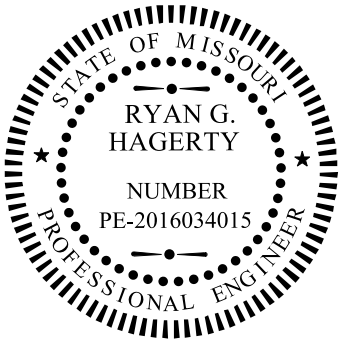
TABLE OF CONTENTS



THIS SHEET HAS BEEN SIGNED, SEALED, AND DATED ELECTRONICALLY

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 W. CAPITOL AVE.
JEFFERSON CITY, MO 65101
Phone (888) 275-6636

George Butler Associates, Inc.
16305 Swingley Ridge Rd.
Chesterfield, MO 63017
Certificate of Authority # 000133
Consultant Phone # 913-492-0400

If a seal is present on this sheet, JSP's has been electronically sealed and dated.

JOB NO. J5P3523/J5P3525
Cole County, MO
Date Prepared: 8/2/2024

Only the following items of the Job Special Provisions (Bridge) are authenticated by this seal: A-F

A. CONSTRUCTION REQUIREMENTS

1.0 Description. This provision contains general construction requirements for this project.

2.0 Construction Requirements. The plans and the asbestos and lead inspection report for the existing structure(s) are included in the contract in the bridge electronic deliverables zip file for informational purposes only.

2.1 In order to assure the least traffic interference, the work shall be scheduled so that a lane/the bridge closure is for the absolute minimum amount of time required to complete the work. A lane/The bridge shall not be closed until material is available for continuous construction and the contractor is prepared to diligently pursue the work until the closed lane/bridge is opened to traffic.

2.2 Bridge work by contractor forces, including erection, rehabilitation or demolition, shall not be allowed over traffic unless a bridge platform protection system is installed below the work area except for work performed above a deck that is intact. The protection system shall be capable of catching all falling objects such as tools, overhang brackets or materials. Lifting of objects that are heavier than the capacity of the bridge protection system shall not be permitted.

2.3 Qualified special mortar shall be a qualified rapid set concrete patching material in accordance with Sec 704. A qualified rapid set concrete patching material will not be permitted for half-sole repair, deck repair with void tube replacement, full depth repair, modified deck repair and substructure repair (formed) unless a note on the bridge plans specifies that a qualified special mortar may be used.

2.4 Provisions shall be made to prevent any debris and material from falling into the waterway or onto the roadway. If determined necessary by the engineer, any debris and material that falls below the bridge outside the previously specified limits shall be removed as approved by the engineer at the contractor's expense. Traffic under the bridge shall be maintained in accordance with the contract documents.

2.5 Any damage sustained to the remaining structure as a result of the contractor's operations shall be repaired or the material replaced as approved by the engineer at the contractor's expense.

2.6 Provisions shall be made to prevent damage to any existing utilities. Any damage sustained to the utilities as a result of the contractor's operations shall be the responsibility of the contractor. All costs of repair and disruption of service shall be as determined by the utility owners and as approved by the engineer.

2.7 A washer shall be required under head and nut when any reaming is performed for bolt installation.

2.8 SSPC-SP2 and SSPC-SP3 surface preparation shall be in accordance with the environmental regulations in Sec 1081 and collection of residue shall be in accordance with Sec 1081 for collection of blast residue. SSPC-SP6, SSPC-SP10 and SSPC-SP11 surface preparation shall be in accordance with the approved blast media and environmental regulations in Sec 1081 and collection of blast residue shall be in accordance with Sec 1081.

3.0 Method of Measurement. No measurement will be made.

4.0 Basis of Payment. Payment for the above described work will be considered completely covered by the contract unit price for other items included in the contract.

B. Rapid Set Concrete Patching Material – Horizontal Repairs

1.0 Description. This specification covers cementitious concrete, polymer-modified concrete and polymer concrete that are suitable for repairing concrete surfaces on bridges or roadways, particularly under fast setting or special conditions. The repairs would involve horizontal applications. The work shall consist of removing, furnishing, preparing, and placing materials at locations as shown on the plans or as directed by the engineer.

2.0 Material. All materials shall be in accordance with MoDOT specifications and as noted herein.

2.1 Aggregate For Extending Commercial Mixture. Coarse and fine aggregates shall be in accordance with Sec 1005, except the requirements for gradation and percent passing the No. 200 sieve shall not apply. Coarse aggregate meeting Gradation E requirements shall be used for repairs greater than one inch (25 mm) in depth. Fine aggregate will be allowed for repairs less than one inch (25 mm). Aggregate specified, bagged, labeled and furnished by the rapid set concrete patching material manufacturer may also be used for mortar extension.

2.2 Material Applications. The contractor shall select and use the product most suitable for the work and field conditions in accordance with these specifications.

2.3 Curing. Rapid set concrete patching material shall be cured until the minimum compressive strength 3200 psi is attained using standard curing specifications, unless otherwise specified by the manufacturer.

2.4 Qualification and Project Acceptance.

2.4.1 Inspection. All materials shall be subject to inspection and sampling by MoDOT at the source of manufacture, intermediate shipping terminal or destination. MoDOT will be allowed free access to all facilities and records as required to conduct inspection and sampling.

2.4.2 Qualification. Prior to use, rapid set concrete patching material shall be qualified. In order to become qualified, a material shall have completed testing through AASHTO's National Transportation Product Evaluation Program (NTPEP). The manufacturer shall contact the AASHTO/NTPEP coordinator to obtain the testing location for the rapid setting concrete patching material.

2.4.2.1 Requested Information. The manufacturer shall submit with samples of the materials, a written request to Construction and Materials with the following information:

(a) Brand name of the product.

(b) Certification that the material meets this specification.

(c) NTPEP test results showing compliance with this special provision.

(d) Specific mixing, handling and curing instructions.

(e) Application type (i.e., bridge or roadway).

2.4.2.2 Qualified List. Upon approval by the engineer, the brand name and manufacturer will be placed on a qualified list of rapid set concrete patching materials. The listing of qualified materials is available from Construction and Materials or on MoDOT's web site. New certified test results and samples shall be submitted any time the manufacturing process or the material formulation is changed. The material will be subject to removal from the qualified list if there is evidence of unsatisfactory performance or a change in manufacturing process or formulation, or when random sampling and testing of material offered for use indicates nonconformity with any of the requirements herein specified.

2.4.3 Provisional Approval. Provisional approval may be granted provided the following requirements have been met:

(a) New Products Evaluation Form

(b) Certified test results from an independent laboratory showing compliance with this special provision.

(c) Documentation prepared by MoDOT covering two years of field performance on MoDOT's system. MoDOT will need to approve the location of the test site. Documentation will contain the placement date, field observations (semi annual), description of field performance and photographs of in-place material.

(d) During placement the manufacturer's representative shall be present on the project to provide technical expertise.

2.4.3.1 Disqualification. If during the two year observation period the repair area(s) fails provisional approval will not be granted. Repair area(s) experiencing any cracking, debonding or spalling will be considered a failure.

2.4.3.2 Length of Provisional Approval. Provisional approval will be granted for three years or until NTPEP testing is completed.

2.5 Certification. The contractor shall supply a manufacturer's certification to the engineer for each lot of material furnished. The certification shall include the name of the manufacturer, a manufacturer certification statement that the material supplied is the same as that qualified and listing the date of qualification.

2.6 Acceptance. Acceptance of the material will be based on the use of a qualified or provisionally approved material, the manufacturer's certification that the material supplied is the same as that approved and upon the results of such tests as may be performed by the engineer.

3.0 Mixture. Unless otherwise specified, rapid set concrete patching material shall be approved commercial mixtures meeting Sections 3.1 – 3.1.3 or deck repair cementitious mortar meeting Section 3.2. Rapid set concrete patching materials shall be specifically designed for the application needed.

3.1 Commercial Mixtures. Rapid set concrete patching material in its sacked form and mixtures when properly prepared in accordance with the manufacturer's specifications, shall

meet the minimum test requirements given in Table 1. Mixtures may be supplied, as required, as a patching mortar or as a patching mortar with aggregate extension. If the material is to be supplied with extender aggregate, this shall also pass the required tests in Table 1 using the maximum allowed amount of extender aggregate.

3.1.1 Mixture Requirements. Rapid set concrete patching material shall be single packaged dry mix requiring the addition of water or other liquid component just prior to mixing. The material shall be capable of ½ inch (13 mm) to full depth repair and require no bonding agent. The material shall not contain soluble chlorides as an ingredient of manufacture. The material shall be placed in accordance to the manufacturer's recommendations.

Table 1
(English Unit)

Physical Test Property	Specification	Requirement for cementitious concrete	Requirement for polymer-modified concrete	Requirement for polymer concrete
Bond Strength by Slant Shear[1]	ASTM C882/C928 [3]	min. 1000 psi @ 24hrs.& min. 1500 psi @ 7 days	n/a	min. 1000 psi @ 24hrs.& min. 1500 psi @ 7 days
Linear Coefficient of Thermal Expansion[1, 2] (for bagged mortar only, without extension aggregate)	ASTM C531	n/a	n/a	4 – 8 X 10-6 in/in/deg F
Resistance to Rapid Freezing & Thawing[1]	AASHTO T161 or ASTM C666	80% min. using Procedure B[5] (300 Cycles)	80% min. using Procedure B[5] (300 Cycles)	n/a
Compressive Strength[1]	AASHTO T22 or ASTM C39	3200 psi @ 3 hr & 4000 psi @ 7 days	3200 psi @ 3 hr & 4000 psi @ 7 days	n/a
Rapid Chloride Permeability[1]	AASHTO T277 or ASTM C1202	Bridge Decks 1000 coulombs @ 28 days Roadway 2000 coulombs @ 28 days	Bridge Deck 1000 coulombs @ 28 days Roadway 2000 coulombs @ 28 days	Bridge Deck 1000 coulombs @ 28 days Roadway 2000 coulombs @ 28 days
Length Change[1, 4]	AASHTO T 160 or ASTM C157	In water Storage (+0.15) In air storage (-0.15)	In water storage (+0.15) In air storage (-0.15)	n/a
Color		gray	gray	gray

[1]The commercial mix test values can be located in the AASHTO's National Transportation Product Evaluation Program (NTPEP) reports for Laboratory Evaluations of Rapid Set Concrete Patching Materials. Data for provisionally approved materials is located at the Construction and Materials Division.
[2]Not required for extended mixtures if the mortar passes this requirement.
[3] ASTM C882 shall be performed on non-water based materials. ASTM C928 shall be performed on water-based materials.
[4] As modified by ASTM C928.
[5] Procedure A may be used in lieu of Procedure B

3.1.2 Construction Requirements. The manufacturer shall provide with the bagged mixture, specifications for the mixing procedure, amount and kind of liquid to be added, and the amount of aggregate extension allowed, if any. All mixing, handling and curing practices recommended by the manufacturer shall be followed and will be considered a part of these specifications.

3.1.3 Removal from Qualified List. All mixtures shall be approved before use. Reoccurring failures of any mixture for any reason will be cause for removal from the qualified list.

3.2 Deck Repair Concrete. A qualified rapid set concrete patching material indicated for horizontal use and intended for patching concrete bridge decks may be used when specified on the plans and as approved by the engineer. If this option is selected, the contractor shall provide a trial mix to determine the total cure time needed to achieve a compressive strength of 3200 psi (22 MPa). Compressive specimens shall be prepared in accordance with current MoDOT test methods and cured to simulate actual field conditions. Testing of compressive specimens shall be performed by methods and at facilities acceptable to the engineer. The repaired deck shall not be opened to traffic until at least 4 hours after the last placement of deck repair concrete, the established cure time has elapsed and until such concrete has achieved a compressive strength of 3200 psi (22 MPa). A new trial mix may be required if the engineer determines the field conditions vary substantially from trial mix conditions. The engineer will make field cylinders to verify the 3200 psi (22 MPa) minimum strength.

4.0 Construction Requirements.

4.1 Mixing. Rapid set concrete patching material shall be mixed and finished according to the manufacturer's recommendation.

4.2 Preparation of Repair Area. Deteriorated, damaged or defective concrete as shown on the plans, required by the specifications or as directed by the engineer, shall be removed. All exposed reinforcement shall be thoroughly cleaned as shown on the plans, required by the specifications or as directed by the engineer. Unless otherwise specified by the commercial mixture manufacturer, the existing surface shall be damp and all free water shall be removed prior to placement of the required material.

4.3 Bonding Agent. A bonding agent may be used if recommended by the rapid set concrete patching material manufacturer.

5.0 Method of Measurement. No measurement will be made for rapid set concrete patching material.

6.0 Basis of Payment. Rapid set concrete patching material will be paid for at the contract unit price for other items and will be considered full compensation for all labor, equipment and material to complete the described work.

C. Rapid Set Concrete Patching Material – Vertical and Overhead Repairs

1.0 Description. This specification covers cementitious concrete, polymer-modified concrete and polymer concrete that are suitable for repairing concrete surfaces on bridges or concrete structures, particularly under fast setting or special conditions. The repairs would involve vertical or overhead applications. The work shall consist of removing, furnishing, preparing, and placing materials at locations as shown on the plans or as directed by the engineer.

2.0 Material. All materials shall be in accordance with MoDOT specifications and as noted herein.

2.1 Aggregate. For Extending Commercial Mixture. Coarse and fine aggregates shall be in accordance with Sec 1005, except the requirements for gradation and percent passing the No. 200 sieve shall not apply. Coarse aggregate meeting Gradation E requirements shall be used for repairs greater than one inch (25 mm) in depth. Fine aggregate will be allowed for repairs less than one inch (25 mm). Aggregate specified, bagged, labeled and furnished by the rapid set concrete patching material manufacturer may also be used for mortar extension.

2.2 Material Applications. The contractor shall select and use the product most suitable for the work and field conditions in accordance with these specifications.

2.3 Curing. Rapid set concrete patching material shall be cured until the minimum compressive strength 1500 psi is attained using standard curing specifications, unless otherwise specified by the manufacturer.

2.4 Qualification and Project Acceptance.

2.4.1 Inspection. All materials shall be subject to inspection and sampling by MoDOT at the source of manufacture, intermediate shipping terminal or destination. MoDOT will be allowed free access to all facilities and records as required to conduct inspection and sampling.

2.4.2 Qualification. Prior to use, rapid set concrete patching materials need to be qualified.

2.4.2.1 Requested Information. The manufacturer shall submit with samples of the materials, a written request to Construction and Materials with the following information:

(a) New Products Evaluation Form

(b) Brand name of the product.

(c) Certification that the material meets this specification.

(d) Certified test results from an independent laboratory showing compliance with this specification.

(e) Specific preparation instructions of repair area.

(f) Specific mixing, handling and curing instructions.

(g) Application type (i.e., vertical or overhead).

2.4.2.2 Field Evaluation. Final approval will be granted when the following requirements are met:

(e) MoDOT report documenting two years of field performance on MoDOT system. The report will contain the placement date, field observations (semi annual), description of field performance and photographs of in-place material.

(f) A manufacturer's representative shall be present during placement of the material to provide technical expertise.

2.4.2.2.3 Disqualification. If during the two year observation period the repair area(s) fails the product will not be added to the qualified list.

2.5 Qualified List. The listing of qualified products are available from Construction and Materials or on MoDOT's web site. New certified test results and samples shall be submitted any time the manufacturing process or the material formulation is changed. The material will be subject to removal from the qualified list if there is evidence of unsatisfactory performance or a change in manufacturing process or formulation, or when random sampling and testing of material offered for use indicates nonconformity with any of the requirements herein specified.

2.6 Certification. The contractor shall supply a manufacturer's certification to the engineer for each lot of material furnished. The certification shall include the name of the manufacturer, a manufacturer certification statement that the material supplied is the same as that qualified and listing the date of qualification.

2.7 Acceptance. Acceptance of the material will be based on the use of a qualified product, the manufacturer's certification that the material supplied is the same as that approved and upon the results of such tests as may be performed by the engineer.

3.0 Mixture. Unless otherwise specified, rapid set concrete patching material shall be approved commercial mixtures meeting Sections 3.1 – 3.1.3.. Rapid set concrete patching materials shall be specifically designed for the application needed.

3.1 Commercial Mixtures. Rapid set concrete patching material in its sacked form and mixtures when properly prepared in accordance with the manufacturer's specifications, shall meet the minimum test requirements given in Table 1. Mixtures may be supplied, as required, as a patching mortar or as a patching mortar with aggregate extension. If the material is to be supplied with extender aggregate, this shall also pass the required tests in Table 1 using the maximum allowed amount of extender aggregate.

3.1.2 Mixture Requirements. Rapid set concrete patching material shall be single packaged dry mix requiring the addition of water or other liquid component just prior to mixing. The material shall not contain soluble chlorides as an ingredient of manufacture. The material shall be placed in accordance to the manufacturer's recommendations.

Table 1
(English Unit)

Physical Test Property	Specification	Requirement for cementitious concrete	Requirement for polymer-modified concrete	Requirement for polymer concrete
Bond Strength by Slant Shear	ASTM C882/C928 [2]	min. 1000 psi @ 24hrs.& min. 1500 psi @ 7 days	n/a	min. 1000 psi @ 24hrs.& min. 1500 psi @ 7 days
Linear Coefficient of Thermal Expansion [1] (for bagged mortar only, without extension aggregate)	ASTM C531	n/a	n/a	4 – 8 X 10-6 in/in/deg F

Resistance to Rapid Freezing & Thawing	AASHTO T161 or ASTM C666	80% min. using Procedure B[3] (300 Cycles)	80% min. using Procedure B[3] (300 Cycles)	n/a
Compressive Strength	AASHTO T22 or ASTM C39	1500 psi @ 3 hr & 3000 psi @ 24 hr	1500 psi @ 3 hr & 3000 psi @ 24 hr	n/a
Rapid Chloride Permeability	AASHTO T277 or ASTM C1202	1000 coulombs @ 28 days	1000 coulombs @ 28 days	1000 coulombs @ 28 days
Length Change	AASHTO T 160 or ASTM C157	In water Storage (+0.15) In air storage (-0.15)	In water storage (+0.15) In air storage (-0.15)	n/a
Color		gray	gray	gray

[1] Not required for extended mixtures if the mortar passes this requirement.
[2] ASTM C882 shall be performed on non-water based materials. ASTM C928 shall be performed on water-based materials.
[3] Procedure A may be used in lieu of Procedure B

3.1.2 Construction Requirements. The manufacturer shall provide with the bagged mixture, specifications for the mixing procedure, amount and kind of liquid to be added, and the amount of aggregate extension allowed, if any. All mixing, handling and curing practices recommended by the manufacturer shall be followed and will be considered a part of these specifications.

3.1.3 Removal from Qualified List. All mixtures shall be approved before use. Reoccurring failures of any mixture for any reason will be cause for removal from the qualified list.

3.2 Vertical Repair. A qualified rapid set concrete patching material approved for vertical use may be used when specified on the plans and as approved by the engineer. The engineer will make field cylinders to verify the 1500 psi (10 MPa) minimum strength. The material shall adhere to the concrete surface without sagging.

3.3 Overhead Repair. A qualified rapid set concrete patching material approved for overhead use may be used when specified on the plans and as approved by the engineer. The material shall be placeable in layers of at least 1 inch on overhead applications without the use of formwork or anchoring devices. The material shall adhere to the concrete surface without sagging. The engineer will make field cylinders to verify the 1500 psi (10 MPa) minimum strength.

4.0 Construction Requirements.

4.1 Mixing. Rapid set concrete patching material shall be mixed and finished according to the manufacturer's recommendation.

4.2 Preparation of Repair Area. Deteriorated, damaged or defective concrete as shown on the plans, required by the specifications or as directed by the engineer, shall be removed. All exposed reinforcement shall be thoroughly cleaned as shown on the plans, required by the specifications or as directed by the engineer. Unless otherwise specified by the commercial mixture manufacturer, the existing surface shall be damp and all free water shall be removed prior to placement of the required material.

4.3 Bonding Agent. A bonding agent may be used if recommended by the rapid set concrete patching material manufacturer.

5.0 Method of Measurement. No measurement will be made for rapid set concrete patching material.

6.0 Basis of Payment. Rapid set concrete patching material will be paid for at the contract unit price for other items and will be considered full compensation for all labor, equipment and material to complete the described work.

D. DIAMOND GRINDING

1.0 Description. This work will only be performed at the discretion of the engineer and will be underrun if not required by the engineer. This work shall consist of grinding the new concrete surface to provide good riding characteristics, a surface texture and proper drainage. If the engineer determines it necessary to provide good riding characteristics, grinding shall be performed on all or part of the bridge approach slabs and sealed in accordance with Sec 703.3.8. The finished surface shall be in accordance with Sec 703.3.7 and as shown on the plans or as directed by the engineer except as modified below.

2.0 Equipment. The equipment shall be of a size that will grind a strip at least 3 feet wide using diamond blades and shall not cause spalls at cracks, joints or other locations.

3.0 Construction Requirements. The construction operation shall be scheduled and proceed in a manner that produces a uniform finished surface. Auxiliary or ramp lane grinding shall transition from the edge of the mainline as required to provide drainage and an acceptable riding surface.

3.1 Deck repair, if required, shall be completed prior to any grinding.

3.2 Grinding shall be accomplished in a manner that eliminates joint or crack faults and provides lateral drainage by maintaining a constant cross slope between grinding extremities in each lane. A maximum tolerance of 1/16 inch will be allowed for adjacent sides of joints and cracks, except that under no circumstances shall the grinding depth exceed 1/4 inch from the top of the original surface. When grinding across faulted joints, a minimum of a 20-foot transition onto the approach side slab shall be used.

3.3 The cross slope of the pavement shall be as shown on the plans and shall have no depressions or misalignment of slope greater than 1/4 inch in 12 feet when measured with a 12-foot straightedge placed perpendicular to the centerline. Areas of deviation shall be reground. Straightedge requirements will not apply across longitudinal joints or outside the ground area.

3.4 As soon as practical after grinding, the surface will be straight edged longitudinally, and all variations exceeding 1/8 inch in 10 feet will be plainly marked. Areas of deviation shall be reground.

3.5 Substantially all of the pavement surface shall be textured. Extra depth grinding to eliminate minor depressions in order to provide texturing on 100 percent of the pavement surface will not be required. No unground surface area between passes will be permitted, except as specified otherwise in the contract documents.

3.6 The grinding process shall produce a final pavement surface that is true to grade and uniform in appearance with a longitudinal line-type texture. The line-type texture shall contain parallel longitudinal corrugations that present a narrow ridge corduroy-type appearance. The peaks of the ridges shall be approximately 1/32 inch higher than the bottoms of the grooves. The grooves shall be evenly spaced. There shall be approximately 50-55 grooves per foot, measured perpendicular to the centerline.

3.7 The contractor shall remove and dispose of all residue from the grinding in a manner and at a location to satisfy environmental regulations. The contractor shall have the engineer's approval for the method of spreading and disposal of the residue prior to beginning any grinding operations.

3.8 Solid residue shall be removed from the pavement surface before any residue is blown by traffic action or wind.

3.9 Residue shall not be permitted to encroach on open lanes.

3.10 The residue shall not enter into gutters or closed drainage systems.

3.11 The contractor may disperse residue onto unpaved shoulders, adjacent roadside embankments, or median ditch areas of divided highways where the residue runoff can percolate into the soil, unless specified otherwise in the contract. The spread rate shall not generate surface runoff. If surface runoff occurs at a grinding location, the contractor shall haul the residue to an approved location at the contractor's expense.

3.12 Discharge of any residue runoff shall not flow into adjacent rivers, streams, lakes, ponds or other open bodies of water.

3.13 Residue shall not be spread within 100 feet of any streams, lakes or other open bodies of water, or within 15 feet of a water filled ditch.

3.14 The contractor shall use appropriate equipment and methods so the discharging of the residue does not cause erosion of soil or damage to established vegetation along the roadway. The contractor shall repair and reseed any areas where the discharge of grinding residue causes damage to roadway slopes or vegetated areas at the contractor's expense.

3.15 If the solids concentration of discharged residue at any particular area is determined to be excessive by the engineer, the contractor shall provide equipment and material to flush the areas with water as directed by the engineer, at the contractor's expense.

3.16 The pavement shall be cleaned prior to opening to traffic as directed by the engineer.

4.0 Smoothness Requirements.

4.1 No diamond grinding shall be performed until the pavement has attained a strength sufficient to be opened to all types of traffic. All diamond grinding shall be completed on any section prior to opening that section to other than construction traffic, unless approved by the engineer.

4.2 The engineer will be the sole authority for determining if the driving surface is sufficiently smooth.

4.3 The engineer will evaluate the smoothness of the concrete wearing surface after the concrete has cured and direct the contractor to diamond grind where deemed necessary.

4.4 After initial diamond grinding operations, if any, the engineer will again evaluate the smoothness of the concrete wearing surface and approach slab, repeating as many times as necessary to achieve the desired surface smoothness.

4.5 Any deficiencies in the final surface due to improper contractor operations or equipment shall be corrected by the contractor at the contractor's expense.

4.6 All areas shall be tested with a 10-foot straightedge in accordance with section 3.4 of this job special provision.

5.0 Method of Measurement. Measurement for diamond grinding will be made to the nearest square yard. Measurement will be based upon the area of initial diamond grinding completed as directed by the engineer. Subsequent passes of diamond grinding over a previously ground area will not be measured. No deduction will be made for gaps to avoid striping or raised pavement markers. No additional measurement will be made for diamond grinding bridge approach slabs.

6.0 Basis of Payment. Payment for diamond grinding will be paid for at the contract unit price per square yard. Payment for diamond grinding will be considered full compensation for all labor, equipment, material, and incidentals to complete this work, including hauling and disposal of grinding residue and cleaning the pavement prior to opening to traffic.

E. SHOTCRETE CONCRETE REPAIR (Job No. J5P3525)

1.0 Description. Substructure repair (formed and unformed), superstructure repair (unformed) and slab edge repair shall be in accordance with Sec 704 and as shown on the contract plans. Shotcrete, in accordance with this Special Provision, shall be used for slab edge repair and may be used at the Contractor's option for formed and unformed substructure and superstructure repairs.

1.1 Shotcrete shall be in accordance with the current requirements of American Concrete Institute (ACI) 506.2-13, "Specification for Shotcrete", except as otherwise specified. Shotcrete shall consist of an application of one or more layers of mortar or concrete conveyed through a hose and pneumatically projected at a high velocity against a prepared surface.

1.2 Shotcrete shall be produced by a dry-mix process. The dry-mix process shall consist of thoroughly mixing all the ingredients except accelerating admixtures and mixing water and conveying the mixture through the hose pneumatically and the mixing water is introduced at the nozzle. For additional descriptive information, the Contractor's attention shall be directed to the ACI 506R-16, "Guide to Shotcrete".

2.0 Contractor Experience Requirements.

2.1 Workers, including foremen, nozzlemen and delivery equipment operators, shall be fully experienced to perform the work.

2.2 Initial qualification of nozzlemen will be based ACI or EFNARC certification for the application process being used. The nozzlemen shall submit documented proof they have been certified in accordance with the ACI 506.3R-91 "Certification of Shotcrete Nozzlemen" or

EFNARC “Nozzleman Certification Scheme”. The certification shall have been done by an ACI or EFNARC recognized shotcrete testing lab and/or recognized shotcreting consultant and have covered the type of shotcrete to be used (plain dry-mix).

2.3 The Contractor may supply 1 reference project for the project nozzleman in lieu of completing test panels in accordance with Section 5.1 of this Job Special Provision to demonstrate the experience of the nozzleman in similar shotcrete application work. Owner contact information for the reference project shall be provided to allow for the Engineer to confirm satisfactory results.

3.0 Shotcrete Materials.

3.1 Shotcrete materials shall consist of one of the following premixed and packaged materials:

a) BASF MasterEmaco S 211SP
b) Euclid Chemical Eucoshot F
c) King Shotcrete MS-D1
d) CTS Cement Low-P

3.2 No material testing is anticipated. Acceptance will be based on the prequalified materials listed in this Special Provision, approval of the nozzleman prior to material placement, and visual inspection. If questions arise based from visual examination, placement methods, curing methods or other potentially undesirable influences the Engineer reserves the right to test any material properties listed on the published product data sheet for the material selected. Testing will be done at the Contractor’s expense.

3.3 Material shall be delivered, stored and handled to prevent contamination, segregation, corrosion or damage.

3.4 Proportioning and Use of Admixtures. Admixtures will not be permitted unless approved by the Engineer.

3.5 Bonding Agents. Bonding agents will not be permitted.

3.6 Air Entrainment. Additional air entrainment admixtures will not be required.

4.0 Construction Submittals.

4.1 At least 15 days before the planned start of formed and unformed substructure repair, a copy of the following information shall be submitted in writing to the Engineer for review:

(a) Written documentation of the nozzlemen's qualifications including proof of ACI or EFNARC certification;

(b) Proposed methods of shotcrete placement and of controlling and maintaining facing alignment including equipment models;

(c) Shotcrete mix; and

(d) One reference project including: Nozzleman’s name, material used, process used, and whether a blow pipe was utilized. Owner contact information shall be provided to ensure satisfactory results were accomplished on the reference project; or

(e) A satisfactory test panel shall be provided with the material to be used.

4.2 The Engineer will approve or reject the Contractor's submittals within 10 days after the receipt of a complete submission. The Contractor will not be permitted to begin formed or unformed substructure repair with Shotcrete until the submittal requirements are satisfied and found acceptable to the Engineer. Changes or deviations from the approved submittals shall be re-submitted for approval. No adjustment in contract time will be allowed due to incomplete submittals.

4.3 A pre-construction meeting scheduled by the Engineer will be held prior to the start of work. Attendance shall be mandatory. The shotcrete Contractor shall attend.

5.0 Field Quality Control.

5.1 Production test panels will not initially be required if a reference project for the nozzleman is provided as outlined in Section 2.3 of this Job Special Provision. The Engineer may halt repair work if satisfactory results are not produced by the Contractor and require production test panels.

5.2 If a comparable project demonstrating satisfactory results cannot be provided, the skills of the nozzleman shall be demonstrated and tested with at least one production test panel being furnished prior to performing repairs.

5.3 Production Test Panels (If Required).

5.3.1 Qualified personnel shall perform shotcreting and coring of the test panels with the Engineer present. The Contractor shall provide equipment, materials and personnel as necessary to obtain shotcrete cores for testing including construction of test panel boxes, field curing requirements and coring.

5.3.2 Production test panels shall be made with the minimum full thickness and dimension of 18 x 18 inch and at least 3½ inch thick with 2-#4 bars placed in each direction. The #4 bars shall be centered in the 3½ inch dimension and evenly spaced in each direction with the bars touching at the 4 intersecting locations.

5.4 Test Panel Curing, Test Specimen Extraction and Testing.

5.4.1 Immediately after shooting, the test panels shall be field moist cured by covering and tightly wrapping with a sheet of material meeting the requirements of ASTM C 171 until delivered to the testing lab or test specimens are extracted. The test panels shall not be immersed in water. The test panels for the first 24 hours after shooting shall not be disturbed.

5.4.2 At the direction of the Engineer at least two 3 inch diameter core samples shall be cut at two of the intersections to ensure consolidation around the bars. If voids are present the material and nozzleman are not approved for use. The Contractor may continue with changes to the materials or nozzleman. The same process will be followed until no voids are present.

6.0 Shotcrete Facing Requirements.

6.1 Shotcrete Alignment Control. The final surface of the shotcrete shall maintain the existing concrete plane surface.

6.2 Surface Preparation. In addition to the manufacturer's recommendations, the surfaces to be shotcreted shall be cleaned of loose materials, mud, rebound, overspray or other foreign matter that could prevent or reduce shotcrete bond. Shotcrete shall not be placed on frozen surfaces.

6.3 Delivery and Application. In addition to the manufacturer's recommendations, a clean, dry, oil free supply of compressed air sufficient for maintaining adequate nozzle velocity shall be maintained at all times. The equipment shall be capable of delivering the premixed material accurately, uniformly and continuously through the delivery hose. Shotcrete application thickness, nozzle technique, air pressure and rate of shotcrete placement shall be controlled to prevent sagging or sloughing of freshly applied shotcrete.

6.3.1 The shotcrete shall be applied from the lower part of the area upwards to prevent accumulation of rebound. The nozzle shall be oriented at a distance and approximately perpendicular to the working face so that rebound will be minimal and compaction shall be maximized. Special attention shall be paid to encapsulating reinforcement. Care shall be taken while encasing reinforcing steel and mesh to keep the front face of the reinforcement clean during shooting operations, so that the shotcrete builds up from behind, to encase the reinforcement and prevent voids and sand pockets from forming. If a blow pipe was used to qualify, a blow pipe shall be required. The blow pipe is used to remove rebound and overspray immediately ahead of the nozzle. Rebound shall not be worked back into the construction. Rebound that does not fall clear of the working area shall be removed. Hardened rebound and hardened overspray shall be removed prior to the application of additional shotcrete using abrasive blast cleaning, chipping hammers, high pressure water blasting or other suitable techniques.

6.3.2 When using multiple layer shotcrete construction, the surface of the receiving layer shall be prepared before application of a subsequent layer, by either:

(a) Brooming the stiffened layer with a stiff bristle broom to remove all loose material, rebound, overspray or glaze, prior to the shotcrete attaining initial set.

(b) If the shotcrete has set, surface preparation shall be delayed 24 hours, at which time the surface shall be prepared by sandblasting or high pressure water blasting to remove all loose material, rebound, hardened overspray, glaze or other material that may prevent adequate bond.

6.4 Defective Shotcrete. The Engineer will have authority to accept or reject the shotcrete work. Shotcrete that is not in accordance with the project specifications may be rejected either during the shotcrete application process, or on the basis of tests. Shotcrete surface defects shall be repaired as soon as possible after placement. Shotcrete that exhibits segregation, honeycombing, laminations, voids or sand pockets shall be removed and replaced. In-place shotcrete determined not meeting the published Technical Information for the product used will be subject to remediation as approved by the Engineer. Possible remediation options range from required latex over coating for excessive cracking up to removal and replacement at the Contractor's expense

6.5 Construction Joints. Construction joints shall be tapered uniformly toward the excavation face over a minimum distance equal to the thickness of the shotcrete layer. Square joints will not be permitted except at the expansion joint. The surface of the joints shall be rough, clean

and sound. A minimum reinforcement overlap at reinforcement splice joints shall be provided. The surface of a joint shall be clean and wet before adjacent shotcrete is applied.

6.6 Final Face Finish. Shotcrete finish shall be a wood float, rubber float, steel trowel or smooth screeded finish.

6.7 Additional Construction Requirements.

6.7.1 If the work to be performed is in the vicinity of a jurisdictional water of the US, care shall be taken to avoid any rebound from entering the regulated waterway.

6.7.2 If the work to be performed is in the vicinity of an enclosed drainage system, care shall be taken to avoid any rebound from entering the drainage system.

6.8 Weather Limitations.

6.8.1 The shotcrete shall be protected if placed when the ambient temperature is below 40°F and falling or when likely to be subject to freezing temperatures before gaining sufficient strength. Cold weather protection shall be maintained until the compressive strength of the shotcrete is greater than 725 psi. Cold weather protection includes blankets, heating under tents or other means acceptable to the Engineer. The temperature of the shotcrete mix, when deposited, shall be not less than 50°F or more than 85°F. The air in contact with the shotcrete surfaces shall be maintained at temperatures above 32°F for a minimum of 7 days.

6.8.2 If the prevailing ambient temperature conditions (relative humidity, wind speed, air temperature and direct exposure to sunlight) are such that the shotcrete develops plastic shrinkage and/or early drying shrinkage cracking, shotcrete application shall be suspended. The Contractor shall reschedule the work to a time when more favorite ambient conditions prevail or adopt corrective measures, such as installation of sun screens, wind breaks or fogging devices to protect the work. Newly placed shotcrete exposed to rain that washes out cement or otherwise makes the shotcrete unacceptable shall be removed and replaced at the Contractor's expense.

6.9 Curing. Permanent shotcrete shall be protected from loss of moisture for at least 1 day after placement. Shotcrete shall be cured by methods that keep the shotcrete surfaces adequately wet and protected during the specified curing period. Curing shall commence within one hour of shotcrete application. When the ambient temperature exceeds 80°F, the work shall be planned such that curing can commence immediately after finishing. Curing shall be in accordance with the following requirements.

> **(a) Membrane Curing.** Membrane curing is required on overhead surfaces that cannot be adequately wet cured. Curing compounds will not be permitted on any surface against which additional shotcrete or other cementitious finishing materials are to be bonded unless the surface is thoroughly sandblasted in a manner acceptable to the Engineer. Membrane curing compounds shall be spray applied as quickly as practical after the initial shotcrete set at rate of coverage of not less than 7.1 square feet per gallon.

7.0 Safety Requirements. Nozzlemen and helpers shall be equipped with gloves, eye protection and adequate protective clothing during the application of shotcrete. Whip checks are required on air lines. The Contractor shall be responsible for meeting all federal, state and local safety requirements.

8.0 Method of Measurement. Measurement of Substructure Repair (Formed), Substructure Repair (Unformed), Superstructure Repair (Unformed) and Slab Edge Repair shall be in accordance with Sec 704.

9.0 Basis of Payment. Payment for Substructure Repair (Formed), Substructure Repair (Unformed), Superstructure Repair (Unformed) and Slab Edge Repair shall be in accordance with Sec 704.

F. SELF-CONSOLIDATING CONCRETE (Job No. J5P3525)

1.0 Description. Self-Consolidating Concrete (SCC) is a specially designed concrete that enables the concrete to flow under the influence of its own weight and does not require mechanical vibration for consolidation. All material, proportioning, mixing and transporting of concrete shall be in accordance with Sec 501, except as specified herein.

2.0 Materials.

2.1 Aggregate. Fine and coarse aggregate shall be in accordance with Sec 1005, except that the requirements for gradation will not apply.

2.1.1 Gradation. The contractor shall submit the target gradation and allowable gradation range of each fraction of each aggregate source used in the mix design. During production, the contractor shall be within the allowable gradation range for each aggregate that was submitted.

2.1.2 Maximum Size. For SCC mixes, 100 percent of each fraction shall pass the ¾-inch sieve.

2.2 Admixture. All chemical admixtures shall be in accordance with Sec 1054, except as noted herein.

2.2.1 High Range Water Reducer. The polycarboxylate based high range water reducer shall be in accordance with AASHTO M 194, Type F or G. The high range water reducing admixture shall be added only after the concrete has reached the job site to reduce the potential for flash setting.

2.2.2 Viscosity Modifier. The viscosity-modifying admixture shall be evaluated according to the test methods and mix design proportions referenced in AASHTO M 194.

2.2.3 Combination. The self-consolidating admixture system shall consist of either a polycarboxylate based high range water-reducing admixture or a polycarboxylate based high range water reducer combined with a separate viscosity-modifying admixture.

3.0 Concrete Mix Design. At least 14 days prior to using SCC, the contractor shall submit a mix design for approval to Construction and Materials. The SCC mix shall be designed by absolute volume methods or an optimized mix design method such as Shilstone or other recognized optimization method.

3.1 Required Information. The mix design shall contain the following information:

(a) Source, type and specific gravity of Portland cement

(b) Source, type (class, grade, etc.) and specific gravity of supplementary materials, if used

(c) Source, name, type and amount of admixture

(d) Source, type (formation, etc.), ledge number if applicable, and gradation of the Aggregate

(e) Specific gravity and absorption of each fraction in accordance with AASHTO T 85 for coarse aggregate and AASHTO T 84 for fine aggregate, including raw data

(f) Unit weight of each fraction in accordance with AASHTO T 19

(g) The design air content and target slump flow

(h) Batch weights of Portland cement and supplemental cementitious materials

(i) Batch weights of coarse, intermediate and fine aggregates

(j) Batch weight of water

3.2 Water Amount. The water per cementitious materials ratio shall meet the following requirements:

Water/Cementitious Materials Ratio	
Minimum	**Maximum**
0.32	0.45

3.3 Percent Fine Aggregate. The percent fine aggregate by absolute volume should range from 35 to 50 percent.

3.4 Minimum Cementitious Amount. The total amount of cementitious materials shall not be below 650 pounds per cubic yard.

3.5 Slump Flow. The slump flow test shall be performed in accordance with ASTM C 1611. The slump flow shall meet the following requirements:

Slump Flow (inches)	
Minimum	**Maximum**
22	30

3.6 Passing Ability. Passing ability of SCC shall be determined in accordance with ASTM C 1621 and shall not exceed 2 inches.

3.7 Visual Stability. The visual stability index rating shall be a maximum of 1.

3.8 Air Content. The minimum air content, when placed in the work, shall be 5.0 percent. Test shall be performed in accordance with AASHTO T 152.

3.9 Compressive Strength. Concrete shall have a 28-day minimum compressive strength of 4000 psi (28 MPa). Test shall be performed in accordance with AASHTO T 22.

4.0 Additional Information. The contractor shall submit a Batching Sequence Plan outlining how the SCC mix will be batched and mixed. The Batching Sequence Plan shall be submitted to the engineer for approval.

4.1 Trial Batch. A trial batch shall be done prior to SCC being used to ensure the mix is in accordance with this special provision. The SCC mix design shall not be used until all of the specified criteria have been met. The trial batch shall be at least 2 cubic yards. The engineer shall be present during the trial batch. The SCC mix shall be tested for air content, slump flow, visual stability index, passing ability and compressive strength.

5.0 Production. SCC mix shall not be used until the concrete mix, the Batching Sequence Plan and the trial batch have been approved. The SCC mix shall not vary from the mix design submitted for approval. Any changes in material sources, aggregate gradations, or material content shall require a new SCC mix be resubmitted for approval. Changes to the water content and chemical admixture dosages will be allowed to handle changes in environmental conditions.

5.1 Forms. SCC mixes generate higher fluid pressures than conventional concrete mixes. Forms shall be mortar-tight and capable of supporting the additional pressure.

5.2 Reinforcement. Reinforcement and other critical components shall be tightly secured in the form to prevent these items from shifting during concrete placement.

6.0 Quality Control. The quality of freshly mixed SCC may fluctuate, the contractor shall conduct air test, slump flow, visual stability index, and passing ability for every truck until consistent and compliant results are obtained. Subsequently, all testing shall be conducted in accordance with MoDOT specifications.

6.1 Slump Flow Requirement. The slump flow shall be within +/- 2 inches of the target slump flow designated by the contractor and shall not exceed 30 inches.