FIVE STAR PRODUCTS, INC.

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DESIGN-A-SPEC™ GUIDELINES
FIVE STAR STRUCTURAL CONCRETE GUNITE

CONTENTS

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PART A - GENERAL CONDITIONS - CONCRETE REPAIR

1.01 SCOPE

The work covered by this document consists of furnishing all equipment, materials, labor and performing all operations required for concrete repairs as directed by the engineer or owner.

1.02 QUALITY ASSURANCE

A. The manufacturer shall have been in the business of manufacturing similar products for over ten years, maintain a strict quality assurance program, offer technical services and provide a representative at the jobsite for product training, prior to product installation, upon written request.
B. The contractor shall submit to the engineer, or owner, at least three job references where the contractor has successfully completed similar applications.

1.03 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered to the jobsite in their original, unopened packages, clearly labeled with the manufacturer's identification, printed instructions and batch code.
B. Store and condition the specified product as per the appropriate product data sheet.
C. For handling instructions, refer to the Material Safety Data Sheet.

1.04 PROJECT/SITE CONDITIONS

Refer to PART C - PREPARATION, ENVIRONMENTAL CONDITIONS, or contact the manufacturer directly for any physical or environmental limitations required by the product.

1.05 MEASUREMENT AND PAYMENT

A. Measurement for concrete repairs shall be on a cubic foot/square foot (liter/square meter) basis of material in place.
B. Payment for concrete repairs shall be at the unit price bid on a cubic foot/square foot (liter/square meter) basis. This payment shall constitute full compensation for all labor, materials, tools, equipment and other items as necessary to complete the work as described in the contract documents. Progress payments will be made on the percentage of the work satisfactorily completed during each payment period in accordance with the provisions of the contract documents.

PART B - MATERIAL SPECIFICATION - CONCRETE REPAIR

2.01 MATERIALS

A. The concrete repair material shall be a dry process gunite applied, packaged cement-based mortar suitable for application by dry process shotcrete requiring only the addition of potable water. The material shall not contain any chlorides or lime other than amounts contained within the hydraulic cement composition. The manufacturer shall be ISO 9001 certified and have at least ten years experience in the manufacture of concrete repair materials. The manufacturer shall offer technical services and provide a representative at the jobsite for product training prior to product installation upon five days advance notice.

B. The concrete repair material shall meet all the following typical performance criteria when cured at 73°F (23°C):

1.	Compressive Strength, ASTM C 109	
	3 Hours	2,500 psi (17.3 MPa)
	1 Day	4,000 psi (27.6 MPa)
2.	Bond Strength, ASTM C 882	
	1 Day	2,000 psi (13.8 MPa)
3.	Length Change, ASTM C 157	
	28 Days Wet	+0.03%
	28 Days Dry	-0.05%
4.	Chloride Ion Permeability, ASTM C 1202	
	3 Days	Very Low
5.	Coefficient of Thermal Expansion, ASTM C 531	5.0×10^{-6} in/in/°F (9.0×10^{-6} mm/mm/°C)

The data shown above reflect typical results based on laboratory testing under controlled conditions. Reasonable variations from the data shown above may result in the field. Test methods are modified where applicable.

C. An acceptable product which meets these criteria is:

Five Star Structural Concrete® Gunite

As manufactured by Five Star Products, Inc., Fairfield, CT 06824 (203) 336-7900.

D. Subject to meeting the performance criteria stated, other products may be formally submitted to the engineer for approval up to three days prior to the bid date. All requests for approval shall contain certified test data verifying conformance with this specification. Three references of successfully completed projects of similar nature and scope of the work detailed in this specification shall be provided, as well as a minimum ten year history of use in the industry. The testing laboratory shall certify to any modifications made to the tests performed and provide details of modifications.

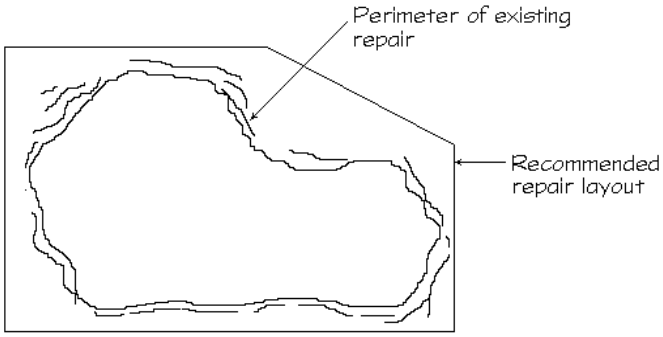
PART C – PREPARATION - CONCRETE REPAIR

3.01 CONCRETE SURFACES
DRY PROCESS

A. Completely remove all loose, delaminated and weak concrete, oil, grease, laitance and other contaminants. Prepare concrete using acceptable mechanical means and concrete cleaners and degreasers as necessary to obtain clean, sound and rough surfaces. Roughen concrete surfaces to an ICRI (International Concrete Repair Institute Technical Guideline 03732) Concrete Surface Profile of 6 or greater. Coarse aggregate shall be exposed. Blow out concrete surfaces using oil free compressed air to remove all dust, debris and other contaminants.

B. The edges of the repair shall taper in toward the center of the repair area and shall have a rough profile. Avoid abrupt changes in depth.
[The minimum repair depth specified should be determined by the product selected and the nature of the repair.]

C. The perimeter of the repair shall be kept to a simple shape. Avoid reentrant corners.



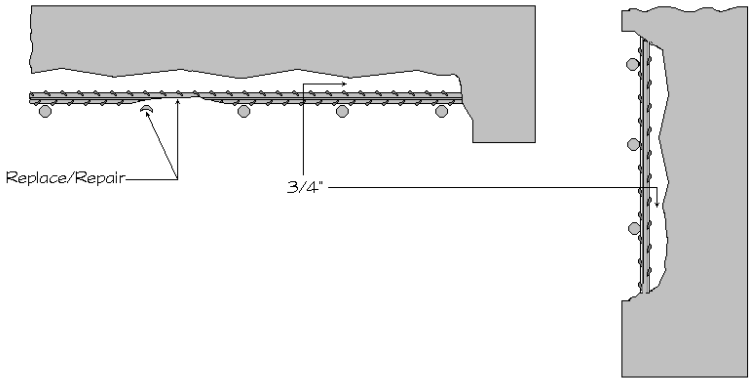
D. All cracks shall be brought to the attention of the engineer and a determination made of whether the cracks are subject to movement. The cracks shall be repaired as directed prior to application of the repair material.

E. All existing joints shall be maintained. New joints, if any, shall be installed as detailed on the drawings.

F. Soak concrete thoroughly with potable water prior to placement. Concrete shall be saturated and free of standing water at time of placement.
[For more detailed information, refer to the following sources: "Guide to Shotcrete", Report of ACI Committee 506R, 1990 and "Surface Preparation Guidelines For The Repair of Deteriorated Concrete Resulting From Reinforcing Steel Oxidation", Report of International Concrete Repair Institute, March 1995.]

3.02 REINFORCEMENT

A. All reinforcing steel that has lost bond with the concrete or has more than one-half of its circumference exposed shall be undercut by at least 3/4 inch (18 mm) or two times the maximum aggregate size.



B. All reinforcement shall be rigidly secured and supported as directed.

C. If more than 20% of the diameter of a reinforcing bar has been deteriorated, the bar will require replacement or will need to be spliced as directed by the engineer.

D. All exposed reinforcing steel shall be free of all loose scale and rust, and other contaminants.

E. The minimum cover over reinforcement shall be in accordance with job specifications or 3/4 inch (18 mm), whichever is greater.

F. Welded wire fabric shall be used and securely fastened on all overhead and vertical repairs when the thickness is 1 1/2 inches (38 mm) or greater.

3.03 ENVIRONMENTAL CONDITIONS

A. Condition and maintain all materials and surfaces that contact repair material to between 35°F and 90°F (2°C and 32°C), but optimally between 55°F and 75°F (13°C and 24°C) whenever possible. Shade from direct sunlight as necessary.
[When faster strength gain is required at low temperatures, or longer working time is required at high temperatures, revise the temperature range above as appropriate by referring to detailed conditioning procedures for Cold Weather or Hot Weather Repairs, PART F – EXTREME WEATHER CONDITIONS.]

3.04 EQUIPMENT AND MATERIALS

A. All necessary tools, equipment and materials shall be in good condition and as close as possible to area being repaired.
B. Appropriate clothing and safety equipment shall be worn to avoid breathing dust and prevent eye and skin contact with both dry and mixed repair materials.
C. Dry process shotcrete equipment shall be either a double chamber or rotary gun.
D. Mortar mixer(s) or hydromix nozzle is required for predampening of repair material.
E. An ample source of potable water shall be available for preconditioning, mixing, cleaning and curing.

3.05 PREDAMPENING

Mortar Mixer

A. Provide an adequate number of mortar mixers to provide an uninterrupted supply of material for placement.
B. Place repair material into mortar mixer. While mixing, add only enough cold water to hold down dust in the hopper. When tightly squeezed in the hand, the mix should remain as separate particles, having no cohesive properties. Over-dampening will cause jamming in the equipment and lines.
C. Only predampen enough material that will be used within 10 minutes.

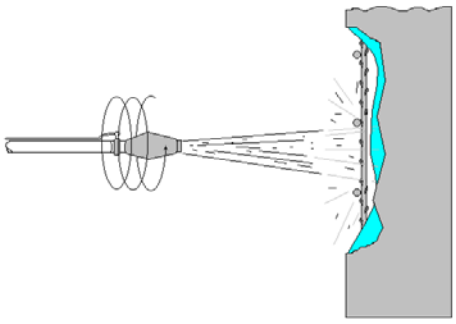
Hydromix Nozzle

A. The use of a hydromix nozzle eliminates the need to predampen in a mortar mixer.

PART D – APPLICATION - CONCRETE REPAIR

4.01 PLACEMENT PROCEDURES
DRY PROCESS
[For large vertical and overhead repairs without congested reinforcement.]

A. Substrate shall be saturated and free of standing water during application.
B. Apply repair material full thickness whenever possible. Overhead placement is applied in layers just thick enough to prevent sagging.
C. Material velocity, water and air pressure should be adjusted to maximize mixing and minimize material rebound. Rebound material shall not be reused.
D. Placement shall follow the procedures contained in ACI 506R-90 for dry mix shotcrete.



REFERENCE

ACI 506R
"Guide to Shotcrete"

PART E – FINISHING AND CURING - CONCRETE REPAIR

5.01 FINISHING
DRY PROCESS

A. Repair material shall be brought to approximate line and grade. Finish as necessary.
[A natural gun finish is the preferred finish from a structural and durability standpoint. For special finishes, scrape off excess material with a sharp-edge cutting screed after initial set and finish as necessary.]

5.02 CURING

A. Repair material shall be cured as recommended by the manufacturer.
B. Repair material shall be protected from excessive evaporation prior to set, freezing, rain, hydrostatic pressure and vibration as recommended by the manufacturer.

PART F – EXTREME WEATHER CONDITIONS - CONCRETE REPAIR

6.01 COLD WEATHER REPAIRS

[Low temperatures delay the set, increase working time and delay the strength development of cement-based products. The procedures below will compensate for these conditions.]

A. All surfaces shall be preconditioned and maintained between 35°F and 90°F (2°C and 32°C) and materials conditioned to between 35°F and 80°F (2°C and 27°C). Higher substrate and material mix temperatures will result in faster strength development. Due to the mass of palletized material and bulk packaging, up to 72 hours of conditioning may be required. Presoak area with hot water where applicable.

B. Heating the repair area shall be accomplished by indirect exposure. Heated enclosures must be windproof and weatherproof. Combustion heaters must be vented and shall not be permitted to heat and dry the concrete locally. *Caution: Exhaust gases may contaminate or cause carbonation within the enclosed environment. Ensure repair material does not dry out during heating.*

C. Maintain temperature above 35°F (2°C) minimum until material reaches 1000 psi (6.9 MPa) or the minimum required strength.
[Specify minimum required strength.]

D. Gradually allow temperature of material to cool to ambient temperature to avoid thermal shock.

REFERENCE

ACI 306R-88
"Cold Weather Concreting"

PART F – EXTREME WEATHER CONDITIONS - CONCRETE REPAIR

6.01 HOT WEATHER REPAIRS

[High temperatures accelerate the set, decrease working time, and accelerate the strength gain of cement-based products. The procedures below will compensate for these conditions.]

A. Materials shall be conditioned as necessary so that the mixed material is between 50°F and 90°F (10°C and 32°C). Due to the mass of palletized material and bulk packaging, up to 72 hours of conditioning may be required.

B. All surfaces in contact with material must be preconditioned and maintained below 90°F (32°C).

C. Cooling of surfaces, materials and equipment can be accomplished by using iced water for mixing and presoaking concrete. Do not put ice directly into repair material. Shade area from direct sunlight or pour material when temperatures are decreasing.

D. Wind breaks shall be provided when necessary to prevent rapid evaporation.

E. Repair material shall remain protected and curing shall be dependent on specified product. Cure repair material in accordance with manufacturer's recommendations. *[Specify appropriate curing method.]*

REFERENCE

ACI 305R-91
"Hot Weather Concreting"