

SECTION 03 31 00 – EPOXY RELATED WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division - 01 Specification Sections, apply to the work of this section.

1.2 SCOPE OF WORK

- A. The following epoxy related work is shown on the drawings and in this project manual:

1. Crack locations and approximate lengths of cracks for epoxy injection work.
2. Epoxy mortar patch locations and approximate sizes.
3. Polymer mortar patch locations and approximate sizes.
4. Locations requiring epoxy bond between fresh and hardened concrete.
5. Locations requiring bolts, dowels or reinforcing steel set in epoxy.
6. Locations requiring skid-resistant surface on concrete by the use of multi-component epoxy or non-epoxy systems.
7. Locations requiring epoxy penetrant sealer.
8. Locations requiring self-penetrating concrete crack filler and sealer using high molecular weight methacrylates.
9. Locations requiring polymer modified cementitious mortar overlay system.
10. Locations requiring epoxy resin overlay system.

These drawings are for the Contractor's guidance only, and are to be considered as a minimum for pricing. Contractor shall not do any additional work beyond what is shown in the drawings without prior written approval of the Architect/Engineer.

- B. Contractor shall fully acquaint himself with the existing job site conditions and discuss the accessibility of the work areas with the Owner.
- C. Contractor shall ensure that there is adequate ventilation in areas where epoxy repair work is being performed and that no work results in nauseating, annoying or toxic fumes and odors from entering occupied areas. Provide barricades around the work area with appropriate signage to keep non-construction people from entering work area.
- D. Contractor shall provide all traffic cones or barriers to direct traffic during the repair of the parking garage. This work shall be done in consultation with the Owner.
- E. During the course of construction, Architect/Engineer may require certain items to be repaired by methods involving epoxies. Repairs may include epoxy injection of cracks, epoxy or polymer mortar patching, epoxy grouted dowels or reinforcing steel, and

bonding fresh concrete to hardened concrete. Such work shall be done by the Contractor in strict conformance to these specifications.

1.3 QUALITY ASSURANCE

A. Applicable Standards – most recent version

1. American Society for Testing and Materials (ASTM)

C881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

2. American Concrete Institute (ACI)

ACI 503 R Use of Epoxy Compounds with Concrete

ACI 503.1 Standard Specification for Bonding, Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive

ACI 503.2 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

ACI 503.3 Standard Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Multi-Component Epoxy System

ACI 503.4 Standard Specification for Repairing Concrete with Epoxy Mortars

ACI 548.1R Guide For Use of Polymers in Concrete

B. Manufacturer's Qualifications: Companies furnishing the epoxy materials shall have a proven track record of at least five years. Furthermore, they shall have in existence a program of training, certifying and supporting a nationally organized program of approved contractors. Evidence of this shall be made available to the Engineer/Architect upon request.

C. Contractor's Qualifications: Contractor performing the work shall be an approved contractor by the manufacturer furnishing the epoxy materials, and shall have no less than five years experience in the various types of epoxy related work required in this project. A notarized certification from the manufacturer attesting to the training shall be submitted to the Engineer/Architect along with the proposal to do the work.

D. Injection Equipment Requirements: Injection equipment used by the Contractor shall be from a manufacturer who has been producing such equipment for a minimum of five years. Such equipment shall have a record of satisfactorily proportioning, mixing, and dispensing of the injection resin being used.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EPOXY MATERIALS

- A. All epoxy material shall be new and manufactured within the shelf life limitations set forth by the manufacturer.
- B. Epoxy shall be a two-part epoxy adhesive material, and shall be of epichlorohydrin/amine type. Polysulphide epoxies are not acceptable.
- C. Epoxy used shall be insensitive to the presence of water and moisture, and shall be capable of application and of strength development even when applied to damp surfaces having a temperature of 40° or above.
- D. Epoxy used shall develop a minimum strength of 2000 psi in tension and 4000 psi in compression at the end of seven days.
- E. Epoxies used shall not deteriorate under approximately 200 freeze thaw cycles.
- F. Epoxies used shall be 100% solids without solvents.
- G. With the exception of epoxy penetrant sealers, epoxies used shall be 100% solids without solvents.
- H. Bonding and strength characteristics of epoxies shall be stable when exposed to ultraviolet rays.
- I. The viscosity of the epoxy used for injection work shall be low enough (about 300 cps at 77°F) to completely fill hairline cracks as small as 10 mils.

2.2 ADDITIONAL REQUIREMENTS FOR EPOXY MORTARS

- A. Epoxy mortar used for bonding, patching, and resurfacing, shall have the following additional properties:
 - 1. Epoxy mortar shall be non-sagging.
 - 2. Sand used in preparing mortar shall be graded oven dry quartzite and furnished in bags.
 - 3. The epoxy mortar patch material shall match the existing texture and color of exposed concrete without giving a blotchy appearance. A test patch shall be applied for approval prior to final acceptance of the mortar. Size of test patch shall be approximately equal to the size of the average mortar patch to be used on the project.

2.3 GENERAL REQUIREMENTS FOR POLYMER MODIFIED CEMENTITIOUS MORTARS

- A. Mortar used for bonding, patching, and resurfacing in exposed or exterior environmental conditions with large cyclic temperature changes shall have the following properties:
 - 1. Mortar shall be non-sagging.
 - 2. Coefficient of thermal expansion shall be comparable with that of concrete (5.5×10^{-6} in/in/°F).
 - 3. Sand used in preparing mortar shall be graded oven dry quartzite furnished in bags.

4. The mortar patch material shall match the existing texture and color of exposed concrete without giving a blotchy appearance. A test patch shall be applied for approval prior to final acceptance of the mortar. Size of test patch shall be approximately equal to the size of the average mortar patch to be used on the project.

2.4 GENERAL REQUIREMENTS FOR HIGH MOLECULAR WEIGHT METHACRYLATE SELF-PENETRATING CONCRETE CRACK FILLER AND SEALER

- A. Crack filler used shall be a synthesized methacrylate monomer having high molecular weight, low viscosity and low volatility with the following properties.
 1. Viscosity shall be between 15 and 30 cps Brookfield LVT W/UL adapter 50 RPM at 77°F.
 2. Density shall be a minimum of 8.5 pounds per gallon at 77°F.
 3. Material shall not gel under 16 hours exposure to 205°F temperature.
 4. Odor should be barely perceptible.
 5. Material shall cure in less than 8 hours at 75° temperature when applied to a surface.
 6. Resin used shall be free of wax additives.

2.5 PRODUCTS AND MANUFACTURERS

A. Epoxy Injection Work

1. **Masterinject** 1380.
2. E-Poxy Industries: Eva-Pox Injection Resin No. 4.
3. Rescon Technology Corp.: Product R303, Concrete Injection Resin.
4. Sika Chemical Corporation: Sikadur Hi-Mod LV or Sikadur 52 Injection Resin.
5. Thermal-Chem, Inc.: Thermal-Chem Injection Resin, Product No. 2.

B. Epoxy Mortar Patch

1. **Master Builders Technologies:** Concessive 1411 or 1482.
2. E-Poxy Industries: Eva-Pox Mortar Mix No. 3.
3. Rescon Technology Corp.: Product No. R616, Concrete Bonder or Product No. R404, Epoxy Mortar Resin.
4. Sika Chemical Corporation: Sikadur 31 Hi-Mod Gel or Sikadur 35 Hi-Mod LV.
5. Thermal-Chem, Inc.: Thermal-Chem Mortar Resin Product No. 3, Thermal-Chem Fibrous Mortar Resin, Product No. 306 or Thermal-Chem Mortar Resin Gel, Product No. 304.

- C. Epoxy for Bonding Steel Plates
1. Master Builders Technologies: Concessive 1440, 1441, or 1442.
 2. E-Poxy Industries: Eva-Pox Bonder No. 1 or Eva-Pox Cold Cure Bonder No. 41.
 3. Rescon Technology Corp.: Product R626, Concrete Bonder.
 4. Sika Chemical Corporation: Sikadur 31 Hi-Mod Gel.
 5. Thermal-Chem, Inc.: Thermal-Chem Bonder, Product No. 4, Normal Cure or Rapid Cure.
- D. Epoxy for Bonding Fresh Concrete to Hardened Concrete
1. Master Builders Technologies: Concessive Liquid (LPL) or Concessive 3007.
 2. E-Poxy Industries: Eva-Pox Fresh Concrete Bonder No. 2.
 3. Rescon Technology Corp.: Product R649, Fresh Concrete Bonder.
 4. Sika Chemical Corporation: Sikadur 32 Hi-Mod.
 5. Thermal-Chem, Inc.: Thermal-Chem Wet Concrete Bonder, Product No. 5 or 501.
- E. Epoxy for Grouting Bolts, Dowels or Reinforcing Steel
1. Master Builder Technologies: Concessive Liquid (LPL), Concessive 3007, Concessive Paste (LPL) for horizontal use in conditioned spaces.
 2. E-Poxy Industries: Eva-Pox Cold Cure Bonder No. 41.
 3. Rescon Technology Corp.: Product No. R606, Concrete Bonder.
 4. Sika Corporation: Sikadur 31 Hi-Mod Gel, (horizontal and overhead use); Sikadur 32 Hi-Mod or Sikadur 35 Hi-Mod LV (vertical downhand use).
 5. Thermal-Chem, Inc.: Thermal-Chem Bonder, Product No. 4, Normal Cure or Rapid Cure.
- F. Epoxy for Skid-Resistant Surface
1. Master Builders Technologies: Concessive 1064.
 2. E-Poxy Industries: Eva-Pox Product No. 730 or 735.
 3. Rescon Technology Corp.: Product R505, Industrial & Hi-Traffic Coating.
 4. Sika Chemical Corporation: Sikadur 22, Lo-Mod.
 5. Thermal Chem, Inc.: Thermal-Chem Ramp and Floor Coating, Product No. 7, System No. 7-02.
- G. Epoxy Penetrant Sealer

1. Adhesive Engineering Company: Pen Seal 25.
 2. E-Poxy Industries: Eva-Pox Perm Seal 50.
 3. Rescon Technology Corp.: Product R117, Penetrant Sealer.
 4. Sika Chemical Corporation: Sikagard 619.
 5. Thermal-Chem, Inc.: Thermal-Chem Penetrating Sealer, Product No. 1-15.
- H. Polymer Modified Cementitious Mortar Patch
1. Master Builders Technologies: Masterpatch 210, Masterpatch 220, or Masterpatch 230 VP.
 2. Rescon Technology Corp.: Polymer Concrete, Product No. R424.
 3. Sika Chemical Corporation: Sikatop 122, or Sikatop 123.
- I. Polymer Modified Cementitious Mortar Overlay System
1. Sika Chemical Corporation: Sikatop 122 Repair Mortar or Sikatop 111 Self-Leveling Mortar.
- J. Epoxy Resin Floor Overlay System
1. Sika Chemical Corporation: Sikafloor 90N.
- K. High Molecular Weight Methacrylate Self-Penetrating Concrete Crack Filler
1. Sika Chemical Corporation: Sika Pronto 19, Crack Healer/Penetrating Sealer.
- L. Corrosion Protection of Reinforcing Steel
1. Sika Chemical Corporation: Armatec 110.
 2. ZRC Chemical Products Company: ZRC Cold Galvanizing Compound.
 3. Rustoleum Zinc.

Substitutions may be considered provided complete technical information and job references are furnished to the Architect/Engineer and approved prior to commencement of work.

Changes in products required to suit temperature and environmental conditions at the time of material application shall be specified as separate line items by the Contractor showing credit or additions to the price for the various tasks.

In using the above products, follow strictly the manufacturer's specifications and directions for mixing and application. Also heed all label warnings by manufacturer. Make application in accordance with applicable safety laws.

2.6 CORROSION INHIBITING PAINT

- A. Z.R.C. Cold Galvanizing Compound manufactured by ZRC Chemical Products Company, Quincy, Massachusetts.

Substitutions may be considered provided complete technical information and job references are furnished to and approved by the Architect/Engineer prior to commencement of work.

2.7 SAND

- A. Sand used for spreading over a surface application of the self-penetrating concrete crack filler and sealer using high molecular weight methacrylate shall be clean, washed, and dried silica sand free from all dust, dirt and organic materials.
1. Free moisture content of the sand shall be limited to a maximum of 0.25% by weight at time of application.
 2. Sand used shall be oven-dried 20-40 graded quartz sand.
 3. Sand used shall be uniformly graded with 100% passing the No. 10 sieve and retained on the No. 20 sieve.
 4. Contractor shall submit samples of the sand to the Owner's Testing Laboratory for acceptance testing prior to commencing work. Do not change the source of material once the material source has been found to be acceptable.

2.8 JOINT FILLER MATERIAL

- A. Filler material shall have a minimum Shore A hardness of 80, or Shore D hardness of 50, and shall conform to ASTM D2240-00.
1. Metzger/McGuire Co.: MM-80.
 2. Sika Chemical Corporation: Sikadur 51 NS/SL.
- B. Filler material shall have a minimum Shore A hardness of 35 and shall conform to ASTM D2240-00.
1. **Tremco:** Vulkem 245.

Substitutions may be considered provided complete technical information and job references are furnished and approved by the Architect/Engineer prior to commencement of work.

PART 3 - EXECUTION

3.1 EPOXY INJECTION

- A. Applicator's Qualifications
1. Epoxy injection work shall only be performed by contractors who have successfully used this process on at least five similar structural repairs of 1000 linear feet or longer, and which have performed successfully for a minimum period of five years.
 2. Only adequately trained epoxy injection applicators shall be used on the job. Furnish certificate of training prior to commencing work.

B. Preparation

1. Before proceeding, the space in the vicinity of the crack location receiving epoxy shall be swept and be in a generally clean condition to permit proper bonding of surface seal.
2. Cracks may be dry or damp, but free of standing water and frost.
3. Entry points shall be established judiciously at a distance along the seal so that epoxy penetrates the crack completely. Spacing of entry points, however, shall be no greater than the thickness of the concrete at that location. Tighter joints will require closer spacing of entry ports.
4. Adequate surface seal shall be applied to the face of the crack between the entry points. Use masking tape at the pre-established entry points to prevent the surface sealer from sealing the entry points. Alternatively, drill and port method may be used to establish entry points. Use only rotary-percussion type drills for drilling holes. Drills shall be fitted with bits having single tooth that produce large cuttings, and hollow stem drill rods that permit simultaneous blowing of compressed air providing immediate expulsion of the cuttings from the hole. Ensure that the drilling operation does not contaminate the cracks.
5. For through cracks, surface seal shall be applied to both faces. Provide entry ports on both faces staggered with each other when the cracked concrete element is greater than 8" thick. Injection of cracks from both faces shall also be necessary when the cracks are contaminated in concrete elements equal to or less than 8" thick.
6. Pre-sealing between ports may be done using a material meeting the requirements of these specifications.
7. Allow adequate time for the surface seal material to cure before proceeding with the injection.

C. Equipment for Injection

1. Pumps used for injection shall be a positive displacement type with interlock to provide positive ratio control in proper proportions. The pumps used shall be electrically or air powered, portable and shall provide an in-line mixing and metering system for the two-component epoxy. The pressure hoses and injection nozzle shall be of such a design as to allow proper mixing of the two components of the epoxy. Dwell time in mixing head shall not exceed ten seconds.
2. The injection equipment shall have automatic pressure control, and shall be capable of injection pressures up to 300 psi to ensure complete penetration of cracks. Equipment used shall also have the capability of presetting the pressures, and shall be equipped with manual pressure control override.
3. The presence of a stand-by injection unit shall be required.

D. Crack Cleaning

1. All cracks shall be cleaned and flushed with water, and checked for port-to-port transmission.

2. All cracks shall be cleaned and flushed with water, checked for port-to-port transmission. Cracks which are contaminated with algae shall be flushed with chlorinated water mixed with copper sulphate.
3. Blow the water out of the cracks using compressed air, and allow adequate time for drying before injecting with epoxy.
4. If in the process of water flushing the cracks, the Contractor notices rust particles being flushed out with the water, or if the water has rust stains, the Engineer shall be notified prior to doing any epoxy injection work. The Engineer will then evaluate the extent of corrosion in the embedded reinforcement, and make necessary adjustments in the repair procedure. The Engineer/Owner reserves the right to either issue a change order for any additional work involved or to delete those portions of the work which show evidence of corrosion of the reinforcing steel. When work is deleted, the Contractor shall give a credit to the Owner on the basis of unit prices quoted for the project.
5. When temperature is near the freezing point of water, ensure that the crack is free of ice before doing the injection work.

E. Epoxy Injection

1. Condition epoxy materials at temperature between 65°F-80°F unless otherwise recommended by the manufacturer. Epoxies beyond this range of temperature shall not be used. Do not store epoxy (even for a short period) in direct sunlight.
2. Epoxy adhesive shall be injected into the crack at the first lower entry port with sufficient pressure to advance the epoxy to the next adjacent port. The original port shall be sealed and entry shifted to the port in which the epoxy appears. This manner of port-to-port injection shall be continued until each joint has been injected for the entire length.
3. If port-to-port travel of epoxy is not achieved, the crack shall be identified, and the Architect/Engineer notified.
4. Samples of mixed material shall be injected into a paper cup every 60 minutes to test ratio mix. These samples shall be dated and numbered and left at the sampling location until reviewed by the testing laboratory.
5. Solvents shall not be used to thin epoxy introduced into the cracks.

F. Test Cores

1. A minimum of one test core shall be taken by the Testing Laboratory for every 100 feet of epoxy injection work. The total number of test cores taken shall not be less than three.
2. Cores shall be 2" to 4" in diameter, taken from locations marked by the Engineer. Before taking the cores from those locations, the Contractor shall use a magnetic reinforcing bar locator or employ other procedures to ensure that the core will not cut through any reinforcing steel. Should it be determined by the Contractor that the core location marked by the Engineer will cut through the reinforcing steel or prestressing tendons, the Contractor shall notify the Engineer for selecting alternate locations.

3. The cores shall be visually inspected for penetration of epoxy in the cracks. If the penetration is less than 95%, the repair work shall be considered unsatisfactory and unacceptable.
4. In addition to the visual inspection, one third of the cores or a minimum of three cores shall be tested under compression by an independent testing laboratory employed by the Owner. The epoxy injection work shall be considered acceptable if the concrete fails prior to adhesive failure.
5. If cores indicate either lack of penetration or deficiency in bond strength under compression test, the Contractor shall re-inject or perform other remedial work acceptable to the Architect/Engineer. Engineer then reserves the right to specify and request additional core samples for inspection and compression test by the testing laboratory, the cost of which shall be borne entirely by the Contractor.
6. All test cores shall be filled completely with polymer mortar to match color, finish, and texture of existing concrete. Mortar used shall comply with the requirements of these specifications.

G. Finishing

1. Allow epoxy adhesive in the cracks to cure before removing the surface seal. Ensure that there is no drainage of epoxy from the cracks due to premature removal of surface seal.
2. The surface of the crack herein treated shall be finished flush with the adjacent concrete surfaces and shall show no indentations or evidence of port fittings.
3. All work shall be performed and conducted in a neat, orderly manner. Clean-up whatever portions of the existing structure that get soiled or stained in the process of epoxy injection work.

3.2 EPOXY MORTAR

A. Applicator's Qualifications

1. Epoxy mortar repair work shall only be performed by contractors who have successfully used this process on at least three similar structural repairs of equal scope which have performed successfully for a minimum period of five years.
2. Only adequately trained and experienced personnel shall be used on the job.

B. Surface Preparation

1. Concrete surface to which the epoxy mortar is to be applied shall be exposed parent concrete free of loose and unsound materials. Surface preparation shall be done by abrasive blasting, waterblasting or as otherwise required by the manufacturer.
2. Necessary approvals shall be obtained by the Contractor from authorizing governmental or other agencies prior to abrasive blasting. Abrasive blasting operations shall comply with the requirements of OSHA and NIOSH (National Institute for Occupational Safety and Health) Standard PB-246-697.

3. Surfaces shall be free of any deleterious materials such as laitance, dust, dirt, and oil.
4. Any exposed reinforcing steel shall also be cleaned and be free of rust and other contaminants. Cleaning shall be accomplished by mechanical means. Use powered wire brushes in locations where reinforcing steel cannot be cleaned by abrasive-blasting or water-blasting. All exposed reinforcing steel shall be coated with a corrosion inhibiting product specified elsewhere in this specification prior to mortar application.
5. Prime the cleaned surface with primer as required by the manufacturer.

C. Concrete Surface Inspection

1. Ensure that the surface temperature is at least 40°F to permit wetting of concrete surface by epoxy coating.
2. The Contractor shall evaluate the moisture content of concrete surface receiving epoxy mortar. This shall be done by determining if moisture will collect at bond lines between concrete and epoxy mortar before epoxy has cured. Evaluate this by taping a piece of polyethylene sheet to the concrete. If moisture collects on underside of the polyethylene sheet before epoxy would cure, then allow concrete to dry sufficiently to prevent the possibility of moisture between old concrete and new epoxy.

D. Mortar Application

1. Condition epoxy compound components to a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Epoxies beyond this range of temperature shall not be used.
2. Stir each of the two parts of epoxy separately before mixing. Then mix in a clean container free of contaminants.
3. Thoroughly blend epoxy components and sand with “Jiffy” mixers or equal to a uniform and homogenous mixture. Small batches of one quart or less may be mixed by spatulas, pallette knives or similar devices.
4. Mixing should be accomplished well within the pot life of epoxy (three minutes when using “Jiffy” mixer or five minutes when mixed by hand) after allowing for time required for application.
5. Apply mortar by trowel or other means suitable for the consistency of the epoxy-sand mortar mix.
6. Build up the repair area in layers with mortar thicknesses within those specified by the manufacturer (1/4" maximum per layer).
7. Consolidate the mortar thoroughly to remove entrapped air.
8. Finish surface of mortar to match the texture and contours of existing concrete.
9. Allow mortar to cure in accordance to manufacturers recommendations.

E. Cleanup

1. Protect surfaces surrounding the work areas against spillage.
2. Epoxy and epoxy mortar spillages shall be cleaned before they set and become difficult to remove.
3. Cleanup all portions of the existing structure that are soiled or stained in the process of epoxy mortar repair work.

3.3 POLYMER MODIFIED CEMENTITIOUS MORTAR PATCH

A. Applicator's Qualifications

1. Mortar repair work shall only be performed by contractors who have successfully used this process on at least three similar structural repairs of equal scope which have performed successfully for a minimum period of five years.
2. Only adequately trained and experienced personnel shall be used on the job.

B. Surface Preparation

1. Concrete surface to which the mortar is to be applied shall be exposed parent concrete free of loose and unsound materials. Surface preparation shall be done by abrasive-blasting, water-blasting or as otherwise required by the manufacturer.
2. Necessary approvals shall be obtained by the Contractor from authorizing governmental or other agencies prior to abrasive-blasting. Abrasive-blasting operations shall comply with the requirements of OSHA and NIOSH (National Institute for Occupational Safety and Health) Standard PB-246-697.
3. Surfaces shall be free of any deleterious materials such as laitance, dust, dirt, and oil.
4. Any exposed reinforcing steel shall also be cleaned and free of rust and other contaminants. Cleaning shall be accomplished by mechanical means. Use powered wire brushes in locations where reinforcing steel cannot be cleaned by abrasive-blasting or water-blasting. All exposed reinforcing steel shall be coated with a corrosion inhibiting product specified elsewhere in this specification prior to mortar application and shall comply with OSHA safety requirements.
5. Prime the cleaned surface with primer as required by the manufacturer.

C. Concrete Surface Inspection: Ensure that the surface and ambient temperature is at least 45°F and rising at the time of application.

D. Mortar Application

1. Condition polymer mortar material to 65°F-80°F unless otherwise recommended by the manufacturer. Materials beyond this range of temperature shall not be used.
2. Mix the two components in a clean container free of contaminants as recommended by the manufacturer.

3. Thoroughly blend components and aggregates with "Jiffy" mixers or equal to a uniform and homogenous mixture. Small batches of one quart or less may be mixed by spatulas, pallette knives or similar devices.
4. Mixing should be accomplished within three minutes when using "Jiffy" mixer or five minutes when mixed by hand.
5. Apply mortar by means suitable for the consistency of the mortar mix.
6. Use permanent fiberglass cloth forms for retaining mortar if mixed to a flowable consistency.
7. Consolidate the mortar thoroughly to remove entrapped air.
8. Finish surface of mortar to match the texture and contours of existing concrete.
9. Allow mortar to cure in accordance to manufacturer's recommendations.

E. Cleanup

1. Protect surfaces surrounding the work areas against spillage.
2. Epoxy and mortar spillage shall be cleaned before they set and become difficult to remove.
3. Cleanup all portions of the existing structure that are soiled or stained in the process of mortar repair work.

3.4 EPOXY BONDING OF FRESH (PLASTIC) CONCRETE TO HARDENED CONCRETE

A. Applicator's Qualifications

1. Epoxy bonding of fresh concrete to hardened concrete shall only be performed by contractors who have had successful experience in bonding concrete on a minimum of three projects of similar scope.
2. Only adequately trained epoxy applicators shall be used on the job. Furnish certificates of training on request.

B. Surface Preparation

1. Remove loose concrete, debris, laitance, oil, grease and other contaminants from surface receiving epoxy. All surfaces shall be clean, sound and free of surface water.
2. Clean concrete surface by abrasive blasting prior to applying epoxy bonder. Abrasive blasting shall take place no more than one day prior to bonding fresh concrete.
3. The Contractor shall obtain all necessary permits from all governmental, environmental, and other agencies having jurisdiction over the area where the abrasive blasting work is to be performed. Abrasive blasting operations shall comply with the requirements of OSHA and NIOSH (National Institute for Occupational Safety and Health) Standard PB-246-697.

4. Remove all abrasive from work area by vacuuming or other appropriate means. Remove blast cleaning residue with compressed air from an oil-and-water-free compressed air source prior to epoxy application.
5. Provide all necessary barriers to contain abrasive within the work area. The Contractor is responsible for all damage to property or injury to people as a result of sandblasting.

C. Epoxy Application

1. Condition epoxy compound materials at a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Epoxies beyond this range of temperature shall not be used.
2. Mix epoxy materials in a clean container free of contaminants.
3. Thoroughly blend epoxy components with mechanical mixers to a uniform and homogenous mixture.
4. Mixing shall be accomplished well within the pot life of the epoxy after allowing for time required for application.
5. Apply epoxy adhesive to concrete surface by brush, roller, broom, squeegee, or spray equipment. The minimum average application thickness shall be between 15-18 mils for normal weight concrete. For lightweight concrete, use a second coat of epoxy bonder having a minimum average thickness of 15 mils. Application of epoxy shall be in strict accordance with manufacturer's instructions.
6. Do not apply epoxy bonder in rain or in the presence of standing water.
7. Do not let the epoxy adhesive reach the gel stage before pouring concrete. This can be determined by checking whether the adhesive is still tacky. If the adhesive loses its tack before plastic concrete is placed, remove the epoxy by abrasive blasting or other suitable means prior to reapplying the epoxy adhesive.
8. Production, placing, consolidation and curing of new concrete shall conform to ACI 301-99 and the project specifications.

D. Cleanup

1. Protect surfaces surrounding the work areas against spillage.
2. Epoxy spillages shall be cleaned before they set and become difficult to remove.
3. Cleanup whatever portions of the existing structure that are soiled or stained in the process of applying epoxy adhesive.

E. Testing

1. The Engineer and Testing Laboratory shall evaluate bonding of fresh concrete to existing concrete after the fresh concrete has sufficiently cured.
2. The evaluation shall be performed by sounding, using one of the following, or similar, methods:

- a. Tapping fresh concrete with a blunt metal instrument.
 - b. Dragging a heavy steel chain across the surface (for horizontal surfaces only).
3. Detection of a hollow sound in any area shall be reason to suspect inadequate bonding, and Contractor shall then core each such area, as required by the Engineer, to determine bonding adequacy.
 4. Coring shall be through the new concrete and into the existing concrete. Core diameter shall be 4" unless specified otherwise by the Engineer. Length of cores shall be twice the core diameter, or twice the thickness of new concrete, or as specified by the Engineer.
 5. Cores will be visually inspected, and further testing may be required as determined by the Engineer.
 6. The cost of any repairs or replacement, and any additional cores or other testing deemed necessary by the Engineer, shall be borne by the Contractor.

3.5 EPOXY GROUTED BOLTS, DOWELS OR REINFORCING STEEL

A. Applicator's Qualifications

1. Epoxy grouting of bolts, dowels or reinforcing steel shall only be performed by contractors who have had successful experience on a minimum of three projects of similar scope.
2. Only adequately trained epoxy applicators shall be used on the job. Furnish current certificate of training on request.

B. Surface Preparation

1. All bolts, dowels and reinforcing bars shall be abrasive blasted no more than eight hours before the grouting. If evidence of oxidation exists on the surface, the bolts, reinforcing bars and dowels shall be recleaned. Blast-clean surfaces using Steel Structures Painting Council, Surface Preparation No. 6, to give a surface condition corresponding to ASa2, BSa2, CSa2 of SSPC Vis 1, depending on the initial surface condition of the steel surface. Prior to blast-cleaning, clean surfaces to conform to SSPC SP1, SP2, and SP3, as required.
2. Unless otherwise printed in manufacturer's instructions, all holes shall be clean of dust, debris, and contaminants. Use compressed air from an oil-and-water-free compressed air source prior to epoxy application.

C. Drilling Holes for Embedment

1. Use only rotary-percussion type drills for drilling holes.
2. Drills shall be fitted with bits having single tooth that produce large cuttings, and hollow stem drill rods that permit simultaneous blowing of compressed air providing immediate expulsion of the cuttings from the hole.
3. Do not cut through any reinforcing steel unless indicated otherwise on the drawings. Where significant amounts of reinforcing are expected, use non-destructive techniques to determine location of reinforcing steel prior to drilling.

Otherwise, use small diameter exploratory holes to detect presence of reinforcing steel prior to drilling holes for grouting.

4. Core drilling equipment, and electric impact hammers or other tools which do not provide for immediate expulsion of the drill cuttings shall not be used.
5. Unless noted otherwise on the drawings, depth of holes used for embedding the bolts, bars or dowels shall be at least ten times their diameter, but not less than 6".
6. Unless noted otherwise on the drawings, depth of hole used for embedding the bolts, bars or dowels shall be at least fifteen times their diameter.
7. Unless noted otherwise on the drawings, the center to center distance between the embedded bolts, bars or dowels shall be at least twelve times their diameter.
8. Unless noted otherwise on the drawings, the edge distance shall be at least six times the diameter of the bolt, bar or dowel.
9. Hole diameter shall normally be 1/4" larger than the outside diameter of the embedded item. In no case shall the hole diameter be 3/8" larger than the diameter of the embedded item.

D. Epoxy Application

1. Condition epoxy compound materials at a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Epoxies beyond this range of temperature shall not be used.
2. Mix epoxy materials in a clean container free of contaminants.
3. Thoroughly blend epoxy components with mechanical mixers to a uniform and homogenous mixture. Mix small batches (up to 1 quart) by use of spatulas, palette knives, or similar devices. Take care to use proper proportions of the epoxy components when using small batches.
4. Mixing shall be accomplished well within the pot life of the epoxy after allowing for time required for application.
5. Partially fill the hole with epoxy. Then insert the bolt, dowel or reinforcing bar into the hole such that the resin material oozes out around the embedded item, ensuring complete contact. Twist the bolt, dowel or bar slightly as it is inserted in the hole to ensure complete contact.
6. As an alternative to inserting the embedded item after the epoxy is poured in the hole, the bolt, dowel, or bar may be positioned in the hole and filled up with epoxy by hand caulking guns or injected with an in-head mixing equipment. In either case, the nozzle shall be provided with a hose or tube of sufficient length to reach the bottom of the hole being filled.
7. Where the holes are horizontal or overhead, the opening shall be covered by a masking or a duct tape. Make a split in the tape and insert the epoxy injection tube through the split. Fill hole completely with epoxy and then insert the embedded item through the split tape. Amount of epoxy should be such that a

small amount of material oozes through the split. Twist the bolt, dowel or bar slightly as it is inserted in the hole to ensure complete contact.

8. Do not apply epoxy in the rain or in the presence of standing water unless permitted by manufacturer's written instructions.

E. Cleanup

1. Protect surfaces surrounding the work area against spillage.
2. Epoxy oozed out from the holes and spillages shall be cleaned before they become difficult to remove.
3. Cleanup whatever portions of the existing structure are soiled or stained in the process of grouting the bolts, dowels or reinforcing bars.

F. Testing

1. The Owner's Testing Laboratory shall evaluate the effectiveness of grouting the bolts, dowels, or reinforcing bars by conducting field proof tests. The load test method shall be submitted to the Engineer for review and approval.
2. Field proof test 10% of the grouted bolts, dowels or bars, with a minimum of two tests prior to commencing installation.
3. The Engineer may elect to increase or decrease the number of tests depending upon the outcome of the tests.
4. The proof load shall be 85% of the theoretical ultimate strength of the bolt, dowel or bar or as otherwise determined by the Engineer. Any slip of the embedded bolt, dowel or bar within the epoxy grout material, or slip at the epoxy/concrete interface before the bolt, dowel or bar yields shall be considered to be a failure of the grouted item.
5. The cost of any repairs failing to meet the proof load and all additional tests deemed necessary by the Engineer shall be borne by the Contractor.

3.6 EPOXY FOR PRODUCING SKID RESISTANT SURFACE ON CONCRETE

A. Applicator's Qualifications

1. Work requiring epoxy application for producing skid resistant surfaces on concrete shall only be performed by contractors who have had successful experience in applying epoxy on at least three projects of similar scope.
2. Only adequately trained epoxy applicators shall be used on the job. Furnish certificates of training on request.

B. Surface Preparation

1. Remove loose concrete, debris, laitance, oil, grease and other contaminants from surface receiving epoxy. All surfaces shall be clean, sound, and free of surface water.

2. Clean concrete by mechanical abrasion such as abrasive blasting, scarifying, or waterblasting and as required by the manufacturer.
3. The Contractor shall obtain all necessary permits from all governmental, environmental and other agencies having jurisdiction over the area where the mechanical abrasion work is to be performed. Abrasive blasting operations shall comply with the requirements of OSHA and NIOSH (National Institute for Occupational Safety and Health) Standard PB-246-697.
4. Where abrasive blasting is used, all abrasive shall be removed from the work area by vacuuming or other appropriate means. Remove blast cleaning residue with compressed air from an oil-and-water-free compressed air source prior to epoxy application.
5. Provide all necessary barriers to contain the abrasive material within the work area. The Contractor is responsible for all damage to property or injury to people as a result of mechanical abrasion process.

C. Epoxy Application

1. Condition epoxy compound material to be at a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Epoxies beyond this range of temperature shall not be used.
2. Stir each of the two parts of epoxy separately before mixing. Then mix the two parts in a clean container free of contaminants.
3. Thoroughly blend epoxy components with mechanical mixers to a uniform and homogenous mixture.
4. Mixing shall be accomplished well within the pot life of the epoxy after allowing for time required for application.
5. Apply epoxy adhesive to concrete surface by brush, roller, broom, squeegee, or spray equipment. The minimum average application thickness shall be between 50-70 mils. Application shall be in strict accordance to manufacturer's instructions.

D. Skid-Resistant Aggregate Application: Apply the skid-resistant aggregate while the epoxy coating is still fluid at the rate of 11-13 pounds per square yard. The aggregate shall be spread uniformly over the entire surface of the concrete.

E. Cleanup

1. Protect surfaces surrounding the work area against spillage.
2. Epoxy spillages shall be cleaned before they set and become difficult to remove.
3. Cleanup whatever portions of the existing structure that are soiled or stained in the process of applying epoxy adhesive.

F. Testing

1. The Testing Laboratory shall evaluate that the thickness of the epoxy adhesive and the amount of skid-resistant aggregate complies to the specifications.

2. The Testing Laboratory shall perform pullout tests on the cured skid-resistant surface. The rate of testing shall be one test for every 1000 square feet of surface area, with a minimum of three tests. The pullout strength (tested in accordance with Appendix A of ACI 503 R-93) shall be at least 100 psi. All failures shall be in the concrete. Any failure that occurs in the adhesive shall be cause for rejection of the coating application.
3. The cost of replacement and any retesting required by the Engineer shall be borne by the Contractor.

3.7 EPOXY PENETRANT SEALER

A. Applicator's Qualifications

1. Work requiring epoxy penetrant sealer on concrete surfaces shall only be performed by contractors who have had successful experience in applying epoxy on at least three projects of similar scope.
2. Only adequately trained epoxy applicators shall be used on the job. Furnish certificates of training on request.

B. Surface Preparation

1. Remove loose concrete, debris, laitance, oil, grease and other contaminants from surface receiving epoxy. All surfaces shall be clean, sound, and free of surface water.
2. Clean concrete by mechanical abrasion such as abrasive blasting or waterblasting.
3. The Contractor shall obtain all necessary permits from all governmental, environmental and other agencies having jurisdiction over the area where the mechanical abrasion work is to be performed. Abrasive blasting operations shall comply with the requirements of OSHA and NIOSH (National Institute for Occupational Safety and Health) Standard PB-246-697.
4. Where abrasive blasting is used, all abrasive shall be removed from the work area by vacuuming or other appropriate means. Remove blast cleaning residue with compressed air from an oil-and-water-free compressed air source prior to epoxy application. Ensure compatibility of concrete curing method and use of this product.
5. Provide all necessary barriers to contain the abrasive material within the work area. The Contractor is responsible for all damage to property or injury to people as a result of mechanical abrasion process.

C. Epoxy Application

1. Temperature of the epoxy must be above 50° for mixing.
2. Stir each of the two parts of epoxy separately before mixing. Then mix the two parts in a clean container free of contaminants.
3. Thoroughly blend epoxy components using a "Jiffy" mixer or equal powered by a low-speed (300-600 rpm) electric drill for at least three minutes.

4. When mixing has been completed, cover mixed epoxy penetrant sealer container and allow a reaction time as required by the manufacturer before applying.
5. Apply the epoxy penetrant sealer when the surface temperature of concrete is at least 40°F with brush, roller or spray equipment. All spray equipment must employ traps to prevent water and oil from contaminating the sealant. Two applications are required at the following rates:

First application: 200-300 sft/gallon
Second application: 250-300 sft./gallon

The second coat shall be applied as soon as the first coat is tack-free. If a surface film develops on the concrete, the application rate should be reduced. (Second coat is not needed with Sikagard 619 when applied at the rate of 300 sft/gallon.

D. Cleanup

1. Protect surfaces surrounding the work area against spillage.
2. Epoxy spillages shall be cleaned before they set and become difficult to remove.
3. Cleanup whatever portions of the existing structure that are soiled or stained in the process of applying the epoxy penetrant sealer.

E. Testing: The Testing Laboratory shall monitor the rate of application of the epoxy penetrant sealer.

3.8 HIGH MOLECULAR WEIGHT METHACRYLATE SELF-PENETRATING CONCRETE CRACK FILLER AND SEALER

A. Applicator's Qualifications

1. Work requiring self-penetrating crack filler and sealer on concrete shall only be performed by contractors who have had successful experience in applying the methacrylate sealer on at least three projects of similar scope.
2. Only adequately trained applicators shall be used on the job. Furnish certificates of training on request.

B. Surface Preparation

1. Remove loose concrete, debris, laitance, oil, grease and other contaminants from surface and cracks receiving sealer. All surfaces shall be clean, sound, and free of surface moisture.
2. Clean concrete by mechanical abrasion such as abrasive blasting.
3. The Contractor shall obtain all necessary permits from all governmental, environmental and other agencies having jurisdiction over the area where the mechanical abrasion work is to be performed. Abrasive blasting operations shall comply with the requirements of OSHA and NIOSH (National Institute for Occupational Safety and Health) Standard PB-246-697.

4. Where abrasive blasting is used, all abrasive shall be removed from the work area by vacuuming or other appropriate means.
5. Remove blast cleaning residue with compressed air from an oil-and-water-free compressed air source prior to self-penetrating crack filler and sealer application. Surface receiving sealer shall be dry, and all cracks shall be free of standing water. Blow cracks clean with compressed air prior to sealer application.
6. All spalls in concrete in the area scheduled to receive the methacrylate sealer shall be repaired using polymer concrete mortar patch prior to sealer application.
7. Temporarily plug all existing drains with rubber plugs or other suitable material to prevent the sealer from getting into the drains.
8. Protect expansion joints from being covered by methacrylate material. All expansion joints which get accidentally covered with the sealer shall be cleaned immediately. All damaged joints shall be repaired or replaced as directed by the Architect/Engineer at no cost to the Owner.

C. Methacrylate Application

1. Do not schedule methacrylate sealer work if there is forecast of rain within twelve hours, or if the ambient temperature is expected to fall below 45°F temperature during application or within twelve hours after application of the sealer.
2. Stir each of the two parts of sealer separately before mixing. Then mix the two parts in a clean container free of contaminants.
3. Condition sealer materials at a temperature between 65°-80°F unless otherwise recommended by the manufacturer in writing. Methacrylate materials beyond this temperature range shall not be used.
4. Thoroughly blend the methacrylate components using a "Jiffy" mixer or equal powered by a low-speed (300-600 rpm) electric drill for five to seven minutes until the liquid clears.
5. Apply the material on horizontal surfaces with roller or squeegee at the rate of approximately 130 square feet per gallon. The concrete substrate must be at a temperature of at least 45°F. Material shall be allowed to pond over cracks. After penetration into the substrate and cracks, remove excess material.
6. Application of sealer shall proceed in an orderly manner in widths between 6 to 10 feet across the length of the work. Overlap shall be kept to a minimum with no overlap exceeding 6 inches.
7. Follow additional directions for surface preparation and application given in the manufacturer's printed technical specifications which are not included in these specifications. The Contractor shall have these specifications with him at the job site prior to start of the work.
8. Apply second coat of methacrylate sealer at the rate of 200 square feet per gallon in the same orderly manner as used for the first coat.
9. Spread sand by mechanical means over the surface treated by the methacrylate sealer at a rate of 0.50 pounds per square yard of surface area. Sand shall be

broadcast within 15 to 35 minutes following the application of the sealer. Sand shall be spread over the width which coincides with the width of the methacrylate sealer. Sand spreader equipment used shall be operated at speeds which will eliminate sand drifts and spread the sand uniformly over the treated area. Excess sand shall be removed completely from the untreated area by brooming or other means prior to application of the methacrylate sealer.

10. Protect sand covered area by covering with a polyethylene sheet. No vehicular traffic shall be allowed on the surface until the methacrylate sealer has cured.
11. Remove all loose sand from the slab prior to opening the area for traffic.

D. Test Area

1. See the drawings for location and size of test area.
2. Contractor shall use the same workers, and materials for applying the methacrylate sealer and the sand to the test area as for the rest of the work. Method of surface preparation and application shall be in strict accordance to these specifications and the manufacturer's printed directions.
3. Contractor shall inform the Owner, Testing Laboratory, Architect/Engineer regarding the schedule for performing the work in the test area. It is mandatory that the manufacturer's representative be also present during the application of the material in the test area.
4. The Testing Laboratory and the Contractor shall accurately record the quantity of material used and calculate the rate of coverage. Adjustments shall be made immediately, and the size of test area increased accordingly to apply material at the rate given in the specifications.
5. Provide a watertight dam around the test area capable of holding at least 3 inches of water for 48 hours. Fill with water and mark the level. Ensure that there is no leakage around the perimeter of the dam. Leave the water standing in the test area for 48 hours. Cover area with polyethylene sheet to prevent evaporation.
6. The Testing Laboratory shall measure water level after 48 hours, and also check soffit of slab under test area for evidence of leaks. If no leak is observed, the methacrylate sealer application shall be considered acceptable and the Contractor shall proceed with the work.
7. If leaks are observed, do not proceed with the rest of the work.

E. Cleanup

1. Protect surfaces surrounding the work area against spillage.
2. Sealer spillages shall be cleaned before they set and become difficult to remove.
3. Cleanup whatever portions of the existing structure that are soiled or stained in the process of applying the methacrylate sealer.

F. Testing: The Testing Laboratory shall perform the following work:

1. Check the materials to ensure that they conform to the specifications.
2. Review the storage facility and the temperature at which the material is stored.
3. Review the surface preparation to ensure that the surface is clean as required in the specifications.
4. Review mixing and application procedures.
5. Test sand to ensure that it complies with the specifications.
6. Review procedures for application of sand to ensure that the rate of coverage is in accordance to the specifications.

3.9 POLYMER MODIFIED CEMENTITIOUS MORTAR OVERLAY SYSTEM

A. Applicator's Qualifications

1. Mortar overlay system work shall only be performed by contractors who have successfully used this process on at least three similar structural repairs of equal scope which have performed successfully for a minimum period of five years.
2. Only adequately trained and experienced personnel shall be used on the job.

B. Surface Preparation

1. Concrete surface to which the mortar is to be applied shall be exposed parent concrete free of loose and unsound materials. Surface preparation shall be done by using a scabbler. Obtain a surface profile having a minimum amplitude of $\pm 1/16"$.
2. Surface shall then be swept clean or vacuumed to clear off debris and dust.
3. Wash surface with water and brush with hard broom to remove all contaminants and oil drippings. Oil and grease spots shall be removed by using a detergent, and then scrubbing with a power brush or a hard broom. Remove all residue by washing and brushing with water.
4. Surface then shall be wet vacuumed to remove excess water.
5. Surface to be prepared shall be wetted prior to and during scarification by a scabbler to minimize the creation of dust.
6. Provide adequate barricades around the work area to prevent injury to people around the work area from flying debris.
7. Ensure that all edges, corners, areas adjacent to columns, walls and doors are satisfactorily prepared as described above. Use small pneumatic bush-hammer or single-head scabbler for preparing such areas.
8. Any exposed reinforcing steel shall also be cleaned and free of rust and other contaminants. Cleaning shall be accomplished by mechanical means. Use powered wire brushes or abrasive-blasting. All exposed reinforcing steel shall be coated with a corrosion inhibiting product specified elsewhere in this specification prior to mortar application.

C. Concrete Surface Inspection

1. Ensure that the surface and ambient temperature is at least 45°F and rising at the time of application.
2. Inspect surface for loose aggregate and concrete particles. Remove all loose concrete.
3. Inspect surface for cracks. All cracks shall be rebonded prior to application of the overlay system.

D. Crack Repair – Method shall be chosen by Engineer

1. Rebond cracks using epoxy injection procedures given elsewhere in these specifications.

** OR **

2. Rebond cracks using self-penetrating concrete crack filler and sealer using high molecular weight methacrylates. Procedures for filling cracks are given elsewhere in these specifications.

** OR **

3. Rebond cracks using both epoxy injection and self-penetrating concrete crack filler and sealer using high molecular weight methacrylate procedures. See drawings for areas requiring the different methods of repair.

E. Mortar Application

1. Condition polymer mortar material to 65°F-80°F unless otherwise recommended by the manufacturer. Materials beyond this range of temperature shall not be used.
2. Mix the two components in a clean mortar mixer free of contaminants as recommended by the manufacturer.
3. Thoroughly blend components and aggregates with “Jiffy” mixers or equal to a uniform and homogenous mixture.
4. Mixing should be accomplished within three minutes when using “Jiffy” mixer.
5. Dampen the surface of concrete receiving the mortar by a portable sprayer just prior to mortar application. The surface shall be saturated surface dry with no standing water.
6. Set the screed to the proper overlay thickness. See drawings for required overlay thickness. Contractor shall use only power vibrating screeds with metal edges to obtain a smooth wet finish.
7. Spread mortar uniformly on the damp surface by broom. Scrub into substrate filling all pores and voids.
8. Consolidate the mortar thoroughly to remove entrapped air.

9. After screeding, wait for a few minutes as recommended by the manufacturer such that the mortar has a desired stiffness. Wait time depends on the ambient temperature and temperature of the applied material. Then finish by power trowel. Small, difficult to reach areas may be finished by hand troweling. Use water from a portable sprayer during the troweling process.

** OR **

10. After screeding, wait for a few minutes as recommended by the manufacturer such that the mortar has a desired stiffness. Wait time depends on the ambient temperature and temperature of the applied material. Then apply a broom finish on the surface parallel to the direction of flow of traffic.

F. Compressive Strength Test Cubes

1. The Testing Laboratory shall take a minimum of one set of four cube compressive strength test samples to be tested in accordance with ASTM C-109-99 (modified) for every 10 cubic feet of mortar used in overlay or part thereof in a day's work.
2. Test one cube after 24 hours, second cube after 72 hours (3 days), third cube after 14 days, and fourth cube after 28 days.

G. Joints in Overlay System

1. All joints in the original surface or floor shall be reproduced in the overlay. Provide any additional joints shown in the drawings.
2. Joints in the overlay shall be produced by saw-cutting.
 - a. Make saw cut as soon as overlay is able to support weight of workers and sawing equipment without damage to finish surface of overlay.
 - b. All joints shall be continuous across the overlay. Do not offset or stagger joints.
 - c. Width of saw cut shall be 1/4". Saw cut shall be made through the full thickness of the overlay.

H. Joint Filler Material

1. Joint filler material shall be scheduled to be applied in the last week of the construction work.
2. Joint filler material shall be applied immediately after the sawcut is made. However, a week prior to completion of the entire work, reinspect the joints. Repair and refill any joints that show gaps or tears.
3. Clean joint thoroughly prior to filling the joint. There shall be no water in the joint at the time of filler application.
4. Fill joint with filler material having a Shore A hardness of 35 or 80, as chosen by the Engineer.
5. Condition the joint material at a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Joint material beyond this range shall not be used.

6. Follow strictly the manufacturer's recommended procedures for applying the joint filler.

I. CURING

1. Unless otherwise written in manufacturer's instructions and approved by Engineer, cure finished surface by applying a fine mist spray of water over the finished surface. Alternatively, cover with wet burlap. Solvent type curing compounds shall not be used on the overlay system.
2. Curing shall start immediately after the finishing work is completed.
3. Overlay shall be maintained in a moist condition for a minimum of 24 hours.
4. Overlay shall be maintained in a moist condition for a minimum of 72 hours.
5. Protect overlay work from rain and freezing conditions. Contractor shall ensure that the overlay is protected by proper insulation in the event freezing conditions are expected during the curing period.

J. CLEANUP

1. Protect surfaces surrounding the work areas against spillage.
2. Mortar and joint filler material spillage shall be cleaned before they set and become difficult to remove.
3. Cleanup all portions of the existing structure that are soiled or stained in the process of mortar repair work.

K. OVERLAY SERVICE

1. Protect overlay from foot and vehicular traffic as well as equipment loads during the curing period, or until the overlay mortar has attained a compressive strength of 4,000 psi.
2. Strength shall be determined from cube compressive strength tests performed in accordance to ASTM C-109-99 (Modified).

3.10 EPOXY RESIN FLOOR OVERLAY SYSTEM

A. Applicator's Qualifications

1. Work requiring epoxy resin floor overlay system on concrete shall only be performed by contractors who have had successful experience in applying epoxy overlay systems on at least three projects of similar scope which have performed successfully for a minimum period of five years.
2. Only adequately trained epoxy applicators shall be used on the job. Furnish certificates of training on request.

B. Surface Preparation

1. Remove loose concrete, debris, laitance, oil, grease and other contaminants from surface receiving epoxy. All surfaces shall be clean, sound, and free of surface water.
2. Clean concrete by mechanical abrasion such as abrasive blasting, shotblasting, scarifying, waterblasting or as required by the manufacturer. Remove all projections and rough spots to achieve a level clean surface.
3. The Contractor shall obtain all necessary permits from all governmental, environmental and other agencies having jurisdiction over the area where the mechanical abrasion work is to be performed. Abrasive blasting operations shall comply with the requirements of OSHA and NIOSH (National Institute for Occupational Safety and Health) Standard PB-246-697.
4. Where abrasive blasting is used, all abrasive shall be removed from the work area by vacuuming or other appropriate means. Remove blast cleaning residue with compressed air from an oil-and-water-free compressed air source prior to epoxy application.
5. Provide all necessary barriers to contain the abrasive material within the work area. The Contractor is responsible for all damage to property or injury to people as a result of mechanical abrasion process. Wet surface during the surface preparation process to minimize the creation of dust. Alternatively, use equipment designed to perform abrasive blasting and vacuuming operations simultaneously which eliminates dust.
6. Any exposed reinforcing steel shall also be cleaned and free of rust and other contaminants. Cleaning shall be accomplished by mechanical means. Use powered wire brushes or abrasive-blasting. All exposed reinforcing steel shall be coated with a corrosion inhibiting product specified elsewhere in this specification prior to epoxy application.

C. Concrete Surface Inspection

1. Ensure that the surface and ambient temperature is at least 45°F and rising at the time of application.
2. Inspect surface for loose aggregate and concrete particles. Remove all loose concrete.
3. Inspect surface for cracks. All cracks shall be rebonded prior to application of the overlay system.

D. Crack Repair

1. Rebond cracks using epoxy injection procedures given elsewhere in these specifications.

** OR **

2. Rebond cracks using self-penetrating concrete crack filler and sealer using high molecular weight methacrylates. Procedures for filling cracks are given elsewhere in these specifications.

** OR **

3. Rebond cracks using both epoxy injection and self-penetrating concrete crack filler and sealer using high molecular weight methacrylate procedures. See drawings for areas requiring the different methods of repair.

E. Epoxy Primer Application

1. Condition epoxy compound material to be at a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Epoxies beyond this range of temperature shall not be used.
2. Stir each of the two parts of epoxy separately before mixing. Then mix the two parts in a clean container free of contaminants.
3. Thoroughly blend epoxy components for 3 minutes with mechanical mixers having a speed of 400-600 rpm to a uniform and homogenous mixture.
4. Mixing shall be accomplished well within the pot life of the epoxy after allowing for time required for application.
5. Apply epoxy adhesive to concrete surface by brush, roller, broom, or squeegee. The minimum average application thickness shall be between 150-250 square feet per gallon. Application shall be in strict accordance to manufacturer's instructions.

F. Epoxy Mortar Application

1. Mix epoxy in the same manner as described above for epoxy primer.
2. While mixing the epoxy components, slowly add 5 parts by loose volume of oven-dried quartz sand to 1 part of the mixed epoxy material, and mix until uniform in consistency.
3. Place epoxy mortar before primer becomes tack free.
4. Place epoxy mortar with trowel. Compact and trowel with vibrating screed having metal edges. Set the screed for proper overlay thickness. See drawings for areas requiring overlay and overlay thickness required.
5. Finish overlay surface with finishing trowel or other mechanical means.
6. Allow epoxy mortar to cure in accordance to manufacturer's recommendations.

G. Compressive Strength Tests

1. The Testing Laboratory retained by the Owner shall take a minimum of one set of four cube compressive strength test samples to be tested in accordance with ASTM C-109-99 (Modified) for every 1000 square feet of epoxy overlay work or part thereof in a day's work.
2. Test one cube after 24 hours, second cube after 72 hours (3 days), third cube after 7 days, and fourth cube after 28 days.

- H. Seal Coat: Allow the overlay system to reach sufficient cure so as not to be damaged by foot traffic (minimum compressive strength 2,000 psi). Then apply a top seal coat of neat epoxy over the epoxy mortar overlay by means of a roller or flat squeegee. Method of

mixing the seal coat epoxy resin and its rate of application shall be the same as that of the epoxy primer.

I. Joints in Overlay System

1. All joints in the original surface or floor shall be reproduced in the overlay. Provide any additional joints shown in the drawings.
2. Joints in the overlay shall be produced by saw-cutting.
 - a. Make saw cut as soon as overlay is able to support weight of workers and sawing equipment without damage to finish surface of overlay.
 - b. All joints shall be continuous across the overlay. Do not offset or stagger joints.
 - c. Width of saw cut shall be 1/4". Saw cut shall be made through the full thickness of the overlay.

J. Joint Filler Material

1. Joint filler material shall be scheduled to be applied in the last week of the construction work.
2. Joint filler material shall be applied immediately after the sawcut is made. However, a week prior to completion of the entire work, reinspect the joints. Repair and refill any joints that show gaps or tears.
3. Clean joint thoroughly prior to filling the joint. There shall be no water in the joint at the time of filler application.
4. Fill joint with filler material having a Shore A hardness of 35 or 80, as chosen by Engineer.
5. Condition the joint material at a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Joint material beyond this range shall not be used.
6. Follow strictly the manufacturer's recommended procedures for applying the joint filler.

K. Testing

1. The Testing Laboratory shall evaluate that the rate of coverage of the epoxy adhesive and the thickness of the overlay complies to the specifications.
2. The Testing Laboratory shall perform pullout tests on the cured overlay surface prior to applying the seal coat. The rate of testing shall be one test for every 1000 square feet of surface area, with a minimum of three tests. The pullout strength (tested in accordance with Appendix A of ACI 503 R-93) shall be at least 100 psi. All failures shall be in the concrete. Any failure that occurs in the adhesive shall be cause for rejection of the overlay system.
3. The cost of replacement and any retesting required by the Engineer shall be borne by the Contractor.
4. Repair all tested areas in the same manner as the overlay system application.

- L. Cleanup
 - 1. Protect surfaces surrounding the work area against spillage.
 - 2. Epoxy spillages shall be cleaned before they set and become difficult to remove.
 - 3. Cleanup whatever portions of the existing structure that are soiled or stained in the process of applying epoxy adhesive.

END OF SECTION 03 31 00