No.							20	20	16,322	16,322	3,26,440
8.1.7	Ornamental Cast iron Pole with of height 3500mm nominal above the foundation top level fabricated with cast iron embellishment, joints, column sections etc re-inforced internally with a pipe inside. The pole should be painted with polyurethane paint of antique finish copper colour finish. Similar to BAJAJ MAKE : EDGAR 3.5 M or equivalent	No.							10	10	54,406	54,406	5,44,060
8.1.8	Supply, installation, testing and commissioning of 45W LED suspension type decorative street light fitting, made of spun aluminium housing, polycarbonate diffuser protector with IP 65 protection for optical compartment with high power LEDs and inbuilt driver with efficiency > 0.85 and having surge protection device,, Color temperature 5700K. Similar to BAJAJ MAKE : BORAGE 45W LED or equivalent	No.							10	10	28,776	28,776	2,87,760
8.2	**Luminaries**												
8.2.1	Supply, installation, testing and commissioning of LED Street light fixture - 70 watt with IP66 protected LM6 high pressure aluminium die cast housing capable of delivering a nominal system lumen output of 7200 lumens with a minimum system efficacy of 100 lumen/watt and a CRI greater than 70. The luminaire shall have a life class of 50,000 hours @ L70 and driver efficiency of >85%.(Similar to Philips Cat. No. BRP410 LED CW072 MR FG S1 PSU or equivalent)	No.							20	20	14,082.38	15,842.67	3,16,853
8.2.2	Supply of 75mm dia HDPE pipe confirming to PN-4 boring of road channel area by using open trench method and laying of HDPE pipe properly continuously jointed restoring the surface where pitting is done ,to original position.	RM							200	200	211.57	238.02	47,604
8.2.3	Supply and laying of 6 SWG wire along with the cable	RM							1000	1000	16.97	19.09	19,087
8.2.4	Providing and fixing thermo plastic poly carbonate pole boxes confirming to IP-65 degree of protection, along with 16A MCB and 5 way connector and 2 No. cable gland suitable for 4x25 sq.mm cable.	No.							60	60	6,219.49	6,996.92	4,19,815
8.2.5	wiring for luminaries in existing poles with following sizes of unarmoured cu cables from pole box to each fittings.												
a	3x2.5 sq mm	RM							1000	1000	188.62	212.20	2,12,198

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
8.3	**High Mast**												
	Supply, installation, Testing and Commissioning 20 m high area lighting High Mast of Wipro/Philips/GE/Thorn, suitable for 06 nos. 250W LED luminaires complete with all standard accessaries like winches, latern carriage etc. including the cost of providing supplying and fixing 6 nos of IP65 rated 250W LED flood light luminaires with High efficiency, long life, high power LED- Chip On Board(COB) Technology with luminaire Lumen output> 22900lm, Luminaire efficacy>92lm//W, CCT- 5000K, 50000 burning hours as per L70 Criteria. Housing: Extruded Aluminium, Highly efficient & specially designed glass lens optics, Constant current- Constant voltage isolated mutistage LED driver with operating voltage ranges from 90V-305V AC. Operating power factor>0.95, THD<10%, Driver efficiency > 85%, Complete assembly with LED, Driver and accessories pre wired in driver compartment, best efficient heat dissipation system similar to Wipro Cat num LF07-272-060-50-XX with beam angles 60degrees. System should include Lightning Arrestor and others accessaries like phosper Bronz Gear, double drum, stainless steel wire ropes, suitable MCB wires/cables as required with alongwith the folowing accessaries as required as under : -20 m High Mast suitable for 6 Nos LF07-582-XXX-50-XX with lantern carriage excluding lightening arrestor, panel, cables & other electrical accessories like MCB etc. The supplier shall provide LM80 and LM 79 test reports from NABL accredited LAB before supplying the luminaires.	No.							0	0	4,25,000	4,78,125.00	0
a	Suitable foundation for the Mast considering soil bearing capacity 10 Ton per Sqm, with base pedestal of approve design, incoporating a suitable cable looping box with terminal blocks MCB etc.												
b	S.I.T.C. of Earth station of Pipe earthing as per IEEE 80 -2000, ans IS 3043 -1987, including duplicate earth connection to the mast with 25X3 mm size MS GI flate.												
c	S.I.T.C. of suitable neon Aviation lights as required.												
	TOTAL CARRIED TO SUMMARY EXTERNAL LIGHTING ZE.08										**6,81,493**		**31,99,584**
ZE.09	**UNINTERRUPTED POWER SUPPLY SYSTEM**												
9.1	Supply, Installation, Testing and Commissioning of **true parallel redundant 2x30 kVA, online, UPS** system suitable for providing power supply to emergency lighting at station, suitable for incoming 415 volts, 3 phase +10 % -20%, 50 Hz, supply and single phase output voltage, variation ± 1%, including isolation transformer, rectifier/dual converter, static switch, inverter, filter, Bypass & static transfer switch for automatic switch over without giving any break of power, maintenance bypass switch, Micro processor/ software controlled annunciation,protection(including against input phase reversal), and menu run diagnostic module,associated cabling and connections/ terminations, complete as per specifications and as required.								1				
	Note-1: The price of above item is inclusive of a manual chnageover switch suitable for terminating 2 nos. of 4 core aluminium conductor armoured cables of suitable size on the incoming side of UPS. The manual change over switch may be wall mounted in the UPS room. From manual chnageover switch to UPS, the connection should be through an adequately rated copper cable, and RS 485 port for display of ON/OFF status of UPS on BMS work station through MODBUS protocol is also included in the price.	Set								1	18,76,275	18,76,275	18,76,275
	Note-2: The above price is also inclusive of suitable size copper conductor, armoured cable from UPS outgoing side to UPS Output Panel. Size shall be cross varified by the E & M designer in reference to the allowable voltage drop before installation.												
9.2	Supply, Installation, Testing and Commissioning of valve regulated lead acid-sealed maintenance free suitable for 30-minute-battery backup to the each UPS of item 9.1, Battery shall comply with relevant regulations & Battery racks shall be made of acid resistant material complete as per specifications & as required.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
9.3	Supply, Installation, Testing and Commissioning of **1 x 15 kVA, online, UPS** system suitable for providing power supply to emergency lighting at station & viaduct, Platform edge door and Computerised Control panel load of approved make, suitable for incoming 415 volts, 3 phase +10 % -20%, 50 Hz, supply and single phase output voltage, variation ± 1%, including transformer, rectifier/dual converter, static switch, inverter, filter, Bypass & static transfer switch for automatic switch over without giving any break of power, maintenance bypass switch, Micro processor/ software controlled annunciation,protection(including against input phase reverssal), and menu run diagnostic module,associated cabling and connections/ terminations, complete as per specifications and as required.	Set							1	1	6,11,861	6,11,861	6,11,861
	Note-1: The price of above item is inclusive of a manual chnageover switch suitable for terminating 2 nos. of 4 core aluminium conductor armoured cables of suitable size on the incoming side of UPS. The manual change over switch may be wall mounted in the UPS room. From manual chnageover switch to UPS, the connection should be through an adequately rated copper cable, and RS 485 port for display of ON/OFF status of UPS on BMS work station through MODBUS protocol is also included in the price.												
	Note-2: The above price is also inclusive of suitable size copper conductor, armoured cable from UPS outgoing side to Emergency Lighting Panel (EMLP). Size shall be cross varified by the E & M designer in reference to the allowable voltage drop before installation.												
9.4	Supply, Installation, Testing and Commissioning of valve regulated lead acid-sealed maintenance free suitable for 30-minute-battery backup to the each UPS of item 9.1, Battery shall comply with relevant regulations & Battery racks shall be made of acid resistant material complete as per specifications & as required.												
	TOTAL CARRIED TO SUMMARY UNINTERRUPTED POWER SUPPLY ZE.09										**24,88,136**		**24,88,136**
ZE.10	**DIESEL GENERATOR**												
1	Supply, installation, testing and commissioning a complete system of 500kVA Prime duty type diesel generator sets to meet the load requirements for all essential loads as mentioned in these Specifications/Contract. The DG set emissions shall cofirm to the latest regulation of the Central Pollution Control Board (CPCB). Installation Batteries with Stand, leads, cover and accessories. 990 Ltrs Day Tank fabricated out of 6mm thick sheet steel with secondary containment tank and with fitments and float level switches. Drip Tray for fuel tank ,Drip Tray below engine crank case The entire set shall be housed in soundproof enclosure mounted on suitable Rubber-in-shear type vibration mounts with 6mm static deflection for isolating the building floor. A nominal base concrete pad (if required) shall be provided over which the engine set with its own base frame and vibration mounts shall be mounted. Adopter Box for cable / bus duct termination with extension bus bars. Any other item not specifically mentioned but required for proper performance and safe working of the system. The DG system shall be provided to interface with Station Management System (SMS)/Building Management system(BMS) for remote monitoring and management in Station Control Room and/or OCC room (if available) respectively.								1				
	AMF Panel												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	The AMF Panel should therefore comprise: (i) 800A , 4 Pole ACB with 4-pole contactor as main Incomer from AMF Panel, copper bus bar of adequate rating with one no. 4-pole ACBs as outgoing for Essential Power Panel 800A and Fire Pump Panel 400A, MCCB of adequate rating, duly interlocked. (ii) Battery charger with normal and trickle charging facility and an isolating switch with voltmeter of range 0-50 volts and ammeter of range 0-50 amps (iii) Over load and Earth Fault protection for the generator set.												
	Incoming breaker shall comprise of following:												
a	Excitor field DC voltmeter and ammeter.												
b	Voltage resrained over current protection (50 V / 51 V) type CDV62 or equivalent with CT's - 1 Set	Set								1	38,01,570	38,01,570	38,01,570
c	Engine cranking relay- 1 Set												
d	Microprocessor based engine control automatic failure stand by relay including all accessories												
e	Selector switch for engine control OFF/ON												
f	Five push buttons – start, stop, reset, test and accept												
g	Three indicating lamps "load on set', 'Load on Mains' and " Set fail to start'.												
h	16 Window alarm annunciators panel with hooter, push buttons, aux. Contactors etc as required as per specification.												
i	Temperature scanner (Messi Bus/Procon)												
j	Underpower Relay with Timer - 1 Set												
k	Reverse Power Relay - 1 Set												
l	Phase Sequence Relay - 1 Set												
m	Differential Protection Relay (87 G/N) - 1 Set												
n	Under / Over Frequency Relay - 1 Set												
	DG Exhaust Pipe as per CPCB and local authority norms												
	Selector switch for engine control OFF/ON												
	SCADA / BMS CONNECTIVITY All the breakers should be provided with communication facilities & contractor should provide single point to communicate with BMS/SCADA for all system parameter of the panel. DC source & other accessories including software and hardware as required.												
	TOTAL CARRIED TO SUMMARY DIESEL GERERATOR ZE.10										**38,01,570**		**38,01,570**
ZE.11	**BMS/SCADA for all system parameter of the panel**												
11.1	**The Specifications shall be read in conjuction with Manual of specifications and standards and Technical Specifacations.**								1	1	49,70,250.00	55,91,531.25	55,91,531.25

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Supply, Installation, testing, commissioning, trainging and AMC of Biluding Management System PLC, Remote Processor, Siganl Interface wiring and cabling with field equipment interface and provision of supervisory control and monitoring for M&E SCADA contractor using standard protocol over Ethernet(Station LAN-Provided by Others(S&T Contractor)) as per specification and Tender clauses.												
11.2	**SOFTWARE - RPU Programming and Configuration Software(Rate included in item 11.1)(Complies to SIL-2)**												
	Programme software for RPU logic develolpment and debugging for use with												
	compatible Personal Computer with Licence to carry required engineering												
	and maintenance function with below marked minimum functions:												
	RPU Programming and Configuartion Functionality												
	RPU dignosis and data monitoring function locally.												
	RPU histroic data download function for record and fault segregation process.												
	RPU software interlock and logic development for process or data management												
	Communication and Integration mangement and configuration of I/Os fucntion												
a	The RPU shall be capable of fully stand-alone operation and shall be independent of any central computer for all specified control or communication applications. The software shall include all necessary routines and modules required to implement any control strategy and shall be user programmable. The programming language shall be English and shall use standard controls terminology.												
b	Input and Output point processing shall include:												
	(i) Continuous update of input and output values, conditions and status. All connected points are to be updated at a maximum of 5 second intervals, under worst conditions.												
	(ii) Analog to digital conversion of input values shall be carried out with at least 11 bit resolution with typically 40 dB series mode rejection @50 Hz. It shall be possible to calibrate the inputs by means of movable jumpers or links to suit the sensor type in use, to achieve a high accuracy reading.												
	(iii) Input reading shall be automatically checked to determine that the reading is within the sensor"s range and within the range of the input circuit, i.e. 0-10V or 4-20mA. Should this not be the case then an alarm status shall be indicated.												
	(iv) All sensor readings shall be in engineering or user-definable units. These units shall be calculated by the sensor scaling type assigned to each sensor.												
	(v) Each sensor shall have, in addition to the checks specified above, operator adjustable High and Low alarm limits. If the sensor reading is outside these limits then an alarm shall be generated. It shall be possible to delay these alarms by a user-defined amount so that spurious alarms are not reported.												
	(vi) All inputs shall be filtered to reject mains frequency interference. The mains frequency of 50 Hz shall be selectable in software.												
c	Each RPU is to be configured to run the control strategies called for in the sequence												
	of operation sections of this specification. Each RPU shall have the required software												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	modules available for arithmetic calculations, logical decisions and relational operators												
	necessary for the implementation of these control sequences.												
	(i) RPU data such as set points, sensor values, loop parameters etc., shall be available to												
	the operator for display and modification at the main supervisor, the portable												
	supervisor or the display panel.												
	(ii) The reschedule time of control loops shall be adjustable, in 5 second intervals.												
d	Each RPU shall provide five independent time zones, each of which shall have three												
	separate start and stop periods within each 24 hours.												
	(i) Unique time program shall be provided for each day of the week, plus a unique												
	holiday schedule. Each RPU time zone may be provided with unique time programs,												
	or they may be grouped and assigned a common time program as configured by												
	the operator.												
	(ii) For each time program, the main supervisor shall have a calendar available which												
	may be used to make simple modifications up to a year in advance. The calendar												
	shall allow these modifications to be permanent or to execute only once and then												
	return to the previous (permanent) schedule.												
	(iii) Calendar days which are intended to operate as Holidays shall also be definable												
	up to a year in advance.												
e	All control strategies shall be held in RAM, battery backed up for at least 2 years. All												
	data shall be available for review and modification from the main or portable supervisors.												
11.4	**Remote Processor Unit (RPU), It's Sub-components and Mounting Panel**												
	Remote Processor Unit (RPU) Modules should have (Digital Input, Digital Output,												
	Analog Input and Analog Output Modules integrated to CPU module along with												
	other required interface or system module for integration of field signals;												
	should capable of standalone monitoring and control function irrespective to												
	server communication interface; should fully equiped with Power Supply module,												
	device protection and intrface terminals and wiring and other devices as required to												
	meet tender specification & functional requirment.												
	The contractor shall cross reference the RPU Panel and others to Housing Type as required.												
	A by-pass switch/s shall be provided to completely by-pass the RPU in the event of a total												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	failure of the Processor and associates equipment to enable the normal operation of												
	the equipment controlled by the RPU. Panels shall be fitted with a suitable pocket to contain												
	circuit diagrams and other relevant Definitive Design Drawings. An "as installed" set shall be												
	having. All wiring and equipment tagging as per most acceptable inernational standards and												
	metro practice.												
	CPU with onboard RS485port for profibus/mpi/Modbus communication.												
	Data and program backup without external battery. CPU shall have scan time of												
	not less than 0.1ms per 1k bit instruction and 5ms per 1k floating point instructions.												
	Micro-Memory Card												
	Power Supply Module with AC/DC converter as required.												
	Al Module of 8 Channel as per Signal list with necessary spare and redundant I/O consideration.												
	DI Module of 16 / 32 /64 Channel as per Signal list with necessary spare and redundant I/O consideration.												
	DO Module of 8 / 16 / 32 Channel as per Signal list with necessary spare and redundant I/O consideration.												
	AO Module of 8 Channel as per Signal list with necessary spare I/O consideration. (Minimum 1 Modules per panel)												
	Front Connector for Programming/console port (Serial RS232 / Ethernet) with portable computer communication BUS.												
	BMS Workstation / Server system interface provison in PLC communication Port (Ethernet TCP/IP Rj45 connector)												
	Field equipment serial RS485/Rs232 Port interface port (3 nos or as required to meet the functional and integration requirment												
	Active Bus Module for IO Modules (As applicable for DI module up to field cable interface TBs)												
	Active Bus Module for DO Modules (As applicable for DO module up to Relay control Board/ field cable interface TBs)												
	Active Bus Module for AI/AO Modules (As applicable for AI/AO module up to field cable interface TBs)												
	Mounting Rail and other cable containment for RPU panel different component mounting and Cable wiring.												
	RPU Required frameware, protocol and data point licence as required to meet the interface and programming requirement in ref to tender specification with provision of spare (i.e. spare of 50% of Total IO Point as future expansion requirement without any upgradation)												
	Bus cable for different module integration. Or as required for intermodule communication.												
	Interface Module and/ or integrator module with or without gateway for ethernet interface provision of M&E SCADA system.												
	Ethernet Module TCP/IP 10/100 MBPS												
	MODBUS/PROFIBUS/BACNET card as required												
	Terminal block 8 slots (as required for field cable interface and termnination)												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	16 channels Relay Board PCB Mounted type, plug in relays. (As per DO module)												
	Allowance for 30% Spare I/O Points Modules and expansion by 50% shall be possible by adding more I/O modules and software reconfiguration												
	Assorted connectors, pre-formed connecting cables, special terminal blocks, bus cables, taps, tap links, networking accessories consisting of patch Panels, Cat 5 patch cords etc.												
	Note:												
	All devices as required to meet tender specification & Operational requirment shall be provided for fully functioning of BMS system.												
	The RIO shall be designed in accordance with the IO signals given as per the IO												
	Summary Provided for stations.												
	All RPU Controller input modules served equipment from outside are												
	protected against voltage transients. All input/output modules are												
	galvanically separated from CPU & internal bus. It is protected against												
	short circuit and it is connected via separate terminal strip. PLCs shall												
	be designed by taking 20% of spares in I/O's signals with Mounting												
	cabinet.												
11.5	**Marshalling Cabinets**												
	Terminal blocks shall be designed and tested in complying with IEC 60947-7-1.												
	Terminal block shall have ability to receive unprepared conductors.												
	Terminal block shall be single terminal type. Each terminal shall be exchangeable												
	without dismounting adjacent terminals and also suitable for designative labeling.												
	Terminal blocks shall be of the rail-mounted type and shall be of screwless type												
	terminals 600V a.c. moulded block type with molded insulating barrier between terminals.												
	Terminal connections shall be such that the conductors shall be connected with the												
	necessary maintained contact pressure. Terminals shall be so constructed that the												
	conductors can be clamped between suitable surface without any significant damage												
	either to conductors or terminals.	umpsur											

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Terminal blocks shall have test probe facilities for connections of test leads and an												
	integral disconnecting device to facilitate testing.												
	The rated cross-section of a terminal block shall be 0.5-2.5 mm2 of round copper												
	conductor. No terminal can carry more two conductors simultaneously connectable on												
	each incoming/outgoing side.												
	The spare terminating block in all MS shall be provided with capacity at least 20% of the												
	number of I/O points.												
	The Marshalling Cabinet shall be of 1.6 mm thick galvanized sheet steel with gray												
	colour epoxy and electrostatic powered coated. The protection class shall be IP 31.												
11.6	**ETHERNET SWITCHES**												
	Providing, Installing, Testing & Commissioning of industrial Ethernet Switches having the												
	following specifications to meet the functional and system requrment in a redundant												
	system architechure												
	1. Ethernet 10/100MBPS Switch												
	2. Network Protocol - IEEE 802												
	3. Data Protocol - Modbus over TCP/IP												
	4. Full or half duplex operation with flow control supported on all the ports												
	5. Reverse polarity protection												
	6. Industrial surge and Spike protection												
	7. IP 30 protection												
	8. Operating temperature 0 to 60 deg C												
	9. Storage temperature -40 to +85 deg C												
	10. Relative Humidity 10 to 95 % non condensing												
	11. UL listed equipment												
	12. 24AWG Cat 6 RJ 45 port and 6 fiber optic port												
11.7	**Integrators/ Modems/ Gateways/Protocol Converters**												
	Supply, installation, testing and commissioning of Integrators/ Modems/ Gateways/												
	Protocol Converters for Integration of standalone Systems with BMS (All software,												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	hardware required for integration with the specific standalone system with BMS shall be												
	supplied by respective contractor). The following Equipments with necessary												
	Data Points as mentioned below shall be considered for integration with individual PLC.												
	Uninterrupted Power Supply												
	Digital Power Meter .												
	DG Set												
	Lifts												
	Escalators												
	Water Meter												
	Fire Alarm Panel												
	HV Panels												
	Fire Fighting systems and Panel flooding system												
	All the Panel boards incoming and out going breakaers												
	PHE systems												
	Systems not listed above but that requires BMS/SCADA to be considered.												
11.8	**Field Devices**												
	Pressure transmitters												
	Pressure transmitters shall have a linear output of 0-10V. Pressure transmitters shall be a												
	span of not greater than twice the s tatic pressure at maximum flow or differential												
	pressure at shutoff as applicable.												
	Water-Flow Meter												
	Water-flow measuring devices consisting of annular averaging pilot tube flow elements												
	having the following minimum Specifications. Select the Annular for the operating flow												
	range, pipe size and fluid temperature.												
	(i) Accuracy - 2%												
	(ii) Repeatability - 1.2%												
	(iii) Pressure Drop - 1.5 kPa maximum												
	(iv) Operating Temperature Range - 4^{o}C to 95^{o}C [140^{o}F to 203^{o}F]												
	(v) Operating Pressure Rating - 174 kPa [250 psig]												
	Level Switch												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Wind Transmitter												
	Wind Speed & Direction Sensors												
	Temperature Sensors												
	Temprature and Humidity Sensors												
11.9	**Control Cable**												
	Supply and laying Control Cables with following specification including 25mm dia rigid												
	GI conduits as applicable for running cable from Cable try / Raceways to equipment panel or												
	required to be laid at open.												
	All control cable shall be suitable for installation in wet and dry locations. The conductor												
	shall be of soft or annealed strand uncoated copper wire.												
	The insulation shall be FRLS, PVC, insulated cables suitable for use on a copper												
	conductor with a maximum operating temperature not less than 70°C.												
	Fillers shall be used in the interstice of the multi-conductor cable where necessary to give												
	the complete cable a substantially circular cross section. Fillers shall be Polyvinyl												
	chloride (PVC) rod or Polyethylene (PE) materials.												
	The cable shall be helically wrapped over the filler and copper shielding with												
	non-hygroscopic Mylar or Polyester tape.												
	The shielding, for control cables, shall be annealed copper tape or suitable width and												
	shall be helically applied with a minimum 10% lap. The annealed copper tape shall be a												
	least 0.1mm thickness and substantially free from burrs.												
	For Analogue Signals and Data Communication												
	2 Twisted Pair 0.5 Sq mm copper Cable with Aluminium Schelding.												
	For Digital Signals												
	12 Core X 1.0 Sq. mm Copper, screened cable												
	05 Core X 1.0 Sq. mm Copper, screened cable												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
11.10	**CAT5e CABLE - Data Cable**												
	Supply, Installation, testing and commissioning of CAT 5e cable with												
	25mm GI conduit & complying to Class 1E type Communication with												
	MODBUS, BACnet, Lontalk, ARCNET on RS 232/485 port to match the control system												
	requirement, thick 20mm dia Conduit shall be supported at regular intervals not												
	exceeding 2.5 m. on horizontal runs and 1.5 m. on vertical runs. as required at site.												
	etc. (For RPU panel internal Data commuication, Station LAN interface, etc..)												
	OPTICAL FIBRE CABLE - Communication Cable												
	Supply, Installation, testing and commissioning of 6 core single mode												
	OFC with all accessories necessary such as listed below:												
	i) 12Port fiber Patch cord Loaded with adapter Plates & Splice tray												
	ii) 24Port fiber Patch cord Loaded with adapter Plates & Splice tray												
	iii) SC-LC, Duplex OFC patch cord, 3mtrs, OM3												
	iv) SC-Style Pigtail, 50/125, Multimode, OM3, 1.5 meter												
	v) Line interface unit for Fo cable termination, supply, installation and connection												
	as required to meet functional requirment.												
	Note: The items indicated above are probable and main items.												
	vendor to include all allied and implied items and required quantity												
	for station building management system as indicated in various areas of												
	BOQ.												
	Qunatity shall be as per detail design requirement or as to meet system operational and functional requirement as required by the client/cunsultant .												
	Make: Honeywell / Equivalent												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	SUB TOTAL BMS/SCADA for all system parameter of the panel ZE.11												**55,91,531.25**
ZE.12	**Safety and Other accessories**												
12.1	Supply and fixing of the following safety equipments in Aux. Sub.Station/MDB room as per detailed descriptions given below and as per relevant IE rules & code of standard practice.												
a)	**1000 mm** wide 15 mm thick rubber matting (complying with I.S.S.) and suitable to withstand 11 kV in front of all panels in ASS building & MDB room as required of `Syntax' make.												
b)	**Laminated** standard shock treatment charts in English & Hindi in ASS, ESR, DG room and Pump room in each station.												
c)	**Danger** plate as per approved Style & sample written in English & Hindi for MV installations as required as per IE rules, IES and IS 2551 (latest) - 8 nos. per station	Lumpsum							1	1	55,225.00	62,128.13	**62,128**
d)	**2 nos.** per station First Aid Box Complete as approved by St. John ambulance or Indian Red Cross												
e)	**4 nos. per** station of 3-fire-buckets set each painted red with 'fire' written complete with sand filling, floor/wall mounting brackets/stand complete as per elevant IS and as required.												
	One Tool kit per station comprising 1 set of flat spanner (Taparia / Jalan), 1 set of box spanner, 1 no. Hacksaw frame with 10 No. blades, 1 no. large, medium, small screw drivers, 1 no. insulated plier, 1 no nose plier, 1 no. hand crimping tool upto 16 sq.mm, 1 no. digital multimeter, 1 no. test lamp and 1 no. tester. Screw driver set for all types of screw heads also to be provided												
	TOTAL CARRIED TO SUMMARY ZE.12												**62,128**
ZE.13	**Mandatary Operational Spares for the Panels And safety items**								1	1	3,31,350.00	3,72,768.75	3,72,769
	R,Y,B Phase Indication lamp Led Type												
	Red / Green On, Off Indication lamp Led Type ,On,Off,trip Indication lamp Led Type												
	Amber trip Indication lamp Led Type												
	3Phase Digital Amp/Volt. Meter 96mm*96mm with inbuilt Selector Switch												
	Electronic Multifunction Meter 3Phase Class1.0 EM6400												
	CTs 1000/5A Cl 1.0 15VA, cast resin for measurement												
	CTs 1000/5A Cl 5P10 15VA, cast resin for protection												
	CTs 100/5A Cl 1.0 5VA, tapewound												
	230V AC or 24V DC shunt trip coil												
	230V AC motor wound spring close mechanism												
	Control MCB 6A SP 10kA MCB, 'C' Curve	Lumpsum											
	CTTB+Neutral Link												
	Power terminals ,Control Terminal Block,Neutral Link,Spreader Terminals												
	Shunt release,UV release												
	RS-485 port for display of ON/OFF status of ACB on BMS workstation through MODBUS protocol												
	Exhaust Fan 8" with Filter and Switch												
	Rotary Operating Handle												
	Control MCB 6A SP 10kA MCB, 'C' Curve,												
	Power Contactor 3Pole 9A 220V AC-3 Duty,Auxiliary Contact Block 2No+2NC												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	On, Off Push Button,Auto Manual Selector Switch												
	Single phase Preventor												
	Over current Relay												
	And not limited to the above and any other items necessay shall also be considered.												
	TOTAL CARRIED TO SUMMARY ZE.13										**3,31,350**		**3,72,769**
ZG.01	**FACADE LIGHTING**												
1	Supply, installation, testing & commissioning of light fittings including all accessories e.g. ballast, HPF condensors, lamps, holders, surface/recess mounting arrangement etc. including necessary supports, accessories and hardware as per specifications & as required at site and as below:												
1.1	Surface mounted RGB direct view aluminum profile 25mm (approx) with snap in notch , to be installed together with aluminium bracket profiles for cable conduit, screws hidden. With opal semi translucent sealed encapsulation. 18w per meter with direct view led profile. .IP67. Approved Makes - Bharat Alurays-Connect/Instapower/Tulip	RM							550	550	28,619	28,619	157,40,450
1.2	LPV-100/24V Qty to be confirm as per site requirement.	No							115	115	26,131	26,131	30,05,065
1.3	Surface mounted linear grazer with adjustable mounting base 45mm with snap in notch , to be installed together with aluminium bracket profiles for cable conduit, screws hidden. With opal semi translucent sealed encapsulation. 18w per meter with direct view led profile. 48w/m .IP67. Approved Makes - Bharat Alurays-Connect/Instapower/Tulip	RM							150	150	49,773	49,773	74,65,950
1.4	LPV-100/24V Qty to be confirm as per site requirement.	No							35	35	26,131	26,131	9,14,585
1.5	LED high-performance floodlight with very narrow beam light distribution.Floodlight made of aluminium alloy, aluminium and stainless steel. Clear safety glass. Silicone gasket. Reflector surface made of pure aluminium. with integral silicone lens and louvre. Swivel range -10°/+170°. Mounting bracket made of steel. 300w, 3000k, 10°,IP67. Approved Make - Bega 84540, Acuity, Simes, instapower	No							2	2	2,78,112	2,78,112	5,56,224
1.6	Exterior projector for permanent outdoor installations to integrate textures, patterns and graphics for limitless creative exterior lighting designs. Flat field, high contrast image projection based on high power LED engine. 0-100% electronic dimming. Full CMY color mixing + additional color wheel with 7 interchangeable colors. 7 gobo slots for projecting graphic images (gobos included). Animation system for creating animated lighting effects (horizontal and vertical). Zoom range from 10° - 43° for exact projection on desired surfaceVariable frost for creating morphing effects and hybrid function as wash light. rotating prisms for creating abstract multi patterns. Intuitive setup, configuration and stand-alone programming via graphical OLED display. RDM and DMX control. Housing: Cast aluminum Finish: Hard anodized, white or metallic grey lacquered Front glass: 5 mm (0.2 in.) anti-reflection coated tempered glass Ingress protection: IP66. Approved Makes - Martin exterior projection 1000, Selecon/ Showline	No							1	1	9,33,240	9,33,240	9,33,240

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
1.7	Surface floodlight with mounting box. Flat beam light distribution. LED 65 W, 8200 lm, half beam angle 28/92°, colour temperature 3000 K. Colour rendering index (Ra) > 90. With replaceable LED module with overheating protection and an expected service life of at least 50,000 operating hours. 2 years warranty of availability of LED module and wear parts. With LED power supply unit, 220-240 V, 0/50-60 Hz. Protection class IP 65. Luminaire made of cast aluminium, aluminium and stainless steel, colour silver. Safety glass with optical texture. Reflector made of pure anodised aluminium. Two cable entries for through-wiring power connecting cable up to 10.5 mm in diameter, max. 5 G 1.5 qmm. Approved Makes - Bega 77584AK3, Simes, Acuity, instapower	No							30	30	80,881	80,881	24,26,430
1.8	LED pole-top luminaire with symmetrical light distribution. Luminaire made of aluminium alloy, aluminium and stainless steel Synthetic diffuser, clear Silicone gasket. Reflector made of pure anodised aluminium. 35w 3000K. IP65. Approved Makes - Bega 77175, Acuity, Simes, instapower	No							10	10	1,05,767	1,05,767	10,57,670
1.9	3 mtr GI Pole as per requirement	No							10	10	9,177	9,177	91,770
	TOTAL CARRIED TO SUMMARY FACADE LIGHTING ZG.01												**321,91,384**
	TOTAL OF ELECTRICAL ITEMS												**1542,85,891**
ZF.01	**FIRE HYDRANT SYSTEM**												
1	Supply installation and testing of fire pumps, electrically driven generally as specified and shown in equipment schedule complete with:												
i)	all accessories												
ii)	vibration mounts												
iii)	test connection excluding starter panel												
iv)	Civil foundation in R.C.C.1:2:4, 200mm high and 150mm projection allround base plate.												
1.1	Sprinkler / Hydrant Main Fire Pumps												
	Providing and fixing horizontal single stage, single outlet pumping set with bronze impeller, C.I. body and connected by a flexible coupling to a totally enclosed fan cooled induction motor mounted on a common M.S. structural base plate with RCC base and with all pump accessories, including pressure switch, pressure guage (both with cut off ball valves) complete as per specifications. Motor to be suitable for 415V, 3-phase, 50 Hz AC supply (specifications as per fire fighting requirements and on the pattern of local authority approval) as per instruction and specifications.												
a	Capacity : 2850 lpm, Head : 90m, HP : 100 HP	No							3	3	6,39,999	6,39,999	19,19,997
b	Capacity : 900 lpm, Head : 40m, HP : 15 HP (For Water Curtain)	No							1	1	1,75,000	1,75,000	1,75,000

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
1.2	Fire Jockey Pumps												
	Supplying, installing, testing, & commissioning of electric driven automatic pressurisation pump set consisting of the following.												
	a) Vertical mounted multi stage centrifugal Jockey pump.												
	b) Squirrel cage induction motor suitable for 415 V, 50Hz, AC supply of the above pump with synchronous speed of 2900 RPM T.E.F.C type such as confirming to IP:55 and flexible coupling and coupling guard with the pump.												
	c) Common bed plate of fabricated mild steel channel or cast iron type.												
	d) Suitable cement concrete pump foundation of 1:2:4 ratio (1 cement : 2 fine aggregate : 4 coarse aggregate) with MS bolts, washers as required.												
	Capacity : 180 lpm, Head : 90 m, HP : 10 HP	No							2	2	1,70,587	1,91,910.38	3,83,821
2	Supply and installation of pressure gauge panel (manifold) as per the requirement & Comprising:	Set							6	6	17,513	19,702.13	1,18,213
	i) Pressure gauges												
	ii) Pressure switches with snubber ball valve and 2 x 1.5 sq mm copper conductor wiring to motor starter panel												
	iii) Water piping from system upto the gauge panel along with valves etc.												
	iv) Sheet metal enclosure with glass paneling etc. as approved												
3	**Internal hydrants/landing valves**												
3.1	Internal hydrants/landing valves generally as specified and all complete with:								15	15	51,812	51,812	7,77,180
	i) 63mm dia Single headed landing valve IS marked (Stainless steel)												
	ii) First aid hose reel with 25 mm dia, 45 m long thermoplastic hose as per IS 12585 rubber hose, ball valve, piping and 7-8mm nozzle as required												
	iii) 38mm synthetic hoses with 63mm instantaneous SS coupling, IS marked- 15 m x 2 lengths with suitable arrangement of connecting the hose pipe with coupling as required.												
	iv) branch pipe and nozzle IS marked (Stainless steel)												
4	Supply, installation, testing and commissioning of external (yard) hydrants inclusive of :	Nos.							9	9	58,538.50	65,855.81	5,92,702
	i) MS Box cabinet of size 750 x 600 x 250 mm of 2mm thickness with 2 nos x 15M Length of 38mm dia synthetic hose with 1 no branch SS nozzle.												
	ii) 63 mm dia single headed landing valve IS marked.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
5	Providing and fixing Orifice Plate made out of 8 mm thick stainless plate for pipe to reduce pressure upto 3.5 Kg/sqcm complete in all respect.												
a)	80 mm dia	Nos							20	20	1,421	1,421	28,420
b)	150 mm dia	Nos							2	2	1,751	1,751	3,502
6	Providing and fixing in position the industrial type Pressure Gauges with gun metal / brass valves complete as required.	Each							44	44	1,038	1,038	45,672
7	**FIRE DOOR**												
7.1	Providing and fixing 4mm thick glass door of size 2.1m x 9.0m along with anodised aluminium frame with centre opening for fire hose cabinet. Suitably marked on the outside with the letters "FIRE HOSE" including locking arrangement.	Nos.							0	0	11,597	11,597	-
7.2	Hose cabinet as approved or as per site conditions with universal locking arrangement. Glazed with 5.5mm clear glass Powder coated Aluminium shutter door as appropriate with universal locking arrangement with aluminium grill of following sizes and types :												
a	Size 1200 x 1500 in 2 mm thick stainless steel sheet	Set							0	0	27,642	27,642	-
b	Size 1500 x 1850 in 2 mm thick stainless steel sheet	Set							35	35	31,136	31,136	10,89,760
c	Size 2100 x 900 in 2 mm thick stainless steel sheet	Set							0	0	29,073	29,073	-
7.3	Hose cabinet door as approved or as per site conditions with universal locking arrangement. Toughen Glass of following sizes and types :												
a	Size 1200 x 1500 in 2 mm thick stainless steel sheet	Set							0	0	29,880	29,880	-
b	Size 1500 x 1850 in 2 mm thick stainless steel sheet	Set							0	0	34,120	34,120	-
c	Size 2100 x 900 in 2 mm thick stainless steel sheet	Set							0	0	32,057	32,057	-
9	**PIPING FOR FIRE FIGHTING SYSTEM**												
9.1	Supply, fabricating, laying, testing, painting and commissioning external piping (UNDERGROUND / ALONG WALL) generally as specified using heavy class G.I. pipe conforming to IS : 1239 & BS : 1387 with all fittings and complete with one protection layer of 4mm thick wrapping and coating for underground piping.												
	i) All pipes and all heavy grade fittings conforming to IS 1239 together with suitable joints, flanges, gaskets, bolts & nuts, washers, fittings, adapter pieces etc.												
a	150mm nominal bore	Mtr							330	330	2,290.51	2,576.83	8,50,353
b	100mm nominal bore	Mtr							60	60	1,538.62	1,730.95	1,03,857
c	80mm nominal bore	Mtr							20	20	1,114.55	1,253.87	25,077
9.2	Excavation upto hard murramas per general profiles and back filling	Cu.m							410	410	497.03	559.15	2,29,253

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
9.3	Making 1:2:4 cement concrete supports and thrust block generally as required and approved.	Cu.m							3	3	3,625.52	4,078.71	12,236
10	**Butterfly Valve**												
	Supplying, fixing, testing and commissioning of Butterfly Valve with C.I. body, SS Disc, Nitrile Rubber Seal & O-Ring PN16 pressure rating as specified.												
a	300mm nominal bore (Gear Operated)	Nos.							1	1	27,500.00	27,500.00	27,500
b	250mm nominal bore (Gear Operated)	Nos.							3	3	21,513.00	21,513.00	64,539
c	200mm nominal bore	Nos.							3	3	15,489.00	15,489.00	46,467
d	150mm nominal bore	Nos.							28	28	14,164.80	15,935.40	4,46,191
e	100mm nominal bore	Nos.							8	8	8,721.27	9,811.43	78,491
f	80mm nominal bore	Nos.							48	48	7,098.48	7,985.79	3,83,318
g	65mm nominal bore	Nos.							0	0	4,738.00	4,738.00	-
h	50mm nominal bore	Nos.							3	3	3,226.00	3,226.00	9,678
10	**Non Return Valve**												
	Supplying, fixing, testing and commissioning of Non-Return Valve with dual plate of C.I. body, SS Plates vulcanized NBR seal flanged end & PN16 pressure rating including insulation as specified.												
a	250mm nominal bore	Nos.							1	1	26,200	26,200	26,200
b	200mm nominal bore	Nos.							0	0	25,500	25,500	-
c	150mm nominal bore	Nos.							6	6	27,857.84	31,340.07	1,88,040
d	100mm nominal bore	Nos.							1	1	6,008	6,008	6,008
e	80mm nominal bore	Nos.							2	2	9,084.10	10,219.61	20,439
f	65mm nominal bore	Nos.							0	0	2,700	2,700	-
g	50mm nominal bore	Nos.							2	2	2,400	2,400	4,800
11	**Y-strainer**												
	Providing, fixing, testing & commissioning of cast Iron double flanged type `Y' strainer with SS 304 perforated metal removable basket including all fittings complete as required and suitable for system pressure.												
a	250mm nominal bore	Nos.							0	0	38,200	38,200	-
b	200mm nominal bore	Nos.							3	3	37,787	37,787	1,13,361
c	150/100 mm nominal bore	Nos.							4	4	22,615	22,615	90,460
d	80mm nominal bore	Nos.							2	2	4,500	4,500	9,000
12	**Foot Valve**												
	Supply and installation of Foot Valves with mating flanges generally as specified all complete.												
a	200mm nominal bore	Nos.							0	0	33,129.89	37,271.13	-

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
b	100mm nominal bore	Nos.							2	2	8,449.15	9,505.29	19,011
13	**Rubber Bellow**												
	Supply, fixing, testing & commissioning of resilient rubber lined single arch vibration eliminators suitable for raw water up to 45 oC temperature, working pressure 15 Kg/cm2 and test pressure 20 Kg/cm2 for :-												
a	200mm nominal bore	Nos.							3	3	9,117	9,117	27,351
b	150mm nominal bore	Nos.							4	4	6,768	6,768	27,072
c	100mm nominal bore	Nos.							1	1	5,333	5,333	5,333
d	80mm nominal bore	Nos.							4	4	4,474	4,474	17,896
e	65mm nominal bore	Nos.							0	0	4,300	4,300	-
f	50mm nominal bore	Nos.							0	0	3,800	3,800	-
14	**Internal Piping**												
14.1	Supply, fabrication, laying, testing and commissioning of heavy grade IS marked G.I. piping conforming to IS: 1239 & BS : 1387 complete with fittings, pipe supports, clamps, painting of two coats of red enamel etc.including support arrangements.												
a	300mm nominal bore (6 mm wall thickness)	Mtr.							15	15	4,000	4,000	60,000
b	250mm nominal bore (6 mm wall thickness)	Mtr.							24	24	3,200	3,200	76,800
c	200mm nominal bore (6 mm wall thickness)	Mtr.							6	6	3,173	3,569	21,416
d	150mm nominal bore	Mtr.							1270	1270	2,181	2,454	31,16,500
e	100mm nominal bore	Mtr.							210	210	1,466	1,649	3,46,291
f	80mm nominal bore	Mtr.							700	700	1,062	1,195	8,36,481
g	65mm nominal bore	Mtr.							600	600	814	916	5,49,461
h	50mm nominal bore	Mtr.							410	410	706	794	3,25,743
i	40mm nominal bore	Mtr.							800	800	499	561	4,48,764
j	32mm nominal bore	Mtr.							625	625	454	511	3,19,222
k	25mm nominal bore	Mtr.							5700	5700	339	381	21,71,173
15	**Air Vessel**												
	Supply, fabrication (as per code), installation, testing and commissioning of Air vessels 300mm diameter and 1000mm high with ball valve inlet/outlet valve drain, air release valve, valve air inlet etc. all complete with including inside painting with epoxy and outside with enamel.	Nos.							2	2	68,520.42	77,085.47	1,54,171
16	**Pressure Vessel**												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Supply, fabrication (as per code), installation, testing and commissioning of Pressure vessels 450mm diameter and 1000mm high fabricated with 8-10mm M.S. plate with ball valve inlet/outlet valve drain, air release valve, valve air inlet etc. all complete with including inside painting with epoxy and outside with enamel.	Nos.							2	2	76,286.43	85,822.24	1,71,644
17	**Fire Brigade Connection (2-way)**												
	Supply, installation, testing and commissioning fire brigade connection with 2 way 63mm valves inlets, stand post and 150mm MS pipe for mounting the stand post etc. as specified all complete as approved. The fire brigade connection shall be provided in a suitable MS box having mesh doors with universal locking arrangement. Note: The drawings of the proposed arrangement shall be provided by the contractor for approval of engineer incharge.	Nos.							1	1	26,528.71	29,844.80	29,845
18	**Fire Brigade Connection (4-way)**												
	Supply, installation, testing and commissioning Siamese connection with 4 way 63mm outlets with non-return valves and sluice valve etc. complete as required and approved including MS cabinets with universal locking arrangement, MS welded mesh inside at road level cabinets. Note: The drawings of the proposed arrangement shall be provided by the contractor for approval of engineer incharge.	Nos.							2	2	61,969.35	69,715.52	1,39,431
19	100 mm dia stainless steel Draw Out connection with foot valve for Fire Brigade.	Set							6	6	6,839	6,839	41,034
20	Air Release Valve												
	Supply, installation, testing and commissioning of 25mm dia Air Release valve with Ball valve to be fixed on top of risers.	Nos.							8	8	6,903	7,624.50	8,577.56
21	Providing & Fixing of Installation control valve with turbine type automatic Alarm Gong to be connected with control valve, drain & test valve as per manufacturer's specifications complete as required												
	a) 150 mm dia	Set							2	2	40,151	40,151	80,302
22	Providing, Fixing, Testing & Commissioning 15 mm dia Quartzite bulb type GEM. Sprinkler head suitable to operate at 68 deg.C (UL/FM/LOC listed/ approved).												
a)	Standard Pendent / Upright type in brass / Chrome finish.	No.							2145	2145	179	179	3,84,000
b)	Side wall Sprinkler 68^{0}C in brass / chorme finish	No.							90	90	550	550	49,500
23	Supply, fixing, testing & commissioning of Braided FM & VDS approved Annular Corrugation Stainless Steel **flexible sprinkler pipe drop** pressure rated upto 200 psi. The drop shall consist of a BRAIDED type 304 stainless steel flexible tube, zinc plated steel Male threaded nipple for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head and with a numbering on the reducer to ease the process for vertical positioning of the sprinklers with Bracket arrangement as per the Ceiling Profile. The bracket assembly shall be one piece open gate bracket complete in all respect.												
a)	1000mm	No.							100	100	895	895	89,510
b)	1200mm	No.							15	15	1,800	1,800	27,000

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
c)	1500mm	No.							100	100	2,200	2,200	2,20,000
24	Supply, fixing, testing & commissioning of 25 mm dia **inspecting and testing assembly** with gun metal valve, sight glass, with 50 mm dia by pass valve and connection to the drain line as required to complete the system.	Set							12	12	8,000	8,000	96,000
25	Supply, fixing, testing & commissioning of 25 mm dia **drain ball valve** (gun metal) at end of sprinkler branch line with connection to the nearest drain with all fittings, pipe and acessoreis complete in all respect.	Set							12	12	2,500	2,500	30,000
26	Providing and fixing UL listed Flow Switch of 65/ 80 / 100 / 150 mm dia on Sprinkler Header complete with flexible full bore paddle, U clamp and NO / NC contact terminals								12	12	5,815	5,815	69,780
27	Supply, fixing, testing & commissioning of UL / FM listed / approved 15 mm NB **water curtain nozzle** chrome plated complete including fixing in position on pipe complete in all respects with Teflon tape.	No.							32	32	2,100	2,100	67,200
28	Providing and Fixing of UL/FM Approved **Deluge Valve** with Grooved Ends low differential, latched clapper design, black enamel coated ductile iron body conforming to ASTM A-536, grade 65-45-12, aluminum bronze clapper, stainless steel spring and shaft, peroxide cured EPDM diaphragm, EPDM seal, brass seat, and Nitrile seat O-rings. & S.S Shaft complete with Electrical release trim, Hydraulic Release trim, Pressure Switch, Solenoid valve actuator and Control Panel, control wiring including necessary accessories, complete with tap off socket arrangement as required, with potential free contact with 2 Nos. NO/NC & ON/OFF arrangement and all other associated works of complete as required. Note: Cable for Integration of deluge valve / Drencher system with Fire Alarm System shall be included.												
a)	50 mm diameter	No.							2	2	40,000	40,000	80,000
b)	80 mm diameter	No.							0	0	60,000	60,000	-
	PORTABLE FIRE EXTINGUISHERS (As per IS 15683)												
29	Supply and installation of portable fire extinguishers as described below:												
29.1	9 liter capacity of water CO2 type, IS marked, with discharge tube including clamps etc.	Nos.							35	35	5,563.23	6,258.63	2,19,052
29.2	4.5 kg capacity Carbon dioxide extinguisher conforming to IS with high pressure discharge tube, horn, control valve, IS marked including clamps etc.	Nos.							35	35	9,446.24	10,627.02	3,71,946
29.3	Mechanical form type 9.0 liter capacity fire extinguisher (for DG room)	Nos.							2	2	7,427.07	8,355.46	16,711
29.4	5 kg capacity of DCP (Dry chemical powder) fire extinguisher	Nos.							4	4	5,563.23	6,258.63	25,035
29.5	Mechanical foam type 50.0 liter capacity fire extinguisher trolley mounted complete set (for Plant Room)	Nos.							2	2	11,287	12,697.88	25,396
	MISCELLANEOUS ITEMS												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
30	Constructing brick masonry manhole in cement mortar 1:4 (1 cement : 4 coarse sand) with R.C.C. top slab with 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), foundation concrete 1:4:8 mix (1 cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with floating coat of neat cement and making channels in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) finished with a floating coat of neat cement, including orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS:10910 on 12 mm dia steel bar conforming to IS 1786 having minimum cross section as 23 mm x 25 mm and overall minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs complete as per standard design :												
a)	Inside size 120x80 cm and 120 cm deep including C.I. cover with frame (medium duty) 455x610 mm internal dimensions.												
	With bricks conforming to IS : 4885	Each							3	3	12,500	12,500	37,500
31	**PANEL FLOODING - CO2 GAS BASED FIRE TRACE TUBE SYSTEM**												
	Supply, fixing, testing and commissioning of Polymer Tube Detection based CO2 System for Electrical Panels including AMF and Communication Panels,The exact quantity of the Panels shall be finalized during detail design stage. (Firetrace Tube Panel Protection System), consisting of the following components:	LS							1	1	13,25,400.00	14,91,075.00	14,91,075
(a1)	CO2 Cylinder, 8 kg capacity, complete with all necessary CO2 Gas, fittings, support and accessories, connected with Valve (with manual release facility).												
(a2)	CO2 Cylinder, 4.5 kg capacity, complete with all necessary CO2 Gas, fittings, support and accessories, connected with Valve (with manual release facility).												
(b)	Filling Adapter												
(c)	Outlet adapter												
(d)	End of Line adapter												
(e)	Pressure switch												
(f)	Flexible Polymer Detection Tube with all necessary fittings & supports.												
(g)	Master Control Unit for controlling each system, complete with pressure switches, buzzers and electronic hooters, including all necessary accessories + electrical wiring to make each entire system functional.												
(h)	Auto weight measuring Unit for Cylinders with automatic audio/visual alarm.												
	Total of Fire Hydrant System ZF.01										**35,09,222**		**201,62,758**
ZF.02	**FIRE ALARM SYSTEM**												
	The Fire Alarm and Detection System specified herein, must conform to M & E Specifications, in addtion to the description given in respective items of BOQ, whether explicitly specified or not. In case of contradiction between M & E specification and description in BOQ, the most stringent of the condition will prevail.												
	All the items / parts mentioned in relevant clauses of the M & E specifications and not specifically mentioned in BOQ shall be deemed to be included in the quoted rates, unless specifically excluded.												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	All the items not specifically mentioned here but necessary to make the system complete and suitable for desired application as per M & E Specifications and Drawings will be deemed to be included in the quoted prices												
1	Supply, installation, testing and commissioning of the Microprocessor based intelligent analogue addressable, modular, expandable networkable, 10 loop (each loop shall consist of minimum 125 detector & 125 devices and 10% spare loop capacity) fire alarm control panel. The panel shall have a built-in integrated voice command center with suitable rating amplifiers for minimum 25 speaker zones. The panel shall support programmable relay for controlling fans/AC equipment and monitoring of fire sprinkler etc controlled by powerful Boolean logic equation. The panel shall have minimum five independent hazard release circuit built-in the panel. The panel shall have 240 volts AC power supply, automatic battery charger, 24 volts, sealed lead acid maintenance free batteries sufficient for 24 hours normal working and then be capable of operating the system for 4 hours during emergency condition. The panel shall be UL/EN listed.	No.							1	1	18,76,000	18,76,000	18,76,000
a	10 Loop Panel												
b	Repeater Driver Board												
c	Communication Board												
d	Software & Graphics												
e	PC with 21" TFT + **80** column Printer.												
f	Nicl. Batteries & Battery Charger.												
g	Amplifier card												
h	Terminal strips for receiving and terminations all external cabling												
i	Provision for interfacing with other systems such as SCADA / BMS with all required Hardware & Software.												
	Note: Provision for additional loops for Future floors shall be included												
2	Supply, Installation, Testing and Commissioning of Repeater Annunciator Panel with Mimic panel as per Specifications and Drawings.	No.							1	1	98,420.89	1,10,723.50	1,10,724
3	Supply, Installation, Testing & Commissioning of following Signal Initiating (Intelligent Analogue Addressable) devices complete with Detector Base etc. etc. complete as specified, required and as approved .												
3.1	Intelligent Addressable Multi Sensor Smoke Detector.	No.							865	865	2,673.99	3,008.24	26,02,131
3.2	Addressable Fault Isolator Base	No.							100	100	1,628.03	1,831.54	1,83,154
3.3	Addressable Fault Isolator	No.							100	100	3,147.83	3,541.30	3,54,130
3.4	Supply installation testing and commissioning of dust and vermin proof addressable analogue Manual Call Boxes to initiate audio visual alarm including the cost of mounting accessories complete as per specifications and as required.	No.							50	50	3,534.40	3,976.20	1,98,810

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.5	Supply, installation, testing and commissioning of Wall/ Ceiling mounting strobes for visual indication including the cost of mounting accessories complete as per specifications and as required.	No.							50	50	2,922.51	3,287.82	1,64,391
3.6	Addressable Loop Sounder 6.8 W.	No.							50	50	2,809.85	3,161.08	1,58,054
3.7	Response Indicator constructed from 16 guage MS stove / ABS plastic enamelled sheet with front 16 guage steel cover plate / ABS plastic complete as required.	No.							265	265	342.40	385.19	1,02,077
3.8	Intelligent Addressable Duct Detector	No.							30	30	7,179.25	8,076.66	2,42,300
3.9	Supply, installation, testing and commissioning of Control Modules including the cost of mounting accessories complete as per specifications and as required.	No.							60	60	3,147.83	3,541.30	2,12,478
3.10	Supply, installation, testing and commissioning of Monitor Modules including the cost of mounting accessories complete as per specifications and as required.	No.							45	45	3,147.83	3,541.30	1,59,359
3.11	Intelligent Addressable water Flow Monitoring Modules	No.							50	50	3,147.83	3,541.30	1,77,065
											-		
3.12	High Temperature (min. 80 C degree trip) Heat detector	No.							25	25	3,147.83	3,541.30	88,533
3.13	Supply, installation, testing and commissioning of wall or ceiling mounted 240V AC illuminated double sided pictorial Exit signs provided with appropriate direction arrow painted in green on white with LED lamp including the cost of in-built rechargable batteries with charger suitable for 90 minute operation and including the cost of mounting accessories for surface/recessed or ceiling suspended complete as per specifications and as required.	No.							0	0	1223	1,223.00	-
4	Supplying, Laying, Termination, Testing & Commisioning of Fire Survival Cables (confirming to BS: 7846 and Section E02, 35 of M & E specifications for perfomance requirements of Fire Survival Cables) armoured, 1 pair 2.5 sq.mm, screened / shielded, Copper conductor (one pair shielded and one pair unshielded) cable or Mineral Insulated cable complying the CWZ category.	RM							2800	2800	78.42	88.22	2,47,021
											-		
5	Supplying, Laying, Termination, Testing & Commisioning of Fire Survival Cables (confirming to BS: 7846 and Section E02, 35 of M & E specifications for perfomance requirements of Fire Survival Cables) armoured, 1 twisted pair 1.5 sq.mm, screened / shielded copper conductor cable or Mineral Insulated cable complying the CWZ category for looping of detection units etc.	No.							4800	4800	71.79	80.77	3,87,680
6	Mandatary Operational Spares for the Panels including with minimum as follows: a. 2 No. for each type of Detector and devices b. 5 No. MCP c. 1 No. controllers in FACP d. 2 No. Power supply e. 5 No. Response indicator f. 2 No. Hooter g. 2 No. Strobe h. All other spares as required	No.							1	1	3,31,350.00	3,72,768.75	3,72,769

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
7	**Fire Rated Material for Cut-outs Closing**												
	Description of Work												
	All the Shaft and services openings in fire rated walls & floors are to be properly fire stopped with 2 hrs fire rated Insulation & integrity with PROMASTOP® Mortar/Cement . The system would involve providing and fixing of PROMASTOP® Cement with required thickness. Penetrations through walls and floors to be sealed with POMASTOP® Mortar as tested to BS: 476 Part 20 & AS 1530 part 4 to maintain the required fire rating of 4 hrs of the building element. Installation shall be done in accordance with the tested specification. The system will have to be supported by a valid Test report of the complete system as per BS 476 part 20 issued by M/s.Promat International Asia Pacific Ltd.	Sqm							200	200	12,499	12,499	24,99,800
	TOTAL CARRIED TO SUMMARY FIRE DETECTION ZF.02										**23,56,473**		**101,36,474**
	TOTAL OF SCHEDULE F												**302,99,232**
	HVAC SYSTEM BOQ for ZERO MILE												
ZA.	**EQUIPMENT & PIPING**												
1.1	Supply, Installation, testing and commissioning of Air Cooled Variable Refrigerant Volume System suitable for R410A and 415 ± 10% , 50 Hz, AC supply. The unit shall consist of indoor units and external condensing units and other accessaries as listed below complete in all respects. The unit shall be fully charged with gas and oil.												
1.1.1	**Outdoor Unit**												
	Supply, installation, testing and commissioning of Modular type outdoor condensing units equipped with highly efficient scrol/hermetic type DC twin rotary compressors with digital/ invertor technology, special acryl precoated heat exchanger, low noise condenser fan with motor, auto check function for errors in display panel, auto address setting, as per specifications and capacities as mentioned below.(The unit shall be fully charged with gas and oil.Price shall include pressure testing).												
	The units shall be complete with necessary mounting frames												
	Capacity shall be as under												
a	26 HP (22TR Nominal Capacity)	Nos							0	0	7,23,668.40	8,14,126.95	-
									0	0			
b	24 HP (20TR Nominal Capacity)	Nos							0	0	6,65,218.26	7,48,370.54	-
									0	0			
c	20 HP (16TR Nominal Capacity)	Nos							0	0	6,17,901.48	6,95,139.17	-
d	18 HP (15TR Nominal Capacity)	Nos							0	0	6,06,768.12	6,82,614.14	-
e	14 HP (11.6 TR Nominal Capacity)	Nos							0	0	4,75,975.00	4,75,975.00	-
f	12 HP (10 TR Nominal Capacity)	Nos							0	0	4,31,812.00	4,31,812.00	-
g	10 HP (8.3 TR Nominal Capacity)	Nos							3	3	3,54,125.00	3,54,125.00	10,62,375.00
h	6 HP (5TR Nominal Capacity)	Nos							3	3	4,07,759.31	4,58,729.22	13,76,187.67

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
1.1.2	**Indoor Units**												
	Supply, installation, tesing and commissioning of ceiling mounted duct type indoor units each complete with coil, pre-filter, etc. The units casing shall be of steel construction, wall mounted split type indoor units and 220 volt, 1 phase, 50 Hz, AC supply all as per specifications.												
	The capacities shall be as follows:												
a	Ceiling mounted duct type 3500 CFM - 6.0 TR Nominal Capacity	Nos							0	0	2,36,862.23	2,66,470.01	-
b	Ceiling mounted duct type 3200 CFM - 5.0 TR Nominal Capacity	Nos							6	6	77,098.52	86,735.84	5,20,415.01
c	Ceiling mounted duct type 2800 CFM - 5.0 TR Nominal Capacity	Nos							0	0	77,098.52	86,735.84	-
d	Ceiling mounted duct type 2500 CFM - 4.0 TR Nominal Capacity	Nos							0	0	71,114.34	80,003.63	-
e	Ceiling mounted duct type 2400 CFM - 4.0 TR Nominal Capacity	Nos							0	0	71,114.34	80,003.63	-
f	Ceiling mounted duct type 2300 CFM - 4.0 TR Nominal Capacity	Nos							0	0	71,114.34	80,003.63	-
g	Ceiling mounted duct type 2000 CFM - 3.0 TR Nominal Capacity	Nos							0	0	76,402.68	85,953.02	-
h	Ceiling mounted duct type 1600 CFM - 3.0 TR Nominal Capacity	Nos							0	0	76,402.68	85,953.02	-
i	Wall mounted split type 2.0 TR Nominal Capacity	Nos							0	0	44,950.94	50,569.81	-
j	Wall mounted split type 1.5 TR Nominal Capacity	Nos							3	3	42,306.77	47,595.12	1,42,785.35
k	Wall mounted split type 1.0 TR Nominal Capacity	Nos							0	0	39,662.60	44,620.43	-
l	Ceiling mounted duct type - 2.5 TR Nominal Capacity	Nos							0	0	49,120	49,120	-
m	Ceiling mounted duct type - 2.0 TR Nominal Capacity	Nos							0	0	42,109	42,109	-
n	Ceiling mounted duct type - 1.5 TR Nominal Capacity	Nos							0	0	38,363	38,363	-
o	Ceiling mounted duct type - 1.0 TR Nominal Capacity	Nos							0	0	38,139	38,139	-
1.1.3	Supply, installation, tesing and commissioning of Corded Remote controllers for operation of indoor units.	Nos							14	14	3,757.51	4,227.20	59,180.78
1.1.4	Supply, installation, tesing and commissioning of Central Remote controller for complete system including all VRV indoor and outdoor units.	Nos							1	1	1,18,291.95	1,33,078.44	1,33,078.44
1.1.5	Supply, installation, tesing and commissioning of Imported fittings Y-joints, T-joints, distributer and headers for all Indoor units at both the floors layout as per layout drawings.	Nos							12	12	11,411.69	12,838.15	1,54,057.82

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
1.2	**Refrigerant Piping**												
	Supply,installation,testing and commissioning of Interconnecting refrigerant pipe work with elastomeric nitrile rubber/closed cell expanded polythene tubular insulation between each set of indoor & outdoor units as per specifications, all piping should be laid on Galvanised/Powder Coated tray supported by Galvanised M S Hangers & Clamps.												
a)	41.3 mm O.D. (insulation : 19 mm)	Mtrs							2.778	3	1,461.25	1,643.91	4,566.41
											-		
b)	34.9 mm O.D. (insulation : 19 mm)	Mtrs							3.556	4	932.42	1,048.97	3,729.68
											-		
c)	28.6 mm O.D. (insulation : 19 mm)	Mtrs							52	52	751.50	845.44	43,962.75
											-		
d)	22.2 mm O.D. (insulation : 13 mm)	Mtrs							18.67	19	747.33	840.75	15,693.93
											-		
e)	19.1 mm O.D. (insulation : 13 mm)	Mtrs							21	21	487.08	547.97	11,507.27
											-		
f)	15.9 mm O.D. (insulation : 13 mm)	Mtrs							99.89	100	400.80	450.90	45,039.90
											-		
g)	12.7 mm O.D. (insulation : 13 mm)	Mtrs							29	29	313.13	352.27	10,215.87
											-		
h)	9.5 mm O.D. (insulation : 13 mm)	Mtrs							78.67	79	228.23	256.76	20,198.36
											-		
i)	6.4 mm O.D. (insulation : 13 mm)	Mtrs							37	37	140.56	158.13	5,850.81
1.3	**Control cum transmission wiring**												
a	Supply,installation,testing and commisioning of contl cum transmission wiring of 2 core x 1.5 sqmm FRLSZH copper in suitable GI conduits between indoor and outdoor units.	Mtrs							201.7	202	334.00	375.75	75,776.25
b	Supply,installation,testing and commisioning of contl cum transmission wiring of 2 core x 1.0 sqmm copper in suitable GI conduits between indoor and outdoor units.	Mtrs									164	164	-
1.4	**DX wall mounted Split Unit**												
1.4.1	Providing, fixing, testing and commissioning of Hi wall split unit air conditioing air cooled type with evaporator coil, fan and fan motor ,air cooled condenser with hermatically sealed recipcating compressor, condenser coil and complete with electrical Wiring as required (Voltage stablizers are not to be provided)												
	Note:Providing and fixing of M.S. angle iron frame work for outdoor unit including P.O. painting of the same is also included in the above scope. Contractor to submit design/Scheme for Iron frame and obtain approval of engineer-in-chage before proceeding further.												
a)	Nominal capacity 1.5 TR	Nos							0	0	62,625.15	70,453.29	-
b)	Nominal capacity 2.0 TR	Nos							0	0	62,625.15	70,453.29	-
c)	Nominal capacity 2.5 TR	Nos							0	0	62,625.15	70,453.29	-

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
1.4.2	Providing, fixing and testing of copper refrigerant piping of apppriate sizes duly insulated with nitrile rubber insulation of 9 mm thickness for all types of split AC units. The pipes plus nitrile rubber insulation are to be covered with PVC flexible conduits for protection.	Mtrs							60	60	2,574.59	2,896.41	1,73,784.83
1.5	**Condensate Drain Piping:**												
	Providing, fixing and testing GI drain piping for condensate from indoor unit to nearest suitable drain system as per site conditions as per instructed at site engineer complete with all required fittings and pviding clean out plug at suitable location when required complete with 6mm thick elastomeric nitrile rubber insulation over GI pipe:												
a	40mm Dia.	Mtrs							31.67	32	528.83	594.93	18,839.57
b	32mm Dia.	Mtrs							38.33	38	431.42	485.35	18,604.99
c	25mm Dia.	Mtrs							27.22	27	389.67	438.38	11,933.64
2	Supply, installing, testing and commissioning of **INVERTER AIR COOLED SPLIT AIR CONDITIONING UNITS** as described in specifications. The unit shall be complete with **Hi wall type/ Cassette /Ductable type indoor unit** and external condensing unit, complete in all respects, inclusive of first fill of refrigerant, copper refrigerant piping, GI condensate drain piping, valves and insulation. Quoted price shall include cost of wireless/wired thermostat, adjustable outdoor frame, control & power wiring and earthing. The unit capacities shall be as delieverd by the system after taking deration into account due to copper piping lengths:												
	Note : Copper piping between indoor & outdoor units duly insulated with closed cell tublar nitrile												
a	4 TR Cassette Type split air conditioning units as described above (R410a) (Cooling Only)	No.							4	4	1,89,505	1,89,505.00	7,58,020.00
b	3.0 TR Ductable Type split air conditioning units as described above (R410a/ R407c) - Non Inverter	No.							0	0	76,942	76,942.00	-
c	5.5 TR Ductable Type split air conditioning units as described above (R410a/ R407c) - Non Inverter	No.							2	2	1,16,838	1,16,838.00	2,33,676.00
d	8.5 TR Ductable Type split air conditioning units as described above (R410a/ R407c) - Non Inverter	No.							0	0	1,82,381	1,82,381.00	-
e	11 TR Ductable Type split air conditioning units as described above (R410a/ R407c) - Non Inverter	No.							0	0	2,23,701	2,23,701.00	-
3	Supplying, installing, testing and commissioning of **Smoke extraction Fire Rated Axial fans** as per specifications. Fan shall be with direct driven Tube axial fan. The fan shall be equipped with mounting bracket, inlet & outlet cone required at suction & discharge, fire rated flexible connection. Cost of spring isolators for the installation of the fans needs to be included.												
.													
3.1	The motor shall be Class H rating and suitable for 415±10% volts 3 phase 50 cycles, AC supply. The motor selected shall be IE2 efficiency at full load. Fan shall be selected for minimum efficiency of 65%.												
3.2	Fan and casing shall be suitable for normal & smoke exhaust application.Motor shall be mounted inside the fan casing & thermally rated for 250 Deg C for 2 hour as per [BS-7346 Part-2 : 1090]												
3.3	External static pressure shall be 15-20 mm (WC) minimum and Total static pressure shall be check by vendor and motor shall be compatible to operate on VFD. EA-1-4, 7-10 shall have External static pressure shall be 35-40 mm (WC) minimum and Total static pressure shall be check by vendor												

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
3.4	Fan if used for any case other than in case of fire shall be selected for lower noise level and shall not exceed 65 DB (A) at 3m distance from the fan. If required contractor to add sound attenuator to meet the desired noise level. Fan shall be selected for minimum efficiency of 65% and motor shall be compatible to operate on VFD.												
3.5	Fan used in case of fire can be selected for higher outlet velocity as sound is not criteria while selecting.												
3.6	The fan capacities shall be as follows:												

S. No.	Description of Items					Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	Equipment Tag	**Space**	**Location**	**CFM**	**Motor kW**												
	EA 1-2	Exhaust Air- Normal (Car Parking)	Basement 2	16000	7.5	No.							2	2	3,30,017	3,30,017.00	6,60,034.00
	EA 3-4	Exhaust Air- Normal (Car Parking)	Basement 2	20500	11	No.							2	2	3,63,569	3,63,569.00	7,27,138.00
	EA 5	Pump Room Hotel	Basement 2	5500	2.2	No.							1	1	1,26,500	1,26,500.00	1,26,500.00
	EA 6	Pump Room Metro	Basement 2	2000	2.2	No.							1	1	1,02,628	1,02,628.00	1,02,628.00
	EA 7 -10	Exhaust Air- Normal (Car Parking)	Basement 1	20500	11	No.							4	4	3,63,569	3,63,569.00	14,54,276.00
	EA 11	BOH	Street Level	3000	1.1	No.							1	1	91,360	91,360.00	91,360.00
	EA 12	Electrical UPS Room	Concourse Level	1500	0.55	No.							0	0	87,266	87,266.00	-
	EA 13	STP Exhaust	Underground	20000	11.0	No.							1	1	2,40,224	2,40,224.00	2,40,224.00
4	Supply, installation, testing & commissioning of **Axial Flow Fans** suitable for installing in both Horizontal or vertical position as per site requirement and complete with totally enclosed fan cooled motor belt drive, motor mount, fire rated flexible connection and vibration isolators. The fan shall be equipped with mounting bracket. Fan capacity shall be as follows																
4.1	Fan used for any purpose other than in case of fire shall be selected for lower noise level and shall not exceed 65 DB (A) at 3m distance from the fan. If required contractor to add sound attenuator to meet the desired noise level. Fan shall be selected for minimum efficiency of 60- 65% and also these fan will operate through VFD. AXF1-14 and 25-32 Fan used in case of fire can be selected for higher outlet velocity as sound is not criteria while selecting.																
4.2	The motor selected shall be IE 2 efficiency TEFC Motors suitable for 415 ± 10% volts, 50 Hz, AC supply and IE 2 efficiency. The maximum rating is specified below and contractor can select a lower rating motor incase the desired performance is being met..																
4.3	External static pressure shall be 20-25 mm (WC) minimum and Total static pressure shall be check by vendor. AXF-15-18 shall have External static pressure shall be 35-40 mm (WC) minimum and Total static pressure shall be check by vendor																
4.4	The fan capacities shall be as follows:																
	Equipment Tag	**Space**	**Location**	**CFM**	**Motor kW**												
	AXF 1	Fresh Air- Normal (Lift Well)	Platform	21000	7.5	No.							1	1	198333	1,98,333.42	1,98,333.42
	AXF2-3	Fresh Air- Normal (staircase)	Technical Floor	18000	5.5	No.							2	2	198333	1,98,333.00	3,96,666.00
	AXF4-7	Fresh Air- Normal (staircase)	Technical Floor	19500	7.5	No.							4	4	198333	1,98,333.00	7,93,332.00
	AXF 8-9	Fresh Air- Normal (staircase)	Technical Floor	15000	5.5	No.							2	2	165300	1,65,300.00	3,30,600.00

S. No.	Description of Items						Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	AXF 10	Fresh Air- Normal (staircase)	Platform	15000	5.5		No.							1	1	165300	1,65,300.00	1,65,300.00
	AXF 11-13	Fresh Air- Normal (staircase)	Street Level	17500	5.5		No.							3	3	1,98,333	1,98,333.00	5,94,999.00
	AXF 14	Fresh Air- Normal (2.4 M Corridor upside)	Street Level	19500	5.5		No.							1	1	1,98,333	1,98,333.00	1,98,333.00
	AXF 15	Fresh Air- Normal (2.4 M Corridor Downside)	Street Level	34000	11		No.							1	1	2,84,193	2,84,193.00	2,84,193.00

S. No.	Description of Items						Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	AXF 16-17	Fresh Air- (Car Parking)	Basement 2	16000	7.5		No.							2	2	2,85,298	2,85,298.00	5,70,596.00
	AXF 18-19	Fresh Air- (Car Parking)	Street Level	20500	11		No.							2	2	3,19,354	3,19,354.00	6,38,708.00
	AXF 20	Fresh Air- (Pump Room Hotel)	Basement 2	5500	2.2		No.							1	1	1,27,843	1,27,843.00	1,27,843.00
	AXF 21	Fresh Air- (Pump Room Metro)	Basement 2	2000	0.75		No.							1	1	87,266	87,266.00	87,266.00
	AXF 22-23	Fresh Air- (Car Parking)	Basement 1	20500	11		No.							2	2	3,19,354	3,19,354.00	6,38,708.00
	AXF 24	Fresh Air- (BOH)	Street Level	3000	1.1		No.							1	1	98,030	98,030.00	98,030.00
	AXF 25	Fresh Air- (UPS Room)	Concourse Level	1500	0.55		No.							0	0	80,648	80,648.00	-
	AXF 26	STP Fresh air	Underground	20000	11		No.							1	1	2,63,317	2,63,317.00	2,63,317.00
5	Supplying, installing, testing and commissioning of double skin construction fan sections (made out of 25mm thick panel) complete with internally mounted motor, fan belt drive, flexible connection, vibrations isolators and complete with following:																	
5.1	TEFC Motors suitable for 415 ± 10% volts, 50 Hz, AC supply and IE 2 efficiency. The maximum rating is specified below and contractor can select a lower rating motor incase the desired performance is being met																	
5.2	Forward curved fan mounted inside double skin housing with efficiency not less than 60-65%																	
5.3	Minimum 20-25 mm (WC) external static pressure shall be considered. However, actual total static pressure shall be calculated and confirmed by the vendor at the time of bidding.																	
5.4	Pre filter (MERV 8) in exhaust air stream.																	
5.5	The rating of fan sections shall be as follows:																	
	FAN Tag	**Space**	**Location**	**CFM**	**SP(mmwg**	**Motor**												
	EA 1-4	ASS DB Room	Concourse	5000	20-25	2.2	No.							0	0	71,100	71,100.00	-
6	Supplying, installing, testing and commissioning of **Ceiling Mounted Inline Fans** suitable for installing in any position in vertical or horizontal ducts. The casing shall be double skin, internally acoustically lined and constructed of galvanised steel. The fan shall be DIDW with forward curve impeller fitted with maintenance free external rotor motor. The motor shall be suitable for 220 ± 10% volt single phase 50 cycles AC supply. All units shall be complete with duct flexible connector, speed regulator (with wiring of 3 m included between fan & regulator) and volume control damper and static pressure or to suit the system, shall be as follows:																	
6.1	The fan shall have low sound level exceeding not more than 45 db(A) at three metre distance. Actual static to be checked by the vendor during the shop drawings.																	
	Fan Tag	**Location**	**CFM**	**SP (mmwg)**														
	IF - 01,02	Fresh / Exhaust air Service area Basement 2	900	10-15			No.							2	2	18,772	18,772.00	37,544.00
	IF - 03,04	Fresh / Exhaust air Service area Basement 1	900	10-15			No.							2	2	18,772	18,772.00	37,544.00

S. No.	Description of Items				Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	IF - 05,06	Fresh / Exhaust BOH area Street level	1300	10-15	No.							0	0	18,772	18,772.00	-
	IF - 07,08	Fresh / Exhaust BOH area Street level	1600	10-15	No.							0	0	18,772	18,772.00	-
	IF - 09	Fresh air solar panel-Concourse Level	1200	10-15	No.							0	0	18,772	18,772.00	-
	IF - 10	Toilet (HE & PWD)-Concourse Level	650	10-15	No.							1	1	10,295	10,295.00	10,295.00
	IF - 11	Toilet (HE & PWD)-Concourse Level	550	10-15	No.							1	1	10,295	10,295.00	10,295.00
	IF -12	Toilet (SHE Concourse Level	400	10-15	No.							1	1	7,025	7,025.00	7,025.00
	IF - 13	Toilet Janitor Concourse Level	200	10-15	No.							1	1	5,935	5,935.00	5,935.00
	IF - 14	Mantainer Concourse Level	450	10-15	No.							1	1	8,115	8,115.00	8,115.00
	IF - 15	Store-Platform	700	10-15	No.							1	1	10,295	10,295.00	10,295.00
	IF - 16-17	FPS-Platform	1000	10-15	No.							2	2	18,772	18,772.40	37,544.80
	IF - 18-23	Store/BOH	750	10-15	No.							6	6	11,687	11,687.33	70,123.99
	IF - 24-25	Store/BOH	550	10-15	No.							2	2	10,295	10,294.54	20,589.08
7	Supplying, installing, testing and commissioning of direct drive propeller fans (Heavy duty). Each fan shall be complete with permanent split capacitor or shaded pole motor, mounting plate, accessories like wire guard, bird screen and fixed louvers for weather protection as required. The fan shall be of following rating:															
	450 mm dia 900 RPM fan suitable for 220±6% volts 50 cycles, 1 phase AC supply.				No.							4	4	3,404	3,404.00	13,616.00
	300 mm dia 900 RPM fan suitable for 220±6% volts 50 cycles, 1 phase AC supply.				No.							16	16	8,590	8,590.00	1,37,440.00
8	Supplying, installing, testing and commissioning of direct drive domestic propeller fans. Each fan shall be complete with permanent split capacitor or shaded pole motor, mounting plate, accessories like wire guard, bird screen and fixed louvers for weather protection as required. The fan shall be of following rating:															
	90-100 CMH, Noise level 38 DB,fan suitable for 220±6% volts 50 cycles, 1 phase AC supply.				No.							1	1	8,000	8,000.00	8,000.00
9	Supply, installing, testing and commissioning of VFD suitable for HVAC application **with minimum IP 55** enclosures complying with the tender specifications and shall be complete in all respects and suitable for following motor rating and shall meet the following specifications :															
	a) The VFD shall have a dual 5% impedance DC link reactor (Harmonic filters) on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating.															
	b) All the VFD's should have factory fitted IP55 enclosure protection															
	c) EMC filters, C1 Category, Drive should support at least 3 PID loops are required															
	Application- wherever required and as mentioned in the drawing			**Motor HP**												

S. No.	Description of Items			Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
		15		No.							12	12	1,13,509	1,13,509.25	13,62,111.00
		10		No.							10	10	84,122	84,121.72	8,41,217.19
		7.5		No.							8	8	76,349	76,349.16	6,10,793.30
		5		No.							1	1	65,412	65,412.01	65,412.01
		3		No.							3	3	65,412	65,412.01	1,96,236.04
		1.5		No.							5	5	44,329	44,328.51	2,21,642.54
10	Supply, installing, testing and commissioning of Adequate number of CO sensors,PLC with power / control cabling for car park ventilation fans (at B1, B2) and logic controller with necessary control cabling will form a part of the same.														
	Please note that VFD, Fan is considered in separate item of the BOQ. Electrical starter panel shall be provided by main electrical contractor.														
10.1	*Second Basement (Zone-01 1283 Sqm, Zone-02 1900 Sqm)*			Lot							1	1	8,49,211	8,49,210.60	8,49,210.60
10.2	*First Basement (Zone-01 1850 Sqm, Zone-02 1830 Sqm)*														
	CO sensor shall be provided one no per 250 Sqm														
11	Supply, installing, testing and commissioning of Sequential Controller to operate Hi-wall split AC's in Server/ UPS room. PLC should capable to start/stop and run equal time.			No							3	3	39,896	39,895.80	1,19,687.40
	TOTAL CARRIED TO SUMMARY For Equipments ZA														**183,68,536.69**
ZB.	**AIR DISTRIBUTION**														
1	Supply, installation and testing of GI sheet metal ducts fabricated in factory as per SMACNA Standard and approved shop drawings. Duct shall be supported via Gripples supports as per the specifications :														
	Duct Size		**Recommended Gauge of GI**												
	1 - 900 mm		26	Sqm.							1500	1500	577	577.00	8,65,500.00
	901 -1200 mm		24	Sqm.							1310	1310	685	685.00	8,97,350.00
	1201 -1800 mm		22	Sqm.							1800	1800	790	790.00	14,22,000.00
	1801 - 2100 mm		20	Sqm.							425	425	890	890.00	3,78,250.00
	2101 - above		18	Sqm.							1000	1000	1,100	1,100.00	11,00,000.00
2	Supply, installation and testing of GI sheet metal ducts Site fabricated as per IS Standard and approved shop drawings. Duct shall be supported via Gripples supports as per the specifications :														
	Duct Size		**Recommended Gauge of GI**												
	Upto 750mm		24	Sqm.							10	10	577	577.00	5,770.00
	750mm- 1500 mm		22	Sqm.							10	10	682	682.00	6,820.00
	1510 mm- 2250 mm		20	Sqm.							10	10	790	790.00	7,900.00
	above 2250 mm		18	Sqm.							10	10	945	945.00	9,450.00
3	Supply, installation and balancing of Extruded Aluminium construction Supply air Grilles with volume control dampers. The grilles will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications. The grilles may be double or single louvered, adjustable or fixed as required by Client			Sqm.							40	40	8,400	8,400.00	3,36,000.00
4	Supply, installation and balancing of Extruded Aluminium construction Return/Exhaust air Grilles without volume control dampers. The grilles will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications. The grilles may be double or single louvered, adjustable or fixed as required by Client			Sqm.							40	40	6,300	6,300.00	2,52,000.00
5	Supply, installation and balancing of Extruded Aluminium construction square / round shape supply air **diffusers** with removable core & anti smudge ring & volume control dampers.The diffusers will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications.			Sqm.							10	10	9,450	9,450.00	94,500.00

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
6	Supply, installation and balancing of Extruded Aluminium construction square / round shape return air **diffusers** with removable core & anti smudge ring & without volume control dampers.The diffusers will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications.	Sqm.							10	10	6,825	6,825.00	68,250.00
7	Supply, installation and balancing of Extruded Aluminium construction **Supply Air Multi Slot Diffuser** complete with air pattern controllers & Hit & Miss volume control damper. The diffusers will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications. Number of slots will vary as per volume of air to be handled.	Sqm.							1	1	15,750	15,750.00	15,750.00
8	Supply, installation and balancing of Extruded Aluminium construction **Return Air Multi Slot Diffuser** complete with air pattern controllers. The diffusers will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications. Number of slots will vary as per volume of air to be handled.	Sqm.							1	1	15,750	15,750.00	15,750.00
9	Supply, installation and balancing of Extruded Aluminium construction Supply/Return air Linear Grilles. The grilles will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications. The grilles may be double or single louvered, adjustable or fixed as required by Client with removable core. Quoted price shall be inclusive of volume control damper behind supply air collar.	Sqm.							1	1	5,250	5,250.00	5,250.00
10	Supplying & fixing of opposed blade GI construction **volume control dampers** in Rectangular supply air duct as per approved drawings and specifications.	Sqm.							40	40	5,775	5,775.00	2,31,000.00
11	Supply, installation, testing and balancing of Powder coated/Anodised extruded aluminium construction inlet air **louvers with bird screen** for fresh air alongwith GI construction volume control damper.The louvers will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications.	Sqm.							40	40	9,450	9,450.00	3,78,000.00
12	Supply, installation, testing and balancing of Powder coated/Anodised extruded aluminium construction exhaust air **louvers with bird screen**.The louvers will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications.	Sqm.							40	40	6,825	6,825.00	2,73,000.00
13	Supply, installation, testing and balancing of Powder coated/Anodised extruded aluminium construction **Door Transfer Grille** for make up/exhaust air. The grilles will be powder coated in shade approved by Client and installed as per approved shop drawings and specifications.	Sqm.							2	2	8,400	8,400.00	16,800.00

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
14	Supply, installation, testing and commissioning of **motorised combined smoke & fire damper.** The quoted price shall include control panel alongwith fire resistant inter connecting wiring and also termination of Fire alarm control wiring.												
a	Smoke & Fire Dampers.	Sqm.							1	1	7,875	7,875.00	7,875.00
b	Control Panel & Wiring (including actuators)	No.							1	1	9,450	9,450.00	9,450.00
15	Supply, installation, testing and commissioning of **motorised damper** complete with control panel, inter												
	Motorized Dampers.	Sqm.							30	30	5,775	5,775.00	1,73,250.00
	Control Panel & Wiring (including actuators)	No.							44	44	9,450	9,450.00	4,15,800.00
16	Supply, installation, testing and balancing of Ex. Al or PVC construction Exhaust Valves for air as per specifications and approved shop drawings. The valves will be in shade approved by Client and installed as per approved shop drawings and specifications.	No.							27	27	1,260	1,260.00	34,020.00
17	Supply, fabrication and installation fire resistant double resin sleeve fire rated flexible connection of size as per approved shop drawing.	Sqm.							10	10	4,725	4,725.00	47,250.00
	Note: All exposed surfaces & duct shall be painted in black mat finish by the HVAC contractor.												
	TOTAL CARRIED TO SUMMARY FOR AIR DISTRIBUTION ZB												**70,66,985.00**
ZC.	**THERMAL INSULATION**												
1	Supply and fixing of duct acoustic lining in supply and return air ducts and room lining as per specifications.												
1.1	15 mm thick nitrile rubber/ crosslinked polyethylene duct lining	Sqm							100	100	1,575	1,575.00	1,57,500.00
1.2	20 mm thick nitrile rubber/ crosslinked polyethylene for wall lining	Sqm.							100	100	2,625	2,625.00	2,62,500.00
2	Supply and fixing of external insulation on supply & return air ducts as per specification. Material of insulation shall be closed cell crosslinked polyethelene/Nitrile rubber as per thickness given below:												
2.1	Insulation of 13 mm thickness	Sqm							100	100	788	788.00	78,800.00
2.2	Insulation of 19 mm thickness	Sqm							100	100	1,155	1,155.00	1,15,500.00
2.3	Insulation of 25 mm thickness on supply & return air ducts exposed to air. Quote price shall include cost of UV protection coating on the insulation.	Sqm							50	50	1,260	1,260.00	63,000.00
3	Supplying and fixing of 25 mm thick pre-moulded pipe section of T.F. quality expanded polystyrene (24 Kg / M^3 density) insulation on chilled water and condensate drain piping/fittings includng valves, flanges, union etc. as per the approved shop drawings and specifications. Pipe shall be finished with 26 Gauge G.I Cladding.												
3.1	MS pipes of 40 mm dia	Rm							1	1	577	577.00	577.00
3.2	MS pipes of 32 mm dia	Rm							1	1	462	462.00	462.00
3.3	MS pipes of 25 mm dia	Rm							1	1	346	346.00	346.00
3.4	MS pipes of 20 mm dia	Rm							1	1	290	290.00	290.00
3.5	Condensate drain pipes of 50 mm dia	RM							1	1	630	630.00	630.00
3.6	Condensate drain pipes of 40 mm dia	RM							1	1	577	577.00	577.00
3.7	Condensate drain pipes of 32 mm dia	RM							55	55	462	462.00	25,410.00
3.8	Condensate drain pipes of 25 mm dia	RM							20	20	347	347.00	6,940.00

S. No.	Description of Items	Unit	AMS	NAR	INS	KDC	GGS	KCP	ZOM	Qty	Unit Rate (INR) (Tender opened on 08.06.2016)	Unit Rate(INR) Considering Inflation @5% per Annum (i.e. 12.5%)	Amount (INR)
	TOTAL CARRIED TO SUMMARY FOR THERMAL INSULATION ZC												**7,12,532.00**
ZD	**ELECTRICAL INSTALLATION**												
1	**CONTROL PANELS FOR AXIAL FANS (IP 55 rated)**												
1.1	Design, manufacture, supply, installation, testing and commissioning of the following cubicle type, dead front, sheet steel, wall mounted control panels including anchoring into the wall, wiring, incoming, earthing & terminating into MPCB in each panel shall be provided by the electrical contractor.												
	The panel shall include the following components & accessories.												
	MPCB as per the ratings given below, suitable for motor duty and able to withstand fault level of 20 KA.												
	DOL / SD starter as per HP gratings given.												
	Terminal block for power distribution.												
	Contactor, over load relay with built in single phasing protection.												
	Phase indicating lights and indicating light for ON status.												
	144 mm x 144 mm voltmeter and digital ammeter.												
	Time delay relay for delayed automatic restart of motor.												
	For on/off/remote and local operation, 3 pole single throw switch shall be provided in each panel to facilitate override of the automatic operation.												
	The number of control panels shall be as follows.												
1.1.1	Suitable rating MCCB, outgoing to VFD operated motor upto 5 HP motor	No.							9	9	22,000	22,000.00	1,98,000.00
1.1.2	Suitable rating MPCB with DOL starter upto 5 HP motor	No.							0	0	24,200	24,200.00	-
1.1.3	Suitable rating MPCB with S/D starter for 7.5 HP motor	No.							0	0	27,500	27,500.00	-
1.1.4	Suitable rating MCCB, outgoing to VFD operated motor of 7.5 HP motor	No.							8	8	25,300	25,300.00	2,02,400.00
1.1.5	Suitable rating MCCB, outgoing to VFD operated motor of 10 HP motor	No.							10	10	30,800	30,800.00	3,08,000.00
1.1.6	Suitable rating MCCB, outgoing to VFD operated motor of 15 HP motor	No.							12	12	50,000	50,000.00	6,00,000.00
	TOTAL CARRIED TO SUMMARY FOR ELECTRICAL INSTALLATION ZD												**13,08,400.00**
	Grand Total for HVAC												**274,56,453.69**

MAHA-METRO **Signature and Seal of Bidder**