

2019 Report on the

Life-Cycle Cost Analysis

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Legislative Request

This report is issued to comply with [Minn. Stat. 174.185](#).

The statute requires a life-cycle cost analysis for every project in the reconditioning, resurfacing and road repair funding categories constructed after July 1, 2011. The LCCA is a comparison of life-cycle costs among competing paving materials using equal design lives and equal comparison periods. Documentation required by the statute includes:

- Lowest life-cycle cost
- Alternatives considered
- Chosen strategy
- Documented justification, if the chosen strategy is not the low cost option

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.

The cost of preparing this report is less than \$5,000.

Life-Cycle Cost Analysis Report

Implementation

[Minn. Stat. 174.185](#) requires a life-cycle cost analysis for every project in the reconditioning, resurfacing and road repair funding categories constructed after July 1, 2011.

The Minnesota Department of Transportation first implemented a LCCA process for roadway rehabilitation projects in 1999. The agency modified the LCCA process in 2010 to meet the specific requirements of legislation and was presented in [Technical Memorandum 10-04-MAT-01](#). After the technical memorandum expired, the LCCA process, with some modifications, was incorporated into the MnDOT Pavement Design Manual that went into effect October 31st, 2014.

The LCCA process, which is consistent with Federal Highway Administration guidelines, is performed on all pavement projects regardless of funding category, but only the results of projects in the reconditioning, resurfacing and road repair funding categories are included in this report. The LCCA process limits the requirement to perform a LCCA to projects with more than 60,000 square yards of pavement (formerly 30,000 square yards in the technical memorandum) and to projects that include placing more than two-inch thickness of pavement material. Thin overlays (two inches or less) are considered short-term preventive maintenance and do not have a viable concrete alternative with an equal design life.

The LCCA process requires the inclusion of at least one portland cement concrete and one hot-mix asphalt alternate with equal design lives. To best determine the most cost effective design, the LCCA may include additional alternatives with other design lives.

Results

In 2019, 35 construction projects were in the reconditioning, resurfacing and road repair funding categories and required a LCCA according to the MnDOT Pavement Design Manual. Four projects required two LCCAs for a total of 39 LCCAs.

The results of the 39 LCCAs are as follows:

- Hot-mix asphalt was the low-cost option for 37 LCCAs. Of these, 35 selected the low-cost option, one selected a different hot-mix asphalt option and one selected a portland cement concrete option. Documented justification for selecting an option that was not the low-cost option is provided.
- Portland cement concrete was the low-cost option for two LCCAs and both were selected for construction.

A table of LCCA results and copies of the LCCAs submitted by MnDOT districts are attached.

Discussion

Hot-mix asphalt is most often the low-cost option in the submitted LCCAs. Portland cement concrete options usually have a greater initial cost than hot-mix asphalt, but become competitive by having lower maintenance costs over the life of the pavement. However, the relatively short design lives of these rehabilitation-type projects do not allow portland cement concrete options to exploit this relative advantage. Portland cement concrete options with longer design lives than hot-mix asphalt alternates are more competitive than the portland cement concrete options with the equal design lives required by the statute.

MnDOT continues to improve and refine its portland cement pavement design procedures. The design program for portland cement pavement thickness design has been updated and a research project is developing a new procedure to design portland cement concrete pavements that are built on top of existing portland cement concrete pavements.

No projects used the alternate bidding process in 2019, but MnDOT continued to provide for its use on projects that were likely to have competitive hot-mix asphalt and portland cement concrete options.

The alternate bidding process is similar to using a LCCA to determine the low-cost option. However, instead of using an estimate for the initial cost of an option, alternate bidding uses actual bid prices. The process is as follows:

1. MnDOT lets a project with two options, one hot-mix asphalt and one portland cement concrete.
2. MnDOT calculates a maintenance factor. This is the difference between the maintenance costs of the two options.
3. Each contractor bids on either of the two options.
4. MnDOT adjusts the bids by adding the maintenance factor to the bids of the option with the greater maintenance costs.
5. MnDOT selects the bid with the lowest adjusted bid.

Conclusion

MnDOT implemented the requirements of [Minn. Stat. 174.185](#) and provided the required results in this report. MnDOT continues to work to ensure that all future projects meet the requirements of the legislation. In addition, MnDOT is innovating new pavement design methods to design the most cost-effective pavement structure.

Appendix A: Summary of LCCA Results

State Project Number (SP#)	Existing Pavement Type	Exception for low-cost option?	Design Life (in years)	Option Description	Present Worth	Optional Material (1)	Selected Option (2)	Alternate Bid? (3)
0707-88	HMA	No	20	PCC Overlay	\$6,239,648.00	PCC	X	No
			20	HMA on CIR	\$8,223,932.00	HMA		
			35	New PCC	\$7,711,502.00	PCC		
1602-50	HMA	No	15	HMA Overlay	\$3,543,282.00	HMA	X	No
			20	PCC Overlay	\$5,288,313.00	PCC		
			20	HMA on FDR	\$4,167,974.00	HMA		
1802-53	HMA	No	13	HMA Overlay	\$6,494,185.00	HMA	X	No
			20	HMA on FDR	\$6,713,624.00	HMA		
			20	PCC Overlay	\$7,873,803.00	PCC		
1806-76	HMA	No	20	HMA on FDR	\$5,127,180.38	HMA	X	No
			20	PCC Overlay	\$8,946,272.88	PCC		
			35	New PCC	\$7,714,825.74	PCC		
2180-115	PCC	Yes	20	New HMA	\$6,596,795.00	HMA	X	No
			20	PCC Overlay	\$6,485,747.00	PCC		
			35	New PCC	\$5,916,081.00	PCC		
2305-29	HMA	No	13	HMA Overlay	\$7,714,982.00	HMA	X	No
			20	New HMA	\$16,725,857.00	HMA		
			20	New PCC	\$19,414,371.00	PCC		
2908-29	HMA	No	20	New HMA	\$624,999.00	HMA	X	No
			20	New PCC	\$1,063,815.00	PCC		
			35	New PCC	\$829,505.00	PCC		
3107-51-1	HMA	No	20	HMA on FDR	\$987,800.00	HMA	X	No
			20	New PCC	\$2,831,799.00	PCC		
			35	New PCC	\$2,235,860.00	PCC		
3107-51-2	HMA	No	17	HMA Overlay	\$1,659,698.00	HMA	X	No
			20	HMA on FDR	\$2,668,910.00	HMA		
			20	New PCC	\$6,401,928.00	PCC		
3111-30	HMA	No	15	HMA Overlay	\$379,046.00	HMA	X	No
			20	New PCC	\$461,079.00	PCC		
			20	New HMA	\$818,066.00	HMA		
3206-20	PCC	No	20	HMA on CIR	\$7,693,468.00	HMA	X	No
			20	PCC Overlay	\$14,767,857.00	PCC		
			35	PCC Overlay	\$13,585,780.00	PCC		

State Project Number (SP#)	Existing Pavement Type	Exception for low-cost option?	Design Life (in years)	Option Description	Present Worth	Optional Material (1)	Selected Option (2)	Alternate Bid? (3)
4010-10	HMA	No	20	PCC Overlay	\$8,052,638.00	PCC		No
			20	HMA on CIR	\$4,056,750.00	HMA	X	
			35	PCC Overlay	\$6,304,884.00	PCC		
4601-32	HMA	No	16	HMA Overlay	\$382,556.47	HMA	X	No
			20	PCC Overlay	\$1,058,449.00	PCC		
			20	HMA Overlay	\$448,281.35	HMA		
4904-45-1	HMA	No	20	New PCC	\$1,367,821.00	PCC		No
			20	New HMA	\$1,181,644.00	HMA	X	
			35	New PCC	\$1,213,821.00	PCC		
4904-45-2	HMA	No	20	New PCC	\$1,710,508.00	PCC		No
			20	New HMA	\$1,374,425.00	HMA	X	
			35	New PCC	\$1,725,259.00	PCC		
5003-17	HMA	No	15	HMA Overlay	\$6,581,860.00	HMA	X	No
			20	PCC Overlay	\$11,986,973.00	PCC		
			20	HMA Overlay	\$7,227,091.00	HMA		
5005-64	HMA	No	15	HMA Overlay	\$3,153,643.00	HMA	X	No
			20	PCC Overlay	\$5,241,189.00	PCC		
			20	HMA on CIR	\$3,360,229.00	HMA		
5208-22-1	HMA	No	20	HMA on FDR	\$735,634.00	HMA	X	No
			20	PCC Overlay	\$1,392,825.00	PCC		
			35	New PCC	\$1,225,641.00	PCC		
5208-22-2	HMA	No	20	HMA on FDR	\$754,196.00	HMA	X	No
			20	PCC Overlay	\$1,392,825.00	PCC		
			35	New PCC	\$1,225,641.00	PCC		
5308-29	PCC	No	20	HMA on CIR	\$7,080,807.00	HMA	X	No
			20	PCC Overlay	\$12,892,980.00	PCC		
			35	PCC Overlay	\$9,959,093.00	PCC		
5507-64	PCC	No	15	HMA Overlay	\$4,892,563.00	HMA	X	No
			20	PCC Overlay	\$10,521,709.00	PCC		
			20	HMA on CIR	\$5,047,588.00	HMA		
6103-34	HMA	No	20	PCC Overlay	\$8,105,384.00	PCC		No
			20	HMA on FDR	\$6,621,218.95	HMA	X	
			35	New PCC	\$9,283,055.00	PCC		

State Project Number (SP#)	Existing Pavement Type	Exception for low-cost option?	Design Life (in years)	Option Description	Present Worth	Optional Material (1)	Selected Option (2)	Alternate Bid? (3)
6105-26	HMA	No	20	New HMA	\$1,827,640.00	HMA	X	No
			20	New PCC	\$2,804,950.00	PCC		
			35	New PCC	\$2,576,670.00	PCC		
6912-77	HMA	No	15	HMA Overlay	\$6,724,375.00	HMA	X	No
			20	HMA on FDR	\$7,979,708.00	HMA		
			20	New PCC	\$15,300,580.00	PCC		
6917-143	HMA	No	15	HMA Overlay	\$4,848,882.00	HMA	X	No
			20	New PCC	\$10,610,181.00	PCC		
			20	New HMA	\$9,649,480.00	HMA		
6936-19	HMA	No	15	HMA Overlay	\$3,414,704.00	HMA	X	No
			20	HMA on CIR	\$3,838,228.00	HMA		
			20	New PCC	\$8,463,415.00	PCC		
7301-38	HMA	No	20	HMA On FDR	\$9,950,226.00	HMA	X	No
			20	PCC Overlay	\$21,620,682.00	PCC		
			35	New PCC	\$16,257,819.00	PCC		
7314-39	HMA	No	15	HMA Overlay	\$435,900.00	HMA	X	No
			20	HMA on FDR	\$516,240.00	HMA		
			20	PCC Overlay	\$983,934.00	PCC		
7901-52	HMA	No	15	HMA Overlay	\$5,123,680.00	HMA	X	No
			20	PCC Overlay	\$7,371,979.00	PCC		
			20	HMA on FDR	\$5,335,740.00	HMA		
7903-54-1	HMA	No	15	HMA Overlay	\$8,855,322.00	HMA	X	No
			20	PCC Overlay	\$13,852,891.00	PCC		
			20	HMA Overlay	\$10,055,999.00	HMA		
7903-54-2	HMA	No	15	HMA Overlay	\$8,855,322.00	HMA	X	No
			20	PCC Overlay	\$13,852,891.00	PCC		
			20	HMA on FDR	\$10,734,117.00	HMA		
7906-96	PCC	No	15	HMA Overlay	\$8,078,847.00	HMA	X	No
			20	HMA on CIR	\$8,337,637.00	HMA		
			20	PCC Overlay	\$17,139,273.00	PCC		
8105-21	HMA	No	20	PCC Overlay	\$7,402,861.00	PCC	X	No
			20	HMA on CIR	\$5,619,394.00	HMA		
			35	New PCC	\$7,805,886.00	PCC		

State Project Number (SP#)	Existing Pavement Type	Exception for low-cost option?	Design Life (in years)	Option Description	Present Worth	Optional Material (1)	Selected Option (2)	Alternate Bid? (3)
8209-111	HMA	No	20	PCC Overlay	\$3,090,672.00	PCC		No
			20	HMA on CIR	\$2,134,627.00	HMA	X	
			35	PCC Overlay	\$2,871,544.00	PCC		
8408-58	PCC	Yes	13	HMA Overlay	\$2,749,004.00	HMA	X	No
			20	PCC Overlay	\$4,001,296.00	PCC		
			20	HMA Overlay	\$2,639,992.00	HMA		
8504-79	PCC	No	15	HMA Overlay	\$4,792,895.00	HMA	X	No
			20	PCC Overlay	\$10,854,499.00	PCC		
			20	HMA Overlay	\$5,107,483.00	HMA		
8604-42	HMA	No	20	New PCC	\$6,505,639.00	PCC		No
			20	HMA on FDR	\$3,252,707.00	HMA	X	
			35	New PCC	\$5,314,356.00	PCC		
8611-26	HMA	No	20	New PCC	\$2,626,595.00	PCC		No
			20	New HMA	\$1,443,682.00	HMA	X	
			35	New PCC	\$2,000,189.00	PCC		
8680-173	PCC	No	20	New HMA	\$67,788,385.00	HMA		No
			20	New PCC/ PCC Overlay	\$46,742,653.00	PCC	X	
			35	New PCC/ PCC Overlay	\$50,080,944.00	PCC		

(1) Option material - The pavement material that each option utilizes.

(2) Selected Option- This is marked (X) if the pavement option was selected to be constructed.

*** If the project uses alternate bidding, more than one option will be marked and the constructed option will be the low-cost option as determined by alternate bidding.

(3) Alternate Bidding? - 'Yes' if the project used alternate bidding to select which option to construct.

Definitions:

HMA = Hot-Mix Asphalt

PCC = Portland Cement Concrete

FDR = Full-Depth Reclamation (recycle existing HMA and Base to use as a new base)

CIR = Cold-in-Place Recycling (Recycle a layer of existing HMA with Cold-Mix Asphalt)

CPR = Concrete Pavement Repair

Rubblize = Break the existing PCC into pieces to act as the new base for HMA pavement

Crack & Seat = Crack and compact the existing PCC pavement to delay reflective cracking in an HMA overlay

Appendix B: Copies of LCCAs

Appendix C: Copies of LCCA Exceptions