

INJECTION INTO DELAMINATION IN CONCRETE WITH LIQUID EPOXY ADHESIVES

The specification information below is intended for use by architects, engineers or other specifiers as a guideline in defining the requirements of Epoxy Adhesive Injection for the structural repair of delaminations in concrete.

NOTES TO THE SPECIFIER

This document has been prepared to assist specifiers in the preparation of the specifications for the injection of liquid epoxy adhesives into delaminations in concrete using the SCB® (Structural Concrete Bonding®) Process from Master Builders, Inc. SCB CONCRETSIVE® 1380 or SCB CONCRETSIVE® 1360 or other SCB CONCRETSIVE® Injection Epoxy Adhesives are recommended materials for such applications.

This document was designed as part of a complete project specification, that is, it is not intended to be a “stand alone” item.

PART 1 - GENERAL

1.1 Scope

- A. The contractor or his subcontractor shall furnish all materials, tools, equipment, appliances, transportation, labor and supervision required to repair cracks by the injection of an epoxy resin adhesive.

1.2 Pre-qualification

- A. Applicator's Qualification: Epoxy Injection shall be performed by a certified applicator of the SCB® (Structural Concrete Bonding) Process.
- B. Workman's Qualification: Contractors/Subcontractors workmen engaged in the epoxy injection process shall have satisfactorily completed a program of instruction in the methods of restoring concrete structures, wooden timbers and beams utilizing the specific epoxy injection process indicated. The curriculum shall include theory in the nature and causes of cracking in concrete and wood, methods for permanently repairing damaged concrete structures, wooden timbers and beams, the technical aspects of correct material selection and use, and the operation, maintenance and trouble shooting of equipment.

PART 2 - PRODUCTS

2.1 Epoxy Resin Adhesive for Injection

(In this section, insert the specification for the injection product showing the test methods and physical properties).

2.2 Surface Seal

2.2.1 Description: The surface seal is that material used to confine the injection adhesive in the fissure during injection and cure.

2.2.2 Properties: The surface seal material shall have sufficient strength to resist injection pressures adequately to prevent leakage during injection.

2.3 Pins

2.3.1 Threaded pins required in 3.1.5 shall be ASTM A-36 steel 3/8 in. diameter and shall be free of loose and/or deleterious substances: i.e. rust, grease, mill scale, etc. Galvanized bolts shall not be used.

2.4 Equipment for Injection

2.4.1 Type: The equipment used to meter and mix the two injection adhesive components, and inject the mixed adhesive into the crack shall be portable, positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle. The pumps shall be electric or air powered and shall provide in-line metering and mixing.

2.4.2 Discharge Pressure: The injection equipment shall have automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 160 +/-5 psi and shall be equipped with a manual pressure control override.

2.4.3 Ratio Tolerance: The equipment shall have the capability of maintaining the volume ratio for the injection adhesive prescribed by the manufacturer of the adhesive within a tolerance of +/- 5% by volume at any discharge pressure up to 160 psi.

2.4.4 Automatic Shut-off Control: The injection equipment shall be equipped with sensors on both the component A and the component B reservoirs that will automatically stop the machine immediately when either reservoir becomes dry.

PART 3 - EXECUTION OF WORK

3.1 Preparation

3.1.1 Surfaces adjacent to cracks or other areas of application shall be cleaned of dirt, dust, grease, oil, efflorescence or other foreign matter detrimental to bond of epoxy injection surface seal. Acids and corrosives shall not be permitted for cleaning.

3.1.2 Entry ports shall be provided along the delamination at a geometric grid interval. Spacing of the entry ports shall be approved by the engineer.

3.1.3 Surface seal material shall be applied to the face of the delamination or other areas of application between the entry ports as needed. For through cracks associated with delamination, a surface seal shall be applied to both faces

3.1.4 Enough time for the surface seal material to gain adequate strength shall pass before proceeding with the injection.

3.1.5 The pins shall be bonded into holes drilled through the delamination to hold the delaminated section together against the pressure of injection. A rotary percussion drill shall be used to drill holes 1/4 in. to 3/8 in. larger than pin size.

3.2 Epoxy Injection

3.2.1 On a grid pattern (spacing of grid ports depends on size and overall thickness of delaminated area), injection of epoxy adhesive shall begin at lower entry port and continue until there is an appearance of epoxy adhesive at the next port adjacent to the entry port being pumped.

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

3.2.3 Epoxy adhesive injection shall continue until delamination is completely filled.

3.2.4 If port to port travel of epoxy adhesive is not indicated, the work shall be immediately stopped and the Engineer notified.

3.3 Finishing

3.3.1 When delaminations are completely filled, epoxy adhesive shall be cured for sufficient time to allow removal of surface seal without any draining or run-back of epoxy material from delaminations and/or associated cracks.

3.3.2 Surface seal material and injection adhesive runs or spills shall be removed from concrete surfaces.

3.3.3 The surface area shall be finished flush with the adjacent concrete, showing no indications or protrusions caused by the placement of entry ports.

3.3.4 After the work has been accepted by the Engineer, cored holes shall be repaired using a two component bonding agent and a suitable grout mix. The bonding agent shall be applied to the surfaces of cored holes followed by application of grout mix placed by hand trowel, thoroughly rodded and tamped in place, and finished to match color, finish and texture of existing concrete to the satisfaction of the Engineer. Material and procedure for filling testing core holes shall be submitted to and approved by the Engineer before proceeding with this work.

3.4 Field Quality Control

3.4.1 Core testing to verify penetration and strength (NOTE: It is imperative that no tendons be cut.)

Initial Cores: The contractor/subcontractor shall obtain three 2 in. diameter initial core samples in the first 200 ft² of delamination repaired and one core for each 200 ft² thereafter.

The cores shall be for the full depth of the delamination and taken from locations as selected by the Engineer. Additionally, the contractor/subcontractor shall provide at no additional expense to the owner the labor, materials, and services required for core sampling and testing as directed by the Engineer, including but not limited to: Preparation, handling, storage and transportation of epoxy injection concrete core test specimens; suitable containers for the storage, curing and transportation of test specimens; suitable storage for supply of test equipment and other items required for sampling and testing.

3.4.2 Methods of Testing Initial Cores

- a. Penetration : Visual examination
- b. Bond Strength/Compression Test: ASTM C 39-86

3.4.3 Test Requirements

- a. Penetration: A minimum of 90 percent of the crack shall be full of epoxy adhesive.
- b. Bond Strength: Concrete failure before adhesive failure, or 6,500 psi with no failure of either concrete or adhesive.

3.4.4 Evaluation and Acceptance of Tests: If the initial cores conform to the requirements of 3.4.2 "Penetration" and "Bond Strength", epoxy adhesive injection work at the area represented by the cores shall be accepted. If the initial cores do not conform to 3.4.2 "Penetration" above, the work shall not proceed further until the area represented by the cores is reinjected and retested for acceptance.

After re-work of areas represented by failed initial cores is complete, the contractor shall obtain verifying cores, the number and location to be determined by the Engineer. Verifying cores shall be tested in accordance with paragraphs 3.4.2 and 3.4.3 for compliance. If cores do not conform to the requirements for 3.4.2 "Bond Strengths" above, the work shall be reinjected.

After re-work of areas represented by failed cores is complete, the contractor shall obtain verifying cores, the number and location to be determined by the Engineer. Verifying cores shall be tested in accordance with paragraphs 3.4.2 and 3.4.3 for compliance.

3.4.5 Payment for Core Testing: Testing of initial core samples which have been taken by the contractor will be performed by the owner's representative at the owner's expense.

Additional cores, called verification cores, required as indicated in Paragraph 3.4.4 (re-work) herein, will be tested by the Owner at the Contractors expense in accordance with a fee schedule established by the Engineer.

3.4.6 Pressure Test of Injection Equipment Method: 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. The pressure check device shall consist of two independent valved nozzles capable of controlling back pressure by opening or closing the valve. There shall be a pressure gauge capable of sensing the pressure build up behind each valve. The valves in the pressure check device shall be closed and the equipment operated until the gauge pressure on each line reads 160. The pumps shall be stopped and the gauge pressure shall not drop below 150 psi within 2 minutes.

Frequency of Pressure Test: The pressure test shall be run for each injection unit at the beginning and every four hours of use for all shifts the unit is used on the work of delamination repair.

3.4.7 Ratio Test of Injection Equipment Method: The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through the ratio check device. The ratio check device shall consist of two independent valved nozzles capable of controlling back pressure by opening or closing the valve. There shall be a pressure gauge capable of sensing the back pressure behind each valve. The discharge pressure shall be adjusted to 160 psi for both adhesive components. Both adhesive components shall be simultaneously discharged into separate calibrated containers. The amounts discharged into the calibrated containers during the same time period shall be compared to determine that the volumes discharged deviate no more than 5% from the correct ratio as specified in the manufacturers product data sheet.

Frequency of Ratio Test: The pressure test shall be run for each injection unit at the beginning and every four hours of use for all shifts the unit is used on the work of delamination repair.

3.4.8 Proof of Ratio and Pressure Testing: At all times during the course of the work the Contractor shall keep complete and accurate records of the pressure and ratio tests specified above. These records shall be available to the Engineer.

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

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