DIVISION 3 - CONCRETE

Section 03730 - Concrete Rehabilitation

Part 1 – General

1.01 Summary

A. This specification describes the patching or overlay of interior and/or exterior horizontal, vertical, or overhead surfaces with a pneumatically placed cementitious, silica fume portland cement mortar/concrete.

1.02 Quality Assurance

A. Manufacturing qualifications: The manufacturer of the specified product shall be ISO 9001 certified and have in existence a recognized ongoing quality assurance program independently audited on a regular basis.

B. Contractor qualifications: Contractor shall be a qualified in the field of concrete repair and protection with a successful track record of 5 years or more. Contractor shall maintain qualified personnel who have receivced product training by a manufacturer's representative.

C. Install materials in accordance with all safety and weather conditions required by manufacturer or as modified by applicable rules and regulations of local, state and federal authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

1.03 Delivery, Storage, and Handling

A. All materials must be delivered in original, unopened containers with the manufacturer’s name, labels, product identification, and batch numbers. Damaged material must be removed from the site immediately.

B. Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.

C. Condition the specified product as recommended by the manufacturer.

1.04 Job Conditions

A. Environmental Conditions: Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature 40ºF (7ºC) and rising.

B. Protection: Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified material.

1.05 Submittals

A. Submit two copies of manufacturer’s literature, to include: Product Data Sheets, and appropriate Material Safety Data Sheets (MSDS).

1.06 Warranty

A. Provide a written warranty from the manufacturer against defects of materials for a period of one (1) year, beginning with date of substantial completion of the project.

Part 2 - Products

2.01 Manufacturer

A. **Sikacem 133**, as manufactured by Sika Corporation, is considered to conform to the requirements of this specification.

2.02 Materials

A. Polymer-modified, silica fume enhanced cementitious mortar:

1. The mortar shall be a blend of selected portland cements, acrylic polymer, microsilica and specially graded aggregates. It shall be applicable for horizontal, vertical, and overhead surfaces.
2. The materials shall be non-combustible, both before and after cure.
3. The materials shall be supplied in a factory-proportioned unit.
4. The polymer-modified cementitious, microsilica mortar must be placeable from 1/3in. in depth and greater.

2.03 Performance Criteria

A. Typical Properties of the mixed polymer-modified, silica fume enhanced, cementitious mortar:

1. Working Time: 5-10 minutes
2. Finishing Time: 10-20 minutes
3. Color: Concrete gray

B. Typical Properties of the cured polymer-modified, silica fume enhanced, cementitious mortar:

1. Compressive Strength (ASTM C-109 Modified) – 3 inch cubes
   a. 2 day: 4000 psi min. (27.6 MPa)
   b. 7 day: 6000 psi min. (41.4 MPa)
   c. 28 day: 8000 psi min. (55.2 MPa)
2. Flexural Strength (ASTM C-78)
   a. 7 days: 1250 psi (8.6 MPa)
   b. 28 days: 1630 psi (11.2 MPa)
3. Splitting Tensile Strength (ASTM C-496)
   a. 7 days: 630 psi (4.3 MPa)
   b. 28 days: 800 psi (5.5MPa)
4. Direct Bond Strength (Pull Off Test) (ACI 503.R)
   a. 28 days: 290-580 psi (2-4 MPa) mostly concrete failure (substrate)
5. Modulus of Elasticity
   Static Modulus (28 days) 3.5×10^6 (24,000 MPa)
   Dynamic Modulus (28 days) 4.8×10^6 (33,000 MPa)
6. The silica fume enhanced, cement mortar shall not produce a vapor barrier.
7. Density (wet mix): 137 lbs./ cu. ft. (2.2 kg/l)
8. Coefficent of Termal Expansion 4.4×10^{-6}/F (8×10^{-6}/C)
9. Freeze thaw resistence (ASTM C-666) 100% @ 300 cycles
10. Rapid chlorides permeability (ASTM 1202 & AASHTO T277) Less than 1000 coulumbs

Note: Tests above were performed with the material and curing conditions @ 71°F – 75°F and 45-55% relative humidity.

Part 3 – Execution

3.01 Surface Preparation

A. Areas to be repaired must be clean, sound, and free of contaminants. All loose and deteriorated concrete shall be removed by mechanical means. Mechanically prepare concrete substrate to obtain a minimum surface profile of +/- 1/3 in.(CSP 6 or greater as per ICRI Guidelines) with a new exposed aggregate surface. Area to be patched shall not be less than 1/3 in.in depth.

B. Where reinforcing steel with active corrosion is encountered, sandblast the steel to a white metal finish to remove all contaminants and rust. Where corrosion has occurred due to the presence of chlorides, the steel shall be high pressure washed after mechanical cleaning. Prime steel with 2 coats of Sika Armatec 110 EpoCem as per the technical data sheet. (See Spec Component SC-201)

3.02 Mixing and Application

A. Material is to be applied by conventional dry spray shotcrete or wet spray equipment. Consult TDS.

B. Placement Procedure Dry Process: At the time of application, the substrate shall be saturated surface dry with no standing water. Apply the material in accordanace with ACI 506R-90 " Guide to Shotcrete". Important factors during shotcreting are: the nozzle distance (2-6ft), angle to substrate (90^{o}) and consistency of mortar. Mortar consistency should be plastic (like firm jelly), immediately after application and before set. A natural gun finish may be used. If gun finish is too rough, you may apply special finishes. Slice off excess material with a sharp-edged cutting screed 5 to 10 minutes after initial set. The surface may then be finished to your requirements: 1. Broomed for rough textured, 2. Wood-floated for a granular texture, 3. Steel-troweled for smooth surface finish.

Placement Procedure Wet Process: At time of application, surface should be saturated surface dry but hold no standing water. Apply material by spraying or troweling for repairing vertical or overhead surfaces. Shoot the material perpendicular to the surface. This minimizes rebound, creates the smoothest pattern (reduces bumps) and properly encases the rebars. The velocity of the shotcrete is sufficient if, at a distance of 18 to 24 in., the shotcrete pattern flattens out on contact with the surface and the rebars are encased. After applying the material, allow to stiffen for approx. 10 minutes before removing bumpy areas with a trowel. If a another layer is desired, allow the material to reach initial set. This will take anywhere from 2-4 hours depending on mix consistency, mix and ambient temperature, wind conditions and humidity. Begin and finish a given patch on the same day.

C. As per ACI recommendations for portland cement concrete, curing is required. Moist cure with wet burlap and polyethylene, a fine mist of water or a water-based* compatible curing compound. Moist curing should commence immediately after finishing. Protect newly applied material from rain, sun, and wind, and frost until compressive strength is 70% of the 28-day compressive strength. To prevent from freezing cover with insulating material. Setting time is dependent on temperature and humidity.

*Pretesting of curing compound is recommended.

D. Adhere to all procedures, limitations and cautions for the silica fume, polymer-modified portland cement mortar in the manufacturers current printed technical data sheet and literature.

3.03 Cleaning

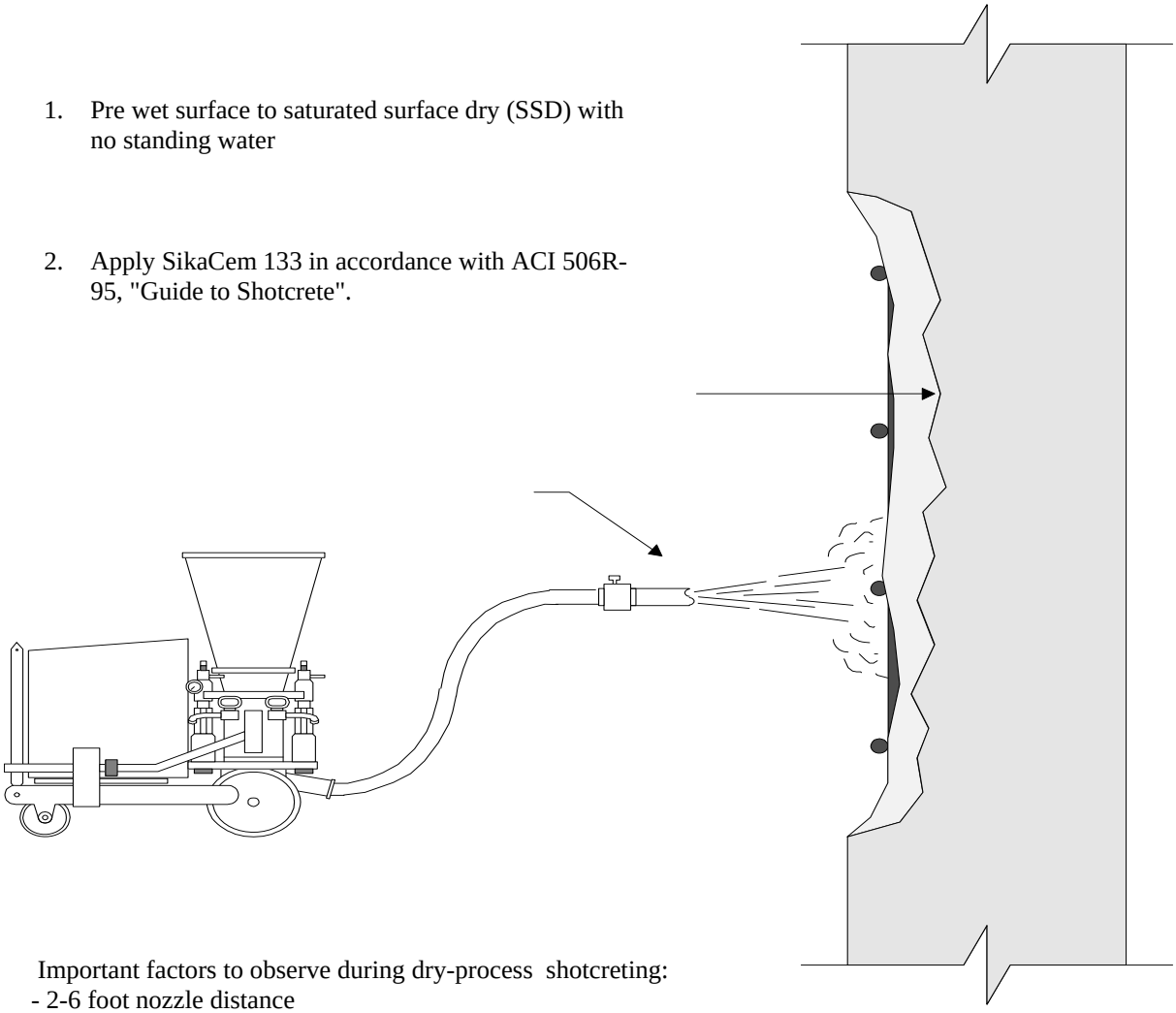
A. The uncured polymer-modified, silica-fume portland, cement mortar can be cleaned from tools with water. The cured polymer–modified, silica-fume, portland cement mortar can only be removed mechanically.

B. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

SC-101 Sikacem 133
Machine-applied

1. Pre wet surface to saturated surface dry (SSD) with no standing water

2. Apply SikaCem 133 in accordance with ACI 506R-95, "Guide to Shotcrete".



Important factors to observe during dry-process shotcreting:
- 2-6 foot nozzle distance
- 90° angle to substrate
- consistency of mortar
-minimum liquid pressure 80 psi

3. Or apply using wet-process spray equipment use 5-6 pints of water per 55lbs. Bag use positive displacement pump equipment apply at low or high velocity

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