

RFP No. HML / INFRA / 01 / 2021

**REQUEST FOR PROPOSAL (RFP)
FOR SELECTION OF
DESIGN & BUILD CONTRACTOR
FOR DEVELOPMENT OF PHYSICAL INFRASTRUCTURE AND
CONSTRUCTION OF ADMINISTRATIVE BLOCK AT
MEDIPARK IN CHENGALPATTU DISTRICT, TAMIL NADU**

**VOLUME IV
SCHEDULE OF WORKS**

**SCHEDULE 2
SITE GRADING, ROADS NETWORK AND STORM WATER DRAINAGE**



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SCHEDULE 2 : Site Grading, Road Network and Storm Water Drainage**1. Scope of Work****1.1. Brief**

The brief scope of work for Excavation & Grading, Construction of Roads and Storm Water Drainage shall be as follows

1.2. Excavation and Grading

The proposed site for the development requires Site Grading / Land Filling. The total area for site grading is 118 acres, which includes area earmarked for Internal Roads, Plots and Common Amenities.

The Site grading shall be done upto 1m length on either side of road from end of Drain to match the top of drain wall and further sloped not steeper than 1.5:1 including, cutting, removing and disposal of all material, bushes, shrubs, stumps, roots, grass, weeds etc. All material arising from clearing and grading shall be disposed by the Contractor at suitable sites with all leads and lifts. The disposal shall be in accordance with Local, state and central regulations.

Grading shall be designed so that plot lines are at the top of slope and with adequate property line setback from the slope to provide for required vertical slope rounding. The tops and toes of cut lines and structures shall be designed to provide for:

- a. Safety of adjacent property; and
- b. Safety of pedestrians and vehicular traffic; and
- c. Required slope rounding for adequate foundation support; and
- d. Required swales, berms and drainage facilities; and
- e. Sufficient setbacks to meet applicable zoning requirements.

Contractor shall be responsible for the protection of adjacent properties during grading operations. Prior to commencing any grading of the site, the exterior boundaries shall be marked or staked as required by the grading inspector. Boundary markers shall be maintained throughout the grading operation. Temporary barriers and/or protective fencing shall be used when necessary to protect trees and adjacent properties.

The contractor shall be responsible for clearing jungle upto the overhead tank and TNEB substation for easy access.

Soil stabilization is required for all graded areas. Slopes, both cut and fill, shall be provided with subsurface drainage as necessary for stability.

Slopes, both cut and fill, shall not be steeper than two horizontal to one vertical (1.5:1), unless special circumstances applicable to the property, including size, shape, topography, location or surroundings, would cause the strict application of the standard to deprive such property of reasonable use. If these conditions exist, a geological and engineering analysis shall verify that steeper slopes are safe and appropriate erosion control measures are specified.

The Contractor shall do all grading, filling-in, or excavating, as required, to completely grade the site to lines and grades shown, and to provide for the indicated drainage. Where finish grade corresponds practically with existing grade, the ground shall be worked up and graded off evenly with existing grade. The grading operation shall generally consist of moving and transporting materials within the area; however, the Contractor shall provide any additional fill material, if necessary, to complete the site grading to the elevations shown, or to waste any excess material which may result. Clearing and stripping shall be as required.

1.2.1. Ground Surface Preparation

Before excavating or placing fill material, complete all clearing and grubbing, and scarifying ground surface to provide ample bond between old and new material.

1.2.2. Placement of Fill

Place fill material in layers not exceeding 250mm. Compact each layer before placing the next layer. As the compaction of each layer progresses, continually level and manipulate to assure uniform moisture and density. Water shall be added to the approximate optimum moisture content in the borrow area prior to placement in the fill area.

1.2.3. Density Requirements

The top 0.5 feet of cut or fill materials that are to support roadway pavements, and walks shall be compacted to 95 percent of the maximum density. All fill below the top 0.5 feet and all fill not supporting roadways, or walks shall be compacted to 90 percent of maximum density, unless otherwise shown on the drawings.

1.2.4. Channels

Construct ditches, and inlet and outlet channels for Drain as directed. Round and trim channel slopes neatly to line. Final flow line grade shall be reasonably uniform to provide free drainage without puddling.

1.2.5. Slope Finishing

Leave earth slopes with a roughened but reasonably uniform surface without noticeable breaks. The final surface shall be similar to that obtained by using a farm disk or harrow parallel to the roadway. Blend slopes smoothly with the adjacent terrain. Grading shall provide for drainage away from all sides of Road.

1.2.6. Disposal of Excess Material

Excess Material shall be disposed of off-site at the Contractor's expense. This alternative shall be as directed by the District Engineer and shall conform to the provisions of this specification.

1.3. Road Network

The Contractor is required to undertake the following activities:

- i. Construction of Roads for approx. 3.30 km length of different ROW as stated in the relevant section along with Drain and/or cross over natural drainage channels. This includes strengthening of 1.53 km of 24-meter road that already exists at the Medipark site.
- ii. The road cross-sections are developed based on the RoW provided for various categories of roads in the master plan. The road cross sections include paved road, earthen embankment and RC Drain.
- iii. The Design and Construction of Roads Area shall be as per drawing provided. Notwithstanding anything to the contrary contained in the Schedules, the Finished Road Level (FRL) shall be designed based on Mean Sea Level (MSL) and also design the natural drainage requirement to optimize storm water pumping by the contractor.
- iv. The Authority does not warrant either the sufficiency or accuracy of site data provided in the Bid Documents or elsewhere. The Contractor shall be fully responsible for independently verifying or obtaining any and all site data that Contractor deems necessary to prepare the bid. Any Site data in Authority's possession that is not included in the Bid Documents will be available for inspection at the Authority's address provided in the Tender.

- v. Width of carriageway is as given in typical cross sections drawings.
- vi. The construction of the roads will also be associated with setting up the following:
 - a) **Roadside Furniture / Road Markings & Signage**
Roadside furniture and Road markings & signage
 - b) **Traffic Sign:**
Traffic signs include roadside signs and curb mounted signs along the entire road network in scope. Signage shall be provided as per IRC Standards.
 - c) **Pavement markings:**
Pavement markings shall cover road marking for the entire road network is scope as per IRC standards.
 - d) **LED Traffic Blinkers:**
For the entire road network in scope as per IRC.
 - e) **Delineators:**
Delineators for the entire road network in scope at the locations as per IRC.
 - f) **Rumble Strips/Speed Breakers**
Rumble Strips/Speed Breakers shall be provided at locations demanding reduction of speeds which include approaches of important junctions, Highways, the same shall be in accordance with the Standards and Specifications
 - g) **Resurfacing of Roads**
The resurfacing of roads (around 1530m of existing 24-meter wide road) in the Medipark shall be in conformity with the standards and specifications provided in this schedule

1.3.1. Design and Construction

1.3.1.1. Typical Cross Sections

Typical Cross Sections details for each ROW for purpose of tender as tender drawings are enclosed. This is only for the purpose of tender and the detailed shall be developed by the contractor.

Note - The actual length of roads may vary as per detailed engineering design. Utilities shown in typical cross sections provided are indicative and typical and shall vary with site conditions during detail engineering.

1.3.1.2. Geometric Design and other Features

a. General

Geometric design and other features of the Project Roads shall be in accordance with the Standards and Specifications as per Annexure A

b. Design Speed

The road sections are provided in the drawing in Annexure A. These roads shall be designed for the following speeds.

Table: the length of roads along with ROW as below:

ROW	Length in Metres	Laning
24m*	1,530 *	4 lanes, with divider(two lane each side)
18m	1,670	2 lanes, without divider
15m	100	intermediate lane, without divider

* 1,530 meters length of 24 m wide road already exists at the Medipark site, which needs to be strengthened.

Table: Design Speed

Road Category	Design Speed (km/hr)
Local street road	30

Design speeds given above are general and these may vary at locations due to Constraints or safety requirement.

1.3.1.3. Coordination on Geometric Design

The contractor, while carrying out detailed design of the Roads and associated facilities has to obtain the approval of the Employer Representative/PMC for the design integration especially with Main Road (SH58) and other link Roads, as the they get developed. Main road shall be developed as State Highway, however as off date the level of Main road at the entry of project site.

1.3.1.4. Standard Lane Width

The Standard lane width shall be 3.5m.

1.3.1.5. Shoulders

The type of shoulders shall be as below:

- Earthen Shoulder – Ref typical road cross section

1.3.1.6. Junctions (At grade)

Junction details are as given below

No of Junctions	Junction Type	Main Road Width	Intersection Road Width
3	T Junctions	24m	18m
2	T Junctions	24m	24m
2	T Junctions	18m	18m
1	T Junctions	24m	15m

1.3.1.7. Embankment & Pavement Design

Construction of embankment and pavement shall conform to the Standards and Technical Specifications

1.3.1.8. Pavement Design Criteria

Pavement design shall conform to the Standards and Specifications

a. Type of pavement

The pavement types for different road and cross sections shall be as given below in **Table: 5**

Table: 5

Main Road	Cross Road
Flexible Pavement	Flexible Pavement

1.3.1.9. Design requirements**a. Design Period**

Flexible pavement shall be designed for a minimum design period of 20 years.

b. Design Traffic

Notwithstanding anything to the contrary contained in the Schedules, the Contractor shall design the pavement for minimum MSA as given below

Table

ROW	24m	18m	15m
Traffic MSA	10	10	10

1.4. Storm Water Drainage

The storm water drains shall be constructed along the road. The storm water drains are proposed at the ends of ROW and shall be constructed as per the sections provided.

The planning and execution of the drain shall ensure effective drainage of the road surface without inundations. The design of drainage system shall be designed up to the disposal points at the site. Flow of drain water shall be ensured with gravity flow with self-cleansing velocity.

Box culverts needs to be constructed wherever necessary. All Concrete Surround of storm water pipes shall be with grade M25 concrete.

Storm water collection systems shall be designed to provide adequate surface drainage. Surface drainage is a function of transverse and longitudinal pavement roughness, inlet spacing and inlet capacity.

The discharge design facilities for storm water collection and conveyance systems include consideration of storm water quantity and quality. The general considerations in design of storm water drain shall be:

- Drains shall be design for appropriate design frequency/return period depending on importance of development and economic considerations.
- Drains shall be planned to take into consideration the ground levels, slope of the ground, valley and ridges and also the land uses planned for urban development.
- Drains shall be planned to get good longitudinal slope, considering the nature of soil and subsoil water level. Drainage of large area can be better achieved by subdividing it into small grids to avoid a long main drain. Aim should be to get a high velocity for the dominant flow.
- Efficiency in maintenance of drainage system is an important consideration in selecting the size, shape and the location. The specification of the drain shall also aim at preventing the possibility of ingress of other extraneous materials, debris, vegetation etc. where grating are provided on drains, they shall be so located as to attract attention of maintenance staff, easy to approach, inspect and clean it.

1.4.1. GULLIES & CONNECTIONS

“Supply and Install Kerb Gully/ flush gully” shall include for supplying and installing with all necessary excavation and backfilling, gully grating, hinged cover and frame all of ductile iron and the gully pot of GRP complete with approved removable bucket, sand deflector, precast concrete make-up and concrete surround to the pot and spout.

Where gully pipes are laid but no kerb entry gullies are to be installed and shall include for provision and installation of end caps and approved concrete marker slabs suitably inscribed and installed as directed by the Authority’s Engineer. The Contractor shall obtain prior approval of the exact locations from the Authority’s Engineer

Supply and installation of saddle or tee connections of different diameters shall include but not limited to the additional excavation around the pipes, provision and installation of saddles or tees/reducers, etc. on the carrier pipelines, couplings, pipe bedding and all incidentals necessary to complete the work. All connections to carrier pipes of diameter less than 500mm shall be by tee connections.

“Break Out existing Gully and Replace” shall include removal of existing frame & cover, gully pot and concrete surround, refurbishment of frame and cover or provision of new frame and cover, new complete gully pot concrete surround and reinstatement of kerbs, road and footpath etc. to original condition.

1.4.2. BUILT UP DRAINS

Drains shall be constructed in Reinforced Cement concrete and shall be finished with smooth surface for inner area.

The drains shall be open or covered. Pre-cast R.C.C cover slab of appropriate thickness and steel shall be provided for cover drains. The pre-cast cover slabs shall be capable of withstanding loads under traffic wherever traffic is expected over the drains.

1.4.3. MANHOLES AND CHAMBERS

The work shall include but not be limited to all necessary excavation, formwork, provision of concrete, reinforcement, GRP coated step irons, building pipes into the walls, removal of surplus materials, backfilling, reinstatement and all incidentals necessary to complete the manhole and chambers. The manhole's cover slab shall be RCC cover slab constructed integral with CI/DI manhole covers where the covers are smaller than the chamber dimensions. Manhole chambers in places of traffic shall be of heavy-duty type. The chamber walls shall be of concrete as per specifications.

Inside of the chambers and benching shall be plastered and finished smooth to provide minimum obstruction to flow.

2. STANDARDS & SPECIFICATIONS

Standards and Specifications of following Project components are given in this section;

- a) Road Works: road furniture, road markings, road signage, traffic control devices, safety Works, pedestrian facilities, median plantation, etc.
- b) Structures: Pipe culverts, storm water drainage structures, storm water drainage outfall structures, utility/services Structures for power supply etc.
- c) Storm Water Drainage network: RCC pipe drains, earthen drain and outfall Structures, etc.

2.1. Road Network

2.1.1. Codes, Standards and Technical Specifications

- a. The Codes, Standards and Technical Specifications applicable for the design and Construction of Project components are:
 - i. Indian Roads Congress (IRC) Specifications, Standards, Design Codes
 - ii. IRC Special Publications
 - iii. Ministry of Surface Transport Publications (Now Ministry of Shipping, Road Transport & Highways)
 - iv. IRC Seminar Publications
 - v. Policy circular/Advisory letters issued to all states/UTs on the matter pertaining to urban transport April 2008 – October 2014
 - vi. Four lane and Six lane Manuals i.e. IRC: SP-84-2014, IRC: SP-87-2013 as per the cross section of road
 - vii. For Wet Utilities CPHEEO manual on water supply and manual on Sewerage.
 - viii. Any supplement issued with the Bid document

Latest version of the Codes, Standards, Specifications, etc., notified/published at least 60 days before the last date of Bid submission shall be considered applicable.

2.1.2. Standards and Specifications for Construction

The Contractor shall comply with the Standards and Specifications for Construction of roads and utilities / services as given below. All Materials, Works and Construction operations shall conform to the Specifications for Road and Bridge Works (Fifth Revision, April 2013), issued by the Ministry of Road Transport & Highways (MoRT&H). Where the Standards and Specifications for a work are not given, Good Industry Practice shall be

adopted to the satisfaction of the Employer's Engineer.

2.1.3. List of Standards

List of Standards are given as per the Tables mentioned below (Latest revision of codes shall be referred)

Table

S. No.	Description	Code/Document
1	Geometric Design Standards for Urban Roads in Plains	IRC:86-1983
2	Guidelines for the Design of Interchanges in Urban Areas	IRC:92-1985
3	Recommended Practice for Traffic Rotaries	IRC:65-1976
4	Space Standards for Roads in Urban Areas	IRC:69-1977
5	Guidelines on Accommodation of Underground Utility Services Along and Across Roads in Urban Areas(Second Revision)	IRC:98-2011
6	Tentative Guidelines on the Provision of Speed Breakers for Control of Vehicular Speeds on Minor Roads	IRC:99-1988
7	Guidelines for Pedestrian Facilities	IRC:103-2012
8	Guidelines for Capacity of Urban Roads in Plain Areas	IRC:106-1990
9	Tentative Recommendations on the Provision of Parking Spaces for Urban Areas	IRC:SP:12-1973
10	Code of Practice for Road Markings(with Paints) (First Revision)	IRC:35-1997
11	Code of Practice for Road Signs (Third Revision)	IRC:67-2012
12	New Traffic Signs	IRC:SP:31-1992
13	Vertical Curves for Highways	IRC:SP:23-1983
14	Guidelines for the design of curves for Highways & Design tables (First Revision)	IRC:38-1988
15	Guidelines on Design of At-Grade Intersections in Rural & Urban Areas	IRC:SP:41-1994
16	Highway Safety Code	IRC:SP:44-1996
17	Guidelines on Urban Drainage	IRC:SP:50-2013

S. No.	Description	Code/Document
18	Standard for vertical and horizontal clearances of Overhead electric power and telecommunication lines as related to roads	IRC:32-1969
19	Tentative Guidelines for the Design of Flexible Pavements	IRC:37-2012
20	Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Third Revision)	IRC:58-2011
21	Dimensions and weights of Road Design Vehicles	IRC:3-1983

Table

Element of roads/services	Design Standards/Guidelines used for design	
	Code No.	Description
Ground improvement	HRB SR No14, 1994	State-of-the-Art-Report: High Embankments on Soft Ground, Part B–Ground Improvement
Embankment filling	HRB SR No.3, 1999	State-of-the-Art-Report: Compaction of Earthwork and Subgrades
Pavement design	IRC:37-2012	Tentative Guidelines for the Design of Flexible Pavements
	IRC:58-2011	Guideline for the design of plain jointed rigid
Road markings	IRC:35-1997	Code of Practice for Road Markings (First Revision)
Signage	IRC:67-2012	Code of Practice for Road Signs (Third Revision)
Safety features	IRC:SP: 44-1996	Highway Safety Code
Traffic lights	IRC:93-1985	Guidelines on Design and Installation of Road
Junctions/Median openings	IRC:SP:41- 1994	Guidelines on Design of At-Grade Intersections in Rural &Urban Areas
High embankments	IRC:75-1979	Guidelines for the Design of High Embankments
Erosion control	IRC:56-2011	Recommended Practices for Treatment of Embankment and Roadside Slopes for Erosion Control(First Revision)
Slope stability	HRB SR.No.1,2000	State-of-the-Art Report: Lime-Soil Stabilization

Element of roads/services	Design Standards/Guidelines used for design	
	Code No.	Description
Kerb and separator	IRC:86-1983	Geometric Design standards for Urban roads in plains
Drains	CPHEEO, IRC SP-42 2014 IRC SP-50 2013	Guidelines for Road Drainage Guidelines for Urban Drainage

2.2. Resurfacing of Roads

In Medipark around 1,530 m of 24-meter wide road is already laid. Successful bidder/contractor must strengthen this existing road through provision of profile correction, which shall be done with 50mm thick “Dense Graded Bituminous Macadam” and surface shall be with 30mm thick “Bituminous Concrete” conforming to Clause 507 of MORT&H Specification for road and bridge works (Fifth Revision). This also includes cleaning of road surface.

Successful bidder/contractor to apply Tack Coat by mechanical means conforming to clause 503 of MORT&H (Fifth Revision) specifications including the cost of cationic bitumen emulsion (RS 1) complying with IS : 8887 or suitable low viscosity paving bitumen of VG 10 grade conforming to IS : 73, thorough cleaning of road surface including pre heating of emulsion to the specified temp as approved by Authority’s Engineer.

Earth Work in Embankment (Berm Filling) up to 1.5 width on both sides of the road is to be done with 40mm thick compacted filling confirming to clause 305 of MORT&H specifications (Fifth Revision).

Marking of Centre and Edge Line with Thermo Plastic Paint and Glass Beads with Road marking Machine confirming to clause 803 of MORT&H specifications (Fifth Revision) is to be done.

2.3. Drain Services

Drainage of Water from Pavement Surface is of paramount importance as far as preserving the Road Assets created by investing huge funds in addition to maintenance of the Structural Soundness and Functional Efficiency of the Road. Design Standards related to Road Drainage are essentially based on the Guidelines given in IRC: SP: 42 “Guidelines on Road Drainage” and in IRC: SP: 50 “Guidelines on Urban Drainage”. The suggested Design Values / Standards are detailed

Sl. No.	Design Parameters	Design Values
1	Camber	2.5% for Carriageway
	Longitudinal Gradient	Minimum 0.3% for satisfactory Drainage
	Drain Type	Cast-in -situ RCC Box Drain and Pipe Culverts across the Crossroads

2.3.1. Concrete Grades of Structures

Structures	Concrete Grade
Substructure	
RCC substructures and foundations	M25
All PCC structural members	M20
All PCC non-structural members	M15

2.3.2. Reinforcement Steel

This shall conform to provisions given in IS: 1786, IS: 423 (Part I).

This will be high yield strength deformed bars (CRS- Corrosion Resistant steel) conforming to Fe 500D

2.3.3. Design Codes

The main design criteria shall be to evolve design of a safe structure having good durability conforming to the various technical specifications and sound engineering practices.

2.4. At-Grade Intersections

All at grade intersection shall be designed as per standards of Ministry of Road Transport and Highways. Additionally, guidelines of Ministry of Urban Development would also be referred.

2.4.1. Cleaning and grubbing

Cleaning Road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth up to 300 mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned, up to a lead of 1000 metres including removal and disposal of top organic soil not exceeding 150 mm in thickness.

2.4.2. STANDARDS AND TECHNICAL SPECIFICATIONS

2.4.2.1. MoRTH Clause 201 – Cleaning and Grubbing

a. Clause 201.1 Scope

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials with all leads and lights. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

2.4.3. Roadway Excavation.

2.4.3.1. MoRTH Clause 301 – Excavation for Road and drain

a. Scope

This work shall consist of excavation, removal and disposal of materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. The cut material may be taken away by the Contractor for re-use or disposal. Hence, the scope shall include a giving credit for suitable cut materials as also the salvage value and disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions or as directed by the Engineer.

2.4.3.2. Classification of Excavated Material

a. 301.2.1 Classification:

All materials involved in excavation shall be classified by the Engineer in the following manner:

- i. Soil : This shall comprise topsoil, turf, sand, silt, loam, clay, mud, peat, black-cotton soil, soft shale or loose murrum, a mixture of these and similar material which yield to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging equipment. Removal of gravel or any other modular material having dimension in any one direction not exceeding 75 mm shall be deemed to be covered under this Category.
- ii. Ordinary Rock (not requiring blasting) shall include:
 - rock types such as laterites, shales and conglomerates, varieties of limestone and sandstone etc., which may be quarried or split with crow bars, also including any rock which in dry state may be hard, requiring blasting but which, when wet, becomes soft and manageable by means other than blasting;
 - macadam surfaces such as water bound and bitumen/tar bound; soling or roads, paths, etc. and hard core; compact moorum or stabilized soil requiring grafting tool or pick or both and shovel, closely applied; gravel and cobble stone
- iii. Hard Rock (requiring blasting)

This shall comprise:

- Any rock or cement concrete for the excavation of which the use of mechanical plant and/or blasting is required,
 - Reinforcement cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and
 - Boulders requiring blasting.
- iv. Hard Rock (using controlled blasting) :

Hard rock requiring blasting as described under (c) but where blasting is to be carried out in locations where built-up area, huts, abodes of people and livestock exist within 200 m.

- v. Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is

prohibited for any reason like people living within 20 m of blast sites etc. and excavation has to be carried out by chiseling, wedging or any other agreed method.

vi. Marshy soil

This shall include soils like soft clays and peats excavated below the original ground level of marshes and swamps and soils excavated from other areas requiring continuous pumping or bailing out of water.

2.4.4. Embankment

Providing and Construction of **Embankment** with approved materials from borrow areas complete as per Technical Specification **Clause 305** with all leads and lifts.

Construction of **Subgrade** with approved material satisfying the requirements of minimum soaked CBR value as indicated in the drawings including all leads and lifts complete as per Technical Specifications **Clause 305 of MoRTH** (Reproduced below).

2.4.4.1. MoRTH Clause 305 – Embankment Construction

a. 305.1 General

305.1.1 Description:

These Specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous backfills with approved material obtained from approved source, including material from roadway and drain excavation, borrow pits or other sources. All embankments sub-grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

Table: Density Requirement of embankment and sub-grade materials

Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
Sub grade and earthen shoulders	Not less than 98%
Embankment	Not less than 97%

Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
Expansive Clays	
a) Sub grade and 500 mm portion just below the sub-grade	Not allowed
b) Remaining portion of embankment	Not less than 90%

Table: Compaction Requirements for Embankment and Sub-grade

Condition of Embankment	Type of Work Maximum laboratory dry unit weight when tested as per IS:2720 (Part 8)
Embankments up to 3 m height, not subjected to extensive flooding	Not less than 15.2 kN/cu.m
Embankments exceeding 3 m height or embankments of any height subject to long periods of inundation	Not less than 16 kN/ cu.m

2.4.5. Shoulders

Construction of **Earthen shoulders** including all leads and lifts complete as per drawing and Technical Specifications **Clause 408**.

2.4.5.1. MoRTH Clause 408 – Shoulder, Island and median**a. Scope**

The work shall consist of constructing shoulder (hard/paved/earthen with brick or stone block edging) on either side of the pavement, median in the road dividing the carriageway into separate lanes and islands for channelizing the traffic at junctions in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

b. Materials

Shoulder on either side of the road may be of selected earth/granular material/paved conforming to the requirements of Clause 305/401 and the median may be of selected earth conforming to the requirements of Clause 305.

Median/Traffic islands shall be raised and kerbed at the perimeter and the enclosed area filled with earth and suitably covered with grass turf/shrubs as per Clause 307 and/or paved as per Clause 409.3.4 or 409.3.5.

c. Size of Shoulder

Shoulder/median dimension shall be as shown on the drawing or as directed by the Engineer.

2.4.5.2. Granular Sub-base

Construction of **Granular Sub-Base** by providing close graded material, spreading in uniform layers with motor grader on prepared surface, mixing by **Mix In Place Method** with rotator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per **clause 401**.

2.4.5.3. MoRTH Clause 401 –Granular Sub-base

a. Scope

This work shall consist of laying and compacting well-graded material on prepared sub grade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

i. 401.2.1 Materials

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, or combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and shall conform to the quality standards as prescribed in the specifications.

Table 400-1 prescribes four grading for **Granular Sub-Base (GSB)**. Grading I and II in Table 3 are well graded granular sub-base materials. These can be used at locations where drainage requirement are not predominant. Grading III and IV are gap graded and addresses to the concern of the drainage requirements. These can be used at location experiencing heavy rainfall, flooding etc. Cases where GSB is to be provided in two layers, it is recommended to adopt either grading III or grading IV for lower layer and either grading I or grading II for upper layer. Minimum thickness of lower layer at locations where drainage

requirements are predominant shall not be less than 150 mm.

ii. **401.2.2**

If the water absorption of the aggregates determine as per IS:2386 (part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate impact Value (AIV) (IS:5640)

iii. **401.3 Strength of Sub-Base**

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished. When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content.

Table: Grading for granular sub-base materials

IS Sieve Designation	Percentage by weight passing IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0mm	100	-	100	-	100	-
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	-	-	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50			10-20	10-25
0.8 mm	-	-	-	-	2-10	-
0.425 mm	10-15	10-15			0-5	0-8
0.0075 mm	<5	<5	<5	<5	-	0-3

2.4.6. Wet Mix Macadam Base

Providing, laying, spreading and compacting crushed graded stone aggregate as per MoRTH Table 400-12 & 400-13 of **Wet Mix Macadam** specifications including premixing the material with water to OMC in mechanical mixer (Pug mill) as per design mix, carriage of mixed material by tipper to site laying in uniform layers, with motor grader/F.E. loader/Paver Finisher, in sub-base/base course on a well prepared under-base and compacting with Vibratory Roller to achieve the desired density including

lighting, guarding, barricading and maintenance of diversion etc. (MoRTH specification : Clause 406).

2.4.6.1. MoRTH Clause 406 – Wet Mix Macadam Base

a. Scope

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared sub-grade/sub- base/base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75mm.

b. Materials

i. 406.2.1 Aggregates

ii. 406.2.1.1 Physical requirements:

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 4(MoRTH table 400-12). If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

Physical requirement of coarse aggregates for wet mix macadam for sub-base/Base courses

S. No.	Test	Test Method	Requirement
1.	Los Angeles Abrasion Value	IS:2386(Part-4) or	40 percent (Max.)
	Or Aggregate Impact value	IS:2386(Part-4) IS:5640	30 percent (Max.)
2.	Combined Flakiness and Elongation indices (Total)	IS:2386(Part-4)	40 percent (Max.)

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles are separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

iii. 406.2.1.1 Grading requirements:

The aggregates shall conform to the grading given in table 5 (MoRTH Table 400-13)

Table: Grading requirements of Aggregate for Wet mix macadam

IS Sieve	Per cent by weight passing the IS Sieve
Designation	Grade 1 layer thickness $\geq 100\text{mm}$
53 mm	100
45 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.0 micron	8-22
75.00 micron	0-5

Material finer than 425mm micron shall have plasticity index (PI) not exceeding 6.

The final gradation approved within these limit shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

2.4.7. Primer Coat

Providing and applying **Primer coat** with bitumen emulsion on prepared surface of granular Base including clearing of road surface and spraying primer by table 6 (MoRTH 500-3) using mechanical means as per Morth clause 502 (Reproduced below)

2.4.7.1. MoRTH Clause 502 - Prime coat over Granular Base

a. Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix.

b. Materials

The bituminous material to be used as primer shall be such that it can penetrate about 10 mm deep into base course. Bitumen emulsion SS1 grade conforming to IS: 8887/ASTM D2397 or medium curing cutback bitumen conforming to IS:2177 can be used as primer. Quantity of SS1 grade bitumen emulsion for various types of granular surface shall be as per Table 6.

Table: Quantity of bitumen emulsion for various types of granular surfaces

Type of surface	Rate of Spray (Kg/Sq.)
WMM/WBM	0.7-1.0
Mechanically Lime/cement stabilized soil bases, lime cement	0.9-1.2

2.4.8. Tack Coat

Providing and applying tack coat with bitumen emulsion conforming to IS: 8887, using emulsion pressure distributor including preparing the surface & cleaning with mechanical broom. On bituminous surface to be applied as per Table 7 (MoRTH 500-5) (Reproduced below).

2.4.8.1. MoRTH Clause 503 Tack coat

a. Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or instructed by the Engineer.

Table: Rate of application of Tack coat

Type of surface	Rate of Spray of binder in Kg/Sq.
WMM/WBM	0.7-1.0
Mechanically Lime/cement stabilized soil bases, lime cement bases	0.9-1.2

b. Materials

The binder used for tack coat shall be either Cationic bitumen emulsion (RS 1) complying with IS 8887/ASTM D 2397 or suitable low viscosity paving bitumen of VG 10 grade conforming to IS:73. The use of cutback bitumen RC:70 as per IS:217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer. The type and grade of tack coat shall be as specified in the Contract or as directed by the Engineer.

2.4.9. Dense Graded Bituminous Macadam

Providing and laying Dense graded bituminous macadam with not less than 50 mm compacted thickness with bitumen of grade and lime filler(percentage by weight of Aggregate) according IRC 94. Prepared in Batch Type Hot Mix Plant of relevant capacity, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled and tandem vibratory rollers to achieve the desired compaction as per MoRTH specification clause No. 505 complete in all respects

2.4.9.1. MoRTH Clause 505 – Dense Bituminous Macadam

a. Scope

This clause specifies the construction of Dense Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses.

The work shall consist of construction in a single or multiple layer of DBM on a previously prepared base or sub-base. The thickness of a single layer will be 50 to 100mm.

b. Materials

505.1.1 Bitumen: The bitumen for dense bituminous macadam shall comply with the Indian Standard Specification for viscosity graded bitumen, IS:73 modified bitumen complying with IS:15462 or as otherwise specified in the Contract. Guidelines for selection of viscosity graded bitumen and modified bitumen are given in Table 500-10 and Table 500-11 respectively.

505.1.2 Coarse Aggregates: The type and grade of modified bitumen recommended for heavy traffic roads in very hot climate. Coarse aggregate (505.2.2) shall satisfy the requirement specified in Table 8 (MoRTH Table 500-8).

Table: Physical requirement for coarse aggregate for Dense Bitumen Bituminous Macadam

Property	Test		Specificatio
Cleanliness (dust)	Grain size analysis	Max 5% passing .0075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness And Elongation index*	Max 35%	IS:2386 Part I
Strength	Los angeles abrasion Value aggregate impact value	Max 35% Max 27%	IS:2386 Part IV
Durability	Soundness either : sodium sulphate or magnesium sulphate	Max 12% Max 18%	IS:2386 Part V
Water absorption	Water absorption	Max 2%	IS:2386 Part III
Stripping	Coating and stripping of bitumen aggregate mix	Maximum Retained coating 95%	IS:6241
Water sensitivity	Retained tensile strength**	Min 80%	AASHTO 283

505.2.3 Fine Aggregates: Fine aggregate shall consist of crushed or naturally occurring mineral material or a combination of the two, passing the 2.36mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable,

dry and free from dust, and soft or friable matter, organic or other deleterious matter. Natural sand shall not be allowed in binder courses. However natural sand upto 50 percent of the fine aggregate may be allowed in binder courses, The fine aggregate shall have a sand equivalent value is not less than 50 when tested in accordance with the requirement of IS:2720 (part 37) .The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4, when tested in accordance with IS:2720(part 5)

505.2.4 Filler: Filter shall consist of finely divided minerals matter such as rock dust , hydrate lime or cement approved by the Employers Engineer. The filter shall be graded within the limit indicated in Table 500-9.

505.2.5 Aggregate Grading and binder content: When tested accordance with IS 2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregate and filler for the particular mixture shall fall within the limits given in Table 9 (MoRTH Table 500-8) for grading.

Table: Compaction Requirements for Embankment and Sub-grade

Grading	1	2
Nominal Aggregate Size*	37.5 mm	26.5 mm
Layer thickness	75-100 mm	50-75mm
IS Sieve (mm)	Cumulative % by weight of total aggregate	
45	100	
37.5	95-100	100
26.5	63-93	90-100
19	-	71-95
13.2	55-75	56-80
9.5	-	-
4.75	38-54	38-54
2.36	28-42	28-42
1.18	-	-
0.6	-	-
0.3	7-21	7-21
0.15	-	-
0.075	2-8	2-8
Bitumen content % by mass of total mix	Min 4.0**	Min 4.5**

*The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained.

** Correspondent to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7 , the minimum bitumen content can be reduced

proportionately further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is -10°C or lower, the bitumen content may be increased by 0.5 percent.

2.4.10. Bituminous Concrete

Providing and laying Bituminous concrete with required compacted thickness with bitumen of grade and lime filler (percentage by weight of Aggregate) according IRC 29 with prepared in Batch Type Hot Mix Plant of relevant TPH capacity, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, tandem vibratory rollers to achieve the desired compaction as per MORTH specification clause No. 508 complete in all respects:

2.4.10.1. MoRTH Clause 508 – Bituminous Concrete

c. Scope

This work shall consist of construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single layer of bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 30mm/40 mm/50 mm thick.

d. Material

508.1.1 Bitumen: The bitumen shall conform to Clause 505.2.1 of MoRTH

508.1.2 Coarse aggregates: The coarse aggregates shall be generally as specified in Clause 505.2.2, except that the aggregates shall satisfy the physical requirements of Table 9 and where crushed gravel is proposed for use as aggregate, not less than 95 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

Table 11: Physical requirement for coarse aggregate for Bituminous Concrete

Property	Test	Specification
Cleanliness (dust)	Grain size analysis	Max 5% passing .0075 mm sieve IS:2386 Part I
Particle shape	Flakiness index Elongation index	Max 15% Max 20% IS:2386 Part I
Strength	Los Angeles abrasion value, aggregate impact value	Max 30% Max 24% IS:2386 Part IV

Property	Test	Specification	
Durability	Soundness either : sodium sulphate or magnesium sulphate	Max 12% Max 18%	IS:2386 Part V
Polishing	Polished stone value	Min 55	IS:2386 Part IV
Water absorption	Water absorption	Max 2%	IS:2386 Part III
Stripping	Coating and stripping of bitumen aggregate mix	Maximum retained coating 95%	IS:6241
Water sensitivity	Retained tensile strength	Min 80%	AASTHO 283

2.4.11. Kerb Stone

Supplying and laying cement concrete Kerb M20 grade mix for median/island complete as per drawing and MoRTH Specification Clause 409.

2.4.11.1. MoRTH Clause 409 – Cement Concrete Kerb and Kerb with Channel

e. Scope

This work shall consist of constructing cement concrete kerbs and kerbs with channel in the central median and/or along the footpaths or separators in conformity with the lines, levels and dimensions as specified in the drawings or as directed by the Engineer.

f. Materials

Kerbs at 1700 of these Specifications.

g. Type of Construction

Cast in situ kerb stones shall be used. Kerb detail as per IRC 86:1983

h. Equipment

A continuous kerb casting equipment of adequate capacity and controls, capable of laying the kerbs in required cross-sections and producing a well-compacted mass of concrete free of voids and honeycombs, shall be used.

i. Construction Operations

- 409.1.1 Kerb shall be laid on firm foundation of minimum 150 mm thickness of cement concrete of M 15 grade cast in-situ or on extended width of pavement. The foundation shall have a projection of 50 mm beyond the kerb stone. Before laying the foundation of lean concrete, the base shall be levelled and slightly watered to make it damp. Section 400 Sub-Bases, Bases (Non-Bituminous) and Shoulders
- 409.1.2 In the median portions in the straight reaches, the kerb shall be cast in continuous lengths. In the portions where footpath is provided and/or the slope of the carriageway is towards median (as in case of super-elevated portion), there shall be sufficient gap/recess left in the kerb to facilitate drainage openings.
- 409.1.3 After laying the kerbs and just prior to hardening of the concrete, saw cut grooves shall be provided at 5 m intervals up to FRL or as specified by the Engineer.
- 409.1.4 Kerbs on the drainage ends such as along the footpath or the median in super elevated portions shall be cast with monolithic concrete channels as indicated in drawings. The slope of the channel towards drainage pipes shall be ensured for efficient drainage of the road surface.
- 409.5. Vertical and horizontal tolerances with respect to true line and level shall be +6 mm.

2.4.12. Road Furniture's

a. IRC 67 Retro Reflective Sign Board

Retro- reflectorized cautionary, mandatory and informatory sign should be as per **IRC :67** made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing.

Retro-reflectorized sign as per **IRC:67** made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 2 mm thick with area not exceeding 0.9 sqm supported on a mild steel single angle iron post 75 x 75 x 6 mm firmly fixed

to the ground by means of properly designed foundation with M15 grade cement concrete 45 x 45 x 60 cm, 60 cm below ground level as per approved drawing.

Delineators (roadway indicators, hazard markers, object markers) should be 80-100 cm high above ground level, painted black and white in 15 cm wide strips, fitted with 80 x 100 mm

rectangular or 75 mm dia circular reflectorised panels at the top, buried or pressed into the ground and conforming to **IRC-79** and the drawings.

Road stud 100x 100 mm should be die-cast in aluminium, resistant to corrosive effect of salt and grit, fitted with lense reflectors, installed in concrete or asphaltic surface by drilling hole 30 mm up to a depth of 60 mm and bedded in a suitable bituminous grout or epoxy mortar, all as per BS 873 part 4:1973.

b. IRC 35 Road marking and strips

The colour width and layout of road makings shall be in accordance with the Code of Practice for Road Markings with paints, IRC : 35, and as specified in the drawings or as directed by the Engineer-in-Charge.

i. General

- The thermoplastic material shall be homogenously composed of aggregate, pigment, resins and glass reflectorizing beads.
- The thermoplastic compound shall be screened/extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.
- The thermoplastic material shall conform to ASTM D36/BS-3262-(Part I).
- The material shall meet the requirements of these specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one-year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/Contractor.
- Marking: Each container of the thermoplastic material shall be clearly and

indelibly marked with the following information:

- The name, trademark or other means of identification of manufacturer.
- Batch number
- Date of manufacture
- Colour (White or yellow)
- Maximum application temperature and maximum safe heating temperature.
- Sampling and Testing: The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Employers Engineer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

ii. **Preparation**

- The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.
- After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

iii. **Application**

Marking shall be done by fully /semi-automatic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Authority's Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the

workmen. The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer or otherwise directed by the Authority's Engineer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine. The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint. Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed.

3. Testing

3.1. General

The materials supplied and the works carried out by the Contractor shall conform to the specifications prescribed in the following Clauses.

For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control tests, as described hereinafter. The testing frequencies set forth are the desirable minimum and the Authority's Engineer shall have the full authority to carry out additional tests as frequently as he may deem necessary, to satisfy himself that the materials and works comply with the appropriate specifications. However, the number of tests recommended in Tables on 'Control Tests and Their Minimum Frequency for Sub-bases and Bases (Excluding Bitumen Bound Bases)' and 'Control Tests and Their Minimum Frequency for Sub-bases and Bases' may be reduced at the discretion of the Engineer if it is felt that consistency in the quality of material can still be maintained with the reduced number of tests.

Test procedures for the various quality control tests are indicated in the respective Sections of these Specifications or for certain tests within this Section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Authority's Engineer.

3.2. Surface Levels

The levels of the subgrade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the

rod shown on the drawings beyond the tolerances as mentioned below.

TABLE: Tolerances in Surface Levels

1.	Subgrade	+ 20 mm - 25 mm
2.	Sub-base + 10 mm a) Flexible pavement b) Concrete pavement [Dry lean concrete or Rolled concrete]	- 20 mm + 6 mm - 10 mm
3.	Base-course for flexible pavement a) Bituminous course b) Other-than bituminous i) Machine laid ii) Manually laid	+ 6 mm - 6 mm + 10 mm - 10 mm + 15 mm - 15 mm
4.	Wearing course for flexible pavement a) Machine laid b) Manually laid	+ 6 mm - 6 mm + 10 mm - 10 mm
5.	Cement concrete pavement	+ 5 mm - 6 mm*

* This may not exceed – 8 mm at 0 – 30 cm from the edges.

3.3. Tests on Earthwork for Embankment, Subgrade Construction and Cut Formation/Fill Formation

3.3.1. Borrow material

Grid the borrow area at 25 m c/c (or closer, if the variability is high) to full depth of proposed working. These pits should be logged and plotted for proper identification of suitable sources of material. The following tests on representative samples shall be carried out:

- a. Sand Content [IS: 2720 (Part-4)]: 2 tests per 3000 cubic metres of soil.
- b. Plasticity Test [IS: 2720 (Part-5)]: Each type to be tested, 2 tests per 3000 cubic meters of soil.
- c. Density Test [IS: 2720 (Part 8)]: Each soil type to be tested, 2 tests per 3000 cubic metres of soil.
- d. Deleterious Content Test [IS: 2720 (Part 27)]: As and when required by the Engineer.
- e. Moisture Content Test [IS: 2720 (Part-2)]: One test for every 250 cubic meters of soil.
- f. CBR Test on materials to be incorporated in the subgrade on soaked/unsaturated samples [IS: 2720 (part 16)]: one CBR test for every 3000 cu.m. at least or closer as and when required by the Authority's Engineer

3.3.2. Compaction Control

Control shall be exercised on each layer by taking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS: 2720 (Part-28). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of anyone test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 6 (if non-destructive tests are carried out, the number of tests shall be doubled) as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance criteria shall be subject to the condition that the mean density is not less than the specified density plus:

$$[1.65 - 1.65 / (\text{No. of Samples})^{0.5}] \text{ times the standard deviation}$$

However, for earthwork in shoulders and median (earthen) and in the subgrade, at least one density measurement shall be taken for every 500 square metres for the compacted area provided further that the number of tests in each set of measurements shall be at least 10. In other respects, the control shall be similar to the described earlier.

3.3.3. Cut formation

Tests for the density requirements of cut formation shall be carried out in accordance

with Compaction Control

3.3.4. Tests on Sub-bases and Bases (excluding bitumen bound bases)

The tests and their frequencies for the different types of bases and sub-bases shall be as per the table provided on 'Control Tests and their Minimum Frequency for Sub-bases and Bases (Excluding Bitumen Bound Bases)'. The evaluation of density results and acceptance criteria for compaction control shall be on lines similar to those set out in Compaction Control

3.3.5. Acceptance criteria

The acceptance criteria for tests on the strength of cement/lime stabilized soil and distribution of stabilizer content shall be subject to the condition that the mean value is not less than the specified value plus:

$$[1.65 - 1.65 / (\text{No. of Samples})^{0.5}] \text{ times the standard deviation}$$

TABLE: Control Tests and Their Minimum Frequency for Sub-bases and Bases (Excluding Bitumen Bound Bases)

SN	Type of Construction	Test	Frequency (min.)
1	Granular	i. Gradation ii. Atterberg limits iii. Moisture content prior to compaction iv. Density of compacted layer v. Deleterious constituents vi. C.B.R.	i. One test per 200m ³ ii. One test per 200m ³ iii. One test per 250 m ³ iv. One test per 500 m ³ v. As required As vi. Required
2	Wet Mix Macadam	i. Aggregate impact Value ii. Grading iii. Flakiness and Elongation Index iv. Atterberg limits of portion of aggregate passing 425 micron sieve v. Density of compacted layer.	i. One test per 200 m3 of aggregate ii. One test per 100 m3 of aggregate iii. One test per 200 m3 of aggregate iv. One test per 100 m3 of aggregate v. One test per 500 m3

3.4. Tests on Bituminous Construction

3.4.1. Tests and frequency

The tests and their minimum frequencies for the different types of bituminous works shall be as given in Table 'Control Tests for Bituminous works, and their Minimum

Frequency'. The Authority's Engineer may direct additional testing as required.

3.4.2. Acceptance criteria

The acceptance criteria for tests on density and Marshall stability shall be subject to the condition that the mean value is not less than the specified value plus:

$$[1.65 - 1.65 / (\text{No. of Samples})^{0.5}] \text{ times the standard deviation}$$

TABLE: Control Tests for Bituminous works, and their Minimum Frequency

SN	Type of Construction	Test	Frequency (min.)
1.	Prime Coat/Tack Coat/Fog Spray	i. Quality of binder	Number of samples per lot and tests as per IS: 73, IS: 217 and IS: 8887 as applicable.
		ii. Binder temperature for application	At regular close intervals.
		iii. Rate of spread of Binder	One test per 500m ² and not less than two tests per day
2.	Bituminous Macadam	i. Quality of binder	Number of samples per lot and tests as per IS: 73, IS: 217 and IS: 8887 as applicable.
		ii. Aggregate Impact Value/Los Angeles Abrasion Value	One test per 50 m ³ of aggregate
		iii. Flakiness Index and Elongation Index	One test per 50 m ³ of aggregate
		iv. Stripping Value	Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates

SN	Type of Construction	Test	Frequency (min.)
		v. Water sensitivity of mix	Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates
		vi. Grading of aggregates	Two tests per day per plant both on the individual constituents and mixed aggregates from the dryer
		vii. Water absorption of aggregates	Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates
		viii. Soundness (Magnesium and Sodium Sulphate)	Initially, one determination by each method for each source of supply, then as warranted by change in the quality of the aggregates.
		ix. Percentage of fractured faces	When gravel is used, one test per 50m ³ of aggregate
		x. Binder content and aggregate grading	Periodic, subject to minimum to two tests per day per plant
		xi. Control of temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling	At regular close intervals
		xii. Rate of spread of mixed material	Regular control through checks of layer thickness

SN	Type of Construction	Test	Frequency (min.)
		xiii. Density of Compacted layer	One test per 250m ² of area
3.	Dense Bituminous Macadam/Semi Dense Bituminous Concrete/Bituminous Concrete	i. Quality of binder ii. Aggregate Impact Value/Los Angeles Abrasion Value iii. Flakiness Index and Elongation Index iv. Stripping Value v. Soundness (Magnesium and Sodium Sulphate) vi. Water absorption of aggregates vii. Sand equivalent test	Number of samples per lot and tests as per IS: 73, IS: 217 and IS: 8887 as applicable. One test per 50 m ³ of aggregate One test per 50 m ³ of aggregate Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates As required

SN	Type of Construction	Test	Frequency (min.)
		viii. Plasticity Index	As required
		ix. Polished stone value	As required, for Semi Dense Bituminous Concrete/Bituminous Concrete
		x. Percentage of fractured faces	When gravel is used, one test per 50m ³ of aggregate
		xi. Mix grading	One set of tests on individual constituents and mixed aggregate from the dryer for each 400 tonnes of mix subject to a minimum of two tests per plant per day

4. Annexure A: Drawings

Please refer to the following table for reference to the Intent Diagrams (in A3 size) corresponding to this Schedule:

Schedule number	Reference number	Title
8	3.1	Road layout
8	3.2	Storm water drain layout
8	3.3	Typical cross section
8	3.4	Road Profile
8	3.5	Drain Profile
8	3.6	Pipe culvert details
8	3.7	Drain cross section details
8	3.8	Site grading details