Ontario Ministry of Transportation

Ontario's Experience with Alternative Bid Contracts

Becca Lane, P.Eng.
Head, Pavements and Foundations Section
Materials Engineering and Research Office
Ministry of Transportation Ontario

Ontario Ministry of Transportation

Outline

- Introduction to LCC
- Traditional Approach
- LCC studies
- Alternative Bid Contracts
- Experience to date
- Future work

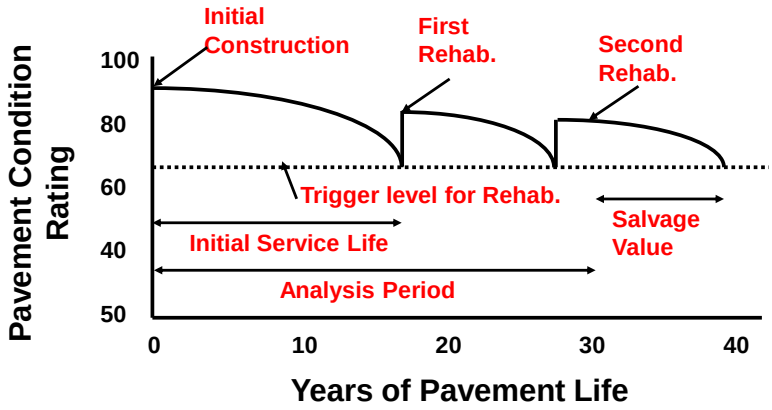
Ontario Ministry of Transportation

Life Cycle Costing

- LCC analysis is an economic assessment of competing pavement design alternatives
- LCC considers all significant costs to the agency over the life of the pavement, expressed in terms of equivalent dollars

Ontario Ministry of Transportation

Typical Life Cycle for Flexible Pavements



Ontario Ministry of Transportation

LCCA Methods

- **Equivalent Uniform Annual Cost**
- **Rate of Return**
- **Benefit-Cost Ratio**
- **Present Worth**

MTO uses *present worth*, the most popular technique for LCCA. This method requires conversion of all future costs to a baseline of today's cost.

Ontario Ministry of Transportation

Present Worth LCC Method

Initial Construction Costs
+ PW Rehabilitation Costs
+ PW Maintenance Costs
+ *(PW User Costs)*
- Salvage Costs

Total PW Life Cycle Cost

Ontario Ministry of Transportation

Present Worth

Present Worth of Costs

$$= \text{Future Cost at Year "n"} \times \frac{1}{(1+\text{Discount Rate})^n}$$

Where: "n"= year of expenditure

Discount Rate reduces future expenditures to present-day dollars

Ontario Ministry of Transportation

Traditional Approach

- **MTO has used LCC to compare concrete and asphalt pavement designs on major freeways since the mid 1980's.**
  - **30 yr. analysis period, 6% discount rate**
- **At end of Planning and prior to Detailed Design, pavement options were developed for:**
  - **Rigid pavements**
  - **Flexible pavements**
- **Pavement selection was based on lowest LCC**
- **Contract included only the selected design**

Ontario Ministry of Transportation

LCC Review

- In 1997, MTO undertook a major review of its LCC methodology.
- The review was funded and directed by MTO and the concrete and asphalt industries.
- Conducted by consortia of independent consultants:
  - ERES Consultants
  - IDI Consultants
  - Brent Rauhut Engineering

Twelfth Annual Pennsylvania Concrete Conference 9

Ontario Ministry of Transportation

1997 LCC Study

- Carried out a literature and records review
- Comprehensive data analysis to determine:
  - key traffic parameters
  - initial pavement service lives
  - typical M&R strategies, timing/performance, quantities
  - unit costs of construction and M&R items
  - appropriate discount rate
- Developed generic pavement designs using MTO methodology
- Reviewed LCCA procedures
- Reviewed user cost models
- Assessed salvage value methods

Twelfth Annual Pennsylvania Concrete Conference 10

Ontario Ministry of Transportation

Initial Pavement Service Life

- To determine service lives, failure analysis of old designs was carried out using historical pavement performance and traffic data
- Performance prediction models were calibrated using new designs and forecasted traffic
- Initial service lives were estimated for DSAC, FDAC, doweled JPC, and composite AC/JPC

Ontario Ministry of Transportation

Maintenance and Rehabilitation

- Rehabilitation Treatments
  - DSAC & FDAC: 80-mm (3") mill and overlay
  - Doweled JPC: Surface texturing, FDR, PDR, 80-mm (3") asphalt overlay
  - Composite AC/PCC: 80-mm (3") mill-and-AC OL
  - Expected lives of Rehabilitation treatments were estimated through failure analyses and calibration of performance prediction models
- Major Maintenance Treatments
  - selective resurfacing: 40-mm (1 ½") mill-and-pave, rout-and-seal, joint resealing

Ontario Ministry of Transportation

Implementation of Revised LCC Policy (1998)

- Based on the consultant recommendations and internal review, the following revisions to the LCC procedures were implemented:
  - 50 year analysis period
  - 7% discount rate
  - 29 year initial life for rigid pavement
  - 18 year initial life for flexible pavement

Ontario Ministry of Transportation

LCC Study #2

- In Dec. 1998, the two-year study recommending changes to the LCC procedures was completed and implemented.
- The asphalt and concrete industries recommended that the study be extended to take into consideration new technologies.
- A follow-up study on the benefits of new technologies and their impact on LCC was carried out and completed in Dec. 2000.

Ontario Ministry of Transportation

Follow-Up Study

- **Study incorporated the benefits of 7 new technologies:**
  - **Polymer-modified and performance graded Asphalt Cements**
  - **Heavy Duty Binder**
  - **Open Graded Drainage Layer** (OGDL)
  - **Skewed vs. perpendicular joints**
  - **Stone Mastic Asphalt** (SMA)
  - **End Result Specifications** (ERS)
  - **Smoothness Specifications**

Twelfth Annual Pennsylvania Concrete Conference 15

Ontario Ministry of Transportation

Implementation of LCC #2

- **Following the inclusion of the benefits of new technologies into the LCC models, MTO published LCC Guidelines**
- **Implementation of LCC guidelines led to the introduction of Alternative Bid Contracts**

Twelfth Annual Pennsylvania Concrete Conference 16

Ontario Ministry of Transportation

Alternative Bid Contracts

- Alternative Bid (AB) contracts incorporate LCC into the bidding process to allow both asphalt and concrete contractors to bid on the same contract.
- The intent is to allow selection of the most cost effective long-term pavement design.

Twelfth Annual Pennsylvania Concrete Conference 17

Ontario Ministry of Transportation

MTO's AB Policy

- In 2001, MTO initiated the AB process for freeway contracts.
- AB contracts are used for all new and full depth reconstruction freeway projects, five 2-lane km (3 miles) or longer in length, where one million or more Equivalent Single Axle Loads are anticipated in the design lane within 5 years of construction.

Twelfth Annual Pennsylvania Concrete Conference 18

Ontario Ministry of Transportation

AB Contracts

- AB contracts require the preparation of two pavement designs, one asphalt and one concrete, and two sets of contract documents.
- Under the AB process, bidders determine their Construction Bid for a concrete or asphalt option, then add a Bid Adjustment Factor, included in the tender documents, to their Construction Bid.
- Bid Adjustment Factors are calculated by MTO in advance, based on LCC models.
- The lowest Total Adjusted Bid wins.

Twelfth Annual Pennsylvania Concrete Conference 19

Ontario Ministry of Transportation

MTO's AB Contracts

- 9 AB contracts have been awarded to date:
  - Hwy 417 (Ottawa) – 2001
  - Hwy 417 (Ottawa) – 2004
  - Hwy 401 (Windsor) – 2004
  - Hwy 401 (Windsor) – 2005
  - Hwy 401 (Windsor) – 2006
  - Hwy 410 (Brampton) – 2006
  - Hwy 3 (Leemington) – 2008
  - Hwy 401 Widening, Hwy 403/410 IC to Hurontario St *(under construction) - 2010*
  - Hwy 404 Extension, Green Lane to Queensville Sideroad *(under construction) - 2010*

Twelfth Annual Pennsylvania Concrete Conference 20

Ontario Ministry of Transportation

Adjustment Factors

- **In all contracts, the Concrete Pavement was the lowest adjusted bid**
- **Savings between the lowest rigid and lowest flexible bid have been in excess of $35 M**

Ontario Ministry of Transportation

Hwy 417 (Contract 2000-0025)

7% Discount rate

Concrete

- 200 mm PCC
- 150 mm Granular O
- 150 mm Granular B mod

- Rigid Adjustment Factor **$1,580,720**

Asphalt

- 40 mm HL-1
- 100 mm MDBC
- 150 mm Granular O
- 450 mm Granular B mod

- Flexible Adjustment Factor **$2,014,041**

2000-0025	417	23,612,400	23,662,473	50,073

Ontario Ministry of Transportation

Hwy 417 (phase 1) – 2001
36.4 km of 2-lane JPC, 200 mm design, $23M

Twelfth Annual Pennsylvania Concrete Conference 23

Ontario Ministry of Transportation

Hwy 417 (Contract 2003-4029)

5.3% Discount rate

Concrete

- 200 mm PCC
- 150 mm Granular O
- 150 mm Granular B

- Rigid Adjustment Factor **$2,561,269**

Asphalt

- 40 mm DFC
- 100 mm HDBC
- 150 mm Granular O
- 450 mm Granular B II

- Flexible Adjustment Factor **$3,421,987**

2003-4029	417	28,755,142	29,799,789	1,044,647

Twelfth Annual Pennsylvania Concrete Conference 24

Ontario Ministry of Transportation

Hwy 417 (phase 2) – 2004
36.5 km of 2-lane JPC, 200 mm design, $29M

Twelfth Annual Pennsylvania Concrete Conference 25

Ontario Ministry of Transportation

Hwy 401 (Contract 2004-3002)

5.3% Discount rate

Concrete
- 260 mm PCC
- 100 mm OGDL
- 300 mm Granular A

Asphalt
- 40 mm SMA 12.5
- 70 mm SP 19
- 95 mm SP 25
- 95 mm SP 25
- 100 mm OGDL
- 500 mm Granular A

- Rigid Adjustment Factor **$2,249,647**
- Flexible Adjustment Factor **$2,869,865**

2004-3002	401	49,997,782	56,033,379	6,035,597

Twelfth Annual Pennsylvania Concrete Conference 26

Ontario Ministry of Transportation

Hwy 401 (phase 1) – 2004
10.4 km of 6-lane JPC, 260 mm thick, $50M

Ontario Ministry of Transportation

Hwy 401 (Contract 2005-3001)

5.3% Discount rate

Concrete
- 260 mm PCC
- 100 mm OGDL
- 300 mm Granular A

- Rigid Adjustment Factor **$1,580,720**

Asphalt
- 40 mm SMA 12.5
- 70 mm SP 19
- 95 mm SP 25
- 95 mm SP 25
- 100 mm OGDL
- 500 mm Granular A

- Flexible Adjustment Factor **$2,014,041**

2005-3001	401	44,613,270	54,271,143	9,657,873

Ontario Ministry of Transportation

Hwy 401 (phase 2) – 2005
9.9 km of 6-lane JPC, 260 mm thick, $44M

Ontario Ministry of Transportation

Hwy 401 (Contract 2005-3046)

5.3% Discount rate

<u>Concrete</u>

- 260 mm PCC
- 100 mm OGDL
- 300 mm Granular A

<u>Asphalt</u>

- 40 mm SMA 12.5
- 70 mm SP 19
- 95 mm SP 25
- 95 mm SP 25
- 100 mm OGDL
- 500 mm Granular A

- Rigid Adjustment Factor **$1,564,753**
- Flexible Adjustment Factor **$1,993,697**

2005-3046	401	52,396,696	60,054,392	7,657,696

Ontario Ministry of Transportation

Hwy 401 (phase 3) – 2006
9.8 km of 6-lane JPC, 260 mm thick, $52M

Ontario Ministry of Transportation

Hwy 410 (Contract 2006-2018)

5.3% Discount rate

Concrete	Asphalt
• 250 mm PCC	• 40 mm SP 12.5FC2
• 100 mm OGDL	• 50 mm SP 19
• 300 mm Granular A	• 50 mm SP 19
	• 100 mm SP 25
	• 100 mm OGDL
	• 150 mm Granular A
	• 410 mm Granular B-I
• Rigid Adjustment Factor **$ 758,669**	• Flexible Adjustment Factor **$1,137,448**

2006-2018	410	45,994,441	50,071,793	4,077,352

Ontario Ministry of Transportation

Hwy 410 (phase 1) – 2006
5.4 km of 6-lane JPC, 250 mm thick, $46M

Ontario Ministry of Transportation

Cost Savings on 6 AB Contracts

Contract	Hwy	Concrete bid	Asphalt bid	Cost Savings
2006-2018	410	45,994,441	50,071,793	4,077,352
2005-3046	401	52,396,696	60,054,392	7,657,696
2005-3001	401	44,613,270	54,271,143	9,657,873
2004-3002	401	49,997,782	56,033,379	6,035,597
2003-4029	417	28,755,142	29,799,789	1,044,647
2000-0025	417	23,612,400	23,662,473	50,073
			Total	28,523,238

Ontario Ministry of Transportation

2006 LCC Update

- In 2006, the Ministry partnered with the Concrete and Asphalt Industries to update and validate the LCC models.
- This included a review of:
  - Premium asphalts
  - SMA
  - Superpave
  - Life of HMA overlays
  - Diamond grinding
  - In-place strength & thickness of PCC
  - Concrete smoothness
  - Perpendicular joints
  - Over-night repair methods
  - Pavement restoration techniques
  - Other new technologies
  - And a brief look at Noise and User Costs

Ontario Ministry of Transportation

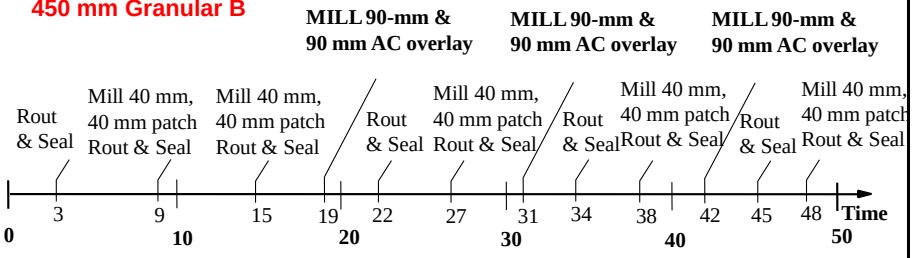
2006 LCC Update

- The 2006 study, carried out by Applied Research Associates, used the Mechanistic Empirical Pavement Design Guide (MEPDG) to evaluate and validate the existing LCC models
- No major changes were proposed to initial services lives
- New M&R schedules were produced for Superpave pavements
- Discount rate is now 5% (as set by the Ministry of Finance)

Ontario Ministry of Transportation

Flexible LCC Model (SP 12.5FC2)

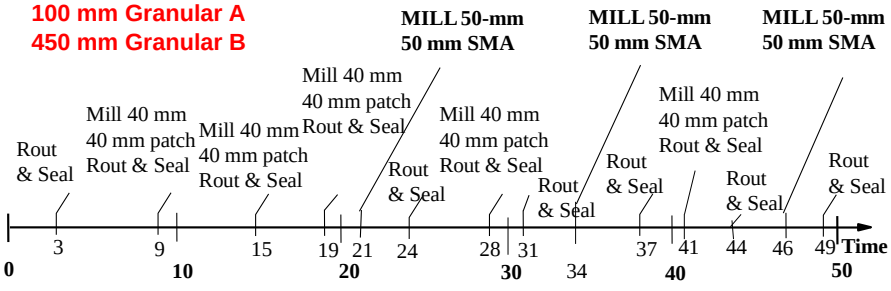
40 mm SP 12.5FC2
60 mm SP 19
220 mm SP 25
100 mm OGDL
100 mm Granular A
450 mm Granular B



Ontario Ministry of Transportation

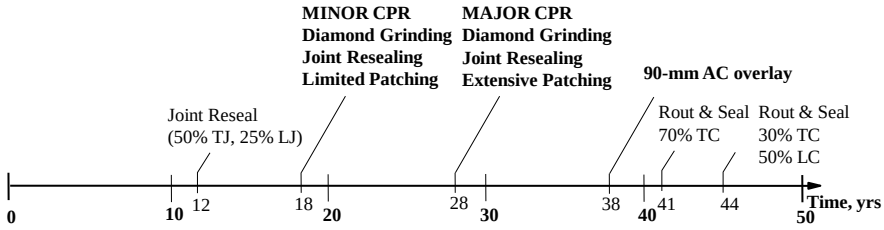
Flexible LCC Model (SMA)

40 mm SMA
60 mm SP 19
220 mm SP 25
100 mm OGDL
100 mm Granular A
450 mm Granular B



Ontario Ministry of Transportation

Rigid LCC Model



Dowelled JPC
250 mm PCC
100 mm OGDL
100 mm Granular Base

Twelfth Annual Pennsylvania Concrete Conference 39

Ontario Ministry of Transportation

Future Work

- **Additional new technologies will be included as performance information becomes available**
- **User Cost Model calibrated for Ontario use…???**
  - **congestion and user delays**
  - **collisions**
  - **fuel savings and greenhouse gas emissions**
  - **noise**

Twelfth Annual Pennsylvania Concrete Conference 40

Ontario Ministry of Transportation

Upcoming Alternative Bid Contracts

- **Hwy 401 Widening, Hwy 403/410 IC to Hurontario St IC – *under construction***
- **Hwy 404 Extension, Green Lane to Queensville Sideroad – *under construction***
- **Hwy 404 Extension, Queensville Sideroad to Ravenshoe Rd (2011)**

Ontario Ministry of Transportation

Conclusions

- MTO partnered with the Asphalt & Concrete Industries to initiate a LCC study in the late 1990's
- This led to the implementation of Alt Bid Contracts
- 9 Alt Bid contracts have been awarded to date, fostering competition for both industries and allowing them equal opportunity to bid the work
- The Alt Bid process requires additional upfront design costs, but results in considerable savings to the Agency at Contract award.

Ontario Ministry of Transportation

Thank you!

Becca Lane, P. Eng.
Head, Pavements and Foundations Section
Materials Engineering and Research Office
Tel: 416-235-3732
Fax. 416-235-3919
email: becca.lane@ontario.ca