

Municipal Interlocking Concrete Pavement (ICP) Performance Modeling

Recipient: Pavement Technical Solutions, Inc.

Grant: \$22,000 PI: Roy McQueen, P.E.

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Project Summary: 15



Background and Need

Decades ago, municipalities committed to using asphalt and concrete for pavement because they were inexpensive and readily available. For municipalities to move to using interlocking concrete pavement (ICP) in streets, there must be a *compelling* cost reductions and operational advantages compared to using conventional pavements.

Objectives

To explore this topic, this study compared life cycle and operational costs of asphalt to ICP in Leesburg, a town in northern Virginia. This municipality granted access to their pavement management system (created by Pavement Technical Solutions) so that cost and performance comparisons could be made. All initial and maintenance costs for asphalt were derived from the Virginia Department of Transportation (VDOT) since most of the streets in Leesburg are owned by this agency.

Specifically, the study:

- Compared ICP & asphalt life cycle cost analysis (LCCA) in Leesburg on primary and secondary (mostly residential) streets
- Used Virginia DOT LCCA performance period of 50 years, a 4% discount rate, as well as designated maintenance intervals, activities and costs for asphalt
- Used ICP maintenance intervals, activities and costs provided by ICPI
- Evaluated down-times and costs for ICP & asphalt for rehabilitation and reconstruction
- Compared utility cut LCCA and performance for utility cuts in the ICP & asphalt pavement

Life cycle maintenance intervals and activities for asphalt (from VDOT):

- Year 12 – Mill and replace with pre-overlay patches on 1% of the surface
- Replace AC wearing course only (one layer)
- Year 22 – Same as Year 12
- Year 32 – Major Rehabilitation – 6-inch thick mill & replace asphalt with pre-overlay patches on 5% of the surface
- Year 44 – Same as Year 22 and 12
- Year 50 – Complete reconstruction with no salvage value

Life cycle maintenance intervals and activities for ICP (from ICPI):

- Year 15 – Replace Cracked pavers - 5%
- Year 25 – Replace cracked pavers and top up jointing sand – 5%
- Year 35 – Replace worn/rutted pavers (10%), replace cracked pavers, (5%) and top up jointing sand (5%)
- Year 45 – Same as Year 35

- Year 50 – Reconstruct with no salvage value

User delay costs were based on the following scenarios:

- 1 mile, 2 lane road ~132,000 sf
- 3,000 vehicles per day (vpd)
- Light truck traffic
- 8-hour daily construction affecting 50% vpd
- 5-minute delay per vehicle
- \$30/hour/vehicle delay cost including personal and business auto and light truck traffic
- New construction time is about the same for ICP and asphalt
- 4 major rehabilitation cycles over 50-year analysis
- 9 fewer days to rehab ICP than asphalt

Utility Cuts in Pavements

This study assumed a 30% reduction in pavement life based on literature search for asphalt. This reduction was *conservatively* assumed for ICP. In reality, this may not be the case.

Asphalt pavement

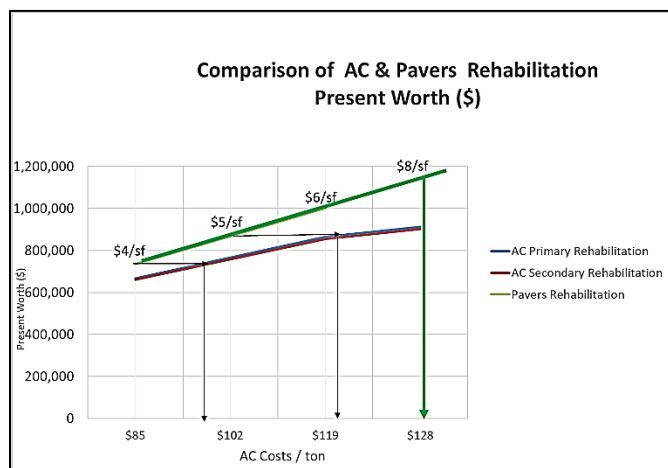
Rout, Seal & Patch:

- 5% of area on years 5.5 & 9.5; 10% in year 22.5; 20% in year 31
- Year 35 – Reconstruct with no salvage value

ICP

- Year 10.5 – Replace 5% cracked pavers
- Year 17.5 – Replace 5% cracked pavers and top up jointing sand
- Year 24.5 – Replace 10% worn/rutted pavers, replace 5% cracked pavers & top up jointing sand
- Year 31.5 – Same as Year 24.5
- Year 35 – Reconstruct with no salvage value

Outcomes



- Better understanding of the relationship between in-place asphalt and ICP LCCAs
- A 40% increase in current asphalt costs (~\$140/ton) can make ICP cost-effective in comparison to asphalt initial and maintenance costs
- For user delay costs during rehabilitation, life cycle costs of ICP and asphalt are about equal
- Rehabilitation of ICP can be accomplished in roughly half the time as asphalt
- Cost savings from utility cuts in ICP compared to asphalt are 10% to 21% in construction and present worth costs, respectively

- ICP will have greater life than asphalt in road sections with utility cuts because ICP is not monolithic and may not experience a significant reduction in pavement life from utility cuts

Compared to the U.S., the higher taxation of asphalt and other petroleum based-products in the United Kingdom and Western Europe work in favor of lower life cycle costs for segmental concrete pavement in those regions.