NATIONAL HIGHWAYS AUTHORITY OF INDIA

(Ministry of Road Transport and Highways)

International Competitive Bidding

Balance work of two laning with/without paved shoulder of Tindivanam-Krishnagiri section of NH-66 from km. 37.600 to km. 219.782 under NHDP Phase-II in the state of Tamil Nadu on Item Rate Contract

BIDDING DOCUMENT- ITEM RATE CONTRACT

VOLUME 2

Section IV - Technical Specifications

G-5 & 6, Sector -10, Dwarka, New Delhi -110075

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TECHNICAL SPECIFICATIONS

1. PREAMBLE

1.1 The Technical Specifications contained herein shall be read in conjunction with the other Bidding Documents.

1.1.1 General

The Technical specifications covering the materials and the workmanship aspects as well as method of measurements and payments are included in this section. These specifications cover the items of civil and non-civil works coming under scope of this document. All work shall be carried out in conformity with the same. These specifications are not intended to cover the minute details. The works shall be executed in accordance with good practices followed for achieving high standards of workmanship, thus ensuring safety and durability of the construction. All codes and standards referred to in these specifications shall be the latest thereof unless otherwise stated.

1.1.2 Inclusive Documents

The provisions of special conditions of contract, those specified elsewhere in the tender document, as well as Good for Construction drawings and notes, or other specifications issued in writing by the Engineer shall form part of the technical specifications of this project.

1.1.3 The attention of the contractor is drawn to those clauses of codes which require supporting specification either by the Engineer or by mutual agreement between the supplier and purchaser. In such cases, it is the responsibility of the tenderer / contractor to seek clarification on any uncertainty and obtain prior approval of the Engineer before taking up the supply / construction. In absence of such prior clarification, the Engineer's choice / design will be final and binding on the contractor without involving any additional payment separately.

1.1.4 Measurement and Payment

The methods of measurement and payment shall be as described under various items and in the Bill of Quantities. Where specific definitions are not given the methods described in CPWD, IS and B.I.S. Code will be followed. Should there be any detail of construction or materials which has not been referred to in the specification or in the Bill of Quantities and Drawings but the necessity for which may be implied or inferred there from, or which is usual or essential to the completion of the work in the trades, the same shall be deemed in the rate and prices entered by the contractor in the Bill of Quantities.

1.1.5 Defective Works

All defective works are liable to be demolished, rebuilt and defective materials replaced by the contractor at his own cost. In the event of such works being accepted by carrying out repairs etc., as specified by the Engineer the cost of repairs will be borne by the contractor.

1.2 SITE INFORMATION

1.2.1 The information given hereunder and provided elsewhere in these documents is given in good faith by the Employer but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim will be entertained on the plea that the information supplied by the Employer is erroneous or insufficient.

1.2.2 The Project Road predominantly traverses the plain terrain. The project corridor has good to fair and deficient horizontal and vertical geometrics, which will be improved to IRC standards.

1.2.3 Seismic Zone

The project road traverses through Seismic Zone IV.

2. GENERAL REQUIREMENTS

The Technical Specifications in accordance with which the entire work described hereinafter shall be constructed and completed by the Contractor shall comprise of the following:

2.1 PART-I: General Technical Specifications

The General Technical Specifications shall be the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision April 2013)", as corrected in the original issued by the Ministry of Surface Transport & Highways, Government of India and published by the Indian Roads Congress (IRC), with a cross reference to relevant Bureau of Indian Standards (BIS) for materials or other aspects not covered by the IRC.

2.2 PART-II: Supplementary / Additional Technical Specifications

The Supplementary Technical Specifications shall comprise of various Amendments / Modifications / Additions to the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS" referred to in PART-I above and Additional Specifications for particular item of works not already covered in PART-I.

2.2.1 A particular clause or a part thereof in "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision April 2013)" as corrected in the original referred in PART-I above, where Amended / Modified / Added upon, and incorporated in PART-II, referred to above, such Amendment / Modification / Addition supersedes the relevant Clause or part of the Clause.

2.2.2 The Additional Specifications shall comprise of specifications for particular item of works not already covered in PART-I.

2.2.3 When an Amended / Modified / Added Clause supersedes a Clause or part thereof in the said Specifications, then any reference to the superseded Clause shall be deemed to refer to the Amended / Modified / Added Clause or part thereof.

2.2.4 In so far as Amended / Modified / Added Clause may come in conflict or be inconsistent with any of the provisions of the said Specifications under reference, the Amended / Modified / Added Clause shall always prevail.

2.2.5 The following Clauses in the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision April 2013)" have been Amended / Modified / Added upon;

Sr. No.	Section No.	Section Title	Clause No.
1.	100	General	102, 107, 108, 109, 110, 111 and 112
2.	200	Site Clearance	-
3.	300	Earthwork, Erosion Control and Drainage	301,304, 305, 306 and 309
4.	400	Sub-base, Bases (Non-Bituminous) and Shoulder	401 and 406
5.	500	Bases and Surface Courses (Bituminous)	501, 502, 503, 504, 505 and 507
6.	600	Concrete Pavement	-
7.	700	Geosynthetics	-

Sr. No.	Section No.	Section Title	Clause No.
8.	800	Traffic signs, Markings and other Road Appurtenances	802 and 811
9.	900	Quality Control for Road works	-
10.	1000	Materials for Structures	1009
11.	1100	Pile Foundations	1118 and 1119
12.	1200	Well Foundations	-
13.	1300	Brick Masonry	-
14.	1400	Stone and Concrete Block Masonry	-
15.	1500	Formwork	-
16.	1600	Steel Reinforcement	1602
17.	1700	Structural Concrete	-
18.	1800	Pre-stressing	1817
19.	1900	Structural Steel	-
20.	2000	Bearing	-
21.	2100	Open Foundations	-
22.	2200	Substructures	-
23.	2300	Concrete Superstructure	-
24.	2400	Surface and Sub-Surface Geotechnical Investigation	-
25.	2500	River Training Work and Protection Work	-
26.	2600	Expansion Joints	-
27.	2700	Wearing Coat and Appurtenances	2708 and 2709
28.	2800	Repair of Structures	-
29.	2900	Pipe Culverts	-
30.	3000	Maintenance of Road	-
31.	3100	Reinforced Earth	3109
32.	3200	Soil Nailing	-

2.2.6 Additional Specifications

The following Appendices have been added to the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision April 2013)".

1. Appendix A-1 Specification for PVC rigid pipes
2. Appendix A-2 Curing Using Liquid Membrane Forming Compound
3. Appendix A-3 Chute Drains for High Embankment Sections
4. Appendix A-4 Specification for Electrical Works

5.	Appendix A-5	Reflective Pavement Markers (Road Studs)
6.	Appendix A-6	Painting on Structures with Synthetic Enamel Paint for Numbering & Span Details of Bridges / Culverts and Water Proof Cement Paint for Parapet, Railing, Kerb and Crash Barrier
7.	Appendix A-7	Specification for compressible pre-moulded asphalt filler board
8.	Appendix A-8	Seismic Restrainers

In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specifications of IRC, BIS, BS, ASTM, AASHTO and CAN / CSA in that order. Where even these are silent, the construction and completion of the works shall conform to sound engineering practice as approved by the Engineer.

2.3 PART III Specifications for Building, Subways and miscellaneous Works. Technical Specifications for Building, Subways, etc. and Miscellaneous works shall be the latest CPWD Specifications-2009 Volume 1 & 2 for Civil Works and General Specifications for Electrical Works Part I - Internal 2013, Part II - External 2012, as published by the Central Public Works Department (CPWD), Govt. of India and deemed to be bound into this document.

2.4 The latest edition of all specifications / standard / codes till 56 (fifty six) days before the final date of submission of the bid, shall be applicable.

PART II

SUPPLEMENTARY TECHNICAL SPECIFICATION

AMENDMENTS / MODIFICATIONS / ADDITIONS TO EXISTING CLAUSES OF GENERAL TECHNICAL SPECIFICATIONS

SECTION 100 GENERAL

CLAUSE 102 DEFINITIONS

The following abbreviations shall be added in this Clause:

"AASHTO"	:	American Association of State Highway and Transportation Officials
"ASTM"	:	American Society for Testing and Materials
"BS"	:	British Standard published by the British Standards Institution
"BIS"	:	Bureau of Indian Standards
"BOQ"	:	Bill of Quantities
"CBR"	:	California Bearing Ratio
"CECRI"	:	Central Electro Chemical Research Institute
"CPCB"	:	Central Pollution Control Board
"IRC"	:	Indian Roads Congress
"IS"	:	Indian Standard published by the Bureau of Indian Standards
"MORT&H"	:	Ministry of Road Transport & Highways (Previously known as 'MOST', Ministry of Surface Transport)
"NHAI"	:	National Highways Authority of India
"PWD"	:	Public Works Department
"QA"	:	Quality Assurance
"WBM"	:	Water Bound Macadam
"WMM"	:	Wet Mix Macadam

CLAUSE 107 CONTRACT DRAWINGS

Sub-Clause 107.1 *Add the following after the end of para*

After careful study of the drawings issued by the employer, the contractor shall where details are not provided or where changes are required due to site conditions, prepare all supplementary and / or additional working drawings based on field / construction information and shall submit the same to the Engineer for approval prior to construction.

CLAUSE 108 SITE INFORMATION

Sub-Clause 108.4 *This clause shall be added at the end:*

"Identification of quarry sites and borrow areas shall be the responsibility of the Contractor. Materials procured from quarry sites and borrow areas identified by Contractor and to be used in Works must comply with the requirements of quality as stipulated in the Technical Specification for particular items of work."

CLAUSE 109 SETTING OUT

Sub-Clause 109.8 *Delete the 3rd sentence in Clause 109.8 and substitute the following:*

"Levels shall be taken by Automatic levels with precision micrometer staff having least count of 1mm."

Clause 110 PUBLIC UTILITIES

Replace whole of this Clause 110 with the following:

Clause 110 ENCUMBRANCES IN CONSTRUCTION AREA, INCLUDING TREES AND UTILITIES

Sub- Clause 110.1 The contractor shall be responsible to coordinate with service provider / concerned authorities for cutting of trees, shifting of utilities and removal of encroachments, etc. and making the site unencumbered from the project construction area required for completion of work. This will include initial and frequent follow-up meetings / actions / discussions, with each involved service provider / concerned authorities. Payment for cutting of trees and shifting of utilities as required by the concerned department shall be made by the Employer.

Sub-Clause 110.2 Drawings scheduling the affected encumbrance such as trees and services like water pipes, sewers, oil pipelines, cables, gas ducts, electricity lines, accessories, telephone poles and OFC cables, etc. including in the contract document shall be verified by the contractor for accuracy of scope.

Sub-Clause 110.3 The Employer will make payments to the respective service provider / authorities for cutting trees and shifting of utilities, wherever required. The contractor shall obtain necessary approval from such Authorities after payments by the Employer and also in cases where payments are not required to be made for such shifting. The Employer will also write to all concerned department / service provider organization for expedite and facilitating cutting of trees, shifting of utilities and removal of encroachments, etc.

Sub-Clause 110.4 Any services and properties affected by the works must be temporarily supported by the Contractor who must also take all measures reasonably required by the various authorities / persons to protect their services and properties during the execution of the works. It shall be deemed to be part of the Contract and no extra payment shall be made for the same.

Sub-Clause 110.5 The Contractor may be required to carry out certain works for and on behalf of various bodies and he shall also provide, with the prior approval of the Engineer, such assistance to the various bodies as may be authorized by the Engineer.

Sub-Clause 110.6 Payment

For coordinating the work of cutting of trees, shifting of utilities and removal of encroachments, etc. no separate payment will be made and these will be incidental to the work.

CLAUSE 111 PRECAUTIONS FOR SAFEGUARDING THE ENVIRONMENT

Sub-Clause 111.1 General

Delete the text of Clause 111.1 in its entirety and substitute the following:

"The Contractor shall take all necessary measures and precautions and otherwise ensure that the execution of the Works and all associated operations on site or off-site are carried out in conformity with statutory and regulatory requirements including those prescribed elsewhere in this document. The provisions specified in the Environment Management Plan Report shall be followed as guidelines.

The Contractor shall take all measures and precautions to avoid any nuisance or disturbance arising for the execution of the Works. This shall wherever possible be

achieved by suppression of the nuisance at source rather than abatement of the nuisance once generated. All vehicles deployed for material haulage shall be spillage proof.

Haul roads shall be inspected at least once daily to clear any accidental spillage. In the event of any spoil, debris, wastes or any deleterious substance from the Site being deposited on any adjacent land, the Contractor shall immediately remove all such material at no cost to the Contract and restore the affected area to its original state to the satisfaction of the Engineer."

The Contractor shall be required to carry out all Environmental mitigation measures and monitoring required during execution of works as directed by the Engineer in Charge. It is pointed out that all costs incurred on such measures / monitoring shall be treated as incidental to the work and shall be deemed to have been included in the cost of item of works covered under the BOQ.

Sub-Clause 111.2 Borrow Pits for Embankment Construction

Delete the text of Clause 111.2 and substitute the following:

"Prior approval shall be sought from the concerned State Authorities, and the Contractor shall comply with all local environmental regulations. For all borrow areas, the actual extent of area / zones to be excavated shall be demarcated with the signboards and the operational areas shall be access controlled.

In the case of borrow from tank beds, a regrade / improvement of the inlet channels (at least up to 100m stretch) shall be undertaken in consultation with the concerned state government departments (the Minor Irrigation department and the State PWD) and local bodies. The Contractor shall ensure that excavation of tank beds is uniform over the entire area and that the finished profile of the bed is smooth.

In the case of borrow from the dry highlands, all borrow areas shall be reinstated by the formation gentle side slopes, re-vegetated and connected to the nearest drainage channel to avoid the formation of pools during / after the rainy seasons.

Plant and machinery used in the borrow areas shall conform to State noise emission regulations. All operation areas shall be water sprinkled to contain dust levels to the National Ambient Air Quality Standards."

Sub-Clause 111.3 Quarry Operations

Delete the text of Clause 111.3 and substitute the following:

"Aggregates shall be sourced only from quarry sites that comply with the local / state environmental and other applicable regulations. Occupational safety procedures / practices for the work force in all quarries shall be in accordance with applicable laws. Quarry and crushing units shall have adequate dust suppression measures, such as sprinklers, in work areas and along all approach roads to the quarry sites. These shall preferable be located on the upwind side."

Sub-Clause 111.5 Pollution from Plants and Batching Plants

Delete the 1st sentence of Clause 111.5 and substitute the following:

"Stone crushing and screening plants, Bituminous hot mix plants, Concrete batching plants etc. shall be located at least one (1) km away from the sensitive receptors (schools, hospitals, etc.) and at least 500m from urban settlements, unless otherwise required by the statutory requirements."

CLAUSE 112 ARRANGEMENT FOR TRAFFIC DURING CONSTRUCTION

Sub-Clause 112.2 Passage of Traffic along a part of the existing carriageway under improvement

Replace the second sentence of this para as under:

"The treatment to the shoulder shall consist of proving at least 150mm thick granular (Wet Mix Macadam / Water Bound Macadam) base course covered with bitumen surface dressing in such a width so as to make 5.5m wide traffic lane available all the time, and the treated shoulder shall be maintained throughout the period during which traffic uses the same, to the satisfaction of the Engineer."

Sub-Clause 114.4 *Add the following as Clause 114.4*

If any 'work' executed by the Contractor does not meet the specifications, it shall be deemed as rejected. The Engineer, in his sole discretion, may consider a proposal by the Contractor to retain, the element or part of the 'Work'. The Contractor's proposal shall be supported by calculations, drawings and other data to prove the soundness of the proposal and shall clearly describe the additional measures required to ensure the intended performance of the 'Work'.

Such corrective measure shall be carried out at the contractor's cost and risk.

SECTION 300 EARTHWORK, EROSION CONTROL AND DRAINAGE

CLAUSE 301 EXCAVATION FOR ROADWAY AND DRAINS

Sub-Clause 301.1 Scope

Add the following as second paragraph under this clause:

"The work shall also include excavation for channel training at culverts / bridges, excavation of existing shoulders and medians for purposes of widening the pavement and excavation of existing embankment for reconstruction to specification."

Sub-Clause 301.3.3 Excavation - General

The following paragraph is added to the sub-clause 301.3.3

"Temporary support to the sides of the excavation, necessary to support the foundation of adjoining structures and to prevent any ground movement shall be provided by the Contractor. Where temporary supports are provided these shall be designed & removed such that no ground movement occurs on removal. The Contractor shall submit his proposal in this respect to the Engineer for approval prior to commencement of the excavation".

Sub-Clause 301.9.3 Insert "including marshy soil" after words "unsuitable material" in the second line of this sub-clause.

CLAUSE 304 EXCAVATIONS FOR STRUCTURES

Sub-Clause 304.3.2 Excavation

At the end of 1st paragraph of Clause 304.3.2 insert the following additional sentences:
"The Contractor shall ensure the stability and structural integrity of adjacent existing foundations and structures and if necessary shall, at his own expense, install temporary or permanent sheet piles, coffer dams, shoring or similar as support or protection to the satisfaction of the Engineer."

CLAUSE 305 EMBANKMENT CONSTRUCTION

Sub-Clause 305.9 Rates

Sub-Clause Add new Sub-Clause after Sub Clause 305.9.11 as under:

305.9.11 "The contract unit rate for construction of embankment with suitable material obtained from roadway excavation within Right of Way (ROW) shall be payment in full for carrying out the required operation including full compensation for items under Clause 305.9.1 excluding Sub Clause (i) & (x) after the suitable material has been received as provided in Clause 301."

CLAUSE 306 SOIL EROSION AND SEDIMENTATION CONTROL

Sub-Clause 306.4 Measurements for Payment

Substitute Clause 306.4 as follows:

"All sedimentation and pollution control works shall be deemed as incidental to the earthwork and other items of work and as such no separate payment shall be made for the same."

Sub-Clause 306.5 Rates

This clause shall be deleted.

CLAUSE 309 SURFACE/SUB-SURFACE DRAINS

Sub-Clause 309.2 Surface Drains

Add the following paragraphs after end of the fourth Para of this clause:

"Drains in super-elevations shall be constructed as per drawings. Geotextile membrane if specified for these drains shall conform to Sub-Clause 702 of Section 700".

"The roadside land between toe of road embankment & drain shall be levelled & sloped towards the drain as per drawing."

CLAUSE 401 GRANULAR SUB BASE

Sub-Clause 401.2 Materials

Sub-Clause 401.2.1 Add the last line in this clause:

Grading for Granular Sub-base materials shall be as Grading I, Table 400-1.

CLAUSE 406 WET MIX MACADAM SUB BASE / BASE

Clause 406.2.1.1 Physical requirement

Delete the second sentence beginning with "If crushed gravel …… and ending with fractured faces" and add as under:

"If crushed boulders are used, not less than 90 percent by weight of crushed boulders retained on 4.75 mm sieve shall have at least two fractured faces.

The constituents of the aggregates shall be produced by integrated crushing and screening plant (Impact or Cone type of capacity 200T/hour) and, unless otherwise instructed by the Engineer, crushing shall be carried out in at least two stages. The fraction of material passing through 4.75mm sieve shall also be crusher run screening only."

SECTION 500 BASE AND SURFACE COURSES (BITUMINOUS)

SECTION 501 GENERAL REQUIREMENTS FOR BITUMINOUS PAVEMENT LAYERS

Sub-Clause 501.2 Materials

Sub-Clause 501.2.2 Delete "crushed gravel or other hard material" from first line of Para 1 and replace

with “crushed boulders”.

Replace word “crushed gravel” in para 2 with “crushed boulders”.

CLAUSE 502 PRIME COAT OVER GRANULAR BASE

Sub-Clause 502.2 Materials

Replace the Para of this clause as under:
The primer shall be cationic bituminous emulsion SS-1 grade conforming to IS:8887.

CLAUSE 503 TACK COAT

Sub-Clause 503.2 Materials

Replace 1st sentence of this clause as under:
The binder used for tack coat shall be cationic bituminous emulsion (RS-1) complying with IS:8887.

CLAUSE 504 BITUMINOUS MACADAM

Sub-Clause 504.2.2 Coarse Aggregates

Delete “crushed gravel or other hard material” from 1st sentence and replace with “crushed boulders”.

Replace word “crushed gravel” in 3rd sentence with “crushed boulders”.

Sub-Clause 504.2.5 Proportioning of Materials

Add below Table 500-7 as under:

“Grading - 1 shall be used for compacted thickness of a layer of 75mm and above, while Grading - 2 shall be used for compacted thickness of a layer of less than 75mm thickness.”

Sub-Clause 504.8 Rate

After the words “required operations” in 1st sentence of this clause, add the words “except the items of tack coat and prime coat (if any).”

CLAUSE 505 DENSE BITUMINOUS MACADAM

Sub-Clause 505.2.1 Bitumen

Second Para of this clause shall read as under:

The bitumen shall be VG-40 for main carriageway & VG-30 for slip roads and conforming to IRC: SP: 53.

Sub-Clause 505.9 Rate

After the words “required operations” in 1st sentence of this clause add the words, “except the items of tack coat and prime coat (if any)”

CLAUSE 507 BITUMINOUS CONCRETE

Sub-Clause 507.2.1 Bitumen

Para of this clause shall read as under:

The bitumen shall be VG-40 for main carriageway & VG-30 for slip roads.

Sub-Clause 507.9 Rate

Replace "Clause 504.9" with "Clause 505.9" in 1st sentence of this clause.

CLAUSE 800 TRAFFIC SIGNS, MARKINGS AND OTHER APPURTENANCES

CLAUSE 802 OVERHEAD SIGNS

Sub-Clause 802.7 Measurements for Payment

Sub-Clause 802.7.1 This clause shall read as under:

"The Structural steel / Aluminum part of the overhead signs shall be measured in tonnes while the sign board shall be measured in square meters."

CLAUSE 811 CONCRETE CRASH BARRIER

Sub-Clause 811.2.4 Measurements for Payment

This clause shall be read as follows:

"The concrete crash barriers shall be measured in cubic metres of concrete placed in position and accepted length of barrier in place. The steel reinforcement shall be measured in tonne."

Sub-Clause 811.2.5 Rate:

Add at the end of the clause:

"and paid as per respective BOQ items."

CLAUSE 1000 MATERIALS FOR STRUCTURE

CLAUSE 1009 STEEL

Sub-clause 1009.3 Reinforcement/ Un-tensioned steel

In the Table 1000.3, replace "IS: 1786 High Strength Deformed bars (HSD)" with "IS:1786 Thermo mechanically treated (TMT) High Yield Strength Deformed Bars (HYSD)". Any other reference to "HYSD" bars in the specifications shall be read as "TMT" bars.

CLAUSE 1100 PILE FOUNDATIONS

CLAUSE 1118 MEASUREMENT FOR PAYMENT

Para 3 shall be replaced as follows:

"Initial pile load tests, vertical and lateral, shall be measured separately in nos. of piles on which tests carried out. The pile integrity tests shall be measured in nos. of piles on which tests carried out. Routine load tests shall not be measured for payment and shall be incidental to work."

CLAUSE 1119 RATE

Para 2 shall be replaced as follows:

The contract unit rate for cast in situ driven and bored piles shall include the cost of concrete and all other items as per section 1700. The contract unit rate shall also include costs of boring, installation, all labour, materials, equipments and all other incidentals involved in conducting routine load tests.

The initial pile load tests, vertical and lateral, including costs of boring, concrete, installation, all labour, materials, equipments for initial load tests shall be measured and paid in nos. of tests carried out. The pile integrity tests shall be measured and paid in nos. of tests carried out. Routine load tests shall not be measured for payment and shall be incidental to the work.

CLAUSE 1600 STEEL REINFORCEMENT

CLAUSE 1602 GENERAL

Paragraph 2 of Clause 1602 shall read as follows:

"Reinforcements shall be thermo mechanically treated (TMT) deformed bars of grade Fe 415 / 500, as specified in the Drawings, conforming to IS: 1786."

CLAUSE 1800 PRE STRESSING

CLAUSE 1817 MEASUREMENTS FOR PAYMENT

Add new para 3 below para 2 as under:

"HYSD reinforcement shall be measured as per clause 1608" and existing para 3 shall be designated as para 4.

CLAUSE 2700 WEARING COAT AND APPURTENANCES

CLAUSE 2708 MEASUREMENTS FOR PAYMENT

In sub clause iv add second sentence as "HYSD reinforcement shall be included in the cost of slab and shall not be measured separately".

CLAUSE 2709 RATE

Add at the end of Para 3:

"The contract unit rate for approach slab shall include cost of reinforcement and providing and laying in position bitumen joint filler with joint sealing compound in the 20 mm thick gap between dirt wall and approach slab."

CLAUSE 3100 REINFORCED SOIL

CLAUSE 3109 MEASUREMENT FOR PAYMENT

Sub Clause 3109.1 Reinforced Soil Wall

Replace para 2 as under:

"The measurement for concrete in crash barrier and friction slab shall be in cubic meter and reinforcement in metric tonne."

ADDITIONAL TECHNICAL SPECIFICATION

Appendix A-1

SPECIFICATION FOR PVC RIGID PIPES

1. Scope

The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, jointing, etc., for service duct, utility duct or drain water pipe line.

2. Materials

The pipes and fittings shall conform to series IV of IS 4985-1978. PVC pipes and fittings shall be free from cracks, flows and defects.

3. Construction Methodology

Before laying pipe line, it shall be first examined for damages and cracks. No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost.

All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside surface.

The pipes shall be carefully laid straight to the correct alignment as indicated in the drawing. All pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer.

The joining of pipes and fittings generally shall be done with approved make of cement solvent including making surface rough. The pipe shall be cut to desired length. Care shall be taken that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

6. Measurement and Rate

The payment shall be made on running meter basis of pipe fixed in position. Unit rates includes,

i. Supplying of PVC pipes and fittings of specified diameter

ii. Laying and cutting the pipe wherever necessary and wastage

iii. Fixing the pipe line with GI clamps not less than 2mm thick and GI nails length not less than 40mm or with PVC clamps, screws, wooden gutties etc.

iv. Making the solution joint

v. All necessary materials, labour and use of tools required to complete the job

The measurement shall be taken along the longitudinal axis center to center which includes fittings, making joint etc.

Appendix A-2

CURING USING LIQUID MEMBRANE FORMING COMPOUND

1. General

Liquid membrane forming compound are sometimes permitted to be used by the engineer for curing concrete for part or whole of the total curing period as specified in sections dealing with concrete construction. These membranes reduce the loss of water from concrete during early hardening period and some type of compounds also help in reducing the temperature-rise of concrete exposed to the radiation from the sun. These specifications cover the type and use of such compounds. However, the use of the same will need specific permission from the engineer, who may require a number of tests to be carried out for establishing the conformity of the product to these specifications and to establish that the curing compound and its method of use does not have any unacceptable effect on the quality of concrete. The cost of the initial acceptance testing and the quality control testing will be borne by the owner, if the method has been specified as a requirement by the engineer. If on the other hand, it is suggested by the contractor as an alternative to wet-curing, the full cost of testing will be borne by him and deemed to be included in his rates for concreting. The cost of curing in any case will be deemed to be part of the concrete rates and will not be paid extra.

All equipment, material etc., needed for curing and protection of concrete shall be at hand and ready for installing before actual concreting begins. Detailed plans, methods and procedures shall be firmly established, shall be settled and got approved in writing from the Engineer-in-charge sufficiently in advance of the actual concreting.

The equipment and method proposed to be utilised shall provide for adequate control and avoid interruption or damage to the work of other agencies.

Only wax-based white pigmented curing compound with water retention of 90 percent shall be used to cure the dry lean concrete. The curing compound shall conform to BS 7542. The curing compound shall be applied uniformly with a mechanical sprayer and with a hood to protect the spray from the wind. The curing compound shall be applied over the entire exposed surface of the DLC, including sides and edges, at the rate of 0.2 liters / square meter.

The first application, referred to as the curing application, shall be applied immediately after the final rolling of the DLC is completed. As soon as the curing compound has lost its tackiness, the surface shall be covered with wet Hessian for three days. The second application, referred to as the de-bonding application, shall be applied 24 to 48 hours prior to the PQC placement. The application shall be made on the DLC surface free of debris and damaged surface. If the DLC is damaged, it shall be corrected prior to application of the second application of the curing compound. No construction traffic except that used for placing the PQC shall be allowed on the DLC surface after the second application of the curing compound. The curing compound shall not be tacky at the time of the PQC placement.

2. Curing Compound

The curing compound shall be conforming to ASTM-C-309-81, Type-2, white pigmented compound. The solids dissolved in vehicle shall be either A (no restrictions) or Class B (resin as defined in ASTM D-883) as approved by the engineer.

White pigmented compound (Type-2) shall consist of finely divided white pigments and vehicle solids, ready mixed for immediate use without alteration.

The compound shall present a uniform white appearance when applied uniformly to a fresh concrete surface at a specified rate of application. It shall be of such consistency that it can be readily applied by spraying to provide uniform coating at temperatures above 4°C. If two coats are to be applied then it should be applied at an interval of approximately one hour. They shall adhere to freshly placed concrete that has stiffened or sufficient resist marking during the application and to damp hardened concrete and shall form a continuous film when applied at a rate of 5 m²/litre. When dry, the covering shall be continuous flexible and without visible breaks or pin holes and shall remain as unbroken film at least 28 days after application. It shall not react deleteriously with the concrete.

The compound shall meet with the requirement of water retention test as per ASTM designation C-156-80. The loss of water in this test shall be restricted to not more than 0.55 kg/m² of exposed surface in 72 hours.

The white pigmented compound (Type 2) when rested as specified in accordance with method E-79 of ASTM shall exhibit a day light reflectance of not less than 60% of that of magnesium oxide.

It shall fulfill the requirement of drying time when tested in accordance with ASTM-C-309-81. The compound applied shall be dry to touch in not more than 4 hours. After 12 hours it shall not be tacky or tack off (peel off) concrete when walked upon nor it shall impart a slippery surface.

The liquid compound should be of a sprayable consistency.

3. Supply and Testing

3.1 Acceptance Testing

Prior to the approval of the brand/trade name of compound and the source of supply and manufacturer acceptance testing shall be carried out to demonstrate the conformance of the compound to Clause 2 above. In addition, testing shall be performed to demonstrate that no adverse/undesirable change in quality of concrete or concrete surface takes place as a result/by-product of use of the compound. These tests should be designed to check properties such as loss of strength at 28 days of surface layer, or of concrete cube, change in surface texture, change in adhesion to subsequently applied layers like plaster, flooring, tiling etc. The type and number of tests are to be as specified by the engineer.

3.2 Routine Testing

a) The liquid membrane forming curing compound should be brought in the manufacturer's original clear containers. Each container shall be legibly marked with the name of the manufacture, the trade name of the compound, the type of compound and class of vehicle/solids, the nominal percentage of volatile material and batch or lot number. The lot numbers will be assigned to the quantity of compound mixed, sampled and tested as single product. The manufacturer shall exercise the care in filling the container so that all are equally representative of the compound produced.

b) Curing compound to be used on site shall be got tested at least 14 days in advance so that the result of water retention tests, reflectance test, drying etc, are available before it can be permitted for use. All of the filled containers represented by the approved sample shall then be sealed to prevent leakage, substitution or dilution. The engineer-in-charge or authorised representative should mark each container represented by the samples with a suitable identification mark for later identification and correlation and shall be kept in store with double lock arrangements. One key shall be kept with the Contractor and the other with Engineer. Random samples shall be collected from every batch of the compound. Frequency of random sampling shall be done as directed by the Engineer. The contractor shall provide samples and labour for collecting samples free of cost. Testing shall be carried out by agency approved by the engineer and in presence of his representative.

4. Method of Application

The compound shall be sprayed using mechanical sprayer of approved design to ensure uniform and continuous membrane on the concrete surface. The coverage shall be at the rate specified by the manufacturer or at the rate of 4m² per litre or as specified by the manufacturer and approved by the engineer. Field trials shall be conducted to decide effective coverage rate, which depends upon surface finish. The engineer after verification of the field and based on the actual experience shall order the rate of application as needed for achieving the proper curing. With a view to ensure thorough and complete coverage, approximately one half of the compound for a given area should be applied by moving the spray gun back and forth in one direction and the remaining half at right angles to this direction. In case the application is still not found uniform, the contractor shall have to apply the second coat as and when directed by the Engineer. If a second coat is to be applied, it should be applied approximately after an interval of one hour. The curing compound shall generally be applied as soon as the bleeding water or shine disappears, leaving dull appearance.

If surface treatment by roughing, hand brushing etc., is required (e.g. as in case of road pavements) the curing compound should be applied immediately after the same. Equipment for spraying curing compound shall be of pressure tank type (5 to 7 kg/cm²) with provision of continuous agitation. A curing jumbo with multiple travelling spray fans shall be provided for effective spray. Spraying on concrete lining shall be done in such a way that the green concrete is not disturbed or damaged or any foot impression left. Necessary schemes or spraying by mechanised means shall be got approved by the Engineer-in-charge. However, in emergency for very small areas/ patches) it can be applied with wire or bristled brush.

Appendix A-3

CHUTE DRAIN FOR HIGH EMBANKMENT SECTIONS

1 Scope

This work shall consist of construction of chute drain on the slope of the road embankment including erosion protection works at the locations and to dimensions shown on the Drawings or as directed by Engineer. Schedule of works shall be arranged that the drains are completed in proper sequence with roadway to ensure that no damage is caused to lack of drainage.

2. Materials

The drains shall be in M-20 grade PCC with a base concrete in M-15 grade concrete as indicated in the drawing. The PCC work shall conform to the relevant clauses of these specifications.

3 Construction Operations

At the locations where the chute drains are to be installed, a rectangular cut in stepped from on the side slopes of the embankment along the line of the chute drain shall be made. The Concrete bed with PCC M-15 grade shall be laid as shown in the drawing.

The water collection arrangement shall be constructed with cement concrete of grades as shown in drawing at shoulder edge between two chutes for guide surface water into the chutes.

Dry stone pitching in one meter width shall be constructed on either side of the chute as shown in the drawing.

4. Measurement for Payment

The Chute Drain shall be measured and paid in running metre. The Contract unit rate specified for Chute drain shall be inclusive of all leads and lifts for excavations, concerting of chute bed and chute, including necessary from work for drainage arrangement between two chutes at shoulder edge, Dry stone pitching shall be paid separately under the corresponding BOQ item.

Appendix A-4

SPECIFICATION FOR ELECTRICAL WORKS

1. Diesel Generating Set

1.1 Diesel Engine

Vertical 6 cylinder, air cooled, naturally aspirated, cold starting, compression ignition, totally enclosed, 4 stroke cycle, high speed Diesel Engine of 1500 RPM under NTP conditions of BS:694/1958. The engine shall be complete with following accessories.

a) Crank Case fly wheel inside

b) Crank Case foot gear inside

c) 12V electrical starter motor with Battery & leads

d) Control panel consisting of cutout, push button for starting, lube oil pressure gauge and Ammeter

e) Exhaust Silencer

f) Air cleaner

g) Fuel lift pump

h) Radiator Assembly

i) Fuel tank of suitable capacity

j) Anti-Vibration Mounting

k) Exhaust pipe

l) Only M.S. pipes for the exhaust and fuel oil lines shall be used

m) Cladding of exhaust pipe work using 50mm thick glass wool/ mineral wool/ rock wool, density not less than 46 kg/sqm and aluminium cladding (0.80 thick) for the complete portion of the exhaust pipe

n) D.G. set upto 1000 KVA capacity shall be supplied with acoustic enclosure as per CPCB norms

1.2 Alternator

Self excited and self regulated 415 V, 0.8 pf (Lag) 3 phase (4 wire), 1500 RPM, 50 Hz alternator provided with static excitation generally conforming to BS:2613/1970. The generator shall be capable of 10% overloading at the rated speed for one hour.

1.3 Arrangement

The engine and alternator shall be coupled by means of a flexible coupling and both shall be mounted on rigid fabricated base frame to form a compact arrangement

1.4 Control Panel

Floor mounting, totally enclosed, sheet steel control panel complete with all internal wiring, earth bus, earthing studs, final paint as per IS-5 & comprising of:-

1 No. MCCB of suitable rating for ON/OFF of power supply.

1 No. Voltmeter Selector Switch.

1 No. Voltmeter (0-500 V)

3 Nos. CTs of suitable CT ratio.

1 No. Ammeter Selector Switch

1 No. AC Ammeter of suitable Scale

1 No. Frequency meter

1 No. P.F. meter

1 No. KW meter

1 No. KWH meter

1 No. Battery Charger

1 No. Changeover Switch from Auto to Main Control

Note: Set of Indicating Lamps Push button's, Emergency Push button & Control fuses as required. Obtaining approval of the installation of DG sets from concerned Electrical Inspectorate & Pollution Control Bodies and any other statutory bodies shall be in the scope of the Electrical Contractor.

1.5 Feeder Pillar

The feeder pillar shall be fabricated out of 2 mm thick sheet steel, and shall be of free standing pedestal mounted pattern, with sloping canopy. The main frame shall be out of 50 mm x 50 mm x 6 mm MS angle iron. Feeder pillar shall have heavy duty hinges and the door shall be front open type with provision of neoprene gaskets. The feeder pillar enclosure shall be provided with pad locking facility and shall be dust and vermin proof, having powder-coated paint finish of approved colour over two coats of rustproof primer paint, carried out over pickled anti-sulphate and anti-rust chemical treatment of the raw sheet steel.

The incoming shall be controlled by a 4P changeover switch to facilitate changeover of supplies between normal & emergency & MCCB/MCB of suitable rating. 3 nos. phase indication lamps

with 2 Amps rewirable fuse shall be provide for checking healthiness of main supply. Suitable panel illumination circuit with tumbler switch shall be provided inside the feeder pillar to enable night shift technicians to attend to the feeder pillar. This lamp shall be connected from a separate SP MCB outgoing circuit.

Outgoing feeder controls shall be by means of four pole/single pole MCBs, time-switches and power contractors as detailed in single line diagram. Time over-riding facility shall be through single pole MCB isolators. Internal wiring for time-switches and contractors shall be carried out using 7/18 PVC insulated copper conductor wires. The bus bar shall be of aluminium and rated for 250/200 Amps. The MCBs and MCB Isolators shall be mounted on DIN channels.

Necessary space shall be provided at the bottom of the feeder pillar to allow glanding and terminations of incoming feeder cable and outgoing feeder cables. Necessary number of knock outs shall be provided at the bottom gland plate for incoming and outgoing feeder cables as per details in single line diagram. The cable alley shall have adequate working space. The removable cover and gland plate of the cable alley shall be duly gasketed and fitted using minimum 8 mm size nuts and bolts. Steel screws are not permissible for the purpose. Adequate louvres shall be provided in the feeder pillar to enable natural ventilation. An earth bus bar of adequate cross section with pre-drilled holes shall be provided inside and two earthing studs shall be provided outside the feeder pillar. Necessary danger boards shall be fixed on the front and back covers of the feeder pillar.

The feeder pillar shall in general conform to IS : 5039 - 1969. General arrangement drawings together with wiring data and makes and complete technical data of components of the feeder pillar shall be submitted by the bidder for approval before manufacturing the feeder pillar. Fabrication and assembly of the feeder pillar shall be taken up only after obtaining approval of the drawing from the purchaser.

1.6 Junction Boxes

The Junction Box for mounting on street light or general area lighting poles shall be fabricated out of 3 mm thick sheet steel, and shall have powder coated paint finish of approved colour over two coats of rust proof primer paint, carried out over pickled anti-sulphate and anti-rust chemical treatment of the raw sheet steel. The junction boxes shall be dust and vermin proof and provided with neoprene gaskets. The front of the junction box shall open upwards, by means of heavy duty hinges provided on the top edge. The bottom of the front cover shall have two numbers key-operated locking arrangements. Provisions inside the junction box shall comprise of 8 way ELMEX type 20 Amps terminal block, insulator mounted 4 way neutral link rated 32 Amps, earthing terminal and rear side hole (to let in luminaire wiring inside the pole) and 1 no. 6 Amps HRC fuse base and fuse link for every lurninaire. Earthing bolts shall be provided on the exterior of the junction box as well. The bottom of the junction box shall have 2 nos knock-outs to facilitate glanding, of aluminium conductor PVC insulated armoured cables. 2 Nos 32 mm x 6 mm thick MS plates shall be welded on the rear side of the junction box to the complete width of the box and projecting 75 mm on either side to take the pair of semi-circular clamps for the purpose made out of 32 mm x 6 mm flats. The clamps and the flats welded on the junction box shall be assembled on the pole using 8 mm dia fine threaded bolts and nuts, together with a set of flat and spring washers. Necessary holes shall be provided on the pair of semi-circular clamps and the 32 x 6 mm flats of the junction box to suit the diameter of the pole. The rear side of the junction box shall be provided with 13 mm bore to allow entry for wiring from the junction box to the lurninaire on pole top. The junction box shall be at a height of 300 mm above finished road level.

Detailed drawings shall be submitted for purchaser's approval before taking up the manufacture of the junction box. Manufacture of boxes shall be taken up only after the drawings are approved. Prior

to mass manufacture, one sample set of box and clamps shall have to be got approved by the purchaser.

2. General Area Lighting

2.1 Poles

The 3M length poles for general area lighting shall be made out of class B 50 mm dia GI pipes. The 9mtr/ l1mtr poles shall be of the steel tubular or steel rail type. The pipes shall be complete with base plate of size 300 mm x 300 mm x 25 mm thick. The heights of poles shall be as detailed out in the drawings. The poles shall be suitably fixed in cement concrete foundation of 500mm x 500mm size & height 500 mm above & below ground level (500mm for 3m poles, 1500mm for 9m poles & 1800mm for 11m poles). The general area of street lighting poles shall be supplied with two coats of corrosion resistant primer. The finishing coat shall be to the specified shade of IS-5. The street lighting poles shall be erected truly vertical.

3. Lighting Fitting and Accessories

3.1 Scope

This specification covers the design, material specification, manufacture, testing, inspection and delivery to site and installation & commissioning of lighting fittings and their associated accessories

3.2 Standards

The lighting fittings and their associated accessories such, as lamps/tubes, reflectors, housings, ballasts, etc. shall comply with the latest applicable standards as specified. Where no standards are available, the supply items shall be backed by test results, shall be of good quality and workmanship & any supply items which are bought out by the VENDOR shall be procured from approved manufacturers acceptable to the PURCHASER/ENGINEER

4. Lighting Fittings - General Requirements

Fittings shall be designed for continuous trouble free operation under atmospheric conditions as applicable in site without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather-proof and rain-proof type and also suitable for use in dusty & vapour prevalent atmosphere.

The fittings shall be designed so as to facilitate easy maintenance, including cleaning, replacement of lamps/starters etc.

Connections between different components shall be made in such a way that they will not work loose by small vibration.

For each type of lighting fitting the VENDOR shall supply the utilization factor to indicate the proportion of the light emitted by the bare lamas which falls on the working plane.

All fittings shall be supplied complete with lamps suitable for operation on a supply voltage and the variation in supply voltage.

The fittings and accessories shall be designed to have low temperature rise. The temperature rise above the ambient temperature shall be as indicated in the relevant standards.

All mercury vapour (now a days LED lamps are being used) and sodium vapour lamp fittings shall be complete with accessories like lamps, ballasts, power factor improvement capacitors, starters wherever applicable, etc. These shall be mounted as far as possible in the fitting assembly only. If these cannot be accommodated inside, then a separate metal enclosed box shall be included to accommodate the accessories and in addition with a fuse and a terminal block suitable for loop-in, loop-out connections. Outdoor type fittings shall be provided with outdoor type weather-proof box.

All fluorescent lamp fittings shall be complete with all accessories like ballasts, power factor improvement capacitors, lamps, starters and capacitors for correction of stroboscopic effect.

Each fitting shall have a terminal block suitable for loop-in, loop-out and T-off connection by 650/1100V, 3 core, PV insulated Cu conductor cable of 2.5 sq.mm in size unless otherwise specified. The internal wiring should be completed by the MANUFACTURER by means of stranded copper wire and terminated on the terminal block.

The mounting facility and conduit knock-outs for the fixtures shall be as specified.

All hardware used in the luminaire shall be suitably plated or anodized and passivated for use in chemical industrial and power plants.

5. Earthing

Each lighting fitting shall be provided with an earthing terminal suitable for connection to the earthing conductor.

All metal or metal enclosed parts of the housing shall be bounded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

6. Painting/Finish

All surfaces of the fittings shall be thoroughly cleaned and degreased. The fittings shall be free from scale, rust, sharp edges and burrs.

When enamel finish is specified, it shall have a minimum thickness of 2 mils for outside surface and 1.5 mills for inside surface. The finish shall be non-porous and free from blemishes, blisters and fading.

The housing shall be stove-enamelled/epoxy stove-enamelled-vitreous enamelled or anodized as indicated on flame-proof fittings is prohibited.

The surface shall be scratch resistant and shall show no sign of cracking or .flaking when bent through 90° over ½" dia mandrel.

The finish of the fittings shall be such that no bright spots are produced either by direct light source or by reflection.

7. Decorative Type Fittings

Decorative fluorescent fittings shall be provided with mounting/housing channel cum reflectors of CRCA sheet steel, stove enamelled.

Diffusers or louvres shall be provided as required. Diffusers shall be of translucent white opal acrylic or depending upon the type of fitting

Fittings shall be suitable for the number of lamps of specified wattage, for directly mounting on ceiling/conduit suspended or for recess mounting in false ceiling, as specified

Decorative incandescent fittings when required, shall be suitable for 60/100/150W lamp, suspended or recess mounting in false ceiling. The fitting for recess mounting shall be provided with copper anodized finished cylinder, ceiling mounting ring and translucent acrylic crystal ring.

8. Accessories for Lighting Fittings

8.1 Reflectors

The reflectors shall be made of CRCA sheet steel aluminium/silvered glass/chromium plated sheet copper as indicated for above mentioned fittings, unless otherwise specified.

The thickness of steel/aluminium shall comply with relevant standards specified. Reflectors made of steel shall have stove enamelled/vitreous enamelled/epoxy coating finish. Aluminium used for reflectors shall be anodized/epoxy stove enamelled/mirror polished. The finish for the reflector shall be as indicated for above mentioned fittings.

Aluminium paint on the reflectors of flame-proof lighting fittings is prohibited.

Reflectors shall be free from scratches or blisters and shall have a smooth and glossy surface having an optimum light reflection coefficient such as to ensure the overall light output specified by the MANUFACTURER.

Reflectors shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be securely fixed to the housing by means of positive fastening device of captive type.

8.2 Lamp/Starter Holders

Lamp holders shall comply with relevant standards. They shall have low contact resistance, shall be resistant to wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met with in normal installation and use.

Lamp holders for the fluorescent lamps shall be of the spring loaded bi-pin rotor type. Live parts of the lamp holder shall not be exposed during insertion or removal of the lamp or after the lamp has been taken out. The lamp holder contacts shall provide adequate pressure on the lamp cap pins when the lamp is in working position.

Lamp holders for incandescent and mercury vapour lamps shall be of bayonet type upto 100W and Edison Screw type for higher Wattage lamps.

Starter holders for fluorescent lamps shall conform to the standards specified. All Material used in the construction of the holder shall be suitable for tropical use.

The starter holders shall be so designed that they are mechanically robust and free from any operational difficulties. They shall be capable of withstanding the shocks met within normal transit, installation and use.

8.3 Ballasts

The ballasts shall be designed, manufactured and supplied in accordance with the relevant standards. The ballasts shall be designed to have a long service live and low power loss.

Ballasts shall be mounted using self locking, anti-vibration fixings and shall be easy to remove without demounting the fittings. They shall be in dusting, non-combustible enclosures.

The ballasts shall be of the inductive, heavy duty type, filled with thermosetting, insulating, moisture, repellent polyester compound filled under pressure or vacuum. Ballasts shall be provided with tappings to set the voltage within the range specified. End connections and taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure. The ballast wiring shall be of copper wire. They shall be free from hum. Ballasts which produce humming sound shall be replaced free of cost by the VENDOR.

Separate ballast for each lamp shall be provided in case of multi-lamp fittings, except in the case of 2 x 20 watts fittings.

8.4 Starters

Starters shall have bimetal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool. Starters shall have brass contacts and radio interference capacitor.

The starters shall generally conform to the relevant standards.

8.5 Capacitors

The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.

The capacitors shall be suitable for operation at supply voltage and shall have a value of capacitance so as to correct the power factor of its corresponding lamp circuit to the extent of 0.95 lag or better.

The capacitors shall be thermetically sealed preferably in a metal enclosure to prevent seepage of impregnant and ingress of moisture.

8.6 Lamps

Incandescent (GLS) lamps shall be provided with bayonet caps upto 100W and E.S. type for higher wattage. Lamps shall be of "clear" type unless otherwise specified.

The fluorescent lamps shall be 'Day-light colour' type unless otherwise specified and shall be provided with features to avoid blackening of lamp ends.

Mercury vapour lamps shall be of high pressure, colour corrected type.

The constructional features of gas discharge lamps for special applications such as stated in para 5.5 or for instant start fluorescent lamps if specified, shall be clearly brought out in the bid.

The lamps shall be capable of withstanding small vibrations and the connections at lead in wires and filaments/electrodes shall not break under such circumstances.

Lamps/tubes shall conform to relevant standards and shall be suitable for supply voltage and frequency specified.

8.7 Spare Parts

Unit prices of the items shall be quoted together with catalogue numbers.

The unit prices shall not however be limited to the above items. The VENDOR may recommend additional spare items and quote the unit prices of the respective items.

8.8 Tests and Test Reports

Type tests, acceptance tests and routine tests for the lighting fittings and accessories covered by this specification shall be carried out as per the relevant standard for the respective fittings and their accessories.

The MANUFACTURER'S type and routine test certificates shall be submitted for tests conducted as per relevant standards for the fittings and accessories. The BIDDER shall submit with his proposal copies of available test certificates of the fittings offered.

9. 30 Mtr High Mast with Mobile Lantern Carriage

9.1 Mast Design Criteria

The mast shall be designed in such a manner that it is capable of withstanding external forces exerted by wind pressure as per site conditions & as per relevant standards and should have a minimum wind load factor of 1.25

9.2 Mast Structure and Construction

The mast shall be fabricated from special steel plates to BS 4360

The mast shall be fabricated from special steel, cut and folded to form polygonal section. All sections shall have only one longitudinal weld as per BS 5135 with no circumferential weld.

30 Mtr. High mast shall be in sections with minimum length of 9.0 mtrs.

Bottom section of mast shall have suitable flange plate welded to it.

9.3 External/Internal Finish/Assemble of mast sections

Fabricated welded mast sections as detailed under clause 9.2 above shall be hot dip galvanised as per BS 729 Part -1 both internally and externally.

After the delivery of mast in 3 sections only, these shall be joined at site by slip stressed fit method with necessary stressing equipment. No site welding or bolted joints shall be accepted. The overlap distance shall have full penetration of longitudinal welds.

9.4 Base compartment

For providing access to the equipments like winch main switch, cable, plug, sockets etc., a door opening of size 320 mm x 700 mm shall be provided for ease of installation/maintenance.

9.5 Head Frame

The head frame designed to be a capping unit of the mast shall be of welded steel construction, galvanised internally and externally after assembly.

The suspension arrangement for lantern carriage shall be with three ropes of stainless steel running on a minimum three pulleys for superior stability. There shall be a fourth pulley for running the electric supply cable.

The pulleys shall be of non-corrodible material and shall run on stainless steel shafts/spindles. They shall be of self lubricating type. The pulleys shall be designed if necessary with suitable guards to ensure correct locations of the cable in their grooves during operation.

The whole head frame assembly shall be covered and protected by spun aluminium canopy.

9.6 Lantern Carriage

It shall be of mild steel construction and hot dip galvanised internally and externally. The lantern carriage shall be so designed and fabricated to hold designed number of flood light fittings and their control gear boxes if any. Lantern carriage shall carry necessary junction box on non-corrodible material and class IP 55.

The lantern carriage shall be so installed that it does not cause any damage to the surface of the mast and is provided with protective buffer arrangement.

There shall be provision for docking and locking of lantern carriage in the elevated position such that wire ropes are not under tension all the time.

9.7 Mechanical Arrangement

Winch - The winch shall be sustaining/self lubricating type without the need of brakes, springs or clutches. Both the drums should operate simultaneously without the need for any external gear arrangement.

The winch shall be provided with two completely separate suspension system and shall not be one on top of the other.

The winch shall have a safe working load capacity of minimum 550 kgs.

Termination of winch ropes shall not involve any distortion or twisting of the rope. At least four turns of rope shall remain on the drums when the lantern carriage is fully lowered.

9.8 Support Ropes

Stainless steel ropes shall be five in number, the winch cable shall be minimum six mm having a breaking load of not less than 2200 kgs. Cable for the lantern carriage shall be min 4.0 mm and three in number having breaking load of not less than 1675 Kgs.

The three suspension stainless steel ropes shall hold the lantern carriage at one end and at the other end shall terminate at a junction plate from which two winch cable shall go to the winch. Necessary provision will be made at the junction plate for adjusting the rope lengths for levelling the lantern carriage.

9.9 Supply Cable

Power supply cable shall be class B insulated with min 5 core conductor provided with multi pin heavy duiy locking type male/female connectors at the ends.

Test lead shall be of five mtr length min 4 core 2.5 sq.m copper conductor provided with multi pin heavy duty locking type male/female connectors at the ends. Under no circumstances the test lead shall travel through the mast.

9.10 Foundation

The tenderer shall design necessary foundation based on required soil bearing capacity. The tenderer shall be responsible for the design of foundation and safe erection/installation of high mast.

Anchor bolts shall be made of high tensile steel grade EN 19. Suitable anchor plate shall be provided for holding down the bolts in position.

9.11 Power Tool

Power tool shall be three phase reversible type.

Rating of motor shall be continuous duty of suitable rating. It shall be capable of taking the load of whole lantern carriage with luminaries, control gear boxes, lightning arrestor & aviation obstruction light mounted on it.

Raising and lowering shall be with the help of remote control box operated from five mtr distance.

Remote control shall have necessary protective devises for over current, overload, single phasing etc.

Manual handle shall be supplied with power tool for operating the winch manually in case of power failures.

9.12 Earthing

Tenderer shall provide necessary pipe earthing as per relevant IS and connect this to the electrical installation as per regulations

10. LT CABLES

10.1 Codes & Standards

The design construction manufacture and performance of cables shall comply with all currently applicable statutes, regulations and safety codes of the locality where cables will be installed. Nothing in this specification shall be constructed to release the Contractor of his responsibility.

Unless otherwise specified the cables shall conform to the latest applicable standards.

10.2 Power Cable

Power cables should be multicore earthed 1.1 kV grade aluminium stranded conductor colour coded, extruded/PVC insulated/XLPE cables, extruded semi-conducting screened over each core and insulation, extruded inner sheathed, common extruded inner sheathed for multi core cable,, galvanised steel strip armoured and overall extruded black sheath conforming to IS-1554 Part II. Armouring of multicore cable shall be of single layer, galvanised steel round wire or flat strip. Wire armour should be used for cable dia over inner sheath upto 13 mm and strip armour to be used for higher dia. The cables should be multicore and suitably designed for variation in power supply as follows:

The voltage variation	± 10 %
Freq. variation	± 5 %
Combined voltage & frequency variation	± 10 %

10.3 PVC Sheath

The PVC compound used for outer sheath shall be resistant to termites, fungus and rodent attacks and shall have in addition the property mentioned in clause 6.0 above.

10.4 Cables Size

L.T. Cables - As mentioned in SLD/Bill of Quantities.

10.4 Laying of LT Cables

a) The cables shall be laid in an excavated trench. The depth of the trench shall be minimum 750 mm below the final ground level but shall be decided on the number of cables to be laid in the trench so that the vertical distance between two adjacent layers of cables shall not be less than 350 mm. The width of the trench shall be decided on the number of cables to be laid in the

trench so that the distance between two adjacent cables shall not be less than one cable diameter.

b) Before laying cables the bottom of the trench shall be well compacted and the cables shall be laid on a 100 mm fine sand bedding. The second layer of 150 mm of fine sand then be spread over the cable and shall be further covered by 150 mm of compact soil. For the second layer of the cable same procedure shall be repeated.

c) The cables shall be protected by placing precast concrete tiles or burnt bricks over the cables on top layer of sand and for the full length of underground cables. Where more than one cable is running in the same trench, the concrete tiles/ bricks shall cover all the cables and shall project a minimum of 80 mm on either side of the cables
In any case the top layer of the cables shall be minimum 600 mm below the finished level of the ground.

d) The top of the cable trench shall be well compacted till the finished level of the ground and shall be approved by the construction manager/consultant if required a laboratory compaction test shall be carried out in presence of the Construction manager/Consultant.

e) Cables under road crossings and any surfaces subjected to heavy traffic shall be protected by running them through hume pipes of suitable size

11. Earthing System

11.1 General

The earthing system shall comply with all currently applicable standards, regulations and safety codes of the locality where the installation is .to be carried out. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.

The installation work shall conform to the latest applicable Electricity Rules, standards (IS:3043) and codes of practice.

11.2 Earth Electrode

Electrodes shall as far as practicable, be embedded below permanent moisture level.
Some electrodes shall be housed in test pits with concrete covers for periodic testing of earth resistivity. Installation of rod/pipe/plate electrodes in test pits shall be convenient for inspection, testing and watering.

11.3 Pipe Earth Electrodes

GI pipe shall be of medium Class-B 40 mm dia and 4.5 m length. Galvanising of the pipe shall confirm to relevant Indian Standards. GI pipe electrodes shall be tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5 cm from each other up to suitable length from bottom. The electrode shall be buried in the ground vertically with its top not less 20 cm below ground level.

11.4 Method of Connecting Earthing Lead to Earth Electrode

In the case of plate earth electrodes, the earthing lead shall be securely bolted to the plate with two bolts, nuts, checknuts and washers. In the case of pipe earth electrodes, they shall be connected by means of a through bolts, nuts and washers and cable socket.

All materials used for connecting the earth lead with electrodes shall be GI in case of GI pipe and GI plate earth electrodes and of tinned brass in case of copper plate electrodes.

The earthing lead shall be securely connected at the other end to the main board.

12. GENERAL

12.1 Scope

The Scope of work under Internal Electrical Works shall cover the supply, installation, testing and commissioning of the complete Internal Electrical Installation detailed as under and as shown in drawings.

a) Design, manufacture, supply, installation, testing and commissioning distribution boards for Power Lighting & Emergency Supply.

b) Supply, installation, testing and commissioning of light control switches, lighting and power receptacle units, all wiring and submains, conducting including point wiring, circuit wiring alongwith wiring accessories and all other items necessary for lighting system. All internal wiring shall be in recessed with UPVC conduits.

c) Obtaining approvals from the Chief Electrical Inspector and all other statutory authorities for the completed scope of work.

It is not the intent to specify completely herein all aspects of design and constructional features of equipments and details of the work to be carried out, nevertheless, the equipment and work shall conform in all respects to high standards of Engineering, design and workmanship and shall be capable of performing in continuous operation in a manner acceptable to the Owner who will interpret the meaning of the specifications and drawings and shall have right to reject or accept any work or material which in his assessment is not complete to meet the requirement of this specifications and or applicable code and standards mentioned elsewhere in this specifications.

12.2 Drawing specifications

Drawings shall be followed as closely as actual building conditions permit. If any deviation from the drawings are necessary to make the work conform the building conditions and to co-ordinate with other works such deviations shall be brought to the attention of the Engineer. Sizes of structural members etc. and services drawing shall be studied to ensure that this installation does not interfere with other trades and so that the locations of electrical equipment maybe positively established.

Where the contractor has to prepare the drawings e.g. Conduit Layouts, Earthing Layout, etc., it shall be contractor's responsibility to have these drawings prepared and got approved by the Engineer before proceeding with fabrication.

12.3 Fabrication Drawings

The contractor shall submit all the fabrication details based on the equipment offered in the tender for the approval of the Engineer before commencing the work. The details shall contain all setting

out details and physical dimensions of all fabrication works, equipment offered and their foundation/mounting details.

12.4 Brochures and data

The contractor shall submit four copies of all brochures, manufacturer's description data and similar literature. One copy will be returned to the contractor after approval.

12.5 Scale

Electrical layout plans shall be drawn to the scale as established on drawings and shall indicate the size and location of all equipments and accessories herein. The contractor shall obtain all dimensions preferably at the site and check those plans for interference with the building structure and other equipment.

12.6 Approval

The Engineer's approval of such drawings, schedule, brochures, etc. will be an approval of general details and arrangements only and shall not relieve the contractor from responsibility for deviation from drawings or specifications unless he has in writing called the Engineer's attention to such deviations at the time of submission nor shall it relieve the contractor from responsibility for errors or omissions of any kind in the shop drawings when approved.

12.7 Storage

All materials and equipments shall be stored properly to the satisfaction of the Engineer so that physical handling and climatic conditions do not affect the equipments.

12.8 Cutting & Patching

Cutting, patching and redoing shall be kept to the minimum. Wherever such works are required to be carried out, necessary permission shall be obtained from Engineer before cutting and patching up. Those shall be subsequently furnished properly to the satisfaction of Engineer. Care shall be taken to prevent spreading of equipment and finishings.

All work, equipment and material shall be protected at all times to prevent obstructions, damage or breakage. All equipments shall be covered and protected against water, dust, sand as well as chemical & / or mechanical damage. At the completion of the work, all equipment shall be thoroughly cleaned and delivered in a perfect unblemished and working conditions.

12.10 Vibration noise Isolation

The contractor shall provide equipment vibration isolation base for floor mounted equipment. Bases shall be separated from building floor by means of approved vibration isolation pads to be provided by the contractor.

12.11 Guarantee

The Contractor shall furnish one year guarantee on all major equipments. This shall include guarantee against defects in workmanship or material in any part or accessory. If any higher period is implied elsewhere in this contract, the same shall hold and govern. If any defects are found during the guarantee period, the defective part or work shall be replaced by the contractor at no additional cost to the Employer.

12.12 Maintenance and operation

The contractor shall advise the operating personnel of the Owner in the maintenance and operation of installation, including necessary training to the owner's personnel at no extra cost.

12.13 Handing over Installation

The contractor shall hand over the complete installation to the Owner representative in clean, brand new & perfect working condition. All areas shall be thoroughly cleaned of all debris, trash and unwanted materials cleaned and handed over in perfectly finished ready to use condition.

12.14 Contract Rates

The rates and prices shall be deemed to have included all labour, materials used, plants and tools, temporary works, minor building works like cutting, chases, holes, making good, grouting, finishing etc., insurance, sales tax, local taxes and duties, establishment charges, profit, supervision, transport, storage, testing & commissioning and other charges and fees and every expenses required to be incurred for proper and due execution including approval from Electrical Inspector and/or from all other statutory authorities or may be required and amended by laws till commissioning of the project.

Rectifications, if any, suggested by such authorities shall be carried out by the contractor at his own cost.

Completion and maintenance of the works shall be executed by the contractor in full satisfaction and discharge of every obligation imposed upon him by these specifications, schedule of drawings.

12.15 Competency of Electrical Staff

Accepted norms of good workmanship is required. The electrical works shall be done by qualified and trained staff having First Class Wireman's license and Supervisory Competency Certificate having sufficient competency in electrical works and under the overall supervision of electrical contractors.

12.16 Approval of Materials

All materials used on the works shall be new and of the best quality available, conforming to the relevant specifications and Approved Makes List. Prior approval should be obtained in writing from the Engineer for all materials proposed to be purchased of makes not included in 'Approved Makes List' and when necessary, approved sample duly identified and labelled shall be deposited with the Engineer.

12.17 As built drawings

On completion of work, the contractor shall submit to the Engineer, a reproducible and five copies of as built drawings showing:-

a) Conduit layout, location of junction boxes and number of wires through each section of conduit.

b) Circuit distribution scheme for each main and sub-distribution board. This shall indicate various outlets controlled by each fuse/circuit breaker and phase wise distribution of load.

c) Location of distribution and sub-distribution boards.

d) Distribution layout of telephone system.

e) Distribution layout of computer network

f) Earthing system

The contractor shall submit the certificate from original equipment manufacturer for the satisfactory installation of all equipments.

a) Indian Electricity Rule 1956 & its latest amendments.

b) Bureau of Indian Standards Specifications of all necessary equipments.

c) Local bye-laws

The contractor shall submit the certificate from original equipment manufacturer for the satisfactory installation of all equipments.

13. Lighting System Equipment

13.1 Scope

This specification covers the design, manufacture, testing, inspection and delivery to site of lighting system equipment such as light control switches, lighting and power receptacle units, wires, ceiling fans, lighting fixtures, conduits and other similar items necessary for lighting system.

14 Sub-Distribution Boards (Normal & Emergency)

14.1 Constructional Features

Boards shall be sheet steel enclosed and shall be fully dust and vermin proof, providing a degree of protection of IP:52. The sheet steel used shall be cold rolled and 2 mm thick.

All boards and panels shall be provided with hinged doors for access to equipment. Doors shall be gasketted all round with neoprene gaskets. For wall mounting, lighting panels when provided with MCBs, a hinged, latched front door shall be provided with key-locking facility and a slotted Bakelite sheet shall be provided inside. Only the MCBs operating knobs shall project out of the bakelite sheet slots for safe operation and neat appearance.

All accessible live connections/metals shall be shrouded and it shall be possible to change individual MCBs from the front of the boards/panels without danger of contact with live metal.

Adequate interior cabling space and suitable removable cable entry plates shall be provided for top/bottom entry of cables through glands and or conduits. Necessary number of glands to suit the specified cable sizes shall be provided. Cable glands shall be screwed on type and made of brass.

Two earthing terminals shall be provided to suit the PURCHASER'S earthing conductor.

All sheet steel parts shall undergo rust-proofing process, which should include degreasing, de-scaling and a recognised phosphating process. The steel works shall then be painted with two coats of Zinc-chromate primer and two coats of final stove-enamelled finish paint of colour. For chemical/corrosive areas, epoxy paint shall be used.

14.2 Busbars

Busbars shall be of aluminium alloy of E91E grade.

Busbars shall be provided with at least the minimum clearances in air as per applicable standards for a 500V, 3 phase system.

Busbars shall be adequately sized for the continuous current rating such that the maximum temperature of the busbars, busbar risers/droppers and contacts does not exceed 85°C under site reference temperature.

The busbars, busbar connections and busbar supports shall have sufficient strength to withstand thermal and electro-mechanical stresses of the fuse/MCB’s let through/cut-off current associated with the specified short-circuit level of the system.

Busbar supports shall be made from suitable insulating material such as Hylam sheets, glass reinforced moulded plastic materials, permmali wood or cast resin. Separate supports shall be provided for each phase of the busbars. If a common support is provided for all three phases, anti-tracking barriers shall be incorporated.

The neutral bus of the main 3 phase, 4 wire distribution board shall be rated not less than 50% of the phase busbars. The neutral bus of the 1 phase ways lighting panel shall be rated same as the phase busbars. The neutral bus should have sufficient terminals and detachable links for full number of single-phase outgoing lighting circuits.

15. Panels/Boards' Component Equipment

15.1 Miniature Circuit Breakers (MCB)

MCBs shall be hand operated, air break, quick make, quick break type conforming to applicable standards.

MCB shall be provided with overload/short-circuit protective device for protection under overload and short-circuit conditions. The minimum breaking capacity of MCBs shall be 10 kA r.m.s. at 415V. DB's shall be provided with locking facility.

15.2 Internal Wiring

Panel/boards shall be supplied completely wired, ready for the PURCHASER'S external connections at the terminal blocks. Wiring shall be carried out with 1100/550V grade, PVC insulated, stranded copper conductors. Conductors of adequate size shall be used to suit the rated circuit current.

Engraved identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire.

All wiring shall be terminated on terminal blocks. Terminal blocks shall be one piece moulded, 650V, of reputed make, preferably stud type for higher current ratings such that wires are connected by cable-lugs and complete with nuts and washers. Terminals shall be adequately rated for the circuit current, the minimum rating shall be 20A.

Terminals for circuits with voltage exceeding 125V shall be shrouded.

Terminals shall be numbered and provided with identification strip for identification of the circuit.

15.3 Labels & Diagram Plate

All door mounted equipment as well as equipment mounted inside the switchboards/panels shall be provided with individual labels with equipment designation/rating. Also the boards/panels shall be provided on the front with a label engraved with the designation of the board/panel as furnished by the PURCHASER.

Labels shall be made of non-rusting metal, 3-ply lamicoid or engraved PVC.

Inside the door of the 1-phase ways lighting panels a circuit diagram/description shall be fixed for reference and identification.

15.4 Light Control Switches

Light control switches of ratings and types, i.e. decorative shall be supplied as indicated in BOQ. The switches shall be grid plate type/Piano Key type suitable for use on 240V, 1 Phase, 50 Hz supply.

Switches shall be of flush type for mounting behind an insulated plate or incorporated with a switch plate for mounting flush with the surface of wall or switch box/suitable enclosure. The switch box/enclosure may be recessed into or mounted on a wall as per the requirements of project layouts.

The size of enclosure boxes shall be chosen to accommodate the number of switches to be installed at the particular location. The enclosures shall be 18-gauge sheet steel stove-enamelled/galvanized. The enclosure box shall be covered with perspex/insulating cover. An enclosure intended for surface mounting shall not have holes or gaps in its sides other than those expressly provided for cable entry.

15.5 Receptacle Units

Receptacle units shall consist of socket outlet with associated switch and plug. The socket outlet and switch or MCB shall be flush mounted within a stove enamelled / galvanized 18 gauge steel enclosure with perspex / insulating cover. The box may be recessed into or mounted, on a wall as

per requirements of project layouts.

The receptacle units shall be suitable for 240V, 1 phase, 50 Hz/415V, 3 phase, 50 Hz supply as indicated.

Single-phase receptacles shall be associated with a switch/MCB of same current rating and the receptacle shall become live only when the associated switch/MCB is in "ON" position.

The plugs shall be provided with cord grips to prevent strain and damage to conductors/wires at connection and entry points.

The types and current rating of receptacle units shall be as indicated in BOQ and they shall conform to the applicable standards.

Whenever required, receptacle units may be provided with MCBs instead of switch.

15.6 Ceiling Fans

Ceiling fans shall be suitable for operating on 230V, 1 phase, 50 Hz supply and shall be complete with standard mounting accessories such as suspension rods, top and bottom caps etc. The fans shall be supplied with appropriate speed regulators.

15.7 Lighting Wires

The wiring of lighting system shall be carried out through 650/1100V; PVC insulated, unarmoured, and stranded copper conductors, unless otherwise specified. The wires shall conform to the applicable standards.

The minimum area of conductors shall be 1.5 sq.mm for point wiring of light fittings and 6A receptacles and 4.0 sq.mm for receptacles rated 16A and above as indicated in BOQ. The Circuit wiring for light fitting shall be with 2.5 sq.mm stranded copper conductors.

The wires shall be coated red, yellow, blue for R, Y, B phase and black for neutral and green for earthing.

The approximate quantities of wires shall be indicated by the PURCHASER only when the same are not covered in the CONTRACTOR'S "Point Wiring" work under lighting system installation work.

Unless otherwise specified, lighting cables shall be of 650/1100V grade, 3, 3½ and 4C, VC insulated and armoured type for main distribution boards.

15.8 Conduits

UPVC (Unplasticised PVC) conduits and their associated fittings as per sizes shall conform to applicable standards. The minimum size of conduit shall be 20 mm.

Supply of conduits shall include all associated fittings like couplers, bends and tees as required for lighting system installation work.

15.9 Junction Boxes

Junction boxes with terminals shall be supplied for branching and terminating lighting cables when required for outdoor areas, 3 phase receptacles etc.

The junction boxes shall be dust and vermin proof and shall be fabricated from 14 gauge sheet steel and shall be complete with removable cover plate with gaskets, two earthing terminals each with nut, bolt and washer. Boxes shall be additionally weatherproof when specified.

The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable/conduit entry knockouts, terminal blocks, HRC fuses, etc.

The terminal blocks, with specified number of terminals, shall be mounted securely on brackets welded to the back sheet of the box. The terminals shall be 600V grade, one piece construction complete with terminals, insulation barriers, galvanized nuts, bolts and washers and provided with identification strips of UPVC. The terminals shall be made of copper alloy and shall be of box clamp type.

The boxes shall be painted with one shop coat of Red oxide Zinc chromate primer followed by a finishing coat of paint as specified.

16. Lighting System Installation Work

16.1 Scope

This specification indicates the requirements of lighting system installation work. The installation, testing and commissioning of complete lighting system and power receptacles shall be carried out in accordance with the Lighting Installation Notes, the PURCHASER'S / ENGINEER'S Drawings and as stipulated in this specification and Data Sheets. Separate Specifications when enclosed, cover the requirements of lighting equipment supply.

16.2 Codes and Standards

Electrical installation work shall comply with the latest applicable Standards, Regulations and Safety Codes of the locality where the equipment will be installed. Nothing in this Specification shall be constructed to relieve the CONTRACTOR of this responsibility.

Installation work shall conform to the latest applicable Code of Practice, Indian Electricity Rules, Fire Insurance Regulations and Standards.

16.3 Installation Work Scope

The installation work shall include storing, unpacking, fixing of all equipment associated with lighting system, routing and laying conduits, wiring, termination with copper lugs wherever required, testing, commissioning and all other work items necessary for completing the job.

The supply of all mounting accessories, earthing wires and incidental hardware and consumables like fixing saddles, spacer plates, junction boxes and conduits required for the fitting fixing/suspension points, point boxes and connectors, jointing ferrules, all fixing brackets, screws and studs, shall be deemed to be included as part of installation work, mounting accessories like saddles, spacer plates, joint boxes, junction boxes and fixing hardware shall be of galvanized mild steel.

The Contractor shall work in co-ordination with the Civil and Air-conditioning Contractors and where holes or openings in walls and floors, cut-outs in false ceilings are required the CONTRACTOR shall inform the ENGINEER and other respective Contractors. Holes in walls made by the CONTRACTOR shall necessarily be patched by him in a good and approved manner, using the same kind of masonry as in the uncut surfaces.

The CONTRACTOR shall be responsible if parts of panels, fittings, etc. are lost or damaged and fluorescent tubes/incandescent lamps/mercury vapour lamps/enclosures of glass/plastic etc. are broken during installation. All damage and thefts shall be made good by the CONTRACTOR till the installation is handed over to the PURCHASER.

The CONTRACTOR shall touch-up painting on lighting panels/boards if the same is damaged during installation handling.

16.4 Point Wiring

Whenever asked for, if installation is to be carried out on point wiring basis, the supply of following shall be deemed to be included as part of the installation work, in addition to the items mentioned in para 16.3.

a) 650/1100V lighting wires for conduit wiring, minimum size of 1.5 sq.mm PVC insulated copper conductor.

b) MS conduits with all relevant accessories and junction/inspection boxes. Minimum size 20 mm for exposed/concealed conduits respectively.

c) Necessary 6A/16A light control switches of grid plate type on MS boxes.

d) Required switch and receptacles units in similar boxes as in item (d) above.

Wiring of each lighting fitting/receptacle unit/ceiling fan/bell etc. shall be considered as one point. However, when two or more receptacles are to be wired at the same location/in the same box, wiring of first receptacle shall be considered as one point and wiring of each of subsequent receptacle at that location shall be considered as half point each.

16.5 Concealed Wiring

For installations requiring concealed conduit wiring, the supply, routing and laying of UPVC conduits of minimum size 20 mm in walls/ceiling, from lighting panels upto fittings, receptacles, inspection/junction boxes etc. shall be in the CONTRACTOR'S scope. The CONTRACTOR shall closely co-ordinate his work with that of the Civil Contractor. The CONTRACTOR shall prepare and furnish drawings showing the location of the embedded conduits/junction boxes/inspection boxes, based on the PURCHASER'S lighting layout drawings.

16.6 Wiring

Unless otherwise stated wiring shall be carried out in UPVC conduits. All types of wiring, concealed or unconcealed shall be capable of easy inspection. Unconcealed wiring when run along walls shall be as near the ceiling as possible. In all types of wiring, due consideration shall be given for neatness and good appearance.

Wherever specified, Emergency lighting shall be switched in through change-over Switch on AC mains failure, and manually switched in for testing, independently of normal lighting. Emergency lighting cables shall run in a separate conduit system.

In large rooms, the lighting system shall be distributed among three phases.

Wiring shall be colour coded so as to enable easy identification of phase and neutral conductors. The neutral shall be of the same size as the phase conductor.

There shall be a circuit breaker or a linked switch on each live conductor of supply mains at the point of entry. The wiring throughout the installation shall be such that there is no break in neutral wire in the form of switch or fuse unit.

Conductors not arranged for connection to the same system and circuit or supply different phases of the same supply, shall be kept a part throughout their entire run.

Receptacles and lighting fittings in general shall be fed from different circuits. Five amps receptacles for toilet or small change rooms can be fed from the lighting circuit with proper isolating arrangement.

Each final sub-circuit from a lighting panel shall be controlled by a single pole switch connected to the live conductor.

For long conduit wiring runs, inspection/pull boxes shall be provided at intervals not exceeding 5m. Such facilities shall also be provided at conduit bends.

16.7 General Practices

All receptacles and switches to be installed in offices and control rooms shall be flush mounted within the wall and those in other areas shall be wall or column mounted.

Ceiling roses shall not embody fuse terminals as an integral part of it. For voltages exceeding 250 volts, a ceiling rose or any similar attachment shall not be used,

A socket outlet shall not embody fuse terminals as an integral part of it. The switch controlling the socket outlet shall be on the live side of the line.

All exposed metal parts of the plug, when the plug is in complete engagement with the socket outlet, shall be in effective electrical connection with the earthing pin.

16.8 Earthing

Conduits and fittings shall be earthed by 14 SWG Copper wires unless otherwise stated, run along the length of the conduit and secured by means of suitable clamps efficiently fastened to conduit pipe. To achieve perfect electrical continuity, the conduits shall be bonded effectively on either end of a coupling and other joints. Earth bonding clips shall be provided.

Conduits shall be grounded at the ends adjacent to switch boards at which they originate or otherwise at the commencement of the run, by a earthing conductor connected at an earth clip, clamp or gland, in effective electrical contact with the conduit.

16.9 Testing and Commissioning

Before a completed installation, or an extension to an existing installation is put into service, installation tests stipulated in applicable Standards and Codes of Practices shall be carried out by the CONTRACTOR in the presence of the PURCHASER's / ENGINEER's representative.

16.10 General Instructions on Electrical Pre-commissioning Arrangement and Tests.

All tests shall be carried out by the contractor using his own instruments, testing equipment as well as qualified testing personnel.

The results of all tests shall conform to the specification requirements as well as any specific performance data guaranteed during finalisation of the contract.

At site all equipment shall be energised only after certification by the personnel performing the test that the equipment is ready for energising and with concurrence of the purchaser.

16.11 Cable Termination and Jointing

Termination and jointing of aluminium conductor power cables shall be by means of compression method using compression type aluminium lugs. Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be of tinned copper compression type.

17. Testing and Commissioning of Electrical Equipment and Installation

17.1 General

The testing and commissioning for all electrical equipment at site shall be according to the procedure laid down below.

All electrical equipment shall be tested, installed and commissioned in accordance with the latest relevant standards and codes of practices published by Indian Standards Institution wherever available and stipulations and in relevant general specifications.

In case where Indian Standards are not available these shall be carried out in accordance with the latest standards and codes of practice published by any other recognised National Standards Institution or latest publications of International Electro Technical Commission (IEC).

The testing of all electrical equipment as well as the system as a whole shall be carried out to ensure that the equipment and its components are in satisfactory condition and will successfully perform its functional operation. The inspection of the equipment shall be carried out to ensure that all materials, workmanship and installation conform to the accepted design, engineering and construction standards as well as accepted codes of practice and stipulations.

17.2 Polarity Test of Switch

In a two wire installation a test shall be made to verify that all switches in every circuit have been fitted in the same conductor throughout and such conductor shall be labelled or marked for connection to the phase conductor or to the non earthed conductor of the supply.

A verification of polarity shall be made and shall be ensured that all fuses and single pole control devices are connected in the live conductor only and for socket outlets that the wiring is correctly connected.

i) Physical inspection for removal of any foreign bodies, external defects, such as damaged insulators, loose connecting bolts, loose foundation bolts etc.

ii) Check for the free movement of mechanism for the circuit-breakers, rotating parts of the rotating machines and devices.

iii) Check for tightness of all cable, busbars as well as earth connections in the main earthing network.

iv) Check for clearance of live busbars and conductors from the metal enclosure.

v) Continuity check in case of power and control cables.

vi) Checking of all mechanical and electrical interlocks including tripping of breakers using manual operation of relay.

vii) Check and calibrate devices requiring field adjustment/calibration like adjustment of relay setting etc.

viii) Check proper connection to earth network of all non-current carrying parts of the equipment and installation.

ix) Check for grease, insulation/lubricate oil leakage and proper charge.

x) Check for alignment of all draws out devices like draw out type circuit breakers, MCC cubicles etc.

xi) Checking of alarm and annunciation circuits by manual actuation of relevant relays.

The following tests shall be carried out on the equipment.

a) Low voltage switchgear (up to 1000 V AC or 1200 V DC)

i) Insulation resistance test with 1000V megger for control, metering and relaying circuits. The minimum value of insulation resistance shall be 1 megohm.
ii) Insulation resistance test with 500 V megger for control, metering and relaying circuits. The minimum value of insulation resistance shall be 1 megohm.
iii) Relay operation test by secondary injection method.
iv) Functional test of the control circuits.
v) Checking of setting of all relays/releases as per drawings.
vi) Effectiveness Test of ELCB, MCBs.

b) Earth Electrode Resistance Test

The earth resistance of the earth electrode is to be measured by an earth testing "Megger" provided with a direct reading ohmmeter. Readings obtained in ohms shall not be more than 1 ohm. If necessary, with the approval of Engineer-in-Charge additional electrode shall be provided away from the resistance are and linked to the electrodes system. Payment for such additional electrode and interconnecting tape/wire will be paid on unit or linear basis.

c) Insulation Resistance Test

Insulation resistance test should be made before the installation is permanently connected to the electric supply. The insulation resistance is to be measured by using an approved

portable hand operated insulation resistance tester reading directly in ohms. The voltage of this tester shall be about 500 volts. The insulation resistance to earth shall not be less than 1 megohm when measured with all fuse links in place, all switches closed and all poles place, all switches closed and all poles or phases of wires are electrically linked.

d) Earth Continuity Test

The earth continuity conductor should be tested for continuity to ensure that there is no breakage or loose connections in the system

18. DATA TO BE FURNISHED BY THE CONTRACTOR AFTER AWARD OF CONTRACT

18.1 Drawings/Data Sheets

The CONTRACTOR shall furnish the following immediately after placement of order for approval of consultant.

a) Duly filled-in data sheets for DG sets as given in Annexure-II of this specification.

b) General arrangement and dimensioned drawings for lighting distribution boards and feeder pillars showing front, side and plan views, outline dimensions, floor openings, floor/wall/structure fixing arrangements, earthing terminals and weights. Each drawing shall also include the undernoted information.

i) Bill of material listing component equipment designation, make, types, ratings, quantity of the various component equipment mounted on the boards/panels.
ii) Sheet steel thickness and finish.
iii) Quantity of boards/panels

c) Schematic wiring diagram of the distribution boards/feeder pillars, showing the terminal number and the terminals. Shop drawings showing conduit layout for internal electrical works is to be submitted

d) Inside view of distribution boards/feeder pillars showing mounting and wiring arrangement of various component equipments. (This drawing shall be submitted only for information and records and shall be based on approved schematic drawing. The correctness of this drawing shall be the responsibility of the CONTRACTOR).

e) Similar relevant drawings with all details as mentioned above for DG set.

f) Descriptive/technical catalogues of air break switches, miniature circuit breakers, metering instruments, light control switches, receptacle units, conduits, junction boxes and ceiling fans.

g) Dimensioned drawing of high mast giving all design particulars shall be submitted for approval before fabrication of the tower.

Note:- The VENDOR shall plan his manufacturing schedule so as to allow at least 3 weeks time for approval of the drawings after their receipt by the PURCHASER.

19. Test Certificates

Type and routine test certificates for the factory built assembly of boards / panels, flameproof enclosures and for all component parts/other equipments e.g. switches, MCBs, fuses, conduits, lighting wires, light switches, receptacles, fans, etc. shall be furnished by the CONTRACTOR For flame-proof enclosures approval certificates for relevant statutory authorities shall be furnished.

The type test certificates shall be forwarded within 3 months from the receipt of order and the routine test certificates shall be furnished for the PURCHASER'S approval at least 2 week before the date of dispatch.

19.1 Statutory Approval for Works

Entire electrical installation shall be got approved by the Electrical Contractor from local authority

or electrical inspector with supporting test certificates/load details for getting electrical supply for said installation from local authority. No separate charges shall be borne by the client for this approval.

ANNEXURE-I

DATA TO BE FURNISHED BY THE VENDOR
AFTER COMPLETION OF WORK

1.0 INSTRUCTION MANUALS FOR DG SETS, CABLES & TRANSFORMER, LT PANELS

1.1 Specified number of copies of instruction manuals, Descriptive bulletins etc, shall be furnished prior to dispatch of the items. The manuals shall include amongst others the following particulars.

1.1.1 General Information on items.

1.1.2 Principal Technical Data relevant to the items.

1.1.3 Description of insulation, sheathing and screening especially for cables. This should include data on resistance to attack by chemicals, fungus rodents and reduced flame propagation and toxic fumes during a fire.

1.1.4 Installation and Commissioning Instructions for DG sets, transformer & LT panels.

2.0 TEST CERTIFICATES

2.1 Type/Routine test certificate for all the types of cables, transformer, DG sets, LT panels, etc.

2.2 Specified number of copies of the approved test certificates shall be furnished to the Engineer before dispatch of items.

Annexure – II

DATA SHEET FOR D.G. SETS
(To be filled by the Bidder)

S.No.	Parameters		100 KVA 63KVA
1.0	**APPLICABLE STANDARDS**	**:**	
2.0	**ENGINE**	**:**	
2.1	Type	:	
2.2	Make	:	
2.3	Model	:	
2.4	BHP	:	
2.5	RPM	:	
2.6	No. of Cylinder	:	
2.7	Specific fuel consumption	:	
2.8	Type of cooling	:	
2.9	Type of starting	:	
3.0	**ALTERNATOR**	**:**	
3.1	Make	:	
3.2	Type of Enclosure	:	
3.3	Mounting	:	
3.4	KW Rating	:	
3.5	KVA Rating	:	
3.6	Insulation	:	
3.7	Excitation	:	
3.8	Terminal Box Provided (Yes/No)	:	
3.9	Earthing Studs	:	
4.0	**DIMENSIONS (LXWXH)**	**:**	
5.0	**WEIGHT (IN KGS)**	**:**	
6.0	**ANTI-VIBRATION PAD PROVIDED (YES/NO)**	**:**	
7.0	**CONTROL PANEL**	**:**	
7.1	Type	:	
7.2	Make	:	
7.3	Facilities provided (bidder to furnish details & brief description) covered :	:	
	a) Monitoring .	:	
	b) Startup	:	
	c) Changeover	:	
	d) Parallel operation/syntring	:	
	e) Operation	:	
	f) Protection & Interlocks & safeguards	:	
7.4	Cable Entry	:	
7.5	Weight	:	
7.6	Dimensions	:	
7.7	Starter Battery Specifications	:	
7.8	List of Mandatory Spares for 2 years Operation (Rates may be separately quoted)	:	

ANNEXURE-III

LIST OF APPROVED MAKES FOR ELECTRICAL WORKS

The owner reserves the right to select any of the brands indicated in the 'list of approved makes'. The tenderer shall quote his rates on the basis of the price of the brand/make stipulated in the item of works as described in BOQ & specification as well as in the list of approved make. The contractor cannot claim anything extra if the owner changes the make but within the list of approved make, before placing the order, all materials shall be with ISI mark.

S. No.	Particulars	Approved Makes
1.	MCB/MCB DBs	MDS/INDO-KOPP/L&T
2.	LT CABLES	FORT GLOSTER / HAVELL'S /RPG
3.	CHANGEOVER SWITCHES	HAVELL'S/CONTROL & SWITCHGEAR / L&T/HPL-SOCOMEC
4.	PVC INSULATED COPPER WIRES	KALINGA/ PLAZA/GRANDLAY
5.	CONDUIT	B EC/PRECISION/ Any ZSS make
6.	WIRING ACCESSORIES (SWITCHES/PLUG & SOCKETS)	ANCHOR/SSK/MK
7.	LIGHT FIXTURES/HIGHMAST	PHILIPS/BAJAJ/KESELEC-SCHREDDER/ HAVELLS/ SURYA
8.	CEILING FAN/EXHAUST FAN	USHA/BAJAJ/POLAR/CROMPTON
9.	DIESEL ENGINE	KIRLOSKAR/GREAVES/CATERPILLAR/ LEYLAND/ JACKSON/ SUDHIR
10.	ALTERNATORS	STAMFORD/JYOTI/K1RLOSKAR ELECTRIC
11.	FLAMEPROOF FITTINGS	BALIGA LIGHTING/BAJAJ/CROMPTON
12.	ELCB	MDS/ L&T
13.	TRANSFORMER	VOLTAMP / KIRLOSKAR ELECTRIC CO. / ALSTOM
14.	LT PANEL	TRIDENT/CONTROL & SWITCHGEAR/ L&T/TRICOLITE/ ADVANCE
15.	COMMUNICATION CABLES	AT&T/NORDEX
16.	UPS	KIRLOSKAR SYSTEMS / WIPRO / TATALIBERT / APC
17.	MCCBs	L&T/GE/LG/ HAVELLS
18.	TIMER	MDS/L&T/BCH

Notes:- Makes of items which have not been specified, will be purchased with the prior approval of the Engineer.

Appendix A-5

REFLECTIVE PAVEMENT MARKERS (ROAD STUDS)

1 General

Reflective pavement marker (RPM) or road stud is a device, which is bonded to or anchored within the road surface for lane marking & delineation for nighttime visibility. It reflects incident light in directions close to the direction from which it came.

2 Definition

Description of terms specific to this standard.

Coefficient of luminous intensity (CIL) or specific intensity-

The ratio of luminous intensity of the retro reflector in the direction of observation to illuminance at the retro reflector on a plane perpendicular to the direction of the incident light expressed in terms of millicadelas per incident lux (mcd/ lx).

Horizontal entrance angle-

The angle in the horizontal plane between the direction of incident light & the normal to the leading edge of the marker.

Observation angle-

The angle at the reflector between the illumination axis & the observation axis.

Retro-reflection-

Reflection in which the radiation is returned in direction close to the direction from which it came, this property being maintained over wide variations of the direction of incident radiation.

Head-

That part of the road stud, which is above the road surface when the road stud is fixed in position in the road.

Upper Surface-

That part of the external surface of the road stud, which is visible when the road stud is fixed in position in the road.

Anchorage-

That part of a road stud, which is below the road surface when the road stud is fixed in position in the road.

3 Material

Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Strene Acrylonitrite) or HIPS (High- Impact Polystyrene) or ABS or any other suitable material approved by the Engineer in charge. The marker shall support a load of 13635 kg tested in accordance with ASTM D4280.

Reflective panels shall consist of number of lenses containing single or duel prismatic cube capable of providing total internal reflection of the light entering the lens face. Lenses shall be moulded of methyl methecrylate conforming to ASTM D788 or equivalent.

4 Design

The slope or retro reflecting surface shall preferably be 35 ± 5 degree to base.

The area of each retro reflecting surface shall not be less than 13.0 sqcm.

5 Optical performance

5.1 Unidirectional

Each reflector or combination of reflectors on each face of the stud shall have a CIL not less than that given in table below.

Minimum CIL value for stud

Entrance angle	Observation angle	CIL in mcd/ lx
		White
0^o U 5^o L&R	0.3^o	220
0^oU 10^o L&R	0.5^o	120

Note: The entrance angle of 0o U corresponds to the normal aspects of the reflectors when the reflecting road stud is installed in horizontal road surface.

5.2 Tests

Co-efficient of luminance intensity can be measured by procedure described in ASTM E809 "Practice for Measuring Photometric Characteristics" or as recommended in BS: 873 Part IV – 1973.

Under test conditions, a stud shall not considered to fail the photometric requirements if the measured CIL at any one position of measurement is less than the values specified in table provided that

(i) The value is not less than 80% of the specified minimum

(ii) The average of the left & right measurements for the specific angle is greater than the specified minimum

6 Fixing of reflective markers

6.1 Requirements

The enveloping profile of the head of the stud shall be smooth & the studs shall not present any sharp edges to traffic.

The reflecting portions of the stud shall be free from crevices or ledges where dirt might accumulate.

All road studs shall be legibly marked with the name, trademark or other means of identification of the manufacturer.

Marker height shall not exceed 20mm.

Marker width shall not exceed 130mm & shall not be less than 100mm.

The base of the marker shall be flat within 1.3mm. If the bottom of the marker is configured, the outer most faces of the configuration shall not deviate more than 1.3mm from a flat surface.

6.2 Placement

The reflective marker shall be fixed to the road surface using the adhesives & the procedures recommended by the manufacturer. No nails shall be used to affix the marker, as nails are hazardous for the roads.

Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry & on new asphalt concrete surfacing until the surfacing has been open to traffic for a period of not less than 14 days.

The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint & any other material which would adversely affect the bond of adhesives.

Use a wire brush, if necessary to loosen & remove dirt, then brush or blow clean.

The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and a slight excess after the marker has been lightly pressed in place.

For epoxy installations, excess adhesive around the edge of the marker excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used if necessary to remove adhesive from exposed faces of pavement markers.

7 Warranty & Durability

The contractor shall obtain from the manufacturer a two-year in-field test/ evaluation report for performance as per the table mentioned above and submit to the Engineer. In addition, a two-year warranty for satisfactory in-field performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days off the intimation from the Engineer at his own cost and with no extra remuneration to be paid for such work.

8 Measurement for payment

The measurement of reflective road markers shall be in numbers of markers supplied and fixed.

9 Rate

The contract unit rate for reflective road markers shall be payment in full compensation for furnishing all labour, material, tools, equipment including all incidental costs necessary for carrying out the work at site conforming to the specifications complete as per approved drawings or as directed by the Engineer.

Appendix A-6

PAINTING OF STRUCTURES WITH SYNTHETIC ENAMEL PAINT FOR NUMBERING & SPAN DETAILS OF BRIGES / CULVERTS AND WATER PROOF CEMENT PAINT FOR PARAPET, RAILING, KERB AND CRASH BARRIER

1. Painting with Synthetic Enamel Paint

Materials

Synthetic enamel paint confirming to IS: 2932 of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary paint of shade to match the top coat as recommended by the same manufacturer as far as top coat shall be used.

Painting on New Surface

Preparation of surface:

The surface shall be thoroughly cleaned and dusted off. All dirt, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer after inspection, before painting is commenced.

Application: The number of coats including the undercoat shall be as stipulated in the item.

(a) **Under coat:** One coat of the specified ordinary paint of shade suited to the shade of the top coat shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

(b) **Top Coat:** Two top coats of synthetic enamel paint of desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

Lettering and Numbering on New Surface:

The letters and numbers for bridges/culverts span and number shall be as per IRC-7-1971. The size of area for painting shall be varied depend upon the numbers and letters. The background area and letters/numbers shall be painted with one prime coat (under coat) and two coats (top coat) of synthetic enamel paint.

Measurement for payment:

The painting of culverts /Bridges numbering and span arrangement shall be measured in number of each side facing traffic.

Rate:

Rate shall include the cost of materials, labour and other operation described above to complete set of letters and numbers required in each side facing traffic.

2. Water Proof Cement Painting

Material:

The water proof cement paint shall be (conforming to IS: 5410) of approved brand and manufacture. The water cement paint shall be brought to the site of work by the contractor in its original container in sealed condition. The material shall be brought in at a time in adequate to suffice for the whole work or at least a fortnight's work, the material be kept in the joint custody of the Contractor and the Engineer-in-Charge. The empties shall not be removed from the site of work till the relevant item of the work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of Surface:

For New work, the surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, algae, grease and other foreign matter by brushing and washing. Pitting in plaster shall be made good and a coat of waterproof cement paint shall be applied over patches after wetting them thoroughly.

Preparation of mix:

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish, Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously.

The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

In case of cement paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

Application:

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

For the work, the surface shall be treated with three or more coat of waterproof cement paint as found necessary to get a uniform shade.

For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

Precaution:

Water proof cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, paints, etc. It shall not be applied on gypsums, wood and metal surfaces.

If water proof cement paint is required to be applied on existing surfaces previously treated with white wash, colour wash, etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour was etc., completely. Thereafter, a coat of cement primer shall be applied followed by two or more coats of water proof cement paint.

Measurement for Payment:

The painting shall be measured in square metre of surface area treated.

Rate:

Rate shall include one prime coat and two coats of the paint over the prime coat including cost of all labour and materials involved in all operations described above.

Appendix A-7

SPECIFICATION FOR COMPRESSIBLE PRE-MOULDED ASPHALT FILLER BOARD

The pre-moulded filler board shall be 20mm thick with a tolerance of +1.5mm and of a firm compressible material and complying with the requirement of IS: 1838.

2 mm dia wire shall be sewn on one face of the filler board. The wire shall be at least 300 mm long and shall be tied to reinforcement wherever possible. The other face shall be glued to the face of the deck slab with approved adhesive.

Measurement will be in square metre. The rate shall include cost of all labour, material including the bitumen capping.

Appendix A-8

SEISMIC RESTRAINERS

Fabrication

Seismic restrainers shall consist of elastomeric bearings which shall be fixed on to the structure with a system consisting of backing plates, mild steel plates, stainless steel plates by suitable arrangement of bolts, lugs etc. A pair of 15 mm thick mild steel plates shall be vulcanized on either side of the elastomeric bearings. Typical details of the Seismic restrainer assemblies are shown in miscellaneous drawings. The Seismic restrainer assembly shall be manufactured as per contractor design for the lateral load capacities mentioned in the respective BOQ item in conformity with the typical arrangement shown in the drawings. The design and drawings for the seismic restrainer assembly shall be prepared by the Contractor and got approved from the Engineer before starting the manufacture of seismic restrainer assembly. Design, fabrication, testing and installation of elastomeric bearings and structural components of the seismic restrainers shall be as per IRC: 83 (Part-II), and Technical Specification section 1900 and 2000.

Measurement for Payment

Seismic restrainer assemblies shall be measured in numbers according to their capacities.

Rate

The contract unit rate for a seismic restrainer assembly shall include cost of design, supplying and fixing of seismic restrainer assembly consisting of elastomeric bearing, backing plates, mild steel plates, stainless steel plates, bolts, lugs etc. all complete as specified on the drawings or as directed by the Engineer. The rate shall include cost of all tests prescribed in the specifications and shown on the approved drawings.

The quantity of cement concrete and steel reinforcement for seismic restrainers and shear keys shall be paid for separately as per relevant BOQ items.