P3 PAVEMENT DESIGN
It’s Different!


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Clarifications

• P3 Project is Design, Build, Finance, Operate or DBFO
• Various Entities – Owner, Equity, Concessionaire, Design Build Joint Venture, Constructors or JV, and Operator
• Pavements Engineering can be for Owner (OE), Design Team, Constructor, or Concession / Operator
Why are they Different?

- Roles are completely different than traditional project delivery
- Requires complex performance forecasting and LCCA
- Consequences of performance deficiencies are significant
- Risk profiles need to be considered
- Pavements can win the job!
Typical DBFO Elements

• Mainline (multiple lanes, multiple traffic loading and subgrade support conditions)
• Rehabilitation sections (salvage to “like new” can make team more competitive)
• Ramps & Loops (can represent >100 pavement designs, integration with mainline)
• Cross Roads (typically Long Life Pavement approach)
What’s Involved?

- Development of pavement concepts (e.g., deferment, long life, alternative materials, etc.)
- Develop initial pavement structures based on subgrade support conditions and traffic loadings
- Performance modelling and evaluation of each initial pavement structure against the performance requirements
- Using detailed LCCA, determine the type and timing of future interventions for each initial pavement design
P3 Design Considerations

- Performance Requirements (as per Concession Agreement)
  - Operational Term (e.g. 30 years, 40 years)
  - Average IRI, Rut, etc.
  - Maximum Tolerable IRI, Rut, etc.
  - Hand Back Requirements
- Consequences of Non-conformance
  - $/day, Lane rental
  - Unplanned interventions
Pavement Strength Testing

- Needs to be initiated ASAP
- Required for:
  - Subgrade support condition (back-calculated subgrade modulus)
  - Pavement rehabilitation design
Distress Prediction Modelling

- Structure
- Age
- Traffic
- Environment
- Condition

Calibrated for local environment

- Crack Initiation
- Crack Progression
- Rutting
- Roughness
- Pot Holes
- Raveling
Distress Prediction Modelling

Lane 1

Lane 2

Models are Calibrated for Local Conditions
Distress modelling by lane allows for optimal treatment timing for all lanes.
Life Cycle Cost Analysis

- Must Consider the Net Present Value (NPV) of all costs over the concession life of the asset
- Life-cycle cost =
  - Initial Construction Costs
  - + NPV Rehabilitation Costs
  - + NPV Routine Maintenance Costs
  - + NPV Lane Closure Costs
  - + NPV Performance Penalty Costs
  - + NPV End of Term Costs
Life Cycle Cost Analysis

Pavement Condition

Very Good

Do-Minimum Strategy

Surface Trt

Overlay

Higher Operating and Maintenance Costs

Lower Operating and Maintenance Costs

0 Years 20 Years

Pavement Age

Strategy 1

Strategy 2

Surface Trt

Overlay

Very Poor
Distress Prediction Modelling

For a given homogenous pavement segment there are thousands of feasible pavement strategies.

Selecting the strategy that meets performance specification requirements.
Multi-Strategy LCCA

Present Value Cost (4% real discount rate, 0% asphalt escalator)
GIS TOOL

Subgrade Strength

Roughness (IRI)
GIS Tool
Post Construction Pavements Engineering

Data Collection – Develop Performance Prediction Models – Asset Management – Regular Update & Optimization of Maintenance & Rehabilitation Plan
Predicted Condition (1 km Sections) 2015

IRI (m/km)
Predicted Condition (1 km Sections) 2017
Predicted Condition (1 km Sections) 2019
Predicted Condition (1 km Sections) 2020

IRI (m/km)
Predicted Condition (1 km Sections) 2021
Predicted Condition (1 km Sections) 2022
Predicted Condition (1 km Sections) 2023

IRI (m/km)
Predicted Condition (1 km Sections) 2024
Predicted Condition (1 km Sections) 2025
QUESTIONS