

# **Pavement Demonstration Program Status Report**

## **Public Act 457 of 2016**

### **June 2021**

#### **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 are and will be outlined in this Pavement Demonstration Program Status Report. A separate technical report, Pavement Demonstration Program Project Evaluation, provides further details about final recommendations. This report is available upon request. 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. Pavement demonstration cost balancing is summarized in Table 2.

**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 concrete 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 concrete 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 concrete overlay		\$931,000
2018/2020	I-94	University	Jackson	M-60 to Elm Street	Continuously reinforced concrete pavement		\$3,488,000**
2021/2022	US-24	Metro	Wayne	Grand River to north of 8 Mile Road	Asphalt reconstruction modification per stabilized subgrade	\$3,190,500**	

\* = estimated costs of the pavement during design phase

\*\* = cost also include engineered cross-section (as well as the pavement)

\*\*\* = project finalized - no further annual monitoring or reporting

NB = northbound; SB = southbound; WB = westbound; FY = fiscal year

**Table 2. Pavement Demonstration Type Cost Balance**

Initial Project Constructed	3-Year Period End	Demonstration Costs		Percent Difference
		Asphalt	Concrete	
2020	2022	\$3,190,500	\$3,488,000*	8.9%
TOTAL**		\$3,190,500	\$3,488,000	8.9%

\* = initial project; \*\* = total since 25% cost balancing requirement

The following is a brief description of the status or condition of each project based on field visits in March, April, and May of 2021. 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.

This demonstration project no longer requires annual monitoring due to final reporting that includes closeout recommendations per the MDOT report RR-784, "Pavement Demonstration Program Project Finalization I-75 Northbound Unbonded Concrete Overlay (MDOT Job Number 73873)." As summarized in this report, since an adequate amount of time has passed and enough data is available to fully evaluate this project and its experimental aspects (unsealed joints, no dowel bars, reduced joint spacing), MDOT recommends that monitoring of this demonstration project end and be considered complete. Per the findings and conclusions of the report, unbonded concrete overlays should have sealed transverse and longitudinal joints. Additionally, transverse joints should be doweled along with longitudinal joints being tied. Finally, a 12-foot joint spacing should be maintained for 6-inch (or more) concrete pavement with adequate provisions to ensure proper drainage of the HMA open graded interlayer.

**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 reconstruction 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 2021 Pavement Demonstration Program Project Evaluation technical report, it is recommended that monitoring of this demonstration project end with its final report because it now has enough condition data and evidence that it is ready for project close out. Moreover, while cracking will likely increase, the relative annual increase is decreasing (slowing). Therefore, additional annual field reviews are unlikely to add benefit since cracking is unlikely to significantly change and/or alter conclusions. This is further supported by 2020 coring and falling-weight-deflectometer (FWD) testing (which is also summarized in the Evaluation report). Alternatively, the other two perpetual pavement demonstration projects (westbound I-96 and northbound I-75) would benefit from more condition data to validate their performance trends, so these may not be ready for close out (finalization). Therefore, a project final report will be assembled for this project (M-84), but the HMA perpetual pavement design concept will continue to be monitored with any other ongoing projects. Interim status of the HMA perpetual pavement design concept will be included in the M-84 final report. Monitoring of this project will continue until this final report is officially approved by MDOT.

Latest Condition Survey: Transverse (thermal) cracking for both directions continues to increase, as northbound increased by 126 feet/lane-mile over last year, (an increase of 5 percent) and southbound increased by 513 feet/lane-mile over last year, (an increase of 15 percent). While the increase on 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 and fatigue (structural) cracking in both directions continues to be very low. Therefore, the perpetual design concept of this demonstration project appears to be effectively supporting the traffic loadings and preventing structural damage, but it is performing poorly in thermal cracking, which is likely due to the HMA mixture characteristics. As supported by the 2020 coring data, FWD testing, and narrow crack widths, most of the cracking is isolated to the surface course so this pavement would be a good candidate for its first mill and resurface project to renew the surface and resist thermal cracking. Therefore, while this project is performing poorly in thermal cracking, the structural characteristic of this pavement is considered good.

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

This project is a 4-inch thin 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. Transverse joints are spaced at 6-feet, while the longitudinal joints are spaced at 5.5-feet. 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 February 2021 Pavement Demonstration Program Project Evaluation technical report, this fix type of thin unbonded concrete overlay is going to be standardized for MDOT use, so a final report will be composed for this project. However, monitoring of this project will continue until this final report is officially approved by MDOT.

**Latest Condition Survey:** Overall, 3,440 of the concrete slabs are cracked or repaired (9.7 percent of the total in the survey area). This is an increase of 1,300 slabs over last year. Of the 3,440 total, 1,863 are on northbound and 1,577 on southbound. Unlike last year, the sealed sections are now exhibiting a higher frequency of cracked or repaired slabs than the unsealed (10.6 percent vs. 8.9 percent). Also, unlike last year, the dense-graded HMA interlayer is now exhibiting a slightly higher frequency of cracked or repaired slabs than the open-graded HMA (10 percent vs. 9.4 percent). From last year to this year, the sealed category saw the largest increase in frequency of cracked or repaired slabs (5 percent to 10.6 percent). The pavement continues to show increases in cracking, raveling, and spalling throughout the project. 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 to fill the joint. 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. Accordingly, locations in poor condition have been repaired and/or maintained and over 90 percent of the remaining slabs exhibit no cracking. 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 three contracted repair projects since being constructed (crack treatments in 2008 and 2019, and a single course HMA 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 February 2021 Pavement Demonstration Program Project Evaluation technical report, it is recommended that low-volume concrete pavement is to be standardized for MDOT use, so a final report will be composed for this project. However, monitoring of this project will continue until this final report is officially approved by MDOT.

**Latest Condition Survey:** It was observed that additional intermittent full-depth concrete slab replacement occurred sometime in 2020, after the previous annual review. A total of 194 of the concrete slabs were noted as being cracked or repaired which is 56 more than last year. However, the number of cracked or repaired slabs only represent approximately 2.3 percent of the total slabs for this pavement. Note that these counts include the 45 slabs that are cracked or repaired 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 intermittent 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 timing of the sawing operation. The repairs continue to deteriorate, due to their age and 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. 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 reconstruction completed in the fall of 2005 in the westbound local and express lane sections. 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 2021 Pavement Demonstration Program Project Evaluation technical report, it is recommended that monitoring of this perpetual pavement demonstration project continue because more performance data is needed to support the current projections.

Latest Condition Survey: The pavement condition remains mostly stable as compared to the last annual assessment, but there were 15 intermittent repair patches (~0.5 percent of the surface area) conducted in the express section sometime in 2020, after the previous annual review. For the local lane section, segregation and raveling of the longitudinal construction joint between the outside lane and the on/off ramps along the project length is increasing, with distress up to 2-feet wide. Similarly, the longitudinal joints between the lanes have started to separate, including intermittent longitudinal joint pop-outs between the lanes. Note that longitudinal joint problems are typically a construction related issue and are, therefore, not considered a problem of the perpetual pavement design. Otherwise, 18 potholes and 40-feet of longitudinal cracking was observed, which is low. 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. For the express lane section, due to the noted repairs, almost all locations with longitudinal joint separation have been restored. Express lanes had approximately 27 intermittent potholes with most located 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. Cracking in this section remains low with 174-feet and 123-feet of longitudinal and transverse crack types, respectively. Therefore, for both sections, the occurrence of cracking is very low as compared to the project length. The performance of both pavement sections 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. Like M-13, a dense-graded unbound aggregate base was used instead of the standard open-graded aggregate base material.

Project Evaluation Recommendation: As stated previously, per the February 2021 Pavement Demonstration Program Project Evaluation technical report, it is recommended that low-volume concrete pavement is to be standardized for MDOT use, so a final report will be composed for this project. However, monitoring of this project will continue until this final report is officially approved by MDOT.

Latest Condition Survey: Only 2 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, 59 additional slabs had noted spalling this year as compared to last year. Approximately 7.5 percent of all slabs are cracked or repaired and approximately 13.1 percent of all slabs have some amount of spalling. Therefore, about 20.6 percent of all slabs are cracked, repaired, or have some spalling. While this percentage is elevated, construction related issues are at least in part contributing to this, including construction warranty repairs and initial spalling due 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. Otherwise, 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 a 40-year HMA perpetual pavement design over rubblized concrete constructed in the fall of 2008. Concrete rubblization is a process that pulverizes and crushes the existing concrete pavement into small fragments, similar to an aggregate base. HMA over rubblized concrete is a standard fix type, however, the HMA resurfacing is normally a 20-year design.

Project Evaluation Recommendation: As stated previously, per the February 2021 Pavement Demonstration Program Project Evaluation technical report, it was recommended that monitoring of this perpetual pavement demonstration project continue because more performance data is needed to support the current projection. Moreover, relative to the design life, the project age is still somewhat low, so there is a limited number of observed distress data points.

Latest Condition Survey: A chip seal with fog coat maintenance project (MDOT Job Number 204267) occurred in 2020, after the previous annual review. Therefore, the following summary of observed distresses will be significantly different from previous years and may not be directly comparable. With this in consideration, transverse cracking decreased from 45 locations to 18 locations (284-feet to 216-feet total). All crack locations are unsealed and full width. This matches the previous review for the number of full width locations. This suggests that these cracks are those from the original pavement that have reflected through the chip seal. Regardless, the cracking is tight, and the amount of transverse cracking is very low at approximately 45-feet/lane-mile.

Longitudinal cracking was previously noted as very low (22-feet total), but due to the maintenance project, no longitudinal cracking was observed. The longitudinal joint between the right lane and right shoulder was noted as widening in some locations, up to 2-inches. However, this was improved by the maintenance project, so now only very few locations have raveling, and it is only up to 1-inch wide. Potholes and delamination at the southern and northern transitions to and from the project were improved but are still present (mostly in the right lane). This distress is typically due to 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 thin unbonded concrete overlay with a 15-year design similar to the M-3 project. It was constructed in 2010 and contains a single uniform test section (unlike M-3, which has four different sections). All joints were sealed and the same dense-graded HMA interlayer 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 February 2021 Pavement Demonstration Program Project Evaluation technical report, this fix type of thin unbonded concrete overlay is going to be standardized for MDOT use, so a final report will be composed for this project. However, monitoring of this project will continue until this final report is officially approved by MDOT.

Latest Condition Survey: It was observed that additional intermittent full-depth concrete slab replacement occurred sometime in 2020, after the previous annual review. A total of 843 of the concrete slabs are cracked or repaired, which is 271 more than last year (an increase of 47 percent). This represents 8 percent of the total survey area. Like previous years, 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 and most joints remain in fair to good condition. While not tracked in the counts due to parking, most of the slabs in the outside parking lanes have been repaired. As noted in past reviews, prior to 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, consisting of about 77 percent of the noted 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 interlayer) 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. Otherwise, it appears that recent annual maintenance work, within the last 3 years has been conducted. Accordingly, locations in poor condition have been repaired and/or maintained. Therefore, 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 with the eastbound direction completed in that same year. The westbound direction was under construction and completed during 2020, so this is the first annual review of the westbound corridor.

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, for both bounds, 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 more than 10-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 in both bounds, 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. Since last year, for the eastbound section, some of these cracks have developed very minor spalls and additional cracks are converging, particularly west of the Cooper Street overpass. Additionally, a very straight and defined transverse crack was observed at station 2147+20, which could indicate a stopped paving sequence or sympathy cracking from the shoulder transverse joint. A similar transverse crack with minor spalling was observed in the westbound section at station 2149+00. These locations should be monitored for future potential distress. Otherwise, for both bounds, no longitudinal cracks were observed. The jointed plain concrete pavement shoulders have straight and tight joints. Regarding construction, 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. To date, there are no observed problems at these locations. For westbound construction, there are several areas where diamond grinding was required to achieve initial ride quality tolerance, particularly west of the Cooper Street off ramp. This may indicate concrete material delivery quality and finishing issues and/or poor uniformity of the base, so these locations will be closely monitored for ongoing performance. Overall, the pavement is considered in good condition, but the future crack propagation is still uncertain.

### **US-24 (Grand River Avenue to 8 Mile Road, Wayne County, Metro Region):**

This will be an HMA reconstruction project with initial construction in 2021 and expected completion in 2022. Within the project limits, US-24 is a boulevard that has four lanes in each direction with additional intermittent inside and outside turn lanes. The cross-section (from bottom to top) will be 8-inches of sand subbase, 16-inches of open-graded drainage course and 7-inches of HMA pavement. However, two sections will stabilize the subgrade, with one of those sections eliminating the 8-inches of sand subbase. Therefore, this project will be split into three sections with descriptions and locations defined in the following test sections:

- Section 1: Stabilized subgrade and no sand subbase, 0.37 miles
- Section 2: Stabilized subgrade, 0.34 miles
- Section 3: Standard section (control without stabilization), 0.27 miles

This pavement demonstration project is intended to provide MDOT with information regarding the benefits to HMA reconstruction projects due to stabilizing subgrade. The three sections will help MDOT understand the influence of stabilized subgrade on the performance, and if the engineered cross-section can be reduced due to the improved subgrade (test section number 1). In accordance with the anticipated end of construction, the annual reviews for this demonstration project are expected to begin in 2023 and first reported in the 2023 Pavement Demonstration Program Status Report.

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