State DOT: ALABAMA

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   Analysis Period: 28 years
   Rigid: 20 (Initial performance period) + 8 (Rehabilitation performance period)
   Flexible: 12 (Initial performance period) + 8 (Performance period for 1st overlay) + 8 (Performance period for 2nd overlay)

2. Are concrete overlays considered as a rehabilitation strategy?
   Typical Rehabilitation for Rigid pavement is remove/replace, clean/sealing joints, grinding and/or paver-laid surface treatment. An unbonded or bonded overlay is considered as reconstruction.

   Typical Rehabilitation for Flexible pavement is mill/fill, micro-surfacing, bituminous surface treatment. Concrete overlays are not performed.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   For LCCA purposes, they are analyzed by the parameters of the 28 year analysis.

   In practice, pavement condition ratings, FWD testing, Division Maintenance prioritization all of which are ultimately driven by funding.

4. What preservation treatments are used and what are the performance assumptions for each?

   Rigid: Cleaning and sealing joints, grinding, asphalt overlay, all of which are assumed to yield equivalent performance.

   Flexible: Micro-surfacing, Open-Graded Friction Course, Bituminous surface treatment, all of which are assumed to yield equivalent performance.

5. Are the planned preservation treatments tied into your pavement management system?

   Yes, the pavement management system tracks all “awarded” projects. However, locally purchased or work performed by DOT forces are not captured unless submitted to the pavement management section by the constructing entity.
   Division personnel are furnished with reports generated by the pavement management system to evaluate the performance and/or current condition of the network and, in turn, schedule and prioritize work based on the data.

6. Are the planned preservation treatments actually accomplished?

   We are no different than any other agency; the accomplishment of planned work is 90% driven by available funding.

State DOT: California

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   It depends on the alternatives. For 5 to 10 year alternatives, analysis period is 20 years. For 20-year alternatives, it is 35 years, and for more than 20-year alternatives, it is 55 years.

2. Are concrete overlays considered as a rehabilitation strategy?
   Only 40-year design life concrete overlay is considered.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   The pavement M&R schedules are consolidated based on the "Pavement M&R Decision Trees" (used for activity scheduling) included in Caltrans districts' ten-year pavement plans. The categorization of these California-specific pavement M&R schedules was based on four factors: the climate region, maintenance service level, existing pavement type/final surface type, and project type/initial M&R strategy (i.e., project alternative).

4. What preservation treatments are used and what are the performance assumptions for each?

   For JPCP:
   1. Concrete Pavement Rehabilitation A involves pavement grinding, significant slab replacement, spall repair, & joint seal repair. Its design life is 5 years. It is for JPCP projects with a total number of slabs that were replaced or exhibit third stage Rigid Cracking greater than or equal to 5% and less than or equal to 7%. For greater than 7%, the project should be scoped and analyzed as a roadway rehabilitation project.
   2. Concrete Pavement Rehabilitation B involves pavement grinding, moderate slab replacement, spall repair, & joint seal repair. Its design life is 5 to 10 years (depending on climate region and initial design life). It is for JPCP projects with a total number of slabs in the lane that were replaced or exhibit third stage Rigid Cracking between 2 and 5%.
   3. Concrete Pavement Rehabilitation C involves pavement grinding, minor slab replacement, spall repair, & joint seal repair. Its design life is 5 years. It is for JPCP projects with a total number of slabs in the lane that were replaced or exhibit third stage Rigid Cracking 2% or less.

   For CRCP:
   1. Punchout Repair A involves significant punchout repairs & 0.15' of flexible overlay. It applies to continuously reinforced concrete pavements that had previous punchout repairs and a flexible overlay.
   2. Punchout Repair B involves moderate punchout repairs & 0.15' of flexible overlay. It applies to continuously reinforced concrete pavements where the total number of current & previous punchout repairs exceed 4 per mile.
   3. Punchout Repair C involves minor punchout repairs & limited diamond grinding around the punchout repair area. It applies to continuously reinforced concrete pavements where the total number of punchout repairs do not exceed 4 per mile.

5. Are the planned preservation treatments tied into your pavement management system?
   No. The PMS is still under development.

6. Are the planned preservation treatments actually accomplished?

While that's the goal, it does not always happen and depends on the budget situation in the future.

State DOT: Colorado

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?

   40 years regardless of pavement type.

2. Are concrete overlays considered as a rehabilitation strategy?

   Yes, but only unbounded, and are rarely used

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   Documented historical performance of various pavement types.

4. What preservation treatments are used and what are the performance assumptions for each?

   Diamond grinding along with limited slab replacement: 20 years
   Unbonded concrete overlay: 20 years for structurally deficient pavement : 20 years
   HMA overlays : 3-10 years for a 2 inch overlay; 8-20 years for a 3 inch overlay

5. Are the planned preservation treatments tied into your pavement management system?

   Yes

6. Are the planned preservation treatments actually accomplished?

   Historically, no, because of exceptional pavement performance. Time to 1st rehab on PCCP was recently increased from 22 to 27 years.

   Diamond grinding and slab replacement are being used and planned for on pavements 25+ years old.

CDOT's Pavement Design Guide with LCCA manual are located at **http://www.coloradodot.info/business/designsupport/bulletins_manuals/Complete%202014%20Pavement%20Design%20Manual%20Tables%20_6-25-2009_.pdf**

State DOT: Florida

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   -40 years

2. Are concrete overlays considered as a rehabilitation strategy?
   -Not at this time.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   -For PCC: conducted study of pavement condition history, work program project information, historical documentation, district interviews of "old timers", etc. Most recent analysis supports 23 years to first rehabilitation (3%full depth slab replacement); 10 years to 5%.

   -For ACC: analysis of extensive historical pavement management data shows an average age to rehabilitation of 16 years (including open and dense surface types).

4. What preservation treatments are used and what are the performance assumptions for each?
   -For PCC: full depth slab replacement, diamond grinding, installation of edge drains, cleaning & resealing joints, and routing and sealing random cracks. Other options include crack, reseat and overlay, rubblization and overlay or reconstruction.

   -For ACC: thin mill and overlay.

5. Are the planned preservation treatments tied into your pavement management system?
   - no, though we routinely investigate the latest preservation technologies, Florida currently does not have a preventive maintenance program for pavements.

6. Are the planned preservation treatments actually accomplished?
   -yes

State DOT: Georgia

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   40 years

2. Are concrete overlays considered as a rehabilitation strategy?
   CRC overlays have been used. Unbonded Concrete overlays are being considered.

   How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   HMA: Every 10 years, reconstruct at 40 years
   CRC: 25 yrs to 1st rehab, reconstruct at 40 years with salvage value
   JPC: 20 years to 1st rehab, reconstruct at 40 years

3. What preservation treatments are used and what are the performance assumptions for each?
   For JPC: Slab replacement at 5% and joint sealing
   For CRC: Punchout repairs at 2.5%
   For both: grinding

4. Are the planned preservation treatments tied into your pavement management system?
   Tied into the decision process

5. Are the planned preservation treatments actually accomplished?
   Yes

State DOT: ILLINOIS

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

All page references refer to the Department's *Bureau of Design and Environment Manual*
http://www.dot.il.gov/desenv/bdemanual.html

1. What length of analysis period does your state use?

   Page 54-1.7, subsection 54-1.04 "Selection of Design Methodology, Pavement Type, and Design Criteria":

   New Construction/Reconstruction Projects. For new construction/reconstruction projects, the pavement selection will be based on an economic analysis using estimated costs of construction and life-cycle activities (see Section 54-7). This procedure uses a 45-year life cycle, a 3% discount rate, and a comparison of pavement types based on annualized costs.

   For reconstruction projects, supplemental designs such as unbonded concrete overlay and rubblizing with HMA overlay will be added to the comparison with mechanistic designs for new rigid and flexible pavements to determine the most appropriate and economical strategy.

2. Are concrete overlays considered as a rehabilitation strategy?

   Pages 53-4.16 and 53-4.17 of Section 53-4 "Pavement Rehabilitation Methods and Strategies":

   Portland Cement Concrete Inlay or Overlay is applicable to Hot-Mix Asphalt surfaced pavements with surface failures and a history of rutting and/or shoving, such as intersections with stopping, starting, standing, and turning actions of vehicles. However, this rehabilitation strategy is not currently recommended for federal-aid interstates or when the traffic factor is > 5.0. Furthermore, use of PCC inlays or overlays shall be approved by the Departments Central Bureau of Design and Environment (BDE).

   Unbonded Concrete Overlay is applicable to addressing structural failures of bare PCC pavements and PCC pavements with HMA overlays. The Concrete Overlay can be JPCP (however, because we have not performance history with such an application, it would have to be an experimental feature) or CRCP (applications of which we are very familiar). Use of Unbonded Concrete Overlay shall be approved by the BDE. Furthermore, the Department technically considers Unbonded Concrete Overlays as reconstruction.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   For life-cycle activities, refer to Figures 54-7.A through 54-7.C attached to this survey.

   Per pages 54-7.1 – 7.6 of Section 54-7 "Pavement Selection Analysis":

   The life-cycle activities for mechanistically designed pavements that are presented in this section were developed by a panel of Department experts who have experience in the areas of design, construction, materials, and maintenance of Illinois pavements. The expert group established rehabilitation, patching, and maintenance strategies for a 45-year analysis period for typical rigid and flexible pavements.

A framework for data collection has been established to gather actual data on maintenance activities and costs. As these data are collected, appropriate modifications to the life-cycle strategies will be made where needed.

4. What preservation treatments are used and what are the performance assumptions for each?

   Refer to subsection 52-5.03 "Rigid Pavement Treatment Summaries":
   - **Crack Sealing – 4 to 8 years performance**
   - **Joint Resealing – 4 to 8 years for hot-poured asphalt sealant; ~8 years for silicone**
   - **Longitudinal Crack Repair (i.e., partial-depth mill and fill with HMA where severe spalling and "D" cracking is present) – 5 to 8 years**
   - **Diamond Grinding – 8 to 15 years**
   - **Diamond Grooving – indefinite**
   - **Ultra-Thin Bonded Wearing Course – 7 to 12 years**
   - **Full-Depth Repairs – 10 to 15 years**
   - **Partial-Depth Repairs – 5 to 15 years**

5. Are the planned preservation treatments tied into your pavement management system?

   No, pavement preservation is not strictly/methodically specified per PMS data. That is, pavement preservation treatments are not anticipated in a programmatic way based on PMS data; the PMS data, if used, is used to help ensure the preservation method is appropriate to the pavement/distress. Although the Districts may choose to use such data in programming preservation projects.

6. Are the planned preservation treatments actually accomplished?

   Yes, but as implied above, not always at the preferred time interval or matching the distress.

ACTIVITY 1 — YEAR 10
• 0.10% Class B Pavement Patching
ACTIVITY 2 — YEAR 15
• 0.20% Class B Pavement Patching
ACTIVITY 3 — YEAR 20
• 2.0% Class B Pavement Patching • 0.50% Class C Shoulder Patching • 100% Longitudinal Shoulder Joint Routing & Sealing • 100% Centerline Joint Routing & Sealing
ACTIVITY 4 — YEAR 25
• 3.0% Class B Pavement Patching • 1.0% Class C Shoulder Patching
ACTIVITY 5 — YEAR 30
• 4.0% Class B Pavement Patching • 1.5% Class C Shoulder Patching • Policy HMA Overlay of Pavement and Shoulder (see Chapter 53-4.04 for thickness)
ACTIVITY 6 — YEAR 35
• 100% Longitudinal Shoulder Joint Routing & Sealing • 100% Centerline Joint Routing & Sealing • 50% Random Crack Routing & Sealing (see Note) • 40% Reflective Transverse Crack Routing & Sealing • 0.10% Partial-Depth Pavement Patching (Mill & Fill Surface - Interstates; Mill & Fill 2.50 in. - Non-Interstates)
ACTIVITY 7 —YEAR 40
• 0.50% Class B Pavement Patching • 100% Longitudinal Shoulder Joint Routing & Sealing • 100% Centerline Joint Routing & Sealing • 60% Reflective Transverse Crack Routing & Sealing • 50% Random Crack Routing & Sealing (see Note) • 0.50% Partial-Depth Pavement Patching (Mill & Fill Surface - Interstates; Mill & Fill 2.50 in. - Non-Interstates)

Note: For random crack routing and sealing, assume 100 ft/station/lane.

MAINTENANCE AND REHABILITATION ACTIVITY SCHEDULE
JOINTED PLAIN CONCRETE PAVEMENT
AND UNBONDED JOINTED PLAIN CONCRETE OVERLAY

Figure 54-7.A

ACTIVITY 1 — YEAR 10
• 0.10% Class A Pavement Patching
ACTIVITY 2 — YEAR 15
• 0.20% Class A Pavement Patching
ACTIVITY 3 — YEAR 20
• 0.50% Class A Pavement Patching • 100% Longitudinal Shoulder Joint Routing & Sealing • 100% Centerline Joint Routing & Sealing
ACTIVITY 4 — YEAR 25
• 0.75% Class A Pavement Patching • 0.50% Class C Shoulder Patching
ACTIVITY 5 — YEAR 30
• 3.0% Class A Pavement Patching • 1.0% Class C Shoulder Patching • Policy HMA Overlay of Pavement and Shoulder (see Chapter 53-4.04 for thickness)
ACTIVITY 6 — YEAR 35
• 100% Longitudinal Shoulder Joint Routing & Sealing • 100% Centerline Joint Routing & Sealing • 50% Random Crack Routing & Sealing (see Note) • 0.10% Partial-Depth Pavement Patching (Mill & Fill Surface)
ACTIVITY 7 —YEAR 40
• 100% Longitudinal Shoulder Joint Routing & Sealing • 100% Centerline Joint Routing & Sealing • 50% Random Crack Routing & Sealing (see Note) • 0.50% Class A Pavement Patching • 0.50% Partial-Depth Patching (Mill & Fill Surface)

Note: For random crack routing and sealing, assume 100 ft/station/lane.

MAINTENANCE AND REHABILITATION ACTIVITY SCHEDULE
CONTINUOUSLY REINFORCED CONCRETE PAVEMENT
AND UNBONDED CONTINUOUSLY REINFORCED CONCRETE OVERLAY

Figure 54-7.B

ACTIVITY 1 — YEAR 5

- 100% Longitudinal Shoulder Joint Routing & Sealing
- 100% Centerline Joint Routing & Sealing
- 50% Random/Thermal Crack Routing & Sealing (see Note)
- 0.10% Partial-Depth Pavement Patching (Mill & Fill Surface)

ACTIVITY 2 — YEAR 10

- 100% Longitudinal Shoulder Joint Routing & Sealing
- 100% Centerline Joint Routing & Sealing
- 50% Random/Thermal Crack Routing & Sealing (see Note)
- 0.50% Partial-Depth Pavement Patching (Mill & Fill Surface)

ACTIVITY 3 — YEAR 15

- 2.00 in. Milling - Pavement & Shoulder
- 1.0% Partial-Depth Pavement Patching (Mill & Fill Additional 2.00 in.)
- 2.00 in. HMA Overlay - Pavement & Shoulder

ACTIVITY 4 — YEAR 20

- 100% Longitudinal Shoulder Joint Routing & Sealing
- 100% Centerline Joint Routing & Sealing
- 50% Random/Thermal Crack Routing & Sealing (see Note)
- 0.10% Partial-Depth Pavement Patching (Mill & Fill Surface)

ACTIVITY 5 — YEAR 25

- 100% Longitudinal Shoulder Joint Routing & Sealing
- 100% Centerline Joint Routing & Sealing
- 50% Random/Thermal Crack Routing & Sealing (see Note)
- 0.50% Partial-Depth Pavement Patching (Mill & Fill Surface)

ACTIVITY 6 — YEAR 30

Interstate Standard Design:

- 2.00 in. Milling - Pavement Only
- 2.0% Partial-Depth Pavement Patching (Mill & Fill Additional 2.00 in.)
- 1.0% Partial-Depth Shoulder Patching (Mill & Fill Surface)
- 3.75 in. HMA Overlay Pavement
- 1.75 in. HMA Overlay Shoulder

Other State Maintained Route Standard Design:

- 2.00 in. Milling - Pavement & Shoulder
- 2.0% Partial-Depth Pavement Patching (Mill & Fill Additional 2.00 in.)
- 1.0% Partial-Depth Shoulder Patching (Mill & Fill Additional 2.00 in.)
- 2.25 in. HMA Overlay Pavement & Shoulder

All Limiting Strain Criterion Designs:

- 2.00 in. Milling - Pavement & Shoulder
- 2.0% Partial-Depth Pavement Patching (Mill & Fill Additional 2.00 in.)
- 1.0% Partial-Depth Shoulder Patching (Mill & Fill Additional 2.00 in.)
- 2.00 in. HMA Overlay - Pavement & Shoulder

MAINTENANCE AND REHABILITATION ACTIVITY SCHEDULE
FULL-DEPTH HMA PAVEMENT
AND HMA OVERLAY OF RUBBLIZED PCC PAVEMENT

Figure 54-7.C

ACTIVITY 7 — YEAR 35
• 100% Longitudinal Shoulder Joint Routing & Sealing • 100% Centerline Joint Routing & Sealing • 50% Random/Thermal Crack Routing & Sealing (see Note) • 0.10% Partial-Depth Pavement Patching (Mill & Fill Surface)
ACTIVITY 8 — YEAR 40
• 100% Longitudinal Shoulder Joint Routing & Sealing • 100% Centerline Joint Routing & Sealing • 50% Random/Thermal Crack Routing & Sealing (see Note) • 0.50% Partial-Depth Pavement Patching (Mill & Fill Surface)

Note: For random/thermal crack routing and sealing, assume 110 ft/station/lane.

MAINTENANCE AND REHABILITATION ACTIVITY SCHEDULE
FULL-DEPTH HMA PAVEMENT
AND HMA OVERLAY OF RUBBLIZED PCC PAVEMENT

Figure 54-7.C
(Continued)

Illinois Tollway

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   - 50 years

2. Are concrete overlays considered as a rehabilitation strategy?
   - Unbonded concrete overlays are considered where they are appropriate. The all Interstate Highway network and geometric requirements limit their applicability.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   - The Tollway uses AASHTO Pavement ME-Design software to forecast timings for critical pavement performance metrics in combination with pavement management data. For much of the newer pavement types and design features there is little long-term historical data. Other agency pavement management, survival data and life cycle cost procedures have been used.

4. What preservation treatments are used and what are the performance assumptions for each?
   - On asphalt shoulders, the Tollway plans microsurfaces, and mill and fill WMA pavement. Shoulders generally last 15 years.
   - On mainline concrete pavements the Tollway uses diamond grinding to restore ride quality and friction as needed.
   - On mainline, the Tollway also performs crack routing and sealing, as well as dowel bar retrofits and full-depth PCC patching with either cast-in-place or precast PCC. The dowel bar retrofit and patching projects are generally combined with a diamond grind or an asphalt overlay.
   - On mainline concrete pavements, the Tollway uses SMA overlays on concrete pavements, and they are expected to last 14, 12, and 10 years (1st, 2nd, and 3rd cycles, respectively).

5. Are the planned preservation treatments tied into your pavement management system?
   - Yes, the treatments are included in the pavement management system.

6. Are the planned preservation treatments actually accomplished?
   - Yes, and their effectiveness is tracked to calibrate performance models for future treatment applications.

State DOT: Indiana Department of Transportation

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?

   50 Years

2. Are concrete overlays considered as a rehabilitation strategy?

   Not right now but may be in future.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   By previous research.

4. What preservation treatments are used and what are the performance assumptions for each?

   Crack Sealing for HMA pavement at every 3 years.
   Joint Sealing for PCCP at every 8 years.

5. Are the planned preservation treatments tied into your pavement management system?

   yes

6. Are the planned preservation treatments actually accomplished?

   Yes, since we adopted LCCA for type selection process.

State DOT: IOWA

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   40 years

2. Are concrete overlays considered as a rehabilitation strategy?
   Yes during the actual project development, but not specifically in the LCCA because we don't have the performance data to support the design life yet.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   Based on the service life determined through our pavement management data.

4. What preservation treatments are used and what are the performance assumptions for each?
   No preservation treatments are included in the LCCA at this time. We have just begun to implement a more robust preservation program. When the timing cycles are more fully defined we will be evaluating the impact on the LCCA both from a cost and performance perspective. Treatments that are being discussed include; microsurfacing, thin overlays, and chip seals. Also the amount of crack sealing/filling will be increased.

5. Are the planned preservation treatments tied into your pavement management system?
   Yes the treatments will be tracked by our new Performance Division.

6. Are the planned preservation treatments actually accomplished?
   Too early to tell, but we believe that is the intent of the Performance Division.

State DOT: Kansas

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   40 years

2. Are concrete overlays considered as a rehabilitation strategy?
   No

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   KDOT had a study completed that recommended we use actual performance times for our LCA. That study determined those times.

4. What preservation treatments are used and what are the performance assumptions for each?
   Concrete – Saw and Seal, HMA Overlay at 20 and 30 years
   Asphalt – HMA Mill and Overlay at 12, 22, and 32 years

5. Are the planned preservation treatments tied into your pavement management system?
   No

6. Are the planned preservation treatments actually accomplished?
   No

State DOT: Louisiana

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   40

2. Are concrete overlays considered as a rehabilitation strategy?

   Evaluated in Year 20 for PCC Alternate.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   Meetings were held with both the concrete and asphalt industries to get their input. Also, we use historical data, PMS information, and field testing (i.e. FWD Testing, etc.) to determine a rehabilitation schedule. See response to #6 below.

4. What preservation treatments are used and what are the performance assumptions for each?

   AC- Structural Cold-Plane and overlay
   PCC - Cleaning and resealing joints, joint patching, and retexturing of travel lanes.

5. Are the planned preservation treatments tied into your pavement management system?

   Yes.

6. Are the planned preservation treatments actually accomplished?

   Activity treatments in LCCA were established from historical data as well as pavement management data and generally coincides with Louisiana preservation treatment history.

State DOT: Michigan

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   - HMA Recon: 33 years
   - JPCP Recon: 34 years
   - HMA over rubblized PCC: 26 years
   - Unbonded JPCP overlay: 25 years

2. Are concrete overlays considered as a rehabilitation strategy?
   - Yes, they are considered a major rehabilitation of a distressed concrete, or composite, pavement.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   - For our LCCA process, for each cycle of maintenance, the timing of actual projects performed on each pavement type are averaged. Per State law, actual project data must be used when putting together these maintenance schedules for pavement type selection and provides network/system wide historical averages that may not be indicative of business practices on any actual project.

   [NOTE: other states generally use the term 'rehabilitation' where MDOT would use 'CPM' or 'maintenance'. MDOT's use of the term 'rehabilitation' generally refers to a fix that is more substantial than a CPM project (e.g. multi-course HMA overlay, crush & shape, unbonded concrete overlay, HMA over rubblized concrete). MDOT does not include these 'rehabilitation' fixes in the LCCA maintenance cycles.]

4. What preservation treatments are used and what are the performance assumptions for each?
   - See attached for a list of preservation treatments and their expected life extension values.

5. Are the planned preservation treatments tied into your pavement management system?
   - MDOT has a very aggressive Capital Preventive Maintenance (CPM) program, with projects being selected only one to two years before construction. Project specific pavement condition data (remaining service life, visual surface distress, IRI, faulting, rutting) is checked against specific fix type thresholds to ensure fix type is appropriate for the existing pavement condition.
   - Planned projects are used in the Remaining Service Life (RSL) assignment process.

6. Are the planned preservation treatments actually accomplished?
   - Yes, the approved CPM projects are usually built.

CPM Fix Life Extensions*

Fix Type	Life extension (in years)	Life extension (in years)	Life extension (in years)
	Flexible	Composite	Rigid
HMA Crack Treatment***	1-3	1-3	N/A
Overband Crack Filling***	1-2	1-2	N/A
One Course HMA Overlay	5-10	4-9	N/A
Mill and One Course HMA Overlay	5-10	4-9	N/A
Single Course Chip Seal	3-6	N/A	N/A
Double Chip Seal	4-7	3-6	N/A
Single Course Micro-Surface	3-5	**	N/A
Multiple Course Micro-Surface	4-6	**	N/A
Ultra-Thin HMA Overlay	3-6	3-6	N/A
Paver Placed Surface Seal	4-6	**	N/A
Full Depth Concrete Repair	N/A	N/A	3-10
Concrete Joint Resealing****	N/A	N/A	1-3
Concrete Spall Repair	N/A	N/A	1-3
Concrete Crack Sealing****	N/A	N/A	1-3
Diamond Grinding	N/A	N/A	3-5
Dowel Bar Retrofit	N/A	N/A	2-3
Concrete Pavement Restoration	N/A	N/A	5-10

* The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

** A life extension will be provided; however, data are not available to quantify the life extension.

*** The life extension values for crack treatments on HMA surfaces should not be added to the values in the R&R fix life guidelines when determining fix lives for entry into RQFS and MPINs. The life extension values for actual crack sealing jobs should still be programmed in MPINs, but should not be included in RQFS.

**** The life extension values for concrete joint resealing and concrete crack sealing should not be added to the values in the R&R fix life guidelines when determining fix lives for entry into RQFS and MPINs. If the fix is applied in reaction to a poor performing pavement and the intent of the job is to get the original life expected out of the pavement, the fix should not be included in RQFS and the life extension value in MPINs should be limited to avoid overestimating the life of the pavement. Otherwise, the life extension value should be programmed in MPINs and included in RQFS.

State DOT: Minnesota

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?

   Minimum of 35 year analysis period for PCC overlays and new PCC pavements – Design Life of 20 years
   Minimum of 50 year analysis period for new PCC pavements – Design Life of 35 years

2. Are concrete overlays considered as a rehabilitation strategy?

   Yes

   How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   Current determination is based upon MnDOT representatives determining the typical type of repairs and performance of those repairs over time for historical pavements and their long term experience.

3. What preservation treatments are used and what are the performance assumptions for each?

   Design Life of 20 years or greater
   - **Full-Depth Reclamation (FDR)**
   - **Stabilized Full-Depth Reclamation (SFDR)**
   - **Rubblization**
   - **Cold-in-place Recycling (CIR)**
   - **PCC overlays (Whitetopping or Unbonded Overlay).**

   Design Life of less than 20 years
   - **Bituminous Overlays that are greater than 2" and no thicker than 5"**

4. Are the planned preservation treatments tied into your pavement management system?

   Currently reviewing Pavement Management Data to determine if the preservation treatments are typical of current practices.

5. Are the planned preservation treatments actually accomplished?

   Currently, the maintenance schedules are not performed as outline and calculated in the LCCA calculation.

See attached MnDOT Technical Memorandum for LCCA of Pavement Preservation Projects.

MINNESOTA DEPARTMENT OF TRANSPORTATION
Policy, Safety, and Strategic Initiatives Division
Technical Memorandum No. 10-04-MAT-01
January 28, 2010

To: Distribution 57, 612, 618, 650

From: Khani Sahebjam
Deputy Commissioner and Chief Engineer

Subject: Life Cycle Cost Analysis (LCCA) of Pavement Preservation Projects

Expiration
This Technical Memorandum supersedes Technical Memorandum No. 07-17-MAT-01. It will remain in effect until January 28, 2015 unless it is superseded.

Implementation
This technical memorandum applies to all *pavement* preservation projects in the reconditioning, resurfacing, and road repair funding categories. Projects that meet the criteria of the Pavement Selection Process will continue to follow that process.

Introduction
To comply with the requirements of legislation and Mn/DOT policy; a Life Cycle Cost Analysis (LCCA) must be submitted with the project Materials Design Recommendation (MDR). The submitted LCCA must include at least one PCC and one HMA option with equal pavement design lives (in years) and analysis periods.

Purpose
This Technical Memorandum implements the requirements of Minnesota state legislation for LCCA of alternate pavement materials and updates LCCA procedures required by Mn/DOT policy.

In 2008, the Minnesota State Legislature passed bill HF 3486 (Chapter 287). This legislation requires a life cycle cost analysis (LCCA) be performed for all pavement projects in the reconditioning, resurfacing, and road repair funding categories that are to be constructed after July 1, 2011. The LCCA are to use equal design lives and equal comparison periods to compare competing paving materials. If the chosen option does not have the lowest life cycle cost, the justification is required to be documented. The legislation requires that the commissioner report annually to members of the Senate and House of Representatives the results of the analyses. The full text of the legislation that applies to the requirement for LCCA is attached in Appendix A.

Guidelines
A LCCA is not required for preventive maintenance projects or for short projects. Preventive maintenance projects include projects that place 2" or less of paving material. Short projects meet the following criteria:

Two-Lane Roadways: Projects less than **2 miles** long
Multi-Lane Roadways: Projects less than **30,000 square yards**

-MORE-

The project length/size listed above is determined using only the driving lanes, no turn lanes, parking lanes or ancillary lanes.

Follow sections I and II to develop a LCCA to submit with the MDR. However, to make the best use of LCCA, perform the LCCA early in the project development process.

I. Procedure

1. Establish Design Life and Pavement Design Alternatives

   - For all LCCA, develop at least one HMA and one PCC pavement design alternative with equal design lives. The alternatives should be pavement designs that are capable of meeting the design life required by the scope of the project and meet Mn/DOT pavement design policy and procedures. However, the design life that best meets the scope of the project may have only one available pavement material alternate that conforms to Mn/DOT pavement design policies and procedures. In such a case, compare the alternate design with the selected design life to at least one HMA and one PCC pavement alternate developed using the closest available design life that provides both a HMA and a PCC alternate.

2. Determine Activity Timing

   - Use District experience, Pavement Manual – Appendix E, and/or HPMA data.

3. Estimate Costs

   - Only costs that demonstrate the differences between alternatives need to be explored.
   - The District will develop the initial and activity costs based on their data and experience.
   - Do not include user costs.

4. Compute Life Cycle Costs

   - Calculate the present worth, of the initial construction and maintenance activities, of each of the pavement alternatives on a cost per mile basis.
   - The present worth will be calculated using a discount rate equal to the real interest rate on 30-year treasury bonds as published each year by the federal Office of Management and Budget (OMB). The value to be used each year will be determined by the Mn/DOT Office of Investment Management and kept on file in the Mn/DOT Estimating Unit.
   - Include any remaining life value of the pavement alternative that remains at the end of the analysis period. Remaining life value is calculated as the prorated share of the cost of the last activity based on the service life that extends past the analysis period.
   - Do not include an inflation rate.

5. Analyze Results

   - Unless there is justification for an exception, choose the low cost alternative. If the chosen alternative does not have the lowest life cycle cost, the District Engineer or designee shall sign off on the supporting justification.

II. Pavement Alternatives

HMA Overlay

Description

- HMA overlay (or mill and overlay) of existing HMA or PCC pavement that will restore ride and reduce pavement distresses. The thickness of a HMA overlay may be designed to improve the load carrying capacity of an existing roadway so that it does not require a seasonal load restriction.

Design

- To remove the requirements for spring load restrictions on a roadway, Mn/DOT has a thickness design procedure based on FWD pavement deflections. A design life is not part of this design procedure. For design life, there is no formal design procedure as the performance of the overlay is very dependent on the condition of the existing pavement. Instead of a design life, HMA overlays have an expected life. Base the expected life on HPMA data and engineering judgment. The expected life of a HMA overlay is typically from 7 to 19 years.

LCCA

- Schedule the 1st overlay or reconstruction at the end of the overlay's functional life.
- Each successive overlay has 1 year less life then the previous overlay.
- Minimum of a 35 year analysis period.

HMA on Base (No Work on Subgrade)

Description

- These projects place HMA on new or existing material that behaves as base in the pavement section. These types of projects include CIR, FDR, crack and seat, full mill and repave, or new base without working the subgrade. Typically, very specific engineering requirements need to be met to make these options practical. Only consider the options that are practical in the LCCA.

Design

- Design these pavements with the Mn/DOT procedures used for new HMA pavement. Some adjustments may need to be made for the properties of the base.
- Design these projects to carry 20 years of accumulated traffic loading.

LCCA

- Use the maintenance schedule provided in the pavement selection memo.
- Minimum of a 35 year analysis period.

PCC Overlay

Description

- These projects place PCC on existing HMA (whitetopping) or existing PCC with a stress relief layer (unbonded overlay). A PCC overlay will functionally and structurally improve an existing pavement.

Design

- Follow Mn/DOT design procedures for either whitetopping or unbonded overlays.
- The design life of these projects may be from 15-35 years.

LCCA

- If the Mn/DOT design procedure results in a thickness less than the minimum PCC thickness allowed by Mn/DOT policy, contact the Pavement Design Unit.
- An intermediate minor CPR project may add an additional 5 years until major CPR or replacement is required.
- For PCC overlay projects, the pavement should receive its first major CPR or reconstruction at the end of its design life.
- Use a life expectancy of about half the pavement design life for major CPR.
- Minimum of a 35 year analysis period.

PCC Pavement (No Work on Subgrade)

Description

- These projects place new PCC pavement on new or existing base and do not involve working the subgrade.

Design

- Follow Mn/DOT design procedures for PCC pavement.
- The preferred design life is 35 years for these projects.

LCCA

- For 35 year designs, use the maintenance schedule provided in the pavement selection memo.
- For designs for less than 35 years, follow the same maintenance schedule guidelines as for PCC overlays.
- Use a 50 year analysis period.

Questions
Contact Jerry Geib, **Pavement Design Engineer, at (651) 366-5496**, for information on the technical contents of this memorandum.

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards unit, designstandards@dot.state.mn.us. A link to all active and historical Technical Memoranda can be found at http://www.dot.state.mn.us/design/tech-memos/index.html.

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Appendix A

Sec. 71. **[174.185] PAVEMENT LIFE-CYCLE COST ANALYSIS.**

Subdivision 1. **Definitions.** For the purposes of this section, the following definitions apply:

(a) "Life-cycle cost" is the sum of the cost of the initial pavement project and all anticipated costs for maintenance, repair, and resurfacing over the life of the pavement. Anticipated costs must be based on Minnesota's actual or reasonably projected maintenance, repair, and resurfacing schedules, and costs determined by the Department of Transportation district personnel based upon recently awarded local projects and experience with local material costs.

(b) "Life-cycle cost analysis" is a comparison of life-cycle costs among competing paving materials using equal design lives and equal comparison periods.

Subd. 2. **Required analysis.**

For each project in the reconditioning, resurfacing, and road repair funding categories, the commissioner shall perform a life-cycle cost analysis and shall document the lowest life-cycle costs and all alternatives considered. The commissioner shall document the chosen pavement strategy and, if the lowest life cycle is not selected, document the justification for the chosen strategy. A life-cycle cost analysis is required for projects to be constructed after July 1, 2011. For projects to be constructed prior to July 1, 2011, when feasible, the department will use its best efforts to perform life-cycle cost analyses.

Subd. 3. **Report.**

The commissioner shall report annually to the chairs and ranking minority members of the Senate and House of Representatives' committees with jurisdiction over transportation finance beginning on January 1, 2012, the results of the analyses required in subdivision 2.

State DOT: Missouri

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?

   The Missouri DOT utilizes a 45 year design life for full depth pavement designs, asphalt or concrete.

2. Are concrete overlays considered as a rehabilitation strategy?

   Yes, unbounded concrete overlays are considered when developing pavement rehabilitation strategies. The unbounded concrete overlay has a thickness of 8 inches placed on a separation layer consisting of geotextile fabric or one inch of hot mix asphalt. The asphalt option is 12 inches of Superpave mix placed over rubblized concrete pavement.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   A Pavement Team was put together to streamline our pavement design process. The team consisted of MoDOT personnel and individuals from the concrete and asphalt paving industry. One of the outcomes was alternate bidding and the use of a LCCA. The team analyzed asphalt and concrete pavement performance and determined what rehabilitation treatments that would be performed and when. Shown below are the assumed rehabilitation treatments for each pavement type:

   Concrete
   1st Rehabilitation – Diamond Grinding at year 25; assumed 1.5% PCCP repair

   Asphalt
   1st Rehabilitation – Coldmill and place 1 ¾ inches of asphalt at year 20; travel way only
   2nd Rehabilitation – Coldmill and place 1 ¾ inch of asphalt at year 33; travel way and shoulders

4. What preservation treatments are used and what are the performance assumptions for each?

   Preventative treatments (i.e. crack sealing, seal coats, etc…) are not included in the LCCA. The Pavement Team reviewed the limited maintenance data available for both pavement types and found little difference.

5. Are the planned preservation treatments tied into your pavement management system?

   Currently, preservation treatments are not tied to our pavement management system.

6. Are the planned preservation treatments actually accomplished?

   No. Preventative treatments are placed by our maintenance forces when needed.

State DOT: NE Department of Roads

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   50 Years

2. Are concrete overlays considered as a rehabilitation strategy?
   Yes

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   Assumptions based on experience.

   Example:
   35yrs initial PCC life + 15yrs w/4" HMA overlay vs.
   20yrs initial HMA life + 15yrs w/4" mill/fill +15yrs w/4" mill/fill

4. What preservation treatments are used and what are the performance assumptions for each?
   Concrete repair, joint and crack seals, HMA armor coat/chip seal, HMA patching, etc.

5. Are the planned preservation treatments tied into your pavement management system?
   No

6. Are the planned preservation treatments actually accomplished?
   Yes, as needed.

State DOT: Nevada DOT

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   35 years

2. Are concrete overlays considered as a rehabilitation strategy?
   Yes, on a case by case basis.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   Rehabilitation schedules are predetermined and vary based on traffic and pavement type.

4. What preservation treatments are used and what are the performance assumptions for each?
   Asphalt:
   - Fog seal, 1-2 years, for reducing raveling and fine crack filling
   - Crack sealing, 2-4 years, preventing moisture infiltration
   - Chip sealing (rural), 3-5 years, crack fill and friction restoration
   - Microsurfacing (urban), 3-5 years, crack fill and friction restoration

   Concrete:
   - Saw and seal, 10+ years, prevent water infiltration
   - Profile grind, 10+ years, restore ride and friction

5. Are the planned preservation treatments tied into your pavement management system?
   yes, but only as a scheduled preservation treatment, then actual projects are prioritized and initiated by a follow-up field review

6. Are the planned preservation treatments actually accomplished?
   Yes, depending on schedule and available budget

State DOT: North Carolina DOT

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   - *Old (Current) Procedure – 30 yrs.*
   - *Proposed Procedure – 45 yrs.*

2. Are concrete overlays considered as a rehabilitation strategy?
   - *No.*
   - *Only for the concrete alternate, as an unbonded overlay at the end of the initial design life.*

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   - *Based on LTPP data and the State's DOT experience for both flexible and rigid pavements.*
   - *Based on an extensive study designed specifically to determine the timing between rehabilitations of NC pavements for both flexible and rigid using historical Pavement Management System (PMS) data and statistical analysis.*

4. What preservation treatments are used and what are the performance assumptions for each?
   - *For flexible pavements, preservation treatments such as crack seal, patching, and chip seal are not included in the analysis, but only minor rehabilitation such as one lift overlay (with a 10-yr. design life at satisfactory performance). The reason is that LCCA was used only for pavements which design structural number was higher than 6, interstate and major US routes mainly. For rigid pavements saw and reseal joints was assumed at year 10 and 20 of the 30-yr. design life.*
   - *Similarly, mill and replace one lift of surface course for flexible pavement is the minimum rehabilitation activity included in the analysis for travel lanes, and fog seal is included for shoulders only. Performance for the mill and replace assumed satisfactory until the next rehab. For rigid pavements, saw and reseal joints along with full-depth patching is included, and performance assumed satisfactory until the next planned rehab.*

5. Are the planned preservation treatments tied into your pavement management system?
   - *Yes, if there is any planned.*
   - *Yes, if there is any planned.*

6. Are the planned preservation treatments actually accomplished?
   - *Old (Current) Procedure - The Divisions make decision on when and what treatment to apply. The information is recorded in the PMS, but not compared with the originally planned life-cycle strategy.*
   - *Proposed Procedure – Planned life-cycle strategy is based on state's averages for timing needed between preservation (for concrete) and rehab activities. Actual activities timing and type; that is the execution of planned life-cycle strategy will depend on the specific pavement condition and decision tree recommendations by the PMS and the Division. Thus, timing and possibly type of activity may vary somewhat from planned.*

State DOT: North Dakota

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?

   North Dakota does not use LCCA for determining reconstruction or rehabilitation strategies.

2. Are concrete overlays considered as a rehabilitation strategy?

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

4. What preservation treatments are used and what are the performance assumptions for each?

5. Are the planned preservation treatments tied into your pavement management system?

6. Are the planned preservation treatments actually accomplished?

State DOT: Ohio

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   35 years

2. Are concrete overlays considered as a rehabilitation strategy?
   Yes, unbonded only

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   Analysis of pavement management data and survey of other states

4. What preservation treatments are used and what are the performance assumptions for each?
   CPR - 10 years
   Asphalt overlays - 10 years

5. Are the planned preservation treatments tied into your pavement management system?
   No

6. Are the planned preservation treatments actually accomplished?
   Possibly but it is not required or monitored.

State DOT: Oklahoma DOT

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?

   We do not use LCCA.

2. Are concrete overlays considered as a rehabilitation strategy?

   Yes

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

   Since we do use LCCA this is not a subject we use.

4. What preservation treatments are used and what are the performance assumptions for each? N/A

5. Are the planned preservation treatments tied into your pavement management system? N/A

6. Are the planned preservation treatments actually accomplished? N/A

State DOT: PENNDOT

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1) What length of analysis period does your state use?
   50 years, see #3 for other treatments.

2) Are concrete overlays considered as a rehabilitation strategy?
   YES

3) How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type? Use ideal schedule:

   11.4.1 Bituminous New Construction or Reconstruction (including construction on rubblized concrete) – 50 Year Pavement Life

   5 years Clean and Seal, 25% of longitudinal joints
   Crack Seal, 500 lineal feet per mile
   Seal Coat or Micro Surface shoulders, if Type 1, 1S, 3, 4, 6 or 6S Maintenance and Protection of Traffic
   User Delay

   10 years Full Depth Patching, 2% of pavement area
   Mill wearing course
   Bituminous Inlay, 1.5" or 2.0"
   Seal Coat or Micro Surface shoulders, it Type 1, 1S, 3, 4, 6 or 6S Maintenance and Protection of Traffic
   User Delay

   15 years Clean and Seal, 25% of longitudinal joints
   Crack Seal, 500 lineal feet per mile
   Seal Coat or Micro Surface shoulders if Type 1, 1S, 3, 4, 6 or 6S Maintenance and Protection of Traffic
   User Delay

   20 years Full Depth Patching, 2% of pavement area
   Mill wearing course Leveling Course, 60 PSY Bituminous Overlay, 1.5" or 2.0" Type 7 Paved Shoulders
   Adjust guide rail and drainage structures, if necessary
   Maintenance and Protection of Traffic
   User Delay

   25 years Clean and Seal, 25% of longitudinal joints Crack Seal, 500 lineal feet per mile
   Maintenance and Protection of Traffic User Delay

   30 years Full Depth Patching, 2% of pavement area
   Mill Wearing Course
   Bituminous Overlay, 1.5" or 2.0"
   Seal Coat or Micro Surface shoulders Maintenance and Protection of Traffic User Delay

35 years Clean and Seal, 25% of longitudinal joints Crack Seal, 500 lineal feet per mile Maintenance and Protection of Traffic User Delay

40 years Full Depth Patching, 2% of pavement area
Leveling Course, 60 PSY Bituminous Overlay, 1.5" or 2.0" Type 7 Paved Shoulders
Adjust guide rail and drainage structures, if necessary
Maintenance and Protection of Traffic
User Delay

45 years Clean and Seal, 25% of longitudinal joints
Crack Seal, 500 lineal feet per mile Seal Coat or Micro Surface shoulders Maintenance and Protection of Traffic
User Delay

11.4.2 Concrete New Construction, Reconstruction (including construction on rubblized concrete), Unbonded Overlay – 50 Year Pavement Life (after Residual Life Discount is applied)

8 years Clean and Seal, 25% of longitudinal joints including shoulders
Clean and Seal, 25% of transverse joints Maintenance and Protection of Traffic User Delay

15 years Concrete Patching, 2% of pavement area
Diamond Grinding, 50% of pavement area
Clean and Seal, all longitudinal joints including shoulders
Clean and Seal, all transverse joints Maintenance and Protection of Traffic User Delay

25 years Concrete Patching, 8% of pavement area
Clean and Seal, all longitudinal joints including shoulders
Clean and Seal, all transverse joints Leveling Course, 60 PSY Bituminous Overlay, 4" or 4.5"
Saw and Seal, all transverse joints
Type 7 Paved Shoulders
Adjust guide rail and drainage structures, if necessary
Maintenance and Protection of Traffic
User Delay

30 years Clean and Seal, 25% of sawed and sealed joints
Crack Seal, 500 lineal feet per mile Seal Coat or Micro Surface shoulders Maintenance and Protection of Traffic User Delay

35 years Partial Depth Patching, 5% - 8% of pavement area
Mill Wearing Course Bituminous Overlay, 1.5" or 2.0" Saw & Seal, all transverse joints
Seal Coat or Micro Surface shoulders Maintenance and Protection of Traffic User Delay

40 years Clean & Seal, 25% of sawed & sealed joints Crack Seal, 500 lineal feet per mile Seal Coat or Micro Surface shoulders Maintenance and Protection of Traffic User Delay

45 years Full Depth Patching, 5% - 8% of pavement area
Leveling Course, 60 PSY Bituminous Overlay, 1.5" or 2.0" Saw & Seal, all transverse joints Type 7 Paved Shoulders Adjust guide rail and drainage structures, if necessary Maintenance and Protection of Traffic User Delay

Note: In Year 50, five years of life remain on the last overlay. Therefore a Residual Life Discount is applied when comparing to New Bituminous Construction or Reconstruction in order to equate total pavement lives.

11.4.3 Bonded Concrete Overlay – 30 Year Pavement Life

5 years Clean and Seal, 25% of longitudinal joints including shoulders
Clean and Seal, 25% of transverse joints
Seal Coat or Micro Surface shoulders, if bituminous
Maintenance and Protection of Traffic
User Delay

10 years Concrete Patching, 5% of pavement area
Diamond Grinding, 50% of pavement area
Clean and Seal, 25% of longitudinal joints including shoulders
Clean & Seal, 25% of transverse joints
Seal Coat or Micro Surface shoulders, if bituminous
Maintenance and Protection of Traffic
User Delay

15 years Clean and Seal, 25% of longitudinal joints including shoulders
Clean and Seal, 25% of transverse joints
Seal Coat or Micro Surface shoulders, if bituminous
Maintenance and Protection of Traffic
User Delay

20 years Concrete Patching, 8% of pavement area
Clean and Seal, all longitudinal joints including shoulders
Clean and Seal, all transverse joints Leveling Course, 60 PSY Bituminous Overlay, 4" or 45"
Saw and Seal, all transverse joints
Type 7 Paved Shoulders
Adjust guide rail and drainage structures, if necessary
Maintenance and Protection of Traffic
User Delay

25 years Clean and Seal, 25% of sawed and sealed joints
Crack Seal, 500 lineal feet per mile Seal Coat or Micro Surface shoulders Maintenance and Protection of Traffic
User Delay

11.4.4 Concrete Pavement Rehabilitation (CPR) & Bituminous Overlay – 30 Year Pavement Life

10 years Partial Depth Patching, 2% of pavement area
Mill Wearing Course
Bituminous Overlay, 1.5" or 2.0" Saw & Seal, all transverse joints
Seal Coat or Micro Surface shoulders, if Type 1, 1S, 3, 4, 6 or 6S Maintenance and Protection of Traffic
User Delay

15 years Clean & Seal, 25% of sawed & sealed joints
Crack Seal, 500 lineal feet per mile
Seal Coat or Micro Surface shoulders, if Type 1, 1S, 3, 4, 6 or 6S Maintenance and Protection of Traffic
User Delay

20 years Full Depth Patching, 2% of pavement area
Leveling Course, 60 PSY Bituminous Overlay, 1.5" or 2.0" Saw & Seal, all transverse joints Type 7 Paved Shoulders
Adjust guide rail and drainage structures, if necessary
Maintenance and Protection of Traffic
User Delay

25 years Clean & Seal, 25% of sawed & sealed joints
Crack Seal, 500 lineal feet per mile Seal Coat or Micro Surface shoulders Maintenance and Protection of Traffic User Delay

11.4.5 Bituminous Overlay on Bituminous Pavement – 10 Year Pavement Life

5 years Clean and Seal, 25% of longitudinal joints
Crack Seal, 500 lineal feet per mile
Seal Coat or Micro Surface shoulders, if Type 1, 1S, 3, 4, 6 or 6S Maintenance and Protection of Traffic
User Delay

11.4.6 Ultra-Thin Whitetopping on Bituminous Pavements – 10 Year Pavement Life

5 years Clean and Seal, 25% of longitudinal joints including shoulders
Clean and Seal, 25% of transverse joints Seal Coat or Micro Surface shoulders Maintenance and Protection of Traffic User Delay

4) What preservation treatments are used and what are the performance assumptions for each?
   See #3

5) Are the planned preservation treatments tied into your pavement management system?
   YES

6) Are the planned preservation treatments actually accomplished?
   NOT ALWAYS due to performance variations and or funding issues.

State DOT: South Dakota

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   - 20 yr Design Life
   - 40 yr Service Life

2. Are concrete overlays considered as a rehabilitation strategy?

   - Yes it can be considered a rehabilitation strategy

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   - Past history of treatments
   - Other States past history with like treatments

4. What preservation treatments are used and what are the performance assumptions for each?

   The following lists of Pavement Preservation Treatments are available in South Dakota's Pavement Preservation Manual located at the following address: http://www.sddot.com/resources/manuals/PavementPreservationGuidelines1112011.pdf

   - Crack Sealing – 4 to 8 years
   - Joint resealing – 4 to 15 years for Hot Pour and 10 to 20 years for Silicone Sealant
   - Diamond Grinding – 8 to 15 years
   - Diamond Grooving – 8 to 15 years
   - Full Depth Repairs – 10 to 15 years
   - Partial-Depth Repairs – 5 to 15 years
   - Dowel Bar Retrofit – 15 to 20 years
   - Cross Stitching – 15 to 30 years

5. Are the planned preservation treatments tied into your pavement management system?

   Yes the following list is included in our PMS as preventive treatment options:
   - Diamond Grinding
   - Pavement Restoration 1 (minor joint & spall)
   - Pavement Restoration 2 (major joint & spall with panel replacement)
   - Saw & Seal Joints
   - Dowel Bar Retrofit

6. Are the planned preservation treatments actually accomplished?

   Yes they are accomplished by it may not be in the actual year the PMC predicts.

   We are in the process of developing a new method to enable update of the PMS treatment curves to ensure that they are predicting a proper timing of the treatments.

State DOT: Texas

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   LCCA typically only used when comparing rigid and flexible pavement (perpetual) options against each other. 30-yr analysis period is typical.

2. Are concrete overlays considered as a rehabilitation strategy?
   Yes

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   Experience-based. Objective data is not available in our PMIS database because the complete pavement structure is not documented.

4. What preservation treatments are used and what are the performance assumptions for each?
   The preservation treatments for flexible pavements are mill & overlay, crack sealing. For rigid pavements full depth repairs, HMA overlays, in some cases grinding & grooving to restore ride & friction and HMA overlays.

5. Are the planned preservation treatments tied into your pavement management system?
   No

6. Are the planned preservation treatments actually accomplished?

   In most cases yes but we do not have a system in place to track if the treatments.

State DOT: UTAH

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   50 years.

2. Are concrete overlays considered as a rehabilitation strategy?
   Yes.

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?

4. What preservation treatments are used and what are the performance assumptions for each?

Question 3 & 4***: The type and frequency of future maintenance and rehabilitation operations vary according to the pavement type being considered. Knowing how a particular pavement type performed in the past is a valuable guide in predicting future performance.***

Typical Maintenance Requirements During the Life of a Pavement		
YEAR	**All PCC Pavement**	**Interstate HMA Pavement**
0	Construction or Reconstruction	Construction or Reconstruction
6		Surface Seal (SS)
10	Joint Seal, Diamond Grinding and Joint Repair	
12		SS
15		2.5 inch HMA overlay and SS
20	Partial and Full Depth Slab Repair	
21 and 24		SS
30	Joint seal, grinding, and joint repair	
36		SS
40	New Pavement	
42		SS
45		2.5 inch HMA overlay and SS
50		New Pavement

Typical Maintenance Requirements During the Life of a Pavement		
Year	HMA – High Volume (AADT > 5000)	HMA Pavement – Low Volume (AADT < 5000)
0	Construction or Reconstruction	Construction or Reconstruction
6		Surface Seal (SS)
8	SS	
12		SS
15	Structural Overlay and SS	
18		SS
23	SS	SS
30	Structural Overlay and SS	SS
38		SS
40		New Pavement
48	New Pavement	

5. Are the planned preservation treatments tied into your pavement management system?
   No, but the assumptions made are tied to our typical preservation treatments.

6. Are the planned preservation treatments actually accomplished?
   Yes, for the most part. Funding does not always allow for the planned time frames.

State DOT: Washington State

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   - 50 years

2. Are concrete overlays considered as a rehabilitation strategy?
   - Yes

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   –Assessment of local historical pavement management rehabilitation records of similar pavement structure, loading, and surface type.

4. What preservation treatments are used and what are the performance assumptions for each?
   Asphalt: Crack Sealing & Pavement Repair (2-3 years)
   Chip Seal (6-8 years)
   Mill & Fill or Overlay (typical 2") (15 years)
   Concrete: Crack Sealing & Pavement Repair (2-3 years)
   Panel Replacement (10 years)
   Diamond Grinding (10 years)
   DBR (15 years)

5. Are the planned preservation treatments tied into your pavement management system?
   The pavement management system is used to help identify where pavement preservation treatments are needed. It is not used directly to identify and trigger specific pavement preservation treatments.

6. Are the planned preservation treatments actually accomplished?
   Yes, if still appropriate at time of treatment. Projects are re-scoped if assumed conditions have changed.

State DOT: WISCONSIN

NATIONAL CONCRETE CONSORTIUM

Performance Assumptions Used to Support LCCA - State Reports - Fall 2013 Meeting

1. What length of analysis period does your state use?
   50 years

2. Are concrete overlays considered as a rehabilitation strategy?
   We do not have procedures in place for concrete overlay design (do not have service lives, etc.).

3. How does your state determine the time until 1st rehabilitation; 2nd rehabilitation; 3rd rehabilitation, etc., for each pavement type?
   We have standard service lives for the different pavement types (HMA, HMA over pulverized HMA, HMA over rubblized concrete, doweled concrete, etc.), based on historical information.

4. What preservation treatments are used and what are the performance assumptions for each?
   Preservation treatments, besides the inclusion of basic maintenance treatments (crack seal, joint repair, etc.) during the 50-year period, are not pre-planned so not included in LCCA.

5. Are the planned preservation treatments tied into your pavement management system?

6. Are the planned preservation treatments actually accomplished?