

DETAIL SPECIFICATION

NAME OF WORK:- Construction of New Road Dahej bye pass to azad garden T.P. ROAD (0/0 to 1/20 km.) Under Bharuch Ankleshwer Urban Development Authority (BAUDA) at Bharuch

ITEM NO - 01	Clearing and grubbing road land including uprooting rank vegetation grass bushes, shrubs, sapling and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials By mechanical means in area of light jungle
	Materials
	JCB machine, tractor
	Workmanship
	The contractor shall clean the site of any trees including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth up to 30 cm measured at a height of 1m above ground level and removal of rubbish up to a distance of 50 m outside the periphery of the area cleared. Jungle clearance shall comprise uprooting of rank vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth up to 30 cm measured at a height of one metre above the ground level. Where only clearance of grass is involved it shall be measured and paid for separately. The roots of trees and saplings shall be removed to a depth of 60 cm below ground level or 30 cm below formation level or 15 cm below sub-grade level, whichever is lower. All holes or hollows formed due to removal of roots shall be filled up with earth rammed and levelled. Trees, shrubs, poles, fences, signs, monuments, pipe lines, cable etc., within or adjacent to the area which are not required to be disturbed during jungle clearance shall be properly protected by the contractor at his own cost and nothing extra shall be payable.
	Mode of measurement and payment:
	The rate shall be for a unit of One Hecter Incl. Complete the Job Describe Above, in all respected manners.
Item No- 02	Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling and consolidation of subgrade in layers at O.M.C. to required dry density including filling the depression which occur during the process using power roller 8T to 10T.(E) From Borrow area within 3.0KM. lead
1.0	The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30 cm and less, loose stones, vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material 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 material 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. In ail cases, the materials shall be disposed off in a neat manner.
2.0	After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes, grades and sections as shown on then plan or directed by the Engineer-in-charge. "The contractor shall provide all labours and materials such as lime, string, 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.S. 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 this respect they may be restored by the department at the cost of the contractor.		
3.0	When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide, shall be cut into existing slope for ensuring adequate bond with the fresh embankment material to be added. The material obtained from the cutting of benches can be utilised in the widening of the embankment. Where the width of the widened portions is insufficient to permit the use of usual rollers, compactions shall be carried out with the help of tandem/sheepfoot rollers, mechanical tampers or other approved plant. The dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other type of hauling equipment.		
4.0	This soil to be used for embankment shall be free from trees, stumps, roots, rubbish or any other objectionable materials. Only materials considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable shall be disposed off as directed by him. The selection of materials to be used in the construction of embankment shall be made after soil survey and investigations are carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side' with all lead and lifts		
	The materials satisfying the density requirements given the table shall be employed for embankment construction.		
	Type of work	Laboratory Dry Density when tested as per IS : 2720 (Pt.VII)	
	-Embankment up to 3 metre height	Not less than 1.44 gm/cc	
	-Embankment exceeding 3 metre height or embankment of any height subject to long period of inundation.	Not less than 1.52 gm/cc	
	-Top 0.5 metre of embankment below the sub grade level and shoulder [Where earth shoulder are specified]	Not less than 1.65 gm/cc	
	Field density shall be a percentage of laboratory density as recommended by the Gujarat Engineering research institute. Location, shape and size of borrow pits shall be as indicated by the Engineer-in-charge. Pits shall not be dug continuously. Ridges of not less than 8 metres width should be left at intervals not exceeding 300 metre. Small drain shall be cut through the ridges of facilities drainage. The outer edge of borrow pits shall be so regulated that the bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of final section of the bank, the maximum depth in any case being limited to 1.5 metres. Also no pits shall be dug within 5 metres of the tow of the final section of the road embankment.		
5.1	No borrow pits shall be allowed at the following sites along the road		
	(i) upto 30 metres on either side of C.D. Works; (ii) upto 15 metres on either side of cart rack crossing for which approaches are to be constructed (iii) in the length in which earth obtained from cutting is specified to be used in the embankment.		
5.2	If there is top layer of black cotton or other objectionable soils, the same shall be removed and disposed off elsewhere and usable material found at lower level will only be used in earthen embankment.		
6.0	The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment.		

	Unless otherwise directed by The Engineer-in-charge. The consolidation including watering and rolling of earthwork shall be carried out by the Department, The operation of laying the successive layer of earth shall have to be suitably synchronized with the consolidation work. If the soil as delivered to the road is too wet, it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm. when being placed in the embankment and a maximum size of 5 cm. when being placed in the top 45 cm. of the embankment. The work of next layers shall be allowed only after the first layer below it has been thoroughly compacted to the density specified.
7.0	Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the step of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing surface, the new material. However when the embankment is to be placed over an old concrete, pavement shall be broken up in pieces not to exceed 0.1 m and may be left under the new-embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt. of the new subgrade level, the same shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.
8.0	To avoid interference with construction of abutments, wing walls or return walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference of damage to the bridge work. Unless directed otherwise the filling around culverts, bridge and other structures up to a distance of twice the height of the embankment from the back of the embankment shall be carried out independent of the work on the main embankment. The fill materials shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days. The embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material the material used for the filler shall conform to the requirement rollers or other heavy equipment, the compaction shall be carried out by mechanical tampers or other methods approved by the Engineer-in-charge. Care shall be taken to see that the compaction plant does not hit or come too close to any structural members so as to cause any damage to them.
9.0	The embankment shall be finished in conformity with the alignment, level, cross sections and dimensions shown on the plans or as directed by the Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulder, road bed and the slopes to conform to the cross section.
10.0	The consolidation of earth work including rolling and watering at O.M.C. as per laboratory requirement shall be carried out by the Department, the field and laboratory investigations and testing of samples shall be carried out by the department. However, the contractor shall give full co-operation and shall bear the charges for layout and collection of samples for testing at authorized Government laboratory. The work of

	<p>laying of earthwork in layers shall be synchronized with the work of compaction and consolidation</p> <p>of the earth work and the operations shall also be synchronized with the field and laboratory testing. When density measurements reveal any soft areas in the embankment, the Engineer-in-charge shall direct that these areas shall be compacted further. In spite of that, specified compactions is not achieved, the materials in the soft area shall be removed as directed and replaced by the approved materials. Deduction of 15% shall be made for the shrinkage from the sectional measurements to be paid to the contractor, if</p> <p>measured before first monsoon and 10% measured after one or more monsoon have passed over the earth embankment.</p>
11.0	<p>The earth work measurements shall be paid on cross sectional measurements and computing the volumes of earth-work in cubic metres by average area method. The contractor shall sign day to day leveling work and also original cross sections in token of his acceptance etc. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual earth work is started. The contractor or his authorised representative shall attend day to day levelling work and sign with date the field book daily, in token of this acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned of any complaint shall be taken. Merely not signing of the level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurement shall be taken on compacted earth work, no deduction for shrinkage shall be made from gross measured quantity of compacted earth work. However the contractor shall have to bear loss of quantity due to all settlement as well as other types of deformations etc. if any that might have taken place at the time of taking the final measurement of this item. If the Compaction as stipulated in para-10 is not done by the department in that case shrinkage from such earthwork quantity shall be deducted as per norms, i.e. 10% after monsoon and 15% before monsoon. 12. The rate of earthwork includes clearing jungles, do gbellling, fixing profiles, erecting necessary pillars or stones for bench mark for leveling purpose, excavating earth from borrow pits, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment to the proper profile camber, grade and slopes. The rate also includes all labour, materials, tools, equipment and incidentals necessary to complete the work according to the specifications. Cutting stuff of cutting in ordinary soil, soft murrum, soft rock, hard murrum and hard rock shall be utilised in embankment construction under this item within the lead specified in that particular item. No payment shall be made under this item for the cutting stuff used in the embankment but labour for cutting will be paid as per specifications in the particular item and only balance quantity brought from borrow pits will be paid in this item.</p>
Item No-03	Box cutting the road surface to proper slope and camber for making a base for road work including removing the excavated stuff and depositing on the road side slope as directed upto 50Mt.lead.
	<p>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,</p>

	<p>stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30 cm. 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.</p>
	<p>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.</p>
	<p>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 deadmen 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 diameter 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</p>

	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.
	Signallers 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 neat stacks at convenient places, without interfering with drainage in any way. The excavated materials shall not be deposited within 3 mt. 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.
	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
	<ul style="list-style-type: none"> i. Filling for roadway embankments ii. Filling existing pits in the right of way as directed by the Engineer including leveling and spreading with all leads and lifts. iii. For landscaping of the road as directed by the Engineer, including leveling 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.
	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.
	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. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.
	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:
	<ul style="list-style-type: none"> 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 up to 50m. iii. Trimming bottoms and slopes of excavation iv. Dewatering v. Disposal of surplus excavated stuff and clearing of site after completion of work. vi. Watering where necessary and compacting to requirements. <p>Erecting all safety provisions and making necessary diversions as directed by Engineer of concerned zone.</p>
Item no:- 04	Dismantling of flexible pavements and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately. (Bituminous Course)
Item no:- 05	Dismantling of flexible pavements and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately. (Granular course)
Item No- 06	Dismantling the existing structure including removing and stacking the dismantled materials as and where directed. (A) R.C.C. work
1.0.	Workmanship:
1.1	The demolition shall consist of demolition of one or more parts of the building as specified or shown in the drawings. Demolition implies taking up or down or breaking up. This shall consist of demolishing whole or part of work including all relevant item as specified or shown in the drawings.
1.2	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 starting the work. This however will not absolve the Contractor from the responsibility of proper and safe demolition.
1.3	Necessary dropping, shoring and 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 in such a way that no damages is caused to the adjoining property.
1.4	Wherever required, temporary enclosures or partitions shall also be provider. Necessary precautions shall be taken to keep the dust nuisance down as and where necessary.
1.5	Dismantling shall be commenced in a systematic manner. All materials which are likely to be damaged by dropping from a height or demolishing roof, masonry etc. shall be carefully dismantled first. The dismantled articles shall be properly stacked as directed.
1.6	AH materials obtained from demolition shall be the property o. Government unless otherwise specified and shall be kept in safe custody untill handed over to the Engineer-in-charge

1.7	Any serviceable materials, obtained during dismantling or demolition shall be separated out and stacked properly as directed, with all lead and lift. All unserviceable materials, rubbish etc. shall be slacked as directed by the Engineer-in- charge.
1.8	On completion of work, the site shall be cleared of all debris rubbish and cleaned as directed
2.0	Mode of measurements & payment:
2.1	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 that employed for construction of work.
2.2	All work shall be measured in decimal system as fixed in its place subject to the following limits, unless otherwise slated hereinafter: (a) Dimensions shall be measured to the nearest 0.01 mt. (b) Area shall be worked out to the nearest 0.01 sq. ml. (c) Cubical connection shall be worked out to the nearest 0.01 Cu. m.
2.3	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 far separating out and stacking the serviceable materials properly and disposing the unserviceable materials with all lead and lift. The rate also includes for temporary storing 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.
2.4	The rate shall be for a unit of one cubic metre
Item No-07	Construction of granular Sub base by providing coarse graded material BTMC 200 mm thick in two layers using metal 53mm to 26.5 mm@ 27.5%, aggregate 26.5 mm to 4.75 mm @ 45% and stone dusts 2.36 mm & below @ 27.5% incl. spreading in uniform layers with motor grader on prepared surface mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density complete as per Clause 401.2 Table 400.1. (Grading-I for subgrade)
Item No-08	Construction of granular Sub base by providing coarse graded material BTMC 200 mm thick in two layers using metal 53mm to 26.5 mm@ 27.5%, aggregate 26.5 mm to 4.75 mm @ 60% and stone dusts 2.36 mm & below @ 12.5% incl. spreading in uniform layers with motor grader on prepared surface mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density complete as per Clause 401.2 Table 400.1. (Grading-V)
	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.
	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).																						
	Grading for Granular Sub-base (GSB-V) Materials																						
	<table><tr><th>IS size (mm)</th><th>Percent by Weight Passing the IS Sieve (Grading-V)</th></tr><tr><td>75.0</td><td>100</td></tr><tr><td>53.0</td><td>80-100</td></tr><tr><td>26.5</td><td>55-90</td></tr><tr><td>9.50</td><td>35-65</td></tr><tr><td>4.75</td><td>25-50</td></tr><tr><td>2.36</td><td>10-20</td></tr><tr><td>0.85</td><td>2-10</td></tr><tr><td>0.425</td><td>0-5</td></tr><tr><td>0.075</td><td>-</td></tr></table>			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	-
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	Physical Requirements for Materials for Granular Sub-bas																						
	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																				
	Construction Operations																						
	Preparation of diameter																						
	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.																						
	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.
	Surface Finish and Quality Control of Work
	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.
	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.
	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
	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.
	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.
	Maximum Permitted Number of Surface Irregularities

	<table><tr><td></td><td colspan="4">Surfaces of carriageways and Paved shoulder</td><td colspan="4">Surfaces of Laybys, Service areas and all Bituminous Base courses</td></tr><tr><td>Irregularity</td><td colspan="2">4 mm</td><td colspan="2">7 mm</td><td colspan="2">4 mm</td><td colspan="2">7 mm</td></tr><tr><td>Length</td><td>300</td><td>75</td><td>300</td><td>75</td><td>300</td><td>75</td><td>300</td><td>75</td></tr><tr><td>Number of Surface Irregularities on Roads of all Category¹⁵</td><td>40</td><td>18</td><td>4</td><td>2</td><td>60</td><td>27</td><td>6</td><td>3</td></tr></table>		Surfaces of carriageways and Paved shoulder				Surfaces of Laybys, Service areas 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 ¹⁵	40	18	4	2	60	27	6	3
	Surfaces of carriageways and Paved shoulder				Surfaces of Laybys, Service areas and all Bituminous Base courses																																
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Number of Surface Irregularities on Roads of all Category ¹⁵	40	18	4	2	60	27	6	3																													
	Rectification																																				
	Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances in Clause 4, 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).																																				
	Arrangements for Traffic																																				
	During the period of construction, arrangement for traffic shall be provided and maintained in accordance with Clause 112.																																				
	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.																																				
	Rate																																				
	The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:																																				
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	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.																																				
Item No-09	Providing and laying of dry lean cement concrete Sub- base over a prepared sub-grade with coarse and fine aggregate conforming to IS: 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per table 600-1, cement content not to be less than 150 kg/ cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, laid with a paver with electronic sensor, compacting with 8-10 tonnes vibratory roller, finishing and curing.																																				
	SPECIFICATIONS FOR DRY LEAN CEMENT CONCRETE (SUB-BASE) (MOR&TH) DRY LEAN CEMENT CONCRETE (SUB-BASE)																																				
	Scope																																				

	The work shall consist of construction of dry lean concrete sub base for cement concrete pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. The work shall include furnishing of all plant and equipment, materials and labour and performing all operations, in connection with the work, as approved by the Engineer.
	The design parameters of dry lean concrete sub-base, viz., width, thickness, grade of concrete, details of joints, if any, etc. shall be as stipulated in the Contract drawings.
	Materials
	Source of Materials:
	The Contractor shall indicate to the Engineer the source of all materials with relevant test data to be used in the lean concrete work sufficiently in advance and the approval of the Engineer for the same shall be obtained at least 45 days before the scheduled commencement of the work. If the Contractor later proposes to obtain the materials from a different source, he shall notify the Engineer for his approval at least 45 days before such materials are to be used.
	Cement:
	Any of the following types of cement may be used with prior approval of the Engineer:
	(I) Ordinary Portland Cement IS : 269 (II) Portland Slag Cement IS : 455 (III) Portland Pozzolana Cement IS : 1489 If the subgrade is found to consist of soluble sulphates in a concentration more than 0.5 per cent, cement used shall be sulphate resistant and shall conform to IS: 6909.
	Cement to be used may preferably be obtained in bulk form. It shall be stored in accordance with stipulations contained in Clause 1014 and shall be subjected to acceptance test prior to its immediate use
	Aggregates:
	Aggregates for lean concrete shall be natural material complying with IS: 383. The aggregates shall not be alkali reactive. The limits of deleterious materials shall not exceed the requirements set out in IS: 383. In case the Engineer considers that the aggregates are not free from din, the same may be washed and drained for at least 72 hours before batching, as directed by the Engineer.
	Coarse aggregate
	Coarse aggregate shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone or crushed gravel and shall be devoid of pieces of disintegrated stone, soft, flaky, elongated, very angular or splintery pieces. The maximum size of the coarse aggregate shall be 25 mm. The coarse aggregate shall comply with Clause 602.2.4.2.
	Fine aggregate:
	The fine aggregate shall consist of clean, natural sand or crushed stone sand or a combination of the two and shall conform to IS: 383. Fine aggregate shall be free from soft particles, clay, shale, loam, cemented particles, mica, organic and other foreign matter. The fine aggregate shall comply with Clause 602.2.4.3.
	The coarse and fine aggregates may be obtained in either of the following manner:
	(I) In separate nominal sizes of coarse and fine aggregates and mixed together intimately before use. (II) Separately as 25 mm nominal single size, 12.5 mm nominal size graded aggregates and fine aggregate of crushed stone or sand or 3 combinations of these two.

	The material after blending shall conform to the grading as indicated in Table 600-1														
	AGGREGATE GRADATION FOR DRY LEAN CONCRETE														
	<table> <tr> <th>Sieve Designation</th><th>Percentage passing the sieve by weight</th></tr> <tr> <td>26.50 mm</td><td>100</td></tr> <tr> <td>19.00 mm</td><td>80-100</td></tr> <tr> <td>9.50 mm</td><td>55-75</td></tr> <tr> <td>4.75 mm</td><td>35-60</td></tr> <tr> <td>600.00 micron</td><td>10-35</td></tr> <tr> <td>75.00 micron</td><td>0-3</td></tr> </table>	Sieve Designation	Percentage passing the sieve by weight	26.50 mm	100	19.00 mm	80-100	9.50 mm	55-75	4.75 mm	35-60	600.00 micron	10-35	75.00 micron	0-3
Sieve Designation	Percentage passing the sieve by weight														
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19.00 mm	80-100														
9.50 mm	55-75														
4.75 mm	35-60														
600.00 micron	10-35														
75.00 micron	0-3														
	Water:														
	Water used for mixing and curing of concrete shall be clean and free from injurious amounts of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in IS: 456.														
	Storage of materials:														
	All materials shall be stored in accordance with the provisions of Clause 1014 of these Specifications and other relevant IS Specifications. All efforts must be made to store the materials in proper places so as to prevent their deterioration or contamination by foreign matter and to ensure their satisfactory quality and fitness for use in the work. The storage place must also permit easy inspection, removal and storage of materials. All such materials even though stored in approved godowns must be subjected to acceptance test immediately prior to their use. The requirement of storage yard specified in Clause 602.2.9 shall also be applicable.														
	Proportioning of Materials for the Mix														
	The minimum cement content shall be 150 kg /cum of concrete and shall be proportioned in accordance with M10 grade.														
	Moisture content:														
	The right amount of water for the lean concrete in the main work shall be decided so as to ensure full compaction under rolling and shall be assessed at the time of rolling the trial length. Too much water will cause the lean concrete to be heaving up before the wheels and picked up on the wheels of the roller and too little will lead to inadequate compaction, a low in-situ strength and an open-textured surface.														
	The optimum, water content shall be determined and demonstrated by rolling during trial length construction and the optimum moisture content and degree of compaction shall be got approved from the Engineer. While lying in the main work, the lean concrete shall have a moisture content between the optimum and optimum +2 per cent, keeping in view the effectiveness of compaction achieved and to compensate for evaporation losses.														
	Cement content:														
	The minimum cement content in the lean concrete shall not be less than 150 kg/cu.m. of concrete. If this minimum cement content is not sufficient to produce concrete of the specified strength, it shall be increased as necessary without additional cost compensation to the Contractor.														
	Concrete strength:														
	The average compressive strength of each consecutive group of 5 cubes made in accordance with Clause 903.5.1.1 shall not be less than 10 MPa at 7 days. In addition, the														

	minimum compressive strength of any individual cube shall not be less than 7.5 MPa at 7 days. The design mix complying with the above shall be got approved from the Engineer and demonstrated in the trial length construction.
	Subgrade
	The subgrade shall conform to the grades and cross sections shown on the drawings and shall be uniformly compacted to the design strength in accordance with these Specifications and Specification stipulated in the Contract. Subgrade material should be of Murrum type in general having CBR value of minimum 8% and Plasticity Index not exceeding 14%. Thickness of the Subgrade should be as indicated in the drawing. Compacted thickness of each layer of Subgrade shall not exceed 200mm and degree of compaction shall not be less than 97%. The lean concrete subbase shall not be laid on a subgrade softened by rain after its final preparation; surface trenches and soft spots, if any, must be properly backfilled and compacted to avoid any weak or soft spot. As far as possible, the construction traffic shall be avoided on the prepared subgrade. A day before placing of the sub-base, the subgrade surface shall be given a fine spray of water and rolled with one or two passes of a smooth wheeled roller after a lapse of 2-3 hours in order to stabilise loose surface. If Engineer feels it necessary, another fine spray of water may be applied just before placing sub-base.
	Construction
	General
	The pace and programme of the lean concrete sub-base construction shall be matching suitably with the programme of construction of the cement concrete pavement over it. The sub-base shall be overlaid with cement concrete pavement only after 7 days after sub-base construction.
	Batching and mixing:
	The batching plant shall be capable of proportioning the materials by weight, each type of material being weighed separately in accordance with Clause 602.9.3.2. The cement from the bulk stock shall be weighed separately from the aggregates. The capacity of batching and mixing plant shall be at least 25 per cent higher than the proposed capacity for the laying arrangements. The batching and mixing shall be carried out preferably in a forced action central batching and mixing plant having necessary automatic controls to ensure accurate proportioning and mixing. Other types of mixers shall be permitted subject to demonstration of their satisfactory performance during the trial length. The type and capacity of the plant shall be got approved by the Engineer before commencement of the trial length. The weighing balances shall be calibrated by weighing the aggregates, cement, water and admixtures physically either by weighing with large weighing machine or in a weigh bridge. The accuracy of weighing scales of the batching plant shall be within ± 2 per cent in the case of aggregates and ± 1 per cent in the case of cement and water.
	The design features of Batching Plant should be such that the shifting operations of the plant will not take very long time when they are to be shifted from place to place with the progress of the work.
	Transporting:
	Plant mix lean concrete shall be discharged immediately from the mixer, transported directly to the point where it is to be laid and protected from the weather by covering the tippers/ dumpers with tarpaulin during transit. The concrete shall be transported by tipping trucks/dumpers, sufficient in number to ensure a continuous supply of material to feed the laying equipment to work at a uniform speed and in an uninterrupted manner.

	The lead of the batching plant to paving site shall be such that the travel time available from mixing to paving as specified in Clause 601.5.5.2 will be adhered to.
	Placing:
	Lean concrete shall be laid/placed by a paver with electronic sensor. The equipment shall be capable of laying the material in one layer in an even manner without segregation, so that after compaction the total thickness is as specified. The paving machine shall have high amplitude tamping bars to give good initial compaction to the sub-base.
	Preferably the lean concrete shall be placed and compacted across the full width of the road, by constructing it in one go or in two lanes running forward simultaneously. Transverse and longitudinal construction joints shall be staggered by 500-1000 mm and 200-400 mm respectively from the corresponding joints in the overlaying concrete slabs.
	Compaction
	The compaction shall be carried out immediately after the material is laid and levelled. In order to ensure thorough compaction which is essential, rolling shall be continued on the full width till there is no further visible movement under the roller and the surface is closed. The minimum dry density obtained shall be 97 per cent of that achieved during the trial length construction vide Clause 601.7. or MDD specified in sanctioned design mix of DLC. The densities achieved at the edges i.e., 0.5 m from the edge shall not be less than 95 per cent of that achieved during the trial construction vide Clause 601.7.
	The spreading, compacting and finishing of the lean concrete shall be carried out as rapidly as possible and the operation shall be so arranged as to ensure that the time between the mixing of the First batch of concrete in any transverse section of the layer and the final finishing of the same shall not exceed 90 minutes when the concrete temperature is above 25 and below 30 degrees Celsius and 120 minutes if less than 25 degrees Celsius. This period may be reviewed by the Engineer in the light of the results of the trial run but in no case shall it exceed 2 hours. Work shall not proceed when the temperature of the concrete exceeds 30 degrees Celsius. If necessary, chilled water or addition of ice may be resorted to for bringing down the temperature. It is desirable to stop concreting when the ambient temperature is above 35°C. After compaction has been completed, roller shall not stand on the compacted surface for the duration of the curing period except during commencement of next day's work near the location where work was terminated the previous day
	Rolling shall be carried out by using vibratory roller of minimum 80-100 KN static weight. The number of passes required to obtain maximum compaction depends on the thickness of the lean concrete, the compatibility of the mix, and the weight and type of the roller etc., and the same as well as the total requirement of rollers for the job shall be determined during trial run by measuring the in-situ density and the scale of the work to be undertaken.
	In addition to the number of passes required for compaction there shall be a preliminary pass without vibration to bed the lean concrete down and again a final pass without vibration to remove roller marks and to smoothen the surface.
	Special care and attention shall be exercised during compaction near joints, kerbs, channels, side forms and around gullies and manholes. In case adequate compaction is not achieved by the roller at these points, use of plate vibrator shall be made, if so, directed by the Engineer.
	The final lean concrete surface on completion of compaction and immediately before overlaying shall be well closed, free from movement under roller and free from ridges,

	low spots, cracks, loose material, pot holes, ruts or other defects. The final surface shall be inspected immediately on completion and all loose, segregated or defective areas shall be corrected by using fresh lean concrete material laid and compacted as per Specification. For repairing honeycombed surface, concrete with aggregates of size 10 mm and below shall be spread and compacted. It is necessary to check the level of the rolled surface for compliance. Any level/thickness deficiency should be corrected after applying concrete with aggregates of size 10 mm and below after roughening the surface. Similarly, the surface regularity also should be checked with 3m straight edge. The deficiency should be made up with concrete with aggregates of size 10 mm and below.
	Segregation of concrete in the dumpers shall be controlled by premixing each fraction of the aggregates before loading in the bin of the batching plant, by moving the dumper back and forth while discharging the mix on it and other means. Even paving operation shall be such that the mix does not segregate.
	Joints:
	Contraction and longitudinal joints shall be provided as per the drawing.
	At longitudinal or transverse construction joints, unless vertical forms are used, the edge of compacted material shall be cut back to a vertical face where the correct thickness of the properly compacted material has been obtained.
	Curing:
	As soon as the lean concrete surface is compacted, curing shall commence. One of the following two methods shall be adopted:
	(A) The initial curing shall be done by spraying with liquid curing compound. The curing compound shall be white pigmented or transparent type with water retention index of 90 per cent when tested in accordance with BS 7542. Curing compound shall be sprayed immediately after rolling is complete. As soon as the curing compound has lost its tackiness, the surface shall be covered with wet hessian for three days. (B) Curing shall be done by covering the surface by gunny bags/hessian, which shall be kept continuously moist for 7 days by sprinkling water.
	Trial Mixes
	The Contractor shall make trial mixes of dry lean concrete with moisture contents like 5.0, 5.5, 6.0, 6.5 and 7.0 per cent using cement content specified and the specified aggregate grading but without violating the requirement of aggregate-cement ratio specified in Clause 601.3.1. Optimum moisture and density shall be established by preparing cubes with varying moisture contents. Compaction of the mix shall be done in three layers with vibratory hammer fitted with a square or rectangular foot as described in Clause 903.5.1.1. After establishing the optimum moisture, a set of six cubes shall be cast at that moisture for the determination of compressive strength on the 3rd and the seventh day. Trial mixes shall be repeated if the strength is not satisfactory either by increasing cement content or using higher grade of cement. After the mix design is approved, the Contractor shall construct a trial section in accordance with Clause 601.7.
	i. If during the construction of the trial length, the optimum moisture content determined as above is found to be unsatisfactory, the Contractor may make suitable changes in the moisture content to achieve a satisfactory mix. The cube specimens prepared with the changed moisture content should satisfy the strength requirement. Before production of the mix, natural moisture content of the aggregate should be determined on a day-to-day basis so that

	the moisture content could be adjusted. The mix finally designed should neither stick to the rollers nor become too dry resulting in raveling of surface.
	Trial Length
	The trial length shall be constructed at least 14 days in advance of the proposed date of commencement of work. At least 30 days prior to the construction of the trial length, the Contractor shall submit for the Engineer's approval a "Method Statement" giving detailed description of the proposed materials, plant, equipment, mix proportion, and procedure for batching, mixing, laying, compaction and other construction procedures. The Engineer shall also approve the location and length of trial construction which shall be a minimum of 60 m length and for full width of the pavement. The trial length shall contain the construction of at least one transverse construction joint involving hardened concrete and freshly laid sub-base.
	The construction of trial length will be repeated till the Contractor proves his ability to satisfactorily construct the subbase.
	i. In order to determine and demonstrate the optimum moisture content which results in the maximum dry density of the mix compacted by the rolling equipment and the minimum cement content that is necessary to achieve the strength stipulated in the drawing, trial mixes shall be prepared as per Clause 601.6.
	After the construction of the trial length, the in-situ density of the freshly laid material shall be determined by sand replacement method with 20 cm diameter density cone. Three density holes shall be made at locations equally spaced along a diagonal that bisects the trial length; average of these densities shall be determined. These main density holes shall not be made in the strip 50 cm from the edges. The average density obtained from the three samples collected shall be the reference density and is considered as 100 per cent. The field density of regular work will be compared with this reference density in accordance with Clauses 601.5.5.1 and 903.5.1.2. A few cores may be cut as per the instructions of the Engineer to check segregation or any other deficiency.
	The hardened concrete shall be cut over 3 m width and reversed to inspect the bottom surface for any segregation taking place. The trial length shall be constructed after making necessary changes in the gradation of the mix to eliminate segregation of the mix. The lower surface shall not have honey-combing and the aggregates shall not be held loosely at the edges.
	The trial length shall be outside the main works. The main work shall not start until the trial length has been approved by the Engineer. After approval has been given, the materials, mix proportions, moisture content, mixing, laying, compaction plant and construction procedures shall not be changed without the approval of the Engineer.
	Tolerances for Surface Regularity, Level, Thickness, Density and Strength
	The tolerances for surface regularity, level, thickness, density and strength shall conform to the requirements given in Clause 903.5. Control of quality of materials and works shall be exercised by the Engineer in accordance with Section 900.
	Traffic
	No heavy commercial vehicles like trucks and buses shall be permitted on the lean concrete sub-base after its construction. Light vehicles if unavoidable may, however, be allowed after 7 days of its construction with prior approval of the Engineer.
	Measurements for Payment

	The unit of measurement for dry lean concrete pavement shall be the cubic metre of concrete placed, based on the net plan areas for the specified thickness shown on the drawings or as directed by the Engineer.
	Rate
	The Contract unit rate payable for dry lean concrete sub-base shall be payment in full for carrying out the required operations including full compensation for all labour, materials and equipment, mixing, transport, placing, compacting, finishing, curing, testing and incidentals to complete the work as per Specifications, all royalties, fees, storage and rents where necessary and all leads and lifts.
	Setting and Drying
	After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.
	Opening to Traffic
	No vehicular traffic shall be allowed on the finished wet mix macadam surface.
	Surface Finish and Quality Control of Work
	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.
	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.
	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
	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.
	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).
	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 diameter 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 re-compacted in accordance with Clause 112. 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.

	Arrangement for Traffic
	During the period of construction, arrangements for traffic shall be done as per Clause 112.
	Measurements for Payment
	Wet mix macadam shall be measured as finished work in position in cubic meters. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm
	Rate
	The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for:
	<ul style="list-style-type: none"> i. making arrangements for traffic to Clause except for initial treatment to verges, shoulders and construction of diversions; ii. supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts; iii. all labour, tools, equipment and incidentals to complete the work to the Specifications; iv. carrying out the work in part widths of road where directed; and v. carrying out the required tests for quality control.
Item No-10	Providing and laying of un-reinforced, dowel jointed, plain cement concrete pavement (concrete Grade M-30) over a prepared sub base with 53 grade cement @ 440 kg per cum, coarse and fine aggregate conforming to IS 383, maximum size of coarse aggregate not exceeding 25 mm, mixed in a batching and mixing plant as per approved mix design, transported to site, laid with a fixed form or slip form paver, spread, compacted and finished in a continuous operation including cost of contraction, expansion, construction and longitudinal joints, joint filler, 200 micron separation membrane, sealant primer, joint sealant, debonding strip, dowel bar, tie rods, admixtures as approved, curing compound, finishing to lines and grades as per drawing.
	CEMENT CONCRETE PAVEMENT
	Scope
	The work shall consist of construction of un-reinforced, dowel joint, plain cement concrete pavement in accordance with the requirement of these specifications and in conformity with the lines, grades and cross sections shown on drawings. The work shall include furnishing of all plants and equipment, materials and labor and performing all operations in connection with work, as approved by Engineer In-Charge.
	The design parameters, viz., thickness of pavement slab, grade of concrete, joint details etc. shall be as stipulated in the drawings.
	Materials
	Source of Material
	The Contractor shall indicate to the Engineer the source of all materials to be used in the concrete work with relevant test data sufficiently in advance, and the approval of the Engineer for the same shall be obtained at least before the scheduled commencement of the work in trial length. If the Contractor subsequently proposes to obtain materials from a different source during the execution of main work, he shall notify the Engineer, with relevant test data, for his approval, at least before such materials are to be used.

	The work shall consist of construction of un-reinforced, dowel joint, plain cement concrete pavement in accordance with the requirement of these specifications and in conformity with the lines, grades and cross sections shown on drawings. The work shall include furnishing of all plants and equipment, materials and labor and performing all operations in connection with work, as approved by Engineer In-Charge.
	The design parameters, viz., thickness of pavement slab, grade of concrete, joint details etc. shall be as stipulated in the drawings.
	Sub Clause
	Cement: Amend the paragraph one as under:
	Adding to sub clause "Portland pozzolana cement (PPC) conforming to (IS: 1489-Part 1) shall only be used."
	Add paragraph-3 as under:
	<p>The Cement procured shall be manufactured by reputed cement producer (except companies having mini plant) with prior permission of the Engineer. The Cement shall be tested at approved laboratory preferably prior to its use in works. The cost of testing shall be borne by the Contractor. In case, the cement test results are not available before its use, the concreting work shall be permitted on the explicit understanding that the Contractor shall remove and redo the work at his own cost in case the cement specimen fails to attain the specified flexural and compressive strength.</p> <p>Contractor shall provide an exclusive cement godown with capacity of minimum 1000 cement bags, under double lock system with one lock of contractor & other of BAUDA Cement from locked godown will be released only by the Engineer</p>
	Sub -Clause Admixtures:
	<p>Add the following at the end of this sub clause:</p> <p>Admixtures containing calcium chloride shall not be used.</p> <p>Add this to the clause</p> <p>Admixture of following brands are permitted only</p>
	Sika, BASF, Cisco, Pidilit or equivalent brand.
	Sub-Clause
	<p>Amend the First sentence of Paragraph one as under:</p> <p>"Aggregates for pavement Concrete shall be natural material complying with IS:383 but with Los Angeles abrasion test results shall not be more than 35 per cent."</p> <p>Refer table 600-2 of MOR&TH 2013 5th Revision</p>

Table 600-2 : Permissible Limits of Deleterious Substances in Fine and Coarse Aggregates

S. No.	Deleterious Substance	Method of Test	Fine Aggregate Percentage by Weight, (Max)		Coarse Aggregate Percentage by Weight (Max)	
			Uncrushed	Crushed*	Uncrushed	Crushed*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Coal and lignite	IS:2386 (Part II)-1963	1.0	1.0	1.0	1.0
ii)	Clay lumps	do	1.0	1.0	1.0	1.0
iii)	Materials finer than 75 μ IS Sieve	IS:2386 (Part I)-1963	3.0	8.0	3.0	3.0
iv)	Soft fragments	IS:2386 (Part II)-1963	–	–	3.0	–
v)	Shale	IS:2386 (Part II)-1963	1.0	–	–	–
vi)	Total of percentages of all deleterious materials (except mica) including SI No. (i) to (v) for col 4, 6 and 7 and SI No. (i) and (ii) for col 5 only		5.0	2.0	5.0	5.0

* Crushed aggregate at least one face fractured

Note: The presence of mica in the fine aggregate has been found to reduce considerably the durability and compressive strength of concrete and further investigations are underway to determine the extent of the deleterious effect of mica. It is advisable, therefore, to investigate the mica content of fine aggregate and make suitable allowances for the possible reduction in the strength of concrete or mortar; in cases where the stretch of the project road passes through micaceous belt.

Coarse aggregates

Coarse aggregates shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone or crushed gravel and shall be devoid of pieces of disintegrated stone, soft, flaky, elongated, very angular or splintery pieces. The maximum size of coarse aggregate shall not exceed 31.5 mm for pavement concrete. No aggregate which has water absorption more than 2 percent shall be used in the concrete mix. The aggregates shall be tested for soundness in accordance with IS:2386 (Part-5). After 5 cycles of testing, the loss shall not be more than 12 percent if sodium sulphate solution is used or 18 percent if magnesium sulphate solution is used. The Los Angeles Abrasion value shall not exceed 35. The combined flakiness and elongation index of aggregate shall not be more than 35 percent.

Fine Aggregates

The fine aggregates shall consist of clean natural sand or crushed stone sand or a combination of the two and shall conform to IS:383. Fine aggregate shall be free from soft particles. clay, shale, loam, cemented particles, mica and organic and other foreign

	matter. The fine aggregates shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS 2720 (Part 37).																		
	Combined Gradation of Fine and Coarse Aggregate Refer table 600-3 from MOR&TH 2013 5th Revision.																		
	<p style="text-align: center;">Table 600-3 : Aggregate Gradation for Pavement Quality Concrete</p> <table border="1"> <thead> <tr> <th>Sieve Designation</th><th>Percentage by Weight Passing the Sieve</th></tr> </thead> <tbody> <tr> <td>31.5 mm</td><td>100</td></tr> <tr> <td>26.5 mm</td><td>85-95</td></tr> <tr> <td>19.0 mm</td><td>68-88</td></tr> <tr> <td>9.5 mm</td><td>45-65</td></tr> <tr> <td>4.75 mm</td><td>30-55</td></tr> <tr> <td>600 micron</td><td>8-30</td></tr> <tr> <td>150 micron</td><td>5-15</td></tr> <tr> <td>75 micron</td><td>0-5</td></tr> </tbody> </table>	Sieve Designation	Percentage by Weight Passing the Sieve	31.5 mm	100	26.5 mm	85-95	19.0 mm	68-88	9.5 mm	45-65	4.75 mm	30-55	600 micron	8-30	150 micron	5-15	75 micron	0-5
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	Water:																		
	Water used for mixing and curing of concrete shall be clean and free from injurious amounts of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in IS: 456.																		
	Sub Clause Equipment for production and processing of aggregates																		
	The Equipment for production and processing of Aggregate for concrete work shall conform to the requirements stated in Additional specification clause Additional technical specification 2																		
	Joint Seals																		
	<p>Amend this clause as under:</p> <p>“The joint sealing compounds shall be of cold applied either poly sulphide or poly urethane/silicone type having flexibility, resistance to age hardening and durability confirming with IRC 57”</p> <p>Cold Pour Sealant shall be one of the following</p> <ol style="list-style-type: none"> 1) poly sulphide IS:11433 part-1, BS:5212 Part-2 2) poly urethane BS: 5212 3) Silicone ASTM 5893-04 <p>Add this to the clause Joint Seals of following brands are permitted only Sika, BASF, Shipra, Pidilit, Perma or equivalent brand.</p>																		
	Sub-Clause Concrete Strength																		
	Sub- Clause The last sentence of this Para shall read as under:																		
	“The water content shall be the minimum required to provide the agreed workability for full compaction of the concrete to the required density as determined by the trial mixes or other means approved by the Engineer and the maximum free water-cement ratio shall be 0.45.”																		
	Add the following at the end of this Clause:																		

	"The concrete for the rigid pavement shall be of minimum M40 Grade with a 28-day compressive characteristic strength of not less than 40 MPa and a flexural strength of not less than 4.5 MPa with a corresponding tolerance factor of 2.33."
	Sub- Clause Workability
	Sub-Clause Delete the last sentence of the para and replace with:
	"The control of workability in the field shall be exercised by Slump Test (IS: 1199) and shall be further confirmed/controlled by Compaction Factor Equipment and the compaction factor shall be in the range of 0.8 to 0.92."
	The Contractor shall carry out laboratory trials of design mix with the materials from the approved sources to be used as per IRC:44. Trial mixes shall be made in presence of the Engineer or his representative and the design mix shall be subject to the approval of the Engineer. They shall be repeated, if necessary, until the proportions, that will produce a concrete which complies in all respects with these Specifications, and conform to the requirements of the design/drawings]
	The proportions determined as a result of the laboratory trial mixes may be adjusted, if necessary, during the construction of the trial length. Thereafter, neither the materials nor the mix proportions shall be varied in any way except with the written approval of the Engineer.
	Design Mix
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	The proportions determined as a result of the laboratory trial mixes may be adjusted, if necessary, during the construction of the trial length. Thereafter, neither the materials nor the mix proportions shall be varied in any way except with the written approval of the Engineer.
	Separation Membrane
	To be added at end of this Clause
	"There shall be no standing water on or under the separation membrane when concrete is placed upon it."
	Weather and Seasonal Limitations Concreting during Monsoon Months
	Concreting should be avoided during rainy season. However, when concrete is being placed during monsoon months and when it may be expected to rain, sufficient supply of tarpaulin or other waterproof cloth shall be provided along the line of the work. Any time when it rains, all freshly laid concrete which had not been covered for curing purposes shall be adequately protected. Any concrete damaged by rain shall be removed and replaced. If the damage is limited to texture, it shall be retextured in accordance with the directions of the Engineer
	Temperature Limitation
	No concreting shall be done when the temperature of the concrete reaching the paving site is above 30°C. Besides, in adverse conditions like high temperature, low relative humidity. Excessive wind velocity, imminence of rains etc., tents on mobile trusses may be provided over the freshly laid concrete for a minimum period of 3 hours as directed by

	the Engineer. To bring down the temperature, if necessary, chilled water or ice flakes should be made use of When the ambient temperature is more than 35°C, no concreting shall be permitted. The iceflakes should not be manufactured from chlorinated water. Generally, the rate of evaporation of water shall not exceed 1 kg/sqm/hour as per IRC:15.No concreting shall be done when the concrete temperature is below 5°C and the temperature is further falling.
	Clause Construction
	Sub Clause Insert the following after sub para (5) after Control Cabin “For more detail description of Batching & Mixing plant please refer additional specification clause 3. Batching & Mixing plant shall also be compliant of all the provisions contained in additional specifications 3.2.”
	Add new clause after clause 602.9.5.6
	i) The final regulation of the surface slab shall be provided by a longitudinal oscillating float travelling across the slab. Before the texture is applied, the longitudinal oscillating float shall complete the traverse of the slab in both directions within the length of the float and shall have a total longitudinal stroke of 200 mm to 300mm.
	ii) The longitudinal float shall either be a separate machine closely following a slip form paver or alternatively it shall be attached to a slip form paver in such a manner that it functions effectively and does not adversely affect the performance of the paver or the surface of the slab.
	iii) The longitudinal oscillating float shall have a minimum length of 3m and a minimum constant width of 250mm with a maximum weight of 10kg/m. The edges of the float shall be curved or chamfered. iv)A minimum length of 500 mm of longitudinal oscillating float shall be within the length of the machine tracks or wheels.
	v) Joint grooves shall be constructed in compliance with Clause 602.6 Where grooves are wet-formed the concrete shall be compacted around the former by a separate vibrating plate compactor with twin plates. The groove former shall be compacted to the correct level by a vibrating pan, which may be included with the transverse joint finishing beam. Final finishing shall be carried out in accordance with sub-Clause (I) of this clause. Any excess concrete on top of the groove former shall be removed before the surface is textured.
	vi) Where a concrete slab is constructed in more than one width or where the edge needs to be matched for one level to another section of surface slab, and the surface levels at the edges are not achieved, the slab shall be supported by separate side forms placed before or after the paver to ensure that edge levels meet the required tolerances.
	<p>Clause Curing</p> <p>Sub clause</p> <p>At the end of second paragraph of this clause add the following; “Additional specification clause A-3 shall also be applicable.”</p> <p>Clause Preparation and Sealing of Joint Grooves</p> <p>Sub Clause Sealing with Sealant</p> <p>Clause Delete this sub clause</p> <p>Clause Add the following at the end of the sub clause:</p>

	“Cold applied polysulphide /poly urethane sealants of either Normal Cure / Fast Cure grade shall be used and applied within the time limit by using gun. Priming over concrete surfaces is not required with polysulphide /poly urethane type sealants.”
	SPECIFICATION FOR PAVEMENT QUALITY CONCRETE FOR ROAD WORK
1.	The Contractors, shall have to purchase cement from open market manufactured by reputed cement companies (as mention in Vol-1). The cement shall be 53 grade PPC conforming to IS 1489 (Part-I), IS: 8112 for physical parameters and IS: 455 for chemical parameters shall be tested at Govt. Approved Laboratory at Contractor's cost as mentioned in Table-1 from special conditions for the Ready-Mix Plant Owners, preferably before its use. In case, the cement test results are not available before its use, the concreting work shall be permitted on the explicit understanding that they will remove and redo the work at their own cost in case the cement specimen fails to attain the specified compressive strength.
2.	PPC conforming to IS 1489 (Part-I), Portland slag cement or mixture of 53 grade cement blended with GGBS, both conforming to IS: 8112 for physical parameters and IS: 455 for chemical parameters will be allowed to be used. Contractor shall provide one independent cement godown with capacity of minimum 25000 cement bags, under double lock system with one lock of contractor & other of BAUDA. Cement from locked godown will be released only by the Engineer.
3.1	Water: The rates proposed in this tender for all concrete and allied works are inclusive of water cost. The Contractors shall have to make their own arrangements at their cost for bringing adequate water of potable quality for mixing concrete, curing purposes, etc., and for this no extra payment will be made.
3.2	The water brought for concreting and curing etc. shall be got tested from the approved laboratory to verify whether it is suitable for above purposes, whenever directed. This testing will be done at Contractor's cost.
3.3	Contractors will have to apply for water connection and avail one metered water connection of suitable size at their cost from nearby Municipal Water main for drinking purposes. The Contractor has to pay the water bill directly to the H.E.'s Department, as per the bill raised by the H.E.'s Department. Condition No. 26 of General Conditions of Contract for Civil works, stands modified to that extent.
4.0	Sand shall be of approved quality with fineness modulus between 2.4 to 3.5 as per approved mix design. The sand will have to be screened to remove the oversized particles and washed to reduce the silt contents below 8% by volume after one hour and to bring it sand. The fine aggregates will be tested as directed by the Engineer.
5.0	If coarse aggregates are found having white spots, the same shall be got tested from approved testing laboratory to eliminate possibility of potential aggregate alkali reactivity before accepting or using spotted aggregates.
6.0	The Contractor should make the necessary arrangement to stock the aggregates separately so that they do not get mixed up with each other and/or with the foreign materials and do not get segregated. The screening of the aggregates shall be done if found necessary as directed by the Engineer.
7.0	The Contractors shall have to bring M.S./Tor steel and structural steel required for this work. M.S./Tor Steel and structural steel shall conform to Indian Standard code of practice requirements of IS: 432, IS: 1139 and IS: 1786. The steel brought on site shall be got tested at Municipal or any other approved laboratory at the Contractors cost before using on site.

	TESTING																														
	To determine the 'K' value, it is necessary to take a plate load test/CBR test within the scope of the work wherever necessary. Contractor shall arrange that his cost for excavation, loading, test and refilling. No payment will be made for this work. For conversion of K-Value to CBR value, the value of CBR/K value shall be adopted																														
	<table border="1"><tr><th colspan="10">APPROXIMATE 'K' VALUE CORRESPONDING TO CBR VALUE FOR HOMOGENOUS SOIL SUBGRADES</th></tr><tr><th>CBR Value (%)</th><th>2</th><th>3</th><th>4</th><th>5</th><th>7</th><th>10</th><th>20</th><th>50</th><th>100</th></tr><tr><th>K- Value (kg/Cm3)</th><td>2.08</td><td>2.77</td><td>3.46</td><td>4.16</td><td>4.84</td><td>5.54</td><td>6.92</td><td>13.85</td><td>22</td></tr></table>	APPROXIMATE 'K' VALUE CORRESPONDING TO CBR VALUE FOR HOMOGENOUS SOIL SUBGRADES										CBR Value (%)	2	3	4	5	7	10	20	50	100	K- Value (kg/Cm3)	2.08	2.77	3.46	4.16	4.84	5.54	6.92	13.85	22
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	from IRC/58 of 1988, as detailed below: -																														
	The recommendations of IRC:15-1981 shall be followed and K-Value of less than 5.10 kg/cm3 tested on the sub grade shall not be permitted. The CBR/ K-value at top of sub grade shall be confirmed as instructed by the Engineer representing BAUDA.																														
8.0	Contractors shall set up a laboratory at site before commencement of work at their cost for performing various tests and at least the following machines and equipment shall be provided therein.																														
	A) 1) Compressive strength testing machine (for cube tests) of minimum 130 tonne capacity, Calibration Certificate of recent calibration made shall be produced before commencement of work. Calibration shall be done every 1 year. Testing machine should be maintained properly. In case of failure, the same shall be repaired or replaced within 2 days. OR																														
	Compressive strength testing machine (for cube tests) of minimum 130 tonne capacity, electrically operated conforming to IS-516 and duly calibrated every 1year. Testing machine should be maintained properly. In case of failure, the same shall be repaired or replaced within 2 days																														
	2) Flexural test machine for testing of beams conforming to IS-516 and duly calibrated every 1 year. Testing machine should be maintained properly. In case of failure, the same shall be repaired or replaced within 2 days																														
	3) Minimum number of moulds for cubes should be 30 Nos.																														
	4) Minimum number of moulds for beam should be 15 Nos.																														
	B) Set of Sieves																														
	C) Laboratory weighing balance of minimum 10 kg. Capacity, with set of standard weights from 1 gm to 5 kg.																														
	D) Aggregate drying equipment's M.S. Tray of 0.6 m x 0.45 m and Kerosene stove or electric hot plate.																														
	E) Equipment for testing of silt content in sand																														
	F) Digital Display thermometer calibrated upto 200 degrees Celsius (for checking concrete temperature).																														
	G) Sieve shaker																														
	H) Kadappa stone platform of size 2.5 m x 0.90 m approx																														

	I) Vibrating table of Size (1 m x 1m).
	J) other machines as may be directed by Engineer.
	All the test records shall be meticulously maintained in the site office and made available as and when required. Contractor must establish this laboratory within 15 days from the date of letter of acceptance of Contract. On failure to establish the laboratory in full a penalty of Rs.300/- per week or part hereof per equipment will be imposed till the Contractor procures the necessary equipment in good working condition.
9.1	Deleted
9.2	Whenever the cubes and beams are required to be sent to the Approved laboratory (As approved by the Engineer-in-Charge), the same shall be transported to the Approved Laboratory by the Contractors at their cost. The acceptance criteria for the test shall be as per I.S. 456. No payment for this will be made to Contractors.
	The Contractors shall arrange to send the cubes and flexural beams to approved material testing laboratory at least two days before the date of testing of the cubes as well as beams failing which penalty of Rupees 500/- per set per day will be imposed and recovered from the Contractors bill. The charges for testing of cubes and beams shall be borne by the Contractors.
	Quality Control in the field shall be exercised on the basis of compressive strength and workability. The maximum water cement ratio shall be 0.40.
9.3	In case the cube test for 28 days period fails, for any particular day's work, a minimum of 2 cores per 150cum. of concrete as per MoRT&H 5th Revision 2013 standards shall be extracted from pavement quality concrete at the locations selected randomly. The average value of test results of 3 cores shall be considered for deciding the concrete strength. The cores shall be extracted preferably from regular size of concrete slab panels (2 on either longitudinal side of the work).
9.4	If average strength fails, the entire quantity of pavement quality concrete poured on that day will not be paid.
	In case the cube test for 28 days period fails, for any particular day's work, additional 3 cores shall be taken from that day's work and will be tested at Contractor's cost. The core will be mini. 150 mm. Dia. If it fails, no payment will be made.
10.1	The density of the compacted concrete shall be such that the total air voids are not more than 3%. The air voids shall be derived from the difference between the density of core and that of concrete cubes taken for the said day's work. The density shall be calculated as per Annexure-VIII. The average value of three cores of at least 150 mm diameter shall be considered.
10.2	All cores taken for density measurements shall also be checked for thickness. In case of doubt, additional cores may be ordered by the Engineer and taken at locations decided by him to check the depth or density of concrete slab without any compensation being paid for the same. Thickness of the slab at any point checked as mentioned above shall have minimum specified thickness as per drawing.
	The cost of the cores and samples to be taken and their testing shall be borne by the Contractors. Cores of slab of M-40 shall be extracted and submitted in the government or NABL approved laboratory approved by the City Engineer. On the failure of compliance of this condition a penalty of Rs.500/- per set per day shall be imposed. However, in circumstances beyond Contractor's control, the matter of waiving penalty will be reviewed by the CEA.

10.3	In calculation of the density, allowance shall be made for any steel in cores. Cores shall be reinstated with epoxy mortar or as directed by the Engineer at the Contractor's costs. In case the cores are taken from the road already opened to traffic, the mix/material adopted for filling shall be such that it will develop the requisite strength in a minimum period. The holes created by cores shall be so filled that these do not shrink. The core holes shall be reinstated within 24 hours of taking cores, failing which a penalty of Rs.1000/- per day shall be charged.
10.4	Core density test shall be carried out in accordance with relevant I.S. Codes. For testing of cores for strength, refer para 17.5
10.5	Sampling and Testing of Beams and Cubes Specimens
	At least three beams and three cube specimens, one set of three each for 7 day and 28-day strength tests shall be cast for every 150 cu.m part thereof) of concrete placed during construction. On each day's work, not less than three pairs of beams and cubes shall be made for each type of mix from the concrete delivered to the paving plant. Each pair shall be from a different delivery of concrete and tested at a place to be designated by the Engineer in accordance with the testing procedure as outlined in Clause 602.3.3. Groups of four consecutive results from single specimens tested at 28 days shall be used for assessing the strength for compliance with the strength requirements. The specimens shall be transported in an approved manner to prevent sudden impact causing fractures or damage to the specimen. The flexural strength test results shall prevail over compressive strength tests for compliance.
	A quality control chart indicating the strength values of individual specimens shall be maintained for continuous quality assurance. Where the requirements are not met with, or where the quality the concrete or its compaction is suspect, the actual strength of the concrete in the slab shall be ascertained by carrying out tests on cores cut at the rate of 2 cores for every 150 cu.m of concrete. The average of the results of crushing strength tests on these cores shall not be less than 0.8 x 0.85 times the corresponding characteristic compressive strength of cubes, where the height to diameter ratio of the cores is two. Where height to diameter ratio is not two, necessary corrections shall be made in calculating the crushing strength of cubes in the following manner:
	The crushing strengths of cylinders with height to diameter ratio between 1 and 2 may be corrected to correspond to the standard cylinder of height to diameter ratio of 2 by multiplying with the correction factor obtained from the following equation:
	$f = 0.11 n + 0.78$ where f = correction factor and
	n = height to diameter ratio
	The corrected test results shall be analysed for conformity with the specification requirements for cube samples. Where the core tests are satisfactory, they shall have precedence for assessing concrete quality over the results of moulded specimens. The diameter of cores shall not be less than 150 mm.
10.6	If, however, the tests on cores also confirm that the concrete is not satisfying the strength requirements, then the concrete corresponding to the area from which the cores were cut should be replaced, i.e., at least over an area extending between two transverse joints

	where the defects could be isolated or over larger area, if necessary, as assessed by additional cores and their test results. The equivalent flexural strength at 28 days shall be estimated in accordance with Clause 602.3.3.2.
	PRE-CONCRETE CONSTRUCTION PHASE:
11	If the contractors excavate certain portion of the road and fails to concrete the same within the stipulated time limit as per the programme, they will be required to reinstate this excavated road portion with bituminous layers as specified and directed by the Engineer. No payment will be made for such restoration.
12	The Contractors will have to obtain NOC from the Traffic Police Department well in advance for closing down the road or part thereof for the execution of the work. The work will have to be carried out in stages depending upon the permission granted by the Traffic Police Department for closure of the road or part thereof. The Contractors should therefore take this into account while quoting.
13	The Contractors should also note that they will have to modify, if required, the detailed programme submitted in the form of BAR Chart or PERT/CPM, considering the permission obtained from Traffic Police before actual starting of the work at site so as to complete the same in the stipulated Contract period.
14	Mix – design to give the target strength as required shall be prepared preferably in accordance with the relevant IRC/IS Specifications. The same shall be done by the contractors and checked by the Engineer. Whenever fresh lot of aggregate is used by the Contractor, the same shall be got checked. For this purpose, gradation analysis of course and fine aggregate shall be performed. The necessary correction shall be made in the mix design accordingly.
15	The mix – design shall preferably conform one of the methods specified in I.S. 10262 or IRC 44. However, preferably the mix design should be done as per details given in IRC-44 of 1976. “Tentative guidelines for cement concrete mix design”
16	In addition to the ingredients mentioned in the bid for preparation of RMC for PQC the contractor shall add fibers may be steel fiber as per IRC: SP:46 or polymeric Synthetic Fibres within the following range of specifications: at the rate of 0.25% by weight of cementations material as directed by Engineer in charge. If PQC will found anywhere without such specified dosage of fibers, a penalty of Rs. 700/- per cumt. Of PQC laid without fibers will be imposed.
	Fibers:
	The fibers may be steel fiber as per IRC: SP:46 or polymeric Synthetic Fibres within the following range of specifications:
	• Effective Diameter : 10 micron – 1.0 mm
	Length : 6-48 mm
	Specific gravity : more than 1.0
	Suggested dosage : 0.6-2.0 kg/cu.m (0.2 -0.6 % by weight of cement in mix).

	Usage will be regulated as stipulated in IRC:44/IS:456 or any other specialist literature.
	Water absorption : less than 0.45 percent
	Melting point of this fiber shall not be less than 160°C.
	The aspect ratio generally varies from 200 to 2000.
	These synthetic fibers will have good alkali and UV light resistance.
	When fibers are used, the mix shall be so designed that the slump at paving concrete is 25±15 mm at site.
	The minimum content of OPC / PPC cement to be used for DLC or PQC shall be as per MoRT&H 5th Revision 2013 & for other grades of concrete required for the subjected project, the same shall be as per table-5 of IS-456 (latest edition at the time of execution).
	The cement to be used, shall be weighed (not on the standard bag basis) while mixing. No claim for excess cement used shall be entertained. If this minimum cement content is not sufficient to produce the strength of concrete specified in the drawing/design, it shall be increased as necessary without additional compensation under the contract, or else the fresh mix design shall be carried out till desired results are achieved.
17	The Granular Subbase should be adequately watered on the previous day and also two hours before starting lean concreting work so as to keep it in moist condition.
18	Double bulkheads for keeping the dowel bars in the proper alignment shall be provided as per drawing, and as directed by the Engineer. Tie bars should not fix in fresh concrete. Tie bars should be aligned exactly perpendicular to finished concrete surface of the slab by means of suitable device to be approved by the Engineer
19	Dowel bars shall be Mild Steel rounds in accordance with details/ dimensions as indicated in the drawings and free from oil, dirt, loose rust or scale. They shall be straight, free from irregularities and the sliding ends sawn or cropped cleanly with no protrusions outside the normal diameters of the bar. The dowel bars shall be supported on double bulk- head or chairs in prefabricated joint assembly position as approved by the Engineer and as detailed in drawing of vol. IV prior to the construction of the slabs.
	Unless shown otherwise on the drawing, dowel bars shall be positioned at the mid depth of the slab within the tolerance of +/-20 mm spaced equally along intended lines of the joints within tolerance of +/-25 mm. They shall be aligned parallel to the finished surface of the slab, to the centre line of the carriage way and to each other within the following tolerance.
	For the bars supported on bulk – head prior to the laying of the slab. All the bars in a joint shall be within +/-4.5 mm per 300 mm length of the bar 2/3rd of the bars shall be within +/-3 mm per 300 mm length of the bar
	No bar shall differ in alignment from adjoining bar by more than 3 mm per 300 mm length of the bar in either horizontal or vertical plane.
	The Dowel bars shall be covered by a sheath of High-Density Polythene pipes of approved quality for half the length plus 25 mm for expansion joints. The sheath shall be tough, durable and of an average thickness, not less than 1.25 mm. The end portion of the sheath shall be plugged with suitable properly tight cap fitting.
	All excavations, trenches, obstructions, materials, etc., taken, kept or stacked on site in connection with the work should be sufficiently barricaded, as per the specifications mentioned in the item included for providing barricade, transverse and longitudinally and blinking lights should be provided at night as directed by the Engineer to prevent against any damage or danger to the traffic. The Contractors shall take all precautions to keep all

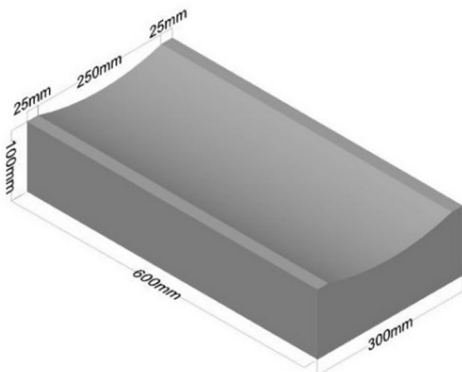
	the blinkers working throughout the night for the guidance of the traffic in the following manner. No extra payment will be made for blinkers. The Contractors should take this in account while quoting for the tender.
	All blinkers shall be red in colour
	At least two blinkers shall be provided across the direction of the traffic
	The Contractors will take any other measures as may be directed by the Engineer from time to time for the safety of the traffic as well as concreted slab etc.
	In the event of contractors not complying with the provisions of this clause, the Engineer may without notice to the Contractors put up the barricade as per the specifications or improve upon the same or improve the lighting or adopt such other measure as he may feel deem necessary and all the cost of such procedures as may be adopted by the Engineer shall be charged to the Contractors in addition to a penalty of Rs.10/- R.M. per day till compliance of these requirements.
20.	CONCRETE BATCHING, MIXING, LAYING & COMPACTION
21.	The laying of M-10 concrete in pavement, will have to be carried out with proper form work only. It shall be ready mix concrete compacted with vibrators and shall have smooth surface. It should have proper cross profile as directed by the Engineer. The surface of M-10 CC shall be maintained smooth till overlaid by slab of M 40. The work will have to be carried out as directed by the Engineer.
	Curing shall be done by covering with Hessian cloth and sprinkling with water for 7 days or till the lean concrete is overlaid by M40. Slab, whichever is earlier, but for a minimum period of 48 hours.
22.	M-10, M-15, M-20, M-40 & above concrete shall be carried out with ready mix concrete only.
23.	For the desired workability, the ready-mix concrete of M 40 will have a slump not more than 25 +/- 10 mm.
24.	Laying of PQC shall be carried out with slip form paving train of required capacity having electronic sensor device with auto dowel bar and Tie bar Insertion.
25.	The water cement ratio shall be strictly adhered to, as per the approved mix design and should be adjusted according to temperature variation during the day of casting of the slab, if found necessary. Care shall be taken to prevent the over vibration and appearance of water / laitance on top surface of the slab. If any excess water is noticed on the surface of the slab, the same shall be removed by moving Hessian cloth on top surface and the concrete mix shall be immediately rectified as directed.
26.	Whenever the needle vibrator is used, the mason must follow with a trowel and punch to the portions of concrete from where the needle vibrator is withdrawn to ensure that no hollow portion remains in the stiff mass of concrete. Plate vibrating shall also follow thereafter immediately.

27	Concrete pavement must be in proper cross profile as per camber prescribed by the Engineer.				
28.1	After the final regulation of the surface of the slab, surface of concrete slab shall be brush – textured in a direction at right angles to the longitudinal axis of the carriageway.				
28.2	The brushed surface texture shall be applied evenly across the slab in one direction by the use of a wire brush not less than 450 mm wide. The brush shall be made of 32- gauge tape wires grouped together in tufts spaced at 10 mm centres. The tufts shall contain an average of 14 wires and initially be 75 mm long. The brush shall have three rows of tufts. The rows shall be 20 mm apart and the tufts in one row shall be opposite the centre of the gap between tufts in the other row. The brush shall be replaced when the shortest tuft wears down to 60 mm. long.				
28.3	The texture depth shall be determined by the sand patch test. The test shall be taken at least once in a week or whenever the Engineer considers it necessary, at times after constructions. 10 individual measurements of the texture depth shall be taken at least 2 Mtr. apart anywhere along the diagonal line across a lane width between points 50 M apart. No measurements shall be taken within 30 mm of the longitudinal edges of the concrete slabs. The texture depth shall not be less than minimum required as per the table below, nor greater than a maximum average of 1.5 mm.				
	<table border="1"> <thead> <tr> <th>Time of Test</th><th>Minimum Texture Depth required</th></tr> </thead> <tbody> <tr> <td>I) Not later than 6 weeks or before the road is opened to public traffic.</td><td>0.65 mm for an average of 10 measurements with no single measurements less than 0.60 mm.</td></tr> </tbody> </table>	Time of Test	Minimum Texture Depth required	I) Not later than 6 weeks or before the road is opened to public traffic.	0.65 mm for an average of 10 measurements with no single measurements less than 0.60 mm.
Time of Test	Minimum Texture Depth required				
I) Not later than 6 weeks or before the road is opened to public traffic.	0.65 mm for an average of 10 measurements with no single measurements less than 0.60 mm.				
28.4	After the application of the brushed texture, the surface of the slab shall have a uniform appearance.				
28.5	Where the texture depth requirements are found to be deficient, the Contractor shall make good the texture across the full lane width over length as directed by the Engineer, by retexturing the hardened concrete surface in an approved manner				
28.6. 1	The following apparatus shall be used for testing the texture depth.				
i	A cylindrical container of 25 ml. internal capacity				
ii	A flat wooden disc 64 mm diameter with a hard rubber disc, 1.5 mm thick, struck to one face, the reverse face being provided with a handle.				
iii	Dry natural sand with a rounded particle shape passing a 300 micron IS sieve and retained on a 150 micron IS sieve.				
28.6. 2	Method – The surface to be measured, shall be dried, any extraneous mortar and loose material removed and the surface swept clear using a wire brush both at right angles and parallel to the carriageway. The cylindrical container shall be filled with the sand, tapping the base 3 times on the surface to ensure compaction, and striking off the sand level with the top of the cylinder. The sand shall be poured into a heap on the surface to be treated. The sand shall be spread over the surface, working the disc with its face kept flat in a				

	circular motion so that sand is spread into a circular patch with the surface depressions filled with sand to the level of the peaks
28.6.3	The diameter of the patch shall be measured to the nearest 5 mm. The texture depth of concrete surface shall be calculated from $31000 / (D \times D)$ mm where D is the diameter of the patch in mm.
29.	It will be the responsibility of the contractor to give the required finish of riding surface by checking with the straight edge and wedge gauge and any deficiency observed shall be rectified as specified in the general specifications for Road Works.
30.	Initial curing shall strictly be done by covering with Hessian cloth and sprinkling with water over the concreted portion as soon as the concrete starts setting. Sprinkling of water be started just after brooming the concrete surface to avoid evaporation of water from the mix. Care should be taken not to disturb, the brushed surface texture.
	Further curing of concrete shall be done by casting 'vatas' in 1m x 1m grid over PQC with cement mortar in 1:6 proportion as directed, for a minimum period of 21 days from the date of casting of c.c. slab.
	A penalty of Rs. 200/- per sq.m. per day will be levied for unattended / broken vatas, And for improper curing.
31	The vertical sides of concrete slab are required to be tarred with hot /cut-back bitumen of 80/100 grade before casting of the adjoining relevant bay. The channels should be erected perfectly in vertical position. Plastic sheet shall properly cover the gaps between two channels and the gaps at the bottom shall be properly sealed in C.M. for which no extra payment will be made.
	The contractors shall have to cast man hole bay, water tables, water entrance bays etc. within 5 days from the date of casting slab, failing which a penalty of Rs. 500/- per set per day shall be levied on contractors.
32	The cement concrete slab pavement in M40 is required to be carried out strictly as per the drawing. As regards thickness no claims on account of additional thickness other than the specified, if provided, will be entertained.
33.	The joints shall be cut within 10 hours to a minimum depth of 90 mm or minimum 1/3rd depth of c.c. bay slab, as directed, failing which these will be got done at contractor's cost and penalty will be levied as directed by Engineer including withholding the payment of adjoining panels of the uncut joints for 5 years.
34	The machine cut joints should be filled in immediately with thermocole as directed by the Engineer till regular dressing of joints is done. No Separate payment will be made for this work.
35	The machine cut joints and expansion joints must be cleaned first by using Raking tool and then air blown with compressor, so as to remove dust, sand particles and foreign matter from the joints before filling them with cold applied liquid sealant of silicon.
	The details of sealing compound and bituminous primer to be followed as per Annexure VII.

36	No separate payment for restoring vattas before and after cutting of joints or damaged on any account shall be made. Such vattas shall be restored immediately by the contractors. After curing period is over, the vattas shall be removed thoroughly, without keeping behind any vatta impression and without damaging the surface texture of the slab
37	The contractors shall observe compliance of following requirement in respect of works of sealing of joint.
38	The joints cut and cleaned shall be got certified from the Engineer before filling with sealing compound as per the specification for sealing of joints in rigid pavements. The spilled over sealing compound if any shall be removed immediately.
39	The regularity of the surface of the slab shall comply with the requirement of following clause.
40.1	Compliance with the requirements of this clause for surface regularity shall be measured using an approved 3 m long straight edge and wedge in such a way as to reveal any and all irregularities. The maximum permitted number of surface irregularity of 4 mm and 7 mm in a length of 300 m shall be 20 & 2 numbers and such irregularities shall be properly recorded in the register.
40.2	Longitudinal irregularity shall normally be measured along any line or lines parallel to the edge of the slab.
40.3	Transverse irregularity shall normally be measured along any line with the straight edge placed at right angles to the center line of the road.
41	If deemed necessary by the Engineer, any section of the slab which deviates from the specified levels and tolerance shall be demolished and reconstructed at the Contractor's expense
42	There shall be a defect liability period of 5 years (60 months) for c.c. pavement
	Any defects in concrete pavement occurring during this defect liability period shall be repaired/ replaced by the contractor in compliance with IRC-SP:83 free of cost. Defects of the concrete pavement shall be identified in compliance with IRCSP:83 by joint site visits of Contractor along with representative of SMC after every monsoon during defect liability period. Defects in concrete pavement thus identified by the joint visit shall be repaired/ replaced in compliance with methods stipulated in IRC-SP:83 within 2 months of identification of such defects during this defect liability period of 7 years.
	PQC panels having crack width up to 1.5mm does not require any repair. Panels having crack width up to 3mm needs to be repaired with Epoxy grouting or any other suitable method as stipulated in IRC-SP:83.
	Whereas PQC panels having crack width exceeding 3mm and d (depth of crack) $> D/2$ (D = depth of slab) are considered as structural cracks and shall be repaired/ replaced as per IRC-SP:83. 50% payment shall be withheld for all panels identified as defective (during

	<p>this defect liability period) due to structural cracks or any other distress (other than crack width upto 3mm) requiring repairs as per IRCSP:83. However, for cracks in Manhole (M.H). bays, entire cost of M.H. bays shall be withheld. The contractor needs to repair/replace & maintain these defective panels during this defect liability period. The withheld amount shall be released on successful completion of repairs/ replacement of these defective panels and its maintenance up to the defect liability period. In case the contractor fails to comply the above, the withheld amount will be considered as penalty and hence will be forfeited. It is obligatory on the part of contractors to take care of such defective panels during the guarantee period. In case of replaced slab, a defect liability period of 7 years shall be enforced from the date of completion of such works. During the defect liability period, dressing of joints complete in all respect shall have to be done free of cost at least once in a year preferably in the month of April or May or as directed by the engineer under supervision of owner. During the initial 2 years of defect liability period contractor shall maintain the thermoplastic paint in visible condition. All eroded and iched/abraded pavement marking shall be redone at contractors cost during this period. Every year during joint inspection pavement Cracking shall also be inspected and attended by contractor. If the Contractor fails to comply with the above conditions, the note of the same will be taken while evaluating the tenders for c.c. road works in future.</p>
42.1	<p>It will be the responsibility of the contractor to arrange for a joint inspection before monsoon every year after completion of the work till the expiry of defect liability period and also at the fag end of the defect liability period. Further, if the contractor fails to do so, the observations made by the staff during site inspection shall be considered for the purpose of noting the defects.</p>
Item No-11	Supply and placing of Kerb Stone of size 600x300x150mm of VYARA make having minimum bending strength 2 Mpa and fixing in appropriate line & level and filling joints with cement:fine sand mortar (1:3). (For Median)
1.0	Material:
	Water shall confirm to M-1, sand shall confirm to M-6, Cement shall confirm to M-3. Pre-cast concrete kerb stone of gray cement based concrete block 35cm length, 30cm height and 15cm thick of M250 grade concrete approved shape.
2.0	Workmanship:
	Sub grade shall be cleaned, levelled, wetted and rammed as directed. kerb stone of approved colour, shape and size, shall be laid in different pattern/design as shown in the drawing or as directed by Consulting Architect/Engineer in charge as directed on top, pressed, tapped gently to bring it in line and level and inter lock with others. The joint shall be as fine as possible. The finished surface shall be true to levels and slopes as directed. Necessary testing of blocks is to be carried out
3.0	Mode of Measurement
	The rate shall include the cost of all materials and labour involved in all the operations described above. The rate shall be for a unit of running meter.

Item No-12	Providing and fixing in position readymade cement concrete Water Drain Channel (600 x 300 x 100 mm) M-30 Grade with all labour, material, testing charge etc. complete as per details in tender specification & as directed by engineer in charge													
														
	<table><tr><td>Sr.</td><td>Parameters</td><td>Minimum Requirements</td></tr><tr><td>1.</td><td>Percentage Water Absorption</td><td>Average not over 6%</td></tr><tr><td>2.</td><td>Tolerance in size (length + breadth)</td><td>± 1.5mm</td></tr><tr><td>3.</td><td>Tolerance in Thickness of block</td><td>± 4mm</td></tr></table>		Sr.	Parameters	Minimum Requirements	1.	Percentage Water Absorption	Average not over 6%	2.	Tolerance in size (length + breadth)	± 1.5mm	3.	Tolerance in Thickness of block	± 4mm
Sr.	Parameters	Minimum Requirements												
1.	Percentage Water Absorption	Average not over 6%												
2.	Tolerance in size (length + breadth)	± 1.5mm												
3.	Tolerance in Thickness of block	± 4mm												
	The face of the kerb shall not exhibit defects such as cracking or flaking when examined													
	For faces described as flat and edges described as straight, the permissible deviations on flatness and straightness are given in Table 1													
	Table 1- Permissible deviations of flatness and straightness													
	<table><tr><td>Length of gauge (mm)</td><td>Permissible deviation of flatness and straightness (mm)</td></tr><tr><td>300</td><td>±1.5</td></tr><tr><td>400</td><td>±2.0</td></tr><tr><td>500</td><td>±2.5</td></tr><tr><td>800</td><td>±4.0</td></tr></table>		Length of gauge (mm)	Permissible deviation of flatness and straightness (mm)	300	±1.5	400	±2.0	500	±2.5	800	±4.0		
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	Bending Characteristic of Kerb as per Table 2													
	Table 2- Bending Characteristic													
	<table><tr><td>Characteristic bending strength (MPa)</td><td>Minimum bending strength (MPa)</td></tr><tr><td>4.5</td><td>4.0</td></tr></table>		Characteristic bending strength (MPa)	Minimum bending strength (MPa)	4.5	4.0								
Characteristic bending strength (MPa)	Minimum bending strength (MPa)													
4.5	4.0													
	The manufacturing company must be an ISO 9001certified Company or should have equivalent quality management systems in place to ensure quality product.													
	The Kerbstone material must be tested at the manufacturer’s laboratory before dispatch for: Bending strength, Water absorption, and dimensional accuracy. Internal test report needed with every supply.													
	Testing to be carried out in accordance with EN 1340.													
Item No-13	Supplying and placing of High Strength interlocking concrete paving block (60 mm thick) of ETA shape (Uni paver) with ISI mark (IS 15658:2006) including 40mm layer of sand for levelling. Colour specified by the architect/site in charge conforming to percentage water absorption not over 6%. Compressive strength 400 Kg/Cum. (For paved shoulder)													

	General			
	This work shall consist of providing and laying 60 mm thick Rubber Dye interlocking concrete block specification & samples over a base layer of 75 mm thick layer of sand of the shape and dimensions shown on the drawings and conforming to these specifications or as approved by the Engineer in charge.			
1.0	MATERIAL			
	Water shall conform to M-1. Cement shall conform to M-3.			
1.0	Rubber Dye interlocking concrete block			
	Rubber dye interlocking concrete block shall be of approved size brand and make as approved by Engineer in charge.			
1.1	The size shape and design of rubber dye interlocking concrete block shall generally be as per manufacturers product or as directed by the Engineer in charge and Architect.			
1.2	The rubber dye interlocking concrete block shall satisfy the tests as regards compress strength transverse strength resistance to wear and water absorption.			
1.3	The colour size shape and design of the rubber Dyed interlocking concrete block shall be directed by Engineer or Architect.			
1.4	The rubber dye interlocking concrete block shall be of best quality as approved by the Engineer In charge. They shall be flat and true to shape. They shall be free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.			
2.0	SAND			
2.1	Sand shall be natural sand, clean well graded, hard strong durable and gritty particular free from immures amounts of dust, clay, kankar modules.			
2.2	For masonry works sand shall confirm to the requirements of IS: 2116.			
2.3	For plain and reinforced cement concrete (PCC and RCC) or pre stressed concrete (PSC) works fine aggregates shall consist of clean, hard strong and durable prices of crushed stone, crushed gravel or suitable combination of natural sand crushed stone or gravel, They shall not contain dust lumps soft or flaky materials mica or other deleterious materials in such quantities as to reduce the strength and durability of concrete, or to attack the embedded steel. Motorized sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregates shall conform to IS L 383 and tests for conformity shall be carried out as per IS : 2386 (Part I to VIII) The contractor shall submit to the Engineer in charge the entire information indicated in Appendix A of IS : 383. The fineness modulus of fine aggregate shall neither be less than 2.00 nor greater than 3.5.			
2.4	Sand fine aggregates for structural concrete shall conform to the following grading requirements as shown in the table below.			
	Fine Sand: The fineness module shall not exceed 1.0 the sieve analysis of fine sand be as under:			
	IS. Sieve Designation	% by wt. passing		
		Zone I	Zone II	Zone III
	10 mm	100	100	100
	4.75 mm	90-100	90-100	90-100
	2.36 mm	60-95	75-100	85-100
	1.18 mm	30-70	55-90	75-100
	600 MC	15-34	35-59	60-79
	300 MC	5-20	8-30	12-40
	150 MC	0-10	0-10	0-10
	Coarse Sand: The fineness modules of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse sand be as under:			
	I. S. Sieve Designation	% by wt. passing		
	4.75 MM	100		

	2.36 MM	90-100	
	1.18 MM	70-100	
	600 MC	30-100	
	300 MC	85-75	
	150 MC	00 -50	
3.0	WORKMANSHIP		
3.1	The rubber dyed interlocking concrete block shall be 60 mm thick for cement concrete M-200 and laid on a layer of 7.5 cm thick layer of coarse sand. The slope in the floors shall be provided in the sub grade. The base layer shall be properly watered, rammed and consolidated. Before laying the pavers blocks, it shall be moisture. Plinth masonry offset shall be depressed so as to allow the sub grade concrete to rest on it.		
3.2	Rubber dyed interlocking concrete block of approved quality shape and design and shall be laid evenly to level and slope as directed by Engineer in charge over a bed of a base layer consisting of 75mm thick sand layer.		
3.3	Laying: The rubber dyed interlocking concrete block shall be laid in plain, diagonal or other pattern as directed. The cement concrete blocks shall be laid properly and set home by gentle taping.		
3.4	End portion of pavement shall be finished with C.M. 1:3 as per detailed drawing etc. complete.		
4.0	MODE OF MEASUREMENT AND PAYMENT		
4.1	The unit rate rubber dyed interlocking concrete block flooring shall include the cost of all materials, tools and plant required for supplying and laying material like brick bats sand pavers blocks, laying of base layer in true level and slope as required applying & placing pavers blocks in position, compacting, finishing, curing.		
4.2	The length and breadth shall be measured correct to a Square meter correct to 2 places of decimal. Length and breadth shall be measured to correct to a centimeter and between the finished the finished face of the skirting, dado or wall plaster and no deduction shall be made nor extra paid for any opening in floors or areas up to 0.1 square meter.		
4.3	The rate shall be for a unit of one Square meter.		
Item No-14	Renovation of manhole by increasing the height at top including cost of excavation refitting of C.I. Manhole frame and cover curing etc. complete incl. all carting and providing of materials which is required for the purpose (except manhole frame and cover) For all type manhole by providing RCC 1:2:4 Partition walls with required reinforcement 25cm thick and circular opening with 500mm clear dia and 0.40mt. Av. Ht.		
	The work shall be carried out for all types of manholes by providing R.C.C. 1:2:4 wall/raising portion, 25 cm thick , with required reinforcement , including forming circular opening of 500 mm clear diameter , and raising the manhole to an average height of 0.40 m , complete in all respects.		
	Scope of work includes:		
	<ul style="list-style-type: none"> • Site clearance and setting out • Excavation around existing manhole as required for execution • Carefully removing and refixing the existing C.I. manhole frame and cover at required new level • Chipping/cleaning of existing manhole surface for proper bond • Providing and laying R.C.C. 1:2:4 for raising portion / partition wall 		

	<ul style="list-style-type: none"> • Providing, cutting, bending, binding and placing of required reinforcement steel • Forming 500 mm clear dia circular opening • Proper compaction, finishing and curing of concrete • Necessary plastering / making good damaged portions if required • Refilling around the manhole after completion • Removal and carting away of malba / surplus earth • Completing the work true to line, level and position as directed by Engineer-in-charge
	Measurement:
	The item shall be measured per number of manhole renovated.
	Rate shall include:
	<ul style="list-style-type: none"> • Labour, materials, tools and plants • Excavation and backfilling • RCC work • Reinforcement • Centering/shuttering • Refixing of existing C.I. frame and cover • Curing, finishing, carting, all leads and lifts • All incidental charges for complete execution
Item No-15	Factory-made Precast Reinforced Cement Concrete Box Culvert of internal size 3.00 m x 3.00 m, manufactured using M-50 grade concrete having required cube compressive strength, reinforced with Fe-500D TMT steel, including design for 5-ton wheel load and suitable for installation under earth cushion ranging from 0.20 m to 3.00 m above the top slab, complete in all respects as per approved drawing, design, specification, transportation, loading, unloading, placing, alignment, jointing, and erection at site.
	The work shall include design, casting, vibration, compaction, curing, demoulding, lifting arrangement, loading at factory, transportation to site, unloading, handling, storage, lowering into position, laying to proper line and level, jointing, sealing, testing and all incidental works required for satisfactory completion of the culvert unit.
	Scope of Work
	The item shall include the following:
	<ul style="list-style-type: none"> • Providing factory-manufactured precast RCC box culvert units of 3.00 m × 3.00 m clear internal size • Concrete of M-50 grade produced from approved design mix with controlled batching • Providing and placing Fe-500D reinforcement steel as per approved structural drawings • Designing the unit for 5 T wheel load

	<ul style="list-style-type: none"> • Suitability of the unit for 0.20 m to 3.00 m earth cushion above top slab • Casting in steel moulds or other approved moulds to achieve true shape, size and finish • Machine mixing, proper vibration and compaction of concrete • Required curing of precast units till specified strength is achieved • Providing necessary lifting hooks / lifting arrangement for safe handling • Loading, transporting and unloading at site without damage • Lowering, placing and fixing the box culvert unit in correct alignment, line and level • Jointing of adjoining units with approved jointing material / mortar / sealant as specified • Finishing the joints smooth, watertight and durable • All labour, machinery, tools, tackles, temporary supports and incidentals required for complete work
	Materials
	1. Concrete Concrete shall be M-50 grade design mix concrete , produced in batching plant or approved controlled system. Cement, fine aggregate, coarse aggregate, water and admixtures shall conform to relevant IS standards. Concrete shall achieve the required strength, durability and workability for precast production.
	2. Reinforcement Reinforcement shall be Fe-500D TMT bars conforming to relevant IS specifications. Reinforcement shall be cut, bent and placed accurately as per approved bar bending schedule and design drawings, with proper cover blocks and tying.
	3. Jointing Material Joints between adjacent precast box units shall be sealed with approved cement mortar / polysulphide sealant / rubber gasket / other approved jointing compound, as specified in the drawings or directed by the Engineer-in-Charge, to ensure proper sealing and serviceability.
	Manufacturing Requirements <ul style="list-style-type: none"> • Units shall be cast in a reputed precast yard / factory under proper quality control • Dimensions shall be accurate and surfaces shall be dense and smooth • Honeycombing, cracks, distortion, edge damage or exposed reinforcement shall not be permitted • Each unit shall be properly cured before dispatch • The precast unit shall attain required handling strength and design strength before transportation • The manufacturer shall submit structural design calculations, reinforcement details, shop drawings and quality control records for approval before manufacture

	<p>Structural Requirement</p> <p>The box culvert shall be structurally designed for:</p> <ul style="list-style-type: none"> • Internal clear opening: 3.00 m × 3.00 m • Design wheel load: 5 Ton • Earth cushion above top slab: 0.20 m to 3.00 m • Dead load, live load, impact load, earth pressure and other relevant forces • Safe lifting, transportation and erection stresses <p>The design shall be prepared and certified by qualified structural engineer and shall conform to applicable IRC / IS codes and approved drawings.</p>
	<p>Transportation and Handling</p> <p>The precast box culvert units shall be transported carefully to avoid cracking, chipping or structural damage. Proper lifting methods, cranes, slings, supports and packing shall be used during loading, unloading and placement. Damaged units shall be rejected.</p>
	<p>Laying and Fixing</p> <p>The unit shall be laid in proper position on prepared bed / foundation already executed under separate item, unless otherwise specified. The box units shall be placed truly to line and level, and adjoining units shall be aligned properly. Joints shall be finished neatly and made serviceable as per specification.</p>
	<p>Quality Control</p> <p>The contractor shall maintain proper quality control for:</p> <ul style="list-style-type: none"> • Concrete mix design approval • Cube strength test results • Reinforcement quality • Dimensional tolerance of units • Surface finish • Proper curing • Handling and erection procedure <p>All tests shall be carried out as per relevant IS codes and records shall be submitted when required.</p>
	<p>Rate Includes</p> <p>The rate shall include:</p> <ul style="list-style-type: none"> • Cost of all materials • Cost of precast manufacture • Reinforcement steel • Moulds, casting, vibration and curing • Loading, transportation, unloading and handling • Lifting and placing in position • Jointing and sealing • Labour, machinery, tools and tackles

	<ul style="list-style-type: none"> • All leads and lifts • Royalty, taxes, insurance, wastage and incidental charges • Complete finished work as per approved design and specification
Item No-16	<p>Cat Eye / Road Stud / RPM: Supplying of Molded Twin Shanks Raised Pavement Markers made of polycarbonate and ABS moulded body and reflective panels with Micro prismatic lens (No Glass bead lens) capable of providing total internal reflection of the light entering the lens face and shall support a load of 13635 kgs. 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 20 mm, 130 mm and 130 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 The color of the marker should be as per the IRC 35-2015 and as directed by Engineer-in-charge.</p>
	<p>The retro-reflective studs are used to supplement Longitudinal/Transverse retro-reflectorize road marking, which would increase visibility in night and adverse weather conditions. The kind of studs that can be used on roads are shown below:</p>
	<p>Some of the key parameters of selecting and installing an RPM are mentioned below:</p>
	<ul style="list-style-type: none"> • Road Stud/ Raised Pavement Marker (RPM) shall be made up of single mould twin shank poly carbonate or ABS Plastic body only. • No Metal Body Road Studs are allowed to use on the road. • No nails shall be used to fix RPM's to avoid safety hazard. Only manufacturer's recommended epoxy adhesives shall be used to fix the RPM • The RPM should have Prismatic lens (No Glass Bead Lens) capable of providing total internal reflection of the light entering the lens face. • 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. • Road studs with anchorage (Shanks) are to be used on the Bituminous roads and the anchorage (Shanks) shall be applied ensuring proper workmanship so that pavement structure will not be affected during installation process. However, the road studs with Anchorages (Shanks) are not recommended for concrete roads. For Concrete roads the fixing should be done with Epoxy Adhesive or as recommended by the manufacturer. <p>The installation of RPM's shall be done only by authorized Converters or Applicators as per the installation instructions given by the manufacturer like 3M or other reputed brands.</p>
	<p>As per Clause 804 of MoRTH</p> <p>Material Details of RPM: RPM/Road stud shall be made of plastic body moulded from Polycarbonate or ABS. It should support a load of 13,635 KG tested in accordance with ASTM D 4280. It should consist of Reflective panels with Micro-prismatic lens capable of providing total internal reflection of the light entering the lens face</p>
	<p>Design:</p> <p>The slope of retro-reflecting surface shall be 35±5° to the base Area of retro-reflecting surface: shall not be less than 13 Sq.cm Optical Performance: All the studs should comply to Tables 800-</p>

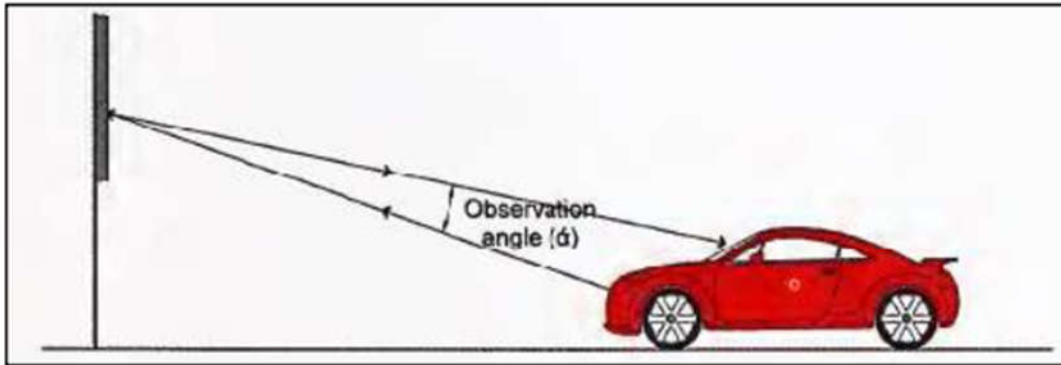
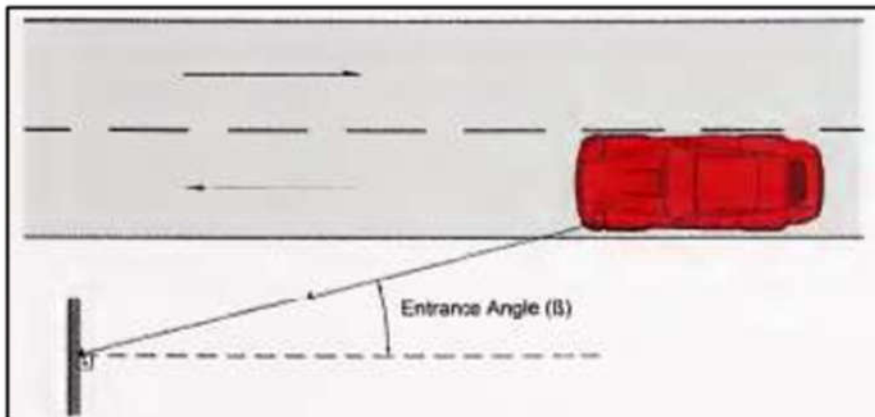
	13 and 800-14 for Coefficient of Luminous Intensity (C.I.L) values. The stud shall not have C.I.L of less than 2 mcd/lx.
	Dimensions: • Length: Not More Than 130mm Width: Not More Than 130mm • Height: Not less than 10mm and Not more than 20mm • Shank diameter: Not Less than 20mm+/-2mm • Shank Height: Not less than 30mm+/-2mm
	Color Scheme & Placement Details for RPM on Various Roads
	The placement details are given below as per Table 5.2 of IRC:35 2015 for undivided and divided carriageways along-with the diagrams The usage of different colours of RPM are as under: a. Centre Line/Traffic Lane Line: White Color RPM/Road Studs b. Shoulder Side Edge Line: Red Color RPM/Road Studs c. Median Side: Yellow Color RPM/Road Studs d. Centre Line with No Overtaking: Yellow Color RPM/Road Studs
	Mode of Measurement
	The rate shall be for a unit of the One number.
Item No-17	STOP Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 cms Octagone as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting
	Materials:
	☐ Sign Board: The STOP sign shall be made out of a 2mm aluminium sheet or 4mm Aluminium Composite Panel (ACP) , ensuring durability and strength. ☐ Size: The sign shall be 90 cm Octagonal as per the design specified in IRC-67-2012 .
	Pre-treatment and Coating:
	☐ The board shall undergo a phosphating process followed by acid etching to prepare the surface for optimal coating adhesion. ☐ It shall be coated with one coat of epoxy primer and two coats of high-quality epoxy paint to provide a robust and weather-resistant finish
	Reflectorizing:
	☐ The board shall be reflectorized with Micro Prismatic Grade retro-reflective sheeting of Type-11 , conforming to ASTM D-4956 and the latest M.O.S.T. Specifications . ☐ The retro-reflective sheeting shall meet Class-C specifications.
	Sign Stand/Post:

	<p>☐ The post supporting the sign shall be 3.6 meters long and made from 75 x 75 x 6mm MS (Mild Steel) square pipe or 65NB circular MS pipe, depending on the requirement.</p> <p>☐ The frame shall be fabricated using iron angles of size 35 x 35 x 3mm to provide stability and support.</p> <p>☐ The post and frame shall be painted with high-quality epoxy coatings in black and white for visibility and durability.</p>
	Installation:
	<p>☐ The installation of the sign shall be carried out in a 1:2:4 concrete mix (CC block) with a block size of 45 x 45 x 60 cm for each leg.</p> <p>☐ The installation includes all works related to excavation, curing, and ensuring proper alignment and stability of the structure, as per the directions of the Engineer-in-Charge.</p>
	Warranty and Testing:
	<p>☐ A 10-year warranty for the retro-reflective sheeting shall be provided by the original manufacturer.</p> <p>☐ A certified copy of a 3-year outdoor exposure test report from a third-party test lab for the product offered shall be submitted by the contractor to ensure the longevity and performance of the reflective materials.</p>
	Sign Details:
	The symbol and layout of the sign shall be in accordance with the instructions given by the Engineer-in-Charge , ensuring compliance with the applicable road signage regulations and standards
	Completion and Supervision:
	The entire process, from fabrication to installation, shall be completed under the supervision of the Engineer-in-Charge , ensuring that all specifications are met and the installation is performed safely and securely.
	Mode of Measurement
	The rate shall be for a unit of the One number.
Item No-18	<p>Cautionary Warning Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); 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 Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor</p>

	exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting
1.	Four type of boards viz. Cautionary, Informatory, Mandatory and Directional Boards shall be as per IRC: 67-2012 as shown in the drawings.
2.	The square plate and rectangle 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 3 mm)
5.	The rates included 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 Indian, 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
11	(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.
12	(c)The payment shall be released only after the successful bidder produces the certificate regarding the "Quality and Guarantee" of the sheeting and the material supplied in the form prescribed by the Engineer-in-charge.
13	Successful bidder shall be responsible for safe delivery, erecting of the boards at various locations of Bharuch.
14	<ul style="list-style-type: none"> The rates shall be inclusive of all taxes, charges, freights, etc. & erection as directed by Engineer-in-charge.
15	<ul style="list-style-type: none"> 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.	The material shall be inspected / tested by BAUDA 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.

18.	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.
19.	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, BAUDA. shall be at its discretion to terminate the contract and security deposit shall be forfeited.
20.	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 mention in the BOQ and as per drawing for each leg including excavation, curing etc. complete under the supervision of Engineer-in-charge. (A) High Intensity Grade.
	•
1.	• GENERAL
	• 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.
	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.
2	MATERIALS
	The various materials and fabrication of the traffic signs shall conform to the following requirements
2.1	Concrete
	Concrete shall be of M25 grade
2.2	Reinforcing steel
	Reinforcing steel shall conform to the requirements of IS:1786 unless otherwise shown in the drawing. Bolts. nuts, washers, high strength bolts shall conform to IS:1367 whereas precision bolts, butts etc. shall conform to IS:1364.
2.3	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. Size of base plates as per BOQ and drawings
2.4	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.
2.5	Aluminum 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 aluminum with overall thickness of 4 mm and 3 mm, and aluminum 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 aluminum 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 6.1, when tested in accordance with the test methods mentioned against each of them.																																																																				
3.0	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 aluminum and 3 mm thick with aluminum composite material. All other signs shall be at least 2 mm thick with aluminum and 4 mm thick with aluminum 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 aluminum composite material shall be minimum 4 mm thick to withstand wind and other loads without deformation.																																																																				
	Table 1: Specifications for Aluminum																																																																				
	<table><tr><th rowspan="2">S.No.</th><th rowspan="2">Description</th><th colspan="2">Specification for 4 mm</th><th>Specification for 3 mm</th></tr><tr><th>Standard Test</th><th>Acceptable Value</th><th>Acceptable Value</th></tr><tr><td colspan="5">A Mechanical Properties of ACM</td></tr><tr><td>1</td><td>Peel off strength with retro reflective sheeting. (Drum Peel Test)</td><td>ASTM D903</td><td>Min. 4 N/mm</td><td>Min. 4 N/mm</td></tr><tr><td>2</td><td>Tensile strength</td><td>ASTM E638</td><td>Min. 40 N/mm²</td><td>Min. 30 N/mm²</td></tr><tr><td>3</td><td>0.2% Proof Stress</td><td>ASTM E638</td><td>Min. 34 N/mm²</td><td>Min. 34 N/mm²</td></tr><tr><td>4</td><td>Elongation</td><td>ASTM E638</td><td>Min. 6 %</td><td>Min. 5 %</td></tr><tr><td>5</td><td>Flexural strength</td><td>ASTM C393</td><td>Min. 130 N/mm²</td><td>Min. 120 N/mm²</td></tr><tr><td>6</td><td>Shear strength with punch shear test</td><td>ASTM D732</td><td>Min. 18 N/mm²</td><td>Min. 18 N/mm²</td></tr><tr><td colspan="5">B Properties of Aluminium Skin</td></tr><tr><td>1</td><td>Tensile strength (Rm)</td><td>ASTM E8</td><td>Min. 150 N/mm²</td><td>Min. 130 N/mm²</td></tr><tr><td>2</td><td>Modulus of elasticity</td><td>ASTM E8</td><td>Min. 70,000 N/mm²</td><td>Min. 70,000 N/mm²</td></tr><tr><td>3</td><td>Elongation</td><td>ASTM E8</td><td>A₅₀ Min. 2%</td><td>A₅₀ Min. 2%</td></tr><tr><td>4</td><td>0.2 % Proof Stress</td><td>ASTM E8</td><td>Min. 110 N/mm²</td><td>Min. 110 N/mm²</td></tr></table>	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
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	In respect of sign sizes not covered by IRC:67-2012, the structural details (thickness etc.) shall be as per the approved drawings.																																																																				
4.0	Having retro-reflective sheeting																																																																				
4.1	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 Indiameter 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.
4.2	Selection of sheeting
	Performance characteristics of sheeting Type I to Type IX used for road signs are presented respectively in Table.3 to Table .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 radiameteration. "Observation angle (symbol α)" is the angle between the illumination axis and the observation axis as shown in Fig. 1.1.
	 <p style="text-align: center;">Fig. 1.1</p>
	"Entrance angle (symbol β)" 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. 1.2
	 <p style="text-align: center;">Fig. 1.2</p>

	"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 -L) on the retro reflective plane at right angles to the direction of the incident light and the illuminated plane sample surface A																																																									
	<p>R' = I / E -1* A</p> <p>The coefficient of retro-reflection R' is expressed in candle per square meter per lux. 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 delinator posts.</p>																																																									
	Table 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.																																																									
	<div><p>Table 2 Suggested Guidelines for Usage of Retro-Reflective Sheeting</p><table><tr><th rowspan="2">Class of Sheeting</th><th rowspan="2">Type of Sheeting (ASTM)</th><th colspan="5">Category of Road</th></tr><tr><th>National/ State Highway</th><th>Major District Roads</th><th>Rural Roads</th><th>Urban/ City Roads</th><th>Expressway</th></tr><tr><td rowspan="2">Class A</td><td>Type I</td><td>No</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td></tr><tr><td>Type II</td><td>No</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td></tr><tr><td rowspan="2">Class B</td><td>Type III*</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td><td>No</td></tr><tr><td>Type IV</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td><td>No</td></tr><tr><td rowspan="3">Class C</td><td>Type VIII</td><td>Yes</td><td>No</td><td>No</td><td>Yes</td><td>Yes</td></tr><tr><td>Type IX</td><td>Yes</td><td>No</td><td>No</td><td>Yes</td><td>Yes</td></tr><tr><td>Type XI</td><td>Yes</td><td>No</td><td>No</td><td>Yes</td><td>Yes</td></tr></table></div>	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
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	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.																																																									
	Class A (Engineering grade sheeting)																																																									
	• 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 3																																																									

Table 3 Acceptable Minimum Co-efficient of Retro-Reflection for Type I Engineering Grade Sheeting (Candels as 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.

• **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 4.

Table 4 Acceptable Minimum Coefficient of Retro-Reflection for Type II Super Engineering Grade Sheeting (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

Class B (High intensity grade sheeting)

• **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 Table5.

Table 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° ^E	+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.

• 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 6.

Table .6 Acceptable Minimum Co-efficient of Retro-Reflection for Type IV High Intensity Micro-Prismatic Grade Sheeting A

(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.																																																																																				
	Class C (Micro prismatic grade sheeting)																																																																																				
	• 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 7.																																																																																				
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	<ul style="list-style-type: none">5 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.																																																																																																			
	<ul style="list-style-type: none">6 Fabrication																																																																																																			
	<ul style="list-style-type: none">Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminum 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 retroreflective sheeting. If the surface is rough, approved																																																																																																			

	<p>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.</p>
	<p>7 Messages/Borders</p>
	<p>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 informatory and other sign boards, the messages (legends, letters, numerals etc.) and borders shall be cutout 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 3 to Table 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.</p>
	<p>8 Warranty and Durability</p>
	<p>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.</p>
	<p>9 Installation</p>
	<ul style="list-style-type: none"> 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 grounded by means of properly designed on. The work of foundation shall conform to relevant specification as specified.
	<p>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.</p>
	<p>10 Measurements for payment</p>

	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.
	11 Rates
	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
	Providing, fixing and fabricating G.I. Pole/ Pipe (B-Class) having a diameter of 6.00 inch and total height 10.5 mt. (clear height - 6.5 mt. vertical and 3.00 mt. horizontal) with synthetic enamel paint (one coat red oxide and two coats of require colour) at the top. 8 ft x 4 ft - 3 mm thick Aluminum sheet supported with frame fabricated from suitable size M.S. angle 40 mm x 40 mm x 6 mm with synthetic enamel paint and provide with 3 m Retro reflective sheeting as a back ground plate dis-planning "Directions/places" in Retro reflective inclusive delivery and foundation of C.C. 1:2:4 at site complete as per attached design sketch.
	Contractor have to carry out work as above-mentioned requirement and As per drawing.
Item No-19	Regulatory / Mandatory Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 60 cms Dia Circle 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 Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting
	Specification as per Item no. 18
	Mode of Measurement
	The rate shall be for a unit of the One number.
Item No-20	Distance Informatory / Destination Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 180x120 cms. rectangular 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 Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 4.0mtr long (2 Nos.) stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50 x 50 x 5mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty

	for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting
	Specification as per Item no. 18
	Mode of Measurement
	The rate shall be for a unit of the One number.
Item No- 21	Facility Informatory Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 80 x 60 cms rectangular 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 Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting
	Specification as per Item no. 18
	Mode of Measurement
	The rate shall be for a unit of the One number.
Item No- 22	Place Identification Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 150x90 cms. rectangular 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 Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 4.0mtr long (2 Nos.) stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting
	Specification as per Item no. 21
	Mode of Measurement
	The rate shall be for a unit of the One number.

Item No-23	<p>Hazard Marker Sign :-Providing and fixing sign boards made out of 1.5 mm aluminium sheet / 3 mm ACP (Aluminum composite Panel); size 90x30 cms. rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 1.8mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting</p>
	<p>Materials:</p>
	<p>☑ Sign Board: The Hazard Marker sign shall be made from 1.5 mm aluminium sheet or 3 mm Aluminium Composite Panel (ACP), providing sufficient strength and durability for long-term outdoor use.</p> <p>☑ Size: The sign shall have a rectangular shape, with dimensions of 90 x 30 cm, as per the design outlined in IRC-67-2012.</p>
	<p>Pre-treatment and Coating:</p>
	<p>☑ The surface of the sign shall undergo a phosphating process followed by acid etching to ensure effective bonding and adhesion of the coatings.</p> <p>☑ The sign shall be coated with one coat of epoxy primer and two coats of high-quality epoxy paint, ensuring a tough, weather-resistant finish that can withstand harsh environmental conditions.</p>
	<p>Reflectorizing:</p>
	<p>☑ The sign shall be reflectorized using Micro Prismatic Grade retro-reflective sheeting of Type-11, compliant with ASTM D-4956 and the latest M.O.S.T. Specifications.</p> <p>☑ The retro-reflective sheeting shall conform to Class-C specifications, ensuring high visibility even in low light conditions.</p>
	<p>Sign Stand/Post:</p>
	<p>☑ The post supporting the sign shall be 1.8 meters long and constructed using either a 75 x 75 x 6 mm MS square pipe or a 65NB circular MS pipe, depending on the specific requirements at the site.</p> <p>☑ The frame for the sign post shall be fabricated from iron angles of 35 x 35 x 3 mm for added strength and durability.</p> <p>☑ Both the post and frame shall be finished with epoxy coatings in black and white for visibility, safety, and weather resistance.</p>
	<p>Installation:</p>
	<p>☑ The installation of the sign shall be carried out by embedding the post in a 1:2:4 concrete mix (CC block) with a block size of 45 x 45 x 60 cm for each leg.</p> <p>☑ The installation includes all activities such as excavation, curing, and ensuring that the sign is properly aligned and stable as per the instructions of the Engineer-in-Charge.</p>
	<p>Warranty and Testing:</p>

	<p>☐ A 10-year warranty shall be provided by the original manufacturer for the retro-reflective sheeting, ensuring that it will retain its reflective qualities for an extended period.</p> <p>☐ A certified copy of a 3-year outdoor exposure test report from an accredited third-party test laboratory shall be submitted by the contractor to verify the longevity and durability of the reflective materials.</p>
	Sign Details:
	The symbol and the design details of the sign shall be provided as per the instructions from the Engineer-in-Charge , ensuring compliance with the required safety and regulatory standards.
	Completion and Supervision:
	All works, including fabrication, painting, installation, and fixing, shall be carried out under the supervision of the Engineer-in-Charge to ensure that all specifications are met and the installation is completed safely and accurately.
Item No- 24	<p>Chevron sign :-Providing and fixing sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminum composite Panel); size 60x50 cm as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3 mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50 x 50 x 5mm; painted with bestquality 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 blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from originaa manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting</p>
	Specification as per Item no. 21
	Mode of Measurement
	The rate shall be for a unit of the One number.
Item No- 25	<p>Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white and yellow color marking should provide liminance coefficinet on cemend road shall be min 130 mcd/m2/lux and Asphalt road shall be min 100 mcd/m2/lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.</p>
1.0	SCOPE:

	Scope of work consist of marking traffic strips using a thermo plastic compound meeting the specific requirements laid down here in.																			
	Thermo plastic compound:																			
	The material shall be screened / extruded on to the pavement in a molten state by thermoplastic applicator machine having facility of controlling temperature & flow of material at specified rate and applying the glass beads at specified rate. The machine shall have a propelling device at a specified speed to make the stripes in desired width & thickness. It also has a dispensing device for glass beads for drop on/spray at specified rate; on immediately laid molten thermoplastic compound. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness & width & capable of resisting deformation by traffic.																			
	Colour:																			
	The colour of the compound shall be white or yellow (IS color no.356) as specified in the drawing or as directed by Engineer in charge.																			
	Method of application:																			
	When the compound is to be applied to cement concrete pavement, a sealing primer as recommended by manufacturer, shall be applied to pavement in advance of placing the strips to ensure proper bonding of the compound. On new concrete surface any laitance and curing compound shall be removed before applying the compound.																			
	Thermoplastic Material:																			
	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.																			
	Composition % by Weight:																			
	<table><tr><td>Component</td><td>White</td><td>Yellow</td></tr><tr><td>Binder</td><td>18.0 minimum</td><td>18.0 minimum</td></tr><tr><td>Glass Beads</td><td>30 to 40</td><td>30 to 40</td></tr><tr><td>Titanium Dioxide</td><td>10% minimum</td><td>---</td></tr><tr><td>Calcium carbonate And Inert fillers</td><td>42</td><td>AS BELOW</td></tr><tr><td>Yellow Pigment</td><td>---</td><td>0.1</td></tr></table>	Component	White	Yellow	Binder	18.0 minimum	18.0 minimum	Glass Beads	30 to 40	30 to 40	Titanium Dioxide	10% minimum	---	Calcium carbonate And Inert fillers	42	AS BELOW	Yellow Pigment	---	0.1	
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	Amount of Yellow pigment, calcium carbonate and inert filler shall be at the proportion of manufacturer, provided all other requirements of specification are met with.																			
	Properties:																			
	The properties of thermoplastic material when tested in accordance with ASTM D36/BS-3262- (Part-I), shall be as below: Luminance: White: Daylight luminance at 45°- 65 percent min. as per AASHTO M-249. Yellow: Daylight luminance at 45° - 45 percent min. as per AASHTO M-249. 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. Skid resistance: Not less than 45 as per BS 6044. Cracking resistance at low temperature: The material shall show no cracks on application to concrete blocks. Softening point: 102.5 + 9.5°C as per ASTM D-36. Flow resistance: Not more than 25 per cent as per AASHTO M-																			

	249. Yellowness index (for white thermoplastic plant): Not more than 0.12 as per AASHTO M-249.																														
	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.																														
	Reflectorisation:																														
	Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Cl.803.4.3.																														
	Marking:																														
	Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:																														
	The name, trade mark or other means of identification of manufacturer. Batch number. Date of manufacture. Colour (white or yellow) Maximum application temperature and maximum safe heating temperature																														
	Sampling and testing:																														
	"The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS Method. The contractor shall furnish to the 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."																														
	Reflect rising glass beds:																														
	General: This specification covers two types of glass beads to be used for the production of reflectorized pavement markings. Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-3 and type 2 beads are those which are to be sprayed on the surface vide cl.803.6.3. The glass beads shall be transparent, colorless and free from milkyness dark particles and excessive air inclusions. These shall conform to the requirements spelt out in cl.803.4.3.3.																														
	Specific requirements: The Glass beads shall meet graduation requirements for two types as below.																														
	<table><tr><th rowspan="2">Sr. No.</th><th rowspan="2">Sieve Size</th><th colspan="2">Percentage Retained</th></tr><tr><th>Type 1</th><th>Type 2</th></tr><tr><td>1</td><td>1.18 mm</td><td>0 to 3</td><td>---</td></tr><tr><td>2</td><td>850 Micron</td><td>5 to 20</td><td>5 to 20</td></tr><tr><td>3</td><td>600 Micron</td><td>---</td><td>---</td></tr><tr><td>4</td><td>425 Micron</td><td>65 to 95</td><td>---</td></tr><tr><td>5</td><td>300 Micron</td><td>---</td><td>30 to 75</td></tr><tr><td>6</td><td>180 Micron</td><td>0 to 10</td><td>10 to 30</td></tr></table>	Sr. No.	Sieve Size	Percentage Retained		Type 1	Type 2	1	1.18 mm	0 to 3	---	2	850 Micron	5 to 20	5 to 20	3	600 Micron	---	---	4	425 Micron	65 to 95	---	5	300 Micron	---	30 to 75	6	180 Micron	0 to 10	10 to 30
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	<p>Roundness: The glass beads shall have a minimum of 70 percent true spheres. Refractive index: The glass beads shall have a minimum refractive index of 1.50.</p> <p>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 Method: As per Cl.803.4.3.4 MORTH</p>
	Application properties of thermoplastic material:
	<p>The thermoplastic material shall readily get screened /extruded at temperatures specified by the manufactures for respective method of application to produce a line of specified thickness which method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.</p> <p>The material upon heating to application temperatures, shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.</p>
	Preparation:
	<p>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 hearing, the material shall not be maintained in a molten condition for more than 4 hrs.</p> <p>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.</p>
	Properties of finished road marking:
	<p>The stripe shall not be slippery when wet.</p> <p>The marking shall not lift from the pavement in freezing weather.</p> <p>After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperature up to 60°C.</p> <p>The marking shall not deteriorate by contact with sodium chloride, calcium, chloride or oil drippings from traffic</p>
	<p>The stripe 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.</p> <p>The color of yellow marking shall conform to IS Color No.356 as given in IS: 164.</p> <p>Refectories paint, if used, shall conform to the specification by the manufacturers and approved by the engineer. Reflect rising glass beads for reflect rising paints where used shall conform to the requirement of Cl.803.4.3.</p>
	Application:
	<p>Marking shall be done by machine. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the engineer.</p> <p>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.</p>
	<p>The thermoplastic material shall be applied hot either by screening or extrusion process. After transfer to the laying apparatus, the materials shall be laid at temperature</p>

	within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.
	Temperature of the pavement shall not be less than 10°C at time of applying the paint. The surface of the pavement shall be marked and cleaned thoroughly to remove dust, oil, grease etc.
	Paint shall be applied in intermittent of continuous lines of uniform width as per drawing and at least 2.5 mm thick. The glass beds shall be at the rate of 250 grams per SQM
	Measurement for payment:
	The painted marking shall be measured in Sq.mtr of actual area marked (excluding the gaps, if any).
	Rates:
	The contract unit rate for road markings shall be payment in full compensation for furnishing all labor, material, 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 specifications.
	The rate shall be paid on Square Meter basis.
Item No- 26	Painting lines, dashes, arrows etc on roads in two coats on new work with ready mixed road marking paint conforming to IS:164 on bituminous surface, including cleaning the surface of all dirt, dust and other foreign matter, demarcation at site and traffic control
Item No- 27	Painting two coats of alternate black & white or black & yellow stripes as per the direction of engineer-in-charge after filling the surface with synthetic enamel paint in all shades on new plastered concrete surface
	Scope of Work:
	The work involves painting lines, dashes, arrows , and other required road markings on new bituminous surfaces using ready-mixed road marking paint conforming to IS:164 .
	Materials:
	<ul style="list-style-type: none"> The road markings shall be carried out using ready-mixed road marking paint that meets the requirements of IS:164 for road markings. The paint shall be reflective or non-reflective as specified, designed for durability, visibility, and adherence to road surfaces. The paint must be of high quality, offering resistance to wear, abrasion, and environmental conditions, ensuring long-lasting visibility of road markings.
	Surface Preparation:
	<ul style="list-style-type: none"> Before the application of the road marking paint, the surface shall be thoroughly cleaned to remove any dirt, dust, grease, oil, or other foreign materials that may hinder proper adhesion. Cleaning shall include the use of appropriate mechanical or manual methods (e.g., brooming, brushing, air pressure cleaning, etc.) to ensure a smooth and clean surface for optimal paint bonding.
	Application of Paint:

	<ul style="list-style-type: none"> • First Coat: Apply the first coat of road marking paint uniformly over the clean, dry surface. The first coat should serve as the base layer and shall be allowed to dry completely before applying the second coat. • Second Coat: Once the first coat has dried, apply the second coat to ensure proper coverage, enhanced visibility, and durability. The second coat shall be applied evenly, ensuring a uniform thickness.
	Marking of Lines, Dashes, Arrows, and Symbols:
	<ul style="list-style-type: none"> • The markings to be painted on the road include lines, dashes, arrows, and any other necessary symbols as per the site's requirements and traffic management plans. • The lines shall be applied as per the dimensions and design specified in the traffic layout provided by the Engineer-in-Charge. • The arrows and symbols shall be applied in accordance with standard road marking patterns, ensuring accurate shape and size for proper traffic guidance.
	Traffic Control:
	<ul style="list-style-type: none"> • The contractor shall provide necessary traffic control during the application of road markings to ensure the safety of workers and prevent disruption to traffic flow. • The area under marking shall be cordoned off with warning signs, barriers, or traffic cones to avoid interference with ongoing traffic. Proper flagmen or traffic marshals should be deployed to direct traffic safely around the work zone. • The contractor shall ensure that the traffic diversion and site demarcation are managed in coordination with the relevant traffic authorities to minimize inconvenience.
	Drying Time and Curing:
	<ul style="list-style-type: none"> • The drying time between coats shall be as per the manufacturer's instructions. Sufficient time shall be allowed for the first coat to dry completely before applying the second coat. • The freshly painted markings shall be left undisturbed for a minimum period to ensure the paint has cured adequately before traffic is allowed back onto the surface.
	Inspection and Quality Control:
	<ul style="list-style-type: none"> • The completed road markings shall be thoroughly inspected for proper alignment, thickness, and uniformity. Any defects, such as inconsistencies in the paint application or inadequate adhesion, must be corrected immediately. • The thickness of the road marking paint should conform to the standards set by IS:164, and a reflectivity test (if applicable) should be carried out to ensure the required visibility.
	Completion:
	<ul style="list-style-type: none"> • Upon completion of the work, the site shall be left clean and free from any tools, equipment, or waste materials, ensuring that the road is ready for use. • The final inspection of the road markings shall be conducted by the Engineer-in-Charge to confirm that the markings meet the specified requirements.
	Warranty:

	The contractor shall provide a warranty for the road markings, ensuring that the markings will remain visible and intact under normal traffic conditions for a specified period (typically 12 months) from the date of completion.
	Measurement for payment:
	The painted marking shall be measured in Sq.mtr of actual area marked (excluding the gaps, if any).
	Rates:
	The contract unit rate for road markings shall be payment in full compensation for furnishing all labor, material, 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 specifications.
	The rate shall be paid on Square Meter basis.
Item No- 28	Providing and fixing ordinary Kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including letter and paints etc. complete
	Kilometer stone shall be of approved quality and shall be of precast 1:2:4 R.C.C. as specified in the item.
	The size, manner of fixing, painting and lettering of K.M. stone shall conform specification as per I.R.C. - 8 (Type design for Highway 5th Kilometer stones). The fixing of K.M. stone shall be carried out in ordinary concrete of grade specified in the item using crushed stone aggregate. The measurement for payment shall be made per No. of K.M. stone fixed in position.
	Unit rate for Kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.
Item No- 29	Providing and fixing Hectometer as per I.R.C. type design including painting, lettering etc. complete.(ii) Fixing in C.C. 1:5:10
	Providing and fixing Hectometer stone/marker conforming to I.R.C. type design and approved dimensions, made of approved quality material, including excavation of pit , providing and placing the marker in proper position, fixing in cement concrete 1:5:10 foundation, maintaining correct line, level, plumb and orientation, and finishing complete.
	The work shall include painting of marker with approved paint , writing and numbering / lettering as per IRC pattern, required background colour, border, figures, direction markings, curing of concrete, refilling around foundation, disposal of surplus excavated material, and all labour, materials, tools and incidental charges complete as directed by the Engineer-in-Charge.
	<p>Scope of work includes:</p> <ul style="list-style-type: none"> • Providing hectometer stone/marker as per IRC type design • Excavation for foundation to required size • Fixing the marker in true line, level and position • Providing cement concrete 1:5:10 in foundation • Proper alignment towards road side as directed • Painting with approved colour and finish • Writing / lettering / numbering as per approved format

	<ul style="list-style-type: none"> • Curing of concrete • Refilling and ramming around the marker • Disposal of surplus earth and debris • Complete finished work in all respects
	<p>Rate shall include:</p> <ul style="list-style-type: none"> • Cost of hectometer stone/marker • Excavation and refilling • Cement concrete 1:5:10 • Painting and lettering • Labour, tools, plants, carriage, all leads and lifts • All materials required for complete fixing
Item No- 30	Overhead Signs - Providing and erecting overhead signs with a corrosion resistant aluminium alloy sheet reflectorised with high intensity retro reflective sheeting of encapsulated lense type with vertical and lateral clearance given in clause 802.2 and 802.3 and installed as per clause 802.7 over a designed support system of aluminium alloy or galvanised steel trestles and trusses of sections and type as per structural design requirements and approved plans.
	A) Truss and Vertical Support
	B) Aluminium alloy plate for over head sign
	Specification as per Item no. 18
	Mode of Measurement
	The rate shall be for a unit of the One number.
Item No- 31	Solar Stud: Supplying of Solar Raised Pavement Markers made of polycarbonate moulded body with circular shape,solar powered, LED self illumination in active mode, 360 degree illumination and reflective panels with micro prismatic lens capable of providing total internal reflection of the light entering the lens face in passive mode. The marker shall support a load of 20000 kg tested in accordance to ASTM D 4280. The marker should be resistant to dust and water ingress according to IP 65 standards and should withstand temperatures in the range of 0 C to 70 C. Color of lighting could be provided in red or yellow (amber) as per requirement and typical frequency of blinking is 1 Hz. There should be current losses of less than 20 micro-amperes at 2.4 V in sleep-charging mode to enhance the life of the marker and a full charge should provide for a minimum autonomy of 50 hours. The height, width and length of the marker shall not be less than 10 mm x 100 mm x 100 mm. Also, the surface diameter of the marker shall not be less than 100 mm respectively. The weight of the marker shall not exceed 0.5 Kilograms. 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 manufacturers recommendation and complete as directed by the engineer
	Material & Manufacturing
1.0	Scope

	The work shall cover the providing and fixing of Raised Pavement marker (RPM) or road stud, a device which is bonded to or anchored within the road surface, for lane marking and delineation for night-time visibility, as specified in the contract.				
2	Material				
2.1	Plastic body of RPM road stud shall be moulded from ASA (Acrylic styrene acrylonitrile) or HIPS (Impact polystyrene) or ABS or any other suitable material approved by the Engineer in charge. The marker shall support a load of 13635 kg. tested in accordance with ASTM D4280				
2.2	Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection the light entering the lens face lenses shall be molded of methyl methacrylate conforming to ASTM D 788 or equivalent.				
3.0	Design				
	The slope or retro reflecting surface shall preferably be 35. + 5 degree to base. The area of each retro reflecting surface shall not be less than 13.0 sqmt.				
4	Optical performance				
4.1	Unidirectional and bi directional studs Each reflector or combination of reflector on each face of the stud shall have a CIL not less than the given in Table 1 or 2 appropriate.				
4.2	Omni directional studs				
	Each omni directional stud shall have a min. CIL of not less than 2mcd/lx				
	Table 1 min. CIL values for category 'A' studs.				
	<i>Entrance Angle</i>	<i>Observation Angle</i>	<i>C.I.L. in mcd/lx</i>		
	<i>White</i>	<i>Amber</i>	<i>Red</i>		
	0° U 5° L&R	0.3°	220	110	44
	0° U 10° L&R	0.5°	120	60	24
	Table 2 min. CIL values for category 'B' studs.				
	<i>Entrance Angle</i>	<i>Observation Angle</i>	<i>C.I.L. in mcd/lx</i>		
	<i>White</i>	<i>Amber</i>	<i>Red</i>		
	0° U 6° L&R	0.3°	20	10	4
	0° U 10° L&R	0.5°	15	7.5	3
	Note:				
1.	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.				
2.	The stud incorporating one or more corner cube reflectors shall be included in category 'A'. the stud incorporating one or more bi-convex reflectors shall be included in category 'B'.				
5	Tests				
5.1	Coefficient of luminance intensity can be measured by procedure described in ASTM 809 "Practice for Measuring Photometric characteristics" or as recommended in BS 879 part 4:1973				
5.2	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 measurements is less than the values specified in Table 1 or 2 provided that				
1)	average of the left and right measurements for the specific angle is greater than the specified minimum				
6.	Fixing of Reflective studs				
6.1	Requirements				

	The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic. The reflecting portion of the studs shall be free from crevices or ledges where dirt might accumulate. Marker height shall not be less than 10mm and shall not exceed 20mm. and it's width should not exceed 130mm. the base of the marker shall be flat within 1.3mm. if the bottom of the marker is configured, the outer most faces of the configurations shall not deviate more than 1.3mm from the flat surface. The marker shall be fitted with two polymer shanks at appropriate places at either ends and shall be slotted along its length. The Shank Length for Each of the shanks shall not be less than 20millimeter.
	All road studs shall be legibly marked with name, trade mark or other means of identifications of the manufacturer.
6.2	Placement
	The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails should be used to fix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used ,the markers shall not fixed if the pavement is not surface dry and on new asphalt concrete surface until the surface has been opened to traffic for period of not less than 14 hours. The portions of the Road surface to which marker is to be bonded by the adhesive shall be free of dirt, curing compound, grease, oil, moisture, loose or and any other material which would adversely affect the bond of the adhesive. The adhesive shall be placed uniformly on the Cleaned pavement surface or on the bottom of the markers in a quantity. sufficient to result in complete coverage of the area of the contact of the better surface with no voids present at a slight excess after the better surface has been lightly pressed in place. 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.
6.3	Warranty and Durability
	The contractor shall obtain from the manufacturer a two year warranty for contractor held performance including stipulated retro reflectance of the reflecting panel and submit the same to the Engineer in charge. In additional a two 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. damage get worn out or low their reflectivity compared to stipulated standards, the contactor would be required to replace all such marker within 15 days of the intimation from the Engineer at his own cost.
7.0	Measurement of Payment
	The measurement or reflective road markers shall be in marker supplied and fixed
8.0	Reme of diff. types of
	The contract unit rate for reflective road marker shall be payment in full compensation for furnishing all labour, materials, tools, equipment including incidental costs necessary for carrying out the work at side conforming to the specifications complete as per approved drawings or as directed by the Engineer.
Item No- 32	Flexible Median Marker : Providing and Fixing of Flexible Median Marker that are made of tough, high impact resistant, injection-molded, thermoplastic body with property of flexibility to provide high durability. The dimension of Flexible Median Marker should not exceed 18.4 cm in height (including shank height),12.5 Cm in

	<p>width. ,0.65 cm in thickness and shank depth shall be 3.4 cm The body structure shall be rounded at all its corners and edges. The plastic used for molding the Flexible Median Marker should survive impact load of 5kg continuously for 750 times at room temperature. The logo of the manufacturer shall be embossed on either side of the body in the injection molding process. The Median Marker shall have flame like shaped body with, fluorescent yellow color retro-reflective sheeting of size not less than 90 Cm square, with fully reflective micro prismatic cube corners as its retro-reflective elements as per IRC 67 2012 and ASTM D4956-09 type XI specifications reflectivity values. The retro-reflective sheeting shall be one or both sides of the Flexible Median Marker and shall be edge protected with no exposed edges which will prevent edge lifting, vandalism, sheeting damage, etc. The Flexible Median Marker shall be fixed by a combination of epoxy adhesive and grouting as recommended by manufacturer and Engineer in charge.</p>
1.0	The overall dimensions of the Flexible Median Marker shall not exceed 18.4 cm in height (including shank height), 12.5 cm in width, and 0.65 cm in thickness, with a minimum shank depth of 3.4 cm suitable for firm anchorage into the pavement surface. The body profile shall be flame-shaped, aerodynamically designed, and rounded at all corners and edges to eliminate sharp projections and reduce damage under impact.
1.1	The thermoplastic material used for molding shall be UV-stabilized, weather-resistant, and crack-resistant, capable of withstanding a continuous impact load of 5 kg for not less than 750 cycles at room temperature without permanent deformation, cracking, or failure. The manufacturer's logo and identification mark shall be clearly embossed on either side of the body during the injection-molding process, ensuring traceability and authenticity.
1.2	Each Flexible Median Marker shall be provided with fluorescent yellow color retro-reflective sheeting of minimum area 90 sq. cm, made of high-intensity fully reflective micro-prismatic cube corner elements, conforming to IRC:67-2012 and ASTM D4956-09 Type XI specifications for reflectivity and performance. The retro-reflective sheeting shall be fixed on one or both sides of the marker, as specified, and shall be edge-protected with no exposed edges, ensuring resistance to edge lifting, vandalism, peeling, or sheeting damage under traffic and weather exposure
1.3	The installation of the Flexible Median Marker shall be carried out on the prepared road surface by proper cleaning and surface preparation, followed by fixing with a combination of approved epoxy adhesive and cementitious/non-shrink grouting, strictly in accordance with the manufacturer's recommendations and directions of the Engineer-in-Charge. The marker shall be aligned true to line and level, ensuring firm bonding with the pavement and stable positioning after curing.
1.4	The rate shall include the cost of materials, retro-reflective sheeting, adhesives, grouting materials, surface preparation, fixing, curing, labour, tools, equipment, testing, handling, transportation, and all incidental works required to complete the item in all respects as per specifications and satisfaction of the Engineer-in-Charge.
Item No- 33	Providing and fixing cylindrical steel bollard of 0.15 mm Dia and height not more than 1.00 m above the surface on road/ footpath spaced at 1.00 m for restricting traffic movement with necessary bolts/welding complete as per the direction of engineer-in-charge.

	<p>The bollard shall be made out of approved quality mild steel pipe / fabricated steel section of required thickness, true in shape, size and alignment, including cutting, bending, welding, grinding, finishing and making smooth surface. The item shall include providing and fixing necessary base plate, anchor bolts, embedded plate, welding, grouting, fasteners, excavation if required, PCC / RCC pedestal or foundation block if specified, fixing arrangement, painting / primer / enamel paint, and all labour, materials, tools, tackles and incidentals required for complete installation as per approved drawing and direction of the Engineer-in-Charge.</p>
	<p>The bollards shall be fixed firmly in position on road / footpath / paved surface with proper alignment, plumb and spacing so as to serve the intended purpose of restricting unauthorized traffic movement.</p>
	<p>Scope of Work</p> <p>The item shall include the following:</p> <ul style="list-style-type: none"> • Providing approved quality cylindrical steel bollard of 150 mm dia • Height of bollard to be not more than 1.00 m above finished surface • Fixing bollards at 1.00 m spacing • Fabrication from MS pipe / steel section of required wall thickness • Cutting, shaping, edge preparation, welding and finishing • Providing and fixing base plate, anchor bolts, holdfasts or embedded arrangement • Making holes / core cutting / local dismantling of surface wherever required • Fixing by bolting and/or welding as per site requirement • Providing grouting with cement mortar / non-shrink grout around base wherever required • Restoring surrounding portion after fixing • Applying one coat of red oxide / zinc rich primer and two coats of approved paint, if specified • Aligning the bollards in straight line and true vertical position • Completion of work as per approved drawing and direction of Engineer-in-Charge
	Materials
	<p>1. Steel Bollard</p> <p>The bollard shall be fabricated from approved quality MS pipe / hollow steel section of suitable wall thickness to withstand impact and service conditions. The steel shall be free from cracks, bends, laminations and other defects.</p>
	<p>2. Base Plate / Anchor System</p> <p>The bollard shall be provided with suitable MS base plate, anchor bolts, foundation bolts or embedded arrangement as per approved design. All bolts, nuts and washers shall be of approved quality and size.</p>
	<p>3. Primer and Paint</p> <p>The exposed steel surface shall be cleaned properly and coated with:</p> <ul style="list-style-type: none"> • One coat of approved anti-corrosive primer / red oxide primer • Two coats of approved synthetic enamel paint or other specified finish <p>Colour shall be as directed by the Engineer-in-Charge.</p>

	<p>Fabrication</p> <ul style="list-style-type: none"> Steel pipe / section shall be cut to required size accurately Top of bollard shall be neatly finished, rounded / capped / closed as per approved design All joints shall be properly welded Welded portions shall be ground smooth and made uniform Surface shall be cleaned of rust, scale, welding burrs and oil before painting
	<p>Fixing</p> <p>The bollards shall be installed on road / footpath at required location and spacing. Fixing may be done by one of the following methods, as specified in drawing or directed by Engineer-in-Charge:</p> <ul style="list-style-type: none"> Fixing with base plate and anchor bolts on hard paved / RCC surface Fixing with embedded portion in concrete pedestal / block Fixing by welding to embedded steel plate / insert plate <p>The bollards shall be truly vertical, properly aligned and firmly secured so that no looseness occurs during service.</p>
	<p>Workmanship</p> <ul style="list-style-type: none"> Bollards shall be placed in straight line unless shown otherwise Spacing shall be maintained at 1.00 m c/c Height above finished surface shall not exceed 1.00 m Welds shall be continuous, strong and neatly dressed Exposed surfaces shall be smooth and properly painted Damaged paint during installation shall be touched up and restored
	<p>Measurement</p> <p>Measurement shall be made per number of bollards fixed and accepted.</p>
Item No-34	Laying 450mm dia Reinforced cement concrete pipe NP4 /prestressed concrete pipe across road for 20m on first class bedding of granular material in double row including fixing collar with cement mortar 1:2, backfilling and PCC. (Across utility ducts)
1	The work shall consist of furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.
2	Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the places of manufacture or at the site before their incorporation in the works.

	NP4, NP3, NP2, NP1 pipes are used for R. C. C. Pipes, where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.
	Production of such certificate will not however relieve the contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during the execution. It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various test as per IS : 458 at his factory.
Item No-35	Planting Flowering plants & Shrubs in central verge with all lead & lift, plant type Bougainvillea & Tecoma in strip pattern & distance for planting in soil mix with suitable manure must be as per IRC:SP:21-2009 or as directed by engineer in-charge
Item No-36	Supply at site of work Yellow garden soil from any available source, approved by the engineer in charge including screening and stacking & Spreading good Yellow Earth (Spreading and good Yellow earth in required thickness
	Soil Preparation and Application of Soil Mixe
	All subsoil areas to be top-soiled shall be cleaned free of rubbish, weeds, all stones exceeding 50mm in diameter and builders debris shall be removed from site. Any areas which are contaminated by petrol, soil or other toxic substances shall be excavated to 300mm below the contamination and have the excavated material removed from site. The excavated areas shall be back filled with imported topsoil as specified. These operations shall take place immediately before top-soiling (with soil mixes) commences.
	Where directed by the Landscape Architect/horticulture expert, the ground shall be decompacted by ripping to a depth of 300mm. All obstructions to cultivation or deleterious material brought to the surface shall be removed from the site and any voids left by this operation shall be back-filled with imported subsoil as specified.
	Subsoil shall be formed to the finished levels and contours after settlement and with overall even compaction.
	No topsoil or soil mixes shall be spread, or cultivation carried out until the subsoil operations have been approved by the Landscape Architect/horticulture expert.
	Topsoil or soil mixes shall be spread on the designated areas to the depth shown on the drawings. The loose depth of the topsoil shall be sufficient to allow the area to conform to the levels shown on drawings after natural settlement has taken place. Soil Mixes shall not be compressed or rolled to achieve levels. Conversely if levels drop below specified levels, additional soil mixes are to be added to achieve levels
	Soil Mixes are to be carefully spread by machine or hand in a moist condition. Very wet or dry soil mixes must not be used. Heavy compaction of soil mixes is to be prevented and compacted soil will be rejected. Soil Mixes are to be spread to the following minimum depths in open ground areas:
	Unless directed otherwise or as shown on the drawings
	When in the opinion of the Landscape Architect/horticulture expert site conditions are unsuitable for working, soiling operations shall cease and shall only be resumed when authorized by him.

	Contractor shall be responsible for soil protection and shall take preventative measures to control erosion and siltation of all areas and shall restore or replace any portion of the site which erodes, silts up or is otherwise damaged by out-washing of soil.
Item No-37	Filling available excavated earth/wethered rock in trenches,sides of foundations etc. in layers not exceeding 20 cm in depth consolidating each disposed layer by ramming and watering.
1.0	Workmanship
1.1	The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.
1.2	As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, brick bats: mortar dropping etc., and filled with earth in layers not exceeding 20 cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid The earth shall be rammed with iron rammers where feasible and with the but ends of crow-bars, where rammer cannot be used.
1.3	The plinth shall be similarly filled with earth in layers not exceeding 20 cms. adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.
1.4	The finished level of filling shall be kept to shape intended to be given to floor
1.5	In case off large pipeflooring like factory flooring, the consolidation may be done by power rollers, where so specified. The extent of consolidation required, shall also be as specified.
1.6	The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling the plinth.
2.0	Mode of Measurements & Payment
2.1	The payment shall be made for filling in plinth and trenches. No deduction shall be made for shrinkage or voids, if consolidated as instructed above.
2.2	The rate shall be for a unit of one cubic meter.
Item No-38	Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (To level of slope) of I.S. 458 / 1971 Class NP3 casted by vertically vibrated technology of 600mm internal diameter incl. excavation of trench for laying pipe, providing 150mm thick sand bed before laying pipes and backfilling the excavated earth.
	MATERIALS:
	R.C.C. NP3 / NP4 Class spun pipes of various diameters of required length shall be supplied by the contractor as per terms and condition attached herewith at end of this item. Water shall conform to M-1, Cement shall conform to M-3, Sand shall conform to M-6, and Cement mortar of required proportion shall conform to M-11 all the required materials for completing the items shall conform to relevant Indian Standard specification requirements.

	Rubber Ring shall confirm to IS: 5382-1985.
	STACKING OF MATERIALS:
	Reasonable care shall be exercised in loading, transporting and unloading of the pipes and specials. Gradual unloading shall be done by inclined plane or by chain block. Handling shall be done such as to avoid impact.
	Before, the actual laying of pipe line started, the pipes and fittings in required quantity shall be arranged lengthwise, by the side of the excavated trench without causing any obstacles to the traffic. If necessary, the pipe shall be got cut by the contractor at his own cost to accommodate specials or fittings or for any other reason.
	The contractor shall be fully responsible for safety of materials at site.
	LAYING (SPIGOT AND SOCKET RUBBER RING ROLL ON JOINT
	Boning Staves and Sight Rails:
	In various the pipes and fittings/specials the centre for each machinehole/chamber or pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 x 100 x 1800 mm) at each machinehole/chamber or junction of pipelines at nearly equal distance from the peg and at sufficient distances there from to be well clear of all intended excavation. So arranged that a sight rail when fixed at a certain level against the post shall cross the centre line of the machinehole/chamber or pipelines. The sight rail shall not in any case be more than 30 m apart; intermediate rails shall be put up if directed by Engineer-in-charge.
	Boning staves of 75 mm x 50 mm size shall be prepared by contractor in various lengths. Each length being of a certain whole number of meters and with a fixed tee head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the cross piece must be fixed below the top-edge of the tee-head at a distance equal to the outside. Diameter of the pipe or the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipe line, top of concrete bed, top of the pipe etc. as the case may be.
	The sight rail of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The centre line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the centre lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the pipe, and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of sight from rail to rail.
	The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides and the tee heads and cross piece of the boning staves shall be painted black.
	For the pipes converging to a machinehole / chamber at various levels. There shall be a rail fixed for every different level when a rail comes within 0.50 m of the surface of the ground. A higher sight rail shall be fixed for use with the rail over the next point. The posts and rails shall in no case be removed until the trench is excavated. The pipes are laid and Engineer gives permission to proceed with the backfilling.
	laying of Pipes and fittings shall be carefully cleaned before installation. Whenever pipe laying is interrupted for any reason. The open end of the pipeline shall be sealed with a suitable expanding stopper or a properly fitted temporary wooden stopper and exposed pipes shall be suitably protected from stones and other objects falling into the trench from above.

	The permissible tolerance for pipe lines in trenches shall be 6 mm in level and 25 mm in line between machineholes. After the laying of a length of a pipeline but before testing the crown of the pipe shall be checked for level and alignment and any necessary adjustment made by un-jointing and removing the pipes concerned. Adjusting the bedding, relaying the pipes and rechecking for line and level. In addition, where a gravity pipeline is shown on the drawings as being straight between machineholes it will not be accepted unless a light can be sighted directly through the length concerned.
	For pipeline jointing systems incorporating flexible jointing rings, pipes shall be laid with the spigot and pointing in the direction of flow and with a gap between the end of the spigot and the base of the socket, or between spigots rubber rings shall comply to IS-5382.
	Jointing:
	General:
	Pipe section shall be joined utilizing spigot and socket flexible joint with rubber ring, as per IS-783. After jointing extraneous material, if any, shall be removed from the inside of the pipe and the newly made joints shall be thoroughly cured. The rubber sealing rings used for jointing shall conform to IS5382.
	Spigot and Socket Joint (Flexible)
	The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The RCC pipes shall be of spigot and socket type and rubber rings shall be used, and the manufacturer's instructions shall be deemed to form a part of these engineer's requirements. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.
	HYDRAULIC/FLOW TEST OF PIPES:
	The contractor shall give at his own cost necessary hydraulic/flow test of pipe line laid. Each section of drain shall be tested for water tightness preferably between machineholes. To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to back fill the pipes up to the top, keeping atleast 90 cm. length of pipe open at the joints. It is necessary at the pipe line are filled up with water for about a week before commencing the application of pressure to allow for the absorption by pipe wall. Pipes shall be tested after the cement mortar joints have been made. The line shall be tested as per I.S.8127-1967 (code of practice for laying for glazed stone-ware pipes) or its latest edition. The contractor shall provide at his own testing equipment of approved make. This shall be approved by the Engineer-in-charge. All pipes, specials, joints found to be leaking or cracked or busted or observed unsuitable shall be removed and repaired. Contractor shall see that no end of any pipe length is kept open even temporarily and that all open ends are immediately at the end of every days work covered up either layer gunny bag cloth bided, properly by means of mild steel wires without any claim for extra cost. Filling above the drains to a depth of twice the diameter of the pipe line shall be completely free from boulders, stones, or brick bats and shall be composed of selected hard variety of murrum well consolidated but not heavily tempered. In the remaining depth, the trench shall be filled up by the selected stuff and murrum as ordered by the Engineer-in-charge. For crossing of obstacles, natural or built up, such as culvert drains bridges etc. the contractor shall approach respective authorities to obtain permission for crossing them. Such work left remaining to be carried out due to want of permission shall be carried out at any later stage or period within a time to the satisfaction of the Engineer-in-charge.

	MODE OF MEASUREMENT AND PAYMENT:
	The measurements shall be paid per meter length of the pipe line laid, jointed and tested and measured along the centre line and shall be paid according to the inner diameter of the pipes providing and as per the rates quoted by the tender in respective items of Schedule-B.
	The pipes may be available in approximate size either in metric system, or British system. No additional payment or reduction in payment will be made for such approximate size.
	No extra payment for dewatering or installing dewatering sets for pumping out such water shall be made. No extra payment for cutting of pipes, if required shall be made to the Contractor.
	In absence of hydraulic/flow test 20% of the amount of the laying and jointing work of pipe line work will be withheld from the running bills till satisfactory hydraulic test is given. If level for invert of pipes is not maintained by the Contractor 100% payment shall be withheld.
Item No-39	Constructing a brick masonry chamber for Storm Water Drain of PCC base 0.15m thick, length 1.5m, depth 1.5m, bottom width 1.5m and top width 1m with C. I. manhole cover on top slab of PCC (1:2:4) and water inlet points from Main carriageway and service road consisting of P.V.C. pipe (10kgf/sqm) of 110mm diameter, C. I. Nahni trap and C. I. grating of 100mm diameter complete as per technical specifications.
	MATERIALs
	WATER: Water shall conform to M-1 of detailed specification of materials.
	SAND: Fine aggregate 0.15 mm to 5.00 (about 0.00597 to 3/16") I.S. sieve No.15 to 480 shall conform to M-6 of detailed specifications of material
	COARSE AGGREGATE
	Coarse aggregate 5 mm to 40 mm shall conform to the latest version of relevant I.S. Specification and M-12 of detailed specification of material.
	SIZE:
	The maximum size of coarse aggregate shall be as large as possible normally not greater than 1/4 of the minimum thickness of concrete member. In case of R.C.C., this size present no difficulty to surround the reinforcement thoroughly and fill up the form work fully and is less than the minimum cover by 6 mm for plain concrete. Maximum size of the coarse aggregate shall be up to 40 mm subject to the above limitation and provided no limiting size is specified in the special provisions.
	Generally, a maximum size of 20 mm shall be found satisfactory for reinforced concrete work.
	The grading between the maximum size and minimum size of 5 mm shall be such as to produce a dense concrete of specified proportion and consistency that will work readily in to position without any aggregate and without the use of excessive water content.
	CEMENT MORTAR:
	Sand or fine aggregate size 0.15 to 5 mm I.S. Sieve No.15 to 480 confirming to relevant specification shall be supplied by the contractor and it shall be mixed with Portland cement in require proportion by volume. It shall be mixed dry and then requirement quantity of water shall be added before final mixing to have thoroughly mix mortar paste. Mortar shall preferably mixed in mixer.

	FLY ASH LIME BRICK:
	Fly ash lime brick shall be used for this item and shall comply with specification or relevant I.S. (latest version). Sample of Fly ash lime bricks shall be got approved by the Engineer, who will keep it in his office for reference.
	WORKMANSHIP:
	The chamber of different types and sizes as specified shall constructed in storm line at such places and such levels and dimensions as shown in drawing or as directed. PCC shall be in 1:4:8 cement concrete.
	Bed Concrete:
	The inlet chamber shall be built in bed of cement concrete 1:2:4 as shown in drawing or as directed. The relevant specification if Item No. 4 shall be followed for 1:2:4 concrete proportion by volume.
	WALLS :
	The walls of chamber shall be constructed using Fly ash lime bricks, having crushing strength not less than 75 Kg/Sq.cm. in C.M. 1:4 (1 Cement : 4 fine sand). The Fly ash lime brick masonry shall conform to relevant specification of M-6A of detailed specification of material. The jointing face of such Fly ash lime brick shall be well buttered with cement mortar before laying so as to ensure that full joints are filled up with mortar.
	PLASTER :
	The inside of wall shall be plastered with 12 mm thick C.M. 1:3 (1 Cement : 3 fine sand) and finished with floating coat of neat cement. All angles shall be rounded to 7.50 cms. radius and all rendered internal surfaces shall have impervious finish obtained by a steel trowel. The external joints of masonry shall be finished smooth as directed.
	CHANNELS AND BENCHING
	Channels shall be semicircular in the bottom half and of diameter equal to the pipe of drain. Above the horizontal of diameter, the sides shall be extended vertically to the level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel with appropriate fall, suitably rounded off in the direction of flow in the main channel, shall be given.
	The channel and benching shall be done in 1:2:4 grade rising at a slope in line from edges of channel. The channels of the bottom of the chamber shall be plastered with C.M. 1:2 (1 Cement; 2 coarse sand) and troweled smooth
	FRAME FITTING:
	Perforated Precast R.C.C. Jali in CC M-30 as per drawing shall be fitted firmly in the precast frame which shall be laid over plaster on top of masonry. Cement mortar shall 1 part cement and 2 parts of sand and layer shall be 25 mm thick.
	TESTING:
	Chamber shall be tested by filling with water up to top as directed.
	After completion of work, chamber covers shall be sealed by means of thick grease.
	MODE OF MEASUREMENTS AND PAYMENTS:

	The rate includes all labours, materials, curing for 14 days, tools and plant, etc. required for satisfactory completion of this item as per drawing and as directed by the Engineer-in-charge.
	The rate shall be for a unit of one chamber including RCC cover with frame