




MINNESOTA DEPARTMENT OF TRANSPORTATION
Policy, Safety, and Strategic Initiatives Division
Technical Memorandum No. 10-04-MAT-01
January 28, 2010

To: Distribution 57, 612, 618, 650
From:  Khani Sahebjam
Deputy Commissioner and Chief Engineer
Subject: Life Cycle Cost Analysis (LCCA) of Pavement Preservation Projects

Expiration

This Technical Memorandum supersedes Technical Memorandum No. 07-17-MAT-01. It will remain in effect until January 28, 2015 unless it is superseded.

Implementation

This technical memorandum applies to all *pavement* preservation projects in the reconditioning, resurfacing, and road repair funding categories. Projects that meet the criteria of the Pavement Selection Process will continue to follow that process.

Introduction

To comply with the requirements of legislation and Mn/DOT policy; a Life Cycle Cost Analysis (LCCA) must be submitted with the project Materials Design Recommendation (MDR). The submitted LCCA must include at least one PCC and one HMA option with equal pavement design lives (in years) and analysis periods.

Purpose

This Technical Memorandum implements the requirements of Minnesota state legislation for LCCA of alternate pavement materials and updates LCCA procedures required by Mn/DOT policy.

In 2008, the Minnesota State Legislature passed bill HF 3486 (Chapter 287). This legislation requires a life cycle cost analysis (LCCA) be performed for all pavement projects in the reconditioning, resurfacing, and road repair funding categories that are to be constructed after July 1, 2011. The LCCA are to use equal design lives and equal comparison periods to compare competing paving materials. If the chosen option does not have the lowest life cycle cost, the justification is required to be documented. The legislation requires that the commissioner report annually to members of the Senate and House of Representatives the results of the analyses. The full text of the legislation that applies to the requirement for LCCA is attached in Appendix A.

Guidelines

A LCCA is not required for preventive maintenance projects or for short projects. Preventive maintenance projects include projects that place 2" or less of paving material. Short projects meet the following criteria:

- Two-Lane Roadways:* Projects less than **2 miles** long
- Multi-Lane Roadways:* Projects less than **30,000 square yards**

The project length/size listed above is determined using only the driving lanes, no turn lanes, parking lanes or ancillary lanes.

Follow sections I and II to develop a LCCA to submit with the MDR. However, to make the best use of LCCA, perform the LCCA early in the project development process.

I. Procedure

1. Establish Design Life and Pavement Design Alternatives

- For all LCCA, develop at least one HMA and one PCC pavement design alternative with equal design lives. The alternatives should be pavement designs that are capable of meeting the design life required by the scope of the project and meet Mn/DOT pavement design policy and procedures. However, the design life that best meets the scope of the project may have only one available pavement material alternate that conforms to Mn/DOT pavement design policies and procedures. In such a case, compare the alternate design with the selected design life to at least one HMA and one PCC pavement alternate developed using the closest available design life that provides both a HMA and a PCC alternate.

2. Determine Activity Timing

- Use District experience, Pavement Manual – Appendix E, and/or HPMA data.

3. Estimate Costs

- Only costs that demonstrate the differences between alternatives need to be explored.
- The District will develop the initial and activity costs based on their data and experience.
- Do not include user costs.

4. Compute Life Cycle Costs

- Calculate the present worth, of the initial construction and maintenance activities, of each of the pavement alternatives on a cost per mile basis.
- The present worth will be calculated using a discount rate equal to the real interest rate on 30-year treasury bonds as published each year by the federal Office of Management and Budget (OMB). The value to be used each year will be determined by the Mn/DOT Office of Investment Management and kept on file in the Mn/DOT Estimating Unit.
- Include any remaining life value of the pavement alternative that remains at the end of the analysis period. Remaining life value is calculated as the prorated share of the cost of the last activity based on the service life that extends past the analysis period.
- Do not include an inflation rate.

5. Analyze Results

- Unless there is justification for an exception, choose the low cost alternative. If the chosen alternative does not have the lowest life cycle cost, the District Engineer or designee shall sign off on the supporting justification.

II. Pavement Alternatives

HMA Overlay

Description

- HMA overlay (or mill and overlay) of existing HMA or PCC pavement that will restore ride and reduce pavement distresses. The thickness of a HMA overlay may be designed to improve the load carrying capacity of an existing roadway so that it does not require a seasonal load restriction.

Design

- To remove the requirements for spring load restrictions on a roadway, Mn/DOT has a thickness design procedure based on FWD pavement deflections. A design life is not part of this design procedure. For design life, there is no formal design procedure as the performance of the overlay is very dependent on the condition of the existing pavement. Instead of a design life, HMA overlays have an expected life. Base the expected life on HMA data and engineering judgment. The expected life of a HMA overlay is typically from 7 to 19 years.

LCCA

- Schedule the 1st overlay or reconstruction at the end of the overlay's functional life.
- Each successive overlay has 1 year less life than the previous overlay.
- Minimum of a 35 year analysis period.

HMA on Base (No Work on Subgrade)

Description

- These projects place HMA on new or existing material that behaves as base in the pavement section. These types of projects include CIR, FDR, crack and seat, full mill and repave, or new base without working the subgrade. Typically, very specific engineering requirements need to be met to make these options practical. Only consider the options that are practical in the LCCA.

Design

- Design these pavements with the Mn/DOT procedures used for new HMA pavement. Some adjustments may need to be made for the properties of the base.
- Design these projects to carry 20 years of accumulated traffic loading.

LCCA

- Use the maintenance schedule provided in the pavement selection memo.
- Minimum of a 35 year analysis period.

PCC Overlay

Description

- These projects place PCC on existing HMA (whitetopping) or existing PCC with a stress relief layer (unbonded overlay). A PCC overlay will functionally and structurally improve an existing pavement.

Design

- Follow Mn/DOT design procedures for either whitetopping or unbonded overlays.
- The design life of these projects may be from 15-35 years.

LCCA

- If the Mn/DOT design procedure results in a thickness less than the minimum PCC thickness allowed by Mn/DOT policy, contact the Pavement Design Unit.
- An intermediate minor CPR project may add an additional 5 years until major CPR or replacement is required.
- For PCC overlay projects, the pavement should receive its first major CPR or reconstruction at the end of its design life.
- Use a life expectancy of about half the pavement design life for major CPR.
- Minimum of a 35 year analysis period.

PCC Pavement (No Work on Subgrade)

Description

- These projects place new PCC pavement on new or existing base and do not involve working the subgrade.

Design

- Follow Mn/DOT design procedures for PCC pavement.
- The preferred design life is 35 years for these projects.

LCCA

- For 35 year designs, use the maintenance schedule provided in the pavement selection memo.
- For designs for less than 35 years, follow the same maintenance schedule guidelines as for PCC overlays.
- Use a 50 year analysis period.

Questions

Contact Jerry Geib, **Pavement Design Engineer**, at (651) 366-5496, for information on the technical contents of this memorandum.

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards unit, designstandards@dot.state.mn.us. A link to all active and historical Technical Memoranda can be found at <http://www.dot.state.mn.us/design/tech-memos/index.html>.

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Appendix A

Sec. 71. [174.185] PAVEMENT LIFE-CYCLE COST ANALYSIS.

Subdivision 1. **Definitions.** For the purposes of this section, the following definitions apply:

- (a) "Life-cycle cost" is the sum of the cost of the initial pavement project and all anticipated costs for maintenance, repair, and resurfacing over the life of the pavement. Anticipated costs must be based on Minnesota's actual or reasonably projected maintenance, repair, and resurfacing schedules, and costs determined by the Department of Transportation district personnel based upon recently awarded local projects and experience with local material costs.
- (b) "Life-cycle cost analysis" is a comparison of life-cycle costs among competing paving materials using equal design lives and equal comparison periods.

Subd. 2. **Required analysis.**

For each project in the reconditioning, resurfacing, and road repair funding categories, the commissioner shall perform a life-cycle cost analysis and shall document the lowest life-cycle costs and all alternatives considered. The commissioner shall document the chosen pavement strategy and, if the lowest life cycle is not selected, document the justification for the chosen strategy. A life-cycle cost analysis is required for projects to be constructed after July 1, 2011. For projects to be constructed prior to July 1, 2011, when feasible, the department will use its best efforts to perform life-cycle cost analyses.

Subd. 3. **Report.**

The commissioner shall report annually to the chairs and ranking minority members of the Senate and House of Representatives' committees with jurisdiction over transportation finance beginning on January 1, 2012, the results of the analyses required in subdivision 2.

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