



CONCRETE PAVEMENT REPAIR UPDATE

The August 1989 issue of MATES (No. 34, "Concrete Pavement Repairs") introduced the repair methods that MDOT developed for jointed reinforced concrete pavements. This article will update our concrete repair methods and include the latest innovations.

As the previous article indicated, after many years of service, areas of distress develop even in the best concrete pavements. Other than base-related failures, the most common types of distress in concrete pavements are:

- 1) Shallow depth surface deterioration and delamination due to the corrosion of reinforcing steel placed too near the concrete surface,
- 2) Transverse cracking,
- 3) Concrete spalling along joints,
- 4) Adhesion failure of poured sealants, and
- 5) Loose neoprene seals.

Early repair of these types of pavement distress is important in order to avoid more extensive repairs, or even total replacement, at a later date. MDOT uses the following general repair methods for the various distress types.

Shallow Depth Repair - The perimeter of the repair area is saw cut, creating a groove with a vertical profile approximately 1/2 in. deep. A vertical profile is important in all concrete repairs because 'feathering' of the edge results in a thin concrete layer which will spall along the patch edges. The unsound concrete within the patch area is removed with chipping hammers. Next the repair area is sand-blasted and cleaned out with compressed air. (In all repair work, care should be taken that the compressed air be free of any oil, as this will contaminate the repair area). The area is then filled with a fast-set prepackaged hydraulic mortar which is trowelled flush with the pavement. The repair can be open to traffic in two hours.

Joint Spalling - Minor to moderate joint spalls can be repaired in a manner similar to that described above for shallow depth repairs. The perimeter is saw cut, the unsound material is removed with chipping hammers, the area blast-cleaned, and blown clean with compressed air. A prepackaged patching material is mixed with a clean pea stone to produce the repair mix. The mix is placed in the area and trowelled flush.

When using poured sealants, the joint groove is reformed by placing a styrofoam block-out material prior to pouring the concrete. After curing two hours, the block-out is removed and the reformed joint groove can be blast-cleaned and sealed with a poured sealant. For neoprene seals that are not going to be removed, a thin, right-angle metal plate is placed in the groove to pre-compress the seal before pouring (Fig. 1). Neoprene seals in good condition will reseal the joint when the metal form is removed.

Sawing and Sealing Cracks - Working transverse cracks are sawed and sealed to reduce spalling and to prevent water and incompressible materials from entering the crack. A small concrete saw with a thin diamond blade is used to groove-out the crack. These saws can follow the crack path, cutting a uniform groove without forming further small cracks. Once again the area is sand-blasted and cleaned with compressed air. The crack is then filled with a low modulus, hot-poured rubber-asphalt sealant. MDOT is also experimenting with a self-leveling silicone material that has potential as a transverse crack sealant.

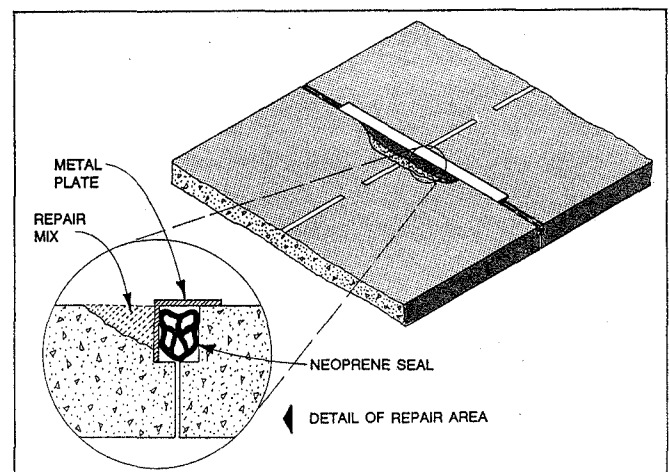


Figure 1.

Resealing Transverse Joints - As with working cracks, joints are sealed to keep out water and incompressible materials. The first step in resealing joints is to remove the old joint material. Loose neoprene seals generally can be pulled out. Tight neoprene seals or poured sealants may need to be sawed out. After a neoprene seal is removed the groove is cleaned by wire brushing, and a new neoprene seal installed. Most poured sealants need to be cut out of the joint with a saw. The joint is then sand-blasted and blown clean with compressed air. Next a sponge-like, round backer rod is pushed down into the groove. This backer rod keeps the sealant from adhering to the bottom of the groove and helps maintain the proper width-to-depth ratio (shape factor). A low modulus silicone sealant is then pumped into the joint. The silicone is tooled to force it against the sides of the joint and to obtain the proper shape. The silicone cures into a flexible watertight seal.

Full-Depth Dowelled Repairs

When distressed concrete pavements are neglected, the joints or cracks may deteriorate to the point where a full-depth concrete repair is the only solution.

As described in the previous article, the limits of the repair area are laid out on the pavement. A minimum width

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(usually 6 ft) is required to facilitate the rig used for drilling the dowel holes. The perimeter of the repair area is saw cut full depth and the concrete removed. The holes for the dowels are then drilled into the remaining pavement slab. A typical patch has 10 dowels at each end. The drill rigs used on most patching jobs can drill all 10 holes simultaneously. Previously, a hole clearance of 1/16 in. was required and the dowels were inserted with no adhesive being used. Currently, the standard dowel joint uses a 1-3/8-in. diameter hole for a 1-1/4-in. dowel bar. After drilling, the holes are cleaned with compressed air and filled with a two-part epoxy grout. The epoxy grout is used to prevent misalignment of the dowel bars which can cause the patch to tip, or can lead to early joint failure. The epoxy grout can be prepackaged and injected with a hand gun similar to a double-barreled caulking gun, or an air-assisted gun can be used. Alternatively, the epoxy can be injected from a bulk system. After the bar is grouted in, the portion of the bar that is to extend into the patch is coated with a debonding agent. Reinforcing mesh is laid in the patch, supported by the dowels, and a rapid-set concrete is placed and finished in the patch.

Three modified versions of the full-depth patch are used. These types are the contraction reinforced grouted (CRG),

the expansion reinforced grouted (ERG), and the tied reinforced grouted (TRG) patches. TRG repairs are similar to the previous general description with the following exceptions. Instead of dowel bars, each end of the patch has epoxy coated, deformed No. 9 reinforcing bars grouted in. No debonding agent is used. These patches are used for repairs at cracks between two existing working joints.

CRG and ERG repairs each have one end tied the same as a TRG. CRG repairs have the standard grouted dowel treatment, described earlier, on the remaining end. ERG repairs are the same as CRGs with the addition of expansion caps on the dowel ends and a fiberboard joint. These caps and fiberboard allow for expansion between the patch and the existing pavement.

The Materials Research Group monitors these pavement repair installations. In most cases they are smooth riding, tightly sealed repairs that significantly extend the life of Michigan's concrete pavements.

-Steve Beck

TECHADVISORIES

The brief information items that follow here are intended to aid MDOT technologists by advising or clarifying, for them, current technical developments, changes or other activities that may affect their technical duties or responsibilities.

MDOT RESEARCH PUBLICATIONS

Evaluation of Lime, Fly Ash Base Course Mixtures - Final Report, Research Report No. R-1310, by V. T. Barnhart. This project, conducted in cooperation with the Federal Highway Administration and in conjunction with the Civil Engineering Department at the University of Michigan and the Michigan Ash Sales Co., was initiated in 1984. Its purpose was to evaluate the use of bituminous and aggregate mixtures containing fly ash, when used in the construction of highway shoulder bases. The fly ash-extended bituminous base course material and the lime/fly ash/aggregate (a pozzolanic, weakly cementitious material) base course mixtures were placed on a shoulder reconstruction and resurfacing project on M 29 in St. Clair County in 1986. Based on the results of field evaluation, there were no observed differences in the performance of the bituminous and aggregate mixtures containing fly ash, and the conventional bituminous base course placed as a control section. Michigan's climate makes the construction scheduling of the lime/fly ash/aggregate base difficult due to the necessity of the material to cure at summer temperatures prior to the onset of winter. From the results of laboratory investigation, the fly ash-extended bituminous base course was found to be more susceptible to moisture damage than the conventional bituminous base course.

Fine Aggregate Tested on the Michigan Department of Transportation Circular Wear Track, Research Report No. R-1312, by R. W. Meuthel. Previous MDOT wear track evaluations have measured the polishing resistance of the coarse aggregate components of bituminous top course mixtures. The MDOT Aggregate Wear Index (AWI) for aggregates in bituminous top course mixtures was implemented to match the polishing resistance of coarse aggregates to the amount of traffic anticipated on trunklines. Recent changes in bituminous mixture designs have resulted in greater use of dense-graded aggregates which are composed of larger percentages of fine aggregates. Inquiry into the frictional performance of fine aggregates prompted the scheduling

of a special wear track series to evaluate the polishing characteristics and frictional performance of selected fine aggregates. The polishing tests indicated that the fine aggregates, including high-polishing limestone, exhibited considerably higher frictional performance than the coarse aggregates. The increased frictional performance was found to be due to the smaller particle size rather than sacrificial removal of aggregate from the test specimen surfaces. Based on the results of this wear track series, the development of bituminous top course mixtures with greater exposure of fine aggregate is recommended. The mixtures would be specially designed with the fine aggregate throughout the mixture to maintain fine aggregate exposure as the surface material is removed by traffic wear. The frictional characteristics of the fine aggregate component of bituminous pavements should be considered when investigating the relationship between aggregate qualities and pavement friction.

PERSONNEL NOTES

Two valued colleagues are retiring this month. **Ellis Swartzel**, head of the Materials Support Unit leaves MDOT after 36 years of service. Ellis started in MDOT's Engineer Training Program in 1956, after graduating from Purdue University. He was then assigned to bridge construction in various parts of the state, until moving to the Jackson District Office as Assistant Bridge Construction Engineer in 1964. In 1985 he joined M&T in Lansing where he made important contributions to the development of the new District Support Section, where his presence will be missed...The Research Laboratory's Machine Shop has been a key factor in highway research. One of the important members of the team, **Ron Houska**, is retiring after 16 years with the Division. Ron's experience in industry as a tool and die maker fit him to the job, which requires as much creative thinking as it does mechanical ability. He's worked on jobs as diverse as helping to fabricate our custom pavement profilometer, to the machining of precision test specimens. Both Ellis and Ron have contributed not only to the technical success of the Division, but have been cooperative and cheerful colleagues. May you both have the best of everything in retirement.

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