

716 REPAIR-REPLACE PCC STRUCTURE

716.01 GENERAL – the materials and methods specified below apply to the particular types of structural repairs as shown on the plans and specified herein.

Due to the time interval between the field survey and notice to proceed, further deterioration may have occurred which would not be reflected in the quantities for the particular bid item; the chief engineer will be the sole judge of the extent and total quantity of repairs that are to be made.

716.02 MATERIALS:

- (A) **Portland Cement Concrete** – Concrete shall conform to Class B High Early Strength Concrete otherwise specified or shown on drawings, but shall contain aggregates no greater than 1/2 inch nominal size.
- (B) **Non-shrink Grout** – A propriety formulation with a minimum bond strength of 3000 psi per ASTM C882, compressive strength of 5000 psi minimum after 24 hours per ASTM C579.
- (C) **Non-shrink Mortar** – Mortar shall be cement base non-shrink type meeting the requirements of ASTM C109 for 3000 psi, 28 day strength. It shall be non-sag, stiff consistency for vertical surfaces, and capable of adhering to damp concrete surfaces.
- (D) **Epoxy Resin Adhesive (bonding agent)** – Epoxy adhesive shall conform to AASHTO M235 Type III, two part mix equal parts (1:1), thixotropic.
- (E) **Low Viscosity Epoxy Grout for Pressure Injection Grouting** – High-modulus, moisture insensitive, low-viscosity, for application at not less than 40 ° F, fast setting, rigid, for grouting both damp and dry cracks. ASTM C881 Types IV, Grade 1, Class B and C. If recommended by epoxy manufacturer, provide a compatible surface sealer. Pressure injection shall be carried out in strict accordance with manufacturer's instruction.
- (F) **Surface Sealant** – Epoxy resin used to seal cracks and ports before injection. ASTM C881, Type IV, Grade 3, Class B and C.
- (G) **Caulking Compound** – A one component, non-sag (gun grade) urethane sealant, color gray, meeting Federal Specification TT-S-00230C Type II for vertical use and ASTM C920.
- (H) **Welded Wire Fabric Reinforcement** – AASHTO M55 non-deformed wire fabric.
- (I) **Non-Shrink Epoxy Grout** – A proprietary formulation, rapid set, flowable epoxy grout, for tight clearances meeting applicable AASHTO Specifications for epoxy and cement components, non-shrink per ASTM C827 and tensile strength of 2000 psi minimum per ASTM C190.
- (J) **Epoxy Mortar** – Epoxy-cement, proprietary formulation, non-metallic, non-flowable, stiff consistency and in accordance with [806.05\(C\)](#).

- (K) **Mastic Lubricant** – Non-flowable material, wash resistant to moisture, compatible with elastomeric material, molybdenum disulfide base.
- (L) **Alternate Concrete Bonding Agent** – Bonding agent compound for bonding uncured concrete to existing concrete shall be Thorobond, Weld-Crete, Link, or approved equal with a polyvinyl acetate homopolymer base for surface bonding application.
- (M) **Anchor Bolts** – Self-anchoring bolts shall be per [822.06\(B\)](#)

716.03 SUBMITTAL:

- (A) **Materials Certification** – Submit certification for all materials in accordance with [822.08\(D\)](#).
- (B) **Construction Drawings** – Submit construction drawings and calculations showing temporary shoring and support systems (if applicable).
- (C) **Drawing Certification** – Shop drawings and construction drawings shall be certified by a Professional Engineer registered in the District.
- (D) **As-Built Drawings** – As-Built drawings shall indicate the type, location and extent of the repairs and the products and methods actually used.

716.04 CONSTRUCTION METHOD CONCRETE REPAIR OR PATCH

- (A) **Limits of Deterioration** – The extent for removal of deficient concrete shall be as indicated by sounding with a hand held steel hammer. A hollow sound indicates deficiency. All sounding shall be performed in the presence of the Chief Engineer or his designated representative. Where sounding indicates a deficient area has increased beyond that indicated on the contract drawings, obtain the Chief Engineer's approval before commencing work.
- (B) **Concrete Removal** – The limits of the repair areas previously designated shall be saw cut along neat lines to a depth of at least 1 inch so as to obtain a rectangular area. The saw cut lines shall encompass the area of deterioration by maintaining a minimum of 2 inches offset from the designated area of deterioration. Special care shall be taken to protect any parts of the structure that are not specifically to be removed. Pneumatic hammers may be used to remove unsound concrete. The maximum hammer size is 90 pound class. All devices proposed for concrete removal shall be approved by the Chief Engineer.
- (C) **Depth of Concrete Removal** – Concrete shall be removed in the previously designated areas to depth at which sound concrete is found. The depth at which sound concrete is found will determine the type of repair to be utilized as follows:
 - (1) Depth Greater Than 4 Inches – Repair Type 1, Concrete Repair
 - (2) Depth 4 Inches or Less – Repair Type 2, Concrete PatchAfter concrete removal to a depth of 2 inches has taken place, the Chief Engineer shall have the option to remove additional concrete depth and designate which repair type will be used. Payment shall be made under the repair type designated.

- (D) **Existing Reinforcing Steel** – Extreme care shall be taken when removing concrete so as not to damage the existing reinforcing steel. If the reinforcing steel is damaged or deemed unsuitable by the Chief Engineer, it shall be replaced by dowel bars that are the same diameter as the damaged reinforcing steel. The minimum size of a replacement dowel shall be a #5 bar. The replacement dowel bars shall be provided at the Contractor's expense.
- (E) **Under Cut** – The perimeter of the repair area shall be under cut or bevel cut to key in the proposed repair.
- (F) **Surface Preparation** – The repair areas shall be structurally sound and free from all dust, dirt, grease, paint and other foreign material. Exposed reinforcing steel shall be sandblasted to a bright metal. The concrete surfaces that are to be repaired shall then be blown clean with oil-free and clean air.

716.05 REPAIR TYPE 1, CONCRETE REPAIR.

- (A) **Welded Wire Fabric with Anchors** – Place 3/8 inch diameter concrete anchors at a maximum spacing of 18 inch on centers in each direction and attach welded wire fabric to anchors. A minimum of one anchor is required per repair area. The welded wire fabric shall be of an appropriate size to fill the repair area.
- (B) **Forms** – Set forms maintaining all chamfers and flush with adjacent concrete surface. Provide adequate ports in forms for applying the bonding agent and placing repair concrete. The forms shall be removable. Provide a minimum of 1 inch cover by bending existing reinforcement back behind finished surface if required.
- (C) **Bonding Agent** – An epoxy resin adhesive shall be applied to the prepared surface. Adhesive shall be applied when the ambient air temperature is in excess of 60°F unless otherwise recommended by the manufacturer. The adhesive shall be in tacky condition immediately prior to placing repair concrete.
- (D) **Repair** – Fill cavity with repair concrete, finish and cure concrete in accordance with [703](#).

716.06 REPAIR TYPE 2, CONCRETE PATCH.

- (A) **Forms** – Set forms maintaining all chamfers and flush with adjacent concrete surface. Provide adequate ports in forms for applying the bonding agent and placing repair concrete. The forms shall be removable. Provide a minimum of 1 inch cover by bending existing reinforcement back behind finished surface if required.
- (B) **Bonding Agent** – An epoxy resin adhesive shall be applied to the prepared surface. Adhesive shall be applied when the ambient air temperature is in excess of 60°F unless otherwise recommended by the manufacturer. The adhesive shall be in a tacky condition immediately prior to placing repair material.
- (C) **Repair** – The material used to effect this repair type shall conform to either of the following:
 - (1) **Epoxy Mortar** – Finish and cure in accordance with the manufacturer's specifications and [703](#).

- (2) Non-Shrink Grout – Finish and cure in accordance with the manufacturer’s specifications and [703](#).

716.07 REPAIR TYPE 3, CRACK REPAIR.

- (A) **General** – The work covered by this item includes surface repair of concrete cracks by pressure injection of epoxy as shown on the contract documents. The method of application shall be approved by the Chief Engineer prior to beginning work.
- (B) **Locations** – Prior to the beginning of work, the Chief Engineer will mark the exact crack locations to receive epoxy injection.
- (C) **Damage** – Extreme caution shall be taken when selecting a pressure necessary to complete crack repair so as not to damage the structure by causing additional cracking. If additional damage occurs, the Contractor shall bear full responsibility.
- (D) **Surface Preparation.**
 - (1) **Cleaning** – Concrete surfaces shall be clean and sound. Clean all cracks of loose matter such as dirt, laitance, oil, grease, salt or any other contaminants by sandblasting compressed air.
 - (2) **Surface Seal** – If necessary, apply surface seal material to the crack and establish entry ports in the surface seal at 6 to 18 inches apart. Substrate temperatures shall not be less than 40°F or as recommended by the epoxy manufacturer. Allow surface seal to set before beginning injection procedure.
- (E) **Injection** – Inject low viscosity epoxy adhesive at the lowest port. Continue injection until epoxy begins to flow out of the port at the next higher level. Plug the first port and start injection at the second port. Repeat until all of the ports are filled. Allow epoxy to cure as per the manufacturer’s specifications.
- (F) **Finish** – After the epoxy injection is complete, all entry ports shall be removed and all excess surface seal and epoxy shall be removed flush with adjacent concrete surfaces.
- (G) **Testing.**
 - (1) **First Test** – After the completion of the first crack repair, the Chief Engineer shall designate a random location within the finished crack repair to be cored. Extreme care shall be taken in the selection of the core locations to avoid primary reinforcing steel. The core shall be 1 inch in diameter, and shall extend to the depth of crack being investigated. This core will be examined by the Chief Engineer to verify the full sealing of the crack. If the crack is not sealed to the satisfaction of the Chief Engineer, the procedure used for crack injection will be modified.
 - (2) **Additional Tests** – The Chief Engineer shall designate one location for every 25 linear feet of crack repair and no less than one additional random location where the cracks have been epoxy injected for the Contractor to core. These cores will be examined by the Chief Engineer to verify full sealing of the cracks.
 - (3) **Core Holes** – The core holes shall be filled with a non-shrink grout and finished to the satisfaction of the Chief Engineer.

716.08 MEASURE AND PAYMENT

(A) Repair Type 1 – Concrete Repair.

- (1) Unit of Measure – The unit of measure will be the square foot.
- (2) Payment – Payment will be made at the contract unit price per square foot, for which payment will include furnishing all materials, labor, tools and equipment to accomplish the work specified.

(B) Repair Type 2 – Concrete Patch.

- (1) Unit of Measure – The unit of measure will be the square foot.
- (2) Payment – Payment will be made at the contract unit price per square foot, for which payment will include furnishing all materials, labor, tools and equipment to accomplish the work specified.

(C) Repair Type 3 – Crack Repair.

- (1) Unit of Measure – The unit of measure will be the linear foot of crack repaired.
- (2) Payment – Payment will be made at the contract unit price per linear foot, for which payment will include furnishing all materials, labor, tools and equipment to accomplish the work specified and shown.