

Repair of Structures

2800

Repair of Structures

2801. DESCRIPTION

Repair of structures shall be carried out in accordance with the repair plans and these specifications or as directed by the Engineer. Where repair work is not covered by these specifications, special specification may be framed.

Implementation of repair schemes shall also conform to provisions of IRC:SP:40.

2802. GENERAL**2802.1. Environmental Aspect**

Care shall be taken to ensure suitable mitigation measures against noise and dust, pollution and damages to the environs whether temporary or permanent and shall be taken as incidental to work.

2802.2. Phasing

The sequence of work shall be in accordance with the drawings or as directed by the Engineer.

2802.3. Traffic Management

Traffic management, signage, signalling arrangement, barricading, and lighting arrangement shall be in accordance with Section 100 and with these specifications and shall be considered as incidentals to work.

2802.4. Safety Precautions

Adequate precautions shall be taken for safety of personnel, road users and existing services, which, during execution, shall be considered as incidentals to work.

Persons working should wear safety helmets and rubber gloves.

2802.5. Dismantling and Removal of Material

Dismantling of any bridge component and removal of materials shall conform to Section 200 and this section and as shown on the drawings or as directed by the Engineer.

**2803. SEALING OF CRACKS BY INJECTION
OF EPOXY RESIN****2803.1. General**

The work of epoxy adhesive utilising the Structural Concrete Bonding Process shall conform to these specifications.

2803.2. The Contractor shall furnish detailed methodology of construction including sources of supply of material, tools, equipment and appliances to be used on work, details of personnel and supervision.

2803.3. Personnel

The Contractor's personnel shall be qualified and experienced in epoxy injection process.

2803.4. Material

The material for injection shall be suitable two-component low viscosity epoxy resin, having the required characteristics of bonding with concrete and resistance to moisture penetration. Epoxy mortar or polysulphide resin may be used for sealing the surface.

The material for epoxy injection shall conform to the following :

- i) The mixing ratio of resin and hardener shall generally be between 1 to 1 and 2 to 1 by volume subject to manufacturer's recommendation.
- ii) Neither the mixed epoxy adhesives nor their individual components shall contain solvents and thinners.
- iii) The components shall be free of lumps or foreign material. The viscosity of the individual components shall not change more than ± 15 per cent when kept in closed containers at 25 degrees Celsius after two weeks.
- iv) Consistency requirement.

	Standard Version cps	Low Viscosity Version cps
Viscosity of Mixed Adhesive at 25 degrees Celsius	(200-300)	(100-190)
v) Pot Life of mixed adhesive at 25 degrees Celsius	1 hour ± 15 minutes *	
vi) Set time of mixed adhesive at 25 degrees Celsius	3 - 6 hours	

*In the case of two component injection system where resin and hardener get mixed at point of injection pot life at 25 degrees Celsius shall be not greater than 15 min ± 10 minutes.

2803.5. Equipment for Injection

The equipment shall be portable, positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at nozzle. The pumps shall be generally electrically powered and shall provide in-line metering and mixing. The tolerance on mix ratio shall be 5 per cent by volume. The injection equipment

shall have automatic pressure control capable of discharging mixed adhesive at any pre-set pressure within the prescribed limits and shall be additionally equipped with a manual pressure control.

The injection equipment shall be equipped with sensors on both the components A and B reservoirs that will automatically stop the machine when only one component is being pumped to the mixing head.

If considered appropriate, suitable compressed air operated epoxy injection gun can be used with prior approval of the Engineer for manual injection of mix when resin and hardener had been mixed in a separate unit.

2803.6. Preparation

Surfaces adjacent to cracks or other areas of application shall be cleaned of dirt, dust, grease, oil efflorescence or other foreign matter by brushing/water jetting/sand blasting. Acids and corrosives shall not be permitted for cleaning.

Entry ports shall be provided along the crack at intervals of not more than the thickness of concrete at the location.

Surface seal material shall be applied to the face of the crack between the entry ports. For through cracks, surface seal shall be applied to both faces.

Before proceeding with the injection, the surface seal material must gain adequate strength with respect to concrete strength of the member/injection pressure.

2803.7. Epoxy Injection

Injection of epoxy adhesive shall begin at lowest entry port and continue until there is an appearance of epoxy adhesive at the next entry port adjacent to the entry port being pumped.

When epoxy adhesive travel is indicated by appearance at the next adjacent port, injection shall be discontinued on the entry port being pumped and entry port shall be sealed. Thereafter, epoxy injection shall be transferred to next adjacent port where epoxy adhesive has appeared.

Epoxy adhesive injection shall be performed continuously until cracks are completely filled.

If port to port travel of epoxy adhesive is not indicated, the work shall immediately be stopped. In case the volume of the injected material

exceeds 2 litres for a particular entry port, the work shall be stopped and the specifications may be reviewed.

2803.8. Precautions for Application

- a) Unless otherwise specified, components A and B, i.e., resin and hardener, shall be at a temperature between 10 degrees Celsius and 35 degrees Celsius at the time of mixing.
- b) Temperature of structural member during epoxy injection shall be between 10 degrees Celsius and 35 degrees Celsius unless otherwise specified.
- c) Immediately prior to use, each component shall be thoroughly mixed with a clean paddle. The paddle shall be of a type that does not induce air into the material. Separate clean paddle must be used for each component.
- d) Any heating of the adhesive components shall be done by application of indirect heat in case the work is to be done in cold climate.
- e) Just before use, the two components shall be thoroughly mixed in the ratios specified by the manufacturer. The length of mixing time shall be in strict accordance with manufacturer's recommendations. When mixed, all adhesives with different coloured components shall have a uniform colour without streaks.
- f) The use of solvents and thinners will not be permitted except for cleaning of equipment.

2803.9. Testing

2803.9.1. Material Testing : Prior to approval of the material, the following tests shall be carried out at site or in an authorised laboratory for each batch of resin and hardener and each combination thereof at the cost of the Contractor.

- i) Viscosity test for resin and hardener and the mix - three specimens each.
- ii) Pot life test - three specimens each.
- iii) Bond test - three specimens each.
- iv) Shear test - six specimens each, 3 after 24 hours and the other three after 72 hours of curing

Subsequent tests shall be carried out as directed by the Engineer.

a) Pot Life Tests

- i) 500 gm of resin formulation shall be prepared by thoroughly mixing the resin and hardener/accelerator/catalyst component in proposed proportion in a 1 kg capacity hemispherical porcelain bowl by means of a spatula or any other agitating device and note down the time and the ambient temperature.
- ii) With a clean dry 25 mm size painter's brush, the resin formulation shall be applied on a clean dry surface such as cement concrete over 15-20 cm length, starting immediately after mixing the formulation and repeating operation every five minutes. When it becomes just difficult to spread the resin properly with the brush, the time is noted. The

time elapsed since completion of mixing of resin formulation is taken as its pot life.

- iii) One pot life test shall be performed on commencement of work and the same shall be repeated every four hours.
- iv) In case the material fails to satisfy the pot life test it shall not be used for injection.

Where the resin and hardener get mixed at point of injection, the pot life is not important and no tests may be required.

b) Bond Test

A standard 150 mm diameter and 300 mm long concrete cylinder shall be cast in 2 pieces by providing a separating media at an axis of 45 degrees Celsius to the longer axis of the cylinder (refer to Fig. 2800/1).

Three sets of such split cylinders shall be prepared in advance. Two pieces of each set shall be joined with epoxy mortar at four points to give a clear gap of about 0.2 mm, which will be injected with epoxy resin at site. After epoxy has been cured, load test is carried out on the cylinder which shall not be less than 80 per cent of the cube strength of the concrete mix and the failure shall not take place at the joint injected with epoxy resin.

c) Shear Tests

Two steel plates, minimum 3mm thick, shall be bonded with epoxy at site using the same resin mix as used/proposed to be used for injection. The assembly shall be kept in mechanical clamp till epoxy is cured. A total of six specimens shall be prepared for each batch of materials. Three test specimens shall then be subjected to a shear force along the axis after 24 hours and the minimum shear strength before failure shall not be less than 1 MPa. (refer Fig. 2800/2).

The remaining test specimens shall be similarly tested after 72 hours of curing. The shear strength before failure shall not be less than 2.5 MPa.

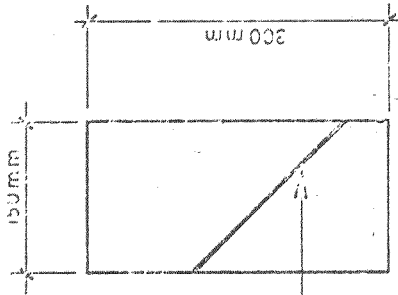
2803.9.2. Core test : If directed by the Engineer, core tests shall be conducted for the acceptance of the work. The selection of the location of cores shall be made under the direction of the Engineer in such a way that damage in critical/stressed areas of the structure is avoided. The procedure for the test shall be as under.

The Contractor shall obtain 5 cm diameter initial core samples in the first 50 linear metres. Thereafter, frequency of core sampling shall be as specified or as agreed by the Engineer.

The depth of the core shall generally be less than 20 cm.

Tests and Acceptance Criteria shall be as follows :

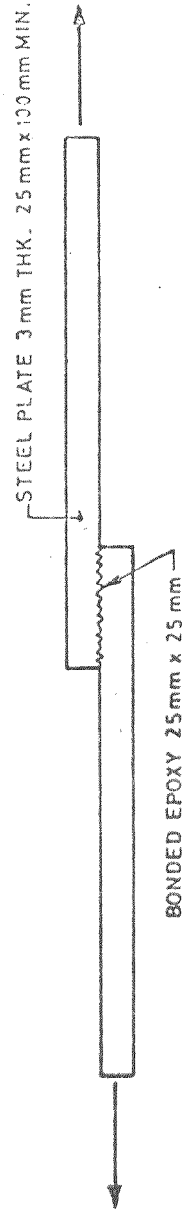
- a) Penetration/Visual Examination - a minimum of 90 per cent of the crack shall be full of epoxy adhesive.



STANDARD CONCRETE
CYLINDER CAST IN 2
PARTS

SEPARATING MEDIUM

FIG. 2800/1



STEEL PLATE 3 mm THK. 25 mm x 100 mm MIN.

BONDED EPOXY 25 mm x 25 mm

SEE SHEETS

- b) Bond Strength : Concrete failure before adhesive failure or 40 MPa with no failure of either concrete or adhesive

If the cores taken in first 50 m length pass tests as specified above, epoxy adhesive injection work at area represented by cores will be accepted.

If cores fail either by lack of penetration or bond strength, work shall not proceed further until the areas represented by the cores are re-injected and retested for acceptance.

Filling of Field Control Testing Core Holes

This procedure consists of using two-component bonding agent applied to surfaces of cored holes followed by application of Non-Shrink cement grout mix placed by hand trowel, thoroughly rodded and tamped in place, and finished to match finish and texture of existing concrete to the satisfaction of the Engineer. Materials and procedures for filling testing core holes shall be submitted to and approved by the Engineer before proceeding with core testing work.

2803.9.3. Test for injection equipment : At all times during the course of the work the Contractor shall keep complete and accurate records and make available to the Engineer of the pressure and ratio tests specified above so that the efficacy and accuracy of the injection equipment is verified.

In addition, the Engineer at any time without prior intimation of the Contractor may request the Contractor to conduct the tests specified below, in the presence of the Engineer.

a) **Pressure Test**

The mixing head of the injection equipment shall be disconnected and the two adhesive component delivery lines shall be attached to the pressure check device, which shall consist of two independent valved nozzles capable of sensing the pressure. The check device shall be closed and equipment operated until the gauge pressure in each line reads 5 MPa. The pumps shall be stopped and the gauge pressure shall not drop below 4 MPa within 2 minutes.

The pressure test shall be run for each injection unit at the beginning and after break of every shift.

b) **Ratio Test**

The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through the ratio check device, which shall consist of two independent valved nozzles. There shall be a pressure gauge capable of controlling back pressure by opening or closing valved nozzles capable of sensing the back pressure behind each valve. The discharge pressure shall be adjusted to read 5 bar for both adhesive components,

which shall be simultaneously discharged into separate calibrated containers during the same time period and the amounts discharged into the calibrated containers simultaneously during the same period shall be compared to determine that the volume/discharge conforms to the manufacturer's recommended ratio for applicable material.

2804. EPOXY MORTAR FOR REPLACEMENT OF SPALLED CONCRETE

2804.1. Material

2804.1.1. Formulation

The epoxy resins for use in the mortar shall be obtained from a reputed manufacturer and the mortar shall be prepared in conformity with the manufacturer's recommendations.

They shall generally conform to the following:

Pot Life : 90 minutes at 25 degrees Celsius

60 minutes at 30 degrees Celsius

45 minutes at 35 degrees Celsius

Bond Strength : 12 MPa

Tensile Strength : 16 MPa

The Contractor shall carry out tests on the samples made out or requirements indicated above.

The sand content in the mortar shall be in accordance with the desired consistency.

2804.2. Proportioning and Mixing

The resin and hardener shall be mixed before adding the dry filler. The mixed ready to use mortar should not contain lumps of unwetted filler and should be uniform in colour. For a total weight of 1 kg or less, hand mixing will be sufficient. For quantities in excess of 1 kg, the component shall be mixed for 3 minutes with a slow speed - 400-600 rpm - electric drill with a Jiffy mixer. The stirrer shall be moved up and down and along the sides until an even streak free colour is obtained. Whipping in an excessive amount of air shall be avoided. If no power is available, a flat putty knife may be used to reach into the corners of the can and hand mixing done for at least 5 minutes.

2804.3. Surface Preparation

Surface upon which epoxy is to be placed shall be free of rust,

grease, oil, paint, asphalt, loose material, unsound concrete, dust or any other deleterious material.

Since cured epoxy does not provide adequate bond with any material, all overlay, whether epoxy or cement based, shall be done within pot life of the base epoxy layer.

2804.4. Contaminants, such as oil, grease, tar, asphalt, paint, wax, curing compounds or surface impregnants like linseed oil or silicones, including laitance and weak or loose concrete shall be removed. When bonding to asphalt, the surface should be roughened so that clean aggregate is exposed. Epoxy bonding agents shall not be applied when it rains, or in standing water. The surface must be dry.

Two general methods of surface preparation shall be followed :

- a) Mechanical that includes grinding, grit blasting, water blasting and scarification.
- b) Chemical that includes acid etching with 15 per cent by weight of hydrochloric solution, followed by repeated flushing with high pressure stream of water.

2804.5. Application

Epoxy primer coat shall be applied with the help of stiff nylon bristle brushes or hard rubber rollers or spray gun depending upon the nature of surface and extent of work area. As far as possible, the coating shall be uniformly thick.

Before the primer coat is fully cured, epoxy mortar shall be applied by means of trowels and floats. The interval between the application of primer coat and epoxy mortar shall be approximately 15/30 minutes depending upon the ambient temperature.

Seal Coat shall be applied after 24 hours curing, after mild roughening of the surface of the mortar.

2804.6. Coverage

The coverage of resin mix would depend on the system of resin used. However, as a general guideline the coverage area shall be as under :

- a) **Primer Coat.** One kg of resin-hardener mix covers an area of 3-6 square metres per coat depending on the finish of the concrete.
- b) **Epoxy Mortar.** One square metre of surface requires approximately 20-24 kg of epoxy mortar when laid to a thickness of 10mm.
- c) **Seal Coat.** 4 to 6 square metres per kg of mix depending on the temperature of application.

2804.7. Cleaning and Maintenance of Equipment

Tools and equipment are best cleaned immediately after use since the removal of cured resin is difficult and time consuming. The bulk of resin shall be removed using a scraper and remainder washed away completely using solvents such as toluene, xylene or acetone. Equipments used for epoxy shall always be cleaned before it hardens. Solvents used for this purpose may be Acetone (flammable), Methyl Ethyl Kethone (flammable), Methyl Chloride (non-flammable). Cured epoxies may be removed using Methylene Chloride.

2804.8. Testing

Epoxy used for making mortar shall conform to all requirements and testing procedures as laid down in Clause 2803.9.

2804.9. Handling Precautions

Epoxy resins can cause irritation of skin in sensitive persons if incorrectly handled. The resin and hardener should not be allowed to come into direct contact with skin. The most effective protection is achieved by wearing rubber or polythene gloves.

2804.10. Personnel and Environment Safety

Any skin contact with epoxy materials, solvents and epoxy strippers should be avoided. Epoxy resins and particularly epoxy hardeners (B component) may cause a rash on the skin. The official toxicity classification on the container labels may be looked for before starting work.

Rubber gloves, with a cloth liner, and protective clothing shall be worn. Barrier creams are recommended but are not substitutes for protective clothing. Eyes shall be protected where splashing could occur while spraying or mixing. Good ventilation shall be ensured and inhalation of vapours avoided. If materials are sprayed, a respirator shall be used.

If skin contact occurs, it shall be immediately washed with a cleaner, followed by soap and water. Should eye contact occur, it shall be flushed immediately with plenty of water for 15 minutes and a doctor called for.

If contact occurs with the clothing, it shall be immediately changed to prevent further skin contact, and if the contact occurs with components A or B, the clothing shall be thrown away. Hardened epoxy is not harmful but will break the clothing.

All emptied, used buckets, rags and containers shall be removed from site. These shall be stored in waste disposal bags and suitably disposed.

2805. EPOXY BONDING OF NEW CONCRETE TO OLD CONCRETE

2805.1. Epoxy resin used for bonding shall be obtained from a reputed manufacturer. The pot life of such bonding epoxy shall not be less than 60-90 minutes at normal temperature.

2805.2. The entire surface of the existing concrete member should be thoroughly cleaned by wire brush and then with compressed air to remove dust and loose particles from the surface. Any crack or spalling of concrete shall be sealed by epoxy injection/epoxy mortar/grouting as decided by the Engineer. A coating of suitable epoxy resin at the rate of 0.8 kg/sq.m. (minimum) should then be applied on the surface of the existing concrete members. Fresh concrete shall then be placed within the pot life of the resin system.

2805.3. Testing

2805.3.1. Epoxy used for bonding work shall satisfy the criteria mentioned in Clause 2803.9.

2805.3.2. Two concrete cubes 150 mm size cast as per approved design mix shall be placed, as shown in Fig. 2800/3 at a distance of 150 mm from each other. Epoxy resin system suggested for bonding new to old concrete shall be applied on the opposite faces of the cubes.

Fresh cement concrete cube of grade as per approved design mix shall be cast with water cement ratio of 0.4 or less in the manner shown in Fig. 2800/3. The assembly shall be cured in water for 28 days and steel spacer removed thereafter.

The cube assembly shall be subjected to compression load after 28 days of curing, thereby subjecting the bond to shearing load. Failure must not occur at this joint.

2806. CEMENT GROUTING

2806.1. Material

Grouting shall normally be performed with a mixture of neat Portland Cement and water. Other additives and admixtures may be added to improve the impermeability, strength, etc. on the approval of the Engineer. The size of the particles and the consistency of the grout must be suited to the passageways it must follow. Neat grout will not

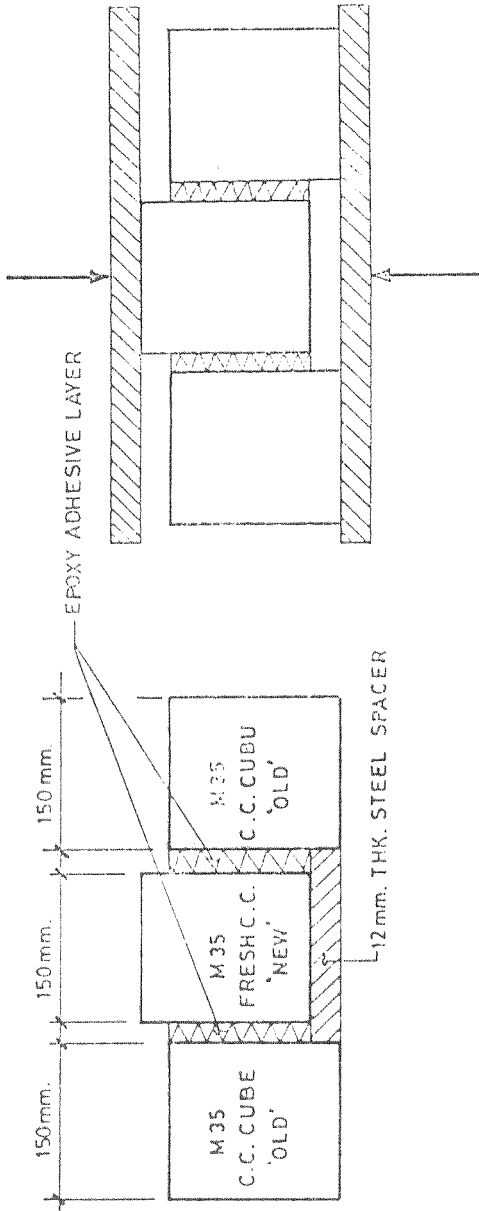


FIG. 2800/3

flow freely into holes smaller than about three times the largest cement particle. Except in large cavities where thick mortar can be placed, the sand should all pass the 28-mesh sieve and have a large portion passing the 50- and the 100- mesh sieves. The proportions of Ordinary Portland Cement to sand will depend upon the size of the spaces to be filled and will vary from a neat grout to about 1:1 mix. The amount of water to be added depends upon the consistency required. Grouts with as little as 16 litres of water per bag of cement could be handled and it should seldom be necessary to use more than 35 to 40 litres of water per bag of cement.

Where necessary and approved by the Engineer, admixtures to Portland Cement grout mixtures may be added for delaying the setting time, increasing flow ability, minimising segregation and shrinkage.

2806.2. Preparation

The surface shall be cleaned with wire brush and compressed air. 15 mm dia and 150 to 200 mm deep holes along the length of the cracks at a spacing of 500 mm may be drilled by wet drilling using rotary percussion drills and nipples inserted in these holes.

2806.3. Proportioning, Mixing and Equipment for Grouting

The cement grout shall be mechanically mixed using a system of power-driven paddles of high speed centrifugal pump. The grout pump to be used shall permit close control of pressures to allow a flexible rate of injection with minimum clogging of valves and ports. The most satisfactory equipment for injecting grout is a pump of the double-acting flexible reciprocating type giving a steady flow. The grout pump shall be so placed as to reduce the waste in cleaning lines. It is preferable to add 50 per cent or more of the mixing water into the mixer before adding the dry ingredients and then the remaining water. A continuous supply of grout is preferable to an intermittent one. Consistency of the grout may be determined by trials starting with thin grout i.e. about 40 litres of water per bag of cement and progressively decreasing the water content to about 15 litres per bag of cement.

Where the mixer and pump are combined in one unit, the dry material shall be screened before mixing. If the mixer and pump are in separate units, the grout shall pass through a screen before it enters the pump.

2806.4. Application

Highest practical pressure within the limits 100-400 kPa should be used in order to force the surplus water from the grout. As the pressure may be distributed hydraulically over considerable areas, vigilance must be exercised to prevent damage or the needless waste of grout. Grouting is to be done by attaching a packer (consisting of expansible tube of rubber) to the end of the grout supply pump through the holes and nipples.

Pressure shall be steady to ensure a continuous flow of grout. Grouting shall not be continued till the hole consumes mix at the rate of not less than 30 litres in 20 minutes or until refusal at the grouting pressure of 400 kPa at any hole until refusal. Should the grout escape from an adjacent nipple, it should be plugged or capped. Any seam, crack or joint through which grout escapes shall be caulked with epoxy mortar as soon as thick grout appears.

2806.5. Cleaning of Equipment

After completion of each grouting operation or temporary shutdown, it is advisable to force clear water through the pump until the discharge line shows no colour, after which the pump covers shall be removed and the valve chambers thoroughly cleaned.

2806.6. Testing

Percolation test done at the end of grouting operation shall give a value of less than 2 lugons.

NOTE : For specialised treatment like polymer modified cementitious grout injection, manufacturer's literature and specification shall be followed.

2807. GUNITING/SHOTCRETE

2807.1. The gunite is a mixture of cement, sand and water. It comprises 100 parts by weight of cement, 300 parts by weight quartz sand, 35-50 parts by weight water and 2 parts by weight approved quick setting compound. In general, dry mix shotcrete shall be used.

2807.2. Ordinary Portland cement conforming to IS:269 shall be used in guniting.

2807.3. Sand for guniting shall comply with the requirements stipulated in IS:383. In general, sand should neither be too coarse to increase the rebound nor too fine to increase the slump. Sand should preferably have a moisture content between 3 to 6 per cent.

The grading of sand shall lie within the limits given below :

IS Sieve Designation	per cent Passing the sieve
4.75 mm	95 - 100
2.36 mm	65 - 90
1.18 mm	45 - 75
600 microns	30 - 50
300 microns	10 - 22
150 microns	2 - 8

2807.4. For thick sections it may be advantageous to incorporate coarse aggregate in the mix provided adequate guniting equipment is available. Coarse aggregate, when used, shall conform to grading given in Table I of IS:9012. The percentage of coarse aggregate may normally be kept as 20 to 40 per cent of the total aggregate and the mix shall be suitably designed.

2807.5. Water/cement ratio for guniting shall fall within the range 0.35 to 0.50 by mass, wet enough to reduce the rebound. Drying shrinkage may be between 0.06 per cent to 0.10 per cent. The quick setting compound shall be added at the nozzle with water just before guniting.

2807.6. Workmanship

The cement and sand shall be batched and mixed and conveyed through a hose pipe with the help of compressed air. A separate line shall bring the water under pressure. The cement, sand and water mix shall be passed through and intimately mixed in a special manifold and then projected at high velocity to the surface being repaired. The density of gunite shall not be less than 2000 kg/cu.m. The strength of gunite shall not be less than 25 MPa. For effective guniting, the nozzle shall be kept 60 to 150 cm away from the surface, preferably normal to that surface. While enclosing reinforcement bars during repairs the nozzle shall be held closer at a slight angle and the mix shall be wetter than the normal.

2807.7. Test panels simulating actual field conditions shall be fabricated for conducting preconstruction testing. The procedure for testing the cubes or cylinders taken from the panels stipulated in clause 6 of IS:9012 shall be followed.

2807.8. It should be ensured from tests that a strength of about 25 MPa at 28 days is available for the mortar/concrete mix.

2807.9. The defective concrete shall be cut out to the full depth

till sound concrete surface is reached. Under no circumstances should the thickness of concrete to be removed be less than clear cover to the main reinforcement. No square shoulders shall be left at the perimeter of the cut-off portion and all edges shall be tapered. Thereafter, all loose and foreign materials should be removed and the surface be sand-blasted to make it rough to receive shotcrete after applying a coat of bonding epoxy as per recommendation of the manufacturer @ 1.0 kg per 1.5 sq.m. of surface area.

2807.10. The exposed reinforcement shall be thoroughly cleaned free of rust, scales etc. by wire brushing. Wherever the reinforcements have been corroded, the same shall be removed and replaced by additional reinforcement. Before application of gunite, a coat of neat cement slurry should be applied on the surface of the reinforcement.

2807.11. Sufficient clearance shall be provided around the reinforcement to permit encasement with sound gunite. Care shall be taken to avoid sand pockets behind the reinforcement.

2807.12. A thickness of 25 to 40 mm of gunite can normally be deposited in one operation. If, for some reason, the total thickness is to be built up in successive operations, the previous layer should be allowed to set but not become hard before the application of the subsequent layer. It would always be necessary to apply guniting on a damp concrete surface.

2807.13. Where required, welded wire fabrics 5cm x 5 cm x No. 10 gauge shall be provided in the first layer of guniting. The fabric shall be tied properly. In case the damage to the concrete member is too deep, the specifications for guniting as well as requirement of placement of wire mesh has to be decided as per field conditions.

2807.14. The stipulations given in IS:9012 regarding application of gunite should be followed so as to keep the rebound to the minimum. The quality of guniting and workmanship shall be such that the percentage of rebound mentioned in IS:9012 can be adhered to. In no circumstances shall the rebound material be re-used in the work.

2807.15. It would be desirable that green gunite is moistened for at least 7 days. Guniting work shall not be done during windy or rainy conditions.

2808. REPLACEMENT/RECTIFICATION OF BEARINGS

2808.1. The replacement/rectification of bearings shall be carried out in accordance with approved repair plan or as approved by the Engineer.

2808.2. Lifting of superstructure spans may be carried out by jacking up from below or by lifting the span from top. Where jacks are employed, their location/number and size shall be selected in such a manner so that there are no undue stresses created in the structure. Jacks may be placed on piers/pier caps or specially erected trestles in accordance with the approved methodology for lifting of superstructure. All jacks shall be operated from one control panel by a single control lever. The system will have provision for manual over ride to control the loads of any particular jack. The jacks should be so synchronised that differential lift between individual jacks shall not exceed 1 mm

2808.3. Necessary repair/replacement of bearings shall be carried out as indicated in the repair plan or as directed by the Engineer. Care shall be taken to plan the execution of repair in the shortest possible period.

2808.4. Precautions during Lifting of Girders for Rectification of Bearings

Walkie talkies system or similar audio arrangements should be available for communicating instructions regarding lifting, stopping, starting etc. The operator shall have a clear view of the jacks and the lifting of each girder controlled by reading the dial gauges.

2809. DISMANTLING OF CONCRETE WEARING COAT

2809.1. Commencement of Dismantling

- i) Before commencing dismantling, the nature and condition of concrete, the condition and position of reinforcement should be ascertained. The Contractor shall familiarise himself with the structural design and ensure that the overall stability of the bridge is not affected.
- ii). The existing expansion joint assemblies shall be removed carefully along the entire width of the carriageway. The deck slab for a width of 400 mm on either side should be removed for placing of reinforcement, anchor rods, anchor bolts and other fixing assemblies for the new expansion joints and pouring of fresh concrete. The gap between the girders over the piers should be cleared of all debris. A temporary platform in the gap at the end of girders shall be erected to collect the materials falling down during concreting and fixing of expansion joints
- iii) The service lines, if any, shall be disconnected/ diverted before the dismantling work starts.

2809.2. Dismantling of concrete wearing coat shall be carried out using jack hammers or suitable manual methods as approved by the Engineer. Care should be taken to avoid any damage to the existing structure including reinforcement or prestressing anchorages for cables,

if any, located in the deck slab.

2809.3. Precautions During Dismantling Work

For general guidelines, reference may be made to Section 100.

Dismantling work shall not be carried out at night, or during storm or heavy rain. A warning device shall be installed in the area to be used to warn the workers in case of mishap/emergency.

Safety helmets conforming to IS:2925 shall be used by the workmen engaged in dismantling work. The sheds and tool boxes should be located away from the work site. Goggles preferably made up of celluloids and gas masks shall be worn at the time of dismantling, especially where tools like jack hammers are deployed to protect eyes from injuries from flying pieces, dirt, dust etc. Leather or rubber gloves shall be worn by the workers during the demolition of RCC work. Screens made up of GI sheets shall be placed wherever necessary to prevent the flying pieces from injuring the workers.

Water should be sprayed to reduce the dust while removing concrete wearing course with jack hammer. No work shall be taken up under the span when dismantling work is in progress.

2810. EXTERNAL PRESTRESSING

2810.1. Various components constituting the system of external prestressing are as follows :

H.T. Strands/Wires, HDPE Sheathing, Deviator Blocks, Anchor Plates, Anchorages and grouting material.

2810.2. Material

H.T. Strands / Wires :

H.T.Strands wires shall conform to Section 1000.

HDPE Sheathing :

HDPE Sheathing shall conform to IS:4984 suitable for a working pressure of 6 bars. Its density shall be 955 kg/cum, shore hardness D63, yield stress 24 MPa and ultimate tensile strength 35 MPa.

Deviator Blocks :

As necessitated by the profile of the external cable, suitable strand/wire deviator block fabricated from M.S.Sections shall be provided. The deviator block shall be given a coat of suitable paint (preferably epoxy based) after sand blasting.

Anchorage :

Depending upon the prestressing force, suitable anchorages and wedges shall be used conforming to relevant codes and section 1800.

2810.3. Workmanship

- a) Stressing of cables shall be carried out as per instructions given in the drawing, and conforming to Section 1800.
- b) Care should be taken to avoid any damage to the existing structure by way of stress concentration or any other reason during fixing of the deviator blocks and after stressing of cable. The deviator blocks shall be so fixed as not to allow any movement due to prestressing forces. Radius of curvature of the surface of the deviator block interfacing with the cable shall be minimum one metre.
- c) The anchorages shall be sealed with suitable epoxy mortar system after the stressing of cables. A minimum cover of 50mm shall be provided for the anchor plates and anchorages.
- d) Suitable grouting inlet points and vent points shall be provided by way of HDPE "T" vent connections to the sheathing.
- e) Grouting of cables shall be carried out as per provisions made in Section 1800.

2810.4. It shall be ensured that no part of the existing structure is damaged/distressed due to the external prestressing.

The behaviour of the girder shall be monitored by measurement of deflection so that only required amount of external prestressing is imparted to the girder. Care shall be taken to avoid excess prestressing and impairment to the girders.

2811. TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2812. MEASUREMENTS FOR PAYMENT

- a) Measurement for sealing of cracks and injection shall be made by weight of epoxy consumed in kg for epoxy grouting. For provision of nipples required for grouting, the payment shall be for number of nipples inserted.
- b) Measurement for sealing of cracks and injection shall be made by weight of cement consumed in kg for cement grouting.
- c) Measurement for application of epoxy mortar for specified thickness shall be per square metre of surface area of application.
- d) Measurement for bonding of old and new concrete by epoxy mortar shall be measured in square metre surface area of interface.

- e) Measurement for guniting/shotcreting, shall be per square metre of surface area of application.
- f) Payment for replacement/rectification of bearings shall be for each number of bearing assembly replaced/rectified.
- g) Dismantling of wearing coat shall be measured in square metre of area of wearing course dismantled.
- h) Provision of external prestressing shall be measured in tonnes of H.T. steel strand/wire measured from anchorage to anchorage before stressing.

2813. RATE

The contract unit rate for sealing of cracks and injection of cement grout shall include cost of all materials, labour, tools and plant, placing in position, testing, curing and other incidental expenses for the satisfactory completion of the work as per these specifications.

The contract unit rate for application of epoxy mortar for specified thickness shall include cost of all materials, labour, tools and plant, placing in position, testing and other incidental expenses including surface preparation for the satisfactory completion of the work as per these specifications and as shown on the drawings.

The contract unit rate for guniting/shotcreting shall include cost of all materials, labour, tools and plant, placing in position, testing, curing, surface preparation and other incidental expenses including the provision of nipples for the satisfactory completion of the work as per these specifications.

The contract unit rate for replacement/rectification of bearings shall include cost of all materials, labour, tools and plant, placing in position, site welding/riveting/bolt connections, operation of jacks and other incidental expenses for the satisfactory completion of the work as per these specifications and as shown on the drawings.

The contract unit rate for dismantling of wearing coat shall include cost of all materials, labour, tools and plant, traffic management, signages, safety precautions and other incidental expenses including removal of existing expansion joints for the satisfactory completion of the work as per these specifications.

The contract unit rate for external prestressing shall include cost of all materials, labour, tools and plant, temporary works, testing, curing and other incidental expenses including the careful monitoring of the deflection of girders being externally prestressed for the satisfactory completion of the work as per these specifications and as shown on the drawings.