Comments to Florida Department of Transportation
Pavement Type Selection Process

Jim Mack, PE, CEMEX

COMMENTS:
To the 2nd Draft of Chapter 4 and the "Summary of Issues and Department's Position"

Comments to 2nd Draft of Chapter 4
Section 4.1 General:

1. As written, it still appears that the only projects that will go through the PTS are essentially new construction and reconstruction.

   It is recommend to reword the first paragraph to:

   > This process is to be used to develop an economic analysis as part of the pavement type selection process for projects on the State Highway System that are greater than one half mile in length for: new construction; addition of new through lanes when reconstruction of the existing base is required; and reconstruction that has the primary purpose of *improving the pavement structure through an overlay process or the* removal and replacement of a substantial amount of the existing pavement and base.
   >
   > It is also recommended to address this issue by expanding on the types of rehabilitation activities discussed in Section 4.3.2 Rehabilitation Strategies, similar to what Ohio DOT has in their Pavement Design Manual (see discussion in Section 4.3.2)

2. Prior to the above first paragraph, it is recommended to add an introductory paragraph that outlines the "guiding principals" for comparing alternate sections in a pavement type selection process. One potential example is:

   > *The Pavement Type Selection process is used to compare two or more alternate pavement sections that could be used for a given project. In order to have a fair and balanced evaluation process, the following three items are required:*
   >
   > 1. *Equivalent pavement designs (eg have the same "structural capacity" using comparable design inputs and conditions)*
   > 2. *Balanced Material Quantity Specifications and Pay Items*
   > 3. *A Life Cycle Cost Analysis procedure that accurately reflects anticipated practices and economic conditions.*

This chapter of the Pavement Type Selection manual addresses Item 3 – Life Cycle Cost Analysis procedures. Items 1 and 2 are addressed in other Department Publications.

Section 4.2 Economic Analysis (EA):

1. In the first sentence of the 2nd paragraph, add the following phrase:

   When the life cycle cost analysis described in this chapter indicates that project costs *for equivalent structural designs* are within ± 10%, the costs will be considered equivalent and alternate bids will be sought.

Section 4.3.1 Time Periods:

1. Discount Rate:

   While I still recommend the use of different discount rates for concrete and asphalt as outlined in my comments on discount rates submitted earlier, I would like clarification on comment 19 of the SUMMARY OF COMMENTS BY INDUSTRY WITH DEPARTMENT RESPONSES, Attachment A. In response 19, FDOT's states:

   Additionally, the Department is looking at the Colorado approach where the ten year running average CPI is used to develop the discount rate.

   While this was once CDOT's procedure, it is my understanding that CDOT now uses the 10 year rolling average of 30-Yr OMB Real Discount Rate (see Ref 1). Based on our review, six states use real discount rates based on OMB Circular A-94, Appendix C. Four states (MI, MO, OH, and WV) use the 30-Year real rates (OH also does sensitivity analysis); CO uses the 10 year rolling average of 30-Yr OMB; and MN uses the 5 year rolling average of 30-Yr OMB.

   For this reason, could FDOT please confirm or provide additional explanation on how the Department will approach the Discount Rate?

Section 4.3.2 Rehabilitation Strategies:

1. It is recommended to replace the first and second paragraphs with stronger wording on the importance of using rehabilitation strategies for the alternate sections that will accurately reflect anticipated practices. As it is currently stated, the rehabilitation strategies are essentially locked in and the designer does have the flexibility to address site specific or district conditions.

   One potential example is:

   The rehabilitation strategy selected for each "equivalent design" should accurately reflect current or anticipated owner-agency pavement management practices, and as

---

[1] Colorado Department of Transportation's Current Procedure for Life Cycle Cost Analysis and Discount Rate Calculations, January 2009, pages 4- 6, https://coloradodot.info/programs/research/pdfs/2009/lcca2009.pdf/view

much as possible be based on historical and/or predicted performance data of "like roadways."

If recent experience with a pavement design is limited, available "best-practice" guidance on pavement rehabilitation strategies should be utilized. Where no data or experience exists, the future rehabilitation strategies shown in Table 4.1 are suggested based on historical performance in Florida and engineering consideration of changes in design methods and growth in truck loadings. However, in using this table, it must be recognized that these scenarios are not intended to indicate the exact future rehabilitation designs, but rather to reflect reasonable strategies and quantities for estimating life cycle cost.

In all cases, the District Pavement Design Engineer or the Engineer of Record will document how the rehabilitation scenario was developed.

2. It is recommended to replace the concrete portion on Table 4.1 with something similar to the following (a similar table was previously submitted – this table contains updates based on the comments and discussions during the rule-making workshops). The reasoning for replacing Year 20 and 30 with "1st rehab activity" and "2nd rehab activity" is so that range of anticipated activity years can be given and the designer can make adjustments based on historical performance or MEPDG prediction curves as described above. The 3rd set of rehab activities have been added in case a longer analysis periods as discussed in Section 4.3.1 is used.

Table 4.1 Future Rehabilitation Strategies (similar Asphalt section needs to be developed)

Concrete			
Rehab Cycle	Urban Arterial	Rural Arterial	Limited Access
1st Rehab (Year 20 -25)	CPR (1-3% of the pavement area is Full Depth Repaired and 100% Diamond Grind[2])	CPR (1-3% FDR & DG)	CPR (1-3% FDR & DG)
2nd Rehab (Year 30 -35)	CPR (3-5% FDR & DG)	CPR (3-5% FDR & DG t)	CPR (3-5% FDR & DG)
3rd Rehab (Year 40 -45)	CPR (5-8% FDR & DG) Or Resf. 1 inch Str. AC and DGFC (Choice should be made on cost analysis)	CPR (5-8% FDR & DG) Or Resf. 3 inch Str. AC and FC (Choice should be made on cost analysis)	CPR (5-8% S FDR & DG) Or Resf. 4 inch Str. AC and FC (Choice should be made on cost analysis)

These changes are based on the approach used by the Ohio DOT, which gives ranges for their rehabilitation activities and in the year that they are done in order to give latitude to designers to account for road type, traffic conditions, predicted or historical performance, etc.

[2] Full Depth Repairs are recommended over "slab replacement" because most often, it is a joint that needs repaired and the amount of patching is much smaller than a full slab replacement.

3. It is recommended that the range of potential activities be expanded and described, again similar to what has been done by Ohio DOT, to allow for other options to be used by the designer. As an example, see Appendix A, which is Section 702.2 from the ODOT Pavement Design Manual describing the "Maintenance Schedules." *Note that while we show ODOT procedures to show how flexibility may be built into the process, we do not necessarily endorse their rehabilitation schedules.*

4. In the current FDOT Proposed Table 4.1, the asphalt rehabilitation activities at year 28 are the same as at year 14. However, for the concrete activates, the amount of repairs, or the type of repair for the second rehabilitation is increased to account for continued deterioration of the pavement. Both pavement types will see an increase in deterioration due to of traffic, which will lead to increased deterioration in both pavements types. As this has been accounted for in the concrete side, a similar accounting needs to take place on the asphalt schedule.

Section 4.3.3 Considerations:

1. Bullet 3 states "Indirect costs" are items such as *motorist delay time, vehicle operating costs, accident costs, etc.* It this authors understanding that these items are "Users Cost" as defined by FHWA and it is agreed that they should be kept separate from the agency costs.

   "Indirect Costs" are items such as preliminary engineering, contract administration, construction supervision, construction inspection, traffic control. They can also include items such as guardrail and sign adjustments, lighting requirements, overhead structures and at-grade structures, etc that can affect the overall cost of the project, but are not necessarily part of the pavement structure. It is especially important that indirect costs are included in the rehabilitation costs due to the time value of money. That is, their values are different because they occur at different times and in different quantities (the number of times that they occur).

   As these indirect costs are costs that the agency will have to expend based on the pavement type selection, it is recommended to add a bullet that these items be included in the economic analysis. A potential example is:

   > *Indirect Costs (preliminary engineering, contract administration, construction supervision, construction inspection, traffic control, etc) will be considered in the economic analysis.*

   It is also recommended to change indirect costs in the existing bullet to "user costs." For example:

   > *User costs (motorist delay time, vehicle operating costs, accident costs, etc.) should be considered separately if there is reason to believe that there will be significant differences in these costs between pavement types.*

Section 4.3.3 Project Development Time Frame and Solicitation of Industry Input:

1. While this section is a major improvement, there is still a question as to how FDOT will address projects already in the pipeline.

   Would FDOT please address how they will evaluate and apply the PTS process to projects that:
   a. Are already in the work plan but not at the 30% design stage
   b. Are beyond the 30% design stage but not at the 60% design stage
   c. Are beyond the 60% design stage

Comments to "FDOT Summary of Issues and Department's Position":

Issue #6 - When validated for FDOT materials, use MEPDG for preparing equivalent pavement design alternatives.

As correctly stated, there is an issue with the values used for the coefficient of thermal expansion (COTE) for concrete. However, the issue is not a fatal issue and it should not slow FDOT's efforts on adopting MEPDG. The error associated with the COTE value is a systematic error or shift due to using the wrong calibration coefficients for the COTE of the reference materials in the standard test procedure. That is, in the calibration of the MEPDG, all COTE values were calibrated to a reference material with an assumed COTE value of 17.3 microstrain/°C when they should have been using the actual measure COTE value of the reference material.

The net result is that there is a systematic shift (all values shifted equally) between the values obtained using AASHTO TP-336 Standard and the values used to calibrate MEPDG. To adjust for that systematic shift, FDOT needs to add to the COTE values they calculate with AASHTO TP-336 test method the difference between their machine's reference material and the assumed 17.3 microstrain/°C reference used in calibrating MEPDG.[3]

In FDOT's Report "Draft Summary of CTE Measurement Results for Pavement Cores and FHWA Samples" by Dale DeFord and Charles Ishee, May 19, 2010, the reported COTE value of the FDOT reference material is 16.1 microstrain /°C. As such, to correct any COTE value that FDOT calculates for use in the current version of MEPDG (MEPDG Ver 1.1), FDOT needs to add 17.3 – 16.1 = 1.2 microstrain /°C to their calculated COTE value. Converting this to °F to be used in the MEPDG, the addition is 0.667 microstrain /°F.

Example:

Calculated COTE Value per AASHTO TP-336	= 7.53 microstrain /°C
Converting COTE Value to °F	= 4.18 microstrain /°F
Addition to account for Systematic Shift	Add 0.667 microstrain /°F
Final COTE Value to use in MEPDG	= 4.85 microstrain /°F

[3] Phone conversation with Gary Crawford, FHWA

Issue #14 - Require OGFC on PCC.

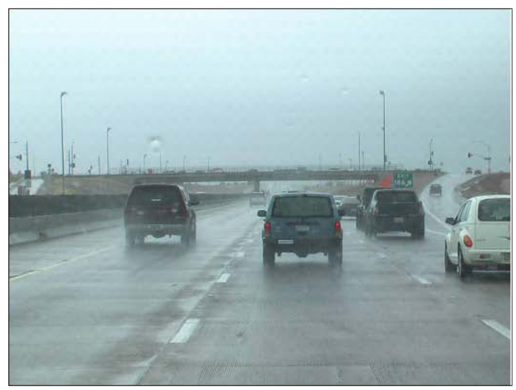
The Department's response is they are "*reviewing projects in the next two fiscal years to find a candidate concrete project to test the addition of a bonded open graded friction course.*"

Our industry's question is "what is the problem that is trying to be solved?" The asphalt industry states that OGFC is good for noise reduction and splash and spray. While we agree that an OGFC does do that, we also have procedures, such as diamond grinding, longitudinal grooving and/or an NGCS (Next Generation of Concrete Surface) to achieve the similar results that last longer and cost less.

For example, the pictures below show the splash and spray difference between two pavements in Phoenix AZ during a rainstorm on March 11, 2006. One is Asphalt Rubber Friction Course (ARFC) that is approximately 5 years old. The second is longitudinally grooved concrete pavement. The pavements are on the same stretch US 60 and the pictures were taking within 5 minutes of each other. As can be seen, the splash and spray is considerably less for the longitudinally grooved concrete pavement.

ARFC - US 60 EB, Phoenix AZ

Longitudinally Grooved PCCP - US 60 EB, Phoenix AZ



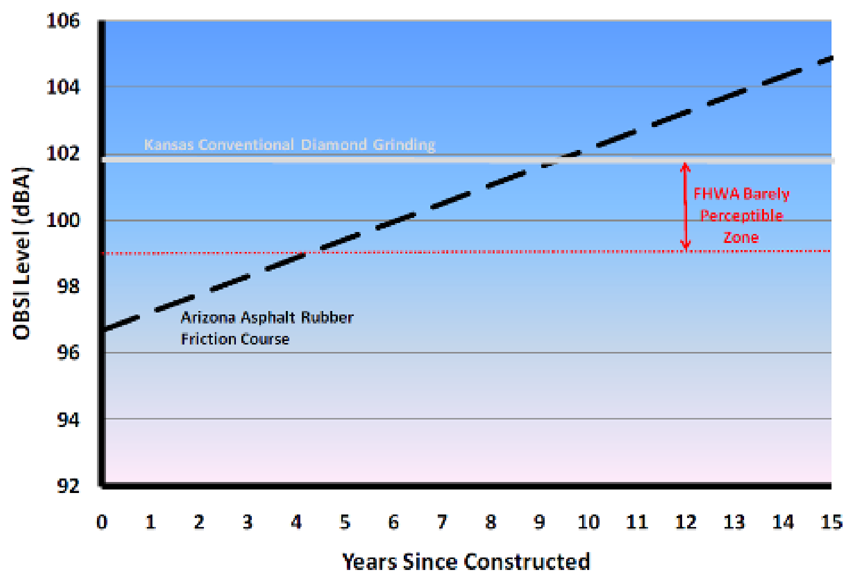
With respect to noise, we do agree that OGFC can be very quite pavements, and in general, the quietest new OGFC is about 2 to 3 dbA quieter than the quietest new concrete pavement[4]. However, as important as initial noise is, "acoustic durability" is also desired (how the acoustic property of a pavement surface changes over time).

As an example, Figure 1 shows the predicted ARFC acoustic longevity as reported by ADOT in 2003 (according to the Arizona DOT, their ARFC increase about 0.5 dbA in noise each year) and the actual Kansas diamond grinding OBSI data measured by the ACPA in 2008. The Arizona ARFC is arguably the quietest AC pavement placed in the US and that is why it was selected for comparison. The ARFC was also evaluated using the ACPA OBSI system in 2008 and the ADOT prediction is fairly close except for about a 5 mile section of freeway which has exceeded 103 dBA after just 8 years.

[4] Typical Noise levels for new surfaces of various pavement types using the On-Board Sound Intensity (OBSI) Method: OGFC ~ 96 to 98 dbA, Dense Grade AC ~ 100 to 102 dbA, NGCS ~ 99 to 101 dbA, Conventional Diamond Ground Concrete ~ 100 to 104, Long, Tine Concrete pavements ~ 101 to 106 dbA, Transverse Tine ~103 to 110 dbA

As indicated in Figure 1, the Arizona ARFC is very quiet when constructed, however after only 4-6 years of service it begins to approach the 100 dBA level which is attainable by concrete pavements placed for the purpose of noise reduction. By the 4th year it is already within the limits of the FHWA barely perceptible difference. After only 8-9 years it is approaching the diamond grinding values that exist on the conventional diamond ground pavements used in Kansas for typical rehabilitation projects. Beyond that period the ARFC level begins to exceed the diamond ground texture levels. The only way to get the ARFC lower is to remove and replace the surface which creates a significant expense and disruption to the freeway system.[5] *Note that if the NGCS were plotted on Figure 1, it would be at approximately the red line indicating the bottom the "Barely Perceptible Zone"*

Figure 1 - Acoustic Longevity of the Arizona ARFC and the Kansas Diamond Grinding



As such, similar to the discussion on requiring a Diamond Grinding for the final surface, we agree that there are times that some type of modified surface will be required. However, for those cases, we ask that the appropriate solution be developed that addresses the "site specific requirement," not use a "one size fits all policy." Furthermore, in such instances we would also like the opportunity to show the advancements that have been made with our product and surface characteristics so that the long term benefits and costs between the two can be adequately determined.

[5] Transportation Noise and Concrete Pavements: Using Quiet Concrete Pavements as the Noise Solution, by Larry Scoffied, American Concrete Pavement Association, http://www.igga.net/File/TransportNoiseAndConcPvmts.pdf

Issue #21 - The viability of Whitetopping as an option to asphalt resurfacing will be investigated once the concrete models have been completed and locally calibrated to Florida materials.

How much investigation or proof is required to show the viability of Whitetopping an asphalt surfacing?

The first Whitetopping was done on South 7th street in Terre Haute, Indiana in 1918. It consisted of a 3 - 4 in. of reinforced concrete overlay of existing flexible pavement. During 1940's and 1950's, whitetopping overlays were used to upgrade military and civil airports for jet use. Highway use started in approximately 1960 and they have included all type of concrete pavements (JPCP, JRCP, CRCP, Fiber reinforced concrete). Ultra-thin & Thin Whitetoppings usage started in the 1990's. It is estimated that there are over 600 whitetopping overlay projects throughout the US (there are 160 whitetopping projects in Iowa alone and over 300 Ultra-thin whitetopping projects as of 2003).

The American Concrete Pavement Association has recently developed a The National Concrete Overlay Explorer which shows the use of concrete overlays on specific highway and roadway sections throughout the contiguous United States[6]. Their database has 186 concrete overlays of asphalt in the US ranging from as thin as 2 inches to as thick as 13 inches (the majority are between 4 and 9 inches). The ages of these whitetopping overlays ranges from newly constructed just this year to 50 years.

Though not in this database yet, in 2009, over 2.8 M square yards of whitetopping overlays were placed on county road market in Iowa (2 times more than any previous year). Most of these overlays were in the 5 to 7 inch range.[7]

Florida has at 4 whitetopping projects (none of which are in the ACPA Database). The first is the US 1 Thin Whitetopping LTPP test sections South of Edgewater. This project consists of 6", 7" and 8" whitetoppings built in 1988. After 22 years of service, there has been minimal maintenance (0 slabs cracked, max 0.04" fault) while a nearby HMAC section has had 2 mill/fill operations since the PCC overlay[8]. The other 3 whitetoppping projects are airport applications. The first is an Ultra-thin Whitetopping in New Smyrna Beach (constructed 1997). The second is a 5 and 6-inch whitetopping in Fernandina Beach (constructed 2002) and the third is a 5.25-inch whitetopping at Williston Municipal Airport (constructed 2006). All three are performing well.

[6] http://overlays.acpa.org/webapps/overlayexplorer/index.html#
[7] Iowa Concrete Pavement Association
[8] FDOT District 5 Concrete Pavement Tour, May 2009. Tour for the TRB Rigid Pavement Construction Committee

Appendix A:
"Maintenance Schedules" from ODOT Pavement Design Manual

702.2 Maintenance Schedules

The maintenance strategies and schedules given below are for informational purposes only. This information is intended to give designers some reasonable guidance when deciding the maintenance actions for an LCCA. Wide latitude is given on both the timing and the work predicted. The designer is not restricted to these schedules; but, because of the wide latitude given, anything outside the schedules may be questioned. All thicknesses given are approximate but overlays much thicker or much thinner than those listed are not expected.

The schedules list only major items of work. The designer may need to include additional items. For instance, tack coats are not listed but are required with all overlays. It is not intended that every item listed be used in a given year. For example, concrete pavement shows both an asphalt overlay and diamond grinding as options but never would the two of them be done at the same time. It is further not intended that actions must take place in every one of the years listed. Depending on the expected performance and the actions predicted for the early years, the later rehabilitation(s) may not be necessary.

702.2.1 Flexible Pavement

Flexible pavement includes new pavement on a new alignment and complete replacement of existing pavement.

- Year 10 - 15: Thin overlay, 1.25" - 3" (~32 - 75 mm), with or without milling.
- Year 18 - 25: Thick overlay, 3" - 7" (~75 - 175 mm), with milling, possibly pavement repairs.
- Year 28 - 32: Thin overlay or micro-surfacing or crack sealing.

Many times the third treatment would not be necessary at all depending on the timing of the first two and the thickness of the overlays and their expected performance.

702.2.2 Rigid Pavement

Rigid pavement includes new pavement on a new alignment and complete replacement of existing pavement. Percentages given are of the total mainline pavement area not including shoulders or ramps or turn lanes, etc.

- Year 18 - 25: 2% - 10% full-depth rigid repairs, 1% - 5% partial depth bonded repairs, diamond grinding, 3" - 6" (~75 - 150 mm) overlay, sawing and sealing.
- Year 28 - 32: 1% - 3% full- and/or partial-depth repairs, 1.25" - 2" (~32 - 50 mm) second overlay with or without milling, 3" - 4" (~75 - 100 mm) first overlay, sawing and sealing, micro-surfacing, crack sealing, diamond grinding.

Best practice dictates the use of diamond grinding for the first treatment. Placing an asphalt overlay on a concrete pavement brings on a new set of problems and is discouraged as the first predicted maintenance action. Remember, this is the predicted performance of pavements built to current specifications, not 1960's specifications.

Again, in many cases the second treatment may not be necessary at all.

702.2.3 Composite Pavement

Composite pavement is a hybrid of rigid and flexible pavement and requires the maintenance actions of both. It is generally expected to receive full-depth rigid repairs, milling and an overlay every 8 - 12 years.

702.2.4 Unbonded Concrete Overlay

An unbonded concrete overlay is in essence a new concrete pavement built on top of the old. It will require maintenance similar to that for a rigid pavement. It may be reasonable to expect slightly less repair for an unbonded concrete overlay versus new rigid pavement due to the much thicker pavement section.

702.2.5 Fractured Slab Techniques
Fractured slab techniques include crack & seat, and rubblize & roll.

- Year 8 - 12: Thin overlay, 1.25" - 4" (~32 - 100 mm) with or without milling.
- Year 16 - 22: Thick overlay, 4" - 8" (~100 - 200 mm) with milling, pavement repair.
- Year 24 - 32: Thin overlay, 1.25" - 4" (~32 - 100 mm) with or without milling, micro-surfacing, crack sealing.

Fractured slab techniques are more likely to require the third maintenance action than is flexible pavement.

702.2.6 Whitetopping
Whitetopping is in essence a new concrete pavement built over an existing flexible pavement. It is expected to perform similar to a rigid pavement or an unbonded concrete overlay.

For more information, see
http://www.dot.state.oh.us/Divisions/HighwayOps/Pavement/Pavement%20Design%20%20Rehabilitation%20Manual/Sect700.pdf