

**PUBLIC WORKS DEPARTMENT,  
GOVERNMENT OF HIMACHAL PRADESH**

**AND**

**HIMACHAL PRADESH ROAD AND OTHER INFRASTRUCTURE  
DEVELOPMENT CORPORATION (HPRIDC),**

**HIMACHAL PRADESH STATE ROADS TRANSFORMATION  
PROJECT (HPSRTP)**

**NAME OF THE CONTRACT:**

**UPGRADATION OF MANDI REWALSAR KALKHAR ROAD  
IN MANDI DISTRICT  
FROM KM 0/000 TO 11/000**

**BIDDING DOCUMENT  
(NATIONAL OPEN COMPETITIVE PROCUREMENT)**

## **Volume -3**

**PART 2 : WORKS REQUIREMENTS**

Section VII

Part- A & B : Technical Specification

Part- C : MSIP & ESMP Requirements

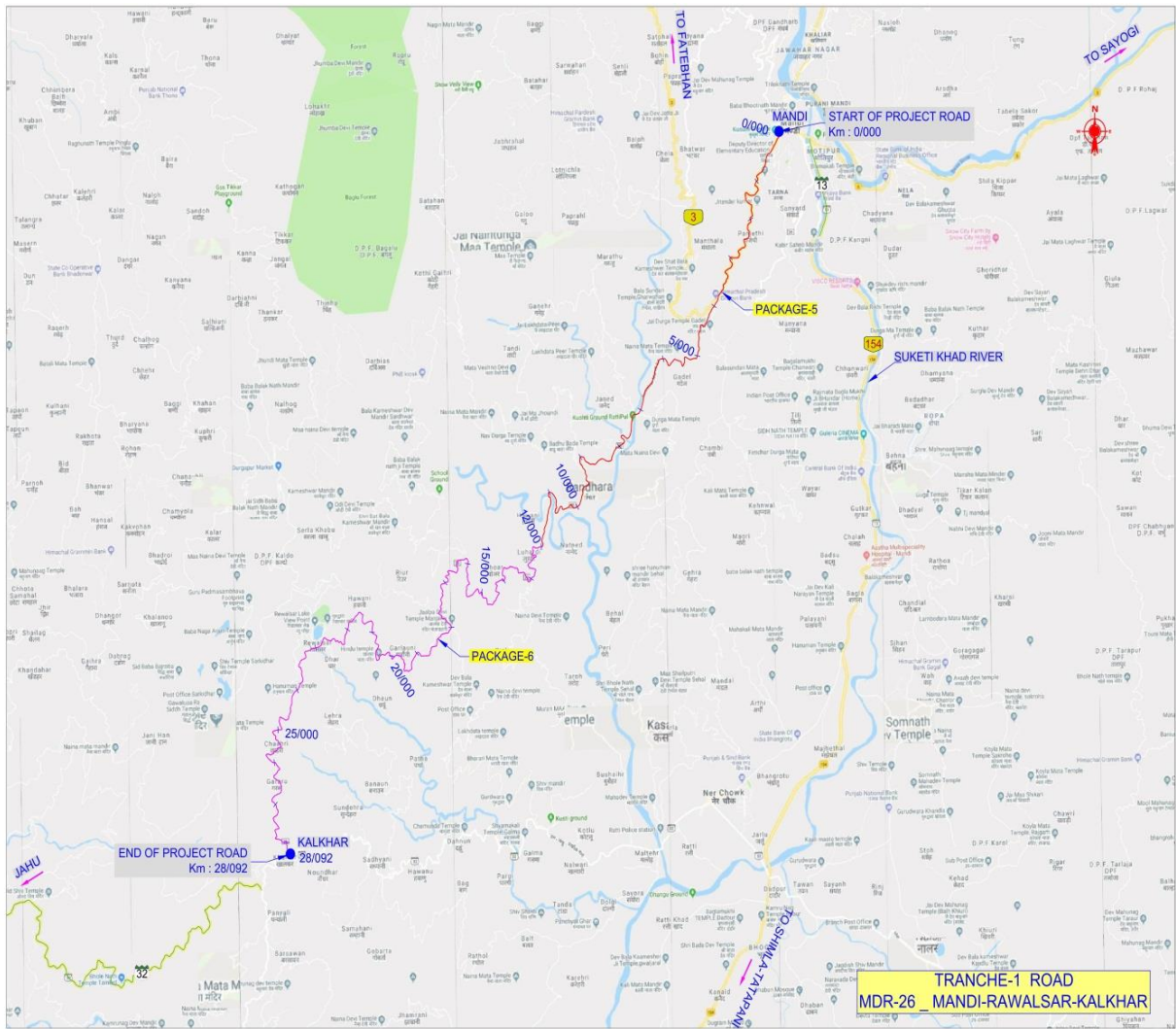
## Scope of Works

### Road, Culverts and Protection Works:

1. The project road involves reconstruction & widening of roads construction of new pavements (Flexible and Rigid), cross drainage works, drainage works (PCC Side drain and RCC U shape / Rectangular shape drains) and protective works (breast walls, toe walls, gabion walls, Retaining walls) and traffic safety (W Metal Beam crash barriers, Pedestrian Guard Railing at footpath edge and other required locations.,) and road appurtenance.
2. The project involves certain trees to be cut has been identified under EMP measure.
3. Construction of RCC Covered drain: Length: 10,980m
4. Construction of PCC Side drain: Length: 5,655m
5. Construction of Minor Bridges: 2 numbers as per detailed drawings
6. Construction of Pipe Culverts: 31 numbers as per detailed drawings
7. Construction of Box Culverts: 1 numbers as per detailed drawings
8. Construction of Slab Culverts: 1 numbers as per detailed drawings
9. Construction of Retaining/Toe wall: Length 1,860m
10. Construction of Breast wall: Length 5,525m
11. Construction of Gabion Walls: Length: 1,600m
12. Shotcreting with MS wire mesh: Length 995m
13. Improvements of Junctions:  
Major Junction: 2 numbers  
Minor Junctions: 8 numbers
14. Construction of Pick Up Bus Bays with Bus shelters: 9 numbers
15. Double Beam W Beam crash barrier: Length: 2,000m
16. Providing Pedestrian Guard Railing: 10,630m
17. Electrical Powered Single Arm Street lights: 185 Numbers
18. Solar Powered Single Arm Street lights: 22 Numbers
19. High mast lighting: 2 Numbers
20. Construction of Rainwater harvesting systems: 11 numbers
21. Construction of suitable Entry and Exit facility to existing properties: As per site requirement
22. Construction of suitable Mitigation measures for ongoing construction bridges: As per site requirement
23. Mitigation Measures at Associated Facilities (At Locations of Construction of Bridges under CRF Scheme)



# PROJECT LOCATION MAP



## **Technical Specification**

### **PART A- STANDARD SPECIFICATIONS**

The Standard Specifications comprise "Specifications for Road and Bridge Works (Fifth Revision, August 2013)", 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.

## **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. Elevation ranges from 450 metres to over 6,826 (Reo Purgyl) metres above sea level. The region extends from the Shivalik range of mountains (barely mountainous region). At 7,026m Reo Purgyl is the highest mountain peak in the state of Himachal Pradesh. The general physiographic divisions from south to north are: The outer Himalayas (Shivaliks), The lesser Himalayas (central zone), The Great Himalayas (northern zone), Zaskar range (shilla Peak-kinnaur, Pangi chamba)

**General Climatic Conditions**

The maximum average temperature is around 25 degrees C. The temperature varies from a maximum of 26 degrees C during the summer (July to September) to a minimum of -4 degrees during the coldest winter (January and February).

The normal average annual rainfall in the project area is approximately 1200 mm. Most of it occurs during the monsoon months of July through September.

**Seismic Zone**

The works are located in Seismic Zone-IV & V as defined in IRC: 6-2017.

**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 STOPPAGE OF CUT MATERIAL FROM SPREADING ON THE ROAD
CLAUSE A-16	SEISMIC RCC RESTRAINERS
CLAUSE A-17	STREET LIGHTING
CLAUSE A-18	TECHNICAL SPECIFICATIONS FOR ELECTRICAL UTILITY SHIFTING MATERIALS
CLAUSE A-19	BIO ENGINEERING WORKS

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 and miscellaneous Works:**

Technical Specifications for Building, and Miscellaneous works shall be the latest Specifications Volume I to VI, 1996 for Civil Works and General Specifications for Electrical Works PART I ó INTERNAL, PART ó 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.

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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.

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peak in the state of Himachal Pradesh. The general physiographic divisions from south to north are: The outer Himalayas (Shivaliks), The lesser Himalayas (central zone), The Great Himalayas (northern zone), Zanskar range (Shilla Peak-Kinnaur, Pangi Chamba)

#### **General Climatic Conditions**

The maximum average temperature is around 25 degrees C. The temperature varies from a maximum of 26 degrees C during the summer (July to September) to a minimum of -4 degrees during the coldest winter (January and February).

The normal average annual rainfall in the project area is approximately 1200 mm. Most of it occurs during the monsoon months of July through September.

The Project road traverses through the snow bound area.

#### **Seismic Zone**

The works are located in Seismic Zone-IV & V as defined in IRC: 6-2017.

**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
<b>CLAUSE A-4</b>	<b>CONTROL BLASTING</b>
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
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CLAUSE A-18	ELECTRICAL WORKS
CLAUSE A-19	BIO ENGINEERING WORKS

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.

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**SECTION 100 GENERAL****CLAUSE 102 DEFINITIONS**

The following abbreviations shall be added in this Clause:

"MOSRT&H"	:	Ministry of Shipping, Road Transport & Highways (Previously known as <del>MOST</del> Ministry of Surface Transport)
"GOHP"	:	Government of Himachal Pradesh
øPMCö	:	Polymer Modified Cement
øBOQö	:	Bill of Quantities
øHPSPCBö	:	Himachal Pradesh State Pollution Control Board
øMDDö	:	Maximum Dry Density
øPWDö	:	Public Works Department

**CLAUSE 102 MATERIAL AND TEST STANDARDS****Add following line at end of the clause**

The latest edition of these standard till 60 (sixty) days before the final date of submission of the tender shall be adopted.

**CLAUSE 105 SCOPE OF WORK****Sub-Clause 105.3**

Delete the text of Clause 105.3 and substitute the following:

øThe 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;
  - Uploading and maintaining weekly and monthly progress reports and other data by the Contractor at the MS Project software or other excel based software and follow as per client requirement.

- 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.ö

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.

## **CLAUSE 106 CONSTRUCTION EQUIPMENT**

### **Add the following at the end of sub-para (b)**

No equipment used in the work shall be more than 5-7 years old, as applicable in terms of list of mandatory equipment in Volume 6I of the Contract.

### **Add the following sub para (l) after sub para (k)**

i) All measuring devices and gauges shall be in good working condition. Measuring devices that are linked to product quality shall be calibrated in presence of the Engineer or his authorized representative or Calibration certificate from manufacturer or authorized testing facility approved by Engineer shall be produced, at prescribed intervals prior to use. 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.

## **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 107.2**

#### **Add the following paragraphs at the end of sub-clause:**

One set of Original "Good For 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 "Good 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**

**This clause shall be added after the Sub-clause 108.3**

öThe quarry charts enclosed with the Tender Documents indicate the location of quarries and other sources from which naturally occurring materials are available, for guidance of the Contractor. 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.ö

## **CLAUSE 109 SETTING OUT**

### **Sub-Clause 109.3**

#### **Add following Para at end of sub-Clause**

The intervals for setting out of centreline as given above is for general guidance only and the contractor may be required to carry out the setting out at more closer intervals as deemed fit by the Engineer. The decision of Engineer in this regards shall be final and binding. No extra payment claims shall be admissible for this reduced interval.

### **Sub-Clause 109.8**

In 1<sup>st</sup> sentence, replaceöí í . having a standard deviation of  $\pm 2$ mm per km,í í ö with öí í . having a standard deviation of  $\pm 1$ mm per km double run leveling,í í

In 2<sup>nd</sup> sentence, replaceöí í . having an accuracy of one second.ö with öí í . having an accuracy of 0.5 second.ö

## **CLAUSE 110 PUBLIC UTILITIES**

### **Sub-Clause 110.2**

#### **Add following as 2nd paragraph to the sub-clause 10.2**

The contractor will not be entitled for any additional compensation for delay in cutting of trees, shifting of utilities and removal of encroachments by the service provider/concerned authorities/public utility bodies.

### **Sub-Clause 110.4**

Add words “and properties” between words “services” and “affected” in 1<sup>st</sup> line of this sub-clause.

### **Sub-Clause 110.7**

**Add following as 2<sup>nd</sup> paragraph to clause 110.7**

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

### **Sub-Clause 110.8**

**Add following as 2<sup>nd</sup> paragraph to clause 110.8**

**Payments made to contractor pursuant to this sub-clause shall be paid by the funds of Himachal Government, but not from the proceeds of the loan.**

## **CLAUSE 111 PRECAUTIONS FOR SAFEGUARDING THE ENVIRONMENT**

### **Sub-Clause 111.1**

#### **General**

**Add following at the end of this sub-clause:**

ōThe Environmental Management Plan (EMP) has been prepared to provide the Contractor with measures to be taken to manage environmental matters during the Contract period. The issuance of the Environmental Management Plan does not relieve the Contractor of the responsibility to ensure total compliance with current laws, rules and regulations in force governing pollution and environmental protection applicable to the State Himachal Pradesh or where the Works are situated. This total compliance is required during the construction phase for construction related activities. The Contractor must carry out the requirements of the EMP and as listed under Clause 111.15.

In all situations where the Contractor is required to obtain approval or a license, from Statutory Authorities or Landowners independent of the Employer, for any activity associated with the Works to be executed under the contract, evidence of the approval or license must be provided to the Engineer for his consent prior to commencement of any operation associated with the work which necessitated this approval or license.

All costs associated with environmental protection during the construction phase (for construction related activities only) including obtaining the necessary approvals and licenses, shall be deemed to be included in the rates for items of work included in the Bill of Quantities. The items mentioned in Bill No. 1(c), which have been covered in MoRT&H specifications or Section VI of Bid document (Technical Specifications) will not be paid separately.

The Contractor shall preserve existing trees, plants, and other vegetation that are to remain within or adjacent to the Works and shall take all precautions necessary to prevent damage or injury thereto. Any accidental cutting/clearance of tree, plants and other vegetation shall be replanted to the satisfaction of the Engineer and at the cost of the Contractor.

On completion of the Works, all areas disturbed by the Contractor's construction activities (such as areas of compounds, material storage, access and haul roads) shall have been restored to their original condition, and agreed as having been restored by the relevant property owner or as may be acceptable to the Engineer. Restoration of an area shall include clearing excess material, scarifying the surface, top soiling, seeding and planting. The cost of this work shall be deemed to be included in the rates of items of work.

The Contractor's on-site establishment shall include an Environmental and Safety Manager with qualification & experience as mentioned in Section III: EVALUATION AND QUALIFICATION CRITERIA, available at any time, who will be responsible for all environmental and safety matters associated with the Works. The nominated person shall have a working knowledge of National and State current laws, rules and regulations in force that relate to the protection of the environment with respect to the Works to be undertaken as part of this Contract.

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 Contractor 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 following at the end of this sub-clause:**

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

be demarcated with the signboards and the operational areas shall be access controlled.

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

In 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.ö

### **Sub-Clause 111.3**

#### **Quarry Operations**

Add following paragraphs at end of Sub- Clause 111.3

öAggregates 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.ö

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 Sub-Clause 111.5 and substitute the following:

öStone crushing and screening plants, 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.ö

### **Sub-Clause 111.6**

#### **Substances Hazardous to Health.**

**Add the following after the first paragraph:**

öThe use of any herbicide or other toxic chemical shall be subject to the approval of the relevant Authorities and strictly in accordance with the manufacturer's instructions. The Engineer will be given at least six (6) working days notice of the proposed use of any herbicide or toxic chemical.

A register of all herbicides and other toxic chemicals delivered to the site, shall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety information, safe handling and storage procedures, and emergency and first aid procedures for the product.ö

### **Sub-Clause 111.8 Environmental Protection**

#### **Sub-Clause 111.8.1**

**Add the following text at the end of 1<sup>st</sup> Paragraph of Sub-Clause 111.8.1:**

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.ö

**After Sub-Clause 111.8.4 Add the following new Sub-Clauses 111.8.5 to 111.8.8**

#### **Sub-Clause 111.8.5**

##### **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.ö

#### **Sub-Clause 111.8.6**

##### **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 111.8.7**

##### **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 111.8.8**

##### **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 111.10**

##### **Control and Disposal of Wastes**

**Add the following sentence between 1<sup>st</sup> and 2<sup>nd</sup> sentence of Sub-Clause 111.10**

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. **Add Following Paragraphs at end of sub-clause 111.10**

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.

## **CLAUSE 112 ARRANGEMENTS FOR TRAFFIC DURING CONSTRUCTION**

### **Sub-Clause 112.1 General**

**Add words “Two weeks” at start of 2<sup>nd</sup> last sentence of first Paragraph of sub-clause 112.1:**

**Add following items after item v) of Sub-Clause 112.1**

vi) Drawings for any temporary diversions away from the existing carriageway

vii) 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.

**Add following paragraphs at end of Sub-Clause 112.1**



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

The Traffic Management Plan shall be as per guidelines given in IRC:SP:55-2014

Special consideration shall be given in the preparation of the Traffic Management 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's Safety Officer 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**

**Replace the paragraphs in the sub-clause with the following paragraphs**

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 without project situation for two-way traffic shall remain open at all times, but, where there is not possible to achieve, one-way traffic on a 3.7m lane (absolute minimum 3.25m) with traffic management shall be used.
- ii) Edge marking on both side of carriageway thus provided shall be provided. For night time movement delinator on both side shall be provided to the satisfaction of the engineer.
- iii) Suitable baricading shall be provided to separate traffic lanes from construction zone.
- iv) Traffic Safety Devices and road signs shall be provided as per IRC:SP:55-2014

- v) Where ever traffic movement is restricted to one way traffic traffic marshals/Flagsmen equiped with red and green flags, lanterns/lights and walkie talkies shall be deployed on both sides during all hours of such construction zones to control traffic movements.
- vi) The surface used by the through traffic shall at all times be a firm all weather compacted surface with Bituminous surface dressing free of pot holes and other defects like ponding of water etc..
- vii) The maximum continuous length over which construction under traffic may take place shall be limited to 500m.
- viii) Construction activity shall always be restricted to only one side of the existing road.
- ix) 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. In case of concentric widening requirements as above shall applyö

### **Sub-Clause 112.3 Passage of Traffic along a temporary diversion**

#### **Replace the clause with following**

Temporary diversion to carry traffic, either at the site of cross drainage structures which are to be replaced or at any other locations, shall comply with the following:

Embankments as per clause 305. The use of fly ash in temporary diversions will not be permitted.

Pavement 3.5m wide or existing carriage width whichever is maximum and 1.0m earthen shoulder on each side with the following provision for road crust in the above width:

- (i) Eartwork/Embankment as per site condition and as approved by engineer in confirmity to clause 305.
- (ii) 200mm compacted granular sub-base as per clause 401,
- (iii) 225mm compacted granular base course as per clause 404, 405 or 406
- (iv) Priming and Tack Coat as per clause 502 and 503 and

- (v) 20mm Close-Graded Premix Surfacing/Mixed Seal Surfacing as per clause 508 with Seal Coat as per clause 511.

Earth shoulders 1.0m wide shall be provided on both side of the pavement as per clause 408

Minimum horizontal radius on curves 50m shall be provided.

Maximum gradient 5 percent and minimum camber of 2.5 percent shall be provided.

Restriction of maximum speed to 30kmph along the temporary diversion shall be adhered.

Cross drainage structures (if any) in temporary diversion shall be adequate to deal with the water flow at all seasons at that location. Account should be taken of the waterway area and other relevant parameters of the existing and proposed replacement structures as given in the drawings. Causeways if provided in temporary diversion and agreed by Engineer may only be overtopped and the road closed to traffic for short periods in extreme flood conditions. Adequate erosion protection must be provided.

The location of temporary diversion, alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be approved by the Engineer. The Contractor shall be responsible for the design of temporary diversions and submit the designs to the Engineer for his approval. If the contractor finds it necessary to construct part of any diversion outside the Right of Way the temporary use of additional land shall be arranged for by him at his expense. Any roadside trees that have to be removed for the construction of temporary diversions shall be the responsibility of the Contractor. The Contractor shall provide adequate warning signs, speed breakers, barriers, marker posts etc., as per IRC: SP 55 - 2014 as well as other stipulations given in clause 112.4 to ensure safety of the traffic, all to the approval of the Engineer. The Contractor shall be responsible for the dismantling and disposal of all temporary diversions when approved by the Engineer.

#### **Sub-Clause 112.4 Traffic Safety and Control**

##### **Add the following paragraph after 2nd paragraph of Sub-Clause**

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

##### **Add the following paragraph after 4th paragraph of Sub-Clause**

öThe design and layout of all traffic management devices shall be in accordance with the roadwork drawings, the Traffic Management Plan and as per IRC:SP:55-2014 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.ö

**Add the following paragraphs after last paragraph of Sub-Clause**

öIn 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**

**Replace the paragraphs in the sub-clause with the following paragraphs**

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 Management 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 till such time they are required and as directed by the Engineer. 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 or existing road 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

Any serious work zone safety deficiency by the contractor in the site-specific traffic management plan approved by the Engineer having failed to provide in fulfilling the approved plan in the repair or maintenance of 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 required repairs and maintenance and take such actions as he considers appropriate for protection of traffic, pedestrians, employees and the works within a specified time. If the Contractor fails to respond within the time given by the Engineer, the same shall be treated as a fundamental breach of contract and the Engineer may suspend works which interfere with traffic until such time as the Contractor provides required repairs and maintenance as the Engineer has directed, or the Engineer may arrange to provide the required repairs and maintenance at cost to the Contractor, these costs being deducted from payment due to the Contractor under the Contract along with liquidated damages.

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 required repairs and maintenance 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 required repairs and maintenance as the Engineer has directed, or the Engineer may arrange to provide the required repairs and maintenance at cost to the Contractor, these costs being deducted from payment due to the Contractor under the Contract.

#### **Sub-Clause 112.6 Measurements for payment and rate**

**Replace the paragraphs in the sub-clause with the following paragraphs**

All arrangement for traffic during construction including temporary safety barricades, temporary traffic signs, providing traffic safety, flag men 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**

**Replace the paragraphs in the sub-clause with the following paragraph**

“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.ö

**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.....in writing" and add the following:**

öThe 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.ö

**Add the following new 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 114.2 Item (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 (xix) 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 (xx) 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 (xxi) 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 new 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**

**Sub-Clause 115.1**

**In the first sentence "date of agreement" shall be substituted by "date of letter of acceptance"**

**Sub-Clause 115.2**

**Add following sentence after 1<sup>st</sup> sentence of 1<sup>st</sup> paragraph of sub-clause 115.2**

öThe General part shall be furnished along with the first issue of the construction programme (refer clause 114.2).ö

**Add following sentence after 1<sup>st</sup> sentence of item b) of sub-clause 115.2**

öContractor shall identify at least two sources for each of the items.ö

**Sub-Clause 115.4 Approval of Proprietary Product/Process/System**

**Add Following sentence at start of sub-clause 115.4**

öOnly proprietary products proven by International usage in comparable projects shall be permitted to be used.ö

**Add following item h) after item g)**

h) Details of projects where similar product/process/system has been successfully used shall be furnished



**CLAUSE 120 FIELD LABORATORY****Sub-Clause 120.1**

**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.ö

**Sub-Clause 120.2 Description**

Add following after Engineer (Construction Supervision Consultant, Project Management Consultant and Contract Management Unit site staff)

**Replace “electric supply etc.” in the second sentence of first paragraph by “electric supply including uninterrupted power supply etc.”**

**Add Following sentences at end of second Paragraph**

öThe floor space required for the field laboratory shall be not less than 300 sqm. A good semi furnished office accommodation shall be provided to the Material Engineers of the Supervision Team as per the direction of the Engineer. 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 rainö

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

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.

The equipment and instruments shall be new and make AIMIL or equivalent and shall be quality certified by Bureau of Indian Standards (BIS).

**Sub-Clause 120.3 Ownership**

**Add the following to the end of sub-clause 120.3:**




“The land for laboratory building shall be provided by the Contractor”

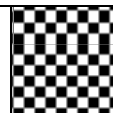

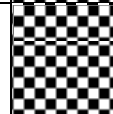



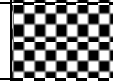











**Table 100-2 : List of Laboratory equipments shall be replaced by following table**







S. No	Sub No.	Item, Specifications	Nos. Required
		<b>A: General</b>	
i)		Balance	
	(a)	7 kg to 10 kg capacity semi -self indicating Electronic Type ó Accuracy 1 gm	2
	(b)	500 gm capacity semi-self indicating Electronic Type ó 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 ó 300 kg capacity	1
	(f)	Triple Beam balance-25kg capacity Accuracy 1gm	2
ii)		Ovens ó Electrically operated, thermostatically controlled	
	(a)	From 100°C to 220°C ó 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
xiii)		Digging Tools (pixels, shovel, fork etc.)	As reqd.
xiv)		Miscellaneous tools (sledge hammer, lump hammer, wooden pegs etc.)	As reqd.
xv)		Maximum and Minimum Thermometer Mercury in Glass thermometer range 0° to 250°C Mercury in Steel thermometer with 30 cm stem, range upto	2 Sets each

























S. No	Sub No.	Item, Specifications	Nos. Required
		300°C	
xvi)		Rain Gauge	1 Set
xvii)		Timer 0-60 minutes with alarm & 1/5 sec accuracy.	3 Sets




<b>B: For Soils and Aggregates</b>			
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 ó 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
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

<b>B: For Soils and Aggregates</b>			
xvii)		Dynamic Cone Penetrometer	1
xviii)		Hydrometer with high speed stirrer and jars	2 sets
xix)		Post-hole augur (to BS-812)	3

<b>C: For Bitumen and Bituminous Mixes</b>			
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 ó 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 1206(part II) ó 1978	1
xii)		BS U- Tube Modified Reverse Flow Viscometer IS 1206(Part III) ó 1978	1
xiii)		Apparatus for Determination of Ductility Test as per IS 1208 ó 1978	1
xiv)		Pensky ó Martin Apparatus for testing flash and fire point as per IS 1209 ó 1978.	1
xv)		Apparatus for Float Test ó IS ó 1210 ó 1978	1
xvi)		Apparatus for Determination of water content (Dean and Shark Method) IS ó 1211 ó 1978	1
xvii)		Apparatus for Determination of Loss on Heating IS ó 1212-	1

<b>C: For Bitumen and Bituminous Mixes</b>			
		1978.	
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

<b>D: For Cement, Cement Concrete and Materials</b>			
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 fine and coarse aggregate as per IS 2386 (Part 3) 1963	2
xiv)		Flexural attachment to compression testing machine	1
xv)		Core cutting machine with 150 mm dia. Diamond cutting edge	1
xvi)		Needle vibrator	1
xvii)		Vibrating hammer as per BS specification	1
xviii)		Air entrainment meter ASTM C - 231	1
xix)		0.5 Cft, 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

<b>E: For Control of Profile and Surface Evenness</b>			
i)		Digital Level complete with all accessories	2 sets
ii)		Distomat or equivalent	2 Nos.
iii)		Theodolite ó Electronically operated with computerised output attachment	2 sets

<b>E: For Control of Profile and Surface Evenness</b>			
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 under table 100-2 shall be replaced by following*

**Notes:**

Any equipment which is not mentioned in this table 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 120.4.1 Add new clause for Environmental Monitoring**

Environmental monitoring has to be carried out by specialist agency/laboratory hired by contractor on approved by the employer. The selection of gadget frequency of monitoring and sampling will be as per the instruction of the Engineer.

**Sub-Clause 120.5 Rate**

öThis Clause shall be replaced as under:ö

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

**Clause 122 Added New Clause as CONTRACTOR'S EQUIPMENT**

**Clause 122.1 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 122.2 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 122.3 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 122.4 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 123 Added New Clause as 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 123.1**

##### **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 CLEARANCES****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 containing road embankment, drain, cross drainage structure and such other area as specified in the drawing or instructed by Engineer. It shall include necessary excavation by harrow discs or any other suitable equipment, back filling of the pits by suitable soil, resulting from uprooting of trees & stumps and making the surface in proper grade by suitable equipment and compacted by power roller to required compaction as per Clause 305.3.4. The work also includes 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 turfing/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 201.5 Measurements for Payment**

**Insert words “, removal of foundations of sign boards, hoarding boards, etc.,” between words “roadway” and “and” in fifth line of paragraph 1**

**Add Following to end of paragraph 1 of sub-clause 201.5**

öRemoval 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.ö

**Delete Third and fourth paragraph of sub-clause 201.5**

**Sub-Clause 201.6 Rates**

**Sub-Clause 201.6.1 Delete 2<sup>nd</sup> line and substitute with the following**

öThese 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, giving credit toward salvage value of material removed, stock piling and disposing of the stocked materials with all lifts and leads.ö

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

**Sub-Clause 202.4 Back-filling**

**After word “operations” in first line add “and wells encountered in the alignment”.**

**Add following to end of sub-clause 202.4**

öThe wells may be capped thereafter if directed by the Engineerö.

**Sub-Clause 202.5 Disposal of Materials**

**Delete the text of Sub-Clause and replace with:**

Materials determined by the Engineer as having salvage value shall be placed in neat stacks of like materials within the Right of Way as directed by the Engineer with all lifts and leads upto the project road limits.

All materials obtained from dismantling operations, which, in the opinion of the Engineer cannot be used or auctioned, shall be removed from the site by the Contractor and disposed off at the nearest tip or other approved location in accordance with all statutory requirements. The Engineer may permit the disposal of boulders, concrete fragments and other incombustible materials by burial within the road reserve, outside paved area. When buried, the top of these materials shall not be less than 300mm below finished surface level.

**Sub-Clause 202.7 Rates**

**Add following at the end of this sub clause:**

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

**SECTION 300 EARTHWORK, EROSION CONTROL AND DRAINAGE****CLAUSE 301 EXCAVATION FOR ROADWAY AND DRAINS****Sub-Clause 301.1 Scope**

**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/river 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)**

**Sub-Clause 301.3.3 Excavation – General**

**Add the following paragraph 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.

**Clause 301.3.11 Use and Disposal of excavated materials**

**Replace the text of this sub-clause with following:** 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.

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

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

Add item (v) at end of list in last paragraph:

õ(v) Disposal of surplus material to all leads í í í ..cumö

### **Sub-Clause 301.9 Rates**

#### **Sub-Clause 301.9.1**

**Replace item (vi) with the following:**

The removal from site and disposal of all surplus or unsuitable materials obtained from excavation operations, which, in the opinion of the Engineer cannot be used in the Works, shall be disposed off and paid under relevant BoQ item.ö

#### **Sub-Clause 301.9.2**

**This Clause shall read as under:**

õThe 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.ö

#### **Sub-Clause 301.9.6 Add this new Sub-Clause after 301.9.5 as under:**

The rebate on contract unit rate of excavation is for the useful material 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.ö

## **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 1<sup>st</sup> paragraph of Clause 304.3.2 insert the following additional sentences:**

öThe 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.ö

**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 replace the words



“production/ support to existing structures” with words  
“protection/support to existing structures.”

## **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 as per IRC: SP: 58 -2001.

#### **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 CBR value shall be conform to the Design CBR value 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 7<sup>th</sup> 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, - and Pavement Design	

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

öThe contractor shall at least 7 working days before commencement of construction of embankment and the subgrade; submit the following to the Engineer for approval:

- 1) 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.
- 2) 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.
- 3) 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.ö

### **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:

öWhere 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 300-2ö.

Add at the end of Para 2

öBackfilling 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).

### **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 305.4.6.1 Embankment construction under water:**

In 4<sup>th</sup> 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**

#### **Sub-Clause 305.9.1**

Insert "Unsuitable material including of marshy soil" in Place of Suitable Material appearing in the second line of item (iii) Add "including

removal of topsoil after word "materials" appearing in first line of item (v).

## **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 309.3.2.1 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:

**SECTION 400 SUB-BASES, BASES (NON-BITUMINOUS) AND SHOULDERS****CLAUSE 401 GRANULAR SUBBASE****Sub-Clause 401.1 Scope**

Add the following at the end of this Clause:

A site trail shall be performed using the proposed mix. The trail length of minimum 60m and for full width of the pavement, shall be outside the main works. The main work shall not start until the trail length has been approved by the Engineer. After approval has been given, the material and mix proportions, construction procedures shall not be changed without the approval of the Engineer.

**Sub-Clause 401.2 Materials****Sub-Clause 401.2.1 This Clause shall be read as under:**

"The material to be used for the work shall be a crushed stone only as per the grading required. Only mixed material shall be brought at work site and in no case mixing of such material at work site shall be permitted. The material shall be free from organic or other deleterious constituents and conform to GSB / Drainage layer Grading V of Table 400-1.

**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 401.2.3 A new clause shall be added as follows:**

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

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

**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.ö

**CLAUSE 403.2 MATERIALS****CLAUSE 403.2.1 MATERIALS TO BE TREATED**

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 403.2.5 QUANTITY OF CEMENT IN CEMENT –SOIL 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.

öThe 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.ö

**CLAUSE 406 WET MIX MACADAM SUB BASE/BASE**

**CLAUSE 406.1 DELETE THE WORDS “AND GRANULAR MATERIAL.” FROM SECOND SENTENCE OF IRST PARAGRAPH.**

**Sub-Clause 406.2.1.1 Physical requirement**

Delete the second sentence beginning with öIf crushed gravel í í í and ending with fractured facesö and add as under:

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

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

Add the following at the end of the paragraph:

Soundness test shall be carried out in accordance with IS: 2386 (Part 5) 1963. The average loss of weight of coarse aggregate after ö5 cycles shall not exceed 12% when tested with sodium sulphate and 18% when tested with magnesium sulphate as specified in IS: 383.

In Table 400 ó 12 at the bottom of the table, also add as under:

öThe aggregate should satisfy both the tests a) Los Angeles Abrasion Value b) Aggregate Impact valueö

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**

Sentence 1 of Para 1 of Clause 406.3.3 shall be read as under:

öWet mix Macadam shall be prepared in an approved Wet Mix Macadam mixing plant of 100T/hour capacity having provision for controlled addition of water and forced/positive mixing arrangement.ö

**Sub-Clause 406.3.4 Spreading of Mix**

Add after Para 2

The work of laying wet mix macadam shall not be done during rain



The work of laying of wet mix macadam course over an existing bituminous layer shall not be permitted. The existing bituminous layer shall be removed completely

#### **Sub-Clause 406.3.5 Compaction**

Delete second sentence of Para 1 of Clause 406.3.5.

Add at the end of first paragraph

öFor 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:

#### **Sub-Clause 406.3.6 Setting and Drying**

Add the following at the end of this Clause:

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

### **CLAUSE 409 CEMENT CONCRETE KERB AND KERB WITH CHANNEL**

#### **Sub-Clause 409.5 Construction Operations**

**Sub-Clause 409.5.1** Add at the end of the first sentence öor as shown in the drawingsö

**Sub-Clause 409.5.2**

Add the words öor to accommodate drainage pipesö at the end of the paragraph after the words ödrainage openingsö.

#### **Sub-Clause 409.7 Rates**

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)**

#### **Sub-Clause 501.2 Materials**

##### **Sub-Clause 501.2.2**

Delete öCrushed gravel or other hard materialö from first line of Para 1 and replace with öcrushed bouldersö

Replace word öcrushed gravelö in para 2 with öcrushed bouldersö

**Sub-Clause 501.3 Mixing**

Para 1, Line 1, replace the word, "Adequate Capacity" with "Hot mix plant of Batch mix type of Minimum capacity of 120T per hour."

**Sub-Clause 501.5.3 Spreading**

Sentences 2 in Para 1 are 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**

Add new para

Para 2, Line 13; sentence starting with "the intermediate rolling is replaced by "Intermediate rolling shall be done with a Vibrator roller or Pneumatic roller of 150-250kN weight having a tyre pressure of at least 0.7Mpa."

"Rolling shall be continued till the density achieved, satisfied the requirement of Clause 903.4.2"

**Sub-Clause 501.8.8.2**

Add the following at the end of para (viii)

Payment of extra bitumen, if any shall not be made.

**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 of I Grade conforming to ASTM D 2397/AASHTO M 140, and shall be refinery produced. The particular grade to be used for the work shall be got approved by the Engineer."

**Sub-Clause 502.3**

Add the following at the end of this clause:

The moisture content in the surface to be primed shall not exceed 3.5  
Sub-Clause 502.8 Rate

Delete Second sentence

The rate shall include the provision of adequate bitumen emulsion to provide the required rate of spray listed in Table 500-3.

**CLAUSE 503 TACK COAT****CLAUSE 503.1 SCOPE**

Add the following sentence:

The purpose of the tack coat is to ensure a good bond between two consecutive bituminous layers. The success of this operation must be checked by cores collected through both the layers.

**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 CRS ó I Grade conforming to ASTM D 2397/AASHTO M 140, and shall be refinery produced. The particular grade to be used for the work shall be got approved by the Engineer.ö

**Sub-Clause 503.8 Rate**

Replace the Second sentence with under clause

The rate shall include the provision of adequate bitumen emulsion to provide the required rate of spray listed in Table 500-5

**CLAUSE 504 BITUMINOUS MACADAM****Sub-Clause 504.2.1 Bitumen**

This Clause shall be read as under:

öThe binder shall be paving bitumen of Penetration Grade S65 complying with Indian Standard Specifications for öPaving Bitumenö, IS: 73.ö

**Sub-Clause 504.2.2 Coarse Aggregates**

Delete öcrushed gravel or other hard materialö from 1st line and replace with öCrushed bouldersö. Replace word öCrushed Gravelö in 4th line with öCrushed bouldersö

Add the following at the end of this clause:

öThe constituents of the aggregates shall be produced by integrated crushing and screening plant (Impact or Cone type of capacity 175-200T/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.ö

Notes below Table 500-6. Add the comments after asterisk (\*) with the following: The aggregate should satisfy both the tests

- a) Los Angles Abrasion value and
- b) Aggregate Impact value

**Sub-Clause 504.8 Rate**

After the words "required operations" in second line of this clause, add the words "except the items of tack coat and prime coat (if any)." The rate shall include the provision of adequate bitumen in the mix to provide the characteristics listed in Table 500-7.

## **CLAUSE 505 DENSE GRADED BITUMINOUS MACADAM**

### **Sub-Clause 505.2.1**

#### **Bitumen**

Add the following at the end of this para: Paving bitumen of VG 30 Grade shall be Used.

### **Sub-Clause 505.2.2**

#### **Coarse Aggregates**

Delete "Crushed Gravel or other hard material" from 1st line of 1st para and replace with "crushed boulders".

Replace word "crushed gravel" in para 2 with "crushed boulders"

Add the following at the end of this clause:

"The constituents of the aggregates shall be produced by integrated 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."

Further, at the bottom of the Table 500-8 table add

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

### **Sub-Clause 505.2.3**

Delete the words "or Naturally Occurring Mineral or a Combination of the two"

appearing in the first sentence of the clause.

### **Sub-Clause 505.2.4**

The first sentence of this clause shall read as "Filler shall consist of cement as approved by the Engineer"

### **Sub-Clause 505.2.5**

Aggregate Grading and Binder Content Add below as follows

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

**Sub Clause 505.3****Mix Design****Sub-Clause 505.3.3**

Insert the following paragraph between the existing paragraphs 3 & 4:

“Mix design shall be carried out in accordance with the modified Marshall method described in Asphalt Institute Manual MS-2.”

**Sub-Clause 505.4.9****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.”

Add the following Sub-clause after Sub-clause 505.4.9.

**Sub-Clause 505.4.10**

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

**Sub-Clause 505.9 Rate**

Delete the existing para two and replace it with the following:

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out the all required operations, except for item of prime coat and tack coat, as specified, and shall include, but not necessarily limited to all components listed in clause 501.8.8.2(i) to (xi). The rate shall include the provision of adequate bitumen in the mix to provide the characteristics listed in Table 500-10.

**CLAUSE 507 BITUMINOUS CONCRETE****Sub-Clause 507.2.2 Coarse Aggregates**

Add the following as second para:

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

After Table 500 ó 16, add the following:

“Aggregate should satisfy both the tests Los Angeles abrasion value and aggregate impact value”

**Sub-Clause 507.2.4 Filler**

This clause shall read as under:

“Filler shall consist of cement as approved by the Engineer.”

**Sub-Clause 507.2.5 Aggregate Grading and Binder Content**

Add 3rd Note below Table 500-17:

\*\*\* “The grading of the aggregate mix as used in work shall be a smooth curve within and approximately parallel to the envelope in Table 500-17-Grade II.”

**Clause 507.4.7 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 507.9 Rate**

Delete the existing para and replace it with the following:

The contract unit rate shall be for all operations as specified in clause 504.8, except that the rate shall include the provision of adequate bitumen in the mix to provide the characteristics listed in Table 500-17.

**CLAUSE 508 CLOSE GRADED PREMIX SURFACING/MIXED SEAL SURFACING**

**Sub-Clause 508.8**

Add the words “except for item of prime coat and tack coat” after the words

“required operations” in 2nd line.

**CLAUSE 510 OPEN GRADED PREMIX SURFACING**

**Sub-Clause 510.1.8**

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

## **SECTION 800 TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES**

### **CLAUSE 801 TRAFFIC SIGNS**

#### **Sub- Clause 801.1 Scope**

In the second sentence of this clause read IRC:67-2010 as IRC:67-2012.

#### **Sub- Clause 801.1.1**

Add new Clause as follows:

öThe signs shall be reflectorised. They shall be retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminum sheeting as per these specifications.ö

#### **Sub –Clause 801.2.5**

The title of this clause shall be read as “Sign Panel” instead of “Substrata”

#### **Sub –Clause 801.2.6**

This clause shall read as under

Replace 1.5mm thick aluminium sheet with 2mm in 2<sup>nd</sup> line of para.

### **Clause 801.3 Traffic Signs Having Retro-reflective Sheeting**

#### **Clause 801.3.1 General Requirements**

The fifth sentence of this clause should read as under:

öThe reflective sheeting shall be of High Intensity grade with encapsulated lens.ö

#### **Clause 801.3.8 Colour for signs**

Add following at end of the Clause

öAll the facility information and place identification sign shall have green (Indian Standard colour no.184, Indian green) background and white lettersö

#### **Clause 801.3.11 Warranty and Durability**

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

öThe Contractor shall obtain from the manufacturer a ten-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and submit the same to the Engineer.

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

**Clause 801.4.1** The first and second sentence of clause shall read as follows:  
Sign posts shall be of GI pipe 80 mm dia.(Confirming to IS:1239) or as shown in the drawing. Post shall be embedded in concrete (M-15) for safeguard against theft. The cost of signpost and its foundation complete including excavation & concrete shall be deemed to be included in the rate of signboard.

**Clause 801.4.2** Add following at the end of this clause:  
öThe 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.ö

**Clause 801.5 Measurement of Payments**  
This clause shall be read as under :  
ö The measurement of cautionary , mandatory , information, route marker, chevron and direction & place identification sign shall be in numbersö

## **CLAUSE 802 OVERHEAD SIGNS**

### **Sub-Clause 802.4 Materials for Overhead Sign and Support Structures**

#### **Sub-Clause 802.4.2**

The last line of this clause öthey shall IS specificationsö shall read as  
öThey 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 802.4.3**

Replace 1.5mm with 2.0mm in the fourth line.

**CLAUSE 803 ROAD MARKINGS**

**Sub-Clause 803.2 Materials**

This clause shall read as under:

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

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

**Sub-Clause 803.3 This clause deleted.**

**Sub-Clause 803.5 This clause deleted.**

**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 805 DISTANCE INDICATOR POSTS**

### **Sub-Clause 805.3**

The first sentence of this clause shall read as under:

The hectometer/ kilometer stones/5<sup>th</sup> Kilometer stones, marker Posts shall be made of concrete of grade as shown in the drawing.

### **Sub-Clause 805.4 Measurement for Payment**

The words 'marker posts' shall be inserted after the words '5th kilometer ' appearing in the 1st line of the clause.

### **Sub-Clause 805.5 Rate**

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

## **CLAUSE 806 ROAD DELINATORS**

### **Sub-Clause 806.2.1**

Add new Sub-Clause as follows:

- a) Triangular Object Markers shall be 300mm side with four red reflectors, made out of 2mm thick aluminium sheet, facet 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 colours as per sign details. The sign plates shall be fixed with 6mm dia. aluminium rivet on MS angle iron frame. The angle iron frames shall be made with angle of size 40mm x 40mm x 5mm. 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.
- b) Rectangular hazard marker 600mm x 300mm made out of 2mm thick aluminium sheet, facet 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 colours as per sign details. The sign plates shall be fixed

with 6mm dia aluminium rivet on MS angle iron frame. The angle iron frame shall be made with angle of size 40mm x 40mm x 5mm. The sign shall be fixed to 80mm dia (NB-MW) MS pipe or as shown in the drawings.

- c) Roadway Indicator shall be 1000mm high made with 100mm 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.
- d) All components of signs & supports shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. The sign backside shall be with grey colour and post shall be white colour/alternate white & black bands. The post below ground shall be painted with three coats of red lead.

## **CLAUSE 807 BOUNDARY STONES**

### **Sub-Clause 807.1 Scope**

Add at the end of Para 1, "The boundary stones shall be of concrete as shown in drawing." The words "HPPWD" or as specified name should be engraved on each stone appropriately.

## **CLAUSE 809 TUBULAR STEEL RAILING**

### **Sub-Clause 809.1 Scope**

This Clause shall read as under:

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

### **Sub-Clause 809.2**

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 809.5 Rate**

The word "painting" shall be replaced with "galvanizing"

## **Sub-Clause 811.3 Metal Beam Crash Barrier**

### **Sub-Clause 811.3.1.1**

Add at the end of the para

öThe 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.ö

**Sub-Clause 811.3.1.2** 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 or ST 42 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 of C channel section made out of 5 mm thick sheet by cold roll forming process of steel conforming to IS: 2062-1992 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.

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 811.3.1.3**

Add at the end of this Clause

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

**Sub-Clause 811.3.3 Installation of Posts**

The sub-clauses 811.3.3.1, 811.3.3.2, 811.3.3.3 and 811.3.3.4 are replaced in a single sentence as below:

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

**Sub-Clause 811.3.3.5** Add "and end section" in first line after "post".

**Sub-Clause 811.3.4.3**

Add at the end of Para öThe guard rail reflector shall be bolted replacing splice washer at every 10th posts interval.ö

**Sub-Clause 811.3.7 Measurements for Payment****Sub-Clause 811.3.7.1**

The 2<sup>nd</sup> sentence "Terminals/Anchors of various types shall be paid by number s " is deleted.

**Sub-Clause 811.3.7.2**

The first sentence will be added as below:

öNo separate measurement for payment shall be made for Terminals/Anchors of various types required for the work and the delineator to replace washer as specified in drawing. The cost of these elements will be deemed to be included in the rate quoted by the contractor.ö

**Sub-Clause 811.3.7.3**

The words öor backfillingö shall be substituted as öand concretingö

**Sub-Clause 811.3.8 Rate**

Add öand drawingsö at the end of last sentence of Clause.

**SECTION 900 QUALITY CONTROL FOR ROAD WORKS****CLAUSE 901 GENERAL****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 901.14.**

**CLAUSE 901.15. 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 1<sup>st</sup> 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 shall have Roughometer values of not greater than 2000 mm/km.

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

#### CLAUSE 903 QUALITY CONTROL TESTS DURING CONSTRUCTION

#### CLAUSE 903 QUALITY CONTROL TESTS DURING CONSTRUCTION

##### Sub-Clause 903.4 Test on Bituminous Constructions

Add the following new Sub-Clauses 903.4.4 & 903.4.5

##### Sub-Clause 903.4.4 Characteristic to be tested on completed Bituminous Layers

The characteristics to be tested on completed bituminous layers are: Relative compaction Layer thickness

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 material has 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 the rest;
- The rate of production is very high.

**Sub-Clause 903.4.5** 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:



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

Density (compaction) test as performed on the extracted cores.  
Workmanship test by measuring roughness of the finished layer by duly calibrated Towed Fifth Wheel Bump Integrator .

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 Towed Fifth Wheel 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.

*Note: Contractor shall arrange the core extraction machine at his cost and shall take cores of the executed bituminous works jointly with Engineer without any extra cost.*

**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 6 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) SettingTime
- ii) CompressiveStrength

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 gravel í í í í í .inert 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.

#### **CLAUSE1008 SAND/FINE AGGREGATES**

Delete from the 3<sup>rd</sup>line the word "crushed gravel" and from the 4<sup>th</sup> 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.

#### **CLAUSE1009 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.

#### **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 30m."

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

#### **CLAUSE1012 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 emboldiments 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.

### 4. 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****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 1215 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 1216 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 MASONRY****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 conform to Section 1000 except cement mortar which shall conform 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.

**CLAUSE 1606 BARS 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.

**CLAUSE1607 TESTING ANDACCEPTANCE**

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-ó testing shall be done and the lot rejected.

**SECTION 1700      STRUCTURAL CONCRETE****CLAUSE 1704      PROPORTIONING OF CONCRETE**

Add the following at the end of this Clause:

öIn 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.ö

**CLAUSE 1707      EQUIPMENT**

Para 1 of this Clause shall read as under:

öUnless 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.ö

Paragraph 3 of this clause shall read as follows:

öThe accuracy of measuring devices shall fall within the following limits:

Measurement of Cement	+ 1% of the quantity of cement in each batch.
Measurement of Water in each batch.	1% of the quantity of water
Measurement of Aggregate	2% of the quantity of Aggregate in each batch.
Measurement of Admixture in each	± 1% of the quantity of Admixture 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 1708      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 and 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 1709      CONSTRUCTION JOINT**

In the fifth 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".

"Bush hammering is not permitted since it loosens the coarse aggregate and results in extensive micro cracks."

**Concreting of Joints:**

"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 1711      ADVERSE WEATHER CONDITIONS**

**Sub -Clause 1711.2**

**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 1712 PROTECTION AND CURING****Sub-Clause 1712.2****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, ROBø 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 1716****TOLERANCES**

Add the following at the end of Clause:

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

<b>Dimension (mm) 'a'</b>	<b>Tolerances (mm) 'δa=(a nominal – a actual)'</b>
a ≤ 200	a   < 5
200 < a ≤ 2000	a   < 3.5 + 0.0075a
2000 < a	a   < 16.5 + 0.001a



**SECTION1800      PRE-STRESSING****CLAUSE1802      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 1803      MATERIALS 562**

Add at the end of second paragraph

öThe 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.ö

Couplers and splices shall be larger in diameter than ducts joined.

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 1803.2.3 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 <sup>3</sup> at 23°C
Yield Stress	:	18.0 N/mm <sup>2</sup>
Tensile Strength :	:	21.0 N/mm <sup>2</sup>
Shore Hardness D-3 sec. Value	:	60
-15 sec. Value	:	58
Notch impact strength at 23°C	:	10 KJ/m <sup>2</sup>
-40°C	:	4 KJ/m <sup>2</sup>
Coefficient of Thermal Expansion for 20°C - 80°C	:	1.50 x 10 <sup>-4</sup> KJ/m <sup>2</sup>

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.

#### **CLAUSE 1804 TESTING OF PRESTRESSING STEEL AND ANCHORAGE**

Add following Paragraphs to the section.

The frequency of such tests should be as follows:

1. For acceptance of the tendon at the stage of submission of tendons, the manufacturer's 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<sub>pk</sub> 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  $\epsilon$  in free length of the tendon under the load  $F_{tu}$  should be  $\epsilon > 2\%$

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  $\sigma_{p \min} = 80 \text{ MPa}$
- The fatigue strength is defined as the stress range ( $\sigma_p$ ), 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.

**CLAUSE1807 TENSIONINGEQUIPMENT**

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 1808 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.

**CLAUSE1809 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 1818 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.

**NEW CLAUSE 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.

**SECTION2000 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.

**CLAUSE2005 ELASTOMERICBEARINGS****Sub-Clause 2005.4 Acceptance Specifications**

In Para 5, substitute the words "Engineer or his authorised representative" for the word "Inspector".

**Sub-Clause 2005.4.5 Inspection Certificate**

Substitute the words "Engineer or his authorised representative" for the word "Inspector".

**Sub-Clause 2005.4.6 Quality Control Certificate**

Delete the words "Inspector" in the third paragraph.

**CLAUSE2006 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**

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."

**New CLAUSE ADD NEW CLAUSE AS UNDER:**

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

**SECTION2100      OPEN FOUNDATIONS**

**CLAUSE2106      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 2305.5 as under :

**Sub-Clause 2305.5 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 1<sup>st</sup> 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**

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 30<sup>th</sup> Nov, 2000 and corrigendum of same circular dated 15<sup>th</sup> Jan., 2001 which shall be adopted. These specifications are reproduced below.*

**TABLE R-1 SUITABILITY CRITERIA FOR ADOPTION OF DIFFERENT TYPES OF EXPANSION JOINTS**

<b>Sl. No.</b>	<b>Type of Expansion</b>	<b>Suitability for Adoption Joint</b>	<b>Special Consideration</b>
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. Simply supported or continuous spans right or skew (upto 30 degree), moderately curved with maximum horizontal movement not exceeding 40 mm. Simply supported or continuous spans, Right or skew (less than 20 degree), moderately curved with	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.

Sl. No.	Type of Expansion	Suitability for Adoption Joint	Special Consideration
		maximum horizontal movement upto 50 mm	
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.
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			

### CLAUSE 2703 RAILINGS AND PARAPETS

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 directed by the Engineer of approved brand and shade.

#### **Sub-Clause 2703.5.4 Tolerance**

The overall horizontal alignment of crash barrier and rails shall not depart from the road alignment by more than  $\pm 30$  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  $\pm 30$ 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 $\pm$ A $\phi$ hardness 22 $\pm$ 3 @ 25°C
Operating temperature	-	.-20°C to + 80°C Shrinkage Less than 1%
Permanent dynamic	-	$\pm$ 25% Movement capability

**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 of 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 RAINCUTS****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.

#### **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's 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.

#### **PROTECTIVE MEASURES**

- a) Short delay blasting with light charges shall be used.
- b) The blast hole shall be covered with 0.6 to 1.0 sq.m. Mild steel plate of minimum 6 mm thickness.

- c) Reinforcement rod mesh not less than 20 mm dia at 150 mm centers in both directions shall be placed over the steel plates.
- d) Steel plate and reinforcements shall be inspected after every blasting operation and all twists shall be removed before reuse to the satisfaction of the Engineer.
- e) The thickness of the covering plate and the kind of dead weight is to be duly approved by the Engineer.

When blasting is necessary adjacent in partially or completely built structures the contractor shall take all precautions necessary to prevent flying rock from causing damage to the structures.

#### **BLASTING WITHIN CERTAIN LIMITS**

No blasting shall be allowed for any of the excavation until freshly placed concrete of nearby structures has reached a minimum strength of 7 MPa.

Normally, blasting shall be resorted to only after 7 days of concreting work in case of OPC (10 days in case of PPC) in adjacent structures.

In no case shall blasting be allowed closer than 15m to any structure after concrete placing has started.

When minor blasting is necessary after concrete placing has started in any structure, the maximum size of charge for distance from 100m and above shall be limited to the following:

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.

**CLAUSE 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**

The open wells shall be classified as under:

- i. Unlined
- ii. 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/m<sup>3</sup>. 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**

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 m<sup>2</sup>/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/m<sup>2</sup> 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 manufacturer, the trade name of the compound, the type of compound and class of vehicle/solids, the nominal percentage of volatile material and batch or lot number. The lot numbers will be assigned to the quantity of compound mixed, sampled and tested as single product. The manufacturer shall exercise the care in filling the container so that all are equally representative of the compound produced.
- b) Curing compound to be used on site shall be got tested at least 14 days in advance so that the result of water retention tests, reflectance test, drying etc, are available before it can be permitted for use. All of the filled containers represented by the approved sample shall then be sealed to prevent leakage, substitution or dilution. The engineer-in-charge or authorised representative should mark each container represented by the samples with a suitable identification mark for later identification and correlation and shall be kept in store with double lock arrangements. One key shall be kept with the Contractor and the other with the 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 4m<sup>2</sup> 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/cm<sup>2</sup>) 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 as per drawing.

### **2. Description**

#### **2.1 Passenger Shelter**

Passanger shelter shall be construction with basement, loead bearing walls and RCC roof slab and internal and external paint.

Basement with stone masonry. The basement shall be raised minimum 450mm from ground level.

Walls are load bearing walls with 230mm thick brick masonry walls for all the shelter upto slab height and above the slab parapet wall shall be constructed. Roof shall be covered with RCC slab with grade 1:1.5:3 (1 part cement : 1.5 parts sand : 3 parts stone chips) with required reinforcement and provide outer projection as sajja around the shelter. It shall have seating arrangement with 50mm thick R.C. slab with mix of concrete for seating slab and back shall be nominal one with 1:1.5:3 (1 part cement : 1.5 parts sand : 3 parts stone chips) with required reinforcement and it will be finished with neat cement punning not lass than 3mm thickness. Entrance steps shall be constructed with neat cement finishing.

The flooring shall be with 25mm thick I.P.S. flooring (M20) over 100mm thick M-15 grade concrete.

Waterproof treatment shall be done above the RCC roof slab.

The exposed surfaces internal and external of the structure shall be painted with two coats of cement based water proof paint of make and brand approved by the Engineer Bus shelter complete as per approved drawing as directed by the Engineer.

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 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.

#### **c) 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.

**d) Measurement for payment:**

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

**e) 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 CONSTRUCTION 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 1m 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 / mm<sup>2</sup>), 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 / m<sup>3</sup> 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 63<sup>0</sup>C, test method ASTM D1499-92a and ASTM G 23-93 apparatus Type E.
- c) Brittleness temperature: No higher than -9<sup>0</sup>C, when tested accordance with ASTM D746.
- d) The properties after aging test shall be as follows:
- e) Appearance of coated mesh: no cracking, stripping or air bubbles, and no appreciable variation in colour.
- f) Specific Gravity: variation shall not exceed 6%.
- g) Hardness: variations shall not exceed 10%.
- h) Tensile strength: variations shall not exceed 25%.
- i) Modulus of elasticity: variation shall not exceed 25%.
- j) Abrasion resistance: variation shall not exceed 10%.
- k) Brittleness temperature shall not exceed 18<sup>0</sup>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:  $\pm 5\%$  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 1m 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 / mm<sup>2</sup>), 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 / m<sup>3</sup> 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<sup>0</sup>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 20 x 40 (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 ó 1800/III (All appendices have references to MOSRT&H Specifications for Road and Bridge Works)

#### **Cement**

As per Appendix ó 1800/III

#### **Sand**

As per Appendix ó 1800/III

#### **Admixtures**

As per Appendix ó 1800/III

#### **Grout**

As per Appendix ó 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 ó 1800/III

#### **Grout Pump**

As per Appendix ó 1800/III

#### **Water pump**

As per Appendix ó 1800/III

#### **Grout Screen**

As per Appendix ó 1800/III

#### **Connections and air vents**

As per Appendix ó 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.ö

**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**

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

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

## **CLAUSE A-17 STREET LIGHTING**

### **I. SCOPE**

The scope covers the design, supply, fabrication, installation, testing and commissioning of all the items as listed below.

1. Street lighting/illumination shall be provided at urban locations as shown in drawing or as directed by the Engineer.
2. Road lighting through LED lamp fixtures on GI street lighting poles & accessories like Junction Boxes. The average illumination level shall be as per National Standard but not less than 40 lux.
3. Power supply arrangement including DP structure, transformer, outdoor feeder pillar, main LT distribution panel etc. for road lighting.
4. Miscellaneous jobs like earthing, laying of PVC/Hume/GI pipes, etc.
5. Liaison with utility companies, for load sanction & release of permanent supply.
6. Preparation of shop drawings during execution of work.
  
7. Preparation of "As built drawings".

#### **ADDITIONAL POINTS**

8. The above list is not exhaustive. All works required to complete the system as per standard code of practice are deemed to be included in the scope of contractor.
9. Before commencement of the work, the contractor shall submit working drawing/shop drawings & cable schedules for approval of consultant/employer. The works has to be carried out on the basis of approved drawings only.
10. All equipment shall be procured from approved manufacturers only. The equipment shall meet the requirement of IS codes & all the routine tests required by the Employer/Consultant are to be carried out by the contractor without any additional cost.

#### **II. GENERAL SPECIFICATIONS**

1. Cable conductor shall be either copper or aluminium stranded and specified as per drawings. Size and type specified on the drawing and specification shall not be substituted by any other size/type without prior approval of Employer/consultant.
2. Cable Accessories
  - a) Single compression cable gland, heavy duty type nickel plated (coating thickness not less than 8 to 10 microns) made from Brass consisting of gland body with hexagonal head, compressor nut, flat check nut, neoprene rubber seal and a metal washer.
  - b) Double compression weatherproof cable gland. Same as above and consisting of gland body nut, gland body, gland nipple, neoprene rubber seal for outer sheath, rubber washer armour clamping ring, armouring clamping core check nut, skid washers.
3. Termination of all cables shall be done through cable boxes, brass cable gland of proper size and a brass Earthing tag.
4. Termination of all single core and multi-core cables shall be done through tinned copper lugs of proper size and same shall be crimped with the help of hydraulic crimping machine.

5. Telephone cables and power cables shall not be allowed to run side by side, but shall be separated to avoid interference due to induction.
6. Bimetallic washers/sleeves shall be used wherever two different metals, e.g. copper or aluminium cables and clamps/busbars are terminated or jointed.
7. Brass bolts, nuts and washers shall be used for termination of cables strips on earth plates, bus bars, breaker terminals.
8. All cables and wiring for power, lighting and control for main LT distribution panel or feeder pillars to poles/equipments shall be the actual measured length of cables laid.
9. Inspection boxes shall be provided for periodical inspection and to facilitate drawing and removal of cables.
10. Lighting load shall be divided equally on all the three phases as far as practicable.
11. Loop system shall be adopted for lighting wiring. Joints in wires shall not be allowed.
12. Each circuit will be controlled by MCB/fuse in the lighting panel. All circuit and points shall be suitably numbered for identification, which will have to be approved.
13. Each light outlet or fan or socket shall have an individual separate 5A SP control switch unless otherwise specified. Group control shall be placed on the phase wire.
14. Only one twin flexible cord of copper conductor minimum size 23/0076 shall be attached to a ceiling rose.
15. Single phase socket above 5A rating and small size motor shall be connected to the power distribution panel.
16. All sockets shall be 3 pin type.
17. Internal wiring shall be of the following types:
  - a) Concealed wiring using heavy gauge PVC conduits and accessories.
  - b) Surface wiring using heavy gauge PVC conduits and accessories
  - c) Surface wiring using GI/MS pipes and the accessories.
  - d) Surface wiring using PVC casing and cover or PVC trunking.
18. Lighting poles shall be earthed by providing galvanised iron pipe electrode and 25 x 5 mm GI earth strip as earth conductor.
19. All the metal clad equipment like breakers, panels, capacitor bank enclosure, switch fuse units, bus bar chambers, DBs, pumps, motors, cable trays and

switch sockets shall be earthed by an earthing conductor of suitable size at two diagonal opposite points.

20. Bare earthing strips/conductors shall not be laid touching the cables.
21. Conduits shall be UPVC conduit concealed in wall ceiling slab. Size of conduits shall be min. 20 mm dia.
22. The distance between any two earth stations shall be about 3 mtrs.
23. All the light fittings, switch sockets, fans, heaters, geysers, etc. shall be earthed by earth conductors of the adequate size and through proper tinned copper lugs.
24. Wherever cables and PVC pipes are run on walls the same shall be supported on MS cleat and aluminium saddles and out of 25 x 2 mm strips.
25. Distance between two adjoining supports or cleats for cables, PVC pipes, PVC conduits, PVC casing, trunking and earthing strip shall be between 250-400 mm on straight run and the same shall be reduced on bends or at junctions or where direction of run is changing.
26. The reinstated area (after excavation and completion of laying any cables, pipes, etc.) shall be finished at a slightly higher level than the adjoining undisturbed area. This is to ensure against the subsequent subsidence of reinstated area underneath.
27. Cleating of cables on walls, inside RCC ducts etc. shall be done by specially made 25 x 2 mm aluminium saddles GI saddles shall not be allowed.
28. Before commencement of work the contractor shall prepare and submit to the consultant (for his approval), complete working drawings and cable schedule.

### III. LIST OF STANDARDS

The works shall be carried out as per the following latest IS codes & other applicable codes of practice, electrical rules and other statutory regulations:

1.	IS:13118 -	:	General requirements of circuit breakers
2.	IS:2147	:	Degree of protection
3.	IS:2705 (Part I, II, III)-	:	Current transformer
4.	IS:3156 (Part I, II, III)-	:	Voltage transformer
5.	IS:10118 -	:	Code of practice for installation & maintenance of switch gear & control gear
6.	IS:1248 (Part II & III) -	:	Electrical direct acting indicating instruments

7.	IS:2026 - (Part I to IV) -	:	Power transformers
8.	IS:10028 (Part I to III) -	:	Code of practice for selection, installation & maintenance of transformer.
9.	IS-9921 (Part I, II & III) -	:	Disconnecter Switches above 1000V AC.
10.	IS:8187 -	:	Drop out fuse above 1000V AC
11.	IS:3070 (Part I) -	:	Lightning Arrestors.
12.	IS:2486 -	:	Insulator & Insulator fittings for 11 kV overhead lines.
13.	IS:5039	:	LV feeder pillars
14.	IS:3043 -	:	Earthing
15.	IS:1554 - (Part I) -	:	PVC Cables upto 1100V
16.	IS:7098 (Part I & II) -	:	General requirements & selection of XLPE Cables upto 1100V AC & 3.3 KV to 33 KV
17.	IS:2713 -	:	Steel tubular poles
18.	IS:9537 (Part I to IV),	:	Rigid steel conduits for electrical wiring.
19.	IS:8828	:	Miniature circuit breaker
20.	IS:2274	:	Code of practice for electrical wiring, installation.
21.	IS:1944 (Part 5)	:	Code of practice for lighting of grade elevated roads.

#### IV. Transformer

##### General

These shall be basically oil filled outdoor type and suitable for 3 phase, 50 Hz AC supply of 11/0.433 kV rating.

##### Oil Filled Transformers

These shall be suitable for outdoor installation. The secondary winding neutral shall be brought out to a bushing for earthing.

The transformer shall be filled with oil of requisite dielectric strength.

The transformer shall be double wound natural air cooled suitable for outdoor installation.

The transformer shall be capable of satisfactory operation at its rated output on normal ratio and at any voltage which does not vary from its rated primary voltage by more than 5% and at a declared frequency which does not vary by more than 3%.

It shall be designed to withstand thermal and mechanical stress of short circuit without any injury.

Particular attention shall be given to the suppression of harmonics.

Core of each transformer shall be made of cold rolled grain oriented high permeability silicon steel.

Insulation of windings and connection shall not deteriorate when the transformer is operated continuously at its specified rating.

The interturn and intercoil insulation shall be so designed that dielectric stress is uniformly distributed throughout the winding under all conditions.

Each transformer shall be provided with taps as mentioned in detailed transformer specification.

Tappings to be provided only on the primary side with off circuit tap changer of -10 to +5% in steps of 2.5%.

Each transformer to be provided with the following:

- 1) Set of earthing terminals
- 2) Set of lifting lugs
- 3) Rating plate and connection diagram engraved on a brass plate.

Name plate giving makers name, serial number, rating etc. should be fixed permanently to each transformer in a convenient position. Order number of purchaser with data should also be engraved on the plate permanently fixed to each transformer.

The transformer, enclosure shall conform to IP:54 as per IS:2147.

Hot spot temperature shall be within allowable limit of the class of insulation used.

Lifting lug shall be provided to facilitate transport and erection.

All test in accordance with relevant IS shall be carried out at works and certificate to that effect in duplicate shall be submitted to the Engineer.

Insulation resistance, between phases, phase to earth and between primary and secondary shall not be less than 5M (five megachms). It shall be the responsibility of the tenderer to guarantee this value.

The transformer shall be provided with cable box. The cable box shall be weather, dust and vermin proof and suitable for accommodating PVC sheathed, PVC insulated aluminium conductor cables.

The transformers shall be (delta) wound on primary and Y (star) wound on secondary.

The neutral point on the secondary side shall be brought out and terminated on to a bushing within the cable box.

The transformer shall be protected with gang operated air break switches and drop out fuses mounted on 2 pole structure.

The tenderer shall submit the test certificates for dielectric strength of oil used.

#### **V. Main LT Panel/Distribution Board/Sub-Distribution Boards**

These shall receive supply from secondary of transformers through MCCB incomer & change over switch of suitable capacity depending upon the provision of standby power.



Moulded Case Circuit Breakers (MCCB) shall be quick make, quick break and trip free type as per IS:2516.

All Miniature Circuit Breakers (MCB's) used in outgoing circuits shall conform to IS:8828 having interrupting rating of 9 KA.

The Main LT panel & Distribution boards, shall be in dust & vermin proof tight sheet steel enclosure, factory assembled and suitable for floor mounting. The degree of protection offered shall be IP:52 as per IS:2147. The enclosures shall be reinforced with thicker plates at flange openings and hinges. Each distribution board shall be provided with gasketed hinged cover.

The board shall be provided with suitable end plates at the top and bottom to receive conduits, cables.

The enclosures shall be so arranged that on opening, the terminals are readily accessible and sufficient space shall be left in the interior of enclosure for accommodation of external conductors from their points of entry into the enclosures upto the terminals. The terminals shall be of substantial mechanical construction providing adequate electrical contacts for aluminium conductors.

The rear portion of distribution board shall enclose the three phases and one neutral bus bar located one below the other in a vertical plane and mounted on non-hygroscopic insulators. The bus bars shall be adequate and take care of possible deformations due to effect of temperature, aging or shocks. The bus bars shall have sufficient mechanical strength to withstand the effect of 9 kA short circuit for 1 seconds. The surface of the insulating parts shall be designed with ridges so arranged as to break the continuity of conducting deposit which may form. The full load rating of any bus bar shall be at least equal to 200A. The rating of neutral bus bars shall be equal to phase bus bar.

The MCB units shall be secured in such a way as to permit change of position or removal without difficult or structural alteration.

All live parts of distribution board shall be protected against accidental contact when cover is opened.

A way label shall be pasted inside the cover of the board with circuit designation so as to indicate the circuit number and its location to which each breaker is connected.

The board shall be complete with all necessary self contained inter-connections, wiring, suitably engraved designation labels and circuit numbers and provided with two external earthing terminals.

The outgoing connections shall be suitably grouped and run to terminal blocks mounted either at the bottom or top of the panel board.

Each terminal block, shall comprise of a number connections separated by insulating barrier.

All hardware required for mounting distribution boards shall also be supplied. The distribution boards shall generally be fixed on frames grouted in the wall.

Not more than two wires shall be connected to one terminal. There shall be 20% spare capacity in terminal block.

Sub-distribution boards i.e. MCB DBs shall be factory built ready to use sleek type with facility for 3 phase incoming & 3 phase/1 phase outgoing of suitable

capacity for lighting & power circuits. These shall have IP:42 protection as per IS:2147.

### **Outdoor Feeder Pillar**

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

The incoming panel shall be controlled by a 4P MCCB/MCB of suitable rating. 3 nos. phase indication lamps with 2 Amps rewirable fuse shall be provide for checking healthiness of main supply. Suitable panel illumination circuit with tumbler switch shall be provided inside the feeder pillar to enable night shift technicians to attend to the feeder pillar. This lamp shall be connected from a separate SP MCB outgoing circuit.

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

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

The feeder pillar shall in general conform to IS : 5039 - 1969.

General arrangement drawings together with wiring data and makes and complete technical data of components of the feeder pillar shall be submitted by the bidder for approval before manufacturing the feeder pillar. Fabrication and assembly of the feeder pillar shall be taken up only after obtaining approval of the drawing from the purchaser.

### **Road Lighting System**

#### **GI Street/Road Lighting Poles**

Poles shall be fabricated out of MS tubular steel stepped and swaged with a welded MS base plate. The entire pole shall be hot dip galvanised. The poles shall be installed in the following manner:-

1. Grouted in 1:2:4 concrete foundation 450 mm dia and 1 .8m height (300mm projecting above the finished ground). The base plate shall be 300mmx300mmx10mm thick.
2. Grouted in the curb barrier upto a depth of 900 to 1000mm, the base plate shall be 10 mm thick 250 mm diameter.

The poles shall have the following accessories and provisions:-

3. An elliptical GI cover plate with Allen screws for opening and access to cable termination system within the pole.
4. 30mm cable entry holes.
5. Cable termination strip of copper 50A capacity with looping in and looping out facility.
6. 10A DP MCB for the outgoing cable to luminaire.
7. Earthing provision 3 tapped holes of 12mm dia or earthing lugs at 500mm above the finished ground level.
8. Side arms (one or two) for fixing on the top of the pole with 3 nos. 12 mm tapped Allen Grub screws. The arms shall be 1.5m long, spaced at an angle of 15° and terminate into a spigot of 40/60 mm dia to match the luminaire.
9. 3 core 2.5 sq.mm flexible stranded copper conductor unarmoured cable from junction box to the terminal of luminaire.
10. GI pipe sleeves 38mm dia for incoming and outgoing cable shall be installed.
11. 25 mm dia GI pipe 300 m long for enclosing 8 SWG GI conductor required for earthing the lighting pole shall be installed.
12. 38 mm dia GI pipe 1.20 mtr. long with perforated holes shall be installed for earthing each lighting pole. For details refer to details of Pipe Type Earthing Electrode under the heading of "Earthing".
13. 8 SWG GI wire about 3 mtr. long shall be used to connect the Pipe type earth electrode to the lighting pole, earthing stud and to JB of cables.

### **Junction Boxes**

The Junction Box for mounting on street light or general area lighting poles shall be fabricated out of 3 mm thick sheet steel, and shall have powder coated paint finish of approved colour over two coats of rust proof primer paint, carried out over pickled anti-sulphate and anti-rust chemical treatment of the raw sheet steel. The junction boxes shall be dust and vermin proof and provided with neoprene gaskets. The front of the junction box shall open upwards, by means of heavy

duty hinges provided on the top edge. The bottom of the front cover shall have two numbers key-operated locking arrangements. Provisions inside the junction box shall comprise of 8 way ELMEX type 20 Amps terminal block, insulator mounted 4 way neutral link rated 32 Amps, earthing terminal and rear side hole (to let in luminaire wiring inside the pole) and 1 no. 6 Amps HRC fuse base and fuse link for every luminaire. Earthing bolts shall be provided on the exterior of the junction box as well. The bottom of the junction box shall have 2 nos knock-outs to facilitate glanding of aluminium conductor PVC insulated armoured cables. 2 Nos 32 mm x 6 mm thick MS plates shall be welded on the rear side of the junction box to the complete width of the box and projecting 75 mm on either side to take the pair of semi-circular clamps for the purpose made out of 32 mm x 6 mm flats. The clamps and the flats welded on the junction box shall be assembled on the pole using 8 mm dia fine threaded bolts and nuts, together with a set of flat and spring washers. Necessary holes shall be provided on the pair of semi-circular clamps and the 32 x 6 mm flats of the junction box to suit the diameter of the pole. The rear side of the junction box shall be provided with 13 mm bore to allow entry for wiring from the junction box to the luminaire on pole top. The junction box shall be at a height of 300 mm above finished road level. Detailed drawings shall be submitted for purchaser's approval before taking up the manufacture of the junction box. Manufacture of boxes shall be taken up only after the drawings are approved. Prior to mass manufacture, one sample set of box and clamps shall have to be got approved by the purchaser.

### **Lighting Luminaries**

#### **Scope**

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

#### **Standards**

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

#### **Lighting Fittings - General Requirements**

Fittings shall be designed for continuous trouble free operation under atmospheric conditions as applicable in site without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather-proof and rain-proof type and also suitable for use in dusty & vapour prevalent atmosphere confirming to IP:65 degree of protection.

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

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

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

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

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

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

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

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

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

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

### **Earthing**

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

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

### **Painting/Finish**

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

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

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

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

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

### **Decorative Type Fluorescent Fixtures**

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

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

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

Fluorescent lamps to be mounted in the false ceiling so as to form a continuous luminous ceiling, shall have an inside reflector of non-fluorescent power occupying 2/3 of inner surface of the tube so that the lamp radiates light mainly in the direction determined by the position of the reflective material.

### **Incandescent Fixtures**

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

### **Industrial Type Fittings**

1. These fittings shall be suitable for use with LED lamps as per requirements and generally as described below.
2. For general industrial use in humid atmosphere, the fittings shall be provided with CRCA sheet steel mounting/housing channel vitreous enameled and with vitreous enameled reflector of minimum 20 SWG thickness.
3. For dusty and vapour prevalent atmosphere, the fittings shall be dust and drip proof type, totally enclosed in sheet steel housing with a heat resistant toughened glass cover or clear acrylic sheet. The housing shall be epoxy stove-enameled and neoprene gaskets shall be provided for sealing.
4. For atmosphere where chemical vapours/fumes are corrosive, the material of fitting housing/mounting, reflectors and end-plates shall be of cast aluminium/aluminium sheet and finished in epoxy stove enamel to resist corrosion. Control gear housings, starters and tube holder assemblies shall be provided with neoprene gaskets to make it proof against entry of corrosive vapours.
5. The angle of cut-off for fittings with filament lamp shall not exceed 70° and that for fittings with fluorescent tubes shall not exceed 79°.
6. The distribution of light shall be such that at least 80% of the total luminous flux from the fitting shall be in the lower hemi-sphere.

7. Fittings shall be suitable for the number of lamps of specified wattage, for directly mounting on ceiling/wall and or conduit suspended.

### **Bulkhead Fittings**

Bulkhead, weather-proof type fittings for use in corridors, staircase landings, covered porches and low ceiling factories, shall be suitable for direct fixing to wall/ceiling and to accommodate upto 150 watts incandescent lamp. The fitting shall be provided with housing of cast aluminium alloy with stove enameled finish, prismatic heat resistant glass cover hinged on to the housing and fixed by screws. Neoprene gaskets shall be provided to make the fitting weather-proof. For mechanical protection to glass cover, a protective wire-guard of 3 mm galvanized wire with stove enameled finish paint shall be provided.

### **Street Light Fittings**

The luminaire shall be HPSV type, highly efficient, pot mirror system housed in die-cast aluminium housing.

### **Accessories for Lighting Fittings**

#### **Reflectors**

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

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

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

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

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

#### **Lamp/Starter Holders**

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

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

Lamp holders for incandescent and LED lamps shall be of bayonet type upto 150W and Edison Screw type for higher Wattage lamps.

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

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

### **Ballasts**

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

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

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

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

### **Starters**

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

The starters shall generally conform to the relevant standards.

### **Capacitors**

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

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

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

### **Lamps**

Incandescent (GLS) lamps shall be provided with bayonet caps upto 150/Lumen/W.

LED lamps shall be life of >50,000hrs

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



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

### **Spare Parts**

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

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

### **Tests and Test Reports**

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

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

### **LT Cables**

#### **Codes & Standards**

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

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

#### **Power Cable**

Power cables should be multicore earthed 1.1 kV grade aluminium stranded conductor colour coded, extruded/PVC insulated, extruded semi-conducting screened over each core and insulation, extruded inner sheathed, common extruded inner sheathed for multi core cable, galvanised steel strip armoured and overall extruded black sheath conforming to IS-1554 Part II, 1976. Armouring of multicore cable shall be of single layer, galvanised steel round wire or flat strip. Wire armour should be used for cable dia over inner sheath upto 13 mm and strip armour to be used for higher dia. The cables should be multicore and suitably designed for variation in power supply as follows:

The voltage variation	$\pm 10 \%$
Freq. variation	$\pm 5 \%$
Combined voltage & frequency variation	$\pm 10 \%$

#### **PVC Sheath**

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

#### **Cables Size**

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

**Laying of LT Cables**

- a) The cables shall be laid in an excavated trench. The depth of the trench shall be minimum 750 mm below the final ground level but shall be decided on the number of cables to be laid in the trench so that the vertical distance between two adjacent layers of cables shall not be less than 350 mm. The width of the trench shall be decided on the number of cables to be laid in the trench so that the distance between two adjacent cables shall not be less than one cable diameter.
- b) Before laying cables the bottom of the trench shall be well compacted and the cables shall be laid on a 100 mm fine sand bedding. The second layer of 150 mm of fine sand then be spread over the cable and shall be further covered by 150 mm of compact soil. For the second layer of the cable same procedure shall be repeated.
- c) The cables shall be protected by placing precast concrete tiles or burnt bricks over the cables on top layer of sand and for the full length of underground cables. Where more than one cable is running in the same trench, the concrete tiles/ bricks shall cover all the cables and shall project a minimum of 80 mm on either side of the cables.  
In any case the top layer of the cables shall be minimum 600 mm below the finished level of the ground.
- d) The top of the cable trench shall be well compacted till the finished level of the ground and shall be approved by the construction manager/consultant if required a laboratory compaction test shall be carried out in presence of the Construction manager/Consultant.
- e) Cables under road crossings and any surfaces subjected to heavy traffic shall be protected by running them through hume pipes of suitable size.

**Earthing System****General**

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

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

**Earth Electrode**

Electrodes shall as far as practicable, be embedded below permanent moisture level.

Some electrodes shall be housed in test pits with concrete covers for periodic testing of earth resistivity. Installation of rod/pipe/plate electrodes in test pits shall be convenient for inspection, testing and watering.

**Pipe Earth Electrodes**

GI pipe shall be of medium Class-B 38 mm dia and 3.5 m length with a funnel on the top of the pipe. A funnel with wire mesh should be screwed to the pipe. Galvanising of the pipe shall conform to relevant Indian Standards. GI pipe

electrodes shall be tapered at the bottom and provided with holes of 12 mm dia drilled not less than 150 mm from each other up to suitable length from bottom. The electrode shall be buried in the ground vertically with its top not less 20 cm below ground level. A brick masonry chamber of 300 mm x 300 mm x 450 mm.

#### **Method of Connecting Earthing Lead to Earth Electrode**

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

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

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

#### **General Instruction on Electrical Pre-commissioning Arrangement and Tests**

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

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

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

#### **Cable Termination and Jointing**

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

#### **Testing and Commissioning of Electrical Equipment and Installation**

##### **General**

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

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

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

The testing of all electrical equipment as well as the system as a whole shall be carried out to ensure that the equipment and its components are in satisfactory condition and will successfully perform its functional operation. The inspection of the equipment shall be carried out to ensure that tall materials, workmanship

and installation conform to the accepted design, engineering and construction standards as well as accepted codes of practice and stipulations.

### **Polarity Test of Switch**

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

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

- i) Physical inspection for removal of any foreign bodies, external defects, such as damaged insulators, loose connecting bolts, loose foundation bolts etc.
- ii) Check for the free movement of mechanism for the circuit breakers, rotating parts of the rotating machines and devices.
- iii) Check for tightness of all cable, busbars as well as earth connections in the main earthing network.
- iv) Check for clearance of live busbars and conductors from the metal enclosure.
- v) Continuity checks in case of power and control cables.
- vi) Checking of all mechanical and electrical interlocks including tripping of breakers using manual operation of relay.
- vii) Check and calibrate devices requiring field adjustment/calibration like adjustment of relay setting etc.
- viii) Check proper connection to earth network of all non-current carrying parts of the equipment and installation.
- ix) Check for grease, insulating/lubricate oil leakage and proper charge.
- x) Check for alignment of all drawout devices like drawout type circuit breakers, MCC cubicles etc.
- xi) Checking of alarm and annunciation circuits by manual actuation of relevant relays.

The following tests shall be carried out on the equipment

#### **a) Low voltage switchgear (upto 1000 V AC or 1200 V DC)**

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

#### **b) Earth Electrode Resistance Test**

The earth resistance of the earth electrode is to be measured by an earth testing "Megger" provided with a direct reading ohmmeter. Readings obtained in

ohms shall not be more than 1 ohm. If necessary, with the approval of Engineer-in-Charge additional electrode shall be provided away from the resistance and linked to the electrodes system. Payment for such additional electrode and interconnecting tape/wire will be paid on unit or linear basis.

c) **Insulation Resistance Test**

Insulation resistance test should be made before the installation is permanently connected to the electric supply. The insulation resistance is to be measured by using an approved portable hand operated insulation resistance tester reading directly in ohms. The voltage of this tester shall be about 500 volts. The insulation resistance to earth shall not be less than 1 meg. ohm when measured with all fuse links in place, all switches closed and all poles place, all switches closed and all poles or phases of wires are electrically linked.

d) **Earth Continuity Test**

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

**Data to be Furnished by the Contractor after Award of Contract**

**Drawings/Data Sheets**

a) The CONTRACTOR shall furnish the following immediately after placement of order for approval of consultant/Employer.

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

i) Bill of material listing component equipment designation, make, types, ratings, quantity of the various component equipment mounted on the boards/panels.

ii) Sheet steel thickness and finish.

iii) Quantity of boards/panels

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

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

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

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

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

### **Test Certificates**

Type and routine test certificates for the factory built assembly of boards/panels, flameproof enclosures and for all component parts/other equipment e.g. switches, MCBs, fuses, conduits, lighting wires, light switches, receptacles, fans, etc. shall be furnished by the CONTRACTOR.

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

### **Statutory Approval for Works**

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

## **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 Hardware fittings ball and socket type for 11 kV distribution overhead line should 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 -CØ 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 $\phi$  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 $\phi$  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 $\phi$  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" x ½", 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" x ½" nut & bolt. Flatter one end and provide a hole 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 suitable 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 Rabbitt / Raccoon.

#### **18. Stay Wire 7/2.5 mm**

MS Galvanized Stay Wire 7/2.5 mm having Tensile strength of 70 kgf/mm<sup>2</sup> 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/mm<sup>2</sup> 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/mm<sup>2</sup> 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/mm<sup>2</sup> 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/mm<sup>2</sup> 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) 20 x 1/2 GI bolt & nuts :Full threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered
- b) 30 x 1/2 GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- c) 40 x 1/2 GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- d) 50 x 1/2 GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- e) 60 x 1/2 GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- f) 80 x 3/4 GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- g) 100 x 3/4 GI bolt & nuts: 2 inch threaded with hexagonal nut double hampering. Bolt head should be hexagonal and hampered.
- h) 120 x 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 VIDHUTÖ 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 ÷ Aøtype 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 shall confirm to relevant HPPWD specification/manual for bio engineering works and as 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; 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	50 mm of washed gravel placed above 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.	50 mm layer of gravel placed above compacted ground. A flat stone or brick surround.	Ground below the bed is dug to a depth of 300 mm. Bed is Made with 100 mm of unsieved soil (lower) and 200 mm of sieved soil (upper). A bund 100 mm high is formed around the edge.

3.24 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**

- a) 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.
- b) 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.
- c) 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 netting 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 strengthen 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 deeds 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 instructions; 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.

<b>Planting configuration</b>	<b>Slope steepness</b>	<b>Row spacing</b>
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 additions 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 running 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.

- 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 approximately 200 mm in depth should be excavated along the lines.
- c) 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.
- d) 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**

- a) 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.

- b) 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 is 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 storeys 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.

**APPENDICIES TO SPECIAL PROVISION****LIST OF STANDARDS**

The contractor shall provide for the use of the Project Manager technical publications, standards and codes of practice, in the Media stipulated by Project Manager. 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