



National Highways Authority of India

(Ministry of Shipping, Road Transport & Highways)

Government of India

(International Competitive Bidding)

BIDDING DOCUMENT

(Item Rate Contract)

EAST-WEST CORRIDORS PROJECT (PHASE - II)

**Balance work of construction of 4-lane road for km 165.400 to km 190.587 of
Jatinga Junction to Harangajo section of NH-54 in the State of Assam**

Contract Package, EW-II(AS-21)-Bal

Volume 2

Feb, 2011

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NATIONAL HIGHWAYS AUTHORITY OF INDIA

Balance work of construction of 4-lane road for km 165.400 to km 190.587 of Jatinga Junction to Harangajo section of NH-54 in the State of Assam

Bidding Document – Item Rate Contract

Contract Package No.: EW-II(AS-21)-Bal

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NATIONAL HIGHWAYS AUTHORITY OF INDIA

Bidding Document – Item Rate Contract

International Competitive Bidding

(Contract Package No.: EW-II(AS-21)-Bal

CONDITIONS OF CONTRACT

Balance work of construction of 4-lane road for km 165.400 to km 190.587 of Jatinga Junction to Harangajo section of NH-54 in the State of Assam

VOLUME - 2

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National Highway Authority of India

TECHNICAL SPECIFICATIONS

SECTION –IV

1. PREAMBLE

The Technical Specifications contained herein shall be read in conjunction with the other Bidding Documents as specified in Volume-I

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.

1.1.1 Inclusive Documents

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

1.1.2 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 separately any additional payment.

1.13 Measurement and payment –

The methods of measurement and payment shall be as described under various items of the specification 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 Drawings and Bill of Quantities but the necessity for which may be implied or inferred therefrom, or which is usual or essential to the completion of the work in the same shall be deemed to be included in the rates and prices entered by the contractor in the Bill of Quantities.

1.14 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 work 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 else where 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.

1.2.3 General climatic conditions

1.2.3.1 The variation in daily temperature in this region is as under

- 1) During summer months, the temperature is varies from 24°C to 30°C.
- 2) During winter months, the temperature varies from 10°C to 14°C.

1.2.3. The normal average annual rainfall in the area is of the order of 2200 mm to 2700mm a good portion of which is concentrated during the months of July to September each year

1.2.4 Seismic zone the works are located in seismic zone V as defined in IRC: 6-2009

1 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 (Fourth Revision August 2001; Reprint, March 2002), issued by the Ministry of Road Transport and Highways, Government of India and published by the Indian Roads Congress; Henceforth called MORT&H Specifications and deemed to be bound into this document.

2.2 Part-II.'Supplementary Technical Specifications.

The Supplementary Technical Specifications Shall comprise of various Amendments\Modifications\ Additions to the "SPECIFICATIONS FOR ROAD BRIDGE WORKS' (referred to in Part-1 above and Additional specifications for Particular item of Works not already covered in Part-1

2.2.1 A Particular clause or part thereof in "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (fourth Revision August 2001 Reprint, March 2002)' referred in part-1 above, where Amended/Modified/Added upon, and incorporated in part- 11, 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-1.
- 2.2.3 When an Amended/Modified/Added clause supersedes a clause or part 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 MORT&H 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 (Fourth Revision August 2001, Reprint March 2002). have been Amended/Modified/Added upon.

Sr. No.	Section No.	Section Title	Clause No.
1.	100	General	102,105,106,107,108,109,110,111,112,114,115,121,124 and 126
2.	200	Site Clearance	201 and 202
3.	300	Earthwork, Erosion Control and Drainage	301,304,305,306 and 309
4.	400	Sub-base, Bases (Non-Bituminous) and Shoulder	401,406,408 and 409
5.	500	Base and Surface Courses (Bituminous)	501,502,503,504,507,509,511 and 512
6.	600	Concrete Pavement	601 and 602
7.	800	Traffic signs, Markings and outer Road Appurtenances	801,802,803,804,805,806,807,808,809 and 810
8.	900	Quality Control for Road works	901,903
9.	1000	Materials for Structures	1002,1006,1007,1008,1009,1010,1012,1014 and 1015
10.	1100	Pile Foundations	1101,1102,1103,1104,1107,1113,1118 and 1119
11.	1200	Well Foundations	1202,1204,1205,1214 and 1215
12.	1500	Form Work	1501,1502,1503,1504,1506,1507,1508,1509,1510,1513
13.	1600	Steel Reinforcement (Un-tensioned)	1602,1604,1605,1606 and 1607
14.	1700	Structural Concrete	1703,1704,1705,1706,1707,1709,1710,1712,1713 and 1715
15.	1800	Prestressing	1801,1802,1803,1804,1806,1807,1808,1815 and 1816
16.	2000	Bearing	2001,2004,2005,2006,2009 and 2011
17.	2100	Open Foundations	2106
18.	2200	Substructures	2204 and 2210

19.	2300	Concrete Superstructure	2305
19	2500	River Training Work and Protection Work	2504 and 2510
20.	2600	Expansion Joints	2602,2604,2607,2608 and 2609
21.	2700	Wearing Coat and Appurtenances	2702,2703,2704,2706,2708 and 2709
22	2800	Repair of Structures (Includes additional clauses)	2809,28011,2812,2813,2814,2815,2816,2817,2818,2819,2820, 2821,2822,2823,2824,2825,2826,2827,2828,2829,2830,2831 and 2832
23.	2900	Pipe Culverts	2906 and 2911
25.	3000	Maintenance of Road	3001,3002,3003,3004
26.	3100	Reinforced Earth	3101,3102,3103,3104 and 3105

2.2.6 Additional Specifications

The Clauses Appendix I to XI have been added to the “SPECIFICATION FOR ROAD AND BRIDGE WORKS” (March 2002, Reprint of Fourth Revision August 2001)

1. Appendix-I Diversion and Filling of Existing Water Courses along the Road Alignment
2. Appendix-II Plantation of Trees and Hedges
3. Appendix-III Chute Drain for High Embankment Section
4. Appendix-IV Erosion Protection Works at Upstream and Downstream of Culverts
5. Appendix-V Void Former
6. Appendix-VI Controlled Blasting
7. Appendix-VII Specifications for Scarification of Existing Pavement and Providing Overlay with Granular Base
8. Appendix-VIII Reflective Studs/Road Pavement Marker.
9. Appendix-IX Way Side Amenities and Truck Parking Sites.
10. Appendix-X Curing Using Liquid Membrane Forming Compound
11. Appendix-XI Pavement Quality Concrete

In the absence of any definite provision 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 "Specifications volume I to VI, 1996 for Civil Works and General Specifications for Electrical Works PART I – INTERNAL, PART – II, EXTERNAL for electric work 1994 as published by the Central Public Works Department (CPWD), Government of India" and deemed to be bound into this document.

PART II
SUPPLEMENTARY TECHNICAL SPECIFICATIONS/ADDITIONS TO EXISTING CLAUSES OF
GENERAL TECHNICAL SPECIFICATIONS

SECTION 100 GENERAL

CLAUSE 102 DEFINITIONS

The following abbreviations shall be added in this Clause:

“MORT&H”	:	Ministry of Road Transport & Highways (Previously known as ‘MOST’, Ministry of Surface Transport)
“NHA”	:	National Highways Authority of India
“BIS”	:	Bureau of Indian Standards
“WBM”	:	Water Bound Macadam
“WMM”	:	Wet Mix Macadam
“CPCB”	:	Central Pollution Control Board
“QA”	:	Quality Assurance
“BOQ”	:	Bill of Quantities
“CECRI”	:	Central Electro Chemical Research Institute

CLAUSE 105 SCOPE OF WORK

Sub-clause 105.3 Delete the text of Clause 105.3 and substitute the following:

“The Contractor shall institute and operate a quality management system complying with SP-47 (Quality systems for road bridges) and SP-57 (Quality system for roads). The quality management system shall be described in a Quality Assurance Plan that shall be submitted to the Engineer for acceptance not later than 28 days after the Letter of Acceptance. The costs associated with preparing, implementing and monitoring the quality management system shall be deemed to be covered in the scope of the work. The Quality Assurance Plan shall cover the following item:

- i. The Contractor’s organization and management including:
 - The definition of the Contract and its documentation;
 - The organization of the Contract, including the line of command and communication links between parties involved in the Contract;
 - Names, roles, responsibilities and authority of principles and key personnel;
 - Control of liaison and meetings with third parties;
 - Identification of the Contractor’s staff responsible for overseeing each major activity;
 - Contractor’s control of sub-contracts;
 - Document control;
 - Program for submission of method statements;
 - Procedure for the preparation, review and adjustment of programmes for the effective progression of the Works;
 - Procedure for the regular review and recording by the Contractor of the quality of the Works;
 - Control of personal selection based on skill and experience;

- Management review and audit to monitor and exercise adequate control over the implementation of the quality plan.
- ii. The Contractor's detailed method statements and construction procedures for each major activity whether directly controlled or subcontracted including:
- Plant and materials to be used, safety measures, the requirement for skilled labour and/or special supervision and working space;
 - Delivering, handling and storage of materials;
 - Environmental control in respect of pollution , noise, dust, temperature, working hours, traffic control etc;
 - Hold points i.e. the stages at which checks are necessary before continuing;
 - Work instructions, quality control procedures, compliance testing, inspection procedures and work acceptance procedures.
- iii. The contractor's construction quality control including;
- A statement of the Contractor's organization for quality control;
 - Control of test laboratories;
 - Control of test, measuring and inspection equipment;
 - Document control;
 - Procedure for monitoring and recording the inspection, test and approval status of the works;
 - Procedures for the collation of quality records and provision of copies to the Engineer;
 - Procedures for the receipt, examination and verification of certificates of conformity and test results for purchased products."

CLAUSE 106

CONSTRUCTION EQUIPMENT

Add the following sub para (g) and (h) after para(f)

- g) Adequate standby equipment including spare parts shall be available.
- h) All measuring devices and gauges shall be in good working condition. Measuring devices that can affect product quality shall be calibrated prior to use and at prescribed intervals against certified equipment Calibration procedures shall be established, maintained and documented and corrective action taken when results are unsatisfactory. Accuracy and fitness of measuring devices shall be ensured by proper maintenance.

CLUASE 107

CONTRACT DRAWINGS

Sub- Clause 107.1

Add the following after the end of para:

After careful study of 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 and shall submit the same to the Engineer for approval prior to construction progressively according to the work programme consented by the Engineer. The Engineer shall be given not less than 21 days for review of these supplementary / working drawings and as directed, the Contractor shall modify the drawings incorporating the comments and requirements of the Engineer.

Detailed construction drawings for the culverts based on good for construction drawings will be furnished by the Contractor after incorporating the details as per the site/location conditions at least one (1) week prior to commencement of work to Engineer and get them approved before execution.

CLAUSE 108**SITE INFORMATION**

Sub-Clause 108.4 This clause shall be as follows:

“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.” No claim shall be entertained on account of materials and increase in lead.

CLAUSE 109**SETTING OUT**

Sub-Clause 109.8 Add the following after the para:

Surveying Equipment and Personnel:

The Contractor shall provide the necessary surveying equipment, accessories, surveyors and labourers required for setting out and related measurements including making available these to the Engineers and his representatives at different stages of work. The surveying equipment shall be of high standard of manufacture as approved by the Engineer, in good working condition with adequate numbers and shall include, inter alia, the following:

1. Precision automatic level with micrometer attachment with tripods and leveling staff reading to 5mm accuracy by direct observation and to 1mm accuracy by estimation or better.
2. Theodolites with tripod – Electrically operated with computerized out put attachment reading to 20 seconds of angle accuracy or better.
3. Total Station with two spare batteries and a charger, three tripods plus tangents sufficient for 4km range, together with an electronic data recorder, 6 data packs and all necessary software for operation.
4. Precision Staff.
5. 3 metre straight edge and measuring wedge fitted with handles, wedges 100mm ht. and 1mm accuracy.
6. Field umbrellas.
7. Ranging rods 50mm dia 3m long straight with one end each metallic conical and painted alternatively black and white along the length.
8. Camber Templates fitted with handles
9. Steel tape graduated in metres, centimeters and millimeters
 - a. 10m long
 - b. 20m long
 - c. 50m long
10. Reference markers and pegs

The Contractor shall maintain the surveying equipment in good condition during the full duration of the Works and replace the ones, which get worn out or otherwise become unworkable.

The surveying equipment and related resources shall be provided under the general obligations of the Contractor requiring no separate payment.

Sub-Clause 109.9 Delete the 2nd and 3rd sentences in Clause 109.9 and substitute the following:

“Setting out of the road alignment and measurement of angles shall be done by using Total Station. Levels shall be taken by Automatic levels with precision micrometer staff having 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

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. The contractor will not be entitled for any additional compensation for delay in cutting of trees, shifting of utilities and removal of encroachment by the 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.

Clause 110.2 Drawings showing 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.

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 will obtain necessary approval from such authorities after payment by the employer and also 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.

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 Contractor and no extra payment shall be made for the same.

The information on affected services is not exhaustive, the location of services within ROW have been indicated based on the information furnished by different authorities and to the extent those authorities are familiar with. The Contractor's work program must take into account the period of notice and duration of diversionary works, clearance of drawings from Railways and all other authorities for finalization of the work programme.

Clause 110.5 During execution of works, the contractor shall take all measures reasonably required to ensure no damages to structures and properties abutting Right of Way (ROW) take place.

Clause 110.6 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.

Clause 110.7 **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.

CLASE 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 conforming 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.”

Clause 111.2 **Borrow Pits for Embankment Construction**

Delete the text of Clause 111.2 and substitute the following:

Borrow pits shall not be dug within the right of way of the road. Contractor shall ensure that proper excavation techniques are used to improve stability and safety of the borrow area. The excavation shall be carried out in such a way the area does not inundate during monsoons generate cesspool of water for breeding site. The area after excavation shall be properly laid and caped. The stipulation in clause 305.2.2 shall govern.

“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 of 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 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 season.

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

Sub-Clause 111.3 Quarry Operations

Delete the text of Clause 111.3 and substitute the following:

“Aggregate 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 preferably be located on the upwind side.”

Sub-Clause 111.5 Pollution from Hot-Mix Plant and Batching Plants

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

“Bituminous hot mix plant and concrete batching plants 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.”

Sub-Clause 111.8 Add the following text at the end of Clause 111.8:

“Water tankers with suitable sprinkling system shall be deployed along the haulage roads and in the work sites. Water shall be sprinkled regular all along the routes to suppress airborne dusts from truck/dumper movements particularly on unpaved roads. Actual frequency will be agreed with the Engineer to suit site conditions.”

After Clause 111.12 Add the following text at the end of Clauses 111.13 to 111.23

Sub-Clause 111.13 Haulage Roads

Existing roads used for hauling shall be strengthened and /or widened by the Contractor in accordance with the requirements for normal and construction traffic. Where such roads are not existing, the Contractor shall construct project specific single lane paved roads in settlement areas and gravel roads in open areas conforming to the Ministry of Road Transport and Highways (MORTH) specifications.

The alignment of the haulage roads shall be fixed to avoid agricultural land to the extent possible. In unavoidable circumstances, suitable compensation shall be paid to the people whose land will be temporarily acquired for the duration of the operations. The compensation shall cover for loss of income for the duration of temporary acquisition and land restoration. Prior to the construction of the haul roads, topsoil shall be stripped and stockpiled for re-use.

Material dumping sites shall be access controlled to prevent the unauthorized entry of the people, grazing cattle and stray animals.

Haulage roads shall be reinstated on completion of hauling for the use of local communities.”

Sub-Clause111.14 Water Sources and Water Quality

The Contractor shall provide independent sources of water supply, such as bore wells, for use in the Works and for associated storage, workshop and work for compounds. Prior approval shall be obtained from the relevant State Authorities and all installations shall be in compliance with local relations. Bore well installed and used for the project shall be left in good operating condition for the use of NHA and local communities. The Contractor shall prevent any interference with the supply to or abstraction from, and prevent any pollution of water resources (including underground percolating water) as a result of the execution of the Works.

Areas where water is regularly or repetitively used for dust suppression purposes shall be laid to fall to specially constructed settlement tanks to permit sedimentation of particulate matter. After settlement, the water may be re-used for dust suppression and rinsing. The Contractor shall protect all watercourses, waterways, ditches, canals, drains, lakes and the likes from pollution as a result of the execution of the Works. All water and other liquid water products arising on the Site shall be collected and disposed of at a location on or off the Site and in a manner that shall not cause either nuisance or pollution.

The Contractor shall at all times ensure that all existing stream courses and drain within, and adjacent to, the Site are kept safe and free from any debris and any materials arising from the Works. The Contractor shall not discharge or deposit any matter arising from the execution of the Works into any water except with the permission of the Engineer and the regulatory authority concerned.

Work force camps shall have septic tank and soak away pits. Operational areas like POL storage areas/hot mix plant areas shall comply with local/state environmental regulations and safety procedures. Storage and handling areas shall be impervious and surrounded by an impervious lined drain to catch any accidental spills. Sotrm water shall be stored in lined holding tanks with oil, grease-tapping facility prior to disposal in to nearby watercourses. The trappings and sludge of holding tanks shall be disposed off in accordance with the procedures approved by the local regulatory authority.

Sub-Clause111.15 Equipment and Vehicle used for the Works

Equipments and vehicles deployed for the construction activities shall not be older than 5 years. Equipments used for road and bridge works shall be based on new technology and shall generate noise and pollutants not exceeding the limits specified by the relevant State Authorities. Vehicles and machineries used for road and bridge works are to be regularly maintained to conform to the National Air Quality Standards. Blasting , if any, will be carried out using small charges.

Sub-Clause 111.16 Air Quality

The Contractor shall device and implement methods of working to minimize dust, gaseous and other air-borne emissions and carry out the Works in such a manner as to minimize adverse impacts on the air quality. Construction camps shall have facilities for LPG fuel. The use of firewood shall not be permitted.

The Contractor shall utilize effective water sprays during delivery, manufacture, processing and handling of materials when dust is likely to be created, and to dampen stored materials during dry and windy weather. Stockpiles of friable materials shall be covered with clean tarpaulins, with applications of sprayed water during dry and windy weather. Stockpiles of materials or debris shall be dampened prior to their movement, except where this is contrary to the Specification.

Any vehicle with an open load-carrying area used for transporting potentially dust-producing material shall have properly fitting side and tail boards. Materials having the potential to produce dust shall not be loaded to a level higher than the side and tail boards and shall be covered with clean tarpaulins in good condition. The tarpaulin shall be properly secured and extend at least 300mm over the edges of the side of the side and tail boards.

The Contractor shall monitor air-quality once weekly in all operational areas under the project and take the necessary steps to comply with the specified requirements. Air quality parameters will include SPM, RPM,SO₂,NO_x,HC and CO, operational areas include work sites, haulage roads, hot mix plants, quarries, crushing plants, stockpiles, borrow sites and spoils disposal sites.

Sub-Clause 111.17 Noise Control

The Contractor shall consider noise as an environmental constrain in the planning and execution of the Works.

The Contractor shall take all necessary measures so that the operation of all mechanical equipment and construction processes on and off the site shall not cause any unnecessary or excessive noise, taking in to account applicable environmental requirements. The Contractor shall use all necessary measures and shall maintains all plant and silence equipment in good conditions so as to minimize the noise emission during construction works.

Any member of the work force likely to be exposed to beyond their threshold noise levels shall be provided with protective equipments, such as earplugs, and shall be rotated every four hours.

Construction operations shall be limited to daytime hours only, particularly in the settlement areas.

Sub-clause 111.18 Vibration Control

The Contractor shall take measures during construction activities to control the movement of the work force and construction machinery/equipment, and to avoid/minimize activities, which produce vibrations.

Sub-Clause 111.19 Construction Camps

The construction camps shall conform to the State and National building regulations as applicable. The area for the storage of polluted material shall be stored on impervious floors and shall be surrounded by impervious ditches in order to avoid spilling of polluted material to surrounding areas.

Construction camps shall be properly arranged to avoid noise pollution to the nearby habitants and to avoid contamination of river and canals from wastewater drainage. To prevent such contamination, wastewater generated at the campsites shall be discharged in to soak pits. These shall be of sufficient capacity to contain 120% of estimated volume. These shall be regularly cleaned and maintained to be effective. Human excreta shall be treated through septic tanks prior to discharge and shall conform to directives and guideline of the State. Water accumulated in tires, empty vessels and containers of all nature will be regularly cleaned to avoid the related health hazards.

Sub-Clause 111.20 Control and Disposal of Wastes

The Contractor shall control the disposal of all forms of waste generated by the construction operations and in all associated activities. No uncontrolled deposition or dumping shall be permitted. Wastes to be so controlled shall include, but shall not be limited to, all forms of fuels and engine oils, all types of bitumen, cement, and surplus aggregates, gravels, bituminous mixtures etc. The Contractor shall make specific provision for the proper disposal of these and any other waste products, conforming to local regulations and acceptable to the Engineer.

Spilling of oil and bituminous products during construction and transport shall be avoided to reduce the chances of contamination of surface as well as ground water.

Degraded material shall be disposed off in a manner as approved by the Engineer and waste water shall be disposed into septic tanks and soak pits etc. The Contractor shall make arrangements to cleanup spoil as soon as the work finishes in a stretch. If such sites are located outside the ROW, restoration of the site to a level acceptable to the landowner(s) will be carried out within time period agreed between landowner(s) and the Contractor. Separators shall be watercourses or as approved by the Engineer in conformance with directives and guidelines.

Disposal of solid waste materials shall be outlined in a plan for which environmental clearances shall be obtained from State environmental regulatory

authorities. Potential locations for solid waste disposal are the natural depressions and borrow areas. The areas used for dumping of uncontaminated debris shall be covered with 300mm soil and shall be planted. Contaminated debris shall be dumped in depressions made impervious with 450 mm thick impervious floor apron as per MORT&H Technical Specifications. Each successive 1.0m layers shall be covered with 500 mm thick soil layer, and the area will be covered with 300mm thick layer and planted.

Sub-Clause 111.21 Transport of Hazardous Materials

Transport of all hazardous materials, in bulk or in sealed containers, shall meet the requirements of the State regulations. Prior to ordering transport of hazardous material in bulk, the Contractor must obtain the approval of the relevant authority as well as of the Engineer. Precautionary measures and conformity with regulations shall be stated in a Method Statement for the approval of the Engineer. Sealed containers of hazardous materials shall be stored in a well-ventilated room, well guarded and secured.

Sub- Clause 111.22 Emergency Response

The Contractor shall plan and provide remedial measures to be implanted in the event of occurrence of emergencies such as spillages of oil or bitumen or chemicals. The Contractor shall provide the Engineer with a statement of the measures he intends to implement in the event of such an emergency, which shall include a statement of how he intends to provide personnel adequately trained to implement such measures.

Sub-Clause 111.23 Measurement

“For Compliance of all provisions made in this Clause 111, it shall be deemed to be incidental to the work and no separate measurement shall be made., The Contractor shall be deemed to have made allowance for such compliance with these provisions in the preparations of his prices for items of work included in the Bills of Quantities and full compensation for such compliance shall be deemed to be covered by them.”

CLAUSE 112 ARRANGEMENT FOR TRAFFIC DURING CONSTRUCTION

Sub-Clause 112.1 General

Delete the last sentence and add the following:

“Two weeks before undertaking work which would involve any obstruction whatsoever to traffic the Contractor shall submit, for the Engineer’s approval a Traffic Control Plan; and

The plan shall include:

- i.) Typical drawings for temporary diversion in accordance with Sub-Clause 112.3.

- ii.) Typical details of arrangements for construction under traffic including details of traffic arrangements proposed to be in place after the cessation or work each day.

Special consideration shall be given in the preparation of the Traffic Control Plan to the safety of pedestrians and workers and delineation of the roadway at night.

Temporary diversions will be constructed only with the approval of the Engineer. Road works shall generally be constructed under traffic.”

Sub- Clause 112.2 This clause shall read as under:

For widening and strengthening of the existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, paved shoulder in a width of at least 2.5m shall be provided on one side of the existing road with the following minimum requirements to be provided by the contractor.

- i.) At least one 5.5m lane to remain open to traffic shall at all times.
- ii.) The surface used by the through traffic shall at all times be a firm all weather compacted surface free of pot holes and other defects.
- iii.) The maximum continuous length over which construction under traffic may take place shall be limited 750m. However, for longer stretches, passing places shall be provided at every 0.75 km interval with at least 50m length.
- iv.) The treatment to paved shoulders shall consist of providing 200mmthick granular base course grading-I Table 400-1 as per Clause 401 covered by 225 mm thick wet mix macadam layer as per Clause 406 and treated with semi-dense bituminous concrete surfacing 25mm thick as per technical clause no. 503.
- v.) Construction activity shall be restricted to only one side or the existing road.

In case of eccentric widening of existing two lane to four/six lane, the additional two lanes shall be constructed first up to the stage of Bituminous Concrete/Cement Concrete Pavement for a minimum length of 2km.and traffic diverted to it and only thereafter the required treatment to the existing carriageway including construction of median shall be taken up.

Sub-Clause 112.3 Add the following at the end of this Clause.

Where the new highway crosses or joins with an existing state highway, or an established road or cart track, the highway, road or cart track shall be kept open at all times. In case the Engineer specifically orders to construct and maintain diversion as descried below, the same will be paid for.

Sr. No.	Type of Road	Carriage-way Width	Unpaved Shoulders Width on each side (m)	Pavement Elements (Compacted)
1	National Highways & State Highways			200mm granular sub base (Grading-I of Table 400-1) 225 mm W.M.M.

				• semi-dense bituminous concrete surfacing 25mm thick as per technical clause no. 503
2	Major District Roads and other District Roads			• 150 mm granular sub-base (Grading-I of Table 400-1) • 150 mm W.M.M. • semi-dense bituminous concrete surfacing 25mm thick as per technical clause no. 503
3	Village Roads and Cart Tracks			• 150 mm granular sub-base (Grading -I of Table 400-1) • 150 mm W.M.M.

Drainage should be provided as directed by the Engineer.

The alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

Sub-Clause 112.4 Traffic Safety and Control

Last line of Para 5 shall be read as under:

“The signs shall be of approved design and of reflectory type.”

Add the following paragraphs at the end of the clause:

“Before commencement of any construction, the Contractor shall prepare and submit detailed proposal covering safety measures along with details of the arrangements for passing traffic during construction, design of barricades, signs, markings, lights, flags etc. conforming and satisfying the requirements of the “Guidelines on Safety in Road Construction Zones” of IRC: SP 55-2001 and get the same approved by the Engineer.”

The Contractor shall be fully responsible for the adequate safety of all site operations and methods of construction.

Persistent breaches of the safety provisions by the Contractor and his employees shall constitute a sufficient cause for action.

The Contractor shall also observe the following additional safety provisions:

- All workers shall use safety helmets at work site, which should be provided by the Contractor;
- All workers shall wear reflective jackets, while working in the traffic movement zone, which should be provided by the Contractor;
- Adequate precautions shall be taken to prevent danger from electric cables, while digging operation is underway;
- Those engaged in welding work shall be provided with welder protective shields;
- All scaffolds, ladders and safety devices shall be maintained in safe and sound conditions;
- All display boards shall be of retro-reflective material and of size as per IRC Specifications or as mentioned in the drawings or as approved by the Engineer;

- All workmen shall wear air mask while working with fly ash;
- In addition, if any directions are given by the Engineer to augment the safety measures, the Contractor has to abide by his directions;
- A safety officer shall be nominated to prepare safety programme and oversee the safety arrangements at site.

Sub-Clause 112.6 Measurement for payment and Rate

This clause shall read as under:

All arrangement for traffic during construction except temporary barricade as mentioned hereafter, and providing traffic safety and control devices, where necessary, shall be considered incidental to the works and shall be contractor's responsibility.

Payment of construction of temporary diversion including temporary cross drainage structures, if required, construction of treated shoulder for traffic during construction shall be measured and paid separately as per relevant item in the BoQ.

During construction activities for widening of road on hill side, the contractor shall provide rock fall fencing and deepen and widen the existing hill side drain to arrest the falling materials from coming to road surface. The fencing shall be of type as shown in the drawing or as decided by the engineer for safety of road users and workers. After the completion of the work, the temporary fencing shall be shifted or removed according to necessity. All works towards providing fencing, shifting of fencing, clearing accumulated debris arrested by fencing regularly, deepening and widening of existing drain etc. shall be considered incidental to the work.

Temporary barricade shall be measured in linear meter. All works in excess of quantitative provisions made in BOQ towards providing temporary barricade shall be considered as incidental to work and no extra payment shall be admissible for the excess quantity. The contract unit rate for the temporary barricade shall be payment in full for the cost of all labor, material, installation, maintenance or replacement, shifting of temporary units from one location to other and refilling the temporary holes made in the ground, removing debris and all other incidentals to complete the work in all respect. The contractor shall take back these temporary barricades in full quantities after the completion of the project or earlier as per direction of the Engineer by paying at the rate or 50% of his quoted rate or Rs. 1000 per meter whichever is more as salvage value to the Employer. Recovery for the salvage value shall be made in last but third interim payment certificate. These temporary units shall not be used in any permanent work in the project.

CLAUSE 114 SCOPE OF RATES FOR DIFFERENT ITEMS OF WORK

Sub-Clause 114.2 Item (ii) Clause 114.2 shall read as follows:

A detailed resource based construction programme including resources planning using computerized critical path network method/PERT in a form, which facilitates control of the progress of the works and consequences of any changes in terms of time. The programme shall also include detailed network, activities for the submission and approval of material, procurement of critical materials for the submission and approval of materials, procurement of critical materials and equipment, fabrication of special products/equipment and their installation and testing and for all activities of the Contractor that are likely to affect the progress of work etc. including updating all such activities on the basis of decisions taken at the periodic site review meetings or as directed by the Engineer. The Contractor shall submit data via electronic media to the Engineer in a form readily compatible with Engineer's planning system.

Add the following as item (xvii) to sub-clause 114.2:

The contractor shall prepare detailed construction drawings for each culvert on the basis of the drawings given in Bid Documents and get them approved by the Engineer. The drawings shall be submitted to the Engineer at least 8 weeks before commencement of construction of culverts

Add the following as item (xviii) to sub-clause 114.2

Monthly progress report will be submitted in a format acceptable to the Engineer. The Report shall state the progress which has been achieved compared with the planned progress, illustrate delay in proportion to the progress planned, analyse the consequences and state planned corrective measures. Intermediate progress reports may also be required.

The first issue of the detailed construction programme including the detailed description of the system and the procedures shall be submitted to the Engineer for acceptance not later than 28 days after the date of receipt of the letter of acceptance.

The contractor shall submit to the Engineer for approval & consent, the updated & revised programme at every three months interval or as such as directed by the Engineer. The updated & revised programme shall be submitted showing the actual progress achieved (physical & financial) and the effects of the progress achieved on the timing of the remaining work including any change to the sequence of the activities.

CLAUSE 115 METHODOLOGY AND SEQUENCE OF WORK

The clause shall be substituted as follows:

Sub-Clause 115.1 Submission of Method Statement

The contractor shall submit method statement within 28 days after the date of letter of acceptance. The methods statement shall be submitted in two parts.

The General part of the methods statement shall describe the Contractor's proposal regarding preliminary works, common facilities, and items that require consideration at the early stage of the Contract. The General part shall be

furnished alongwith the first issue of the construction programme (refer clause 114.2) and shall include information on

- a) Sources of materials like coarse aggregate and fine aggregate, quantity and quality of materials available in different source.
- b) Sources of manufactured materials like cement, steel, bitumen reinforcement, prestressing strands and bearings. Wherever possible the Contractor shall identify at least two sources for each of the items; he shall also submit test certificates or recently manufactured materials for the consideration of the Engineer.
- c) Locations of site facilities like batching plant, hot mix plant, aggregate processing plant, crushing plant etc.
- d) Details of facilities/approaches for transportation of men, equipment and materials for construction of pavement, foundations and substructure in riverbed ,and plan for free traffic flow and safe drainage.
- e) Information on procedures to be adopted by the Contractor for prevention and mitigation of negative environmental impact due to construction activities.
- f) Any other information required by the Engineer subsequent to the scrutiny of method statement.

The General part of the Q.A. Programme shall accompany the methods statement under sub-clause 105.3.

The Special part of the methods statement shall be submitted to the Engineer by the Contractor for each important item of work like construction of embankments and sub-grade, pavements, pile/well foundations, concreting, prestressing, repair and rehabilitation of existing structures, concrete super structure, dismantling of structures and pavement and for any other item as directed by the Engineer. These statements shall give information on

- i) Details of personnel both for execution and quality control of the work.
- ii) Equipment deployment with details of number of units, capacity, standby arrangements.
- iii) Sequence of construction, details of temporary or enabling works like, diversions, cofferdams, formwork including specialized formwork for superstructure, details of borrow areas, method of construction of embankment and sub-grade, pavements, pile, wells, concreting procedures, details of proprietary process and products (e.g. details of prestressing systems, proprietary piling systems, bearing, expansion joints etc.) and details of equipment to be deployed,. Wherever necessary, technical literature, design calculations and drawings shall be included in the methods statement.
- iv) Testing and acceptance procedures including documentation.
- v) Special part of the Q.A Programme referred in clause 105.3 for the particular item of work shall be submitted along with the methods statement for the concerned activity.
- vi) Engineer shall examine and approve the methods statement or direct the Contractor to resubmit the statement with required modifications. The modified statement shall be submitted within 14 days of receipt of Engineer's comments.

The sole responsibility for the safety and adequacy of the methods adopted by the Contractor shall rest on the Contractor irrespective of any approval given by the Engineer.

Sub-Clause 115.2 Approval of Proprietary Product/Process/System

Only proprietary products proven by International usage in comparable projects shall be permitted to be used. Fully authenticated details of licensing and collaboration arrangement shall be submitted by the manufacturer, where relevant.

Within 90 days of award of work the Contractor shall submit the following information for all proprietary products for approval by the Engineer.

i) Name of manufacturer and name of product/process/system.

Complete details of the manufacturer of the product/ process/system shall be furnished. Details of projects where similar product/process/system has been successfully used shall be-furnished. Authenticated copies of license/collaboration agreement shall be furnished.

ii) General features of the product/product process/system.

Detailed write up with methods statements shall be furnished for each product/process/system. This shall include compete working drawings & installation drawings, technical specifications covering fabrication, materials, system of corrosion protection etc.

i) Details of product development and development testing.

ii) Acceptance test and criteria.

Manufacturer shall submit a quality assurance system document. Details of acceptance test and criteria of acceptance shall be furnished in this document.

i) Installation procedure.

ii) Maintenance procedure and schedule

iii) Warranty proposal

The Engineer may instruct any additional tests for the purpose of accepting the product. The charges of these additional tests shall be borne by the Employer only in case the product satisfies the specifications.

CLAUSE 121 FIELD LABORATORY

Sub-Clause 121.1 Add the following at the end of the clause

This facility will be provided and maintained by the Contractor , as incidental to work and no separate payment shall be made for this item.

Sub-Clause 121.2 Description

Replace the words “shown in drawings” in the first sentence of first paragraph of this Clause with the words “per provisions indicated in this Clause and at a location approved by the Engineer.” Replace “electric supply etc” to the second sentence of first paragraph by “including uninterrupted power supply etc.”.

Delete the first sentence of second paragraph “The floor space..... in the drawing” and substitute the following:

“The floor space required for the field laboratory shall be not less than 500sqm.”

The fourth sentence of second paragraphs “The furnishing..... In Table 100-2” shall read as under.

“A good semi furnished office accommodation shall be provided to the Material Engineers of the Supervision Team as per the direction of the Engineer.

Add the following at the end of this Clause:

“There shall also be provided a concrete paved area, for storing samples adjacent to the laboratory, of about 300 sqm and another 200sqm shall be suitably roofed with open sides giving protection against sun and rain.

Within 14 (fourteen) days of the commencement date, the Contractor shall prepare and submit a layout plan and details of the laboratory building and make/supplier of the equipment to the Engineer for his approval.

The field laboratory to be provided under the Contract shall be handed over to the Engineer in finished and fully equipped condition not late than 2 months after the receipt of notice to Commence Work, and the field laboratory with all equipment/instrument shall be to the entire satisfaction of the Engineer. During the 2 month period starting from the Notice to Commence work, the laboratory tests shall be performed in another laboratory proposed by the Contractor and approved by the Engineer.

Sub-Clause 121.3 Laboratory Equipment

Delete the text of the Clauses 121.3.1 to 121.3.4 and substitute the following:

Sub-Clause 121.3.1 General

This Clause shall read as under:

The following items of laboratory equipment shall be provided in the field laboratory :

The equipment and instruments shall be new and shall be quality certified by Bureau of Indian Standards (BIS)

S. No	Sub No.	Item, Specifications	Nos. required
A: General			
(i)		Balance	
	(a)	7 kg to 10 kg capacity semi -self indicating Electronic Type –Accuracy 1 gm	2
	(b)	500 gm capacity semi-self indicating Electronic Type – Accuracy 0.01 gm	2
	(c)	Chemical balance 100gm capacity - Accuracy 0.0001gm	1
	(d)	Pan balance 5 kg capacity - Accuracy 0.5 gm	2
	(e)	Platform Scale – 300 kg capacity	1
	(f)	Triple Beam balance-25kg capacity Accuracy 1gm	2
(ii)		Ovens – Electrically operated, thermostatically controlled	
	(a)	From 100°C to 220°C – Sensitivity	2
(iii)		Sieves, as per IS 460-1962	
	(a)	IS Sieves 450 mm internal dia. of sieve sets as per BIS of required sieve sizes complete with lid and pan	2 set
	(b)	IS sieve 200 mm internal dia. (brass frame and steel or brass wire cloth mesh) consisting of sieve sets of required sieve sizes complete with lid and pan	2 set
(iv)		Sieve shaker capable of taking 200 mm and 450 mm dia. Sieves electrically operated with time switch assembly (As per BIS)	1
(v)		200 tonnes compression testing machine	1
(vi)		Stop watches 1/5 sec. Accuracy	2
(vii)		Glassware comprising of Beakers, Pipettes, dishes, measuring cylinders (100 to 1000 cc capacity) glass rods and funnels, glass thermometers range 0°C to 100°C and metallic thermometers range 300°C	1 Dozen each
(viii)		Hot plates 200 mm dia (1500 watt)	6
(ix)		Enamel trays	
	(a)	600 mm x 450 mm x 50 mm	10
	(b)	450 mm x 300 mm x 40 mm	10
	(c)	300 mm x 250 mm x 40 mm	6
	(d)	Circular plates of 250 mm dia.	6
(x)		Water Testing Kit	1
(xi)		First Aid Box	1
(xii)		Spatula Set of 100 and 200 long	3
(xiii)		Digging Tools (pixels, shovel, fork etc.)	As reqd.
(xiv)		Miscellaneous tools (sledge hammer, lump hammer, wooden pegs etc.)	As reqd.
(xv)		Maximum and Minimum Thermometer	2 Set
(xvi)		Rain Gauge	1 Set
(xvii)		Timer 0-60 minutes with alarm & 1/5 sec accuracy.	3 Sets

Sub-Clause 121.3.2

For Soil and Aggregates

**Sub-
121.3.3
For
and
Mixes**

B: For Soils and Aggregates			
(i)		Water Still, 3 liter/hr with fittings and accessories	1
(ii)		Liquid limit device with Casagrande and ASTM grooving tools as per IS:2720	1
(iii)		Sampling pipettes fitted with pressure and suction inlets, 10 ml capacity	2 set
(iv)		Compaction apparatus (Proctor) as per IS: 2720 (Part 8) complete with collar, base plate and hammer	1 set
(v)		Modified AASHTO compaction apparatus as per IS 2720 (part 7) 1980 or Heavy Compaction Apparatus as per IS complete with collar, base plate and hammer	1 set
(vi)		Sand pouring cylinder with conical funnel and tap and complete as per IS 2720 (Part 28) 1980 including modified equipment	4
(vii)		Sampling tins with lids 100 mm dia x 75 mm ht 1/2 kg capacity and miscellaneous items like moisture, tins with lid (50 grams) etc.	12
(viii)		Lab CBR testing equipment for conducting CBR testing, load frame with 5 Ton capacity, electrically operated with speed control as per IS:2720 (Part 16), and consisting of following:	1 set
	(a)	CBR moulds 150-mm dia – 175-mm ht complete with collar, base plate etc.	24
	(b)	Tripod stands for holding dial gauge holder	24
	(c)	CBR plunger with settlement dial gauge holder	1
	(d)	Surcharge weight 147-mm dia 2.5 kg weight with central hole	48
	(e)	Spacer disc 148-mm dia, 47.7-mm ht. With handle	3
	(f)	Perforated plate (Bass)	24
	(g)	Soaking Tank for accommodating 24 CBR moulds	1 each
	(h)	Proving rings of 1000 kg. 2500kg. and 5000 kg. capacity	1 each
	(i)	Dial gauges, 25 mm travel-0.01 mm/division	10
	(j)	Aluminum Tis	
		50 x 30 m	36 nos
		55 x 35 m	36 nos
		70 x 45 m	36 nos
		70 x 50 m	36 nos
		80 x 50 m	36 nos
(ix)		Standard Penetration test equipment	1
(x)		Nuclear Moisture Density meter or equivalent	2
(xi)		Speedy moisture density complete with chemicals	2
(xii)		Unconfined compression test apparatus	1 set
(xiii)		Aggregate Impact Test Apparatus	1
(xiv)		Aggregate Impact Test Apparatus as per IS 2386 (Part 4) 1963	1
(xv)		Los Angeles abrasion Test Apparatus as per IS 2386 (Part 4) 1963	1
(xvi)		Riffle Box of Slot size of 50mm as per ASTM C 136	1

**Clause
Bitumen
Bitumen**

Sub-Clause
Cement,
Concrete
Materials

C: For Bitumen and Bituminous Mixes			
(i)		Constant temperature bath for accommodating bitumen test specimen, electrically operated and thermostatically controlled, 50 liter capacity temp, range ambient 80°C	2
(ii)		Penetrometer automatic type, adjustable weight arrangement and needles as per IS 1203 -1978	2
(iii)		Solvent extraction or centrifuge type apparatus complete (AASHTO, T-164) with extraction thimbles with stocks of solvent and filter paper	1
(iv)		Laboratory mixer including require accessories about .02 cum capacity electrically operated fitted with heating jacket	1
(v)		Marshall compaction apparatus automatically operated as per ASTM 1559-62 T and complete with electrically operated loading unit, compaction pedestal heating head assembly, dial micrometer and bracket for flow measurement, load transfer bar, specimen mould 100 mm dia (4in) with base plate, collars, specimen extractor, compaction hammer 4.53kg (10 lb.) x 457 mm (18 in) fall	1set
(vi)		Distant Reading Digital Thermometer for Measuring Temperatures in Asphaltic Mixes	As required
(vii)		Riffle Box	1
(viii)		Automatic Asphalt Content Gauge [Nuclear or equivalent]	1
(ix)		Thin film Oven test apparatus to the requirement of AASHTO T 179, including accessories	1
(x)		Ring Ball Apparatus as per IS 1205 – 1978	1
(xi)		Asphalt Institute Vacuum Viscometer as per IS 1206 (part II) – 1978	1
(xii)		BS U – Tube Modified Reverse Floro Viscometer IS 1206 (Part III) – 1978	1
(xiii)		Apparatus for Determination of Ductility Test as per IS 1208-1978	1
(xiv)		Pen Sky – Martars closed tester for testing flash and fire point as per IS 1209 – 1978	1
(xv)		Apparatus for Float Test – IS – 1210 – 1978	1
(xvi)		Apparatus fo Determination of water content (Dean and Shark Method) IS - 1211 – 1978	1
(xvii)		Apparatus for Determination of Loss on Heading IS – 1212-1978	1
(xviii)		Apparatus of Determination of specified Gravity IS -1202 – 1978	1
(xix)		Core cutting machine with 100 mm dia. Diamond cutting ~~edge~~	1
(xx)		Apparatus for Storage Stability test for Modified Bitumen	1
(xxi)		Apparatus for Storage Stability test for	1

121.3.4
For
Cement
and

D: For Cement, Cement Concrete and Materials			
(i)		Water still	1
(ii)		Vicat needle apparatus for setting time with plungers, as per IS 269-1967	1
(iii)		Moulds	
	(a)	150 mm x 300 mm ht cylinder with capping component	As required
	(b)	150 mm x 150 mm x 150 mm cubical for compressive strength	As required
	(c)	150mm x 100 x 600 mm beam for flexural strength	As required
(iv)		Concrete permeability apparatus	1
(v)		High frequency mortar cube vibrator for cement testing	1
(vi)		Concrete mixer power driven, 1 cu ft capacity	1
(vii)		Variable frequency and amplitude vibrating table size 1 metre x 1 metre, as per the relevant British Standard	1
(viii)		Flakiness & Elongation test apparatus	2 each
(ix)		Aggregate impact test apparatus as per IS 2386 (Part 4) 1963	2
(x)		Los Angeles abrasion apparatus as per IS 2386 (Part 4) 1963	1
(xi)		Flow table as per IS 712 -1973	1
(xii)	(a)	Equipment for slump test	2
	(b)	Compaction factor test equipment	1
(xiii)		Equipment for determination of specific gravity for fine and coarse aggregate as per IS 2386 (Part 3) 1963	2
(xiv)		Flexural attachment to compression testing machine	1
(xv)		Core cutting machine with 150 mm dia. Diamond cutting edge	1
(xvi)		Needle vibrator	1
(xvii)		Vibrating hammer as per BS specification	1
(xviii)		Air entrainment meter ASTM C – 231	1
(xix)		0.5 Cft cylinder for checking bulk density of aggregate with tamping rod	1
(xx)		Soundness testing apparatus for cement	1
(xxi)		Flexural Beam testing machine with accessories	1
(xxii)		Chemicals solutions and consumable	As reqd.
(xxiii)		Chloride Testing kit for chemical analysis of chloride content	1
(xxiv)		ION Exchange kit for rapid determination of sulphate content	1

Sub-Clause 121.3.5 For Control of Profile and Surface Evenness

E: For Control of Profile and Surface Evenness			
(i)		Digital Level complete with all accessories	2 sets
(ii)		Distomat or equivalent	2 Nos.
(iii)		Theodolite – Electronically operated with computerized output attachment	2 sets
(iv)		Total Station with all accessories	1 sets
(v)		Towed Fifth Wheel Bump Indicator	2 sets
(vi)		3 meter straight edge and measuring wedge	2 sets
		Camber templates 2 lane	
(vii)		String line Arrangement with paver and sensor powers	1
	(a)	Crown type cross-section	2 sets
	(b)	Straight run cross section	2 sets
(viii)		Steel tape	As reqd
	(a)	5 m long	As reqd
	(b)	10 m long	As reqd
	(c)	20 m long	As reqd
	(d)	30 m long	As reqd
	(e)	50 m long	As reqd
(ix)		Precision Staff of 1mm least count	3 sets
Note: The contractor shall provide any other equipment required to check quality as per the requirement of specification in addition to the above.			

Note:

The laboratory set-up must be complete including a set of reference standards, adequately staffed and operational to the satisfaction of the Engineer not later than 2 months from the date of receipt of Notice to commence the works.

The Contractor shall be responsible for the provision of adequately experienced and qualified laboratory staff, in sufficient numbers to be able to meet all testing requirements to the approval of the Engineer, and for the supply of all transportation of staff, testing equipment and samples necessary to allow the testing to be performed in a time scale compatible with the needs of the Site.

Contractor shall arrange to maintain the laboratory in satisfactory manner and will carry stocks of spare equipment and laboratory consumables until the issue of Taking Over Certificate.

Sub-Clause 121.4 Ownership

This Clause shall read as under:

“Land for the laboratory shall be provided by the Contractor. The field laboratory building shall be and remain the property of the Contractor. The equipment provided for tests shall be the property of the Contractor which will be removed by him at his own cost after issuance of taking over certificate.”

Sub-Clause 121.5 Maintenance

This Clause shall read as under:

“The Contractor shall arrange to maintain the field laboratory including sample store yards in a satisfactory manner until the issue of Taking over Certificate for the whole work. Maintenance includes all activities described in Clause 120.4 and maintenance of equipment and running of the same including chemicals and consumables.”

Sub-Clause 121.6 This clause stands deleted.

Sub-Clause 121.7 Rate

This clause shall be read as under:

The construction, supply, installation, maintenance, and operation including all consumables like chemicals & reagents etc. and all other expenses involved in connection thereto for the field laboratory shall be incidental to the work, and shall not be paid for separately.

CALUSE 124 PROVIDING AND MAINTAINING VEHICLES FOR THE ENGINEER

The heading of this clause shall read as under:

**PROVIDED AND MAINTAINING VEHICLES FOR
EMPLOYER/EMPLOYER’S PRERESNETATIVE AND HIS STAFF**

Sub-Clause 124.1 Scope

This clause shall read as under:

“The work covers providing and maintaining Diesel/Petrol driven vehicles for use by the Employer/Employer’s representatives and his as described under the Bill of Quantity.”

Sub-Clause 124.2 Description

Para 1 of this clause shall read as under:

“The passenger cars shall be petrol/ diesel run, Ambassador cars of equivalent or equivalent having cylinder capacity of minimum 1400cc for the Project Director of the Employer. The vehicles shall be of the year 2006 make or later.

Sub-Clause 124.4 Withdrawal of Vehicles

The first sentence for this Clause shall read as under:

The Contractor shall withdraw particular vehicles if not required for use by Employer/Employer’s Representative.

Sub-124.5 Measurement for Payment

In 2nd line. Replace “vehicle day” by “vehicle month” and add the following the end of this clause:

“Average mileage per month shall not exceed 3000 km per vehicle.”

Sub-Clause 124.6 Rates

Replace the word “Engineer” by “Employer/Employer’s Representative.”

Clause 126 SUPPLY OF VIDEO CASSETTES

The heading of this clause shall be read as under

“Supply of VIDEO CASSETS AND DIGITISED CD ROMS.”

SUB-Clause 126.1 Add the words “and CD ROMs” after Video cassettes” in the last sentence of the sub clause.

Following shall be added at the end of this sub clause

“In order to avoid sequencing of the construction work to be covered it may be necessary that the video film shall be taken at intervals for each activity from the commencement to the end of road or bridge structure. This sequence can be edited suitably at a later stage to reconstruct the activities for the purpose of training engineers as well as information and record for the posterity.

SECTION 200 SITE CLEARANCE

CLAUSE 201 CLEARING AND GRUBBING

Sub-Clause 201.1 Scope

Replace with following Para:

This work shall consist of cutting, excavating, removing, and disposing of all materials such as trees of girth up to 300 mm. bushes, shrubs, stumps, roots, grass weeds, rubbish etc. and top soil up to 150 mm, which in the opinion of Engineer is unsuitable for incorporation in the work including drawing out stagnant water if any from the area of road, drain, cross drainage structure and other area as specified in the drawing or instructed by Engineer. It shall include necessary excavation by harrow discs or any other suitable equipment, back filling of the pits by suitable soil, resulting from uprooting of trees & stumps and making the surface in proper grade by suitable equipment and compacted by power roller to required compaction as per Clause 305.3.4. The work also includes handing, salvaging and disposal of cleared material. Clearing and grubbing shall be performed less than one month in advance earth operation and in accordance with requirement of these specifications.

Sub-Clause 201.4 Disposal of Materials

Replace “1000m” with “5000m” in the second paragraph, last sentence. Identification of location for disposal of all types of unserviceable/suitable/unsuitable materials shall be the responsibility of the contractor and approved by Engineer.

Sub-Clause 201.5 Measurements for payment

Delete the last two sentences in first paragraph and the whole of second and third paragraph and replace as under:

Cutting of tress upto 300 in girth measured at 1 meter above ground including removal of stumps and root and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operation and no separate payment shall be made for the same.

Removal of stumps and roots of trees of girth above 300 mm trees cut by other agencies and back filling to required compaction as specified in this clause shall be measured in terms of number separately on the basis of girth size of stumps of trees as given in Bill of Quantity and will be payable. For the purpose of stump removal, girth size shall be measured 150mm above ground.

Sub-Clause 201.6 Rates

Sub-Clause 201.6.1 This Sub-Clause shall read as under:

The Contract unit rate for the clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidental necessary to complete the work. These will include removal of stumps of any size /girth and roots of trees left over after cutting of trees carried out by the Contactor or any other agency. The excavation and backfilling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with al lifts and upto a lead of 5000m.

The removal from site and disposal of all materials obtained from clearing and grubbing operations, which, in the opinion of the Engineer can not be used or auctioned, shall be included in the contract unit rate.

Sub-Clause 201.6.2 Substitute for “up to a lead of 1000m” with “leads” in last line.

Sub-Clause 201.6.4 Add new Clause

The contract unit rate for removal of stumps and roots of trees of girth above 300mm left over after cutting of trees carried out by another agency shall include excavation, handing, salvaging, pilling and disposing of the cleared materials with all lifts and leads.

**CLAUSE 202 DISMANTLING CULVERTS, BRIDGES AND OTHER STRUCTURES/
PAVEMENTS**

Sub-Clause 202.3 Dismantling of Pavements

Add at the end of 2nd para:

The existing bituminous pavement surface, sub-base courses (Wet Mix Macadam or Water Bound Macadam, Stone Soling, Brick Soling etc.) shall be removed by ripping, pavement breaker or any other suitable equipment, or any other suitable means as approved by the Engineer.

Dismantling of existing base and sub-base courses shall be measured by taking cross section at 10m intervals before dismantling by making 30cm wide trench in full width and depth of pavements and computing the volumes in cum by method of average cross sectional areas.

Sub-Clause 202.4 Backfilling

After “operations” add “and wells encountered in the alignment”.

Add after last sentence:

The wells may be capped thereafter if directed by the Engineer. The filling of wells and capping will be paid separately in the relevant items of earth work, concrete, RCC works as the case may be.

Sub-Clause 202.5 Disposal of Materials

The first paragraph of the sub clause shall read as below

“All materials obtained on dismantling shall be the property of the Employer. The Contractor shall give rebate for the value of the dismantled material and then the Contractor is free to dispose of the materials with all leads and lifts.”

Sub-Clause 202.6 Measurements for Payment

Add the following item after item (vi):

(vii)	Dismantling expansion joints of bridge	.....	linear meter
(viii)	Removal of existing drainage spout	.....	no.
(ix)	Dismantling of pavements	.....	cum
(x)	Removal of wearing course	.....	Sqm
(xi)	Removal of signboard/Bill boards	....	No

Sub-Clause 202.7 Rates

Substitute the word 'up to a lead of 1000m' with 'all leads'.

Add at the end of this sub clause:

The contract unit rates for various items of rebate shall be on the full quantities obtained from dismantling.

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 301.2.1 Classification

Add at the end of para (a)

"Conglomerates and boulders not requiring blasting having maximum dimension in any direction upto 300mm shall also be covered under this category"

Delete "and conglomerates" from first line of para b (i)

Delete the words beginning "gravel and cobble....." upto "...75 and 300mm" in Para b(ii)

Delete para b (iv)

Add para (f) after para (e) as under:

"Hard Rock (controlled blasting)

Hard rock requiring blasting as described under (c) but where full scale blasting is prohibited for any reason and excavation has to be carried out by less quantity of explosive placed at pre-determined critical locations so that maximum returns can be made."

Sub-Clause 301.3.3 Excavation – General

Delete the last two sentences of para 5 beginning and ending with:

"If trees were removed by the Engineer." and

"The cost of planting ...to the work."

Add:

Temporary support to the sides of the excavation, necessary to support the foundation of adjoining structures and to prevent ground movement shall be provided by the Contractor. Where temporary supports are provided these shall be designed and 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 301.3.5 Rock Excavation

The first sentence of first para shall read “Rock, when encountered in road excavation, shall be removed upto a level of 100mm below the base of WMM.”

Sub-Clause 301.3.7 Excavation of road shoulders/verge/medians for widening of pavement or providing treated shoulders

The title of this Clause shall be read as under:

“Excavation of road shoulders/verge & medians for widening of pavement or for providing treated/paved shoulders and medians.”

The first sentence of this Clause shall be replaced as under:

“In works involving widening of existing pavements or providing paved shoulders, the existing shoulders/verge/median shall be removed to its full width and upto top of sub-grade. The sub-grade material within 0.5m from the lowest part of the pavement crust for widened portion or paved shoulders shall be loosened and recomputed as per Clause 305 to a density not less than 97% of maximum dry density determined according to IS:2720 (Part 8). Any unsuitable material encountered in this portion of sub-grade shall be removed and replaced with suitable material and compacted in accordance with Clause 305”.

While removing the existing shoulders/verge/median, care shall be taken to see that no portion of the existing pavement designated for retention is loosened or disturbed. If the existing pavement gets disturbed or loosened, it shall be dismantled and cut to a regular shape with sides vertical and the disturbed/loosened portion removed completely and re-laid as directed by the Engineer, at the cost of the Contractor.

Sub-Clause 301.3.11 Disposal of excavated materials

Delete this sub-clause and replace with:

“All the excavated materials shall be the property of the Employer. Suitable material obtained from the excavation of the roadway, shoulders, verges, drain, cross drainage works, etc. shall be used for:

- i) Filling for roadway embankments with all lifts and leads.
- ii) Filling existing pits in the right of way as directed by the Engineer, including leveling and spreading with all lifts and leads.
- iii) For landscaping or the road as directed by the Engineer, including leveling and spreading with all lifts and leads.

Excavated rock shall be available to the contractor for using in the manner as he desired (other than the above items of work) after affording the rebate against the respective items of BOQ.

The contractor shall remove unsuitable and surplus material, which, in the opinion of the Engineer cannot be used in the works, from site and disposed off at the approved location in accordance with all statutory requirements as approved by the Engineer with all lifts and leads and no extra payment shall be made for the same. Area of dumping of such materials shall be arranged by the contractor.

Sub-Clause 301.6 Preparation of Cut Formation

Second para shall be read as under:

“In rock formation, the rock shall be cut 100mm below the specified elevation of base WMM and the surface irregularities shall be corrected. The gap between rock cut and base of WMM shall be filled with 100mm thick granular sub-base as per grading –I of Table 400-1 of Clause 401. The unsuitable material shall be disposed of in accordance with Clause 301.3.11.”

Sub-Clause 301.8 Measurements for Payment

In first line of first para add “and drains” after the word “roadway”

Delete the last para from “works involved....” and substitute:

“Work involved in excavation for roadway and drains shall be measured in unit indicated below:

- | | |
|---|--------|
| ➤ Excavation in all classes of soil including marshy soil | ...cum |
| ➤ Excavation in ordinary rock | ...cum |
| ➤ Excavation in hard rock with or without blasting | ...cum |
| ➤ Preparing Rocky Subgrade | ...sqm |
| ➤ Loosening & re-compacting sub-grade | ...cum |

Sub-Clause 301.9 Rates

Sub-Clause 301.9.1 In para (ii) the phrase “lead upto 1000m or as otherwise specified” shall be substituted by “all leads”.
Add extra item after item (vi)

(vii) The removal from site and disposal of all surplus or unsuitable materials obtained from excavation operations, which, in the opinion of the Engineer cannot be used in the Works, shall be included in the Contact unit rates.”

Sub-Clause 301.9.2 This Clause shall be read as under:

“The contract unit rate for loosening and re-compacting at sub-grade level shall include full compensation for loosening to the specified depth, removing the loosened soil outside the roadway excavation rolling the surface below, breaking the clods, spreading the excavated soil in layers, watering where necessary and compacting to the requirements.”

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

Sub-Clause 301.9.5 Replace “but leads upto 1000m “ by “ and all leads” at the end of this para.

Sub-Clause 301.9.6 Replace “the additional haul or transportation involved beyond the initial lead of 1000m.” with “any haul and transportation involved”.

Sub-Clause 301.9.7 Add new sub-clause as under:

The Contract unit rate for rebate of materials obtained from excavation/cutting shall take into account for full compensation to be made by the Contractor who shall be responsible for arranging approval, payment of royalty and complying the requirement of mining department and other authorities of Central/ State Government for reuse of materials obtained from rock cutting”.

CLAUSE 304 EXCAVATION 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 foundation 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.”

Sub-Clause 304.3.4 Preparation of Foundation

In para 2 and 3 of clause 304.3.4 substitute ‘Concrete M15’ in place ‘1:3:6 nominal mix’.

Sub-Clause 304.4 Measurement for payment

In the second sentence of Para 1 of clause 304.4 after the words “.....cutting of slopes,” insert the words protection/support to existing structures,”

Sub-Clause 304.5 Rates

Sub-Clause 304.5.1 In item Serial Number (v) replace “leads upto 1000m on as otherwise specified ‘by’ all leads”

Clause 305 EMBANKMENT CONSTRUCTION

Sub-Clause 305.2 Material and General Requirements

Sub-Clause 305.2.1 Physical requirements:

Sub-Clause 3052.1.1 Add at the end of the 1st Paragraph
“Use of fly ash available from thermal power station located within 100Kms of work may be required. The embankment with fly ash shall be executed as per additional technical specification Appendix-XXIII for”Construction of Embankment with fly ash”.

Sub-Clause 305.2.1.2 Add the following at the end of Sub-Clause:

“Soils having medium and high swelling potential shall be defined on the basis of Liquid limit, Plastic limit, Shrinkage limit, Gradation, Free swelling Index, Field dry density and Field Moisture Content and types of clay minerals present in the soil and as directed by the Engineer. The location and the extent of these soils with medium to high swelling potential should be defined as directed by the Engineer.”

Sub-Clause 305.2.1.4 Delete second sentence “However, the Engineer requirements of these specifications”.

Sub-Clause 305.2.2.2 Borrow material

Para 1 of this clause shall be read as under:

No borrow area shall be made available by the employer for this work. The arrangement for the source of supply of the material for embankment and sub-grade as well as compliance to the different environmental requirement in respect of excavation and borrow areas as stipulated, from time to time, by ministry of Environmental and Forest, Government of India and local bodies, as applicable, shall be the sole responsibility of the contractor.”

After the 7th paragraph delete Table 300-2 and substitute the following:

Table 300-2
Compaction requirements of Embankment and Sub grade

S.No.	Type of Work/Material	Relative compaction as %age of maximum laboratory dry density as per IS 2720(Part 8)
1	Sub-grade and earthen structures	Not less than 97%
2	Embankment	Not less than 95%
3	High Embankment (Height >6m	Not less than 97%
4	Expansive clays	Not Allowed
5	Design CBR of sub-grade & Shoulder shall be per Drawing ,but not less than 8%	

Para 8 of this clause given below Table 300-2 shall read as under:

The contractor shall at least 7 working days before commencement of construction of embankment and the sub-grade; submit the following to the Engineer for approval:

- (i) The values of maximum dry density and optimum moisture content obtained in accordance with IS:2720 (Part 8) for each fill material proposed to be used in the construction of embankment and sub grade.

- (ii) The Graphs of Density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.
- (iii) The dry density moisture content-CBR relationships, heavy compact efforts conforming to the IS 2720 (Part 8) for each of the fill material proposed to be used in the sub grade.

The above information shall form the basis for compaction only upon its approval by the Engineer.”

Add the following new Sub-Clause:

Sub-Clause 305.2.2.3 Construction of embankment with fly ash/pond ash available from coal or lignite burning thermal plants as waste materials

Construction of Embankment using fly ash/Pond ash shall be carried out complete as per IRC SP:58-2001 and Additional Specification-Appendix, XXIII for “Construction of embankment with fly ash.”

Sub-Clause 305.3 Construction operations

Sub-Clause 305.3.1 Setting Out:

Add the words “with minimum 300mm wide” after the words sufficiently wider” appearing in the fifth line of this clause.

Sub-Clause 305.3.4 Compacting Ground Supporting Embankment/ Subgrade

Para 1 of this clause shall be read as

“Where necessary the original ground shall be leveled, scarified, mixed with water and then compacted by rolling to facilitate placement of first layer of embankment so as to achieve minimum dry density as given in Table 300-2”.

Add at the end of Para 2

“Backfilling layers in pits trenches and below the original ground are to be compacted to the relative natural ground density. The natural ground density shall be determined by conducting field density tests at three widely spaced locations along the central line of the proposed additional carriageway at a depth between 0.5m to 1.0m. Samples of natural ground are collected at each location, and are tested in accordance with IS:2720(Part 8).The relative density (i.e. the percentage of the field dry density to the laboratory maximum dry density) is assessed for each sample and the greatest relative density obtained is selected as the “natural ground density”. If the natural ground density is less than 85% then these are to compacted after necessary watering so as to achieve not less than 85% of relative compaction.

“Where necessary to facilitate compaction of the sub-grade to 97% relative compaction as stated above, a further depth below the sub-grade of maximum thickness of 0.2m shall be loosened, watered and

compacted in accordance with Sub Clause 305.3.5 and 305.3.6 to not less than 95% of dry density determined in accordance with IS:2720 (Part-1)”

Sub-Clause 305.3.5.2 **In Para 3, substitute “IS: 2720(Part 8)” for IS: 2720(Part7)”**

Sub-Clause 305.3.6 **Compaction**

The second para of this clause shall be read as under:

“Vibratory roller of not less than 80-100KN static weight with plain or pad foot drum or pneumatic tyre roller of 300KN weight having tyre pressure of at least 7kg/sqcm shall be used for compaction.”

Insert the following sentence before the last sentence of Paragraph 5.

“The co-relation between sand replacement densities and nuclear gauge densities shall be based on trials with minimum 30 coherent density measurements”.

Sub-Clause 305.4.6 **Add the following at the end Clause**

In section/ reaches where embankment has to be constructed on marshy or boggy/water logged soils, coarse sand blanket layer (>75 micron) of minimum 500mm thickness shall be laid before taking up the construction of embankment. The provision of this blanket layer of sand is payable separately.

Sub-Clause 305.8 **Measurement for Payment**

Add the following at the end of the first paragraph

“The original ground level referred to above shall mean the actual levels obtained after the site is cleared and grubbed plus a thickness not exceeding 150mm to account for the incidental item of backfilling after clearing and grubbing as per Clause 201 of the specification to bring back the ground level to the original level which was existing before start of clearing and grubbing”. The original ground level referred above shall be same as the OGL referred in Clause 109.6”

Sub-Clause 305.9 **Rates**

Sub-Clause 305.9.1 Add “including removal of topsoil after word “material appearing in first line of item (v).

Insert “including removal and replacement of marshy soil” after words “unsuitable material” appearing in the second line of item (iii).

Add the following new Sub-Clause:

Sub-Clause 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 item 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	Measurement for Payment Suitable Clause 306.4 as follows: "All temporary 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 paragraph after end of the fifth 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.
Sub-Clause 309.3	Sub-Surface Drains
Sub-Clause 309.3.1	Scope The first sentence of this clause shall read as: "Sub-surface drains shall be closed jointed perforated pipes , surrounded by granular material laid in a trench to drain the pavement courses".
Sub-Clause 309.3.2	Materials Grading requirements for filter material shall conform to clause I of Table 300-3.
Sub-Clause 309.3.2.A	Pipe The first and second sentences of this clause shall read as: "Perforated pipes for the drains are of PVC. The size and grade of the pipe to be used is as specified in the drawing."

Sub-Clause 309.3.4**Laying of Pipe and Backfilling**

Delete para 4 of this clause.

Sub-Clause 309.4**Measurement for Payment**

This clause shall read as:

“Construction of drains shall be measured as finished work in position as below:

- | | | | |
|-------|--|-------|---------------|
| a) | Unlined drain | ..... | running metre |
| b) | Median drain as shown in the drawing with PCC M20, NP2 pipe, leveling concrete M15 and filter media. | ..... | running metre |
| c) | Open lined drain as per drawing with all arrangements such as collection chamber, NP-4 pipe for discharge etc. | ..... | running metre |
| d) | Covered drain | | |
| i) | Excavation | ..... | Cum |
| ii) | Levelling concrete M15 | ..... | Cum |
| iii) | Course random rubble masonry | ..... | Cum |
| iv) | RCC grade M25 | ..... | Cum |
| v) | Steel Reinforcement | ..... | MT |
| vi) | Precast perforated slab | ..... | Nos. |
| vii) | Sumps, type S1 & S2 (Manhole) | ..... | Nos. |
| viii) | RCC pips | ..... | Running metre |
| f) | Semi circular chute drains with bail mouth metre entry | ..... | Running |
| g) | Energy Dissipation basin | ..... | Nos. |
| h) | Iron grating | ..... | Nos. |

Sub-Clause 309.5**Rates**

Delete “except for removal of unsuitable material for which the lead shall be 1000m.” at the end of 1st sentence.

Delete last sentence of the paragraph.

SECTION 400**SUB-BASES, BASES (NON BITUMINOUS) AND SHOULDERS**

General

Sub clause (i) of 401.8 stands deleted and remaining sub paras (ii) to (v) are renumbered as (i) to (iv).

Sub clause (i) of clause 405.7.1 stands deleted and remaining sub paras (ii) to (iv) are renumbered as (i) to (iii).

The provision of clause 401.8,(i) to (v) be read as "Clause 401.8 (i) to (iv)" in the sub-clauses 402.8, 403.8,404.7,407.7 and 410.7

CLAUSE 401 GRANULAR SUB BASE

Sub-Clause 401.1 Scope

Add the following at the end of this Clause:

"A site trial shall be performed in accordance with Clause 901.16."

Sub-Clause 401.2 Materials

Sub-Clause 401.2.1 Para 1 of this Clause shall be read as under:

"The material shall be free from organic or other deleterious constituents and conform to the Grading 1 given in Table 400-1 with the percentage passing 0.075 mm size restricted to 5%. The portion of the total aggregate passing 4.75 mm sieve shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS:2720 (Part – 37)."

Delete para 2 of Clause 401.2.1.

Sub-Clause 401.2.2 Physical Requirements

Add at the end of this Clause as under:

The Contractor shall, at least 21 working days before the commencement of the construction of the sub-base course, submit to the Engineer, the results for approval of the laboratory testing on the physical properties defined above. The construction of the sub-base course shall be taken up only the Engineer's approval of the material.

Sub-Clause 401.3 The clause shall read as follows:

It shall be ensured prior to actual execution that the material to be used in the sub-base has a minimum CBR value of 30% and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified either by performing CBR tests in the laboratory or by conducting DCP test. The CBR tests shall be conducted on specimen soaked of 4 days and compacted to 98% of the maximum dry density as per IS:2720 (Part 8).

When decided by the Engineer – Dynamic Cone Penetration (DCP) tests shall be performed in-situ as per TRRL (UK) Road Note No. 31 and in situ CBR calculated by co-relation given by TRRL.

CLAUSE 406 WET MIX MACADAM SUB BASE/BASE

Sub-Clause 406.2.1.1 Physical Requirements

Delete the second sentence beginning with “If crushed gravel...” and ending with “... fractured faces.” And as under.

“If crushed boulders are used, not less than 90% by weight of crush boulders retains on 4.75mm 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 4.75 mm sieve shall also be crusher run screening only.”

Add the following at the end of the paragraph.

Soundness test shall be carried out in accordance with IS:2386 (Para 5) 1963. The average loss of weight of coarse aggregate after “5 cycles shall not exceed 12% when tested with sodium sulphate and 18% when tested with magnesium sulphate as specified in IS:383.

From the Table 410-10 delete at the bottom of the table asterisk and modify as under:

“The aggregate should satisfy the both the tests a) Los Angeles Abrasion Value b) Aggregate Impact Value.”

Sub-Clause 406.3.3 Preparation of Mix

Para 1 of Clause 406.3.3 shall be read as under:

“Wet mix Macadam shall be prepared in an approved Wet Mix Macadam mixing plant of 200T/hour capacity having provision for controlled addition of water and forced/positive mixing arrangement.”

Sub-Clause 406.3.4 Spreading of Mix

Substitute para 2 of clause 406.3.4.

The mixing shall be spread only by paver finisher for the main pavement under the carriageway and shoulders. In exceptional cases where it is not possible for the paver to be utilised, mechanical means, like motor grader, may be used with the prior approval of Engineer.

Clause 406.3.5 Compaction

Delete second sentence of Para 1 of Clause 406.3.5.

Sub-Clause 406.4 Opening to Traffic

The Clause shall be read as follows:

No vehicular traffic of any kind shall be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

CLAUSE 408 CEMENT CONCRETE KERB WITH CHANNEL

Sub-Clause 408.5 Construction Operations

Sub-Clause 408.5.1 Substitute “M10” with “M15” in the first sentence.

Clause 408.5.6 Add at the end of the first sentence “or as shown in the drawing”
Add new Sub-Clause:

“After erection, kerbs shall be painted with one coat primer and two coats of colour paint (white and black). All colours shall be ready mix oil bound and shall be approved by the Engineer”.

Sub-Clause 408.6 Measurements for Payment

This Clause shall be read as under:

Cement concrete kerb/kerb with channel shall be measured in cubic metre.
Foundation of kerb, where separately provided shall be measured in cubic metre.

Sub-Clause 408.7 Rates

This clause shall read as under:

The contract unit rate for cement concrete kerb/kerb with channel shall be payment in full compensation for furnishing all materials, labour, tools, equipment for construction and other incidental cost necessary to complete the work. Foundation for kerb, wherever provided, shall be paid separately as per contract.

CLAUSE 409 FOOTPATHS AND SEPARATORS

Sub-Clause 409.2 Materials

Parts (c) of this Sub-Clause 409.2 shall be deleted.

SECTION 500 BASE AND GAP SURFACE COURSE (BITMINOUS)

General

Sub para (i) of clauses 501.8.8.2 stands deleted and remaining sub paras (ii) to (xi) are renumbered as (i) to (x).

The provision “clause 401.8 (i) to (v)” be read as “Clause 401.8 (i) to (iv) in the clause 502.8 and 503.8.

The provision “clause 501.8.8.2 (i) to (xi) be read as clause 501.8.8.2 (i) to (x)” in the following clauses.

504.8, 505.8 506.8, 507.9, 508.9,509.9, 510.8, 511.1.8, 512.8, 513.8, 515.9, 516.9, 517.11, 518.9, 519.2.8, 519.3.7, 520.9 and 522.8

Sub-Clause 501.2 Materials

Sub-Clause 501.2.2 Delete “Crushed gravel or other hard material” from 1st line of 1st Para and replace with “crushed boulders”.
Replace word “Crushed gravel” in Para 3 with “crushed boulders”.

Sub-Clause 501.3 Mixing

Para 1, Line 3 and 4, replace with the word, “Adequate Capacity” with “Hot mix Plant of Batch mix type of Minimum capacity of more than 120T per hour.”

Sub-Clause 501.5.3 Spreading

Para 1 is replaced with the following:

“Bituminous mix shall be spread with paver fitted with electronic sensing device and string line arrangement (supported by steel pegs @ 5m apart) on either side of paving width for automatic leveling, surface evenness and profile control. Use of string lines is compulsory to provide signal to electronic sensing device fitted with a Paver Finisher.”

Sub-Clause 501.6 Compaction

Para 2, Line 13; sentence starting with “the intermediate rolling” is replaced by “Intermediate rolling shall be done with a Pneumatic roller of 150-250kN weight having a tyre pressure of at least 0.7Mpa.
Add new Para, “Rolling shall be continued till the density achieved, satisfied the requirement of Clause 903.4.2.

Sub-Clause 501.8.3.4 Laying the Profile Corrective Course

Clause 501.8.3.4.1 This Clause shall read as under:

“The surface on which profile corrective course is to be laid shall be thoroughly swept clean of dust and any other extraneous material using mechanical broom and dust collected removed or blown off using compressed air except in places where mechanical means cannot reach.

After preparing the granular surface as in Clause 501.8.3.1, 501.8.3.2 and 501.8.3.3, the profile corrective course with materials as per Clause 501.8.2.3/501.8.2.4 shall be laid and compacted to the requirement of particular specification Clause. Where a bituminous profile corrective course is to be laid over primed granular surface, a tack coat conforming to Clause 503 shall be applied prior to laying profile corrective course.

Where the profile corrective course is to be laid with Granular sub base and Wet mix macadam, the existing bituminous layer shall be scarified completely without disturbing the existing granular sub-base. The scarified surface shall be free of loose materials and compacted before laying the profile corrective course. The laying of profile corrective course with granular sub-base and Wet Mix Macadam shall be as per Clause 401 and 406 and as per drawing”.

Sub-Clause 501.8.3.4.2 Laying on existing bituminous surface

This Clause shall read as under:

“An existing bituminous surface shall be prepared as per Clause 501.8.3.3 and 501.8.3.4.1. The bituminous profile corrective course shall be laid after applying tack coat conforming to Clause 503 and compacted to the requirement of specification Clause.”

Sub- Clause 501.8.8.1 Rate for Scarifying:

Substitute for word “within 1000m of their origin” with “with all leads”

CLAUSE 502 PRIME COAT OVER GRANULAR BASE

Sub-Clause 502.2.3 Choice of Primer

This clause shall be read as under:

“Primer used for prime coat shall be bitumen emulsion complying with IS 8887 and CSS-I Grade conforming to ASTM D 2397/AASHTO M 140, and shall be refinery produced. The particular grade to be used for the work shall be got approved by the Engineer.

CLAUSE 503 TACK COAT

This clause shall be read as under:

“Binder: The binder used for tack coat shall be bitumen emulsion complying with IS: 8887 and CSS-I Grade conforming to ASTM D 2397/AASHTO M 140, and shall be refinery produced. The particular grade to be used for the work shall be got approved by the Engineer.”

Sub-Clause 503.8 Rate

The 2nd sentence of this para shall be read as:

“The rate shall cover the provision of tack coat at the rate of 2.5 kg/10 sqm. for tack coat applied on granulas surface treated with primer and 2 kg/10 sqm. on bituminous surface.

CLAUSE 504 BITUMINOUS MACADAM

Sub-Clause 504.2.1 Bitumen

This Clause shall be read as under:

“The binder shall be paving bitumen of Penetration grade S65 complying with Indian Stranded Specifications for “Paving Bitumen”, IS: 73.”

Sub- Clause 504.2.2 Course Aggregates

Delete “Crushed gravel or other hard material” from 2nd line of 1st Para and replace with “Crushed boulders”

Replace word “Crushed gravel” in Para 3 with “crushed boulders”.
Add the following at the end of this clause:

“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.”

Sub-Clause 504.2.5 Proportioning of Materials

Add below Table 500-4 of Clause 504.2.5 as under:

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

Sub-Clause 504.8 Rate

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

CLAUSE 507 DENSE GRADED BITUMINOUS MACADAM

Sub-Clause 507.2.1 Bitumen

Delete words “indicated in Table 500-10” and insert “grade of S-65” in 3rd and 4th line.

Sub-Clause 507.2.2 Coarse Aggregates

Delete “Crushed gravel or other hard material” from 2nd line of 1st para and replace with “Crushed boulders”.

Replace word “Crushed gravel” in Para 2 with “crushed boulders”.

Add the following at the end of this clause:

“The constituents of the aggregates shall be produced by integrated 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.”

Further from the Table 500-8, replace at the bottom of the table against asterisk “Aggregate may two tests” as under:

“Aggregate should satisfy both the tests Los Angeles Abrasion Value and Aggregate Impact Value”

Sub-Clause 507.2.3 Delete the words “or Naturally Occurring Mineral or a Combination of the two” appearing in the first sentence of the clause.

Sub-Clause 507.2.4 The first sentence of this clause shall read as “Filler shall consist of finely divided hydrated lime or as approved by the Engineer.”

Sub-Clause 507.2.5 Aggregate Grading and Binder Content

In Table 500 – 10, the following may be substituted:

Grading	1	2
Layer Thickness	75mm to 100mm	50 – 75 mm
Bitumen grade (pen)	65	65

The note-1 below Table 500 -10 shall read as:

“The grading of the aggregate mix as used in work shall be a smooth curve within and approximately parallel to the envelope in Table 500-10”.

Sub-Clause 507.3 Mixture Design

Sub-Clause 507.3.1 Requirement for the Mixture

Add the following requirements to list of Table 500-11:

- Water sensitivity (ASTM D1075): Retained stability (Ratio of Marshal Stability for 24h immersion and 30min Immersion in water at 60 degree centigrade temperature)= not less than 75%
- Stability to flow ratio = 205 to 410
- Filler – Bitumen ratio = 0.6 to 1.2

Sub-Clause 507.3.3 Insert the following paragraph between the existing paragraphs 3 & 4:
“Mixed design shall be carried out in accordance with the modified Marshal method described in Asphalt Institute Manual MS-2.”

Sub-Clause 507.4.9 Rolling

Add at the end of Para 1

“The rolling shall be continued till the density achieved as at least 98% of that of laboratory Marshall Specimen compacted as detailed in Table 500-11.”

Add the following new Sub-clause after Sub-clause 507.4.9

Sub-Clause 507.4.10 “The dense bituminous layers except Profile corrective course shall be laid with sensor paver capable of paving in width of 8-10m in single operation.”

Sub-Clause 507.9 Rate

This sub-clause shall read as under:

Add the words “except for items of prime coat and lack coat” after the words “required operations” in 2nd line.

“The contract unit rate shall be all as specified in Sub-clause 507.9.”

CLAUSE 508 SEMI-DENSE BITUMINOUS CONCRETE

Sub-Clause 508.9 Rate

This Sub-clause shall read as under:

“The contract unit rate shall be all as specified in Sub-clause 507.9.”

CLAUSE 509 BITUMINOUS CONCRETE

Sub-Clause 509.2.1 Bitumen

Binder shall be modified bitumen as per Clause 521 and as per IRC-SP:53-2002. In case of non-availability of modified binder, normal straight run Bitumen (60/70 grade) shall be used.

Sub-Clause 509.2.2 Coarse Aggregates

Add the following as second para:

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 be crusher run screening only.”

Sub-Clause 509.2.4 Filler

This clause shall read as under:

“Filler shall consist of finely divided hydrated lime or cement as approved by the Engineer.”

Sub-Clause 509.2.5 Aggregate Grading and Binder Content

The Note -1 below Table 500-18 shall be substituted:

“The grading of the aggregate mix as used in work shall be a smooth curve within and approximately parallel to the envelope in Table 500-18-Grade 1.”

Sub-Clause 509.3 Mixture Design

Sub-Clause 509.3.1 Requirement for the mixture

Add the following requirements to the list of Table 500-19:

- Water sensitivity (ASTM D1075): Retain stability (Ratio of Marshal Stability for 24h immersion and 30min Immersion in water at 60 degree centigrade temperature)= not less than 75%
- Swell Test (Asphalt Institute, MS -2 , No.2). maximum =1.5%

Add the following new Sub-clause after Sub-clause 509.4.8.

Sub-Clause 509.4.9 “The bituminous concrete layer shall be laid with sensor paver capable of paving in width of 8-10m in single operation.”

Sub-Clause 509.9 Rate

Add the following at the end of the Clause:

In case of using modified binder, the cost of modifier and its mixing with the bitumen in the refinery for the preparation of modified bitumen shall be paid separately.”

CLAUSE 511 OPEN GRADED PREMIX SURRACING

Sub-Clause 511.1.2.1 Delete the words “suitable grade as specified in contract or as directed by the Engineer” and insert “grade S-65”

Sub-Clause 511.1.8 Add the words “except for item of prime coat and tack coat” after the words required operations” in 2nd line.

CLAUSE 512 CLOSE GRADED PREMIX SURFACING/MIXED SEAL SURFACING

Sub-Clause 512.1.2 Close graded Premix surfacing shall be “Type B”

Sub-Clause 512.8 Add the words “including for item of prime coat and tack coat” after the words required operations” in 2nd line.

SECTION 600 CONCRETE PAVEMENT

CLAUSE 601 DRY LEAN CEMENT CONCRETE SUB-BASE

Sub-Clause 601.2 Materials

Sub-Clause 601.2.1 This Clause shall read as follows:

Source of Materials

“Provisions of Clause 1002 of these specifications shall apply to source of material”

Sub-Clause 601.2.2 Cement

The Clause shall read as follows:

“Any of the following type of cements, capable of achieving the Design strength may be used with the prior approval of the Engineer, but preference shall be to use 43 grade.

- i) Portland cement 33 grade conforming to IS: 269
- ii) Portland cement 43 grade conforming to IS:8112

If the soil around has a soluble sulphate exceeding 0.5% the cement used shall be sulphate resistant and conform to IS: 12330.

“Cement to be used shall be obtained in bulk form. The bulk cement shall be stored in accordance with clause 1014. The cement shall be subjected to acceptance test just prior to its use.”

Sub-Clause 601.2.4 Water

This item shall read as under:

“Water used for mixing and curing concrete shall conform to Clause 1010 of section 1000.”

Sub-Clause 601.4 Subgrade

Sentence 2 shall be read as:

“The Lean Concrete sub-base shall be laid on drainage layers as per drawings. The drainage layer shall be as per grading class III of Table 330.3. The material shall be crushed stone aggregate. The CBR of drainage layer shall be more than 30.”

Sub-Clause 601.5 Construction

Sub-Clause 601.5.4 Placing

Add in the beginning of Clause 601.5.4:

“One day before placing of the dry lean cement concrete sub-base, the surface of the drainage layer shall be given a fine spray of water and rolled with a smooth wheeled roller after a lapse of 2-3 hours after watering. The Engineer may instruct another fine spray of water to be applied just before placing of the dry lean cement concrete sub-base.”

Sub-Clause 601.5.7 CURING

Add the following in last.
Method ‘a’ shall be adopted.

CLAUSE 602 CEMENT CONCRETE PAVEMENT

Sub-Clause 602.2 Materials

Sub-Clause 602.2.2 Cement

Replace the last para with:

“it is the responsibility of the Contractor to test and propose the type of cement which will result in a concrete complying in all respects with the

specifications. Cement to be used shall be obtained in bulk. Bulk cement shall be stored in accordance with Clause 1014. The cement shall be subjected to acceptance test just prior to use.”

Sub-Clause 602.2.4.2 Coarse Aggregate

Delete words “crushed gravel” from 3rd line in first para and replace with “Crush Boulders”.

Add the following para at the end of clause:

“The stone Polishing Value, as measured by BS: 812(Part 114), shall not be less than 55.”

Sub-Clause 602.2.4.3 Fine Aggregate

Add the following at the end of this Clause:

“The fine aggregates shall be natural sand conforming to the grading Zone-II as per IS:383.”

Add following Para as Clause 602.2.4.4

Sub-Clause 602.2.4.4 Combined All –In Aggregate

The grading limits for all-in aggregates shall be as per IS:383 for 20mm nominal size aggregates and as given under:

IS Sieve Designation	Percentage Passing
40mm	100
20mm	95-100
4.75mm	30-50
600 micron	10-35
150 micron	0-6

Sub-Clause 602.2.5 Water

This clause shall read as under:

“Water used for mixing and curing shall conform to Clause 1010 of Section 1000.”
Water for preparation of concrete during hot weather shall be from water chilling plant installed at site.

Sub-Clause 602.2.7 Premoulded Joint Filler

Replace Clause 602.2.7 with:

“Joint filler board for expansion joints shall be of the same thickness as the specified joint width within a tolerance of $\pm 1.5\text{mm}$ and shall comply with the Requirements of IS: 1838 or BS Specification No. 2630. The filler for each joint shall be furnished in a single piece for the full depth and width required for the

joint. Holes to accommodate dowel bars shall be accurately bored or punched to give a sliding fit on the dowel bars.

Sub-Clause 602.2.8 Joint Sealing Compound

Replace Clause 602.8 with:

“The joint sealing compound shall be hot applied electrometric type, complying with AASHTO M 282 for joints in asphalt pavements or joints between asphalt and concrete pavements, and cold applied polyurethane or polysulphide type complying with BS:5212 – 1990 for joints in concrete pavements.

The Joint sealant shall be resistant to age hardening and shall have flexibility to accommodate movements of minimum 25% of the joint width as shown in the drawings without risk of breaking of the sealant or adherence failure. The dimensions shall be so proportioned; that the adherence to the groove walls is fully intact within the movements limits

Suitable primers as recommended by the manufacturers of each type of joint sealant shall be used.

Each lot or batch of joint sealant compound and primer shall be delivered to the job-site in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, date of manufacture, storage life, and safe heating temperature for hot applied sealant, and shall be accompanied by the manufacturer's certification stating that the compound meets the requirements of these specifications.

The Manufacturer's health and safety precautions shall be available at the job-site for each joint sealing compound and primer and it is the responsibility of the Contractor to ensure that all precautions are met.

Sub-Clause 602.3 Proportioning of Concrete

Sub-Clause 602.3.3 Concrete Strength

Sub-Clause 602.3.3.1 Replace the entire Clause 602.3.3.1 with:

“The pavement concrete shall be a class M-40 concrete with a minimum 28 days compressive characteristic strength of 40 MPa and minimum flexural characteristic strength is 4.5MPa.”

While designing the mix in the laboratory, correlation between flexural and compressive strengths of concrete shall be established on the basis of at least thirty tests on samples. However, quality control in the field shall be exercised on the basis of flexural strength. It may, however, be ensured that the materials and mix proportions remain substantially unaltered during the daily concrete production. The water content shall be the minimum required to provide the agreed workability for full compaction of the concrete to the required density as determined by the trial mixes or other means approved by the Engineer and the maximum free water cement ratio shall be 0.45.”

Sub-Clause 602.3.3.2 Replace the entire Clause 602.3.3.2 with;

“The ratio between the 7 and 28 days strength shall be established based on the results of the design mix trials, refer Clause 602.3.5.1. The average flexural strength of the 7 days cured specimens shall be divided by the average strength of the 28 days cured specimens for each batch, and the ratio between 7 days and 28 days flexural strength R_7 shall be determined to an accuracy of three decimal places. If, during the construction of the trial length or during normal working, the average value of any six consecutive 7 days test results divided by R_7 falls below $4.50 + 1.65 \cdot s$ MPa, (where s is the standard deviation of the group) then the Contractor shall stop paving and propose for the approval of the Engineer corrections to the mix to improve the flexural strength. The Contractor shall provide evidence, that the proposed corrections result in the required flexural strength before paving operations may be resumed by producing minimum six beams with the proposed corrected mix and testing these for 7 days flexural strength. No additional payment will be made for any changes to the mix.”

Sub-Clause 602.3.5 Design Mix

Add the following at the end of sub-clause 602.3.5.1
Following parameters shall be used

- | | | | |
|------|--|---|--------------|
| i) | Characteristics flexural strength at 28 days | = | 4.5 Mpa |
| ii) | Target mean strength at 28 days | = | 5.80 Mpa |
| iii) | Water cement ratio | = | 0.45 maximum |
| iv) | Slump as per IS:1199 | = | 31±15 mm. |

Sub-Clause 602.5 Separation Membrane

Replace the sub clause with the following:

A separation membrane shall be used between the concrete slab and the sub-base. Separation membrane shall be impermeable plastic sheet 125 microns thick laid flat without creases. It shall be white in colour shall be swept clean of all the extraneous materials using air compressor. Wherever overlap of plastic sheets is necessary, the same shall be at least 300 mm and any damaged sheeting shall be replaced at the Contractor's expense. The separation membrane may be nailed to the lower layer with concrete nails.

Sub-Clause 602.6 Joints

Sub-Clause 602.6.2 Transverse Joints

Sub-Clause 602.6.2.1 Replace the first para as follows:

“Transverse joints shall be contraction and expansion joints. Contraction joints shall be provided at 4.5 m intervals, except where expansion joints are provided. Expansion joints shall be provided at the junction of the approach slabs of bridges and the rigid pavement. Furthermore, transverse joints shall be provided at special locations like transitions to structures, transition to flexible pavements, off carriageway areas as shown on the drawings. The exact position of transverse joints shall be coordinated with adjoining construction packages and shall be proposed by the contractor in writing for the approval of the

Engineer. Transverse joints shall be straight within the following tolerances along the intended line, which is the straight line perpendicular to the longitudinal axis of the carriageway at the position of the joint.

Sub-Clause 602.6.2.2 Contraction Joints

Replace the entire Clause 602.6.2.2 with

“Contraction joints shall be as shown in the drawings.

The crack inducing joint groove, as indicated in the drawing and to 1/3 depth of the slab shall be cut as soon as the concrete is hard enough to take the load of the joint sawing machine without causing damages to the slab. The Contractor shall furnish a method statement, which describes his proposed methods for determination of the time period available for sawing the crack inducing joint grooves together with the capacity and number of sawing machines for approval of the Engineer. The method statement shall include establishment of maturity strength relationships in the laboratory and measurement of the in-situ maturity of the concrete by maturity meters (COMA-Meter by German Instruments A/S or similar) or other internationally recognized methods.

Sub-Clause 602.6.2.3 Expansion Joints

Add new para at the end of this sub-clause:

Joints at the junction of rigid and flexible pavements:

Joints shall be provided at the junctions of rigid and flexible pavement with transition slab as shown in drawing. Where due to unavoidable reasons, the joints cannot be constructed at the junction of the two contract package dowel bars shall be provided in the rigid pavement and other measures as directed by the Engineer taken joints between bituminous pavement and concrete pavements (at locations other than junction between contract packages) shall be constructed.

Sub-Clause 602.7.2 Concreting in Hot Weather

Add to the first para:

“If the concrete temperature exceeds 70° C during hardening, the Contractor shall -at his own expense – prove to the Engineer that durability parameters are unaltered (for example micro cracking, compressive strength of sawn cylinders or other as agreed with the Engineer).”

Sub-Clause 602.9 Construction

Sub-Clause 602.9.1 General

Add new para at the end of Clause 602.9.1 as follows:

“Paving shall be carried out in full carriageway width, including paved shoulders, where required. The paver should be able to run at least at an average uniform speed of 1m per minute”.

Sub-Clause 602.9.3.2 Batching Plant and Equipment

Add at the end of the Clause:

"Batching Plant should have output capacity at least 20% more than output required to meet the paving speed of 1m per minute. The Contractor shall not use more than two plants to meet the daily output requirement of concrete. The batching plant should have suitable devices for adjusting the slump of the mix and should have facility for the computer printouts of every batch produced".

Sub-Clause 602.9.4.1 Insert in the ninth line after uniform speed – "of at least 1 m per minute".

Sub-Clause 602.9.4.7 The New para to clause 602.9.4.7 as follows:

"The marketing shall be located on the horizontal surface at the edge of the paved shoulder and shall be carried out using prefabricated template figures approximately 80mm high and 5mm thick as approved by the Engineer. The figures shall be fixed to a plate which shall be inserted approximately 2mm into the plastic concrete by vibration and left in place until the concrete has hardened."

Sub-Clause 602.9.8 Surface Texture

Replace the sub-clause with the following:

"Surface texturing/mechanical tining of concrete pavement shall begin immediately after finishing of the concrete before application of curing membrane. Texturing/Tining shall be done with a specified machine specially designed for the purpose for providing grooves at an uniform spacing (c/c) of 18 mm to 21mm, depth (3 mm to 4mm) and width (3mm), parallel to the centre line of roadway extending over the entire roadway width but within 75mm of pavement edge & omitting within +/- 20mm of the sawed longitudinal joints."

Sub-Clause 602.10 Trial Length

Sub-Clause 602.10.2 Add new para to Clause 602.10.2 as follows

"All trials shall be carried out using the same paving width and slab thickness as used in the permanent works."

Sub-Clause 602.10.4 Replace the entire Clause 602.10.4 with:

"Transverse joints and longitudinal joints of each type that are to be included in the pavement work shall be constructed and assessed in the trial length."

Sub-Clause 602.10.5.3 Density

Replace the entire Clause 602.10.5.3 with:

"(v) In –situ density shall be assessed as described in Clause 903.5.2.2 from at least 3 cores drilled when the concrete is not less than 7 days old. Should any of the cores show honey-combing in the concrete, the trial length shall be rejected and further use of the spreading and compacting unit shall not be permitted until further trials have shown that modification can be made which will result in adequate compaction."

Sub-Clause 602.10.5.5 Strength

Add new clause as under:

“Minimum of thirty (30) beams for flexural strength and thirty (30) cubes for compressive strength shall be prepared from the concrete delivered to the paving plant. Each pair of beams and cubes shall be from a different batch of concrete. Compressive and flexural strength shall be tested after 28 days curing.

At the age of 28 days thirty (30) cores with diameter 150 mm shall be saw cut from the slab. The cores shall be saw cut in both ends to provide a specimen height of 300 mm ± 5 mm and shall be tested for compressive strength at the age of 28 days.

The concrete strength shall be deemed satisfactory if:

- The average flexural strength exceeds $4.50 + 1.65 \cdot s$ (MPa), where s is the standard deviation of the thirty tests, and the strength of any sample is not less than characteristic strength less 1.65 times standard deviation.
- The average compressive strength of the cores divided by 0.8 is equal to or exceeds the average compressive strength of the thirty cubes.

Sub-Clause 602.10.5.6 Temperature Measurements

Add new clause as under:

“The temperature development in the concrete slab during hardened shall be recorded. The temperature shall be measured in the middle of the slab (vertically) at a horizontal distance of at least 1000 mm from any free edge. The temperature shall be recorded every 3 hours after installment of the thermometer and the temperature –age relationship shall be determined. The maximum recorded temperature shall not exceeds 70°C. If the temperature exceeds 70°C the trial length shall be condemned and the Contractor shall propose methods to reduce the temperature development and carry out a new trial length at his own expense.

Sub-Clause 602.11 Preparation and Sealing of Joint Grooves

Sub-Clause 602.11.3 Sealing with Sealant

Sub-Clause 602.11.3.1 Replace first sentence with:

“Prior to application of the sealant the primer recommended by the manufacturer shall be applied.”

Clause 602.11.3.3 Replace the entire Clause with:

“Sealant complying with Clause 602.2.8 shall be used. Cold applied sealant shall be mixed and applied within the time limit specified by the manufacturer. Primers shall be applied neatly with an appropriate brush or as recommended by the manufacturer.

Sub-Clause 602.11.4 Testing of applied Sealant

Replace the entire Clause with:

“Each delivery of joint sealant compound and primer shall be tested in accordance with AASHTO M282 for hot applied joint sealant and BS: 5212: Part 2 for cold applied sealant at a recognized independent laboratory. In case deliveries are made more frequent than every three months, testing may be reduced to every three months. The laboratory shall be approved by the Engineer in advance.”

Sub-Clause 602.13 Opening to Traffic

Replace the entire Clause with:

“No vehicular traffic (including the Contractor’s vehicles) shall be allowed on the finished surface until a field flexural strength of minimum 4.50 MPa has been achieved. It is the responsibility of the Contractor to produce a sufficient number of series of test specimens to verify the field flexural strength.

Each series of test specimens for measurement of field flexural strength shall consists of minimum 3 test specimens. The specimens shall be cured at conditions similar to the field conditions. The method for curing and storing of the test specimens in order to imitate field conditions shall be proposed by the Contractor and approved by the Engineer. The required minimum field flexural strength of 4.50 MPa is achieved when the average flexural strength of minimum 3 specimens exceeds $4.50 + 1.65*s$, where s is the standard deviation of the group.

Prior to opening to traffic the joints shall be sealed and areas adjacent to the pavement shall be completed to a degree that will ensure traffic safety . Opening to traffic shall not constitute a final acceptance of the pavement.

SECTION 700 GEOSYNTHETICS

Clause 704 shall be replaced as follows:

704.1 General

Geogrid Reinforced Soil works (GRSW) includes detailed design (to be supplied by the Contractor) for the entire earth reinforced works for different section heights, supply and construction of Reinforced soil high embankment as per proprietary/patented System technology. The specialized firm/Technology provider would be an ISO 9001:2000 certified Designer and value added engineered system solution provider in Geosynthetics, with at least 10 years experience having completed at least one major project in India.

The proprietary/patented System shall be proven in use for a minimum period of 10 years internationally or in India involving minimum 10 reinforced soil structures of height exceeding 7m involving integrally jointed Geogrid as reinforcement, of which at least one should be 'Counterscarp Reinforced slope cum wall structure' of height exceeding 25m or more project involving hilly terrain stabilisation. Further the specialized system provider must have 10 years proven experience of providing Geogrid reinforced foundation treatment for 10 structure of height of 6m and above.

The contractor, unless having own expertise and experience in above specified structures, shall be required to enter qualified technology provider having necessary experience as per forgoing paragraph.

The System design of the Technology provider shall be proof checked/vetted by a practicing Geotechnical Engineer with minimum 15 years' standing and experience in Reinforced soil structure design and supervision in India in major projects.

The GRSS system consisting of select prefabricated green face elements, swiveling Block facia, select faciafill, structural reinforcing elements with all accessories/fittings and backfill material in accordance with the proprietary/patentees specifications and in close conformity with the lines, grades, design and dimensions of the proposed structure and it's configuration shown on the schematic tender drawings and shall be subject to meeting global stability considerations.

The guarantee period for the GRSS shall be 1 (One) year from the date of completion of works in addition to defect liability period specified elsewhere in the tender document. The installation contractor shall furnish guarantee as approved by the Engineer, supported by a third party liability insurance coverage amounting to 10% of the RE wall job value, covering a period of one year from date of completion of work.

The work shall generally be done in conformity to the MOSRTH "Specifications for Road and Bridge works" : 4th Revision Section 3100, and this amended Clause 704, amendments and this specification, while the design shall conform to requirements of BS 8006-1995.

Since Reinforced Soil slope structure pertains to specialized proprietary/patented system, the contractor shall made his own arrangements to procure the qualified system, secure the supplies and services needed and execute the work as per pre-qualified Technology provider's specifications and guidance only.

704.2.4. Elements

Reinforced Soil slope structure shall be executed as specialized system consisting of:

- i. Design and detail engineering of GRSS
- ii. Swiveling type special Block Facia elements
- iii. Scarificial Pyragreen or equivalent weld mesh wedge formwork & facia module
- iv. Geogrid reinforcing elements of all types of facia
- v. Foundation/ground improvement
- vi. Select backfill material
- vii. Filtration and drainage works
- viii. Vegetative green face structure regime

704.2.4. Design and Detail engineering of the system

Typical conceptual configuration of the GRSW shown in this Bid/BOQ is based on ISO 9001 certified ENVIRO system solution, meeting geophysical and environmental considerations, and particular specification of materials, based on which the bid offer would be accepted. However, The contractor is free to choose any other alternative system. The contractor is required to get the approval from the Engineer for the system proposed to be adopted with design prior to execution of the works.

The detailed design and drawings of the work shall be done in accordance with MOSRTH specifications conforming to proprietary/patented system design meeting guidelines of BS: 8006:1995 "Strengthened/Reinforced Soils and Other fills" and IRC 78, with scope of protection works as per drawings, including ground improvement for Reinforced soil foundation treatment for global stability and deficient bearing capacities.

The estimated safe Bearing capacity in the project site is in the range of 18-20 Ton/m² at 2 m to 3 m depth from the general ground level. The technology provider of the GRSW shall be required to provide a comprehensive design of the structural stability of the superstructure involving global stability considering the ground improvement measures necessary for up to maximum 8 m high front face of structure, with or without sloping overburden surcharge up to 20m high, subject to actual data from soil investigation carried out by the contractor on award of work.

704.2.5 Facing Elements in the GRSS

Steep slope may be designed as reinforced soil monolith or as counterscarp slope formation for both in cutting and filling on hilly terrain using patented/proprietary Reinforced soil system elements, shape and size, interconnection between elements by special connectors, UV stabilized Geogrid wraps, using selected earth/debris fill, GI weld mesh fascia module of Pyragreen or equivalent concertina design and construction methodology or equivalent.

Reinforced slope design in middle or top stages of embankment sloping overburden flanges may be supported by micro reinforced selected vegetative regime, Retained fill drainage galleries and intermediate horizontal pore pressure dissipation bays shall be as per design.

NURA-HEX type or equivalent swiveling PCC blocks design/Galvanised twisted wire Gabion monolith fascia/structure may be used as fascia elements, due hilly terrain and terraced contour.

704.2.6

Facia Design

i.

Facia for reinforced Green face slope construction

The fascia shall consist of prefabricated Concertina Weldmesh Wedge support elements duly connected to Geogrid in layers as a sacrificial Fascia formwork. They shall conform to the details and dimensions of system design. Each element shall have inbuilt Geotextile filtration protection for prevention of migration of fines and drainages and connection to the wrap of layered Geogrid reinforcement.

ii.

Facia for steep Block faced reinforced slope construction

PCC M25 fascia blocks shall be specially designed to adopt to turning slope contour and shall be configured in face with 1:10 to 1:12 batter, elements shall be connected with Geogrids using special connectors as per the technology provider's specification, incorporating proprietary/patented system, select filling, connection arrangements, detailing and design.

PCC Block fascia may be replaced by suitable discrete nominally reinforced RCC M25 precast panel fascia of PRECON shape or equivalent, of 150mm thickness, subject to minimum panel size of 2.5 m² per panel, with adjoining tongue and groove permitting erection in curved alignment.

iii.

Vegetative regime behind Pyragreen fascia

The green face regime shall be filled with hand placed turf sods, supported by a wedge of good earth, intermixed with seeding and fertilizer regime, carefully filling interstices and compacting the wedge configuration to ideally achieve a maximum compaction of 93% modified proctor density.

iv.

Exposed finish

The exposed face of the elements shall have the Dry packed rubble finish as per design of technology provider.

v.

Tolerances

Since the fascia shall be made with Green face/Block facing, they shall be manufactured within the following tolerances:

All dimensions : within 50mm

Evenness of the front facia 2000 mm template	:	$\pm 50\text{mm}$
Difference between lengths of two diagonals:		75mm maximum

vi. Handling, Storage and Transportation

All elements shall be handled, stored and transported in such a manner as to eliminate the warping of wedge support panels, misplaced alignment and excessive bending stresses.

704.2.7 Reinforced Soil Reinforcing Material

The reinforcing material to be used in GRSS shall be compatible with the backfill material meeting 'Particular specifications', as mentioned in Appendix-A of this document.

704.2.7.1 Geogrid reinforcement

The Geogrid material shall be dimensionally stable, have high junction strength, and be able to retain its geometry under construction stresses and have resistance to damage during construction, to ultra violet degradation encountered during execution of GRSS. Manufacturer's index Test batch certificates shall be furnished to certify these properties. Batch certificates shall be supplemented by Third party test certificates, from accredited test laboratories, to assert conformance of specified properties for quality assurance.

The ultimate limit state design of Reinforced soil structure with Geogrids may consider Base strength of Geogrid derived from Creep rupture criterion. Longterm design strength shall be determined with appropriate F.O.S of system provider for Geogrid considering various partial material factors of safety.

Further, Geosynthetics to be used in this project shall be of following types:

- a) Geogrid-as main soil reinforcing elements
- b) Non-woven Geotextile-for providing filtration and drainage
- c) Micro-reinforcing grids for vegetative reinforcement

For main soil slope reinforcement Uniaxial HDPE/PP Extruded and orientated Geogrids of Peak strength range 40-200 kN/m, meeting 'Particular material specification' in Appendix-A shall be used conforming to MOSRTH specification Clause: 701.

HDPE/PP Bi-axial Geogrids used for foundation treatment / geocell shall have minimum 20kN/m Peak strength in 12-14% elongation in both principal directions. Mono-oriented Geogrids of peak strength 40-200 kN/m shall be used in Geocell mattress diaphragm design with a Basal Bi-axial Geogrid separator, where required in design for foundation improvement. Only extruded and integrally jointed Bi-axial HDPE/PP Geogrid shall be used in foundation treatment. Woven, laced, knotted or jointed tape-form grids, coated or uncoated shall not be permitted in this project due to their dimensional instability and poor junction strength.

HDPE Geogrid shall be made from high molecular weight, extruded and oriented high-density polyethylene or polypropylene with integrated joints exhibiting high junction strengths. Minimum mass as per unit area of such Geogrids shall be 250gsm. Overall,

the material should be conforming to ISO 9001, meeting requirement of BS 8006-1995 etc.

For mono-oriented HDPE/PP Geogrid reinforcements, the long term design strength (LTDS) shall be calculated by using the following minimum values of material partial factor of safety based on Creep Strain serviceability criterion buried 20° C for 100 years service design life:

TABLE-I: Ultimate Limit State Analysis

Minimum partial factor of safety for calculation of 100 years long term design strength in accordance with BS 8006; 1995 requirement.	Base strength of HDPE/PP Geogrid derived from:
	Creep Rupture
Partial Factor of safety for creep deformation (at 20° C) f_{CD}	2.10
Partial Factor of safety for variation in manufacture from control specimen (fm 11)	1.00
Partial Factor of safety for extrapolation of creep test data (fm 12)	1.00
Partial Factor of safety for construction installation damage (susceptibility to damage) (fm 21)	1.01
Partial Factor of safety for partial chemical and biological degradation environment (fm 22)	1.00

Non-woven Geotextile conforming to MOSRTH specifications made from needle punched Non-Woven polypropylene (PP) staple fibers shall be used for filtration and drainage reinforcement. Geotextile may be used for filtration and drainage process in wall facia as well behind the reinforcing fill to allow free drainage environment to fill materials, and shall be designed based on system requirement.

The Geotextile must posses maximum resistance to creep, Hydrolysis, environmental stress cracking (ESC), photo oxidation (UV exposure) and thermal oxidation and installation damage as per ASTM or ISO guidelines and shall conform to ISO 9001 certified manufacture.

704.2.7.2 Acceptance criterion for Geogrid and Geotextile

In absence accreditation and adequate testing facilities of Geosynthetics in India, The acceptance criterion of Geosynthetics shall be subject to following:

1. Geogrid manufacture range used in slope/ wall/ foundation structure shall be certified by Board of Agreement certification from European Union (Such as ICT, BBA etc) or BIS, based on controlled production under ISO 9001 certification and should have been proven in use in India for at least last eight years, based on which Manufacturer's index test batch certificates shall be the basis of ascertaining properties of supplies. Recently developed products under trial use for last 1-4 years shall not be permitted to be used.
2. Geogrids used in superstructure and foundation shall have integral junction, subject to minimum junction strength of 1.5 times the long term design strength, whose characteristic strength properties shall be certified by 3rd party accredited test certification.
3. The manufacturers of extruded oriented Geogrids shall be able to supply Tensile creep rupture test data/ results for the period of 70000 hrs (8 years) minimum for extrapolation of data to 120 years over a temperature of 20° C in buried environment.
4. The Board of agreement accredited and ISO 9001 certified manufacturer of Geogrid/ Geotextile shall supply production batch certification, which shall be the basis of acceptance

of the product. On compliance of above verification no further field testing shall be necessary.

704.2.7.3 Particular specification of Geogrids

Select Geogrids shall be chosen meeting the 'Particular Specification' shown in Appendix-A

704.2.7.4 Metallic Stripes/ Reinforcements

System solution with metallic stripes or rods pertaining to passive anchorage system is not acceptable for this project, sue to high seismicity and high rainfall in Assam.

703.2.8 Reinforced soil Backfill

Backfill material shall be chosen from selected predominantly cohesive-granular materials from Debris or spoils from hill slope cutting generated from alignment. Backfill material in the reinforced soil fill shall be reasonably free from organic soil, oversize rock/ stones exceeding 60mm nominal size, soft crushable shale or otherwise deleterious materials and shall conform to the following mechanical and characteristic requirements.

Minimum characteristic requirements of soil fill (for all reinforcing elements) to be used in design

$$\begin{array}{lll} \phi \text{ (Drained)} & > & 30^\circ \text{ C} \\ C' & < & 5 \text{ k/M/m}^2 \\ y & = & 18\text{-}20 \text{ KN/m}^3 \end{array}$$

Sieve size	Percent Passing
250mm	100%
100mm	more than 75%
75 micron	less than 15%
Coefficient of uniformity $C_u = (D_{60}/D_{10}) > 2$	
Plasticity Index < 8	

Acceptance limits for materials with more than 15% passing 75 micron are related to the percentage of particles smaller than 15% microns as follows:

- Materials with more than 15% percent passing 75 micron sieve but less than 10% of particles smaller than 15 microns are acceptable.
- Materials with more than 15% percent passing 75 micron sieve but more than 20% of particles smaller than 15 microns are inadequate and shall not be used.
- Materials with more than 15% percent passing 75 micron sieve and 10 to 20% of particles smaller than 15 microns are acceptable provided that the internal effective friction (drained) angle is not smaller than 300.

Embankment backfill shall be selected to provide a free draining environment to allow zero pore pressure co-efficient. If this can not be ensured, additional horizontal and vertical drainage galleries/ bay shall be provided using natural and geosynthetic drainage systems

Materials not conforming to the above

Materials not conforming to the above requirements may be used with the written consent of Engineer after carrying out necessary tests. Such materials shall be tested for their functional properties to assure that they are consistent with the parameters used in the concept design.

Limitations on slope edge Compaction

Compaction of backfill material shall be done in layers of 300mm (or as per system requirement) @ 93-98% modified proctor density, under controlled moisture condition, where as the compaction within 1.8, form facia / slope edges shall not exceed 95% modified proctor density to avoid transmission of compaction thrust to the Facia.

704.3 DESIGN AND CONSTRUCTION REQUIREMENTS

704.3.1. Checking of the Reinforced soil design parameters

(i) Properties of backfill

Prior to selection and use of backfill, after ensuring availability of necessary volume of supplies the same shall be tested and got approved by the Engineer. In each case the data shall be the basis of actual site specific design of the GRSS, which shall be periodically checked to ensure uniformity of the application.

(ii) Assessment of safe bearing capacity

The successful contractor shall evaluate the safe bearing capacity of foundation by plate load tests in representative location at highest height along the alignment and use the data for design of GRSS. Necessary reinforced soil key shall be provided to account for seismic inertia in hill slope stability.

(iii) Assessment of ground level & embedment depth

Prior to commencement of detail engineering exact ground levels shall be determined to assess the undulations and necessary sectorisation of various height segments with reference to founding depth.

704.3.2. Foundation Treatment

In all cases if the foundation is found deficient in bearing capacity than that required catering to wall geometry eccentricity of loading and global stability, ground treatment as conceptually proposed with key, shall be designed and installed before construction of the superstructure.

GRSS design shall include necessary foundation treatment to meet deficient bearing capacity by using layered Geogrid-soil foundation mattresses or in more severe cases using Geocell mattresses, catering to bearing capacity improvement and global stability of the embankment. No other treatment like unreinforced granular blanket etc shall be permitted, keeping in mind the seismicity in the site location.

Ground treatment for gully portion using reinforced geocell mattress may be provided using Bi-oriented Geogrids as per technology provider's design.

704.3.3. Excavations

Excavation shall be in accordance with the requirements of general and special specifications and in reasonably close conformity to limit and construction staged shown in drawings.

The foundation for reinforced earth structure shall be graded level for a width equal to or exceeding the length of reinforcing strips of as shown on the drawings. Prior to embankment construction, if required by engineer, the existing founding stratum shall be compacted with a smooth wheel vibratory roller. Any foundation materials found to be unsuitable should be removed and replaced.

704.3.5. INSTALLATION

704.3.5.1. Foundation preparation

The foundation soil slope reinforced soil structures shall be graded level for a width equal to or exceeding the length of reinforcing geosynthetics. Prior to wall construction, if required by the engineer, the foundation shall be compacted with a smooth wheel vibratory roller. Where foundation soil is found to be unsuitable ground reinforcement is required to be carried out, as approved by the proof consultant or Engineer-in-charge.

704.3.5.1 Embankment construction

The reinforced soil slope embankment shall be constructed using end on technique, with configuration as shown in tender drawing. The configuration of embankment shall be designed and checked for global and local stability, with provision of Foundation treatment using layered foundation mattress or Geocells constructed with HDPE Geogrids.

The face batter in slope shall be placed carefully using temporary formwork for mid and top slopes. Only hand held vibro compactor shall be used within 1.8m of slope face, beyond which the compaction shall be done using roller compactors.

The Pyragreen or equivalent concertina face Wedge support elements shall be placed in line and batter and kept in position using required supports/brace tie. Elements shall be placed in successive lifts in sequence shown in design, as backfill placement proceeds. As fill materials is placed behind facia, the elements shall be maintained in desired position by means of temporary stay and formwork which shall be removed as per guidelines of the Technology provider during construction.

External bracing may be needed for the initial lifts. However, bracing shall be placed in an area not more than 1.50 meter wide beyond the outer face of facia.

Vertical Drainage bay using natural drainage material conforming to MOSRTH specification clause 309.3.2 shall be provided behind the reinforced fill to cater to free draining

environment. Besides, horizontal drainage bay using laminar drainage composites shall be provided as required.

Vegetation in upper slope shall be established based on detail agronomic consideration of long term sustainable variety of bio environment and shall be maintained as long required by proper watering, fertilization and rearing program or till at least 6 months after installation during monsoon, till the vegetation takes root.

704.3.3.5.2. Backfill placement

The founding soil shall be graded and leveled for receiving the foundation treatment in horizontal sectors of not less than 30m in length. Care shall be taken not to build on filled up soil exceeding 300 mm depth, though lesser undulations and depressions may be filled up, protrusions and level variations graded and compacted to arrive at horizontal platform. This may entail excavation and backfilling, which shall be treated as a part of the scope of work.

The contractor shall take precaution to minimize over excavation. The contractor, if required, shall design excavation support.

All materials shall be installed at designated elevation and orientation as shown in the detail working drawing to be provided by the technology provider and as directed by the Engineer.

Geosynthetic reinforcement should be installed under pretension to avoid kinks and warps. A nominal tension shall be applied to the reinforcement and maintained by staples, stakes, or hand tensioning until the reinforcement has been covered by at least 300 mm of soil fill.

Broken chipped, sustained or otherwise damaged units shall not be placed in the structure, unless they are repaired and the Engineer approves the repair method and results.

704.3.3.5.3. Backfill Compaction

Backfill placement shall follow closely the erection of each lift. At each reinforcement level, backfill should be roughly leveled before placing and fixing the grids. Reinforcing grids shall be placed normal to the face of slope or as shown on the drawings. The maximum completed layer thickness shall be in the range of 300mm. the reinforcing elements shall be laid free from all kinks, Damage and displacement during deposition, Spreading, Levelling and compaction of the fill. The program of filling shall be such that no construction plant runs directly on the reinforcement.

All construction plant having a mass exceeding 1000Kg shall be kept at least 1.8m away from the face of the slope. In this area (Up to at least 1.8m away from the face of slope), following compaction plant shall be used:

- 1) Vibratory plate compactor of maximum weight 1000Kg.
- 2) Vibro tamper having weight not exceeding 75Kg.

Compaction by other method like using Dozer or Back Blade compaction by Dozer or excavator bucket shall be preferred with due approval from the technology provider after ascertaining the level of compaction so achieved. During construction of reinforced fill, the retained material beyond the reinforcement at the rear or the structure shall be maintained at the same level as reinforced fill.

Temporary framework shall be used to support the construction as per specified details given in the drawing. The forms, scaffolding and props shall be sufficient in numbers to allow taking up of the sectional construction schedule specified in the design. Compaction should be performed to obtain 93 to 95% of the maximum standard proctor density (ASTM D698) within 1.8m from the face and 95%-98% in area beyond 1.8m distance from face.

704.3.3.5.4. Drainage

- 1) Verical Drainage media behind the reinforced soil fill shall be placed with Non-woven Geotextiles of appropriate design. A drainage gallery adjoining the facia of the reinforced soil structure shall be provided with minimum 300mm compacted width as shown on the concept drawing, or designed with Non-woven Geotextile separators as per system design of the technology provider.
- 2) Subsurface drainage bay with Geotextile wrapped granular media shall be provided on slope structure to retard the ingress of water within slope and discharge the rainwater to the surface drains, spaced at a maximum 5 meters spacing along the length of the structure, to allow gravity dissipation of pore water ingress, channelised outside the embankment structure.
- 3) At the crest and berms of the hill slope subsurface collector dissipater drainage using Geotextile wrapped granular media shall be provided, connected to a graded outfall.
- 4) Open surface drains shall be provided outside Toe of well on to divert overland flow of surface run off from rain and precipitation.

704.3.3.5.5. Geogrids storage and installation

All Geogrids shall be of UV stabilized variety. However they shall be stored under shade away from direct sunlight and shall be installed in buried environment within 6 months of arrival at site.

Geogrid reinforcement shall be installed by unrolling at site under recommended pre-tension. A nominal tension shall be applied to the reinforcement and maintained by staples, stakes, or hand tensioning until the reinforcement has been covered by at least 250mm of soil fill. Particular attention shall be paid on top most layer of geogrid which shall always need to have at least 250mm compacted overburden, or covered by a earthfill wearing course or drainage structure preventing surface erosion due to run-off.

Geogrids shall be covered with soil by suitable earth moving equipment for grading and leveling in each 250mm layer, where no heavy plant or equipment shall directly move over the Geogrids, but will always travel over a layer of soil layer. Jointing of Cut lengths of Geogrid shall not be permitted as principal reinforcements. The same may be used however in warp reinforcement in turn around portion. The installer therefore needs to carefully sort out and store smaller residual cut lengths from a standard roll for lower heights of wall/slope where requirement of embedment is smaller to avoid wastages.

704.3.3.5.6. Installation of Geotextile

All Non-woven Geotextiles shall be of UV stabilized variety. However they shall be stored under protective covering in covered shade away from direct sunlight and shall be installed in buried environment within 2 months of arrival at site, or within 7 days of removal of protective wrapper.

Geotextile shall be installed with requisite overlaps as per design, free from all kinks, damages due to protrusions and unsoaked in water before installation. Geotextiles, shall not need stitching unless expressly specified by the technology provider suiting his design.

Mutilated, torn, soiled or otherwise damaged fabric shall not be placed in the system unless they are repaired and the Engineer approves the repair method and results.

704.4 SUPERVISION

Guidance of the technology provider shall be in accordance with his ISO 9001 certified installation guidelines and supervision provided by periodic deputation of technical staff during the construction phases to ensure that the quality of the works performed by the Contractor is in accordance to the specifications of the technology provider.

The Technology provider shall depute a qualified engineer for supervision guidance to the contractor's engineer and provide periodic site visits ensuring implementation of a quality control procedure and monitoring of GRSS installation and guidance for correlation of defective installation, if any. Installation shall be done under express quality control procedure implemented under ISO 9001 certified process control of the Technology provider only. All expenses relative to his visits to site shall be borne by the contractor.

704.5 APPROVAL OF PROPRIETARY PRODUCT / PROCESS / SYSTEM

Only proprietary/patented systems capable of providing qualified design and engineering meeting, conformance requirement shall be accepted. ISO 9001:2000 certified Systems and Geosynthetic product manufacture are eligible to qualify for this project, which shall be got approved prior to commencement of work. Incomplete or ambiguous proposal shall be liable for rejection.

704.6 Quality control and acceptance of GRSS works

The Geosynthetic works shall conform to the specification in Appendix-A, manufactured, Supplied and certified by ISO 9001 quality standards.

The overall work shall be done with following quality control parameters:

- a. ISO 9001 certified geosynthetic system provider and designer's design and quality conformance
- b. ISO 9001 certification on geosynthetic production batch tests from manufacturer.
- c. Pre-qualified competent System provider's defect liability and warranty,
- d. Design certification by Expert Proof checking as required in Clause 704.1.
- e. MOSRTH specification & BS 8006-1995 guidelines

For quality assurance during construction the system provider shall issue detail installation guidelines with directives on following, duly certified by the Proof consultant and accepted by the Engineer:

- a. Project planning and scheduling, enumerating construction priorities
- b. Foundation adequacy
- c. Installation guidelines
- d. Quality conformance schedule and directives for system design adequacy
- e. Installation monitoring and remedial action.

704.7 Measurements for payments

- 1) Design and detail engineering, periodic supervision guidance as well as proof checking of design by competent expert firm shall be measured as a Lump-Sum job.
- 2) The measurement for Geogrid reinforcement, Geotextiles, laminar drainage composite and connectors shall be measured and paid in square meters of actual installation.
- 3) PCC Block facia, accessories (except Geogrids or Geotextiles) for connection of facia elements will be measured and paid in Square meter elevation area of facia installed.
- 4) Concertina sacrificial Wedge support Pyragreen facia or equivalent, its accessories (except Geogrids or Geotextiles) for facia elements will be measured and paid in Square meter area installed in elevation of vertical facia plane.
- 5) Rates for Geotextile for subsurface drainage, filtration, separator or drainage gallery shall be measure in Square meter of actual installation.
- 6) Slope protection measures using Micro-reinforcing vegetation system shall be measured and paid in Square meters of slope face area.
- 7) Natural filter medium shall be measured and paid in cubic meters.
- 8) Excavation, installation of geosynthetics (Geogrids/Geotextiles etc. as per design) and compacted rockfill for Geocell foundation treatment and Key in soil-Geogrid composite shall be measured and paid in cubic meters.
- 9) Earthwork in Excavation and Compacted soil fill for the embankment shall be measured and paid in Cubic meters.

704.8 RATE

- a) Rates for Design and detail engineering and shall include periodic supervision guidance as well as proof checking and certification of design/works by a competent expert firm.
- b) The rate for GI Concertina sacrificial Facia wedge support elements shall include the cost of providing, transportation and fixing with all materials, labour plants/machinery required for completing the work of facia elements (excluding Geogrids/Geotextiles) at site including cost of transportation and storage . The rate shall include cost of accessories, props, scaffolding etc.
- c) The cost of foundation shall include all items of excavation, dewatering, levelling, grading and compaction, temporary formwork, providing and installation of all reinforcing elements (Geogrids/Geotextiles), compacted infill / backfill as per design, labour, supervision and all equipment hire charges.
- d) The rate for Geogrids/ Geotextiles shall include contingencies for bulk procurement process, storage at site, transportation, installation etc.
- e) Rate for slope protection shall exclude cost of Micro Geogrids, but include seeds, fertilizer, dressing and deseeding, all installation, accessories and watering and maintenance for a period of six months.
- f) Rate for Filter medium shall include cost of excavation/filling and installation as specified.
- g) The cost of work filter medium shall include cost of all materials, labour and equipment etc. complete.
- h) The cost of backfill material shall include cost of earth including specified compaction for reinforced slope construction, transportation in all leads and lifts and testing.

APPENDIX-A

PARTICULAR SPECIFICATIONS OF MATERIALS TO BE USED IN THIS PROJECT

1.1 Extruded and Mono Oriented HDPF/PP Geogrids

- Geogrids shall be stiff grid like material with high dimensional stability and junction strength, made by a single extrusion process followed continuously by orientation of the long chain molecules of polymer, having integral/ fused joints.
- They shall be made from high density polyethylene or polypropylene in a mesh like stiff matrix with oval/ oblong aperture in roll form. They shall exhibit high junction strength, stiffness and creep resistance with long term design life exceeding 100 years.
- Characteristic Properties of select Mono-oriented Geogrids: (specification to match)

Table-1

Specification	Test Method	Unit	Types of mono-oriented Geogrids					
			MGG 1	MGG 2	MGG 3	MGG 4	MGG 5	MGG 6
Peak Tensile Strength	GRI-GG1	kN/m	60.0	65.0	80.0	110.0	120.0	160.0
Max. peak elongation	GRI-GG1	%	13.0	13.0	13.0	13.0	13.0	13.0

Note:

- Description of Geogrids as MGG-1, MGG-2 etc does not denote product quote, but correlates to item reference in BOQ only
- Polymer : High Density Polyethylene, Polypropylene, Permissible variation $\pm 5\%$
- Mono Oriented geogrids shall manufactured under ISO 9001/2 quality assurance program. Manufacture's conformity batch test certificate conforming ISO 9000 series quality assurance by the batch production shall be provided, following which no further testing shall be necessary.

1.2 Extruded & Bi-oriented HDPE/PP Geogrids

Bi-oriented Geogrids shall be manufactured in the same process as incase of mono-oriented Geogrids, but shall have additional stretching in the perpendicular cross plane direction also, resulting in square/ rectangular shaped apertures having integral/ fused joints. They shall exhibit high junction strength, stiffness and creep resistance with creep resisted design life of at least 100 years and supplied in Roll form.

Characteristic Properties of select Bi-oriented Geogrids: (Specification to match)

Table-2

Specification	Test Method	Unit	Types of bi-oriented HDPE Geogrids
			BGG-1
Peak Tensile Strength	GRI-GG1	kN/m	14.5 (MD) 20.5(TD)
Peak Elongation	GRI-GG1	%	16(MD) 13(TD)
Minimum Strength at 5% elongation	GRI-GG1	kN/m	9.5(MD) 15.0(TD)
Minimum junction strength in ratio to Peak strength	GRI-GG2	%	60%

Note:

- Description of Geogrids as BGG-1. BGG-2 etc does not denote product quote, but correlates to item reference in BOQ only
- Polymer: High Density Polyethylene/ Polypropylene
- Permissible variation $\pm 5\%$

Bi-oriented Geogrids shall be manufactured under ISO 9001 quality assurance programme. Manufacturer's conformity batch test certificate, conforming ISO 9001 series quality assurance by the batch production shall be provided, following which no further testing shall be necessary.

1.3 **Polymer Connector Bodkins**

Polymer connector (Type – TR-1) shall be a flexible tubular rod made of HDPE having 25 mm diameter, or as typically recommended by the Geosynthetic manufacturer to suit their system and Geogrid. The connector rod shall be chosen depending upon the variety of Geogrid chosen from the same manufacturer, based on their recommendation.

1.4 **Non-woven Needle punched Polypropylene Geotextiles for Filtration and Drainage**

specification	Test Method	Units	Non-woven Polypropylene Geotextile	
			NWT-1	NWT-2
Type		Mechanically bonded Non-woven		
Raw Material		100% polypropylene		
Peak Tensile Strength	EN ISO 10319	kN/m	10.0(MD) 9.0(CMD)	18.0(MD) 16.0(CMD)
Peak Elongation	EN ISO 10319	%	80(MD) 80(CMD)	80(MD) 80(CMD)
Static Puncture (CBR test)	EN ISO 12236	kN	1.5	2.8
Aperture size				
Thickness	EN 964/1	Mm	1.5	2.5
Opening size	EN ISO 12236	$O_{90} \mu M$	130	100
Flow rate	EN ISO 11058	$l/m^2/s$	100	120

- Manufacturer's conformity batch test certificate conforming ISO 9000 series quality assurance by the batch production shall be provided, following which no further testing shall be necessary.
- Description of Geotextiles as NWT-1 or NWT-2 does not denote product quote, but correlates to item reference in BOQ only
- Polymer: Polypropylene yarn, UV stabilized
- Permissible variation $\pm 5\%$

1.5 **Geogrid for Micro Reinforcement of vegetation**

Bi-oriented Micro-reinforcing Geogrids shall be made from HDPR/PP polymer material with high dimensional stability and junction strength, made by a single extrusion process followed continuously by orientation of the long chain molecules of polymer in both directions, having integral/ fused joints.

They shall be made from high density polyethylene or polypropylene in a mesh like stiff matrix with rectangular/ Square aperture in roll form. They shall exhibit high junction strength, stiffness and creep resistance.

Characteristic Properties of select Micro reinforcing Geogrid: (Specification to match)

Specification	Unit	Test Method	Types of bi-oriented HDPE Geogrids	
Polymer			PP	
Mesh Shape			QUADRANGULAR	
UV Stability			With Carbon black	
Aperture	mm		45,0 x 50,0	
			MD	TD
Peak Tensile Strength	kN/m	GRI-GG1	8,0	10,0
Strength at 2% strain	kN/m	GRI-GG1	2,0	2,0
Strength at 5% strain	kN/m	GRI-GG1	4,0	4,0
Elongation at peak	%		15,0	15,0

- Manufacturer's conformity batch test certificate conforming ISO 9000 series quality assurance by the batch production shall be provided, following which no further testing shall be necessary.
- Description of composite as PDC-1 does not denote product quote, but correlates to item reference in BOQ only.
- Polymer : HDPE/PP
- Permissible variation $\pm 5\%$

1.6 Prefabricated Laminar Core Drainage composite

Specification	Test Standard	Unit	Type PCD-1
Type	100% HDPE drainage core jacketed in 100% sleeve, UV stabilized Size 100mm wide x 250m length toll form		
Peak tensile strength (MD)	3.0 kN		
Discharge capacity	150 m ³ per year at 200 kPa confining pressure		
1. Drain Core	Profiled Extruded drainage Geonet core strip, or corrugated PVC core min. 90mm wide, inserted within jacket in tape form.		
Discharge capacity ($\sigma = 200$ KPa, i-1)	ASTMD 4716	m ³ / yr	150
Tensile strength CoreNet+Geotextile	ISO 10319	KN	3.50
Core Net	ISO 10319	KN	3.00
Min. Unit length		g/m	80
2.Filter jacket	Nonwoven PP fabric jacket, sleeved over core drainage strip		
Opening size (AOS)	EN ISO 12236	Micro n	144
Permittivity Water Permeability	EN ISO 11058	m/s	2.38x10 ⁻³

Manufacturer's conformity batch test certificate conforming ISO 9000 series quality assurance by the batch production shall be provided, following which no further testing shall be necessary.

Note:

- Description of composite as PDC-1 denotes type only and is not a product name.
- Polymer : Composite
- Permissible variation $\pm 5\%$

1.7 Pyragreen Concertine G.I. Weld mesh Wedge support formwork facia module

Proprietary concertina proprietary design facia module system or shall be used as facia support with layered Geogrids. Rectangular Concertina prefabricated face wedge supports shall be prepared in layflat form to be connected to Geogrid reinforcement using special connection. The concertina shall be made from 4mm dia Galvanised wires formed into but welded mesh of

75mm nominal aperture size as per proprietary design, shape and size, with special 6mm temporary external tie bracing at suitable intervals, loop connectors and internal connector to Geogrids. The galvanization coating of wire shall be of 200 gsm specification.

1.8 NURAHEX PCC Blocks

Proprietary PCC Blocks shall be as per concept drawings with special arrangement for rotational hinges in plan layout to allow facia to follow contours of hilly terrain, with stepped features to provide system batter of 1:8 – 1:12.

Proprietary RCC PRECON panels shall be of 150mm nominal thickness, made of M25 grade, as per concept drawings with special arrangement for rotational hinges in plan layout to allow facia to follow contours of hilly terrain and shall be erected with 1:25 – 1:50 batter, to account for Geogrid strain. U-trough bed block shall be used under precast facia. If the contractor opts using Panel facia, the change of bed block design shall be deemed to be included.

SECTION 800 TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES

CLAUSE 801 TRAFFIC SIGNS

Sub-Clause 801.1 This Clause shall be read as follows:-
 “The sings shall be reflectories. They shall be retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminum sheeting as per these specifications.”

Sub-Clause 801.2.6 This clause shall read as under:

 “The aluminum sheet used for signs shall be 2 mm thick.”

Sub-Clause 801.3 Traffic Signs Having Retro-reflective Sheeting

Sub-Clause 801.3.1 General Requirements

 The fifth sentence of this clause should read as under:

 “The reflective sheeting shall be of High intensity grade with encapsulated lens.”
Delete last sentence of this clause.

Sub-Clause 801.3.3 Engineering Grade Sheeting

Delete this clause

Sub-Clause 801.3.6 This clause shall read as under:

“Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting as per Clause 801.3.2, except those in black which shall be of non-reflective sheeting.

Sub-Clause 801.3.7 Add following in the clause

“All the facility information and place identification signs shall have blue (Indian standard colour No. 166: French Blue) background and white letter.”

Sub-Clause 801.3.11 Warranty and Durability

The first and second sentences of this clause shall read as under:

“The Contractor shall obtain from the manufacturer a seven-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and submit the same to the Engineer. In addition, a seven year warranty for satisfactory in-field performance of the finished sign with retro-reflective sheeting of high intensity grade, inclusive or the screen printed or cut-out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor/Supplier and passed on to the Engineer.”

Sub-Clause 801.4.1 The third & fourth sentence of clause shall read as follows:

Sign posts shall be of MS pipe 80mm dia. (NB-MW) or as shown in the drawing. Post shall be embedded in concrete (M-125) for safeguard against theft. The cost of signpost and its foundation complete including excavation & concrete shall be deemed to be included in the rate of signboard.

Sub-Clause 801.4.2 Add following at the end of this clause:

“The sign back shall be painted with two coats of grey colour epoxy paint. The sign post shall be painted in black & white alternate bands with two coats of epoxy paint.”

Sub-clause 801.5 Measurement for Payment

Add “as well as other informatory signs” after the words “place identification signs,”

CLAUSE 802 OVERHEAD SIGNS

Sub-Clause 802.1 General

Add at the end of the Clause:

“The locations of cantilever overhead and overhead signs (gantry type) shall be decided by the Engineer.”

Sub-Clause 802.5 Materials for Overhead Sign and Support Structures

Sub-Clause 802..5.2 The last line of this clause “they shall.... IS Specifications” shall read as

“They shall be thoroughly decaled, cleaned, primed along with all other components of signs, except reflective portion. They shall be painted with two coats of epoxy paint. The sign back side shall be painted with grey colour and post shall be printed in black & white alternate bands. The post below ground shall be painted with three coats of red lead paint.”

Sub-Clause 802.5.3 Replace “1.5mm” with “2.0mm” in the fifth line.

Sub-Clause 802.8 Measurements for Payment

This clause shall read as
Measurement for overhead signs shall be made in number.

Sub-Clause 802.9.1 This clause shall read as under:

“The contract unit rate for overhead sign structures shall be payment in full compensation for furnishing all labour, materials, tools, equipments, fabrication and installation. All other items like excavation for foundation, concrete & reinforcement in foundation, painting of structural steel & sign board etc., shall be considered incidental and no separate payment shall be made. The quot5ede rate for overhead signs shall include the cost of Gantry supporting it.”

Sub-Clause 802.9.2 This clause stands deleted.

CLAUSE 803 ROAD MARKINGS

Sub-Clause 803.2 Materials

This clause shall read as under:

“Road markings shall be hot applied thermoplastic compound and the materials shall meet the requirements as specified in Clause 803.4

The road markings shall be laid in one layer with appropriate road marking machine approved by the Engineer. Before the road-marking machine is used on the permanent works, the satisfactory working of the machine shall be demonstrated on a suitable site, which is not part of the permanent works. The rate of application shall be checked and adjusted as necessary before application on a large scale is commence, and thereafter daily.”

Sub-Clause 803.3 Ordinary Road Marking Paint

This Clause shall be deleted.

Sub-Clause 803.5 Reflectorised Paint

This Clause shall be deleted.

Sub-Clause 803.6 Application

Add the following Sub-Clause at the end of this Clause

i) General

Road traffic markings shall be constructed to accuracy within the tolerances given below:

- The width of lines and other markings shall not deviate from the specified width by more than 5%.
- The position of lines, letters, figures, arrows and other markings shall not deviate from the true position specified by more than 20 mm.
- The alignment of any edge of a longitudinal line shall not deviate from the true alignment by more than 10mm in 15m.
- The length of segments of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

In broken lines, the length of segments and the gap between segments shall be as indicated on the Drawings. If these lengths are altered by the Engineer. The ratio of the lengths of the painted sections shall remain the same.

Line and curves, whether broken or unbroken, shall not consist of chords but shall follow the correct radius.

ii) Faulty Workmanship or Materials

If any materials not complying with the requirements is delivered at the Site or used in the Works, or if any sub-standard work is carried out, such material or work shall be removed, replaced or repaired as required by the Engineer, at the Contractor's own cost. Rejected traffic markings and paint that has been splashed or has dripped onto the surfacing, kerbs, structures or other such surfaces shall be removed by the Contractor at his own cost, in such a way that the markings of spilt paint will not show up again later."

CLAUSE 804 HECTOMETRE/KILOMETRE STONES

Sub-Clause 804.3 The first sentence of this clause shall read as under:

"The hectometer/kilometer stones shall be made of concrete of grade as shown in the drawing."

Sub-Clause 804.3.1 New Clause 804.3 shall be added as follows:

Marker post shall be provided as shown in drawing. The posts shall be embedded in the ground as shown in drawing.

Sub-Clause 804.4 Measurement of Payment

The measurement will be in numbers of 200 meters, kilometers, 5th kilometer stone and marker posts fixed at site.

Sub-Clause 804.5 Rate

The word'/ marker posts' shall be inserted after the words '5th kilometer stone' appearing in the clause.

CLAUSE 805 ROAD DELINATORS

Sub-Clause 805.2 This clause shall read as follows:

- (a) Triangular object Marker shall be 300mm side with four red reflector, made out of 2mm thick aluminum sheet, face to be fully covered by high intensity grade white retro reflective sheeting of encapsulated lens type as per clause 801. The background/ border/ symbols shall be made by screen-printing of desired colour as per sign details. The sign plate shall be fixed with 6mm dia. Aluminum rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 40mmX40mmX5mm. The sign shall be fixed with nut=bolts & welding on MS pipe 50mmdia (NB-MW) and 500 mm high or as shown in the drawings.
- (b) Rectangular hazard marker 600mm X 300 mm made out of 2mm thick aluminum sheet, face to be fully covered by high intensity grade white retro reflective sheeting of encapsulated lens type. The background/border/symbols shall be made by screen-printing on desired color as per sign details. The sign plate shall be fixed with 6mm dia aluminum rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 40 mmX40mm X5 mm. The sign shall be fixed to 80mm dia (NB-MW) MS pipe or as shown in the drawings.
- (c) Roadway Indicators shall be 1000 mm high made with 100 mm dia. NB medium weight MS pipe. One reflector of high intensity grade retro reflective sheeting with encapsulated lens shall be provided on top of the reflector. The white & red reflector shall be provided alternatively of 40 mm width, so that total width of reflector shall be 120mm. A wire mesh cover of 150 mm height shall be provided on top or as shown in the drawings.
- (d) All components of signs & supports shall be thoroughly descaled, cleaned primed and painted with two coats of epoxy paint. The sign backside shall be with grey colour and post shall be white colour/alternate white & black bands. The post below ground shall be painted with three coats of red lead.

CLAUSE 806 BOUNDARY STONES

Sub-Clause 806.1 General

Add at the end of Para 1, "The boundary stones shall be of concrete as shown in drawing." The words 'NHA' should be engraved on each stones appropriately.

CLAUSE 807 FENCING

Sub-Clause 807.1 General

This clause shall be read as follow:

“The work comprises of fixing GI chain link fencing system Mesh size 75 mm X 75 mm height of fence 1.0 m with posts, supports, allied wires & accessories as per drawings and specifications and subject to approval of the Engineer.”

Sub-Clause 807.2 This Clause shall be read as follows:

- (a) Chain link Mesh:3.00 mm Dia. Galvanised Chain Link Fencing. mesh 75 X 75 mm.Height:1.8m.
- (b) Posts (Stiffener/Corner & End):Made out of ISMC 75 & Flat 75X6 placed at every 2.0 m centres.
- (c) Additional angle iron supports with ISA 40 X 40 X 6 shall be provided at Stiffener post & corner post/End post.
- (d) Finishing: All posts, supports & Accessories shall be Hot Dip Galvanized (zinc coated, 0.22 kg per sqm; minimum single spot confirming to relevant IS Specifications).

Sub-Clause 807.3 Deleted.

Sub-Clause 807.4 This Clause shall be read as follows:

Entry gate should be made of similar material of fence.

Sub-Clause 807.6 Rate

This Clause shall be read as follows:

“The contract unit rate for fencing shall be payment in full compensation for furnishing all labour, materials, tools, equipment, excavation, concreting assembly/fabrication and installation at site and all other incidental costs necessary to complete the work to these specification.”

Clause 808 TUBULAR STEEL RAILING

Sub-Clause 808.1 General

This Clause shall read as under:

“The work shall consist of supplying, fixing and erecting tubular Galvanized Iron (GI) railing including providing inserts, fixing arrangement on the crash barrier or at other places as shown in the drawings and as directed by the Engineer.”

Sub-Clause 808.2 This Clause shall read as under:

“The railing shall be of GI pipe OD 100 mm @ 8.82 kg/m. It shall be galvanized (zinc coated, 0.22kg/sq. metre; minimum single spot) confirming to relevant IS Codes or as shown in the drawings.”

Sub-Clause 808.5 Rate

The word ‘painting’ shall be replaced with ‘galvanizing’.

Clause 809 CONCRETE CRASH BARRIER

Sub-Clause 809.2.2 This clause shall be read as below:

The concrete barrier shall be constructed with grade and concrete as indicated in the drawing and with thermo mechanically treated (TMT) deformed bars of grade S 415 conforming to IS-1786.

Sub-Clause 809.3.2 The word 'bridges' shall be replaced with 'bridges & culverts'.

Sub-Clause 809.5 Measurements for Payment

This clause shall read as under:

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

SUB-Clause 809.6 Rate

Add at the end of the clause;

"and paid as per respective BOQ items"

CLAUSE 810 METAL BEAM CRASH BARRIER

Sub-Clause 810.1.2 The sub-clause 810.1.2 is modified as under:

"The design, materials to be used and the location of metal beam crash barrier shall conform to relevant drawings or as otherwise directed by the Engineer."

Sub-Clause 810.2.1 This clause shall be read as;

Metal beam is a "W" Profiled corrugated beam in single or double row and single or double faced as specified in the drawing made out cold roll forming form steel strip of 3 mm thick using steel of Fe 410 grade or ST 42 grade conforming to IS: 5986 with hot dip galvanized 550 gm per square meter.

The beam after forming shall have formed width of 312 mm and depth of 83 mm and shall have punched holes for fixing as specified in drawings.

The metal crash barrier posts & spacer shall consist "C" channel section made out of 5mm thick sheet by cold roll forming process of steel conforming to IS:2062-1992 Grade "A" with hot dip galvanized 550 gm per square meter.

All bolt, nuts and washers as specified in drawings shall conform to IS:1367 & IS:1364 unless otherwise specified and are hot dip galvanized 550 gm per square meter.

The Guard rail reflector shall be made of material and placed in position as shown in drawings. It shall be hot dip galvanized 550 gm per square mete.

Beams to be erected on a radius of 50 m or less shall be shop curved to the appropriate curvature of the installation.

The mechanical properties of the base metal for Beam shall conform to the following requirements:

- i) Yield point, minimum 345 MPa
- ii) Tensile strength, minimum 483 MPa and
- iii) Elongation, in 50 mm, minimum 12 percent

Test specimens for mechanical properties and coating shall be prepared and tested as specified in relevant IS codes.

Sub-Clause 810.2.3 Add at the end of this Clause

The size of the concrete foundation block for embeddings guard posts and grade of concrete shall be as shown in the drawing.

Sub-Clause 810.4 Installation of Posts

The sub-clause 8.10.4.1, 810.4.2, 810.4.3 and 810.4.4 are replaced as below:

The guard posts shall be embedded in the concrete footing of size and the grade of concrete along with the depth of the embedment of post or as indicated in the drawing.

Sub-Clause 810.4.5 Add “and end section” in first line after “post”.

Sub-Clause 810.5.3 Add at the end of Para 1st “The guard rail reflector shall be bolted replacing splice washer at every 10th posts interval as indicated in the drawing or as directed by the Engineer.”

Sub-Clause 810.7 Measurements for Payment

Sub-Clause 810.7.1 The 2nd sentence “Terminals/Anchors of various types shall be paid by number” is deleted.

Sub-Clause 810.7.2 The first sentence will be substituted as below

“No separate measurement for payment shall be made for Terminals/Anchors of various types required for the work and the delineator to replace washer as specified in drawing. The cost of these elements will be deemed to be included in the rate quoted by the contractor”.

Sub-Clause 810.7.3 The words “or backfilling” shall be substituted as “and concreting”

Sub-Clause 810.8 Rate

Add “and drawings” at the end of last sentence of clause.

Section 900 QUALITY CONTROL FOR ROAD WORKS

Clause 901 GENERAL

Sub-Clause 901.1 This clause shall read as under:

“All material to be used, all methods adopted and all works performed shall be strictly in accordance with the requirements of these Specifications. The Contractor shall set up a field laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out all required tests and Quality Control work as per Specifications and/or as per Clause 121 and/or as directed by the Engineer. The list of laboratory equipment and the facilities to be provided shall be as per Clause 121 and shall be got approved from the Engineer in advance”.

Sub-Clause 901.5 This clause shall read as under:

“The Contractor shall provide necessary cooperation and assistance in obtaining the samples for tests and carrying out the field tests as required by the ‘Engineer’ from time to time. This shall include provision of laboratory, equipment, transport, consumables, personnel, including labour, attendants, assistance in packing and dispatching and any other assistance considered necessary in connection with the tests”.

CLAUSE 903 QUALITY CONTROL TESTS DURING CONSTRUCTION

Sub-Clause 903.4 Tests on Bituminous Constructions

Sub-Clause 903.4.1 Add at the end of this Clause:

“The density test shall be carried out by 100mm diameter core cutter machine on dense Bituminous Macadam and Bituminous Concrete as per the frequency specified”.

In Table 900-4, Serial No.6 for Dense Graded Bituminous Macadam/ Semi Dense Bituminous Concrete/Bituminous Concrete, modify the Frequency(Minimum)” values for Item No. (vii), (ix) and (xviii) as under

S. No.	Type of Construction	Test	Frequency (Minimum)
6	Dense Bituminous Macadam/ Semi Dense Bituminous Concrete/Bituminous Concrete	(vii) Sand Equivalent Test	Three tests on aggregates for each 400 t of mix subject to two tests per plant per day.
		(ix) Polished Stone Value (PSV)	Initially one set of three representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates.
		(xviii) Density of Compacted Layer	One test per 250 m ² area subject to the condition that 10% of density tests shall be done on the edges.

Add the following note at the end of Table 900-4:

Note

1. *The laboratory and field tests shall be performed on materials and works at the frequency values indicated against each. The Supervision Personnel shall ensure that there are no deviations in this regard.*
2. *The Contractor shall prepare a detailed manual for Quality Assurance including the methodology for the respective tests, the data formats and the methodology for the analysis and interpretation of test results based on the reference Standards and Practices indicated in the Technical Specifications and obtain the approval of the Engineer.*
3. *Daily, Weekly and Monthly Reports on the testing done, results obtained thereof must be prepared indicating the location of sampling and testing, deviations from the acceptance norms for materials and works and actions taken in respect of removal of defective works must be prepared by the Contractor and authenticated by the Supervision Personnel that these tests were done in their presence and that the testing has been carried out as per the prescribed methodology.*

Sub-Clause 903.4.2 Tests on Bituminous Constrictions

Add the following Sub-Clause 903.4.3:

Sub-Clause 903.4.3 Characteristic to be tested on completed Bituminous Layers

The characteristic to be tested on completed bituminous layers are:

- Relative compaction
- Layer thickness

For testing the above characteristic, the following sampling criteria shall apply:

a) Random Sampling

When testing any lot, or an isolated section, which is obviously defective or exhibits abnormal variation of the characteristics under consideration, all samples shall be taken in a random pattern.

b) Lot Size

The lot size shall normally be a section laid and compacted in one process and for which essentially the same materials had been used. Where production and shall not exceed two full days production. However, the Engineer for investigating compliance with the specifications may order a lot of any smaller size if

- The factors affecting the Characteristics under investigation exhibit abnormal variation within the normal lot size.
- The area is obviously defective or of poorer quality of the rest.
- The rate of production is very high.

Sub-Clause 903.5 Quality control tests for Road Construction.

Sub-Clause 903.5.2 Pavement Concrete

Sub-Clause 903.5.2.1 Sampling and testing of beam and cube specimens

Replace first para ("At least for compliance.") with:

"One each day's work, at least six pairs of beams for flexural strength and six pairs of cubes for compressive strength shall be cast of concrete delivered to the paving plant as long as the total daily production is less than 300m³. For daily productions over 300m³, two additional beams and two additional cubes shall be cast of each 100m³, (or part thereof). Each pair of beams and cubes shall be from different deliveries of concrete. All specimens shall be transported in an approved manner to prevent any damage to the specimen. From each pair of beams and cubes one specimen shall be tested at 7 days and one at 28 days. The group of beams specimens from each day's production tested at 28 days shall be used for assessing the strength for compliance with the strength requirements. The group of beam specimens from each day's production tested at 7 days shall be used for early indication of the 28 days strength as described in clause 603.3.3.2. The flexural strength results prevail over compressive strength tests results for compliance."

Replace second para (A quality the following manner.") With:

"Where the 28 days strength requirements are not met; or where in the opinion of the Engineer the quality of the concrete or its compaction is suspected, the actual strength of the concrete in the slab shall be ascertained by carrying out tests on six cores cut from the concrete at such locations. The cores shall be 150mm diameter, shall be saw cut in both ends to provide a specimen height of 300mm + 5mm and shall be tested for compressive strength. The concrete will be acceptable if :

- The average compressive strength of the six cores when corrected to 28 days strength using the factors given in Table 900-5 or an age-strength relationship for the actual mix determined by the contractor and approved by the Engineer-is at least the average compressive strength of the cores tested from the trail length, refer clause 602.10.5.4;
- None of the cores show considerable honeycombing.

Sub-Clause 903.5.2.1 Sampling the Testing of Beam and Cube Specimens.

Delete Sixth para ("In order test beams.").

Sub-Clause 903.5.2.1 Sampling the Testing of Beam and Cube Specimens.

Delete Seventh para ("The standard deviation the requirement.").

Sub-Clause 903.5.2.1 Sampling the Testing of Beam and Cube Specimens.

Delete eight para ("An individual is substandard.").

Sub-Clause 903.5.2.1 Sampling the Testing of Beam and Cube Specimens.

Add at the end of paragraph (“Beams shall And cubes required.”) with:

“The Engineer may permit a reduction in the number of beams and cubes required when previous test results have shown satisfactory strength and when he is satisfied with the variation in quality of the mix.”

Sub-Clause 903.5.2.1 Sampling the Testing of Beam and Cube Specimens.

Delete eleventh para (“The flexural They were taken.”).

Sub-Clause 903.5.2.1 Strength Requirements.

The figure 2.33 in twelfth paragraph shall be replaced by the figure 1.65.

Sub-Clause 903.5.2.1 Sampling the Testing of Beam and Cube Specimens.

Delete thirteenth para (“Should the concrete Flexural strength.”).

Sub-Clause 903.5.2.1 Sampling the Testing of Beam and Cube Specimens.

Delete fourteenth para (“The equivalent obtained from Table 900-5).”

Sub-Clause 903.5.2.2 In-situ density

Add as para 5 of this clause:

“This clause is not applicable for cement concrete kerb and kerb with channel.”

Sub-Clause 903.5.2.4 Summary of Control Tests.

In Table 900-6,item5(1)”Strength of concrete”, change test frequency to:

“on each day’s work, at least six pairs of beams and six pairs of cubes for total daily production less than 300m³ .Two additional beams and two additional cubes for each 100m³(or part thereof) in excess of 300m³.”

Sub-Clause 903.5.2.4 Summary of Control Tests in Table 900-6, items(1)”(one strength on hundred concrete”, charge test frequency to:)
“As per clause 903.5.2.1”

Sub-Clause 903.5.2.5 Add the following new clause :

Temperature Measurements

“The temperature development in the concrete slab during hardening shall be recorded for each day’s production. The temperature shall be measured in the middle (vertically) of the slab at a horizontal distance of at least 1000mm from any free edge. The temperature shall be measured using a thermometer that shows maximum temperatures.6gfvFrom each day’s production three

thermometers shall be installed at commencement, in the middle of production and at completion of placing concrete. Measurements shall be recorded for 3 days after placing of concrete.”

SECTION 1000 MATERIALS FOR STRUCTURES

CLAUSE 1002 SOURCE OF MATERIALS

This clause shall read as follows:

The contractor shall identify the sources of materials like coarse aggregate and sand and notify the Engineer regarding the proposed sources prior to delivery.

Samples of material from the source shall be tested, in the presence of Engineer’s representative, for conformity to specifications. It shall also be ensured that the variation in the test results of different samples is within acceptable limit. If the production from the approved source proves unacceptable at any times, the contractor shall provide new sources of acceptable material from other sources at his own expenses conforming to specifications.

The manufactured items like cement, steel reinforcement, prestressing strands, the contractor shall intimate the Engineer details of source (plant where the material is manufactured), testing facilities available with the manufacturer arrangements for transport and storage of material at site. If directed by the Engineer, the contractor shall furnish samples and test results of recently manufactured material. The Engineer at its discretion, may require the contractor to test the material in an independent laboratory approved by the Engineer, and furnish test certificates. The cost of these tests shall be borne by the contractor. The sampling and test procedures shall be as laid down in Indian Standards or where these are not available as per the direction of the Engineer. Only materials from the sources approved by the Engineer shall be brought to the site. If the material from the approved sources proves unacceptable at any time, the contractor shall provide new sources of acceptable material conforming to specifications from other sources at his own expense.

For proprietary items like bearings, expansion joints refer clause 115.2

CLAUSE 1006 CEMENT

This clause shall read as follows:

Cement to be used in bridge structures shall conform to the following standard.

IS:12269-Specification for 53 Grade ordinary Portland cement.

For Other works ordinary Portland cement 33 grade conforming to IS:269 or Ordinary Portland cement 43 grade to IS 8112 can be used with the prior approval of the Engineer.

Minimum cement content mentioned elsewhere from durability considerations shall not be reduced. From strength considerations, these cement shall be used with a certain caution as high early strengths of cement in the 1 to 28 day range can be achieved by finer grinding and higher constituent ratio for C3S/C2S, where C3S is Tricalcium Silicate and C2S is Dicalcium silicate, such cements, the

further growth of strength beyond say 4 weeks may be much lower than that traditionally expected. Therefore, further strength tests shall be carried out for 56 to 90 days to fine tune the mix design from strength considerations directed by the Engineer.

Total chloride content in cement shall not exceed 0.05 percent by mass of cement. Total sulphur content calculated as sulphuric anhydride(SO₃) shall in no case exceed 2.5 percent and 3 percent when Tri-calcium aluminate percent by mass is upto 5 or greater than 5 respectively.

Manufactures test certificate shall be submitted to the Engineer by the contractor for every consignment of cement. The certificate shall cover all the tests for chemical requirements, physical requirements and chloride content as per provisions of IS:12269

Independent test of samples drawn from the consignment shall be carried out at the site laboratory or in an independent laboratory approved by the Engineer, immediately after delivery. The following properties shall be tested.

- i) Setting Time
- ii) Compressive strength

The cost of the tests shall be borne by the Contractor. In case the cement is stored beyond 90days from the date of delivery at site, the following tests shall be carried out at the site laboratory before the cement is used.

- i) Setting Time
- ii) Compressive strength

Lot size for independent testing of cement at site shall be the quantity received at site on any day subject to maximum of 500 tonnes.

CLAUSE 1007

COARSE AGGREGATES

Delete, crushed gravel, natural gravel, or a suitable combination thereof or other approved inert material” in 4th and 5th line of 1st Para and replace with “or crushed boulders. For this purpose, boulder greater than average dimension of 300mm shall only be used.”

Add the following at the end of Para 2.

“Costs of all tests shall be borne by the Contractor.”

Add the following at the end of clause

”Integrated stone crusher with Primary and Secondary (Cone or Impact Type) crushers shall be employed for getting proper size and grading of coarse aggregates.”

The alkali aggregate reactivity should be measured and reported for getting approval for the source aggregates at the beginning of the work using methods given in IS: 2386. The tests may be repeated if the source or the type of rock being exploited for getting aggregates, changes.

CLAUSE 1008 SAND/FINE AGGREGATES

Delete from the 3rd line the word “crushed gravel and from the 4th line “gravel” in para 2.

Add the following at the end of Clause:

“The alkali aggregate reactivity shall be measured and reported for getting approval for the source.”

CLAUSE 1009 STEEL

Sub-clause 1009.2 Steel for Pre-stressing

Add (e) to the list of codes to which acceptable pre-stressing steel shall conform:
(e) Stress relieved low relaxation seven-ply strand for pre-stressed concrete IS:14628.”

Sub-clause 1009.3 Reinforcement/Un-tensioned steel

In the table 1000.3, replace “IS: 1786 High Yield Strength Deformed bars (HYSD)” 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 (HYSD)” bars

Delete “All steel shall be procured from original producers, no” and replace with “No”
Delete last Para of the Clause.

CLAUSE 1010 WATER

In para (c) the permissible limit for chlorides (Cl) shall be read as “250mg/lit for structures having length more than 30m.”

In case of Structures of lengths 30 m and below, the permissible limits of chlorides may be increased upto 500mg/ltr.

CLAUSE 1012 CONCRETE ADMIXTURES

Sub-Clause 1012.1 Add the following at the end of paragraph 2:

Admixtures shall not impair the durability of concrete; they shall not combine with the ingredients to form harmful compounds or endanger the protection of reinforcement against corrosion. Only Chloride free admixtures shall be used.

Paragraph 3 Shall be read as follows:

For all admixtures being used the packing shall be marked with the name of the supplier/manufacturer, brand name (name of product) and main effect. A certificate for the admixture in question shall be submitted. The certificate shall include the following information:

1. General

- A. Chemical name of the active component in the admixture.
- B. Value of dry material content, ash content and relative density of admixture, which can be used for uniformity tests?
- C. Chloride ion content expressed as a percentage of weight of cement.
- D. pH value and colour
- E. Normal side effects e.g. whether the admixture leads of air entrapment at recommended dosage and if so to what extent
- F. Side effect when overdosed.
- G. If two or more admixtures have to be used in one mix, their compatibility.
- H. Increase in risk of corrosion of reinforcements and embodiments due to use Of admixtures
- I. Latest date of test and name of test laboratory.

2. Storing

- A. Shelf life
- B. Max. & Min. allowable temperature
- C. Other instructions (e.g. requirements of stirring)

3. Dosage

Maximum and minimum to be specified as a percentage of weight of cement.

Add the following at the end of the clause:

After selecting a few acceptable brands and types of admixture based on the manufacturer's data/technical literature, independent acceptance test should be carried out for the same using the approved combination of cement/sand/aggregates intended for use in the project. After establishing the basic acceptability using strength criteria (compression and tensile strengths) a number of trail mixes be designed using different proportions of admixtures/cement/water etc. to establish the data bank on the behavior of the admixture for the project site conditions. A spectroscopic signature of accepted product should be obtained and preserved for comparison for acceptance of the production lots.

Retrial should be conducted with change in source/type of cement.

Workmanship

The dosage should be finalized on the basis of field trail and special mechanical devices should be used for dispensing the admixture in the batching/mixing plant. No addition of admixture after dosage is permitted (including addition in transit mixers.)

Manufacturer's experts should be available for consultation/trouble-shooting of problems associated with their product. The conditions of storage, shelf life etc., as specified by the manufacturer should be strictly observed. The manufacturer's quality Assurance plan during process of production should be obtained and filed for reference/record.

Sub-Clause 1012.2 The following para shall be added after para “(e)”:

(f) Where high performance concrete is used, silica fume shall be added as per IS: 456-2000 to an extent of 5 to 10% of weight of cement. Also the chemical and physical properties of silica fume shall conform to ASTM (C 12040 – 97). The mixing and handling silica fume shall be as per the direction of manufacturers.

CLAUSE 1014 STORAGE OF MATERIAL

Sub-clause 1014.3 Aggregates

The following shall be added to this clause:

“Aggregates shall be stored or stockpiled in such a manner that segregation of fine and coarse sizes will be avoided and also that various sizes will not become intermixed before proportioning. They shall be stored, stockpiles and handled in such a manner that will prevent contamination by foreign materials.”

CLAUSE 1015 TESTS AND STANDARDS OF ACCEPTANCE

Add the following as Para 3:

“Independent testing of pre-stressing strands shall be carried out by the contractor for each consignment from each source at site in the laboratory approved by the engineer before use. The tests shall be carried out for the properties as listed in clause 7.21 of BS-5896:1980. These tests are in addition to the tests carried out by the manufactures.”

SECTION 1100 PILE FOUNDATIONS

CLAUSE 1101 DESCRIPTION

Sub-clause 1101.2 Add the following at the end of clause 1101.2:

The contractor shall submit information regarding proprietary system of piling as per clause 115.2

The contractor in his methods statement shall include the procedure for carrying out initial and routine tests of piles including calculations and drawings. The format for reporting test results shall be included in the methods statement.

Sub-clause 1101.4 Add the following as sub-clause 1101.4

The scope of work shall comprise of the following:

- a. Providing all materials including concrete temporary and permanent casing as required, labour and equipment excluding reinforcement steel which shall be measured and paid separately for installation of bored cast-in-situ piles
- b. Initial and routine testing of piles.
- c. Integrity testing of piles as per provision of bid documents.

- d. Provision of access to movement of equipment, barricading where necessary, pollution control measures, including measures to control noise to minimize acceptable levels and site clearance.

Sub-Clause 1102.1 Delete "At least one bore hole for every foundation of the bridge shall be executed" from 3rd sentence of 1st para and substitute with "As soil investigation has already been carried for the design, confirmatory bore hole shall be executed for foundation of bridge at least at one location or as instructed by the Engineer at foundation location and shall be payable separately."

CLAUSE 1103 TYPES OF PILES

This clause shall be read as follows:

Bored cast-in-situ piles as shown in drawings or as directed by the Engineer shall be provided.

CLAUSE 1104 MATERIALS

Sub-Clause 1104.2 The first sentence of this clause is amended as follows:

Concrete to be used in Cast-in-situ piles shall be grade as per BOQ or as directed by engineer.

CLAUSE 1107 CAST IN-SITU CONCRETE PILES

Add the following after the words "as approved by the Engineer" in the second sentence of the para 13.

It is permissible to install casing by giving a semi-rotary/rotary motion to keep it sinking as the borehole as is advanced.

Add the following at the end of Para 13.

Temporary liners shall be provided in piles upto depth where sub soil encountered during drilling is weak/soft and may collapse during the boring. The temporary liner shall be provided for a depth of 2 m into non-collapsible stratum. Temporary lines shall be withdrawn simultaneously as the concreting of the pile progresses unless otherwise specified in drawing (**IS: 2911-Part I-Section II**)

Add the following at the end of Para 15.

Bored site in piles shall be installed using hydraulic rotary rig of appropriate capacity. The cutting edge shall be calyx of diamond cutting edge as per the soil/rock condition. Drop Chiseling in hard rock may be permitted in the special cases provided it does not affect the adjacent structure adversely in any case.

Concreting of bored cast-in-situ piles shall be done by tremie process.

Add the following at the end of sub paragraph (a) of paragraph 20.

In the exceptional case of interruption, which can be resumed within 1 or 2 hours, the tremie pipe shall not be taken out of the concrete. Instead it shall be raised or lowered slowly, from time to time. Concreting shall be resumed by introducing a little richer concrete with a slump of about 200mm.

If the concreting cannot be resumed before final set of concrete already placed, pile shall be rejected.

The top of a concrete in a pile shall be brought above the cut off level to permit removal of all laitance and weak concrete before pile cap is laid.

10% extra cement shall be added in addition to cement requirement as per design mix for all underwater concreting.

CLAUSE 1113 PILE TESTS

Sub-Clause 1113.1 General

Add the following at the end of paragraph 1.

The initial load test shall be static/cyclic load test as directed by the Engineer.

Para 2 Shall be read as follows:

There shall be two categories of tests on piles, namely, initial tests and routine tests. Initial tests should be carried out on test piles which are not to be incorporated in the work. Routine tests shall be carried out as a check on working piles. The numbers of initial and routine tests on piles shall be determined by the Engineer depending upon the number of foundations, span length, type of superstructure and uncertainties of foundation strata. In any case, the initial load test shall not be less than 2% of the total numbers of working piles on each bridge site. However, it shall be ensured that at least one routine pile load test shall be carried out on every alternate foundation location or equivalent number of locations as directed by the Engineer.

Add the following at end of paragraph 4.

“The objective of the test is limited to checking of design working load both vertical and lateral on individual pile.”

Paragraph 5 shall be read as follows.

The methodology of carrying out load tests of arriving at safe load on piles shall conform to IRC:78-2000. It shall be ensured that the testing arrangement is symmetrical and the thrust is axial to the pile and the test frame. Joints of the loading frame should be inspected prior to commencement of loading and during test where a tension pile system is used. Pressure gauges and dial gauges shall be calibrated at an approved laboratory immediately prior to use and then at regular interval not exceeding 3 months. The reading shall be corrected with the aid calibration curve.

Recording of Data and presentation: The documentation of the tests results shall be carried out as per clause 9 of IS: 2911(Part IV) and submitted to the Engineer.

In case the safe load (vertical and lateral) determined by initial test exceeds or equals the design working load, no alternation or modification shall be made to the foundation working details.

If the state of load (vertical and lateral) determined from any of the initial tests falls below the design working load value, modification to foundation detail including change in depth and / or number of piles shall be made and necessary revised

Drawings shall be issued by the Engineer to the contractor within 4 weeks from the presentation of test results to the Engineer.

No pile work, to be incorporated in permanent works, shall be taken up before carrying out initial load tests approval of initial load test result by the engineer.

In case the safe load determined from any of the routine tests, falls below the design working load value, the pile shall be rejected and remedial measures as directed by the Engineer shall be taken by the contractor at his own cost.

Calibration of testing equipment:

Pressure gauges and dial gauges shall be calibrated at an approved laboratory immediately prior to use and then at regular intervals not exceeding 3 months. The readings shall be corrected with the aid of calibration curve.

Clause 1115 IMPORTANT CONSIDERATIONS, INSPECTION / PRECAUTIONS FOR DIFFERENT TYPE OF PILES

Sub-Clause 1115.2.7 This Clause shall read as follows:

Sub-Clause 1115.2.7.1“For large diameter piles, it is essential to conduct non-destructive tests to evaluate the integrity of piles.

Integrity testing of piles shall be conducted by a Sub-Contractor nominated by the Employer.

Objective of testing is to detect pile defects, including cracks, soil intrusions, voids, variation in pile diameter and pile length.

The nominated Sub-Contractor shall design the instrument system and testing procedures and provide personnel and instruments for carrying out the tests.

A method statement detailing the testing procedure including reporting test results shall be submitted to the Engineer at least 28 days before commencement of tests for his approval.

The Contractor shall provide all reasonable facilities to the nominated Sub-Contractor. The Contractor shall provide all inserts provided in detailed drawings.

Clause 1115.2.7.2. Atleast 15 days shall elapse between the installation of piles and sonic testing of piles. Piles with unacceptable defects shall be rejected by the Engineer. Remedial measures as directed by the Engineer shall be taken by the Contractor at his own

cost. Concreting the pile caps shall commence only after the piles are accepted by the Engineer.

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 test carried out. The pile integrity tests shall be measured in nos. of piles on which test carried out routine load tests shall not be measured and shall be incidental to work.”

CALUSE 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 cost 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 cost of boring, concrete, installation, all labour, materials, equipment for initial load tests shall be measured and paid in nos. of piles on which tests carried out. Routine load test shall not be measured for payment and shall be incidental to the work.

SECTION 1200 WELL FOUNDATIONS

CLAUSE 1202 GENERAL

Sub-Clause 1202.2 Substitute 1st sentence of this clause “At least one commencement of work” with “As soil investigation has already been carried out for foundation of bridge for the design, confirmatory bore holes shall be carried out for foundation of bridge at least at one location or as instructed by the Engineer at well foundation location and shall be payable separately.”

Note: 1) Whenever both borehole and electricity resistivity (RE) methods are proposed, at least one (ER) shall be conducted in the vicinity of one borehole to calibrate the ER results with actual sub soil finding and nature. Other ER shall be carried out except locations of proposed borehole.

Electrical Resistivity method shall be conducted at location decided by the Engineer using either Schlumberger or Winner arrangement in accordance with IS:3043 or EM 1110-1-1802. Calibration of equipment shall be submitted to the Engineer prior to the test. Specialist geophysicist shall be responsible for conducting and preparation of recommendations and reports. The test results along with reference and conclusions with supporting documents as regard to sub soil profiling and conditions with depth (upto at least twice the width of foundation below founding level) shall be provided within 3 days of testing.

CLAUSE 1204 CUTTING EDGE

Sub-Clause 1204.3 Para (1) of this clause shall be read as under:

The cutting edge shall be laid 300mm above the prevalent water level or at the bottom of well cap level as specified in the drawings, in case the riverbed is dry.

CLAUSE 1205 WELL CURB

Sub-Clause 1205.1 Following paras shall be added after Para 1:

The well curb shall be placed truly in position and level.

When the curb is to be laid in dry bed, the site shall be leveled by open excavation before the cutting edge is placed.

For wells, which are to be placed in water, on earthen/sand island where possible shall be constructed and curb placed or cast on this island. In case of any deep or fast flowing water where an island may not be possible, as a special measure, the precast curb/steel caisson may be floated and lowered in its final position with the help of necessary equipment.

CALUSE 1214 MEASUREMENT FOR PAYMENT

Add the following at the end of Para (a)

Earthwork in excavation upto bottom of well cap, if any shall be measured in cubic meters and shall be carried out and paid in accordance with section 300 of these specifications.

Para (c) of this clause shall be read as under:

The measurement for well sinking shall be made in running meters through all types of strata as specified in the contract. The depth of sinking shall be measured from the level specified in the contract or the level at which the cutting edge is laid whichever is lower. If no level is specified in the contract, sinking shall be measured from the low water or from the level at which the cutting edge was laid, whichever is lower.

Add the following as para (g)

The electrical Resistivity test shall be paid separately and the work shall be measured in number. The payment shall be made only after the successful completion of borehole upto the specified depth and submission of approved soil report to the full satisfaction of the Engineer.”

CLAUSE 1215 RATE

Add the following at the end of Para (a)

Diversion of active water channel for carrying out construction shall be incidental to work.

Para (e) of this clause shall be read as under:

The contract unit rate for sinking shall include the cost of labour, tools and plant and for operation required, such as formation of island, dewatering. Excavation and bailing out material, providing and placing kentledge on top of well and removing the same, sand filling and contingencies warranting provision of temporary top plug or cap in the event of floods being expected at the site making further sinking not possible, and also other incidental works to sink well to the level shown on the drawings. It shall also include blasting or use of divers for removal of obstacles from under the cutting edge of the well. The rate shall include sinking in all types of strata. The rate shall cover all testing and supervision required for the work.

Add the following as para (h)

The contract unit rate shall include the cost of all labour, materials ,tools and plant and equipment required for carrying out the Electrical Resistivity tests as per this specification ,transfer and/or shifting and setting out the equipment, attendance of specialist geophysicist, any special arrangements required to perform the test in water-logged/marshy areas etc, and making available the test report along with graphs, supporting documents and recommendations as specified or directed by the Engineer inclusive of all incidental costs to complete the work as per the specifications

SECTION 1400 STONE MASONARY

Sub- Clause 1402 MATERIALS

Replace this clause by following

“Stone to be used, besides quarry stone, shall be obtained by dressing the boulders of average diameter not less than 300mm and at least five faces shall be chiseled. All other materials used in stone masonry shall confirm to section 1000 except cement mortar which shall confirm to clause 1304.”

SECTION 1500 FORMWORK

CLAUSE 1501 DESCRIPTION

The Clause shall read as below.

The contractor shall prepare a formwork mobilization and utilization plan and submit the plan for Engineer’s approval at least 28 days before the commencement of construction of structures. The requirement of formwork shall be worked out considering the overall construction program of all the structures to be cast in one or more stages, as specified in the drawings. The plan shall take into account the time required for erection of formwork, retention in position, stripping and removal and subsequent use in the next and subsequent structures.

Notwithstanding Engineer’s approval of mobilization plan, if due to any reason, contractor has to arrange additional formwork, to meet the requirements of the construction program, it shall be done by the contractor without any extra cost to the Employer.

CLAUSE 1502 MATERIALS

This Clause shall read as under:

“All materials shall comply with the requirements of IRC-87.

Material and components used for formwork shall be examined for damage or excessive deterioration before use/reuse and shall be used only if found suitable after necessary repair. Only steel formwork shall be used. The steel used for forms shall be of such thickness that the forms remain true to shape. All bolts should be countersunk. The use of approval internal steel ties or plastic spacers shall be permitted. Structural steel tubes used as support for forms shall have a minimum wall thickness of 4mm.”

Clause 1503 DESIGN OF FORMWORK

Sub-Clause 1503.1 Add at the end of this Sub-clause “The work of formwork shall not commence without approval of the Engineer”

Sub-Clause 1503.2 The following shall be added at the end of this Clause:

“For distribution of load and load transfer to the ground through staging, an appropriately designed base plate must be provided which shall rest on firm sub-strata”.

CLAUSE 1504 WORKMANSHIP

Sub-Clause 1504.1 Add the following at the end of Clause 1504.1

“The loading from the formwork shall be distributed to the soil of the permanent works below (e.g. pile cap) in such a manner that any total or differential settlements are within acceptable limits. Subsoil characteristics shall be taken into account while designing the staging to avoid untoward failures. All the pipes etc. used for staging shall be free from kinks, bends etc.”

Clause 1506 PRECAUTIONS

Add the following as items of this clause:

- Adequate support against sideways and lateral loads due to construction operations and wind shall be provided.
- In case cantilevers are supported directly from the ground, the supports for cantilevers shall be removed simultaneously with main supports only after approval for the same from the Engineer.
- Forms shall be rigid and of adequate section to reduce deflections. Forms shall have sufficient rigidity to resist horizontal pressures caused by flowing concrete resulting from use of superplasticisers. The formwork shall resist the lateral pressure caused due to fast rate of placement by concrete pumps.

Clause 1507 PREPARATION OF FORMWORK BEFORE CONCRETING

Add at the end of last para:

“Concreting shall not commence without approval of the Engineer”

Clause 1508

REMOVAL OF FORMWORK

Add the following as para 5 Clause. 1508.

For prestressed units, the side forms shall be released, as early as possible and the soffit forms shall permit without restraint deformation of the member, when prestress is applied. Form supports and forms for cast in situ members shall not be removed until sufficient prestress has been applied to carry the dead load and any formwork supported by the member and anticipated construction loads.

CLAUSE 1509

RE-USE OF FORMWORK

This Clause shall read as under:

“After forms are stripped all materials shall be examined for any damage and damaged pieces, if any, shall be removed either as rejected or for rectification if possible. The materials found fit to be reused shall be thoroughly cleaned. Holes bored through sheathing for form ties shall be plugged by driving in common corks or foamed plastics. Patching plaster may also be used to fill small holes. After cleaning and before re-fixing, each formwork shall got approved from the Engineer.

Formwork and staging shall be so used as to ensure quality of the exposed surface. However, if in the opinion of the Engineer, any particular pane/member has become unsatisfactory for use at any stage, the same will be rejected and removed from site.

All bent steel props shall be straightened before reuse. The maximum deviation from straightness shall not exceed 1/600 of length. However the maximum number of users shall be limited to 20 times since only steel formwork is to be used. The maximum permissible axial loads in used props shall be suitably reduced depending upon their condition.”

CLAUSE 1510

SPECIALISED FORMWORK

Replace the words ‘slip-form work’ by ‘climbing formwork’ in the first sentence of this clause.

The first sentence of Para2 of this clause shall read as follow:

Slip forming is not permitted.

Replace the word “plywood” by “marine plywood” in the fourth paragraph of this clause.

Clause 1513

RATE

Add the following at the end of the first para:

“The unit rate shall also include all costs for preparation of erection scheme, designs of false work and formwork and their approval.”

SECTION 1600 STEEL REINFORCEMENT (UN-TENSIONED)

CLAUSE 1602 GENERAL

Paragraph 2 of Clause 1602 shall read as follows:

“Reinforcements shall be thermo mechanically treated (TMT) deformed (HYSD) bars of grade Fe 415/Fe500 conforming to IS: 1786 only uncoated steel shall be used as reinforcement unless specified”.

CLAUSE 1604 BENDING OF REINFORCEMENT

Para 1 shall be read as follows:

“The reinforcement shown on the drawings shall be considered merely symbolic representations of the shape and position and shall not be used by the contractors to justify any deviation from the stipulated requirements. Bar bending schedules and supplementary drawings as may be required shall be furnished by the contractor and got approved by the Engineer before start of work. The bending schedules shall state the number, shape and length of bar and weight in respect of each type. System of bar referencing should be coherent and systematic. A separate bar bending schedule shall be prepared for auxiliary bars like spacers, chairs etc.

CLAUSE 1605 PLACING OF REINFORCEMENT

Paragraph (c) (i) of Clause 1605 shall be read as follows:

Cover blocks shall be made of concrete or cement mortar with the same durability properties as the surrounding concrete and with the same type of constituents. In visible surfaces, the cover blocks shall be of the same colour and texture as the surrounding concrete. The contractor's proposal for blocks shall be submitted to the Engineer for acceptance.

Add the following as sub Para (f) to this Clause:

Tolerances:

1. Tolerance of cover Deviation shall not exceed +10 mm. No negative tolerance is allowed.
2. Tolerance in position: Tolerance for deviation from the positions shown in the drawings shall not exceed the following:

Structural depth d (mm)	Tolerance (mm)
d < 1000	< 10
1000 < d < 2000	< 0.01d

2000 < d

< 20

CLAUSE 1606 BAR SPLICES

Sub-Clause 1606.1 First sentence of Clause 1606.1 shall read as follows:

To the extent possible, all reinforcement shall be furnished in full lengths as indicated in drawings.

Add the following as paragraph of Clause 1606.1:

The location of joints in continuous reinforcing bars, not shown in drawings, shall be submitted to the Engineer for acceptance. If nothing contrary has been specified, the number of bars to be joined in any cross-section shall not exceed one-third of the total.

Sub-Clause 1606.2 Welding

Sub-Clause 1606.2.1 Add the following at the end of the paragraph

“In prestressed concrete members, when welding of un tensioned reinforcement is permitted by the Engineer, it shall be carried out before insertion of the prestressing tendons/sheathing.”

CLAUSE 1607 TESTING AND ACCEPTANCE

Add the following as the last paragraph of Clause 1607:

Manufacturer's test certificate regarding compliance with Indian Standards for each lot of steel shall be obtained and submitted to the Engineer. If required by the Engineer, the contractor shall carry out confirmatory tests in the presence of a person approved by the Engineer. Cost of these tests shall be borne by the contractor. The sampling and testing procedure shall be as laid down in IS: 1786-1985. However if any test piece selected from a lot fails, no re- testing shall be done and the lot rejected.

SECTION 1700 STRUCTURAL CONCRETE

CLAUSE 1703 GRADES OF CONCRETE

Sub-Clause 1703.2 shall be replaced with the following:

Sub-Clause 1703.2 The lowest grades of concrete in bridges and corresponding minimum cement contents and water-cement ratios shall be maintained as indicated in table 1700-2 and 1700-3.

TABLE 1700-2 For all major bridges (bridges with total length 60m and above, RUB, Flyovers, Grade Separators) and minor bridges (bridges with total length less than 60m & Underpasses)

(A) Minimum cement content and maximum water cement ratio

Structural Member	Min. cement content (kg/cum)		Max. water cement ratio	
	Major Bridges	Minor Bridges	Major Bridges	Minor Bridges
PCC Members	360	310	0.45	0.45
RCC Members	400	400	0.45	0.45
PSC Members	400	400	0.45	0.45

(B) Minimum strength of concrete

Member	Major Bridges	Minor Bridges
PCC Members	M25	M15
RCC Members	M30	M20
PSC Members	M35	M35

TABLE 1700-3 For culverts and other incidental structures:

(A) Minimum cement content and maximum water cement ratio

Structural Member	Min. cement content (kg/cum)	Max. water cement ratio
PCC Members	250	0.50
RCC Members	310	0.45

(B) Minimum strength of concrete

Member	Grade
PCC Members	M15
RCC Members	M20

Notes:

1. The minimum cement content is based on 20mm aggregate (nominal max-size). For 40mm and larger size aggregates, it may be reduced suitably but the reduction shall not be more than 10 per cent.
2. For under water concreting, the cement shall be increased by 10 per cent.

The cement content shall be as low as possible but not less than the quantities specified above. In no case shall it exceed 540 kg/cum.

CLAUSE 1704 PROPORTIONING OF CONCRETE

Add the following at the end of this Clause:

“In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the manufacture’s weight per bag, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stock at site and not by bag, it shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be periodically checked.

It is most important to keep the specified water-cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined as frequently as possible; frequency for a given job being determined by the Engineer according to the weather condition . The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. The determination of moisture content in the aggregates shall be done as per IS: 2386 (Part III). Suitable adjustments shall also be made in the weight of aggregate to allow for the variation in weight of aggregates due to variation in their moisture content.

Sub-Clause 1704.4 Additional requirements

In Para (a) substitute “0.06%” for “0.1%”, “0.06%”, for “0.2%”, and “0.1%” for “0.3%” for the three items respectively.

Sub-Clause 1704.6 Add the following as clause 1704.6.

Materials for pumped concrete:

Materials for pumped concrete shall be batched consistently and uniformly. Maximum size of aggregate shall not exceed one-third of the internal diameter of the pipe.

Grading of aggregate shall be continuous and shall have sufficient ultra fine materials (materials finer than 0.25mm). Proportion of fine aggregates passing through 0.25mm shall be between 15 and 30% and that passing through 0.125mm sieve shall not be less than 5% of the total volume of aggregate. Admixtures to increase workability can be added. When pumping long distances and in hot weather set-retarding admixtures can be used. Fluid mixes can be pumped satisfactorily after adding plasticizers and super plasticizers. Suitability of such concrete shall be verified by trial mixes and by performing pumping test.

CLAUSE 1705 ADMIXTURES

This Clause shall read as under:

“Duly tested admixtures/additives conforming to IS: 6925 and IS: 9103, (without replacement of Cement) may be used subject to satisfactory proven use, with the approval of the Engineer. Admixtures generating Hydrogen or Nitrogen and containing chlorides, nitrates, sulphides, sulphates and any other material liable to affect the steel or concrete shall not be permitted.

The general requirement, physical and chemical requirements shall be as per Clause 1012.”

CLAUSE 1706 SIZE OF COARSE AGGREGATE

Table 1700-7 shall be modified as given below:

Components	Maximum nominal size of Coarse aggregate (mm)

a. RCC Well Curb.	20
b. RCC/PCC well steining, PCC below foundations and approach slab, annular filling around foundation.	40
c. Well cap or pile cap; solid wall type abutments, piers, median walls , splayed wing walls and their foundations	40
d. RCC works in T-beam and slab /solid slab/ voided slab and box girder superstructure, wearing coat, kerb, crash barrier, approach slab, hollow abutments and piers, pier/ abutments caps, pedestals, dirt walls, piles, all components of counter fort type abutments, columns, cantilever return wall etc.	20
e. All PSC works	20
f. Any other item	As specified by the Engineer

CLAUSE 1707

EQUIPMENT

Para 1 of this Clause shall read as under:

Unless specified otherwise, equipment for production, transportation and compaction of concrete shall be as under:

- a) For production of concrete: Batching and mixing of the concrete shall be done in a concrete batching and mixing plant fully automatic of a minimum capacity of 40 cum/hour. The plant shall be approved by the Engineer.”

Paragraph 3 of this clause shall read as follows:

“The accuracy of measuring devices shall fall within the following limits:

Measurement of Cement	±	1% of the quantity of cement in each batch.
Measurement of Water	±	1% of the quantity of water in each batch.
Measurement of Aggregate	±	2% of the quantity of Aggregate in each batch.
Measurement of Admixture	±	1% of the quantity of Admixture in each batch.

Paragraph 3 (b) & 3 (c) shall remain unchanged.

Add the following paragraph at end of the clause:

Batching, mixing transportation and placing concrete.

Once the concreting of a section of a is started, it has to be completed as a continuous operation. Before starting an important placement, the contractor shall submit to the Engineer an equipment list to ensure that sufficient equipment is available for batching, mixing, transporting and placing concrete

and once the concrete of a section is started, it can be completed as a continuous operation within a reasonable time.

CLAUSE 1709 TRANSPORTING, PLACING AND COMPACTION OF CONCRETE

Add the following paragraph at the end the clause:

For Placing Concrete with Pumps: Pipe Lines from the pump to the placing area should be laid out with a minimum of bends. For large concrete placements standby pumps shall be available. Suitable valves (air release valves shutoff, valves etc.) shall be provided as per the site needs. The pumping of concrete shall be preceded by a priming mix to lubricate the pump and pipeline. A rich mix of creamy consistency shall be required for lubricating the pipeline; continuous pumping shall be done to the extent possible. After concrete has been placed the lines all related equipment shall be cleaned immediately. A plug sponge ball shall be inserted in the end near the pump and shall be forced through the line by either water or air pressure. Pipes for pumping should not be made from materials, which can harm concrete; aluminum alloy pipeline shall not be used.

CLAUSE 1710 CONSTRUCTION JOINT (Refer Appendix 1700/1, Preparation of the Surface of the Joint)

In the first paragraphs, add after the words “the surface shall be roughened” the words “the coarse aggregate shall be made visible to a depth of 5mm to 10mm.

In the third paragraph under the heading “Preparation of the Surface of the Joint” add the following at the end of paragraph.

“Bush hammering is not permitted since loosens the coarse aggregate and result in extensive micro cracks.”

Concreting of Joints:

Under the heading “concreting of Joints”, add the following at the end of sub-Para 3”

“At vertical construction joints, a fine mesh on the surface of the stopping board shall be placed, if directed by the Engineer, the facilitate removal of laitance.”

CLAUSE 1712 ADVERSE WEATHER CONDITIONS

Sub-Clause 1712.2 Hot Weather Condition Add the following at the end of paragraph 1 of the above clause:

Where the contractor proposes to use ice to cool the concrete or mixing water or any of the ingredients, the contractor shall provide a refrigeration plant to avoid use of contaminated ice.

Placement of concrete shall not shall be permitted when day temperature exceeds 40°C

CLAUSE 1713 PROTECTION AND CURING

Sub-clause 1713.1 Water Curing

Add the following at the end of par 1 ;

Water sprinklers or perforated pipes shall be used for curing of concrete for all major bridges, ROB's and grade separators. Such arrangement must be in place & tested before concreting for its proper functioning and shall be maintained for a minimum period of 14 days after concreting.

Approved concrete curing compounds should be preferred where water curing cannot be done reliably-

CLAUSE 1715 TOLERANCES

Add the following at the end of clause;

In the absence of any information in drawings or specifications, for particular cases, the following limitations shall apply.

Dimension (mm) 'a'	Tolerances (mm) '$\delta_a = (a_{\text{nominal}} - a_{\text{actual}})$'
$a \leq 200$ $200 < a \leq 2000$ $2000 < a$	$|\delta_a| < 5$ $|\delta_a| < 3.5 + 0.007a$ $|\delta_a| < 16.5 + 0.001a$

SECTION 1800 PRE-STRESSING

CLAUSE 1801 GENERAL

Add the following as the last paragraph of this clause;

Prestressing system shall conform to FIP Recommendation "Recommendations of acceptance of post –tensioning systems", June 1993.

CLAUSE 1802 MATERIALS

Sub Clause 1802.2 Sheathing

Sub-clause 1802.2.1 "The second and third sentences of Para 6 shall be read as follows;

The joint between the end of coupler and the duct shall be sealed with heat shrink tape to prevent penetration of slurry during concreting. The couplers of adjacent ducts should be staggered at least 300mm apart.

Sub-Clause 1802.2.2 Add the following at the end of Pare 1,
Couplers and splices shall be larger in diameter than ducts joined.

Sub-Clause 1802.2.3 Pull-in or push-in of prestressing stands shall be mechanized.

Strands shall not be placed in the ducts before concreting. The ducts shall be sealed at the ends by plastic caps to prevent water from entering.

Cables shall not be threaded after concreting. In such cases a temporary tendon shall be inserted in the sheathing, or the sheathing shall be stiff ended by other suitable method during concreting. The sheathing supports shall be such as to prevent floatation of empty cable duct during concreting.

Add the following as additional sub-clause

Sub-Clause 1802.2.4 Corrugated HDPE sheathing ducts.

When high-density polyethylene (HDPE) sheathing ducts are specified, the material for the ducts shall be with more than 2 percent carbon black to provide resistance to ultraviolet degradation and shall have the following properties:

Specific Density	:	0.954 g/cm ³ at 23 °C
Yield stress	:	18.0 N/mm ²
Tensile Strength	:	21.0 N/mm ²
Shore Hardness D 3sec. Value	:	60
-15 sec. Value	:	58
Notch impact strength at 23°C	:	10 KJ/m ²
-40° C	:	4KJ/m ²
Coefficient of Thermal Expansion for 20 ° C- 80 ° C	:	1.50X10 ⁻⁴ KJ/m ²

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

The duct shall be corrugated on both side. The ducts shall transmit full tendon strength from the tendon to the surrounding concrete over a length not greater than 40 duct diameters.

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

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

The joints shall be able to withstand an internal pressure of 0.5 bar for 5 minutes as per test procedure given in Appendix -1A of IRC:18 – 2000.

They shall conform to the requirements specified in Appendix-1A/1B of IRC: 18-2000 and a test certificate shall be furnished by the manufacturer. The tests specified in Appendix-1B of IRC: 18-2000 are to be performed as part of additional acceptance tests for pre-stressing systems employing corrugated HDPE sheathing ducts and are not meant for routine testing purposes.

Sub-Clause 1802.3 Anchorages

Heading of the clause shall be “Anchorages and Tendon couplers”

Sub-Clause 1802.3.1 The word “Anchorages” shall be replaced by the words “Anchorages and couplers”
in sentence 1 of the paragraph.

The sentence “Anchorages shall conform to BS:4447 in the second line of 1st paragraph is deleted.

Add the following after the words “furnished to the Engineer” in sentence 3 of paragraph 1 of this clause:

“Couplers which connect two tendons to form a continuous tendon, should be tested in the same way as anchorages formed by mechanical means.”

CLAUSE 1803 TESTING OF PRESTRESSING STEEL AND ANCHORAGE

Add following Paragraphs to the section.

All samples shall be representative of the lot and in the case of wire or strand shall be taken from the same master roll. At least 5.0m length shall be selected from each lot for testing. Also two anchorage assemblies, complete with distribution plates of each size or types to be used, shall be tested. Testing of anchorage – cable assemblies shall be carried out in accordance with procedures in FIP document “Recommendations for the acceptance of Post Tensioning system”, June 1993.

The frequency of such tests should be as follows:

- 1) For acceptance of the tendon at the stage of submission of tendons, the manufacturers certificate together with the data of previously conducted and most recent test results of “Acceptance Testing” is acceptable subject to further as given below:
- 2) Acceptance testing for the works
 - a) Static load test for tendon-anchorage assembly
 - A series of three tests using the proposed combination of anchorage systems and the prestressing strand/wire/bars. All the tests should meet the following requirements.
 - Residual deformations of anchorage components after the test should confirm the reliability of the anchorage.
 - The increase in the displacement between the anchorage components as well as between prestressing steel and anchorage components should not be disproportionate to the increase in tendon force.
 - The above relative displacements during the 0.8 Fpk load stage should stabilize within the first thirty minutes of the load duration of 1 hour.
 - The mode of failure of tendon should be by the fracture of the prestressing steel. Failure of the tendon should not be induced by the failure of anchorage components.
 - The measured anchorage efficiency should be:
(Refer CEB Guidelines for details).
 - The total elongation ϵ_u in free length of the tendon
Under the F_{tu} should $\epsilon_u \geq 2\%$

b) Dynamic load test with tendon / anchorage assembly

This test is to be carried out for every new combination of type of anchorage and tendon. A series of three successful tests shall be carried out for acceptance of the systems. This test is considered as essential for both unbonded and bonded cables as per FIP document.

Requirements:

Each test result should meet the following requirements

- Fatigue failure of anchorage components should not occur.
- The minimum fatigue strength of post-tensioning system should be $\Delta\sigma_p \text{ min} = 80\text{MPa}$
- The fatigue strength is defined as the stress
- Range ($\Delta\sigma_p$) which is endured for 2 million cycles with failure of more than 5% of the initial cross section of the tested tendon at beginning of the test.

Sub-Clause 1804.5 Insert following Para after Para 1

Mixture of water-soluble oil such as Dromas – B and Water is to be flushed through empty metallic ducts before threading of cables, and after threading of cable at frequency of at least once in a month. The layer of oil formed on sheathing / prestressing steel shall be fully flushed out by using clean water before final grouting by cement grout.

CLAUSE 1806 TENSIONING EQUIPMENT

Add the following at the end of Para 2

Jack and Pump shall be calibrated by an approved laboratory prior to use and then at intervals not exceeding three months.

“A Standby set of jack, pump and pressure gauges shall always be available at site where prestressing is in progress.”

Before initial use and subsequently at suitable intervals, the pre-stressing equipment shall be checked to determine any variation from the normal values during use.

So far as these variations depend upon external influence (e.g. temperature increase of oil jacks) they shall be taken into account.

CLAUSE 1807 POST TENSIONING

Add the following at the end of Para 5 of this clause:

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

Add the following at the end of this Clause:

"The contractor shall submit fabrication drawings, detailing prestressing cables, anchorage, couplers chairs and supports, templates or forms holding anchorage assemblies etc. for Engineer's approval at least one month before commencement of work in superstructure. Stressing schedules shall be prepared by the Contractor and submitted to Engineer for approval."

CLAUSE 1808 GROUTING OF PRE-STRESSED TENDONS

Add new Para at the end of Clause as under:

"Where directed by the Engineer the Contractor shall perform full –scale site test to determine the adequacy of grout mix, equipment and grouting method. The Contractor shall submit a method statement detailing the test procedure.

Special Attention is directed to Appendix 1800/ III of the Standard Specification Contractor shall arrange for testing of all grout components and of the mix, prior to the start of grouting and whenever the source of any component is changed, to ensure that the grout is free of anything that could promote shrinkage or cracking of the grout or corrosion in the tendon. Father samples of grout and its components shall be obtained for each day of grouting at each site where grouting is carried out and a full chemical analysis shall be performed on the samples."

CLAUSE 1815 RATE

Add at end of Para 4:

Cost of fixing anchorage / sheathing for dummy cables and future prestressing cable shall be incidental to work and shall not be measured/ paid extra. No additional cost shall be payable for stressing of cables for compensation of no fall of prestress or for any other reason.

CLAUSE 1816 JOINT IN CONSTRUCTION WITH PRE-CAST-UNIT

Add new clause:

"Joints between a series of precast concrete units which are to be prestressee together by post-tensioning shall be such as to ensure even transfer of compression from one unit to another.

Whatever be the method of jointing, the holes of the prestressing steel shall be accurately made and shall meet one another in true alignment at ends. Jigs shall always be used. Care shall be taken to ensure that the jointing material does not enter the duct or press the sheath against the prestressing steel.

Jointing by application of mortar on the face of a unit and then placing another unit against it shall not be permitted.

Suitability and effectiveness of the method should be got confirmed from a suitably designed mock-up".

SECTION 2000 BEARINGS

CLAUSE 2001 DESCRIPTION

Add the following as paragraph 2 of this clause:

“Within 90 days of award, the Contractor shall submit detailed specifications, designs and drawings including installation drawings and maintenance manual, for the approval of the Engineer. Designs shall also include view and modifications of design and drawings of bearing pedestals and other elements required for installation. The installation of bearings shall be carried out under the supervision of the supervision of the manufacture of the bearings. The Contractor shall provide the bearings only from the manufactures approved and enlisted by the Ministry of Road Transport & Highway. In addition to routine testing of the materials and bearings at manufactures premises, the Contractor shall arrange at his cost testing of randon sample of 1% (Minimum 1no. of each type) of bearings from independent agencies, other than manufacture’ own facilities, duly approval by the Engineer. The bearings shall be selected by the Engineer/his authorized representative and duly sealed in his presence for dispatch to the independent agency.”

Sub-Clause 2004.1 Spherical Bearings

Spherical Bearings: Spherical Bearings shall conform to the requirements of sections 9.1 and 9.2 of BS 5400. However materials of bearing elements may conform to Indian Standards nearest to the specifications stated in the above sections of BS: 5400.

Clause 2005 ELASTOMERIC BEARINGS

Sub-Clause 2005.3 Acceptance Specifications

In Para 5, substitute the words “Engineer or his authorized representative” for the word “Inspector”.

Sub-Clause 2005.3.5 Inspection Certificate

Substitute the words “Engineer or his authorized representative” for the word “Inspector”

Sub-Clause 2005.3.6 Quality Control Certificate

Delete the words “/Inspector” in the third paragraph.

CLAUSE 2006 POT BEARINGS

The clause shall read follows:

“Pot Bearings shall conform to the requirements of IRC:83 (Part III) – 2002.”

Sub-Clause 2006.1 General

Sub-Clause 2006.1.2 Add after 2nd sentence “Provisions of IRC83 (Part III) shall be applicable for POT,POT cum PTFE, PIN and Metallic Guide Bearings”

CLAUSE 2009 MEASUREMENT FOR PAYMENT

Add the following after Para 2

“Tar Paper bearings shall be measured in square meters.”

CLAUSE 2011 Add new clause as under:

Sub Clause 2011.1 “Tar Paper bearings shall be reinforced bitumen laminated Kraft paper conforming to IS-1398.”

Sub Clause 2011.2 Seismic restrainers

Seismic restrainers shall consist of vertical 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 elastomeric bearings and the seismic restrainer assembly shall be manufactured as per manufactures’ design for the lateral load capacities mentioned in the respective BOQ item in conformity with the typical details shown in the drawings. The design and drawings for the seismic restrainer assembly shall be 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), IRC:83 (Part-III) and section 2000 of the specifications.

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

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

SECTION 2100 OPEN FOUNDATIONS

Sub-Clause 2103 GENERAL

Add the following as sub para (vii):

Confirmatory borehole, Foot and Plate load tests and Electrical Resistivity tests at proposed foundation location.

Sub-Clause 2104.3 Construction

Add the following prior to the paragraph:

Confirmatory boreholes at least one foundation locations or as instructed by the Engineer apart from Foot load test and Electrical Resistivity shall be carried out at the proposed foundation location well in advance of actual foundation construction works.

Accordingly, the contractor should plan his entire contract schedule as per drawing. Volume IV of part II.

Clause 2106 TOLERANCES

Reference to Tolerance shall be made to Clause 1715.

Sub-Clause 2107 MEASUREMENT FOR PAYMENT

Add the following before the first paragraph:

The work of carrying out boreholes in dry and in water-logged areas /flowing water/marshy land submission of complete results and reports to the satisfaction of Engineer shall be considered as incidental to the foundation works and nothing extra shall be paid.

The Electrical Resistivity test shall be paid separately and the work shall be measured in number. The payment shall be made only after successful completion of borehole up to the specified depth and submission of approved soil report to the full satisfaction of Engineer.

The measurement of Foot load and Plate load test shall be measured and paid as per Appendix VI&V of Additional Technical Specification.

Sub-Clause 2108 RATE

(i) Add the following before the first paragraph:

The contract unit rate for Electrical Resistivity test shall include the cost of all labour, material, tools and plant and equipment required for carrying out the Electrical Resistivity, Test as per this specification, transfer and/ or shifting and setting out of equipment, attendance of specialist geophysicist, any special arrangements required to perform the test in water-logged/marshy areas etc. and making available the test report along with graphs, supporting documents and recommendations as specified or directed by the Engineer inclusive of all incidental costs to complete the work as per the specifications.

The rates of Foot load and Plate load test shall be as per Appendix VI & V of Additional Technical Specification.

(ii) Add the following at the end of first paragraph:

If the Engineer based on sub-soil conditions as obtained from confirmatory boreholes, foot and plate load test and / or due to any other site conditions decides to lower the foundation level, no additional claims shall be admissible except earthwork excavation and concrete quantity measured as per respective sections of these specifications.

SECTION 2200 SUB-STRUCTURE

CLAUSE 2204 PIERS AND ABUTMENTS

Add the following paragraph at the end of clause:

“Wherever necessary, suitable cofferdams or other means shall be provided to exclude water from the construction area. The Contractor shall provide necessary pumping equipment for dewatering areas.”

Sub-Clause 2210 Rate

This Clause shall read as follows:

“The contract rate for masonry, concrete and reinforcement in substructure shall include all works as given in respective sections and cover the cost of incidental items like providing cofferdams, dewatering, providing special formwork, where necessary, and all other items for furnishing and providing substructure as mentioned in this section.”

The necessary material (thermocole, bituminous fibrous board or equivalent material) and labour, tools etc. required for maintaining 20 /40 mm gap between faces of various structure (old / new) wherever required / as shown in drawing shall be incidental to work and not be measured / paid separately.

SECTION 2300 CONCRETE SUPER-STRUCTURE

Sub-Clause 2305.1.2 PSC Girder and Slab

Casting of the deck, beam and slab shall be done in single stage without construction joints. The portions of deck near expansion joints shall be cast along with reinforcements and embedment for expansion joints. For this purpose, the portion of deck slab near expansion joints may be cast subsequently. In this case the Contractor shall, in his method statement, indicate the location of construction joints for Engineer’s approval.

The surface finish of deck be true to lines and levels as shown in drawings. Bearings shall be set as shown in drawings.

Clause 2305 PRESTRESSED CONCRETE CONSTRUCTION

Sub-Clause 2305.2 Box Girder

Add the following at the end of paragraph 1

“Contractor shall, in his method statement, indicate the location of construction joints for Engineer’s approval.”

Add new sub clause 2305.4 as under:

Sub-Clause 2305.4 PSC Solid Slab

Casting of the slab shall be done in a single stage without construction joints. The portions of deck near expansion joints shall be cast along with Reinforcements and embedments for expansion joints.

The deck slab shall be finished rough, but true to lines and levels as shown in drawings. Bearings shall be set as shown in drawings.

SECTION 2500 RIVER TRAINING WORK AND PROTECTION WORK

CLAUSE 2504 PITCHIG/REVTMENT ON SLOPES

The title of this Clause shall read as under:

“PITCHING/REVTMENT ON SLOPES & FILTER MEDIA”

Sub-Clause 2504.2.1 Pitching

Delete 2nd and 3rd sentence of Para 2 and replace by following

“Stones to be used for pitching, besides quarry stone, will be dressed from boulders of least dimension not less 400 mm of which at least four faces shall be chiseled. The stone subject to marked deterioration by water or weather shall not be used.”

Sub-Clause 2504.2.2 Filter Media

Add after 1st Para:

“The material for filter media behind abutment shall conform to general guide lines given in Appendix 6 of IRC-78(Standard Specification and Code of Practice for Road Bridges – Section- VII).”

Sub-Clause 2510 Rate

Add new para in the end of the Clause:

“Filter media and cement concrete bedding, wherever required, shall be measured in cubic meter and paid separately as per contract.”

SECTION 2600 EXPANSION JOINTS

Clause 2602 GENERAL

Paragraph c,d,e – deleted.

Add the following at the end of the clause.

“The expansion joints, shall be procured only from those manufactures / suppliers of expansion joints who are empanelled with MORT&H.

The MORT&H (formerly, Ministry of Surface Transport) had issued modified interim specifications for expansion joints vide letter dated 31/03/97 and revised vise letter no. RW/NH-34059/1/96 – S&R dated 30th Nov. 2000and corrigendum of same circular dated 15th Jan. 2001 which shall be adopted. These specifications are reproduced below.”

TABLE R – 1

SUITABILITY CRITERIA FOR ADOPTION OF DIFFERENT TYPES OF EXPANSION JOINTS.

Sr. No.	Type of Expansion	Suitability for Adoption Joint	Expected Service Life	Special Consideration
1.	Buried Joint	Simply supported spans upto 10 meters	10 Years	Only for deck with bituminous / asphaltic wearing coat. Steel plate may need replacement, if found corroded or distorted at the time of relaying / renewal of wearing coat.
2.	Filler Joint	Fixed end of simply supported spans with insignificant movement or simply supported spans not exceeding 10 meters.	10 Years	The sealant and joint filler would need replacement if found damaged.
3.	Asphaltic Plug Joint	Simply supported spans for right or skew (upto 20 degree), moderately curved or wide deck with maximum horizontal movement not exceeding 25mm. Ambient temperature should be in the range of 5 degree to 50 degree Celsius.	10 Years	Chloroprene / Closed Foam seal may need replacement during service.
4.	Compression Seal Joint* (Chloroprene Seal & Cell Foam Seal)	Simply supported or continuous spans right or skew (upto 30 degree), moderately curved with maximum horizontal movement not exceeding 40mm.	10 Years	Chloroprene / Closed Foam Seal may need replacement during service.
5.	Elastomeric Slab Seal Joint*	Simply supported or continuous spans, Right or skew (less than 20 degree), moderately curved with maximum horizontal movement upto 50mm.	10 Years	Liable to excessive wear and tear under high traffic intensity. Not suitable for bridges located in heavy rainfall area and spans resting on yielding support.
6.	Single Strip Joint*	Moderate to large simply supported, cantilever / continuous construction having right skew or curved deck with maximum horizontal movement upto 70mm.	25 Years	Electrometric seal may need replacement during service.
7.	Modular Strip / Box Seal Joint	Large to very large continuous / cantilever construction with right skew or curved deck having maximum horizontal movement in excess of 70mm.	25 Years	Electrometric seal may need replacement during service.
8.	Special Joints for Special conditions.	For bridges having wide decks and large span length involving complex movement / rotations in different	25 Years	Electrometric seal may need replacement during service. Provision of these joints may be made with prior approval of the

directions / planes, provision of special types of modular expansion joints such as Swivel joists joints may be made.

Ministry

* These are proprietary items for which 10 years warranty shall be insisted upon from the suppliers. The contractor shall submit all relevant information as per clause 115.1

The Clause 2604 be replaced fully as below:

CLAUSE 2604 BURIED, ASPHALTIC PLUG AND COMPRESSION SEAL JOINTS

Sub-Clause 2604.1 Buried Joint

- (a.) This joint shall consist of continuously laid bituminous / asphaltic surfacing over the joint gap, bridged by a steel plate resting freely over the top surface of the deck concrete.
- (b.) The width of the joint gap shall be kept as 20mm.
- (c.) The steel plate shall conform to weldable structural steel as per IS: 2026. The plate shall be 12 mm thick and 200mm wide. The plate shall be made of minimum number of pieces (not exceeding two pieces per traffic lane width) welded together to form the required length.
- (d.) 8 mm dia, 100mm long nails, spaced at 300mm centre to centre along the centre line of the plate shall be welded to the bottom surface of the steel plate to protrude vertically into the joint gap in order to prevent dislodging of the plate.
- (e.) The plate and the nails shall be protected against corrosion by galvanizing or any other approved anticorrosive coating with a minimum thickness of 100 micron. These shall be completely free from the oil, rust, loose paint or other similar material before application of anticorrosive coating.
- (f.) The concrete surface shall be free from any loose material and cleared of any grease, oil paint etc. and the surface shall be sand blasted, clean of all laitance and level true, prior to placement of the steel plate.
- (g.) The plate shall be placed symmetrical to the concrete line of the joint and it shall be ensured that the plate does not get displaced from its position while laying wearing course.

Sub-Clause 2604.2 Asphaltic Plug Joints

Sub-Clause 2604.2.1 Asphaltic plug joint shall consist of a polymer modified bitumen binder, carefully selected single size aggregate, closure / bridging metallic plate and heat resistant foam caking / backer rod.

Sub-Clause 2604.2.2 General Requirements

- (a.) The joints shall extend to the full depth of the wearing course down to structural concrete. Where needed, a recess may be cut into the deck slab concrete to accommodate the minimum required depth of the joint.
- (b.) The joint shall be provided in the entire width of the structure including kerb and / or footpath. A recess in the kerb and / or footpath shall be made to allow the joint to pass beneath them. The expansion gap in the adjoining kerb and / or footpaths shall be sealed with a suitable sealant such as polysulphide sealant.
- (c.) Expansion joint shall cater for a horizontal movement of 25mm & vertical movement of 2mm. This shall be certified by the manufacturer / supplier of the joint.
- (d.) The minimum width (in traffic direction) of the joint shall be 500mm and maximum width shall be 750mm.
- (e.) Minimum depth of joint shall be 75mm and maximum depth shall not exceed 100mm.
- (f.) The joint shall be capable of performing satisfactorily, within the temperature range of -5 to +50 degree C.

Sub-Clause 2604.2.3 Material

- (a.) Binder:

The polymer modified bitumen binder shall have the capacity to fill the gaps and voids between single size aggregates and to impart flexibility to accommodate various design movements. It shall be patented to blend with bitumen, synthetic polymer, fillers and surface active agent and shall satisfy following requirements.

Softening point	:	100 deg. C minimum
Core penetration at 25 deg. C: 0.1 mm (BS 2499)	:	100mm max.
Flow resistance at 70 deg. C : 5 hours (BS 2499)	:	3mm max.
Extension Test	:	5 cycle of extension to 50 percent at a rate of 1190 and tested to limits (BS 2499)
Safe Heating temperature	:	210 deg. C

- (b) Aggregates:

The aggregate shall be single size aggregate chosen from basalt granite, grit stone or gabbro group. The nominal size of aggregate shall be 12.5 mm for depth of joints upto 75mm and 230mm for joints of more depths of joints. The aggregate shall not be flaky and the Flakiness index shall not be more than 25%. The aggregate shall satisfy following grading requirements:

IS Sieve Designation	1.1.1.1.1.1 Nominal Size of Aggregates	
	20mm	25 mm

	Percent by weight passing the sieve	
26.5 mm	100	-
19.0 mm	85 – 100	100
13.2 mm	0 – 35	85-100
09.5 mm	0 – 7	0-35
06.3 mm	-	0-7
02.3 mm	0 – 2	0-2
600 micron	-	2
75 micron	0 - 1	0-1

The aggregate should have good (i) Polished Value (PVS), (ii) Aggregate Abrasion Value (AAV), (iii) Aggregate Impact Value (AIV) and (iv) Aggregate Crush Value (ACV). In addition surface characteristic should promote proper adhesion. The following are the required values:

PSV > 60
AAV < 05
AIV < 18
ACV = 10-25

(c.) Closure Plate

The closure plate shall be weldable structural steel conforming to IS 2062. The minimum thickness of steel plate shall be 6mm and the width.

The minimum thickness of steel plate shall be 6 mm and the width shall not be less than 200 mm. Closure plate shall be provided with as large length as possible and welded together to form the required length. The number of pieces shall not be more than two per traffic land width. It shall be provided with equidistant holes at a maximum spacing of 300 mm centers for anchorage to the caulking/ backer rod along the longitudinal centre line of the plate. The plate shall be protected against corrosion by galvanizing or any other approved anti-corrosive coating paint with a minimum thickness of 100 micron.

(d) Foam caulking/ Backer rod

A closed-cell polyolefine or open cell polyurethane foam cylindrical caulking or backer rod having diameter equal to 150 per cent of the joint opening shall be provided. It shall be heat resistant and posses good flexibility and recovery characteristics with density of 25 to 30 Kg/cum.

Sub – Clause 2604.2.4 INSTALLATION

- (a) The Expansion joint shall be installed by the manufacturer / Supplier.
- (b) The block out for the joint shall be marked and constructed to the dimensions as indicated in the drawing or recommended by the manufacturer / supplier.
- (c) The recess for the block out shall thoroughly cleaned of any loose or foreign material wire brushing and air blowing and dried with hot compressed air.
- (d) The recess in the deck slab, if required, shall be repaired with epoxy mortar and cleaned and dried again.

- (e) The foam caulking/backing rod shall be placed about 25 mm down in the joint opening.
- (f) The aggregate shall be washed, cleaned and heated to a temperature between 170°-180°C prior to placement.
- (g) The binder shall be preheated to temperature of 170 - 190⁰ C before application.
- (h) While sealing the joint opening with preheated binder, care shall be taken that the binder does not spill on to the joint surface of the deck.
- (i) The joint shall not be installed when the ambient temperature goes below + 5 deg. C or above + 35 deg. C or while it is raining / snowing. (Planning for installation must taken into account the weather condition).
- (j) When clement weather resumes, the joint installation may be continued after the upper layer and/or exposed surface of the partially completed joint has been re-prepared by heating and/ or coating with binder as necessary.

Sub-Clause 2604.2.5 Handling and storage

All the aggregate and binder shall be pre-bagged and clearly marked. All the material shall be stored on concrete platform at 150 mm above the ground in covered enclosures to avoid contamination.

Sub-Clause 2604.2.6 Tests and Standard of Acceptance

The material shall be tested in accordance with these specifications and shall meet prescribed criteria. The manufacturer / supplier shall furnish the requisite certificates from the recognized testing laboratory of India or aboard.

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

CLAUSE 2604.3 COMPRESSION SEAL JOINT

Clause 2604.3.1 Compression seal joint shall consist of steel armored nosing at two edges of the joint gap suitably anchored to the deck concrete and a performed chloroprene elastomer or closed cell foam joint sealer compressed and fixed in to the joint gap with special adhesive binder.

Clause 2604.3.2 Material

(a.) Steel Noising

The steel noising shall be of angle section ISA 100 x 100 conforming to weld able structural steel as per IS: 2662. The thickness of legs shall not be less than 12mm. The top face of the angle shall be provided with Bleeder holes of 12mm diameter spaced at a maximum 100mm centers so as the ensure that there are no voids in the concrete beneath the angle.

(b.) Anchorage

The anchorage steel shall conform to IS: 2062 or equivalent. The steel nosing shall be anchored to the deck by reinforcing bars, headed studs or bolts or anchor plates cast in concrete or a combination of anchor plates and reinforcing bars, headed studs or bolts. Anchor bars, studs or bolts shall engage the main structural reinforcement of the deck and in case of anchor plates or anchor loops this shall be achieved by passing transverse bars through the loops or plates.

The minimum thickness of anchor plate shall be 12-mm. Total cross sectional area of bars, studs or bolts on each side of the joint shall not be less than 1600 mm sq. per metre length of the joint and the center to center spacing shall not exceed 250 mm. The ultimate resistance of anchorages shall not be less than 600 KN/m in any direction.

(c.) Corrosion Protection

All steel section shall be protected against corrosion by hot dip galvanization or other approved anticorrosive coating with a minimum thickness of 100 micron.

(d.) Joint Seal

- i.) The sealing element shall be a performed continuous chloroprene or closed cell foam seal with high tear strength, insensitive to soil, gasoline and ozone, it shall have high resistance to aging and ensure water tightness. The seal should be vulcanized in a single operation for the full length of the joint required for carriageway, kerbs and footpaths, if any. The seal shall cater for a horizontal movement upto 40 mm and vertical movement of 3 mm.
- ii) The physical properties of chloroprene / closed cell foam sealing element shall conform to the following.

Chloroprene seal

Shall be performed extruded multi web cellular section of chloroprene of such a shape as to promote self removal of foreign material during normal service operations. Chloroprene of joint seal shall conform to Clause 915.1 of IRC:83 (Part -II) and satisfy the properties stipulated in Table – 2. Strip Seal Element Specification of these specifications except in respect of the working movement range of the sealing element which shall be as specified in Clause 2.4.1 above.

Closed Cell Foam Seal

Shall be performed non extruded non cellular section made from low density closed cell, cross linked ethylene vinyl acetate, polyethylene, copolymer that is physically brown using nitrogen. The material shall possess properties as indicated in Table. 1:

	Property	Specified Values
i.)	Density	41.7 – 51.3 kg/cum
ii.)	Compression Set on 25 mm	50% compression samples (ASTM D3575) for 22 hours at 23 degree Celcius, 2 hours

		recovery, 13 percent set
iii.)	Working temperature	-70 to +70 deg. C
iv.)	Water absorption (total immersion for 3 months) (ASTM D3575)	0.09766 kg/sqm
v.)	Tensile Strength	0.8 Mpa
vi.)	Elongation at break (ASTM D3575)	195 +/- 20

(e) Lubricant and Adhesive

The type and application of material used in bonding the performed joint seal to the steel noising and concrete shall be as recommended by the manufacturer / supplier of the seal system.

Handling and storage

Sub-Clause 2604.3.3

- (a) The expansion joint material shall be handled with care and stored under cover.
- (b) All joint material and assemblies shall be protected from damage and assemblies shall be supported to maintain true shape and alignment during transportation and storage.

Sub-Clause 2604.3.4 Installation

- (a) The expansion joint shall be installed by the manufacturer / supplier or their authorized representative, who will ensure compliance of installation procedure and instruction
- (b) The dimension of the joint recess and the width of the gap shall conform to the approved drawings.
- (c) Anchoring steel shall be welded to the main reinforcement in the deck maintaining level and alignment of the joint.
- (d) Concreting of pocket / recess shall be done with great care using proper mix conforming to same grade as that of the deck concrete but not less than M30 grade in any case. The water cement ratio shall not be more than 0.40. If needed, suitable admixtures may be used to achieve the workability. The width of pocket shall not be less than 300 mm on either side of the joint. Care shall be taken to ensure efficient bonding between already cast / existing deck concrete and the concrete in the joint recess.
- (e) At the time of installation, joint shall be clean and dry and free from spalls and irregularities, which might impair a proper joint seal.
- (f) Concrete or metal surfaces shall be clean, free or rust, laitance, oils dirt, dust or other deleterious materials.

- (g) The lubricant cum adhesive shall be applied to both faces of the joints and joint seal prior to installation in accordance with the manufacturer's instructions.
- (h) The joint seal shall be compressed to the specified thickness for the rated joint opening and ambient temperature at the time of installation which shall be between +5 to 350C.
- (i) The joint seal shall be installed without damage to the seal. Loose fitting or open joints shall not be permitted.

Sub- Clause 26.04.3.5 Acceptance Criteria

- (a) All steel elements shall be furnished with corrosion protection system.
- (b) For the joint seal the acceptance test shall conform to the requirements stipulated in Para above. The manufacturer/ supplier of this type of joint shall produce a test certificate to this effect conducted in a recognized laboratory in India or aboard.
- (c) Prior to acceptance 25 percent of the completed and installed joints, subject to a minimum of one joint, shall be subjected to water tightness test. Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25 mm above the highest point of deck. The width of pending shall be at least 50 mm .beyond the anchorage block of the joint on either side. The depth of water shall not fall below 25 mm anytime during the test. A close inspection of the underside of the joint shall not reveal any leakage.

Sub Clause 26.04.3.6 Test and Standards of Acceptance

The material shall be tested in accordance with these specifications and shall meet the prescribed criteria. The manufacturer I supplier shall furnish the requisite certificates from the recognized testing laboratory of India or abroad.

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

The clause 2607 be replace fully as below :

Sub-Clause 2607 STRIP SEAL AND MODULAR / BOX SEAL JOINTS

Sub Clause 2607.1 Strip Seal Expansion Joint

This clause shall be read as under :

Clause 2607.1.1 Components

Strip Seal expansion joint shall comprise the following items :

- (a) Edge Beam
This shall be either extruded or hot rolled steel section or cold rolled cellular steel section including continuously shop welded section with suitable profile .to mechanically lock and sealing element in place throughout the normal movement

cycle. Further the configuration shall be such that the section has a minimum thickness of 6 mm all along the cross section. The minimum height of the edge beam section shall be 75 mm.

(b) Anchorage

Edge beam shall be anchored to the deck by reinforcing bars, headed studs or bolts or anchor plates cast in concrete or a combination of anchor plate and reinforcing bars, headed studs or bolts. Anchor bars, studs or bolts shall engage the main structural reinforcement of the deck and in Case of anchor plates or loops. This shall be achieved by passing transverse bars through the loops or plates.

The minimum thickness of anchor plate shall be 12mm. Total cross sectional area of bar studs or bolts on each side of the joint shall not be less than 1600 mm Sq. per meter length of the joint and the center to center spacing shall not exceed 350 mm. the ultimate resistance of anchorages shall not be less than 600 KN/m in any direction.

Sub-Clause 2607.1.2 Material

- (a) The steel for the edge beams shall conform to any of the steel grade corresponding to RST 37-2 or 37-3 (DIN) or 52-3 (DIN), ASTM A36 or A588, CAN/CSA Standard G 40.21 Grade 300w or equivalent
- (b) Anchorage steel shall conform to IS: 2026 or equivalent.
- (c) All steel sections shall be protected against corrosion by hot dip galvanization or any other approved anticorrosive coating with a minimum thickness of 100 micron.
- (d) Chloroprene of strip seal element shall conform to Clause 915.1 or IRC: 83 (Part-II). The properties of chloroprene shall be as specified in **Table – 2**:

TABLE – 2

STRIP SEAL ELEMENT SPECIFICATIONS

Sealing element is made of chloroprene and must be extruded section. The working movement range of the sealing element shall be at 70mm.

PROPERTY	SPECIFICATION
Hardness*	
DIN 53505	63 ± 5 shore A
ASTM D 2240 (Modified)	55 ± 5 shore A
Tensile Strength*	
DIN 53504	Min 11 MP
ASTM D 412	Min 13.8 MPa
Elongation at fracture*	
DIN 53504	Min 350 per cent

ASTM D 412	Min 250 per cent
Tear Propagation Strength	
Longitudinal	Min 10 N/mm
Transverse	Min 10 N/mm
Shock Elasticity	Min 25 per cent
Abrasion	Min 220 Cu. mm
Residual Compressive Strain	
(22h/70 deg C/30 per cent strain)	Max 28 per cent
Ageing in hot air	
(14 days / 70 deg. C)	
Change in hardness	Max + 7 Shore A
Change in Tensile strength	Max – 20 per cent
Change in elongation at fracture	Max – 20 per cent.
Ageing in Ozone	
(24h/50 pphm/25 deg.)	No cracks.
C/20 per cent elongation)	
Swelling behavior in oil (168h / 25 deg. C)	
ASTM Oil No. 1	
Volume Change	Max + 5 per cent
Change in Hardness	Max – 10 Shore A
ASTM Oil no. 3	
Volume Change	Max + 25 per cent
Change in Hardness	Max + 20 shore A
Cold Hardening Point	Max – 35 deg. C

* Only one set of specifications viz. ASTM or DIN shall be followed depending on the source of supply.

Sub-Clause 2607.1.3 Fabrication (Pre Installation)

- (a) The strip seal joint system and all its component parts including anchorages shall be supplied by the manufacturer / system supplier.
- (b) The width of the gap to cater for movement due to thermal effect, prestress, shrinkage and creep, superstructure deformations (if any) and sub-structure deformation (if any) shall be determined and intimated to the manufacturer. Depending upon the temperature at which the joint is to be installed, the gap dimension shall be preset.
- (c) Each strip seal expansion joint system shall be fabricated as a single entity unless stage construction as excessive length prohibits monolithic fabrication,. It shall fir the full width of the structure as indicated on the approved drawings. The system shall be pre- set by the manufacturer prior to transportation. Prestressing shall be done in accordance with the joint opening indicated on the drawing.
- (d) The finally assembled joint shall then clamped and transported to the work site.

Sub-Clause 2607.1.4 HANDLING AND STORAGE

- (a) For transportation and storage, auxiliary brackets shall be provided to hold the joint assembly together.
- (b) The manufacturer / supplier shall supply either directly to the Engineer or to the Bridge Contractor all the materials of strip seal joints including sealants and all other accessories for the effective installation of the joining.
- (c) Expansion joint material shall be handled with care. It shall be stored under cover on suitable lumber padding.

Sub-Clause 2607.1.5 INSTALLATION

- (a) The joint shall be installed by the manufacturer / supplier or their authorized representatives who will ensure compliance to the manufacturer's instructions for installation.
- (b) Taking the width of gap for movement of the joint into account, the dimensions of the recess in the decking shall be established in accordance with the drawings or design data of the manufacturer. The surfaces of the recess shall be thoroughly cleaned and all dirt and debris removed. The exposed reinforcement shall be suitably adjusted to permit unobstructed lowering of joint into the recess.
- (c) The recess shall be shuttered in such a way that dimensions in the joint drawing are maintained. The formwork shall be rigid and firm.
- (d) Immediately prior to placing the joint, the presetting shall be inspected. Should the actual temperature of the structure be different from the temperature provided for presetting, correction of the presetting shall be done. After adjustment, the brackets shall be tightened again
- (e) The joint shall be lowered in a pre-determined position., Following placement of the joint in the prepared recess, the joint shall be leveled and finally aligned and the anchorage steel on the one side of the joint welded to the exposed reinforcement bars of the structure. Upon completion, the same procedure shall be followed for the other side of the joint. With the expansion joint finally held at both sides, the auxiliary brackets shall be released, allowing the joint to take up the movement of the structure.
- (f) High quality concrete shall then be filled in to the recess. The packing concrete must feature low shrinkage and have the same strength as that of the superstructure, but in any case not less than M-35 grade. Good compaction and careful curing of concrete is particularly important. After the concrete has cured, the movable installation brackets and shuttering still in place shall be removed.
- (g) The neoprene seal shall be field installed in continuous length spanning the entire roadway width. To ensure proper fit of the seal and enhance the ease of installation, dirt, spatter or standing water shall be removed from the steel cavity using a brush, scraper or compressed air. The seal shall be installed without any damage to the seal by suitable hand method or machine tools.
- (h) As soon as the concrete in the recess has become initially set, a sturdy ramp shall be placed over the joint to protect the exposed steel beams and neoprene seals from the site traffic. Expansion joint shall not be exposed to traffic before the carriageway surfacing is placed.

- (i) The carriageway surfacing shall be finished flush with the top of the steel sections. The actual junction of the surfacing / wearing coat with the steel edge section shall be formed by a wedge shaped joint with a sealing compound. The horizontal leg of the edge beam shall be cleaned beforehand. It is particularly important to ensure thorough and careful compaction of the surfacing in order to prevent any premature depression forming in it.

Sub-Clause 2607.1.6 Acceptance Criteria

- (a) All steel elements shall be finished with corrosion protection system.
- (b) For neoprene seal, the acceptance test shall conform to the requirements stipulated in Table - 1. The manufacturer/supplier shall produce a test certificate accordingly conducted in a recognized laboratory, in India or abroad.
- (c) The manufacturer shall produce test certificates indicating that anchorage system had been tested in a recognized laboratory to determine optimum configuration of anchorage assembly under dynamic loading.
- (d) Prior to acceptance 25 percent of the completed and installed. Joints subject to a minimum of one joint shall be subjected to water tightness test" Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25mm above the highest point of deck. The width of ponding shall be at least 50mm beyond the anchorage block of the joint on either side. The depth of water shall not fall below 25mm anytime during the test. A close inspection of the underside of the joint shall not reveal any leakage.
- (e) Investigation of fatigue strength of the edge beam section with anchorages to with stand 2x10⁶ load change cycles of 85 KN vertical load and 10 KN of horizontal load without showing sign of distress shall be required. The supplier shall produce a test certificate in this regard conducted in a recognized laboratory, in India or abroad.
- (f) As strip seal type of joint is specialized in nature, generally of the proprietary type, the manufacturer shall be required to produce evidence of satisfactory performance of this type of joint.

Sub-Clause 2607.1.7 Tests and Standards of Acceptance

The materials shall be tested in accordance with these specifications and shall meet the prescribed criteria- The manufacturer/supplier shall furnish the requisite certificates from the recognized testing laboratory of India or abroad.

Sub-Clause 2607.2 Modular Strip/Box Seal Joint

Sub-Clause 2607.2.1 A modular expansion joint consist of two or more modules / cells to cater to a horizontal movement in excess of 70 mm. It shall allow movements in all 3 directions and rotation about all 3 axes as per design requirements. It shall also ensure that during all movement cycles of the joint, opening and closing (gaps) of all modules are equal.

Sub-Clause 2607.2.2 Component

- a) The structural system consisting of two edge beams, one or more central /

separation beams or lamellas and cross support bars supporting individual or multiple central beams to transfer the loads to the bridge deck through the anchorage system.

- b) Resilient or shock absorption support system for central beams as well as support bars no dampen dynamic loading thus reducing the forces transmitted to the substructure and anchorages as also to accommodate vertical and transverse movements apart from longitudinal movement.
- c) Sliding or control system which allows closing and opening of the joint and also ensures that all modules open and close equally.
- d) Mechanically locked sealing system of chloroprene which provides watertight, noiseless and easy replacement system.

Sub Clause 2607.2.3 Materials

- (a) Edge and Central Beams

These shall be either extruded or hot rolled steel sections or cold rolled cellular steel sections including continuously shop welded sections for central beams with suitable profile to mechanically lock the sealing element in place throughout the normal movement cycle. Further, the configuration shall be such that the section has a minimum thickness of 10 mm all along the cross section (flange and web). The thickness of lips holding the seal shall not be less than 6mm. The cold rolled cellular sections shall be relieved of any locked in stresses through annealing process. These shall be closed at both ends and be air tight after installation of seal to prevent ingress of moisture in the hollow portion.

- (b) Chloroprene Seal

This shall be performed extruded single strip or cellular section of chloroprene of such a shape as to promote self removal of foreign material during normal joint operation. The seal shall possess high tear strength and be insensitive to oil, gasoline and ozone. It shall have high resistance to ageing and ensure water tightness

- (c) Anchorage

The anchorage steel shall conform to IS:2062 or equivalent Edge beam shall be anchored to the deck by anchor plates cast in concrete or a combination of anchor plate and reinforcing bars, headed studs or bolts. Anchor bars, studs or bolts shall engage the main structural reinforcement of the deck and in case of anchor plates or loops, this shall be anchored by passing transverse bars through the loops or plates.

The minimum thickness of anchor plate shall be 12mm. Total cross sectional area of bars, studs or bolts on each side of the joint shall not be less than 1600 mm Sq. per meter length of the joint and the centre to centre spacing shall not exceed 250 mm. The ultimate resistance of anchorages shall not be less than 600 KN/m in any direction. The anchor loop at the edge profiles should be at a light angle to the joint Planned deviations of this direction are allowable only for

the range of 90 deg. +/- 20 deg. (The anchoring reinforcement of the construction must lie parallel to the anchor loops

(d) Support and Control System

The overall system and components of the resilient/shock absorption system and sliding / control system shall conform to the specifications recommended by the manufacturer. The centre to centre spacing of transverse support bars shall not exceed 1.75m.

(e) Corrosion Protection

All Steel section shall be protected against corrosion by hot dip galvanizing or any other approved anti corrosive coating with a minimum thickness of 100 micron.

Sub-Clause 2607.2.4 Fabrication (Pre-installation)

- (a) The modular expansion joint system and all its component parts including anchorages shall be supplied by the manufacturer
- (b) The width of the gap to cater for movement due to thermal effect, prestress, shrinkage and creep, superstructure deformations (if any) and. sub-structure deformation (if any) shall be determined and intimated to the manufacturer. Depending upon the range of temperature at which the joint is to be installed the gap dimension shall be preset.
- (c) Each modular expansion joint system shall be fabricated as a single entity free from any joint in the longitudinal direction unless stage construction or excessive length prohibits monolithic fabrication. It shall fit the full width of the structure as indicated on the approved drawing. The system shall be pre-set by the manufacturer prior to transportation. Pre-setting shall be done in accordance with he joint opening indicated on the drawing.
- (d) The finally assembled joint shall then be clamped and transported to the work site.

Sub-Clause 2607.2.5 Handling and Storage

- (a) For transportation and storage, auxiliary brackets shall be provided to hold the joint assembly together.
- (b) The manufacturer / supplier shall supply either directly to the Engineer or to the Bridge contractor entire assembly modular Strip/Box seal joints including sealants and all other accessories for the effective installation of
- (c) Expansion joint material shall be handled with care. It shall be stored under cover on suitable lumber padding:

Sub-Clause 2607.2.6 Installation

- (a) The joint shall be installed by the manufacturer/supplier only
- (b) Taking the width of gap for movement of the joint into account, the dimensions of the recess in the decking shall be established in accordance with the drawings or design data of the manufacturer. The surface of the recess shall be thoroughly cleaned and all dirt and debris removed. The exposed reinforcement shall be suitably adjusted to permit unobstructed lowering of the joint into the recess.
- (c) The recess shall be shuttered in such a way that dimensions in the joint drawing are maintained. The formwork shall be rigid and firm.
- (d) Immediately prior to placing the joint, the presetting shall be inspected. Should the actual temperature of the structure be different from the temperature provided for presetting correction of the presetting shall be done. After adjustment, the brackets shall be tightened again
- (e) The joint shall be lowered in a pre-determined position. Following placement of the joint in the prepared recess, the joint shall be levelled and finally aligned and the anchorage steel on one side of the joint welded to the exposed reinforcement bars of the structure. Upon completion, the same procedure shall be followed for the other side of the joint. With the expansion joint finally held at both sides, the auxiliary brackets shall be released, allowing the joint to take up the movement of the structure.
- (f) Controlled concrete having strength not less than that in superstructure subject to the minimum of M-35 shall be filled into the recess. The packing concrete must feature low shrinkage. Good compaction and careful curing of concrete is particularly important. After the concrete has cured the, movable installation brackets and shuttering still in place shall be removed.
- (g) The chloroprene seal shall be field installed in continuous lengths spanning the entire roadway width. To ensure proper fit of the seal and increase the ease of installation, dirt, spatter or standing water shall be removed from steel cavity using a brush, scraper or compressed air. The seal shall be installed without damage to the seal by suitable hand method or machine tools.
- (h) As soon as the concrete in the recess has become initially set. a sturdy ramp shall be placed over the joint to protect the exposed steel beams and neoprene seals from the site traffic. Expansion joint shall not be exposed to traffic loading before the carriageway surfacing is placed.
- (i) The carriageway surfacing shall be finished flush with the top of the steel sections. The actual junction of the surfacing / wearing coat with the steel edge section shall be formed by a wedge shaped joint with a sealing compound. The horizontal leg of the edge beam shall be cleaned beforehand. It is particularly important to ensure thorough and careful compaction of the surfacing in order to prevent any premature depression forming in it.

Sub-Clause 2607.2.7 Acceptance Criteria

- (a) All steel elements shall be finished with corrosion protection system.

- (b) For Chloroprene seal, the acceptance test shall conform to the requirements stipulated in clause 2607.1.2 (d). The manufacturer / supplier shall produce a test certificate accordingly, conducted in a recognized laboratory, in India and abroad.
- (c) Fatigue strength of internal beams and support connection shall be investigated to withstand 2 million cycles of vertical load of 85 KN and a horizontal load of 10 KN without showing signs of distress. The supplier shall have to produce a test certificate in this regard conducted by a recognized laboratory from India or abroad.
- (d) The manufacturer shall produce test certificates indicating that anchorage system has been tested in a recognized laboratory to determine optimum configuration of anchorage assembly under dynamic loading.
- (e) Prior to acceptance 25 percent of the completed and installed joints, subject to a minimum of one joint, shall be subjected to water tightness test. Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25mm above the highest point of deck. The width of ponding shall be at least 50mm beyond the anchorage block of the joint on either side. The depth of water shall not fall below 25mm anytime during the test. A close inspection of the underside of the joint shall not reveal any leakage.
- (f) As Modular strip / box seal type of joint is specialized in nature, generally of the proprietary type, the manufacturer shall be required to produce evidence of satisfactory performance of his product.

Sub-Clause 2607.2.8 Test and Standards of Acceptance

Material shall be tested in accordance with these specifications and shall meet the prescribed criteria. The manufacturer / supplier shall furnish the requisite certificates from the recognized testing laboratory of India or abroad.

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

CLAUSE 2609 MEASUREMENT FOR PAYMENT

The expansion joint shall be measured in running metres. For filled joints, the rate per running metre shall include the cost of sealant for the depth provided in this drawing. The expansion joint shall be measured along the width of the deck slab from one end to the other including length through footpaths and parapets.

CLAUSE 2610 RATE

The Contract unit shall include the cost of all material, labour, equipment and other incidental charges for fixing the joints complete in all respects as per these specifications in the case of Bridge Contractor supplying the expansion joint. If the manufacturer supplies the expansion joint directly to the Engineer, the cost of installation, handling and fixing shall be borne by the Bridge Contractor.

SECTION 2700 WEARING COAT AND APPURTENANCES

Sub-Clause 2702.1 Bituminous Wearing Coat

Sub-Clause 2702.1.1 Replace the Sub-para with the following :

Principles of Bituminous wearing coat shall comprise the following :

- i. A layer of mastic asphalt as shown in the drawings after applying a prime coat over the top of the deck before the wearing coat is laid. The prime coat and the layer of mastic asphalt shall be laid as per Clause 503 and 515 respectively.
- ii. 50mm thick bituminous concrete wearing coat in two layers of 25mm each as per Clause 512.

Sub-Clause 2702.1.2 Deleted.

CLAUSE 2703 RAILINGS AND PARAPETS

Sub-Clause 2703.3 Cast-in-Situ Railings and parapets

Last sentence of paragraph 3 shall be replaced by the following.

“Location of construction joints shall be determined in advance and approved by Engineer.”

Add the following additional clauses:

Sub-Clause 2703.5 Concrete crash barrier for bridges

Sub-Clause 2703.5.1 General

This work shall consist of construction, provision and installation of concrete crash barrier on the Bridge deck / approach slab / approaches at locations and of dimensions as shown on the drawings or as directed by the Engineer.

Sub-Clause 2703.5.2 Materials

All material shall conform to Section 1000-Materials for Structures as applicable, and relevant Clauses in Section 1600 shall govern the steel reinforcement. The concrete barriers shall be constructed either by the “cast-in-place with fixed forms” method or the “ extrusion or slip form” method or a combination thereof at the Contractor’s option with the approval of the Engineer, where “extrusion or slip from” method is adopted , full details of the method and literature shall be furnished.

Grade of concrete for crash barrier shall be as per BOQ or as directed by Engineer.

An expansion joint with Polysulphide Joint sealants and bituminous fiberboard shall be provided in the crash barriers at the location of expansion joints / gaps on the bridge, approaches etc.

Sub-Clause 2703.5.3 Construction Operations

The location of crash barrier shall be strictly adhered to as shown on the drawing and as directed by the Engineer. Concrete crash barriers shall present a smooth, uniform appearance in their final position, conforming to the horizontal and vertical lines shown on the planes or as ordered by the Engineer and shall be free of lumps, sags or other irregularities. The top and exposed faces of the barriers shall conform to the specified tolerances, as defined in Clause 809.4, when tested with 3 m straight edge, laid on the surface.

The crash barrier or precast shall be given two coats of cement paint or aqua based paint as directed by the Engineer of approved brand and shade.

Sub-Clause 2703.5.4 Tolerance

The overall horizontal alignment of crash barrier and rails shall not depart from the road alignment by more than $\pm 30\text{mm}$, nor deviate in any two successive lengths from straight by more than 6mm and the faces shall not vary more than 12mm from the edge of a 3m straight edge. Barriers shall be at the specified height as shown in the plans above the edge of the nearest adjacent carriageway or shoulder, within a tolerance of $\pm 30\text{mm}$.

Sub-Clause 2703.5.5 Measurements for Payment

All barriers shall be measured in cubic metres of concrete completed for the barriers including approach and departures ends. The sealing of opening in crash barrier at expansion joints with polysulphide rubber joint sealant and bituminous fiberboard as per Clause 2703.6 shall be incidental to work. The reinforcement in barriers shall be measured and paid separately in relevant item of BOQ. The painting over crash barrier shall be measured in square meter and paid separately.

Sub-Clause 2703.5.6 Rate

The Contract unit rate shall include full compensation for furnishing all labour, materials excluding steel reinforcement, tools, equipments and incidental costs necessary for doing all the work involved in constructing the concrete barrier complete in place in all respects as per these Specifications.

Sub-Clause 2703.6 POLYSULPHIDE RUBBER JOINT SEALANT

Polysulphide Joint Sealants with bituminous fiberboard shall be provided in the Expansion Joints / gaps in Crash Barriers.

Before application it shall be ensured that the top of the bituminous fiberboard and the concrete faces are dry, sound, free from dirt, grease and other loose foreign matter. A thin coat of primer shall be applied on concrete faces with a brush to air dry before applying sealant. The components of the sealant i.e. base and hardener shall be mixed in a slow speed mixed sealant till uniform color is obtained. Placement of the mechanical mixer shall be done with either cartridge

or fully enclosed gun barrels within 30 minute of mixing. Manufacturer's recommendation shall be followed.

The sealing compound shall be two packs, low modulus of elasticity Polysulphide elastomer having bituminous ingredients such as Cico T-680 or equivalent with following properties of the cured compound.

Tensile strength	-	0.4 MPa $\pm$ 10%
Modulus of elasticity	-	At 100% elongation: 0.15 MPa
Elongation	-	Elongation at break 550%
Hardness	-	Shore 'A' hardness 22 $\pm$ 3 @ 25°C
Operating temperature	-	-20°C to + 80°C
Shrinkage	-	Less than 1%
Permanent dynamic	-	$\pm$ 25%

Movement capability

Polysulphide material shall be approved by the Engineer prior to procurement.

Measurements for Payments

Cost for providing Polysulphide Joint sealants and bituminous fiberboard in the Expansion Joints in Crash Barriers shall be deemed to be included in the unit rate of Crash Barrier and shall not be measured separately.

CLAUSE 2704 APPROACH SLAB

Provision of approach slab shall be in accordance with "Guide lines regarding approach slab for bridges" given in MOST circular no. RW/NH-34015/2/86-S&R dated 22 June 1994.

CLAUSE 2706 WEEP HOLE

This clause shall read as under:

"Weep holes shall be provided in solid plain concrete/reinforced concrete/brick masonry abutments, wing walls, return walls as shown in the drawing or as directed by the Engineer to drive moisture from the back filling. Weep holes shall be provided with 100mm dia PVC pipe of approved thickness and shall extend through the full width of concrete with slope of about 1 vertical: 20 horizontal towards the draining face.

The spacing of weep holes shall generally be 1m in either direction or as shown in the drawing with the lowest at about 150mm above the low water level or ground level whichever is higher or as directed by the Engineer."

CLAUSE 2708 MEASUREMENTS FOR PAYMENT

Substitute Para (ii) of this clause by following:

"Railing shall be measured in running meter/cubic meter as per unit provided in BOQ."

CLAUSE 2709 RATE

The second paragraph shall be read as follows:

“The Contract unit rate of parapets and railings shall include the cost of labour, materials tools and plant required fro completing the unit in accordance with specifications.”

Add at the end of Para 2:

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

SECTION 2800 REPAIR OF STRUCTURES

CLAUSE 2809 DISMANTLING OF EXISTING WEARING COAT, EXPANSION JOINTS AND DRAINAGE SPOUTS

Sub-Clause 2809.1 Add the following at the end of Clause 2809.

The existing wearing coat, concrete as well as bituminous overlay, shall be removed for the entire length including approach slab for all minor bridges with solid slab superstructure. Only damaged portion of wearing coat shall be removed for major bridges and minor bridges with T-Beam and slab superstructure.

Sub-Clause 2809.2 This Clause shall read as follows:

The removal operations shall be carried out mechanically using pavement breakers and compressors. Removal shall be done carefully to avoid damage to any part of existing structure. In delicate locations for example around spouts, removal shall be done by manual methods. After removal, the concrete deck surface shall be closely inspected for identifying and distress such as cracks, pockets of loose or honeycombed concrete etc. The deck surface shall be thoroughly cleaned with special efforts to remove any loose material. Expansion joints and spouts shall be removed carefully so that deck concrete is not damaged.

Sub-Clause 2809.3 Add the following at the end of the Clause 2809.3

Dismantled material shall no be stacked on the deck nor shall it be thrown below the bridge. It shall be neatly piled at points designated by the Engineer with all lifts and leads. Materials which can be used for auctioned shall be stored in neat piles at locations designated by Engineer with all lifts and leads.

New Clauses 2811 to 2829 shall be add after Clause 2810 as given below and existing Causes 2811, 2812 and 2813 shall be renumbered as 2830, 2831 and 2832.

CLAUSE 2811 DISMANTLING OF EXISTING RAILING, KERBS, FOOTPATH SLABS, PART OR COMPLETE DECK SLAB, APPROACH SLABS AND DAMAGED

CONCRETE IN WING WALLS/RETURNS, PIERS AND ABUTMENTS, RCC/BRICK MASONRY, ENCLOSURES OF BEARINGS

Railing, kerbs, footpath slabs, approach slabs, part or complete deck slabs and damaged concrete in wing walls / returns, piers and abutments, RCC/ Brick masonry exclusive of bearings of the existing structures shall be dismantled as shown in drawings or as directed by the Engineer.

The work shall be executed in accordance with Specifications Section 200 Clause 202. All damaged concrete in wing walls, returns, piers and abutments shall be thoroughly inspected to identify the effects of dismantling. The decision of Engineer regarding extent of dismantling shall be final. Care shall be taken to avoid damage to any part of the existing structure. Dismantling work for railings and kerbs shall be done carefully such that the existing reinforcement, which will project into new work, is not damaged or lost. Reinforcement shall be cleaned thoroughly.

Dismantled material shall not be stacked on the deck nor shall it be thrown below the bridge. It shall be neatly piled at points designated by the Engineer with all lifts and leads upto 1000m. Materials, which can be used or auctioned, shall be stored in neat piles at locations designated by Engineer with all lifts and leads.

Water shall be sprayed to reduce while dismantling work is in progress. Dismantling work shall not be carried out at night, during storms or heavy rain.

Goggles and gas masks shall be worn at the time of dismantling. Leather glove shall be worn by the workers. Screens made of G.I. sheets shall be placed wherever necessary to prevent the flying pieces from injuring the workers. Damage caused to any component of the bridge structure during removal operations shall be restored by the Contractor at his cost. The service lines, if any, shall be disconnected/diverted before dismantling work commences.

CLAUSE 2812

DISMANTLING OF EXISTING DAMAGED BRICK / COURSE RUBBLE MASONRY IN WING WALLS / RETURNS, PARAPETS etc.

Damaged brick / course rubble masonry in wing walls / returns and all brick / course rubble masonry parapets shall be dismantled as shown in drawings or as directed by the Engineer.

The work shall be executed in accordance with Specification Section 200 Clause 202. Damaged brick / course rubble masonry in wing walls / returns shall be thoroughly inspected to identify the extent of dismantling. The decision of the Engineer regarding extent of dismantling shall be final. Care shall be taken to avoid damage to any part of the existing structure.

Dismantled material shall not be stacked on the deck nor shall it be thrown below the bridge. It shall be neatly piled at points designated by the Engineer with all lifts and leads. Materials, which can be used or auctioned, shall be stored in neat piles at locations designated by Engineer with all lifts and leads.

Leather glove shall be worn by the workers. Screens made of G.I. sheets shall be placed wherever necessary to prevent the flying pieces from injuring the workers.

Damage caused to any component of the bridge structure during removal operations shall be restored by the Contractor at his cost.

CLAUSE 2813

DISMANTLING OF EXISTING SPLAYED WING WALL FOR CONSTRUCTION OF ADJACENT 2 LANE BRIDGE – a) BRICK COURSE RUBBLE MASONRY, b) CONCRETE

Existing brick / course rubble masonry / concrete wing wall shall be dismantled for construction of adjacent 2 Lane Bridge as shown in drawings or as directed by Engineer.

The work shall be executed in accordance with Specifications Section 200 Clause 202 only portions which interfere with the construction of wing walls/returns/median wall of adjacent 2-lane bridge shall be dismantled. The decision of the Engineer regarding extent of dismantling shall be final.

During dismantling all precautions shall be taken to prevent failure of retained earth of the approaches.

Dismantled material shall not be stacked on the deck nor shall it be thrown below the bridge. It shall be neatly piled at points designated by the Engineer with all lifts and leads. Materials, which can be used or auctioned, shall be stored in neat piles at locations designated by Engineer with all lifts and leads.

Goggles and gas masks shall be worn at the time of dismantling. Leather glove shall be worn by the workers. Screens made of G.I. sheets shall be placed wherever necessary to prevent the flying pieces from injuring the workers.

Damage caused to any component of the bridge structure during removal operations shall be restored by the Contractor at his cost.

CLAUSE 2814

DOWEL BARS IN DECK SLAB, PIER, PIER CAPS AND AT LOCATIONS OF PARAPET, EXPANSION JOINT, PIER NOSING, JACKETING AND ATTACHMENT FOR SEISMIC RESTRAINER AND GROUTING WITH EPOXY RESIN.

20 – 25mm dia and 150 – 300mm deep holes shall be drilled in existing slab at location shown in the drawings.

Holes shall be drilled vertically using rotary drill machines. Care shall be taken that the holes are drilled vertical and the deck concrete is not damaged. It shall be ensured that buried reinforcement of the deck is not damaged due to drilling by avoiding locations above reinforcement. Rebar detector shall be used for this purpose. 16 – 20mm dia. dowel bars shall be inserted in the hole and kept in undisturbed position with appropriate fixture. The annular space shall be filled by epoxy grouting.

Work of epoxy grouting shall be done in accordance with MOST Specifications Section 2800 Clause 2803. It shall be ensured that the inside of the hole is dry. Epoxy resin shall be Resicrete 21 or equivalent with following properties:

Compressive strength	-	min 35 MPa at 24 hours.
Tensile strength	-	15 – 20 MPa at 7 days.
Flexural strength	-	30 – 40 MPa at 7 days.
Viscosity @ 25°C	-	00 – 1200 cps

The epoxy resin material shall be approved by the Engineer prior to procurement and use.

The contract unit rate shall include all incidental expenses as required for fixing dowel bars including making barricading, draining out water etc. where necessary, cleaning etc. all complete as per drawing

CLAUSE 2815 RAILING / PARAPETS.

Cast-in-situ railings/parapets shall be constructed in accordance with the requirements of structural concrete Section 1700. The reinforcement shall conform to Section 1600. The formwork shall conform to Section 1500. The work in general shall conform to Section 2700 clause 2703.

The reinforcement of the railings/parapets shall be welded with the existing reinforcement of the deck slab and with the dowel bars as shown in the drawings or as directed by the Engineer.

In case there are no old dowel bars, fresh dowel bars shall be fixed into deck slab as per clause 2814.

CLAUSE 2816 REPAIR OF CORRODED REINFORCEMENT

Repair of corroded reinforcement (where corrosion has reduced the diameter of the bar by more than 20%) shall be done by providing new reinforcement, which is either welded or firmly secured with the old reinforcement.

1. Material

Steel which is to be used as additional reinforcement where the diameter of existing main longitudinal reinforcement has been reduced to 80% of the original, should satisfy the requirements of IS: 226-1975 or IS: 1786-1976. However, the BRC fabric or weld mesh, which are to replace/strengthen the corroded stirrups, or tie bars, should be from reputed manufacturer.

2. Repairing Procedure

The exposed reinforcement showing signs of deterioration by corrosion shall be cleaned by grit blasting.

When corrosion products have been removed, the diameter of the reinforcement shall be measured. If the diameter of the reinforcement is found to be reduced to 80% of the original, then additional reinforcement of equivalent diameter free from rust shall be firmly secured with the old reinforcement, preferably by

welding, if existing reinforcement can be welded or with a lap of at least 40 times the dia of the bar.

CLAUSE 2817 PROVIDING AND FIXING DRAINAGE SPOUT INCLUDING SEALING WITH NON-SHRINK FREE FLOW CEMENT GROUT.

For all existing bridge decks drainage spout shall be replaced and new drainage spouts shall be provided as shown in the drawings.

The waterproofing material shall be provided, around the area of drainage spout and spout pipe, from the top of the deck.

The work shall be executed in accordance with Specifications Section 2700 Clause 2705 except to the extent modified below.

The work shall be carried out after the wearing coat is removed. The existing spouts shall be removed carefully with minimum damage to surrounding concrete. The pocket formed shall be sufficiently large to ensure good flow and compaction of non-shrink cement grout around the new spout. In case the earlier spouts were providing in railing kerb, holes shall be drilled in slab without excessively damaging surrounding concrete.

CLAUSE 2818 REPAIR TO LEACHED, HONEYCOMBED, SPALLED CONCRETE.

Leached, honeycombed, spalled concrete (area of damage less than 0.5 m²) shall be repaired with average 50mm average thick PMC mortar in two or more layers with a bond coat of PMC slurry between two successive layers. All loose concrete shall be chipped off with a chipping machine so that loose layers of concrete are removed exposing the reinforcement. All loose concrete sticking with the reinforcement shall be removed. Where reinforcement bars are already exposed, the chipping shall continue so as to expose half the diameter, prior to further treatment. The concrete surface shall be thoroughly cleaned with wire brush and oil free air blast. Where the damaged areas are large, sand blasting should be done to clean the reinforcement and the surrounding concrete. If reinforcement is seen, the same shall also be cleaned thoroughly. The reinforcement shall be coated with PMC slurry within one hour of cleaning to prevent rusting. The PMC shall be brush applied on the cleaned reinforcement ensuring that full surface area is covered in accordance with the manufacturers' recommendation.

Before applying PMC repair mortar the prepared concrete substrata shall be thoroughly soaked with clean water. Free surface water shall be removed before priming. The substrata shall be primed with PMC slurry.

The Specification for polymer modified cementitious (PMC) mortar / debonding slurry are as under:

The anti corrosive polymer latex, which is to be used should consist of water based QA-Acrylic polymer incorporated with non-alcoholic bipolar corrosion inhibitor. The polymer to be used shall be MONOBOND-2000 or equivalent.

Colour: Milky white liquid

Solid content: The polymer solid content shall be 36 ± 1 percent. The particles shall be of nearly spherical shape with a diameter of 0.35 ± 0.05 micrometer. The manufacture shall certify the above requirements about solid content & grain size. In order to keep control over the quality, the manufacture shall provide infrared absorption spectrum analysis for the material to be supplied by them.

Mixing proportion: *Anti-corrosive polymer modified mortar.*

- Cement - 100 parts by weight
- Monobond-2000 - 40 parts by weight
- Mix no. 10 silica sand - 300 parts by weight

The sand, which is to be used for constituting the PMC repair mortar, should be silica sand as the basic material, which is categorized in two groups.

- a) Coarse Silica and
- b) Fine Silica

The grading of the above groups should follow the limits provide below.

Quartz sand mix no. 10

I.S. Sieve no.	Percentage passing by weight.
10mm	100
4.75mm	100
2.36mm	100
1.18mm	85 – 90
600 microns	45 – 55
300 microns	15 – 20
150 microns	5 – 10
75 microns	0 – 3

In the event of using local sand, the sand to be used must satisfy the limits of deleterious materials & the requirements of soundness as given in Clause 3.2.1 & clause 3.6 respectively of IS: 383, confirmatory test shall be conducted by the contractor and sample kept for comparison by the Engineer.

Curing

Air-corrosive polymer modified mortar curing procedure outline apply to normal weather conditions. Under hot weather, take precautions to avoid drying. PMC work should be carried out at a temperature below 40°C .

Under unusual condition weather conditions e.g. high humidity and / or high wind velocity or imposed constraints special curing procedure shall be followed for which approval shall be obtained from the Engineer.

Anti-drying shall be considered to be taken place only during favorable uninterrupted weather condition existing throughout the existing recommend drying period. Some judgments shall be made in this respect and if conditions

are deemed unfavorable for drying to occur, then drying must be prolonged for the full recommend period after weather clears.

As PMC work proceeds, precautions shall be taken to prevent rapid drying of the PMC repair mortar. This is usually accomplished by covering the filled surfaces with an impermeable sheet shortly after the work has been done.

The sheet shall be kept in place until further work is carried out over the mortar or in case where the mortar is likely to be disturbed the sheet shall be kept in place for 24 hours.

No foot traffic for further work shall be allowed over mortar until 12 hours for the time of the completion of work.

Curing compound may also be used as curing membrane. Care shall be taken to ensure complete covering particularly around the interface with the host concrete.

For the first day the repaired concrete patch shall be protected from harsh environment by laying a polythene sheet over it, lapping down the edges.

Mixing PMC

Methods for Mortar mixing

To mix PMC, it is necessary to have the following items:

- A suitable sized non-ferrous mixing container preferably plastic.
- A high-speed drill with mixing paddles.
- Promark batching containers for measuring out components to be mixed.

Pour all the liquid polymers latex into mixing container. After shaking the latex to disperse the solid uniformly throughout the liquid before use. Begin mechanical mixing and while doing so, slowly add the dry components, i.e. cement & sand.

Mix for about 5 minutes until solids have been well dispersed. The resulting mix should look uniform, feel creamy & be free from lumps & grits.

Precautions shall be taken not to entrap an excessive amount of air into the mix during mixing.

Since the desired consistency depends on type & brand of cement as well as weather conditions if necessary to achieve the desired consistency. Record the amounts of cement required & use this for subsequent mixes. Do not reduce the quantity of cement noted in the Mix Proportions.

In case the slurry sets before application of mortar, a fresh coat of slurry shall be applied. Under no circumstances, water shall be added in PMC repairs mortar mix. Under mortar or mortar, which has partially, set shall not be re-mixed & used.

Mechanical Strength of Mortar

Anti-corrosive polymer modified mortar shall have the following:

	7 day	28 days
Compressive strength	18 N/MM ²	38 N/MM ²
Flexural strength (IS 5816-1959)	-	10 N/MM ²
Split tensile strength (IS 5816-1959)	-	6 N/MM ²

For anti-corrosion polymer modified bonding slurry.

The anti-corrosive polymer modified bonding slurry shall be QA Acrylic base MONOBOND 2000 or equivalent.

The bonding slurry should remain tacky state prior to placing of the freshly mixed concrete or mortar mechanical strength of polymer modified bonding slurry.

Mixing proportions of Bonding Slurry as follows:

Cement	-	100 parts by weight
MONOBOND 2000	-	40 parts by weight
Fine silica sand	-	100 parts by weight

The fine silica sand, which is to be used for consistency in anti-corrosive polymer modified bonding slurry, should be with fine silica sand with following sieve sizes.

I.S. Sieve No.	Percentage passing by weight
10 mm	100
4.75 mm	100
2.36 mm	100
1.18 mm	100
600 microns	90 – 100
300 microns	40 – 60
150 microns	0 – 10
75 microns	0 – 3

Mechanical strength of Bonding Slurry

Bond strength:-

- WET – 3- 4 N/MM²
- DRY – 7- 8 N/MM²

Above bonding slurry should confirms to following properties,

- ASTM-C1059-86 (Latex agents for bonding fresh to old concrete)
- ASTM-C1042-86 (Bond strength of latex system with cement)
- Pot life: 1 hour for 5 kg bonding slurry mix.

CLAUSE 2819

REPAIR TO AVOID IN ARCHES WITH PMC MORTAR

The voids created in the masonry arches by dislodged stones shall be filled with PMC mortar.

The surface shall be thoroughly cleaned with wire brush and oil free blast. Before applying PMC repairs, the prepared substrate shall be thoroughly soaked with clean water. Free surface water shall be removed before priming. The substrate shall be primed with PMC slurry. Repair mortar shall be applied before primer has set i.e. within 20-30 minutes. The mortar shall be applied with trowel and shall be well worked inside and compacted. The surface shall be smooth finished to match adjacent surface. Unused mortar or mortar which has partially set shall not be used. Mortar shall be applied in layers to avoid sagging. Manufacturer's recommendation shall be followed.

Specifications given in clause 2818 shall be followed.

CLAUSE 2820 SEALING OF CRACKS IN CONCRETE IN PIER/ABUTMENT CAPS, SLABS, GIRDERS, PEDESTAL WALLS ETC. WITH EPOXY RESIN INJECTION.

The work is to seal all cracks in concrete in pier/abutment caps, slabs, girders, pedestal walls etc.

The work shall be executed in accordance with Specifications Section 2800 clauses 2803 and 2804.

The cracks shall be sealed with epoxy mortar prior to injection.

CLAUSE 2821 INSPECTION AND CLEANING OF BRIDGE BEARINGS AND GREASING OF STEEL ROCKER-ROLLER / PLATE BEARINGS AND REMOVAL OF ALL DEBRIS AROUND BEARINGS.

The work shall consist of inspection of bearings to check whether the bearings are functioning properly and if any parts of the bearing or nuts and bolts are missing, to replace them. The work shall also include cleaning of bearings and oiling and greasing of metallic bearings, wherever required. Realignment / readjustment of bearings, and replacement of missing parts of metallic bearings, requiring jacking up of superstructure is excluded from the scope of work. Replacement of existing bearings with new bearings is also excluded from the scope of the work.

The area around the bearings and their pedestals shall be cleared of all debris, vegetation, dust etc. and cleaned for proper inspection.

When grease boxes are fixed around the metallic bearings, (a) the same shall be permanently removed along with the old grease and (b) bearings shall be cleaned for proper inspection.

In case of elastomeric bearings, these shall be inspected for their proper seating, rotation, bulging, cracking; splitting etc. and a record thereof shall be provided to the Engineer for necessary instruction.

In respect of metallic bearings, fresh graphite grease as approved by the Engineer shall be applied to the surface, which are sliding, rotating or moving due to movements in bearings. The materials, specially graphite grease, required for oiling and greasing of metallic bearings, wherever required, shall be as per

approval of the Engineer. Grease used shall be such that it retains its properties for long life and shall not affect the bearings parts.

All other surfaces of the metallic bearings shall be cleaned of all rusts, corrosion and a coat of anti corrosive oil paint applied as per directions of the Engineer.

Missing parts of metallic bearings, nuts and bolts etc. shall be replaced by the contractor at no extra cost to the Employer.

CLAUSE 2822

CONTROLLED JACKING UP OF SUPER STRUCTURE, RESETTING OF SEGMENTAL BEARINGS AND PROVIDING MISSING SPACER PLATES, REPLACING EXISTING DAMAGED BEARING.

The condition of the existing bearings shall be carefully examined thoroughly jointly by the Contractor and the Engineer. Arrangements for examination shall be done by contractor. The contractor shall submit design and drawing of steel trestle tower for approval of the Engineer.

The work shall be executed before laying of new wearing coat and expansion joint. The superstructure shall be jacked up nominally at abutment end for resetting of the bearings. Jacking up of superstructure is a specified work. Contractor shall furnish a methodology statement with his proposal for replacing/resetting/repair of bearings. Lifting shall be done through hydraulically operated jacks. The jacks shall be placed under cross diaphragm. Adequate distribution plates shall be placed at top and bottom of the jack to reduce the stress on concrete. If the soffit of the cross diaphragm is weak. The same shall be first repaired with epoxy mortar and/or epoxy injection and lifting will commence only after such repair is fully cured. In addition to jacks, the span will also be supported on packing plates which shall be placed under the cross diaphragm between the jacks. The extent of lifting shall be decided by the Engineer.

Only proven type of jacks shall be used. These jacks shall be provided with lock nut system. The jacks shall be randomly tested for 1.50 times the capacity. In lifted condition the span will be supported on the lock nut arrangement of the jacks with no pressure on the hydraulic circuit. The contact stress on concrete shall not exceed 40 MPa. Suitable M.S. distribution plates have to be provided at top and bottom of the jack for this purpose. All jacks shall be connected to a common pump and it will be ensured that the deck is lifted equally upstream and downstream. For monitoring this dial gauges shall be provided. Only steel packing plates shall be used. Specification for epoxy mortar/epoxy injection shall be followed for repair to soffit of cross diaphragm.

The cross diaphragm shall be closely watched during lifting and also for the entire duration when the span is supported on jacks and packages. If developments of cracks are observed, the lifting will be stopped and alternate arrangements for supporting the superstructure shall be made subject to approval of Engineer.

The segment of operations has been shown in the drawing, but since the work will be specialized one, the contractor shall have the option to develop his own

methodology and detailing for jacking up the deck slab along with girder subject to approval of the Engineer.

Measurement:

Jacking up of superstructure shall be measured lumpsum per span measured from centre to centre of bearings along span. Replacement of existing bearing, resetting of segmental bearing and providing missing spacer plate shall be paid separately.

Rate:

The rate shall include the full payment for making arrangement for inspection of individual bearing, preparation of detail design and methodology, cost of grillage of RSG, cost of jack, dial gauges, distribution plates, other tools, plants and equipments, labour and all other incidental. The rate shall also include cost for epoxy mortar/epoxy injection for repair to soffit of cross diaphragm.

CLAUSE 2823

APPLYING 1:3 CEMENT MORTAR TO EXPOSED SURFACE OF MASONRY OF EXISTING WING WALLS/RETURNS, ABUTMENT PIER.

All exposed masonry surface of existing wing walls / returns, abutments, piers etc. shall be provided with 20mm thick plaster. Walls/returns and Retaining wall at sides of approach slabs with brick masonry and finishing with 1:3 Cement Mortar 20 mm thick plaster.

Existing wing walls and returns wherever deficient shall be built up and retaining walls shall be constructed at sides of the approach slabs as shown in the drawings.

The work shall be done in accordance with Specifications Section 1300. Masonry for construction of short retaining walls at sides of approach slab shall be laid over a 100mm thick M 15 PCC leveling course.

CLAUSE 2824

BUILDING UP OF EXISTING WING WALLS/RETURNS AND RETAINING WALL AT SIDES OF APPROACH SLABS WITH BRICK MASONRY AND FINISHING WITH 1:3 CEMENT MORTAR 20 MM THICK.

Existing wing walls and returns wherever deficient shall be built up and retaining walls shall be constructed at sides of the approach slabs as shown in the drawings. The work shall be done in accordance with Specifications Section 1300. Masonry for construction of short retaining walls at sides of approach slab shall be laid over a 100 mm thick M 15 PCC leveling course.

CLAUSE 2825

SEALING OF WIDE GAPS AT JUNCTION OF WING WALL AND ABUTMENT WITH BRICK BATS AND FINISHED WITH 1:3 CEMENT MORTAR INCLUDING PROVIDING BITUMINOUS DEBONDING LAYER.

Due to settlement of the wing wall a gap being created at the junction of the wing wall and the abutment, shall be sealed by filling with brickbats and finishing with plaster.

The abutment face of the gap shall be coated with one layer of bituminous compound. The gap shall be filled with bricks bats and rammed. The vertical exposed surface of the gap shall be plastered. Thereafter, cement slurry shall be poured from the top under gravity till refusal. The top surface of the gap shall then be plastered and finally finished.

CLAUSE 2826 EARTH FILLING BELOW APPROACH SLAB

Cavities underneath the slab shall be filled.

The work shall be executed in accordance with Specification Section 300 Clause 305. The cavities formed below the approach slabs shall be filled with approved back fill material. The filling shall be done in layers not exceeding 150mm. The masonry retaining wall shall also be built up in companion layers of 150mm. The compaction shall be done with the help of suitable equipment after necessary watering.

CLAUSE 2827 CASTING OF APPROACH SALB

The grade of concrete shall be as indicated in drawing/BOQ.

Approach slabs, which are cracked / missing or otherwise damaged shall be recast.

The work shall be executed in accordance with Specifications Section 2700 Clause 2704. The approach shall be laid over lean concrete as per drawing. The base shall be consolidated to proctor density 98.

CLAUSE 2828 STONE PITCHING 300MM THICK ON SLOPES GROUTED WITH 1:3 CEMENT MORTAR.

Slope protection with stone pitching shall be provided at abutments. The work shall be executed in accordance with Specifications, Section 2500.

CLAUSE 2829 PROVIDING AND PLACING IN POSITION MECHANICALLY FABRICATED GABION WALL AROUND ABUTMENT AND PIERS INCLUDING EXCAVATION AND BACK FILLING.

The work shall be executed in accordance with specification Section 2500 clause 2503. Excavation and back filling shall be done in accordance with Specification Section 300.

Gabions shall consist of a double twisted Zinc & PVC coated wire mesh container of variables sizes, uniformly partitioned into internal cells, interconnected with other similar units, and filled with stone at the site to form flexible permeable, monolithic structures. Mechanically fabricated double twisted hexagonal mesh type gabion such as Maccaferri or equivalent confirming to ASTM/ BS Specifications shall be used.

Mechanically fabricated double twisted hexagonal mesh shall be approved by the Engineer prior to procurement and use.

CLAUSE 2830 **The existing clause 2811 of the Specifications shall be renumbered as 2830.**

CLAUSE 2831 **The existing clause 2812 of the Specifications shall be renumbered as 2831.**

Add the following as items (i) to (x).

- i) Dismantling of kerbs, railings, parapets, footpaths, ...Cum solid slab superstructure or part of slab and approach slabs, etc. RCC and masonry items shall be measured under separate heads.
- j) Steel handrail running meter
- k) Dismantling of existing damaged brick masonry Cum
- l) Dismantling of course rubble masonry wings walls, piers, abutments and their foundations Cum
- m) Provision of dowel bars Nos
- n) Drainage spouts Nos
- o) Repairs of concrete with PMC mortar with average thickness of 50mm of mortar applied. sqm
- p) Sealing of cracks in masonry by cement grouting (in terms of weight of cement consumption). kg
- q) Building up of existing course rubble masonry / concrete walls Cum wing
- r) Repair of voids in arches Cum
- s) Sealing of cracks in RCC abutments, piers, slabs, girders etc. by epoxy injection (In terms of weight of epoxy actually consumed for mortar and injection.) kg
- t) Earth fill below approach slabs Cum
- u) Concrete in approach slab Cum
- v) Inspection, cleaning and greasing of bearings Nos
- w) Stone pitching Cum
- x) Gabion Walls Cum

CLAUSE 2832 **RATE**

Add the following at the end of Clause.

- i) The contract unit rate for dismantling of existing railing / parapets shall include the cost of all materials, labour, tools and plants, disposal of dismantled materials, safety measures and all other incidental expenses necessary for the completion of work as per Specifications.
- ii) The contract unit rate for dismantling of existing wing walls shall include the cost of all materials, labour, tools and plants, disposal of dismantled materials, safety measures and all other incidental expenses necessary for the completion of work as per Specifications.
- iii) The contract unit rate for providing dowel bars shall include the cost of all materials, labour, tools and plants, drilling of holes, placing dowel bars in position, grouting with non-shrink free flow cement, wastage, sampling, testing and all other incidental expenses necessary for the completion of work excluding steel reinforcement as per Specifications.
- iv) The contract unit rate for repair of leached, honeycombed, spalled concrete by PMC or grouting shall include the cost of all materials, labour, tools and plants, safety measures and all other incidental expenses necessary for completion of work as per Specifications for the respective items.
- v) The contract unit rate of earth filling below approach slab shall include the cost of all materials, labour, tools and plants and all other incidental expenses necessary for completion of work as per Specifications.
- vi) The contract unit rates for approach slabs shall include the cost of all materials, labour, tools and plants and all other incidental expenses necessary for completion of work as per Specifications.
- vii) The contract unit rate for cleaning of bearing shall include the cost of all materials, labour, operations, tools and plants and all other incidental expenses necessary for completion of work as per Specifications.
- viii) The contract unit rate for stone pitching shall include the cost of all materials, labour, tools and plants and all other incidental expenses necessary for completion of work as per Specifications.

SECTION 2900 PIPE CULVERTS

CLAUSE 2906 JOINTING

Delete the first and second sentences of Para 1 of this Clause and substitute:
“The pipes shall be jointed by collar. The collars shall be RCC 150 to 200mm wide and having the same strength as the pipes to be jointed.”

Sub-Clause 2907 BACKFILLING

Second sentence shall be replaced as below:

The backfill shall be with selected granular material conforming to clause 305 of MORT&H specifications and as approved by the Engineer.

Sub-Clause 2911 Rate

Delete 2nd Para of this clause and replace by following:

“Other works such as excavation, providing selected granular material, cement concrete bedding, concrete and masonry works shall be paid separately as per contract rate.”

SECTION 3000 MAINTENANCE OF ROADS

Replace the entire clause with the following:

CLAUSE 3001 GENERAL

“The specifications shall apply to all items of road maintenance works as categorized below as required to be carried out under the Contract or as directed by the ‘Engineer’. The works shall be carried out in conformity with the relevant Specifications to the required level, grade and lines using approved materials. The scope would include maintenance of the existing highway and diversion roads in the project section to facilitate uninterrupted traffic during construction. The works shall be carried out using light duty machinery or manual means provided the quality of the end product does not suffer. In execution of maintenance works, a reference is made to the IRC publications: “Manual for Maintenance of Roads” and “ Code of Practice for Maintenance for Bituminous Surfaces of Highways, IRC 82 – 1982” for guidance and compliance wherever applicable. Wherever the Specification is not clear, good engineering practice shall be adopted in the construction to the satisfaction of the Engineer.”

CLAUSE 3002 ROUTINE MAINTENANCE

Sub-clause 3002.1 Scope

This shall consist of repair of pot holes/patches, repair of shoulders, cleaning of drains/ and culverts, cleaning / clearing of roadway, clearing / removal of vegetation, removal of dead animals etc.

The repair of pot-holes / patches shall be completed within 48 hours of its occurrence. On failure to do so, the Engineer / Employer may get the repairs to pot-holes and patch work completed at the cost of contractor as provided in clause 49.4 of Conditions or Particular Application.

Sub-Clause 3002.2 Measurement of payment

Pot-holes shall be measured in sqm of the patch taken up for the patch repair. All other works except patch repair mentioned in sub-clause 3002.1 shall be incidental to the contract and measurement will be made for treated patches only.

Sub-Clause 3002.3 Rate

The Contract unit rate shall be payment in full for the stretch maintained as per BOQ.

CLAUSE 3003 Special Repairs

Sub-Clause 3003.1 Scope

The special repairs shall include restoration of rain cuts, heavy patch work involving more than 10% of the surface area on account of flood, rains, accident related damages to highway/structures, restoration of structures etc. to pre flood condition or any other repair as directed by Engineer in writing.

Sub-Clause 3003.2 Measurement for payment

The special repairs shall be measured as per the volume of work for the particular items.

Sub-Clause 3003.3 Rate

The contract unit rate shall be payment in full for each of the items based on the unit rate as per BOQ.

Sub-Clause 3003.5 This Clause shall be read as under:

“The contract unit rate for maintenance of road shall be inclusive of restoration of earthen shoulders”.

CLAUSE 3004 Renewals

Sub-Clause 3004.1 Scope

The renewal shall be with 25 mm thick Semi Dense Bituminous Concrete to renew highly patched surfaces and shall be paver laid as per the relevant Specifications.

Sub-Clause 3004.2 Measurement for Payment

The renewal shall be measured in cum. Tack coat shall be measured separately and paid as given in BOQ.

Sub-Clause 3004.3 Rate

The contract unit rate shall be payment in full based on the unit rate as per BOQ.

SECTION 3100 Reinforced Earth Structures

CLAUSE 3101 (a) Scope of works

The work includes detailed design (to be supplied by the contractor) for the entire reinforced earth structure for different sectional heights, supply assembly and erection of soil reinforcing elements, supply & placement of fascia panels,

construction of earthwork in layers and all associated components as per the requirement of patented / proposed technology and approved design including supervision of all works including earthwork and pavement works for effectiveness of RES. The design shall take into account the earthquake / seismic factor. The work also includes preparing, submitting and getting approval to all the designs and method statements along with programme to match with over all completion of the work.

The reinforced earth structure shall be designed to cater for all the design loads including earth pressure, surcharge and live loads as per National Highway traffic and other design criteria specified in IRC codes. The design of reinforced earth structure shall be based on the actual site conditions and shall match with the approved construction drawings of bridges / flyovers / underpasses / ROB etc.

The design shall be realistic and based on the assessment of the geo-technical parameters of the site influencing the design.

In case the design of reinforced earth structure needs strengthening / improvement of existing ground, detailed proposals shall be incorporated in the design. The soffit of foundation pad should be at least 1m below the ground level. The design life of the structure shall be 100 years.

The guarantee period for the Reinforced Earth Structure shall be Fifteen (15) years from the date of completion of bridge/flyover/underpass/ROB works irrespective of defect liability period. The contractor(s) shall furnish the guarantee bond as directed by the Engineer.

(b) Eligibility Conditions.

The proposed RES shall have proven adoption with regard to durability. Documentary proof for the proprietary system and its satisfactory performance for at least 10 years shall be submitted along with the proposal.

Proof of successful completion of at least one project of construction of the reinforced earth structure with the proposed technology for a height not less than 10m for bridges/flyovers/underpasses/ROB in India, shall be submitted.

Interested Bidders / Approved sub-contractor must have proven successful experience in the design, supply of all components, construction and supervision of complete reinforced earth structures.

(c) Technology of the reinforced earth structure

The agency shall submit details of technology, its design principles, durability and details of its adoption on at least one Project in India. (The detailed design has to be got approved from the Engineer & NHAI before the execution of this work). The technology and design /drawings must be certified by the principals/patentees. In absence of the relevant Indian standards, the design shall conform to relevant British Standards. The seismic design shall be as per FHWA/AFNOR standards. The design shall take into account the Earthquake/seismic factor.

(d) Design Loads

The following loads shall also be considered while designing walls apart from all applicable loads:-

- i) Traffic live load surcharge : 2.2 N/cm²
- ii) Dead load surcharge : 1.2 N/cm² or higher as per design
- iii) Traffic impact load on crash barrier: 30 KN/m for tensile strength
& 7.5 KN/m for the pullout resistance.
- iv) Seismic loads as per maximum acceleration expected at site. (Zone factor of Table-5, IRC-6:2000) and analyzed as per Mononobe-Okabe (M-O) method.

CLAUSE 3102

Material Specifications

The materials proposed to be used in this work shall meet the requirements of the patented reinforced earth structure technology to be adopted by the agency for this work, which will be furnished by the Agency along with the tender. However, the material shall also meet the following broad specifications.

i) Soil Reinforcing Elements

The soil reinforcing element proposed to be used shall conform to the relevant Indian Standards, if available. In the absence of relevant Indian standards, the material shall conform to relevant available British standards meeting ultimate and serviceability requirements. The standard to which the material to be used for reinforcing elements shall be clearly specified in the proposal and got approved by the Engineer prior to commencement of works.

ii) Backfill Requirements (For Steel and Geosynthetic Reinforcing elements.)

Backfill materials used in the Reinforced Earth volume shall be reasonably free from organic or otherwise deleterious materials and shall conform to the following mechanical and physico-chemical requirements.

(a) Mechanical Requirements

Sieve size	Percentage Passing.
100mm	100%
75 micron	less than 15%

$$\text{Coefficient of uniformity } C_u = (D_{60}/D_{10}) \geq 2$$

Acceptance limits for materials with more than 15% passing 75 micron are related to the percentage of particles smaller than 15 microns as follows:

- Materials with more than 15% passing 75 micron sieve but less than 10% of particles smaller than 15 microns are acceptable.

- Materials with more than 15% passing 75 micron sieve and more than 20% of particles smaller than 15 microns are inadequate and shall not be used except as specified in (e) below.
- Materials with more than 15% passing 75 micron sieve and 10 to 20% of particles smaller than 15 microns are acceptable provided that the internal friction angle is not smaller than 30°.

(b) Physico-Chemical Requirements (For Steel Reinforcing elements)

Materials with a resistivity of 5000 Ωcm or more are readily acceptable, based on a standard test as directed by the Engineer.

Materials with resistivity less than 1000 Ωcm are inadequate and shall not be used except as specified in (e) below.

Materials with resistivity between 5000 and 1000 Ωcm are acceptable provided that in water extracted from soil-water mix, the content of chlorides does not exceed 200 ppm, the content of sulphates does not exceed 1000 ppm and the pH value is in the range of 5 to 10.

The foundation soil physico-chemical requirements should also meet the above criteria. If not, special consideration will be given to the design of reinforcing strips and facing panels.

(c) Quality Control

Initially at approval of source and subsequent at each change of source, backfill is to be checked for sieve analysis, resistivity and angle of internal friction. The results will indicate what further tests are needed, if any.

i) Water for compaction

Water of minimum resistivity exceeding 700 Ωcm shall be used for compaction.

ii) Materials not conforming to the above

Materials not conforming to the above requirements may be used with the written consent of Engineer after carrying out test. Such materials shall be tested for their functional properties to assure that they are consistent with the parameters used in the design calculations.

(f) Compaction

Compaction of backfill material shall be 100% P.D. for 1 meter depth below road crust and 95% of P.D. for remaining portion of fill materials.

iii) Facia Material

The facing shall be of precast reinforced concrete panels M-35 grade with aesthetic finish as per approved drawing. The panels shall be machine finished and shall be manufactured by the approved sub-contractor who will be supplying reinforcing element and has successfully completed at least one project of construction of retaining walls of height not less than 10m for bridges/flyovers/grade separators/underpasses/ROBs in India.

The facing should be designed to cater to maximum transversal, vertical and longitudinal flexibility to cater to seismic and ground movements.

Facia unit joint filler should be durable, resistant to the effect of air pollution and water / saline water.

Bedding material shall consist of either cement mortar / concrete or a durable gasket seating such as resin bonded cork strip.

Connection between the facia and the reinforcing element shall be using polyethylene strips / rods, fiber glass / galvanized steel dowels or any other material shown in the drawing. All material used shall be tested to provide 100 percent joint strength as of parent soil reinforcing element in continuity.

Overlapping in principal reinforcement or in the joint shall ensure load transfer through joints, perpendicular to the direction of laying.

CLAUSE 3103 Construction Requirements

Sub-Clause 3103.1 Excavations

Excavations shall be in accordance with the requirements of General and Special Specifications and in reasonably close conformity to the limits and construction stages shown on the drawings. The plan area of the reinforced earth structure shall be excavated to provide a nominally level base which may be stepped at the back as required to receive the horizontal reinforcing element.

Sub-Clause 3103.2 Foundation Preparation

The foundation of Reinforced Earth Structure shall be graded level for a width equal to or exceeding the length of reinforcing strips or as shown on the drawings. Prior to wall construction, if required by the Engineer, the foundation shall be compacted with a smooth wheel vibratory roller. Any foundation soils found to be unsuitable shall be removed and replaced. Ground improvement / strengthening measure, as necessary, for the design and execution of RES shall be carried out.

Sub-Clause 3103.3 Erection

Precast concrete panels shall be placed vertically with the aid of light crane. For erection, panels are handled by means of lifting devices set into the upper edge of the panels. Panels shall be placed in successive horizontal lifts in the sequence shown on the drawings as backfill placement proceeds. As fill material is placed behind a panel, the panels shall be maintained in vertical position by means of temporary wooden wedges placed in the joint at the junction of the two adjacent top rows of panels during construction. As construction proceeds and a fourth row is erected, the lowest row of wedges can be removed and so on.

External bracing may also be needed for the initial lift. However, bracing shall be placed in an area not more than 1.50 meter wide beyond the other face of panels.

Vertical tolerances (plumbness) and horizontal alignment tolerance shall not exceed 10mm when measured along a 3 meter straight edge. The maximum allowable offset in any panel joint shall be 10mm.

Sub-Clause 3103.4 Facia Batter

It may be necessary to set facing unit at an additional batter than as provided in the drawing as there is a tendency for initially positioned units of facia to lean outwards as the fill material is placed and compacted. Care and caution shall be taken to counter this phenomenon.

Sub-Clause 3103.5 Orientation of Soil Reinforcing Element

The soil reinforcing element shall be placed (free from all kinks, damage and displacement during deposition, spreading, leveling and compaction of the fill) at right angles to the face of the wall, with greater cross sectional dimensions in the horizontal plane. The placement of the elements including their vertical / horizontal spacing and length shall be as in the drawing.

Sub-Clause 3103.6 Backfill Placement

Backfill placement shall follow closely the erection of each lift of panels. At each reinforcing strip level, backfill should be roughly leveled before placing and connecting / bolting the soil reinforcing element. Soil reinforcing element shall be placed normal to the face of the wall or as shown in the drawings. The maximum layer thickness shall not exceed those specified in the approved design and method statement.

At the end of each day's operation, the contractor shall shape the last level of backfill as to permit runoff of rainwater away from the wall face. Back fill should be compacted in accordance to the project Specifications for embankment except that the minimum required compaction shall be 100% to 95% of maximum density as specified and shall be determined by the standard tests and that the moisture content shall be plus or minus 2% of the Optimum Moisture Content as determined. Backfill compaction shall be accomplished without disturbance or distortion of soil reinforcing elements and panels compaction in a strip of 1.0meter wide adjacent to the backside of the wall facing, shall be achieved by the use of a manually operated

vibrating compactor, such that adverse edge stresses are not transferred to the facing panels during construction.

During construction of reinforced fill the retained material at the rear of the structure shall be maintained at the same level as the reinforced fill.

Sub-Clause 3103.7 Drainage

Drainage shall be provided as per drawing given in detail. The retained fill shall have a suitably designed drainage bay and associated drainage system to allow for free draining of the reinforced fill.

Sub-Clause 3103.8 Quality Control for Backfill and Reinforcing Elements.

QAP for reinforced soil walls construction is as given below:-

I. With Geogrids

- a.) Test related to Geogrids
 - i.) Tensile strength certificates for the supplier for each lot.
 - ii.) Independent testing for tensile strength, at the owner's cost.
 - iii.) Determination of interaction coefficients by shear box test, maximum once in a project, if the values used in design are not as per the codes of practices, otherwise at owners cost.
- b.) Tests related to selected backfill.
 - i.) At source approval:
 - Grain size analysis
 - Shear test for Φ_{peak}
 - Maximum dry density with standard compaction
 - Electrochemical properties of soil.
 - ii.) During construction for every 30,000 cum or minimum one test.
 - Grain size analysis
 - Shear test for Φ_{peak}
 - Maximum dry density with standard compaction
 - Electrochemical properties of soil.
 - Density of each compacted layer (>90% of MDD)

II. With Steel

- a.) Test related to steel
 - i.) Tensile strength testing, one for every lot.
 - ii.) Test for galvanization, one for every lot.
 - iii.) Determination of interface friction by pull out test maximum once in a project, if the values used in design are not as per the codes of practices, otherwise at owner's cost.
- b.) Tests related to selected backfill
 - i.) At source approval:
 - Grain size analysis
 - Shear test for Φ_{peak}

- Maximum dry density with standard compaction
 - Electrochemical properties of soil.
- ii.) During construction for every 30,000 cum or minimum one test.
- Grain size test
 - Shear test for Φ_{peak}
 - Maximum dry density with standard compaction
 - Electrochemical properties of soil
 - Density of each compacted layer (>90% of MDD)

Sub-Clause 3103.9 Supervision

A technical representative of the patentee shall be present on site throughout during the casting and erection phases to ensure that the quality of the works performed by the contractor is in accordance to the Specifications, drawings and method statement.

All expenses relative to his presence on site shall be borne by the contractor.

CLAUSE 3104 Measurement for Payment

- i.) The measurement shall only be for the elevation area of concrete fascia panels on each face of the RES in square meter above the foundation pad upto top of finished fascia panel. Components like soil reinforcing elements, leveling pad below fascia wall, sub surface drainage pipe (if required), filter fabric, filter medium below reinforced zone, between reinforced and retained zone and behind the fascia, down take pipes and associated precast concrete façade for surface drainage, excavation for full width upto the bottom of foundation pad deemed to be incidental to the work.
- ii.) The measurement for payment of selected soil fill in soil reinforced zone shall be in cubic meter.
- iii.) The measurement for crash barrier and friction slab shall be in cubic meter.

CLAUSE 3105 Rate

Rate for fascia fixing shall include cost of concrete fascia panel, foundation pad and capping beam and shall include all items of excavation, ground improvement / strengthening, reinforcing steel, joints, all necessary temporary formwork, labour, plant hire, material storage, handling expenses, equipment, scaffolding and all lifts and leads, as shown in the drawing, unless otherwise specified to be treated separately for completing the works. Rate for fascia panel shall be deemed to be inclusive of providing soil reinforcing elements, all material transportation and storage costs of the same. The rate shall also include cost of laying the reinforcing elements including all overlaps, jointing or stitching, heat bonding or extension.

Rate for soil fill shall include compaction as desired in requisite layers through mechanical means, cost of hire or labour for plant operations, dressing and leveling slopes, including special measures for edge reinforcements as shown in the drawing.

Rate for reinforced concrete crash barrier and friction slab shall cover cost of all materials, labour, tools, plant and equipment required for mixing, transporting and placing in position, vibrating and compacting, finishing and curing as per relevant clause including all incidental expenses, sampling and testing , quality assurance and supervision. Rate shall be inclusive of fixing and removing formwork and false work.

ADDITIONAL TECHNICAL SPECIFICATION

- | | | |
|-----|---------------|--|
| 1. | Appendix-I | Diversion and Filling of Existing Water Courses along the Road Alignment |
| 2. | Appendix-II | Plantation of Trees and Hedges |
| 3. | Appendix-III | Chute Drain for High Embankment Section |
| 4. | Appendix-IV | Erosion Protection Works at Upstream and Downstream of Culverts |
| 5. | Appendix-V | Void Former |
| 6. | Appendix-VI | Controlled Blasting |
| 7. | Appendix-VII | Specifications for Scarification of Existing Pavement and Providing Overlay with Granular Base |
| 8. | Appendix-VIII | Reflective Studs/Road Pavement Marker. |
| 9. | Appendix-IX | Way Side Amenities and Truck Parking Sites. |
| 10. | Appendix-X | Curing Using Liquid Membrane Forming Compound |
| 11. | Appendix-XI | Pavement Quality Concrete |

ADDITIONAL TECHNICAL SPECIFICATIONS

CLAUSE A-1 DIVERSION AND FILLING OF EXISTING WATER COURSES ALONG THE ROAD ALIGNMENT

Where watercourses have to be diverted from the sites of embankments, the original channels shall be cleared of all vegetation and soft deposits as directed by the Engineer and carefully filled in with suitable materials and compacted as specified. The new channel/ side drain shall be formed as shown in the drawings or as directed by the Engineer.

1. Measurement for Payment

The work involved in filling existing watercourses shall be measured as follows:

- (i) The work involved in filling existing watercourses shall be measured under clearing and grubbing item on area basis.
- (ii) Excavation and removal of soft deposits shall be measured in cubic metre.
- (iii) Filling with suitable material shall be measured in cubic metre.
- (iv) The works involved in forming the new channel/side drain shall be measured under the relevant items of work.

2. Rates

- (a) Clause 201.6.1 shall apply for clearing of vegetation growth.
- (b) Clause 301.9.3 shall apply for removal of soft deposits and filling with suitable materials.
- (c) The contract unit rates for the item of new channel formation shall be payment in full for carrying out the operations required for the relevant items".

Clause A-2 PLANTATION OF TREES AND HEDGES

1. Scope

The work shall consist of:

- a.) Planting of trees saplings in median or other designated locations.

b.) Planting of hedges within medina area.

2. Materials

2.1 Dump Manure

Dump manure shall be of well decayed (at least six months) organic or vegetable matter, obtained in the dry state from the municipal dump or other similar sources approved by the Engineer. The manure shall be free from earth, stone, brickbats or other extraneous matter.

2.2 Farmyard Manure

Farmyard manure shall be well decayed (should be at least six months covered in dump), free from grits and any other unwanted materials.

2.3 Good Earth

The soil shall be agricultural soil of sandy-loam texture free from kankar, moorum, shingle, stone, brickbats, building rubbish and any other foreign matter. The earth shall be free from clods or lumps of sizes bigger than 75mm in any direction. It shall have pH value ranging between 6.0 to 8.5.

2.4 Oil Cake (Neem/Castor/Groundnut)

The cake shall be free from bush, dust, grit and any other foreign matter.

Saplings of Trees

The sapling of trees shall be of medium height, leafy type and draught resistant variety native to the area and be of good quality of minimum of 2m height or caliper dia of 25mm as directed by the Engineer.

2.6 Sapling of Hedges

The saplings shall be of draught resistant variety normally grown hedges in the area approved by the Engineer.

3. Construction Operations

3.1 Tree Planting and Refilling Earth after Mixing with oil Cake, Manure and Watering.

Holes of circular shape of 90 cm dia and 100 cm in depth in ordinary soil shall be excavated and the excavated soil broken to clods of sizes not exceeding 75mm in any direction shall be stacked outside the hole. Stones, brickbats, unsuitable earth and other

rubbish, all roots and weeds etc. other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the site as directed. Useful material, if any, shall be stacked properly and separately. Good earth in quantities required to replace such discarded stuff shall be brought and stacked at site by the contractor, depth not more than 50 cm from ground level. The pit shall be treated for termite by raking the soil upto 50mm and treated with 5% Aldrin or Chloradang dust in soil.

The tree hole shall be manured with powered neem/caster oil cake along with farm yard manure/dump manure screened through 16mm sieve and these shall be uniformly mixed with the excavated top soil after the manure has been broken down to powder (size of particles not to exceed 6 mm in any direction) in equal proportion. A 2m high sapling of trees shall be placed at the centre of the hole and then the mixture shall be filled into the hole upto the level of adjoining ground and then profusely watered to enable the soil to subside. The refilled soil then be dressed evenly with its surface about 50 to 75mm below the adjoining ground level or as directed by the Engineer.

The planting shall be completed soon after completion of the median.

4. Circular Mild Steel Tree Guard with Bars

The tree guard shall be 90cm in diameter.

The tree guards shall be formed of (i) 3 Nos. 25 x 25 x 3mm angle iron verticals 1.95m long excluding splayed outward at lower end upto an extent of 5 cms, (ii) 3 Nos. 25 x 5 mm MS flat rings fixed as per design, (iii) 15 Nos. 1.55 long 6m dia bars. Each ring shall be in two parts in the ratio 1:2 and their ends shall be turned in radically for a length of 4cm at which they are bolted together with 8mm dia and 30mm long MS bolts and nuts.

The vertical iron shall be welded to rings along the circumference with electric plant 15 Nos. bars shall be welded to rings at equal spacing along the circumferences of ring. The lower end of the angle iron verticals shall be splayed outwards upto an extent of 5cm. The lower end of the flat of lower ring shall be at the height of 1.95m. The middle ring shall be in the centre of the top and lower ring. The bars shall be welded to the rings as directed by the Engineer. The entire tree guard shall be give two coats of paints of approved brand and of required shade over a priming coat of ready mixed primer of approved brand. The design of the tree guard shall be approved by the Engineer.

5. Planting of Hedges

The hedges saplings shall be planted in two rows, one each along each edge of the media. Bed for the sapling shall be prepared with necessary manuring and the live saplings shall be planted in lines parallel to the median edge to the directions of the Engineer.

Spacing between saplings in a row shall be such that a thick hedge can be grown and this shall generally be not further away than 300mm.

The planting shall be completed soon after completion of the medians.

6. Grassing of Median Area

The included area of the median between the hedges shall be seeded and mulched to develop grass cover in accordance with clause 308.

7. Maintenance

The saplings of trees and hedges planted shall be watered and maintained by the contractor till issue of final taking over certificate. Maintenance shall also include watering, weeding out of undesirable plants and replacement of dead plant, manuring and trimming of the hedges.

8. Measurement for Payment

Planting of tree saplings including provision of tree guards and maintenance shall be measured in number.

Planting of hedges along median edges including maintenance shall be measured in length or each row in liner meter.

Seeding and mulching of the median are between the hedges shall be measured as per clause 308.

9. Rates

The contract unit rate for planting of trees and hedges shall include the cost of all labour and material involved in all the operations described above including cost of saplings, tree guards and maintenance as mentioned above, the cost of supplying and stacking the requisite quantity of manure and oil cake and other incidentals.

CLAUSE 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 so arranged that the drains are completed in proper

sequence with roadway to ensure that no damage is caused due to lack of drainage.

2 Materials

The drains shall be of half round pipe of 600-mm dia formed by joining half RCC pipe of NP2 type as shown in the drawings. The RCC work shall conform to the relevant clauses of these specifications.

The toe wall below ground level shall be of plain cement concrete of M 15 grade to Clause 1700, as shown in the Drawings.

Dumped riprap for erosion protection at ground level, it shall be constructed as shown in drawing with hard, unweathered and durable rubble stone of size 150 to 250 mm.

3 Construction Operations

At the locations where the chute drains are to be installed, a rectangular cut on the side slope of the embankment along the line of the chute drain shall be made. The Concrete bed with PCC M-10 shall be laid with semi circle in the middle. The laying & jointing of pipe shall be done with Cement Mortar 1:3, when concrete in bed is still green. The sloping bed of the drain shall be to a regular line and suitably compacted to provide a firm bed.

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

The toe wall shall be constructed with PCC M-15 as shown in drawing. The Rip-Rap/ stone pitching 300mm thick shall be constructed upto 1m on either sides of the drain and at ground level as shown in the drawings.

4. Measurement for Payment

The Chute Drain shall be measured and paid in running metre. The Contract unit rates specified for Chute drain shall be inclusive of all leads and lifts for excavations, concreting of pipe bed, placing and jointing of pipes with Cement Mortar, construction of PCC toe wall, rip-rap/stone pitching for erosion protection and drainage arrangement between two Chutes at shoulder edge, etc. for completing the chute construction.

CLAUSE A-4

EROSION PROTECTION WORKS AT UPSTREAM AND DOWNSTREAM OF CULVERTS

1. Scope

The work shall consist of provision of erosion protection works in the form of bed flooring and curtain or cut-off walls at the upstream and downstream ends of new as well as existing box/pipe culverts. The work shall be carried out to such designs and at such locations as indicated in the Drawings or as directed by the Engineer.

The erosion protection works shall consist of dry rubble stone bed flooring and random rubble masonry curtain (cut-off) wall at the upstream and downstream ends of box/pipe culverts.

2. Materials

The material for bed flooring shall be dry rubble stones (each stone weighing not less than 40 kg.)

The curtain wall shall be constructed of random rubble masonry in cement mortar 1:3 to Section 1400

3. Construction Operations

Curtain Wall

Trench for the curtain wall shall be excavated as per Clause 304 at such locations and to such depths shown in the Drawings or as directed by the Engineer. After preparing the foundation bed, the curtain wall shall be constructed to the thickness shown in the Drawings and to levels upto top of the bed flooring.

Floor Paving

The bed for the flooring shall be prepared by excavation to Clause 301 or filling to Clause 305, levelled and compacted to at least 95% MDD. The top of bed shall be prepared to such levels that after construction of the bed flooring, it is in line with the invert of the culvert barrel and sloping away. The bed flooring shall end before the curtain wall.

The bed flooring shall be constructed as per Clause 2506 of MOST Specification for Road & Bridge Works (3rd Revision).

Measurement and Payment

Trench excavation for the curtain wall shall be measured in cu.m as structural excavation in accordance with Clause 304.

Cutting and filling of the floor area shall be measured as per Clause 301 and 305 respectively.

Dry rubble stone bed flooring and random rubble masonry in cut off walls shall be measured in cu.m for each class of material. Preparation of bed for the flooring including necessary compaction of the same shall be considered incidental to the work and shall not be measured separately.

Rate

The contract unit rate for the different items of work shall include the cost of all materials, labour, tools and plants, incidentals, etc. for completing the work according to the above specifications.

Clause A-5 VOID FORMER

Void former tubes shall consist of galvanised corrugated light sheet metal tube subject to approval of Engineer having minimum thickness of 0.5 mm with end cones and tie down clips. The diameter and the sheet metal thickness of the void formers shall satisfy the following:

Internal Dia (d) (mm)	Sheet Metal Thickness-(t) (mm)
<700	0.5
≥700 <1000	0.7

Corrugations

The void formers shall be spirally lock seamed and corrugated on patented special machines with three 6-8 mm tube corrugations between the seams. The spacing between seams shall not exceed 120mm. The radial rigidity of the tube shall be as below:

(t) (mm)	Radian stiffness (cm⁴/m)
0.5	0.20
0.7	0.35

End Cones

Void formers are to be supplied with end cones mounted in place on the tubes to seal the void formers. The diameter at the end of cone shall be equal to half the dia of void formers and length of cone shall be equal to diameter of cone.

“Suitably designed wooden plug can also be used with the approval of Engineer”.

Tie Down Clips

In order to minimise horizontal and vertical movement of the void formers during concreting operations the void formers shall be fitted with tie down clips with necessary accessories.

Storage and Installation of Void Formers

The roundness of the void tubes before pouring of concrete shall meet tolerances permitted as per concreting specifications. The stiffness of the tubes must be sufficient enough to resist a change of roundness not more than 2 cm on account of the pressure from concrete.

The tie down clips down shall be fixed in such a way that movement does not exceed +1cm vertically and +2 cm. horizontally. In case of joints, these shall be strong enough to stop the pipes from moving in relation to each other.

Rate

The unit rate of Reinforced Concrete or Prestressed Concrete voided slab as defined in respective sections shall be deemed to cover the cost of void former, end cones, tie down clips and other accessories, their storage and installation at site including all operations as per instructions of the manufacturer.

CLAUSE A-6 CONTROLLED BLASTING

GENERAL

The specifications for excavation in rock are covered by MoRT&H “Specifications for Road & Bridge Works” (4th revision 2001), vide section 300. The following specifications are additional and supplementary to the same.

CONTROLLED BLASTING

Whenever required by the Engineer, the rock blasting shall be controlled so that vibration generated during the blasting do not cause damage to the building and installation around built up areas. Similarly, the rock pieces should not fly off the pits and thus damage the buildings and installation and life and limb of people around. Apart from the general precautions mentioned in the MoRT&H specifications, following protective measures and limits for use of explosives are suggested as guidelines.

PROTECTIVE MEASURES

- a) Short delay blasting with light charges shall be used.
- b) The blast hole shall be covered with 0.6 to 1.0 sq.m. Mild steel plate of minimum 6 mm thickness.
- c) Reinforcement rod mesh not less than 20 mm dia at 150 mm centers in both directions shall be placed over the steel plates.
- d) Steel plate and reinforcements shall be inspected after every blasting operation and all twists shall be removed before reuse to the satisfaction of the Engineer.
- e) The thickness of the covering plate and the kind of dead weight is to be duly approved by the Engineer.

When blasting is necessary adjacent in partially or completely built structures the contractor shall take all precautions necessary to prevent flying rock from causing damage to the structures.

BLASTING WITHIN CERTAIN LIMITS

No blasting shall be allowed for any of the excavation until freshly placed concrete of nearby structures has reached a minimum strength of 7 MPa. Normally, blasting shall be resorted to only after 7 days of concreting work in case of OPC (10 days in case of PPC) in adjacent structures.

In no case shall blasting be allowed closer than 15m to any structure after concrete placing has started.

When minor blasting is necessary after concrete placing has started in any structure, the maximum size of charge for distance from 100m and above shall be limited to the following:

	Safe particle velocity 10 mm/sec. Charge in kgs per delay	Safe particle velocity 3 mm/sec. Charge in kgs per delay.
100	10.7	2.6
150	24.2	5.8
200	43.0	10.3
250	67.3	16.7
300	96.9	23.2
350	131.9	31.6
400	172.3	41.2
450	218.2	52.2
500	269.3	64.5

Any deviation in the above-recommended limits will be adopted only after the specific approval of the Engineer. The contractor shall submit the scheme with charges and delays he proposed to use for blasting, for approval of the Engineer.

It is generally recommended that where the blasting is to be done, within 20 m of the nearest point of permanent building, the area shall be line drilled on periphery before blasting.

The Contractor shall be responsible for all damage caused by blasting whether to permanent or temporary structures and shall replace or repair the structures at his own cost.

PRECAUTIONS AFTER BLASTING

After the blast, the supervisor must carefully inspect the work and satisfy

himself that all the charges have exploded. After the blast takes place in underground works, the workmen shall not be allowed to go to the face till toxic gases have disappeared from the face.

If it is suspected that part of the blast has failed to fire or is delayed, sufficient time shall be allowed to elapse before entering the danger zone. When fuse and blasting caps are used, a safe time should be allowed and then the supervisor alone shall leave the shelter to inspect the blasting zone.

None of the drillers are to work near the misfired hole until one of the two following operations have been carried out by the Supervisor:

Either (i) the Supervisor should very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper or jet of water or compressed air (using a pipe of soft material) and withdraw the fuse with the primer and a fresh detonator with fuse should be placed in these holes and fired out, or (ii) the hole may be cleared of 30 cm of tamping and its direction then be ascertained by placing a stick in the hole. Another hole may then be drilled at least 60 centimeters away and parallel to it and about 30 cm less in depth, this hole shall then be charged and fired. The balance of the cartridges and detonators found in the muck shall be removed.

Before leaving his work, the Supervisor of the concluding shift shall inform the Supervisor of the relieving shift of any case of misfires and should point out the position with a red cross denoting the same and also stating what action, if any, he has taken in the matter.

The Supervisor should also at once report at the office of the Contractor and the Engineer all cases of misfire, the cause of the same and what steps were taken in connection with these.

The names of the day and night shift Supervisors must be noted daily in the Contractor's office.

If a misfire has been found to be due to a defective detonator of dynamite the whole quantity or box from which the defective article was taken, must be thoroughly inspected by the Contractor.

Drilling in holes not completely exploded by blasting shall not be permitted.

PERSONNEL

Excavation by blasting will be permitted only under the personal supervision of competent and licensed blasters and trained workmen.

All supervisors and workmen in-charge of preparation, handling, storage and blasting work shall be adequately insured by the Contractor.

Storage shall be in charge of a very reliable person approved by the Engineer, who may, if necessary conduct police enquiries as to his reliability, antecedents etc. The contractor shall have to produce a security for the person in-charge of the explosives, if and when required by the Engineer, of the civil authorities of the district.

The Contractor shall make sure that his supervisors and workmen are fully conversant with all the rules to be observed in storing, handling and use of the explosives. It shall be ensured that the supervisors in charge are thoroughly acquainted with the details of the handling of explosives and blasting operations.

BASE

Where existing pavement is to be overlaid with a granular base of less than 500 mm, total thickness shall be scarified in accordance with Sub-Clause 501.8.3.2. Where the existing pavement contains multiple bituminous layers, the scarification shall be to the underside of the lowest bituminous layer. The contractor will verify that all bituminous layers have been removed using appropriate methods as approved by the Engineer. The bituminous surfacing material removed from the existing pavement may be used in other parts of works provided it complies with the relevant clauses and approved by the Engineer.

After scarification and removal of all the bituminous layers from the existing pavement to be overlaid, to the full satisfaction of the Engineer, the existing pavement shall be lightly sprinkled with water, if necessary, and rolled with three passes of 80-100 kN smooth wheeled roller. The existing pavement shall then be proof rolled with 8 tonne single drum vibrating roller in the presence of the Engineer who shall determine the suitability of the existing pavement for overlay.

After proof rolling, where the overlay includes a sub-base layer of compacted thickness less than 75mm, the surface prepared for the overlay shall be lightly tined as directed by the Engineer. No tinning is required in case compacted thickness of sub-base layer of overlay is more than 75mm.

Clause A-8

REFLECTIVE STUDS/ROAD PAVEMENT MARKER

1. General

Reflective pavement marker (RPM) or reflective road stud is a device, which is bonded to or anchored within the road surface for lane marking & delineation for night time 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 the terms of millicandelas 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 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 road stud is fixed in position in the road.

3. MATERIALS

Plastic body of RPM/Reflective road stud shall be moulded from ASA (Acrylic Strene Acrylonitrile) 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 lenses containing single or dual prismatic cube capable of providing total internal reflection of the light entering the lens face. Lenses shall be moulded of methyl methacrylate 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

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

1. Minimum CIL value for stud

2. Entrance angle	3. Observation Angle	4. CIL in MCD/lx
		5. White
6. 0° U 5° L&R	7. 0.3°	8.220
9. 0° U 10° L&R	10. 0.5°	11. 120

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

6. Tests

Co-efficient of luminance intensity can be measured by procedure described in ASTM E809 “Practice for measuring Photometric Characters” 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.

7. Fixing of reflective markers

i. 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 portion 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 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.

8. Placement

The reflective marker shall be fixed to the road surface using the adhesives & the procedure 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 adhesive.

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 in 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.

9. Warranty & Durability

The contractor shall obtain from the manufacturer a two year in-filed 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 which carries out the work of fixing of reflective road markers/reflective Road Studs. In case the markers are displaced, damaged, get worn out or loose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer at his own cost and with no extra remuneration to be paid for such work.

10. MEASUREMENT FOR PAYMENTS

The measurements of CF reflective road markers / reflective road studs shall be in numbers of markers supplied & fixed.

11. RATE

The contract unit rate for reflective road markers / reflective road studs 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.

CLAUSE A-9 WAY SIDE AMENITIES AND TRUCK PARKING SITES

1. Scope

The work covers the provision of construction of way side amenities and truck parking sites as shown in the drawings. Work includes building complex with provision for electrical supply, all electric items like lights, fans and complete wiring, providing water supply including all pipes, fittings, tanks, tube well, pumps, valves etc. complete, septic tank, sewer lines, drains, boundary wall, internal surfaced roads, lawns etc. complete with specifications as shown in the drawings.
Maintenance

The contractor should arrange to maintain the way side amenities, truck parking sites till the issue of Taking Over Certificate.

2. Measurement

The measurement for construction completion of way side amenities and truck parking sites with all provisions of furnishing shall be on square metre of the payable area shown in the drawings.

3. Rate

The Contract unit rate for constructing and providing way side amenities and truck parking site complex which include cost of all the operations involved in the construction of the complex connected services, fittings, furnishing, land scaping, electrical items like wiring, switching, fitting of lights, fans, fire extinguisher etc. complete, providing water supply and including all types of

necessary fitting of tube-wells pumps and valves etc. complete, septic tank, sewer lines, drains furnishing internal road etc. complete, and as shown in drawings.

A-10

CURING USING LIQUID MEMBRANE FORMING COMPOUND

1.1 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 beings. 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.

1.1.1 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 0.2 litre/m². 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 tested 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 fulfil 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.

1.1.2 Supply and Testing

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 5502. In addition, testing shall be performed to demonstrate that on adverse/undesirable change in quality of concrete or concrete surface takes place as a result/by-product of the 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.

Routine Testing

1. 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.

2. 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.

1.1.4 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 5m² 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 trials 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.

CLAUSE A-11 PAVEMENT QUALITY CONCRETE

Surfacing texturing of the plastic concrete shall begin immediately after finishing of the concrete and before application of the curing memberane. Texturing shall be done using steel tines. The tines shall be supported by an independent self-propelled rolling mechanical bridge. The bridge supporting the rectangular steel tines shall be equipped and operated with automatic sensing and control devices that follow the same control line as the slip form paver. The tining machine should be capable of providing for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface. The tining rake shall be checked for cleanliness and for missing, bent, or broken tines before tining.

Tine texturing shall performed so that the grooves produced will be uniform in spacing, depth and width. Texture shall be parallel to the centreline of the roadway and shall extend over the entire roadway width to within 75mm of the pavement edge. Tining will be omitted within +/-20mm of the sawed longitudinal joints. Texture grooves shall be 3 mm in width and 3 to 4 mm in depth. The center to center spacing of the grooves shall be 18 to 21 mm.

The tining of the texturing operations is critical. Grooves that close following texturing will not be permitted and texturing shall be completed so that the surface is not torn or unduly roughened by texturing operation. Swerving groove patterns will not be permitted. The completed textured surface shall uniform in appearance.