MODIFIED BY EI 87-035
EFFECTIVE 9/29/87

SUPERSEDED BY EI 91-032
EFFECTIVE 6/18/92

ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

JECT: RAPID SETTING CONCRETE PAVEMENT REPAIRS

---ject Code: 7.27-3-502

Distribution: 30 Main Office 32 Regions 34 Special

Code: EI 87-18

Date: 6/18/87

Supersedes:

APPROVED:

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Attached and listed below are special specifications for Rapid Setting Concrete Repair Materials that replace existing or previously used items.

Item 18502.0701 - Surface Preparation for Rapid Setting Concrete Pavement Repairs

Replaces:

Item 10502.0710	Surface Preparation for
Item 10502.071001	Polymer Concrete Placement

Item 18502.0702 - Furnish and Placement of Rapid Setting Concrete Pavement Repairs

Replaces:

Item 10502.0711	Furnish and Place Rapid Setting
Item 10502.071201	Polymer Concrete for PCC Pavement Repairs
Item 10502.0703	Rapid Setting Magnesium Phosphate
Item 10502.070310	Concrete Pavement Repairs

Also included are Materials Specifications 701-09, 701-10 and 721-20 for the new specifications.

Guidelines and Application:

1. Use for partial depth repair of spalled or deteriorated areas of PCC pavements that are not receiving an overlay and where extended life and durability are required. Present estimates for the life of these materials is approximately 10 years. The items would not normally be used for short term solutions or pavements that cannot utilize the life extension benefits possible with these materials. Due to the high cost associated with these items, the designer should consider other alternates for large spall areas or where substantial volume of deteriorated concrete is to be removed and replaced.

2. The Designer should be confident of the quantities estimated for repair because these items are expensive and overruns may drastically affect contract costs.

3. It is estimated the cost of surface preparation (Item 18502.0701) will range from $20.00 to $35.00/sf depending on project quantities and conditions.

4. The cost of Rapid Setting Concrete Repair Material (701-09, & 701-10) in place (Item 18502.0702) is estimated to range from $100 to $150/cu. ft. depending on project conditions and quantities. This is based on utilizing a 60% extension rate with aggregate. $100-$150/cu. ft. translates into a bid price of approximately $1.20-$1.80 per lb. of premixed bagged material.

5. The cost of Rapid Setting Polymer Concrete (721-20) in place (Item 18502.0702) is believed to be more expensive than either of the 701 materials; however a contractor may find it more economical for small repairs that are widely spaced due to simplified mixing requirments (can be mixed in suppliers' plastic bags). Increased use and market conditions may reduce future costs.

6. The following chart depicting material yield should be of assistance to designers when estimating quantities.

PATCHING MATERIAL YIELD WITH AGGREGATE EXTENSION

MATERIAL

701-09, 701-10	50 lbs. + 60% aggregate ext. = 0.60 cu. ft.
	50 lbs. + 75% aggregate ext. = 0.67 cu. ft.
721-20	50 lbs. + 75% aggregate ext. = 0.65 cu. ft.
	50 lbs. + 85% aggregate ext. = 0.68 cu. ft.
	50 lbs. + 100% aggregate ext.= 0.72 cu. ft.

Economic Justification

Use of these items for pavement repair and/or pavement rehabilitation will require economic justification. Due to the high cost associated with repairing PCC pavements, a point is reached where other methods of repair (overlay) or pavement replacement become economically feasible. The designer shall compare viable alternates giving consideration to a) realistic design life or life extension, b) cost of each alternate and c) life cycle analysis in the form of present worth or annualized costs. The analysis should also be applied to an alternate that postpones work for a given period of time (say 5 years) to determine the consequences and costs of such an action. Life cycle analysis for our purposes will utilize a discount rate of 4% which represents the difference between interest rate and inflation rate.

The life cycle analysis should be included as part of the Design Reports (Project Reports) submitted in the early design phases of the project. If they are not part of these reports or if no reports are prepared, the life cycle analysis (economic justification) should be submitted separately during the same time frame to the Facilities Design Division, Preliminary Plan Review Bureau. For those projects where that Bureau is not involved in the review process, the justification should be sent to the Final Plan Review Bureau as part of the special specification request as soon as possible but not later than two (2) months prior to PS&E.

This instruction takes effect with the letting of November 19, 1987 but may be used in earlier lettings if desired.

ITEM 18502.0701 SURFACE PREPARATION FOR RAPID SETTING CONCRETE PAVEMENT REPAIRS
ITEM 18502.0702 FURNISH AND PLACEMENT OF RAPID SETTING CONCRETE PAVEMENT REPAIRS

Description: This work shall consist of patching spalls, potholes, corner breaks or other surface distress in Portland cement concrete pavements and joints. The patch area shall be prepared by removal of existing patching material and broken, damaged or disintegrated concrete and patched with one of the rapid setting concretes listed below where indicated on the plans or directed by the Engineer. The Contractor will have the option of using one of the types of repair material listed below.

Materials: The materials used shall meet the requirements of the following subsections:

Coarse Aggregate (703-0204 Crushed Slag shall not be used)	703-02
Rapid Setting Concrete Repair Material - Normal Weather	701-09
Rapid Setting Concrete Repair Material - Cold Weather	701-10
Rapid Setting Methylmethacrylate Polymer Concrete	721-20
Water	712-01

The aggregate shall be sized as follows, based upon the depth of application of the mixture:

Depth of Application	Gradation
Up to 4 inches	Type CA1 Table 501-2
4 inches and greater	Type CA2 Table 501-2

The following aggregate extension rates by weight of the dry component of the patching material shall be used:

Patch Material Type	Type CA1 or CA2 Crushed Aggregate	Type CA1 or CA2 Uncrushed Aggregate
701-09 and 701-10	60-65%	75-80%
721-20	75-80%(Type CA1) 100-105%(Type CA2)	85-90%(Type CA1) 100-105% (Type CA2)

The amount of water (if required) added shall be no greater than required by the patching material manufacturer's instruction. The moisture content of the aggregate shall be determined by the Contractor. The Contractor shall adjust the patching material manufacturer's water content allowing for the aggregate moisture content. This adjustment shall be approved by the Engineer before mixing.

Aggregate used in Methylmethacrylate (MMA) polymer concrete shall be completely dry at the time of mixing.

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MMA polymer concrete is flammable. Safety precautions should be taken to prevent fire and explosion. Protective equipment should be worn to prevent skin contact.

Construction Details: The areas to be repaired are indicated on the plans or will be designated by the Engineer. Repairs shall conform to the details shown on the plans or be in accordance with the directions of the Engineer. The area around the spall or other distress will be sounded with a 16 oz. hammer and the perimeter of the area to be patched will be designated by the Engineer. All asphalt concrete, foreign materials of any kind, and unsound concrete shall be removed from the repair area.

The Contractor has the option of using chipping hammers, a small milling machine, or high pressure water blast for concrete removal. When MMA polymer concrete is used, high pressure water blast is not permitted.

1. Chipping Hammers. The edges of the patch shall be chipped to produce a nearly vertical, intentionally rough sound edge. No undercutting shall be required or permitted. The floor of the patched area shall be chipped away to produce a minimum patch depth of an inch at all points within the patch if MMA polymer concrete is used. Patches that use other materials shall be a minimum two inches deep.

   Chipping hammers that are used shall not damage the concrete that is to remain. Chipping hammers shall weigh not more than 45 pounds with the bit and muffler removed. The hammer shall deliver no more than 1600 blows per minute. The Contractor shall provide the Engineer with information from the hammer manufacturer that these requirements are not exceeded. The air pressure used to power the hammer shall not exceed 100 psi measured at the air compressor. An air pressure gauge in proper working condition shall be provided. Only sharp chisel point bits shall be used. All bits determined by the Engineer to be dull shall be sharpened or replaced. If the Engineer determines that the Contractor's operations are resulting in damage to concrete that is to remain, the Contractor shall make immediate corrections. These corrections shall include the use of a lighter chipping hammer if so ordered by the Engineer.

2. Milling Machine. Milling machines that are used for concrete removal shall result in the same surface preparation as in 1. Chipping Hammers. Their use shall be approved by the Engineer.

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3. High Pressure Water Blast. The edges of the patch shall be blasted to produce a nearly vertical, intentionally rough sound edge. No undercutting shall be required or permitted. The floor of the patched area shall be blasted away to produce the minimum patch thickness required by the type of material, at all points within the patch.

Water blasters shall have a minimum pressure of 10,000 psi when measured at the machine.

Sand blasting shall follow concrete removal to remove any remaining contaminants or loose chips of concrete.

Immediately prior to placing the patching material, the area to be patched shall be cleaned of all loose material by vacuum or air blasting. The air used for sand and air blasting shall be free of oil or any other foreign substances that would contaminate the cleaned surfaces. Air compressors shall be equipped with moisture traps. Air blasting shall have a pressure sufficient to remove all loose debris. The Contractor is required, at all times while sand, water or air blasting to provide protection by means of approved screening to prevent damage to, or interference with traffic in adjacent lanes.

If patching material is not placed during the same working day as when the patch area is prepared, the area shall be resandblasted, followed by vacuum or air blasting before patching material placement.

Patches being filled with MMA polymer concrete shall be completely dry, and primed with a compatible primer before placing MMA polymer concrete.

Steel pavement mesh which is exposed in the area to be patched shall be removed and not replaced.

Patching material shall not be placed in wet weather. If, in the opinion of the Engineer, the patching material is damaged, it shall be removed and replaced.

Temperature limitations for placing the R.S.C. are as follows:

Ambient Temperature Range	Patching Material Type	
50°-90°F	701-09	R.S.C. (Normal Weather)
35°-50°F	701-10	R.S.C. (Cold Weather)
35°-90°F	721-20	Methylmethacrylate Polymer Concrete

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The materials shall be mixed in a mortar-type mixer or mixer of such capacity that one batch will completely fill the area(s) to be patched. MMA polymer concrete may be mixed in manufacturer supplied plastic bags or a mortar type mixer. The mixer(s) shall be inspected and approved by the Engineer prior to use. If water is required it shall be the first material added to the mixer. The moisture content of the aggregate used to extend the yield shall be determined and the amount of water added shall be adjusted accordingly to compensate for the moisture content. The Contractor shall provide a device to accurately measure the amount of water and aggregate. Aggregate used with MMA polymer concrete shall be completely dry. The materials shall be mixed following the manufacturer's directions.

Before placing the patching material at a pavement joint, forms shall be placed abutting the pavement edge and parallel to the joint. A straight edge shall be formed at the joint. Forms shall be flush with the vertical pavement edge. A joint space to be sealed under the appropriate item(s) shall also be provided. The forms shall be coated with a material that is compatible with the patching material but will not adhere to it.

The patching material, except MMA polymer concrete, shall be placed in one lift, starting at one edge of the repair area and working to the opposite edge. MMA polymer concrete may be placed in lifts. All patches equal to or greater than two inches in depth shall be consolidated by internal vibration following Standard Specifications 555-3.04 E "Vibrating" to minimize the possibility of voids in the patch. The patching material shall be hand screeded and finished to meet the adjacent elevation, cross slopes, and texture. Once placed, no curing procedure is required for any type of patching material; however it shall be allowed to air dry at least one hour prior to allowing traffic to travel over the patched area.

Method of Measurement:

Surface Preparation for Rapid Setting Concrete Pavement Repairs. The quantity to be measured will be the number of square feet of prepared area plane to the surface of the pavement.

Furnish and Placement for Rapid Setting Concrete Pavement Repairs. The quantity to be measured shall be the number of pounds of dry premixed component of the R.S.C. repair material incorporated into the work.

Basis of Payment:

Surface Preparation for Rapid Setting Concrete Pavement Repairs. The unit price per square foot shall include the cost of all labor and equipment necessary, including disposal of the removed material, to complete the surface preparation up to but not including sand blasting.

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Furnish and Placement for Rapid Setting Concrete Pavement Rapirs. The unit price per pound of dry premixed material shall include the cost of all labor, material and equipment necessary to complete the work including sandblasting, air blasting, vacuuming, primer and forms.

Payment will be made under:

Item No.	Item	Pay Unit
18502.0701	Surface Preparation for Rapid Setting Concrete Pavement Repairs	Square Foot
18502.0702	Furnish and Placement of Rapid Setting Concrete Pavement Repairs	Pound

701-09 RAPID SETTING CONCRETE REPAIR MATERIAL (Normal Weather)

SCOPE. This specification covers a rapid setting concrete mix, consisting of a dry component made up of the cementing medium and fine aggregate to which water or an emulsified component is added. The resulting mixture is generally used in the repair of Portland cement concrete pavements.

GENERAL. The rapid setting concrete shall be of a high strength, have rapid strength gain characteristics in normal weather (above 50°F ambient temperature); bond to the existing concrete and be durable. The R.S.C. shall be able to accept coarse aggregate to extend the yield and result in a workable mixture.

MATERIAL REQUIREMENTS. The material, as delivered without additional coarse aggregate, and mixed in accordance with the manufacturer's instructions shall have the following properties when tested under NYSDOT Test Method 701-13F:

1. A minimum one hour compressive strength of 2500 psi, a 24 hour strength of 3500 psi and a 28 day strength of 5000 psi.

2. A minimum bond strength of 200 psi after 24 hours.

3. A minimum initial setting time of 5 minutes at 75±°2F.

4. The ability to withstand 50 cycles of freeze-thaw (10% NaCl solution) with a maximum loss of 6%.

5. Expansion of no more than 0.40% and contraction of no more than 0.05%.

6. A workable mixture when extended with a minimum 60% CAl coarse aggregate by weight of dry R.S.C. component.

The material delivered from the manufacturer in moisture proof bags shall weigh within ±3% of the labeled bag weight. The manufacturer's name, address, mixing instructions, and manufacturing date shall be printed on each bag.

BASIS OF ACCEPTANCE. Application for approval of the R.S.C. shall be submitted to the Director of the Materials Bureau accompanied by 100 lbs. of the material in its normal packaging. Upon approval, the name of the product will be placed on the Department's Approved List. Such products will then be accepted on the basis of the brand name labeled on the bags. The Department reserves the right to sample and test the R.S.C. at any time.

701-10 RAPID SETTING CONCRETE REPAIR MATERIAL (Cold Weather)

SCOPE. This specification covers a rapid setting concrete mix, consisting of a dry component made up of the cementing medium and fine aggregate to which water or an emulsified component is added. The resulting mixture is generally used in the repair of Portland cement concrete pavements.

GENERAL. The rapid setting concrete shall be of a high strength, have rapid strength gain characteristics in cold weather (between 50°F and 35°F ambient temperature) without any additional heating of its components, bond to existing concrete and be durable. The R.S.C. shall be able to accept coarse aggregate to extend the yield and result in a workable mixture.

MATERIAL REQUIREMENTS. The material as delivered without additional coarse aggregate, and mixed in accordance with the manufacturer's instructions shall have the following properties when mixed, cured, and tested under NYSDOT Test Method 701-13F at 35°F:

1. A minimum one hour compressive strength of 2500 psi, a 24 hour strength of 3500 psi and a 28 day strength of 4000 psi.

2. A minimum bond strength of 150 psi after 24 hours, when bonded to 35°F concrete.

3. A minimum initial setting time of 5 minutes at 35°F.

4. The ability to withstand 50 cycles of freeze-thaw (10% NaCl solution) with a maximum loss of 6%.

5. Expansion of no more than 0.40% and contraction of no more than 0.05%.

6. A workable mixture when extended with a minimum 60% CA1 coarse aggregate by weight of dry R.S.C. component.

The material delivered from the manufacturer in moisture proof bags shall weigh within ±3% of the labeled bag weight. The manufacturer's name, address, mixing instructions and manufacturing date shall be printed on each bag.

BASIS OF ACCEPTANCE. Application for approval of the R.S.C. shall be submitted to the Director of the Materials Bureau accompanied by 100 pounds of the material in its normal packaging. Upon approval, the name of the product will be placed on the Department's Approved List. Such products will then be accepted on the basis of the brand name labeled on the bags. The Department reserves the right to sample and test the R.S.C. at any time.

721-20 - RAPID SETTING POLYMER CONCRETE

SCOPE: This specification covers the material requirements of a two component, rapid setting, methylmethacrylate based polymer concrete repair material. The material is used with a primer to repair hardened concrete.

MATERIALS REQUIREMENTS:

A. Polymer Concrete Mortar - The polymer concrete mortar shall be a two component methyl methacrylate based system. One component shall be a premixed powder consisting of catalyst, fine fillers, and fine aggregate not to exceed 1/16" in size. The other component shall be a methyl methacrylate monomer liquid capable of chemically reacting with the powder component such that the mixture hardens to a completely cured condition within three (3) hours at temperatures between 35°F and 100°F inclusive. The working life of the mixture shall be a minimum of 10 minutes and its workability shall be consistent throughout the above temperature range. The shelf life of the unopened components, stored at room temperature and in a dry atmosphere, shall be 6 months, minimum. Material older than 12 months from the date of manufacturer shall not be used.

B. Properties of Cured Polymer Concrete - Polymer Concrete Mortar specimens, when prepared in accordance with the manufacturer's mixing instructions, shall exhibit the following properties when cured 168±2 hours at 73±5F:

	PROPERTY	REQUIREMENT	TEST
1.	Modulus of Rupture, psi, min.	1500	ASTM C580
2.	Elastic Modulus, psi	$(0.5 \text{ to } 1.0)\times10^{6}$	ASTM C580
3.	Thermal Expansion Coefficient, in/in/°F	$(1.0 \text{ to } 2.0)\times10^{-5}$	ASTM C531

C. The material shall also exhibit the following properties when tested under NYSDOT Test Method 701-13F:

1. A minimum one hour compressive strength of 2500 psi, a 24 hour strength of 3500 psi, and a 28 day strength of 5000 psi.

2. Be able to withstand 50 cycles of freeze-thaw (10% NaCl solution) with a maximum loss of 6%.

D. Primer - The primer shall be a two component methyl methacrylate resin system capable of enhancing the bond between the polymer concrete and the substrate. It shall have a curing time of 20 to 60 minutes at temperatures between 35°F and 100F inclusive.

E. Flammability - The polymer concrete shall not support or sustain combustion within five (5) minutes after mixing.

The material delivered from the manufacturer shall be in moisture proof bags and the contents shall weigh within ±3% of the labeled bag weight. The manufacturer's name, address, date of manufacturer and mixing instructions shall be printed on each bag.

BASIS OF ACCEPTANCE: Application for material approval shall be submitted to the Director of the Materials Bureau accompanied by at least a 50 pound, production run, sample of material. Upon approval, the name of the product will be placed on the Department's Approved List. Products so listed will be acceptable at the work site on the basis of the brand name labeled on the container. The Department reserves the right to sample and test the material at any time.