BUREAU of BRIDGES and STRUCTURES

SPANNING SAFETY CONNECTING EFFICIENTLY

Bridge Deck Patching

Priority Preservation Support Unit
Bridge Preservation
MDOT Bureau of Bridges and Structures

BPP Local Agency Outreach Training

Jacob D. Creisher Jr., P.E.
Engineer Manager
Statewide Bridge Support Unit

Tom Ranck
Structures Engineer
Statewide Bridge Support Unit

Inventory

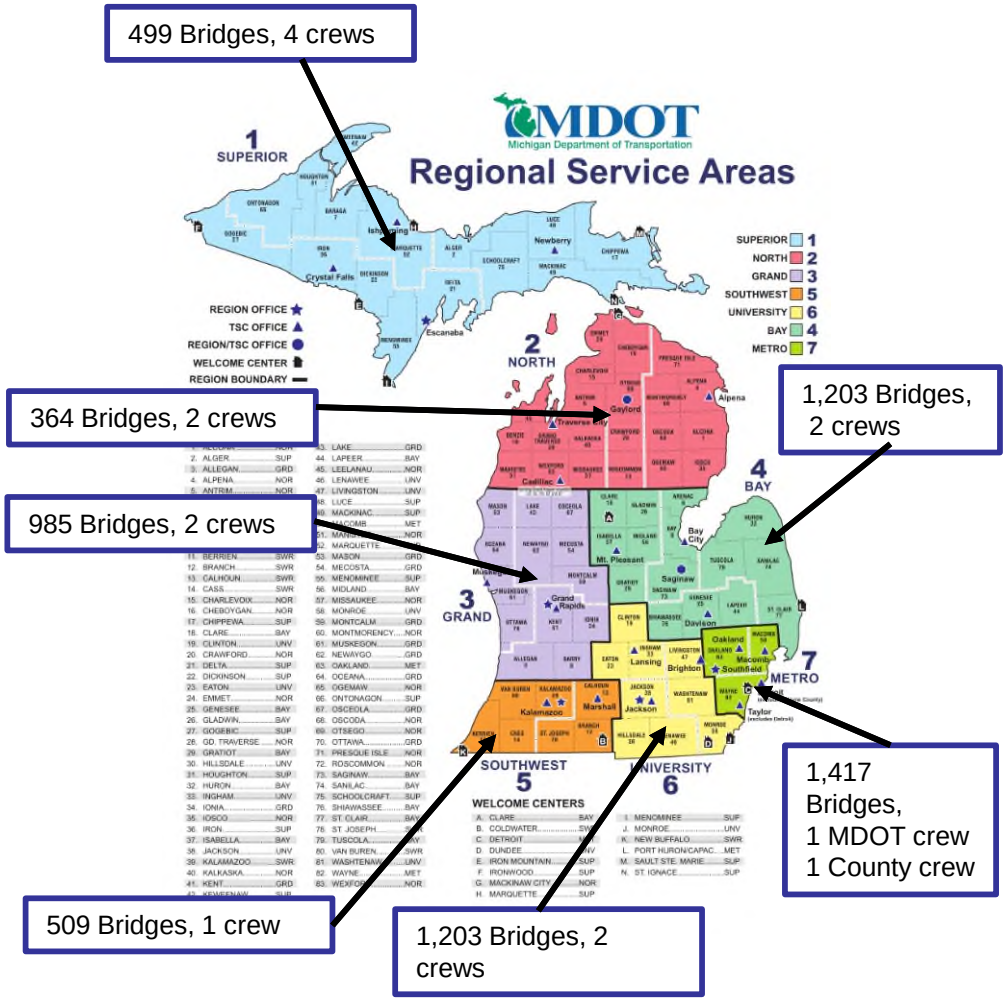
- 5,943 MDOT owned structures
- 58 ‘Big Bridges’ (deck area >100,000 sft)
- 12 Bascule or Movable bridges
- 3 bridge authorities (International, Mackinaw, Blue water)

Structure Inventory Summary	Count
Total No. of Structures	5,943
Highway (NBI) Structures greater than 20'	4,510
Highway Structures less than 20'	1,135
Rail Road Structures (X)	125
Pedestrian Structures (P)	160
Other Non-Highway Structures (V, Plaza)	13
Additional Bridge Inventory Information	
Posted Structures	24
Closed Structures	13
Fracture Critical Structures	81
Scour Critical Structures	476
Scheduled/Under Construction (S, G)	114

Structure Condition Summary	Count
Good/Fair (5 or Greater)	5,553
Highway included in NBI	4,247
Non NBI Structures (<20, RR, Ped, etc.)	1,306
Poor (4)	329
Highway included in NBI	231
Non NBI Structures (<20, RR, Ped, etc.)	98
Serious/Critical (3 or less)	55
Highway included in NBI	32
Non NBI Structures (<20, RR, Ped, etc.)	23
Unrated Structures	6
Highway included in NBI	0
Non NBI Structures (<20, RR, Ped, etc.)	6

Maintenance Workforce

- 7 Regions
- 14 Regional“Bridge” Crews Statewide
- 3 Central Office Bridge Crews
  - Statewide Steel Bridge
  - Statewide Region Support Unit
  - Statewide Reachall



Bridge Maintenance Activities

- Bridge Cleaning
- Silane
- Joint Replacement
- Deck Patching
- Substructure Patching
- Rip Rap Installation
- Healer Sealer
- Thin Epoxy/polymer Overlay
- Pressure Relief Joints

The information in this presentation is recommended to MDOT's maintenance forces. Consult with your local bridge engineer prior to all structural bridge work.

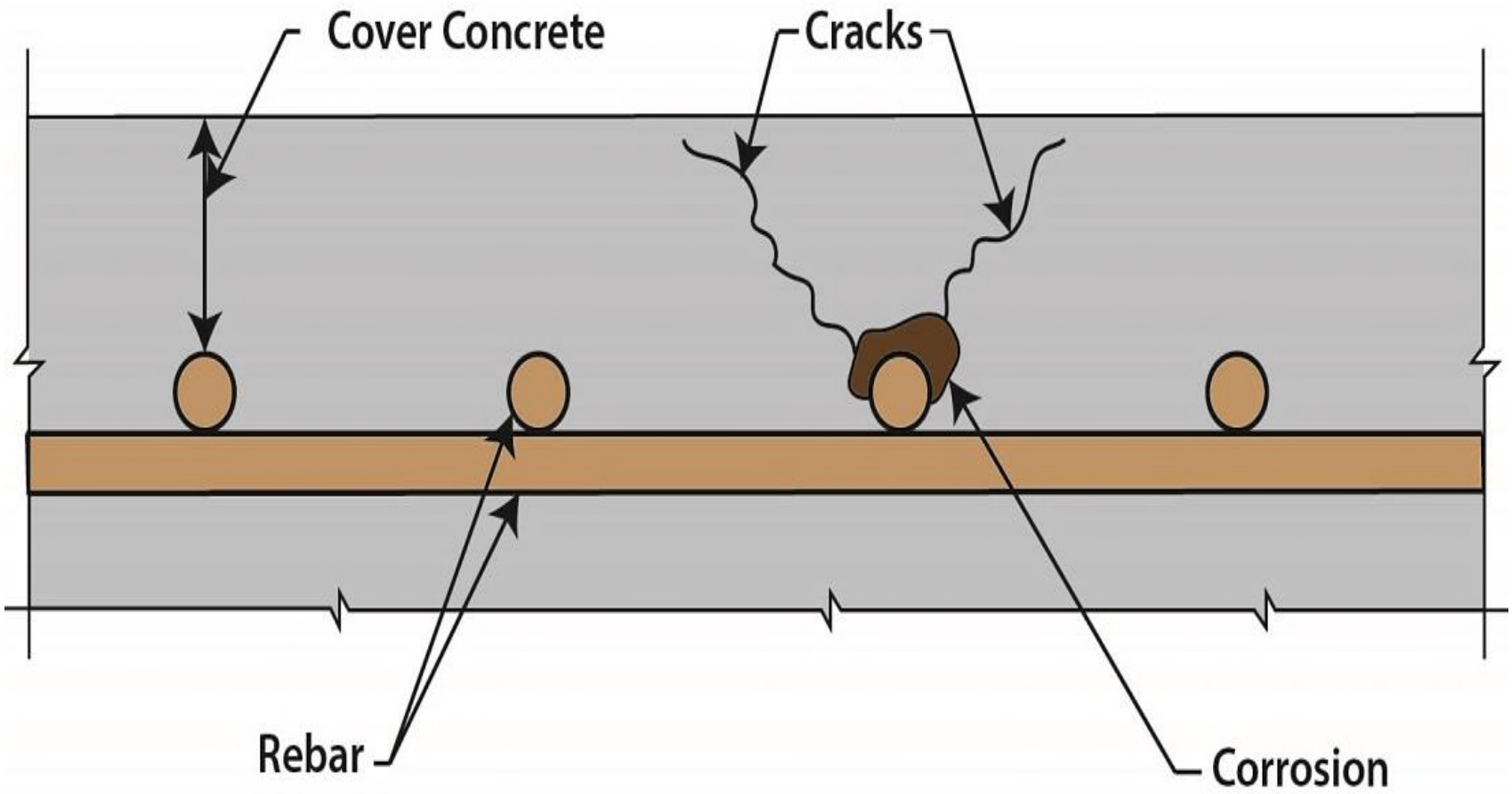
Agenda

- Causes of Concrete Deterioration
- Deck Patch Scoping
  - Types of Deck Deterioration: Scaling, shallow delamination, deep delamination, full depth
- Deck Patch Equipment
- Patch Preparation
  - Best Practices
- Material Selection
  - Rapid Set Concretes
- Patch Installation
  - Best Practices
- Curing Process
- Preservation Practices

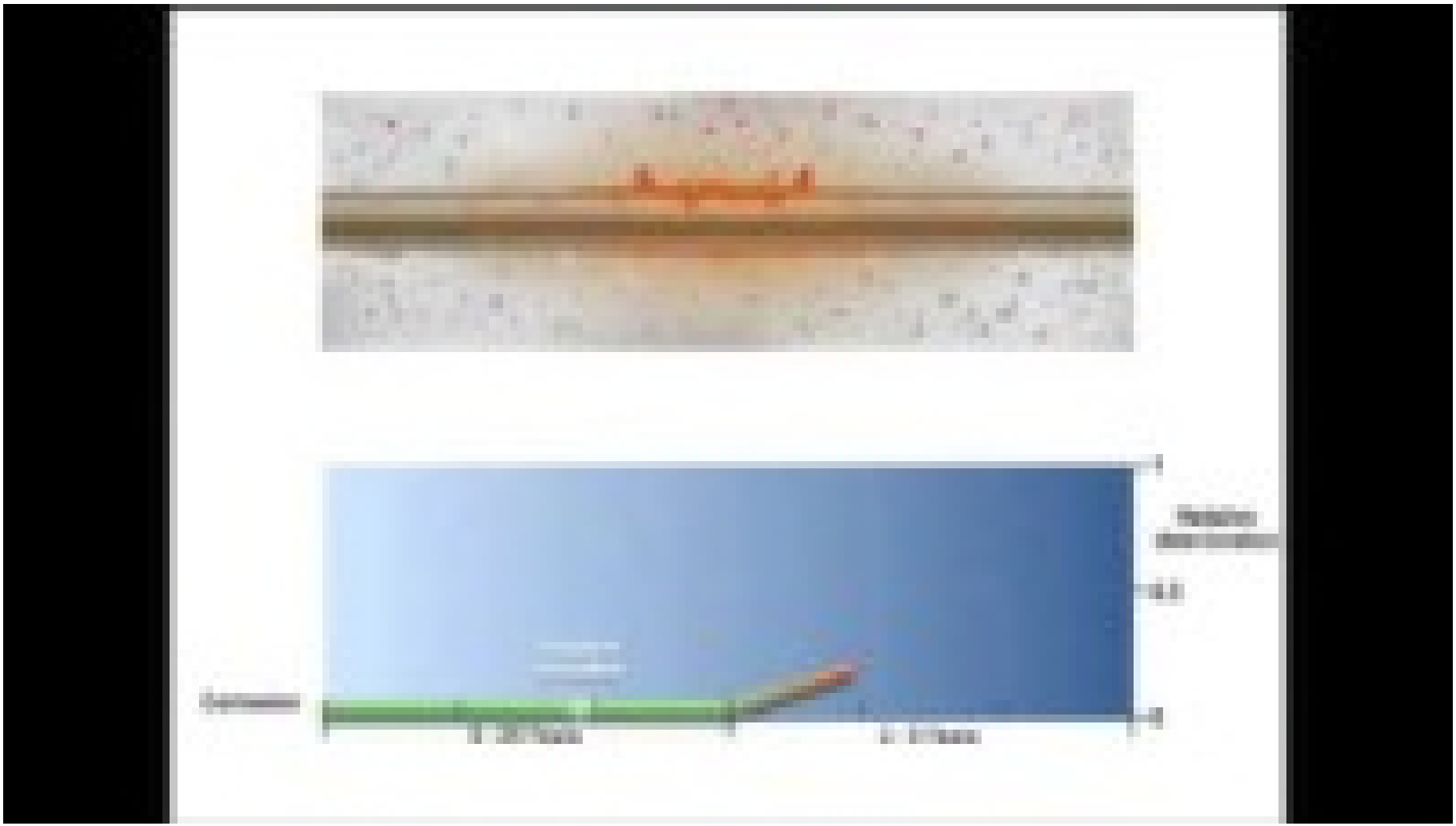
Causes of Concrete Deterioration

- Steel reinforcement corrosion
- Chloride intrusion
- Structural defects (Environmental stresses, aggregate expansion, poor mixing create weak spots)

Steel Reinforcement Corrosion

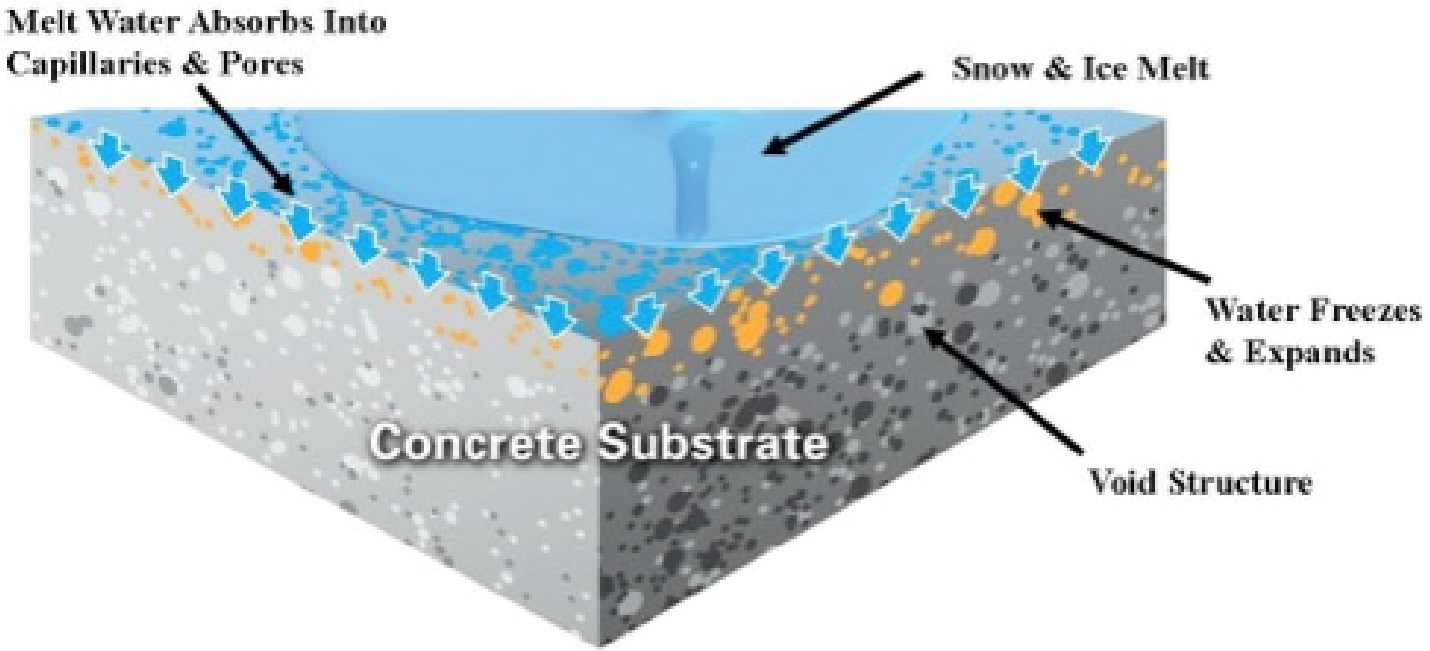


Steel Reinforcement Corrosion



Steel Reinforcement Corrosion

Chloride Intrusion



Structural Defects

- Plastic Shrinkage cracks (Improper Curing process)
- Construction movement - Loss of bearing (settlement or shoring problems)
- Incorrect Design loads - Other issues inducing stresses not designed for.

Deck Patch Scoping

Visually inspect deck surface & bottom for all areas of deterioration

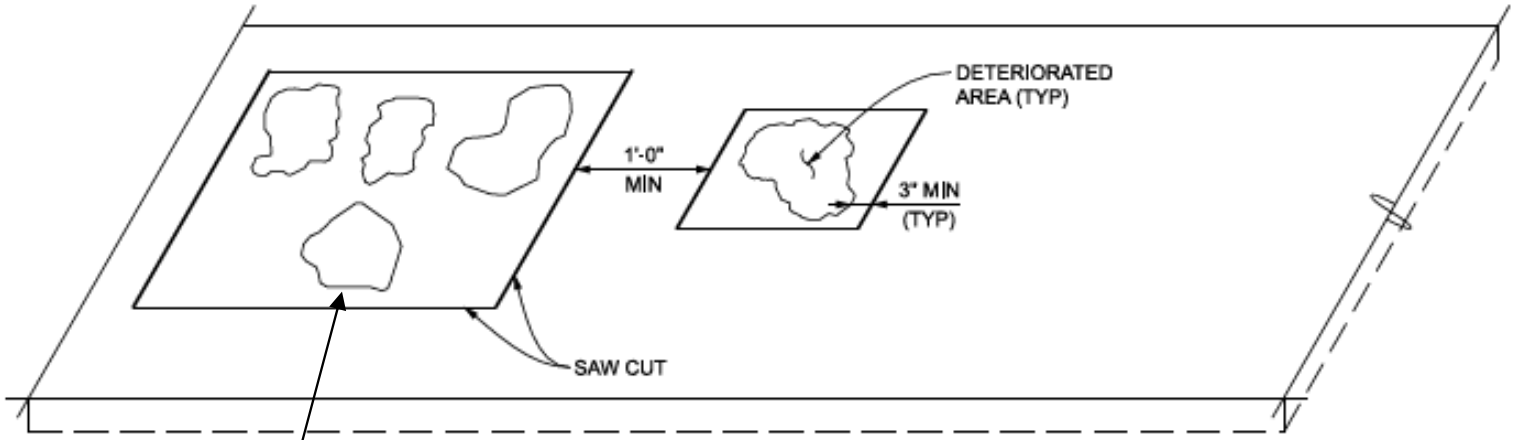
Do your homework!
History of bridge:
Shallow overlay?
Deep Overlay?
Previous patches failing?

Deck Patch Scoping

Sound area to be patched and/or around patch area to identify all unsound concrete

Deck Patch Scoping

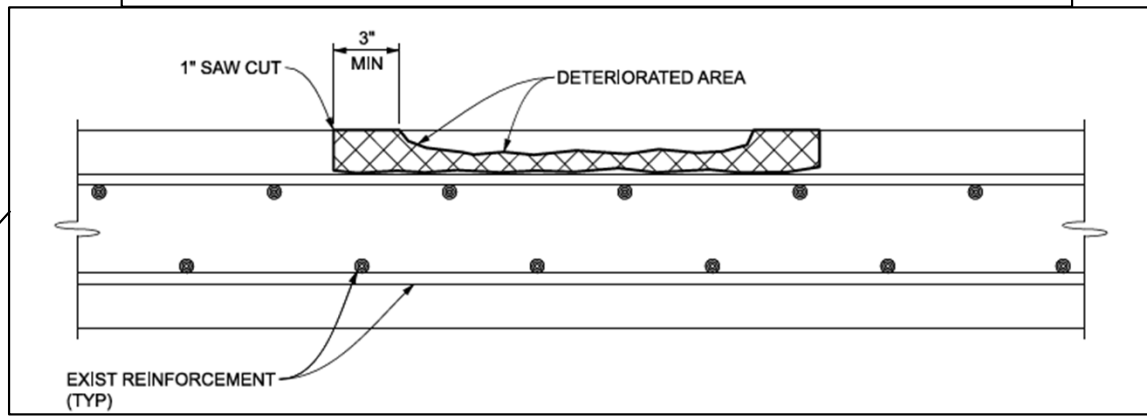
Sound area to be patched and/or around patch area to identify all unsound concrete



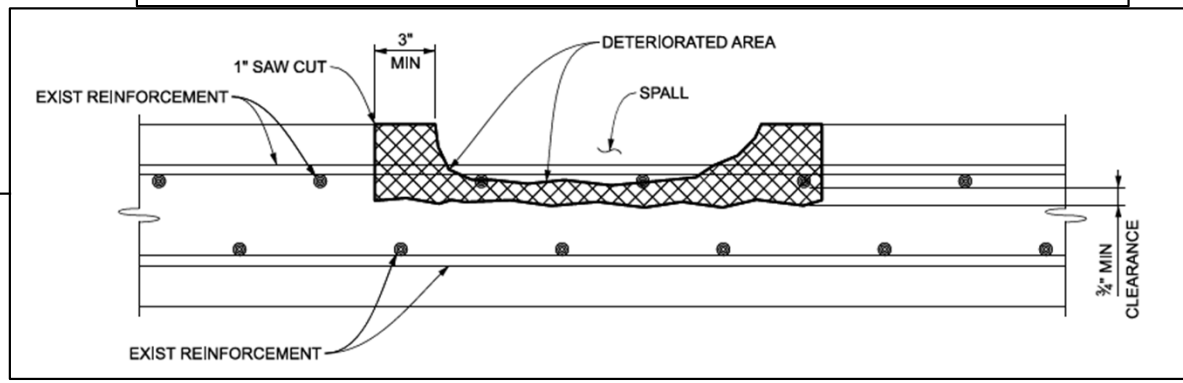
Mark limits of removal to encompass deteriorated area plus 3” min on all sides. If two patches are less than 1 ft apart, combine the patches

3 Types of Patches

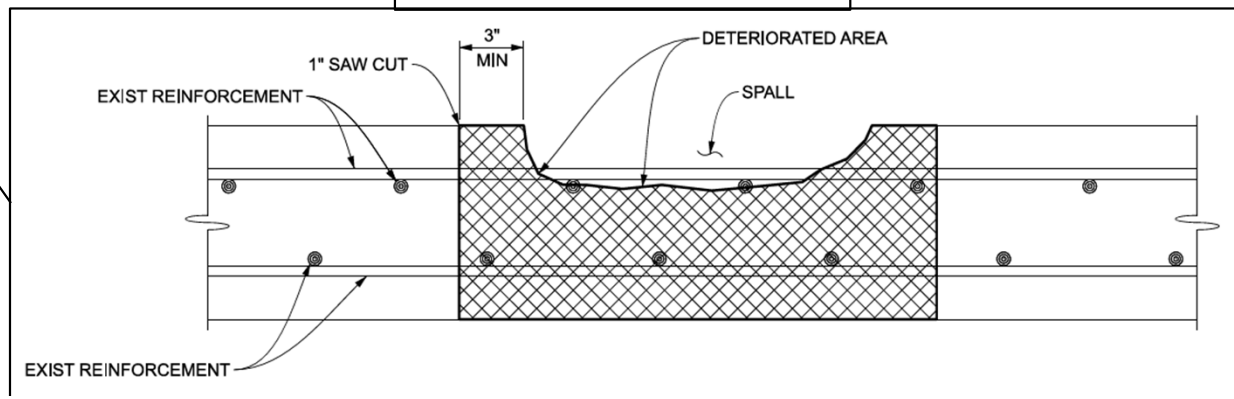
Shallow Patch – Above Reinforcement



Deep Patch – Below Reinforcement



Full Depth Patch



3 Types of Patches

Deck Patch Equipment

Necessities:

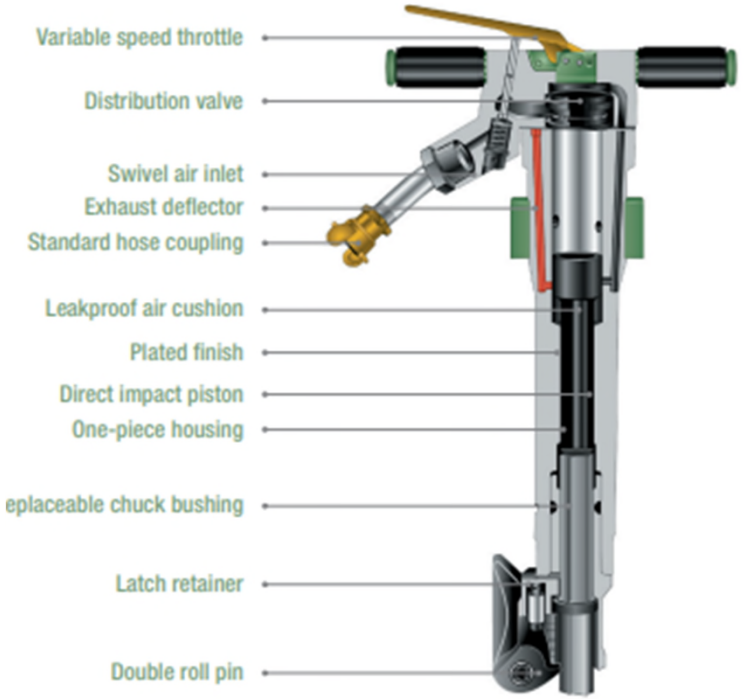
- Concrete Saw
- Jack Hammer
- Air Compressor
- Sandblaster
- Concrete Finishing Equipment

Optional:

- Roller Screed
- Vibratory Screed
- Vacuum Truck

Deck Patch Equipment

Deck Patch Equipment



Deck Patch Equipment

Deck Patch Equipment

Model 1028

0.5 cubic foot capacity

Clemco's smaller machines are light, transportable, and industrial quality. Maximum working pressure 125 psi.

*0.5-cuft and 1-cuft systems include the **Apollo 20 Supplied-Air Respirator**.*

Patch Preparation

Saw Cutting

Can use walk behind saw or hand held saw

Keep saw depth to 1” is best as possible. Ensure to cut 1” past intersections.

Patch Preparation

Chip Limits of Deterioration

Patch Preparation

Ensure to chip all unsound concrete

Patch Preparation

Ensure to chip all unsound concrete

Patch Preparation

Check Edges

Patch Preparation

Clean Patch Areas

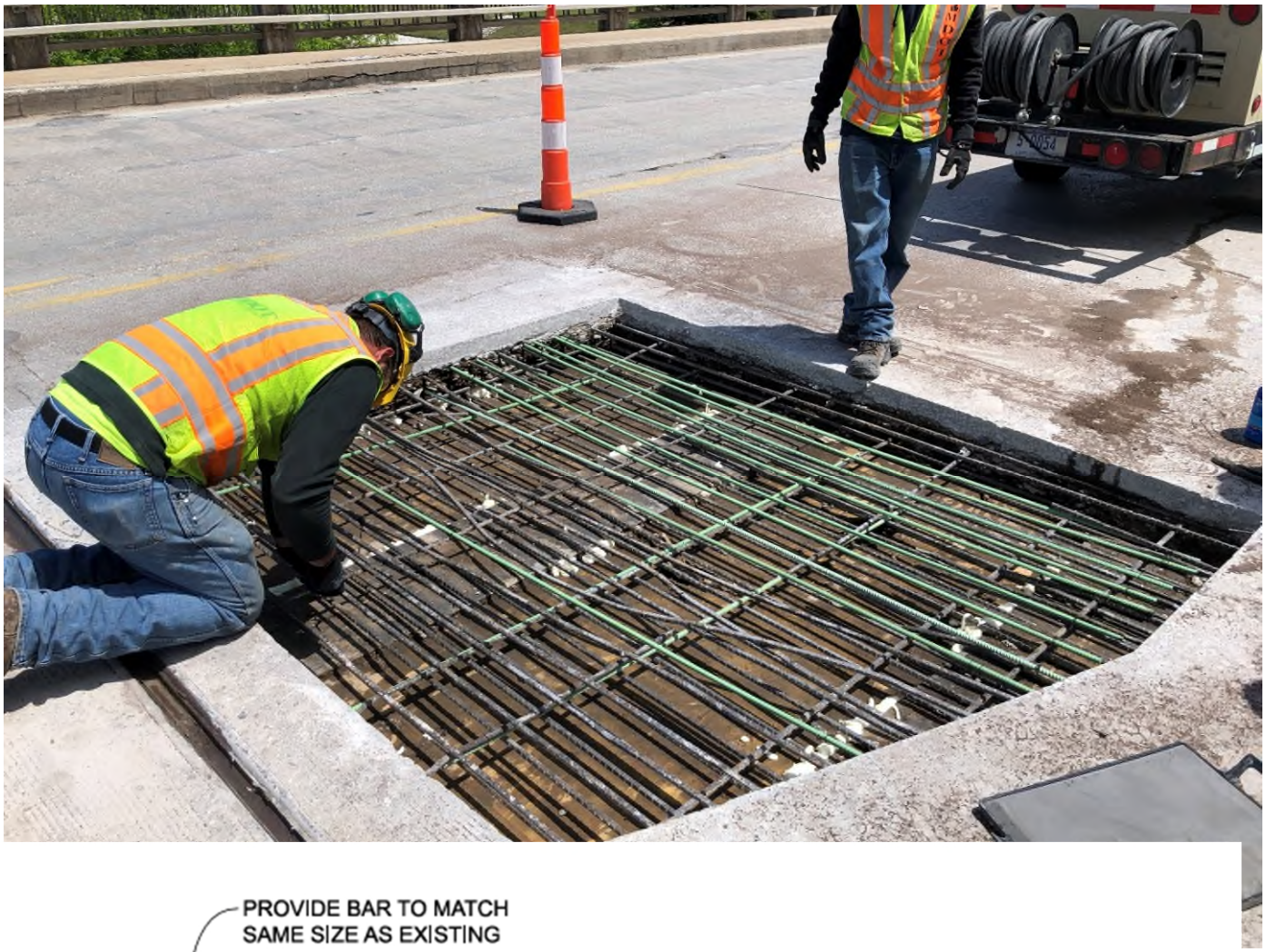
Patch Preparation

Clean Patch Areas

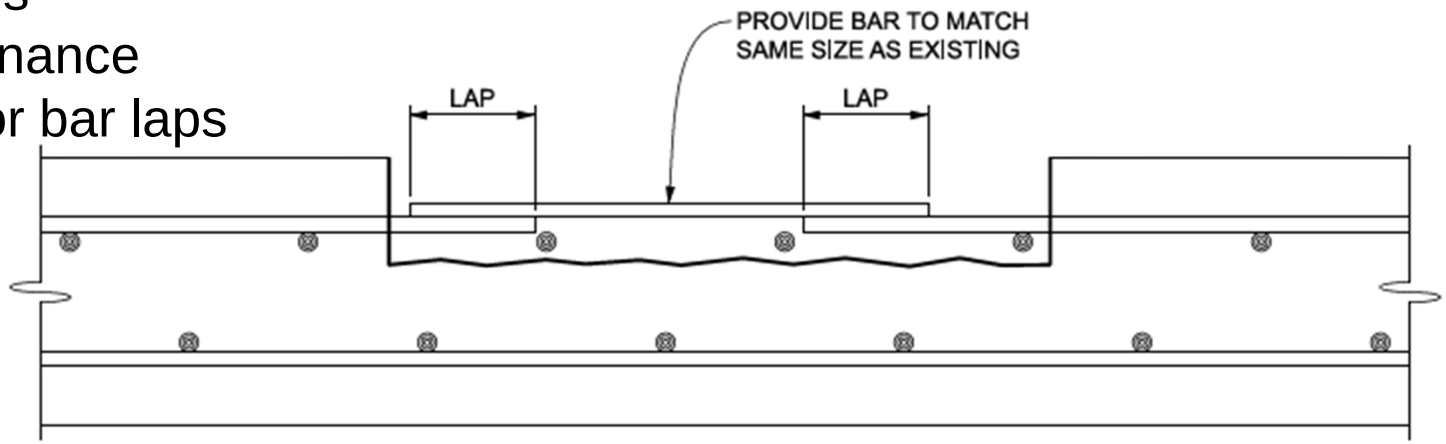
Reinforcement Steel

Ensure to sandblast heavily corroded steel

Replace in kind any damaged or missing steel. Epoxy Coated steel is preferred



MDOT's Maintenance spec for bar laps



BAR	LAP
#4	20"
#5	26"
#6	31"

Patch Preparation

Full Depth Patch

Patch Preparation

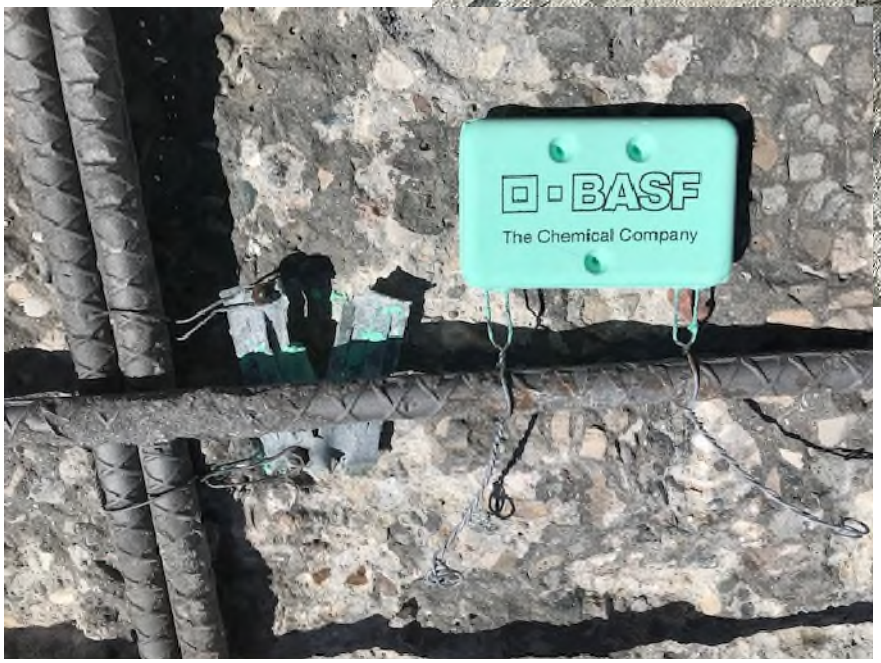
Poor Formwork

Patch Preparation

Proper Bracing

Patch Preparation

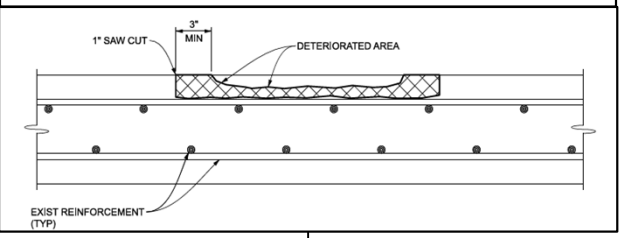
Galvanic Anodes



Material Selection

Depth of Patch

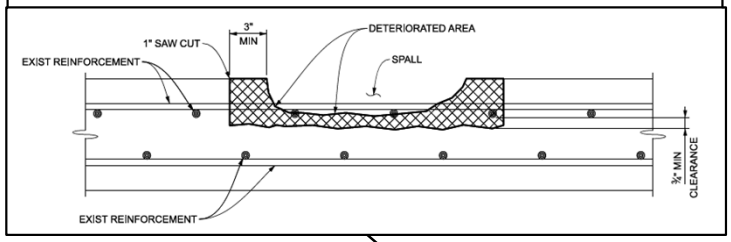
Above Reinforcement (shallow)



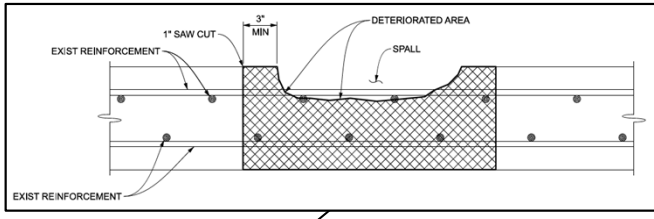
Polymer (chemical) Concretes similar to:

- T-17
- Kwikbond PPC
- E-Chem EP Patch

Below Reinforcement (Deep)



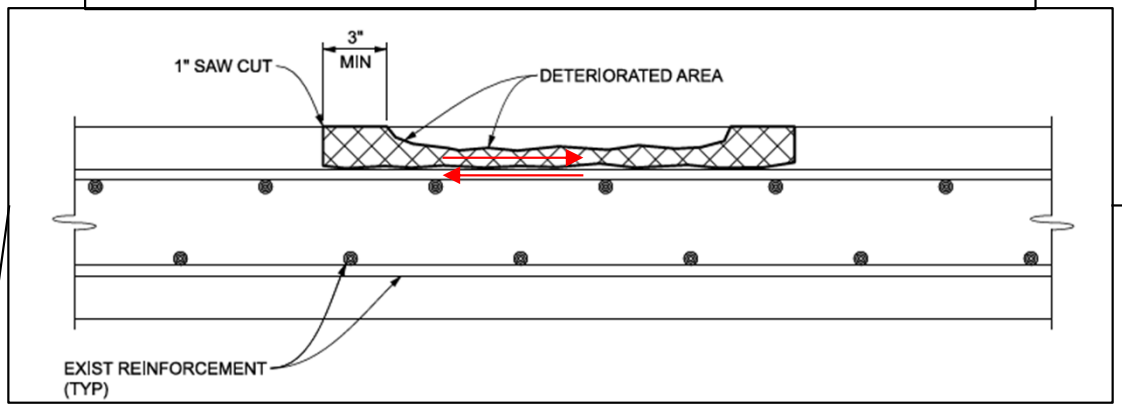
Full Depth



- All concretes used in Shallow
- BASF 10-60
- 4500 Concrete
- Latex Modified Concrete

3 Types of Patches

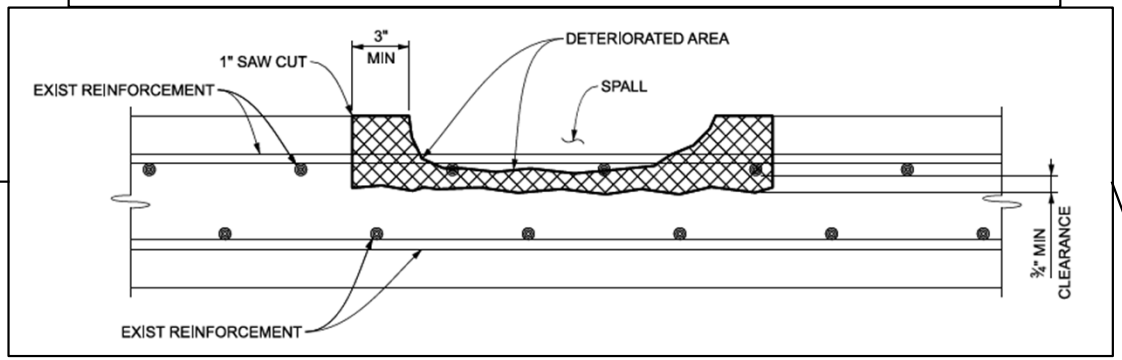
Shallow Patch – Above Reinforcement



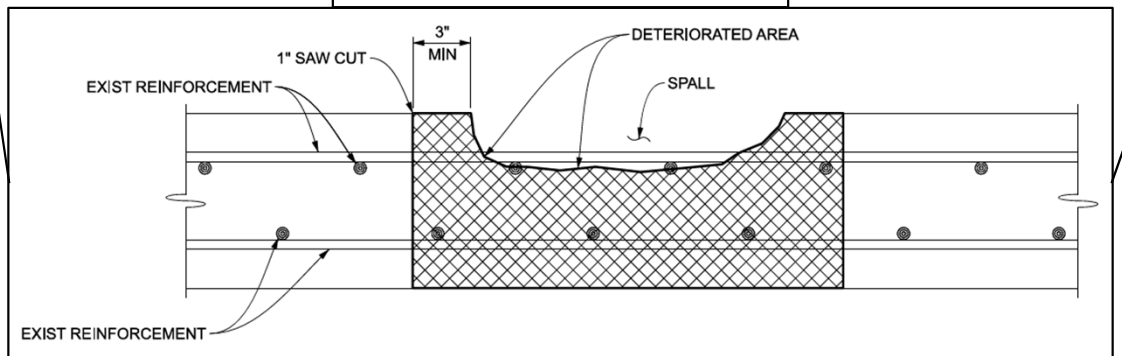
Polymer (chemical) Concretes similar to:

- T-17
- Kwikbond PPC
- E-Chem EP Patch

Deep Patch – Below Reinforcement



Full Depth Patch



- All concretes used in Shallow
- BASF 10-60
- 4500 Concrete
- Latex Modified Concrete

Material Selection

Rapid Cure Time

- MasterEmaco T 1060 by BASF – Rapid Mortar
  - 2-3 Hours
- Castek T-17
  - 2-3 Hours
- Kwikbond Polymers – PPC Easy Patch
  - 2-3 Hours
- Echem – EP Patch
  - 3-5 Hours

Longer Cure Time

- MDOT – 4500 Concrete
  - 7 Day (wet)
- Latex Modified Concrete
  - 48 Hours wet & 48 hours dry

Rapid Set Concretes

BASF 1060

Rapid Set Concretes

BASF 1060

Technical Data Guide

MASTER® BUILDERS SOLUTIONS

3 | 03 01 00 Maintenance of Concrete

MasterEmaco® T 1060

Very rapid-setting cement-based concrete repair mortar

FORMERLY 10-60 RAPID MORTAR

PACKAGING
MasterEmaco T 1060
50 lb (22.6 kg) polyethylene-lined bags
3,000 lb (1,360 kg) bulk bags

MasterEmaco T 1060DR
50 lb (22.6 kg) polyethylene-lined bags

YIELD
0.43 ft³ (0.012 m³) per 50 lb (22.6 kg)
- WHEN EXTENDED 50%:
0.57 ft³ (0.016 m³)
- WHEN EXTENDED 100%:
0.77 ft³ (0.022 m³)

STORAGE
Store in unopened containers in cool, clean, dry conditions

SHELF LIFE
- 50 LB BAGS:
1 year when properly stored
- 3,000 LB BULK BAGS:
6 months when properly stored

VOC CONTENT
0 g/L less water and exempt solvents

DESCRIPTION
MasterEmaco T 1060 is a one-component, shrinkage-compensated, very rapid-setting, cement-based mortar. It is designed for repairing horizontal concrete surfaces where high early strength gain is required. MasterEmaco T 1060DR is a reduced dust version available separately.

PRODUCT HIGHLIGHTS
- Extra low permeability helps minimize chloride intrusion
- Very rapid-setting so that structures can be opened to vehicular traffic in 1 hour
- Low residual moisture, can be coated in as little as 4 hours
- Excellent resistance to freeze/thaw cycling
- Shrinkage-compensated, minimizing cracking from drying shrinkage, reducing stress at the bond line
- Can be extended up to 100% by weight, providing higher yields
- Proprietary cement blend bonds to carbonated and noncarbonated concrete substrates

APPLICATIONS
- Interior and exterior
- Horizontal surfaces
- Applications requiring high early-strength gain
- Structural concrete repairs
- Partial and full-depth repairs

SUBSTRATES
- Concrete

HOW TO APPLY

SURFACE PREPARATION

CONCRETE

1. Concrete must be structurally sound and fully cured (28 days).
2. Saw cut the perimeter of the area being repaired into a square with a minimum depth of 1/2" (13 mm).
3. Refer to current ICRI Guideline no. 310.2R for surface prep requirements to permit proper bond.

REINFORCING STEEL

1. Remove all oxidation and scale from the exposed reinforcing steel in accordance with ICRI Technical Guideline No. 310.1R.
2. For additional protection from future corrosion, coat the prepared reinforcing steel with MasterProtect P 8100 AP.

Rapid Set Concretes

BASF 1060

Rapid Set Concretes

BASF 1060

Rapid Set Concretes

Castek – T-17

Rapid Set Concretes

Castek – T-17

CASTEK® INC.
A TRANSPO INDUSTRIES COMPANY

Technical Data Sheet

MMA Polymer Concrete Patching Material
T-17

T-17 is a 100% reactive, rapid setting, solvent-free methyl methacrylate (MMA) polymer concrete system that can be used as a repair for partial or full depth patching, grouting, and structural repairs. This system is to be used on horizontal concrete surfaces, on grade, above and below grade.

The polymer concrete consists of a two-component system. The T-17 liquid component consists of a solvent free 100% reactive, low viscosity methyl methacrylate (MMA). The T-17 powder component consists of a prepackaged blend of sand, inert fillers, polymers, and initiators. The material can be applied at a minimum ½" (13mm) thickness. For deeper patching, the T-17 should be extended with a special aggregate.

Application Procedure

Surface Preparation: All surfaces that are to receive T-17 must be thoroughly clean, dry and free of all dirt, grease, rust and other contaminates that might interfere with the proper adhesion of the polymer concrete. All damaged or deteriorated concrete shall be removed using jack-hammers or any other means and cut back to sound concrete. All surfaces must be thoroughly shot-blasted or sandblasted prior to applying T-17.

Priming: Priming is done with T-41s MMA primer using either rollers or brushes at a rate of 0.01gal/ft² (0.4L/m²). The primer resin is mixed with an appropriate amount of powder hardener (BPO) as shown in Table 1. The primer coat must be allowed to cure tack-free before application of the patching material.

Table 1: Mixing Instructions for T41-s Primer

Ambient Temperature °F (°C)	No. of 1oz (30g) Bags of BPO per gal (3.79L) of T41-s Resin
14 – 35 (-10 – 2)	6
36 – 55 (2 – 13)	5
56 – 75 (13 – 24)	4
76 – 104 (24 – 40)	3

T-17 Mixing: For small batches, the material can be mixed in a polyethylene bag that is available upon request. This is done by adding the powder, a pre-measured amount of liquid component to the bag, twisting the top with both hands so as to leave a small air space above the material, holding the bag closed with one hand and using the other to agitate the components in the bag until completely mixed. After powder and liquid are mixed, additional aggregate should be added and repeat mixing procedure.

For larger mixing, a rotary drum mortar mixer may be used. The inside of the mixer should be clean and dry. Add appropriate amount of Transpo T-17 liquid to the mixer, the Transpo T-17 powder component, and mix until uniform consistency. Next, add the additional coarse aggregate and re-mix for another minute. The amount of aggregate and resin added per bag of Transpo T-17 powder depends on the depth of the patch. Refer to Table 2:

Table 2: Mixing Instructions for T-17 per 50 lb (22.7 kg) bag of T-17 Powder

Depth of Patch in (mm)	Amt. Extension	Agg. Size in (mm)	Amt. Agg. lb (kg)	T-17 Liquid gal (L)	Yield ft³(m³)
2 (51) and above	100%	3/4 x 3/8 (19 x 10)	50 (22.7)	0.875 (3.3) 112 OZ	0.72 (0.07)
½ - 2 (13 – 51)	50%	3/8 x 3/16 (10 x 5)	25 (11.3)	0.75 (2.8) 96 OZ	0.56 (0.05)
Less than ½ (13)	0%	-	-	0.625 (2.4) 80 OZ	0.40 (0.03)

TRANSPO
The Smart Solutions Company

Rapid Set Concretes

Castek – T-17

T-17 Methyl Methacrylate Polymer Concrete Patch Material

- Application temperature 14 to 100 degrees F
- Fast set time of 45 minutes (@ 70 degrees F)
- Reinforcement not necessary
- Does not require drum mixer

Rapid Set Concretes

Castek – T-17

Rapid Set Concretes

Castek – T-17

Rapid Set Concretes

Castek – T-17

Patch Installation

Material Placement

Patch Installation

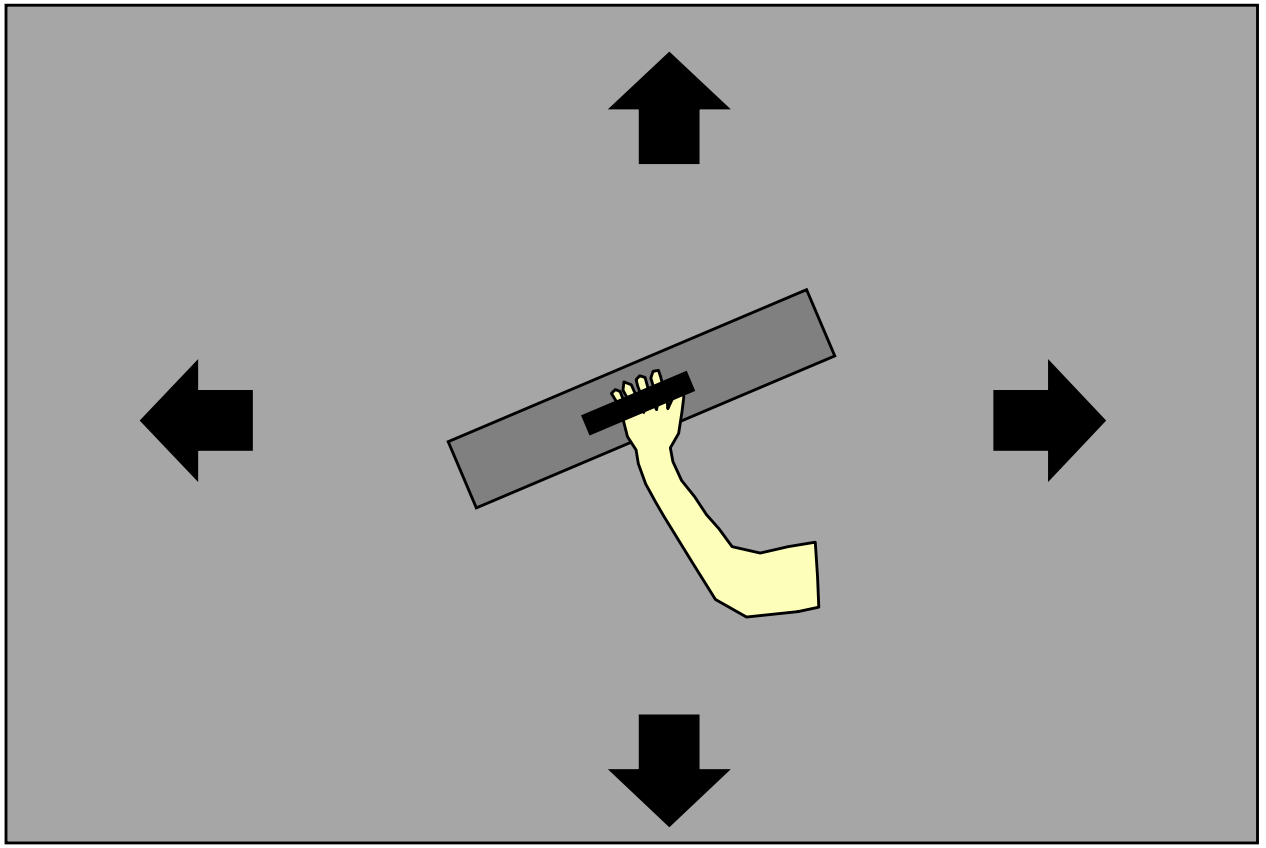
Material Placement

Ensure to screed concrete to keep existing roadway crown.

Patch Installation

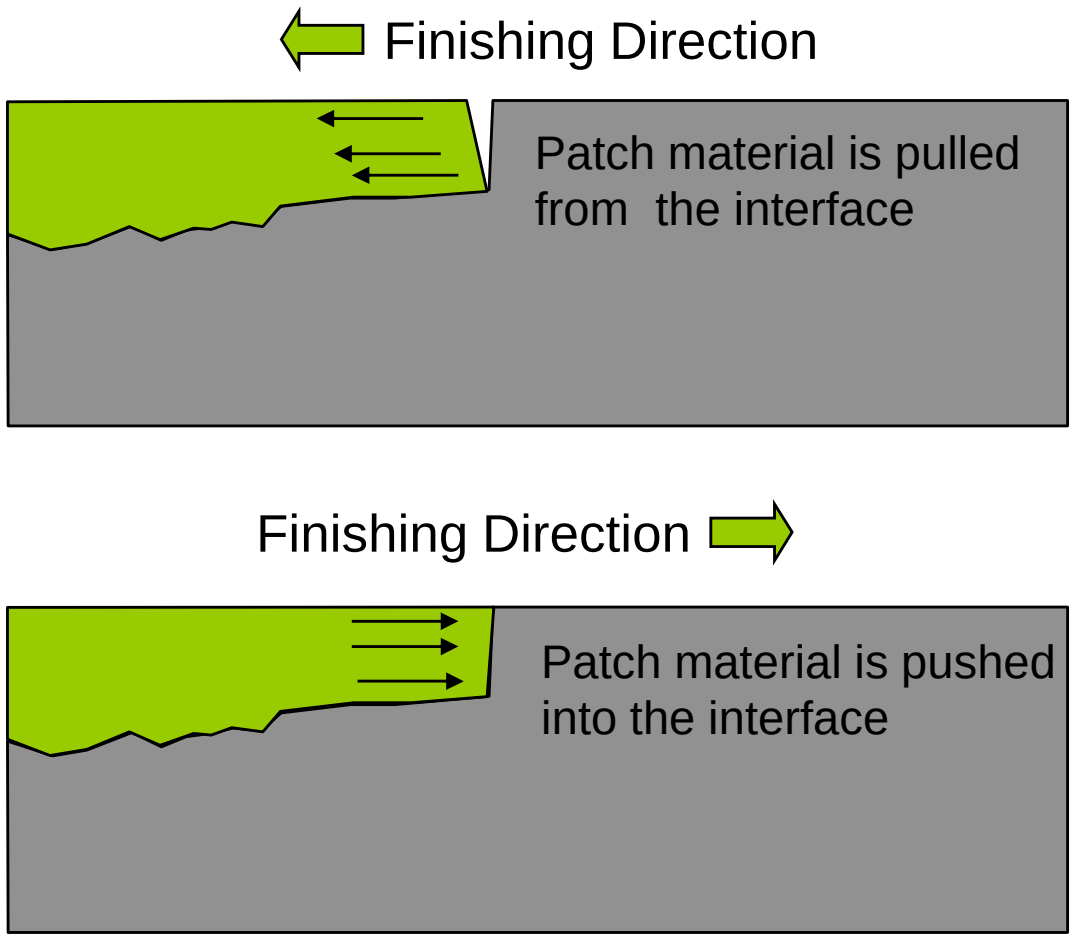
Finishing

Finish concrete towards the outside of patch



Patch Installation

Finishing



Patch Installation

Curing – Soaked Burlap

Patch Installation

Curing – Heating & Housing

Bridge Deck Preservation Practices

- Cleaning bridge
- Application of silane or other penetrating sealers
- Epoxy crack chasing or epoxy healer sealer
- Thin epoxy overlay or other polymer overlay

Cleaning Bridge Deck

Surface Washing

Cleaning Expansion Joints

Silane Application

Healer Sealer

Thin Epoxy / Polymer Overlays

Questions?????