Understanding Equivalent Pavement Designs

Determining the True Life-Cycle Cost of Pavements

AMERICAN CONCRETE PAVEMENT ASSOCIATION

Life-cycle costs are an increasingly important decision point in the selection of pavement materials. Life-cycle cost analysis (LCCA) requires careful consideration of the complete costs over time—not only the cost to construct the pavement system, but the cost to keep it in good condition over time.

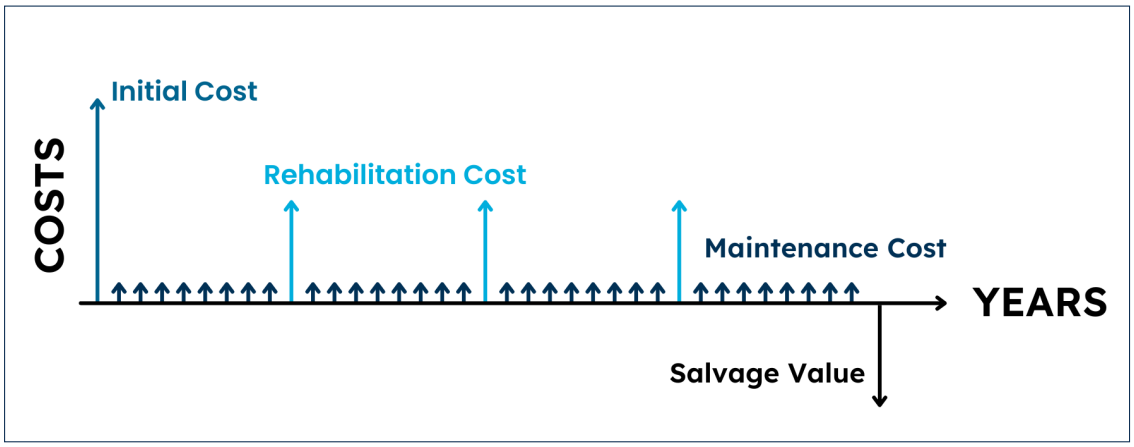

Figure 1:
Illustration shows factors considered in life-cycle cost analysis of pavements.

Figure 1 illustrates some of the key considerations that are critical to an objective LCCA.

One of the challenges in creating an objective LCCA is to avoid "apples to oranges" comparisons of the pavement designs. There are a number of differences between concrete pavements and asphalt pavements. For example, concrete pavements are generally constructed in one pass, while asphalt pavements typically have a structural component and a top layer (wearing course).

Another key difference is temperature sensitivity. Concrete pavements do not flex under extreme heat conditions, eliminating the need to increase pavement thickness in these areas, as illustrated in **Figure 2**.

Equivalent Pavement Designs

LCCA offers an excellent tool for engineers to evaluate options, compare alternatives and identify how the alternatives vary outcomes. Small changes can greatly affect cost effectiveness.

Accurate LCCA begins with an evaluation of equivalent pavement designs. Design procedures such as AASHTOWare's Pavement ME Design and the industry-developed PavementDesigner.org are two robust mechanistic-empirical tools that can be used to determine thicknesses for pavement type selection. Using these resources, a design engineer can input different variables to obtain equivalent pavement designs, i.e., those with similar load-carrying capacity for a given time period.

Figure 3 provides the initial, rehabilitation, and maintenance costs for concrete pavement. In this example, concrete strength was 4000 psi and the design did not include integral curbs. If either the concrete strength were increased or an integral curb and gutter were used as design options, the initial concrete cost would be reduced.

The LCCA examples are based on:

- *Engineering News Record*'s quarterly "Construction Economics " report.
- Initial costs based on 1-mile of 12' wide pavement with curbs placed separately.
- A 30-year design life.

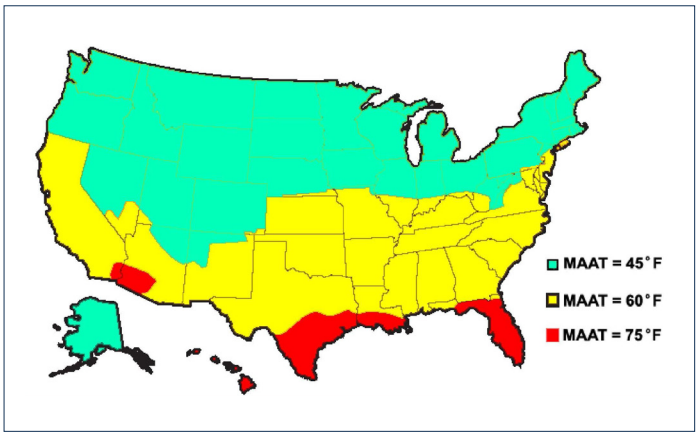

Figure 2:
Higher means average temperatures will require thicker sections of asphalt pavement.

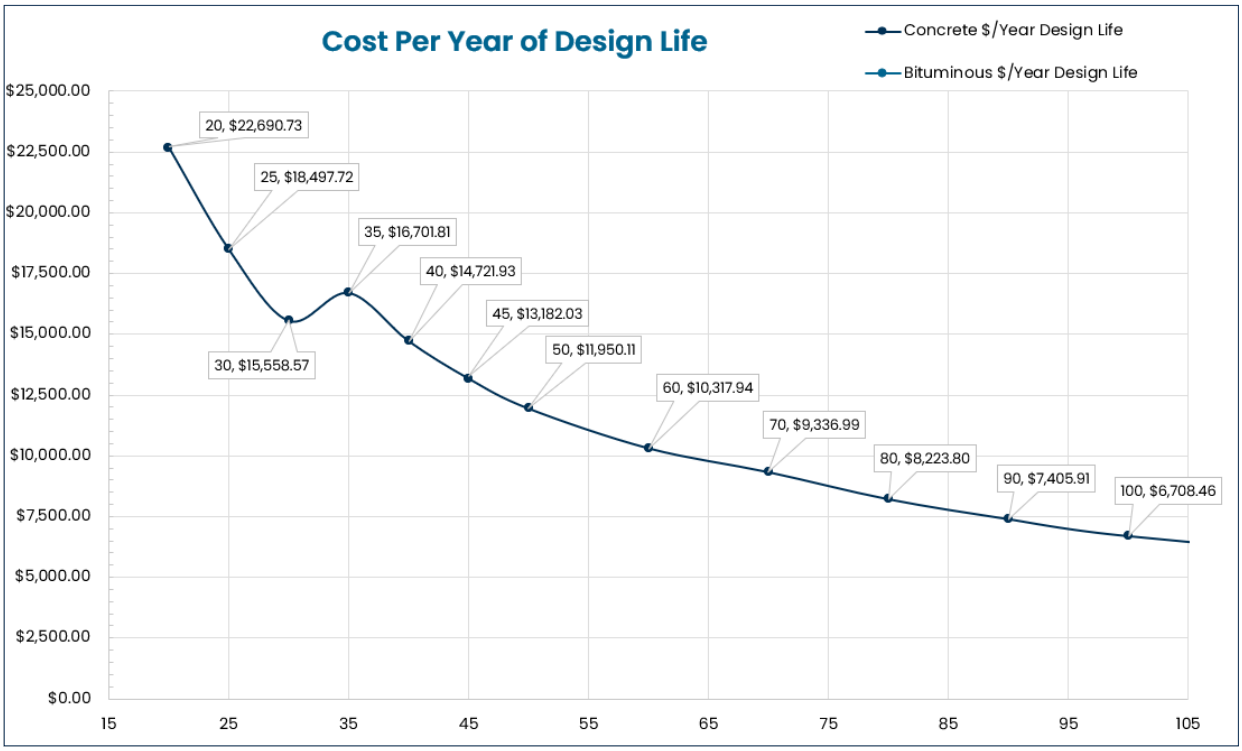

Figure 3:
Small increases in thickness—in many cases, 1/2- to 1-inch—will double (or more than double) a concrete pavement's design life. The additional investment, when viewed in terms of cost per year of design life, is extremely beneficial.

(Image courtesy of the Concrete Paving Association of Minnesota)

SOURCE MATERIAL

- Engineering News Record, a publication of The McGraw-Hill Companies, Inc., New York, N.Y. Review of August 2006 and April 2010 issues.
- StreetPave™ software, the American Concrete Pavement Association, Skokie, Ill.
- "Construction and Materials Tips," 3rd quarter 2005, Texas Department of Transportation, Austin, Texas.

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