Life Cycle Cost Analysis and Perpetual Pavements

Perpetual Pavement Demonstration Workshop
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LCCA - Definition

“A process for evaluating the total economic worth of a usable project segment by analyzing initial costs and discounted future cost, such as maintenance, reconstruction, rehabilitation, restoring, and resurfacing costs, over the life of the project segment.”

Section 303, Quality Improvement of the National Highway System (NHS) Designation Act
The Life Cycle

- Initial Construction
- Rehabilitation
- Maintenance
- Salvage
Performance and Cost

- Time
- Ride
- Quality
- Cost
- Performance Period
- Analysis Period
- Remaining Life
- Time
Initial Construction

- Material & Labor
- Traffic Control

Cost

Time
Rehabilitation

- Major Intervention - Restore Ride
- Labor & Materials
- Traffic Control
Salvage Value

- Account for worth of in-place materials
Cost Components

• Agency
  - Materials
  - Labor
  - Traffic Control

• User
  - Delay
  - Vehicle Operating

• Environmental
  - Emissions
Agency Costs

- Initial Construction
  - 70 to 90%
- Rehabilitation
  - 10 to 25%
- Reactive Maintenance
  - Almost no effect
- Salvage Value
  - Very little effect
Work Zone User Costs

- WZ Speed Change VOC
- WZ Speed Change Delay
- WZ Reduced Speed Delay
- Queue Stopping VOC
- Queue Stopping Delay
- Queue Idle Time
- Queue Added Travel Time
Work Zone User Cost Rates

July 2006 Dollars

$/veh/hr

Passenger Car  Single Unit Truck  Combination Unit Truck

0  5  10  15  20  25  30  35
LCCA Computations

\[ NPV = I.C. + \sum_{k=1}^{N} R.C._k \left[ \frac{1}{(1+i)^{n_k}} \right] \]

NPV = Net Present Value
I.C. = Initial Cost
R.C. = Rehabilitation Costs
i = Discount Rate
n = Time

Consider Variability
LCCA Software

- Sponsored by Asphalt Pavement Alliance
- Follows FHWA Recommendations
  - LCCA in Pavement Design Interim Technical Bulletin
WZUC Example

- 4-lane interstate
- AADT = 40,000
- Work Zone
  - 1 lane open each direction
  - 5 miles long
- Three Scenarios
  - 24 hour closure
  - 16 hour closure
  - 12 hour closure
LCCA Output

Queue Length Graph

Closure Example

Queue Length, miles

Hour of Day

Inbound

Outbound

Alt 1 - WZ 1
Perpetual Pavement Analysis

- 4-Lane Highway
- 5 Mile Project
- 50 Year Analysis
- 20,000 AADT (initial)
  - 20% Trucks
  - 2% growth
- Alternative 1
  - Conventional Design (8” HMA; $50/ton)
  - 12 years between rehab with reconstruction in year 36
    - Mill 4”, replace with 6”
- Alternative 2
  - Perpetual Design (12” HMA; Base $50/ton, Surface $60/ton)
  - 15 years between rehab - no reconstruction
Cost Summary

- Initial Construction Cost
  - Average Agency Cost Component
    - Conventional
    - Perpetual

- Average WZUC
  - Conventional
  - Perpetual
User Delay - Year 36

Work Zone User Cost = $5,846,290
Summary

• Compared to conventional pavements, perpetual pavements can have:
  - Higher initial cost
  - Lower life cycle cost
  - Lower user cost
  - Longer rehabilitation cycles
  - Higher performance

• Major Advantage in most cases
  - User Cost

• Also need to consider
  - Noise
  - Ride
  - Environmental Issues
Thank You!

Download LCCA at:
www.asphaltalliance.com