

### LIFE CYCLE COST ANALYSIS

*Reference: IDM 402-4.02 Life-Cycle Cost*

The following BDA provides additional guidance for the revisions to IDM 402-4.02. Item numbers below correspond to items in the IDM. A [sample spreadsheet](#) is included to illustrate how Life Cycle Cost Analysis (LCCA) might be used to evaluate different aspects of a project. A [service life / design life table](#) is also included for reference. The table provides the generally assumed design life of various bridge components and treatments as well as service life ranges queried from BIAS. It should not replace more accurate information when research studies, further analysis or knowledge of historic trends indicate otherwise.

2. Design Life. According to the AASHTO Bridge Design Specifications, a new bridge should have a design life of 75 years. Also the design life of the wearing surface should be considered separately from the design life of the deck/superstructure. As seen in the attached Service Life Figure, treatments on a lightly travelled, rarely salted local road may last 50% longer or more. Similarly interstates and heavily used, heavily salted roads may reduce the design life of bridge components and treatments by 25% or more. The above information should be considered in light of engineer judgment.

3. Agency Costs. The following are a few variations that may affect an analysis.

- a. Steel superstructures may have higher maintenance costs due to painting cycles than concrete superstructures, but may have a longer design life if the deck of the concrete superstructure cannot be replaced.
- b. Fracture Critical and Special Inspections may require more frequent and more expensive inspections than standard routine inspections.
- c. A treatment with a longer design life (such as galvanizing) or a slightly wider structure may have a higher initial cost but a lower design life cost compared to a more expensive Maintenance of Traffic scenario.

4. User Costs. The temporary traffic control strategy to be used on the project needs to be determined before user costs can be calculated as added travel time associated with the work will vary depending on the strategy. Once the user costs are known the results should be considered along with agency cost to select the optimal design life. When considering user cost analysis:

- Results on the order of \$100 or \$1000 typically signify a negligible or modest impact to the public, while \$10,000 or \$100,000 can indicate significant impacts pending the AADT and the distribution of the user cost through the day. For instance \$10,000 per

day on a heavily traveled interstate most likely is negligible but would be substantial on a low volume, rural, two lane highway.

- \$1,000,000, or higher equates to significant impact on any road and means that extensive mitigation, through a full Traffic Management Plan will most likely be needed. In turn this leads to additional project costs, e.g. public information, additional law enforcement patrols, etc.
- The manner in which the user cost is distributed for each hour of the day should be considered along with the delay and queue length that it is associated with. A modest daily user cost that is evenly distributed throughout a number of hours may be acceptable as opposed to it being concentrated in just one or two hours.
- Drivers in different locales will accept different amounts of inconvenience. In large urban areas a 15 minute delay or a 1 mile queue may be regarded as normal, while in a rural environment any delay or queue seems out of place.

A few examples are included with this BDA to illustrate potential scenarios in which LCCA may be useful to assist in determining the most cost effective solution. The scenarios are as described briefly below:

- 1) Example #1 evaluates the potential cost benefit of including two Polymeric Thin Deck Overlays in advance of the traditional rigid overlay cycle. This example also illustrates the extended life as a result of the added treatments. (Note salvage value for longer service life was calculated for the bridge over the entire 74 year design life and the wearing surface over the shorter 20 year service life of the overlay.)
- 2) Example #2 is a hypothetical situation in which a new interstate/county road interchange will be constructed. This scenario assumes the bridges will be the same size and engineering judgment is used to predict a longer service life (+50%) on the county road than on the interstate bridge.
- 3) Example #3 is known as a sensitivity analysis and also shows the comparison of multiple alternatives. It is not generally possible to determine the exact service life of a given treatment. The example shows the Polymeric Thin Overlay was assumed to have a design life of 15 years when in reality it had a 12 year service life. In this situation, the Polymeric Overlay was still the right solution despite the reduced service life because it resulted in an extended life of the structure and an overall lower life cycle cost.
- 4) Example #4 illustrates how user costs can be incorporated into the analysis to evaluate two possible Maintenance of Traffic Scenarios. This example describes a replacement structure with moderate traffic counts and long detour lengths. This type of analysis would be used in conversations with the district Traffic Engineer and Project Manager to determine if the higher initial cost outweighs the inconvenience to the traveling public.

- 5) Example #5 considers the potential benefit of incorporating inspector access into a large river structure in the initial construction. This scenario estimates the improvements would eliminate the need for a snooper truck(s) and would cut inspection time by a quarter with appropriately placed ladders, walkways and tie-off locations and without the lost time for MOT set up and tear down. The analysis only considers the additional cost during initial construction and inspection costs.