

PART 2 – WORK REQUIREMENTS

Section VI (a): Scope of Works

Works Requirements

Section VI (A): Scope of Works

Section: Bhawarna - Lambgaon

The proposed configuration of the project is as under:-

Typical Rural Section (Intermediate lane)

Carriageway	: 5.50m
Shoulder (Granular)	: 2 x 1.0m
Roadway width	: 7.50m

Typical Urban Section (Intermediate lane)

Carriageway	: 5.50 m
Sidewalk/Lined Drain	: 2 x 1.2m
Roadway width	: 7.90m

Bridges & Culverts

It is proposed to widen/reconstruct 75 no. of culverts with clear width 9.00m in the entire section and 6 bridges with 10.0 m formation width

Pavement Design

Flexible pavement has been designed for design life of 15 years. The most common layer configuration is:-

New/Reconstruction:

Semi Dense Bituminous Concrete (SDBC)	:25mm
Dense Bituminous Maccadam (DBM)	: 50mm
Wet Mix Macadam (WMM)	:250mm
Granular Sub-base (GSB)	:150 mm

Drainage& Protection Structures

Construction of slope protection structures & retaining walls using Plum Concrete with Stone Facia

Section VI (a): Technical Specifications

- **Standard Specifications**

HIMACHAL PRADESH STATE ROAD PROJECT

SPECIFICATIONS

Part A- Standard Specifications

The Standard Specifications comprise "Specifications for Road and Bridge Works (Fourth Revision, August 2001)", issued by the Ministry of Shipping, Road Transport & Highways (MoSRT&H), Government of India and published by the Indian Roads Congress.

Bidder, if does not already possess a copy of the above, may purchase the same from the Secretary, Indian Road Congress, Jamnagar House, Shahjahan Road, New Delhi, 110 001

- **Special Provisions**

HIMACHAL PRADESH STATE ROAD PROJECT**SPECIFICATIONS****Part B - Special Provisions****Preamble**

The Special Provisions are an amplification of the Standard Specifications and contain provisions in respect of items of work not covered by or at variance with the Standard Specifications.

The Special Provisions contained herein shall be read in conjunction with the other Bidding Documents. The Special Provisions covering the materials and the workmanship aspects as well as method of measurements and payments are included in this section. These Provisions 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.

Where there is any ambiguity or discrepancy between the Special Provisions and the Standard Specifications, the requirements of Special Provisions shall prevail.

Clause numbers herein correspond with the numbers of related articles, if any, in the Standard Specifications. The numbering of new clauses is continuous with related clauses in the Standard Specifications.

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 Contractor and the Engineer. In such cases, it is the responsibility of the Contractor to seek clarification on any uncertainty and obtain prior approval of the Engineer before taking up the supply/construction. In the absence of such prior clarification, the Engineer's choice/design will be final and binding on the contractor without entitling the contractor for any additional payment.

Measurement and Payment

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

Defective Works

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

Site Information

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

In general, the topography of the road is mountainous. The approximate longitude and latitude of the Project road is 31° 53' 30" N Lat. 32° 01' 30" N Lat. and longitude of 76° 30' 40" E Long. to 76° 36' 10" E Long. The heights within the project road section vary between 600m to more than 1035 m

General Climatic Conditions

The maximum temperature is around 37 degrees C in the month of May . The temperature varies from a maximum of 37 degrees C during the summer (July to September) to a minimum of 0 to 4 degrees during the coldest winter (January and February).

The normal average annual rainfall in the project area is approximately 1250 mm. Most of it occurs during the monsoon months of June through September.

Seismic Zone

The works are located in Seismic Zone-V as defined in IRC: 6-2000.

Additional Specifications

The additional specifications shall comprise of specifications for particular items of work not covered in Part – A and Part - B above.

The following Appendices describing additional specifications have been added to the Part – A, Standard Specifications:

CLAUSE A-1	PLANTATION OF TREES AND HEDGES
CLAUSE A-2	CHUTE DRAIN FOR HIGH EMBANKMENT SECTIONS
CLAUSE A-3	UTILITY DUCTS
CLAUSE A-4	CONTROL BLASTING
CLAUSE A-5	SPECIFICATIONS FOR SCARIFICATION OF EXISTING PAVEMENT AND PROVIDING OVERLAY WITH GRANULAR BASE/DBM.
CLAUSE A-6	FILLING OF OPEN WELLS
CLAUSE A-7	WAY SIDE AMENITIES AND TRUCK PARKING SITES
CLAUSE A-8	CURING USING LIQUID MEMBRANE FORMING COMPOUND
CLAUSE A-9	SPECIFICATION FOR GUARD POST
CLAUSE A-10	SPECIFICATION FOR PASSENGER SHELTER
CLAUSE A-11	SPECIFICATION FOR PAINTING OF STRUCTURES WITH SYNTHETIC ENAMEL
CLAUSE A-12	CONSTRUCTION OF GABION WALL
CLAUSE A-13	CONSTRUCTION OF RE WALL WITH GABION WIRE MESH SYSTEM
CLAUSE A-14	GROUTED DOWELS FOR SLOPE STABILITY AND PROTECTION WORKS
CLAUSE A-15	TEMPORARY BARRICADING FOR STOPPAGEW OF CUT MATERIAL FROM SPREADING ON THE ROAD
CLAUSE A-16	SEISMIC RCC RESTRAINERS
CLAUSE A-17	PLUM CONCRETE
CLAUSE A-18	ELECTRICAL WORKS
CLAUSE A-19	BIO ENGINEERING WORKS

Section VI: Work requirements

In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specifications of IRC, BIS, ASTM, AASHTO and BS 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.

Specifications for Buildings, 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.

The Specifications for Buildings and other Miscellaneous Works, not covered by specifications in Part-A and Part-B above, shall be "Specifications Volume I to VI, 1996 or latest for Civil Works" published by Central Public Works Department (CPWD), Government of India.

The Specifications for Electrical Works shall be "Specifications for Electrical Works - Internal Works (Part -1) and External Works (Part -2), 1994 or latest, published by Central Public Works Department (CPWD), Government of India

SECTION 100 GENERAL**CLAUSE 101 INTRODUCTIONS**

Read "Appendix 1" as "Appendix 1 & 2" in 3rd line of 2nd paragraph.

CLAUSE 102 DEFINITIONS

The following abbreviations shall be added in this Clause:

"MOSRT&H"	:	Ministry of Shipping, Road Transport & Highways (Previously known as 'MOST', Ministry of Surface Transport)
"GOHP"	:	Government of Himachal Pradesh
"BIS"	:	Bureau of Indian Standards
"PMC"	:	Polymer Modified Cement
"QA"	:	Quality Assurance
"BOQ"	:	Bill of Quantities
"HPSPCB"	:	Himachal Pradesh State Pollution Control Board
"MDD"	:	Maximum Dry Density

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 items:

- 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;
 - Procedures for the preparation, review and adjustment of programmes for the effective progression of the Works;
 - Procedures 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.
 - Sanitation and living condition for workers
 - Selection of site for Hot Mix Point
- 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."

The general procedures of the QA-programme shall be submitted to the Employer and Engineer for approval not later than twenty-eight days after the date of receipt of letter of acceptance. The special part of the QA-programme shall be submitted successively to the effect that it shall have been approved prior to the commencement of the activities to which the programme shall apply.

Sub-Clause 105.4 Delete the words "15 days in advance" in the first line of the Clause.

Add at the end of this paragraph

"Submission of Contractor's programme of work, method etc., as covered in this Clause shall be at least one month in advance, unless the Quality Assurance plan of the project as finalised and approved by the Engineer demands other time schedule for various submissions and approvals in which case the QA plan requirements will prevail. In the latter case, as directed by the Engineer, he shall furnish"

CLAUSE 106 CONSTRUCTION EQUIPMENT

Insert the following para before the first para . "The trial run is to be carried out

laying the relevant pavement material and it shall not be a part of the permanent works. The trial is to be carried out on prior approval of equipment from engineer in-charge.”

Add the following sub para (g), (h) and (i) after sub 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 actions taken when results are unsatisfactory. Accuracy and fitness of measuring devices shall be ensured by proper maintenance.
- i) The contractor shall furnish to the Engineer the detailed technical literature and other relevant documents regarding the performance of plant/equipment to the ‘Engineer’ for approval prior to its purchase or mobilisation on site”. Adequate standby equipment including spare parts shall be available.

CLAUSE 107 CONTRACT DRAWINGS

Sub clause 107.1 Replace first sentence of sub-clause with:

“The drawings provided with the Tender Documents shall be the contract drawings according to which the works are to be executed and completed unless otherwise modified or supplemented by the ‘Engineer’ during the course of the work”.

Sub-Clause 107.3 Delete the entire sub clause and replace with the following:

“Two copies of typical drawings, on the basis of which execution of the work would be carried out, shall be given to the contractor by the Engineer progressively according to the work programme submitted by the Contractor and approved by the Engineer. Drawings of particular activity shall be issued to the Contractor at least 15 days in advance of the scheduled date of the start of the activity.

After careful study of the drawings issued by the Engineer, the Contractor shall prepare 4 sets of detailed construction drawings / working drawings with necessary field / construction information and shall submit the same to the Engineer for approval along with a construction methodology at least 21 days in advance of the scheduled date of the start of the activity

After reviewing the construction drawing, the Engineer shall issue 2 sets of the drawing to the contractor duly stamped “Good for Construction” along with Drawing Number, Revision Number and date at least 14 days in advance of the scheduled date of the start of the activity

One set of Original “Construction drawings” shall be kept at the Construction site and second set shall be kept at the contractors site office under document control section and should be available for Inspection / Verification at any time. All Superseded / Obsolete drawing should be clearly marked as “Superseded” or “Obsolete

The contractor shall maintain a document control procedure for “Construction Drawings” also as per QA – Programme in accordance with provision of Clause 105.3. The contractor shall include all the above activities in their Construction Programme, which is to be submitted in accordance with the Conditions of Contract.

CLAUSE 108 SITE INFORMATION

Sub-Clause 108.4 Delete the clause and shall be read as follows:

The Contractor shall identify quarries; borrow areas and other sources of materials required for the work. Contractor shall satisfy himself that the required materials are available in adequate quantities and complying with the requirements of specifications. No claims shall be entertained on account of non-availability of materials and increase in leads etc.

It is the sole responsibility of the Contractor to arrange the quarries, borrow areas etc., on license / lease basis or otherwise, and study in detail before tendering, the scope of taking the quarry on lease. Advance information must be collected by the contractor regarding the procedure laid down and the consequent delay in arranging the quarries on lease and must make alternative arrangement to procure the quarry products from lease holders. No separate payment will be made for arranging such quarries, borrow areas, etc.”

CLAUSE 109 SETTING OUT

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 least count of 1 mm.”

CLAUSE 110 ENCUMBRANCES IN CONSTRUCTION AREA, INCLUDING TREES AND UTILITIES

Sub-Clause 110.7 Delete the Sub-clause 110.7 and replace with the following:

The Contractor may be required to carry out the removal or shifting of certain services/utilities on specific orders from the Engineer. However for coordinating the work of cutting of trees and removal of encroachments, etc. no separate payment to the contractor will be made and these will be incidental to the work.

For the utilities which are to be shifted by the contractor as instructed by the Engineer as part of the civil works shall be paid by the funds of Himachal Government, but not from the proceeds of the loan.

CLAUSE 111 PRECAUTIONS FOR SAFEGAURDING THE ENVIRONMENT

Sub-Clause 111.1 General

Delete the Clause 111.1 and substitute the following:

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

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.”

Sub-Clause 111.2 Borrow Pits for Embankment Construction

Add the following between the first sentence and second sentence of the Clause 111.2:

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

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

Sub-Clause 111.3 Quarry Operations

Delete the Clause 111.3 and substitute the following:

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

The possible suggestive locations are furnished, however contractor is responsible for arranging the material sources in accordance with the requirements of technical specifications.

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 of respective state.”

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 regularly all along the routes to suppress airborne dusts from truck/dumper movements particularly on unpaved roads. The sprinkling shall be carried out minimum twice a day as instructed by the Engineer to suit site conditions.”

After Clause 111.12 Add the following new 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 do not exist, the Contractor shall construct project specific single lane paved roads in settlement areas and gravel roads in open areas conforming to the Ministry of Shipping, Road Transport and Highways (MOSRT&H) 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 upon completion of hauling for the use of local communities.”

Sub-Clause 111.14 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 force compounds. Prior approval shall be obtained from the relevant State Authorities and all installations shall be in compliance with local regulations. Bore wells installed and used for the project shall be left in good operating condition for the use of HPRIDC/HPPWD 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 waste 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 drains 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. Storm 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-Clause 111.15 Equipment and Vehicles 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.

Sub-Clause 111.16 Air Quality

The Contractor shall device and implements 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 spoil 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 silencing 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 equipment, 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 materials 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 guidelines of the State. Water accumulated in tires, empty vessels and containers of all nature will be regularly cleaned to avoid the related health hazards.

The following are the locations along the project road where no construction camps or installation for setting up of contractor plant shall be allowed :

- | | | |
|---|------------------------------|--|
| • | <i>Km 1+50 – Km 2+000</i> | <i>Wild life Crossing & River</i> |
| • | <i>Km 3+500 – Km 4+50</i> | <i>Wild life Crossing & River</i> |
| • | <i>Km 6+000 – Km 8+000</i> | <i>Wild life Crossing & Tea Plantation</i> |
| • | <i>Km 9+000 – Km 13+000</i> | <i>Forest, Wild life crossing and major settlement</i> |
| • | <i>Km 15+000 – Km 16+500</i> | <i>Major Settlement & Steam</i> |
| • | <i>Km 20+500 – Km 22+500</i> | <i>Wildlife Crossing</i> |

Sub-Clause 111.20 Control and Disposal of Wastes

The Discharge Standards promulgated under the Environment protection Act, 1986, shall be adhered to strictly. All waste arising from the project is to be disposed of in a manner acceptable to the Engineer and the State Pollution Control Board. 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 materials shall be disposed of in a manner as approved by the Engineer and wastewater 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 land owner(s) will be carried out within a time period agreed between landowner(s) and the Contractor. Separators shall be used to separate POL materials from wastewater prior to discharging to the 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 whose bed must be impervious e.g., stone quarry sites or depressions made impervious with 450mm thick impervious floor apron as per MOSRT&H Technical Specifications. Each successive 1.0m layers shall be covered with 500mm 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 implemented 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 the requirements of Section VI(c) [Environmental Management Plan] and contract conditions 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 ARRANGEMENTS 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) Drawings for any temporary diversions away from the existing carriageway
- ii) Details of the traffic management measures to be used where traffic will use part of the existing carriageway in accordance with Sub-Clause 112.2; these shall include the traffic arrangements proposed to be in place after the cessation of work each day.

The Traffic Control Plan shall conform to the typical arrangements shown in the road works drawings, or as otherwise directed by the Engineer. 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.

The Engineer’s written approval of the Traffic Control Plan, including any temporary diversions, shall be obtained by the Contractor before any work is commenced.

The Contractor shall appoint a Safety Officer who shall have day-to-day responsibility for implementing and maintaining all safety measures.

The entire Contractor’s staff shall wear high-visibility orange or yellow jackets or waistcoats while at the construction site.

As part of the suppression of dust due to the progress of earthworks, at all times it shall be ensured that dust suppression measures are taken up in accordance with the provisions of EMAP.

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

Sub-Clause 112.2 Passage of Traffic along a part of the Existing Carriageway under Improvement

This clause shall be 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, the following requirements must be respected:

- i) Normally, a roadway width equivalent to the available roadway width with out project situation for two-way traffic shall remain open at all times, but, where there is not possible to achieve, one-way working on a 3.7m lane (absolute minimum 3.25m) with traffic control shall be used.
- 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 like ponding of water etc..
- iii) The maximum continuous length over which construction under traffic may take place shall be limited to 500m.
- iv) Construction activity shall be restricted to only one side of the existing road.
- v) In any case Engineer and Contractor shall ensure that a continuous road section of length in excess of 1 km (i.e 1000 m thousand meters) shall not be permitted for taking up of earth works and an aggregate length of the section where the earth works are in progress at any given instant shall not be more than 7000 m or 7 km.

In case of eccentric widening of existing two lanes to four lanes, the additional two lanes shall be constructed first up to the stage of Bituminous Concrete for a minimum length of 2 km. 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 Passage of Traffic along a temporary diversion

Replace from third line onwards the rest of first para with the following.

“ with 3.5m carriageway and 1.0m earthen shoulders on each side (total width of roadway 5.5m) with the following provision for road crust in the 3.5m width”

Sub-Clause 112.4 Traffic Safety and Control

This clause shall read as under:

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, signs, delineators, markings, lights and traffic controllers as are necessary for the information and protection of all road users, including pedestrians and cyclists, passing through the section under improvement. The Contractor shall be fully responsible for the adequate safety of all site operations and methods of construction.

The design and layout of all traffic management devices shall be in accordance

with the roadwork's drawings and the Traffic Control Plan, or as otherwise directed by the Engineer. All signs, barricades, and delineators shall be reflectorised. Regulatory, Warning and Informatory signs shall conform to IRC 67-2001 with sign faces made from retro-reflective sheeting of High intensity grade or Engineering grade. Barricades of mild steel with firm and sturdy supporting, delineators and any other markers shall be made retro-reflective using either sheeting or plastic corner-cube reflectors.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the route to be taken by the diverted traffic shall be clearly marked with delineators and appropriate signs. At night the route shall also be delineated with lanterns or other suitable light sources.

One-way traffic operation shall be established whenever the traffic is to use part of the carriageway where there is insufficient width for two-way traffic. This shall be done with temporary traffic signals, or traffic controllers using STOP / GO signs, with flag mans round the clock as per the drawings. At night the STOP / GO signs shall be illuminated.

Warning signs shall be erected on all approaches to the works site in accordance with the road works drawings and the Traffic Control Plan, or as otherwise directed by the Engineer.

In any case Engineer and Contractor shall ensure that a continuous road section of length in excess of 1 km (i.e 1000 m thousand meters) shall not be permitted for taking up of earth works and an aggregate length of the section where the earth works are in progress at any given instant shall not be more than 7000 m or 7 km.

At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting to the roadway. Work which affects the use of side roads and existing accesses shall not be undertaken without providing adequate provisions to the satisfaction of the Engineer.

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

Sub-Clause 112.5 Maintenance of Diversions and Traffic Control Devices

This clause shall read as under:

The Contractor shall at all times maintain the signs, lights, barricades, round the clock flag mans and other traffic control devices in the correct position as per the drawings and the Traffic Control Plan, or as otherwise directed by the Engineer. All signs, lights, barricades and other traffic control devices, as well as the riding surface of diversions, shall be maintained in a satisfactory condition. The Contractor shall be responsible for replacing or repairing all signs, lights, barricades, and other traffic control devices that are lost, stolen, damaged or defaced.

The barricade shall be approved for the type and quality prior to the use for the traffic management by the Engineer, the barricading shall be made of MS steel sheets with properly designed support and anchorage system acceptable to the Engineer.

Any temporary roadway shall be kept free of dust by frequent applications of water.

Upon completion of the Works all temporary roads, temporary bridges, signs, lights, barriers, other traffic control devices and other equipment shall be completely removed unless otherwise approved in writing by the Engineer

If in the opinion of the Engineer the Contractor has failed to properly to provide and repair or maintain existing or temporary roadways, or provide sufficient or appropriate warning signs, lights, barricades, traffic control, etc. he shall instruct the Contractor, in writing, to provide such signs and take such actions as he considers appropriate for protection of traffic, pedestrians, employees and the works. If the Contractor fails to respond within the time given by the Engineer, the Engineer may suspend works which interfere with traffic until such time as the Contractor provides sufficient signs etc. as the Engineer has directed, or the Engineer may arrange to provide the required signs etc. at cost to the Contractor, these costs being deducted from monies due to the Contractor under the Contract.

Sub-Clause 112.6 Measurements for payment and rate

Replace this clause by following:

All arrangement for traffic during construction including temporary safety barricades, temporary traffic signs, providing traffic safety, flag mans round the clock and control devices where necessary, temporary diversions and temporary cross drainage structures, if required, and construction of treated shoulders for traffic during construction, as mentioned hereafter, shall be payable separately as per relevant items in the BOQ if provided, else treat the items as incidental to the works.

Temporary safety barricade shall be measured in linear meter-month. The contract unit rate for the temporary safety barricade shall be payment in full for the cost all labour, materials, installation, maintenance or replacement, shifting of temporary units from one location to other and refilling the temporary holes made in the ground including removing debris and all other incidentals to complete the work in all respect. These temporary units shall not be used in any permanent work in the project.

Temporary traffic signs shall be measured in Number - month. The contract unit rate for the temporary traffic signs shall be payment in full for the cost all labour, materials, installation, maintenance or replacement, shifting of temporary traffic signs from one location to other and refilling the temporary holes made in the ground including removing debris and all other incidentals to complete the work in all respect. These temporary traffic signs shall not be used in any permanent work in the project.

Traffic safety and control devices shall be measured in Number - month. The contract unit rate for the traffic safety and control devices shall be payment in full for the cost of all procurement, installation, maintenance or replacement, shifting of traffic safety and control devices from one location to other and all other incidentals to complete the work in all respect. These traffic safety and control devices shall not be used in any permanent work in the project.

CLAUSE 113 General Rules for the Measurement of Works for Payment

Clause 113.2 **Delete** this sub-clause and replace with:

“The rates in the Bill of Quantities are deemed to include the costs of haulage from the source of supply to the site for all materials required for the works.”

Clause 113.3 Measurement of Pavement Thickness for Payment on Volume Basis

Delete the second sentence of paragraph 5 " The average thickness of the pavement course" and add the following:

"The levels indicated on the Drawings or as modified by the Engineer are the levels to which the works shall be completed. The average thickness of pavement course at any section shall be the arithmetic mean of the difference of levels before construction at all the grid points and the levels after construction at the same grid points provided that the actual accomplished levels lie within the tolerances provided in the specifications."

No measurement or payment shall be made for bituminous mixes laid in excess of the thickness or width shown on the drawings or specified by the Engineer.

Add the following sub-Clause 113.6 after Clause 113.5

Sub-Clause 113.6 Measurement of Works & Survey Checks

The Contractor shall provide a sufficient number of qualified surveyors, helpers and labourers etc. as and when required by the Engineer to facilitate survey checks and/or during measurement of works. The cost of the same shall be deemed to be included in the item rates quoted by the Contractor and no additional payment whatsoever shall be made by the Employer

CLAUSE 114 SCOPE OF RATES FOR DIFFERENT ITEMS OF WORK

Sub-Clause 114.2Item (ii) of 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 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 as per clause 107 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 delays 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.

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

Cost of establishment of contractor's camp, offices and other facilities necessary for the execution and control of the works.

Sub-Clause 114.4 Add the following as Clause 114.4

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

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

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 methods 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 proposals regarding preliminary works, common facilities, and items that require consideration at the early stage of the Contract. The General part shall be furnished along with 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 sources;
- b) Sources of manufactured materials like cement, steel, bitumen, reinforcement, pre-stressing strands and bearings. Wherever possible the Contractor shall identify at least two sources for each of the items; he shall also submit test certificates of recently manufactured materials for the consideration of the Engineer.
- c) Locations of site facilities like batching plant, hot mix plant, wet mix plant, aggregate processing plant, crushing plant etc.
- d) Details of facilities/approaches for transportation of men, equipment and materials for construction of pavements, 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, pre-stressing, repair and rehabilitation of existing structures, concrete superstructure, dismantling of structures and pavement and for any other item as directed by the Engineer. These statements shall be submitted at least 4 weeks in advance of the commencement of the activity or item of work, unless otherwise stipulated in the contract.

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, piles, wells, concreting procedures, details of proprietary process and products (e.g. details of prestressing systems, proprietary piling systems, bearings, 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 complete 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 300 sqm.”

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 150 sq m and another 100 sqm 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 later 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 make AIMIL or equivalent 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 1 °C	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

S. No	Sub No.	Item, Specifications	Nos. Required
xiii)		Digging Tools (pickaxe, shovel, fork etc.)	As reqd.
xiv)		Miscellaneous tools (sledge hammer, lump hammer, wooden pegs etc.)	As reqd.
xv)		Maximum and Minimum Thermometer Mercury in Glass thermometer range 0° to 250°C Mercury in Steel thermometer with 30 cm stem, range upto 300°C	2 Sets each
xvi)		Rain Gauge	1 Set
xvii)		Timer 0-60 minutes with alarm & 1/5 sec accuracy.	3 Sets

Sub-Clause 121.3.2 For Soils and Aggregates

B: For Soils and Aggregates			
i)		Water still, 3 litre/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
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 ½ 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 (Brass)	24
	(g)	Soaking tank for accommodating 24 CBR moulds	
	(h)	Proving rings of 1000 kg, 2500 kg and 5000 kg capacity	1 each
	(i)	Dial gauges, 25 mm travel- 0.01 mm/division	10
	(j)	Aluminium Tins	
		50x30m	36 nos
		55x35m	36 nos
		70x45m	36 nos
		70x50m	36 nos
		80x50m	36 nos
ix)		Standard Penetration test equipment	1
x)		Nuclear Moisture Density Meter or equivalent	1

B: For Soils and Aggregates			
xi)		Speedy moisture meter complete with chemicals	2
xii)		Unconfined compression test apparatus	1 set
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
xvii)		Dynamic Cone Penetrometer	1
xviii)		Hydrometer with high speed stirrer and jars	2 sets
xix)		Post-hole augur (to BS-812)	3

Sub-Clause 121.3.3 For Bitumen and Bitumen Mixes

C: For Bitumen and Bituminous Mixes			
i)		Constant temperature bath for accommodating bitumen test specimen, electrically operated and thermostatically controlled, 50 litre 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 required accessories about .02 cum capacity electrically operated fitted with heating jacket	1
v)		Standard 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. (4 in) with base plate, collars, specimen extractor, compaction hammer 4.53 kg (10 lb.) x 457 mm (18 in) fall	1 set
v) a		Modified Marshall compaction apparatus d 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 152.4 mm dia. (6 in) with base plate, collars, specimen extractor, compaction hammer 10.2 kg (22.5 lb.) x 457 mm (18 in) fall	1 set
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	1

C: For Bitumen and Bituminous Mixes			
		1206(part II) – 1978	
xii)		BS U- Tube Modified Reverse Flow Viscometer IS 1206(Part III) – 1978	1
xiii)		Apparatus for Determination of Ductility Test as per IS 1208 – 1978	1
xiv)		Pensky – Martin Apparatus for testing flash and fire point as per IS 1209 – 1978.	1
xv)		Apparatus for Float Test – IS – 1210 – 1978	1
xvi)		Apparatus for Determination of water content (Dean and Stark Method) IS – 1211 – 1978	1
xvii)		Apparatus for Determination of Loss on Heating IS – 1212-1978.	1
xviii)		Apparatus of Determination of specified Gravity IS-1202-1978	1
xix)		Core cutting machine with 100mm dia. Diamond Cutting Edge	1
xx)		Apparatus for Elastic Recovery test for Modified Bitumen	1
xxi)		Apparatus for Storage Stability test for Modified Bitumen	1
xxii)		Apparatus for Separation test for modified bitumen	1

Sub-Clause 121.3.4 For Cement, Cement Concrete and Materials

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)	150mmx150 mm x150mm cubical for compressive strength	As required
	(c)	150mmx100 mm x600mm 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	2each
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	2

D: For Cement, Cement Concrete and Materials			
		fine and coarse aggregate as per IS 2386 (Part 3) 1963	
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, 1 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 computerised output attachment	2 sets
iv)		Total Station with all accessories	2 sets
v)		Car mounted Bump Indicator	1 set
vi)		3 metre 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	
	(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
x)		Wheeled straight edge and template	2 sets

Note: Any equipment which is not mentioned in this clause but which is necessary for the work or for complying with the provisions of the contract and section 900 of MOSRT&H specification or as required by the Engineer shall be provided by the Contractor.

The laboratory set-up must be complete including a set of reference standards (IRC, BIS, AASHTO, TRL, FHWA etc.), 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.

The contractor shall provide any other equipment required to check quality as per the requirement of specification in addition to the above.

The contractor shall provide the access to the laboratory and the lab equipment alongwith a skilled personnel to carry out the test in case Engineer intend to carry out the independent testing.

Sub-Clause 121.4 Ownership

Replace the clause with the following:

“The field laboratory building and equipment shall become the property of the Contractor, but for the use of the Engineer for the duration of contract the land for laboratory building shall be provided by` the Contractor”

Sub-Clause 121.6 Measurement for Payment

Delete the 2nd paragraph of the sub-clause and substitute with the following:

“The Contractor shall arrange to manage and maintain the field laboratory including sample store yards in a satisfactory manner until the issue of Taking over Certificate for the complete work”.

Sub-Clause 121.7 Rate

Deleted, no separate payment will be made for providing and maintaining the laboratory and shall be incidental to works.

CLAUSE 126 SUPPLY OF DIGITISED CD ROMS

The heading of this clause shall be read as under:

“Supply of DIGITISED CD ROMS.”

Sub-Clause 126.1 Delete “video cassettes” Add the words “CD ROMs” instead 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.

“One of the video films should cover the entire contract stretch before start of actual execution of work highlighting the different tasks contemplated to be executed in the contract. Similarly one of the video films should cover the

entire contract stretch after completion of all the works, highlighting the tasks scheduled to have been done as per contract, the details of tasks executed as per orders of the Engineer and the deviation, if any.”

Sub-Clause 126.2 Delete the words “master cassette” and substitute with “CD ROMS”

Sub-Clause 126.3 Delete the words “master cassette” and substitute with “CD ROMS”

Clause 127 CONTRACTOR’S EQUIPMENT

Clause 127.1 List of Equipment

Before starting any construction activity, the Contractor shall submit, to the Engineer, a detailed list of the equipment to be used during construction.

The list will state:

- type of equipment
- Identification codes (name and inventory code)
- Manufacturers name
- Year of manufacture
- Proposed assignments on the project

Clause 127.2 Working Condition of the Equipment

All equipment on Site shall be in working condition and maintained according to the manufacturers recommendation.

The Engineer shall check the performance and output of each item of equipment during the Site Trials specified for each construction process and carried out as specified in Clause 901.16.

If the performance of the equipment does not conform to the output assumed to complete the work as stated in the work programme or does not conform to the achievement of the specified quality, the Engineer will not permit construction work on the road until the Contractor proves full compliance with the working plan and Specifications.

Clause 127.3 Maintenance of Equipment

The Contractor shall maintain his equipment on Site to the satisfaction of the Engineer. He shall provide workshop, skilled personnel and transport facilities to the Site maintaining it during the Contract at his own expense.

Clause 127.4 Measurement and Payment

No separate payment shall be made for any work included in this Clause and the costs shall be deemed to be included in the rates of the relevant items entered in the Bill of Quantities.

Clause 128 Safety Provisions

The Contractor shall, throughout the execution and completion of the Works and the remedying of defects therein, ensure proper safety

measures including the following:

- i) Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from solid construction except for such short period work as can be done safely from ladders. When a ladder is used, an extra labourer shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable foot-holds and hand-holds shall be provided on the ladder, which shall be having inclination not steeper than 1 horizontal to 4 vertical;
- ii) Scaffolding or staging more than 3.25 metres above the ground or floor, swinging or suspended from an overhead support or erected with stationary support, shall have a guard rail properly attached, bolted, and otherwise secured at least 1 metre high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the support of structure;
- iii) Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if height of platform or gangway or stairway is more than 3.25 metres above ground level or floor level, it shall have closely spaced boards of adequate width and suitably provided with guard rails as described above; and minimum 200 mm x 25m kick board
- iv) Every opening in floor of a structure or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of one metre;
- v) Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length. Width between side rails in a rung ladder shall in no case be less than 30 cm for ladders up to and including 3 metres in length. For longer ladders the width shall be increased at least 6 mm for each additional 30 cm of length. Spacing of steps shall be uniform and shall not exceed 30 cm;
- vi) All trenches, 1.5 metres or more in depth, shall at all times be supplied with at least one ladder for each 20 metres in length or fraction thereof. Ladder shall be extended from bottom of trench to at least 1 metre above surface of the ground. Sides of a trench which is 1.5 metres or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of collapsing of sides. Excavated material shall not be placed within 1.5 metres of edge of trench or half of depth of trench, whichever is more. Cutting shall be done from top to bottom. Under no circumstances, undermining or undercutting shall be done;
- vii) Before any demolition work is commenced and also during the process of this work, all roads and open areas adjacent to the work site shall either be closed or suitably protected;
- viii) No electric cable or apparatus which is liable to be a source of danger or a cable or apparatus used by operation shall remain electrically charged;

- ix)** All practical steps shall be taken to prevent danger to persons employed by the Employer, from risk of fire or explosion, or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe;
- x)** Workers employed on mixing asphalt materials, cement, lime mortars/concrete shall be provided with protective footwear, hand gloves and protective goggles;
- xi)** Those engaged in welding or handling any materials injurious to eyes shall be provided with protective eye goggles/eye shields;
- xiii)** Stone breakers shall be provided with protective goggles and protective clothing and shall be seated at sufficiently safe intervals;
- xiv)** When workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that manhole covers are open and manholes are ventilated for at least one hour before workers are allowed to enter them. Manholes so open shall be cordoned off with suitable railing and provide warning signals or boards to prevent accident to public;
- xv)** Whenever men are employed on the work of lead painting, the following precautions shall be taken:
- No paint containing lead or lead products shall be used except in the form of paste or ready made paint;
 - Suitable face masks shall be supplied for use by workers when paint is applied in the form of sprayer or when a surface having lead paint is to be dry rubbed for removal of the paint;
 - Overalls shall be supplied by the Contractor to workmen and adequate facilities shall be provided to enable workers to wash during and on close of day's work;
- xvi)** Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:
- a) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good working order and properly maintained.
 - b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, free from defects and inspected daily.
 - c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 shall be in charge of any hoisting machine including scaffold or of signals to operator.
 - d) In case of every hoisting machine and of every chain hook, shackle swivel and pulley block used in hoisting, lowering or as a means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine with a variable safe working load, each safe working load and conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in the paragraph shall be loaded beyond safe working

load except for the purpose of testing.

- e) In case of the Employer's machines, safe-working loads shall be notified by the Engineer or his representative. As regards Contractor's machines, the Contractor shall notify safe working load of each machine to Engineer or his representative whenever he brings it to site of work and get it verified by him.
- f) Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliance shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce the risk of accident during descent of load to the minimum. Adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energised, insulating mats, working apparel such as gloves and boots, as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity;
- g) All scaffolds, ladders and other devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

xvii) Provision must be made by the Contractor to issue all those working on the Site (including Engineers and Employer and their Staff) until protective helmets, reflective jackets and appropriate footwear.

Clause 128.1 Measurement and Payment

No separate payment shall be made for any measures/work included in this Clause and the costs thereof shall be deemed to be included in the rates of the relevant items entered in the Bill of Quantities

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 minimum up to 100mm but not exceeding 150mm, which in the opinion of Engineer is unsuitable for incorporation in the work including draining out stagnant water if any from the area of road land, drain, cross drainage structure and other area as specified in the drawing or instructed by Engineer. However, for the locations requiring the depths beyond 150mm, the same shall be carried out by the contractor at his own cost as per the instruction of the 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 keeping the cleared material in stock pile within the ROW not less than 500m in distance, measuring and recoding the volume, keeping the stock pile till completion of bituminous works, re-using the top soil in turving/seeding and disposal of unsuitable material. The quantity of stock pile should have a minimum volume equivalent to the area of clearing and grubbing carried out with 100mm thickness and the same shall be deducted from volume of excavation or added to the volume of filling in the respective area. Clearing and grubbing shall be performed less than one month in advance of earthwork operation and in accordance with requirement of these specifications.

Sub-Clause 201.4 Substitute the words in last sentence of second para “upto a lead of 1000 m” with “all leads”

Sub-Clause 201.5 Measurements for Payment

Delete the last two sentences in first paragraph and add at the end of third para replace as under:

Cutting of trees upto 300 mm in girth measured at 1 meter above ground including trimming of branches of trees extending above the roadway including removal of foundations of sign boards, hoarding boards, etc., and back filling of pits etc. and shall be considered incidental to the clearing and grubbing operations and no separate payment shall be made for the same.

Removal of stumps & roots of trees of **any size girth** cut by other agencies and back filling to required compaction as specified in this clause shall be considered incidental to the clearing and grubbing operations and no separate payment shall be made for the same.

Sub-Clause 201.6 Rates

Sub-Clause 201.6.1 Delete 2nd line and substitute with the following

“These will also include removal of stumps and roots of trees of 300mm in girth size as well as stumps left over after cutting of any size girth carried out by other agency, removal of sign boards, hoarding boards, including their foundations, excavation and back filling to required density, where necessary, and handling, salvaging, stock piling and disposing of the stocked materials with all lifts and leads.”

Sub-Clause 201.6.2 Replace the words “upto a lead of 1000 m” and substitute with “leads”.

CLAUSE 202 DISMANTLING CULVERTS, BRIDGES AND OTHER STRUCTURES/ PAVEMENTS

Sub-Clause 202.4 Back-filling

After “operations” add “and water wells either in use or abandoend which are encountered in the alignment”. Add after last sentence “The wells may be capped thereafter if directed by the Engineer”.

Sub-Clause 202.5 Disposal of Materials

Replace the sub-clause with the following:

“All materials obtained by dismantling shall be property of the contractor. The material which in the opinion of the Engineer can not be salvaged shall be disposed at contractor’s own cost in accordance with EMP guidelines.”

Sub-Clause 202.7 Rates

Replace the sub-clause with the following:

“The Contract unit rates for the various items of dismantling shall be paid in full for carrying out the required operation including full compensation for all labour, materials, tools, equipment, safeguards and incidents necessary to complete the work. These will also include excavation and backfilling where necessary to the required compaction. The unit rate shall be inclusive of disposal of all unserviceable material with all leads and lifts as per the EMP guidelines.”

SECTION 300 EARTHWORK, EROSION CONTROL AND DRAINAGE

CLAUSE 301 EXCAVATION FOR ROADWAY AND DRAINS

Sub-Clause 301.1 Scope

Insert the following between the words “roadway” and “side drains” in the second line:

“road shoulders, verge, medians,”

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

The para (a) under this clause shall read as under:

“(a) Soil

This shall comprise top soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick, spade and stroke/ or shovel, rake or other ordinary digging implement, including excavation of unsuitable soil (as described in Clause 305.2). Removal of gravel or any other nodular material having dimension in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category. Conglomerates and boulders not requiring blasting having maximum dimension in any direction upto 300mm and excavation of unsuitable soils (as described in clause 305.2) shall also be covered under this category”

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

Delete the words beginning “gravel and cobble.....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 had.”

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 the following paragraph is at the end of sub-clause 301.3.3

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

Sub-Clause 301.3.5 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 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 or to a width minimum as per construction equipment deployed by the contractor 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 recompactd 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”.

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 Contractor. Suitable material as approved and directed by the Engineer obtained from the excavation of the roadway, shoulders, verges, drains, cross drainage works, etc. shall be used for:

- i) Filling roadway embankment.
- ii) Filling existing pits/ ponds in the right of way as directed by the Engineer, including levelling and spreading.
- iii) For landscaping of the road as directed by the Engineer, including levelling and spreading.

Unsuitable and surplus material, which, in the opinion of the Engineer cannot be used in the works, shall be removed from site by the Contractor and disposed of at the nearest dip or other approved location in accordance with all statutory requirements and EMP.

Sub-Clause 301.3.12 Back-filling

After the last sentence add the following:

“Density requirements for back filling shall be in accordance with Table 300-2” of MoSRT&H.

Sub-Clause 301.8 Measurements for Payment

Delete the first sentence of the first paragraph and replace with:

“Excavation for roadway shall be measured by taking cross-section volume calculated in accordance with Clause 109 and deducting clearing and grubbing volume in accordance with Clause 201 and other excavation volume which are measured and paid separately in the respective area. For the purpose of calculating the quantities the contractor shall use the software approved by the Engineer, the same shall be installed at Engineer’s and employer’s offices with no additional costs”

Add new para after 1st paragraph as below:

The rebate towards rock material obtained from excavation and dismantling shall be measured as total quantity of excavated rock and dismantling

Delete item (v) of last paragraph and replace with:

“(v) Disposal of surplus material to all leads”

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 also be included in the Contract unit rates.”

Sub-Clause 301.9.2 This Clause shall 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 301.9.5 Replace words “but leads upto 1000” by “and all leads” at the end of this Para.

Sub-Clause 301.9.6 Replace words “the additional haul or transportation involved beyond the initial lead of 1000 m” for “all leads”.

Add new Sub-Clause after 301.9.6 as under:

Sub-Clause 301.9.7 The contract unit rate for rebate of materials obtained from excavation cutting of rock shall be taken into account for full compensation, for

arranging approval, payment of royalty and complying the requirement of mining department and other authorities of Central/ State Government for re-use of materials obtained from rock cutting.”

CLAUSE 302 BLASTING OPERATIONS

Sub-Clause 302.1 Add the following in between 1st and 2nd sentence of first para

All work of blasting shall be carried out by taking all necessary precautions against soil erosion, damage to hill side, water pollution etc. and to protect satiability of hill slope, rock shall be excavated with chiseling and wedging out rock (where blasting is prohibited). All earthworks in excavation including rock shall be carried out true to the lines, grades, side slope, width, camber, super elevation and level.

Sub-Clause 302.4 Blasting Operations

Add the following at the end of para 4 of this sub-clause:

Before placing charges, the holes shall be free of obstructions for its entire depth. All necessary precautions shall be exercised so that the placing of the charges will not cause caving of material from the walls of the holes.

CLAUSE 303 PRESPLITTING ROCK EXCAVATIONS SLOPES

Sub-Clause 303.2 Construction Operations / Pre splitting Operations

Add the following after para 2 of this sub-clause:

Potentially dangerous boulders or other material located beyond the excavation limits shall be removed.

Fourth para shall be read as under:

Presplit holes shall be extended to a minimum of 9 m beyond the limits of the production holes to be detonated, or to the end of the cut as applicable.

Add the following after para 10:

The presplit line shall be detonated before detonating any production holes, except when the closest horizontal distance between the production line and presplit line is greater than 16 m.

CLAUSE 304 EXCAVATIONS FOR STRUCTURES

Sub-Clause 304.3.2 Excavation

At the end of 1st paragraph of Clause 304.3.2 insert the following additional sentences:

“The Contractor shall ensure the stability and structural integrity of adjacent existing foundations and structures and if necessary shall, at his own expense, install temporary or permanent sheet piles, coffer dams, shoring or similar as support or protection to the satisfaction of the Engineer.”

Sub-Clause 304.3.4 Preparation of Foundation

In Para 2 and 3 of clause 304.3.4 substitute 'Concrete M-15 in place of 1:3:6 nominal mix'.

Sub-Clause 304.3.6 Add the following at the end of clause

Any loss to the public / private property due to the negligence of the contractor and which, in the opinion of the Engineer, shall be protected and continued in use without any change during the course of execution of the work, shall be the sole responsibility of the contractor. Safety measures taken

by the contractor in this respect shall be got approved from the Engineer. However if any of the objects is damaged it shall be replaced or restored to the original condition at his expense. If the contractor fails to do so, within the required time as directed by the Engineer or if, in the opinion of the Engineer, the actions initiated by the contractor to replace /restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement / restoration directly through any other agency at the risk and coat of the contractor after issuing a prior notice to the effect.

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 S. N. (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 305.2.1.1 Physical Requirements:

Add at the end of the 1st paragraph of Sub Clause 305.2.1.1 insert the following additional sentence;

“Use of flyash available from Thermal Power Station located within 100 kms of work may be required. The embankment with flyash shall be executed.

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, Expansion ratio determined from CBR test, 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 305.2.1.5 Add the following at the end of first sentence:

“The material to be used in sub grade should satisfy the requirement of the 4 day soaked design CBR of 10% when tested as per IS: 2720 (Part 16) at 97% maximum dry density (IS: 2720-Part 8).”

Sub-Clause 305.2.2.2 Borrow Materials

Para 1 of this Clause shall 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 requirements in respect of excavation and borrow areas as stipulated, from time to time, by the Ministry of Environmental and Forest, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.”

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

Table 300-2

Compaction Requirements of Embankment and Subgrade

S. No.	Type of Work/Material	Relative Compaction as %age of maximum laboratory dry density as per IS 2720 (Part 8)
1	Subgrade and earthen shoulders	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	4 Day Soaked CBR Value of Sub grade & Shoulder materials shall be as 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 subgrade; 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 subgrade.
- (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 compactive 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.”

Sub-Clause 305.3 Construction Operations**Sub-Clause 305.3.4 Compacting Ground Supporting Embankment/Sub grade**

Para 1 of this clause shall be read as:

“Where necessary the original ground shall be levelled, 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 be

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-8) at contractor’s own cost”.

Sub-Clause 305.3.6 Compaction

The second Para of this Clause shall read as under:

“Vibratory roller of not less than 80-100 KN static weight with plain or pad foot drum or pneumatic tyre roller of 300 KN weight having tyre pressure of at least 7 kg/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 Embankment construction under water:

In 2nd Sentence, replace”..... particle size not exceeding 75mm” with particle size not exceeding 200mm”.

Sub-Clause 305.8 Measurement for Payment

Para 1 shall be read as:

“Earthwork in embankment/sub-grade construction shall be measured separately by taking cross sections at intervals after clearing and grubbing and if necessary compaction of original ground before the embankment work starts and after its completion and computing the volumes of earthwork in cubic metre. For the purpose of calculating the quantities the contractor shall use the software approved by the Engineer, the same shall be installed at Engineer’s and employer’s offices with no additional costs”.

Sub-Clause 305.9 Rates

Add “including removal of topsoil after word “materials” appearing in first line of item (v).

Clause 305.9.6 Replace “up to a lead of 1000m” with “all leads” in the last sentence.

CLAUSE 306 SOIL EROSION AND SEDIMENTATION CONTROL

Sub-Clause 306.4 Measurements for Payment

Substitute Clause 306.4 as follows:

“All temporary sedimentation and pollution control works, which are not provided in the Bill of Quantities, 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.”

CLAUSE 309 SURFACE/SUB-SURFACE DRAINS

Sub-Clause 309.2 Surface Drains

Add the following paragraphs 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 should read as:

“Sub-surface drains shall be close 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 Class 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 Measurements for Payment

This Clause shall read as:

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

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

CLAUSE 401 GRANULAR SUB BASE

General

Sub clause (i) of clause 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

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 0.075mm 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 this clause and substitute with the following:

"The material shall be free from organic or other deleterious constituents and conform to the Grading 1 given in Table 400-1

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 upon 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 in field. The CBR tests shall be conducted on specimen soaked for 4 days and compacted to 98% of the maximum dry density as per IS: 2720 (Part 8).

Sub-Clause 401.4.2 Spreading and compacting

The second paragraph of this clause shall read as follows:

The materials shall be carried to work site by tipper / dumper. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work."

The third paragraph of this Clause shall be deleted

CLAUSE 403 CEMENT TREATED SOIL SUB-BASE/BASE

The title of this Clause shall be read as follows:

"CEMENT STABILISED UPPER SUB-BASE"

Clause 403.1 Scope

Substitute clause 403.1 as follows:

"This work shall consist of machine laying and compacting a sub base course of crushed aggregate treated with cement on prepared lower subbase, in accordance with the requirements of these specifications and in conformity with the line, grade and cross-section shown on the drawings or as directed by the Engineer."

Add the following at the end of this Clause:

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

Clause 403.2 Materials

Clause 403.2.1 Materials to be Stabilised

The Clause shall read as under:

“The material for the cement stabilised upper subbase course shall meet the following criteria:

The material used for cement treatment shall be crushed stone aggregate. The material shall have a grading shown in Table 400-4. It shall have a uniformity coefficient not less than 5; capable of producing a well closed surface finish. If the material passing 425 micron sieve is plastic before mixing with cement it shall have a liquid limit not greater than 25 percent and plasticity index not greater than 6 percent determined in accordance with IS: 2720 (Part – 5).

The coarse fraction of the material before mixing with cement shall have a maximum Aggregate Impact Value (AIV) of not more than 30 per cent when tested as per IS: 2386 (Part-4) or IS: 5640.

The combined Flakiness and Elongation Indices for the coarse fraction before mixing with cement shall not 30 per cent when tested as per IS: 2386 (Part-1).

The material before mixing with cement shall have a 10 percent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part 3).

The water absorption value of the coarse fraction before mixing with cement shall be determined as per IS: 2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383.

Before mixing with cement, the material passing 425 micron (0.425 mm) sieve when tested according to IS: 2720 (Part 5) shall have Liquid Limit and Plasticity Index and Plasticity Modulus (product of Plasticity Index and percentage passing 0.425mm Sieve Size) values not more than 25 per cent, 6 per cent and 90 respectively.

Before mixing with cement, the fraction of material passing 22.4mm sieve shall have a Laboratory CBR (4-day soak) value of 75 or more, when tested in accordance with IS: 2720 (Part 16) and samples prepared at 98% of Maximum Dry Density and Optimum Moisture Content corresponding to IS: 2720 (Part 8).”

Clause 403.2.2 Cement

This clause shall read as under:

“Cement for cement stabilisation shall comply with the requirements of IS: 269, 455 or 1489.”

Clause 403.2.3 Lime

This clause is deleted.

Clause 403.2.4 Quantity of Cement in Stabilised Mix

This clause shall read as under:

“The quantity of cement to be added as percent by weight of dry crushed stone aggregate shall be 4 percent. The mix design shall be done on the basis of 7 day unconfined compressive strength (UCS) and durability test under 12 cycles of wet-dry condition. The cement treated subbase material shall have a minimum 7-day laboratory UCS value of 7 MPa when compacted at 98 per cent of Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) as per IS: 2720 (Part 8). The value of UCS for samples compacted at 98 per cent of MDD and OMC (as per IS: 2720, Part 8) at field shall be not less than 5 MPa.

The contractor shall at least 21 working days before commencement of the construction of the cement treated upper subbase course, submit to Engineer the results for approval of the laboratory testing on the physical properties of materials as defined in Clause 403.2.1 and the mix design data as defined above. The construction of the cement treated upper subbase course can be taken up only upon Engineer’s approval of the material and the mix design.

Clause 403.3.2 Degree of Pulverisation

This clause shall be deleted.

Clause 403.3.3 This Clause shall be read as under:

“Cement stabilised upper subbase shall be prepared in an approved mixing plant of sufficient capacity having provision for controlled addition of ingredients i.e. water, cement and aggregate and forced/positive mixing arrangement.”

“The cement stabilised upper subbase mix shall be spread by paver finisher fitted with arrangement for proper control of line and level in full width of the pavement including shoulder.”

CLAUSE 406 WET MIX MACADAM SUB BASE/BASE

Sub-Clause 406.1 Add the following at the end of this Clause.

A site trial shall be performed in accordance with Clause 901.16 of these specifications and only if satisfactory compaction can be obtained to the full depth of the layer may the compacted depth of a single layer exceed 150 mm with prior approval of the Engineer.”

Sub-Clause 406.2.1.1 Physical requirement

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

“If crushed boulders are used, not less than 90% by weight of crush boulders retains on 4.75 mm sieve shall have at least two fractured faces.

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

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 400-10 delete at the bottom of the table asterisk and modify as under:

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

Add the following at the end of the paragraph 2:

Soundness test shall be carried out in accordance with IS: 2386 (Part 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.

Add the following at the end of this Clause:

“The material shall be derived from boulders or parent rock that is hard, sound, durable and unweathered. It shall contain no deleterious constituents such as organic matter, clay and decomposed rock.”

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 min 60T/hour capacity having provision for controlled addition of water and forced/positive mixing arrangement.”

Delete last sentence of para 1 “For small quantity.....concrete mixers”

Delete the third sentence in para 2 of this Clause and substitute therefore the following:

“Unless otherwise instructed by the Engineer, the moisture content of the wet mix at the time of compaction shall be between 85% and 115% of the optimum moisture content and no segregation should be permitted”

Sub-Clause 406.3.4 Spreading of Mix

Replace the first and second sentence of second paragraph as follows:

“Wet Mix Macadam material shall be delivered to the site in ready mixed condition. Water shall be added at the mixing plant in such quantities as to ensure that additional watering will not be necessary during the compaction of the layer.

“The first layer of mix shall be either spread by paver finisher or motor grader (with prior approval from Engineer). The second or final layer of mix shall be spread by paver finisher fitted with string line arrangement preferably in full width of the pavement including hard shoulder.”

Add the following at the end of Para

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.

Sub-Clause 406.3.5 Compaction

Delete second sentence of Para 1 of Clause 406.3.5.

Add at the end of first paragraph

“For a narrow strip of soil or any pavement material to be compacted, for

instance in the widening portion, vibratory rollers of smaller width than usually used for main carriageway could be necessary. In that case the weight of the roller could be less than the minimum required static weight of 80 kN. This roller can be accepted provided it belongs to the same class as the wider one based on amplitude of vibration and weight per width of drum:

In para 7, replace the first sentence with :

“Rolling shall be continued till the density achieved over the full thickness of material laid satisfies the requirements of Clause 903.3”

Sub-Clause 406.3.6 Setting and Drying

Add the following at the end of this Clause:

“The completed Wet Mix Macadam should be primed, in accordance with Clause 502, immediately after the surface is dry.”

“In case if the completed Wet Mix Macadam as mentioned above can not be covered with bituminous layer the contractor shall rectify the works at his own cost in accordance with clause 502.”

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.

CLAUSE 408 CEMENT CONCRETE KERB AND KERB WITH CHANNEL

Sub-Clause 408.3 Type of Construction

This Clause shall be read as under:

The cement concrete kerb shall be cast in situ laid with kerb casting machinery.

Sub-Clause 408.5 Construction Operations

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

Add at the end of the first sentence “or as shown in the drawings”

Sub-Clause 408.5.2 Add the words “or to accommodate drainage pipes” at the end of the paragraph after the words “drainage openings”.

Sub-Clause 408.6 Substitute

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

Sub-Clause 408.7 This Clause shall read as under:

The contract unit rates 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.

SECTION 500 BASE AND SURFACE COURSES (BITUMINOUS)

General

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

The provision “clause 401.8 (i) to (v)” be read as “Clause 401.8 (i) to (iv) in the clauses 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 (ix)” in the following clauses.

504.8, 505.8, 506.8, 507.9, 508.9, 509.9, 510.8, 511.1.8, 511.2.9, 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 501.2.2 Coarse Aggregates

The first sentence of paragraph 1 shall read as:

“The coarse aggregates shall consist of crushed rock or crushed gravel and shall be obtained through the use of cone crusher, shaft Impactor and vibratory screens of suitable capacity.”

Sub-Clause 501.3 Mixing

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

Add the following after the first sentence of paragraph 1

“The Hot mix plant shall be attached with an electronically controlled Pyrometer and have a system to take print out of quantity and temperature of bitumen, aggregate and mixed material.”

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 levelling, 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 501.8.2.4 Profile corrective course and its application

This Clause shall be read as under:

“The type of material for use as profile corrective course shall be of Dense Graded Bituminous Macadam or Bituminous Macadam as shown on the drawings with the same specifications as for bituminous courses”

Sub-Clause 501.8.3.2 Replace the word “1000 m” with “all leads” in the last line.

Sub-Clause 501.8.3.4 Laying the Profile Corrective Course

Sub-Clause 501.8.3.4.1 This Clause shall be 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 Clauses 501.3.1., 501.3.2 and 501.3.3, the profile corrective course with materials as per Clause 501.2.3/501.8.2.4 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 the profile corrective course.”

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 In the last sentence replace “1000m” 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: The primer used for prime coat shall be bitumen emulsion complying with IS 8887 and CSS – I Grade conforming to ASTM D 2397/AASHTO M 208-01, 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

Sub-Clause 503.2 Materials

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 208-01, and shall be refinery produced. The particular grade to be used for the work shall be got approved by the Engineer.”

Sub-Clause 503.4.3 Application of tack coat

Add at the end of the clause The application of the tack on the primed surface shall carried out as required and as per the instruction of the Engineer.

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 Standard Specifications for “Paving Bitumen”, IS: 73.”

Sub-Clause 504.2.2 Coarse Aggregates

The first sentence of paragraph 1 shall read as:

“The coarse aggregates shall consist of crushed rock or crushed gravel and shall be obtained through the use of Cone crusher, Shaft Impactor and vibratory screens of suitable capacity.”

Sub-Clause 504.2.5 Proportioning of materials

Add following between first and second sentence:

“Grading-1 shall be used for compacted thickness of a layer of 75mm and above while Grading-2 shall be used for compacted thickness of a layer of less than 75 mm thickness. The Contractor shall give job mix formula for the mix design indicating mix properties. The laying of mix shall be done after approval of the Engineer.”

Sub-Clause 504.3.6 Rolling

In the second paragraph replace the first sentence by:

“Rolling shall be continued until the density achieved is at least 98% of that of laboratory Marshall Specimen compacted by 75 blows on each of the two faces of the specimen”.

Sub-Clause 504.8 Rate

Delete the sub-clause and substitute with the following:

“The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operation as specified except the items of tack coat and prime coat, if any. The rate shall include but not necessarily limited to all components list in clause 501.8.8.2.(i) to (ix)”

no extra payment shall be made for the bitumen content above the minimum required if the required bitumen content is more as per the jobmix formula.

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

The first sentence of paragraph 1 shall read as:

“The coarse aggregates shall consist of crushed rock, crushed gravel and shall be obtained through the use of cone crusher, shaft impactor and vibratory screens of suitable capacity.”

Sub-Clause 507.2.4 Filler

Delete the clause and substitute with the following

Filler shall be cement as approved by the Engineer.

Sub-Clause 507.2.5 Aggregates grading and binder content

Add following between first and second sentence:

“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. The Contractor shall give job mix formula for the mix design indicating mix properties. The laying of mix shall be done after approval of the Engineer.”

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

Grading	1	2
Layer Thickness	75mm to 100mm	50-75mm
Bitumen grade (pen)	65	65
Bitumen content % by mass of total mix	Min.4%	Min.4.25%

Sub Clause 507.3 Mixture Design

Sub-Clause 507.3.1 Requirement for the Mixture

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

Water sensitivity (ASTM D1075): Retained stability (Ratio of Marshal Stability for 24 h 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 Marshall method described in Asphalt Institute Manual MS-2.”

Add the following at the end of clause

The job-mix grading shall be within the limit stated in sub clause 507.2.5 and the bitumen content shall be determined by carrying out a series of Marshall stability tests as per AASHTO: T 245 and durability test as per ASTM D 1075 and satisfying the following criteria:

- No of blows each end 75
- Minimum stability (kN at 60C) 8.0
- Minimum flow (mm) 2.0
- Marshall quotient (kN/mm) 3.0-5.0
- Air voids in total mix (%) 4-7
- Voids in mineral aggregate filled with bitumen (%) 70-85
- Loss of Marshall Stability by submerging Specimens in water at 60°C for 24 hrs. as compared to stability measured after Submersion in water at 60°C for 30-40 minutes 25 percent max.
- Air voids at refusal density (300 blows at each end of Marshall Specimen at Optimum Binder Content) 3% min.

Sub-Clause 507.4.8 Spreading

Add the following at the end of the clause

“The dense bituminous layers except Profile corrective course shall be laid with sensor paver capable of full paving in full paving width in single operation.”

Sub-Clause 507.4.9 Rolling

Add at the end of Para 1 “The rolling shall be continued till the density achieved is at least 98% of that of laboratory Marshall specimen compacted as detailed in Table 500-11.”

Sub-Clause 507.9 Rate

Delete the sub-clause and substitute as follows:

“The contract unit rate for dense bituminous macadam shall be payment in full for carrying out the required operation as specified except the items of tack coat and prime coat, if any. The rate shall include but not necessarily limited to all components list in clause 501.8.8.2.(i) to (ix)”

no extra payment shall be made for the bitumen content above the minimum required if the required bitumen content is more as per the jobmix formula.

CLAUSE 508 SEMI-DENSE BITUMINOUS CONCRETE

Sub-clause 508.2.1 Bitumen

Bitumen used shall be Crumb Rubber Modified Bitumen (CRMB), i.e. Straight Run Bitumen of Penetration Grade S55 Blended with Treated Crumb Rubber complying **Clause 521**.

Delete words “65” indicated in last line of Table 500-15 and insert “CRMB S-55”

Sub-clause 508.9 Delete the sub-clause and substitute as follows:

“The contract unit rate for **semi-dense bituminous concrete** shall be payment in full for carrying out the required operation as specified except the items of tack coat and prime coat, if any. The rate shall include but not necessarily limited to all components list in clause 501.8.8.2.(i) to (ix)”

no extra payment shall be made for the bitumen content above the minimum required if the required bitumen content is more as per the jobmix formula.

CLAUSE 509 BITUMINOUS CONCRETE

Sub-Clause 509.2.1 Bitumen

Bitumen used shall be Crumb Rubber Modified Bitumen (CRMB), i.e. Straight Run Bitumen of Penetration Grade S55 Blended with Treated Crumb Rubber complying **Clause 521**.

Sub-Clause 509.2.4 Filler

This clause shall be read as under:

“Filler shall be cement as approved by the Engineer.”

Sub-Clause 509.2.5 Aggregate Grading and Binder Content

In Table 500-18, the following may be substituted:

Grading	1	2
Bitumen content % by mass of total mix	Min.4.5%	Min.4.5%

The Note -1 below Table 500-18 shall read as:

“When tested in accordance with IS: 2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 500-18. In order to reduce the segregation of aggregates in the BC layer, grading 2 of Table 500-18 will be used for layer of thickness up to 50 mm.” (not up to 45 mm as indicated)

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:

The job-mix grading shall be within the limit stated in sub clause 509.2.5 and the bitumen content shall be determined by carrying out a series of Marshall stability tests as per AASHTO: T 245 and durability test as per ASTM D 1075 and satisfying the following criteria:

No. of blows each end	75
- Minimum stability (kN at 60C)	9.0
- Minimum flow (mm)	2.0
- Marshall quotient (kN/mm)	3.0-6.0
- Air voids in total mix (%)	4-6
- Voids in mineral aggregate filled with bitumen (%)	70-85
-Loss of Marshall Stability by submerging Specimens in water at 60°C for 24 hrs. as compared to stability measured after Submersion in water at 60°C for 30-40 minutes	25 percent max.
- Filler binder ratio	0.6-1.2
- Air voids at refusal density (300 blows at each end of Marshall Specimen at Optimum Binder Content)	3% min.
-Swell Test (Asphalt Institute, MS-2, No.2), maximum = 1.5%	

Sub-Clause 509.4.2 Preparation of base

Add at the end of para:

“Before laying the bituminous concrete layer, the bond between the Dense Graded Bituminous Macadam with the underlying Bituminous Macadam if any must be checked by coring through both the layers at a frequency decided by the Engineer.”

Sub-Clause 509.4.7 Spreading

Add the following at the end of the clause:

“The bituminous concrete layer shall be laid with sensor paver capable of paving in full pavement width in single operation”.

Sub-Clause 509.4.8 Rolling

Add the the following at the end of the clause:

“Rolling shall be continued until the density achieved is at least 98% of that of laboratory Marshall Specimen compacted by 75 blows on each of the two faces of the specimen.”

Sub-Clause 509.9 Rate

Replace the wordings from “The contract Clauses 507.9” in this clause with the following:

“The contract unit rate for bituminous concrete shall be payment in full for carrying out the required operation as specified except the items of tack coat and prime coat, if any.

no extra payment shall be made for the bitumen content above the minimum required if the required bitumen content is more as per the jobmix formula.

Clause 510 Surface Dressing

Sub-Clause 510.2.1 Binder

This clause shall be read as under:

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

Clause 511 OPEN GRADED PREMIX SURFACING

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

Sub-Clause 511.1.8 Rate

Delete the sub-clause and substitute with the following:

“The contract unit rate for open graded premix surfacing shall be payment in full for carrying out the required operation as specified except the items of tack coat and prime coat, if any. The rate shall include for all component list in clause 501.8.8.2.(i) to (ix)”,

CLAUSE 512 CLOSE GRADED PREMIX SURFACING/MIXED SEAL SURFACING

Sub-Clause 512.8 Rate

Delete the sub-clause and substitute as follows:

“The contract unit rate for close graded premix surfacing/mixed seal surfacing shall be payment in full for carrying out the required operation as specified except the items of tack coat and prime coat, if any. The rate shall include for all component list in clause 501.8.8.2.(i) to (ix)”,

CLAUSE 521 Modified Binder

Sub-Clause 521.2.1 Base Binder

Read 1st sentence of the para as under:

The base binder shall be Bitumen of penetration grade CRMB 55 as per IS 73.

Sub-Clause 521.2.2 Modifier

Read last sentence of the Para as under:

Only modified binder blended at the refinery shall be used.

SECTION 800 TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES**CLAUSE 801 TRAFFIC SIGNS****Sub- Clause 801.1 General****Sub- Clause 801.1.2** This Clause shall read as follows:

“The signs shall be reflectorised. They shall be retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these specifications.”

Sub-Clause 801.2.6 This clause shall read as under:

“The aluminium sheet used for signs shall be 2mm 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 used on permanent traffic signs shall be of High Intensity grade with encapsulated lens; the sheeting used on temporary signs and temporary traffic control devices may be either High Intensity grade or Engineering grade.”

Delete last sentence of this clause.

Sub-Clause 801.3.3 Engineering Grade Sheeting**Sub-clause 801.3.7 Colour**

Delete the first sentence and the list.

Add the following sentence:

All the signs, including the facility information and place identification signs, shall have the colours specified in IRC 67-2001.

Sub-clause 801.3.11 Add the following sentence to the end of the first paragraph:

In addition the Contractor/supplier shall submit a lot certificate in original from the manufacturer of the retro-reflective sheeting stating that the material lot being supplied under the purchase order conforms to the standards specified for retro-reflective sheeting and carries the appropriate warranty.

Sub-clause 801.4.1 The third & subsequent sentences of the clause shall read as follows:

Except where ribs or flanges are an integral part of the sign plate and provide the necessary stiffening, sheet metal sign plates exceeding 500mm in any dimension shall be stiffened by the attachment of a frame or stiffening member(s) to the back of the sign plate. Sign posts shall be of MS or G.I. pipe 80mm dia. (NB-MW) or as shown in the drawing. All open-ended posts, or other hollow sections, shall be effectively capped to prevent the entry of water. Post shall be embedded in concrete (M-15) for safeguard against theft. The cost of the 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 801.6 Rate

Add, “including cost of concrete” after the word “at the site” in the 2nd line.

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 descaled, 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 painted 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 802.9.1 This clause shall read as under:

“The structural steel part of the overhead signs shall be measured in tones while the sign board shall be measured in square metre. All other items like painting of structural steel and signboard etc. shall be considered incidental and no separate payment shall be made. The contract unit rate for over head sign structures shall be payment in full compensation for furnishing all labour, materials, tools, equipment, excavation, fabrication, installation and all other incidental works necessary to complete the works to the specification. Excavation for foundation, concrete and reinforcement in foundation shall be paid extra in respective item of Bill of Quantities

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 thermoplastic material shall be factory mixed, from a manufacturer approved by the Engineer, and shall be of a tropical grade suitable for application, by the means proposed, to the specified road surfaces.

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 commenced, 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**Sub-Clause 803.6.3** Substitute 250gm by 350gms in the last line of this sub-clause

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

Sub-Clause 803.6.6 Tolerances

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 10 mm in 15 m.
- 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 split 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 hectometre/kilometre stones shall be made of concrete of grade as shown in the drawing."

CLAUSE 805 ROAD DELINATORS**Sub-Clause 805.2** This clause shall be substituted as follows:

The delineators shall conform to Recommended Practice for road Delineators, IRC: 79.

- a) Roadway Indicators shall be 1000mm 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 40mm width, so that total width of reflector shall be 120mm. A wire mesh cover of 150mm height shall be provided on top or as shown in the drawings.

b) Rectangular hazard marker 600mm x 300mm made out of 2mm thick aluminium 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 of desired colour as per sign details. The sign plate shall be fixed with 6mm dia aluminium rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 40mmx40mmx5mm. The sign shall be fixed to 80mm dia (NB-MW) MS pipe or as shown in the drawings.

c) Triangular Object Marker shall be 300mm side with four red reflectors, made out of 2mm thick aluminium 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. aluminium 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 50mm dia (NB-MW) and 500mm high or as shown in the drawings. 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 words 'HPPWD' should be engraved on each stone appropriately".

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 concrete 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, 0.22 kg/ sq. metre; minimum single spot) conforming 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 809.3.2 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 metres of concrete placed in position and accepted length of barrier in place. The steel reinforcement shall be measured in tonne.

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 810.1.1** Add after the first sentence:

“All components shall be obtained from a specialist manufacturer of crash barrier systems approved by the Engineer.”

Sub-Clause 810.1.2 The clause 810.2 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 of cold roll forming from steel strip of 3 mm thick using steel of Fe 410 grade conforming to IS: 5986 with hot dip galvanised 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 5 mm thick sheet by cold roll forming process of steel conforming to IS: 2062-1999 Grade 'A' with hot dip galvanised 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 meter.

The metal crash barrier shall be fitted with reflector tabs placed in position as shown on the drawings. They shall be made of metal that has been hot-dip galvanised and they shall be faced with High Intensity grade retro-reflective sheeting. Reflectors shall be bolted to the beams at every 10th post, or as otherwise specified on the drawings.

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

Sub-Clause 810.2.3 Add at the end of this Clause

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

Sub-Clause 810.4 Installation of Posts

The sub-clause 810.4.1, 810.4.2, 801.4.3 and 810.4.4 are replaced as below:

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

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

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.”

Sub-Clause 810.7 Measurements for Payment

Sub-Clause 810.7.1 The 2nd sentence "Terminals/ Anchors of various types shall be paid by numbers" 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, concrete footing and metal reflector 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 Add the words, “and concreting” after “backfilling” in second line of this sub-clause

Sub-Clause 810.8 Rate

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

Add the following clauses at the end

CLAUSE 812 ROAD STUDS (RAISED PAVEMENT MARKERS)

Sub-Clause 812.1 General

Road studs shall be designed to provide effective, long-lasting visibility at night. They shall be durable and incorporate abrasion-resistant retro-reflective lenses and be suitable for installation on asphalt and cement concrete road surfaces. They shall show white, red or yellow colour and be uni-directional or bi-directional as shown on the Drawings or as otherwise directed by the Engineer.

Sub-Clause 812.2 Materials

Road studs shall conform to ASTM D4280 type "H". Each retro-reflective lens element shall be not less than 10 sq. cm in area and shall be of a corner cube micro prismatic type with an abrasion-resistant coating or protective layer. The minimum coefficient of retro-reflection shall be as indicated in Table 800-5.

TABLE 800-5 ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR ROAD STUDS (milli candel as per lux)

Observation Angle	Entrance Angle	White	Yellow	Red
0.2	0	279	167	69
0.2	20	112	67	28

The Contractor shall supply a certificate from an independent laboratory to the effect that the stud has been tested and meets the standard.

The body of the stud shall be made of moulded plastic or metal alloy, and shall be able to withstand heavy loads and impacts. The studs shall not project more than 20 mm above the level of the surrounding road surface.

The studs shall be designed for direct application to the road surface by means of special adhesive.

The Contractor shall supply a certificate from an independent laboratory to the effect that the stud has been tested and meets the ASTM D 4280 standard for Specific Intensity, Compressive Strength and Abrasion.

Prior to supplying the studs the Contractor shall submit samples to the Engineer for approval.

Sub-Clause 812.3 Application

Road studs shall be fixed in the positions indicated on the Drawings or as otherwise directed by the Engineer. The road studs shall be fixed to the road surface by means of an approved adhesive, in accordance with the manufacturer's instructions. Sufficient adhesive shall be used to give complete coverage of the contact area and to provide a slight excess. The road studs shall be pressed down on the prepared area and all excess adhesive pressed out. The excess adhesive shall then be removed immediately with a suitable solvent. The studs shall be protected against impact until the adhesive has hardened. Before fixing, the surface shall be thoroughly cleaned.

Sub-Clause 812.4 Warranty and Durability

The Contractor shall obtain from the manufacturer a two-year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel and submit the same to the Engineer. In addition, a two-year warranty for satisfactory infield performance of the road stud shall also be given by the Contractor who carries out the work of fixing the studs. Studs which become displaced, damaged, get worn out or lose their reflectivity shall be replaced by the contractor at his own cost.

Sub-Clause 812.5 Measurement for Payment

The measurement shall be made in numbers of road studs fixed at site.

Sub-Clause 812.6 Rate

The Contract unit rate for road studs shall be payment in full for all materials, labour and tools required for supplying and fixing of road studs and all other incidental costs for completing the work to the specifications.

Clause 813 PAINTING CONCRETE STRUCTURES

Sub-Clause 813-01 The work shall consist of painting the concrete structures like kerbs and walls with black and white paint. Before applying the paint, surface shall be cleaned to remove any dust and any other foreign material. In the case of existing surface having extensive fungus, the surface shall be cleaned thoroughly with Bio-wash. After cleaning the surface one coat of either sealer or any cement based primer shall be applied. Subsequently two coats of elastomeric paint shall be applied as shown on the drawing or as otherwise directed by the Engineer.

Sub-Clause 813.2 Measurement for Payment

The measurement shall be made in square metre of painted surface

SECTION 900 QUALITY CONTROL FOR ROAD WORKS

CLAUSE 901**General****Sub-Clause 901.1**

This clause shall read as under:

"All materials 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."

Sub-Clause 901.9**Add following at the end of this sub clause**

The site trails to be carried out by the contractor as per the direction of the Engineer shall be treated as incidental to the work. The surface regularity tests on pavement courses shall be incidental to the work.

Add the following Clause after Clause 901.15.**Clause 901.16.****Site Trial**

Full scale Site trials shall be carried out by the Contractor on all earthwork and pavement materials proposed for the Works using the equipment and methods proposed by the Contractor for constructing the Works. The trials shall be carried out under the full supervision of the Engineer.

The trials shall be carried out to enable the Contractor to demonstrate the suitability of his mixing, placing and/or compaction equipment to provide and compact the material to the specified density and to confirm that the other specified requirements of the completed earthworks and pavement courses can be achieved.

Each trial area shall be at least 200 square metres and shall be laid to the specified depth for the material. It may form part of the Works as ordered by the Engineer provided it complies with the Specification. Any areas which do not comply shall be removed.

The Contractor shall allow in his programme for conducting Site trials and for carrying out the appropriate tests on them. The trials on earthworks and each pavement layer shall be undertaken at least 14 days ahead of the Contractor's intention to commence full scale work on earthworks and on each pavement layer.

The following data shall be recorded at each Site trial:

- the composition and grading of the material, including the bitumen content and properties.
- the moisture content at the time of laying;
- the temperature at the time of laying and rolling;
- the type and size of compaction equipment and the number of passes;

- the maximum density or target density and the density achieved in the trial;
- the maximum compacted thickness of layer;
- the surface levels and surface irregularities;
- any other relevant information.

At least ten sets of tests shall be made on each 200 square metres of trial area. The site trials shall be deemed successful provided nine out of ten sets of results meet the specified requirements for the material in Clause 903. The above data recorded in the trial shall become the agreed basis on which the particular material shall be provided and processed to achieve the specified requirements.

If, during the execution of the Works, the construction control tests indicate that the requirements for a material are not consistently being achieved, then work on that layer shall stop until the cause is investigated. Such investigation may include further laboratory and Site trials on the material to determine a revised set of data as above, when agreed, shall be the basis on which all subsequent material shall be provided and processed to achieve the specified requirements.

Approval by the Engineer to a set of data recorded as above in a Site trial shall not relieve the Contractor of responsibility to comply with the requirements of Technical Specifications.”

CLAUSE 902 Control of Alignment, Level and Surface Regularity

Sub-Clause 902.3 Surface Levels

Add “and or thickness” after the word “levels” in the 1st line of the first paragraph.

Add at the end of first sentence “or as desired by the Engineer” in the last paragraph.

Sub-Clause 902.4 Surface Regularity of Pavement Courses

Add after the last paragraph

“ In addition to the above requirements, the surface wearing course shall have smooth longitudinal profiles which provide a high standard of ride quality. Roughness testing shall be carried out upon completion of the wearing course. The ride quality of the surface course, measured over 50 or 100 m intervals, shall have Roughometer roughness values of not greater than International Roughness Index (IRI) value of 3.0 m/km (three), measured by Class I instruments, at the time of handing over of mile stone / road section and 3.5 IRI (three and half) 3.25 IRI (three ana a quarter) afte upon the completion of the twelve month Defect Liability Period (DLP)”.

- Roughness testing shall be carried out for each lane length constructed. For the purpose of determining readability
- Each lane shall be divided into sections 500m long
- Any remaining length less than 500m shall be included with the section immediately preceding it and an average roughness determined for the total section.

The roughness count shall be determined by the average of three replicate test runs. Roughness testing shall be carried out using a Roughometer at 32 km/hr in accordance with IRC and CRI guidelines. The Roughometer shall be calibrated against a MERLIN as outlined in IRC and CRI

guidelines. If the vehicle is changed the Roughometer shall be re-calibrated with the new vehicle.

In addition to the above requirements, the surface wearing course shall have smooth longitudinal profiles which provide a high standard of riding quality. Roughness testing shall be carried out upon completion of the wearing course. The riding quality of the surface course, measured over 50 or 100 m intervals, shall have Roughmeter roughness values of not greater than International Roughness Index (IRI) value of 3.0 m/km (three), measured by the Class I instruments, at the time of handing over of the mile stone / road section and 3.5 IRI (three and half) 3.25 m/km IRI (three and a quarter) after upon completion of the twelve month Defect Liability Period (DLP)

CLAUSE 903 Quality Control Tests During Construction

Sub-Clause 903.4 Tests on Bituminous Constructions

In Table 900-4, serial No.6 for Dense Bituminous Macadam/Semi Dense Bituminous Concrete and for Bituminous Concrete, add the following at the end in the frequency (Minimum) column:

"10% of the density tests shall be done within 300mm width from edges."

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

"The density test shall be carried out by 100 mm 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, modifies 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	(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.

Add the following Sub-Clause 903.4.3 & 903.4.4

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

Add the Sub-Clause at the end of para:

The characteristics to be tested on completed bituminous layers are:

Relative compaction

Layer thickness

The bond between two successive bituminous layers and therefore the efficiency of the tack coat.”

For testing the above characteristics, 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 is on a continuous basis, a lot shall normally mean one-day 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 than that of the rest;
- The rate of production is very high.

Sub-Clause 903.4.4 “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 levelling, surface evenness and profile control. Use of string line is compulsory to provide signal to the electronic sensing device fitted with a Paver Finisher”.

Bituminous works shall be tested immediately after laying/finishing for:

- a) Thickness (compacted) measured by extracting cores and shall be dealt in accordance with Specifications Section 900.

- b) Density (compaction) test as performed on the extracted cores
 c) Check bond between bituminous layers by extracting cores.

“If there is no bond between the last spread bituminous layer and the underlying one, verified on 8 out of 10 cores, extracted from locations decided by the Engineer, such works shall be rejected.”

- d) Workmanship test by measuring roughness of the finished layer by duly calibrated TRL's Response Type Bump Integrator

Note: Contractor shall arrange the core extraction machine at his cost and shall take cores of the executed bituminous works jointly with Engineer at no extra cost to the Employer.

The result of tests shall be compared with the prescribed acceptable values. The payment of all such works executed shall be based on the test results. In case test results for (b) and (c) above fall below the required values in accordance with specifications, the deductions as specified below shall be worked out and applied for the executed bituminous works. Separate deduction shall be made for each attribute i.e. density test and roughness test.

Density (compaction) Test: Basis of Deduction

Core Density	Deduction in the payable rate
Less Upto 1% of requirement	@ 5%
Less above 1% and upto 2% of requirement	@ 15%
Less above 2% and upto 3% of requirement	@ 30%
Less above 3% of requirement	@ 100%. Such works shall be rejected and NIL payment shall be made.

The minimum deduction in the payable rate shall be made for an area not less than 250 sqm for each failure of density (compaction) test.

Workmanship Test: Roughness measured longitudinally

The finished bituminous layers (DBM and BC) shall be tested for workmanship (immediately before allowing traffic) by measuring roughness longitudinally separately for each lane with the Calibrated Bump Integrator. Calibration of Bump Integrator device shall be carried out using the procedure recommended in the World Bank Technical Publication No. 46. The measured roughness shall **not** exceed a value of **2000 mm/km** for finished DBM and BC layers.

In case DBM is laid in two separate lifts, the roughness shall be measured on the final DBM layer. Any completed layer (DBM and BC) having roughness in excess of the value **2000mm/km** shall be paid in accordance with the deduction formulae as specified below:

Measured Roughness	Deduction in the payable rate
- Upto 5% more than the requirement	Nil

Measured Roughness	Deduction in the payable rate
- More than 5% and upto 30% more than the requirement	@ (10%+1% for every 1% in excess of 5% of prescribed limit)
- More than 30% and upto 40% more than the requirement	@ 50%
- Above 40% of more than the requirement	@ 100% (i.e. Nil payment)

“The area for which deduction in the payable rate apply, shall be determined by the Engineer based on analysis of roughness results. However, regardless of any other consideration, the minimum deduction applicable shall not be less than one lane for one km surface area i.e. 3500 sqm.”

Sub-Clause 903.5 Quality Control Tests for Road Constructions.

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 leastfor 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 groups 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 groups 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 test results shall 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 suspect, 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 150 mm diameter, shall be saw cut in both ends to provide a specimen height of 300 mm \pm 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 trial 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 and Testing of Beam and Cube Specimens.

Delete seventh para (“The standard deviation the requirements.”)

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

Delete eighth para (“An individualis substandard.”)

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

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

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

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

Sub-Clause 903.5.2.4 Summary of Control Tests.

In Table 900-6, item 5 (I) “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 300 m³. Two additional beams and two additional cubes for each 100 m³ (or part thereof) in excess of 300m³.”

Sub-Clause 903.5.2.4 Summary of Control Tests in Table 900-6, item S(I) “(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 1000 mm from any free edge. The temperature shall be measured using a thermometer that shows maximum temperatures. From 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 the 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 test results of different samples is within acceptable limits. If the product from the approved source proves unacceptable at any time, the Contractor shall provide new sources of acceptable material from other sources at his own expense conforming to specifications.

The manufactured items like cement, steel reinforcement, prestressing strands; the Contractor shall intimate the Engineer details of the source (plant where the material is manufactured), testing facilities available with the manufacturer and 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 his discretion, may require the Contractor to test the materials 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 directions 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, conforming 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 cements shall be used with a certain caution as high early strengths of cements in the 1 to 28 day range can be achieved by finer grinding and higher constituent ratio for C_3S/C_2S , where C_3S is Tricalcium Silicate and C_2S is Dicalcium Silicate. In 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 and 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 (SO_3) 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 should cover all the tests for chemical requirements, physical requirements and chloride content as per the provisions of IS:12269.

Independent tests 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 90 days 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 a maximum of 500 tonnes.

CLAUSE 1007 COARSE AGGREGATES

Delete from the first sentence “crushed gravelinert material” appearing in 4th and 5th line of Para 1.

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 the 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 winning 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 the 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 prestressing steel shall conform:

(e) Stress relieved low relaxation seven-ply strand for pre-stressed concrete IS: 14268

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" bars.

Delete last Para of the clause.

CLAUSE 1010 WATER

In Para (C) the permissible limit for Chlorides (Cl) shall be read as "250 mg/lit for structures having length more than or equal to 30 m."

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

CLAUSE 1012 CONCRETE ADMIXTURES

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

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 of 1012.1 shall 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. Values 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 to 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 the 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 tests 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 trial 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 trial 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.

CLAUSE 1014 STORAGE OF MATERIALS

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 the various sizes will not become intermixed before proportioning. They shall be stored, stockpiled 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 steel 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 7.2.1 of BS- 5896:1980. These tests are in addition to the tests carried out by the Manufacturer.

SECTION 1200 WELL FOUNDATIONS

CLAUSE 1202 GENERAL

Sub-Clause 1202.2 Substitute 1st sentence of this clause "At least onecommencement 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) Wherever both borehole and electrical resistivity (ER) methods are proposed, atleast one ER shall be conducted in the vicinity of one borehole to calibrate the ER results with actual sub-soil findings 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 Wenner 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 inference and conclusions with supporting documents as regards to sub-soil profiling and conditions with depth (upto atleast twice the width of foundation below founding level) shall be provided to Engineer within 3 days of testing.

CLAUSE 1204 CUTTING EDGE

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

The cutting edge shall be laid 300 mm above the prevalent water level or at top 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.

CLAUSE 1214 MEASUREMENTS FOR PAYMENT

Add the following at the end of Para (a)

Earthwork in excavation above bottom of cutting edge shall be measured in cubic meters and shall be carried out and paid in accordance with section 300 of these specifications.

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 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 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 specify the strata such as soil (all types of soil including boulders) and types of rock.

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 300 mm 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 repairs.

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 approved internal steel ties or plastic spacers shall be permitted. Structural steel tubes used as support for forms shall have a minimum wall thickness of 4 mm.”

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 or the permanent works below (e.g. pile cap) in such a manner that any total or differential settlement 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 sideway 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 be 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 panel/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 Para 2 of this clause shall read as follows:

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 bars of grade Fe 415 conforming to IS: 1786. Only uncoated steel shall be used as reinforcement unless specified".

CLAUSE 1604 BENDING OF REINFORCEMENT

Para 1 of Clause 1604 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 any 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 cover 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 2 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 untensioned 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, ROB,s, Flyovers, Grade Separators) and minor bridges (bridges with total length less than 60 m & 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	0.40	0.40

(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 /cu.m.

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 manufacturer'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 conditions. 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 aggregates 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 0.25 mm). Proportion of fine aggregates passing through 0.25mm shall be between 15 and 30% and that passing through 0.125 mm 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 requirements, 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 foundations.	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, dirt walls, coping on masonry wing walls, hollow abutments and piers, pier / abutment caps, pedestals, dirt walls, piles, all components of counter fort type abutments, columns, cantilever return walls etc.	20
e. All PSC works	As specified by the Engineer
f. Any other item	

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 \pm 1% of the quantity of cement in each batch.

Measurement of Water \pm 1% of the quantity of water in each batch.

Measurement of Aggregate \pm 2% of the quantity of Aggregate in each batch.

Measurement of Admixture \pm 1% of the quantity of Admixture in each batch.

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

Add the following paragraph at the end of the clause:

Batching, mixing transportation and placing concrete.

Once the concreting of a section 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 concreting 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 of 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 pipelines; 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; aluminium alloy pipelines shall not be used.

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

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

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 it loosens the coarse aggregate and results 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 inner surface of the stopping board shall be placed, if directed by the Engineer, to facilitate removal of laitance."

CLAUSE 1712 ADVERSE WEATHER CONDITIONS

Sub-Clause 1712.2 Hot Weather Conditions

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 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 Para I:

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) ' $\delta_a = (a_{\text{nominal}} - a_{\text{actual}})$ '
$a \leq 200$	$ \delta_a < 5$
$200 < a \leq 2000$	$ \delta_a < 3.5 + 0.0075a$
$2000 < a$	$ \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 Para 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 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-3 sec. Value	:	60
-15 sec. Value:	:	58
Notch impact strength at 23 °C :	:	10 KJ/m ²
- 40 °C :	:	4 KJ/m ²
Coefficient of Thermal Expansion for 20 °C - 80 °C	:	1.50 x 10 ⁻⁴ KJ/m ²

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

The ducts shall be corrugated on both sides. 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 methods, as convenient to suit the individual requirements of the location, subject to the 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.

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 systems", 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 testing 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 displacements between the anchorage components as well as between the prestressing steel and anchorage components should not be disproportionate to the increase in tendon force.

- The above relative displacements during the 0.8F_{pk} 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/FIP Guidelines for details).
- The total elongation ϵ_u in free length of the tendon under the load F_{tu} should be $\epsilon_u \geq 2\%$

b) Dynamic load test with tendon/ anchorage assembly

This test is to be carried out for every new combination of type of anchorage and tendons. 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 without 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, pumps and pressure gauges shall always be available at site where prestressing is in progress.

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, anchorages, 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 Specifications. 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 tendons. Further 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 anchorages / sheathing for dummy cables and future prestressing cables 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 short fall of prestress or for any other reason.

CLAUSE 1816 JOINTS IN CONSTRUCTION WITH PRE-CAST-UNIT

Add new clause:

Joints between a series of precast concrete units which are to be prestressed 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 review and modifications of designs and drawings of bearing pedestals and other elements required for installation. The installation of bearings shall be carried out under the supervision of the manufacturer of the bearings. The Contractor shall provide the bearings only from the manufacturers 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 own cost testing of random samples of 1 % (Minimum 1 no. of each type) of bearings from independent agencies, other than manufactures' own facilities, duly approved by the Engineer. The bearings shall be selected by the Engineer / his authorised representative and duly sealed in his presence for dispatch to the independent agency.

CLAUSE 2004 SPECIAL BEARINGS

The clause shall read follows:

Sub-Clause 2004.1 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 authorised representative" for the word "Inspector".

Sub-Clause 2005.3.5 Inspection Certificate

Substitute the words "Engineer or his authorised 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 MEASUREMENTS FOR PAYMENT

Add the following after Para 2:

"Tar Paper bearings shall be measured in square meters."

CLAUSE 2011 Add new clause as under:

"Tar Paper bearing shall be reinforced bitumen laminated Kraft paper conforming to IS-1398".

SECTION 2100 Open Foundations

CLAUSE 2106 TOLERANCES

Reference to Tolerance shall be made to Clause 1715.

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 structures (old / new) wherever required / as shown in drawing shall be incidental to work and shall not be measured / paid separately.

SECTION 2300 CONCRETE SUPER-STRUCTURE

Clause 2305 PRESTRESSED CONCRETE CONSTRUCTION

Sub-Clause 2305.2 Box Girder

Add the following at the end of paragraph 1:

“Contractor shall, in his methods 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 PITCHING/REVTMENT ON SLOPES

The title of this Clause shall read as under:

“PITCHING/REVTMENT ON SLOPES & FILTER MEDIA”

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-II).”

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 manufacturers/ suppliers of expansion joints who are empanelled with MOSRT&H.

The MOSRT&H (formerly, Ministry of Surface Transport) had issued modified interim specifications for expansion joints vide letter dated 31/03/97 and revised vide letter No. RW/NH-34059/1/96 - S&R dated 30th Nov, 2000 and 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**

Sl. No.	Type of Expansion	Suitability for Adoption Joint	Expected Service Life	Special Consideration
---------	-------------------	--------------------------------	-----------------------	-----------------------

Sl. No	Type of Expansion	Suitability for Adoption Joint	Expected Service Life	Special Consideration
1.	Buried Joint	Simply supported spans upto 10 metres	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 metres.	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 25 mm. Ambient temperature should be in the range of 5 degree to 50 degree Celsius.	10 Years	Only for decks with bituminous/ asphaltic wearing coat. Not suitable for bridge with longitudinal gradient more than 2 % and cross camber/ superelevation exceeding 3 %. Not suitable for curved spans and spans resting on yielding supports.
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 40 mm.	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 50 mm	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 seal joint*	Moderate to large simply supported, cantilever/ continuous construction having right, skew or curved deck with maximum horizontal movement up to 70 mm	25 Years	Electrometric seal may need replacement during service.

Sl. No	Type of Expansion	Suitability for Adoption Joint	Expected Service Life	Special Consideration
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 70 mm	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 movements/ rotations in different directions/ planes, provision of special type of modular expansion joints such as Swivel joints may be made.	25 Years	Electrometric seal may need replacement during service. Provision of these joints may be made with prior approval of the 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

BURRIED, 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 20 mm.
- c) The steel plate shall conform to weldable structural steel as per IS:2026. The plate shall be 12 mm thick and 200 mm 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, 100 mm long nails, spaced at 300 mm centers along the center 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 of 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 center line of the joint and it shall be ensured that the plate does not get displaced from its position while laying the wearing course.

Sub-Clause 2604.2 Asphaltic Plug Joint

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 caulking/ 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 joints.
- 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 25 mm & vertical movement of 2 mm. This shall be certified by the manufacturer/ supplier of the joint.
- d) The minimum width (in traffic direction) of the joint shall be 500 mm and maximum width shall be 750 mm.
- e) Minimum depth of joint shall be 75 mm and maximum depth shall not exceed 100 mm.
- f) The joint shall be capable of performing satisfactorily, within the temperature (ambient) 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 aggregate 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 requirement:

Softening point	:	100 deg. C minimum
Core penetration at 25 deg. C 0.1 mm (BS2499)	:	100 mm max.
Flow resistance at 70 deg. C 5 hours (BS 2499)	:	3 mm max.
Extension Test (blocks prepared o ASTM D)	:	5 cycle of extension to 50 per cent at a rate of
1190 and tested to limits (BS2499)	:	3.2 mm/h at 25 deg.C

Safe heating temperature : 210 deg. C

b) Aggregates:

The aggregate shall be single size aggregate chosen from basalt granite, grit stone or gabro group. The nominal size of aggregate shall be 12.5 mm for depths of joints upto 75 mm and 20 mm for joints of more depths of joint. The aggregate shall not be flaky and the Flakiness Index shall not be more than 25 per cent. The aggregate shall satisfy following grading requirements:

IS Sieve Designation	Nominal size of aggregate	
	20 mm	12.5 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	---	---
75 micron	0-1	0-1

The aggregate should have good (I) Polished Stone Value (PSV), (ii) Aggregate Abrasion Value (AAV), (iii) Aggregate Impact Value (AIV) and (iv) Aggregate Crush Value (ACV). In addition surface characteristics 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 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 lane 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 center 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/Cu.m.

**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 blockout 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 – 190° 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 aggregates 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.

Clause 2604.2.6

Tests and Standard of Acceptance

The material shall be tested in accordance with these specification and shall meet prescribed criteria. The manufacture/ 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 2604.3

COMPRESSION SEAL JOINT

Clause 2604.3.1

Compression seal joint seal joint shall consist of steel armoured nosing at two edges of the joint gap suitably anchored to the deck concrete and a performed chloprene 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 nosing

The steel nosing shall be of angle section ISA 100 x 100 conforming to weldable structural steel as per IS:2062. The thickness of legs shall not be less than 12 mm. The top face of the angle shall be provided with Bleeder holes of 12 mm diameter spaced at a maximum 100 mm centers so as to 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 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 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 galvanizing or any 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 vulcanised in a single operation for the full length of the joint required for carriageway, kerbs and footpaths, if any. The seal shall cater for a horizontal movement 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 of performed non extruded non cellular section made from low density closed cell, crossed linked ethylene vinyl acetate, polyethylene copolymer that is physically brown using nitrogen. The material shall possess properties as indicated in **Table. 1** below.

Table – 1

	Property	Specified Value
i)	Density	41.7 – 51.3 Kg/ Cu.m
ii)	Compression Set on 25 mm	50 percent compression samples (ASTM D3575) for 22 hours at 23 degree Celcius, 2 hour 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/ sq.m.
v)	Tensile strength	0.8 Mpa
vi)	Elongation at break (ASTM D3575)	195 +/-20 percent

e) **Lubricant cum 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.

**Sub-Clause
2604.3.3**

Handling and Storage

- 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 instructions.
- 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 the 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 also 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 of rust, laitance, oils, dirt, dust or other deleterious materials.
- g) The lubricant cum Adhesive shall be applied to both faces of the joint and joint seal prior to installation in accordance with the manufacture'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 35°C.
- i) The joint seal shall be installed without damage to the seal. Loose fitting or open joints shall not be permitted.

**Sub-Clause
2604.3.5**

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 ponding shall be atleast 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
2604.3.6**

Test and Standards of Acceptance

The material shall be tested in accordance with these specifications and shall meet the prescribed criteria. The manufacturer/ 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 replaced fully as below:

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 12 mm. Total cross sectional area of bar 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.

Sub-Clause 2607.1.2

Material

- a) The steel for 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 300 W or equivalent.
- b) Anchorage steel shall conform to IS : 2062 or equivalent.
- c) All steel sections shall be protected against corrosion by hot dip galvanizing 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** below:

TABLE – 2

STRIP SEAL ELEMENT SPECIFICATION

Sealing element is made of chloroprene and must be extruded section. The working movement range of the sealing element shall be at 70 mm.

PROPERTY	SPECIFIED VALUE
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	
(22 h/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	
(24 h/50 pphm/25 deg C/20 per cent elongation)	No cracks
Swelling behaviour in Oil	
(168h/25 deg. C)	
ASTM Oil No. 1	
Volume Change	Max + 5 per cent
Change in Hardness	Max – 10 Shore A
ASTM Oil No. 3	
Volume Change	Max + 25 per cent
Change in Hardness	Max + 20 Shore A

PROPERTY	SPECIFIED VALUE
----------	-----------------

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 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. Prestressing shall be done in accordance with the joint opening indicated on the drawing.
- d) The finally assembled joint shall then be clamped and transported to the work site.

**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 jointing
- 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 representative 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 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 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, scrapper 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 recognised 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 withstand 2×10^6 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.

The minimum height of the edge beam and central beam sections shall be 80 mm. Minimum cross sectional area of edge beam shall be 1500 sq.mm. The material shall conform to any of the steel grade corresponding to RST 37-2 or 37-3 (DIN), ASTM A36 OR A588, CAN/CSA Standard G 40.21 Grade 300 W or equivalent. The material for support bars may be same as that of edge / central beams or as per manufacturer's recommendations.

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.

Chloroprene seal shall conform to clause 915.1 of IRC:83 (Part-II). The properties of chloroprene shall conform to Table 2 of these specification.

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 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. The anchor loop at the edge profiles should be at a right 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 center to center 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 the 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**

I 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 of Modular Strip / Box Seal joints including sealants and all other accessories for the effective installation of the jointing.
- c) Expansion joint material shall be handled with care. It shall be stored under cover on suitable lumber padding.

**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 leveled 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 the 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 had 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 specialised 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

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.

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

Clause 2608

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 2609

RATE

The contract unit rate 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

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 materials 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 form” method is adopted, full details of the method and literature shall be furnished.

Grade of concrete for Crash barriers on deck slab, approach slab etc. shall be M40, whereas concrete grade of M 25 shall be used for crash barriers on right return walls, retaining walls etc.

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 plans 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 concrete crash barrier or precast shall be given two coats of cement paint or aqua based paint as as directed by the Engineer of approved brand and shade.

Sub-Clause 2703.5.4 Tolerance

Bidder

Chief Engineer-cum- Project Director,
State Roads Project, Nirman Bhawan, Shimla-171002 (H.P)

The overall horizontal alignment of crash barrier and rails shall not depart from the road alignment by more than ± 30 mm, nor deviate in any two successive lengths from straight by more than 6 mm and the faces shall not vary more than 12 mm from the edge of a 3 m 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 ± 30 mm.

Sub-Clause 2703.5.5 Measurements for Payment

All barriers will be measured in linear metres of concrete in place, including approach and departure ends. The steel rails on the top of crash barrier shall be measured and paid separately. The sealing of opening in crash barrier at expansion joints with polysulphide rubber joint sealant and bituminous fibreboard as per sub-clause 2703.6 shall be incidental to work. The painting shall be measured in square meter.

Sub-Clause 2703.5.6 Rate

The Contract unit rate shall include full compensation for furnishing all labour, materials including steel reinforcement as per drawings, tools, equipment 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 100 mm 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 150 mm above the low water level or ground level whichever is higher or as directed by the Engineer."

CLAUSE 2709 RATE

The second paragraph shall be read follows:

"The contract unit rate of parapets and railings shall include the cost of all labour, materials tools and plant required for completing the unit in accordance with specifications".

Add at the end of Para 2:

The contract unit rate for approach slab shall include cost of providing and laying in position bitumen joint filler with joint sealing compound in the 20 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 2809.1

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 the 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 any 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 clause 2809.3

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 1000m.

New clauses 2811 to 2829 shall be added after Clause 2810 as given below and existing clauses 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 MOSRT&H Specifications Section 200 clause 202. All damaged concrete in wing walls; returns, piers and abutments shall be thoroughly inspected to identify the extent 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 railing and kerbs shall be done carefully such that the existing reinforcement, which will project into the 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. 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 dust 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 gloves 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 MOSRT&H Specification Section 200 Clause 202. Damaged brick / course rubble masonry in wing walls / return 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 designate 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 gloves 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 MOSRT&H Specifications section 200 clause 202 only portions which interfere with the construction of wing walls/return/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 lead up to 1000m. Materials, which can be used or auctioned,

shall be stored in neat piles at locations designated by Engineer with all lifts and lead up to 1000m.

Goggles and gas masks shall be worn at the time of dismantling. Leather gloves 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 FIXING DOWEL BARS IN DECK SLAB AND GROUTING WITH NON-SHRINK FREE FLOW CEMENT GROUT

20 mm dia. holes, 150 mm deep, shall be drilled in existing slab at locations 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. 16/12 mm dia. dowel bars shall be inserted in the hole and kept in undisturbed position with appropriate fixture. The annular space shall be filled by non-shrink free flow cement grout.

Measurement for Payment

Measurement shall be made for number dowel bars to be fixed in deck slab. The reinforcement steel shall be measured separately.

Rate

Contract unit rate for each dowel bar fixed in deck slab shall cover cost of all material, labour, tools, plant and equipment required for drilling of holes in deck slab, non shrink cement grout etc. but excluding cost of reinforcement steel.

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 manufacturers.

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 spouts 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 MOSRT&H 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 provided 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 substrate shall be primed with PMC slurry.

The specifications 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

- o Cement -100 parts by weight
- o Monobond-2000 - 40 parts by weight
- o 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
10 mm	100
4.75 mm	100
2.36 mm	100
1.18 mm	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 CI 3.2.1 & CI 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 favourable uninterrupted weather condition existing throughout the existing recommend drying period. Some judgments shall be made in this respect & if conditions are deemed unfavourable 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 of 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 & 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. Records 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

A. Mechanical Strength of Bonding Slurry

Bond Strength –

- WET- 3-4 N/MM²
- DRY –7-8 N/MM²

Above bonding slurry should confirm 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 VOID 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 the adjacent surface. Unused mortar or mortar which has partially set shall not be used. Mortar shall be applied in layers to avoid sagging. Manufacturers 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 & 2804.

The cracks shall be sealed with epoxy mortar prior to injection.

CLAUSE 2821 INSPECTION & 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 instructions.

In respect of metallic bearings, fresh graphite grease as approved by the Engineer shall be applied to the surfaces, which are sliding, rotating or moving due to movement 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 bearing 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 FOR RESETTING/REPLACEMENT OF ROCKER AND ROCKER CUM ROLLER BEARINGS, SEGMENTAL BEARINGS AND ELASTOMERIC BEARINGS

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 specialized work. Contractor shall furnish a methodology statement with his proposal for 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 1.5 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 30 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 & 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 diaphragms shall be closely watched during lifting and also for the entire duration when the span is supported on jacks and packing. If development of cracks is observed, the lifting will be stopped and alternate arrangement for supporting the superstructure shall be made subject to approval of Engineer.

The cost of all operations under this clause including all tools and plant, materials, jacks, pumps, labour etc. shall be incidental to cost of resetting / replacement of bearings.

CLAUSE 2823 APPLYING 1:3 CEMENT MORTAR TO EXPOSED SURFACE OF MASONRY OF EXISTING WING WALLS / RETURNS, ABUTMENT PIERS

All exposed masonry surface of existing wing walls / returns abutments, piers etc. shall be provided with 20 mm 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 MOSRT&H 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 P.C.C. levelling 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 20mm 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 MOSRT&H 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 P.C.C. leveling course.

CLAUSE 2825 SEALING OF WIDE GAPS AT JUNCTION OF WING WALL AND ABUTMENT WITH BRICK BATS AND FINISHING 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 MOSRT&H specifications 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 SLAB

The grade of concrete shall be as indicated in drawings/BOQ.

Approach slabs, which are cracked / missing or otherwise damaged shall be recast.

The work shall be executed in accordance with MOSRT&H specifications Section 2700 clause 2704. The approach slab 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 MOSRT&H specifications Section 2500 clause 2503. Excavation and back filling shall be done in accordance with MOSRT&H specifications Section 300.

Gabions shall consist of a double twisted Zinc & PVC coated wire mesh container of variable 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 conforming 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 (w).

i)	Dismantling of kerbs, railings, parapets, footpaths, solid slab superstructure or part of slab and approach slabs, etc. RCC and masonry items shall be measured under separate heads.	Cum
j)	Steel handrail	linear 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 to concrete with PMC mortar with average thickness of 50 mm 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 wing walls	Cum
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
t)	Concrete in approach slab	Cum
u)	Inspection, cleaning and greasing of bearings	Nos
v)	Stone pitching	Cum
w)	Gabion Walls	Cum

Clause 2832

Rate

Add the following at the end of the 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 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 plant, drilling of holes, placing dowel bar in position, grouting with non shrink free flow cement, wastage, sampling, testing and all other incidental expenses necessary for completion of work excluding steel reinforcement as per specifications.
- iv) The contract unit rate for repair to leached, honeycombed, spalled concrete by PMC or guniting 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 rate 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 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**RESTORATION OF RAIN CUTS**

Sub-Clause 3002.4 Measurement of Payment

The items shall be measured in Km-months.

Sub-Clause 3002.5 Rate

Clause shall be read as under:

The Contract unit rate for the maintenance of the road shall be inclusive of all items of work covered in Clause 3002.1 through Clause 3002.4.

ADDITIONAL TECHNICAL SPECIFICATION**CLUASE A-1****PLANTATION OF TREES AND HEDGES****1 Scope**

The work shall consist of:

- a) Planting of tree saplings in median or other designated locations.
- b) Planting of hedges within median 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 6 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 freeform bush, dust, grit and any other foreign matter.

2.5 Sapling 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 for 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 90cm dia and 100cm 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 50cm 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 powdered 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 6mm 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 shall 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.

3.2 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 5mm MS flat rings fixed as per design (iii) 15 Nos. 1.55m long 6m dia bars. Each ring shall be in two parts in the ratio of 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 top and lower ring. The bars shall be welded to the rings as directed by the Engineer. The entire tree guard shall be given two coats of paint 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.

3.3 Planting of Hedges

The hedges saplings shall be planted in two rows, one each along each edge of the median. Bed for the saplings 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 farther away than 300mm.

The planting shall be completed soon after completion of the medians.

3.4 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.

4 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.

5 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 as length or each row in linear metre.

Seeding and mulching of the median area between the hedges shall be measured as per Clause 308.

6 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 guard and maintenance as mentioned above, the cost of supplying and stacking the requisite quantity of manure and oil cake and other incidentals.

CLUASE A-2

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 side 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.

CLUASE A-3 UTILITY DUCTS

Scope

The work shall consist of laying and jointing of R.C.C. Utility Ducts in accordance with the requirements of these specifications.

Materials

Reinforced concrete pipes shall be of NP 4 type conforming to IS: 458 as shown in the drawings.

Laying of Pipes

Laying of Pipes shall be carried out in accordance with clause 2905; the Pipes shall be fitted and matched so that when laid in work they shall have a smooth uniform invert.

Jointing

The Pipes shall be jointed either by collar joint or flush joint. Caulking shall be carried out as directed by the Engineer. The provisions of clause 2906 of the

specifications shall be followed to the extent applicable. The Engineer's decision shall be final and binding.

Back Filling

Where directed by the Engineer shall be carried out in accordance with clause 2907 of the specifications.

Closing of Ends

The ends of Pipes shall be closed with plastic covers to prevent ingress of foreign materials

Measurement of Payments

The utility ducts shall be measured from end to end in linear meter.

Rate

The contract rate for ducts shall include the cost of pipes including collars and covers, handling and storing of Pipes, laying in positions and jointing, construction of head wall and inspection chamber, complete and all incidental works necessary for completion. Excavation including back filling where necessary shall not be measured and paid separately and the same shall be included in the rate for Utility Ducts.

CLUASE A-4

CONTROL BLASTING

GENERAL

The specifications for excavation in rock are covered by MOSRT&H "Specifications for Road & Bridge Works" (4th revision 2001), vide section 300. The following specifications are additional and supplementary to the same.

CONTROL 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 MOSRT&H specifications, following protective measures and limits for use of explosives are suggested as guidelines.

PROTECTIIVE 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:

Distance in m	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.

CLUASE A-5 SPECIFICATIONS FOR SCARIFICATION OF EXISTING PAVEMENT AND PROVIDING OVERLAY WITH GRANULAR BASE/DBM

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.

CLUASE A-6 FILLING OF OPEN WELLS

1. Scope

- (i) The work shall consist of removal and disposal of all unsuitable and obstructing materials, demolition of well lining, placing of selected materials in layers, and compaction in layers for filling of open wells originally used as sources for potable water. The work shall be carried out in accordance with the Specifications and as directed by the Engineer.
- (ii) These specifications would be applicable for open wells (with sizes less than 6m in diameter) over which the road embankments would be built. These would not be applicable for plugging of open wells, which are outside the limits of embankments. These open wells would require plugging using suitable materials so as to protect against contamination of aquifer. These specifications would also not be applicable for filling of ponds and water reservoirs.

Classification of Wells

- (iii) The open wells shall be classified as under:
 - a) Unlined

b) Lined

The casing/lining of wells may be of masonry, burnt clay, concrete rings or any other type.

2. Materials

- (i) The fill materials shall be sand, gravel, selected soil and such materials free from logs, stumps, roots, rubbish, compressible materials or any other ingredient likely to deteriorate, or affect the filling and shall be free from any hazardous material such as harmful chemicals, sewage etc., which could cause contamination of ground water. A mixture of sand and gravel would be acceptable as filling material because little settling would occur afterwards.
- (ii) The types of material to be used shall be as per Table-1 and as directed by the Engineer.

Table-1: Material for Filling of Open Wells

S. No.	Description	Material Type
1	Well with standing water	Mixture of sand and gravel upto 1.5m height below natural ground level. The selected granular soil with Plasticity Index (PI) < 6 for the remaining depth of well. To achieve the desired compaction, the top 1.5m shall be executed by lowering the standing water level by more than 1.5m below natural ground level.
2	Dry well with depth	Mixture of sand and gravel upto 1.5m height below natural ground level. The selected granular soil with Plasticity Index (PI) < 6 for the remaining depth of well.

Note: (1) Materials for filling of wells of sizes less than 1m in diameter shall be mixture of natural sand and gravel. (2) The selected materials (soils and sand-gravel mixtures) shall have MDD (as per IS2720, Part-8) not less than 16.0 kN/m³. The sand-gravel mix shall be as per sub clause 2504.

The size of the coarse material in soil shall not exceed 25 mm. In case of sand-gravel mixtures, the maximum particle size shall not be more than 75 mm. Sand-gravel mixtures with excessive amounts of gravel (>30%) shall not be permitted.

3. Construction Operations**(a) Removal of Obstructing Materials**

- (i) All debris such as pump, metal wires and rods, pipes, any other equipment, floating materials and logs, degradable and also not degradable materials that would cause incomplete filling of the voids shall be removed from the bed of wells so that the selected fill materials do not slump or settle afterwards. The removal and disposal shall also cover all plastic materials (e.g. used polythene bags, pipes etc.), sewage, dead animals, boulders etc. as directed by the Engineer.
- (ii) In case of lined open wells, the lining shall be dismantled up to

the level of natural ground level or one metre in height, whichever is higher.

(b) Disinfect Standing Water in Open Wells

- (i) All open wells with standing water shall be disinfected to kill microorganisms. This can be accomplished using by adding chlorine bleach @ 5 litres of chlorine bleach for every 2,500 litres of standing water and as directed by the Engineer.

(c) Removal of Well Lining

- (i) The upper 1m of well casing/lining shall be removed when the fill material within 1m of the existing ground surface.

(d) Placing and Compaction

- (i) The placing and compaction operations would commence after completion of the preceding tasks, (a) and (b), to the satisfaction of the Engineer.
- (ii) The fill material as specified in Table-1 above shall be placed in the well in layer of 500 mm using shovels and as directed by the Engineer. Dumping of materials from dump trucks and front-end loaders into the abandoned wells shall not be allowed.
- (iii) Each layer of fill material shall be compacted with the help of plate compactor or power hammer and as directed by the Engineer.
- (iv) Before allowing the next layer, it shall be ensured that the earlier layer is at the desired compaction and as directed by the Engineer.
- (v) It shall be ensured that no further consolidation/settlement takes place while in service after filling of open wells. The site over the filled open well shall be shaped as directed by the Engineer to stop ponding of water and also to absorb any settling of filling material.

4. Measurements

- (i) Measurement of well filling shall be in cum for finish work for the following items.
 - a) Mixture of sand & gravel
 - b) Selected granular soil

5. Rates

- (i) The contact unit rates for filling of open wells shall include removal of debris, dismantling of lining, cost of fill materials, machinery, labour, all compaction works, environmental protection works, if so directed by the Engineer, and disposal of unsuitable materials complete with all leads and lifts and as directed by the Engineer.

CLUASE A-7

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.

2. Maintenance

The contractor should arrange to maintain the way side amenities, truck parking sites till the issue of Taking Over Certificate.

3. 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.

4. 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.

CLUASE A-8 CURING USING LIQUID MEMBRANE FORMING COMPOUND**1. General**

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

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

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

2. Curing Compound

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

White pigmented compound (Type-2) shall consist of finely divided white pigments and vehicle solids, ready mixed for immediate use without alteration. The compound shall present a uniform white appearance when applied uniformly to a fresh concrete surface at a specified rate of application. It shall be of such consistency that it can be readily applied by spraying to provide uniform coating at temperatures above 4°C. If two coats are to be applied then it should be applied at an interval of approximately one hour. They shall adhere to freshly placed concrete that has stiffened or sufficient resist marking during the application and to damp hardened concrete and shall form a continuous film when applied at a rate of 5 m²/litre. When dry, the covering shall be continuous flexible and without visible breaks or pin holes and shall remain as unbroken film at least 28 days after application. It shall not react deleteriously with the concrete.

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

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

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

The liquid compound should be of a sprayable consistency.

3. Supply and Testing

3.1 Acceptance Testing

Prior to the approval of the brand/trade name of compound and the source of supply and manufacturer acceptance testing shall be carried out to demonstrate the conformance of the compound to Clause 1.1.1. In addition, testing shall be performed to demonstrate that no adverse/undesirable change in quality of concrete or concrete surface takes place as a result/by-product of 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.

3.2 Routine Testing

- a) The liquid membrane forming curing compound should be brought in the manufacturer's original clear containers. Each container shall be legibly marked with the name of the manufacture, the trade name of the compound, the type of compound and class of vehicle/solids, the nominal percentage of volatile material and batch or lot number. The lot numbers will be assigned to

the quantity of compound mixed, sampled and tested as single product. The manufacturer shall exercise the care in filling the container so that all are equally representative of the compound produced.

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

4. Method of Application

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

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

CLAUSE A-9 SPECIFICATION FOR GUARD POST

1. General

The work covers the construction, supply, priming, painting & fixing of guard posts at locations as shown on the drawing(s) or as directed by the Engineer.

Guard posts shall generally be located at all horizontal curves (<1000m radius) where metal beam crash barrier has not been provided.

- 1.1** The posts shall be of concrete grade M25 and shall conform to IS 10262-1982. Guidelines for concrete mix design. The precast member shall be properly checked against spalling, bruises, cracks etc. after 28 days curing to the satisfaction of the Engineer.

The posts shall be fixed at-places as shown in the drawing as decided by the Engineer with the bottom 470 mm below proposed hard shoulder finished surface. The fixation shall be such that it shall not get tilted or dislocated under normal condition.

After erection, guard posts shall be painted with one coat-primer and two coats of colour paint (white & black). All colours shall be of ready mix oil bound and shall be approved by the Engineer. There shall be three white and three black bands alternately placed.

Measurement for payment of posts

The measurement shall be in number.

Rate

The contract unit rate for guard posts shall be paid in full compensation for furnishing of all labour, materials, tools, equipment for construction, fixing, painting at site and all other incidental costs necessary to complete the work to these specifications.

CLAUSE A-10 SPECIFICATION FOR PASSENGER SHELTER

1. Scope

The work consists of providing passenger shelter including seating arrangement and raised footpath of length 13.75m on each side of the structure as per drawing.

2. Description

2.1 Passenger Shelter

It will be a permanent structure supported on R.C. columns at the corners and having sloped reinforced concrete slab with protrusions on all sides. Panel walls on three sides shall be built with brick jail of 125mm thick set in cement mortar 1:4 (1 part cement : 4 parts sand). It shall have seating arrangement with 50mm thick R.C. slab with raised back with atleast 1.5% reinforcement. The mix of concrete for seating slab and back shall be nominal one with 1:2:4 (1 part cement : 2 parts sand : 4 parts stone chips) and it will be finished with neat cement punning not less than 3mm thickness. The flooring shall be with 25mm thick I.P.S. flooring (1:2:4) over 100mm thick M-10 grade concrete. All walls, ceiling and roof top shall be finished with cement mortar (1:4). The exposed surfaces of the structure shall be painted with two coats of cement based paint of make and brand approved by the Engineer.

2.2 Raised Footpath

Raised footpath shall be constructed with one layer of brick flat soling laid over one layer of brick on end soling placed on 100mm thick M-10 concrete. Brick on end soling shall be laid in herring bone pattern with joints filled with powdered earth or sand. The joints of top layer of soling shall be filled up with cement mortar (1:3).

All works shall be done as per Technical Specifications sections 1300, 1700 & 1900 and drawings.

3.0 Measurement for Payment

The passenger shelter shall be measured in number of finished constructed structure.

4.0 Rate

The Contract unit rate shall be payment in full for construction of the passenger shelter. Raised footpath, ground preparation etc. shall be considered as incidental to work.

CLAUSE A-11 SPECIFICATION FOR PAINTING OF STRUCTURES WITH SYNTHETIC ENAMEL

1 Materials:

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

Painting on New Surface

Preparation of surface.:

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

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

(a) Under coat:

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

(b) Top Coat:

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

Lettering and Numbering on New Surface:

The letters and numbers for bridges/culverts span and number shall be as per IRC-71971. The size of area for painting shall be varied depend upon the numbers and letters. The background area and letters/numbers shall be painted with one prime coat (under coat) and two coats(top coat) of synthetic enamel

paint.

Measurement for payment:

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

Rate:

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

Water Proof Cement Painting

Material:

The water proof cement paint shall be (conforming to IS:5410) of approved brand and manufacture.

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

Preparation of Surface:

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

Preparation of mix:

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

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

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

Application:

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

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

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

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

Precaution:

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

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

Measurement for payment:

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

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

CLAUSE A-12 CONSRTUCTION OF GABION WALL

General

This work shall consist of providing and laying factory manufactured wire gabion of approved size, design and filled with approved rock fill, lids closed all as per approved design, drawings and Technical Specifications and as approved by the Engineer.

The Contractor shall be required to provide complete design including its foundation and detailed engineering with working drawings in required numbers. This shall be supported by certificate from the supplier of gabions that he has proven experience in supplying and placing gabions for major highway projects and providing technical backup using in-house facilities.

Gabion walling being a specialised work, the Contractor shall ensure expert supervision by specialist from the technology provider from time to time.

The Gabion wall shall be designed with the given specification using proven system design certified with ISO 9001 / 2 or equivalent as approved by the Engineer. The designer may adopt system design for Gabion wall following any proprietary patented technique.

No extra cost either for patent or any design or expert supervision shall be made to the Contractor.

Glossary

- a) Double Twisted Wire Mesh: A non-ravelling mesh made in mechanically twisting continuous pairs of wires through three and half turn (commonly called double twisted) which are then interconnected in the adjacent wires to form hexagonal shaped openings.
- b) Mesh Size: The average distance measured at right angles between twisted sides over meshes.
- c) Selvedge wire: Terminal wire used to edge the wire mesh perpendicular to the double twist by mechanically wrapping the mesh wires around it at least 2.5 times.
- d) Edge wire: Terminal wire used to edge the wire mesh parallel to the double twist by continuously weaving at mechanically into the wire mesh.
- e) Lacing wire: The Zinc + PVC coated metallic wire which interconnects empty units, closes and secure stone filled units.
- f) Stiffener: A length of Zinc Coated steel wire used for support of facing by connecting the front panel to the back or side panel of a gabion or across the corners of gabion cell. Stiffener formed at the project site is of wire having the same diameter as for the lacing wire.
- g) Geosynthetic: Geosynthetic is a general classification for all synthetic material used in geotechnical engineering applications. It includes geotextile and geonets. The material shall be as per Section 700.

Materials

Wires: - All wires shall be galvanised and PVC coated. The following shall be the diameter of different types of wires.

- a. **Mesh Wire** :- Internal diameter 2.77 mm and external diameter 3.70 mm.
- b. **Selvedge Wire** :- Internal diameter 2.2 mm and external diameter 3.20 mm.
- c. **Lacing Wire** :- Internal diameter 2.2 mm and external diameter 3.20 mm.

Mesh :-

The Mesh of the gabion box be hexagonal in shape with opening size 80 x 100 as shown in the drawings.

Box :-

The box size shall not be larger than 3 m x 1.5 m x 1 m nor smaller than 1 m x 1 m x 1 m. Wherever the length of the box is more than 1.5 m diaphragms are to be provided such that nowhere the continuous length of the box is more than 1.5 m. Diaphragms shall be manufactured of the same material as the parent gabion and have selvedge wire through out their perimeter.

Fabrication

Wire mesh unit shall be manufactured with all components mechanically connected at the production facility. The external face, reinforcing panel, and lid of the Wire mesh shall be woven into a single unit. The ends, back, and diaphragm shall be factory connected to the base. All perimeter edges of the mesh forming the basket shall be selvedged with wire having larger diameter

The facing element of a unit is divided into two cells by means of a diaphragm positioned at approximately 1 m centres. The diaphragm shall be secured in position to the base so that no additional lacing is necessary at the job-site.

The procedure for using lacing wire consists of cutting a sufficient length of wire (+ / - 1.0m), and first looping and / or twisting the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 150 mm, pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and / or twisting.

Rock Fill

Rock for gabion unit filling shall be angular to round, durable and of such quality that it shall not disintegrate on exposure to water or weathering during the life of the structure. The size of rock shall range between 250 mm and 400 mm. The range in sizes shall allow variation of 5% oversize and / or 5% undersize rock provided that it is not placed on the exposed surface.

Backfill Material

Backfill Material shall be made of a good quality free draining, granular and / or selected fill. The recommended soil gradation is in the range of 0.02 mm to 6 mm or as indicated by AASHTO T-27 and FHWA Demo 82. Soils outside of this range may be suitable subject to the approval of the Engineer.

Tests

All following tests on the mesh and lacing wire must be performed prior to manufacturing the mesh:

i. Wire

- a) Tensile Strength: The wire used for manufacturing of Gabion or equivalent System and the lacing wire shall have a tensile strength of (38-48 kg / mm²), in accordance with ASTM A 641-97.
- b) Elongation: The test must be carried out on a sample at least 30 cm long. Elongation shall be less than 10% in accordance with ASTM A 370-92.
- c) Zinc coating: Minimum quantities of zinc according to ASTM A 641-97 Class III soft temper coating.
- d) Adhesion of Zinc coating: The adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A 641-97.

ii. PVC (Polyvinyl Chloride) coating

- a) Specific gravity: 1.30-1.35 kg / m³ in accordance with ASTM D 792 Table 1.
- b) Hardness: Between 50 and 60 shore D, according to ASTM D 2240.

- c) Tensile strength: not less than 20.6 Mpa according ASTM D 412-92.
- d) Modulus of elasticity: Not less than 18.6 Mpa according to ASTM D 412-92.
- e) Abrasion resistance: The percentage of the weight loss shall not be less than 12%, according to ASTM D1242-92.
- f) Creeping corrosion: The percentage of corrosion of the wire from a square cut end shall be less than 25 mm when the specimen has been measured for 2000 hrs in a 5% solution of HCl (hydrochloric acid 12 Be)

iii. **Accelerated aging test**

- a) Salt spray test: Test period 3,000 hours, test method ASTM B117-94.
- b) Exposure of UV rays: Test period 3,000 hours at 63⁰C, test method ASTM D1499-92a and ASTM G 23-93 apparatus Type E.
- c) Brittleness temperature: No higher than -9⁰C, when tested accordance with ASTM D746.

The properties after aging test shall be as follows:

- d) Appearance of coated mesh: no cracking, stripping or air bubbles, and no appreciable variation in colour.
- e) Specific Gravity: variation shall not exceed 6%.
- f) Hardness: variations shall not exceed 10%.
- g) Tensile strength: variations shall not exceed 25%.
- h) Modulus of elasticity: variation shall not exceed 25%.
- i) Abrasion resistance: variation shall not exceed 10%.
- j) Brittleness temperature shall not exceed 18⁰C.

iv. **Galvanized and PVC coated wire mesh (8 x 10 mesh type)**

- a) PVC coating thickness: Nominal 0.5 mm, minimum 0.38 mm
- b) Mesh Wire: Diameter 2.77 mm internal, 3.70 mm external
- c) Selvedge Wire: Diameter 3.40 mm internal, 4.40 mm external
- d) Mesh Opening: Nominal Dimension D = 80 mm

v. **Galvanized and PVC coated lacing wire and internal stiffeners**

- a) PVC coating thickness: Nominal 0.5 mm, minimum 0.38 mm
- b) Lacing wire: Diameter 2.20 mm internal, 3.20 mm external
- c) Stiffener Wire: Diameter 2.20 mm internal, 3.20 mm external

The procedure for using lacing wire consists of cutting a sufficient length of wire (+ / - 1.0m), and first looping and / or twisting the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 150 mm, pulling each loop tight and

finally securing the end of the lacing wire to the wire mesh by looping and / or twisting.

Tolerances

Wire Zinc coating in accordance with ASTM A641-97 Class III soft temper coating.

Gabion unit: $\pm 5\%$ on the length, width, and height Mesh opening Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed 16% and 4% on the nominal dimension D values.

Standard Codes

ASTM A 641-97 Specification for Zinc Coated (Galvanized) Carbon Steel Wire.

ASTM A 370-92 Test Methods and definitions for Mechanical Testing of Steel Products

ASTM A 90-93 Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc Alloy Coating

ASTM A 313-92 Specification for Chromium- Nickel stainless and Heat resisting steel springs wire

ASTM A 764-93 Specification for Steel Wire, Carbon, Drawn Galvanized and Galvanized at size for Mechanical springs

Construction Technique

Assembly

The Gabion units are supplied folded flat and packed in bundles. The facing section of the units are assembled individually by erecting the sides, back, ends, and diaphragm, ensuring that all panels are in the correct position, and the tops of all sides are satisfactorily aligned. The four corners of the basket shall be connected first, followed by the internal diaphragm to the outside walls. All connections shall be made using lacing wire or ring fasteners. The use of ring fasteners shall be done in accordance with the manufacturer's recommendations.

Installation

Prior to installing the assembled gabion unit system, the foundation on which the units are to be placed shall be cut or filled and graded to the lines and grades shown in the drawings. Surface irregularities, loose material, and vegetation shall be removed during the preparation of the foundation.

Filling of Gabion Units

The gabion units or boxes shall be assembled individually by erecting sides, back, ends and diaphragms, ensuring that all panels are in the correct position, and the tops of all sides are satisfactorily aligned. The four corners of the box shall be connected first, followed by the internal diaphragm to the out side walls. All connections shall be made using lacing wire.

Prior to installing the assembled units, the foundation on which the Gabion wall is to be placed shall be cut or filled, compacted and graded to the lines and grades shown in drawings as per Section 300. Surface irregularities, loose material and vegetation shall be removed during the preparation of the foundation.

The gabion units shall be carried to their final position and connected with adjoining empty units, along the vertical and top edges of their contact surfaces as per manufacturers recommendations or as directed by the Engineer. When a structure requires more than one layer of units, the upper layer shall be connected to the top of the lower layer along the front and back edges as per manufacturer's recommendations or as directed by the Engineer.

Then boxes shall be filled with rock as specified in Clause A-8.3.3 During the filling operation some manual stone placement is required to minimize voids. For vertical or near vertical structures the exterior of the box shall be carefully hand placed to give a neat, flat and compact appearance. Care shall be taken when placing fill material to assure that the sheathing of the PVC coated box will not be damaged.

The boxes shall be filled in stages so that local deformation may be avoided. That is, at no time shall any box be filled to a depth exceeding 300 mm higher than that of the adjoining cell. It is also recommended to slightly overfill the boxes to allow for settlement of the rock.

Internal connecting wires

Internal connecting wires shall be used when a structure requires gabion unit layers to be stacked on top of each other. Internal Connecting Wires shall connect the exposed face of a unit to the opposite side of the unit. An exposed face is any side of a unit that will be exposed or unsupported after the structure is completed. In this respect, lacing wire shall be used.

Connecting wire shall be installed after filling of each layer of 300 mm or 250 mm as the case may be.

Placement of the Backfill

Prior to starting this operation a non-woven geotextile filter shall be placed at the facing section and backfill interface. The characteristics of the non-woven geotextile shall be as specified by the Engineer. The geotextile should have a 500 mm return at both top and bottom.

The granular backfill shall be done in lifts of approximately 300 mm. Compacting is to proceed parallel to the wall, ensuring that the compacting machine does not within 1000 mm of the rear of the face section. The homogeneity of the backfill and the level of compaction required shall be ensured.

Lid Closing

Once the boxes are completely full, the lids shall be pulled tight until the lid meets the parameter edges of the box. The lid must then be tightly laced and / or fastened along all edge ends, and tops as shown in approved drawings.

Measurement for Payment

Gabion walls so constructed shall be measured in cubic metre of finished work.

Rate

The contract unit rate for the construction of Gabion walls shall be in cum and cover the cost of excavation or filling for foundation, double twisted wire mesh, rock filling including transportation, laying, all labour, testing, technical supervision and all incidentals necessary for completing the work according

to these specifications. The cost also covers the provision of technical expert advice, design and working details which shall be arranged by the Contractor. Transportation of rock fill shall be incidental to the work and shall not be paid extra.

CLAUSE A-13 CONSTRUCTION OF RE WALL WITH GABION WIRE MESH SYSTEM

This work shall consist of providing and laying factory manufactured gabion with wire mesh of approved design, filled with approved rock fill, structural backfill with lids closed all as per design, drawings and Technical Specifications and as approved by the Engineer.

General

The Contractor shall be required to provide complete design including its foundation and details engineering with working drawing in required numbers. This shall be supported by certificate from the supplier of gabions that he has proven experience in supplying and placing gabions for major highway projects and providing technical backup using in house facilities.

Gabion Wire Mesh System being a specialised work, the Contractor shall ensure expert supervision by specialist from the technology provider time to time.

The Gabion wall shall be designed with the given specification using proven system design certified with ISO 9001 / 2 or equivalent as approved by the Engineer. The designer may adopt system design for Gabion wall following any proprietary patented technique.

No extra cost either for patent or any design or expert supervision shall be made to the Contractor.

Glossary

- a) Double Twisted Wire Mesh: A non-ravelling mesh made in mechanically twisting continuous pairs of wires through three and half turn (commonly called double twisted) which are then interconnected in the adjacent wires to form hexagonal shaped openings.
- b) Mesh Size: The average distance measured at right angles between twisted sides over meshes.
- c) Selvedge wire: Terminal wire used to edge the wire mesh perpendicular to the double twist by mechanically wrapping the mesh wires around it at least 2.5 times.
- d) Edge wire: Terminal wire used to edge the wire mesh parallel to the double twist by continuously weaving at mechanically into the wire mesh.
- e) Lacing wire: The Zinc + PVC coated metallic wire which interconnects empty units, closes and secure stone filled units.
- f) Stiffener: A length of Zinc Coated steel wire used for support of facing by connecting the front panel to the back or side panel of a gabion or across the corners of gabion cell. Stiffener formed at the project site is of wire having the same diameter as for the lacing wire.
- g) Geosynthetic: Geosynthetic is a general classification for all synthetic material used in geotechnical engineering applications. It includes geotextiles and geonets. The material shall be as per Section 700.

Materials

- Wires: -** All wires shall be galvanised and PVC coated. The following shall be the diameter of different types of wires.
- a. **Mesh Wire:** - Internal diameter 2.77 mm and external diameter 3.70 mm.
 - b. **Selvedge Wire:** - Internal diameter 3.20 mm and external diameter 4.20 mm.
 - c. **Lacing Wire:** Internal diameter 2.2 mm and external diameter 3.20 mm.
 - d. **Stiffener Wire:** - Internal diameter 2.2 mm and external diameter 3.20 mm.
- Mesh: -** The Mesh of the box and reinforcing wire mesh panel shall be hexagonal in shape with opening size 80 x 100 as shown in the drawings.
- Box: -** The box size shall not be larger than 3 m x 1.5 m x 1 m nor smaller than 1 m x 1 m x 1 m. Wherever the length of the box is more than 1.5 m diaphragms are to be provided such that nowhere the continuous length of the box is more than 1.5 m. Diaphragms shall be manufactured of the same material as the parent gabion and have selvedge wire through out their perimeter.

Fabrication

Wire mesh unit similar to Gabion unit shall be manufactured with all components mechanically connected at the production facility. The external face, reinforcing panel, and lid of the Wire mesh shall be woven into a single unit. The ends, back, and diaphragm shall be factory connected to the base. All perimeter edges of the mesh forming the basket shall be selvedged with wire having larger diameter

The facing element of a unit is divided into two cells by means of a diaphragm positioned at approximately 1 m centres. The diaphragm shall be secured in position to the base so that no additional lacing is necessary at the job-site.

The procedure for using lacing wire consists of cutting a sufficient length of wire (+ / - 1.0m), and first looping and / or twisting the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 150 mm, pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and / or twisting.

Rock Fill

Rock for the facing section of a Wire Mesh unit shall be hard, angular to round, durable and of such quality that it shall not disintegrate on exposure to water or weathering during the life of the structure. The rocks shall range between 150 mm and 300 mm. The range in sizes shall allow for a variation of 5% oversize and/or 5% undersize rock, provided that it is not placed on the exposed surface. The size shall be such that a minimum of three layers of rock must be achieved when filling the 1 m high unit and a minimum of two layers for the 0.6 m high units.

Backfill Material

Backfill Material shall be made of a good quality free draining, granular and / or selected fill and shall be Mechanically Stabilised. The recommended soil gradation is in the range of 0.02 mm to 6 mm or as indicated by AASHTO T-27 and FHWA Demo 82. Soils outside of this range may be suitable subject to the approval of the Engineer.

Tests

All following tests on the mesh and lacing wire must be performed prior to manufacturing the mesh:

i. **Wire**

- a) Tensile Strength: The wire used for manufacturing of Gabion or equivalent System and the lacing wire shall have a tensile strength of (38-48 kg / mm²), in accordance with ASTM A 641-97.
- b) Elongation: The test must be carried out on a sample at least 30 cm long. Elongation shall be less than 10% in accordance with ASTM A 370-92.
- c) Zinc coating: Minimum quantities of zinc according to ASTM A 641-97 Class III soft temper coating.
- d) Adhesion of Zinc coating: The adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A 641-97.

ii. **PVC (Polyvinyl Chloride) coating**

- a) Specific gravity: 1.30-1.35 kg / m³ in accordance with ASTM D 792 Table 1.
- b) Hardness: Between 50 and 60 shore D, according to ASTM D 2240.
- c) Tensile strength: not less than 20.6 Mpa according ASTM D 412-92.
- d) Modulus of elasticity: Not less than 18.6 Mpa according to ASTM D 412-92.
- e) Abrasion resistance: The percentage of the weight loss shall not be less than 12%, according to ASTM D1242-92.
- f) Creeping corrosion: The percentage of corrosion of the wire from a square cut end shall be less than 25 mm when the specimen has been measured for 2000 hrs in a 5% solution of HCl (hydrochloric acid 12 Be)

iii. **Accelerated aging test**

- a) Salt spray test: Test period 3,000 hours, test method ASTM B117-94.
- b) Exposure of UV rays: Test period 3,000 hours at 630C, test method ASTM D1499-92a and ASTM G 23-93 apparatus Type E.
- c) Brittleness temperature: No higher than -90C, when tested accordance with ASTM D746.

The properties after aging test shall be as follows:

- a) Appearance of coated mesh: no cracking, stripping or air bubbles, and no appreciable variation in colour.
- b) Specific Gravity: variation shall not exceed 6%.
- c) Hardness: variations shall not exceed 10%.
- d) Tensile strength: variations shall not exceed 25%.
- e) Modulus of elasticity: variation shall not exceed 25%.
- f) Abrasion resistance: variation shall not exceed 10%.

g) Brittleness temperature shall not exceed 18°C.

iv. **Galvanized and PVC coated wire mesh (8 x 10 mesh type)**

- a) PVC coating thickness: Nominal 0.5 mm , minimum 0.38 mm
- b) Mesh Wire: Diameter 2.77 mm internal, 3.70 mm external
- c) Selvedge Wire: Diameter 3.40 mm internal, 4.40 mm external
- d) Mesh Opening: Nominal Dimension D = 80 mm

v. **Galvanized and PVC coated lacing wire and internal stiffeners**

- a) PVC coating thickness: Nominal 0.5 mm, minimum 0.38 mm
- b) Lacing wire: Diameter 2.20 mm internal, 3.20 mm external
- c) Stiffener Wire: Diameter 2.20 mm internal, 3.20 mm external

The procedure for using lacing wire consists of cutting a sufficient length of wire (+ / - 1.0m), and first looping and / or twisting the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 150 mm, pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and / or twisting.

Tolerances

Wire Zinc coating in accordance with ASTM A641-97 Class III soft temper coating.

Gabion unit: ± 5% on the length, width, and height Mesh opening Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed 16% and 4% on the nominal dimension D values.

Standard codes

ASTM A 641-97 Specification for Zinc Coated (Galvanized) Carbon Steel Wire.

ASTM A 370-92 Test Methods and definitions for Mechanical Testing of Steel Products

ASTM A 90-93 Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc Alloy Coating

ASTM A 313-92 Specification for Chromium- Nickel stainless and Heat resisting steel springs wire

ASTM A 764-93 Specification for Steel Wire, Carbon, Drawn Galvanized and Galvanized at size for Mechanical springs

Construction Technique

Assembly

Wire mesh units are supplied folded flat and packed in bundles. The facing section of the units are assembled individually by erecting the sides, back, ends, and diaphragm, ensuring that all panels are in the correct position, and the tops of all sides are satisfactorily aligned. The four corners of the basket

shall be connected first, followed by the internal diaphragm to the outside walls. All connections shall be made using lacing wire or ring fasteners.

The use of ring fasteners shall be done in accordance with the manufacturer's recommendations.

Following assembly of the facing section the reinforcing panel shall be unfolded to the required length behind the facing section and the shipping folds removed. They can be removed by placing the fold over a 2" x 4" (5 cm x 10 cm) steel board and walking along the sides.

Installation

Prior to installing the assembled Wire mesh system units, the foundation on which the units are to be placed shall be cut or filled and graded to the lines and grades shown in the drawings. Surface irregularities, loose material, and vegetation shall be removed during the preparation of the foundation.

The Wire mesh system units are carried to their final position and connected with the adjoining empty units along the vertical and top edges of their contact surfaces using the same connecting procedure(s) described before. Whenever a structure requires more than one layer of units, the upper layer shall be connected to the top of the lower layer along the front and back edges of the contact surface using the same connecting procedure(s) described before.

Filling of Facing Station

The facing section shall be filled with rock as specified. During the filling operation manual stone placement is required to minimize voids. For vertical or near vertical structures the exterior of the basket may be carefully hand placed to give a neat, flat, and compact appearance. Care shall be taken when placing fill material to ensure that the sheathing on the PVC coated baskets will not be damaged. The cells shall be filled in stages so that local deformation may be avoided. That is, at no time shall any cell be filled to a depth exceeding 1-foot (0.30 m) higher than the adjoining cell. It is also recommended to slightly overfill the baskets to allow for settlement of the rock.

Internal Connecting Wires

Internal connecting wires shall be used when a structure requires layers to be stacked on top of each other. Internal Connecting Wires shall connect the exposed face of a unit to the opposite side of the unit. An exposed face is any side of a unit that will be exposed or unsupported after the structure is completed. In this respect, lacing wire shall be used.

Connecting wire shall be installed after filling of each layer of 300 mm or 250 mm as the case may be.

Placement of the Structural Backfill

Prior to starting this operation a geotextile filter shall be placed at the facing section and backfill interface. The characteristics of the geotextile shall be as specified by the Engineer. The geotextile should have a 300 mm return at both top and bottom.

The granular backfill shall be installed in lifts of approximately 300 mm and dumped in the middle section of the anchor mesh panel. Compacting is to proceed parallel to the wall, ensuring that the compacting machine does not come in contact with the mesh panel or within 1000 mm of the rear of the

face section. The homogeneity of the backfill and the level of compaction required shall be ensured.

Lid Closing

Once the boxes are completely full, the lids shall be pulled tight until the lid meets the parameter edges of the box. The lid must then be tightly laced and / or fastened along all edge ends, and tops as shown in approved drawings.

Mesh Cutting and Folding

Where shown on the drawings or otherwise directed by the engineer, the Wire Mesh System may be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and surplus mesh either folded back or overlapped so that it can be securely fastened together with lacing wire or fasteners. Any reshaped Wire Mesh System shall be assembled, installed, filled and closed as specified in the previous sections.

Measurement for Payment

The quantities for slope protection works with Wire Mesh System with Gabion facia shall be measured as separate items and the following shall be applied:

The excavation limits for a wire mesh structure shall be determined by the exterior of the facing boxes and a line coincident with the back of the reinforcement panel. Quantities shall be determined from the cross section and the linear distance of boxes, and paid for under the appropriate excavation items.

The quantity for rock filled facia gabions shall be the external outer face of the in-situ wire mesh system, measured in cubic metres.

The measurement of wire mesh in the reinforcement zone shall be measured in square metres.

The measurement of selected fill material in the reinforcement zone shall be measured in cubic metres.

Rate

The contract unit rates for the construction of Wire Mesh System shall be in Sqm. and the Gabion facia shall be in cum and shall cover the cost of excavation or filling, compacting for foundation, double twisted wire mesh, rock filling including transportation, laying, all labour, testing, technical supervision and all incidentals necessary for completing the work according to these specifications. The cost also covers the provision of technical expert advice, design and working details which shall be arranged by the Contractor. Transportation of rock fill shall be incidental to the work and shall not be paid extra. Rates also include ground improvement/ strengthening of the formation, if required

CLUASE A-14

GROUTED DOWELS FOR SLOPE STABILTY AND PROTECTION WORKS

Scope

This work shall consist of furnishing, drilling, installing and grouting of dowels in conformity with the dimensions, lines and grades shown on the plans, or as determined by the engineer. The work shall generally be done in conformity to BS: 8006 Specifications.

It shall be essentially a steel bar of 32 mm diameter and of required length inserted into a predrilled hole and then grouted so that there is no empty space between the hole wall and the dowel surface. The metal used for the

production of the dowel shall conform to (BS4449:1997) High Yield Deformed - Steel having a Yield strength of 460 MPa to 500 MPa, and a Rupture strength of 600 MPa.

Material Property Requirements

Water

As per Appendix – 1800/III (**All appendices have references to MOSRT&H Specifications for Road and Bridge Works**)

Cement

As per Appendix – 1800/III

Sand

As per Appendix – 1800/III

Admixtures

As per Appendix – 1800/III

Grout

As per Appendix – 1800/III

Equipment

The following equipment shall be used for the purposes of drilling and grouting dowels.

Drilling Equipment

Drilling of holes is commonly done by a rotary or rotary percussion handheld or remotely operated drill equipment. It must be capable of providing a stable drill hole having dimensions within the permitted tolerance and which is free of obstructions or major protrusions so that the bar can be inserted without undue resistance.

Grout mixer and Agitator

As per Appendix – 1800/III

Grout Pump

As per Appendix – 1800/III

Water pump

As per Appendix – 1800/III

Grout Screen

As per Appendix – 1800/III

Connections and air vents

As per Appendix – 1800/III

Construction and Installation Requirements

Drilling

The drill holes for rock dowels are commonly produced by a rotary or rotary percussion mechanism with air or water used as flushing medium. The drilling machine or technology employed may be handheld or remotely operated drill rigs. The diameter of drill hole shall be minimum 25 mm larger than dowel diameter.

Installation of Dowel

The boreholes are cleaned by flushing with compressed air or water. The dowel is inspected for damages or corrosion, immediately prior to installation. The dowels of required lengths are inserted into the hole till it touches the hole end.

Grouting

Grout shall be injected to fill the hole completely. This will be ensured when the grout of the same consistency comes out of the hole. In case the length of dowel protrudes from the hole, it shall be covered by concrete by hand packing.

Measurement for Payment

The quantity to be paid for dowels shall be in linear metre of individual dowels properly installed and grouted.

Rate

The contract unit rate for the installation of dowels shall include approval of design and drawings by the Engineer. All excavation works and the cost of all materials, drilling of holes, transportation, installation and grouting etc. Any dowel which because of blockage can not serve its intended purpose shall not be paid for.

CLAUSE 15 TEMPORARY BARRICADING FOR STOPPAGE OF CUT MATERIAL FROM SPREADING ON THE ROAD**Description**

The work shall consist of fabricating, supplying and erecting at site the Mild Steel Barricading, including painting a coat of steel primer and two coat of synthetic enamel paint conforming to Additional Technical Specifications Clause A-7, removing, carriage and re-erecting at other desired locations the Mild Steel Barricades complete as per Drawings and as directed by the Engineer. The units shall be kept always in working conditions. The repair/ replacement of any member shall be the responsibility of the contractor.

Materials

The barricading shall be made of M.S. Structural Steel as per the drawing and approved by the Engineer.

Fabrication

The temporary barricading shall be factory manufactured as per the drawings.

The work shall conform to the following sections of MOSRT&H Specifications.

Excavation in foundations	Section 300
Structural concrete	Section 1700
Structural Steel	Section 1900

Fixing at Site**Erection**

The Temporary Barricading units shall be erected true to the levels, grades and verticality. They shall be secured to the foundation by means of foundation bolts in cement concrete. The lateral support shall be provided by the steel

anchor stay wires (wherever required) which shall be fixed to the rock / ground by means of spikes and nails. Various units shall be jointed together by means of bolts and nuts as shown on the drawing.

Reuse

The temporary barricades shall be put to reuse wherever required. To do so, the foundation nuts and spikes of stay wire shall be removed and the units fixed at the desired location as per Sub-Clause A-15.4.1 above.

Measurements for Payment

The temporary barricades shall be measured in numbers for the new supply and erection.

The re-erection shall be measured in linear meters.

Salvage Value

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 of 50% of his quoted rate or Rs. 4,500/- per meter, whichever is more as salvage value to the Employer. Recovery for the salvage value shall be made in Final Payment certificate. These temporary units shall not be used in any permanent work in the project.”

Rate

The contract unit rate for supplying the complete barricading unit as per drawing will include the fabrication, applying a coat of approved steel primer, two coats of synthetic enamel as per Additional Technical Specifications Clause A-7, supplying steel stay wires, spikes, nails and foundations bolts etc.

The contract unit rate for erecting the temporary barricades will include initial erection, including founding and fixing stay wire etc, removal of barricading units, spikes and nails, stay wire and cutting foundation bolts and re-erecting at desired locations in proper foundations with foundation bolts and stay wires etc. including maintenance and replacement of damaged parts and bringing the unit to working conditions to the satisfaction of the Engineer.

CLAUSE A-16 SEISMIC RESTRAINERS

Fabrication

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

Measurement for Payment

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

Rate

- (a) The contract unit rate for a seismic restrainer assembly shall include cost of design, supplying and fixing of seismic restrainer assembly consisting of elastomeric bearing, backing plates, mild steel plates, stainless steel plates, bolts, lugs etc. all complete as specified on the drawings or as directed by the Engineer. The rate shall include cost of all tests prescribed in the specifications and shown on the approved drawings.
- (b) The quantity of cement concrete and steel reinforcement for seismic restrainers and shear keys shall be paid for separately as per relevant BOQ items.

CLAUSE A-17 PLUM CONCRETE**Size**

The size of stone plums may be from 150-300 mm. The maximum dimension of these stones or plums shall not exceed 1/3 rd the least dimension of the members.

Material

All plums shall be hard, durable, clean and free from soft materials or loose pieces or deleterious substance in them & shall not have sharp corners.

Construction operations

During concreting the first layer of concrete of the specified mix shall be laid to a thickness of the maximum size of the plums to be used. The plums shall then be laid while the top portion of this concrete is still green but sufficiently stiff to prevent complete submergence of the plum under their own weight. These plums shall be about half embedded in the concrete & the remaining part exposed so as to form a key with the next layer of the concrete. No plum shall be used for concrete laid under water.

While placing the plums, care shall be taken to see that the clear distance between any two plums is not less than either the width or thickness of either of the plums. The distance from the plums to the outer surface from any steel reinforcement shall be equal to greatest width of plums.

If plums of stratified stone are used they shall be laid on their natural bed. Stones with concave faces shall be laid with the concave upward.

The thickness of the next and successive layers of concrete shall be at least twice that of the largest plum.

Quantity of plum

The total volume of plums shall not exceed 15% of the volume of the finished concrete.

Mix of concrete

Plum concrete 1:5:10 [1 Cement : 5 Sand : 10 Graded Stone Aggregate 40 mm nominal size] with 15% plums

Measurement

Measurement shall be for providing & laying plum concrete with about 15% plums and curing complete including the cost of form work in retaining wall/breast wall including entire carriage of materials within all leads and lifts and other incidentals.

CLAUSE A-18- Technical Specifications for Electrical Utility Shifting

Materials

1. 11 kV Pin Insulator

11 kV porcelain Pin Insulator Brown, Glazed conforming to IS: 731 of 1971 with latest amendments with forged steel pins, hot dip galvanized, with spring washer, nut with check nut conforming to Fig. 5 of IS: 2486 Part II of 1974 with latest amendments as per sketch.

2. 11 kV Disc Insulator

11 kV Brown Glazed ball and socket type 16 mm, Type B Porcelain Disk Insulators of EMS 45 kN of size 255 mm dia 145 mm height conforming to IS: 731 of 1971 with suitable Hardware fittings as per IS. and sketch.

3. 11kV Hardware fittings

The Hard fittings –ball and socket type for 11 kV distribution overhead line should be comply with the dimensional requirements indicated in the sketch attached. For guidance on general shape and design, the relevant Indian Standard specification IS 2486 Part I, II & III and IS 10136 shall be complied with. (see Technical Specifications also).

4. 11 kV Stay Set complete

Brown Glazed H Type Strain Insulator of Designation 'C' for 11 kV 140 mm long with two holes 25 mm dia as per IS: 5300 of 1969 with latest amendments with 20 mm GI Stay Rod 1800 mm long Turn Buckle, 2 Nos. Stay Clamp of suitable size etc. as per sketch furnished.

5. LT Pin Insulator

LT Porcelain Brown glazed Pin Insulators Type I in conforming to IS: 1445 of 1977 with latest amendments, having an overall height of 100 mm and base diameter 70mm with suitably matched LT forged GI Pins 260 mm x 16 mm with spring washer of 3mm thick and standard hexagonal nut (All ferrous components except small fittings like spring washers, nuts etc. hot dip galvanized and small fittings like spring washers etc. Electro Galvanized with suitable collar and conforming to the fig. Furnished herewith of IS: 7935 of 1975 as a single composite unit with suitable packing clamps fabricated out of 40 x 6 mm MS Flat hot dip galvanized as per IS: 2633 of 1972 and latest revisions as per sketch enclosed.

6. LT Shackle Set complete

LT Brown Porcelain Shackle Insulators having an overall height of 75 mm and diameter of 90 mm for the top rain shed and 85 mm for the bottom rain shed and minimum bore dia of 15 mm as per type I in suitable for a minimum failing load of 11.5 KN and conforming to IS: 1445 of 1997 and latest revision thereof with GI Straps 185 mm x 30 mm manufactured from 3 mm thick plates with 115 mm x 12 mm GI Bolts having threads for 65 mm with hexagonal nuts and spring washers and conforming to Fig. 3 of IS: 7935 of 1975 and latest revision thereof (all except small fittings hot dip galvanized) (A set consists of two straps, two bolts, two nuts and two spring washers) as per sketch enclosed.

7. LT Stay Set complete

Brown Glazed H type Stay Insulators of designation 'A', 90 mm long with two holes 16 mm dia as per IS: 5300 of 1969 and latest amendments with 16 mm, Stay rod 1800 mm long fabricated from 16 mm MS rod as per drawing with standard hexagonal nut and washer 3 mm thick completely galvanized as per IS: 2633 of 1972 and its latest revisions, Turn buckle, Stay Clamp 2 Nos. of suitable size etc., as per sketch furnished.

8. 11 kV 'V' Cross Arm

11 kV 'V' Cross Arm made of 75mm X 40 mm MS channel having overall size 1070 X 310 mm with suitable clamps with bolts and nuts all hot dip galvanized, as per relevant IS and drawing attached..

9. 11 kV 'F' type Bracket

11 kV Pole Top Bracket 'F' type made of 50 mm x 8 mm MS Flat 385 mm x 60 mm overall size with suitable holes for fixing bolts and insulator pin, hot dip galvanized as per specification.

10.4 Line Cross Arm

4 line Cross Arm for RCC/PSC Poles fabricated out of 65 x 65 x 6 mm MS angles as per drawing, furnished with suitable clamps fabricated from 50 x 6 mm flat as per drawing with 2 numbers of MS hexagonal headed and round necked bolt with hexagonal nut of size 12 mm dia and 60 mm long threaded to a minimum length of 40 mm conforming to IS: 1363 of 1960 and latest revisions all hot dip galvanized as per IS: 2633 of 1972 and latest revisions as per sketch.

11.2 Line Cross Arm

2 line Cross Arm for RCC/PSC poles fabricated out of 50 x 50 x 6 mm MS angle with suitable clamps fabricated from 50 x 6 mm MS flat as per drawing furnished and specifications with 2 numbers of MS hexagonal headed and round necked bolt with hexagonal nut of size 12 mm dia and 60 mm long threaded to a minimum length of 40 mm conforming to IS: 1363 of 1960 and latest revisions thereof, all hot dip galvanized as per IS: 2633 of 1972 and latest revisions as per sketch.

12.1.8 mts. Long Cross Arm

1.8 mt. Long Cross Arm for RCC/PSC poles fabricated out of 65x 65 x 6 mm MS angle with suitable clamps fabricated from 50 x 6 mm MS flat as per drawing furnished and specifications with 2 numbers of MS hexagonal headed and round necked bolt with hexagonal nut of size 12 mm dia and 60 mm long threaded to a minimum length of 40 mm conforming to IS: 1363 of 1960 and latest revisions thereof, all hot dip galvanized as per IS: 2633 of 1972 and latest revisions as per sketch.

13.2.4 mts. Long Cross Arm

2.4 mt. Long Cross Arm for RCC/PSC poles fabricated out of 65x 65 x 6 mm MS angle with suitable clamps fabricated from 50 x 6 mm MS flat as per drawing furnished and specifications with 2 numbers of MS hexagonal headed and round necked bolt with hexagonal nut of size 12 mm dia and 60 mm long threaded to a minimum length of 40 mm conforming to IS: 1363 of 1960 and latest revisions thereof, all hot dip galvanized as per IS: 2633 of 1972 and latest revisions as per sketch.

14.3.2 mts. Long Cross Arm

3.2 mt. Long Cross Arm for RCC/PSC poles fabricated out of 75x 75 x 6 mm MS angle with suitable clamps fabricated from 50 x 6 mm MS flat as per drawing furnished and specifications with 2 numbers of MS hexagonal headed and round necked bolt with hexagonal nut of size 12 mm dia and 60 mm long threaded to a minimum length of 40 mm conforming to IS: 1363 of 1960 and latest revisions thereof, all hot dip galvanized as per IS: 2633 of 1972 and latest revisions as per sketch.

15. Knee brazing

40 mm dia., B-Class GI pipe, 1.15mts. length, flatter both end and provide centre hole 30mm away from both end suitable for ½" bolt. 1 set clamp with two numbers, 3"x½", 2"thread, GI nut & bolt, hot dip galvanized as per ISS-2633/1964 with latest amendment thereof. Suitable for fixing pipe knee brazing on 8 or 9mts. PSC poles below 1.5mts from top.

16. Earth pipe

45mm dia., 2.5mts. length, 'B' Class GI pipe with 3"x½" nut & bolt. Flatter one end and provide a whole suitable for ½" bolt 5 cm away from the other end.

17. AB Switch – 200 Amps.

EHI make 200 Amps triple pole 11kV tilting type gang operated out door, three post insulators per phase type, Air-Break switches with flexible braided copper strip of size 25 X 5 mm suitably for horizontal mounting. Each switch shall include operating handle 20mm internal dia.6mts. operating pipe or rod of single length with suitable supporting brackets for the pipe or rod for easy operation, padlocks and keys completed with all fittings, nuts which may work loose in operation, must be provided with spring washers on split pins. The switches shall be manufactures in accordance with ISS.9921/85 with latest amendments. All metal parts should be hot dip galvanized as per ISS.2633/1964 with latest revisions thereof. The spacing between phases should be 760mm and the base channel should have a length of approximately

650mm. The AB Switches must also be fitted with 6 Nos. Aluminum conductor clamping arrangements suitable for clamping ACSR Conductors "Rabbit" / "Raccoon".

18. Stay Wire 7/2.5 mm

MS Galvanized Stay Wire 7/2.5 mm having Tensile strength of 70 kgf/mm² minimum conforming to grade 4 of IS: 2141 of 1979 in 100kg coil.

19. Stay Wire 7/3.15 mm

MS Galvanized Stay Wire 7/3.15 mm having Tensile strength of 70 kgf/mm² minimum conforming to grade 4 of IS: 2141 of 1979 in 100kg coil.

20. GI wire 5 mm

GI wire 5 mm having a minimum Tensile strength of 55 kg/mm² conforming to IS: 280 of 1978 with latest amendments if any, with hard quality Galvanized coatings as per IS: 4826 of 1968 with latest amendments. Coils wrapped in hessian or canvas and suitably packed. in 100 kg coils.

21. GI wire 4 mm

GI wire 4 mm having a minimum Tensile strength of 55 kg/mm² conforming to IS: 280 of 1978 with latest amendments if any, with hard quality Galvanized coatings as per IS: 4826 of 1968 with latest amendments. Coils wrapped in hessian or canvas and suitably packed. in 100 kg coils.

22. GI wire 3.15 mm

GI wire 3.15 mm having a minimum Tensile strength of 55 kg/mm² conforming to IS: 280 of 1978 with latest amendments if any, with hard quality Galvanized coatings as per IS: 4826 of 1968 with latest amendments. Coils wrapped in hessian or canvas and suitably packed. in 100 kg coils

23. GI bolt & nuts:

- a) 2" x 1/2" GI bolt & nuts :Full threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered
- b) 3" x 1/2 "GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- c) 4" x 1/2 "GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- d) 5" x 1/2 "GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- e) 6" x 1/2 "GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- f) 8" x 3/4 "GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.

- g) 10" x $\frac{3}{4}$ " "GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- h) 12" x $\frac{3}{4}$ " "GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered

24. Weather Proof Wire:

- a) W/P wire - 6 mm

ISI marked "VIDHUT" brand 6mm Hst twin core Aluminium cable red and black PVC insulated and black PVC sheathed for WP application conforming to IS 694/1990 with latest amendment and rated for 1100v.

- b) W/P wire – 2.5 mm

ISI marked "VIDHUT" brand 2.5mm Hst twin core Aluminium cable red and black PVC insulated and black PVC sheathed for WP application conforming to IS 694/1990 with latest amendment and rated for 1100v.

- c) W/P wire – 1.5 mm

ISI marked "VIDHUT" brand 1.5mm Hst single core Aluminium cable red PVC insulated and black PVC sheathed for WP application conforming to IS 694/1990 with latest amendment and rated for 1100v.

25. 'A' Type Pole:

The technical particulars of the poles shall be as follows: 11 KV 'A' type pole structure 13m long made out of M S Angles of size 110x110x8mm and brace using 75x75x6mm or the nearest size as per drawing including painting with two coats of gray enamel paint over one coat of Red Oxide primer of approved quality, after scraping and cleaning the surface etc.

26. PSC Poles 8 m

PSC Electric Poles 8 meters long with working load of 140 kg and Cross Section at bottom 275 x 90 mm and top 105 x 90 mm with 8 numbers tensioned 4 mm dia. and 2 numbers untensioned 4 mm dia. Steel Steel wires the maximum pretension in 4mm HTS wire being 1760 kg and the untensioned HTS wire should be held in position by suitable MS stirrups.

27. PSC Poles 9 m

PSC Electric Poles 9 meters long with working load of 200 kg and Cross Section at bottom 315 x 105 mm and top 115 x 105 mm with 12 numbers tensioned steel wire 4 mm dia and 2 Nos. 4 mm dia untensioned steel wire the maximum pre-tension in 4mm HTS wire being 1760 kg and the untensioned HTS wire should be held in position by suitable MS stirrups and also with necessary holes provided at the top for fixing pole top bracket and 6 mm dia. MS helical reinforcement at top.

CLAUSE A-19 BIO ENGINEERING

The specification of the detailed design is discussed under the following sections.

1. PROVISION OF SEED

- a. The Contractor shall provide or collect seeds of the required species in accordance with the requirements described hereafter, of the species and quantities required, as and when required. He shall supply all necessary expertise, resources and facilities to ensure that these requirements are met in full. It is essential that the seed is of high quality as it forms the basis to the success of any bio-engineering program. High quality seeds refer to those seeds which have high germination percentage, collected from healthy plant and free from impurities, diseases and insect pests and also they should be properly processed and stored.
- b. The Engineer will give indications as to the expected amounts of seeds required and the time of availability. But it is the Contractor's responsibility to ensure that adequate quantities of seeds are obtained in a timely fashion. The required quantity of seed depends upon the germination percentage and the spreading nature of the plant.
- c. The weights to be specified are for sun-dried seeds separated completely from fruiting bodies and other unwanted parts, and ready for storage and subsequent sowing. There is usually a large discrepancy between this weight and that of freshly collected, untreated fruits. The fruits and seeds should be properly processed and stored according to the nature of the seed. Most of the seeds need to be removed from their fruits before sowing or storage. Separation of the seed must be done carefully to avoid damage of the seed. If the seeds are to be sown immediately after proceeding i.e. within few days put them into a cloth bag and keep cool until required. However, if the seeds are to be kept for more than a week they must be stored properly to avoid loss of viability.
- d. Should the Contractor be unable to supply the specified seeds, the advice of the Engineer should be sought. It may be possible to substitute other species. Seed should not be obtained commercially without the Engineer's written authority as some commercial sources may supply old or badly treated seeds.

1.1 GRASS SEED COLLECTION

- 1.1.1. The species of grass seeds to be collected will be determined by the Engineer. The Contractor will be responsible for determining seed sources, though these may be specified by Engineer's instructions. Seeds should normally be collected in or very close to the project area. So that it is suitable for that area and need less effort for transportation.
- 1.1.2. Seeds must be collected from as many individual plants as possible. With grasses it is difficult to determine the best genetic material from the appearance of the form; but it is

generally sound practice to select from the largest and most vigorous plants. If it is collected from many parents the quality will be better genetically.

- 1.1.3. The Contractor may under no circumstances damage or remove the roots of grass plants while collecting seed. The Contractor is responsible for safety measures and making all necessary arrangements with landowners, farmers and local district forest office, as applicable, before the collection of seeds. Also, the nature of seed should be known previously so that the collected seeds should be treated or stored properly.
- 1.1.4. Seeds may only be collected when fully ripe. Seeds collected early are not viable when planted and will cause a failure of the planting programme. The Contractor will be held liable if the germination rate of seeds is seriously lower than the normally expected percentage. Many grasses necessary for bioengineering can not be obtained commercially such plant seed should be harvested from the natural habitat and their suitability should be tested.
- 1.1.5. Immediately after collection, seeds must be separated from flower heads by the method normally used by farmers for other grasses. Once separated, the seeds must be sun-dried before storage. Otherwise, the quality will be decrease.
- 1.1.6. Seeds must be stored in cool, dry, ventilated building with adequate precautions taken against pest. Containers should be raised above the floor. (to protect them from damp floor) They should not be kept in the same building as cement, or any chemicals, fuels or lubricants as the excreted gas may damage the young embryo. Grass is best stored in bags made of hessian (jute) sheet. Seeds should be carefully inspected on a weekly basis to ensure that there is no deterioration or mould formation, or pest attack. Seeds can only be stored successfully if they have been properly dried in the sun beforehand. Most species have seeds that store best if they are properly dried and then kept dry and cool.

1.2. TREE AND SHRUB SEED COLLECTION

- 1.2.1. The species of tree and shrub seeds to be collected will be determined by the Engineer. The Contractor will be responsible for determining seed sources, though these may be specified by Engineer's instructions. Seeds should normally be collected in or very close to the working area.
- 1.2.2. Seeds must be collected from as many healthy individual plants as possible. The plants from which the seeds are collected must show vigorous growth and good form. Abnormal and stunted plants should not be considered.
- 1.2.3. The Contractor must under no circumstances damage plants while collecting seed. The Contractor is responsible for making all necessary arrangements with landowners, farmers and local district forest office, as applicable, before the collection of seeds.
- 1.2.4. The collection of seeds from trees can be a dangerous business, placing the collectors at considerable personal risk. Specialist equipment and training is available in the region for this purpose. It is the Contractor's responsibility to ensure safe working conditions for his employees or subcontractors.
- 1.2.5. Seeds may only be collected when fully ripe. Seeds collected early are not viable when planted and will cause a failure of the planting programme. The Contractor will be held liable if the germination rate of seeds is seriously lower than the normally expected percentage.

- 1.2.6. Immediately after collection, seeds must be separated from fruit by the method normally used by farmers and foresters for this purpose; this depends on the individual species but may be a time consuming process for certain fruits. Once separated, the seeds must be sun-dried before storage.
- 1.2.7. Seeds must be stored in cool, dry, ventilated building with adequate precautions taken against pest. Containers should be raised above the floor. They should not be kept in the same building as cement, or any chemicals, fuels or lubricants. If kept in sealed containers, the seeds should be carefully inspected on a weekly basis to ensure that there is no deterioration or mould formation. Seeds can only be stored successfully if they have been properly dried in the sun beforehand.

2. PROVISION OF PLANT CUTTINGS

- a. The species of plants to be collected for vegetative propagation will be determined by the Engineer. The Contractor will be responsible for determining plant material sources, through these may be specified by the Engineer's instructions. Plants should normally be collected in very close to working area.

2.1. PROVISION OF GRASS CUTTINGS

- 2.1.1. Cuttings of various types must be taken from grass species which are known to propagate easily by vegetative means.
- 2.1.2. Cuttings must be made from as many healthy individual plants as possible. The plants from which the cuttings are taken must show vigorous growth and good form. Grass clumps showing growth should not be considered as sources.
- 2.1.3. Apart from the clumps which are dug to make cuttings, the Contractor must under no circumstances damage other plants. The Contractor is responsible for making all necessary arrangements with landowner's farmers, and district forest office, as applicable, before the making of hardwood cuttings.
- 2.1.4. The type of cuttings to be made depends on the species.
- 2.1.5. Where roots are required for cuttings, grass clumps should be carefully dug up. They must not be pulled hard, as this can damage the material. They must be separated carefully by hand, using a sharp knife or razor blade when necessary. There must be no tearing of the plant fabric.
- 2.1.6. Stem cuttings must be made using sharp secateurs. The top cut should be made at right angles to the stem and the bottom cut should be made at 45° to the stem: this is to show the orientation of the planting.
- 2.1.7. Once cuttings have been made, they must be wrapped in wet hessian jute immediately. At all times cuttings are to be kept moist and as cool as possible, and should be wrapped in wet hessian between all operations such as digging out of the ground, splitting out, trimming and planting. Under any circumstances, all cuttings must be planted the same day that they are made.

2.2. PROVISIONS OF HARDWOOD CUTTINGS

- 2.2.1. Hardwood cuttings must be taken from shrubs and trees of species which are known to propagate easily by vegetative means.

- 2.2.2. Cuttings must be made from as many healthy individual plants as possible. The plants from which the cuttings are taken must show vigorous growth and good form. Mis-shaven and shunted plants should not be considered as sources.
- 2.2.3. Apart from the branches from which cuttings are taken the Contractor must under no circumstances damage plants while taking cuttings. The Contractor is responsible for taking safety precautions and for making all necessary arrangements with landowners, farmers and the local district forest office, as applicable, before the making of hardwood cuttings.
- 2.2.4. Hardwood cuttings must be made from stem which are between 6 and 18 months old. Materials outside this range are normally vigorous or strong enough to survive as cuttings. The Contractor may be held liable if the success rate of cuttings is seriously lower than the normally expected percentage.
- 2.2.5. Hardwood cuttings must be made using sharp secateurs or a sharp saw. The top cut should be made at right angles to the stem and the bottom cut should be made at 45° to show the orientation of planting. Under no circumstances must there be any damage to the bark of cutting.
- 2.2.6. Hardwood cuttings are normally 300 to 500 mm in length and 20 to 40 mm in diameter. This size should not be exceeded for the majority of species unless specified by the Engineer
- 2.2.7. A number of species can be propagated using large truncheon cuttings. Hardwood cuttings should be in average in the range of 1500 to 2500 mm in length and 30 to 80 mm in diameter unless otherwise specified.
- 2.2.8. Once cuttings have been made, they must be wrapped in wet hessian jute immediately. At all times, cuttings are to be kept moist and as cool as possible, and should be wrapped in wet hessian between all operations such as taking from the parent plant, trimming and planting. Under any circumstances, all cuttings must be planted the same day that they are made.

3. NURSERY CONSTRUCTION

- a. The Contractor shall provide nurseries to contribute stocks of grasses shrubs and trees for planting operations as required by the Engineer. This shall be done according to the specifications described here under, as and when required by the Engineer. The Contractor shall supply all necessary expertise, resources and facilities to ensure that these requirements are met.
- b. The establishment and effective operation of plant nurseries is a skilled business requiring experienced and trained staff. These specifications alone do not provide all the information needed to set up and run nurseries. The Contractor should seek the advice of specialist and should refer to the large number of reference books available on the subjects.
- c. The purpose of a nursery is to supply good quality, healthy plants of the correct type and species at the precise time they are required and at a reasonable cost.

3.1. NURSERY ESTABLISHMENT

3.1.1. The Contractor shall provide nursery facilities adequate to supply all of the stock required for planting operations. Alternatively he may procure planting stock from elsewhere at the time of site planting providing it is of standard acceptable to the engineering and as described hereunder.

3.1.2. In selecting a site for nursery the Contractor must fulfill the following requirements

- a. Nurseries must be as close as possible to all sites to be planted. They must be at the same altitudes as and in an identical climatic area to the sites to be planted.
- b. Nurseries should be a reliable and adequate supply of water which remains constant throughout the latter part of the dry seasons.
- c. Nurseries should have all weather vehicular access.
- d. Nurseries should have a perimeter of stock proof fencing effective against all domestic animals.
- e. Nurseries should have a weather and pest proof office cum seed store and proper storage facilities for seed. Seed must be kept cool, dry and in sealed containers.
- f. All nurseries should be provided with at least two above ground compost bays built of stone brick or timber. These will be used on an alternate basis to ensure a continual supply of compost.
- g. A constant staff of qualified and experienced people must be provided.
- h. There must be adequate space in each nursery location for all operations to be performed in the cycle of work. In particular all plants need to be spaced out periodically as they grow and there must be adequate bed area to accommodate them.

3.2. CONSTRUCTION OF NURSERY BEDS

3.2.1. Nursery beds must be made in a different way according to their purpose. The Contractor must ensure that there are adequate beds available for all the operations to be undertaken in the nursery.

3.2.2. There must be paths around all beds to ensure the best possible access for operations such as weeding and watering.

3.2.3. The table below summarizes the constructions details of the four main bed types

Bed type	Beds for grass seeds, grass slips and tree stool cuttings	Seed beds for tree seedlings	Standout beds for poly pots seedlings	Beds for the propagation of bamboo culm cuttings
Bed size	1000 mm wide × 250 mm high	1000 mm wide × 170 mm high	1000 mm wide × 150 mm high	1000 mm wide × 300 mm high
Details of construction	50 mm of washed gravel placed above the ground;	50 mm of washed gravel placed above	50 mm layer of gravel placed above	Ground below the bed is dug to a depth of 300 mm. Bed is Made

	then 50 mm of 1:1 mix of sieved soil and compost; and topped with 150 mm of 3:1 mix of sieved forest topsoil and washed sand	the ground; then 50 mm of unsieved forest soil; 1:3 mix of sieved forest soil and washed sand; and topped with 20 mm of washed, sieved and sterilized sand.	compacted ground. A flat stone or brick surround.	with 100 mm of unsieved soil (lower) and 200 mm of sieved soil (upper). A bund 100 mm high is formed around the edge.
--	--	---	---	---

- 3.2.4. Soil beds should be constructed to hold grass seeds, grasses being propagated by vegetative means and tree stool cuttings. These can be of many practical length but must be flat and of one meter in width. They should rise to a height of 250 mm above the surrounding ground. They are made up as follows: 50 mm of washed gravel is placed above the ground; then 50 mm of 1:1 mix of sieved soil and compost; and the bed is topped with 150 mm of 3:1 mix of sieved fertile, loamy forest topsoil and washed sand. All sieving should be done with a mesh size of 2 mm or smaller. One square meter of such bed will contain 100 grass slips spaced at 100 mm centre within rows at 100 mm centre and climate of the nursery.
- 3.2.5. Seed beds must be made very carefully for germinating small seeds of shrubs and trees. These can be of any practical length but must be flat and of one meter in width. They should rise to a height of 170 mm above the surrounding ground. They are made up as follows: 50 mm of washed gravels is placed above the ground; then 50 mm of unsieved forest soil; 50 mm of 1:3 mix of sieved forest soil and washed sand; and the bed is topped with 20 mm of washed, sieved and sterilized sand. All sieving should be done with a mesh size of 1 mm or smaller.
- 3.2.6. Standout beds should be constructed to hold seedling in polythene pots. These can be of any practical length but must be flat and of one meter in width. Bed floors should be above surrounding ground level and they should have a surround preferably made from flat stones or bricks. One square meter of standout bed will contain an average of 115 filled pots of the size specified (100×180 mm) when spaced out.
- 3.2.7. Beds for the propagation of bamboo culm cuttings should be made specially. These can be of any practical length but must be flat and of one meter width. They should rise to a height of 300 mm above the surrounding ground. They are made up as follows: the ground below the bed is dug to a depth of 300 mm; the bed itself is then made with 100 mm of unsieved soil on the original surface, and 200 mm of sieved soil above this. All soil sieving should be done with a mesh size of 2 mm or smaller. Finally, a bund 100 mm high is formed around the edge
- 3.2.8. Shades must be constructed over the beds and kept in position over delicate seedlings during hours of intense sunlight, according to need. Shades should be 750 to 1000 mm above the soil or the top of filled pots and angled so as to be effective for as much of the day as possible (i.e. with the lower side to the south). Bamboo stripes laced together with coir (coconut fiber) string are particularly suitable in most cases; but over tree and shrub seed beds thatched shades with a polythene lining must be used

4. NURSERY OPERATION AND MANAGEMENT

- a. The Contractor must operate the nursery according to a high standard. The nursery is to be staffed well tended at all times. It must be maintained in a clean tidy and efficient manner at all times. Plants must always be healthy and vigorous.
- b. Due to the nature of bio eng works nurseries will normally be operated and managed by small local Contractor with a range of agricultural skills. Nurseries may also be operated and managed by direct employees of the division road office.
- c. Plants must be kept properly weeded at all times.
- d. Watering as required for good plant growth must be carried out regularly in the cool of the evening between sunset and dusk. The Contractor must ensure that the soil is kept moist but not saturated at all times. Beds must be kept moist even when empty, so that the soil is kept in good condition.
- e. The timing of many nurseries operations is of great importance. Activities such as seed sowing and the taking of cuttings must be carried out within the critical few weeks when they will yield the desired results. Most other operations such as spacing out root pruning and watering must also be carried out in timely manner. The Contractor is responsible to keep works to the strict schedule required and under no circumstances to permit delays.

4.1 NURSERY PRODUCTION OF GRASS

- 4.1.1 Grass will be propagated in nurseries either by seedling in carefully prepared beds or by vegetative propagation.
- 4.1.2 Where grass seedlings are required in nursery, finely sieved fertile soil mixed with clean sand to a sheet of sandy loam must be placed in beds before the seeds are sown. Seeds will be covered with a sheet of hessian jute until they have germinated when it will be carefully removed. Watering of fresh seedlings will be by a fine spray and not by the rose of watering can
- 4.1.3 Grasses to be propagated by vegetative methods will be of the species instructed. The Contractor should obtain adequate quantities of the plant material required but under no circumstances to cause serious depletion of grass stocks in any steep or erosion prone area.
- 4.1.4 Vegetative propagation will normally be rhizome cuttings. With this method the grass is treated in exactly the same way as a bamboo being propagated by the traditional farmer's technique. A clump is carefully dug up and brought to the nursery, being kept cool and damp at all times. Stems are cut above the first or second node above the ground: this usually gives a length of 100 to 200 mm. the clump is separated carefully with the minimum damage to the rhizome and fine roots. Slips should be separated out which keeps a length of stem and about 50 mm of the rhizome. Each slip should have some buds on the rhizome but in some grasses these can be difficult to see. The slips should be planted with the soil surface at the same level as it was originally in rows at 200 mm centres within the rows. A sheet of hessian jute should be placed over the tops of the cuttings. When the new shoots are about 50 mm long it can be removed.
- 4.1.5 Every two to three months, all grasses should be lifted from the beds split carefully and replanted. It is normal that once split out three times the previous bed area is required. This is a standard practice to bulk up the supply of planting stock without having to grade the natural vegetation cover in the region of the nursery.

4.2. NURSERY PRODUCTION OF TREES AND SHRUBS IN POLYPOTS

- 4.2.1 Trees and shrubs will be seeded either in the seed beds or directly in the polythene pots ("polypots"). Finely sieved fertile soil mixed with clean sand to a texture of sandy loam must be placed in well shaded beds for seedlings. Watering of fresh seedling will be by fine spray and not by the rouse of a watering can.
- 4.2.2 All plants must be grown in the pots of dimension 100×180 mm (4×7inches) or greater when laid flat. The pots should be black 200 gauge polythene. They must have adequate drainage holes at the bottom and filled with fertile forest topsoil mixed with clean sand to a texture of sandy loam.
- 4.2.3 Roots protruding from the bottom of pots must be pruned with a razor blade on a regular basis which will not exceed weekly and may need to be more frequent. Protruding roots should never be allowed to become more than 25 mm in length.
- 4.2.4 When polypot seedlings begin to compete with each other for light they should be replaced as required. This would typically mean doubling the bed space occupied by the plants.
- 4.2.5 To be acceptable for planting on site, trees and shrubs must be healthy, vigorous and showing no signs of damage with irregular growth fungal or pest attack or nutrient disorders. They must be at least 300 mm in height above soil surface level and of good form. The roots must be in good condition and there should be no sign of disturbance to the soil in the polythene pot even after transport to site.

4.3 NURSERY PRODUCTION OF HARDWOOD PLANTS BY VEGETATIVE METHOD

- 4.3.1 Trees and shrubs which can be propagated by vegetative methods may be specified by the Engineer. The Contractor should produce these by the appropriate method, as required.
- 4.3.2 All cuttings and stools must be made as specified in Provision of hardwood cuttings and planted in fertile soil beds of the type specified.
- 4.3.3 Cuttings must be planted 300 mm apart in holes slightly larger than their diameter. They must be placed at such a depth that only one bud remains above the soil surface (i.e. about 30 mm of the cuttings).
- 4.3.4 When plants compete with each other for light they should be cut back as necessary.
- 4.3.5 To be acceptable for planting on site, trees and shrubs produced in this way must be healthy vigorous and showing no signs of damage wilt irregular growth fungal or pest attack or nutrient disorders. They must be at least 500 mm in height above soil surface level and of good form.

4.4. EXTRACTION OF PLANTS FROM THE NURSERY

- 4.4.1. The Contractor is responsible for extracting plants from nursery beds and preparing them ready for transport. They should be extracted from beds only on the morning that they are required for planting on site.

- 4.4.2. Plants must be hardened off starting at least 2 weeks before they are to be taken out of the nursery. This process requires a gradual reduction in the amount of watering and shading. The aim is to prepare them for transfer to a much more hostile location.
- 4.4.3. The night before the plants are to be lifted, they should be thoroughly watered. This is to make the soil softer and ease the business of extracting the roots.
- 4.4.4. Plants growing in the soil beds should be carefully lifted from the soil. There must be no pulling of stems or roots but they must be dug out extracted with no strain on any part of the plant.
- 4.4.5. Plants from soil beds must be wrapped in wet hessian jute. Hardwood plants should have a ball of soil around the roots. Grass clumps can have most of the soil shaken or washed off.
- 4.4.6. Polypot seedlings should be lifted and stacked neatly in metal or wooden trays. They must always be lifted by the pot and never by the stem or leaves.
- 4.4.7. All plants are to be kept moist in a cool, shady place, until they are loaded for transport to site. In the vehicle they must not be stacked high. For transport on rough roads they must be packed in carefully so that they do not fall over or roll around. The vehicle must be shaded.

4.5. COMPOST AND MULCH PRODUCTION

- 4.5.1. The Contractor is to produce compost and mulch for nursery or site operations. It is to be produced in a timely manner in the quantities required. Compost is normally required to sustain the long term fertility of nursery beds. Mulch may also be used in the nursery but is normally produced to enhance site planting works, particularly the direct seedling of grass.
- 4.5.2. Compost and mulch should be made from annual and perennial weeds of poor rooting characteristics. The greenery should be collected when there is most material available but before it forms seeds.
- 4.5.3. Collected material should be chopped finely and stored in a mound, compost bay or pit. The maximum size for chopped compost is 50 mm; the maximum size for chopped mulch is 150 mm.
- 4.5.4. Both compost and mulch should be kept moist but not waterlogged and in an aerated condition. They should be completely turned once a month on a regular schedule. Compost can have cow manure mixed in to assist the process of decomposition.
- 4.5.5. Neither compost nor mulch should be applied until they are fully rotted. By this time they should be black and the parts of individual plants should be indistinguishable. Early application can lead to a nutrient loss in the soil if microbes extract nitrogen to decompose the organic material.

5. FINAL SLOPE PREPARATION FOR BIO-ENGINEERING

- a. The Contractor shall prepare slopes for planting operations as required by Engineer. This shall be done according to the specifications described hereunder, as and when required. The Contractor shall supply all necessary expertise, resources and facilities to ensure that these requirements are met.

- b. In the course of all slope preparation works it is essential that no damage is done to existing vegetation unless the Engineer's instruction specifically requires certain plants to be removed.
- c. The timing of many bio-engineering operations is of the greater importance. Activities such as planting and seed sowing must be carried out within the critical few weeks when they will yield the desired results. All other operations must be carried out in a timely manner to permit this to happen. The Contractor is responsible to keep works to the strict schedule required and under no circumstances to permit delays.

5.1. CUT SLOPE PREPARATION FOR GRASS PLANTING

- 5.1.1. The objective of final cut slope preparation is to produce a surface adequately prepared for grass planting. Grass lines are used to provide a strong surface cover but need a well prepared surface in which to be planted; if the grass is to be an effective form of slope protection, it must be allowed to establish properly on a slope which does not subject it to undue stress from erosion and mass movement in its initial stages.
- 5.1.2. The Contractor must ensure that the slope under instruction is termed to a straight angle according to the Engineer's specification. Cut slopes to be planted with grass will normally be instructed as 3 vertical: 2 horizontal but this may be varied at the Engineer's discretion. In any event, a straight profile must be obtained. Concavities must be filled with well compacted material or in some cases, with dry stone detention. Convexities must be removed and it is essential that the general profile does not have a shape giving over steep segments.
- 5.1.3 All loose material must be removed from the slope and tipped elsewhere in an approved location.

5.2. FINAL PREPARATION OF FILL SLOPES FOR BIO-ENGINEERING

- 5.2.1. The objective of the final preparation of final preparation of fill slopes is to produce a surface adequately prepared for shrubs or tree planting or grass sowing or a combination of these. Vegetation is used to provide a strong surface cover but needs a well prepared surface in which to be planted: if it is to be an effective form of slope protection it must be allowed to establish properly on a slope which does not subject it to undue stress in its initial stages.
- 5.2.2. The Contractor must ensure that the slope under instruction is trimmed to a straight angle according to the specification. In an event a straight profile must be obtained. All masses of loose debris especially where it has previously been tipped at the head of the slope must be removed.. Concavities must be filled with well compacted material or in some cases, with dry stone detention. Convexities must be removed and it is essential that the general profile does not have a shape giving over steep segments.

6. SITE PLANTING AND SOWING

- a. The Contractor shall plant or sow grasses shrubs trees as required by the Engineers. This shall be done according to the specification described hereunder as and when required. The Contractor shall supply all necessary expertise resources and facilities to ensure that these requirements are met.
- b. Due to the nature of bio engineering work they will normally be undertaken by small local contractors with the range of agricultural skills. Any bio engineering sit activities may also be managed by direct employees of the division road office

- c. It is the Contractor's responsibility to ensure that all planting stocks whether provided from a nursery under a separate contract or through a separate instructions is of high quality and is vigorous enough to grow on the site to be planted.
- d. All seeds and other planting stocks must be appropriate for the precise site conditions in which they are to be planted and the Contractor must ensure that they apply to the specific altitude and other environmental characteristics of the site in questions.
- e. The timing of many bio engineering operations is of great importance. Activities such as planting and seed sowing must be carried out within the critical few weeks when they will yield the desired results. All other operations must be carried in a timely manner to permit this to happen. The Contractor is responsible to keep works to the strict schedule required and under no circumstances to permit delays.

6.1. SOWING OF GRASSES ON SITE

- 6.1.1. The sowing of grasses is intended to create a strengthened slope surface which is resistance to erosion. The Contractor is required to carry out the sowing of the grass seeds according to the Engineer's specific instructions.
- 6.1.2. It is assumed that the site will already have been prepared for sowing under separate instructions; but it is nevertheless the responsibility of the Contractor to ensure that the condition of site is good enough for the successful establishment of grasses.
- 6.1.3. The Contractor is required to supervise all field operations very closely. The sowing of grass seeds is a delicate business and should be approached in the same way as for agricultural crops. The Contractor should employ experienced agricultural laborers for this work.
- 6.1.4. Seed will have been collected and stored under separate instructions well before the time of sowing. However, it is the Contractor's responsibility to check that it has been carefully stored and remains fully viable.
- 6.1.5. Immediately before sowing the ground surface should be tightly scarified to ease early root penetration. Seeds should then be laid thinly over the surface. Under no circumstances should they be broadcast because the lightness of perennial grass seeds and the steepness of the slopes to be treated give poor cover using such a technique. The Contractor is responsible for ensuring that the correct quantities of seeds are used while giving a good even cover.
- 6.1.6. A cover of 25 grammas of grass seed per square meter of surface should be achieved unless otherwise specified.
- 6.1.7. After sowing a mulch of prepared and dried cut herbs should be laid over the whole seeded areas in a thin layer. If the mulch is too thick it will prevent light from grating to the seed and will inhibit germination. However freshly cut herbs should not be used because of the danger of resprouting and weeding.
- 6.1.8. If specified the mulch should be secured with jute netting of mesh size 300×500 mm and the needing fixed in the place using suitable live pegs or hardwood cuttings at one meter centre.

6.2 DIRECT SEED SOWING OF SHRUBS AND TREES ON SITE

- 6.2.1 The direct sowing of shrubs and trees is intended to create a strengthened slope surface which is resistant to erosion and anchorage of unsuitable surface layers. The technique is particularly effective where very stony materials preclude the use of other planting techniques or where the site will be badly affected by disturbance during the planting but would benefit from relatively cheap seedling. The Contractor is required to carry out the sowing of shrubs and tree seeds according to the Engineer's specific instructions.
- 6.2.2 It is assumed that the site will already have been prepared for seed sowing under a separate instruction; but it is nevertheless the responsibility of the Contractor to ensure that the condition of site is good enough for the successful establishment of shrubs and trees.
- 6.2.3 The Contractor is required to supervise all field operations very closely. The sowing of any seeds is a delicate business and should be approached in the same way as for agricultural crops. The Contractor should employ experienced agricultural laborers for this work.
- 6.2.4 Seed will have been collected and stored under a separate instruction well before the time of sowing. However it is the Contractor's responsibility to check that it has been carefully stored and remains fully viable.
- 6.2.5 Sowing should start at the top of the slope and the laborers should work downwards. Care must be taken not to disturb areas already seeded.
- 6.2.6 To sow the seeds a small hole should be made in the slope. The tool used to do this depends on the size of the seed. For some seed a piece of gabion wire is adequate; for others a piece of mild steel with a flattened end is required. The hole should be in the best soil available but if there is little real soil then a crevice between 2 stones is acceptable. 2 seeds should be placed in each hole and a covering of soil or whatever fines are available should be placed over them. This covering should never exceed 10 mm and should preferably be about 5 mm; it should never be less than this. Seeds should be placed at 50 to 100 mm centre as ground conditions dictate.
- 6.2.7 In some cases the seed can be broadcast starting at the site and working down slope as evenly as possible so that the whole site is lightly covered. This is used where the site is still active and only warrants minimum expenditure, or where the site is naturally rough providing plenty of niches in which the seeds can catch. Quantities of seed depend on the type of seed involved but are generally half that of the quantities used in the nursery.

6.3. SITE PLANTING OF GRASS SLIPS AND CUTTINGS

- 6.3.1. The planting of grass slips and cuttings is intended to create a strengthened slope surface which is resistant to erosion. The Contractor is required to carry out the planting of grass seedlings or rooted cuttings, according to the Engineer's specific instructions. The configuration of plant will be determined according to individual site conditions. It will be either random contoured or down slope.
- 6.3.2. It is assumed that the site will already have been prepared for planting under a separate instruction; but it is nevertheless the responsibilities of the Contractor to ensure that the conditions of the site is good enough for the successful establishment of grasses, and accords with the specifications given in clauses 5, and 5.1 or 5.2

6.3.3. Using appropriate tools (such as tape measures and spirit level); planting lines must be marked out with string as required. Unless specified differently the row spacing to be marked out is as shown in table below.

Planting configuration	Slope steepness	Row spacing
Random lines	Slope less than 30 degrees Slope 30 to 45 degrees Slope more than 45 degrees	1000 mm centre 500 mm centre 250 mm centre
Contour lines	Slope less than 30 degrees Slope 30 to 45 degrees Slope more than 45 degrees	1000 mm centre 500 mm centre 250 mm centre
Diagonal lines	All slopes	500 mm centre
Down slope lines	All slopes	500 mm centre

6.3.4. The Contractor is required to supervise all field operations very closely. The planting of grass slips is a delicate business and should be approached in the same way as the transplanting of millet seedlings. The Contractor should employ experienced agricultural laborers for this work.

6.3.5. The plants supplied to the Contractor should be prepared for planting by the Contractor as given below. The Contractor is to transport them from the nursery wrapped in hessian jute. At all times plants are to be kept moist and as cool as possible and should be wrapped in wet hessian jute between all operations such as extraction from the bed pruning and planting. Under any circumstances all plants supplied must be planted the same day that they are lifted from the nursery.

6.3.6. Grass slips or cuttings should be carefully separated from the clumps to give the maximum viable planting material. Any roots in excess of 35 mm should be cut off using a sharp Knife or razor blade. Shoots and stems should be lopped off 100 mm above ground level.

6.3.7. Planting should be started at the top of the slope under no circumstances should new plants be walked on or otherwise be disturbed. Using a small bar (usually made of mild steel and with a flattened end), a hole should be made that is just big enough for the roots. The slips or cutting is inserted; care must be taken that the roots are not tangled or bent back to the surface. Soil is then replaced around the roots and firmed with the fingers. The spacing of plants within rows should be 100 mm unless otherwise specified.

6.3.8. If the soil is dry and there is no rain within 16 to 24 hours of planting, the site should be watered carefully within a fine spray. The Contractor will be required to water for the 1st two weeks after planting in the event of inadequate rainfall.

6.3.9. In certain circumstances it may not be possible to provide grass plants from a nursery. In this case the Engineer will specify the species and expected source of grass plants. It is important to minimize disruption to neighboring land in the event that species are collected from areas surrounding the road. It is the Contractor's responsibilities to collect the stock required from an area and not to give rise to any soil erosion through the excessive removal of plants in one locality.

6.4. SITE PLANTING OF SHRUBS AND TREES RAISED IN POLYTHENE POTS

6.4.1. The planting of trees and shrubs is intended to replace or restore something of the natural vegetation on the slope to be treated. The Contractor is required to carry out the planting of seedlings to the Engineer's specific instruction.

- 6.4.2. it is assumed that the site will already have prepared for planting under a separate instruction; but it is nevertheless the responsibility of the Contractor to ensure that the condition of the site is good enough for the successful establishment of delicate young plants.
- 6.4.3. The spacing of plants will be determined according to the individual site conditions. However it will normally be at one meter centre unless otherwise specified.
- 6.4.4. The Contractor is required to supervise all field operations very closely. The planting of trees and shrubs is a delicate business and should be approached in the same way as the planting of horticultural seedlings. The Contractor should employ experienced agricultural or forestry laborers for this work.
- 6.4.5. The plants supplied to the Contractor will normally be from a nursery as arranged by separate instructions, and will be ready for planting. They should be at least 300 mm in height above the soil surface and hardened off in the normal way. The Contractor is to collect the plants from the nursery and transport them to site with all due care. The plants will normally be supplied in polythene pots never by the stem or leaves. At all times they are to be kept as cool as possible. The Contractor is responsible for ensuring that the soil around the roots does not dry out. Under any circumstances, all plants supplied must be planted within three days of removal from the nursery.
- 6.4.6. Planting should be started at the top of the slope and under no circumstances should new plants be walked on or otherwise disturbed.
- 6.4.7. A planting pit wide and deep enough for the main root to be buried in without bending it and wide enough for all the roots and surrounding soil ball should be made at the time of planting. Some compost if available should be mixed with the soil from the slit prior to backfilling around the roots. The polythene pots must be removed from the seedling by cutting it away with a razor blade. The plant should then be carefully placed into the hole, the compost and soil packed in, and all surrounding soil firmed up taking care not to cause any damage to the plant or its roots. The surface over and around the pit should then be mulched using any appropriate locally available material, such as manure compost dead leaves or cut herbage.
- 6.4.8. The Engineer may specify bigger seedlings for areas such as those to be used intensively for amenity purposes. These will normally have been growing in a nursery for at least a year and should have well developed roots as well as aerial parts. They will be provided either as bare root stock with a substantial root ball or in pots of a minimum of 100×180 mm laid flat dimensions. When these larger seedlings are planted the pits will be of 300 mm diameter and 300 mm in depth. In addition well-rotted compost will be mixed with the soil backfill in a ratio of at least one part compost to ten parts soil.

6.5. SITE PLANTING OF HARDWOOD CUTTINGS

- 6.5.1. Certain trees and shrubs can be planted on site by means of hardwood cuttings. Where these are specified, and Contractor is required to carry out the planting of cuttings as required in the Engineer's Instructions.
- 6.5.2. It is assumed that the site will already have been prepared for planting under separate instructions; but it is nevertheless the responsibility of the Contractor to ensure that the condition of the site is good for the successful establishment of the delicate young plants.

- 6.5.3 The spacing of hardwood cuttings will be determined according to individual site conditions. However, it will normally be at 500 mm centers unless otherwise specified.
- 6.5.4 The Contractor is required to supervise all field operations very closely. The plant of tree and shrub cuttings is a delicate business and should be approached in the same way as the planting of horticultural cuttings (e.g. those of tea). The Contractor should employ experienced agricultural or forestry laborers for this work.
- 6.5.5 The cuttings supplied to the Contractor will normally be from the nursery as arranged by separate instructions, and will be ready for planting. They should be at least 300 mm in length. The Contractor is to collect the cuttings from the nursery and transport them from the nursery wrapped in hessian jute. At all times, cuttings are to be kept moist and as cool as possible, and should be wrapped in wet hessian jute between all operations such as cutting from the parent plant, trimming and planting. Under any circumstances, all plant supplied must be planted the same day that they are lifted from the nursery.
- 6.5.6 Planting should be started at the top of slope. And under no circumstances should new plants be walked on or otherwise disturbed. Using a small bar (usually made of mild steel and with a flattened end) the hole should be made that is just big enough for cutting. The cutting is inserted and the soil is replaced around it and firmed with the fingers. The cutting should be inserted to a depth such that two thirds to three quarters of it is buried.
- 6.5.7 If the soil is dry and there is no rain within 16 to 24 hours of planting, the site should be watered carefully with a fine spray. The Contractor will be required to water for the first two weeks after planting in the event of inadequate rainfall.
- 6.5.8 In certain circumstances it may not be possible to provide cuttings from nursery. In this case the Engineer will specify the species and expected sources. The Contractor should then obtain the cuttings required in the manner described in clause 2.2 (Provision of hardwood cuttings)
- 6.5.9 The Engineer may specify bigger cuttings for specific areas, using large truncheon cuttings. Under no circumstances should these cuttings be hammered into the ground.

6.6. BRUSH LAYERING, PALISADES AND FASCINES

- 6.6.1. Under certain conditions, the Contractor will be required to construct vegetation structures using hardwood cuttings. Where these are specified, the Contractor is required to carry out the necessary preparation and planting works as required in the Engineer's instructions.
- 6.6.2. It is assumed that the site will already have been prepared for planting, under a separate instruction; but it is nevertheless the responsibility of the Contractor to ensure that the condition of the site is good enough for the successful establishment of delicate young plants.
- 6.6.3. The cuttings supplied to the Contractor may be from a nursery as arranged by separate instructions, and will be ready for planting. They should be at least 400 mm long brush layering, 600 mm long for palisades and 1000 mm in length for fascines. The Contractor is to collect the cuttings from the nursery and transport them from the nursery wrapped in hessian jute. At all times, cuttings are to be kept moist and as cool as possible, and should be wrapped in wet hessian between all operations such as cutting from the parent plant, trimming and planting. Under any circumstances, all plants supplied must be planted the same day that they are lifted from the nursery.

- 6.6.4. If the instruction to the Contractor includes the provision of cuttings, then the Engineer will specify the species and expected sources, and the Contractor must then obtain the cuttings required. This will be done in the manner described in clause 2.2 (provision of hard woodcuttings).except that the size of cuttings will be of a minimum length of 600 mm for brush layering on landslide debris, 450 mm for brush layering on road embankments, 600 mm for palisades and 1000 mm for fascines, and minimum diameters of 30 mm for brush layering, 40 mm for palisades and 50 mm for fascines.
- 6.6.5. The Contractor is required to supervise all field operation very closely. The planting of tree and shrub cuttings is a delicate business and should be approached in the same way as the planting of horticultural cuttings (eg those of tea). The Contractor should employ experienced agricultural or forestry labourers for this work.
- 6.6.6. Planting should always be started at the top of the slope and under no circumstances should new plants be walked on or otherwise disturbed.
- 6.6.7. Brush layering should be constructed as given below, unless specified differently.
- a. Starting at the bottom of the area to be treated, and using appropriate measuring equipment exact lines should be marked out. From 1 metre above the bottom of the slope, a precise contour line should be marked out every 1 metre up the slope.
 - b. Starting at the bottom, trenches of depths approximately 450 mm on landslide debris or 350 mm on road embankments should be excavated along the lines.
 - c. Cuttings should then be placed into each trench at 50 mm centres, the correct way up and angled so that they are at right angles to the maximum slope angle. All cuttings should be inserted to a depth such that two –thirds of their length is buried.
 - d. The trench should then be partially backfilled and another line of cuttings placed along the trench at 50 mm centres and 100 mm behind the first line and with the individual cuttings offset to coincide with the gaps between the cuttings in the first line. This results in cuttings at 25 mm centres in each brush layer (ie 40 cuttings per runnings metre). The trench is then completely backfilled and gently compacted. Any loose or excess material is cleared down the slope before the next line is planted.
 - e. In some cases it will be specified that cuttings should be placed in a criss-cross fashion. Where this is to be done, one layer of cuttings is laid in the trench at 30° to one side of the line of maximum fall of slope. A second layer of cuttings is laid on top of this, at 30° to the other side of the line of maximum fall of slope. Backfilling and compaction are then completed.
- 6.6.8. Palisades should be constructed as given below, unless specified differently.
- a. Starting at the top of the area to be treated, and using appropriate measuring equipment, exact lines should be marked out. From 1 metre below the top of the slope, a precise contour line should be marked out every 1 metre down the slope.
 - b. Starting at one end and using a small bar (usually made of mild steel and with a flattened end), a hole should be made that is just big enough for the first cutting. The cutting is inserted and the soil is replaced around it and firmed with the fingers. The cutting must be the correct way up and angled so that it is vertical. The cutting should be inserted to a depth such that two-thirds to three-quarters of it is buried.
 - c. This process should be repeated along the entire line, with a series of cuttings placed at 50 mm centres
 - d. If a double line is specified, then a second line of cuttings must be placed in the same way, 100 mm behind the first and with the individual cuttings offset to coincide with the gaps between the cuttings in the first line.
 - e. The soil around the single or double line is then completely backfilled into any remaining gaps and gently compacted. Any loose or excess material is cleared down the slope before the next line is planted.

- 6.6.9. Fascines are bundles of hardwood cuttings laid horizontally in trenches, and parallel to the line of the trench. The bundles are thereby completely buried. Fascines should be constructed as given below, unless specified differently.
- Starting at the bottom of the area to be treated, and using appropriate measuring equipment exact lines should be marked out. From 1 metre above the bottom of the slope, a precise contour line should be marked out every 1 metre up the slope.
 - Starting at the bottom, trenches approximately 200 mm in depth should be excavated along the lines.
 - Cuttings should then be laid along each trench, so that they lie horizontally along the trench. There should normally be eight cuttings together, although where material is short a minimum of four cuttings is permissible. They must be overlapped so that no two ends coincide. The cuttings must then be tied using jute or coir (coconut fibre) string at 500 mm intervals to form a bundle. As the fascine is created, it thereby forms a continuous bundle right across the slope.
 - The trench should then be backfilled and gently compacted. The top of the fascine should be 50 to 100 mm below the surface. Any loose or excess material is cleared down the slope before the next line is planted.
- 6.6.10 The Engineer may specify that orientations other than along the contour of the slope are used. In this event, the Contractor must alter the laying out of lines accordingly and meet the precise angle required.
- 6.6.11 If the soil is dry and there is no rain within 16-24 hours of planting, the site should be watered carefully with a fine spray. The Contractor will be required to water for the first two weeks after planting in the event of inadequate rainfall.

7. SITE PROTECTION

- The Contractor is to protect a planted site for the period specified. Protection is to include the prevention of damage to all manner of site works and plants by local people and domestic or wild animals. It also includes an active role in tending the plants and improving their growth, as specified below.
- Because of the long time required for plants to become robust, the period of maintained by the Contractor will normally be for 12 months. However, in the case of small contracts, a period of only six months may be specified.

7.1 PROVISION AND ROLE OF SITE WARDENS

- 7.1.1 The Contractor is required to provide an adequate number of site wardens to fulfill the specified requirements. The function of the warden is broader than that of watchman. It involves the number of routine maintenance operations.
- 7.1.2. Wardens must be mature and reliable characters who need little supervision for the adequate fulfillments of their duties. They must be active and physically fit. Old people who are losing their strength should not normally be employed. They must be experienced agricultural workers familiar with caring for plants. They must be prepared to remain on site through all hours of daylight and through all adverse weather conditions. They must eat their meal on site and at no time leave the site untended for any reason whatsoever.
- 7.1.3. The role of warden is primarily to tend the plants. He or she must take the initiative in weeding, mulching, replanting failed plants, pruning and protecting plants against all pests. This is an active role requiring individuals with considerable energy and initiative. The warden must work constantly to maintain and improve the site and its bio engineering plants.
- 7.1.4. The warden is also required to protect plants from damage by local people, domestic and wild animals. In doing this he or she should use a friendly approach to people as far as possible. The Contractor must educate the warden fully in the reasons for the job, so that he or she can explain to others the importance of safeguarding plants on the site. Wardens should be effective communicators with others since they also fulfill an inevitable function as the ambassador between the Department of Road and local road neighbors.

8. SITE AFTERCARE AND MAINTENANCE.

- a. The Contractor should maintain plant bioengineering site as required by Engineer. This shall be done under the specifications described here under, as and when required. The Contractor shall supply all necessary expertise and resources to ensure that these requirements are met.
- b. The Contractor shall carry out weeding as required throughout the site all annual weeds and other unwanted plants shall be cut just above the ground and the aerial parts will be used to make compost or mulch. Weeds must not be pulled out by the roots since this disturbs the ground surface.
- c. weeding should be carried out throughout the growing season. It must be undertaken with particular diligence at the end of the monsoon, so that there is the minimum amount of competition during the subsequent dry season.
- d. the Contractor shall carry out mulching as required throughout the site. All plants required under the bioengineering specifications will be mulched using material prepared as specified under mulch preparation, or the aerial parts of weeds cut on the site or brought from elsewhere for the purpose. The desired plants should be kept mulched at all times but special care must be taken in the spring, when the soil moisture deficit it at its greatest.
- e. The Contractor shall replace failed, damaged, diseased and very weak plants, using fresh, healthy plants of the same species, at the correct time of the year for planting. This replanting operation will normally be carried out during the monsoon in the year following the first planting works. Vegetation structures will be enriched by the planting of additional cuttings or seedlings, as instructed by the Engineer. Failed seedling areas will be reseeded at the appropriate time of the year.
- f. In replanting the enriched works the Engineer may specify the use of different species. This will be done where failures or poor performance of plants may be attributed to poor stock or an incorrect initial choice of species.
- g. All bio-engineering sites must be maintained so that there are at least the following two storey of vegetation. In certain locations, however, there may be a number of additional vegetation storeys.
 - I in dense ground cover of healthy grass plants, in the configuration specified at the time of planting
 - II an open canopy of shrubs or trees with a deeper rooting network.
- h. In general it is necessary to keep the upper canopy thinned in order to maintain the lower ground cover. Most grasses require high light intensities and become degraded if subjected to excessive shade from the over storey. It is therefore the Contractor's responsibility to thin the canopy as necessary to permit adequate levels of light to penetrate for the optimum growth of the grass under storey.
- i. All thinning and pruning operations are to be undertaken in accordance with the guidelines issued by the geo-environmental unit. Since these are skilled silvicultural operations, the Contractor must take appropriate professional advice and employ suitably skilled personnel.
- j. All products from thinning and pruning operations are to be disposed The Contractor should follow the instructions of the Engineer in the regard
- k. Other maintenance operations are to be undertaken by the Contractor according to the instructions of the Engineer.

- **Appendices to Special Provisions**

Appendices to Special Provision

Appendix 1

LIST OF STANDARDS

The Contractor shall provide for the use of the Engineer technical publications, standards and codes of practice, in the Media stipulated by the Engineer. In all cases original publications of the edition currently in force are assumed.

The publications shall become the property of the Employer upon completion of the Contract.

Section VI (a): Supplementary Information

Project Location Map

