

provided for holding bars securely in position.

4.0. Binding wire

- 4.1. Mild steel binding wire shall be of 1.63 mm of 1.22 mm (16 to 18 gauge diameter and shall conform IS 280-2006.
- 4.2. The use of black wire will be permitted for binding reinforcement bars It shall be free from free form dirt, paint, grease of oil. oil scale or loose of thick rust and any other undesirable coating which may prevent adhesion of cement mortar at the time of binding.
- 4.3. Only new binding wire shall be delivered to the site all binding wire shall be inspected before binding to its position and defective brittle, rusted, used wire, shall be discarded

5.0. PROTECTION OF REINFORCEMENT

- 5.1. Uncoated reinforcing steel shall be protected from rusting of chloride contamination. Reinforcement shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing. etc. as directed by the Engineer. Reinforcements shall be stored on bricks, racks of platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.
- 5.2. Portions of uncoated reinforcing steel and dowels projection from concrete shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

6.0. Workmanship

- 6.1. The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed by The Engineer in charge,
- 6.2. Reinforcing steel shall conform accurate to the dimensions given in the bar bending schedules shown relevant drawing.

7.0. BENDING OF REINFORCEMENT

- 7.1. Bar bending schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.
- 7.2. Reinforcing steel shall conform to the dimensions and shapes given in the

approved bar bending Schedules.

- 7.3.** Bars shall be bent cold to the specified shape and dimensions or directed by the Engineer using a proper bar bender operated by hand power to obtain the correct radius of bends and shape.

Bar shall not be bent or straightened in a manner that will damage parent material or the coating bars bent during transport or handling shall be straightened before being used on work and shall not be heated to facilitate straightening.

8.0. PLACING OF REINFORCEMENT

- 8.1.** The reinforcement cage should generally be fabricated in the yard at ground level and then shifted and placed in position. The reinforcement shall be placed strictly, in accordance with the drawings and shall be assembled in position only when structure is otherwise ready for placing of concrete. Prolonged time gap, between assembling of reinforcements and casting of concrete, which may result in rust formation of the surface, shall not be permitted.
- 8.2.** Reinforcement bar shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS : 280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1mm.
- 8.3.** Bars shall be kept in position usually by the following methods:
In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to Satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.
- 8.4.** In case of dowels for Columns and walls the vertical reinforcement shall be kept in position by means of timber templates with slots in them accurately, or with cover blocks tied to the Reinforcement Timber templates shall be removed after the concreting has progressed up to a level just below their location.
- 8.5.** Layers of reinforcements shall be separated by spacer bars at approximately One meter intervals. The minimum diameter of spacer bars shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate. Whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.
- 8.6.** Necessary stays, blocks, metal chairs, spacers, metal hangers supporting wires etc, or other subsidiary, reinforcement shall be provided to fix the reinforcements firmly in its correct position.

- 8.7. Use of pebbles broken stone, metal pipe, brick, mortar or wooden blocks etc as devices for positioning reinforcement shall not be permitted.
- 8.8. Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic coated binding wires especially manufactured for the purpose.
- 8.9. placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.

9.0. Lapping

- 9.1. All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, Except where shown on the drawing; will be permitted without approval of the Engineer. The lengths of splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1 1/4 times the maximum sized of coarse aggregate, whichever is greater, If this is not feasible. overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

10.0 Welding

- 10.1 Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.
- 10.2 While welding may be permitted for T.M.T. reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special. Welding grade of S 415 grade bars conforming to IS:1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mg + V}{5} + \frac{Ni + Cu}{15}$$

is 0.4 or less.

- 10.3 The method of welding shall conform to IS:2751 and IS:9417 and to any supplemental specifications to the satisfaction of the Engineer.

- 10.4** Bars shall be bent cold to the specified shape and dimensions or as directed by Engineer in charge using the proper bender tool, operated by hand or power to attain proper radius of bends. Bars shall not be bend or straightened in manner that will injure the material. Bars bent during transport or handling shall be straightened before being used in the work. Bars shall not be heated to facilitate bending.
- 10.5** Unless otherwise specified a 'U' type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bane shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times of the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any spiting of the concrete.
- 10.6** All reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during pacing of concrete by annealed binding wire not less than 1 mm in size and by using say blocks or metal chairs spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals, Bars shall not be allowed to seg between supports not displaced during concreting or any other operations of thw work All devices used for positioning shall be of not corrodible material wooden and metal supports shall not extended to the surface of the concrete, except where shown in drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed Pieces of broken stone or brick and wooden blocks shall not be used Layers of bars shall be separated by spacer bars pre-cast mortar blocks or other approved devices. Reinforcement after bending placed in position shall be maintained in a clean condition until completely embedded in concrete, Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings. All bars protruding from concrete and to which other bars are to be sliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.
- 10.7.** Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1 mm in such a manner that they do not slip over at the time of fixing and concreting.

As far possible bars of full length shall be used in case this is not possible, overlapping of bars shall be done as directed by the Engineer in charge When practicable overlapping bars shall not touch each other, but kept apart by 25 mm Where no feasible overlapping bars shall be bound with annealed wires not less than 1 mm thick twisted tight. The overlaps shall be staggered for different bars and located at points along the span where neither sheer not bending moments is maximum.

- 10.8.** Whenever indicated on drawing of desired the Engineer in charge bars shall be jointed by coupling which shall have a cross section sufficient to transmit the full stresses of bars. The end of the bars that are jointed by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross section of the bar. Threads shall be standards threads Steel for coupling shall conform to IS 226.
- 10.9.** When permitted or specified on the drawings joints of reinforcement bars shall butt welded so as to transmit their full stresses Welded joints shall preferable by located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded Only electric arc welding using a process which excludes air from the molten metal and conforms to any or other special provisions for the work shall be accepted Suitable means shall be provided for holding bars securely in position during welding It shall be ensured that no voids are left in welding and when welding is done in two or three stages previous surface shall be cleaned properly Ends of bars shall be cleaned of all loose scale rust stages paint and other foreign matter before welding Only competent welders shall be employed on the work. The M S electrodes used for welding shall conform IS 814 Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number shall frequency to test shall be as directed by the Engineer in charge.

11.0 MODE OF MEASUREMENTS & PAYMENT

- 11.1** For the purpose of payment the bar shall be measured correct up to 10 mm length and weight payable works out at the rate specified below:

Sr. No.	Diameter of Steel	Weight of steel per running meter	Sr. No.	Diameter of Steel	Weight of steel per running meter
1	6 mm	0.22 Kg / Rmt	8	20 mm	2.47 Kg / Rmt
2	8 mm	0.39 Kg / Rmt	9	22 mm	2.98 Kg / Rmt
3	10 mm	0.62 Kg / Rmt	10	25 mm	3.85 Kg / Rmt
4	12 mm	0.89 Kg / Rmt	11	28 mm	4.83 Kg / Rmt
5	14 mm	1.21 Kg / Rmt	12	32 mm	6.32 Kg / Rmt
6	16 mm	1.58 Kg / Rmt	13	36 mm	7.99 Kg / Rmt
7	18 mm	2.00 Kg / Rmt	14	40 mm	9.86 Kg / Rmt

11.1. Excess consumption over 5% will be charged at penal rate.

11.2 Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in tonnes on the basis of IS 1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

11.3. The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting, storing, blending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment supplies, incidentals, sampling, testing and supervision.

The unit Rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rate shall also cover sampling, testing and supervision required for the work.

11.4 The rate shall be for a unit of One Kg.

Item No 20 **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 or slope) of I.S. 458/1971 Class NP3 casted by vertically vibrated technology of following internal diameter. 900mm dia.**

1. This 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 of 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 place of manufacture or all the site before their incorporation in the works.

NP3, NP2 and NP1 pipes, are used for R.C.C. pipes, where the testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturer on company's letterhead in the given hereinafter from.

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 execution. it will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various tests as per IS; 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____

Manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirements of IS : 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carry out tests at our factory sites.

We have experience of manufacturing of pipes _____ years. The pipes supplied by us to M/s _____ satisfy the requirement of IS : 458.

Date : _____

Manufacture's

Place : _____

Signature : _____

3. No pipes shall be placed in position until the foundations have been approved by the Engineer-in-charge where two or more pipes are to be laid adjacent to each other. they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be lifted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.
4. The pipes shall be jointed either by collar joint or by flush point in the former case, the collars shall be of R.C.C. 150 to 200mm. wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 to 20mm. according to the diameter of the pipes, caulking material shall slightly wet mix of cement and sand in the ratio of 1.2 rammed with Caulking irons, Before caulking the collar shall be so placed that its centre coincides with that

of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self-centering joint with a joining space 13cm wide. The joining space shall be filled with cement mortar, 1 cement to 2 sand mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing the joint shall be kept covered and damp for at least four days.

5. R.C.C. pipes shall be measured along their centre between their inlet and outlet ends in linear metres.
6. The rate for the pipes shall include the cost of pipe including loading unloading handing, storing laying in position and joining complete.
7. **The rate shall be for a unit of one running meter.**

Item No 21 Supplying and fixing reinforced concrete heavy duty non pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slope) of class NP3 1200mm diameter.

1. This 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 of 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 place of manufacture or all the site before their incorporation in the works.

NP3, NP2 and NP1 pipes, are used for R.C.C. pipes, where the testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturer on company's letterhead in the given hereinafter from.

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 execution. it will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various tests as per IS; 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____
Manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirements of IS : 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carry out tests at our factory sites.

We have experience of manufacturing of pipes _____ years. The pipes supplied by us to M/s _____ satisfy the requirement of IS : 458.

Date : _____

Manufacture's

Place : _____

Signature : _____

3. No pipes shall be placed in position until the foundations have been approved by the Engineer-in-charge where two or more pipes are to be laid adjacent to each other. they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be lifted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.
4. The pipes shall be jointed either by collar joint or by flush joint in the former case, the collars shall be of R.C.C. 150 to 200mm. wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 to 20mm. according to the diameter of the pipes, caulking material shall slightly wet mix of cement and sand in the ratio of 1.2 rammed with Caulking irons, Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self-centering joint with a joining space 13cm wide. The joining space shall be filled with cement mortar, 1 cement to 2 sand mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing the joint shall be kept covered and damp for at least four days.
5. R.C.C. pipes shall be measured along their centre between their inlet and outlet ends in linear metres.
6. The rate for the pipes shall include the cost of pipe including loading unloading handing, storing laying in position and joining complete.
7. **The rate shall be for a unit of one running meter.**

Item No 22 Providing and filling sand around the pipe including hand packing ramming, watering, filling measure boxes etc. complete as directed.

Area around pipes shall be filled with sand immediately after the pipes have been laid and the joining material has hardened. The material shall be clean, free from boulders large roots, excessive amount of sods or other vegetable matter and lumps and shall be approved by the Engineer-in charge. Filling up to 0.3 metre above the top of the pipe shall be carefully done and the soil thoroughly rammed, temped or vibrated in layers of not exceeding 150 mm. particular care being taken to thoroughly consolidate the materials under the launches of the pipe. Filling shall be carried out simultaneously on both sides of the pipes in such a manner that unequal pressures do not occur. In case of high embankments after filling up to the top in the above said manner a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layer are added and compacted.

Materials shall be filled in pharas 3m. x 1.5. m x 0.5 m size and shall be measured in Cu.M. unit.

Rate includes cost of materials and spreading including labour and tools needed for the above operations.

Item No 23 Providing Diversion of road 5.50 mt width (Having 7.50 mt formation width) For structure by providing & spreading Earth work , 100 mm GSB-III, 100 mm GSB -V, 100 mm WMM ,BUSG Manually Width Side shoulder and loose pipe. The length of Road is depend on site condition etc as directed by Engineer in Charge .

The temporary diversion shall be prepared as per the instruction of the Engineer-in-charge of the work. The complete diversion shall be maintained in trafficable condition till completion of the whole work. The diversion shall be well dressed and smooth so that traffic can be ply smoothly on the same. The necessary provision of caution / warning boards, red reflector at night time and guards stones on both sides shall be provided for the safety purpose.

Diversion shall start and end well out side the work site so that no accident take place. Embankment of earth shall be carried out with proper watering and rolling to form level surfaces. It shall have gentle slope or grade so that every vehicle including bullock cart can pass on it. Uniform layer of locally available GSB type material form river bed shall be spreaded on earthen embankment for hard and uniform riding surface. If work will be continued till monsoon season, agency has to provide pipes to allow water flow and shall be responsible for repair of diversion if washed out or damaged. Original road shall be completely blocked to avoid accident.

Diversion shall be maintained till traffic is restored on original road by filling depressions or cuts by GSB material and rolling and spraying water to reduce dust at site of work.

Diversion of road 5.50 mt width (having 7.50 mt formation width) for structure by providing & spreading earth work, 100 mm GSB-III, 100 mm GSB-V, 100 mm WMM, BUSG manually width side shoulder and loose pipe & also provide necessary traffic sign, diversion board for smooth & safe traffic. Proper maintaining the diversion during the whole work of completed and open for traffic. After completion works removing the same diversion for clearing the water way. Demolition of diversion serviceable materials shall be stacking as directed by Engineer-in-charge.

The length of road is depend on site condition etc. as directed by Engineer in charge.

Payment shall be made on Rmt. basis.

Item No 24 Providing Diversion of road 5.50 mt width (Having 7.50 mt formation width) For structure by providing and laying 37.5 mm BM, 18 Sealcoat. The length of Road is depend on site condition etc as directed by Engineer in Charge .

The temporary diversion shall be prepared as per the instruction of the Engineer-in-charge of the work. The complete diversion shall be maintained in trafficable condition till completion of the whole work. The diversion shall be well dressed and smooth so that traffic can be ply smoothly on the same. The necessary provision of caution / warning boards, red reflector at night time and guards stones on both sides shall be provided for the safety purpose.

Diversion shall start and end well out side the work site so that no accident take place. Embankment of earth shall be carried out with proper watering and rolling to form level surfaces. It shall have gentle slope or grade so that every vehicle including bullock cart can pass on it. Uniform layer of locally available GSB type material form river bed shall be spreaded on earthen embankment for hard and uniform riding surface. If work will be continued till monsoon season, agency has to provide pipes to allow water flow and shall be responsible for repair of diversion if washed out or damaged. Original road shall be completely blocked to avoid accident.

Diversion shall be maintained till traffic is restored on original road by filling depressions or cuts by GSB material and rolling and spraying water to reduce dust at site of work.

Providing Diversion of road 5.50 mt width (having 7.50 mt formation width) for structure by providing and laying 37.5mm B.M., 18 seal coat.

The length of road is depend on site condition etc. as directed by Engineer in charge.

Payment shall be made on Rmt. basis.

- Item No 25** **Construction 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 220 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 fixed form paver or conventional method, compacting with 8-10 tonnes vibratory roller, finishing and curing etc. complete as directed..**

601 DRY LEAN CEMENT CONCRETE SUB-BASE

601.1 Scope

601.1.1 The work shall consist of construction of (zero slump) 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.

601.1.2 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 drawings.

601.2 Materials

601.2.1 Sources of Materials

The Contractor shall indicate to the Engineer the source of all materials with relevant test data to be used in the dry 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 in trial length. If the Contractor later proposes to obtain the 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 45 days before such materials are to be used.

601.2.2 Cement

Any of the following types of cement may be used with prior approval of the Engineer:

Sr.No	Type	Conforming to
1	Ordinary Portland Cement 43 Grade	IS : 8112
2	Portland Slag Cement	IS : 455
3	Portland Pozzolana Cement	IS : 1489 Part-1

If the sub grade soil contains soluble sulphates in a concentration more than 0.5 percent, sulphate resistant cement conforming to IS : 6909 shall be used.

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.

601.2.3 Fly-ash

Fly-ash upto 20 percent by weight of cementitious material (cement+flyash) may be used along with 43/53 grade cement may be used to replace OPC cement grade 43 upto 30 percent by weight of cement. Fly-ash shall conform to IS:3812 (Part 1) and its use shall be permitted only after ensuring that facilities exist for uniform blending through a proper mechanical facility with automated process control like batch mix plant conforming to IS:4925 and IS:4926.

601.2.4 Aggregates

601.2.4.1 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 forth in Table 600-2. In case the Engineer considers that the aggregates are not free from dirt, the same may be washed and drained for at least 72 hours before batching, or as directed by the Engineer.

601.2.4.2 Coarse Aggregates

Coarse aggregates shall comply with Clause 602.2.6.2, except that the maximum size of the coarse aggregate shall be 26.5mm and aggregate gradation shall comply with Table 600-1.

601.2.4.3 Fine Aggregates

The fine aggregate shall comply with Clause 602.2.6.3.

601.2.4.4 The material after blending shall conform to the grading as indicated in Table 600-1.

Table 600-1 : Aggregate Gradation for Dry Lean Concrete

Sieve Designation	Percentage by- Weight Passing the Sieve
26.50 mm	100
19.0 mm	75-95
9.50 mm	50-70
4.75 mm	30-55
2.36 mm	17-42
600 micron	8-22
300 micron	7-17
150 micron	2-12
75 micron	0-10

601.2.5 Water

Water used for mixing and curing of concrete shall comply with Clause 602.2.7.

601.2.6 Storage of Materials

All materials shall be stored in accordance with the provisions of Clauses 602.2.12 of these Specifications and other relevant IS Specifications.

601.3 Proportioning of Materials for the Mix

601.3.1 The mix shall be proportioned with a maximum aggregate cementitious material ratio of 15:1. The water content shall be adjusted to the optimum as per Clause 601.3.2 for facilitating compaction by rolling. The strength and density requirements of concrete shall be determined in accordance with Clauses 601.7 and 601.8 by making trial mixes. Care should be taken to prevent one size of aggregate falling into the other size of the hopper of the feeding bin while loading the individual size of aggregates into the bins.

601.3.2 Moisture Content

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 Engineer. While laying in the main work, the lean concrete shall have a moisture content between the optimum and optimum +2 percent, keeping in view the effectiveness of compaction achieved and to compensate for evaporation losses.

601.3.3 Cement Content

The cement content in the dry lean concrete shall be such that the strength specified in Clause 601.3.4 is achieved. The minimum cement content shall be 220 kg/cu.m of concrete. In case flyash is blended at site as part replacement of cement, the quantity of flyash shall not be more than 20 percent by weight of cementitious material and the content of OPC shall not be less than 120 kg/cu.m. If this minimum is not sufficient to produce dry lean concrete of the specified strength, it shall be increased as necessary by the Contractor at his own cost.

601.3.4 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 Clauses shall be got approved from the Engineer and demonstrated in the trial length construction.

601.4 Sub-grade

The sub-grade shall conform to the grades and cross-sections shown on the drawings and shall be laid and compacted in accordance with Clause 305. The subgrade strength shall correspond to the design strength specified in the Contract. As far as possible, the construction traffic shall be avoided on the prepared sub-grade.

601.5 Drainage Layer

A drainage layer conforming to Clause 401 shall be laid above the subgrade before laying the Dry Lean Concrete sub-base, as specified in the drawings and the Contract.

601.6 Construction

601.6.1 General

The Dry Lean Concrete shall be laid on the prepared granular drainage layer. The pace and programme of the Dry Lean Concrete sub-base construction shall be matching suitably with the programme of construction of the cement concrete pavement over it. The Dry Lean

Concrete sub-base shall be overlaid with concrete pavement only after 7 days of sub-base construction.

601.6.2 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 Clauses 602.9.2, 602.9.3.1 and 602.9.3.2.

The design features of Batching Plant should be such that the plant can be shifted quickly.

601.6.3 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 tipping trucks with tarpaulin during transit. The concrete shall be transported by tipping trucks, 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 601.6.5.2 will be adhered to. Tipping truck shall not have old concrete sticking to it. Each tipping truck shall be washed with water jet before next loading as and when required after inspection.

601.6.4 Placing

Lean concrete shall be placed by a paver with electronic sensor on the drainage layer or as specified in the Contract. 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. One day before placing of the dry lean cement concrete subbase, the surface of the granular sub-base/drainage layer shall be given a fine spray of water and rolled with a smooth wheeled roller. Preferably the lean concrete shall be placed and compacted across the full width of the two lane carriageway, by constructing it in one go. In roads with carriageway more than 2 lanes a longitudinal joint shall be provided. Transverse butt type joint shall be provided at the end of the construction in a day. Transverse joints in the concrete pavement shall not be coterminous with the transverse construction joint of the Dry Lean Concrete.

The Dry Lean Concrete shall be laid in such a way that it is atleast 750 mm wider on each side than the proposed width including paved shoulders of the concrete pavement. The actual widening shall be decided based on the specifications of the paver, such that the crawler moves on the Dry Lean Concrete, and the cost of extra width shall be borne by the Contractor.

601.6.5 Compaction

601.6.5.1 The compaction shall be carried out immediately after the material is laid and levelled. In order to ensure thorough compaction, rolling shall be continued on the full width till there is no further visible movement under the roller and the surface is well closed.

The minimum dry density obtained shall not be less than 98 percent of that achieved during the trial length construction in accordance with Clause 601.7. The densities achieved at the edges i.e. 0.5 m from the edge shall not be less than 96 percent of that achieved during the trial construction.

601.6.5.2 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 temperature of concrete is between 25°C and 30°C, and 120 minutes if less than 25°C. 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 120 minutes.

Work shall not proceed when the temperature of the concrete exceeds 30°C. 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.

601.6.5.3 Double drum smooth-wheeled vibratory rollers of minimum 80 to 100 kN static weight are suitable for rolling dry lean concrete. In case any other roller is proposed, the same shall be got approved from the Engineer, after demonstrating its performance. The number of passes required to obtain maximum compaction depends on the thickness of the dry lean concrete, the compactibility of the mix and the weight and type of the roller and the same as well as the total requirement of rollers for the jobs shall be determined during trial run by measuring in-situ density and the scale of the work to be undertaken.

Except on super elevated portions where rolling shall proceed from the inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First, the edge/edges shall be compacted with a roller running forward and backward. The roller shall then move inward parallel to the centerline of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

601.6.5.4 A preliminary pass without vibration to bed the Dry Lean Concrete down shall be given followed by the required number of passes to achieve the desired density and, a final pass without vibration to remove roller with vibration 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 locations, use of plate vibrators shall be made, if so directed by the Engineer.

601.6.5.5 The final lean concrete surface on completion of compaction 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. For repairing honeycombed/hungry surface, concrete with aggregates of size 10 mm and below shall be spread and compacted as per Specifications. It is necessary to check the level of the rolled surface for compliance. Any level/thickness deficiency shall be corrected after applying concrete with aggregates of size 10 mm and below after roughening the surface. Surface regularity also shall be checked with 3 m straight edge. Strength tests shall be carried out, and if deficiency in strength is noticed, at least three (evenly spread) cores of minimum 100 mm dia per km shall be cut to check deficiency in strength. The holes resulting from cores shall be restored by filling with concrete of the specified strength and compacted by adequate rodding.

601.6.5.6 Segregation of concrete in the tipping trucks shall be controlled by moving the dumper back and forth while discharging the mix into the same or by any appropriate means. Paving operation shall be such that the mix does not segregate.

601.6.6 Joints

Construction and longitudinal joints shall be provided as per the drawings.

Transverse butt type joint shall be provided at the end of the construction in a day. Longitudinal construction joint shall be provided only when full width paving is not possible. Transverse joints in Dry Lean concrete shall be staggered from the construction butt type joint in Concrete pavement by 800-1000 mm.

Longitudinal joint in Dry Lean Concrete shall be staggered by 300-400 mm from the longitudinal joint of concrete pavement.

At longitudinal or transverse construction joints, unless vertical forms are used, the edge of compacted material shall be cut back to a vertical plane where the correct thickness of the properly compacted material has been obtained.

601.6.7 Curing

As soon as the lean concrete surface is compacted, curing shall commence. One of the following methods shall be adopted:

- a) Curing may be done by covering the surface by gunny bags/hessian, which shall be kept wet continuously for 7 days by sprinkling water.
- b) The curing shall be done by spraying with approved resin based aluminized reflective curing compound conforming to ASTM-C 309-81 in accordance with Clause 602.9.12. As soon as the curing compound has lost its tackiness, the surface shall be covered

with wet hessian for three days. The rate of application shall be as recommended by the supplier.

- c) Wax-based white pigmented curing compound with water retention index of not less than 90 percent shall be used to cure the dry lean concrete. The curing compound shall conform to BS:7542. The compound shall be applied uniformly with a mechanical sprayer and with a hood to protect the spray from the wind. The curing compound shall be applied over the entire exposed surface of the Dry Lean Concrete, including sides and edges, at the rate of 0.2 litres/sq.m, or as recommended by the supplier.

The first application, referred to as curing application shall be applied immediately after the final rolling of Dry Lean Concrete is completed.

As soon as the curing compound loses tackiness, the surface shall be covered with wet hessian for three days. The second application of curing compound also referred to as the debonding application, shall be applied 24 to 48 hours prior to the placement of the concrete pavement. Any damaged Dry Lean Concrete shall be corrected prior to the second application. Normally, the manufacturer's instructions shall be followed for its application.

601.7 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 percent using specified cement content, specified aggregate grading and 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 optimum moisture for the determination of compressive strength on the third and the seventh day. Trial mixes shall be repeated if the strength is not satisfactory by increasing cement content. After the mix design is approved, the Contractor shall construct a trial section in accordance with Clause 601.8.

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 the satisfactory mix. The cube specimens prepared with the changed mix 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 ravelling of surface.

601.8 Trial Length

601.8.1 The trial length shall be constructed at least 14 days in advance of the

601.8 Trial Length

- 601.8.1 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 proportions, 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 100 m length laid in two days and for full width of the pavement. The trial length shall be outside the main works. The trial length shall contain the construction of at least one transverse construction joint involving hardened concrete and freshly laid Dry Lean Concrete sub-base. The construction of trial length shall be repeated till the Contractor proves his ability to satisfactorily construct the Dry Lean Concrete sub-base.
- 601.8.2 After the construction of the trial length, the in-situ density of the freshly laid material shall be determined by sand replacement method. Three density holes shall be made at locations equally spaced along a diagonal that bisects the trial length and average of these densities shall be determined. The density holes shall not be made in the strip 500 mm from the edges. The average density obtained from the three samples collected shall be the reference density and is considered as 100 percent. The field density of regular work will be compared with this reference density in accordance with Clauses 601.6.5.1 and 903.5.1.2.
- 601.8.3 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.
- 601.8.4 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.
- 601.9 Tolerances for Surface Regularity, Level, Thickness, Density and Strength
Control of quality of materials and works shall be exercised by the Engineer in accordance with Section 900 as stated below
- 903.5 Quality Control Tests for Concrete Road Construction
- 903.5.1 Dry Lean Concrete Sub-base
- 903.5.1.1 Sampling and Testing of Cubes Samples of dry lean concrete for making cubes shall be taken from the uncompacted material from different locations immediately before compaction at the rate of 3 samples for each 1000 sq.m or part thereof laid each day. The sampling of mix shall be done from the paving site.

Test cubes of 150 mm size shall be made immediately from each mix sample.