

# **Pavement Demonstration Program Status Report**

## **Public Act 457 of 2016**

### **June 2020**

#### **Background**

Public Act 457 of 2016, MCL 247.651i states the Michigan Department of Transportation (MDOT) may conduct pavement demonstration projects to evaluate new construction methods, materials, or designs that do not have actual Michigan historical project maintenance, repair, or resurfacing schedules or costs recorded by the pavement management system. The pavement demonstration project may be all or a portion of that project using either concrete or asphalt as determined by the department. Each demonstration project shall include measurable goals and objectives for determining the success of that project. The department shall measure the interim success of each demonstration project each year and make a final report for each demonstration project following the demonstration life of the project, which may be shorter than the actual pavement life of the material used for the project, that assesses the cost-effectiveness and performance of the pavement materials and design used in the project and compares the results to the pavement material identified under the department's standard pavement selection process.

#### **Project Selection**

Selection of candidate projects is a collaborative effort among MDOT Construction Field Services pavement personnel, MDOT region personnel and pavement industry groups. Once the demonstration project is identified, it goes to MDOT's Engineering Operations Committee for formal approval. Once approved, the project becomes part of the Pavement Demonstration Program. All costs for the demonstration project are funded by the respective MDOT region's rehabilitation and reconstruction budget.

#### **Project Finalization Process**

All demonstration projects are continually being evaluated to determine if there is enough information to create appropriate performance curves and make a final determination as to their applicability to standard MDOT practice. Final recommendations will be outlined in this Pavement Demonstration Program Status Report. A separate technical report, Pavement Demonstration Program Project Evaluation, will be made available to provide further details about final recommendations. Additionally, a final comprehensive report on each project will be made available once final recommendations are officially approved by MDOT.

#### **Project List**

The list of demonstration projects to date and approximate pavement costs are shown in Table 1.

**Table 1. Pavement Demonstration Project List**

FY Let/Built	Route/Road	Region	County	Location	Description	Pavement Costs*	
						Asphalt	Concrete
2003/ 2003	I-75 NB	North	Ogemaw	Ski Park Road to Roscommon County Line	Unbonded overlay		\$1,980,000
2003/ 2005	M-84/Bay Road SB	Bay	Bay/ Saginaw	Pierce Road to Delta Road	Perpetual pavement	\$700,000	
2004/ 2005	M-3/Gratiot Avenue	Metro	Wayne	St. Aubin Street to McClellan Street	Thin unbonded overlay		\$2,200,000
2005/ 2005	M-13/Euclid Avenue	Bay	Bay	Mary Drive to North Street	Low volume concrete		\$1,200,000
2005/ 2005	I-96 WB	Metro	Wayne	M-39 to Schaeffer Road	Perpetual pavement	\$4,800,000	
2006/ 2006	M-99/Eaton Rapids Road	University	Jackson	Village of Springport	Low volume concrete		\$100,000
2008/ 2008	I-75 NB	North	Cheboygan	Topinabee Mail Route Road north for 2.37 miles	Perpetual pavement over rubblized concrete	\$781,000	
2009/ 2010	M-1/ Woodward Avenue	Metro	Wayne	Tuxedo Street to Chandler Street	Thin unbonded overlay		\$931,000
2018/ 2019	I-94	University	Jackson	M-60 to Elm Street	Continuously reinforced concrete pavement		\$3,488,000**

\* = estimated costs during design phase; \*\* = cost includes pavement and engineered cross-section; NB = northbound; SB = southbound; WB = westbound; FY = fiscal year

The following is a brief description of the status or condition of each project based on field visits in April and May of 2020. Condition ratings of good/fair/poor have been assigned to each project based on a subjective evaluation of the condition at the time of the latest field visit. These are intended to provide the reader with a general sense of the performance (in terms of anticipated distress and ride quality per the design type) of each project and may not reflect any future decisions about each project once enough information is obtained to make a final determination.

**I-75 Northbound (Ski Park Rd. to Roscommon Co. Line, Ogemaw County, North Region):**

This project, constructed in 2003, is a 6-inch unbonded concrete overlay on the northbound direction only, with a 20-year design life. It includes the following test sections:

- Section 1: 10-foot transverse joint spacing, unsealed joints, no load transfer bars, 0.260 miles
- Section 2: 10-foot transverse joint spacing, sealed joints, no load transfer bars, 0.252 miles
- Section 3: 12-foot transverse joint spacing, unsealed joints, no load transfer bars, 1.439 miles
- Section 4: 12-foot transverse joint spacing, sealed joints, no load transfer bars, 1.421 miles
- Section 5: 12-foot transverse joint spacing, sealed joints, load transfer bars, 0.478 miles

The southbound direction, constructed at the same time, was rubblized (existing concrete pavement broken into smaller pieces resembling gravel) and overlaid with 6.5-inches of hot mix asphalt (HMA). This section serves as an approximate comparison to the northbound demonstration project in consideration of the time of construction and similar existing cross-sections prior to their overlays.

Project Evaluation Recommendation: Per the 2018 Pavement Demonstration Program Project Evaluation technical report, it is recommended that monitoring of this demonstration project end because enough time has passed (14 years) to fully evaluate its experimental aspects (unsealed joints, no dowel bars, and reduced joint spacing). That report concluded that unbonded concrete overlays should have sealed transverse and longitudinal joints. Additionally, transverse joints should be doweled along with tied longitudinal joints. Finally, 12-foot joint spacing should be maintained for 6-inch concrete pavement with adequate provisions to ensure proper drainage of the HMA open-graded interlayer. A final report on this project is currently under review by MDOT and our industry partners. Final recommendations are to be officially approved by MDOT after completion of that review. Monitoring of this project is suspended due to this ongoing review.

**M-84/Bay Road Southbound (Pierce Road to Delta Road, Saginaw County, Bay Region):**

This project is a 6.5-inch HMA 40-year design perpetual pavement completed in the fall of 2005. This was a two-lane road that was upgraded to a four-lane boulevard section and built over a two-year period. The northbound direction contains a standard 6.5-inch HMA cross-section (20-year design) that was built in 2004. The southbound direction contains the perpetual pavement, which is a 40-year design. Polymerization of the asphalt binder used in the HMA and a thicker unbound aggregate base are expected to increase the service life over the standard cross-section. With the perpetual pavement concept, the cross-section and materials used are designed to eliminate cracking that initiate at the bottom of the asphalt pavement. This would leave only surface cracking that can be maintained with mill/resurface preventive maintenance fixes at intervals that could be as long as 15 years. The initial costs of a perpetual pavement, however, can be significantly higher than a standard design.

Project Evaluation Recommendation: Per the February 2020 Pavement Demonstration Program Project Evaluation technical report, it is recommended that monitoring of all current perpetual pavement demonstration projects continue because these require further investigation, have not aged enough, or need more performance data to determine if this demonstration type should be standardized. It was recommended that for this project, further investigation with pavement coring should be conducted to determine if noted distress is localized to the surface.

Latest Condition Survey: Transverse cracking for both directions continues to increase, as northbound increased by 217 feet/mile over last year (an increase of 10 percent) and southbound increased by 351 feet/mile over last year (an increase of 11 percent). While the increase in southbound is greater than northbound, the cracks in southbound remain tight (approximately 1/16<sup>th</sup> of an inch) and those in northbound are much wider (approximately 1 inch) with some observed faulting. The amount of longitudinal cracking in both directions continues to be minimal. While the transverse cracking is high in both directions, it may be isolated to the surface course of the southbound perpetual pavement (as indicated by the narrow width of cracks), so this pavement may be a candidate for the first mill and resurface project. This project's performance is considered fair. However, this perpetual pavement section is exhibiting more surface cracking as compared to the other two perpetual demonstration pavements (I-96 in Metro Region and I-75 in North Region).

Therefore, additional investigation with pavement coring and falling weight deflectometer (FWD) testing was conducted in April and May of 2020. This information will help determine the cracking propagation (top or bottom) to verify whether the perpetual pavement is performing as designed with all or most cracking propagating from the surface. Additionally, cores will verify depth of the asphalt pavement per direction and the FWD data will characterize unbound base support conditions. This information will be summarized separately from this Pavement Demonstration Program Status Report but included in the Pavement Demonstration Program Project Evaluation technical report.

**M-3/Gratiot Avenue (St. Aubin Street to McClellan Street, Wayne County, Metro Region):**

This project is a 4-inch unbonded concrete overlay with a 15-year design that was constructed in the fall of 2005. Standard MDOT unbonded overlays are 6-inches or thicker. This project contains 4 test sections involving a combination of sealed and unsealed joints, with two different HMA bond breaking interlayer mixes. The HMA interlayer mixes are a standard dense-graded HMA and a more open-graded (drainable) HMA. The test sections are as follows:

- Section 1: Open-graded HMA interlayer, unsealed joints, 1 mile
- Section 2: Open-graded HMA interlayer, sealed joints, 0.85 miles
- Section 3: Dense-graded HMA interlayer, sealed joints, 0.75 miles
- Section 4: Dense-graded HMA interlayer, unsealed joints, 0.80 miles

Project Evaluation Recommendation: Per the 2018 Pavement Demonstration Program Project Evaluation technical report, this fix type of thin unbonded concrete overlay is going to be standardized for MDOT use. However, monitoring of this project will continue until this fix type is officially approved by MDOT.

Latest Condition Survey: Overall, 2,140 of the 6-foot by 5.5-foot concrete slabs are cracked or repaired (6 percent of the total in the survey area). This is an increase of 818 slabs over last year. Of the 2,140 total, 1,011 are on northbound and 1,129 on southbound. The sealed sections are exhibiting fewer cracked or repaired slabs than the unsealed (830 vs. 1,310 or 5 percent vs. 6.9 percent), while the dense-graded HMA interlayer is exhibiting fewer cracked or repaired slabs than the open-graded HMA (796 vs. 1,344 or 4.9 percent vs. 7 percent). From last year to this year, the open-graded HMA interlayer category saw the largest increase in cracked or repaired slabs (815 to 1,344). The pavement continues to show increases in cracking, raveling, and spalling throughout the project, particularly in Section 1. The longitudinal joint in the middle of the rightmost northbound lane, has significant spalling. It is most severe in Sections 2 and 3 but improves in Section 4. Asphalt repair has been used in some of the joint, but much of it is not repaired. Otherwise, most of the distresses are concentrated in and around intersections, transitions, bus lanes, and manholes. To address these distresses, it appears that annual maintenance work has been conducted. In fact, during this condition survey another repair project was being conducted with full and partial-depth concrete slab replacement. While there are isolated locations in poor condition, the rest of the pavement is in fair condition. Therefore, the overall performance of this pavement section is characterized as fair.

A 2004 HMA multicourse resurface on the composite section directly adjacent to the north end of this project (north of I-94) was being used as an approximate comparison section. This section has

had two repair projects since being constructed (a crack treatment in 2008 and single course resurface in 2014). Currently, this location has sealed and unsealed cracking.

**M-13/Euclid Avenue (Mary Drive to North Street, Bay County, Bay Region):**

This project is a low-volume concrete pavement with a 20-year design that was constructed in the summer of 2005. The concrete is 6-inches thick, compared to a minimum concrete thickness of 8-inches on non-freeway routes. Joints are spaced 5.5-feet in both directions (transversely and longitudinally) and are unsealed. A dense-graded unbound aggregate base was used instead of the standard open-graded aggregate base material.

**Project Evaluation Recommendation:** Per the 2018 Pavement Demonstration Program Project Evaluation technical report, it is recommended that a performance curve for life-cycle purposes be developed based on the data from the M-13 project with a maximum traffic restriction (and/or other design restrictions) per this new pavement fix type. At the time of this recommendation, this project and the other M-99 project were approximately 13 years old and performing as good or better than standard concrete reconstruction projects. Since initial construction costs of this design type are generally lower than the standard 8-inch minimum design and their performance is at least equivalent, it was concluded (based on a qualitative and quantitative evaluation of available data) that they are a cost-effective alternative for low-volume roadways. Monitoring of this project will continue until this fix is officially approved by MDOT as a standard fix type.

**Latest Condition Survey:** 138 of the 5.5-foot by 5.5-foot slabs were noted as being cracked or repaired this year. This is a slight increase as compared to last year. Still, the number of cracked or repaired slabs only represent approximately 1.7 percent of the total slabs for this pavement. Note that these counts include the 40 slabs that are cracked at the south side of the Pinconning River Bridge. The probable cause for the higher distress levels at the south side of the bridge is heavy equipment (large crane, etc.) that was parked on the area during a 2009 bridge repair project. Otherwise, there is a significant amount of scaling and spalling at the joints, particularly within the first 550-feet of the south end of the project in the northbound lanes, where they were filled with a spray-on asphalt emulsion patching material (commonly referred to by its commercial name AMZ). This joint deterioration is commonly related to the equipment used to saw the joints and the timing of the sawing operation. The repairs continue to pop-out, possibly due to further concrete spalling or slab movement, but about half of the repairs remain stable. The mid-lane longitudinal joint of the rightmost lane, in both directions is exhibiting some widening and low levels of faulting at various locations. This appears to have impacted the cross slope of the lane. Overall, the performance of this pavement section is characterized as good.

**I-96 Westbound (M-39/Southfield Freeway to Schaefer Rd., Wayne County, Metro Region):**

This project is a 14-inch HMA perpetual pavement constructed in the fall of 2005 in the westbound local and express lanes. The eastbound local and express lanes were reconstructed using standard MDOT concrete design. The concrete is a 20-year design, while the perpetual pavement is a 40-year design, so this is not a direct comparison.

**Project Evaluation Recommendation:** As stated previously, per the February 2020 Pavement Demonstration Program Project Evaluation technical report, it is recommended that monitoring of all current perpetual pavement demonstration projects continue because these require further investigation, have not aged enough, or need more performance data to determine if this

demonstration type should be standardized. It was recommended that for this project, more data is needed due to the low age of this project relative to the design life and minimal observed distress. Currently, the distress is too low to estimate an inflection point for the future distress progression.

Latest Condition Survey: The pavement condition remains mostly stable as compared to the last annual assessment. For the local lanes, the previously noted segregation and raveling of the longitudinal construction joint between the outside lane and the on/off ramps along the project length remains mostly stable. However, some infrequent random longitudinal joint pop-outs are present between lanes. For the express lanes, longitudinal joint separation and raveling was observed between the leftmost and middle lanes along with the rightmost lane and right shoulder with severe separation observed at two different locations approximately 1,000-feet in length. Note that longitudinal joint problems are typically a construction-related issue and are, therefore, not considered a problem of the perpetual pavement design. No change was observed in the condition of the two transverse cracks that developed around the edges of a culvert along the westbound local lanes. Otherwise, the local lanes had approximately 8 potholes, while the express lanes had approximately 11 intermittent potholes. Most of these were in shaded locations under bridge overpasses. This may suggest that these areas are blocking sun light and preventing evaporation of water, so they are retaining water longer, which in turn, is causing damage to those lanes. The local lanes had approximately 35-feet of longitudinal cracking and the express lanes had approximately 16-feet of longitudinal cracking with 36-feet of transverse cracking. The occurrence of this type of cracking is very low as compared to the project length. Therefore, the performance of this pavement section is characterized as good.

**M-99/Eaton Rapids Road (Village of Springport, Jackson County, University Region):**

This is the second low-volume roadway concrete pavement with a 20-year design similar to the M-13 project (5.5-foot joint spacing in both directions), except the joints for this project are spaced at 6-feet in both directions. It was constructed in summer/fall of 2006 and is approximately 800-feet in length.

Project Evaluation Recommendation: As stated previously, per the 2018 Pavement Demonstration Program Project Evaluation technical report, it is recommended that a performance curve for life-cycle purposes be developed with a maximum traffic restriction (and/or other design restrictions) per this new pavement fix type. Monitoring of this project will continue until this fix is officially approved by MDOT as a standard fix type.

Latest Condition Survey: Only 6 new cracked concrete slabs were noted this year within the project limits. However, existing distresses, including cracks, spalls, and corner breaks were showing increases in severity levels. Moreover, 32 additional slabs had noted spalling this year as compared to last year. Approximately 7.4 percent of all slabs are cracked or repaired and approximately 7 percent of all slabs have some amount of spalling. Therefore, about 14.4 percent of all slabs are cracked, repaired, or have some spalling. While this percentage is elevated, most repairs are related to construction warranty work and much of the spalling is likely related to late sawing of the joints. This spalling is consistent with observations of the first annual review in 2007, where early cracking within inches of the joint was observed. There is some faulting, but it is isolated and minimal. Similar to previous surveys, the progression of distress (number and severity of distresses) is steady. Overall, performance of this pavement section is characterized as fair.

**I-75 Northbound (Topinabee Mail Rte. Rd. north for 2.37 mi, Cheboygan Co, North Region):**

This is another 40-year HMA perpetual pavement design constructed in the fall of 2008. For this project, the existing concrete pavement was rubblized prior to the paving of the HMA. Rubblization is a standard fix type, however, the HMA resurfacing is normally a 20-year design.

Project Evaluation Recommendation: As stated previously, per the February 2020 Pavement Demonstration Program Project Evaluation technical report, it is recommended that monitoring of all current perpetual pavement demonstration projects continue because these require further investigation, have not aged enough, or need more performance data to determine if this demonstration type should be standardized. It was recommended that for this project, more data is needed due to the low age of this project relative to the design life and minimal observed distress. Currently, the distress is too low to estimate an inflection point for the future distress progression.

Latest Condition Survey: Transverse cracking increased from 14 locations to 45 locations (244-feet to 284-feet total). This is still considered very low at approximately 60 feet/lane-mile. Longitudinal cracking also remains low as it marginally increased from 7-feet to 22-feet. About half of all observed cracks are sealed and unsealed cracks continue to be very tight. However, the longitudinal joint between the right lane and right shoulder continues to separate in some areas (up to 2-inches in width). Also, some localized areas on the pavement surface exhibited low levels of segregation. Particularly at the southern and northern transitions to and from the project, some potholes and surface delamination were observed (mostly in the right lane). These are typically construction related issues. Overall, the performance of this pavement section is characterized as good.

**M-1/Woodward Avenue (Tuxedo Street to Chandler Street, Wayne County, Metro Region):**

This project is a 4-inch unbonded concrete overlay with a 15-year design similar to the M-3 project. It was constructed in 2010 and does not contain test sections. All joints were sealed and the same HMA interlayer (drainable open-graded HMA) was used throughout. Transverse joints are spaced at 6-feet, while the longitudinal joints are spaced at 5-feet.

Project Evaluation Recommendation: As stated previously, per the 2018 Pavement Demonstration Program Project Evaluation technical report, this fix type of thin unbonded concrete overlay is going to be standardized for MDOT use. However, monitoring of this project will continue until this fix type is officially approved by MDOT.

Latest Condition Survey: The pavement continues to be in similar condition as observed last year but was recently repaired with intermittent full-depth concrete slab replacement. A total of 572 of the 6-foot by 5-foot slabs are cracked or repaired, which is 158 more than last year (an increase of 38 percent). This, however, still only represents 5.4 percent of the total survey area. Similar to last year, intermittent black staining was noted on either side of some longitudinal and transverse joints. Further investigation will be needed to determine its cause. This may be due to pumping of water at the HMA interlayer. However, the associated slabs of this staining do not show much distress. While not tracked in the counts due to parking, most of the slabs in the outside parking lanes have been repaired with the noted repair project. Before being repaired, many of these slabs were shattered and faulted. Similarly, the outermost travel lanes, (next to the parking lanes) have more distressed or repaired slabs than the inner travel lanes, making up nearly 75 percent of the cracked or repaired slabs. This may be due to a water drainage issue (as the water travels to the outside of the roadway and gets trapped in the base) and/or due to propagation of the distress from

the parking lanes. Past reviews have speculated that the parking lanes may have been constructed at a different time than the rest of the travel lanes and may be made of different material (due to their color difference in comparison to the rest of the travel lanes), so their observed distresses may be material related. Further investigation will be needed to determine the observed performance differences. Overall, the performance of this pavement section is characterized as fair.

**I-94 (M-60 to Elm Street, Jackson County, University Region):**

This is a 6-lane (3 lanes in each direction) reconstruction project using a 13-inch thick continuously reinforced concrete pavement (CRCP). Due to the existence of underground abandoned mineshafts within the right-of-way of this roadway, CRCP was selected to provide additional safety against the risk of subsidence. This is the first use of CRCP by MDOT since the late-1970s. Construction began in the spring of 2019. The eastbound direction was completed in that same year. However, the westbound direction is under construction during 2020, so annual reviews of this direction (with eastbound) will not begin until 2021. Therefore, only the eastbound direction is summarized in the latest condition survey below.

Latest Condition Survey: The CRCP pavement type is designed to have tight transverse cracks that are closely spaced from 1.5-feet to 6.0-feet apart to maximize load-transfer efficiency and minimize flexural stresses. Thus far, tight transverse cracks are appearing as expected. Some are in groups spaced 3-feet to 6-feet apart and others appear as single cracks, spaced several feet from the next crack. Transverse cracks should continue to appear as the pavement ages and crack spacing is expected to reduce (as new transverse cracks appear and reduce isolated cracks). For now, this crack spacing is adequate, but some intersecting cracks were observed, which are concerning at this early stage. Cracks should be relatively straight and not intersect. These will be monitored for future progression and potential for distress. Otherwise, no longitudinal cracks were observed. The jointed plain concrete pavement shoulders had straight and tight joints with no sympathy cracks coming from the shoulder joints to the mainline lanes. Finally, it should be noted that during I-94 eastbound construction, the concrete supply to the paver was intermittent from stations 2153+00 to 2154+50. Therefore, additional hand finishing was required in this area. Additionally, the middle lane had a full-depth patch at station 2132+10 because of construction damage to the newly paved CRCP. These locations could not be adequately reviewed due to ongoing construction barriers, but these locations will be monitored in the future. Overall, the current ride quality is good, but for now, the pavement is considered in fair condition because the crack propagation is still uncertain.

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