

LESSONS LEARNED AND IMPROVEMENTS TO VIRGINIA'S CONCRETE PATCHING

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Overview

- **Recent Concrete Patching in Virginia history**
- **Issues**
- **VTRC Report 19-R14**
 - **Findings**
 - **Recommendations**
- **Improvements to VDOT's Concrete Patching**

Virginia History

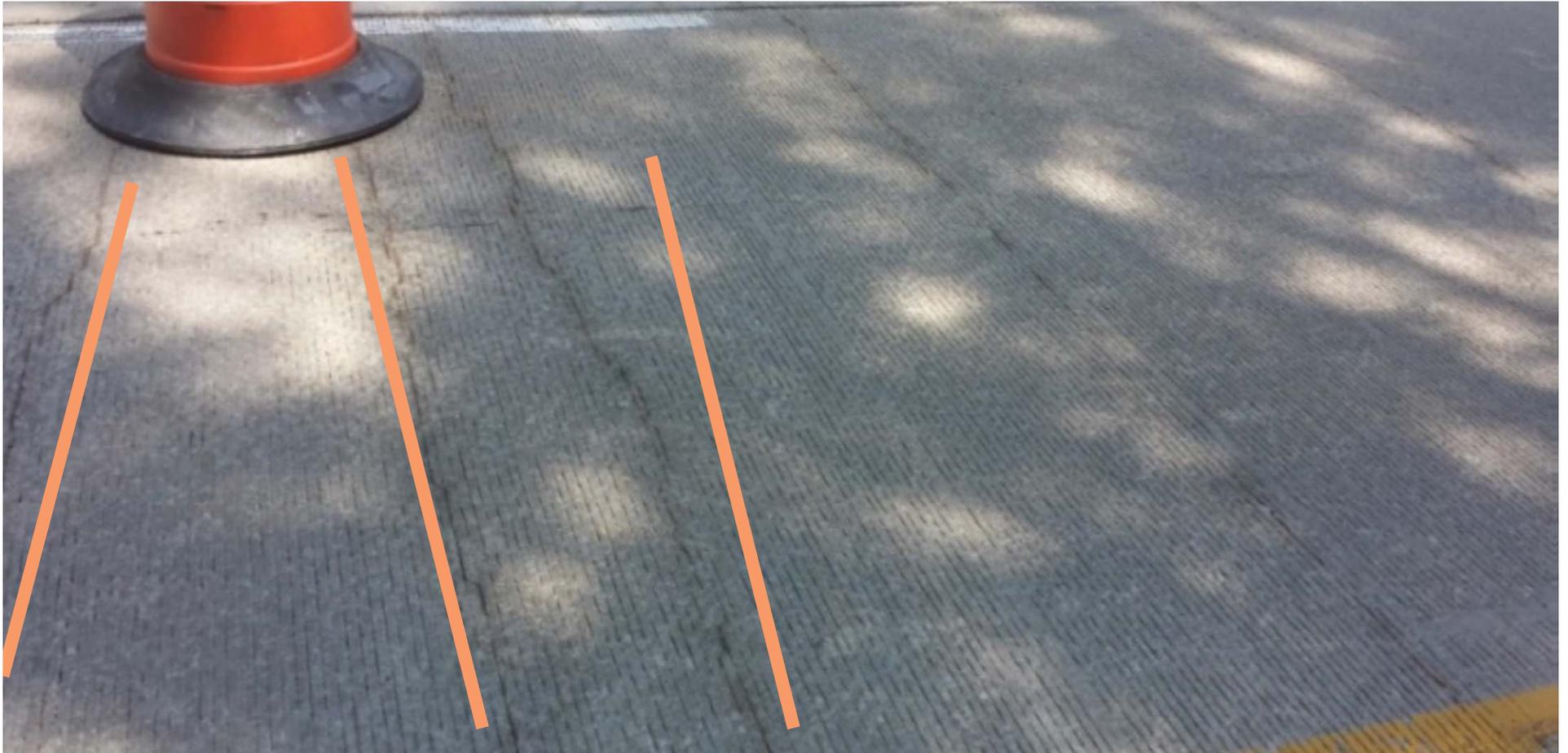
- The Virginia Department of Transportation (VDOT) uses full-depth concrete repair to patch hydraulic cement concrete pavement that has distresses (punchouts, spalls, extensive cracking, and corroded steel) in continuously reinforced concrete pavement (CRCP).
- Attempt to ensure load-carrying capabilities by reestablishing the continuity of reinforcing steel through the patched area and replacing the damaged concrete with new high early strength concrete.

Virginia History

- Latest Special Provision for concrete patching was published in 2007.

Virginia Issues

- The performance of concrete patches in CRCP varied from months to many years.
- Unknown performance cycle made pavement engineers hesitant to use patching in contracts



**Five-Year-Old Patch on I-85 with Cracks Close Together.
The cracks were caused by the use of concrete with a
high cement content.**

4-5 years old patch with many cracks



Failure adjacent to new patch



VTRC Report 19-R14 Overview

- **Purpose**
 - Determine the causes of premature repair failure in CRCP.

VTRC Report 19-R14 Findings

- *One of the most significant causes of premature failures of patches was the use of high early strength concrete mixtures with high cement contents (as high as 800 lb) that cause excessive shrinkage cracking.*

VTRC Report 19-R14 Findings

Other more localized causes of premature failures of patches could be the following:

- cutting of the continuous reinforcement, which allows the concrete to move and redistribute the stresses in the pavement
- re-establishment of the continuity of bars when they are bent or too short or more than one bar is present (i.e., a leftover spliced bar per location from a previous patch) in the existing concrete
- damage to concrete adjacent to the patch during concrete removal
- poor concreting practice with respect to the proper consolidation of the concrete in the vicinity of the adjacent hardened concrete
- reinforcement in the old concrete being too close to the surface (i.e., not enough concrete cover because of the use of the tube feeding of bars in old pavement)

VTRC Report 19-R14 Conclusions

- One of the most significant causes of premature failures of patches is the use of high early strength concrete mixtures with high cement contents that cause excessive thermal and shrinkage cracking.
- When feasible, low cement factors and supplementary cementitious materials should be used with a longer time for opening to traffic.
- Other minor causes of patch failure include:
 - Lack proper consolidation and curing time
 - Base erosion near joint
 - Poor workmanship in removing deteriorated concrete

VTRC Report 19-R14 Conclusions

- Opening patches to traffic should be based on the maturity method or temperature match cured cylinder strength.
- Cracked patches are structurally inadequate for current and future traffic and typically fail in less than 1 year to 5 years.
- An asphalt overlay placed on the patched CRCP provides good service life.

VTRC Report 19-R14 Recommendations

1. VDOT's Materials Division and Construction Division should require in future special provisions that concrete patching mixtures include much less cement (as in the regular paving concrete) and include fly ash or slag when longer lane closures can be specified. In a single project, multiple mixture designs with varying cementitious materials could be used for achieving the required strength.
2. Chapter 6 of the VDOT Materials Division Manual of Instructions should be revised to indicate that the VDOT districts should require preliminary engineering prior to patching to consider the condition of the existing pavement, future traffic, and the need for patching and placing an overlay to improve the structural capacity.

Improvements to VDOT's Concrete Patching Program

- **VDOT has already implemented recommendation #2.**
- Chapter 6 of the MOI has been updated.
- Benefit of updating the Manual of Instructions is that the patches will have a longer service life and ride quality will be maintained because the increased pavement section can handle the loads imposed by increased traffic for future design life.

Improvements to VDOT's Concrete Patching Program

- **VDOT is working on recommendation #1.**
 - Special provision on concrete patching has not been updated since 2007.
 - VDOT has created an internal working group to look at the special provision and VTRC Report 19-R14 to determine where we need to focus on improvements.
 - Special provision has gone through multiple iterations until it is at a point for wide distribution for comment.
 - Special provision will be sent to industry shortly for comment.

Proposed changes to Special Provision

1. Removal of Type IV- Type B patches.

- a) All type IV patches will now be full depth repairs that are full lane width and not less than 6 feet long.

Proposed changes to Special Provision- Materials

- a. **Proposed Language:** *“The Contractor shall have Department approved HCC mix designs before initiation of work. HCC materials shall conform to the requirements of Section 217.02 and Table II-17 for A-3 Paving mix design, and a minimum 15% Class F Flyash or 3 % Silica Fume or 25% GGBF slag shall be used. The maximum cement materials content shall be no more than 600 pounds per cubic yard or less unless otherwise approved by the Engineer to satisfy early strength requirements for opening to traffic.”*
- b. **Changes**
 - a. Removal of no maximum upper limit on cementitious materials.
 - b. Addition of maximum cement materials content shall be no more than 600 lbs/cu.yd. unless otherwise approved.

Proposed changes to Special Provision- Construction Methods

Concrete sawn full depth to be removed shall be lifted out by means of chains, lift-pins, or other devices approved by the Engineer. **Concrete breaking in-place will not be permitted unless approved by the Engineer on extremely deteriorated pavement sections that cannot be removed by lifting.** During the removal operations, utmost care shall be exercised to minimize disturbance and damage to the base material, and the adjacent sound pavement and shoulder.

Any areas damaged during concrete sawing and removal operations shall be repaired at the Contractor's expense to the satisfaction of the Engineer by extending the patch boundary or by repairing spalls. Spalls greater than ¼ inch wide and 2 inches long and over ½ inch in depth below the pavement surface shall be repaired using an epoxy mortar approved by the Engineer.

Proposed Changes for Special Provision

- **Send out to industry for review and comments**
- **Comment disposition**
- **Goal is to have it in place for 2021 season**

QUESTIONS?

Thank you.