ITEM 1155.8198 M - CRACK REPAIR (3 mm or wider) BY INJECTION OF PORTLAND CEMENT GROUT

DESCRIPTION:
Install injection ports, seal the crack opening, inject the crack with grout, and restore the sealed surface to a flush condition in areas visible to the public. Perform the work at locations indicated on the contract plans or where directed by the Engineer.

MATERIAL REQUIREMENTS:
A. Crack Sealant - epoxy paste that completely cures in 4 hours or less and retains the injected grout. Any other type of crack sealant is subject to a project demonstration and approval by the Engineer.
B. Portland Cement Grout Ingredients:
- Portland Cement, Type II §701-01
- Fly Ash (Type F) §711-10
- Microsilica §711-11
- Grout Sand §703-04
- Water §712-01
- Admixtures §711-08
- Expansive Agent -

Include an air entraining admixture to create 5 - 15% air entrainment. If an expansive agent is used, use a maximum 1%, by weight of cementitious material, and eliminate any air entraining admixture.

Cracks 3 mm to 6.5 mm. Design a grout (portland cement, water and admixtures) with a minimal water content that will fill and flow throughout the crack. Up to 25% by loose volume of the portland cement may be replaced, in combination or alone, as follows:

- Fly Ash 0 to 25%
- Microsilica 0 to 10%

Cracks 6.5 mm wide and wider. Use a loose volume ratio of 1 part cementitious material (portland cement, fly ash, microsilica) to 1 - 3 parts grout sand.

Perform mix trials to select a suitable grout for the application. When the repairs will be visible to the public, match the color of the repair to the adjacent material, to the satisfaction of the Engineer.

Demonstrate that the grout to be used flows satisfactorily through an installed injection port.

EQUIPMENT:
Use only equipment in good working order, as approved by the Engineer.
A. High Speed Colloidal Mixer – provide a machine operated high speed colloidal mixer that operates in the range of 800 to 2000 revolutions per minute.
B. Positive Displacement Pump - to maintain a consistent pressure (from 0 to 0.35 MPa) to uniformly force grout into the cracks.
CONSTRUCTION DETAILS:

A. Crack and Surface Preparation. Remove all debris or contaminants accessible within the cracks by using hand tools, water blasting or oil-free high pressure air blasting, vacuuming, or other methods suitable to the Engineer. Remove all materials, including moisture, from the surface adjacent to the crack which might interfere with crack sealant bonding.

B. Injection Port Installation. Attach injection ports to the prepared surface by placing them onto (surface adapters) or into the cracks (socket ports) and affixing with crack sealant. Larger cracks may be ported by inserting an anchored tube into the crack. Other injection port designs and attachment methods require approval by the Engineer.

For cracks uniform in width, use injection port spacing sufficient to completely fill the crack. For cracks that get tighter with depth, double the injection port spacing. Intermediate ports may be placed for observation. To permit maximum flow into the void, position ports on the wider crack sections and at intersections, rather than at an exact spacing. Port spacing may be modified by the Engineer as experience is gained.

FOR CRACKS COMPLETELY THROUGH A MEMBER:
1. Cracks accessible from one side - space the ports not less than the thickness of the member.
2. Cracks accessible from both sides - space the ports not less than twice the thickness of the member and stagger them relative to the ports on the opposite side. Make the stagger between ports (on opposite sides of the member) at least the thickness of the member.

Place the endmost ports at the ends of the crack so as to insure complete filling of the crack.

FOR MULTIPLE CRACKS ALL OVER A MEMBER: Space the ports as far apart as practical, but not less than 200 mm from one another. A 200 mm spacing presumes a 100 mm penetration in each direction, if the adjacent ports are not plugged when grout reaches them. For cracks that taper to an end, place the endmost ports about 100 mm from the end.

C. Crack Seal. After the ports have been installed, seal the crack opening with crack sealant, being careful not to plug the injection ports. Allow the crack sealant to cure completely before injecting grout.

Apply crack sealant when surface and ambient temperatures are above 10°C.

D. Water Flush. Prior to any grout injection, flush the crack with pressurized water using the grout injection procedure, or a similar procedure, to clean out any remaining debris, verify that water exits from all the installed ports, check for leaks, and dampen the walls of the crack. The Engineer will decide if this procedure is unsuitable for a particular crack.

E. Grout Injection. Perform grout injection only when the surface and ambient temperatures are above 7°C and are not expected to fall below 7°C during the next 24 hours.

UNIFORM WIDTH CRACKS - start toward the middle of a horizontal crack and work outward, or the lowest point of a sloping or vertical crack and work upward.

VARIABLE WIDTH CRACKS - start at the widest points of all types of cracks and work outward. Secure the feed line to the first port. Initiate and continue flow until grout exits from the adjacent port. (Plug observation ports and continue through the same port to achieve maximum penetration.)
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Temporarily stop the injection process, remove the feed line, and seal the port. Attach the feed line to the adjacent port and repeat this procedure along the crack until the last port is sealed.

Generally, use higher pressures when injecting narrow deep cracks, medium to low for wider cracks, and lowest pressures when injecting a delaminated area or an area susceptible to lifting. Low pressure applied for a longer duration is more effective than high pressure applied for a shorter duration.

Exercise care to assure a continuous injection operation. In the event of leakage from a crack, stop the injection process until the leak is sealed.

Allow the grout to fully cure prior to performing subsequent work in the repaired area.

F. Verification. Take a minimum of 2 cores for each days work to verify acceptability of the injection operation. Take 25 or 50 mm cores, at locations mid-way between injection ports, to a depth of at least 150 mm. The Engineer will verify acceptability of the injection operation before progressing with other crack repair operations. Coring frequency may be reduced if acceptable injection operations occur routinely, as determined by the Engineer.

G. Clean Up. In all areas visible to the public, remove spillage, the ports and crack sealant until flush with the adjacent surface. Remove stains and repair any damage to the satisfaction of the Engineer at no additional cost.

METHOD OF MEASUREMENT:

The Engineer will measure the work as the number of linear meters of crack repaired as required.

BASIS OF PAYMENT:

Include the cost of all labor, materials and equipment necessary to complete the work in the price bid per linear meter.

The Engineer will authorize payment after the measured length of crack has been repaired, and surface cleaned, as required.