



Concrete Pavement Repair In Minnesota: Let's Learn from Each Other

Gordon "Gordy" Bruhn
MnDOT Concrete Engineering Unit
Minnesota Concrete Council
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mn DEPARTMENT OF
TRANSPORTATION

Gordon "Gordy" Bruhn
Senior Concrete Rehabilitation Specialist
gordon.bruhn@state.mn.us
Office) 651-366-5523

Concrete Pavement Rehabilitation (CPR) Website
www.dot.state.mn.us/materials/concretepavement.html

www.dot.state.mn.us/materials/concretepavementrehabilitation.html

Pavement rehabilitation program

Investigation

It is recommended that investigation into soundness of the pavement be performed before a project and specific repairs are decided upon. This investigation should include 'chaining' the pavement, coring and sometimes milling at the joints to determine severity of deterioration, and coring near and far away from the joints to test for freeze-thaw durability.

Revisions and modifications

CD-HV and CX repair details have been revised to include 11 dowel bars per lane instead of the previously published 8 dowel bars per lane. CPR details and State Aid repair details have been modified and combined as of August 2015. Review the CPR memo and boiler plates for details about specific revisions and modifications.

CPR memo and boiler plates

- [CPR memo with changes and boiler plates \(revised 4/22/16\) - Adobe Acrobat \(.pdf\)](#)
- [CPR boiler plates \(revised 4/22/16\) - Microstation \(.dgn\)](#)

MnDOT Repair Details

- Type A Repairs, Joint and Crack Sealing
- Type B Repairs, Partial Depth Repairs (PDR's)
- Type C Repairs, Full Depth Repairs (FDR's)
- Dowel Bar Retrofits (DBR's)
- Concrete Grinding (Surface Planning for Ride and Friction)

Concrete Pavement Rehab Website

www.dot.state.mn.us/materials/concretepavementrehabilitation.html

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Determine if PDR's are a Feasible Repair

- Partial Depth Repairs perform best when used correctly...
- Meaning, PDR's should remain (mostly) partial depth.
- Take Cores to determine extent (depth) of deterioration



Stay away from pavements with Alkali-Silica Reactivity (ASR) or have Expansive Aggregates (D-cracked pavements)



D-cracked pavement

Some Roadways Are Too Far Gone



Compromised Air Entrainment System

Coring the Project is **ESSENTIAL**.
PDR's work well when placed on solid concrete.

Typical Minnesota Bottom up Deterioration


When in Doubt, Take it Out!




Preparing a CPR Project?

- ▶ Consider traffic/amount of truck traffic,
- ▶ Life expectancy...How long do you want it to last?
- ▶ Remember, Full Depth Repairs are the "Gold Standard"
- ▶ Location of the repairs...A PDR's isolated in the wheel path will not last as long.

The Good



The Bad



You Never Know What Lies Below Little Late to Take Cores Now

The Ugly



Could have done a FDR for less cost

You Never Know What Lies Below

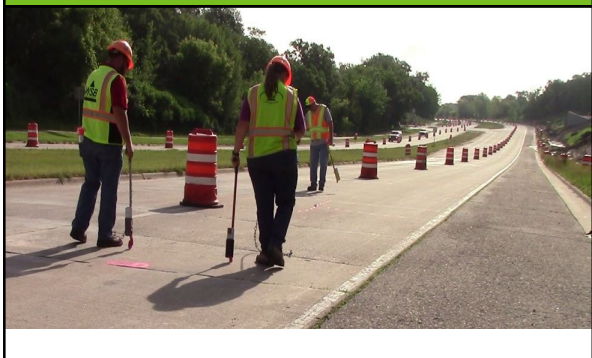
I-394 Bit Overlaid Twice



Core Shows Underlying Pavement was Solid



Contract Admin Chains & Marks Repair Areas



All Required Work is Combined Into a Single Pay Item, Including...

Concrete Removal



Use of ≤ 35 pound
chipping hammers
for removal



Milling is not required,
Contractors use mills to
speed up removals process

Minimum Depth of 2 Inches Taper Edges 30° to 60° from Vertical



≤ 35 lbs.
jackhammer

Tie Steel Placed Across Contraction Joint

- ▶ Cut and remove steel and dowel bars



NOTE: cross-sectional diameter loss of dowel bar

Before Proceeding, Inspect!

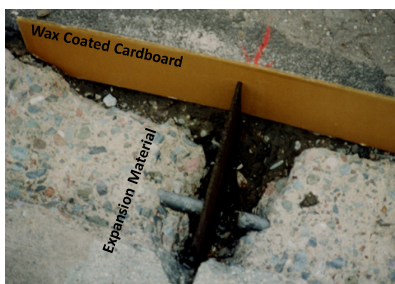
- Check removal by sounding with hammer
- If unsound concrete is found, remove with a small $\leq 35\#$ chipping hammer



Remove Reinforcing Steel

Install Compression Relief Material

Cut Dowel to allow full depth Bit Fiber Install
Separate the repair from the adjacent lane



PDR "Special" (Type BE)

- Spot full depth removal
- Drill and grout 8" rebar(s)
- Measured Ft² at surface for Type BA payment
- Also measured at mid-depth for Type BE payment



Cracked PDR "Special" (Type BE)



Reflective Crack at Thickness Differential



#4 epoxy coated rebar 8" long, w/4" drilled & grouted

This is not the intent of a BE repair

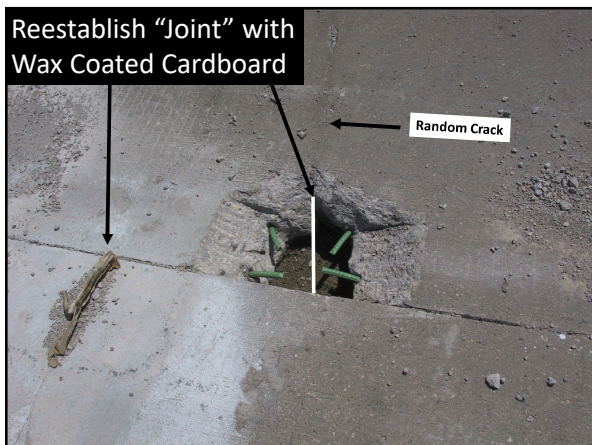


Take Cores!

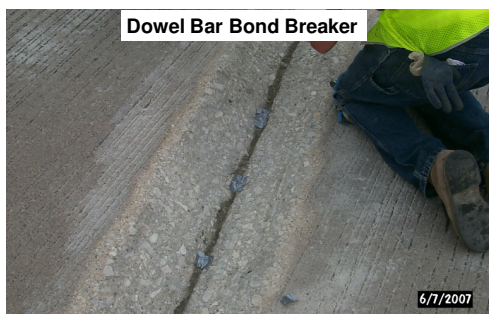
Changing a Partial Depth Repair to a Full Depth Repair



Reestablish "Joint" with Wax Coated Cardboard



Duct Tape Placement on Dowel Bars





Partial Depth MnDOT Mix-3U18

Bag Mix

3000# Bulk Bag Mix

Mobile Mixers

- Small Aggregate 100% passing 3/8" sieve
- 850 lbs Type I Cement
- 6.5% - liquid air
- Maximum 1 inch slump
- Cure times down to as little as 12 hours
- Ready Mix is NOT Allowed

Apply Bonding Grout Just Prior to Concrete Backfill

**Do Not Allow Grout to Dry.
If Grout Whitens, Re-Sandblast**

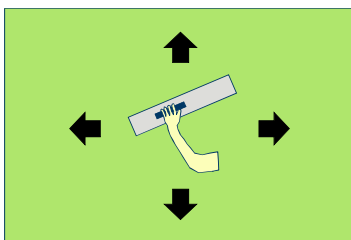
Reestablishing Longitudinal Crack



Vibrate 3U18 Concrete



Finishing Tip



Thick layer of Grout along outside Edges

- ▶ Not an edge sealer,
- ▶ Due to 30°-60° tapered edges, Use as a sacrificial coating of grout around perimeter of repair.
- ▶ Same grout as bonding grout



Curing must take place within 10 minutes of final finishing...



Dowel Bar Retrofits

Curing Compounds Alpha-Methyl-styrene or Linseed oil ONLY



Finally...



Saw & Hot Pour Seal Repairs

**Saw & Sealing is Incidental,
Within the Limits of the Repair**



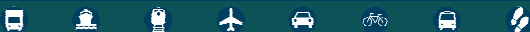


CONCRETE PAVEMENT REHAB

Knowledge Book by **Gordon BRUHN**

State of Minnesota, 2017

We all have a stake in **A+B**



HOW TO READ THIS BOOK ?

Concept

Task

General Comment

Available document

Highlight

Clickable object. Click to access more information.

Text Clickable text. Click to access more information.

Beware : important information !

Movie

This Knowledge Book must be displayed in Slide Show mode for the links to be activated.

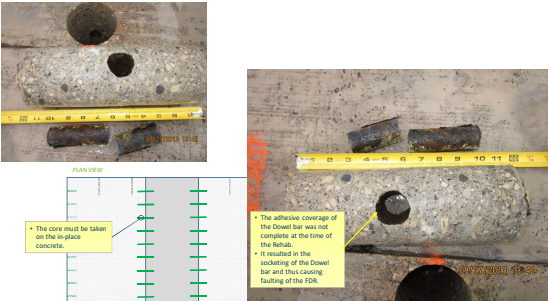
The Book uses Power Point Software and is Interactive

TABLE OF CONTENT

ESSENTIAL INFORMATION	HOW TO PREPARE A PROJECT
<ul style="list-style-type: none"> • Composition of concrete • Concrete pavement fundamentals • Material durability Issues 	<ul style="list-style-type: none"> • Preliminary phase • The different types of cracks • Chaining • Hammering • Coring
HOW TO CARRY OUT THE REPAIRS	PERIPHERAL INFORMATION
<ul style="list-style-type: none"> • All the different repairs • Partial Depth Repairs • Failed Partial Depth Repairs • A Repairs • Paving Full Depth Repairs 	<ul style="list-style-type: none"> • Warranty • Traffic Management • Plans • Milestones • Additional Notes from the Author



PRELIMINARY PHASE – FAULTING – SOCKETED VOIDS AROUND DOWEL BARS



PLAN VIEW

- The core must be taken on the in-place concrete.
- The adhesive coverage of the Dowel bar was not complete at the time of the fault.
- It resulted in the socketing of the Dowel bar and thus causing faulting of the FDR.

A FDR CD + CX is the only solution to Re-establish the load transfer, provided that there is no severe material durability issue.

Gang Drill...Bit size at least 1/8th
Greater than Dowel Diameter



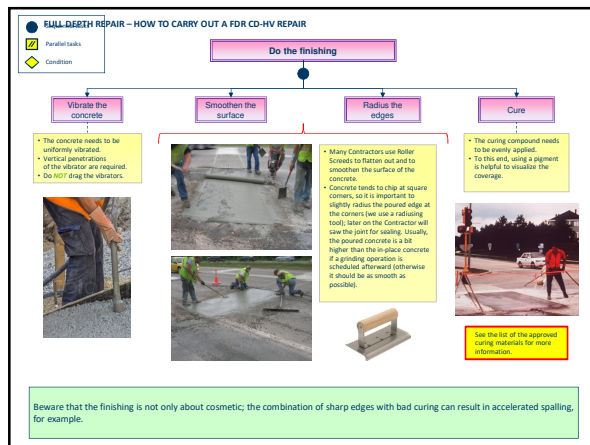
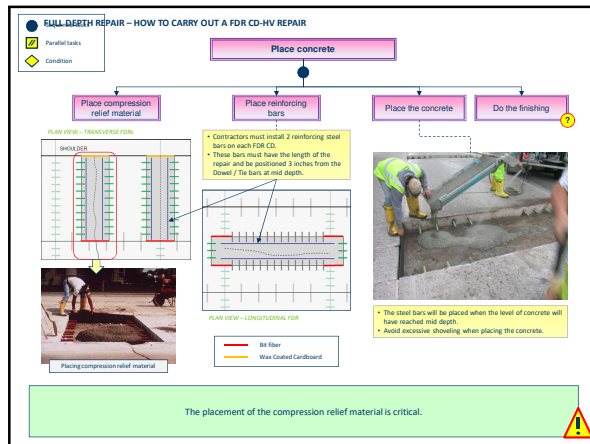
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Compressed Air Cleaning
150 psi minimum



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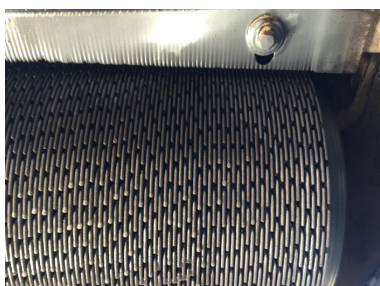




Concrete Diamond Grinding



Concrete Diamond Grinding



Repair Warranty

- Repair any areas of failure within thirty (30) calendar days at no cost to the department.
- The 30 calendar day warranty commences after all Type B, Type C, Dowel Bar Retrofits repair and Concrete Grinding (if required) are completed in a single traffic lane.
- Not just a visual check, check the bond to the in place pavement by chaining the PDR's.



Failed Partial Depth Repair?

- ▶ More In Place Pavement Needed to be Removed
- ▶ Agency should have done a better check!
- ▶ On CPR Projects...
You don't get what you expect, you get what you inspect.



Ultra High Early Concrete Mixes Seem to be predisposed to cracking



Shrinkage Cracks are Considered to be Failed Repairs



