

Office of the Auditor General
Performance Audit Report

Pavement Operations
Michigan Department of Transportation

March 2018

State of Michigan Auditor General
Doug A. Ringler, CPA, CIA

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Article IV, Section 53 of the Michigan Constitution



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Report Summary

Performance Audit

Pavement Operations

Michigan Department of Transportation (MDOT)

Report Number:
591-0310-17

Released:
March 2018

MDOT is responsible for Michigan's 9,669-mile State highway system, which comprises all M, I, and U.S. routes. MDOT's Pavement Operations Section, regional offices, and transportation service centers are responsible for determining the most cost-effective pavement material for projects, testing supplier materials prior to and throughout project completion, and conducting pavement demonstration projects to identify new construction methods, materials, and/or designs. As of July 31, 2017, the Pavement Operations Section in the Construction Field Services Division had 47 employees and expended \$5.8 million during fiscal year 2016. In addition, as of July 31, 2017, the regional offices and transportation service centers had 84 and 252 employees, respectively, who had pavement operations related responsibilities.

Audit Objective			Conclusion
Objective #1: To assess the effectiveness of MDOT's efforts to ensure that pavement material used meets specifications.			Effective
Findings Related to This Audit Objective	Material Condition	Reportable Condition	Agency Preliminary Response
None reported.		Not applicable.	

Audit Objective			Conclusion
Objective #2: To assess the effectiveness of MDOT's pavement type selection process.			Effective
Findings Related to This Audit Objective	Material Condition	Reportable Condition	Agency Preliminary Response
None reported.		Not applicable.	

Audit Objective			Conclusion
Objective #3: To assess the sufficiency of MDOT's efforts to manage the Pavement Demonstration Program.			Sufficient, with exceptions
Findings Related to This Audit Objective	Material Condition	Reportable Condition	Agency Preliminary Response
MDOT has not quantified the performance and/or cost-effectiveness of its eight pavement demonstration projects to allow determined benefits to be implemented in future projects (<u>Finding #1</u>).		X	Agrees

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Auditor General

March 14, 2018

Mr. Todd Wyett, Chair
State Transportation Commission
and
Kirk T. Steudle, PE, Director
Michigan Department of Transportation
Murray D. Van Wagoner Building
Lansing, Michigan

Dear Mr. Wyett and Mr. Steudle:

This is our performance audit report on Pavement Operations, Michigan Department of Transportation.

We organize our findings and observations by audit objective. Your agency provided the preliminary response to the recommendation at the end of our fieldwork. The *Michigan Compiled Laws* and administrative procedures require an audited agency to develop a plan to comply with the recommendations and to submit it within 60 days of the date above to the Office of Internal Audit Services, State Budget Office. Within 30 days of receipt, the Office of Internal Audit Services is required to review the plan and either accept the plan as final or contact the agency to take additional steps to finalize the plan.

We appreciate the courtesy and cooperation extended to us during this audit.

Sincerely,

A handwritten signature in cursive script that reads "Doug Ringler".

Doug Ringler
Auditor General

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AUDIT OBJECTIVES, CONCLUSIONS, FINDINGS, AND OBSERVATIONS

ENSURING PAVEMENT MATERIAL USED MEETS SPECIFICATIONS

BACKGROUND

The Michigan Department of Transportation's (MDOT's) Pavement Operations Section operates three American Association of State Highway and Transportation Officials accredited labs (aggregate*, concrete, and hot mix asphalt*) that test supplier materials to ensure that they meet specifications prior to and as needed during their use on an MDOT project. Their respective responsibilities include:

Aggregate lab:

- Evaluation of construction aggregates.
- Management of the Aggregate Supplier Program.
- Updating of the Aggregate Inspection Manual.

Concrete lab:

- Freeze thaw testing of aggregate.
- Testing of concrete cylinder strength.
- Testing of cement, concrete products, and concrete mix design.
- Testing of concrete project disputed results.

Hot mix asphalt lab:

- Management of asphalt binder and emulsion certification programs.
- Verification of mix design.
- Testing of daily mix samples.
- Testing of hot mix asphalt project disputed results.

Also, MDOT's 7 regions and 22 transportation service centers test materials throughout a project's construction to ensure that the materials continue to meet specifications.

AUDIT OBJECTIVE

To assess the effectiveness* of MDOT's efforts to ensure that pavement material used meets specifications.

CONCLUSION

Effective.

* See glossary at end of report for definition.

**FACTORS
IMPACTING
CONCLUSION**

- MDOT appropriately tested materials for the 9 completed concrete projects and the 25 completed hot mix asphalt projects that we reviewed.
- MDOT processed 100% of the 268 dispute samples received from October 1, 2014 through July 31, 2017 in a timely manner.
- MDOT took appropriate corrective action for the 21 dispute and 5 failed binder samples that we reviewed.
- MDOT properly certified the following suppliers and materials that we reviewed:
 - 25 prequalified aggregate suppliers.
 - 1 emulsified asphalt supplier and 2 emulsified asphalt materials.
 - 2 asphalt binder suppliers and 7 asphalt binder materials.
- MDOT appropriately tested and followed up on the 49 identified failures for asphalt binder samples received from January 1, 2015 through June 15, 2017.

MDOT'S PAVEMENT TYPE SELECTION PROCESS

BACKGROUND

For all projects with an estimated pavement cost exceeding \$1.5 million, Section 247.651h of the *Michigan Compiled Laws* requires MDOT to utilize a life cycle cost analysis (LCCA) to identify the most cost-effective pavement materials. LCCA considers the total cost of the initial project and anticipated costs for subsequent maintenance, repair, or resurfacing.

Also, MDOT utilizes an alternate pavement bidding (APB) process when the LCCA results in two pavement alternatives with similar costs. Bidding these projects with alternate pavement options is designed to allow market competition to determine the best value. APB projects must be approved by MDOT's Engineering Operations Committee.

MDOT's regional offices are responsible for determining pavement materials for rehabilitation and reconstruction projects that do not require an LCCA.

AUDIT OBJECTIVE

To assess the effectiveness of MDOT's pavement type selection process.

CONCLUSION

Effective.

FACTORS IMPACTING CONCLUSION

- MDOT followed the pavement type selection process for the 12 pavement projects that we reviewed.
- MDOT received appropriate approval for the 7 APB projects bid from October 1, 2014 through July 31, 2017.

MANAGING THE PAVEMENT DEMONSTRATION PROGRAM

BACKGROUND

Section 247.651i of the *Michigan Compiled Laws* allows MDOT to conduct pavement demonstration (research) projects to evaluate construction methods, materials, and/or designs not currently utilized by MDOT. The law requires MDOT to:

- Include measurable goals and objectives for each project.
- Measure the interim success of projects annually.
- Create a final report that assesses the cost-effectiveness and performance of the project compared with standard pavement material and methods currently used by MDOT.
- Provide an annual report to the Legislature on the status of each demonstration project.

As of August 2017, MDOT had 8 active demonstration projects:

Fiscal Year Let	Route or Road	County	Location	Pavement Costs
2003	I-75 NB	Ogemaw	Ski Park Road to Roscommon County Line	\$1,980,000
2003	M-84 SB	Bay/Saginaw	Pierce Road to Delta Road	\$700,000
2004	M-3	Wayne	St. Aubin Street to McClellan Street	\$2,200,000
2005	M-13	Bay	Mary Drive to North Street	\$1,200,000
2005	I-96 WB	Wayne	M-39 to Schaeffer Road	\$4,800,000
2006	M-99	Jackson	Village of Springport	\$100,000
2008	I-75 NB	Cheboygan	Topinabee Mail Road north for 2.37 miles	\$781,000
2009	M-1	Wayne	Tuxedo Street to Chandler Street	\$931,000

AUDIT OBJECTIVE

To assess the sufficiency of MDOT's efforts to manage the Pavement Demonstration Program.

CONCLUSION

Sufficient, with exceptions.

**FACTORS
IMPACTING
CONCLUSION**

- MDOT identified overall measurable goals and objectives for the projects.
- Reportable condition* related to the need to quantify the performance and/or cost-effectiveness of the pavement demonstration projects.

** See glossary at end of report for definition.*

FINDING #1

MDOT needs to quantify the performance and/or cost-effectiveness of its pavement demonstration projects.

MDOT has not quantified the performance and/or cost-effectiveness of its pavement demonstration projects to allow determined benefits to be implemented in future projects.

Section 247.651i(1) of the *Michigan Compiled Laws* requires that MDOT measure the success of each demonstration project on an annual basis, compare the results of each project to the standard materials used, and report on the overall success of the materials and design at the end of each project's demonstration life.

As of August 2017, MDOT's 8 active demonstration projects were 8 to 14 years old. MDOT visually assessed the projects on an annual basis; however, it had not compared the performance of any of the projects against the standard materials and/or methods utilized in MDOT's road rehabilitation and reconstruction projects.

MDOT informed us that it does not have policies or procedures to evaluate or measure the success of the demonstration projects.

RECOMMENDATION

We recommend that MDOT quantify the performance and cost-effectiveness of its pavement demonstration projects.

AGENCY PRELIMINARY RESPONSE

MDOT provided us with the following response:

MDOT concurs with the recommendation.

In general, to measure performance of MDOT's highway network, MDOT uses Distress Index (DI) values that MDOT has collected every other year since 1992 for the MDOT road network (30 thousand lane miles). At an appropriate time, MDOT plots the DI as a function of age for the projects of a fix type. MDOT then fits a logistic growth curve to the data to determine the fix life, or the time the pavement fix type is expected to last without maintenance. When plotted for demonstration projects, this curve, coupled with maintenance information, can be used to compare and contrast to standard types of fixes, which may or may not exist for a particular type of demonstration project.

As of the audit period and as described in the audit finding, MDOT had not yet used DI data to evaluate and analyze the pavement performance of the referenced demonstration projects. The ages of the projects, in conjunction with the technical type of projects, are recently at a point which MDOT can begin DI plotting. After the issue was discussed as part of the LCCA process updates, MDOT began developing the DI life cycle curves for two of the demonstration projects (M-1 and M-3) that, eventually, might lead to a new standard MDOT fix.

For three of the demonstration projects (M-84, I-96, and I-75 Cheboygan County), however, early data would likely provide unrealistic performance characteristics. These three demonstration projects were constructed with a 40 year design life, which will take additional evaluation time. Therefore, for

these projects, predictions of long term performance using DI efforts may not be possible until additional data is available.

Also, relative to compliance with law, MDOT has documented its visual/qualitative evaluations of the conditions of pavement demonstration projects. The results of these evaluations are reported annually to the legislature. The 2017 legislative report incorporated a brief qualitative statement on performance of each demonstration project.

By August 1, 2018, MDOT will evaluate and quantitatively analyze the performance of the three remaining demonstration projects (I-75 Ogemaw County, M-13, and M-99) not referenced above, to ascertain if performance trends can be determined and, if appropriate, determine applicability as a standard fix.

MDOT will develop a process for evaluating demonstration projects to determine applicability into design standard practice by August 1, 2018.

DESCRIPTION

MDOT is responsible for Michigan's 9,669-mile State highway system, which comprises all M, I, and U.S. routes.

MDOT's Pavement Operations Section, regional offices, and transportation service centers share responsibility for ensuring the quality and cost-effectiveness of pavement material used during construction. These responsibilities include testing and approving supplier materials prior to use on a project; testing materials throughout a project's construction; retesting disputed results; certifying suppliers; quantifying the cost-effectiveness of pavement materials for specific projects; and conducting pavement demonstration projects to identify new construction methods, materials, and/or designs.

As of July 31, 2017, the Pavement Operations Section in the Construction Field Services Division had 47 employees and expended \$5.8 million during fiscal year 2016. In addition, as of July 31, 2017, the regional offices and transportation service centers had 84 and 252 employees, respectively, who had pavement operations related responsibilities.

AUDIT SCOPE, METHODOLOGY, AND OTHER INFORMATION

AUDIT SCOPE

To examine the activities and records related to MDOT's pavement operations. We conducted this performance audit* in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

PERIOD

Our audit procedures, which included a preliminary survey, audit fieldwork, report preparation, analysis of agency responses, and quality assurance, generally covered October 1, 2014 through July 31, 2017.

METHODOLOGY

We conducted a preliminary survey of MDOT's pavement operations to formulate a basis for establishing our audit objectives and defining our audit scope and methodology. During our preliminary survey, we:

- Interviewed MDOT management and staff regarding their functions and responsibilities.
- Reviewed applicable State laws and MDOT's policies, procedures, and manuals.
- Obtained an understanding of MDOT's processes related to:
 - Receipt and testing of materials in the concrete, aggregate, and asphalt labs.
 - Approval and tracking of tested stock material.
 - Updating and maintaining of initial construction costs, initial user costs, and maintenance costs for the LCCA calculation.
 - Review and approval of pavement mix designs for hot mix asphalt.
 - Management of the Pavement Demonstration Program.

OBJECTIVE #1

To assess the effectiveness of MDOT's efforts to ensure that pavement material used meets specifications.

* See glossary at end of report for definition.

To accomplish this objective, we:

- Reviewed the MDOT Pavement Operations Section and regional labs to ensure proper certification.
- Reviewed 25 of 271 prequalified aggregate suppliers to determine if they met MDOT requirements. We randomly selected our sample to eliminate bias and enable us to project the results to the entire population.
- Reviewed 2 of the 12 emulsified asphalt suppliers and/or materials added to MDOT's approved emulsified asphalt certifiers list during the audit period to ensure that all material requirements were met. We randomly selected our sample to eliminate bias and enable us to project the results to the entire population.
- Reviewed 14 of the 58 hot mix asphalt designs submitted by contractors for 14 hot mix asphalt projects to determine if MDOT ensured that the mix design met specifications. We randomly selected our sample to eliminate bias and enable us to project the results to the entire population.
- Analyzed the sufficiency and completeness of MDOT's testing of the 476 asphalt binder samples received from suppliers from January 1, 2015 through June 15, 2017.
- Reviewed 9 of the 88 concrete projects and 25 of the 349 hot mix asphalt projects completed during the audit period to determine if proper testing of materials was completed. We randomly selected our sample to eliminate bias and enable us to project the results to the entire population.
- Reviewed the 2 asphalt binder suppliers and the 7 asphalt binder grades added to the approved asphalt binder certifiers list during the audit period to ensure that all material requirements were met.
- Analyzed the timeliness of MDOT's processing of the 268 dispute samples received by the regions during the audit period.
- Reviewed 5 of the 49 asphalt binder samples that failed the materials testing between January 1, 2015 and June 15, 2017 to determine if the region took proper action. We judgmentally selected our sample to represent different binder materials and contractors; therefore, we could not project our results to the entire population.
- Reviewed 21 of the 202 dispute samples tested during the audit period to determine if the proper action was taken by the region for materials that did not meet

specifications. We randomly selected our sample to eliminate bias and enable us to project the results to the entire population.

OBJECTIVE #2

To assess the effectiveness of MDOT's pavement type selection process.

To accomplish this objective, we:

- Reviewed 12 of the 112 pavement projects let during the audit period to determine if MDOT followed the pavement type selection process. We randomly selected our sample to eliminate bias and enable us to project the results to the entire population.
- Reviewed all 7 APB projects approved during the audit period to determine if the projects had proper approval.

OBJECTIVE #3

To assess the sufficiency of MDOT's efforts to manage the Pavement Demonstration Program.

To accomplish this objective, we:

- Reviewed MDOT's annual reports provided to the Legislature during fiscal years 2015, 2016, and 2017.
- Reviewed all 8 demonstration projects to determine how MDOT measured the success of projects.
- Reviewed all 8 demonstration projects to determine if MDOT had established measurable goals or objectives.

CONCLUSIONS

We base our conclusions on our audit efforts and any resulting material conditions* or reportable conditions.

When selecting activities or programs for audit, we direct our efforts based on risk and opportunities to improve State government operations. Consequently, we prepare our performance audit reports on an exception basis.

**AGENCY
RESPONSES**

Our audit report contains 1 finding and 1 corresponding recommendation. MDOT's preliminary response indicates that it agrees with the recommendation.

The agency preliminary response that follows the recommendation in our report was taken from the agency's written comments and oral discussion at the end of our fieldwork. Section 18.1462 of the *Michigan Compiled Laws* and

* See glossary at end of report for definition.

the State of Michigan Financial Management Guide (Part VII, Chapter 4, Section 100) require an audited agency to develop a plan to comply with the recommendations and to submit it within 60 days after release of the audit report to the Office of Internal Audit Services, State Budget Office. Within 30 days of receipt, the Office of Internal Audit Services is required to review the plan and either accept the plan as final or contact the agency to take additional steps to finalize the plan.

GLOSSARY OF ABBREVIATIONS AND TERMS

aggregate	A substance composed of mineral crystals or mineral rock fragments used in pavement.
APB	alternate pavement bidding.
DI	Distress Index.
effectiveness	Success in achieving mission and goals.
hot mix asphalt	A carefully controlled mixture of asphalt binder and well-graded, high quality aggregate that is thoroughly compacted into a uniform density.
LCCA	life cycle cost analysis.
material condition	A matter that, in the auditor's judgment, is more severe than a reportable condition and could impair the ability of management to operate a program in an effective and efficient manner and/or could adversely affect the judgment of an interested person concerning the effectiveness and efficiency of the program.
MDOT	Michigan Department of Transportation.
performance audit	An audit that provides findings or conclusions based on an evaluation of sufficient, appropriate evidence against criteria. Performance audits provide objective analysis to assist management and those charged with governance and oversight in using the information to improve program performance and operations, reduce costs, facilitate decision-making by parties with responsibility to oversee or initiate corrective action, and contribute to public accountability.
reportable condition	A matter that, in the auditor's judgment, is less severe than a material condition and falls within any of the following categories: an opportunity for improvement within the context of the audit objectives; a deficiency in internal control that is significant within the context of the audit objectives; all instances of fraud; illegal acts unless they are inconsequential within the context of the audit objectives; significant violations of provisions of contracts or grant agreements; and significant abuse that has occurred or is likely to have occurred.



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