



MnDOT Selection of Pavement Surface for Road Rehabilitation

Major Findings:

- The Minnesota Department of Transportation (MnDOT) meets many but not all recommended practices for selecting pavement for road rehabilitation projects.
- State law requires comparing pavement alternatives of “equal design life,” but national literature does not recommend it. Neither law nor policy defines the term, and interpretations differ.
- MnDOT’s identification of feasible pavement alternatives is incomplete. Costs and timing of similar maintenance in life-cycle cost analyses differed by MnDOT district; the basis for data districts used was not always shown.
- When comparing pavement alternatives, MnDOT does not evaluate “user costs,” although doing so is recommended. Further, MnDOT assesses only some of the recommended noneconomic factors and does not have a process to evaluate all relevant economic and noneconomic factors.
- MnDOT’s approach for computing life-cycle costs does not account for the uncertainty of inputs such as pavement costs.
- MnDOT is considering using material-specific inflation rates in calculating pavement materials’ costs, but the case for doing so is weak, and

forecasting long-term inflation is unsupported in economics literature.

- MnDOT’s use of alternate bidding has had limited impact on bid prices and industry competition. MnDOT cost estimates and schedules of maintenance do not reflect local conditions.

Key Recommendations:

- The Legislature should repeal the requirement on equal design lives in life-cycle cost analyses.
- MnDOT should identify a full range of pavement alternatives. It should require districts to update cost estimates, as needed, in their life-cycle cost analyses and justify their estimates of costs and timing of rehabilitation and maintenance.
- MnDOT should change its alternate bidding process. Its cost estimates should better reflect districts’ market conditions; its rehabilitation schedules should reflect road conditions.
- MnDOT should quantify certain user costs and supplemental costs and also account for the uncertainty of inputs in life-cycle cost analyses.
- MnDOT should develop a process for weighing both economic and noneconomic factors before selecting pavement type.
- MnDOT should avoid using material-specific inflation rates to calculate life-cycle costs.

The Minnesota Department of Transportation (MnDOT) meets many recommended practices for selecting pavement type in road rehabilitation projects, but it needs to improve analyses of life-cycle costs and change its “alternate bidding” process.

Report Summary

In general, road pavements are either bituminous (also called asphalt) or concrete. They need rehabilitation when they crack or exhibit other stresses but can still support traffic. The Minnesota Department of Transportation (MnDOT) is responsible for developing and administering state transportation programs, including those for rehabilitating roads on the state trunk highway system. It has eight district offices that are chiefly responsible for identifying road problems and assessing ways to fix them.

Most of MnDOT's pavement projects are road rehabilitation projects. Between fiscal years 2009 and 2013, 85 percent of pavement projects were rehabilitation; the rest were new construction or reconstruction. Of 388 rehabilitation projects during this period, 88 percent were bituminous, 10 percent were concrete, and 2 percent were both pavement types. In fiscal year 2013, total MnDOT contracts for road rehabilitation summed \$365.5 million.

Minnesota's two paving industries have voiced concerns about MnDOT's process and policies for selecting the type of pavement used in rehabilitation projects. In this evaluation, we compared MnDOT's procedures to those recommended by national experts. We found that MnDOT follows many recommended practices but not all of them.

Some cost estimates in MnDOT life-cycle cost analyses are outdated, or a basis for the data is unknown.

An important component of selecting pavement type is conducting life-cycle cost analyses. Such analyses require calculating costs of rehabilitation and maintenance over the entire lifetime of pavement alternatives, converting future costs to present-day values, and identifying the low-cost pavement.

"Agency costs" are a basic component of life-cycle cost analyses. These are the costs of pavement alternatives' initial and future rehabilitation and maintenance over a specified period (often 35 years). The costs are to be based on historical bid data and reflect market prices at the time of construction.

MnDOT bases its costs on historical data. However, in a sample of 40 projects, 12 (30 percent) had costs that were more than a year old at the time the project was let for bidding; 2 of those were more than three years old. When cost estimates are not timely, MnDOT should update them.

In life-cycle cost analyses, districts enter costs of an initial rehabilitation based on their own experience. Some also enter their own costs of future rehabilitation and maintenance, and the years in which that work is expected to occur. The analyses do not consistently make clear the basis for determining initial and future costs and timing of the work. MnDOT should require districts to justify their cost estimates and timing of rehabilitation and maintenance in life-cycle cost analyses.

Minnesota law requires comparing pavement alternatives of "equal design life," even though doing so is not recommended.

Statutes require MnDOT to compare life-cycle costs for pavement alternatives having "equal design lives." However, neither law nor MnDOT policy defines the phrase.

Interpretations of the phrase differ among MnDOT's materials engineers. National literature on life-cycle cost analyses does not recommend equal design lives. Until 2014, MnDOT standards did not include thin concrete designs, making it difficult to identify alternatives of equal design life.

For life-cycle cost analyses, MnDOT policy requires that at least two pavement alternatives of opposite

National literature on life-cycle cost analyses does not recommend comparing pavement alternatives of "equal design life," but Minnesota law requires it.

In evaluating pavement alternatives, MnDOT does not account for costs of drivers' time delays or vehicle operating costs.

materials have equal design lives. In analyses containing more than two pavement alternatives, a district can comply with the policy even when it selects an alternative that does not have a design life equal to the others. In a sample of 19 projects, districts in 8 cases (42 percent) selected a low-cost alternative with a design life different from other pavement alternatives.

The requirement for equal design lives is unnecessary if districts compare pavement alternatives over an equal number of years and calculate the pavement's remaining service life at the end of those years. Further, in early 2014, MnDOT issued design guidelines for thinner concrete overlays than in the past. Districts may now use such designs when circumstances warrant them. The Legislature should repeal from law the requirement for equal design lives in life-cycle cost analyses.

MnDOT data on feasible pavement alternatives are incomplete.

To select appropriate pavement type, it is important to first identify potential pavement alternatives. MnDOT's data for doing so are incomplete. MnDOT should identify a full range of feasible pavement alternatives for road rehabilitation.

MnDOT does not estimate user costs of pavement alternatives.

"User costs" are costs incurred by drivers when traveling through work zones of rehabilitation projects. They include costs of drivers' time delays and vehicle operating costs. National literature recommends estimating user costs when they can be estimated reasonably and when they differ among the pavement alternatives under consideration. However, MnDOT's policy prohibits districts from including user costs in life-cycle cost analyses; nor are such costs evaluated in other documents. Some districts informally consider user costs, such as when a pavement alternative

would require 100-mile detours. MnDOT should determine the conditions and rehabilitation strategies associated with high user costs and require districts to estimate the costs when they are likely to vary widely among pavement alternatives.

MnDOT does not consider all factors affecting pavement alternatives or formally evaluate economic and noneconomic factors.

National literature recommends formally evaluating economic and noneconomic factors that affect pavement alternatives. MnDOT districts identify pavement alternatives for road problems and are required to analyze the alternatives' economic factors. But MnDOT does not require districts to analyze some recommended noneconomic factors, especially nontechnical ones, such as resource conservation or municipalities' preferences on pavement type. Further, MnDOT does not use a formal decision-making tool to objectively weigh all economic and noneconomic aspects of pavement alternatives. MnDOT should require districts to evaluate relevant noneconomic factors. It should also develop a process for weighing all factors pertaining to the pavement alternatives.

MnDOT does not account for uncertainty in the data used in life-cycle cost analyses.

Computations in life-cycle cost analyses can be based on a single, fixed value, such as an average cost for a bituminous overlay based on costs from past projects. A recommended alternative is to acknowledge the uncertainty behind those values and use statistical measures to identify the likelihood that a specific estimate will actually occur. MnDOT's process for computing life-cycle costs does not account for the uncertainty of inputs, such as pavement costs. MnDOT should study the feasibility of estimating

MnDOT's economic analysis of "alternate bidding," where both pavement industries bid on a project to determine the pavement type, showed the process had little economic advantage over traditional projects.

life-cycle costs while accounting for the uncertainty of values for specific inputs.

MnDOT uses statewide averages to calculate life-cycle costs for projects using "alternate bidding."

In alternate bidding, both industries bid on a road project, and the pavement type is determined in the winning bid, not by MnDOT. The intent is to increase competition and get optimal prices on road projects.

For alternate bidding, national experts recommend using historical bid data to estimate costs of rehabilitation and maintenance over a pavement's life cycle. MnDOT does this, but it uses statewide average costs in lieu of a district's costs. Further, MnDOT uses a centrally developed schedule of rehabilitation and maintenance activities. MnDOT should continue to estimate costs centrally but modify them when such estimates do not reflect market prices in the district. MnDOT should use the central schedule of rehabilitation unless it does not reflect local road conditions and needs.

MnDOT's use of alternate bidding has had limited impact on bid prices and pavement industry competition.

Agencies should periodically review their alternate bidding process. MnDOT's economic analysis showed

alternate bidding had little economic advantage over traditional projects. MnDOT should change alternate bidding, such as by targeting it to more suitable projects.

The case for using material-specific inflation rates is weak.

For life-cycle cost analyses, national literature recommends that agencies use cost estimates that are presented in "real" dollars—removing the effects of inflation. MnDOT's practices do this.

Some people argue that recent high costs of bituminous should be reflected in estimates of future costs in life-cycle cost analyses. The U.S. Office of Management and Budget recommends using real dollars instead of predicting future inflation, unless there is reliable evidence supporting different patterns of future costs. Research on forecasting inflation for oil prices shows that estimates of "no change in price" are superior to methods predicting specific oil price changes, except for in the very short-term—far shorter than the 35-year horizon of life-cycle cost analyses. The uneven nature of long-term bituminous prices makes predicting inflation difficult. MnDOT has considered calculating life-cycle costs with material-specific inflation rates but should avoid such calculations.

Summary of Agency Response

In a letter and attachment dated March 12, 2014, Minnesota Department of Transportation Commissioner Charles Zelle said the report "provides timely input" to MnDOT's efforts to update pavement-type selection procedures. He said that MnDOT works to select economical pavement repairs and that the report identifies opportunities to improve this process. Commissioner Zelle wrote that MnDOT will consider the report's recommendations as the department rewrites its Pavement Design Manual, but he added that some recommendations, such as to evaluate noneconomic factors that affect pavement alternatives, would be difficult to implement. The commissioner also said OLA's recommendations add "layers of complexity with the assumption that more precision could be achieved." He cautioned that additional complexity may perpetuate a "perception of bias" that pavement industries have suggested is evident in the current system.

The full evaluation report, *MnDOT Selection of Pavement Surface for Road Rehabilitation*, is available at 651-296-4708 or: www.auditor.leg.state.mn.us/ped/2014/pavement.htm