FDOT FLORIDA PAVEMENT TYPE SELECTION TRAINING

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PAVEMENT TYPE SELECTION (PTS) IN PAVEMENT DESIGN

FDOT Ref:
PAVEMENT TYPE SELECTION MANUAL
Document No. 625-010-005
http://www.dot.state.fl.us/pavementmanagement

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PAVEMENT TYPE SELECTION (PTS) IN PAVEMENT DESIGN

- Goals
  - Develop pavement design and pavement type selection by letting the engineering criteria and life cycle cost analysis objectively evaluate potential pavements alternatives
  - Stimulate competition and improvement in products among paving materials industries

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PAVEMENT DESIGNS

- Pavement structural designs are based on:
  - Flexible Pavement Design Manual (Document No. 625-010-002)
  - Rigid Pavement Design Manual (Document No. 625-010-006)
    - MEPDG design supplement to the Rigid Pavement Design Manual

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PAVEMENT DESIGNS

- Pavement design inputs -
  - such as traffic, pavement performance, service lives, rehabilitation strategies and costs used are based upon FDOT data, experience and research
  - Document and justify each project input actions to file

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PTS COSTS

- MUST involve the District Estimate Engineer
  - Document involvement of the District Estimate Engineer
  - It is **NOT** sufficient to just use statewide average costs
  - Consult State Estimate Office if necessary
  - Consult State Pavement Design Engineer if necessary

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CANDIDATE PROJECTS FOR PTS

- *Projects greater than half a mile*
- New Construction
- Reconstruction
  - Addition of new through lanes when modification of the existing base material is required
  - Primary purpose of removal and replacement of substantial amount of existing pavement and base

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PTS REPORTS NOT REQUIRED

- *Projects less than half a mile*
- *By Executive Committee Decision these type projects should be concrete pavement*
  - New Weigh Stations
  - Rest Areas
  - Welcome Stations
  - Access, internal traffic flow and parking

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PTS REPORTS NOT REQUIRED

- *When adding lanes to an existing roadway and the same pavement type is used*

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PTS REPORTS NOT REQUIRED

- *Adding a lane of concrete pavement to adjacent existing asphalt pavement is not recommended*
  - FDOT procedure require added lanes match existing pavement sections
  - Dissimilar pavement types could cause joint separation and differential settlement between the asphalt and concrete lanes

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PTS REPORTS NOT REQUIRED

- *Could cause drainage, traffic operations, maintenance and differential pavement performance problems*

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1993 AASHTO PAVEMENT TYPE SELECTION GUIDELINES APPENDIX B

- Reprinted in Chapter 3 of the PTS Manual
- PRINCIPAL FACTORS
  - Traffic
  - Soil/Embankment Characteristics
  - Weather
  - Construction Considerations
  - Recycling
  - Cost Comparison (initial and life-cycle)

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PRINCIPAL FACTORS

- TRAFFIC
  - The percentage of commercial traffic and frequency of heavy load applications generally have the major effect on the structural design of the pavement

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TRAFFIC

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PRINCIPAL FACTORS

- TRAFFIC
  - "For heavily traveled facilities in congested locations, the need to minimize the disruptions and hazards to traffic may dictate the selection of the strategies having long initial service life with little maintenance or rehabilitation regardless of relative economy"
  - Per '93 AASHTO Appendix B, page 3-4

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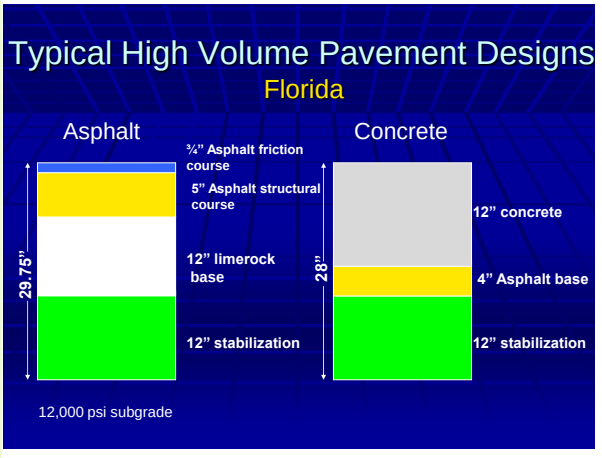
SOIL AND EMBANKMENT BASE OPTIONS



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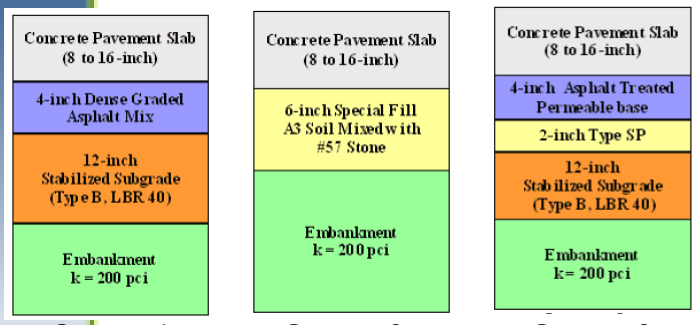
SOIL AND EMBANKMENT BASE FOR CONCRETE PAVEMENT OPTIONS



Structure 1 Structure 2 Structure 3

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SOIL AND EMBANKMENT BASE OPTIONS

- Asphalt Base
  - Std. Index 287 and 505
- Asphalt/Cement Treated Permeable Base (ATPB/CTPB)
  - Std. Index 287 and 505
- Special Select Soil
  - Std. Index 505

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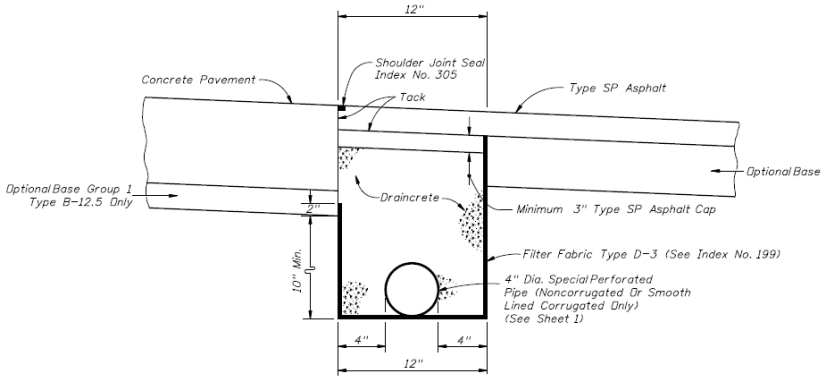
ASPHALT BASE SUBDRAINAGE – WITH ASPHALT SHOULDER



ASPHALT BASE SUBDRAINAGE

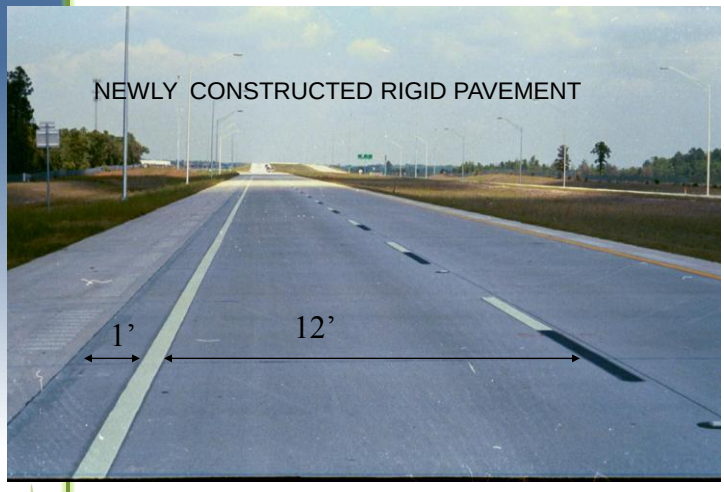
ASPHALT /CEMENT TREATED PERMEABLE BASE

SPECIAL SELECT SOILS EMBANKMENT OPTION

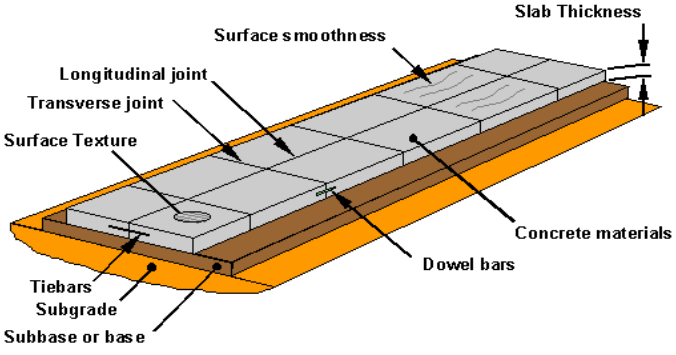
SPECIAL SELECT SOILS EMBANKMENT OPTION

- Special Select Soil
  - Std. Index 505
  - Consult with District Materials Engineer (DME) to see if local soils are available to consider this option
  - Specifically state in the report whether or not the Special Select Soil is a viable option based on DME recommendations

13 – FT OUTSIDE LANE



CONCRETE PAVEMENT COMPONENTS




ASPHALT PAVEMENT COMPONENTS
STABILIZED SUBGRADE
LIMEROCK BASE LAYER


PLACEMENT OF LIMEROCK BASE IN LIFTS

NEWLY CONSTRUCTED FLEXIBLE PAVEMENT

- NEWLY CONSTRUCTED FLEXIBLE PAVEMENT

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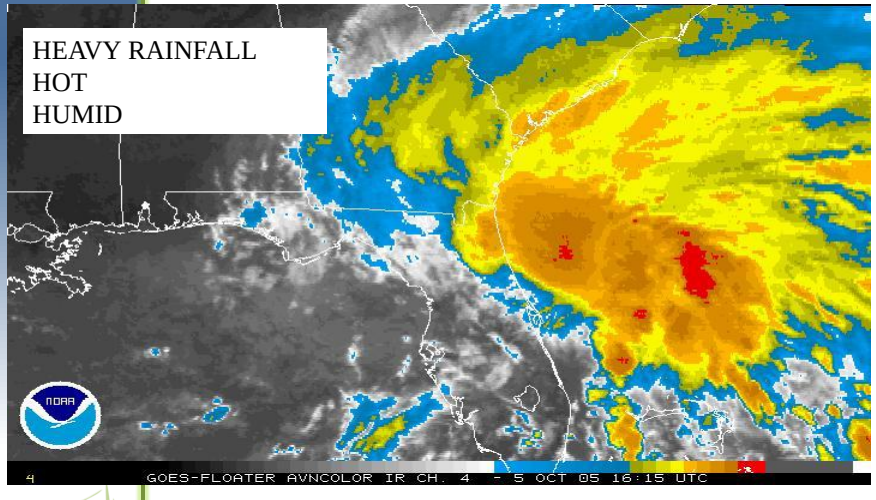
WEATHER



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WEATHER

- Heavy rainfall conditions require adequate drainage
  - For concrete pavements, drainable base and edge drains shall be taken into consideration for Economic Analysis

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PROVIDE FOR ADEQUATE PAVEMENT DRAINAGE

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CONSTRUCTION CONSIDERATIONS

- Urban arterials
- Need to minimize impact to business and time traffic is closed
  - Numerous business entrances
  - Major signalized intersections
  - Several utilities installations
- Rural arterials
  - Maintenance of traffic scheme may be similar

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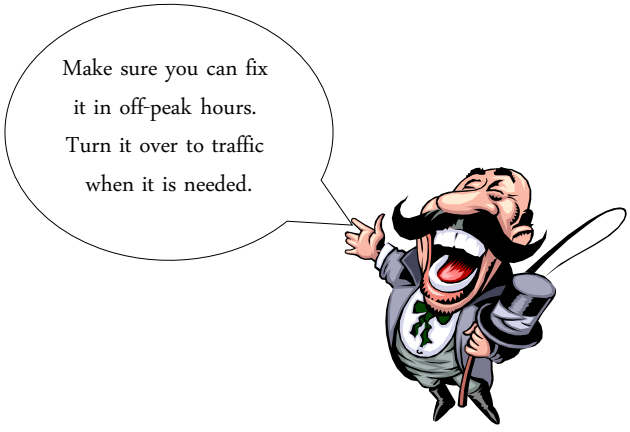
CONSTRUCTION CONSIDERATIONS



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RECYCLING

- Both alternates will allow the use of recycled material.

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COST COMPARISON

- Cost comparison
  - Cost Comparison (initial and life-cycle) will discuss more under economic analysis

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FLEXIBLE PAVEMENT

Statewide Avg. Costs: From 2011/01/01 TO 2011/12/31

ASPHALT

Item	Cost(SY)
FC-5 (¾")(PG76-22)	4.25
Type SP (TL-D) 2½"(PG76-22)	10.25
Type SP (TL-D) 2½"	10.00
OBG-11 (12")	13.75
Type B Stab.(12")	3.00
Total	41.25

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SOIL AND EMBANKMENT BASE FOR CONCRETE PAVEMENT OPTIONS

Structure 1

Item	Cost(SY)
Concrete Slab(12")	75.00
Type B-12.5(4")	17.51
Type B Stab.(12")	3.00
Total	95.51

NOT INCLUSIVE OF EDGEDRAIN

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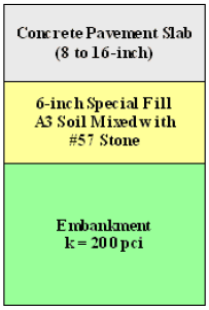
SOIL AND EMBANKMENT BASE FOR CONCRETE PAVEMENT OPTIONS



Structure 2

Item	Cost(SY)
Concrete Slab(12”)	75.00
Subbase Stabilized(6”)	5.50
Total	80.50

NOT INCLUSIVE OF EDGEDRAIN

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SOIL AND EMBANKMENT BASE FOR CONCRETE PAVEMENT OPTIONS

Structure 3

Item	Cost(SY)
Concrete Slab(12”)	75.00
ATPB/CTPB (4”)	20.00
Type SP(2”)	8.75
Type B Stab.(12”)	3.00
Total	106.75

NOT INCLUSIVE OF EDGEDRAIN

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AASHTO PAVEMENT TYPE SELECTION GUIDELINES SECONDARY FACTORS

- Performance of similar pavements in the project area
- Adjacent existing pavements
- Availability of local materials
- Contractor capabilities

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SECONDARY FACTORS

- Traffic and worker safety
- Incorporation of experimental features
- Stimulation of competition
- State / local government, Municipal preference

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OTHERS FACTORS

- Other considerations that may effect final decision is presence of grade control
  - Median barriers
  - Drainage facilities
  - Curbs
  - Lateral and overhead clearances
  - Structures which may limit the structural section design or rehabilitation strategies

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

- "The purpose of the process is to provide a fair and impartial evaluation of competing pavement types over the analysis period by using the analysis and cost parameters described in Chapter 4"

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

- IMPLEMENTATION DATE
  - Effective June 1, 2011 for applicable projects let in FY 2013 (July 1, 2012-June 30, 2013) and beyond that have not completed Phase 2 review

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

- To help achieve accurate economic analysis, industry input will be included in three stages
  1. Initial Pavement Type Selection Report
  2. Phase 1 – Check Reviews
  3. Phase 2 – Check Reviews

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

•For Project Scheduling and Management use these specific work activities numbers for the three stages

Code	Code Description
00000371	SUBMIT PAVE TYPE RPT INITIAL
00000372	SUBMIT PAVE TYPE RPT 30% (PH1)
00000373	SUBMIT PAVE TYPE RPT 60% (PH2)

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

Question: When should the Initial Pavement Type Selection Report(PTSR) be performed?

Answer: Manual Section **4.3.4 Project Development Time Frame and Solicitation of Industry Input**

- The District Pavement Design Engineer or the Engineer of Record will develop and the District Design Engineer will approve a preliminary Pavement Type Selection Report prior to incorporating the project into the work program.

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

Question: Pavement Type Selection Report(PTSR) and Advanced Projects – Design-Bid-Build (DBD) to Design Build (DB), Build Finance (BF) or Design Build Finance (DBF) be performed ?

Answer: Update the existing PTSR on file and send to the State Pavement Design Engineer at least three weeks before planned advertisement

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

Question: When should the Initial Pavement Type Selection Report(PTSR) be performed?

Answer: Manual Section **A.4.2 Distribution**

- "Copies of the approved project level Pavement Type Selection with supporting documentation will be submitted to the State Pavement Design Engineer at least six months prior to its adoption into the Work Program"

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

Each completed iteration of PTS reports with supporting documents MUST be sent to the State Pavement Design Engineer for review

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

The State Pavement Design Engineer will distribute electronic copies of each completed PTS iteration reports to the President of the Concrete Paving Alliance and the Executive Director of the Asphalt Contractors Association of Florida for reviews

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

The industry has three weeks to send comments back to the State Pavement Design Engineer

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

The District Secretary and Chief Engineer will resolve any disagreements generated by the comments received from the industries and the information provided by the Department

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

Revisions to Chapter 4

Any modifications to chapter 4 will be made only when issues have been resolved between the Department and industry

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PAVEMENT TYPE SELECTION & INDUSTRY INVOLVEMENT

Consequences of NOT following rule

Caution: Noncompliance with the rule could delay projects

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ECONOMIC ANALYSIS

- Time periods
  - Analysis period will be 40 years
  - Initial new construction pavement design will be 20 years
  - Discount rate is 3.5%
  - Reliability used should be the same for each pavement type
  - Rehabilitation strategies should be project specific

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ECONOMIC ANALYSIS

- From Upper Management per State Pavement Design Engineer
  - Remove FC-5 from initial new construction year of the asphalt option for LCCA
  - Remove grinding from initial new construction year of the concrete option for LCCA

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ECONOMIC ANALYSIS

- From Upper Management per State Pavement Design Engineer
  - Include FC-5 in the rehabilitation scenarios of the asphalt option for LCCA
  - Include grinding in the rehabilitation scenarios of the concrete option for LCCA

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ECONOMIC ANALYSIS

- From Upper Management per State Pavement Design Engineer
  - These decisions are part of agreement with the industries that FC-5 and Grinding are not structural components of asphalt or concrete pavements but instead are Department “preferences” to control hydroplaning and provide smooth pavements

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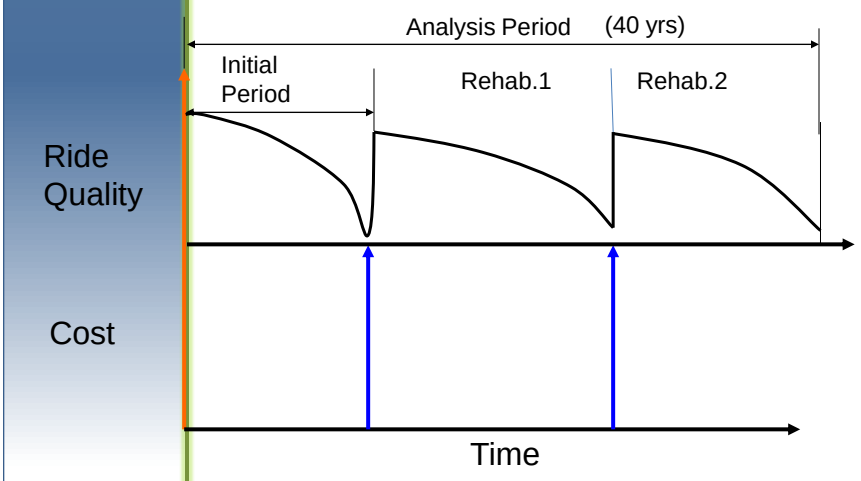
ANALYSIS PERIOD



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FUTURE REHABILITATION STRATEGIES

"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"

PTSM Section 4.3.2

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FUTURE REHABILITATION STRATEGIES

•"The District can and should modify the baseline strategies used in the economic analysis on a project specific basis, if justified, by taking into consideration pavement performance of existing pavements having similar and traffic conditions and which are located in similar geotechnical and geographical regions."

PTSM Section 4.3.2

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TABLE 4.1
FUTURE REHABILITATION STRATEGIES

•Adequate data must be provided with these rehabilitation strategies

•A pavement history of both types of pavements should be provided in the appendix of the PTS report

•Again - justification is needed for PTS rehabilitation strategies

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TABLE 4.1
FUTURE REHABILITATION STRATEGIES

Concrete Pavement

Rehab Period	Urban Arterial	Rural Arterial and Limited Access
•20 year	CPR (3% Slab Replacement)	CPR (3% Slab Replacement)
•30 year	CPR (5% Slab Replacement)	(5% Slab Replacement) or Crack, Seat and overlay ARMI 4" Str. AC and FC

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TABLE 4.1
FUTURE REHABILITATION STRATEGIES

Concrete Pavement

20 year CPR (3% Slab Replacement)

30 year CPR (5% Slab Replacement)

3% and 5% Slab Replacement estimated quantity is **ONLY for the outside lanes** unless project specific historical data say otherwise

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TABLE 4.1
FUTURE REHABILITATION STRATEGIES

	Asphalt Pavement		
•Rehab Period	Urban Arterial	Rural Arterial	Limited Access
•14 year	Mill 2” Resf.1” Str. AC and DGFC	Mill 2” Resf.3” Str. AC and FC	Mill 3” Resf.4” Str. AC and OGFC
•28 year	Mill 2” Resf.1” Str. AC and DGFC	Mill 2” Resf.3” Str. AC and FC	Mill 3” Resf.4” Str. AC and OGFC

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ECONOMIC ANALYSIS

- User cost should be considered separately if it will be significantly different between pavement types
  - Frankly there is no need to run the user costs unless the District believes it will make a significant difference
  - User costs if required should be performed using FHWA RealCost software
  - http://www.fhwa.dot.gov/infrastructure/asstmgmt/lccasoft.cfm

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ECONOMIC ANALYSIS

Indirect costs such as:

- Engineering
- CEI
- MOT

- Should be considered separately if it will be significantly different between pavement types
- Frankly there is no need to include these costs unless the District believes it will make a significant difference

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ECONOMIC ANALYSIS

- The cost of shoulder construction and rehabilitation shall be considered
- Costs will be summarized by project mile
- Salvage value which represent any significant remaining life after the last rehabilitation should be considered

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ECONOMIC ANALYSIS

- For Example:
- Design Period = 40 yrs
  - Expected last rehabilitation Service Life = 14 yrs
  - Last rehabilitation occurs at year 35
  - Last Rehabilitation Cost = $1 Million

Salvage Value = 1 M x [14-(40-35)/14]

Salvage Value = $642,857

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ECONOMIC ANALYSIS

- Spreadsheet for the Life Cycle Analysis portion of the Pavement Type Selection report is available through request to the District Pavement Design Engineers
- For consistence in the review of these reports, this spreadsheet must be used for the Life Cycle Analysis portion

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ECONOMIC ANALYSIS
ALTERNATE BIDDING

- When life cycle cost analysis indicate that project costs for the competing pavement types are within 10% of each other:
  - Alternate bidding should be considered
  - Dept. alternate bidding guideline is at:

  http://infonet.dot.state.fl.us/PavementManagement/publications.htm

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ECONOMIC ANALYSIS
ALTERNATE BIDDING

- If the alternates are within 10%, send the report to the State Pavement Design Engineer for review and checks of the life cycle cost analysis before it is signed and sealed by the District Design Engineer (DDE)

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ECONOMIC ANALYSIS
ALTERNATE BIDDING

•Project costs will be considered to be within10% of each other if they are within the value determined by calculating 10% of the average present worth costs of the pavement alternatives.

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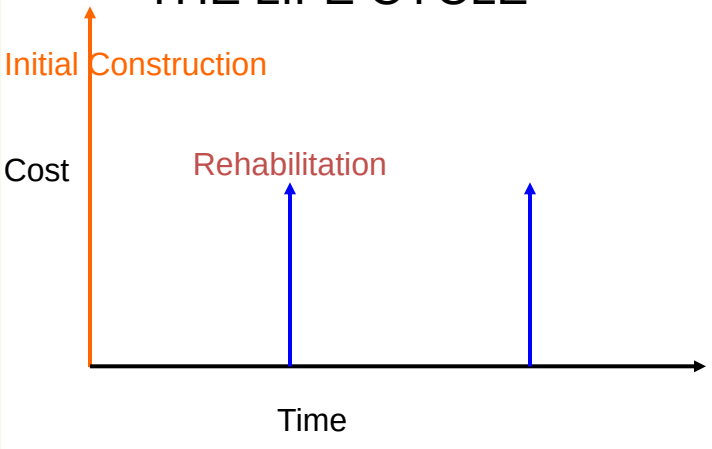
THE LIFE CYCLE



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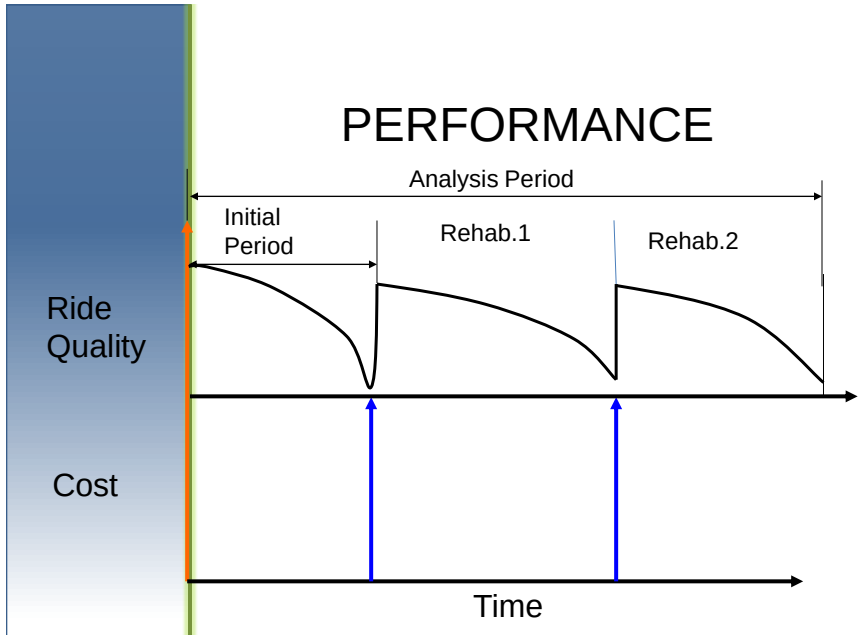

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LIFE-CYCLE COST ANALYSIS

What it takes to do one:

- An understanding of the pavement design process
  - Flexible Pavement Design Manual (Document No. 625-010-002)
  - Rigid Pavement Design Manual (Document No. 625-010-006)
  - Pavement Type Selection Manual (Document No. 625-010-005)
  - An understanding of the sensitivity of each design input

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LIFE-CYCLE COST ANALYSIS

How it is done in Florida:

- Present Worth Analysis (PW)
- Summarized on project mile basis

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LIFE-CYCLE COST ANALYSIS

Present Worth Analysis:

Discounts all future costs to the present

$$PW = IC + \sum_{t=0}^{t=n} pwf\ [FRC]$$

IC = Initial Cost
FRC = Rehabilitation Cost
pwf = Present Worth Factor

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LIFE-CYCLE COST ANALYSIS

Present Worth Factor:

$$pwf = \frac{1}{(1 + i)^n}$$

pwf = Present Worth Factor for discount rate i and year n
i = Discount rate (3.5%)
n = Number of years when cost will occur

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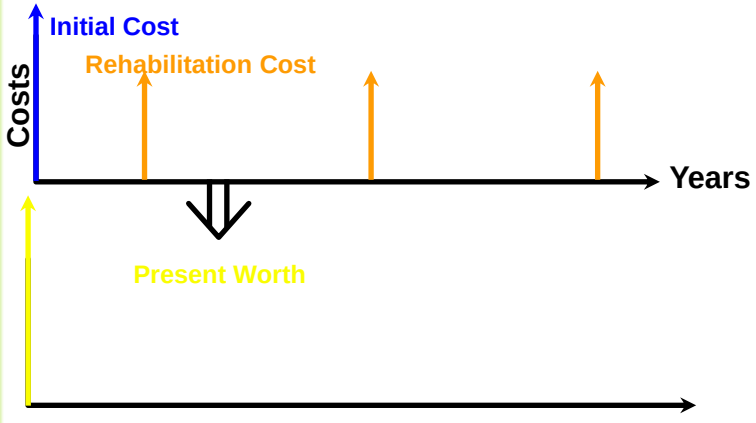
LIFE-CYCLE COST ANALYSIS

Present Worth Analysis:

Discounts all future costs to the present



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DISTRICT QUALITY CONTROL

- Shall be by an Independent Qualified Professional Engineer

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QUALITY ASSURANCE REVIEW

- Review of District Pavement Type Selection activities will be conducted annually.

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MECHANISTIC–EMPIRICAL PAVEMENT DESIGN GUIDE

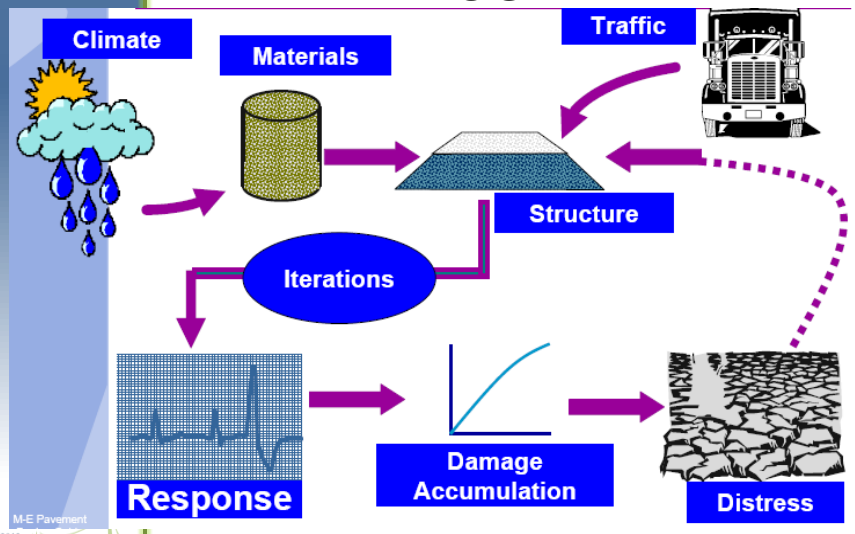
MECHANISTIC–EMPIRICAL PAVEMENT DESIGN GUIDE

(ME PDG)

M-E PAVEMENT DESIGN PROGRAM

- ME PDG models the effects of climatic, materials and traffic variables on the performance of a given pavement
- An incremental damage approach is used to calculate the accumulated damage in the pavement over the design life
- The total damage over the design life is the sum of the damage accrued in each time increment
- This procedure then empirically relates damage over time to pavement distresses

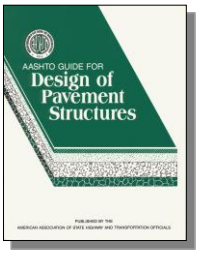
OVERVIEW OF ME PDG PROGRAM

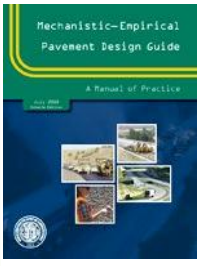


ME PDG DEVELOPMENT

- 1986 AASHTO Design Guide, Part IV: Recommended development of Mechanistic based design procedure
- 1996 National meeting and recommendations for M-E design
- 1998-2004 Development & calibration under NCHRP 1-37A
- 2004-2006 Independent review, NCHRP 1-40A
- 2005 Independent model validation, NCHRP 1-40B
- 2006 Improvements & Recalibration, NCHRP 1-40D
- Release Version 1.000 February 2007
- National meeting, 10-11 April 2007, Irvine, CA
- AASHTO balloting October 2007: Interim AASHTO MEPDG

MEPDG & COMPARISON WITH AASHTO DESIGN GUIDE





- Empirical methodology based on AASHO Road Test in the late 1950's

Vs

- State-Of-The-Art fundamental engineering principles and algorithms, climate models, materials characterization, and extensive field calibration

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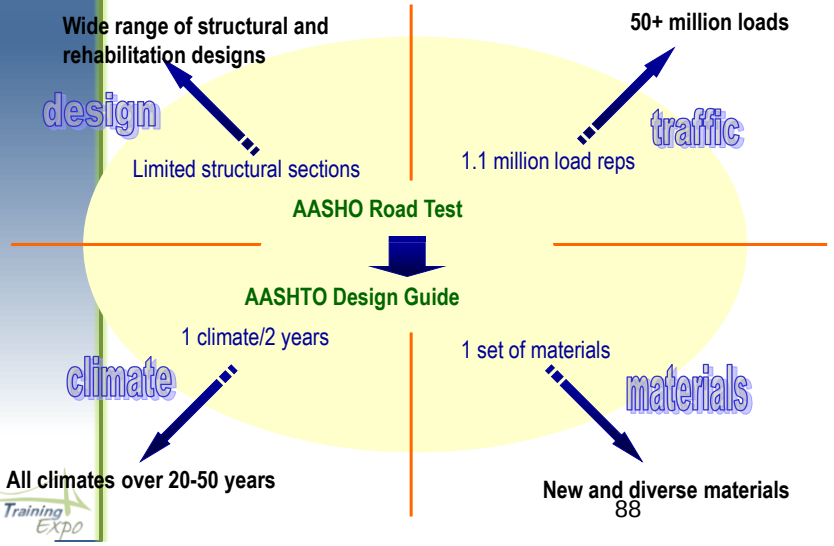
CURRENT AASHTO vs. CURRENT NEEDS



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EQUALITY CHALLENGE

•NCHRP 1-37A panel required **equality** between asphalt and concrete designs.

- **Traffic:** No ESALs (because they are different between asphalt and concrete), rather basic truck loadings (e.g., axle load distribution, ….)
- **Climate:** Same weather stations and inputs
- **Unbound aggregates and subgrade:** resilient modulus input

EQUALITY CHALLENGE

•NCHRP 1-37A panel required **equality** between asphalt and concrete designs.

- **Reliability:** exact same procedure using standard error of prediction
- **Calibration with field sites:** same procedure used
- **Performance:** IRI and key distress types

M-E PAVEMENT DESIGN PROGRAM

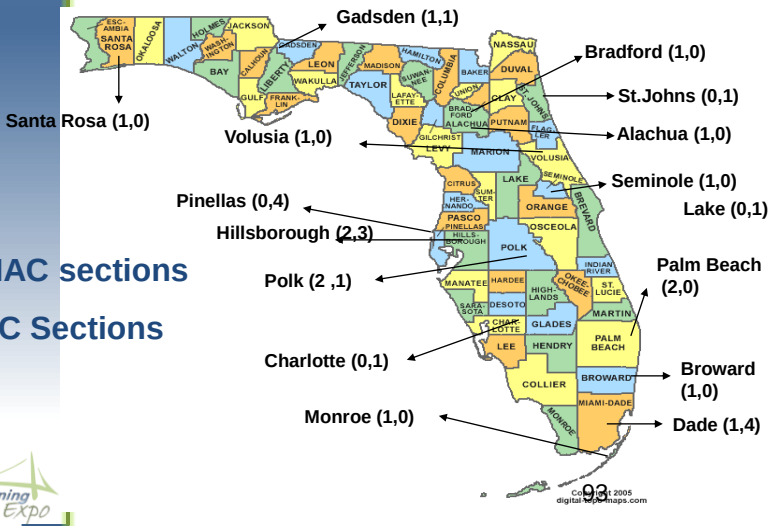
- FDOT Development of MEPDG Thickness Design Tables based on Research by Texas Transportation Institute(TTI) report is available at :

- http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_RD/FDOT_BDH10_rpt.pdf

MODEL VERIFICATION/CALIBRATION

- M-E PDG models calibrated using a national data base of LTPP sections
- Calibration to local conditions is important
- Calibration factors input to program for specific distresses

MAP OF FL CALIBRATION SECTIONS



15 HMAC sections

16 PCC Sections

STATUS OF FLORIDA ME PDG IMPLEMENTATION

- Rigid Design Procedure based on ME PDG software version 1.0 is shown in Appendix E of the current manual.
- The Rigid Pavement Design Manual under revision will be updated with Rigid Design Procedure based on ME PDG software version 1.1.

STATUS OF FLORIDA ME PDG IMPLEMENTATION

•Based on work still being done in the asphalt area, the department is not using either ME PDG software version 1.0 or 1.1 for production of Flexible Pavements Designs at this time