



CONSTRUCTION LEADERS

LETTER OF TRANSMITTAL	
DATE: August 11, 2015	PCL JOB NO: 5515002
ATTN: Chris Barker	TRANSMITTAL NO: 088

To: **State of Vermont Agency of Transportation**
 One National Life Drive
 Montpelier, VT 05633-5001
 (802) 828-0053

Re: Hartford Lateral Slide
 Project No.: IM 091-2(79)
 Contract ID.: 12A132

County: Windsor PCL FILE NO: 5515002-025.2

WE ARE SENDING Attached Under separate cover via **Email & SP** the following:
 Shop drawings Prints Plans Samples Specifications
 Copy of Letter Change Order Other

COPIES	SPEC.	REVISION	DESCRIPTION
1	900.608	2	HPC Rapid Set Mix Design

TRANSMITTED for as checked below:

For approval Approved as submitted Resubmit Copies for approval
 For your use Approved as noted Submit Copies for distribution
 As requested Returned for corrections Return Corrected prints
 For review and comment

Remarks:

The attached mix design has been revised to use Rapid Set DOT Repair Mix. Also included is the filled out mix design sheet as requested by the Agency.

Please return an email of this approved submittal to Erich Heymann (ewheymann@pcl.com) and Jeremy Mackling (jmackling@pcl.com).

We request the review and return of this submittal within **2 days**. Please advise if this request cannot be met so we can plan accordingly.

By: **Erich Heymann**, Project Engineer

COPY TO: Project Files



CONSTRUCTION LEADERS

**SUBMITTAL NO. : 25.2
HPC Rapid Set Mix Design**

Item No.	Specification	Description
1	900.608	HPC Rapid Set Mix Design

PROJECT:
HARTFORD LATERAL SLIDE
PROJECT NO.: IM 091-2(79)
CONTRACT ID.: 12A132

OWNER:
STATE OF VERMONT AGENCY OF TRANSPORTATION

ENGINEER OF RECORD:
STATE OF VERMONT AGENCY OF TRANSPORTATION

CONTRACTOR:
PCL CIVIL CONSTRUCTORS, INC.

AUGUST 11, 2015



DOT Repair Mix

High Performance Concrete Repair Material



Highlights:

- **FAST**
Ready for traffic and loading in 2 hours
- **DURABLE**
Formulated for long life in critical applications
- **STRUCTURAL**
For repair and new construction
- **CONFORMS TO**
ASTM C928, California Test No. 551
- **MULTI-PURPOSE**
Use for concrete repair, highway repair, dowel bar retrofit, construction of pavements & bridges, parking decks & ramps, sidewalks & steps, joint repair, formed work and more

MANUFACTURER:

CTS Cement Manufacturing Corp.
11065 Knott Ave.
Cypress, CA 90630
Tel: 800-929-3030
Fax: 714-379-8270
Web: www.ctscement.com
E-mail: info@ctscement.com

PRODUCT NAME:

Rapid Set® DOT REPAIR MIX
High Performance Concrete Repair Material

DESCRIPTION: DOT REPAIR MIX is a high performance, fast-setting, multipurpose repair material. Durable in wet environments, DOT REPAIR MIX is a blend of Rapid Set hydraulic cement, high performance additives and ASTM C33 concrete sand. DOT REPAIR MIX is non-metallic and no chlorides are added. Mix DOT REPAIR MIX with water to produce a flowable, quality repair material that is ideal where fast strength gain, high durability and low shrinkage are desired. DOT REPAIR MIX is ready for traffic and loading within 2 hours.

APPLICATIONS: Use DOT REPAIR MIX for concrete repair, highway repair, dowel bar retrofit, construction of pavements & bridges, parking decks & ramps, sidewalks & steps, joint repair and formed work. For freeze thaw durability, in some geographical areas DOT REPAIR MIX contains an air-entraining admixture.

ENVIRONMENTAL ADVANTAGES: Use DOT REPAIR MIX to reduce your carbon footprint and lower your environmental impact. Production of Rapid Set cement emits far less CO₂ than portland cement. Contact your Rapid Set representative for LEED values and further environmental information.

RECOMMENDED USE: Apply DOT REPAIR MIX in thicknesses from 1/2" to 4" (1.2 to 10.2 cm). For thicker applications, DOT REPAIR MIX can be extended with clean, dry coarse aggregate conforming to ASTM C33.

SURFACE PREPARATION: For repairs, application surface shall be clean, sound and free from any materials that may inhibit bond such as oil, asphalt, curing compound, acid, dirt and loose debris. Mechanically abrade surface and remove all unsound material. Apply DOT REPAIR MIX to a thoroughly saturated surface with no standing water.

MIXING: The use of a power driven mechanical mixer, such as a mortar mixer or a drill mounted mixer, is recommended. Organize work so that all personnel and equipment are in place before mixing. Use clean potable water. **DOT Repair Mix may be mixed using 3 to 5 quarts (2.8 to 4.7 L) of water per 55 lb (25 kg) bag. Use less water to achieve higher strengths. Do not exceed 5 quarts (4.7 L) of water per bag.** Place the desired quantity of mix water into the mixing container. While the mixer is running add Rapid Set® DOT REPAIR MIX. Mix for the minimum amount of time required to achieve a lump-free, uniform consistency (usually 1 to 3 minutes). Do no retemper.





DOT Repair Mix

High Performance Concrete Repair Material

PLACEMENT: DOT REPAIR MIX may be placed using traditional construction methods. Organize work so that all personnel and equipment are ready before placement. Place, consolidate and screed quickly to allow for maximum finishing time. Use a method of consolidation that eliminates air voids. On flat work do not install in layers; install full depth sections and progress horizontally. Do not wait for bleed water; apply final finish as soon as possible. DOT REPAIR MIX may be troweled, floated or broom finished. To extend working time use Rapid Set® SET Control® set retarding admixture or cold mix water. Do not install on frozen surfaces. DOT REPAIR MIX may be applied in temperatures ranging from 45°F to 90°F (7°C to 32°C).

COLD WEATHER: Environmental and material temperatures below 70°F (21°C) may delay setting time and reduce the rate of strength gain. Lower temperatures will have a more pronounced effect. Thinner sections will be more significantly affected. To compensate for cold temperatures, keep material warm, use heated mix water and follow ACI 306 Procedures for Cold Weather Concreting.

WARM WEATHER: Environmental and material temperatures above 70°F (21°C) may shorten setting time and increase the rate of strength gain. Higher temperatures will have a more pronounced effect. To compensate for warm temperatures, keep material cool, use chilled mix water and follow ACI 305 Procedures for Hot Weather Concreting. The use of SET Control set retarding admixture will help offset the effects of high temperatures.

CURING: Water cure all DOT REPAIR MIX installations by keeping exposed surfaces wet for a minimum of 1 hour. Begin curing as soon as the surface starts to lose its moist sheen. When experiencing extended setting time due to cold temperature or the use of retarder, longer curing times may be required. The objective of water curing shall be to maintain a continuously wet surface until the product has achieved sufficient strength. An ASTM C309 curing compound may be applied upon final set. Adhesives, thin set or paint can be applied after 6 hours. If used as a topping that will receive traffic, a high-quality sealer or epoxy can be applied per the manufacturer's recommendations after 12 hours.

YIELD & PACKAGING: DOT REPAIR MIX is available in 55 lb (25 kg) bags. One 55 lb (25 kg) bag of DOT REPAIR MIX will yield approximately 0.5 cubic feet. When extended 100% by weight with quality coarse aggregate conforming to ASTM C33, yield is approximately 0.8 cubic feet.

SHELF LIFE: One year when stored in cool, dry conditions, out of direct sunlight.

USER RESPONSIBILITY: Before using Rapid Set products, read current technical data sheet, bulletins, product label and material safety data sheet at www.ctscement.com. It is the user's responsibility to review instructions and warnings for any Rapid Set product in current technical data sheet, bulletins, product label and material safety data sheet prior to use.

WARNING: DO NOT BREATHE DUST. AVOID CONTACT WITH SKIN AND EYES. Use material in well-ventilated areas only. Exposure to cement dust may irritate eyes, nose, throat, and the upper respiratory system/lungs. Silica exposure by inhalation may result in the development of lung injuries and pulmonary diseases, including silicosis and lung cancer. Seek medical treatment if you experience difficulty breathing while using this product. The use of a NIOSH/MSHA-approved respirator (P-, N- or R-95) is recommended to minimize inhalation of cement dust. Eat and drink only in dust-free areas to avoid ingesting cement dust. Skin contact with dry material or wet mixtures may result in moderate irritation to thickening/cracking of skin to severe skin damage from chemical burns. If irritation or burning occurs, seek medical treatment. Protect eyes with goggles or safety glasses with side shields. Cover skin with protective clothing. Use chemical resistant gloves and waterproof

PHYSICAL DATA			
Conforms to ASTM C-928, Conforms to California Test No. 551			
Neat Bag (0.8 to 1.2 gal of water)		100% Extension (1.0 to 1.2 gal of water)	
Yield			
0.5 cu ft		0.9 cu ft	
Compressive Strength			
1 hr*	3300 psi	1.5 hrs	2500 psi
3 hrs	4800 psi	3 hrs	5000 psi
24 hrs	6500 psi	24 hrs	6500 psi
28 days	9500 psi	28 days	8000 psi
Flexural Strength, ASTM C-78			
4 hrs		400 psi	
1 day		700 psi	
28 days		800 psi	
Modulus of Elasticity			
28 days		4,000,000 psi	



* After final set

boots. In case of skin contact with cement dust, immediately wash off dust with soap and water to avoid skin damage. Wash skin areas exposed to wet concrete with cold, running water as soon as possible. In case of eye contact with cement dust, flush immediately and repeatedly with clean water and consult a physician. If wet concrete splashes into eyes, rinse eyes with clean water for at least 15 minutes and go to the hospital for further treatment.

PROPOSITION 65 WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Please refer to the MSDS and www.ctscement.com for additional safety information regarding this material.

LIMITED WARRANTY: CTS CEMENT MANUFACTURING CORP. (CTS) warrants its materials to be of good quality and at its option, within one year from date of sale, will replace material proven defective or refund purchase price thereof, and such replacement or refund shall be the limit of CTS's responsibility. Except for the foregoing, all warranties expressed or implied, including merchantability and fitness for a particular purpose, are excluded. CTS shall not be liable for any consequential, incidental, or special damages arising directly or indirectly from the use of the materials.





Repair Mortar Evaluation

NTPEP

Rapid Set DOT Repair Mix (2014-01-011)

Extended

May 4, 2015

REPORT OF TESTS

SUBJECT: **Physical Analysis of Rapid Setting Repair Mortar (NTPEP)**

PROJECT: **Polymer Modified Category - DOT Repair Mix Extended**

MATERIALS: Shipped to Nelson Testing Laboratories in November 2014

PROJECT #: 2014-01-011

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SPECIFICATION: ASTM C 928, "Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs"

TEST METHODS: AASHTO T 22, "Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens"

AASHTO T 27, "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates"

AASHTO T 85, "Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate"

AASHTO T 103, "Standard Method of Test for Soundness of Aggregates by Freezing and Thawing"

AASHTO T 160, "Standard Method of Test for Length Change of Hardened Hydraulic Cement Mortar and Concrete"

AASHTO T 161, "Standard Method of Test for Resistance of Concrete to Rapid Freezing and Thawing"

AASHTO T 277, "Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration"

ASTM C 39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens"

ASTM C 157, "Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete"

ASTM C 666, "Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing"

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TEST METHODS: ASTM C 884, “Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay”

ASTM C 1202, “Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration”

ASTM C 1583, “Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)”

TEST DATA

<u>Material:</u>	Rapid Set DOT Repair Mix Extended
<u>Mixing and Curing Temperature</u>	73 degrees F.
<u>Batch Dates</u>	November 2014
<u>Water Addition Rate</u>	10.43 pounds of water per 55.0 pounds of material
<u>Curing Method</u>	73 F, 50% RH (unless listed otherwise below)
<u>Aggregate Extension</u>	33.0 pounds of aggregate with 55.0 pounds of material - Aggregate details within Appendix

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TEST RESULTS

AASHTO T22/ASTM C39 - Compressive Strength (PSI)

Average of three 4 x 8-in cylinders

DOT Repair Mix Extended

Compressive Strength @ 1 hour **3,940 psi**

Specimen 1 3,810 psi
Specimen 2 3,870 psi
Specimen 3 4,130 psi

Compressive Strength @ 3 hours **6,590 psi**

Specimen 1 6,710 psi
Specimen 2 6,560 psi
Specimen 3 6,510 psi

Compressive Strength @ 1 day **7,690 psi**

Specimen 1 7,460 psi
Specimen 2 7,860 psi
Specimen 3 7,740 psi

Compressive Strength @ 7 days **8,730 psi**

Specimen 1 8,790 psi
Specimen 2 8,480 psi
Specimen 3 8,920 psi

Compressive Strength @ 28 days **10,100 psi**

Specimen 1 10,330 psi
Specimen 2 9,630 psi
Specimen 3 10,330 psi

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TEST RESULTS (continued)

ASTM C157 – Length Change (%) - modified per ASTM C928

Average of three (3 x 3 x 11 ¼-in) specimens

Initial measurement @ 3 hours pursuant to ASTM C928

DOT Repair Mix Extended

Length Change (air cure) @ 28 days **-0.028%**

Specimen 1 -0.029%
Specimen 2 -0.027%
Specimen 3 -0.029%

Length Change (water cure) @ 28 days **+0.007%**

Specimen 1 +0.006%
Specimen 2 +0.008%
Specimen 3 +0.008%

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TEST RESULTS (continued)

AASHTO T161/ASTM C 666 – Freeze-Thaw Resistance (Procedure A)

Average of three (3 x 3 x 11-in) specimens

DOT Repair Mix Extended

Durability Factor @ 300 Cycles **98.8**

Specimen 1	100.0
Specimen 2	97.5
Specimen 3	98.8

Mass Loss/Gain @ 300 Cycles **0.0%**

Specimen 1	0.0%
Specimen 2	0.0%
Specimen 3	0.0%

Length Change @ 300 Cycles **0.024%**

Specimen 1	0.025%
Specimen 2	0.024%
Specimen 3	0.024%

Surface Condition @ 300 Cycles* **No change**

Specimen 1	No change
Specimen 2	No change
Specimen 3	No change

**see appendix for pictures*

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TEST RESULTS (continued)

AASHTO T161/ASTM C 666 – Freeze-Thaw Resistance (Procedure B)

Average of three (3 x 3 x 11-in) specimens

DOT Repair Mix Extended

Durability Factor @ 300 Cycles	95.0
Specimen 1	95.2
Specimen 2	95.6
Specimen 3	94.1
Mass Loss/Gain @ 300 Cycles	0.0%
Specimen 1	0.0%
Specimen 2	0.0%
Specimen 3	0.0%
Length Change @ 300 Cycles	0.004%
Specimen 1	0.008%
Specimen 2	0.002%
Specimen 3	0.002%
Surface Condition @ 300 Cycles*	No change
Specimen 1	No change
Specimen 2	No change
Specimen 3	No change

**see appendix for pictures*

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TEST RESULTS (continued)

ASTM C884 – Thermal Compatibility

Average of three 8 x 10 x 4-in specimens

DOT Repair Mix Extended

Thermal Compatibility @ 5 cycles

PASS (no delamination)

Specimen 1	Pass (no delamination)
Specimen 2	Pass (no delamination)
Specimen 3	Pass (no delamination)

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TEST RESULTS (continued)

AASHTO T277/ASTM C1202 (coulombs) – Rapid Chloride Permeability

Average of three 4 x 2-in specimens

DOT Repair Mix Extended

Chloride Permeability @ 28 day

603 coulombs

Specimen 1	522 coulombs
Specimen 2	638 coulombs
Specimen 3	648 coulombs

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TEST RESULTS (continued)

ASTM C1583 – Direct Bond Strength (PSI)

Average of three 2-in diameter specimens applied at a thickness of 2.0-in over a >5,000 psi concrete base shot-blasted to achieve a profile of ICRI CSP 5.

DOT Repair Mix Extended

Direct Bond Strength @ 28 day

404 psi

Specimen 1	390 psi
Specimen 2	456 psi
Specimen 3	364 psi

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Appendix

PICTURES

AASHTO T161/ASTM C666 (Procedure A)
Freeze-Thaw Beams (extended) – Before Testing



AASHTO T161/ASTM C666 (Procedure A)
Freeze-Thaw Beams (extended) – After 300 Cycles



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PICTURES

AASHTO T161/ASTM C666 (Procedure B)
Freeze-Thaw Beams (extended) – Before Testing



AASHTO T161/ASTM C666 (Procedure B)
Freeze-Thaw Beams (extended) – After 300 Cycles



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 Appendix

AGGREGATE ANALYSIS

AASHTO T27 – Gradation (%)

DOT Repair Mix Extended

Cumulative % Retention

1.50-in	0.0
1.00-in	0.0
0.75-in	0.0
0.50-in	0.0
0.375-in	0.5
No. 4	73.5
No. 8	98.1
No. 16	100.0
No. 30	100.0
No. 50	100.0
No. 100	100.0

AASHTO T103A - Soundness

DOT Repair Mix Extended

Soundness	1.3%
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AASHTO T84/T85 – Specific Gravity & Absorption

DOT Repair Mix Extended

Specific Gravity Dry	2.598
Specific Gravity SSD	2.615
Absorption	0.65%