



SURAT MUNICIPAL CORPORATION

CARPET/RECARPET 2026-27

SOUTH WEST (ATHWA) ZONE

TENDER NOTICE NO. Dy. Commissioner/S.W.(Athwa)Zone/No.01/2026-2027 (Work No.02)

VOLUME III- TECHNICAL SPECIFICATION

ITEM WISE DETAIL Technical Specification for Construction of Flexible Pavement AS PER MoRTH 2013 (FIFTH REVISION) SPECIFICATIONS AND IRC NORMS

Name of Work:- Construction of TP/Non TP roads from sub grade to wearing course/ road carpet/ road recarpet falling 24.00 mt & Above wide in SOUTH WEST (ATHWA) ZONE jurisdiction of Surat city by contractor's own batch mix plant and WMM plant to be installed within surat city limit with sensor operator paver finisher with contractor's own machinery and mobile laboratory including construction / repair of footpath, divider, water table and providing & laying/ fixing of pavement markings, road studs, road signages and with other traffic safety measures. (Work No-02)

Uploading of tender documents	Dt-22/06/2026
Last date of Document downloading	Dt-07/07/2026 UP TO 18.00 Hrs.
Last date of Online bid submission	Dt-07/07/2025 UP TO 18.00 Hrs.
Online query	Bidder shall have to post their queries on E mail address exen.swz@suratmunicipal.gov.in on or before 01/07/2026 up to 11:00 A.M.
Pre bid Meeting	-
Physical submission of EMD, Tender fee.	During Dt-08/07/2026 To 16/07/2026, 18.00 Hrs. at the office of "Chief Accountant, Surat Municipal Corporation, Muglisara, by Speed Post/RPAD only." In sealed cover duly super scribed with name of work and tender notice no.
Opening of Technical bid (Online)	Probable Dt - 08/07/2026 11:00 hrs. onward

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1.1 Description

The land width required for the roadway, gutters side slopes and catch water gutters shall be cleared of all trees having a girth of 30cm. and less, loose stones, vegetation bushes, stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30cm. below the grade formation and slopes and excavation filled up with excavated materials and loose. Useful materials shall be arranged in convenient stacks along the roads boundary or as directed at places within 50 meters lead, and handed over to the department in convenient sections. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works, property or people in the neighborhood. If the materials disposed off outside the road land, necessary permission from the private land owners shall be taken by the contractor and royalty etc. if any paid by him without claiming any compensation. All materials shall be disposed off in a neat manner.

After cleaning the site, the alignment of the road shall be properly set out true to line, curves, slopes, grade and sections as shown on the plans or directed by the Engineer. The Contractor shall provide all labour and materials such as lime, strings, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out establishing bench marks and giving profiles. The Contractor shall be responsible for maintaining the B.M. profiles, alignments and other marks as long as they are required for the work in the opinion of the Engineer. If the Contractor defaults in the respect even after the direction by the Engineer within the specified time, they may be restored by the Engineer at the cost of Contractor. Levels and section of the ground shall be taken and recorded in the presence of the Contractor or his authorized representative before the excavation is started so as to serve as the basis of measurement. The Contractor or his representative shall sign the book in token of his acceptance of the level etc. If there is any disagreement the Contractor shall inform of it in writing to the Engineer with the specified reference to the sections before starting further work. Once the work is started no cognizance of any complaint shall be taken merely not signing of the book shall not be deemed as disagreement.

Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10m to 50m or other intervals as directed by the Engineer to conform to the curved or straight alignment, section, grade and side slopes. The line outs shall be clearly marked and profiles of embankments where excavated materials are to be used shall be set up with the toe line marked on each side. The road way section shall first be excavated with vertical side or each lift and the sides slopes for that shall be excavated in steps. These steps shall be smoothened to the required slope when the excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specifics grade unless so directed by the Engineer in writing. If excavation is done below the specified level or outside the section, it shall not be paid for and the contractor shall be required to fill up at his own cost such extra excavation in the road portion, with approved materials of the embankment grade in layer watered and fully loose to attain maximum density laid down for the embankment in its relevant item. The Engineer may require measurement ridges and dead men to be left at specified intervals or places and kept intact till ordered to be removed, for the purposes of check

measurements. The excavation shall be finished neatly, smoothly and evenly to the correct lines, curves, grades, section and side slopes as shown on the plans or directed by the Engineer. The sub-grade if loose, shall be scarified, watered and loose to the same density as the embankment. The section, side slopes and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters will be well drained by providing necessary diversion etc. and not damaged due to obstruction of any drainage, necessary passages shall be provided leading away seepage, springs, surface flow or rainwater safely without damaging the work. If any damage occurs due to default of the contractor in this respect, he shall make good the damage at his cost. If it is necessary in the execution of the work to interrupt existing surface drainage, irrigation channels, sewers or under drainage, temporary arrangements shall be provided till such time as is necessary. The Contractor at his own cost shall make good the interrupted drainage and sewer etc. unless separately provided in the tender. Any damage to the existing works or work in hand caused as a result of his operations or negligence shall be made good by the Contractor at his own cost. Road side gutters shall be excavated to the specified section and shall be measured along with the main cutting in cubic meters.

Signalers shall be stationed at each end to regulate traffic where it is heavy, If necessary. Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers, the members of the public, animals etc. due to the negligence of the Contractor, he will be responsible and liable to all the consequence including compensation. When the useful excavated materials are to be used in embankment within a lead 50 meter and all lift, it shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials are temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations should be arranged properly, Materials required for items other than bank shall be arranged in neatstacks at convenient places, without interfering with drainage in any way. The excavated materials shall not be deposited within 3mt. from the top edge of slope or top of the bank. The lead shall be measured from the junction point of cutting and embankment up to 50 mt. on either side. The contract rate shall be for a unit of one cubic meter for the stratus mentioned in the wording of the item of excavation acceptably completed, as directed by the Engineer.

1.2 Disposal of excavated materials

All the surplus excavated materials shall be the property of the contractor. Suitable material obtained from the excavation of the roadway shoulders, verge, drains, cross drainage works etc. shall be used for

Filling for roadway embankments

Filling existing pits in the right of way as directed by the Engineer including leveling and spreading with all leads and lifts.

For landscaping of the road as directed by the Engineer, including leveling and spreading, with all leads and lifts.

Surplus material such as rubble, stones etc. not intended for uses above shall be used as a raw material for crusher with prior permission of Engineer.

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 off including all lead & lifts. No

place will be made available by the employer for disposing off the material and no claim will be entertained on that account.

1.3 Measurements for payment

Excavation for roadway shall be measured by taking cross-sections at suitable intervals in the original position before the work starts and after its completion and computing the volumes in **cu. m.** by the method of average end areas for each class of material encountered. At the option of the Engineer, the Contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the original ground level as accurately as possible. The contractor shall see that these remain intact till the final measurements are taken.

1.4 Rates

The contract unit rates for the items of roadway and drain excavation shall be payment in full for carrying out the operations required for the individual items including full compensation for:

Setting out

Transporting the excavated materials and depositing the same on sites of embankments spoil banks or stacking as directed within lifts and lead up to 50m.

Trimming bottoms and slopes of excavation

Dewatering

Disposal of surplus excavated stuff and clearing of site after completion of work.

Watering where necessary and compacting to requirements.

Erecting all safety provisions and making necessary diversions as directed by Engineer of concerned zone.

Removing of Existing metalled grouted road surface upto base course including stacking of material upto lead of 50 mt. (Note : Removing of Existing road shall be Carryout only by Cutter Machine /Hydraulic Bracker)

ITEM NO.1(A):Removing of Existing metalled grouted road/Asphal Road surface upto base course including stacking of material upto lead of 50 mt. (Note : Removing of Existing road shall be Carryout only by Cutter Machine /Hydraulic Bracker)

As per Item no.2

ITEM NO.1(B): Providing cutting of existing bituminous surface upto suitable depth in line and alignment using Mechanically operator cutter machine before excavating existing surface for utility laying including cost of all type of machinery, fuel, labour, etc and as per direction of Engineer Incharge .

As per Item no.2

ITEM NO.2: Excavation of the soil by means of Disc Harrowing or Rotavator, as the case may be, upto 240 mm depth for full width of road and breaking the soil into pieces less than 20 mm etc.by the use of rotavator and as directed by engineer in charge. (200 mm compacted thickness)

2.1 Description

The work includes excavation for the specified depth with ploughing with Disk harrow or Rotavator as directed by Engineer to proper slope, line and length. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 300 mm and less, loose stones, vegetation, bushes stumps and all other objectionable materials. All the materials cleared

will be the property of Surat Municipal Corporation. Useful materials shall be arranged in convenient stacks along the roads boundary or as directed at places within 50 meters lead and handed over to the department in convenient section. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, in convenience or damage to the works, Property or people in the neighborhood. After working with plough the fraction of the soil having more than 25 mm lumps, will be crushed/broken to finer size. If ploughing is used longitudinal and transverse travel has to be completed to satisfaction of Engineer. Watering is not permitted.

For fly ash-soil stabilization, the soil before addition of stabilizer shall be pulverized to that extent that of least 80% through 4.75mm sieve.

It is mandatory to excavate with rotavator for all categories of road except Residential roads where Disk Harrow shall be used for excavation.

ITEM NO.3: Supplying Fly ash including collecting, carting, stacking and spreading the same as per details in tender specification & as directed by engineer in charge.

Table 1 Chemical Requirements for Fly Ash as Pozzolana (Table No.3-IRC:SP:89-2010)

Sr. No.	Characteristics	Requirements for fly Ash		Method of test
		Anthracitic fly ash	Lignitic fly ash	
1.	$\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ in percent by mass, Min	70	50	IS:1727
2.	SiO_2 in percent by mass, Min	35	25	IS:1727
3.	MgO in percent by mass, Max	25	5.0	IS:1727
4.	SO_3 in percent by mass, Max	2.75	3.5	IS:1727
5.	Available alkalies as $\text{Na}_2\text{O}/\text{K}_2\text{O}$ in percent by mass, Max	1.5	1.5	IS:4032
6.	Total chlorides in percent by mass, Max	0.05	0.05	IS:1727
7.	Loss on ignition in percent by mass, Max	5.0	5.0	IS:1727

Limits regarding moisture content of fly ash shall be as agreed to between the purchaser and the supplier. All tests for the properties specified in above table shall, however, be carried out on oven dry samples.

Table 2 Physical Requirement for Fly Ash as a Pozzolona (Table No.4-IRC:SP:89-2010)

Sr.No.	Characteristics	Requirement
1.	Fineness-specific surface in m^2/Kg by Blaine's permeability test, Min	250
2.	Particles retained on 45 micron IS sieve, Max	40
3.	Lime reactivity in N/mm^2 , Min	3.5
4.	Soundness by autoclave test expansion of specimen in percent, Max	0.8
5.	Soundness by Lechatelier method-expansion	10

	in mm, Max	
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3.1 Spreading of fly ash

Quantity of fly ash to be added with soil at rate of **50 kg per Square Meter** area of soil.

Spreading the stabilizer at the required dosage rate can be carried out manually. For manual method for spreading stabilizer bags of stabilizer are spotted at a set spacing, they are then broken open and the stabilizer raked across the surface as uniformly as possible. Standard weight of bag containing fly ash should be 50 kg.

3.2 Measurements for Payment

The fly ash shall be measured in terms of M.T. weight and corresponding gate passes of each load issued from SMC Weigh Bridge shall be submitted. The payment for the fly ash quantity shall be done accordingly.

3.3 Rate

The contract unit rates consist of the following:

Collecting the fly ash of required gradation from the source.

Carting of the fly ash to the construction site.

Weighing the same at SMC weigh Bridge / approved weigh bridge with prior permission of Engineer.

Stacking the fly ash in required quantity as directed by Engineer.

Spreading the fly ash evenly at a rate of **50kg/SM** as directed by Engineer.

ITEM NO. 4: Supplying and carting of Hydrated lime (CaO content not less than 70%) and spreading the same with the excavated soil and flyash thoroughly by Disc Harrowing Rotavator or as the case may be, including watering, Tests required to be carried out etc. complete as per details in tender specification & as directed by engineer in charge.

Lime for lime-soil stabilization work shall be commercial dry lime slaked at site or pre-slaked lime delivered to the site in suitable packing. The lime shall have purity of not less than 70 percent by weight of Quick-lime (CaO) when tested in accordance with IS:1514. Lime shall be properly stored to avoid prolonged exposure to the atmosphere and consequent carbonation which would reduce its binding properties.

Lime for stabilization shall confirm the requirements of class C hydrated lime, which should have at least 95%, 99% and 100% passing through 0.212mm, 0.300 mm and 0.850mm respectively.

4.1 Spreading the Hydrated Lime

Quantity of lime to be added with soil at rate of **10 kg per Square Meter** area of soil.

Spreading the stabilizer at the required dosage rate can be carried out manually. For manual method for spreading stabilizer bags of stabilizer are spotted at a set spacing, they are then broken open and the stabilizer raked across the surface as uniformly as possible. Standard weight of bag containing hydrated lime should be 50 kg.

Lime has a much lower bulk density than cement and it is possible, therefore, to achieve a more uniform distribution with lime when stabilizers are spread manually. The uniformity of the layer of stabilizer spread over the surface, before the mixing operation, determines the uniformity of the mixed material produced.

4.2 Mixing lime and Fly ash with soil particles

Mixing lime and fly ash thoroughly with soil particles by means of rotavator and quantity of water as per OMC to be achieved from soil tests. Robust mixing equipment of suitable power for the layer being processed is required to pulverize the soil and blend it with the stabilizer and water. The most efficient of the machines available carry out the operation in one pass, enabling the layer to be compacted quickly and minimizing the loss of density and strength caused by any delay in compaction. Multi pass machines are satisfactory, provided the length of pavement being processed is not excessive and each section of pavement can be processed within an acceptable time.

The plasticity of the material is overriding factor in the ability of mixing plant to mix the soil with stabilizer. A review of work showed that all plastic soil could be satisfactorily mixed with cement using the plant. For cohesive soils a factor of the plasticity index of the soil multiplied by the percentage of the fraction of the soil which was finer than 425 micron in particle diameter may be used to suggest the values for the different types of mixing plant available, which are given in

Table 3.

Table 3 Soil Plasticity Limits for Stabilization Using Different Types of Plant (Table No.13-IRC:SP:89-2010)

Type of Machinery ^a	Plasticity Index X Percentage of fraction finer than 425 micron	Normal maximum depth (mm) capable of being processed in one layer
Agricultural Disc harrows, Disc ploughs, rotavators	Less than 1000	120-150
Light duty rotavators (< 100 hp)	Less than 2000	150
Heavy duty rotavators (> 100 hp)	Less than 3500	200-300 (depending on soil type and horsepower of mixer)

4.3 Addition of Water

The water to be used for lime stabilisation shall be clean and free from injurious substances. Potable water shall be used.

The moisture content at compaction checked vide IS: 2720 (Part 2) shall neither be less than the optimum moisture content corresponding to IS: 2720 (Part 8) nor more than 2 percent above it. If it is necessary to add water to bring the moisture content to the required value this can either be done as part of the mixing operation or after the material has been prepared prior to the

^aSelection of the appropriate Machinery should be left to the decision of the Engineer.

addition of the stabilizer. To ensure a thorough distribution of the added water, it is preferable to add water as part of the mixing operation. Water added during the mixing process should be through a spray system such that it is added in a uniform manner over the required area and mixed uniformly to the required depth. Where the mixing plant does not enable water to be added or where it is not possible to add enough water during mixing it should be added to the prepared material using a spray system that enables the amount to be controlled over the whole area. The material to be stabilized should then be mixed prior to the addition of the stabilizer to ensure the distribution of the water throughout the layer.

4.4 Rate and mode of payment

Payment will be made on M.T. basis, contractor has to weight the loaded and unloaded truck on any of the weigh bridge of Municipal Corporation.

ITEM NO 5: Rolling and compaction of Subgrade with 8 T. vibratory roller and filling in depressions which occur during the process as per details in tender specification & as directed by engineer in charge.

5.1 Compaction

Compaction is carried out in two stages:

An initial rolling and trimming which may be carried out followed by a final mixing pass of the rotavator.

Final mixing, levelling and compaction between one and seven days after the initial mixing of Soil-lime-fly ash are beneficial. This time gap allows for the reactions between the lime and clay to take place and thus provide a more workable soil.

5.2 Curing

Proper curing is very important for three reasons:

It ensures that sufficient water is retained in the layer so that the hydration reactions between the stabilizer, water and the soil can continue

It reduces shrinkage, and

It reduces the risk of carbonation from the top layer.

In temperate climate curing presents few problems. It is usually carried out by sealing the compacted surface to prevent escape of water during the curing period (usually seven days) during which time all construction traffic must be kept off the stabilized material. Before spraying is started the surface should be swept free of loose material and any damp areas should be free of standing water. The following methods of curing are suggested:

Covering with an impermeable sheeting with joints overlapping at least 300 mm and set to prevent ingress of water.

Spraying with a bituminous sealing compound.

spraying with a resin based aluminous curing compound similar to those used for concrete. This has particular application where it is desirable to reduce the increase in temperature immediately under the surface which would result from the use of a black (bituminous) seal.

In a hot dry climate, the need for good curing is most important but the prevention of moisture loss is very difficult. If the surface is constantly sprayed and kept damp day and night the moisture content in the main portion of the layer will remain stable but the operation is likely to leach stabilizer from the top portion of the layer. If the spraying operation is intermittent and the surface dries from time to time (a common occurrence if this method is used) the curing will be completely ineffective.

Curing through spraying water can be much more efficient if a layer of sand 30 mm to 40 mm thick is first spread on top of the layer. In this case, the number of spraying cycles per day can be very much less and there is a considerable saving in the amount of water used.

When the stabilized layer is to be covered by other pavement layers the construction of the upper sections will provide a very good curing seal but care has to be taken to ensure that this work does not damage the top of the stabilized layer. During the period of time prior to the construction of the next layer some system of curing is required because, this is the most critical period in terms of shrinkage in the layer.

Primer can also serve as a curing membrane but, results have shown that a prime coat breaks down when it penetrates into the surface and completely loses any ability to seal it. A portion of any curing membrane must sit on the surface to achieve an effective seal if the top of the stabilized layer is sprayed lightly with water followed by an application of a viscous cutback bitumen, the loss of moisture is effectively reduced to zero. Similarly, the top of the stabilized layer can be sprayed with an emulsion to achieve the same result. It is essential, however, that all traffic is kept off the curing membrane for several days at which time excess bitumen can be absorbed by the surface.

5.3 Surface Finish and Quality Control of Work

5.3.1 General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings, subject to the permitted tolerances described herein-after.

5.3.2 Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The corresponding tolerance for edges of the roadway and Sub grade layers of pavement shall be ± 25 mm.

5.3.3 Surface Levels

The levels of the sub grade shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of ± 20 mm.

For checking compliance with the above requirement for sub grade, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

5.3.4 Surface Regularity of Pavement Courses

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per

Table 4.

Table 4 Maximum Permitted Number of Surface Irregularities

	Surfaces of carriageways and	Surfaces of Laybys, Service areas
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	Paved shoulder				and all Bituminous Base courses			
Irregularity	4 mm		7 mm		4 mm		7 mm	
Length	300	75	300	75	300	75	300	75
Number of Surface Irregularities on Roads of all Category ^a	40	18	40	20	60	27	60	30

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 15 mm for Sub grade.

5.3.5 Rectification

Where the surface regularity of sub grade and the various pavement courses fall outside the specified tolerances in Clause 0, the Contractor shall be liable to rectify these in the manner described below.

Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of MoRTH-2013 (Fifth revision) Clause 305.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH -2013 (Fifth revision) reproduced in Chapter **Error! Reference source not found..**

5.4 Strength

When lime- fly ash is used for improving the subgrade, the soil-lime-fly ash mix shall be tested for its soaked CBR value. In case of variation from the design soaked CBR of 8%, in situ value being lower, the pavement design shall be reviewed based on the actual soaked CBR values. The extra pavement thickness needed on account of lower soaked CBR value shall be constructed by the Contractor at his own cost.

^a Category of each section of road as described in the Contract

5.5 Arrangements for Traffic

5.5.1 General

The Contractor shall at all times, carry out work on the roadway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same, For all works involving improvements to the existing roadway, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement or along a temporary diversion constructed close to the roadway, Before taking up any construction or maintenance operation, the Contractor shall prepare a Traffic Management Plan for each work zone and submit it to the Engineer for prior approval, if required. This plan should include following:

Provision of a qualified safety officer with support staff to serve as a site safety team, as directed by Engineer.

Provision of traffic safety devices and road signs in construction zones as per IRC: SP:55.

Safety measures for the workers engaged including personal protection equipment.

First aid and emergency response arrangements.

Details and drawings of arrangements in compliance with other sub Sections of this Section.

5.5.2 Passage of Traffic along a Part of the Existing Carriageway under Improvement

For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders may be provided on the side on which work is not in progress on receipt of requirement of Engineer. The treatment to the shoulder shall consist of providing at least 150 mm thick granular (Wet Mix Macadam/Water Bound Macadam) base course covered with bituminous surface dressing in a width of at least 1.5 m and the treated shoulder shall be maintained throughout the period during which traffic uses the same, The continuous length, in which such work shall be carried out, would be limited normally to 500 m at a place, However, where work can be allowed in longer stretches by engineer looking to the site condition.

In case of eccentric widening of existing two-lane to four-lane, the additional two-lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. In case of concentric widening, stipulations as in paragraph above shall apply.

After the works are completed, the treated shoulder shall be dismantled, the debris disposed of and the area cleared.

5.5.3 Traffic Safety and Control

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per the traffic management plan submitted by the Contractor, referred to in Clause 0.

All construction equipment shall be equipped with flashing yellow beacons.

The Contractor shall conduct all operations to minimize any drop-offs (abrupt changes in roadway) exposed to traffic. Drop-offs in the travelled way shall be protected by a wedge of compacted stable material capable of carrying traffic (the wedge being 1 vertical to 4 horizontal or flatter).

The Engineer shall authorize other methods, to protect drop-offs when conditions do not allow a wedge of compacted, stable material.

Warning signs, barricades, warning lights, and all other traffic control devices shall not be removed if the hazard has not been eliminated. Only upon receipt of specific written authorization from the Engineer, the Contractor may remove or cease to maintain warning signs, barricades, warning lights, and all other traffic control devices.

The barricades erected on either side of the carriageway/portion of the carriageway closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device. At night, the passage shall be delineated with lanterns or other suitable light source including solar energy bulbs.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs shall be of approved design and of reflective type, as directed by the Engineer.

5.5.4 Maintenance of Diversions and Traffic Control Devices

Signs, lights, barriers and other traffic control devices, adequate lighting and other arrangements, as well as the riding surface of diversions and treated shoulders shall be maintained in a satisfactory condition till such time they are required and as directed by the Engineer.

5.5.5 Measurements for Payment and Rate

Arrangements, as contained in MoRTH-2013 (Fifth Revision), Provision of treated shoulders for safety of road users during construction shall be measured and paid as per the BOQ. However, their maintenance, dismantling and cleaning debris shall be considered as incidental to the Works and shall not be paid separately.

5.6 Measurements for Payment

Stabilised soil sub-grade shall be measured as finished work in position in cubic metres.

5.7 Rate

The Contract unit rate for lime stabilised soil sub-grade shall be payment in full for carrying out the required operations including full compensation for:

making arrangements for traffic to Clause 0 except for initial treatment to verges, shoulders and construction of diversions;

supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;

all labour, tools, equipment and incidentals to complete the work to the Specifications;

carrying out the work in part widths of road where directed; and
carrying out the required tests for quality control.

ITEM NO. 6: Providing and laying Granular Sub Base (drainage layer) conforming to grading V of Table 400-1 of each layer not exceeding 200mm thickness and compacted thickness as per design & drawing with specified graded stone metal and sand mixed in pugmill and laid with mechanical means spreading with motor grader and compacting with vibratory roller having minimum 80-100 kN static weight to achieve desired density of 98% of MDD including all materials, labour, machinery, tests required to be carried out with all leads and lifts etc., complete as per details in tender specification & as directed by engineer in charge.

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one layer as sub-base according to lines, grades and cross-sections shown on the drawings.

6.1 Material requirements

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table 5 and physical requirements given in

Table 6. If the water absorption of the aggregates determined as per IS: 2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

Table 5 Grading for Granular Sub-base (GSB-V) Materials

IS size (mm)	Percent by Weight Passing the IS Sieve (Grading-V)
75.0	100
53.0	80-100
26.5	55-90
9.50	35-65
4.75	25-50
2.36	10-20
0.85	2-10
0.425	0-5
0.075	-

Table 6 Physical Requirements for Materials for Granular Sub-base

Physical properties	Test procedure	Requirement
Aggregate Impact Value (%)	IS:2386 (Part 4) or IS:5640	40 maximum
Liquid Limit (%)	IS:2720 (Part 5)	Maximum 25
Plasticity Index (%)	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS: 2720- Part 8) (%)	IS:2720 (Part 5)	Minimum 30

6.2 Construction Operations

6.2.1 Preparation of Sub-grade

Immediately prior to the laying of sub-base, the subgrade already finished as mentioned in ITEM NO. 5 shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

6.2.2 Spreading and Compacting

The Granular sub-base material of the grading-V and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing so as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS: 2720 (Part 8). The mix shall be spread on the prepared subgrade with the help of a motor grader of adequate, capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation.

Moisture content of the mix shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on superelevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the proceeding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

6.3 Surface Finish and Quality Control of Work

6.3.1 General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings, subject to the permitted tolerances described herein-after.

6.3.2 Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The tolerance for edges of the roadway and Sub-base layers of pavement shall be ± 25 mm.

6.3.3 Surface Levels

The levels of the Granular sub-base shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of ± 10 mm.

For checking compliance with the above requirement for Granular sub-base, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

6.3.4 Surface Regularity of Pavement Courses

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per Table 4.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 8 mm for Granular Sub-base.

6.3.5 Rectification

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances in Clause 0, the Contractor shall be liable to rectify these in the manner described below.

Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of MoRTH-2013 (Fifth revision) Clause 401. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH -2013 (Fifth revision).

6.4 Arrangements for Traffic

During the period of construction, arrangement for traffic shall be provided and maintained in accordance with Clause 5.5.

6.5 Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic meters. The protection of edges of granular sub-base extended over the full formation width shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

6.6 Rate

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

Making arrangements for traffic to Clause 5.5 except for initial treatment to verges, shoulders and construction of diversions.

Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts.

All labour, tools, equipment and incidentals to complete the work to the Specifications.

Carrying out the work in part widths of road where directed.

Carrying out the required tests for quality control.

ITEM NO. 7: Providing and laying Wet Mix Macadam with paver finisher in specified thickness, each layer not exceeding 200 mm compacted thickness including premixing in WMM plant with well graded crushed stone aggregate, with watering and spreading by mechanical means to required profile and compacting by vibratory roller of minimum 80-100 kN static weight to achieve desired density of 98% of MDD including all material, labour, machinery, test with all leads and lifts etc., complete as per details in tender specification & as directed by engineer in charge.

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 Granular sub- base or existing pavement as the case may be in accordance with the requirements of the specifications of Wet Mix Macadam for Base course. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings. The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be up to 200 mm.

7.1 Material requirements

Coarse aggregates shall be crushed stone. The aggregates shall conform to the physical requirements set forth in Table 7.

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).

Table 7 Physical Requirements of coarse Aggregates for Wet Mix Macadam

Test	Test Method	Requirements
Los Angeles Abrasion	IS: 2386 (Part-4)	40 percent (Max.)

value OR Aggregate Impact value	IS: 2386 (Part 4) or IS 6640	30 percent (Max.)
Combined Flakiness and Elongation indices (Total)	IS: 2386 (Part-I)	35 percent (Max.) ^a

Table 8 Grading Requirements of Aggregates for Wet Mix Macadam

IS Sieve size (mm)	Percent by Weight passing the IS Sieve
53.00	100
45.00	95-100
26.50	-
22.40	60-80
11.20	40-60
4.75	25-40
2.36	15-30
0.60	8-22
0.075	0-5

Material finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits 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.

7.2 Construction Operations

7.2.1 Preparation of Base

The surface of the Granular sub-base to receive the Wet Mix Macadam course shall be prepared to the specified grade and camber and cleaned of dust, dirt and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained.

Where the WMM is to be laid on an existing metalled road, damaged area including depressions and potholes shall be repaired and made good with the suitable material. The existing surface shall be scarified and re-shaped to the required grade and camber before spreading the coarse aggregate for WMM.

7.2.2 Provision of Lateral Confinement of Aggregates

While constructing wet mix macadam (WMM), arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying soil having minimum 8% soaked CBR in adjoining shoulders along with that of wet mix macadam layer. The practice of constructing WMM in a trench section excavated in the finished formation must be completely avoided.

Where the WMM course is to be constructed in narrow widths for widening of an existing pavement, the existing shoulders should be excavated to their full depth and width up to the sub-grade level except where widening specifications envisages laying of a stabilised sub-base using in-situ operations in which case the same should be removed only up to the sub-base level.

7.2.3 Preparation of Mix

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. The plant shall have following features:

For feeding aggregates- three/ four bin feeders with variable speed motor

Vibrating screen for removal of oversize aggregates

Conveyor Belt

Controlled system for addition of water

Forced/positive mixing arrangement like pug-mill or pan type mixer

Centralized control panel for sequential operation of various devices and precise process control

Safety devices

Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. The mixed material should be uniformly wet and no segregation should be permitted.

7.2.4 Spreading of Mix

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared Granular sub-base in required quantities. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted. The mix may be spread by a paver finisher. The paver finisher shall be self-propelled of adequate capacity with following features:

Loading hoppers and suitable distribution system, so as to provide a smooth uninterrupted material flow for different layer thicknesses from the tipper to the screed.

Hydraulically operated telescopic screed for paving width up to 8.5 m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.

Automatic levelling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by

depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual laying in inaccessible remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual laying is intended to be used, the same shall be done with the approval of the Engineer.

7.2.5 Compaction

After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100kN weight may be used. For a compacted single layer up to 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN with an arrangement for adjusting the frequency and amplitude. An appropriate frequency and amplitude may be selected. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one-third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-base/base course or sub-grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case shall the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

7.2.6 Setting and Drying

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

7.3 Opening to Traffic

No vehicular traffic shall be allowed on the finished wet mix macadam surface.

7.4 Surface Finish and Quality Control of Work

7.4.1 Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The tolerance for edges of the roadway and WMM layers of pavement shall be ± 25 mm.

7.4.2 Surface Levels

The levels of the Base course shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of ± 10 mm, in case of Machine laid mix and ± 15 mm, in case of Manually laid mix.

For checking compliance with the above requirement for Wet Mix Macadam, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

7.4.3 Surface Evenness

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per

Table 4.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 8 mm for Wet Mix Macadam.

7.4.4 Quality Control

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision).

7.4.5 Rectification of Surface Irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to sub-grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, re-shaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompacted in accordance with Clause 7.2. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

7.5 Arrangement for Traffic

During the period of construction, arrangements for traffic shall be done as per Clause 5.5.

7.6 Measurements for Payment

Wet mix macadam shall be measured as finished work in position in cubic meters.

7.7 Rate

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for:

making arrangements for traffic to Clause 5.5 except for initial treatment to verges, shoulders and construction of diversions;

supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;

all labour, tools, equipment and incidentals to complete the work to the Specifications;

carrying out the work in part widths of road where directed; and

carrying out the required tests for quality control.

ITEM NO. 8: Supplying and applying Slow Setting-1 (SS-I) bitumen emulsion confirming to IS 8887, for application of prime coat over Wet Mix Macadam at the rate of 0.85 kg per Sq.Meter area, including all materials, labour, machinery, test with all leads and lifts etc., complete as per details in tender specification & as directed by engineer in charge.

Prime coat consists of the application of a single coat of bitumen emulsion to a porous granular surface preparatory to the superimposition of bituminous treatment or mix. The work shall be carried out on a previously prepared Wet Mix Macadam.

8.1 Material

The primer shall be cationic bitumen emulsion SS-1 grade conforming physical and chemical properties shown in

Table 9. Quantity of SS-1 grade bitumen emulsion for Wet mix macadam shall be **0.85 kg/Sq.mt.** Quantity of Bitumen emulsion shall be such that it can be absorbed by the surface without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C.

Table 9 Physical and Chemical properties of Bitumen Emulsion Grade SS-1

Sr. No.	Properties	
1	Residue on 600 micron IS Sieve, percent by mass, (Max)	0.05
2	Viscosity by Saybolt Furol viscometer, seconds: At 25° C	20-100
3	Coagulation of emulsion at low temperature	Nil
4	Storage stability after 24 h, percent (Max)	2
5	Particle charge	Weak Positive
6	Stability to mixing with cement (percentage coagulation), Max	2
7	Tests on residue:	
	Residue by evaporation, percent, (Min)	50

	Penetration 25°C / 100g/5 sec	60-350
	Ductility 27° C/cm, A4in	50
	Solubility: In trichloroethylene, percent by mass (Min)	98
8	Distillation in percent, by volume at	
	190° C	20-55
	225° C	30-75
	260° C	40-90
	315° C	60-100
9	Water content, percent by mass, (Max)	20

If Emulsion is stored for more than 90 days, its properties as mentioned in

Table 9 should be checked apart from the frequency mentioned in Table 26.

Preferred source for bitumen emulsion is Hindustan Colas Ltd. (HINCOL) or equivalent industry which follows standards of IS: 8887-2004 and must be PSU manufacturers.

8.2 Weather and Seasonal Limitations

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. Surface can be just wet by very light sprinkling of water.

8.3 Construction

8.3.1 Equipment

The primer shall be applied by a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at the rate of **0.85 kg per SM**. Hand spraying shall not be allowed except in small areas, inaccessible to the distributor, or in narrow strips where primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

8.3.2 Preparation of Road Surface

Prime coat must be applied immediately after compaction of WMM upto 98% Maximum dry density is achieved on field.

8.3.3 Application of Bituminous Primer

After preparation of the road surface as per Clause 0, the primer shall be sprayed uniformly at the rate of **0.85 kg per SM**. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified. No heating or dilution of SS-1 bitumen emulsion and shall be permitted at site.

8.3.4 Curing of Primer and Opening to Traffic

A primed surface shall be allowed to cure for at least 24 hours or such other higher period as is found to be necessary to allow all the moisture/volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with a light

application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course.

8.4 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Table 26 shall apply.

8.5 Arrangements for Traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 5.1.1.6.

8.6 Measurement for Payment

Prime coat shall be measured in terms of surface area of application in square meters.

8.7 Rate

The contract unit rate for prime coat shall be payment in full for carrying out the required operations including full compensation for:

Making arrangements for traffic to Clause 5.1.1.6. except for initial treatment to verges, shoulders and construction of diversions;

Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;

All labour, tools, equipment and incidentals to complete the work to the Specifications;

Carrying out the work in part widths of road where directed; and

Carrying out the required tests for quality control.

Payment shall be made on the basis of the provision of prime coat at an application rate of quantity at **0.85 kg per SM**, with adjustment, plus or minus, for the variation between this quantity and the actual quantity approved by the Engineer after the preliminary trials referred to in Clause 0.

ITEM NO. 9: Supplying and applying Rapid Setting-1 (RS-I) bitumen emulsion confirming to IS 8887, for application of Tack coat before application of binder course at the rate of 0.27 kg. per Sq. Meter area, including all materials, labour, machinery, tests required to be carried out with all leads and lifts etc., complete as per details in tender specification & as directed by engineer in charge.

The work shall consist of the application of a single coat of bitumen emulsion to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with Chapter 8.

9.1 Materials

The binder used for tack coat shall be either Cationic bitumen emulsion (RS-1) complying with IS:8887. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

The binder used for tack coat shall be Cationic bitumen emulsion RS-1 grade conforming physical and chemical properties shown in

Table 10. The rate of application of Tack coat on Granular surfaces treated with primer is **0.27 kg/sq.mt.**, and it shall be applied uniformly. No dilution or heating at site of RS-1 bitumen emulsion shall be permitted. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C.

Sr. No.	Properties	
1	Residue on 600 micron IS Sieve, percent by mass, (Max)	0.05
2	Viscosity by sayboltfurol viscometer, seconds: At 50° C	20-100
3	Coagulation of emulsion at low temperature	Nil
4	Storage stability after 24 h, percent (Max)	2
5	Particle charge	Positive
6	Miscibility with water	No coagulation
7	Tests on residue:	
	Residue by evaporation, percent, (Min)	60
	Penetration 25°C/100g/5 sec	80-150
	Ductility 27° C/cm, A4in	50
	Solubility: In trichloroethylene, percent by mass (Min)	98

If Emulsion is stored for more than 90 days, its properties as mentioned in

Table 10 should be checked apart from the frequency mentioned in Table 26.

Preferred source for bitumen emulsion is Hindustan Colas Ltd. (HINCOL) or equivalent industry which follows standards of IS:8887-2004 and must be PSU manufacturers.

9.2 Weather and Seasonal Limitations

Bituminous material shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. The surface shall be slightly damp, but not wet while using emulsion.

9.3 Construction

9.3.1 Equipment

The tack coat shall be applied by a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a rate of **0.27 kg per SM**. Hand spraying shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

9.3.2 Preparation of Base

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of MoRTH-2013 (Fifth Revision) Clauses 501.8. The granular surfaces shall be primed as per Chapter 0. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

9.3.3 Application of Tack Coat

The application of tack coat shall be at the rate of **0.27 kg per SM**, and it shall be applied uniformly. No dilution or heating at site of RS-1 bitumen emulsion shall be permitted. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C. The

method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

9.3.4 Curing of Tack Coat

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

9.4 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Table 26 shall apply.

9.5 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 5.1.1.6.

9.6 Measurement for Payment

Tack coat shall be measured in terms of surface area of application in square meters.

9.7 Rate

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for:

Making arrangements for traffic to Chapter Clause 5.1.1.6. except for initial treatment to verges, shoulders and construction of diversions;

Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;

All labour, tools, equipment and incidentals to complete the work to the Specifications;

Carrying out the work in part widths of road where directed; and

Carrying out the required tests for quality control.

The rate shall cover the provision of tack coat, at the rate of **0.27 kg per SM**, with the provision that the variation between this quantity and actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

ITEM NO. 10: Providing and laying DENSE GRADED BITUMINOUS MACADAM (DBM) as per gradation and bitumen for mixing shall be as arrived from mix design, provided in no case it shall be less than 4.0% for Grade I and 4.5% for Grade II by wt. of total mix as binder by batch mix type hotmix plant and laying by Manual paver finisher including consolidation by rollers as specified including providing and operating plant, Manual paver and machinery, cost of fuel, oil lubricant and labour charges, tests required to be carried out including cost of aggregate and filler (if found required as per mix design) etc complete (But including cost of providing bitumen)

(a) 4.50% bitumen (including cost of bitumen)

(b) 4.00% bitumen (including cost of bitumen)

The specification describes the design and construction procedure for 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 layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50 mm to 75 mm

for DBM-II, whereas it can be 75 mm to 100 mm with DBM-I in case of redesigning the pavement for achieved soaked CBR value being lower than design soaked CBR of 8%.

10.1 Materials

10.1.1 Bitumen

The bitumen shall be viscosity grade paving bitumen VG 30 complying with the Indian Standard Specification IS: 73 or as otherwise specified in the Contract. The type and grade of bitumen to be used shall be VG 30 grade of paving bitumen satisfying specified in

Table 11.

Table 11 Requirements for Paving Bitumen VG 30

Sr.No.	Characteristics	Requirement
1	Penetration at 25°C, 100 g, 5 s, 0.1 mm, Min	45
2	Absolute viscosity at 60°C, Poises	2400-3600
3	Kinematic viscosity at 135°C, cSt, Min	350
4	Flash point (Cleveland open cup), °C, Min	220
5	Solubility in trichloroethylene, percent, Min	99
6	Softening point (R&B), °C, Min	47
7	Tests on residue from rolling thin film oven test:	
	a) Viscosity ratio at 60°C, Max	4.0
	b) Ductility at 25°C, cm, Min	40

10.1.2 Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. The aggregates shall satisfy the requirements specified in

Table 12. Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces. Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36 mm sieve and retained on the 75-micron sieve. Natural sand shall not be allowed in binder courses. However, natural sand up to 50 percent of the fine aggregate may be allowed in base courses. The fine aggregate shall have a sand equivalent value of 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).

Table 12 Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam

Property	Test	Specification	Method of Test
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Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 35% Max 27%	IS:2386 Part IV
Durability	Soundness: 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	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength	Min. 80%	AASHTO 283

10.1.3 Aggregate Grading and Binder Content

When tested in accordance with IS:2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and filler for the particular mixture shall fall within the limits given in

Table 13 for grading 1 or 2 as specified in the Contract. To avoid gap grading, the combined aggregate gradation shall not vary from the lower limit on one sieve to higher limit on the adjacent sieve.

Table 13 Composition of Dense Graded Bituminous Macadam

Grading	1	2
Nominal aggregate size ^a	37.5 mm	26.5 mm

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

Layer thickness	75 - 100 mm	50 - 75 mm
IS Sieve (mm)	Cumulative % by weight of total aggregate passing	
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	7-2
0.15	-	-
0.075	2-8	2-8
Bitumen content % by mass of total mix	Min 4.0 ^a	Min 4.5 ^b

10.2 Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS-2. Where maximum size of the aggregate is more than 26.5 mm, the modified Marshall method using 150 mm diameter specimen described in MS-2 and ASTM D 5581 shall be used. This method requires modified equipment and procedures. When the modified Marshall test is used, the specified minimum stability values in Table 15 shall be multiplied by 2.25, and the minimum flow shall be 3 mm. The Fines to Bitumen (F/B) ratio by weight of total mix shall range from 0.6 to 1.2. Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 14. Alternatively, minimum bitumen content recommended as given in

^aCorresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately.

^bCorresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately.

Table 13 can be used for production of mix, provided the mix satisfies the requirements as given in

Table 13, Table 14 and Table 15. The compacted layers of Dense Graded Bituminous Macadam (DBM) shall have a minimum field density equal to or more than 92% of the density based on theoretical maximum specific gravity (G_{mm}) obtained on the day of compaction in accordance with ASTM D 2041.

Table 14 Requirements for Dense Graded Bituminous Macadam

Properties	Requirement	Test Method
Compaction level	75 blows on each face of the specimen	
Minimum stability (kN at 60°C)	9.0	AASHTO T245
Marshall flow (mm)	2-4	AASHTO T245
Marshall Quotient(Stability/Flow)	2-5	MS-2 and ASTM D2041
% air voids	3-5	
% Voids Filled with Bitumen (VFB)	65-75	
Coating of aggregate particle	95% minimum	IS: 6241
Tensile Strength ratio	80% Minimum	AASHTO T 283
% Voids in Mineral Aggregates(VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 15	

Table 15 Minimum Percent Voids in Mineral Aggregate (VMA)

Nominal Maximum Particle Size (mm)	Minimum VMA Percent Related to Design Percentage Air voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

10.2.1 Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

Source and location of all materials

Proportions of all materials expressed as follows:

Binder type, and percentage by weight of total mix

Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler

A single definite percentage passing each sieve for the mixed aggregate

The individual gradings of the individual aggregate fraction, and the proportion of each in the combined grading

The results of mix design such as maximum specific gravity of loose mix (G_{mm}), compacted specimen densities, Marshall stability, flow, airvoids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test

Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch

Test results of physical characteristics of aggregates to be used

Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

10.2.2 Plant Trials - Permissible Variation in Job Mix Formula

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 16 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with MoRTH-2013(Fifth revision)Section 900.

Table 16 Permissible Variations in the Actual Mix from the Job Mix Formula

Description	Base/binder Course
Aggregate passing 19 mm sieve or larger	±8%
Aggregate passing 13.2 mm, 9.5 mm	±7%
Aggregate passing 4.75 mm	±6%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±5%
Aggregate passing 0.3 mm, 0.15 mm	±4%
Aggregate passing 0.075 mm	±2%
Binder content	±0.3%

Mixing temperature	$\pm 10^{\circ}\text{C}$
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10.3 Construction Operations

10.3.1 Weather and Seasonal Limitations

Laying shall be suspended:

In presence of standing water on the surface;

When rain is imminent, and during rains, fog or dust storm;

When the base/binder course is damp;

When the air temperature on the surface on which it is to be laid is less than 10°C for mixes with conventional bitumen;

10.3.2 Preparation of Base

The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with Chapter 0 and chapter 0.

10.3.3 Prime Coat

Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of Chapter 8 .

10.3.4 Tack Coat

Where the material on which the dense bituminous macadam is to be laid is either bitumen bound layer or primed granular layer, tack coat shall be applied, as specified, in accordance with the provisions of Chapter 9.

10.3.5 Mixing and Transportation of the Mix

Pre-mixed bituminous materials shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Appropriate mixing temperatures are given in Table 17 of these Specifications. The difference in temperature between the binder and aggregate shall at no time exceed 14°C . In order to ensure uniform quality of the mix and better coating of aggregates, the hot mix plant shall be calibrated from time to time.

Table 17 Mixing, Laying and Rolling Temperatures for Bituminous Mixes (Degree Celsius)

Bitumen viscosity grade	Bitumen Temperature	Aggregate Temperature	Mixed material Temperature	Laying Temperature	^a Rolling Temperature
VG-	160-170	160-175	160-170	150 Min	100 Min

^aRolling must be completed before the mat cools to these minimum temperatures.

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VG-30	150-165	150-170	150-165	130 Min	90 Min
VG-20	145-165	145-170	145-165	135 Min	85 Min
VG-10	140-160	140-165	140-160	130 Min	80 Min

If a continuous type mixing plant is used, the Contractor must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for that bituminous bound material. In the case of a designed job mix, the bitumen and filler content shall be derived using this combined grading. Table 17 gives the mixing, laying and rolling temperature for dense mixes using viscosity grade bitumen.

In case of modified bitumen, the temperature of mixing and compaction shall be higher than the mix with viscosity grade bitumen. The exact temperature depends upon the type and amount of modifier used and shall be adopted as per the recommendations of the manufacturer. In order to have uniform quality, the plant shall be calibrated from time to time.

Bituminous materials shall be transported in clean insulated and covered vehicles. An asphalt release agent, such as soap or lime water, may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

10.3.6 Spreading

Prior to spreading the mix, the base shall be prepared by carrying out the required operations as per MoRTH -2013 (Fifth revision) Clause 501.8 depending upon the site conditions. Except in areas where paver cannot get access, bituminous materials shall be spread, levelled and tamped by an approved self-propelled paving machine equipped with an electronic sensing device. The essential features of the paver finisher shall conform to Annex A of IRC:27. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay. The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of the paver, and its method of operations, shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space (such as confined space, foot ways, of irregular shape and varying thickness, approaches to expansion joints, etc.) where paver cannot be used, the material shall be spread, raked and levelled with suitable hand tools by trained staff.

The minimum thickness of material laid in each paver pass shall be in accordance with, the minimum values given in the relevant parts of these Specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine laying shall stop 300 mm short of the joint. The remainder of the pavement up to the joint, and the corresponding area beyond it, shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material, with a temperature greater than 145°C, shall not be laid or deposited on bridge deck water-proofing systems, unless precautions against heat damage.

Bituminous material shall be kept clean and uncontaminated. The only traffic permitted to run on bituminous material to be overlaid shall be that engaged in laying and compacting the next course or, where a binder course is to be sealed or surface dressed, that engaged on such surface treatment. Should any bituminous material become contaminated, the Contractor shall make it good to the satisfaction of the Engineer, in compliance with MoRTH-2013 (Fifth revision) Clause 501.8.

Binder course material shall be covered by either the wearing course or surface treatment, whichever is specified in the Contract.

10.3.7 Rolling and Compaction

Bituminous materials shall be laid and compacted in layers, which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

Compaction of bituminous materials shall commence as soon as possible after laying. Compaction shall be substantially completed before the temperature falls below the minimum rolling temperatures stated in the relevant part of these Specifications. Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this, rolling shall commence at the edges and progress towards the center longitudinally except that on super-elevated and unidirectionally cambered portions, it shall progress from the lower to the upper edge parallel to the center line of the pavement. Rolling shall continue until all roller marks have been removed from the surface. All deficiencies in the surface after laying shall be made good by the attendants behind the paver, before initial rolling is commenced. The initial or breakdown rolling shall be done with 8-10 tonne static weight smooth-wheel rollers. The intermediate rolling shall be done with 8-10 tonne static weight or vibratory roller or with a pneumatic tyre roller of 12 to 15 tonne weight, with a tyre pressure of at least 0.56 MPa. The Contractor shall demonstrate the efficiency of the equipment proposed to be used by carrying compaction trials. The procedure for site trials shall be submitted to the Engineer for approval. The finish rolling shall be done with 6 to 8 tonne smooth wheel tandem rollers. Rolling shall continue until the specified compaction is achieved.

Where compaction is to be determined by density of cores, the requirements to prove the performance of rollers shall apply in order to demonstrate that the specified density can be achieved. In such cases the Contractor shall specify the plant, and the method by which he intends to achieve the specified level of compaction and finish at temperatures above the minimum specified rolling temperature. Laying trials shall then demonstrate the acceptability of the plant and method used.

Bituminous materials shall be rolled in a longitudinal direction, with the driven rolls paver. The roller shall first compact material adjacent to joints and then work from the lower to the upper side of the layer, overlapping on successive passes by at least one-third of the width of the rear roll or, in the case of a pneumatic - tyred roller, at least the nominal width of 300 mm.

In portions with super-elevated and unidirectional camber, after the edge has been rolled, the roller shall progress from the lower to the upper edge.

Rollers should move at a speed of not more than 5 km per hour. The roller shall not be permitted to stand on pavement which has not been fully compacted, and necessary precautions shall be taken to prevent dropping of oil, grease, petrol, diesel or other foreign matter on the pavement either when the rollers are operating or standing. The wheels of roller machine shall be in good

working order, to prevent the mix from adhering to the Wheels. Only sufficient moisture to prevent adhesion between the wheels of rollers and the mix should be used. Surplus water shall not be allowed to stand on the partially compacted pavement.

Where joints are made, the material shall be fully compacted and the joint made flush in one of the following ways:

All joints shall be cut vertical to the full thickness of the previously laid mix. All loosened material shall be discarded and the vertical face coated with a suitable viscosity grade hot bitumen, or cold applied emulsified bitumen. While spreading the material along the joint the material spread shall overlap 25 mm to 50 mm on the previously laid mix beyond the vertical face of the joint. The thickness of the loose overlap material should be approximately a quarter more than the final compacted thickness. The overlapped mix shall be dragged back to the hot lane so that the roller can press the small excess into the hot side of the joint to obtain a high joint density.

By using two or more pavers operating in echelon, where this is practicable and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling.

All longitudinal joints shall be offset at least 300 mm from parallel joints in the layer beneath or as directed, and in a layout approved by the Engineer. Joints in the wearing course shall coincide with either the lane edge or the lane marking, whichever is appropriate. Longitudinal joints shall not be situated in wheel track zones.

For transverse joints method 0 above shall apply. Transverse joints in the successive and adjoining layers shall have a minimum offset of 2 m.

The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials.

10.4 Opening to Traffic

It shall be ensured that the traffic is not allowed, on the surface until the dense bituminous layer has cooled to the ambient temperature.

10.5 Surface Finish and Quality Control of Work

10.5.1 Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 10 mm there from.

10.5.2 Surface Levels

The levels of the Binder course shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of ± 6 mm.

For checking compliance with the above requirement for Dense graded Bituminous Macadam, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

10.5.3 Surface Evenness

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per

Table 4.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 6 mm for Dense graded Bituminous Macadam.

10.5.4 Quality Control

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision) which is reproduced in chapter 20.

10.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 5.5

10.7 Measurement for Payment

Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tonnes or by the square metre at a specified thickness as indicated in the Contract drawings, or documents.

10.8 Rate

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out all the required operations as specified and shall include, to all components listed below,

Making arrangements for traffic to Clause 5.5 except for initial treatment to verge, shoulders and construction of diversions;

Cleaning of the surface;

Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lifts;

Mixing, transporting, laying and compacting the mix, as specified including all wastage in cutting joints;

All labour, tools, equipment, plant including installation of hot mix plant, power supply units and all machinery, incidental to complete the work to these Specifications;

Carrying out the work in part widths of the road where directed;

Carrying out all tests for control of quality;

The rate shall cover the provision of bitumen at the application rate specified in the contract, with the provision that the variation in actual percentage of bitumen used shall be assessed and the payment adjusted accordingly as per Contract;

The rates include for all testing, mix design, transporting and testing of samples, and cores and tests as directed by the Engineer; and

The cost of all plant and laying trials as specified to prove the mixing and laying methods shall be deemed to be included in the Contractor's rates.

The rate shall include the provision of bitumen, at 4 percent and 4.5 percent by weight of the total mixture for grading 1 and grading 2 respectively. The variation in actual percentage of bitumen used shall be assessed and the payment adjusted plus or minus accordingly.

ITEM NO. 11: Supplying and applying Rapid Setting-1 (RS-I) bitumen emulsion conforming to IS 8887, for application of Tack coat before application of wearing course at the rate of 0.25 kg. per Sq. Meter area, including all materials, labour, machinery, tests required to be carried out with all leads and lifts etc., complete as per details in tender specification & as directed by engineer in charge.

The work shall consist of the application of a single coat of bitumen emulsion to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with Chapter 10.

11.1 Materials

The binder used for tack coat shall be either Cationic bitumen emulsion (RS-1) complying with IS : 8887. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

The binder used for tack coat shall be Cationic bitumen emulsion RS-1 grade conforming physical and chemical properties shown in

Table 10. Rate of application of Tack coat on Granular surfaces treated with primer shall be **0.25 kg/Sq. Meter.**, and it shall be applied uniformly. No dilution or heating at site of RS-1 bitumen emulsion shall be permitted. The normal range of spraying temperature for a bituminous emulsion shall be 20° C to 70° C.

If Emulsion is stored for more than 90 days, its properties as mentioned in

Table 10 should be checked apart from the frequency mentioned in Table 26.

Preferred source for bitumen emulsion is Hindustan Colas Ltd. (HINCOL) or equivalent industry which follows standards of IS: 8887-2004 and must be PSU manufacturers.

11.2 Weather and Seasonal Limitations

Bituminous material shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10° C. Where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet.

11.3 Construction

11.3.1 Equipment

The tack coat shall be applied by a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

11.3.2 Preparation of Base

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of MoRTH - 2013 (Fifth Revision) Clauses 501.8. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

11.3.3 Application of Tack Coat

The application of tack coat shall be at the rate of **0.25 kg per SM**, and it shall be applied uniformly. No dilution or heating at site of RS-1 bitumen emulsion shall be permitted. The

normal range of spraying temperature for a bituminous emulsion shall be 20° C to 70° C. The method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

11.3.4 Curing of Tack Coat

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

11.4 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Table 26 shall apply.

11.5 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 5.1.1.6..

11.6 Measurement for Payment

Tack coat shall be measured in terms of surface area of application in square meters.

11.7 Rate

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for:

Making arrangements for traffic to Chapter Clause 5.1.1.6. except for initial treatment to verges, shoulders and construction of diversions;

Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;

All labour, tools, equipment and incidentals to complete the work to the Specifications;

Carrying out the work in part widths of road where directed; and

Carrying out the required tests for quality control.

The rate shall cover the provision of tack coat, at the rate of 0.25 kg per SM, with the provision that the variation between this quantity and actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

ITEM NO. 12: Providing and laying 25mm to 50mm thick compacted BITUMINOUS CONCRETE (BC) using aggregates as per gradation and percentage of bitumen for mixing shall be as arrived from mix design, provided in no case bitumen percentage shall be less than 5.2% for Grade I and 5.4% for Grade II by Wt. of total mix as binder by batch mix type hot mix plant and laying by Manual paver finisher including consolidation by rollers as specified including providing and operating plant, Manual paver and machinery, cost of fuel, oil, lubricant and labour charges, tests required to be carried out including cost of aggregate and filler (if found required as per mix design) etc. complete (including cost of providing bitumen)

(a) 5.40% bitumen (including cost of bitumen)

(b) 5.20% bitumen (including cost of bitumen)

(c) 5.40% bitumen (Excluding cost of bitumen)

(d) 5.20% bitumen (Excluding cost of bitumen)

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 30 mm/40 mm/50 mm thick.

12.1 Materials

12.1.1 Bitumen

The bitumen shall be viscosity grade paving bitumen VG 30 complying with the Indian Standard Specification IS: 73 or as otherwise specified in the Contract. The type and grade of bitumen to be used shall be VG 30 grade paving bitumen satisfying the requirements specified in

Table 18.

Table 18 Requirements for Paving Bitumen VG 30

Sr. No.	Characteristics	Requirement as per IS:73
1	Penetration at 25°C, 100 g, 5 s, 0.1 mm, Min	45
2	Absolute viscosity at 60°C, Poises	2400-3600
3	Kinematic viscosity at 135°C, cSt, Min	350
4	Flash point (Cleveland open cup), °C, Min	220
5	Solubility in trichloroethylene, percent, Min	99
6	Softening point (R&B), °C, Min	47
7	Tests on residue from rolling thin film oven test:	
	a) Viscosity ratio at 60°C, Max	4.0
	b) Ductility at 25°C, cm, Min	40

12.1.2 Aggregates

The coarse aggregates shall be generally as specified in MoRTH-2013 (Fifth revision) Clause 504.2.2, except that the aggregates shall satisfy the physical requirements of

Table 19 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 19 Physical Requirements for Course Aggregate for Bituminous Concrete

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm	IS:2386 Part I

		sieve	
Particle Shape	Combined Flakiness and Elongation Indices	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value	Max30%	IS:2386 Part IV
Durability	Soundness either: Sodium Sulphate or	Max 12%	IS:2386 Part V
Polishing	Polished Stone Value	Min 55	BS:812-114
Water Absorption	Water Absorption	Max 2%	IS:2336 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained	IS:6241
Water	Retained Tensile	Min 80%	AASHTO

12.1.3 Aggregate Grading and Binder Content

When tested in accordance with IS : 2386 Part 1, the combined grading of the coarse and fine aggregates and filler shall fall within the limits shown in

Table 20 .The grading shall be as specified in the Contract.

Table 20 Composition of Bituminous Concrete Pavement Layers

Grading	1	2
Nominal aggregate size ^b	19 mm	13.2 mm
Layer thickness	50 mm	30—40 mm
IS Sieve(mm)	Cumulative % by weight of total aggregate passing	
26.5	100	
19	90-100	100
13.2	59-79	90-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58

^aIf the minimum retained tensile test strength falls below 80 percent, use of anti-stripping agent is recommended to meet the requirement

^bThe nominal maximum particle size is the largest specified sieve size up on which any of the aggregate is retained.

1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix	Min 5.2 ^c	Min 5.4 ^d

12.2 Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS-2. The Fines to Bitumen (F/B) ratio by weight of total mix shall range from 0.6 to 1.2. Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 21. Alternatively, minimum bitumen content recommended as given in

Table 20 can be used for production of mix, provided the mix satisfies the requirements as given in

Table 20, Table 21 and

Table 22. The compacted layers of Bituminous Concrete (BC) shall have a minimum field density equal to or more than 92% of the density based on theoretical maximum specific gravity (G_{mm}) obtained on the day of compaction in accordance with ASTM D 2041.

Table 21 Requirements for Bituminous Concrete

Properties	Requirement	Test Method
Compaction level	75 blows on each face of the specimen	
Minimum stability (kN at 60°C)	9.0	AASHTO T245
Marshall flow (mm)	2-4	AASHTO T245
Marshall Quotient(Stability/Flow)	2-5	MS-2 and ASTM D2041
% air voids	3-5	

^cCorresponds 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.

^dCorresponds 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.

% Voids Filled with Bitumen (VFB)	65-75	
Coating of aggregate particle	95% minimum	IS: 6241
Tensile Strength ratio	80% Minimum	AASHTO T 283
% Voids in Mineral Aggregates(VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 22	

Table 22 Minimum Percent Voids in Mineral Aggregate (VMA)

Nominal Maximum Particle Size (mm)	Minimum VMA Percent ^a Related to Design Percentage Air voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

1.1.1.1 12.2.1.1 Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

Source and location of all materials

Proportions of all materials expressed as follows:

Binder type, and percentage by weight of total mix

Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler

A single definite percentage passing each sieve for the mixed aggregate

The individual gradings of the individual aggregate fraction, and the proportion of each in the combined grading

The results of mix design such as maximum specific gravity of loose mix (G_{mm}), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test

Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch

Test results of physical characteristics of aggregates to be used

Mixing temperature and compacting temperature.

^aInterpolate minimum voids in the mineral aggregate (VMA) for designed percentage air voids values between those listed

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

1.1.1.2 12.2.1.2 *Plant Trials - Permissible Variation in Job Mix Formula*

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 23 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with MoRTH-2013(Fifth revision)Section 900.

Table 23 Permissible Variations in the Actual Mix from the Job Mix Formula

Description	Base/binder Course
Aggregate passing 19 mm sieve or larger	±7%
Aggregate passing 13.2 mm, 9.5 mm	±6%
Aggregate passing 4.75 mm	±5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±4%
Aggregate passing 0.3 mm, 0.15 mm	±3%
Aggregate passing 0.075 mm	±1.5%
Binder content	±0.3%
Mixing temperature	± 10°C

12.3 Construction Operations

12.3.1 Weather and seasonal limitations

Laying shall be suspended:

In presence of standing water on the surface;

When rain is imminent, and during rains, fog or dust storm;

When the base/binder course is damp;

When the air temperature on the surface on which it is to be laid is less than 10°C for mixes with conventional bitumen and is less than 15°C for mixes with modified bitumen;

When the wind speed at any temperature exceeds the 40 km per hour at 2 m height.

12.3.2 Preparation of base

The surface on which the Bituminous Concrete is to be laid shall be prepared in accordance with MoRTH-2013 (Fifth revision) Clauses 501 and Clause 902 as appropriate. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

12.3.3 Tack coat

Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Chapter 0.

12.3.4 Mixing and transportation of the mixture

Pre-mixed bituminous materials shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Appropriate mixing temperatures can be found in Table 24 of these Specifications; the difference in temperature between the binder and aggregate should at no time exceed 14°C. In order to ensure uniform quality of the mix and better coating of aggregates, the hot mix plant shall be calibrated from time to time.

Table 24 Mixing, Laying and Rolling Temperatures for Bituminous Mixes (Degree Celsius)

Bitumen viscosity grade	Bitumen Temperature	Aggregate Temperature	Mixed material Temperature	Laying Temperature	^a Rolling Temperature
VG-40	160-170	160-175	160-170	150 Min	100 Min
VG-30	150-165	150-170	150-165	130 Min	90 Min
VG-20	145-165	145-170	145-165	135 Min	85 Min
VG-10	140-160	140-165	140-160	130 Min	80 Min

If a continuous mixing plant is to be used for mixing the bituminous bound macadam, the Contractor must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for that bituminous bound material. In the case of a designed job mix, the bitumen and filler content shall be derived using this combined grading. Further details are available in the Manual for Construction and Supervision of Bituminous Works.

^aRolling must be completed before the mat cools to these minimum temperatures.

Bituminous materials shall be transported in clean insulated vehicles, and unless otherwise agreed by the Engineer, shall be covered while in transit or a waiting tipping. Subject to the approval of the Engineer, a thin coating of diesel or lubricating oil may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

12.3.5 Spreading

The general provisions of MoRTH-2013 (Fifth revision) Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

12.3.6 Rolling

The general provisions of MoRTH-2013 (Fifth revision) Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

12.4 Opening to Traffic

The bituminous macadam shall be *covered* with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay, by the Contractor the course shall be covered by a seal coat to the requirement of MoRTH-2013 (Fifth revision) Clause 512 before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

12.5 Surface Finish and Quality Control

12.5.1 General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings, subject to the permitted tolerances described herein-after.

12.5.2 Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 10 mm there from.

12.5.3 Surface Levels

The levels of the Wearing course shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of ± 6 mm, in case of machine laid mix and ± 10 mm, in case of manually laid mix.

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course, if the thickness of the former is thereby reduced by more than the following limits:

- 4 mm for bituminous wearing course of thickness 40 mm or more
- 3 mm for bituminous wearing course of thickness less than 40 mm
- 5 mm for concrete pavement slab

For checking the compliance with the above requirement for bituminous wearing courses and concrete pavements, measurements of the surface levels shall be taken on a grid of points spaced at 6.25 m along the length and at 0.5 m from the edges and at the center of the pavement. In any length of pavement, compliance shall be deemed to be met for the final road surface, only if the tolerance given above is satisfied for any point on the surface.

12.5.4 Surface Regularity of Pavement Courses

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per

Table 4.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 3 mm for Bituminous Concrete.

12.5.5 Rectification

Where the surface regularity of sub grade and the various pavement courses fall outside the specified tolerances in Clause 0, the Contractor shall be liable to rectify these in the manner described below.

For bituminous construction, other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material over a suitable tack coat, if needed, and recompacting as per specifications. Where the surface is high, the extra thickness in the affected layer shall be removed and replaced with fresh material and compacted to Specifications.

For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 m in length and not less than 3.5 m in width.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision).

12.5.6 Riding Quality

The riding quality of bituminous concrete wearing surface, as measured by a standard towed fifth wheel bump integrator, shall not be more than 2000 mm per Km.

12.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 5.1.1.6..

12.7 Measurement for Payment

Bituminous Concrete Materials shall be measured as finished work either in cubic metres, tonnes or by the square metre at a specified thickness as indicated in the Contract drawings, or documents, or as otherwise directed by the Engineer.

12.8 Rate

The contract unit rate for Semi-Dense Bituminous Concrete shall be payment in full for carrying out all the required operations as specified and shall include, to all components listed below,

Making arrangements for traffic to Clause 0 except for initial treatment to verge, shoulders and construction of diversions;

Cleaning of the surface;

Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lifts;

Mixing, transporting, laying and compacting the mix, as specified including all wastage in cutting joints;

All labour, tools, equipment, plant including installation of hot mix plant, power supply units and all machinery, incidental to complete the work to these Specifications;

Carrying out the work in part widths of the road where directed;

Carrying out all tests for control of quality;

The rate shall cover the provision of bitumen at the application rate specified in the contract, with the provision that the variation in actual percentage of bitumen used shall be assessed and the payment adjusted accordingly as per Contract;

The rates include for all testing, mix design, transporting and testing of samples, and cores and tests as directed by the Engineer; and

The cost of all plant and laying trials as specified to prove the mixing and laying methods shall be deemed to be included in the Contractor's rates.

The rate shall include the provision of bitumen, at 5.2 percent and 5.4 percent for grading 1 and grading 2 by weight of the total mixture respectively. The variation in actual percentage of bitumen used will be assessed and the payment adjusted plus or minus, accordingly.

ITEM NO. 13: Collecting, carting and stacking Stone Dust on road side as directed and flushing the same on Bituminous surfaces at the rate of 0.30 C.M. per 10 smt. as per details in tender specification & as directed by engineer in charge.

13.1 Description

Stone dust required for the work shall be clean properly graded, free from organic materials silt clay, clods, grass roots etc. and shall be got approved from Engineer.

The material shall be stacked in form of chatta on a fairly level ground. It shall be stacked on road land beyond the top of the bank and on level conveying with all leads and lifts of the works site and

stacking. Material shall be collected in required quantity only at required stage of work. The stone dust shall pass 100% from 600 micron and pass 85 to 100% from 75 micron sieve.

Before flushing the stone dust, it shall be thoroughly cleaned and free from all organic materials. Stone dust spreaded at the rate of 0.03 cu. mt. per 10 sq. mt. To ensure that the required stone dust used, the road surface shall be marked into length and breadth. The flushing shall be done as per direction of Engineer. The payment shall be made on square meter basis. The rate includes collecting carting and stacking to site and flushing on bitumen surface at required rate.

ITEM NO. 13 A : Providing & Laying Bitumen painting (VG30) by mechanical sprayer on wearing course(BC)surface using bitumen @ 5.0kg. / 10.0 S.M. And spreading stone dust @ 0.03 C.M. / 10.0 S.M. On painted surface including operating cost of contractor's own equipment, fuel, lubricants, carting of required materials, all labour and material cost (excluding cost of bitumen) preparing surface by brushing with wire brushes, sweeping with mechanical broom / compressed air and finally fanning the cleaned surface with gunny bags to remove all loose dirt etc. complete as per details in tender specification & as directed by engineer in charge.

SCOPE :

This work shall consist of application of single coat of bitumen to an existing/newly carpeted or re-carpeted road surface.

Materials:

Binder used for painting shall be 60/70 grade OR VG-30 bulk bitumen as specified in contract.

Construction Operation:

Preparation of base:

The surface on which the surface painting is to be applied be clean of dust and any extraneous material before the application of the binder, by using an air-compressor or by any mechanical means as specified by the Engineer.

Application of binder:

The work shall consist of application of a single coat of low viscosity liquid bituminous materials to an existing prepared road surface. After bringing it to desired viscosity binder shall be applied at the rate of 5.0 kg/10 sqmt.

The bitumen is applied for 10 Sq. mt. of existing/newly carpeted or recarpeted black top surface uniformly either by sprayer or mechanical means. Binder may be heated to 163 degree C to 177 degree C temperature appropriate to the bitumen grade and sprayed on the road surface at the rate specified above. It shall be the responsibility of contractor to carefully handle the inflammable bitumen material so as to safe guard against any fire mishap.

Measurement for payment:

Bituminous surface painting shall be measured interims of surface area of application in square meters.

Rate :

The rate for Bituminous surface painting shall be payment in full for carrying out the required operations including full compensation for-

Making arrangement for traffic.

Furnishing all materials to be incorporated in work including all royalties, fees, rents where, necessary and all lead and lifts.(Bitumen shall be issued by SMC)

All labour, tools, equipment and incidentals to complete the work to the specifications.

Carrying out the work in part width of road when directed and

Carrying out the required test for quality control.

ITEM NO. 14: Preparing surfaces by excavating with spades, scraping with shovel, brushing with wire brushes for removing caked mud up to 150mm thick etc. sweeping with brooms and finally fanning the cleaned surface with gunny bags to remove all loose dirt etc. including carting of excavated stuff from site.including all lobour & equipment.

This work shall consist of preparing an existing granular or black-topped surface for laying bituminous course. The work shall be performed on such widths and lengths as shown on the drawings or as instructed by the Engineer. The existing surface shall be firm and clean, and treated with Prime or Tack coat where specified in the Contract.

14.1 Construction operations for Preparing Existing Granular Surface

Where the existing surface is granular, all loose materials shall be removed, and the surface lightly watered where the profile corrective course to be provided as a separate layer is also granular. Where the profile corrective course of bituminous material is to be laid over the existing granular surface, the latter shall, after removal of all loose material, be primed in accordance with Clause 502 and a tack coat applied in accordance with Chapter 9.

The surface of all granular layers on which bituminous works are to be placed, shall be free from dust. All such layers must be capable of being swept, after the removal of any non-integral loose

material, by means of a mechanical broom, without shedding significant quantities of material and dust removed by air jet, washing, or other means approved by the Engineer. After cleaning, the surface shall be correct to line and level within the tolerances specified for base course.

ITEM NO. 15: Picking of the bituminous surface using JCB excavator or by any mechanical means, cleaning and removal of loose and unsuitable material on the road surface including cost of fuel, oil, lubricant, labour charges and disposal of loose unsuitable material from site to the disposal site as directed by Engineer in charge.

15.1 Description

This work shall consist scratching of existing top bituminous layer i.e. wearing coat up to 20 mm depth in the specified width which shall be partly removed with care and without causing undue disturbance to the underlying layer with suitable equipment such as JCB excavator as per instruction of Engineer. It also includes removing and stacking reusable/unusable materials, disposal of unusable materials within lead of 5 km. from the site of work as directed by Engineer. This work shall be carried out for re-carpeting the existing bituminous roads only. This work shall be carried out in such a way that actual picking area shall be minimum 25 % of the area to be re-carpeted.

15.2 Mode of Payment

The payment shall be made on sq.mt. basis. The payment shall be made only for the once which has been carried out generally up to 20 mm. depth by JCB excavator as directed by Engineer.

ITEM NO. 16: Scarifying the graveled macadam, bituminous macadam surface 6 cm. to 10 cm. deep including stacking the useful materials and disposing remaining stuff including loading and unloading and carting the same within city limit as directed by Engineer in charge.

16.1 Description

The item shall include all necessary excavation of mud, earth, graveled macadam bituminous surfaces (6cm. to 10cm. depth) up to the layer of required base with augers and spates / JCB excavator. The base shall be properly cleaned so as no caked mud, earth or any other material which would interfere adhesion of the mix material with the base. The scrapped material shall be disposed from site within lead of 50 mt., as per the instruction of the Engineer.

16.2 Mode of Payment

The payment shall be made on sq.mt. basis. The payment shall be made only for the once which has been excavated generally 6 cm. to 10cm. depth by augers and spates / JCB excavator as directed by Engineer.

ITEM NO. 17(A): Providing, supplying & Fixing heavy duty I.S.I mark RCC precast machinehole frame with cover at site as per design for circular machinehole including labour charge etc., Complete as per details in tender specification & as directed by engineer in charge.

For circular machinehole of I.S.I. Mark (Heavy Duty)

Outer diameter : 860mm

Thickness : 175mm

Protection for edge: 25 x 25 x 3mm M.S. angle shall be provided to project the edges of frame with anti-corrosive paints.

Clear Opening : 560mm

Tolerance : +/- 5mm.

Heavy duty cover (Circular)

Outer diameter : 715mm

Thickness : 100mm

Lifting hooks : 16mm Tot bar welded to the bottom with steel. It shall be easily and quickly opened with crow bars and pickaxes.

Protection for edge : Same as for frame.

Design Load and carrying capacity : 35 M.T.

Tolerance : +/- 5mm

Notes:

Cover shall conform I.S. 12592 (Part-I 1988).

Frame shall conform I.S. 12592 (Part-II 1991)

17(A).1 Mode of Measurement and Payment

The mode of payment shall be as per No.

ITEM NO. 17(B): Providing and fixing RCC pre cast Inlet Chamber Cover of M-30 grade as per Drawing and Specifications.

[1]. size 750 mm x 600 mm (1) Outer side dimension: 900mm x 750mm. (2) Thickness: 75mm (3) Lifting Hooks: 12mm MS bar welded to the bottom with steel. It shall be easily and quickly opened with crow bars and pickaxes. (4) Protection for edge: MS strip of minimum 2 mm thick around the periphery of the cover painted with anti corrosive paint. (5) Design load and carrying capacity: 15 MT (6) Tolerance +/- 5mm. The maximum cement content in the concrete shall be 360 kg/m³ with a maximum WATER CEMENT RATIO of 0.45. Concrete weaker than GRADE - M 30 shall not be used. Compaction of concrete shall be done by machine vibration. Design and dimensions are as per attached drawing. Order will be as and when required in staggered manner. Note:- (1) Cover shall conform IS:12592 (Part-1,1988) with latest amendments if any. (2) It is compulsory to mark "SMC-CS" on each R.C.C. pre cast Cover.

[2]. size 600 mm x 450 mm (1) Outer side dimension: 750mm x 600mm. (2) Thickness: 75mm (3) Lifting Hooks: 12mm MS bar welded to the bottom with steel. It shall be easily and quickly opened with crow bars and pickaxes. (4) Protection for edge: MS strip of minimum 2 mm thick around the periphery of the cover painted with anti corrosive paint. (5) Design load and carrying capacity: 10 MT (6) Tolerance +/- 5mm. The maximum cement content in the concrete shall be 360 kg/m³ with a maximum WATER CEMENT RATIO of 0.45. Concrete weaker than GRADE - M 30 shall not be used. Compaction of concrete shall be done by machine vibration. Design and dimensions are as per attached drawing. Order will be as and when required in staggered manner. Note:- (1) Cover shall conform IS:12592 (Part-1,1988) with latest amendments if any. (2) It is compulsory to mark "SMC-CS" on each R.C.C. pre cast Cover.

17 (B).1 Mode of Measurement and Payment

The mode of payment shall be as per No The measurement for payment shall be per number of inlet Chamber Cover.

ITEM NO. 17 (C): Providing and fixing RCC pre cast Inlet Chamber Frame of M-30 grade as per Drawing and Specifications.

[1]. size 750 mm x 600 mm (1) Outer side dimension : 1050mm x 900mm. (2) Thickness : 150mm (3) Protection for edge: 25mm x 3mm M.S.strip shall be provided to welded with reinforcement. (4) Clear opening: 750mm x 600mm. (5) Tolerance +/- 5mm. The maximum cement content in the concrete shall be 360 kg/m³ with a maximum WATER CEMENT RATIO of 0.45. Concrete weaker than GRADE - M 30 shall not be used. Compaction of concrete shall be done by machine vibration. Design and Dimensions are as per attached drawing. Note:- (1) Frame shall conforms IS:12592 (Part-2,1991) with latest amendments if any.

[2]. size 600 mm x 450 mm (1) Outer side dimension : 890mm x 740 mm. (2) Thickness : 125mm (3) Clear opening: 600mm x 450mm. (4) Tolerance +/- 5mm. The maximum cement content in the concrete shall be 360 kg/m³ with a maximum WATER CEMENT RATIO of 0.45. Concrete weaker than GRADE - M 30 shall not be used. Compaction of concrete shall be done by machine vibration. Design and Dimensions are as per attached drawing. Note:- (1) Frame shall conforms IS:12592 (Part-2,1991) with latest amendments if any.

17(C).1 Mode of Measurement and Payment

The mode of payment shall be as per No The measurement for payment shall be per number of inlet Chamber Frame.

ITEM NO. 18: Raising & Lowering Existing Machineholes & Inlet chamber (with frames) of drainage, storm drainage, sewer trap chamber, scraper machinehole frame & cover any utility services up to newly carpeted/recarpeted road surface including both of plain cement concrete ordinary grade 1:1.5:3. (1 Part of cement : 1.5 Part of sand : 3 part of coarse aggregate) The inside & outside surface of chamber shall be plastered in cement mortar 1:3 (1 part of Cement and 3 part of sand) include labour required to carry out the work. and cleaning the bitumen on the top surface & removing road material from machinehole etc. complete.

The item shall consist of dismantling the existing machinehole cover up to required depth and raising/lowering the chamber with plain cement concrete 1:1.5:3 (1 cement: 1.5 coarse sand: 3 stone aggregate) up to the newly re-carpeted/carpeted road surface including fixing the machinehole cover frame in concrete and plastering the chamber.

18.1 Materials

The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg of cement as 0.035 cu.mt. in volume.

Ingredients required for ordinary concrete containing one 50 kg. bag of cement for 1:1.5:3 mix shall be of 1 part of cement 1.5 parts of sand and 3 parts of black metal of 20 mm nominal size. For measuring sand and metal suitable box shall be prepared.

Fine aggregate shall be cleaned, hard, coarse sand. It shall be free from dust and such other substances. The sand shall be got approved by Engineer. The coarse aggregate shall be of hard, broken black trap metal of 20 mm nominal size. This should be of approved quality and taken from a quarry approved by the Engineer.

The water for mixing shall be potable water to satisfaction of the Engineer. The quantities of water shall be just sufficient to produce a dense. Concrete of required workability for the job. Mixing shall be continued till materials are uniformly distributed and on uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shown complete

coating or mortar containing its proportionate amount of cement. Before laying concrete, the existing chamber shall be dismantled up to required depth and frame shall be removed shall when be thoroughly wetted, all free water removed and then coated with neat cement grout. The cover frame shall be fixed at required level so that cover could be fixed at road level surface. The contractor at his own expenses shall put up necessary shoring strutting and planking or cut slopes to a surface angle or both with due regard to the safety of personnel works and to the satisfaction of Engineer.

The contractor shall furnish the design and drawing of complete form work (i.e. the forms as well as their supports) for approval of the Engineer before any erection is taken up. The design of form work shall ensure that the forms can be conveniently removed without disturbing the concrete. The design shall facilitate proper and safe access to all parts of form work for inspection. The form work shall be robust and strong, the joints shall be leak-proof. The form work shall be so made as to produce a finished concrete true to shape, line and levels. Forms shall be made sufficiently rigid by the use of ties and bracings to prevent any sagging between supports.

18.2 Plastering

The inside and outside surface of chamber shall be plastered in cement mortar 1:3 (1 part of cement and 3 parts of sand). The mortar shall be laid on the wall between the screed using the plaster's float and pressing the mortar so that the raked joints are properly filled. The plaster shall than finished off with a wood.

Curing shall be started as soon as the mortar used for finishing has hardened sufficiently and not to be damaged when watered.

18.3 Rate

The rate shall include the cost of dismantling the existing chamber up to required depth removing the frame, raising the chamber up to required level with cement concrete, fixing the frame, plastering the chamber wall, fixing machinehole cover and all labour and materials as well as tools and plants required for the work.

The measurement for payment shall be per number of machinehole.

NOTES

Providing all materials to be incorporated in work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lift.

The work of lowering/raising the man hole and the frame cover on the newly carpeted/re-carpeted road shall be completed before the laying final wearing coat, if two layers are to be laid and same shall be completed before laying binding course in case of single layer to be laid. Any accidents occurring due to the bad levels of man hole shall be the sole responsibility of the contractor.

ITEM NO. 18.(A): Raising & Lowering up to 10 cm inlet Chamber to the required level upto FRL of DBM/BCIncluding all Materials, formwork including removing existing Inlet Chamber frame Cover and Fixing Existing Inlet Chamber frame Cover and Removing Existing Material from Inlate Chamber (Add or Deduct Rs. 568.00 per 0.10 mt depth increase or decrease)

The rate shall include the cost of dismantling the existing chamber up to required depth removing the frame, raising the chamber up to required level with cement concrete, fixing the frame, plastering the chamber wall, fixing machinehole cover and all labour and materials as well as tools and plants required for the work as Above Specification.

The measurement for payment shall be per number of inlet Chamber.

ITEM NO. 19: Carting and conveying of bitumen from refinery / any depot of oil companies to Surat including loading & unloading in suitable tanks/drums etc. Complete (without octroi charge applicable from time to time).

[1] From Koyali and Savli refinery (baroda)

[2] From Vapi

[3] From Mumbai

[4] From Hazira

Entire quantity of asphalt required for this work shall be carted by the contractor completely at his cost and risk from the refinery or any depot of Refinery as directed by Engineer for which the following terms and condition shall be binding to him.

All the original bills and gate passes issued by Refinery shall be in the name of Surat Municipal Corporation for this tender work only.

All the gate-passes in original issued by the refinery shall have to be submitted to the Engineer. The vehicle Number of the tanker carrying the asphalt shall be shown correspondingly on the gate pass.

The contractor shall produce original purchase bill indicating the quality grade of asphalt and shall also produce test results/certificate regarding grade for the same in original.

A register showing day to day receipt, consumption and balance of asphalt shall have to be maintained at the site of work by the contractor.

The weight of bulk asphalt supplied shall be taken as per verification of actual net weight at weigh bridge installed at Hotmix plant site either at Bhatar or any other S.M.C. plant site.

If difference between each tanker's weight as per suppliers/refinery bill and SMC weigh bridge may cross +/- 1% by weight, the differed quantity shall be recovered from the contractor at the rate at the time of execution of the work or at the rate of Rs.35,000/- per M.T. whichever is more.

19.1 Mode of Payment

The payment shall be made on M.T. basis.

ITEM NO. 20(i) : Providing SEMI DENSE BITUMINOUS CONCRETE (SDBC) with aggregates as per gradation and bitumen for mixing @ 5.50% by Wt. of total mix as binder by batch mix type hot mix plant including cost of fuel, oil, lubricant and labour charges tests required to be carried out including cost of aggregates and Including cost of bitumen.

20.1 SCOPE :

This clause specifies the construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single or multiple layers of bituminous concrete on a previously prepared bituminous bound surface. A single layers shall be 25 mm to 100 mm in thickness.

20.2. Materials

20.2.1. Bitumen:

The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for paving bitumen, IS:73 and of the penetration indicated in Table 3.2. for bituminous concrete, or as otherwise specified in the Contract.

20.2.2. Course aggregate :

The coarse aggregate shall be generally as specified in It.No.10 Clause 2.2.2., except that the aggregates shall satisfy the physical requirements of Table 3.1

TABLE 3.1

PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index	Max 30% (Combined) ²
Strength*	Los Angeles Abrasion Value ³ Aggregate Impact Value ⁴	Max 30% Max 30%
Polishing	Polished Stone Value ⁵	Min.55
Durability	Soundness ⁶ Sodium Sulphate Magnesium Sulphate	Max 12% Max 18%
Water Absorption	Water Absorption ⁷	Max 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures ⁹	Minimum retained coating 95%
Water Sensitivity**	Retained Strength ⁸ Tensile	Min 80%

Note : (##) Vibrator roller shall be used for compaction of roads having width 120 feet and above. For road having width below 120 feet a tandem roller without operating vibratory system shall be used for compaction.

Notes : 1. IS: 2386 Part 1 6. IS:2386 Part 5 2 IS: 2386 Part 1
2. IS: 2386 Part 1 7. IS:2386 Part 3
(the elongation test to be done only on non-flaky aggregates in the sample)
3. IS:2386 Part 4*
4. IS:2386 Part 4* 8.AASHTO T823**
5. BS:812 Part 114 9. IS:6241

* Aggregate may satisfy requirements of either of these two tests.

** The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

20.2.3. Fine aggregates :

The fine aggregates shall be all as specified in clause 2.2.3.

20.2.4. Filler:

Filler shall be generally as specified in clause 2.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 3.1 then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

20.2.5. Aggregate grading and binder content:

When tested in accordance with IS:2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 3.2 for grading 1 or 2 as specified in the Contract.

20.3. Mixture Design

20.3.1. Requirements for the mixture:

Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 3.3.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 2.5.

20.3.2. Binder content :

The binder content shall be optimized to achieve the requirements of the mixture set out in Table 3.3 and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5mm sieve and retained on the 22.4mm sieve, where approved by the Engineer in charge.

20.3.3. Job mix formula:

The procedure for formulating the job mix formula shall be generally as specified in clause 2.3.3. and the results of testes enumerated in Table 3.3 as obtained by the Contractors.

TABLE 20.2

COMPOSITION OF BITUMINOUS CONCRETE PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	19mm	13mm
Layer Thickness	50-65 mm	30-45 mm
IS Sieve (mm)	Cumulative % by weight of total aggregate passing	
45		

37.5		
26.5	100	
19	79-100	100
13.2	59-79	79-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix ²	5.0 – 6.0	5.0 – 7.0
Bitumen grade(viscosity grade)	30	30

Notes : 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

TABLE 20.3

REQUIREMENTS FOR BITUMINOUS CONCRETE PAVEMENT LAYERS

Minimum stability (kN at 60oC)	9-0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-5
Per cent voids in mineral aggregate (VMA)	See Table 2.5
Per cent voids filled with bitumen (VFB)	65-75
Loss of stability on immersion in water at 60oC (ASTM D 1075)	Min.75 per cent retained strength

20.4. Construction Operations :

20.4.1. Weather and seasonal limitations: The provisions of clause 1.3.1. shall apply.

20.4.2. Preparation of base :

The surface on which the Bituminous concrete is to be laid shall be prepared in accordance with Clause 1.3.2 as appropriate, or as directed by Engineer in charge. The surface shall be thoroughly

clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom can not access, other approved methods shall be used as directed by Engineer in charge.

20.4.3. Tack coat :

Where specified in the contract, or otherwise required by the Engineer in charge, a tack coat shall be applied in accordance with the requirements specified in clause 1.3.3

20.4.4. Mixing and transportation of the mixture: The provisions as specified in clause 1.3.4 shall apply.

20.4.5. Spreading : The general provisions of clause 1.3.5 shall apply.

20.4.6. Rolling : The general provisions of clause 1.3.6 shall apply.

20.5. Opening to Traffic: The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the Engineer in charge in writing.

20.6. Surface Finish and Quality Control:

The general provisions of clause 1.4 shall apply. All materials and workmanship shall comply with the provisions set out in Section 900 of "specifications for road and bridge works- fourth revision published by Indian Road Congress 2001" .

20.7. Arrangements for Traffic: During the period of construction arrangements for traffic shall be made in accordance with the provisions of clause 1.5.

20.8. Measurement for payment: The measurement shall be all as specified in clause 1.8

20.9. Rate : The rate shall be all as specified in clause 1.9 except that the rate shall include the mixing of bitumen at minimum 5.5 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed only for consumption purpose.

Description :

All the detailed specification stated in as above shall be applicable except that the contractor shall have provide mix seal surface premix to corporation for department use at plant site as and when required by the Corporation in sufficient quantity under this item. Corporation will arrange to lift the premix material from the plant site to the site of work.

Mode of Payment :

The payment shall be made on M.T. basis. The rate covers procurement of required material and labour to prepare premix and only issuing to the plant site.

ITEM NO. 20(A) : Providing and filling yellow soil/mixed soil with necessary dumping filling of the trenches of each layer not exceeding 150mm depth of not including watering, raming,consolidation,labour charge & tests required to be carriedout etc., Complete

A.1 Quality control tests during construction

A.1.1. General

The materials supplied and the works carried out by the Contractor shall conform to the specifications prescribed in the MoRTH-2013 (Fifth revision) Clauses for the relevant items of work.

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 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 Table 25 and Table 26 may be reduced at the discretion of the Engineer if it is felt that consistency in the quality of materials 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.

Table 25 Control Tests and their Minimum Frequency for Sub-Bases and Bases (Excluding Bitumen Bound Bases)

Sr.No.	Type of Construction	Test	Frequency (min.)
1	Lime/Fly ash Stabilised soil Subgrade	i) Quality of lime	One test for each consignment subject to a minimum of one test per 5 tonnes
		ii) Lime/Cement content	Regularly, through procedural checks
		iii) Degree of pulverization	Periodically as considered necessary
		iv) CBR test on a set of 3 specimens	As required
		v) Moisture content prior to compaction	One set of two tests per 500 sq.mt.
		vi) Density of compacted layer	One set of two tests per 500 sq.mt.
		vii) Deleterious constituents	As required
2	Granular Sub-Base	i) Gradation	One test per 400 cu.m
		ii) Moisture content prior to compaction	One test per 400 cu.m
		iii) Density of compacted layer	One test per 1000 cu.m
		iv) Deleterious constituents	As required
		v) CBR	As required
3	Wet Mix Macadam	i) Aggregate Impact Value	One test per 1000 cu.m of aggregate
		ii) Grading of aggregate	One test per 200 cu.m of aggregate
		iii) Combined Flakiness and Elongation Indices	One test per 500 cu.m of aggregate

		iv) Density of compacted layer	One set of three tests per 1000 sq.mt.

Table 26 Control Tests for Bituminous Works and their Minimum Frequency

Sr.No.	Type of Construction	Test	Frequency (min.)
1	Prime Coat/Tack Coat	i) Quality of binder	Number of samples per lot and tests as per IS:8887 as applicable
		ii) Binder temperature for application	At regular close intervals
		iii) Rate of spread of Binder	Three tests per day
2	Dense Bituminous Macadam/Bituminous Concrete	i) Quality of binder	Number of samples per lot and tests as per IS:73
		ii) Aggregate Impact Value/ Los Angeles Abrasion Value	One test per 350 cu.m of aggregate for each source and whenever there is change in the quality of aggregate
		iii) Flakiness and Elongation Indices	One test per 350 cu.m of aggregate for each source and whenever there is change in the quality of aggregate
		iv) Soundness test (Sodium or Magnesium Sulphate test)	One test for each source and whenever there is change in the quality of aggregate
		v) Water absorption of aggregates	One test for each source and whenever there is change in the quality of aggregate
		vi) Mix grading	One set for individual constituent and mixed aggregate from dryer for each 400tonnes of mix subject to minimum of two tests per day per plant
		vii) Stability and voids analysis of mix including theoretical maximum specific of loose mix	Three tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to minimum of two tests per day per plant
		viii) Moisture Susceptibility of	One test for each mix type whenever there is

		mix (AASHTO T283)	change in the quality or source of coarse or fine aggregate
		ix) Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	At regular intervals
		x) Binder content	One set for each 400 tonnes of mix subject to minimum of two tests per day per plant
		xi) Rate of spread of mix material	After every 5th truck load
		xii) Density of Compacted layer	One test per 700 sq.mt. area

Daily, weekly, monthly reports on test results shall be prepared indicating the location of sampling and testing, deviation from the specified values for materials and works and remedial action taken in respect of removal of defective work shall certified be prepared by the Contractor. The test record shall be certified by the Engineer that these tests were done in his presence and testing carried as per prescribed methodology.

Table 27List of Laboratory Equipments

Sr. No.	Name of the Project	Number
GENERAL		
1.	Weigh Balances	
	5 - 20 kg capacity Electronic type -Accuracy 1 gm	1 No.
	500 gm capacity-Electronic Type Accuracy 0.01 gm	1 No.
	Electronic 5 kg capacity Accuracy 0.5 gm	1 No.
	Platform Balance scale-300 kg capacity	1 No.
	Chemical Balance 100 gm capacity-accuracy 0.001 gm	-
2.	Oven-electrically operated, thermostatically controlled (including thermometer), stainless steel interior, From 0°C to 220°C Sensitivity 1°C	1 No.
3.	Sieves: as per IS:460-1962	1 Set
4.	Sieve shaker capable of shaking 200 mm and 450 mm dia. sieves- electrically operated with time switch	1 No.
5.	200 tonnes compression testing machine	1 No.
6.	Stop watches 1/5 sec. accuracy	1 No.
7.	Glass thermometers range 0°C to 100°C and metallic thermometers range up to 300°C.	2 No. each
8.	Hot plates 200 mm dia. (1500 watt.)	1 No.
9.	Enamel trays	

	600 mm x 450 mm x 50 mm	2 Nos.
	450 mm x 300 mm x 40 mm	2 Nos.
	300 mm x 250 mm x 40 mm	2 Nos.
	Circular plates of 250 mm dia.	2 Nos.
FOR SOILS		
1.	Apparatus for Sand replacement method for density	
2.	Lab CBR testing equipment for conducting CBR testing, load frame with 5 Tonne capacity, electrically operated with speed control as per IS:2720 (Part 16) and consisting of following:	1 Set
	CBR moulds 150 mm dia. - 175 mm ht.	6 No.
	Tripod stands for holding dial gauge holder	4 Nos.
	CBR plunger with settlement dial gauge holder	1 No.
	Surcharge weight 147 mm dia. 2.5 kg wt.	6 Nos.
	Spacers disc 148 mm dia. 47.7 mm ht. With handle	2 Nos.
	Perforated plate (Brass)	2 Nos.
	Soaking tank for accommodating 6 CBR moulds	2 Nos.
	Proving rings of 1000 kg, 2500 kg capacity	1 No. each
	Dial gauges 25 mm travel- 0.01 mm/division	2 No.
3.	Nuclear moisture Density meter or equivalent	1 No.
4.	Speedy moisture meter complete with chemicals	1 No.
FOR BITUMEN AND BITUMINOUS MIXES		
1.	Constant temperature bath for accommodating bitumen test specimen, electrically operated and thermostatically controlled (to accommodate minimum six Specimens)	1 No.
2.	Penetrometer automatic type, including adjustable weight arrangement and needles as per IS:1203-1958	1 No.
3.	Soxhlet extraction or centrifuge type apparatus complete with extraction thimbles with solvent and filter paper	1 No.
4.	Marshall compaction apparatus automatically operated as per ASTM 1559-62 T complete with accessories (with 180 N Marshall Moulds)	1 set
5.	Furol viscometer	1 No.
6.	Ductility meter	1 No.
7.	Softening point (Ring and ball apparatus)	1 No.
8.	Distant reading thermometer	1 No.
9.	Core cutting machine suitable for up to 150 mm dia. core	1 Set
(D) FOR CONTROL OF PROFILE AND SURFACE EVENNESS		
1.	3 meter straight edge and measuring wedge	1 Set

2.	Camber template 2 Lane	
	Crown type cross-section	1 Set
	Straight run cross-section	2 Sets
3.	Steel tape	
	5 m long	2 Nos.
	10 m long	2 Nos.
	20 m long	2 Nos.
	30 m long	2 Nos.
	50 m long	1 No.

B.2 Ownership

The field laboratory building and equipment shall be the property of the Contractor. The Employer and the Engineer shall have free access to the laboratory.

B.3 Maintenance

The Contractor shall arrange to maintain the field laboratory in a satisfactory manner until the issue of Taking Over Certificate for the completed work.

B.4 Rate

Provision and maintenance of the field laboratory is not a payable item as it is incidental to the work.

ITEM NO.20 (B) : Earth work in embankment for subgrade and shoulders by using mechanical means with approved material AS HARD MURRUM/QUARRY SPALL having 4 days soaked CBR equal to or more than 8%, laying in layers not exceeding 250 mm loose, breaking clods, dressing to the required lines, curves, grades, watering to OMC and compacting to 97% modified Proctor density with vibratory rollers having minimum 80 - 100 KN staticweight including all labour, equipments charges & tests required to be carriedout with all leads and lifts etc. complete.

2.1 Earthwork in embankment including median with murrum or selected yellow soil suitable for gardening in layers of 10cm thickness including watering, ramming and consolidating etc. with all leads and lifts etc. complete.

CLAUSE 305 EMBANKMENT CONSTRUCTIONS

Clause 305.1 General

Clause305.1. (Modification)	The second sentence in first para should be read as "Construction of embankments including subgrade, median, earthen shoulders "
Clause 305.2.1 (Modification)	Physical requirements Replace the existing table 300-1 by the following:

Table 300-1

DENSITY REQUIREMENTS OF EMBANKMENT AND SUBGRADE MATERIALS.

Type of work	Engineering properties of samples remoulded as per IS 2720(part 8)		
	Max dry density (gm/cc)	Cohesion (Kg/Sq cm)	Angle of internal min. friction (Degree)

Type of work	Engineering properties of samples remoulded as per IS 2720(part 8)		
Embankment up to 3 m height, not subjected to extensive flooding	Not less than 1.52	-	-
Embankments exceeding 3 m height and upto 6 m height	Not less than 1.60	-	-
Subgrade and earthen shoulders / verge / backfill	Not less than 1.75	-	-
High embankment (embankments exceeding 6 m height) - Approaches to ROB and flyover	Not less than 1.80	0.10	27 ⁰

<p>Clause 305.2.2.2 (Modification)</p>	<p>Borrow Materials</p> <p>Para 1 of this Clause shall read as under:</p> <p>"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 subgrade 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 Indian and the local bodies, as applicable, shall be the sole responsibility of the Contractor. No earth, except when the road is in cutting, shall be borrowed from the Right of Way."</p> <p>The Table 300-2 shall read as under:</p>
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Table 300-2

Compaction requirements for embankment and subgrade

Type of Work / Material	Relative compaction as %age of maximum laboratory dry density as per IS:2720 (Part 8)
Subgrade and earthen shoulders	Not less than 97
Embankment Up to 6 m height exceeding 6 m height	Not less than 95 Not less than 97
Expansive clays a)Subgrade and 500 mm portion just below the subgrade b)Remaining portion of embankment	Not Allowed Not less than 90

Clause 305.2.2.4 Para 8 of this Clause given below Table 300-2 shall read as under:

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

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.

The graphs showing values of dry density against moisture content from which each of the values in (i) above (maximum dry density and optimum moisture content) was determined.

The dry density-moisture content-CBR relationships for each of the fill material proposed to be used in the subgrade.

Materials to be used in subgrade shall have a 4 days soaked CBR value of minimum 8% at

specified density indicated in Table 300-2

Clause 305.3	Construction Operations
Clause 305.3.4 (Modification)	<p>Compacting ground supporting embankment/subgrade</p> <p>Para 1 of this clause shall read as under:-</p> <p>Where necessary, the original ground shall be levelled, mixed with water and then compacted by rolling to facilitate placement of 1st layer embankment and its compaction in accordance with the requirement as given in table 300.2.</p> <p>Add the following sentence at the end of para 2.</p> <p>"Where necessary to facilitate compaction of the subgrade to 97% relative compaction as stated above, a further depth of maximum of 0.20 meter thickness shall be loosened, watered and compacted in accordance with Clause 305.3.5 and 305.3.6 to not less than 95% of maximum dry density, determined in accordance with IS:2720(Part 8)."</p>
Clause 305.3.6 (Addition)	<p>Compaction</p> <p>Insert in 3rd line of second para of this clause:</p> <p>"15-30 tonne weight having tyre pressure of at least 7 kg./sq.cm" in place of "adequate capacity capable of achieving required compaction".</p>
Clause 305.9.1 (Modification)	Insert "including removal of top soil "after word materials appearing in first line of item (v)"
Clause 305.9.6	Read "all leads & lifts " in place of "1000 m" in the last sentence.
Clause 309	Surface / Sub surface drain
Clause 309.4 & 309.5(Modification)	<p>Rates</p> <p>Replace "1000 m" with "all leads & lifts" for both clauses.</p>

PART-II :

ITEM NO.21 FOOTPATH, KERB & DIVIDER

ITEM NO.21.1: Excavating the road surface upto required depth including removing the excavated materials and depositing on the road side upto 50 mt. lead etc. complete. Including labour, machinery & equipments require to complete this item and as detailed in tender specification & as directed by engineer in charge.

DESCRIPTION :-

The land width required for the roadway, gutters side slopes and catch water gutters shall be cleared of all trees having a girth of 30 cm. and less, loose stones, vegetation bushes, stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30 cms. below the grade formation and slopes and excavation filled up with excavated materials and loose. Useful materials shall be arranged in convenient stacks along the roads boundary or as directed at places within 50 metres lead, and handed over to the department in convenient sections. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works, property or people in the neighborhood. If the materials disposed off out side the road land, necessary permission from the private land owners shall be taken by the contractor and royalty etc. if any paid by him without claiming any compensation. All materials shall be disposed off in a neat manner.

After cleaning the site, the alignment of the road shall be properly set out true to line, curves, slopes, grade and sections as shown on the plans or directed by the Engineer-in-charge. The Contractor shall provide all labour and materials such as lime, strings, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out establishing bench marks and giving profiles. The Contractor shall be responsible for maintaining the B.Ms. profiles, alignments and other marks as long as they are required for the work in the opinion of the Engineer- in-charge. If the Contractor defaults in the respect even after the direction by the Engineer-in-charge within the specified time, they may be restored by the Engineer-in-charge at the cost of Contractor. Levels and section of the ground shall be taken and recorded in the presence of the Contractor or his authorised representative before the excavation is started so as to serve as the basis of measurement. The Contractor or his representative shall sign the book in token of his acceptance of the level etc. If there is any disagreement the Contractor shall inform of it in writing to the Engineer-in-charge with the specified reference to the sections before starting further work. Once the work is started no cognizance of any complaint shall be taken merely not signing of the book shall not be deemed as disagreement.

Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10 m to 50 m or other intervals as directed by the Engineer-in-charge to conform to the curved or straight alignment, section, grade and side slopes. The line outs shall be clearly marked and profiles of embankments where excavated materials are to be used shall be set up with the toe line marked on each side. The road way section shall first be excavated with vertical side for each lift and the sides slopes for that lift shall be excavated in steps. These steps shall be smoothened to the required slope when the excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specifics grade unless so directed by the Engineer in writing. If excavation is done below the specified level or outside the section, it shall not be paid for and the contractor shall be required to fill up at his own cost such extra excavation in the road portion, with approved materials of the embankment grade in layer watered and fully loose to attain maximum density laid down for the embankment in its relevant item. The Engineer may required measurement ridges and deadmen to be laft at specified intervals or places and kept in tact till ordered to be removed, for the purposes of check measurements. The excavation shall be finished neatly, smoothly and evenly to the correct lines, curves, grades, section and side slopes as shown on the plans or directed by the Engineer-in-charge. The sub-grade if loose, shall be scarifies, watered and loose to the same density as the embankment. The section, side slopes and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters will be well drained by providing necessary diversion etc. and

not damaged due to obstruction of any drainage, necessary passages shall be provided for leading away seepage, springs, surface flow or rainwater safely without damaging the work. If any damage occurs due to default of the contractor in this respect, he shall make good the damage at his cost. If it is necessary in the execution of the work to interrupt existing surface drainage, irrigation channels, sewers or under drainage, temporary arrangements shall be provided till such time as is necessary. The Contractor at his own cost shall make good the interrupted drainage and sewer etc. unless separately provided in the tender. Any damage to the existing works or work in hand caused as a result of his operations or negligence shall be made good by the Contractor at his own cost. Road side gutters shall be excavated to the specified section and shall be measured along with the main cutting in cubic metres.

If slides occur in the cutting they shall be removed as ordered by the Engineer-in-charge. If finished slopes slide in to the road way before the final acceptance of the work, such slides shall be removed by the Contractor and shall be paid for at the contract rate for the class of excavation involved provided the slides are not due to any negligence of the Contractor. The classification of the material in slides shall conform to its condition at the time of removal and payment made accordingly regardless of its time of prior conditions. Care shall be taken to see that excavation is arranged in a safe way so that there will be no risk to the work or workman by slides, falling materials, boulders and collapsing slides.

If there is traffic nearby or if there are towns village in the neighborhood barricades and/or traffic signal shall be provided day and night for the duration of the work in such a way as to prevent accidents. Warning signals shall be displayed at 7 mt. from the danger point on both sides to give sufficient warning. If necessary, signalers shall be stationed at each end to regulate traffic where it is heavy. Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers, the members of the public, animals etc. due to the negligence of the Contractor, he will be responsible and liable to all the consequence including compensation.

When the useful excavated materials is to be used in embankment within a lead 50 metre and all lift, it shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations should be arranged properly, Materials required for items other than bank shall be arranged in neat stacks at convenient places, without interfering with drainage in any way. The excavated materials shall not be deposited within 3 m from the top edge of slope or top of the bank. The lead shall be measured from the junction point of cutting and embankment up to 50 mt. on either side. The contract rate shall be for a unit of one cubic metre for the stratus mentioned in the wording of the item of excavation acceptably completed, as directed by the Engineer-in-charge.

DISPOSAL OF EXCAVATED MATERIALS :-

All the surplus excavated materials shall be the property of the contractor. Suitable material obtained from the excavation of the roadway shoulders, verge, drains, cross drainage works etc. shall be used for

- i) Filling for roadway embankments
- ii) Filling existing pits in the right of way as directed by the Engineer including levelling and spreading with all leads and lifts.
- iii) For landscaping of the road as directed by the Engineer, including levelling and spreading, with all leads and lifts.
- iv) Surplus material such as rubble, stones etc. not intended for use as above shall be used as a raw material for crusher with prior permission of Engineer-in-charge.

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 off including all lead & lifts. No place will be made available by the employer for disposing off the material and no claim will be entertained on that account.

21.1.1 MEASUREMENTS FOR PAYMENT

Excavation for roadway shall be measured by taking cross sections at suitable intervals in the original position before the work starts and after its completion and computing the volumes in cu. m. by the method of average end areas for each class of material encountered. At the option of the Engineer, the Contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the original ground level as accurately as possible. The contractor shall see that these remain intact till the final measurements are taken.

21.1.2 RATES :-

The contract unit rates for the items of roadway and drain excavation shall be payment in full for carrying out the operations required for the individual items including full compensation for :

- (i) Setting out
- (ii) Transporting the excavated materials and depositing the same on sites of embankments, spoil banks or stacking as directed within lifts and lead upto 50 m.
- (iii) Trimming bottoms and slopes of excavation.
- (iv) Dewatering
- (v) Desposal of surplus excavated stuff and clearing of site after completion of work.
- (vii) Watering where necessary and compacting to requirements.
- (viii) Erecting all safety provisions and making necessary diversions as directed by Executive Engineer/Engineer-in-charge.

ITEM NO.21.2: Dismantling of structures of roadways, including disposing off unserviceable material free of cost which will be the ownership of contractor or as directed by the Engineer with all leads and lift etc. Including labour, machinery & equipments required to complete this item etc.

- (A) R.C.C. Pardi
- (B) Removing existing Kotah Stone
- (C) Brick/stone masonry
- (D) Plain concrete
- (E) Bituminious Pavement
- (F) Non bituminious pavement

WORKMANSHIP :-

21.2.1 The term Demolition shall consist of one or more parts of the building as specified or shown in the drawing. Demonization implies taking up or down or breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown in the drawings.

21.2.2 The demolition shall always be planned before hand and shall be done in reverse order of the one in which the structure was constructed. This scheme shall be got approved from the Engineer-in-

charge before stating the work. This however will not absolve the contractor from the responsibility of proper and safe demolition.

21.2.3 Necessary propping, the shoring and or under pinning shall be provided for the safety of the adjoining work or property, which is to be left intact, before dismantling and demolishing is taken up and the work shall be carried out such that no damage is caused to the adjoining property.

21.2.4 Wherever required, temporary enclosures or partitions shall also be provided. Necessary precautions shall be taken to keep dust nuisance down as and where necessary.

21.2.5 Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height. The or demolishing roofs, masonry etc. shall be carefully removed first. The dismantled articles shall be passed by hand where necessary, lowered to the ground (as not thrown) and then properly stacked as directed.

21.2.6 All materials obtained from demolition shall be the property of Corporation unless otherwise specified and shall be kept in safe custody until handed over to any store to Surat Municipal Corporation as specified the Engineer-in-charge.

21.2.7 Any serviceable materials, obtained during dismantling demolition, shall be separated out and stacked properly on site or any stop of S.M.C. as directed, with all lead and lift. All unserviceable materials, rubbish etc. shall be stacked as directed by Engineer-in-charge.

21.2.8 On completion of work the site shall be cleared of all debris rubbish and cleaned as directed.

21.2.9 Rates :

21.2.9.1 Measurements of all work except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed. The demolition of lime concrete shall be measured under this item. Specification for deduction for voids, openings etc. shall be on same basis as the employed for construction of work.

21.2.9.2 All work shall be measured in decimal system as fixed in its place subject to the following limit, unless otherwise stated hereinafter : (a) Dimensions shall be measured to the nearest 0.01 mt. (b) Areas shall be worked out to the nearest 0.01 sq.mt.

21.2.9.3 The rate shall include cost of all labour involved and tools used in demolishing and dismantling including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable materials properly and disposing the unserviceable materials with all lead and lift. The rate also includes for temporary shoring for the safety of the portion not required to be pulled down or of adjoining property and providing temporary enclosures or partitions where considered necessary.

21.2.9.4 The rate shall be for a unit of as per Schedule-B.

ITEM NO.21.3: Preparation of subgrade with compacting. levelling and consolidation of subgrade with mini roller/plate vibrator machine including watering and filling in depression which occur during the process. including labour, machinery, equipments required to execute this item etc. complete as detailed in tender specification & as directed by engineer in charge.

Immediately following the spreading of the subgrade material rolling shall be started with mini roller/plate vibrator machine.

Except on superlevated portion where the rolling shall proceed from inner edge to outer, rolling, shall be from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to

the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half way width.

Rolling shall continue until the subgrade material is thoroughly keyed and the creeping of the subgrade ahead of the roller is no longer visible. During the process rolling shall not be done when the subgrade is soft or yielding or when it causes a wave like motion in the sub-grade course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of subgrade material and rerolling until, the entire surface conforms to desired camber and grade. In no case shall use of screening be permitted to make up depressions.

The bandage materials where it is required to be used shall be applied, successively in two or more thin layers at a slow and uniform rate. After each applications, the surface shall be continuously sprinkled with water, the resulting slurry swept in with hand brooms or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding materials sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller. After the final compaction of subgrade course the road shall be allowed to dry overnight. Next morning hungry spot shall be filled with screening of binding materials as directed, lightly sprinkled with water, if necessary and rolled. No traffic shall be allowed on the road until the base has set. The Engineer-in-charge shall have the discretion to stop hauling traffic from using the completed subgrade course if in his opinion it would cause excessive damage to the surface.

MODE OF PAYMENT :-

Payment will be made on Sq.mt. basis consolidation of finished work and shall also includes cost of watering, rent of machinery, cost of fuel, wages of drivers and cleaners, earthen and murrum bund etc. and watchman etc.

ITEM NO.21.4: Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 20 mm nominal size) and curing complete excluding cost of form work and reinforcement for reinforced concrete in vertical and horizontal fins upto floor two.including labour,machinery, equipments required to execute this item etc. complete.

21.4.1 Materials:-

Water shall conform to M-1. Cement shall conform to M-3.Sand shall conform to M-6.Stone aggregate 40 mm nominal size shall conform to M-12.

M-1 WATER :

1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil and injurious alkalies, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in I.S. 456-2000.

1.2 If required by the Engineer-in-charge it shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength as specified in I.S. 269-1989. Any indication of unsoundness, change in time of setting by 30 minutes or more or decrease of more than 10 percent in strength of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

1.3 Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.

1.4 Hard and bitter water shall not be used for curing.

1.5 Portable water shall generally be found suitable for curing mortar or concrete.

M-2 CEMENT :

2.1 Cement shall be ordinary portland slag cement as per I.S. 269-1989 or Portland slag cement as per I.S. 455-1976 and revised latest I.S.

M-3 SAND :

3.1 Sand shall be natural sand, clean, well graded, strong, durable and gritty particles free from injurious amounts of dust, clay, kankar nodules, soft or flaky particles, shale, alkali, salts, organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8% of silt as determined by field tests. If necessary the sand shall be washed to make it clean.

3.2 Coarse Sand : The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse shall be as under ---

I.S. Sieve Designation	% by weight passing sieve	I.S. Sieve Designation	% by weight passing sieve
4.55 mm	100	600 Micron	30-100
2.36 mm	900-100	300 Micron	5-70
1.18 mm	70-100	150 Micron	0-60

3.3 Fine Sand : The fineness modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under ---

I.S. Sieve Designation	% by weight passing sieve	I.S. Sieve Designation	% by weight passing sieve
4.55 mm	100	600 Micron	40-85
2.36 mm	100	300 Micron	5-50
1.18 mm	75-100	150 Micron	0-10

M-4 STONE COARSE AGGREGATE FOR NOMINAL MIX CONCRETE :

4.1 Coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

4.2 The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below. However, in case of reinforced cement concrete the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6mm. less than the cover whichever is smaller.

TABLE

I.S. Sieve Designation	Percentage Passing for single sized aggregates of nominal size		
	40 mm	20 mm	16 mm
80 mm	-	-	-
63 mm	100	-	-

40 mm	80-100	100	-
20 mm	0-20	85-100	100
16 mm	-	-	85-100
12.5 mm	-	-	-
10 mm	0.5	0.20	0.30
4.75 mm	-	0.50	0.50
2.75 mm	-	-	-

NOTE:- This percentage may be varied somewhat by the Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.

4.3 The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests indicated in I.S. 383-1990 and I.S. 456-2000 shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If the aggregates are covered with dust, they shall be washed with water to make, them clean.

21.4.2 WORKMANSHIP :

21.4.2.1 General :-

Before starting concreting the bed of foundation trenches shall be cleared of all loose materials, leveled, Watered and rammed as directed.

21.4.2.2 Proportion of Mix :-

The proportion of cement, sand coarse aggregate shall be one part of cement, 5 parts of sand 5 parts of stone aggregate shall be measured by volume.

21.4.2.3 Mixing :-

The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantity of work if approved by Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of break down of machineries and in the interest of the work, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However in such case 10% more cement than otherwise required shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period 1 1/2 to 2 minutes. The quantity of water shall be just sufficient to produce dense concrete of required workability for the purpose.

21.4.2.4 Transporting and placing the concrete :-

The concrete shall be handed from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.

The concrete shall be laid in layers of 15 cms to 20 cms.

Compacting :-The concrete shall be rammed with heavy iron rammer and rapidly to get the required compaction and to allow the interstices to be filled with mortar.

21.4.2.5 Curing :-

After the final set, the concrete shall be kept continuously wet, if required by ponding for a period of not less than 7 days from the date of placement.

21.4.3 Mode of measurements and payment :-

The concrete shall be measured for its length breadth and depth, limiting dimensions to those specified on plan or as directed. The rate shall be for a unit of one cubic meter.

ITEM NO.21.5: Supplying and filling fine sand (Pana/Stone Dust/Crush sand) in 25/75 mm (Avg.) compacted thickness over the base including necessary compaction, watering etc. complete. item includes levelling by using mini roller/plat vibrator machine and as per details in tender specification & as directed by engineer in charge.

21.5.1 MATERIALS :

21.5.1.1 Fine sand (Pana) shall conform to specification of material M-3.

21.5.2 WORKMANSHIP :

Fine sand (Pana) shall be supplied to worksite and staked at suitable place. It shall be got approved by Engineer-in-charge. Fine sand (Pana) shall be filled in compacted thickness of 25/75 mm. It shall be compacted and watered thoroughly.

ITEM NO.21.6: Providing 100 mm thick readymade C.C. kerb of strength M20 (Size 300 x 380 mm) purchased from S.M.C.'s approved paver block manufacturer and setting in line, level and in truly vertical position, including filling joints 10mm width in C.M. 1:1 (1 Part of cement 1 part of coarse sand) smooth pointing in C.M. 1:1 (1 Part of cement : 1 Part of stone dust) including watering, test required to be carried out etc. complete and as directed by Engineer-in-charge). including watering, labour, tests required to be carried out, machinery, equipments required to execute this item etc. complete.

(A) For regular edge of footpath

(B) For rounding at the edge of footpath (for fanning portion)

Item includes all materials, labour, equipment, tools, plants, watering, cleaning etc. complete.

RAW MATERIAL:

CEMENT:-

The cement used in the manufacture of high quality precast concrete paving block shall be conforming to IS 12269 (53 grade) ordinary Portland Cement or IS 8112 (43 grade ordinary Portland cement). The minimum cement content in concrete used for making paver blocks should be 310 kg/Cu.M. And the upper limit of cement shall not be more than 425kg/Cu.M.

AGGREGATES :-

The fine and coarse aggregates shall consist of naturally occurring crushed or uncrushed materials which, apart from the grading requirements comply with IS 383-1970. The fine aggregates used shall contain a minimum of 25% natural silicon sand. Lime stone aggregates shall not be used. Aggregates shall contain no more than 3% by weight of clay and shall be free from deleterious salts and contaminants.

WATER :-

The water shall be clean and free from any deleterious matter. It shall meet the requirements stipulated in IS:456-2000.

OTHER MATERIALS :-

Any other material/ingredients used in the concrete shall conform to latest IS specifications.

C.C.BLOCK CHARACTERISTICS:

The C.C. block should have perpendicularities after release from the mould and the same should be retained until the laying.

The concrete mix design should be followed for each batch of materials separately and automatic batching plant is to be used to achieve uniformity in strength and quality.

The C.C. block shall be manufactured in single layer only. Skilled labours should be employed for laying blocks to ensure line and level, for laying, desired shape of the surface and adequate compaction of the sand in joint.

The C.C. block must be of size 300 mm x 100 mm x 380 mm and casted in M-200 Grade with 4" (110 mm) radius rounding at the top and 2 (two) nos. 12 mm keys at the other vertical face as directed by Engineer-in-charge.

When foot path meets with a junction or approach road at the end of foot path, a turning radius equal to the width of foot path should be made as per below and as directed by Engineer-in-charge.

Sr No.	Turning Radius	No. of C.C. Block to be fix	Size of C.C. Block in rounding
1.	1.00 mt.	4 Nos.	Outer 370 mm x inner 340 mm x thickness 100 mm x Height 380 mm
2.	1.50 mt.	6 Nos.	
3.	2.00 mt.	8 Nos.	

Strength is measure of the ability of the concrete kerb unit to withstand load. It is determined under laboratory conditions using bending strength. A load is uniformly applied through a 401mm swivel parallel and rigid bearers rounded to a radius of 201mm until its failure is reached. For each kerb the individual strength in MPa is determined using the second moment of area. For each of calculation, the second moment of area and distance from the centroid to the extreme tensile fibre are incorporated for the profiles specified within the standard. For other profiles please refer to individual manufacturers who will supply the relevant information. The bending strength in MPa is recovered to check compliance with BS EN, The number of the kerbs per sample will vary depending on previous production performance assessed statistically by attributes of variables.

The characteristic bending strength shall not be less than the value corresponding to the class in the table that follows. None of the individual results shall be less than the corresponding minimum bending strength in the table. Where kerbs, due to their geometry, cannot be tested according to this standard they shall be considered to be in the same class as tested kerbs provided they have at least the Bending strength classes.

Class Strength	Marking (MPa)	Characteristic Bending (MPa)	Minimum Bending Strength
1	S	3.5	2.8
2	T	5.0	4.0
3	U	6.0	4.8

WEATHERING RESISTANCE:

Is a measure of the ability of the concrete kerb to withstand weathering specific conditions exist such as frequent contact of the surface with de icing salt under frost conditions. It can be assessed under laboratory conditions by measuring the amount of spalled material from a surface under the cycle of freezing thawing action using a deicing salt solution, or, if non-icing salt is used, then the measurement of the porosity by measuring the water absorption of the kerb could be used.

ABRASION RESISTANCE:

Is a measure of the ability of the concrete kerb to withstand erosion caused by trafficking in service. It is assessed under laboratory conditions by abrading the surface of the kerb with a flow of a hard abrasive material while applying a known force. The resulting loss of material from the kerb surface is measured by determining the abraded width.

SLIP/SKID RESISTANCE:

Is a measure of the ability of the concrete kerb laid in service to withstand slipping for pedestrians and skidding for vehicles. The unpolished slip resistance value is determined using standard rubber material attached to a pendulum friction tester and tested under wet conditions. To determine the polished pvaer value (PPV) for all paving units BS 7932:1988 should be used. This test method measures the slip resistance of the kerb after it has been synthetically trafficked (or polished) under laboratory conditions to replicate the performance of kerb during their life under traffic conditions. For more details please contact interpave.

Kerb and edgings are mainly used as edge restraints to paved surfaces or where changes in surface materials or levels occur. They retain any unbound construction material, e.g. laying course material, within the paved area and help support the applied loads by preventing horizontal displacement of the pavement construction. Channels may be used in these applications as well but can also be used to intercept and transport surface water. In vehicular areas kerb, edging and channel units will inevitably be over-run or suffer side impact from vehicle tyres sometime in their service life. By selecting the appropriate units and ensuring correct installation they will give long and durable service.

TOLERANCES:

Performance deviations the value for possible deviation from manufacturer's declared values are as follows.

Length:

1% to the nearest mm, with a minimum of 4mm and not exceeding 10mm.

Other dimensions:

Other faces : 3% to the nearest mm, with a minimum 3 mm not exceeding 5 mm.

Other parts : 5% to nearest mm, with a minimum of 3 mm not exceeding 10 mm

Flatness and straightness:

Length of gauge mm	Permissible deviation mm
300	1.5
400	2.0
500	2.5
800	4.0

The difference between any two measurements of single kerb shall be $\leq \pm 5$ mm.

Installation of concrete kerbs, edging and channel units has five main stages:

- Preparation of support layers.
- Construction of unit foundation.
- Laying to line and level.
- Bedding of units.
- Haunching of units.

The unit foundation itself must be supported, either on an extension to the underlying pavement sub layers or, for thin pavements (e.g. edgings on pedestrian footways), directly on an adequate subgrade. The depth of the unit and that of the pavement construction will determine on which pavement layer the kerb foundation will sit.

Products should be laid using one of the following alternative methods:

1. Units set on a race of freshly mixed concrete.
2. Units bedded on a mortar bed on top of a hardened concrete race or onto a mortar bedding on a carriageway.
3. Units bonded to the pavement surface.

LAYING OF C.C. BLOCK AS KERB :

C.C. block shall be placed in line, level and in true vertical position with 12 mm gap including filling joints in C.M. 1:1 (1 Part of cement : 1 part of stone dust) and smooth pointing in C.M. 1:1 (1 cement of cement : 1 part of stone dust) including watering.

At the Residential units, it shall be kept 8" (200 mm) open above water table and at the commercial complex, it shall be kept 3" (75 mm) open above water table and as directed by Engineer-in-charge.

SAMPLING AND TESTING PROCEDURE FOR C.C. BLOCK:

Sample size:

- Internal : Average of minimum 3 samples per 3000 blocks - for paver block manufacturers.
- External : Minimum 3 blocks per 3000 blocks.

Sampling for testing :

Sampling for testing of C.C. kerb shall be done in accordance with Appendix-A in item no.6.

Compressive strength : testing for 28 days compressive strength shall be undertaken.

Abrasion Resistant: It is assessed under laboratory conditions by abrading the surface of the kerb with a flow of a hard abrasive material applying a known force. The resulting loss of material from the kerb surface is measured by determining the abraded width.

Bending strength : The characteristic bending strength shall be less than the value corresponding to the class. None of the individual results shall be less than the corresponding minimum bending strength.

The rate shall be for a unit of one R.M.

For ensuring quality control and workmanship, above test shall be taken at 01 (One) test per each 1000 (One thousand) Nos. of C.C. block.

The C.C. block shall be got tested at (R&B) field laboratory of GERI (R&B) or S.V.N.I.T., or Govt. approved laboratory.

Laying on pavement surface:

The units may be laid directly onto a suitable pavement surface which should extend to a width to fully support the units and any required haunching. The units are bonded to the surface using a suitable synthetic resin compound or with a modified strengthened mortar.

Jointing:

Concrete kerbs are generally laid with unfilled, close joints with a minimum joint width of 12 mm they must not be butt-jointed. Mortar joints should be filled by 1:1 (1 Cement : 1 stone dust) and enlashed with the mortar which should be freshly mixed, consisting of 1:1 (1 Cement : stone dust) where mortar joints are used, they should be completely filled and fully compacted. Joint width should be 12 mm.

Where units are laid over or adjacent to a jointed concrete pavement, suitable joints should extend through the line of the units at the joints and continue through the kerb race. When mortar joints are used, movement joints should be provided. These movement joints should be formed of 12 mm thick easily compressible material, extend through the kerb race. Mortar should be used as soon as possible and any material that has begun to set or has been mixed for more than two hours discarded. Contractors need to plan the work to ensure risk is kept to an acceptable level. This may involve the following actions.

- Rethink the phasing of the kerb installation to maximise the number of kerbs being laid at one time.
- Lay direct from the pack rather than double handling by stringing out ahead of final laying.
- Use machinery capable of handling both packs and individual kerbs.
- Use machinery solutions for the handling of non standard kerb details such as feature kerbs, transition kerbs, drop kerbs, quadrants (cheeses) and radius kerbs.
- Ensure that workers are trained in the safe use of mechanical lifting equipment.
- Provide training in safe lifting techniques for works involved with kerb laying.
- Consider use of alternative lightweight kerb components for certain circumstances.

Kerb laying by hand involves a serious risk of injury to those who are doing the work and therefore employers need to take action to control this risk. When taking the risk, the best solutions will be those which address all three main hazards, the weight of the kerb, the repetitive nature of the operation and poor posture during work. The hierarchy of control measures is suggested. You should try to adopt the solution nearest the top of hierarchy first, as these will give the best level of risk control. In rare cases, where it is not possible to use any mechanical solutions, short stretches of kerb may be laid manually. Where this is necessary workers should be trained in good handling techniques. The use of lighter weight kerbs or devices that allow two people to share the lift will reduce the risk of injury.

GENERAL GUIDANCE:

It is important that work procedures are drawn up before commencement to identify any hazards. Failure to do this can result in lack of co-ordination of materials and multiple handling of product. Correct personal protective clothing should be provided.

Planning the work:

Work should be planned and coordinated to avoid unnecessary handling.

For operations where fork lift vehicles are used, kerbs should be stacked onto timber pallets. Ensure that pallets are robust as the failure of a pallet could allow kerbs to fall.

Stripping and wrapping of packs should only be removed just prior to use of the kerbs.

Care should be taken when cutting bands and/or removing wrapping to avoid kerbs falling.

Accurate placement of the concrete bed will minimise shovelling operations.

Accurate preparation of the concrete bed and any excavated trench will reduce the amount of adjustment to kerbs once laid.

Where power tools are used for cutting these should be concrete cutters with diamond blades and water flow lubrication for cooling and dust suppression.

The rate should be for a unit of One R.M.

ITEM NO.21.7: Providing and fixing interlocking type Rubber Moulded cement concrete paver block of approved shape, design and colour having 60 mm thickness (M-35), purchased from SMC's approved paverblock manufacture only and fixing on fine sand bedding. Item includes levelling by using plate vibrator compactor machine. Item also includes all material colour, equipments, tools, plants, curing, watering, cleaning, test required to be carriedout etc. complete.

A-With Colour

B-Without Colour

C-With Colour (produced by C&D waste)

D-Without Colour (produced by C&D waste)

21.7.1 RAW MATERIAL

21.7.1.1 CEMENT:-

The cement used in the manufacture of high quality precast concrete paving block shall be conforming to IS 12269 (53 grade) ordinary Portland Cement or IS 8112 (43 grade ordinary Portland cement). The minimum cement content in concrete used for making paver blocks should be 310 kg/Cu.M. And the upper limit of cement shall not be more than 425kg/Cu.M.

21.7.1.2 AGGREGATES :-

The fine and coarse aggregates shall consist of naturally occurring crushed or uncrushed materials which, apart from the grading requirements comply with IS 383-1970. The fine aggregates used shall contain a minimum of 25% natural silicon sand. Lime stone aggregates shall not be used. Aggregates shall contain no more than 3% by weight of clay and shall be free from deleterious salts and contaminants.

21.7.1.3 WATER :-

The water shall be clean and free from any deleterious matter. It shall meet the requirements stipulated in IS:456-2000.

21.7.1.4 OTHER MATERIALS :-

Any other material/ingredients used in the concrete shall conform to latest IS specifications.

21.7.2 PAVER BLOCKS CHARACTERISTICS

The concrete pavers should have perpendicularities after release from the mould and the same should be retained until the laying.

The surface should be of anti-skid and anti glare type. The paver should have uniform chamfers to facilitate easy drainage of surface run off.

The pavers should have uniform interlocking space of 2 mm to 3 mm to ensure compacted sand filling after vibration on the paver surface.

The concrete mix design should be followed for each batch of materials separately and automatic batching plant is to be used to achieve uniformity in strength and quality.

The pavers shall be manufactured in single layer only.

Skilled labour should be employed for laying blocks to ensure line and level for laying, desired shape of the surface and adequate compaction of the sand in the joints.

The pavers are to be skirted all round with kerbing using solid concrete blocks of size 100 mm x 200 mm x 400 mm or as directed by the Engineer. The kerbing should be embedded for 100 mm depth. The concrete used for kerbing shall be cured properly for 7 days minimum.

21.7.3 LAYING OF PAVER BLOCKS :-

21.7.3.1 PRIMING :-

It will be responsibilities of the Contractors to ensure that the machinehole/pipeline cable trenches/circular drainage system etc. raised to driveway level using the requisite materials as per instruction of Engg. The areas of potholes/deep depressions at the isolated locations also have to be filled up before laying the paver blocks. No extra payments will be made for this purpose.

It will be the responsibility of the Contractors to ensure that undulations on the paver blocks are eliminated after the traffic is allowed on it. Proper slope for drainage of water needs to be ensured by the Contractor. All necessary materials, tools, tackles are required to be arranged by the Contractor.

21.7.3.2 BEDDING SAND COURSE :-

The bedding sand shall consist of a clean well graded sand passing through 4.75 mm sieve and suitable for concrete. The bedding should be from either a single source or blended to achieve the following grading.

In Sieve Size	% Passed
9.52 mm	100
4.75 mm	95-100
2.36	80-100
1.18	60-100
600 Microns	25-60
300 Microns	10-30
150 Microns	5-15
75 Microns	0-10

Contractor shall be responsible to ensure that single-sized, gap graded sands or sands containing an excessive amount of fines or plastic fines are not used. The sand particles should preferably be sharp not rounded as sharp sand possess higher strength and resist the migration of sand from under the block to less frequently areas even though sharp sands are relatively more difficult to compact than rounded sands, the use of sharp sands is preferred for the more heavily trafficked driveways. The sand use for bedding shall be free of any deleterious soluble salts or other contaminants likely to cause efflorescence.

The sand shall be of uniform moisture content and within 4%-8% when spread and shall be protected against rain when stock piled prior to spreading. Saturated sand shall not be used. The bedding sand shall be spread loose in a uniform layer as per drawing. The compacted uniform thickness shall be of 45 mm and within +/- 5 mm. Thickness variation shall not be used to correct irregularities in the base course surface.

The spread sand shall be carefully maintained in a loose dry condition and protected against pre-compaction both prior to and following screeding. Any precompacted sand or screeded sand left overnight shall be loosened before further laying of paving blocks take place.

Sand shall be slightly screeded in a loose condition to the predetermined depth only slightly ahead of the laying of paving unit.

Any depressions in the screeded sand exceeding 5 mm shall be loosened, raked and rescreeded before laying of paving blocks.

21.7.4 LAYING OF INTERLOCKING PAVER BLOCKS :-

Paver blocks shall be laid in herringbone laying pattern throughout the pavement. Once the laying pattern has been established, it shall continue without interruption over the entire pavement surface. Cutting of blocks, the use of infill concrete or discontinuities in laying pattern is not permitted in other than approved locations.

Paver blocks shall be placed on the uncompacted screeded sand bed to the nominated laying pattern, care being taken to maintain the specified bond through out the job. The first row shall be located next to an edge restraint. Specially manufactured edge paving blocks are permitted or edge blocks may be cut using a power saw, a mechanical or hydraulic guillotine, bolster or other approved cutting machine.

Paver blocks shall be placed to achieve gaps nominally 2 to 3 mm wide between adjacent paving joints. No joint shall be less 1.5 mm not more than 4 mm. Frequent use of string lines shall be used to check alignment. In this regard the "laying face" shall be checked at least every two meters as the face proceeds. Should the face become out of alignment, it must be corrected prior to initial compaction and before further laying job is proceeded with.

In each row, all full blocks shall be laid first. Closure blocks shall be cut and fitted subsequently. Such closure blocks shall consist of not less than 25% of a full blocks.

To infill spaces between 25 mm and 50 mm wide concrete having screened sand, coarse aggregate mix shall be used. Within such mix the nominal aggregate size shall not exceed one third the smallest dimension of the infill space. For smaller spaces dry packed mortar shall be used.

Except where it is necessary to correct any minor variations occurring in the laying bond, the paver blocks shall not be hammered into position. Where adjustment of paver blocks necessary care shall be taken to avoid premature compaction of the sand bedding.

21.7.4.1 INITIAL COMPACTION :-

After laying the paver blocks, they shall be compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than Two (2) passes of a suitable plate compactor.

The compactor shall be a high-frequency, low amplitude mechanical flat plate vibrator having plate area sufficient to cover a minimum of twelve paving blocks. Prior to compaction all debris shall be removed from the surface.

Compaction shall proceed as closely as possible following laying and prior to any traffic. Compaction shall not, however, be attempted within one metre of the laying face. Compaction shall continue until lipping has been eliminated between adjoining blocks. Joints shall then be filled and recompacted as described in Cl. 3.5.

All work further than one metre from the laying face shall be left fully compacted at the completion of each day's laying.

Any blocks that are structurally damaged prior to or during compaction shall be immediately removed and replaced.

Sufficient plate compactors shall be maintained at the paving site for both bedding compaction and joint filling.

21.7.4.2 JOINT FILLING AND FINAL COMPACTION :-

As soon as possible after compaction and in any case prior to the termination of work on that day and prior to the acceptance of vehicular traffic, sand for joint filling shall be spread over the pavement.

Joint sand shall pass a 2.36 mm (No.8) sieve and shall be free of soluble salts or contaminants likely to cause efflorescence. The same shall comply with the following grading limits.

In Sieve Size	% Passed
9.52 mm	100
4.75 mm	95-100
2.36	80-100
1.18	60-100
600 Microns	25-60
300 Microns	10-30
150 Microns	5-15
75 Microns	0-10

The Contractor shall supply a sample of the jointing sand to be used in the contract prior to delivering any such materials to site for incorporation into the works. Certificates of test results issued by a recognized testing laboratory confirming that the samples conform to the requirements of this specifications shall accompany the sample.

The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the jointing sand shall be compacted with not less than one (1) Pass by the plate vibrator and joints refilled with sand to full depth.

This procedure shall be repeated until all joints are completed filled with sand. No traffic shall be permitted to use the pavement until all joints have been completely filled with sand and compacted.

Both the sand and paver block shall be dry when sand is spread and broomed into the joints to prevent premature setting of sand.

The difference in level (lipping) between adjacent blocks shall not exceed 3 mm with not more than 1% in any 3 m x 3 m area exceeding 2 mm. Pavement which is deformed beyond above limits after final compaction shall be taken out and reconstructed to the satisfaction of the Engineer.

21.7.4.3 EDGE RESTRAINT :-

Edge restrains need to be sufficiently robust to withstand override by the anticipated traffic, to withstand thermal expansion and to prevent loss of the laying course material from beneath the surface course. The edge restraint should present a vertical face down to the level of the underside of the laying course.

The surface course should not be vibrated until the edge restraint, together with any bedding or concrete haunching, has gained sufficient strength. It is essential that edge restraints are adequately secured.

21.7.5 SAMPLING AND TESTING PROCEDURES FOR PAVER BLOCKS :-

21.7.5.1 SAMPLE SIZE:-

Internal - Average of minimum 3 samples per 5000 blocks - for paver block manufacturers.

External - Minimum 2 blocks per 10000 blocks. Average of minimum 8 blocks per site - for captioned contractors.

21.7.5.2 SAMPLING FOR TESTING :-

Sampling for testing of paver blocks shall be done in accordance with Appendix-A.

21.7.5.3 COMPRESSIVE STRENGTH :-

Testing for 28 days compressive strength shall be undertaken in accordance with Appendix-B. The average compressive strength of 60 mm thick paver blocks tested shall be 31.8 MPa.

Note:- 10% lower tolerance limit in compressive strength shall be allowed.

21.7.5.4 WATER ABSORPTION :-

Testing for water absorption shall be in accordance with IS 2185:1979:Part I (Specifications for concrete masonry blocks) Appendix C

APPENDIX -A

SAMPLING OF PAVER BLOCKS :-

Method of Sampling:

The paver blocks required for carrying out the tests, a sample of 20 block shall be taken from every consignment of 4000 blocks or part thereof the same size, shape and thickness and the same batch of manufacture from these samples the blocks shall be taken at random for conducting the tests.

21.7.5.5 MARKING AND IDENTIFICATION :-

All samples shall be clearly marked at the time of sampling in such a way that the designated section of Part thereof and the consignment represented by the sample, are clearly defined.

The sample shall be dispatched to the approved test laboratory taking precaution to avoid damage to the paving in transit. Protect the paving from damage and contamination until they have been tested. The samples shall be stored in water at $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 24 hours prior to testing

APPENDIX - B

PROCEDURE FOR TESTING OF COMPRESSIVE STRENGTH FOR PAVER BLOCK :

Reference: BS 6717 Part I (1993) Specification for Paver Blocks B-1 Testing Machine: The testing machines shall be of suitable capacity for the test and capable of applying the load at the rate specified. It shall comply, as regards repeatability and accuracy with the requirements of relevant IS specification.

B-2 Procedure - The sample specimens shall be tested in wet condition after being stored at least 24 hours, in water maintained at a temperature of $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ before the specimens are submerged in water, the necessary area shall be determined.

The plates of the testing machine shall be wiped clean and any loose grit or other material removed from the contact faces of the specimen. Plywood nominally 4 mm thick, shall be used as packing between the upper and lower faces of the specimen and the machine plates, and these boards shall be larger than the specimen by a margin of at least 5 mm at all points. Fresh packing shall be used for each specimen tested. The specimen shall be placed in the machine with the wearing surface in a horizontal plane and in such a way that the axes of the specimen are aligned with those of the machines plates. The load shall be applied without shock and increased continuously at the rate of approximately 15 N/sqmm per minute until no greater load can be sustained. The maximum load applied to the specimen shall be recorded.

B-3 CALCULATION OF CORRECTED STRENGTH:-

The compressive strength of each block specimen shall be calculated by dividing the maximum load by full cross section area and multiplying by an appropriate factors.

Thickness and Chamfer Correction Factors

For Compressive Strength

Work Size Thickness in mm	Correction Factors	
	Plain Block	Chamfered Block
60	1.00	1.06
80	1.12	1.18
100	1.18	1.24

B-4 COMPRESSIVE STRENGTH CALCULATION:-

The average corrected compressive strength for the designed block section shall be calculated.

APPENDIX –C

METHOD FOR THE DETERMINATION OF WATER ABSORPTION:-

The test specimens shall be completely immersed in water at room temperature for 24 hours. The specimens shall then be weighed, while suspended by a metal wire and completely submerged in water

They shall be removed from the water and allowed to drain for one minute. Visible surface water being removed with a damp cloth and immediately weighed

Subsequent to saturation, all specimens shall be dried in a ventilated oven at 100 to 115°C for not less than 24 hours and until two successive weightings at intervals of 2 hours show an increment of loss not greater than 0.2 percent of the last previously determined mass of the specimen.

Calculate the absorption as follows:

$$\text{Absorption} = \frac{A - B}{B - C} \times 10000 \text{ kg/m}^3$$

$$\text{Absorption percent} = \frac{A - B}{13} \times 100$$

Where

A = wet mass of unit in kg

B = dry mass of unit in kg. And

C = suspended immersed mass of unit in kg.

SMC's approved paver block manufacturer list (for kind ready reference)

- (1) Laxmi Tiles : S/10-14, Kanaknidhi complex, Opp.Gandhi Smruti Hall, Timaliawad, Surat-395001
- (2) Kismat Tiles and Fly ash Product : Plot No.3, Block No.118, Mazadagali, GIDC Pipodara, N.H.No.08, Surat.
- (3) Anjani Cement Article : B/H L.P. Savani school, Opp.Madhavdeep Row House, Naher kanthe, Adajan-Pal, Palgam road, Surat.
- (4) Krishna Precast : Block No.1225, Atit Autogarage compound, Near Sayan check post, Sayan-Variav road, Variav, Surat-394520
- (5) Nishu Cem Block Pvt. Ltd. : 409, Ashirwad Paras, Opp.Krishna Bunglows, Corporate road, Prahalad Nagar road, Ahmedabad-380015.

The above list may change during the course of execution of this work in the event of modification of this list by SMC the modified list shall come into the picture with immediate effect.

ITEM NO.21.8: Providing and setting 50 to 60 mm thick rouge kotah stone water table in line, level and in required gradient including 25 mm thick bedding in C.M. 1:6 (1 Part of cement : 6 Part of coarse sand) with sufficient ramming consolidation. Providing joints in C.M. 1:3 (1 Part of cement : 3 Part coarse sand) and smooth pointing in C.M. 1:1 (1 Part of Cement, 1 Part of coarse sand) including watering etc. complete and as per details in tender specification & as directed by engineer in charge.

Size : 2'0" x 1'0" (600mm x 300mm)

Size : 1' x 1' (40 to 50 mm thick)

21.8.1 MATERIALS :

21.8.1.1 Water shall conform to specification of material M-1 as mentioned in Item no.15.4.

21.8.1.2 Cement shall conform to specification of material M-3 as mentioned in Item no.15.4

21.8.1.3 Sand shall conform to specification of material M-6 as mentioned in Item no.15.4

21.8.1.4 Cement mortar shall conform to specification of material M-4

CEMENT MORTAR :

Water shall conform to specification M-1. Cement shall conform to specification M-3. Sand shall conform to M-5.

PROPORTION OF MIX : Cement and sand shall be mixed to specified proportions, sand being measured by measuring boxes. The proportion of cement shall be by volume on the basis of 50 Kg./Bag of cement being equal to 0.0342 cu.m. The mortar may be hand mixed or machine mixed as directed.

PREPARATION OF MORTAR : In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed.

The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes.

21.8.1.5 Rough kotah stone shall conform to specification of material M-11

21.8.2 WORKMANSHIP :

21.8.2.1 The rough kotah stones of required size shall be supplied by Surat Municipal Corporation from any of the Municipal Store at the rate shown in attached Schedule-A. The carting of rough kotah stones from Municipal Store to the worksite shall be done by the contractor at his own cost. The loading and unloading of rough kotah stones shall be carried out with enough care. The stones shall be stacked at site suitably and properly.

21.8.2.2 Before laying the stone the bottom surface shall be levelled to the required gradient. Bedding of C.M. 1:6 (1 Part of Cement and 6 part of coarse sand) shall be laid in 25 mm thickness.

21.8.2.3 Each stone shall be thoroughly wetted before laying and shall be laid evenly and firmly on bedding of cement mortar. There shall be no cavities left. The joints shall be of uniform thickness

and in straight line as per pattern. The joints shall be filled with cement mortar in prop. 1:3 (1 part of cement and 3 part of coarse sand).

21.8.2.4 After daywork the joints shall be opened to a depth of about 5 mm and then grouted with cement pointing 1:1 (1 part of cement : 1 part of coarse sand).

21.8.2.5 CURING :

The paving area of footpath shall be kept wet with damp sand or watered atleast for seven days.

The water table shall be laid in required gradient so that water can drain out easily.

21.8.3 MODE OF MEASUREMENT AND PAYMENT :

21.8.3.1 No deduction shall be made nor extra shall be paid for any opening in watertable area upto 0.1 R.mt.

21.8.3.2 The rate shall include carting of rough kotah stones from Municipal Store to worksite.

21.8.3.3 The rate shall include the cost of all materials, labour and tools involved in all the operation as described above.

21.8.3.4 The rate shall be for a unit of one R.mt.

ITEM NO.21.9 : Providing and fixing in position readymade cement concrete Water Drain Slab (300 x 300 x 80 mm) M-30 Grade with all labour, material, testing charge etc. complete as per details in tender specification & as directed by engineer in charge.

(A) readymade cement concrete Water Drain Slab (600 x 300 x 100 mm)

Cl. no.6.2.5.1 The average 28 days compressive strength of paver blocks shall meet the specified requirement. Individual paver blocks strength shall not be less than 85 percent of the specified strength. In case blocks of age less than 28 days are permitted to be supplied, correlation between 28 days strength and the strength at specified age for indentified batch/mix of blocks shall be established.

Table 3 Compressive Requirements of Concrete Paver Blocks

(Clause 6.2.5.2. and 9.1.4)

Sr. No.	Grade of Paver Blocks	Minimum Average 28 Days Compressive Strength
(1)	(2)	(3)
i)	M-30	$Z_{f_{ck}} + 0.825 \times S.D.$ (established standard deviation rounded off to nearest 0.5N/mm ²)
ii)	M-35	
iii)	M-40	
iv)	M-50	
v)	M-55	

Note :- S.D. - Standard Deviation considered as 5, as per 456-2016.

Table 1 Recommended Grades of Paver Blocks for Different Traffic Categories*(Clauses 5 and 9.1.4)*

S1 No.	Grade Designation of Paver Blocks	Specified Compressive Strength of Paver Blocks at 28 Days N/mm ²	Traffic Category	Recommended Minimum Paver Block Thickness mm	Traffic Examples of Application
(1)	(2)	(3)	(4)	(5)	(6)
i)	M-30	30	Non-traffic	50	Building premises, monument premises, landscapes, public gardens/parks, domestic drives, paths and patios, embankment slopes, sand stabilization area, etc
ii)	M-35	35	Light-traffic	60	Pedestrian plazas, shopping complexes ramps, car parks, office driveways, housing colonies, office complexes, rural roads with low volume traffic, farm houses, beach sites, tourist resorts local authority footways, residential roads, etc
iii)	M-40	40	Medium-traffic	80	City streets, small and medium market roads, low volume roads, utility cuts on arterial roads, etc
iv)	M-50	50	Heavy-traffic	100	Bus terminals, industrial complexes, mandi houses, roads on expansive soils, factory floor, service stations, industrial pavements, etc
v)	M-55	55	Very heavy-traffic	120	Container terminals, ports, docks yards, mine access roads, bulk cargo handling areas, airport pavements, etc

ITEM NO.21.10: Supplying and fixing RCC collar (300 mm dia) for tree plantation including all taxes, carting, loading, unloading etc. complete with all labour, material charge etc. complete as per details in tender specification & as directed by engineer in charge.

(A) Tree guard ID 500mm, 800 x 800 x 75 mm (Type D) (set 4)

R.C.C. collar of various diameters of required length shall be supplied by the contractor and fixing as per Engineer instruction.

The rate shall be for a unit of one number.

ITEM NO.21.11: Providing and applying two coats of synthetic enamel paint including primer to kerb as per technical specifications and as directed by Engineer-in-charge.

21.10.1 MATERIALS :

The synthetic enamel paint shall confirm I.S. 1932-1964. The ready mixed primer, brushing red lead shall confirm to I.S. 102-1962. The thinner (linsed oil) shall confirm to I.S. 75-1973. If for any reason, thinning is necessary in case of ready mix paint, the brand of thinner recommended by manufacturer shall be used.

21.10.2 WORKMANSHIP :

General :

The materials required for work of painting shall be obtained directly from approved manufacturer or approved dealer like Asian, Nerolac, ICI, Berger etc. and brought to the site in marker's drums, kegs, etc. with unbroken seal.

All materials not in actual use shall be kept properly protected, lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of tarpentine to prevent formation of skin. The materials which have become state or flate due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in

smaller container. No left over paint shall be put back into stock tins., When not in use, the containers shall be kept properly closed.

If for any reasons, thinning is necessary, the brand of thinner recommended by the manufacturer shall be used.

The surface to be painted shall be thoroughly cleaned and dusted. All rust dirt, and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed parts of the work shall be carried out in wet, damp or otherwise unfavourable weather and all the surfaces shall be thoroughly dry before painting work is started.

21.10.3 APPLICATION OF PRIMER :

After the preparation of the surface, the priming coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

During painting, every time, after the priming coat has been worked out of the brush bristles or after the brush has been unloaded the bristles of the brush shall be opened up by striking the brushing shall be opened up by striking the brush against portion of the unpainted surface with the end of the bristles, held at right angles to the surface, so that bristles there after will collect the correct amount of paint when dipped again in to a paint container. The primary coat shall be allowed to dry completely before painting is started.

No hair marks from the brush or clogging at paint puddles in the corner of panels angles of mouldings etc. shall be left on the work.

Special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

The container when not in use shall be kept close and free air so that paint does not thicken and also shall be kept guarded from dust.

21.10.4 APPLICATION OF PAINT :

Brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of particular paint. The shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Each coat shall be allowed to dry completely and lightly rubbed with every fine grade of sand paper and loose particles brushed off before next coat is applied. Each coat shall very slightly in shade and shall be got approved from Engineer-in-charge before next coat is started.

Each coat except the last coat shall be lightly rubbed down with sand-paper or fine pumice stone and cleaned of dust before the next is applied. No hairmarks from the brush or clogging of paint puddles in the corners of panels, angles of mouldings etc. shall be left on the work.

Special care shall be taken while painting over bolts, butts, rivets, overlaps etc.

Approved best quality brushed shall be used.

21.10.5 MODE OF MEASUREMENTS AND PAYMENT :

The wall surface shall be measured under this item.

All the work shall be measured net in the decimal system as executed subject to the following limits unless otherwise stated hereinafter.

- (a) Dimensions shall be measured to the nearest 0.01 metre.
- (b) Areas shall be worked out to the nearest 0.01 Sq.metre.

No deductions shall be made for openings not exceeding 0.5 Sq.m. each and no addition shall be made for painting to beadings mouldings, eds, jambs, soffits, silts etc. of such opening.

In case of fabricated structural steel and iron work, priming coat of paint shall be included with fabrication. In case of trusses if measured in Sq.mt. compound girders, stanchions, lattices, girders and similar work, actual area shall be measured in Sq.m. and no extra shall be paid for painting on bolts, heads, nuts, washers etc. No addition shall be made to the weight calculated for the purpose of measurements of steel and iron works for paint applied on shop or at site.

The different surfaces shall be grouped into one general item, areas of uneven surfaces being converted into equivalent plain areas in accordance with the table given as per Annexure. If for payment. The rate shall be for a unit of one Sq.metre.

ITEM NO.21.12: Removing existing kotah stone flooring in mortar and vertical stone kerbing including stacking of serviceable material carting at SMC store disposal of unserviceable material with all lead and lift.

Details specification as per Item No.21.2 and as directed by Engineer-in-charge .

ITEM NO.21.13: Removing and resetting existing rough kotah stone water table for footpath in line, level and proper gradient including 25 mm thick bedding in CM 1:6 (1 Part of Cement, 6 Part of coarse sand) with sufficient ramming, consolidation, Providing joints in C.M. 1:3 (1 Cement : 3 Coarse sand) and smooth pointing in C.M. 1:1 (1 Cement : 1 Coarse sand) including watering etc. complete as per details in tender specification & as directed by engineer in charge.

21.12.1 MATERIALS :

21.12.1.1 Water shall conform to specification of material M-1 as mentioned in item no.21.4. Cement shall conform to specification of material M-3 as mentioned in item no.21.4. Sand shall conform to specification of material M-6 as mentioned in item no.21.4 . Cement mortar shall conform to specification of material M-11 as mentioned in item no.21.8.

21.12.2 WORKMANSHIP :

21.12.2.1 The existing water table shall be removed carefully and in such a way that no damage is caused to the adjoining structures, cables and service lines etc. The dismantled stone shall be properly stacked as directed by Engineer-in-charge.

21.12.2.2 Before resetting the stones the watertable the bottom surface shall be watered and rammed properly. The surface shall be levelled to the proper gradient so that water drain out easily.

21.12.2.3 Restting of rough kotah stones for watertable shall be carried out as per the detailed specification of **Item No.21.8** using the rough kotah stones obtained from existing footpath.

21.12.2.4 On completion of resetting work the site shall be cleared off all rubbish and cleaned as directed.

21.12.3 MODE OF MEASUREMENT AND PAYMENT :

21.12.3.1 The rate shall include the cost of all materials, labour, and tools involved in all the operations described above except rough kotah stones.

21.12.3.2 The rate shall be for a unit of one R.mt.

ITEM NO.21.13 (A) : Removing and resetting Existing paver block, including all watering leveling, cleaning, labour & Equipments chagres etc. complete as per details in tender specification & as directed by engineer in charge.

Removing and resetting Existing interlocking type rubber moulded cement concrete paver block on fine sand bedding (excluding cost of fine sand.). Item includes levelling by using vibratory plates compacted machine. Item also includes all labour, equipments, tools, plants, watering, cleaning etc. complete.

ITEM NO.21.14: Excavation for 27 cm wide and 25 cm deep Gishi in Ashpalt Bitumeneous road for erection of concrete wall as a road devider and removal of all excavated materials / asphalts etc. from the site as per details in tender specification & as directed by engineer in charge at the cost of contractor.

21.14.1 After the site has been cleared, the limits of excavation shall be set true to lines, ourves and stopes.

21.14.2 Excavation shall be in asphalt road, hard murrum, metal road, rubble soling which may be required or split with craw bars, chiselling, weding, grouting tools or pick or both and sharrel. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.

21.14.3 The depth to which the excavation is to be carried out shall be as shown on the drawing, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.

21.14.4 The bottom of the foundation shall be both longitudinally and transversely or step bed as directed by the Engineer-in-charge. concrete is laid the surface shall be slightly watered and rammed. In the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawing or as other wise ordered by the Engineer-in-charge the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level. If there are any slips or blows in the excavation false shall be remained by the contractor at his own cost.

21.14.5 Backfilling shall be done with approved material after concrete or masonry is fully set and carried out in such away as not to cause thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface making due allowance for settlement in 250 mm loose layers which shall be watered and comparted.

21.14.6 All the excavated material shall be the property of the Corporation where the excavated material is directed to be used in the construction of embankment, it shall be directly deposited at the required location.

21.14.7 The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades including signs making lights and flaymen as may be required by the Engineer-in-charge for the information and protection of traffic approaching or lossing through the section of the high way under improvement. Before taking up any

construction an phased programme for the control of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

21.14.8 The measurement shall be paid on Running meter basis.

ITEM NO.21.15 : Providing and laying cement concrete cast-in-situ/Precast kerb in M-20 grade as per drawing and as per details in tender specification & as directed by engineer in charge with all leads, lifts, loding & unloding etc. complete.

(i) 775mm height cement concrete M-20 grade cast-in-situ/Precast Kerbs & Fixing for Median as per drawing and as per details in tender specification & as directed by engineer in charge.

(ii) 0.15 (th.) *0.30(l)* 0.48(Ht.) mt. in size cement concrete M-20 grade pre cast Kerbs & Fixing as per drawing Purchsed from SMC's approved manufactures and as per details in tender specification & as directed by engineer in charge.

ITEM NO.21.16 : Removing and resetting existing ready made C.C.Kerb of strength of required size & thickness in line,level and truly vertical position ,including filling joints in C.M.1:1(1part of cement 1 part of coarse sand) smooth pointing in C.M.1:1 (1part of cement : 1 part of stone dust)including watering etc.complete as directed by engineer-in-charge.

Removing and resetting Existing ready made C.C.Kerb of strength of required size & thickness on fine sand bedding (excluding cost of fine sand.). Item includes levelling by using vibratory plates compacted machine. Item also includes all labour, equipments, tools, plants, watering, cleaning etc. complete.

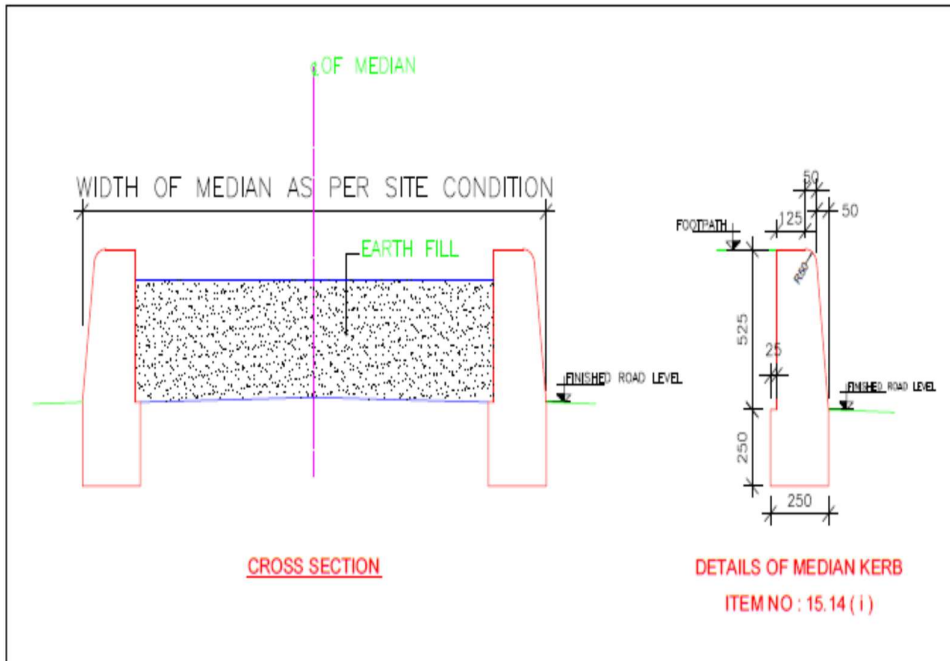
MODE OF MEASUREMENT AND PAYMENT :

The rate shall include the cost of all labour, tools and all Equipments involved in all the operations described above except rough kotah stones.

Measurement for this Item will be in Sqm.

ITEM NO.21.17 : Providing and laying cement concrete cast-in-situ Guard Stone (1:2:4) (1 cement : 2 coarse sand : 4 graded stoneaggregate of 20 mm nominal size) including cost of form work including, curing labour,machinery, equipments required to execute this item etc. complete. Size :- (750 X 350 X 400)

ITEM NO.21.18 : Providing and laying cement concrete cast-in-situ Guard Stone (1:1/2:3) (1 cement : 1/2 coarse sand : 3 graded stoneaggregate of 20 mm nominal size) including cost of form work including, curing labour,machinery, equipments required toexecute this item etc. complete. Size :- (600 x 225 x 400)



(ii) 0.15 (th.) * 0.30(l) * 0.48(Ht.) mt. in size cement concrete M-20 grade pre cast Kerbs & Fixing as per drawing Purchsed from SMC's approved manufactures and as directed by Engineer with all leads, lifts etc. complete.

Cement concrete precast kerrb shall be procured from SMC's approved manufacturer.

Shall be in conformance with Section 1700 of Specification of road and bridge work (MORT & H). Measurement for this Item will be in RM and rates for the Item complete in all respects as per the instructions of Engineer representating SMC will be as indicated in BOQ.

PART-III :

ITEM NO.22.: PAVEMENT MARKING & CAT EYE

ITEM NO.22.1 Providing and applying 2.50 mm thick hot applied thermoplastic road marking of white / yellow colour on bituminous / concrete surface with fully automatic machines as per detailed drawings / engineers instructions for Lane markings, edge markings / arrows including materials, labour charges, tests required to be carried out etc. complete as per details in tender specification & as directed by engineer in charge.

- (a) For Edge line marking of 15cm width
- (b) For Center Line marking of 10cm width
- (c) For pedestrian markigns at junctions (Zebra Crossing)
- (d) For pedestrian markigns at junctions (STOP LINE)

- (e) Letter markings at junctions
- (f) Direction arrow markings at junctions
- (g) For lane line marking of 15cm width

ROAD MARKINGS :-

General :-The colour, width and layout of road markings 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.

Materials :-

Road markings shall be of ordinary road marking paint, hot applied thermoplastic compound, or reflectorised paint as specified in the item and the material shall meet the requirements as specified below.

Hot Applied Thermoplastic Road Marking :-

General:-

- (i) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- (ii) The thermoplastic compound shall be screeded or 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.
- (iii) The colour of the compound shall be white or yellow (OS colour No. 356) as specified in the drawings or as directed by the Engineer.
- (iv) Where the compound is to be applied to cement concrete pavement, a scaling primer is recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

Thermoplastic Material:

General:- The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads.

Requirements:-

Composition: The pigment, beads and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table below:

Table : PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL

(Percentage by weight)

Component	White	Yellow
Binder	18.0 Min.	18.0 Min.
Glass Beads	30-40	30-40
Titanium Dioxide	10.0 min.	--
Calcium Carbonate and Inert fillers	42.0 Max.	See
Yellow Pigments	--	Note

Note:- Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirements of this specification are met.

Properties:- The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262-(Part-I), shall be as below:

(i)(a)Luminance:-

White: Day light luminance at 45 degree-65 per cent min. as per AASHTO M-249

Yellow: Day light luminance at 45 degrees-45 per cent min. as per AASHTO M-249.

(b) Drying time: When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.

(c) Skid resistance: not less than 45 as per BS 6044.

(d) Cracking resistance at low temperature: The material shall show no cracks on application to concrete blocks.

(e) Softening point: 102.5;±9.5 degree C as per ASTM D-36.

(f) Flow resistance: Not more than 25 per cent as per AASHTO M-249.

(ii) Yellowness index (for white thermoplastic paint): not more than 0.12 as per AASHTO M-249.

(iii) Storage life:-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.

(iv) Reflectorisation:- Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Reflectorising glass beads.

(v) Marking:- Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

- 1.The name, trade mark or other means of identification of manufacturer
- 2.Batch number
- 3.Date of manufacturer
- 4.Colour (white or yellow)
- 5.Maximum application temperature and maximum safe heating temperature.

(vi) 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 employer 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.

REFLECTORISING GLASS BEADS:-

General:- This specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type-1 beads are those which are a constituent of the basic thermoplastic compound vide above table and beads are those which are to be sprayed on the surface vide Clause table.

The glass beads shall be transparent, colourless and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in Clause table.

Specific requirements:-

(A) Gradation:- The glass beads shall meet the gradation requirements for the two types as given table below:

GRADATION REQUIREMENTS FOR GLASS BEADS

Sieve Size	Per cent retained	
	Type-1	Type-2
1.18 mm	0 to 3	--
850 Micron	5 to 20	0 to 5
600 Micron	--	5 to 20
425 Micron	65 to 95	--
300 Micron	--	30 to 75
180 Micron	0 to 10	10 to 30
below 180 Micron	--	0 to 5

(B) Roundness:- The glass beads shall have a minimum of 70 per cent true spheres.

(C) Reflective Index:-The glass beads shall have a minimum reflective index of 1.50.

(D) Free flowing properties:-The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow test.

Test Methods: The specific requirements shall be tested with the following methods:

(i) Free flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccator which is filled within 25 mm of the top of a desiccator plate with sulphuric acid water solution. Cover the desiccator and let it stand for 4 hours at 20 to 29 degree C. Remove sample from desiccator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.

(ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 3262 (Part-I).

(iii) The Contractor shall furnish to the employer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of this specification. However, if so required, these tests may be carried out as directed by the Engineer.

Application properties of thermoplastic material:-

The thermoplastic material shall readily get screeded/extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

The material upon heating to application temperatures, shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

Preparation:-

(i) 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.

(ii) 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.

Properties of finished road making:-

- (a) The stripe shall not be slippery when wet.
- (b) The making shall not lift from the pave in freezing weather.
- (c) After application and proper drying, the stripe shall show no appreciable deformation or discolouration under traffic and under road temperatures upto 60 degree C.
- (d) The marking shall not deteriorate by contract with sodium chloride, calcium chloride or oil drippings from traffic.
- (e) The stipe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
- (f) The colour of yellow marking shall conform to IS Colour No.356 as given in IS-164.

REFLECTORISED PAINT:-

Reflectorised paint, if used, shall conform to the specification by the manufacturers and approved by the Engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirement of Clause table

APPLICATION:-

- Marking shall be done by machine. For locations where painting cannot be done machine, approved manual methods shall be used with prior approval of the 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 on extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufcturer 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 decree C during application. All surfaces to be markd shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.
- The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes places.
- 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. In addition to the beads included in the material, a further quantity of glass beads of Type-2, conforming to the above noted specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.
- The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS-3262 (Part-3).

- The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks upper surface of the lines shall be level, uniform and free from streaks.

Marking:- Marking like lane markings, centre line marking and edge line marking shall be done strictly as prescribed in IRC-35-1977.

MEASUREMENTS AND PAYMENT:-

- The painted marking shall be measured in Sq.meters of actual area marked (excluding the gaps, if any)
- In respect of marking like directional arrows and lettering etc, the measurement shall be by numbers.
- Contractor shall have to submit the manufacture test certificate before starting the work at no extra cost.
- Contractor shall have to submit the test report of both thermoplastic paint and glass beads from approved laboratory for paint & glass beads at no extra cost before producing bill and then after on end when asked by SMC.
- Contractor shall have to submit the filled as mentioned above in soft (signed & scanned) and two hard copies.

Rate:-

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

ITEM NO.22.2 Supplying of Molded Shank Raised Pavement Markers made of polycarbonate and ABS molded body and reflective panels with micro prismatic lens capable of providing total internal reflection of the light entering the lens face and shall support a load of 16000 kg tested in accordance to ASTM D 4280 Type H and complying to Specifications of Category A of MORTH Circular No RW/NH/33023/10-97 – DO III Dt 11.06. 1997. The height, width and length shall not exceed 50 mm, 100 mm and 100 mm and with minimum reflective area of 13 Sqcm on each side and the slope to the base shall be 35 +/- 5 degree. The strength of detachment of the integrated cylindrical shanks, (of diameter not less than 19 +/- 2 mm and height not less than 30 +/- 2 mm) from the body is to be a minimum value of 500 Kgf. Fixing will be by drilling holes on the road for the shanks to go inside, without nails and using epoxy resin based adhesive as per manufacturer's recommendation and complete as directed by the engineer. (3M or Equivalent Brand)

General

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

22.2.1. Definitions

22.2.1.1 Description of Terms Specific to this standard

22.2.1.2 Coefficient of luminous intensity(CIL) or specific intensity = the ratio of luminous intensity of the retro-reflector in the direction of observation to luminance

at the retro- reflector on a plane perpendicular to the direction of the incident light expressed in terms of millicandelas per incident lux (mcd/lx).

22.2.1.3 Horizontal entrance angle – the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

22.2.1.4 Observation angle – the angle in the reflector between the illumination axis and the observation axis.

22.2.1.5 Retro – reflection – reflection in which the radiation is returned in direction close to the direction from which it came. This property being maintained over wide variations of the direction of incident radiation.

22.2.1.6 Head – that part of a road stud which is above the road surface when the road stud is fixed in position in the road.

22.2.1.7 Upper surface – that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.

22.2.1.8 Anchorage – that part of a road stud which is below the road surface when the road stud is fixed in position in the road.

22.2.2 Material

22.2.2.1 Molded Twin Shank Raised Pavement Markers made of polycarbonate and ABS molded body and reflective panels with micro prismatic lens capable of providing total internal reflection of the light entering the lens face and shall support a load of 16000 kg tested in accordance to ASTM D 4280 Type H and complying to Specifications of Category A of MORTH Circular No RW/NH/33023/10-97 – DO III Dt 11.06. 1997.

22.2.2.2 Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be molded of methyl methacrylate conforming to ASTM D 788 or equivalent.

22.2.3 Design

22.2.3.1 The slope of retro-reflecting surface shall preferably be 35 ± 5 degree to base.

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

22.2.4 Optical Performance

22.2.4.1 Unidirectional and bi-directional studs

22.2.4.2 Each reflector or combination of reflectors on each face of the stud shall have a C.I.L. not less than given in Table 1 or 2 as appropriate.

Table 1 Minimum C.I.L Values for Category 'A' studs

Entrance	Observation angle	C.I.L. in mcd/lx		
		W	A	R
0° U 5° L & R	0.3 °	2	11	4
0° U 10° L &	0.5 °	1	60	2

Table 2 Minimum C.I.L Values for Category 'B' studs

Entrance	Observation angle	C.I.L. in mcd/lx		
		W	A	R
0° U 6° L & R	0.3 °	2	10	4

0° U 10° L &	0.5°	1	7.	3
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Note :The entrance angle of 0° U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.

22.2.4.3 A stud that incorporates one or more Corner cube reflectors shall be considered to be included in category 'A' . A stud that incorporates one or more bi-concex reflectors shall be considered to be included in category 'B'.

22.2.4.4 Omni-directional studs Each omni-directional stud shall have a minimum C.I.L. of not less than 2 mcd/lx/

22.2.4.5 Tests

22.2.4.6 Coefficient of luminance intensity can be measured by produced described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS: 873 – Part

4:1973.

22.2.4.7 Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Table

1 or 2 provided that.

- (i) the value is not than 80% of the specified minimum, and
- (ii) The average of the left and right measurements for the specific angle is greater than the specified minimum.

Flexural Strength: When tested in accordance with ASTM D4280, a marker shall withstand 8914 N (909 kgf, 2000 lbf) without breakage.

Lens Impact Strength: When impacted in accordance with ASTM D4280, the face of the lens shall show no more than two radial cracks longer than 6.4 mm (0.25 in.). There shall be no radial cracks extending to the edge of the abrasion resistant area. There shall be no delamination.

Shank Breakage Test: When impacted with an Instron point and distributed load, the shanks should not break from the clamped RPM body for an applied force of less than 500 Kgf.

22.2.5 Fixing of Reflective Markers

22.2.5.1 Requirements

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

22.2.5.1.2 The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.

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

22.2.5.1.4 Marker height with Molded Twin Shank shall not exceed 50 mm.

22.2.5.1.5 Marker width shall not exceed 130 mm.

22.2.5.1.6 The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.

22.2.5.2 Placement

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

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

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

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

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

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

22.2.6 The contractor shall obtain from the manufacturer a One year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel and submit the same to the Engineer. In addition, a One year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carried out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer at this own cost and with no extra remuneration to be paid for such works.

22.2.7 Measurement for Payment

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

22.2.8 Rate

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

PART-IV :

ITEM NO.23.: ROAD SIGNAGES

ITEM NO.23.1: Cautionary warning sign :- Providing and fixing sign boards made out of 2 mm aluminium sheet; size 90 x 90 x 90 cms. equilateral triangle as per design of IRC 67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflectivesheeting as per latest M.O.S.T. Specifications; 3.1 m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm as required; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing as site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc. complete under the supervision of engineer in charge. (B) High Intensity Grade.

ITEM NO.23.2: Informatory Signs :- Providing and fixing sign boards made out of 2 mm aluminium sheet; size 80 x 60 cms. rectangle as per design of IRC 67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1 m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm as required; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc. complete under the supervision of engineer in charge. (B) High Intensity Grade.

ITEM NO.23.3: Regulatory/ Mandatory Signs :- Providing and fixing sign boards made out of 2 mm aluminium sheet; size 60 cms. diameter circle as per design of IRC 67-1977. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1 m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm as required; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg. including excavation, curing etc. complete under the supervision of engineer in charge. (B) High Intensity Grade.

ITEM NO.23.4: Direction sign (Junction board) :- Providing and fixing sign boards made out of 2 mm aluminium sheet; size 244 x 122 cms. rectangle as per design of IRC 67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflectivesheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC -30-1968, 3.1 m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5 mm, 75 x 75 x 6 mm as required; painted with best quality epoxy coatings in black and white bends. The details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc. complete under the supervision of engineer in charge. (B) High Intensity Grade.

(1) Four type of boards viz. Cautionary, Informatory, Mandatory and Directional Boards shall be as per IRC : 67-2012 as shown in the drawings annexed hereto.

- (2) The square plate and 7 plate for writing the messages shall be of Aluminum of thickness 2 mm on which the Retro Reflective Sheeting of Engineer Grade shall be pasted as per the standard size of the letters, signs, arrows etc.
- (3) The Directional Boards shall be as per the size shown in the drawings. The letters, signs and arrows shall be mentioned thereon as per the instruction of the Engineer-in-charge. The plates shall be of Aluminum having thickness 2 mm.
- (4) The bidder shall invariably submit the samples of RR Sheeting (Engineer Prismatic – Blue, White, Red and Black colours) and Aluminum sheet (Thickness 2 mm) without which the tender shall not be considered and shall stand canceled.
- (5) The rates shall be quoted for the RR boards including the supporting M.S. angles and fixing in prescribed concrete grade as shown in drawing.
- (6) The kind & nos. of boards (Mandatory-informatory-cautionary-Directional) : The numbers of each category of Boards is given in the price-bid.
- (7) The supporting structure & the joint of the boards with the supporting structure should withstand the wind velocity.
- (8) Moreover, the bidder shall submit a copy of his import license of RR sheeting or the certificate showing him the authorized dealer for India, in the case, the bidder is not a manufacture of RR sheeting. The successful bidder shall also procure purchase bill of parent company if asked to do so.
- (9) The Municipal Corporation reserves the right to accept the Tender in favour of different Tenderer on item wise basis either in full or part, OR reject all the offers without assigning any reason thereof.
- (10)(a) The bidder shall invariably submit the samples and also the technical literature giving full details for each item, In no case, the offer shall be considered without the samples of the item quoted in the offer.
- (10)(b) The bidder shall invariably submit a warranty of 7 years from the original manufacturer of the sheeting and he shall also attach Test Certificate as recognized by the MOST.
- (10)(c) The payment shall be released only after the successful bidder produces the certificate regarding the "Quality and Guarantee" of the sheetings and the material supplied in the form prescribed by the Engineer-in-charge (see Annexure-c). The said Guarantee shall be given on the Gujarat Stamp Paper worth Rs.100/-.
- (11) The time limit will be 06 (six) months from the date of work-order, failing which a penalty at a rate of 0.2% of the total tender amount per day shall be charged. The maximum penalty shall be 10 % of the Tender value. Decision of the Municipal Commissioner will be final and binding to the bidder for recovery of penalty.
- (12) Successful bidder shall be responsible for safe delivery, erecting of the boards at various locations of Surat Municipal Corporation, Surat.
- (13) The rates shall be inclusive of all taxes, charges, freights, etc. & erection as directed by Engineer-in-charge.
- (14) Tender once offered can not be withdrawn except with the permission of Addl. City Engineer), Surat Municipal Corporation.

- (15) No interest will accrue to be payable on the Security Deposit and Earnest Money Deposit.
- (16) Warranty / Guarantee period shall be minimum 12 (twelve) months from the date of completion of work. Security Deposit will be retained up to the warranty / guarantee period.
- (17) Tender once accepted shall be binding on the bidder even if the formal agreement is not signed.
- (18) It may be noted that Municipal Corporation does not hold either 'C' or 'D' declaration forms. The offer made shall be strictly non-conditional.
- (19) A payment terms of 100 % payment against documents through Bank shall not be accepted by the Corporation. Advance payment terms shall not be accepted.
- (20) A list of major orders with performance certificate executed with reputed customers Govt. and semi-Govt. bodies, Corporation or / Municipalities etc. should be enclosed for ready reference.
- (21) The material shall be inspected / tested by Corporation's representative at manufacture's work shop prior to dispatch. The successful bidder shall have to make arrangement for the same at his own cost. He shall also be required to show the live demonstration of the Retro reflective sheeting used for the sign boards at his own cost and risk in appropriate condition i.e. Dark.
- (22) The decision of the Municipal Commissioner shall be conclusive and final regarding any dispute whatsoever and shall be binding to the successful bidder.
- (23) If any of the item are not found conforming to the approved samples, the same will be rejected and will have to be replaced by the successful bidder at his own cost, risk and consequences.
- (24) Also the bidder shall invariably submit guarantee / warranty for the components for the warranty / guarantee period. If any defect is found, the same will have to be replaced by the successful bidder at his own cost, However if the quality is found sub-standard, as compared to the approved sample, at any point of any times, S.M.C. shall be at its discretion to terminate the contract and security deposit shall be forfeited.
- (25) The paper indicating these terms and conditions shall be invariably submitted along with the offer duly signed at the place stipulated.

(26) The details of symbols supplying computerized sticker sign (Logo) and pasting the same as per for instructions of Engineer-in-charge. The fixing at site in C.C. 1:2:4 block of size 45 x 45 x 60 cm. (as per drawing) for each leg including excavation, curing etc. complete under the supervision of Engineer-in-charge. (A) High Intensity Grade.

23.1 GENERAL

23.1.1 The colour configuration, size and location of all traffic signs shall be in accordance with the Code of Practice for Road Signs, IRC: 67-2012 as shown on the drawings. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

23.1.2 In general, cautionary and mandatory signs shall be fabricated through process of screen printing in regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

23.2 MATERIALS:- The various materials and fabrication of the traffic signs shall conform to the following requirements.

23.2.1 CONCRETE:- Concrete shall be of M25 grade

23.2.2 REINFORCING STEEL:-Reinforcing steel shall conform to the requirements of IS:1786 unless otherwise shown in the drawing.

23.2.3 Bolts, nuts, washers, high strength bolts shall conform to IS:1367 whereas precision bolts, nuts etc. shall conform to IS:1364.

23.2.4 PLATES AND SUPPORTS:-Plates and support sections for the sign posts shall conform to IS:226 and IS:2062 or any other relevant IS Specifications.

23.2.5 ALUMINUM:-Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminum alloy conforming to IS:736 - Materials designation 24345 or 1900.

23.2.5.1 Aluminium Composite Materials (ACM)

ACM sheets used for sign boards is a sandwiched construction with a thermoplastic core of 'Low Density Polyethylene' (LDPE) between two thick skins/sheets of aluminium with overall thickness of 4 mm and 3 mm, and aluminium skin thickness of 0.4 - 0.5 mm and 0.25 - 0.3 mm respectively on both sides. The retro reflective sheeting must be applied on the top surface with aluminum surface with recommended surface preparation from sheeting manufacturer. A fluorocarbon coating may be applied over the exposed surface of aluminium to ensure corrosion resistant and weather proof and thus shall conform to relevant ASTM. The mechanical properties of 4 mm and 3 mm ACM and that of its aluminum skin shall conform to the requirement given in Table A-1, when tested in accordance with the test methods mentioned against each of them.

23.2.5.2 Plate Thickness

Shoulder mounted ground signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick with aluminium and 3 mm thick with aluminium composite material. All other signs shall be at least 2 mm thick with aluminium and 4 mm thick with aluminium composite material. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under prevailing wind and other loads. All overhead signs made with aluminium composite material shall be minimum 4 mm thick to withstand wind and other loads without deformation.

Table A-1:- Specifications for Aluminum Composite Material (ACM)

S.No.	Description	Specification for 4 mm		Specification for 3 mm
		Standard Test	Acceptable Value	Acceptable Value
A	Mechanical Properties of ACM			
1	Peel off strength with retro reflective sheeting. (Drum Peel Test)	ASTM D903	Min. 4 N/mm	Min. 4 N/mm
2	Tensile strength	ASTM E638	Min. 40 N/mm ²	Min. 30 N/mm ²
3	0.2% Proof Stress	ASTM E638	Min. 34 N/mm ²	Min. 34 N/mm ²
4	Elongation	ASTM E638	Min. 6 %	Min. 5 %
5	Flexural strength	ASTM C393	Min. 130 N/mm ²	Min. 120 N/mm ²
6	Shear strength with punch shear test	ASTM D732	Min. 18 N/mm ²	Min. 18 N/mm ²
B	Properties of Aluminium Skin			
1	Tensile strength (Rm)	ASTM E8	Min. 150 N/mm ²	Min. 130 N/mm ²
2	Modulus of elasticity	ASTM E8	Min. 70,000 N/mm ²	Min. 70,000 N/mm ²
3	Elongation	ASTM E8	A ₅₀ Min. 2%	A ₅₀ Min. 2%
4	0.2 % Proof Stress	ASTM E8	Min. 110 N/mm ²	Min. 110 N/mm ²

23.2.7 In respect of sign sizes not covered by IRC:67-2012, the structural details (thickness etc.) shall be as per the approved drawings.

23.3 HAVING RETRO-REFLECTIVE SHEETING

23.3.1 GENERAL REQUIREMENTS:

The retro reflective sheeting used on the signs shall consist of white or coloured sheeting having a smooth outer surface which has the property of retro reflection over its entire surface. It shall be weather resistant and exhibit colour fastness. It shall be new and unused and show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible

shrinkage or expansion. A certificate of having the sheeting tested for coefficient of retro reflection, daytime colour and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance, 3 years outdoor weathering and its having passed these tests shall be obtained from International/Government Laboratory/Institute by the manufacturer of the sheeting and in case the certificate is obtained from international agency, it should also be obtained from Indian agency within 3 years of launching of product by the manufacture in abroad. Alternatively, a certificate conforming to ASTM Specification (D 4956-09) on artificial accelerated weathering requirements from a reputed laboratory in India can be accepted provisionally. In such a situation, the Employer/Client, if so desires, could seek for a performance guarantee which would be released after receipt of certificate meeting the requirement of three years outdoor weathering of the sheeting. Retro reflective sheeting is divided into three classes as follows:

CLASS "A" SHEETING: - Engineering and Super Engineering Grade Sheeting as per ASTM.D 4956-09 Type I and II.

CLASS "B" SHEETING: - High Intensity and High Intensity Prismatic grade sheeting as per ASTM D 4956-09 Type III and IV.

CLASS "C" SHEETING: - All Micro Prismatic grade sheets as per ASTM D 4956-09 Type VIII,IX and XI.

23.3.2 Selection of sheeting

Performance characteristics of sheeting Type I to Type IX used for road signs are presented respectively in Table A-3 to Table A-9. The definition of key words in understanding the performance characteristics are given below.

"Retro-reflection" means the reflection of light which is returned in directions close to the direction from which it came, and this property being maintained even over wide variations of the direction of the incident radiation.

"Observation angle (symbol α)" is the angle between the illumination axis and the observation axis as shown in Fig. A.1.

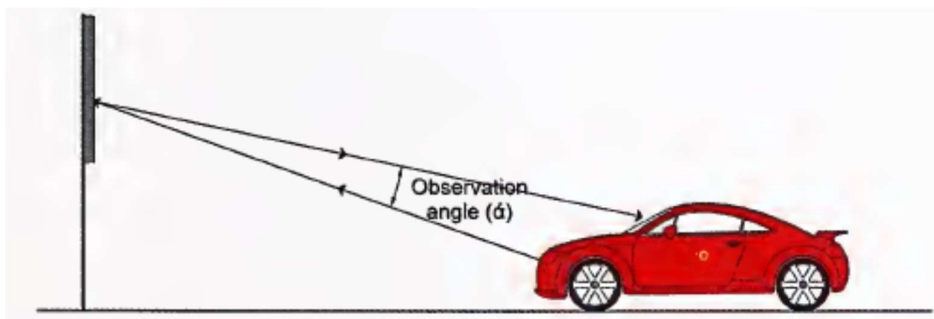


Fig. A.1

"Entrance angle (symbol p)" means the angle from the illumination axis to the reference axis. The reference axis is an axis perpendicular to the retro reflective surface as shown in Fig. A.2.

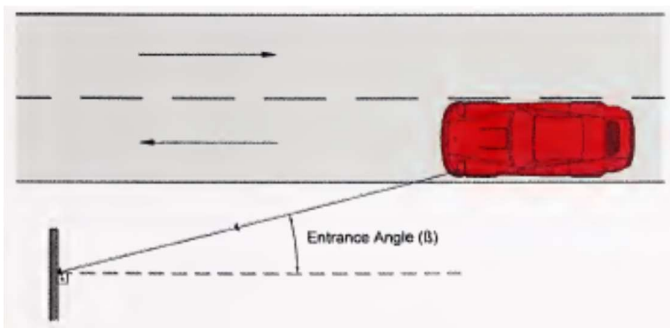


Fig. A-2

"Coefficient of retro-reflection R' " can be obtained from the luminous intensity (I) of the retro-reflective area in the direction of observation and the illumination (E) on the retro reflective plane at right angles to the direction of the incident light and the illuminated plane sample surface A ,

$$R' = I / E \cdot A$$

The coefficient of retro-reflection R' is expressed in candle per square meter per lux (cd.mrr2lx 1). Though the sheeting as per ASTM classification are available from Type I to Type IX, a "higher" type of sheeting used in the ASTM need not necessarily imply that it is better than a "lower"-type sheeting, rather it meets different performance characteristics. Each type of sheeting has certain performance characteristics and the type of sheeting for a road should be selected which suits the situation encountered by road users in viewing the signs on the particular road. For example, sheeting with high coefficient of retro reflection at small observation angle will give better performance for driver's viewing the sign from long distances.

Similarly, signs with wide observation angle give good performance for drivers encountering situations to observe the signs involving wide observation angle. Micro prismatic sheeting is preferred for gantry mounted overhead signs. Type IV micro prismatic sheeting may be used for delineator posts.

Table A-2 suggests a general guideline for selection of sheeting considering the performance characteristics of each type of sheeting for different category of roads and also on economic consideration and visibility requirements in Indian context. However, the choice for selection of type of sheeting would rest with the client.

Table A-2 Suggested Guidelines for Usage of Retro-Reflective Sheeting

Class of Sheeting	Type of Sheeting (ASTM)	Category of Road				
		National/ State Highway	Major District Roads	Rural Roads	Urban/ City Roads	Expressway
Class A	Type I	No	Yes	Yes	No	No
	Type II	No	Yes	Yes	No	No
Class B	Type III*	Yes	Yes	Yes	Yes	No
	Type IV	Yes	Yes	Yes	Yes	No
Class C	Type VIII	Yes	No	No	Yes	Yes
	Type IX	Yes	No	No	Yes	Yes
	Type XI	Yes	No	No	Yes	Yes

* Type III sheeting is available both as glass beaded and micro prismatic technology as per ASTM D4956-09. The light reflecting efficiency of glass beaded sheeting is lower than the micro prismatic sheeting.

23.3.4 Class A (Engineering grade sheeting)

23.3.4.1 Type I engineering grade sheeting

This sheeting shall be of enclosed lens glass bead type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table A-3.

Table –A-3. Acceptable Minimum Co-efficient of Retro-Reflection for
Type I Engineering Grade Sheetting (Candelas per Lux per Square Meter)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.2°	- 4°	70	50	25	9.0	14	4.0	1.0
0.2°	+30°	30	22	7.0	3.5	6.0	1.7	0.3
0.5°	- 4°	30	25	13	4.5	7.5	2.0	0.3
0.5°	+30°	15	13	4.0	2.2	3.0	0.8	0.2

When totally wet, the sheeting shall not show less than 90 per cent of the values, of retro reflection indicated in above Table. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro-reflectance.

23.3.4.2 Type II super engineering grade sheeting

This sheeting shall be of enclosed lens glass-bead type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table A-4.

Table –A-4. Acceptable Minimum Coefficient of Retro-Reflection for
Type II Super Engineering Grade Sheetting (Candelas per Lux per Square Meter)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.2°	-4°	140	100	60	30	30	10	5
0.2°	+30°	60	36	22	10	12	4	2
0.5°	-4°	50	33	20	9	10	3	2
0.5°	+30°	28	20	12	6	6	2	1

When totally wet, the sheeting shall not show less than 90 per cent of the values, of retro reflection indicated in above Table. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro-reflectance.

23.3.4.3 Class B (High intensity grade sheeting)

23.3.4.3.1 Type III high intensity grade

This high intensity retro-reflective sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent waterproof plastic having a smooth surface or as a non-metallic micro prismatic reflective material element. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table A.5.

Table –A-5. Acceptable Minimum Coefficient of Retro-reflection for

Type III High Intensity Grade Sheeting A (Encapsulated Lens Type)(Candelas per Lux per Square Meter)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.1° ^B	-4°	300	200	120	54	54	24	14
0.1° ^B	+30°	180	120	72	32	32	14	10
0.2°	-4°	250	170	100	45	45	20	12
0.2°	+30°	150	100	60	25	25	11	8.5
0.5°	-4°	95	62	30	15	15	7.5	5.0
0.5°	+30°	65	45	25	10	10	5.0	3.5

A Minimum Coefficient of Retro reflection (RA) (cd.lx 1 .nr2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

When totally wet, the sheeting shall show not less than 90 per cent, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

23.3.4.3.2 Type IV High intensity micro-prismatic grade sheeting (HIP)

This sheeting shall be of high intensity retro-reflective sheeting made of micro-prismatic retro-reflective element material coated with pressure sensitive adhesive. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table A-6.

Table A.6 Acceptable Minimum Co-efficient of Retro-Reflection for Type IV High Intensity Micro-prismatic Grade SheetingA

(Candelas per Lux per Square Meter)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.1° ^B	-4°	500	380	200	70	90	42	25
0.1° ^B	+30°	240	175	94	32	42	20	12
0.2°	-4°	360	270	145	50	65	30	18
0.2°	+30°	170	135	68	25	30	14	8.5
0.5°	-4°	150	110	60	21	27	13	7.5
0.5°	+30°	72	54	28	10	13	6	3.5

A Minimum Coefficient of Retro-reflection (RA) (cd.lx'1 .m 2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

When totally wet, the sheeting shall show not less than 90 per cent of the values of retro reflection indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

23.3.5 Class C (Micro prismatic grade sheeting)

23.3.5.1 Type VIII Micro prismatic grade sheeting

Retro-reflective sheeting is typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D: 4956-09)as indicated in Table A.7.

When totally wet, the sheeting shall show not less than 90 per cent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

Table A.7 Acceptable Minimum Co-efficient of Retro-reflection for

Type VIII Prismatic Grade Sheeting A (Candelas per Lux per Square Meter)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow -Green	Fluorescent Yellow	Fluorescent Orange
0.1° ^B	-4°	1000	750	375	100	150	45	30	800	600	300
0.1° ^B	+30°	460	345	175	46	69	21	14	370	280	135
0.2°	-4°	700	525	265	70	105	32	21	560	420	210
0.2°	+30°	325	245	120	33	49	15	10	260	200	95
0.5°	-4°	250	190	94	25	38	11	7.5	200	150	75
0.5°	+30°	115	86	43	12	17	5	3.5	92	69	35

A Minimum Co-efficient of Retro-reflection (RA) (cd.lx~ 1 .nrr2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

23.3.5.2 Type IX Micro prismatic grade sheeting

Retro-reflective sheeting is typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table A.8.

When totally wet, the sheeting shall show not less than 90 per cent of the values, of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

23.3.5.3 Type XI Micro Prismatic Grade Sheeting

Retro-reflective sheeting is typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table A.9.

When totally wet, the sheeting shall show not less than 90 per cent of the values, of retroreflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

Table A.8 Acceptable Minimum Co-efficient of Retro-reflection for

Type IX Prismatic Grade Sheeting A (Candelas per Lux per Square Meter)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1° ^B	-4°	660	500	250	66	130	30	530	400	200
0.1° ^B	+30°	370	280	140	37	74	17	300	220	110
0.2°	-4°	380	285	145	38	76	17	300	230	115
0.2°	+30°	215	162	82	22	43	10	170	130	65
0.5°	-4°	240	180	90	24	48	11	190	145	72
0.5°	+30°	135	100	50	14	27	6	110	81	41
1.0°	-4°	80	60	30	8	16	3.6	64	48	24
1.0°	+30°	45	34	17	4.5	9.0	2	36	27	14

A Minimum Co-efficient of Retro-reflection (RA) (cd.lx 1 .m²).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

Table A.9 Acceptable Minimum Coefficient of Retro-reflection for

Type XI Prismatic Grade Sheeting A (Candelas per Lux per Square Meter)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Florescent yellow-Green	Florescent yellow	Florescent Orange
0.1° ^B	-4°	830	620	290	83	125	37	25	660	500	250
0.1° ^B	+30°	325	245	115	33	50	15	10	260	200	100
0.2°	-4°	580	435	200	58	87	26	17	460	350	175
0.2°	+30°	220	165	77	22	33	10	7	180	130	66
0.5°	-4°	420	315	150	42	63	19	13	340	250	125
0.5°	+30°	150	110	53	15	23	7	5	120	90	45
1.0°	-4°	120	90	42	12	18	5	4	96	72	36
1.0°	+30°	45	34	16	5	7	2	1	36	27	14

A Minimum Co-efficient of Retro-reflection (RA) (cd.lx 1 .m²).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

23.3.6 Adhesives

The sheeting shall have a pressure-sensitive adhesive of the aggressive tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. The sheeting shall be applied in accordance with the manufacturer's specifications.

23.3.7 Fabrication

Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro reflective sheeting. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5 mm. Where screen printing with transparent colours is proposed, only butt joint shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

23.4 Messages/Borders

The messages (legends, letters, numerals, etc.) and borders shall either be screen-printed or of cut out from durable transparent overlay or cut-out from the same type of reflective sheeting for the cautionary and mandatory sign boards. Screen printing shall be processed

and finished with materials and in a manner specified by the sheeting manufacturer. For the informative and other sign boards, the messages (legends, letters, numerals etc.) and borders shall be cut-out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut-outs shall be from durable transparent overlay materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. Whenever transparent overlay film is used for making any type of sign, the coloured portion of sign shall have coefficient of reflectivity not less than the reflectivity of type and colour of sheeting normally used, as given in Table A.3 to Table A.9. Cut-out messages and borders, wherever used, shall be either made out of retro-reflective sheeting or made out of durable transparent overlay except those in black which shall be of non-reflective sheeting or opaque in case of durable transparent overlay. Creating coloured areas by means of screen-printing with ink shall not be permitted.

23.5 Warranty and Durability

The retro reflective sheeting type "A", "B" and "C" shall be covered respectively under 5, 7 and 10 year warranty respectively issued for field performance including the screen printed areas and cut-out sheeting and cut-out durable transparent overlay film. The contract shall indicate the minimum retro-reflectivity of the signs at the end of the warranty period.

23.5.1 INSTALLATION:

Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area up to 0.9 Sq. mt. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be mild steel, reinforced concrete or Galvanized Iron (G. I.). Post shall be firmly fixed to the ground by means of properly designed on. The work of foundation shall conform to relevant specification as specified.

23.5.2 All components of signs and supports, other than the reflective portion and G. I. posts shall be thoroughly decayed, clean, primed and painted with two coats of epoxy paint. Any part of Mild Steel (M.S.) post below ground shall be painted with three coats of red lead paint.

23.6. Other Detail Specifications regarding signages follows as per IRC-67-2012.

23.7. MEASUREMENTS FOR PAYMENT:

The measurements of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured in No.

23.7.1 RATE:

The contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

Note : In any discrepancy specifications mentioned in Price-Bid shall be final and regarding dimensions details shown in drawings shall be final and for this decision of Engineer-in-charge will be final.

ITEM NO.23.5: Providing Supplying & Fixing jumbo swiss type traffic bollard made out of 1.5 mm thick CRC sheet in conical shape having 188cms, bottom dia 30cms, top dia 22cms, with top circular direction plate of 30cms dia for arrow fabricated as per attached drawing and coated with black epoxy powder coating and Retro reflectorised three yellow strip 15cms wide and arrow Micro Prismatic grade sheeting as per ASTM 4956-09 Type-XI Fixing with cement concrete M-25 grade, Foundation size 30cm*30cm*35cm as per the instruction of Engineer in charge .

Detail Specification of regarding Retro Reflected sheet, Micro Presmatic Grade Sheet, Adhesive, Febrication, Messages/Borders, Installation, Warranty & Durability and Installation as follows as per IRC-67-2012.

Details given in BOQ with Relevant from Building Specifications of R & B will be applied with these specifications. Work should be in accordance with existing Swiss Bollards in surat city. The Swiss type bollard shall be approved from the Engineer-In charge before commencement of work.

23.5.1. MEASUREMENTS FOR PAYMENT:

The measurements of Swiss Bollard shall be measured in No.

23.5.2 RATE:

The contract unit rate shall be payment in full for the cost of making the road Bollard, including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

PART-V : TRAFFIC SAFETY ,TRAFFIC CONTROL AND SURVEY

ITEM NO:-24 TRAFFIC SAFETY ,TRAFFIC CONTROL AND SURVEY

ITEM NO:-24.1 : Providing and installing barricades including supplying, painting with flourescent paint/white paint and fixing CGI sheet 24 SWG of required height as per site condition and M.S. angle of required size to restrain at 2.5 mt. c/c and dismantalling the same after completion of work and allowing for movement of traffic as per drawing and as per instruction from engineer in charge

Payment for barricading as per BOQ (Vol.2 of tender) shall be made after completion of work of stretch on which the erection of barricading done by the contractor of before completion of work the barricading may found dismantled / removed or disturbed then it will not be entitled for any payment. During execution of work if at particular location contractor is instructed to do barricading and if barricading is not erected than contractor shall be lavied penalty at the rate of Rs.100 per sq.mt./day for such non performance

ITEM NO:-24.1 (A) Reuse of the above barricades in item 24.1 for traffic safety purpose without procuring new barricades.

Shifting of barricades same as per requirement during construction period and dismantling the same after completion of work as directed by Engineer and as per site requirements.

There should be provision of clear procedures/ written guidance describing the key information to be exchanged during shift.

Shifting should be conducted in presence of engineer incharge.

Shifting of barricades records should be maintained and analyzed for payment as per rate mention in vol 02.

Before working on road or along road side, the executing agency shall obtain approval for working on road from Safety Department. Barricade to control or to protect traffic is to be provided as per the norm mentioned below and to be approved by the site-in-charge and the safety officer of the concerned department before starting the job.

Care should be taken to block only one-half of road width at a time. Caution boards and boards indicating diversion are to be placed at both sides of barricade.

Care should be taken while shifting, no damage of the permanent type barricading material for reuse that barricading for next project. If there is found some damages or dismantling of the barricade, it should be paid by contractor.

Installation of a steel poratable barricade

Installation of a steel poratable barricade with horizontal rail 300 mm wide, 2.5m in length fitted on a 'A' frame made with 45x45x5 mm angle iron section,1.5 m in height, horizontal rail painted (2 coats) with yellow and white stripes,150mm in width at an angle of 45°, 'A' frame painted with 2 coats of yellow paint completed as per a s per drawing, IRC SP: 55-2001, and to be installed as per instruction of Engineer-in-charge.

The contractor shall have to deposit all portable barricade specified in item No 6 to SMC's store or depot as per instruction of Engineer in charge in workable condition after completion of work & before submission of final bill. It will be the property of SMC (owner) for which payment made by SMC as per rate mentioned in BOQ (vol.2 of tender). If contractor will not deposit entire portable barricades then SMC will recover the payment for missing barricades as actual made by

SMC. It is contractor's responsibilities to maintain barricades in order & safe guard from damage & thefts.

However, dimensions and other details of barricades under this item shall be as detailed in item description as stated above

ITEM NO:-24.2 : Provision and fixing of traffic signs for limited period at suitable locations as per requirement during the construction in construction zone comprising of warning zone, approach transition zone, working zone and terminal transition zone with a minimum distance of 60 cm from the edge of the kerb in case of kerbed roads and 2 to 3 m from the edge of the carriageway in case of un-kerbed roads, the bottom edge of the lowest sign plate to be not less than 2 m above the road level, fixed on 60 mm x 60 mm x 6 mm angle iron post, founded and installed as per approved design and drawings, removed and disposed of after completion of construction work, all as per IRC:SP:55-2001.

ITEM NO:-24.3 : Provision of metal drum/empty bitumen drum/delineator, 300 mm in diameter, 800 mm high, filled with earth for stability, painted in circumferential strips of alternate black and white 100 mm wide fitted with reflectors 3 Nos of 7.5 cm dia, all as per IRC:SP:55- 2001.

The drums shall be of size 300mm in dia., 800mm height. They shall be constructed of lightweight, flexible and deformable material of plastic so that no damage is caused to the vehicle when stuck. Steel drums shall not be used. They may be of bright red, yellow or white colours. They should be portable enough to be shifted from place to place within a temporary traffic control project to accommodate changing conditions but would remain in place for a prolonged period. the markings on drums shall be horizontal, circumferential, alternative orange and white retro – reflective strips 100 mm wide . Each drum shall have a minimum of two orange and white strips.

Any non- retro reflective spaces between the horizontal orange and white strips shall not exceed 50mm wide. Drums shall have closed tops that will not allow collection of roadwork or other debris. When they are used in regions susceptible to freezing they should have drainage holes in the bottom so that water will not accumulate and freeze, causing a hazard if struck by a motorist. Ballast shall not be placed on top of drum.

The measurement shall be for each piece and payment for each piece for providing and maintenance at site as per the direction of the engineer.

ITEM NO:-24.4 Carrying out Topographic survey in full width of road showing location of inlet chamber, machinehole of storm line & drainage line with total station instrument etc. on existing road along with level survey of road for road profile at minimum 15 mt. class interval with chainage markings on site including C-Section, L-Section & centre line marking of roads as per instruction of engineer in charge.

Carrying out level survey of road for road profile at minimum 15 mt. class interval with chainage markings on site including c/s and l/s and marking centre line of roads as per instruction of engineer in charge.

ITEM NO:-24.5 Supplying and fixing the necessary blinkers, delineators, traffic cones, etc as per site requirement and as directed by engineer in charge

Delineators

Traffic cones, Etc.

Blinkers

Contractor will have to provide and maintaining the blinker during the construction period as per instruction of Engineer in charge. It is contractor's responsibilities to maintain barricades in order & safe guard from damage & thefts.

The measurement shall be for each piece and payment for each piece for providing and maintenance at site as per the direction of the engineer.

PART-VI :

ITEM NO:-25 Milling work of the road surface on Bituminous/Rigid pavements and stacking the same at any of the Municipal Depot/place as directed by Engineer in charge within Surat city limit.

ITEM NO:-25.1 Milling the existing bituminous pavement up to a depth of 50mm by milling machine in a single cutting depth, to make a uniform surface without disturbing the base including diversion of traffic, removing milled materials and disposal of milled material to an approved dumping yard (within 12 km lead) including loading and unloading, all leads and lift, fuel, lubricant charges etc complete

ITEM NO:-25.2 Milling the existing bituminous pavement for a depth more than 50 mm but up to 100 mm by milling machine in a single cutting depth to make a uniform surface without disturbing the base including diversion of traffic, removing milled materials and disposal of milled material to an approved dumping yard (within 12 km lead) including loading and unloading, all leads and lift, fuel, lubricant charges etc complete

ITEM NO:-25.3 milling the existing bituminous pavement for a depth more than 100 mm but up to 200 mm by milling machine in double cutting depth to make a uniform surface without disturbing the base including diversion of traffic, removing milled materials and disposal of milled material to an approved dumping yard (within 12 km lead) including loading and unloading, all leads and lift, fuel, lubricant charges etc complete

ITEM NO:-25.4 Milling the existing bituminous pavement for a depth more than 200 mm but up to 300 mm by milling machine in three cutting depth to make a uniform surface without disturbing the base including diversion of traffic, removing milled materials and disposal of milled material to an approved dumping yard (within 12 km lead) including loading and unloading, all leads and lift, fuel, lubricant charges etc complete.

ITEM NO:-25.5 Milling the existing concrete pavement for a depth up to 50 mm by milling machine including diversion of traffic, removing milled materials and disposal of milled material to an approved dumping yard (within 12 km lead) including loading and unloading, all leads and lift, fuel, lubricant charges etc complete.

PART-VII: MICROSURFACING

Note:- MICROSURFACING work shall have to be carried out on T.P. roads having any road width as directed by Engineer in charge

ITEM NO:-26.1 Providing and laying micro surfacing course comprising of dry fine aggregate conforming to Type-III grading of specification, polymer modified cationic slow setting bitumen emulsion (Having 60% binder content 3.6% polymer), ordinary portland cement, chemical additives and water in the following proportion.

(i) Fine aggregate conforming to type-III grading @ 12 kg. per S.M. of road surface coverage.

(ii) Bitumen emulsion @ 13% by weight of fine aggregate.

(iii) Cement @ 1.5% by weight of fine aggregate.

(iv) Additive @ 2% by weight of fine aggregate.

(Note: (1) This item includes the cost of any bitumen required as tack coat as per the specification, and all the cost of bitumen emulsion, ordinary Portland cement, chemical additives, aggregates and water.

(2) This item includes the crack sealing with bitumen of grade VG 30-sand grout, if any before applying micro surfacing layer.

(3) This item includes the cost of making surface leveled with any mechanical means before applying micro surfacing layer.

ITEM NO:-26.2 Providing and laying micro surfacing course comprising of dry fine aggregate conforming to Type-II grading of specification, polymer modified cationic slow setting bitumen emulsion (Having 60% binder content 3.6% polymer), ordinary portland cement, chemical additives and water in the following proportion.

(i) Fine aggregate conforming to type-II grading @ 9 kg. per sqm. of road surface coverage.

(ii) Bitumen emulsion @ 13.5% by weight of fine aggregate.

(iii) Cement @ 1.5% by weight of fine aggregate.

(iv) Additive @ 1.5% by weight of fine aggregate.

(Note: (1) This item includes the cost of any bitumen required as tack coat as per the specification, and all the cost of bitumen emulsion, ordinary Portland cement, chemical additives, aggregates and water.

(2) This item includes the crack sealing with bitumen of grade VG 30-sand grout, if any before applying micro surfacing layer.

(3) This item includes the cost of making surface leveled with any mechanical means before applying micro surfacing layer.

For Item No. 26

MEASUREMENT AND PAYMENT

MEASUREMENT OF THE WORK

The quantity of micro surfacing measured for payment shall be the number of square meters of paved surface conforming to this specification and accepted by the Engineer.

1.0. GENERAL

In general the guidelines and specifications as mentioned in IRC SP 81-2008 including all tables and appendices shall be considered as a primary reference.

1.1 SCOPE

The work shall include lowering of higher level patchwork to the level as directed by engineer in charge, sealing of cracks with VG 30 grade bitumen-sand grout, the design, testing, construction and quality control required for the proper application of Micro surfacing.

1.2 DESCRIPTION

Micro surfacing is a mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water and other additives, properly proportioned, mixed and spread on a paved surface. The mix will be able to accept traffic after a short period of time and the end product will withstand heavy traffic and maintain a skid resistant surface throughout its service life if properly designed and applied.

1.3 REFERENCED STANDARDS

IS 2386 (Part-1)	Methods of Test for Aggregate for Concrete : Particle size and shape
IS 2386 (Part-3)	Methods of Test for Aggregate for Concrete : Specific gravity, density, voids, absorption and bulking.
IS 2386 (Part-4)	Methods of Test for Aggregate for Concrete : Mechanical Properties
IS 2386 (Part-5)	Methods of Test for Aggregate for Concrete : Soundness
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregate
ASTM D 1664	Test Method for Coating and Stripping of Bitumen-Aggregates Mixtures.
ASTM D 2172	Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.

ASTM D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate
3910 Design, Testing and Construction of Slurry Seal

ASTM E 303 Method for Measuring Surface Frictional Properties Using the British Pendulum Tester,

ASTM E 965 Test Method for Measuring Surface Macrot texture Depth Using a Volumetric Technique

ISSA A 143 Recommended performance guidelines for Micro-Surfacing

ISSA TB 112 Method to Estimate Slurry Seal Spread Rates and to Measure Pavement Macro texture

ISSA TB 145 Test Method for Determination of Methylene Blue Adsorption Value (MBV) of mineral Aggregate Fillers and fines.

1.1.0 MATERIALS

1.1.1 AGGREGATES

The aggregates shall consist of 100% crushed stone, durable, clean and free from earth soil or undesirable particles.

Not less of 90% by weight of the aggregate retained on 4.75 mm sieve shall have at least two fractured faces.

The combined aggregate, when tested according ASTM D2419, shall have a sand equivalent not less than 50. The aggregates methylene blue index when tested according ISSA TB 145, shall be less than 10 mg/g.

Coarse aggregate and parent rock from which the sand is obtained shall conform the requirements in table II-1.

Table II-1. Requirements of aggregates for micro surfacing

Test	Test Method	Requirement
Loss Angeles Abrasion Value ¹	IS 2386 (Part 4)	max. 40%
Aggregate Impact Value 5	IS 2386 (Part 4)	max. 30%
Flakiness and Elongation Indices (Total) ²	IS 2386 (Part 1)	max. 30%
Coating and Stripping of Bitumen Aggregate Mixtures	ASTM D 1664	max. 95%
Soundness (i) Loss with sodium sulphate (ii) Loss with magnesium silphate	IS 2386 (Part 5) 5 cycles 5 cycles	max. 12% max. 18%
Water absorption	IS 2386	max. 2%

1.1.2 MINERAL FILLER

Mineral filler will be ordinary port land cement. At the time of use, it shall be sufficiently dry to flow freely and essentially free from agglomerations. The quantity of filler shall be preferably in the range of 0.5 % to 2 % by weight of dry aggregate.

1. Aggregates may satisfy requirements of either of the two tests.
2. To determine the combine proportion the flaky stone from a representative sample should be first separated out. Flakiness index is the weight of flaky stone particles divided by the total weight of stone sample. Only the elongated particles should be separated out from the remaining (non-flaky) stone metal. Elongation index is the weight of the elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index are added up.

1.1.3 EMULSIFIED ASPHALT

The binder shall be polymer modified cationic bitumen emulsion of Slow Setting grade, complying with following requirement.

It shall be a modified (polymer modified/Latex modified) bitumen emulsion confirming to requirement specified in Table-8. The modifier shall be polymer/rubber preferably synthetic or natural rubber latex blended into bitumen or aqueous phase of emulsion prior to or during the emulsification process. The bitumen emulsion may also be required to be specifically design for the purpose as per the quality and the grading of aggregates for a climatic condition.

The requirement of modified bitumen emulsion for micro surfacing work shall be as per

Table-8 (As mentioned below) of IRC-SP-81-2008 which shall be assured at all the time.

Requirement	Specification	Method of Test
Residue on 600 μ m IS Sieve (Percent by mass), maximum	0.05	IS 8887
Viscosity by say bolt Furol Viscometer, at 250C, in second	20-100	IS 8887
Coagulation of emulsion at low temperature	Nil	IS 8887
Storage stability after 24 h (168 h), %, maximum	2(4)	IS 8887
Particle charge, + ve / - ve	+ ve	IS 8887
Tests on Residue:		
(a) Residue by evaporation, % maximum	60	IS 8887
(b) Penetration at 250C/ 100 g/ 5 s	40-100	IS 1203
(c) Ductility at 270C, cm, minimum	50	IS 1208
(d) Softening Point, in 0C, minimum	57	IS 1205
(e) Elastic recovery*, %, minimum	50	IS 15462
(f) Solubility in trichloroethylene, % minimum	97	IS 1216
Coating ability and water resistance		Annex F
Coating, dry aggregate		IS: 8887
Coating, after spraying		
Coating, wet aggregate		
Coating, after spraying		
Miscibility with water	Nil	Annex H IS:

		8887
Water content in %	Max 40	ASTM D 244
Distillation in %	60 - 0	ASTM D 244
Oil distillate, by volume of emulsion residue in %		

* In case, elastic recovery is tested for Torsional Elastic Recovery as per Appendix-8, the Minimum value shall be 20%.

1. This requirement shall be applicable only under situations where the ambient temperature is below 150C.
2. The residue shall be obtained by distillation when the binder is conventional bitumen and by evaporation for polymer modified binders.

1.1.4 WATER

All water shall be compatible with the slurry mix, and be free of garbage, solids or visually appreciable contaminants.

1.1.5 ADDITIVES

Additives may be used to adjust the break-set of the micro surfacing or improve the resulting finished surface. Its use shall be made initially in quantities determined by the mix design with field adjustments if required.

1.2.0 MIXES

1.2.1 GENERAL COMPOSITION OF THE MIX

A job mixture shall be selected that conforms to the specification limits, and that is suitable for the traffic, climatic conditions, curing conditions and final use.

The mixture shall be one of the types whose characteristics conform to the requirements of Table-II-4. Criteria for the selection of the most suitable type can be found in ISSA A 143, taking into account that the specific conditions of the project can make advisable the use of a different criteria.

Table-II-4. Mix composition and application rates

Sieve Size	Percentage by mass passing	
	Type-II	Type - III
9.5 mm		100
6.3 mm	100	90-100
4.75mm	90-100	70-90
2.36mm	65-90	45-70
1.18mm	45-70	28-50

600 micron	30-50	19-34
300 micron	18-30	12-25
150 micron	10-21	7-18
75 micron	5-15	5-15
Residual bitumen content, % by weight of dry aggregate	7-13	6-11
Application rate of dry aggregates, Kg/m ²	8-12	12-16

1.3.0 MIX PROPERTIES

The mix proportions shall be selected to satisfy the values in Table II-5

Table II-5 : Micro surfacing Mix Properties

Test	Standard	Unit	Limits
Consistency	ASTM D 3910	cm	2-3
Set time	ASTM D 3910	min	15-240
Cure Time	ASTM D 3910	min	max. 480
Loss on Wet Track Abrasion Test	ASTM D 3910	g/m ²	500

It must be noted that laboratory values may vary from site values. Thus, set and cure time should be checked at the maximum temperature expected during construction. The most important factor is that after proper mixing and laying the mix sets and cures quickly so as to permit opening to traffic as soon as possible.

1.4 PAVED SURFACE CHARACTERISTICS

Once the micro surfacing mix is spread and cured, the paved surface shall meet the following requirements :

Table II-6 : Paved Surface Requirements

Test	Standard	Unit	Limits *	
Mix Type			II	III
Surface Texture	ASTM E 965	mm	min. 0.6	Min. 0.8
Skid Resistance coefficient	ASTM E 303	-	min. 0.55	Min. 0.60

* The mix type mentioned here are the same as given in table-II-4.

1.5 DESIGN PROCEDURE

1.5.1 GENERAL

Before work commences, the contractor shall submit a mix design covering the specific materials to be used on the project. This design must have been performed by a qualified laboratory. The mix shall be designed in such a manner that the quantities of various ingredients of mix i.e. Bitumen Emulsion, Cement, Additive; Fine Aggregate shall not be less than the quantities specified in nomenclature of items for Type-III & Type-II micro surfacing, otherwise the mix design shall not be accepted by the Engineer-in-Charge. No extra payment shall be made for the extra quantities used in the Mix Design beyond the quantities of various ingredients specified in the nomenclature of the items.

1.5.2 LABORATORY REPORT

The laboratory report will show the results of tests performed on the individual materials, comparing their values to those required by this specification. The report shall provide the following information.

- a) Characteristics of the materials within the micro surfacing required by this specification.
- b) Dosage of aggregates and mineral filler and resulting aggregate gradation.
- c) Dosage of asphalt emulsion, water and additives as required
- d) Characteristics of the micro surfacing mix, including:
 - Consistency
 - Set time
 - Cure time
 - Loss on Wet Track Abrasion Test

1.6 EQUIPMENT

1.6.1 GENERAL

All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working order at all times.

1.6.2 MIXING EQUIPMENT

The mixing unit shall be truck or trailer mounted. It shall be equipment with a continuous flow mixing unit and will have suitable means of accurately metering each individual material being capable of delivering a predetermined proportion of aggregate, water, additive and asphalt emulsion to the mixer. All feeding mechanism must be continuous feed and proportioning must remain constant at all times. Furthermore, these mechanisms shall allow that the machine can be accurately calibrated and the quantities of materials used during any period can be estimated.

The equipment shall be capable of pre-wetting the aggregate immediately prior to mixing with the emulsion. The mixing unit of the mixer shall be capable of thoroughly blending all of the ingredients together without violent mixing to form a homogenous mass before leaving the

mixer and shall be capable of discharging the mixed product continuously. An electronic flow meter shall be fitted to continuously monitor the delivery rate and quantity of the asphalt emulsion. It is convenient that the mix comes to the spreader box through a diverter that allows to distribute the mix in it as necessary.

The mixing machine shall be equipped with an approved fines feeder that includes an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer. The mineral filler shall be fed at the same time and location as the aggregate.

The machine must be equipped with a water pressure system and fog-type spray bar, adequate for complete fogging with water of the surface receiving the micro surfacing treatment. Fog spray bars can be attached at the front of the vehicle or behind the rear axle.

The machine shall also be fitted with a pump, suitable for refilling the emulsion tank from drums or storage tanks.

1.6.3 SPREADING EQUIPMENT

Attached to the mixer machine shall be a mechanical type squeeze distributor, equipped with flexible material in contact with the surface of the pavement to prevent loss of mix on varying grades and crown by adjustments to ensure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall be adjustable in width. The box shall be kept clean and build up of asphalt and aggregate on the box or in the corners shall not be permitted. Use of burlap drags or other drags may be approved at the discretion of Engineer - in - charge.

The spreader box shall be equipped with hydraulically driven augers with paddles to agitate and distribute the mix evenly in the spreader box without causing segregation.

The equipment shall be maintained in good working order at all times. In particular, the emulsion tank, pumps, pipe work and emulsion fillers shall be checked and cleaned frequently.

1.6.4 COMPACTION EQUIPMENT

The micro surfaced layer shall be compacted with a self-propelled pneumatic tyre roller, with a tyre pressure of 50 PSI (3.4 atm), equipped with water spray system.

1.6.5 AUXILIARY EQUIPMENT

Hand squeegees, shovels, and other equipment shall be provided as necessary to perform the work.

1.7.1 CLEANING EQUIPMENT

Sufficient equipment shall be provided to thoroughly clean the surface to be covered. The equipment shall include: power blowers, air compressors, water flushing equipment and brooms suitable for cleaning the surface and cracks of the old surface

1.8 MACHINE CALIBRATION

Each mixing unit to be used in performance of the work shall be calibrated. Previous calibration documentation covering the exact materials to be used may be accepted provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's metering devices. No machine will be allowed to work on the project until the calibration has been completed and accepted.

1.9 MATERIALS HANDLING AND STOCKPILING

The aggregate shall be stockpiled in an area that drains readily. Precautions shall be taken to prevent contamination of the stockpile by oversize rock, soil or vegetation. The aggregate shall be loaded on to the micro surfacing machine without segregation and shall be protected from prolonged exposure to rain.

The asphalt emulsion may be supplied to the work site in bulk tanks suitably equipped to transfer the emulsion to the micro surfacing machine or in drums.

All water sources shall be checked for suitability and approved by the Engineer before work commences.

1.10 COMPOSITION, RATE OF APPLICATION AND TOLERANCES

1.10.1 COMPOSITION

The percentage of each component shall be as determined by the laboratory mix design after final adjustment in the field. A minimum amount of water shall be added as necessary to obtain a fluid and homogeneous mixture.

A chemical additive diluted in water, or certain quantity of filler, may be added to obtain a workable and homogeneous mixture. The percentage of additive used depends on the type of aggregate, weather conditions and type of emulsion.

1.10.2 RATE OF APPLICATION

Unless otherwise directed by the Engineer-in-charge, the micro surfacing mixture shall be, consisting of aggregate as mentioned in the relevant grading table and at a rate not less than 12 kg per square meter area of road for type III microsurfacing and for microsurfacing type II the same shall not be less than 9 Kg per square meter of surfacing area of road of proper consistency at all times so as to provide the amount required by the surface condition according to Table-II-4. The work shall be carried out as per the job mix approved by the Engineer-in-charge.

1.10.3 TOLERANCES

Tolerances for the micro surfacing mixture and finished surface shall be as follows:

- a) After the designed residual asphalt content is determined, a plus or minus one percentage point variation will be permitted.
- b) The percentage of aggregate passing each sieve shall not differ more than specified for the different sizes in Table-II-7 from the job mix formula.

Table-II-7 : Tolerances for aggregates respect to the job mix formula

Aggregate size	%
> 2.36 mm	± 5
75 micron to 2.36 mm	± 4
< 75 micron	± 2

- c) The mix consistency shall not vary more than ± 0.5 cm from the job mix formula after field adjustments.
- d) The average surface texture shall be not less than specified in Section 3.3.
- e) The average skid resistance coefficient shall be not less than specified in Section 3.3.

1.11 WEATHER LIMITATIONS

The micro surfacing shall not be applied if the ambient temperature is below 50 C No. micro surfacing shall be applied when there is danger that the finished product will freeze within 24 hours.

The micro surfacing shall be placed only when rain is not threatening. It will not be applied if weather conditions prolongs the curing time beyond a reasonable time.

1.12 PREPARATION OF THE SURFACE

1.12.1 GENERAL

Immediately prior to applying the micro surfacing, the surface shall be cleared of all loose material, silt spots, vegetation, oil spots and other objectionable material. Any standard cleaning method will be acceptable except water flushing when cracks are present in the pavement surface.

Manholes, valve boxes, and other service entrances will be protected before micro surfacing application. Care shall also be taken not to pave over drainage grids or similar features.

1.12.2 TACK COAT

If the micro surfacing is going to be placed over a brick or concrete surface, highly absorbent asphalt surface or over a surface where aggregate has become exposed and is polished or slick, a light tack coat shall be applied. The tack coat material shall be a RS or SS type emulsion diluted with water at 1:2 and shall be applied at a rate of about 0.2-0.6 litre/m² using a suitable pressurized asphalt distributor.

1.13 APPLICATION

1.13.1 GENERAL

The surface shall be pre-wetted by fogging ahead of the spreader box if required by local conditions. Water used in pre-wetting the surface shall be applied at such a rate that the either surface is damp with no apparent flowing water in front of the spreader box.

The micro surfacing mixture shall be of the desired consistency upon deposit in the spreader box and no additional elements shall be added at this stage. A sufficient amount of mix shall be carried in all parts of the spreader at all times so that complete coverage is obtained. Overloading of the spreader shall be avoided.

No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregates fines from the coarse aggregate shall be permitted. If the coarse aggregate settles to the bottom of the mix the material shall be removed from the pavement. No excessive breaking of the emulsion shall be allowed in the spreader box. No streaks, such as those caused by oversized aggregate shall be left in the finished pavement.

1.13.2 JOINTS

Build-up of binder on longitudinal and transverse joints shall be kept to a minimum. An excessive overlap will not be permitted on longitudinal joints. The width of spreading will be adjusted to produce the minimum number of longitudinal joints. When possible, longitudinal joints shall be placed on lane lines. Half passes and odd width passes will be used only in minimum amounts.

1.13.3 HAND WORK

Areas which can not be reached with the micro surfacing machine shall be surfaced using hand squeegees to provide complete and uniform coverage. The area to be hand worked shall be lightly dampened prior to mix placement and the mix worked immediately. Care shall be exercised to leave no unsightly appearance from handwork. The same type finish as applied by the spreader box shall be required. Handwork shall be completed during the machine application process.

1.13.4 CURING

The minimum curing time required before opening to traffic shall be agreed with the Engineer and shall be strictly followed. If drying conditions dictate, the curing time may be extended by either the Engineer or the contractor.

1.13.5 ROLLING

Rolling is normally not required on micro surfacing surfaces. However, in the cases described below and when required by the Engineer, the paved surface will be subjected to a minimum of five complete passes, using a roller as described in 5.4.

The areas where rolling can be necessary include: heavily trafficked areas, slopes, areas with very little traffic, runways, taxiways, tight or elevated trunks, truck terminal yards, airfields, intersections and, in general, areas where braking, acceleration and steering turns are likely to occur.

Rolling shall start immediately after clear water appears on the surface of the micro surfacing (no stain on a paper) and no pick up on the tires of the roller occur. When rolling is required, it shall be completed before opening to traffic. Normally no rolling takes place on micro surfacing applied to normal asphalt pavement.

1.13.6 TRIAL SECTIONS

Prior to construction it shall be mandatory to perform trial sections (area not less than 280 sq mt for a length of 80 meter and a width of 3.5 meter) to check the suitability of the equipment. These trial sections shall be a part of the project. Samples will be taken to carry out the tests for its compatibility and suitability for the said project. The trial sections shall be repeated until the satisfactory results are found out of the various tests.

Upon failure of any of the tests, additional trial sections will be required until each mixing unit is authorized to work.

No payment shall be made for trial sections and all the charges incidental for performing and executing the trial sections including all material, labour, fuel what so ever used for it, shall be borne by contractor.

1.14 QUALITY CONTROL

1.14.1 BEFORE CONSTRUCTION

Prior to the beginning of the works the contractor will provide the Engineer with the following:

- a) A 5 liter sample of the asphalt emulsion that is going to be used in the work, together with a certificate from the manufacturer. The certificate must state the type of emulsion, the type of bitumen used the percentage of asphalt residue and the specification the emulsion complies with.
- b) A sample of aggregate mix (10-15 kg) that is going to be used and suitable amount of coarse aggregate 5-20 mm from which the aggregate mix is prepared. The samples shall be submitted with a certificate showing the results in the tests required in section 2. of this specification.
- c) A 5 liter sample of the water to be used throughout the construction period.
- d) A sample of the additives used, if any.

When performing the trial sections, samples of micro surfacing mix shall be taken and analyzed for determination of residual binder content, aggregate gradation and mix consistency. Verification of rate of application will also be made. The suitability of mix shall be such that it can be opened for traffic within the stipulated time as mentioned in this tender. The trial repetitions shall be performed again, even if all other tests are satisfactory but not passing this time criteria.

1.14.2 DURING CONSTRUCTION

Once in the mix design all the characteristics required for the materials and mix have been determined, during construction, the Contractor shall monitor the quality only according the parameters described in the "List of Mandatory Tests" (Annexure "A") and shall provide the Engineer with the corresponding reports. Besides, samples shall be taken and tested when the Engineer will consider it as necessary in order to check any of the characteristics included in this specification.

Minimum control of the process shall include: cone consistency (ASTM D 3910), residual asphalt content from extraction (ASTM D 2172) and aggregate gradation (ASTM C 136) as well as rate of application (ISSA TB 112).

Initially, the number of samples shall be one per each full micro surfacing machine load at project start. After a period of time the number of samples can be reduced at the discretion of the Engineer. However, under no circumstances it will be less than one per work day per machine.

1.14.3 FINISHED SURFACE

One batch will be considered for the purpose of this specification, as two consecutive micro surfacing machine loads, and it will be accepted or rejected as a unit.

- a) Surface texture, according ASTM E 965, not later than 15 days after spreading the micro surfacing.
- b) Skid resistance coefficient, according ASTM E 303, 2 months after the mix has been spread.

c) The finished surface shall be compacted adequately with pneumatic tyre roller as mentioned in the tender.

1.14.4 NON COMPLIANCE

If any two successive tests fail on the stockpile material, the job shall be stopped until the contractor can demonstrate to the Engineer that the conditions have been corrected.

If any two successive tests on the mix from the same machine fail, the use of the machine will be suspended until the contractor can demonstrate to the Engineer that the problems have been corrected and the machine is working properly.

1.15 TRAFFIC CONTROL

Suitable methods of traffic control be used to protect the micro surfacing from all types of traffic until it will be sufficiently cured to support the traffic without damage. The micro surfacing surface should normally be opened to traffic as soon as final breaking of the emulsion has occurred. However, it shall be responsibility of the contractor to determine when the surface is safe for opening to traffic.

1.16 MEASUREMENT AND PAYMENT

1.16.1 MEASUREMENT OF THE WORK

The quantity of micro surfacing measured for payment shall be the number of square meters of paved surface conforming to this specification and accepted by the Engineer.

The quantity of aggregate measured for payment shall be the quantity brought at site and used for the work conforming to this specification and accepted by the Engineer.

The quantity of Polymer modified bitumen emulsion measured for payment shall be the quantity brought at site and used for the work conforming to this specification and accepted by the Engineer.

The quantity of cement measured for payment shall be the quantity brought at site and used for the work conforming to this specification and accepted by the Engineer.

In case that tack coat is applied, it will be measured for payment as square meters treated and accepted by the Engineer.

SCOPE

The work to be executed under this Specification consists of the removal of Asphalt and Concrete surface by cold milling to a specified depth, the hauling of the cold milled material to designated stockpiles and disposal areas and the sweeping of the pavement.

CONTROL OF TRAFFIC

1. The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. When adequate detours or side-tracks are included in the contract, or are otherwise available, traffic shall be temporarily diverted while the work is in progress.
2. If facilities for the diversion of traffic are not available, the Contractor shall arrange the work to provide for the flow of traffic in accordance with the requirements of the control of traffic.
3. In addition, on the approaches to the work and at intervals for the appropriate speed zone, temporary reflectorised signs 'Cycle Hazard Grooved Road', shall be clearly displayed.

4. Notwithstanding the previous paragraph (3) all temporary signage shall comply with the site specific requirements.
5. All traffic control personnel are to possess valid state drivers licences and relevant certification in accordance with the control of traffic.
6. Documentation denoting the names of traffic control personnel and their respective traffic control certification are to be forwarded to the Superintendent for inspection prior to the commencement of work.
7. Notwithstanding the previous clause, inspection of the credentials of traffic control personnel does not place the Superintendent as the guarantor of such documentation.
8. Responsibility pertaining to the qualifications of Traffic Control personnel shall be borne by the Contractors.
9. All costs occurring as a result of obtaining equipment, personnel or services to provide traffic control to comply with the requirements of this Specification shall be borne by the Contractor.

CONTROL OF WORK

1. The Engineer In Charge may direct the depth, width, length, alignment and section of road to be cold milled at any time.
2. The Engineer In Charge may order work to cease temporarily on account of dust nuisance, excessive windrows or loose material, excessive roughness of the cold milled surface or any circumstances which the Engineer In Charge considers may adversely affect the work or public safety.

COLD MILLING OPERATION

1. The operation of the cold milling machine shall be controlled either by levelling beam or string line and automatic sensors unless otherwise approved by the Engineer In Charge.
2. The nominated depth(s) of cut of the cold milling machine shall be as directed by the Engineer In Charge. The cut shall be automatically controlled, with the control set such that the maximum difference in levels between adjacent runs shall not exceed 5mm. The average depth of cut measured across the cut from the adjacent surfaces to the top of the milled surface and at intervals along the work shall not vary by more than 5mm from the specified thickness. When string line and automatic sensors are used the top of the milled surface shall not vary by more than 5mm from the specified depth below the string line.
3. Prior to milling operations the Contractor shall determine, using appropriate equipment such as metal detectors etc, the location of any hidden utilities or buried objects that may be damaged by milling operations. The onus of locating such structures and determining their susceptibility to damage by operations are the sole responsibility of the Contractor.
4. The Contractor shall liaise with the relevant Authorities for all underground utility services within the site of the works. The utility Authorities' contact persons are shown in the general Specification,
5. If in the opinion of the Engineer In Charge, the milled floor contains material that is deemed unsuitable, that material shall be milled to a depth as directed by the Engineer In Charge. Additional payment shall be based upon a square meter rate commensurable with the remainder of the works quoted.
6. When milling near access chambers or other similar structures the cold milling machine shall be operated as close as possible to the structure without causing damage to it. The remaining asphalt and base course shall be removed by hand or other method approved by the Engineer In Charge. A ramp using asphalt shall be formed and compacted around the structure. The ramp shall have a minimum taper length of 1.0m for each 50mm thickness of asphalt and concrete surface removed or part thereof. This work shall not constitute a variation of contract.
7. At the end of the day's work, or whenever the milled pavement is left unattended and reopened to traffic, the work shall be arranged so that no longitudinal or transverse edges of milled asphalt and base course, which can affect traffic, are left unattended. Prior to reopening the milled pavement to unrestricted use by traffic and at the end of the day's work, the final milled lane shall be bevelled such that the maximum lip between the milled run and the unmilled run does not exceed 10mm. When bevelling is not possible, the fall off in levels shall be ramped with milled material.
8. Longitudinal and transverse ramps, used to tie the milled surface into the existing road levels, shall have a minimum taper length of 1m for each 50mm variation in levels or part thereof. Where the speed limit exceeds 60km/h, transverse ramps shall have a taper length of 2.5m for each 50mm.

9. Any material not removed by the cold milling machine adjacent to concrete medians, kerb and gutter or drainage structures such as pit grates shall be removed by hand or other means approved by the Engineer In Charge. When necessary for traffic safety, or when directed by the Engineer In Charge, milled material or asphalt ramps shall be placed by the Contractor.

10. Any weakened planes of asphalt and base course which are not removed by the milling operation but in the opinion of the Engineer In Charge will break up under traffic shall be removed either by an additional pass of the cold milling machine or by other means to the satisfaction of the Engineer In Charge.

11. Following the cold milling operation all loose material shall be removed from the road pavement, gully pits and median areas. The pavement shall be swept and the site left in a clean and tidy state to the satisfaction of the Engineer In Charge. All cold milled material shall be removed from the site and transported to stockpile site(s) or otherwise removed from the site to the satisfaction of the Engineer In Charge.

12. If sub-surface utilities or structures are damaged by milling operations, the Contractor shall notify the relevant Authority and arrange for the damage to be rectified to reinstate the utility or structure to pre-construction condition. All costs associated with such rectification works shall be borne by the Contractor.

13. Prior to covering the milled surface, the Contractor shall arrange to inspect the surface with the Engineer In Charge prior to the removal of milling equipment from site.

TRANSPORT

1. The Contractor shall supply sufficient trucks to enable a continuous output to be achieved by the cold milling machine with minimal delay.

2. When loading by conveyor, the trucks shall back up and maintain a similar speed to the cold milling machine. The driver shall distribute the load of milled material uniformly over the truck body. The Contractor shall comply with all regulations regarding the covering and securing of loads where applicable. The cover shall overlap the truck body by at least 250mm and be tied down securely.

3. Any Shifting Charges for Shifting of Milling Machine/Dumper or any other machineries from one road/one zone to another road/zone for carry out milling work within SMC limit shall be borne by Contractor. No Compensation shall be paid towards such type of Shifting.

4. Any Damages/Settlement/Breakages occurred in Milling machine and any other machineries deployed during the Milling work or shifting or any other reasons shall also be borne by Contractor. Whatever Machineries required to remove/uplift the machineries from settlement portion/fallen Condition of milling machine shall also be arranged by contractor. No compensation shall be given to contractor in such type of cases.

5. If any damages/accident of public properties/Vehicles occurred during work/shifting of machineries (required for subject work) whatever damages Compensation/Expenses done towards such cases, Contractor shall have to take all type of Liabilities in such cases.

DISPOSAL OF MILLINGS

1. Proposed stockpile site(s) shall be nominated by the Engineer In Charge.

2. The cold milled material shall be tipped in orderly stockpiles and not isolated heaps. When measurement is by volume, the stockpiles shall be levelled to a height of 2 metres and be uniform in shape.

3. Where the Engineer In Charge does not wish to keep the R.A.P. , the Contractor will be fully responsible for their disposal. (R.A.P. = Reclaimed asphalt pavement which is the outcome product by process of milling.)

4. Unless otherwise specified or instructed, the milled material shall be stockpiled at the specified depot and the ownership of the milled material will be of S.M.C. In any case if the milled material is not required by S.M.C., the same shall be disposed off by contractor without any extra payment for that.

5. The Contractor shall stock the R.A.P . (R.A.P. = Reclaimed asphalt pavement which is the outcome product by process of milling.) material at specified depots within city limit, as directed by Engineer Incharge. The ownership of the R.A.P material will be of S.M.C.

MEASUREMENT AND PAYMENT

MEASUREMENT OF THE WORK

The quantity of milling work measured for payment shall be the number of square meters of surface conforming to this specification and accepted by the Engineer in charge.

SIGNATURE OF THE BIDDER

Date: -

Place: -

EXECUTIVE ENGINEER
SOUTH WEST (ATHWA) ZONE
SURAT MUNICIPAL CORPORATION.