Pavement Design Guide

Manual Notices Archive

Manual Notice 2018-2

From: Daniel L. Stacks, P.E., Director, Maintenance Division

Manual: *Pavement Manual*

Effective Date: July 09, 2018

Purpose

The *Pavement Manual* has been revised to better document the required information and supporting documentation to be included for changing load limits on county roads and bridges.

Contents

Chapter 13, Section 4.3 Required Information and Supporting Documents. The portion of Table 1.4 listing the required information and supplementing documentation for Roads has been simplified and the section following on what documentation is required for an Engineering Analysis has been expanded to list the minimum requirements.

Contact

Address questions concerning information contained in this Manual Notice to Randy Ormsby at (512) 416-3196 or randy.ormsby@txdot.gov.

Archives

Past manual notices are available in a pdf archive.

Manual Notice 2018-1

From: Daniel L. Stacks, P.E., Director, Maintenance Division

Manual: *Pavement Manual*

Effective Date: May 01, 2018

Purpose

The *Pavement Manual* has been revised to reflect the transfer of the Pavement Design Group from the Construction Division to the Maintenance Division. The *Pavement Manual* is now the responsibility of the Maintenance Division, so most references to the Construction Division have been changed to the Maintenance Division and contact information has been changed as needed. In addition, information from a May 2017 memo regarding procedures for responding to Public Information Act requests for PMIS and Skid Data have been incorporated into this version.

Contents

Throughout: All references to Construction Division, Materials and Pavements Section have been replaced by Maintenance – Pavement Asset Management Section.

Chapter 1, Section 2 – Overview of Policy. The policy regarding procedures for responding to Public Information Act Requests for PMIS and Skid Data has been added at the end of this section.

Chapter 1, Section 4 – Contacts has been updated to reflect current contacts in both Maintenance and Construction.

Contact

Address questions concerning information contained in this Manual Notice to Randy Ormsby at (512) 416-3196 or randy.ormsby@txdot.gov.

Archives

Past manual notices are available in a pdf archive.

Manual Notice 2017-1

From: Tracy D. Cain, P.E., Director, Construction Division

Manual: *Pavement Manual* (formerly known as the *Pavement Design Guide*)

Effective Date: April 01, 2017

Purpose

This manual notice is intended to transmit changes to the content of the *Pavement Manual*, formerly known as the *Pavement Design Guide*.

Changes

In addition to the following changes, numerous minor editorial revisions have been performed throughout the manual.

Chapter 1, Introduction

- **Chapter 1, Section 2, Overview of Policy**
  - Renamed the section to "Overview of Policy"
  - New section includes a table summarizing policies on the pavement design and construction required by TxDOT.
- **Chapter 1, Section 3, Training**
  - Renamed section. Information moved from Section 2.
  - Revised the list of available training courses.
- **Chapter 1, Section 4, Contacts**
  - New section added. Information moved from Section 3.
  - Updated contact information.

Chapter 2, Pavement Design Process

- **Chapter 2, Section 2, Pavement Design Standard Operating Procedure (SOP)**
  - Added requirements on a completion date for reviewing and updating district's SOP and submitting a copy of the SOP to CST-M&P. Revised sentence under, final authority for pavement design, to allow district director of operations the approval of pavement designs in metropolitan districts.
- **Chapter 2, Section 3, District Pavement Engineer's Role**
  - Revised "Job Functions for District Pavement Engineer" document. Revised required and recommended training for district pavement engineer in Table 2-1.

- **Chapter 2, Section 4, Pavement Types**
  - Added a paragraph regarding traffic loading distribution on thicker HMA sections and/or sections with treated bases.
- **Chapter 2, Section 5, Pavement Type Selection**
  - List principal and secondary factors to consider in the selection process.
  - Removed information about alternate bidding and recommended screening criteria for an alternate bid contract. Added link to RealCost computer software for performing life-cycle cost analysis (LCCA).
  - Deleted information about Texas pavement type selection (TxPTS) computer program and life-cycle cost analysis program developed by CTR.
- **Chapter 2, Section 6, Approved Pavement Design Methods**
  - Added FPS 21 analytical method for designing flexible pavements and TxCRCP-ME for designing continuously reinforced concrete pavements (CRCP).
  - Revised section to allow the use of AASHTO design procedure (1993) for CPCD designs only and not to be used for flexible pavement designs.
  - Revised sentence regarding the impact of swelling foundation soils is no longer considered in FPS 21.
  - Added recommendation on mechanistic design check when the FPS-generated pavement surface thickness is 2-4 in.
  - Removed reference to FPS-11.
  - Added information about allowing the FPS 21 designer to estimate the soil triaxial class if the in-situ soil PI or type is known.
  - Removed "experience-based design" section.
- **Chapter 2, Section 7, Pavement Design Categories**
  - Revised figure 2-8, Design process for new pavement/full reconstruction.
- **Chapter 2, Section 8, Information Needed for Pavement Design**
  - Deleted reference to alternate bidding throughout the section.
  - Added information under "adjusting TPP-supplied traffic data" and removed paragraph regarding TPP mainframe traffic Log (T-log) for estimating traffic data.
  - Removed reference to Tex-231-F,"Static Creep test", for determining HMA modulus.
  - Added a sentence on last paragraph about district's taking adequate measures for evaluating existing pavement conditions before rehabilitation.
- **Chapter 2, Section 9, Pavement Design Reports**
  - Revised paragraph indicating when a full design report is not required.
  - Added the use of TxACOL computer software for designing HMA overlays of rigid pavements.

- Removed requirements for the approval of the use of grade 1 flexible base.
- List TxCRCP-ME design method for CRCP and AASHTO DARWin 3.1 design method for CPCD rigid pavements and removed TSLAB86 design method for rigid pavements.
- Revised table 2-5, procedures for completing the pavement design report.
- Added a requirement to determine the appropriate surface aggregate classification (SAC) using Form 2088 as part of the flexible pavement design only. This form needs to be included in the pavement design report.

Chapter 3, Materials Investigation and Selection Information

- **Chapter 3, Section 2, Geotechnical Investigation for Pavement Structures**
  - Revised table 3-1, Existing data sources.
  - List the New PMIS (PA) as TxDOT's new pavement management system.
  - Information on Texas triaxial class (TTC) was moved to chapter 5, section 3.
  - Revised table 3-3, removed SPA, PSPA and DSPA testing devices and added the Veris soil mapping system for measuring soil conductivity and the total pavement acceptance device (TPAD).
  - Added soil organic content test under subsurface exploration.
  - Revised information on potential vertical rise (PVR) and added PVR treatment strategies.
  - Revised treatment guidelines section.
  - Added findings from research project about soil organic content.
- **Chapter 3, Section 3, Flexible Base Selection**
  - Section renamed to "Flexible Base Selection."
  - Removed requirements for the approval of the use of grade 1 flexible base.
  - Added grade 1-2 base and removed grade 1 and 2 information.
  - Revised flexible base descriptions.
  - Revised table 3-8, example flexible base selection chart.
- **Chapter 3, Section 4, Treated Subgrade and Base Courses**
  - Section renamed to "Treated Subgrade and Base Course."
  - New section. This section includes information for the treatment of subgrades and base courses using cement, lime, fly ash, emulsion, foamed asphalt, and asphalt to meet engineering requirements.
- **Chapter 3, Section 5, Performance Graded Binders (PG Binders)**
  - Information moved from Section 4.
  - Removed PGEXEL3.EXE program and replaced it with "TxDOT's PG-SPG grade selection.xlsm" computer program and the Federal Highway Administration's LTPPBinder program for binder selection.

- Updated PG binder selection information.

- **Chapter 3, Section 6, Hot-Mix Asphalt Pavement Mixtures**
  - Section renamed to "Hot-Mix Asphalt Pavement Mixtures."
  - Information moved from section 5.
  - Updated information to concur with the 2014 specification book.
  - Renamed from "wet weather accident reduction program" (WWARP) to "wet surface crash reduction program" (WSCRP). Updated WSCRP information.
  - Updated table 3-10, Tex-204-F, Mix design options.
  - Removed use of perpetual pavements and added it in chapter 5, section 5.
- **Chapter 3, Section 7, Concrete Materials**
  - Renamed to "Concrete Materials."
  - Updated information on cement types and blended cements. Added information on fly ash, aggregates, water, and chemical admixtures.
- **Chapter 3, Section 8, Reinforcing Steel**
  - Added information on steel requirements.
- **Chapter 3, Section 9, Hydraulic Cement Concrete**
  - Updated information on primary ingredients and workability, durability and adequate strength. Updated table 3-11, concrete classes.
- **Chapter 3, Section 10, Geosynthetics in Pavement Structures**
  - Changed the section order for clarification.
  - Updated information on geosynthetic materials, applications, specifications and testing. Updated Table 3-14, departmental materials specifications (DMS) used for geosynthetics.

Chapter 4, Pavement Evaluation

- **Chapter 4, Section 1, Overview**
  - Updated information on pavement functional conditions, and non-destructive and destructive testing.
- **Chapter 4, Section 2, Visual Pavement Condition Surveys**
  - Updated information on flexible and rigid pavements visual survey condition categories.
- **Chapter 4, Section 3, Non-Destructive Evaluation of Pavement Functional Properties**
  - Updated information on roughness and skid resistance.
- **Chapter 4, Section 4, Non-Destructive Evaluation of Pavement Structural Properties**
  - Updated list of non-destructive tools used in TxDOT and their descriptions. Added the use of the modulus temperature correction program (MTCP) under falling weight deflectometer. Backcalculation of deflection data was moved to Chapter 5, Section 4.

- Added information on evaluating deflection data for load transfer on rigid pavements. Revised Table 4-1, typical dielectric values for various pavement materials.
- Removed COLORMAP software and replaced it with PaveCheck for analysis of raw GPR data.

◆ **Chapter 4, Section 5, Destructive Evaluation of Pavement Structural Properties**

- Updated information on field sampling procedures. Added the augering procedure.

◆ **Chapter 4, Section 6, Geotechnical Investigation for Pavement Structures**

- No changes.

Chapter 5, Flexible Pavement Design

◆ **Chapter 5, All Sections**

- References to FPS-19W replaced with FPS 21.

◆ **Chapter 5, Section 3, FPS 21 Design Parameters**

- Introduction - Removed option to use older versions of FPS and AASHTO (1993) for flexible pavement designs.
- Data Input Components - Removed swelling potential, PVR, and swelling rate analysis from FPS 21 (Table 5-1).
- Project Information Input Screen (Input page 1) - Added a state map with links to each district. Added the function to recall previously saved files for editing and further analysis.
- Design Confidence Level - Instruct to only use Level 'D' by exception since designs generated will be very conservative.
- Final Serviceability Index - Modified "Minimum Serviceability Index" to "Final Serviceability Index."
- District Temperature Constant - FPS 21 is set to '31' as the default value.
- Interest Rate (%) - FPS 21 is set to 7% as the default value.
- Number of Output Pages - Deleted Section. This option was removed from FPS 21.
- Traffic Data - Methodology cited in Chapter 2, Section 9, is allowed to adjust TPP report traffic loading.
- Detour Design for Overlays - The built-in help addresses the five models. Graphics of the selected model are displayed when clicking on the input field.
- Total Number of Lanes - If a facility includes a continuous left turn lane, it has to be counted as a lane if the highway is restriped/partitioned to cause the lane to be designed for through traffic.
- Design Type - Section moved from Chapter 2. Section includes the seven basic design types and provides instructions on how to operate the "Design Type" interactive menu. FPS 21 has the capability of designing pavement structures with up to six layers over the subgrade.

- Layer Code (CDE) - Section removed.
- Minimum Depth - It is directed not to use ‘zero’ as the minimum thickness except in the overlay design mode (Design Type 6), and to check the district SOP for guidelines on fixed or minimum layer thicknesses.
- FPS Pavement Design Results - It is recommended to run the Mechanistic Check, in addition to the Modified Texas Triaxial Design Check, for any FPS design result that produces HMA surface from 2-4 thick.
- Subgrade Triaxial Class Number - Additional procedures included for obtaining estimated Texas Triaxial Class values for the subgrade soils, either based on county-specific soil types or from basic soil properties such as plasticity index.

◆ **Chapter 5, Section 4, FPS 21 Modulus Inputs and Backcalculation Methodology**

- Added new section.
- Modulus inputs for HMA are based on a temperature of 77°F.
- Virgin and Modified-in-Place Materials - Updated recommended design values for Seal Coats, Dense-Graded Hot-Mix Asphalt, Superpave, Stone-Matrix Asphalt, Emulsified Asphalt Treatment (Base), and Flexible Base.
- Backcalculation Methodology - When determining the seed moduli range for the surface, MODULUS assumes the layer is HMA and automatically fills the min/max seed values in accordance with the temperature posted. Where non-bituminous materials are the surface during testing, the user must insert seed values commensurate with the type of material tested.
- Additional Adjustments to Backcalculated Modulus Values - Section added. It lists correction factors applied to backcalculated HMA and Flexible Base values.

◆ **Chapter 5, Section 5, Pavement Detours and Pavement Widening**

- Pavement Widening - Figure 5-2 added to illustrate recommended widening joint locations for Super2 construction.

◆ **Chapter 5, Section 6, Perpetual Pavement Design and Mechanistic Design Guidelines**

- Designing Perpetual Pavement Using FPS 21 - Updated multiple design parameters listed in Table 5-6 (pavement design type, analysis period, confidence level, and time to first overlay). Updated procedure to conduct the mechanistic check for perpetual pavements.

Chapter 6, Flexible Pavement Construction

◆ **Chapter 6, Section 1, Overview**

- Changed the section order for clarification.

◆ **Chapter 6, Section 2, Base and Subgrade Preparation**

- Added information on Intelligent Compaction (IC).

◆ **Chapter 6, Section 3, Pavement Surface Preparation**

- Added information for cutting prime into cement-treated base.
- Revised information on placing seal coats.
- Added information on pavement repair.
- Updated tack coat information to include less-tracking materials.

- **Chapter 6, Section 4, Special Considerations for the Construction of Perpetual Pavements**
  - Added the need for geotechnical investigations.
- **Chapter 6, Section 5, Plant Operations**
  - Editorial revisions only.
- **Chapter 6, Section 6, Mix Transport**
  - Added information on material transfer devices.
- **Chapter 6, Section 7, Placement**
  - Added information on TOM mixtures and PFC mixtures.
  - Revised information on “tender zone” for certain mixtures.
  - Added information on the Spray-Paver.
  - Added information on Thermal Imaging Systems.
- **Chapter 6, Section 8, Compaction**
  - Additional information on “tender zone” for certain mixtures.
  - Comments added concerning Intelligent Compaction.
- **Chapter 6, Section 9, Ride Quality**
  - This section was moved to Chapter 11.

Chapter 7, Flexible Pavement Rehabilitation

- **Chapter 7, Section 2, In-place Surface Recycling**
  - Updated information on in-place recycling.
- **Chapter 7, Section 3, Geosynthetics**
  - Updated information on geosynthetics used in pavement bases.
- **Chapter 7, Section 6, HMA Overlays**
  - Updated section to reflect new specification changes and added information on TOM mixtures.
- **Chapter 7, Section 7, Surface Treatments**
  - Added information regarding scrub seals.
- **Chapter 7, Section 8, Concrete Overlays**

- Replaced from “ultrathin whitetopping” to “thin whitetopping.”
- Revised information under the three subcategories for whitetopping including slab thickness requirements.

- **Chapter 7, Section 10, Alternate Pavement Rehabilitation Options**
  - Updated alternates to include TOM, PFC, and TBFC.

Chapter 8, Rigid Pavement Design

- **Chapter 8, Section 1, Overview**
  - Revised criteria for when CPCD section may be used.
- **Chapter 8, Section 2, Approved Design Method**
  - List TxCRCP-ME as the design method for CRCP section.
- **Chapter 8, Section 3, Rigid Pavement Design Process for CRCP**
  - Added Section 3 to describe inputs for TxCRCP-ME design program and process.
- **Chapter 8, Section 4, Rigid Pavement Design Process for CPCD**
  - Revised section to only pertain to CPCD design.
  - Removed allowance to use k-values other than 300 pci and the use of plate load testing to verify k-value during construction.
- **Chapter 8, Section 6, Terminal Anchor Joint Selection for Concrete Pavement**
  - Removed the original Section 6, “Concrete Pavement Standards,” and replaced it with information regarding terminal anchor joints for concrete pavement.

Chapter 9, Rigid Pavement Construction

- **Chapter 9, Section 3, Concrete Plant Operation**
  - Revised section content to coincide with current Item 421 requirements.
- **Chapter 9, Section 6, Paving Operations**
  - Added information on stingless concrete pavement, placing concrete, and revised texturing section to coincide with Item 360 requirements.
- **Chapter 9, Section 7, Joints**
  - Added information on longitudinal construction joints, expansion joints, and joints sealing.

Chapter 10, Rigid Pavement Rehabilitation

- **Chapter 10, Section 4, Bonded Concrete Overlay**
  - Removed evaluation criteria for bonded concrete overlays from this chapter. These are included in Chapter 8.

- Added description of saw cutting and joint sealing.

- **Chapter 10, Section 5, Unbonded Concrete Overlay**
  - Removed evaluation criteria for unbonded concrete overlays from this chapter. These are included in Chapter 8.
- **Chapter 10, Section 6, Stitching**
  - Added findings from project 0-5444 on Joint Separation in Concrete Pavements.

Chapter 11, Ride Quality

- Added a new chapter that discusses ride quality of pavement surfaces.

Chapter 12, Premature Distress Investigations

- **Chapter 12, All Sections**
  - Chapter renamed from "Forensics" to "Premature Distress Investigations."
  - Information moved from old Chapter 11, "Forensics."
  - Removed forensics and replaced it with distress.
  - Removed the use of "forensic review and report" (FR&R) in all sections.
- **Chapter 12, Section 1, Overview**
  - Added that CST-M&P will provide technical assistance on premature pavement distress investigations upon request.
- **Chapter 12, Section 2, Investigation Team**
  - Revised and compiled information from old Sections 2, 3, and 4 and placed it under new Section 2.
  - Added that the director of CST-M&P will serve as the premature distress investigation team coordinator.
- **Chapter 12, Section 3, Investigation Process**
  - Renamed the section.
  - Revised and compiled information from Section 5 and 6 and moved it to new Section 3.

Chapter 13, Load Zoning and Super Heavy Load Analysis

- **Chapter 13, All Sections**
  - Replaced "Minute Order" with "Executive Order."
- **Chapter 13, Section 1, Overview of Load Zoning**
  - Removed the Deputy Director as having authority to approve the executive orders.
- **Chapter 13, Section 2, Changing Load Zones on Roads**
  - Updated instructions in Table 13-1.

- CST-M&P notifies the affected district by email (not phone) and updates the publicly accessible load zone map.

- **Chapter 13, Section 3, Emergency Load Zones on Roads**
  - Updated instructions in Table 13-2.
  - CST-M&P notifies the district and the Department of Motor Vehicles of approval and updates the publicly accessible load zone map.
- **Chapter 13, Section 6, Super Heavy Load Evaluation Process**
  - Updated flowchart of the super heavy load evaluation process (Figure 13-3).
  - When the maximum trailer tire load is equal or greater than 10,000 lb., CST-M&P will recommend additional pavement evaluation or request a reroute.

Contact

Contact the Construction Division, Materials & Pavements Section (CST-M&P), at (512) 506-5808 for further information regarding the methods in this manual.

Archives

Past manual notices are available in a pdf archive.

Manual Notice 2011-1

From: Russel W. Lenz, P.E., Director, Construction Division

Manual: *Pavement Design Guide*

Effective Date: January 01, 2011

Purpose

This manual notice is intended to transmit changes to the content of the *Pavement Design Guide*.

Changes

Chapter 1, Section 1, Guide Overview

Under subsection, "Purpose," added wording to the end of the first sentence to identify the projects described in this manual as "traditionally-let."

Chapter 2, Section 1, Introduction

- Added information on preliminary pavement design, pavement design concept conference, and pavement design standard operationg procedure.

Chapter 2, Section 2, Pavement Design Standard Operating Procedure (SOP)

- Added new section on pavement design standard operating procedure.

Chapter 2, Section 3, District Pavement Engineer's Role

- Information was moved from Chapter 2, Section 2.

Chapter 2, Section 4, Pavement Types

- Information was moved from Chapter 2, Section 3.
- Figure 2-2. Generalized perpetual pavement design was updated. The "Construction Considerations" document was updated.

Chapter 2, Section 5, Pavement Type Selection

- Information was moved from Chapter 2, Section 4.
- Under subsection, "Principal Factors," added information to the first paragraph describing alternate bidding for higher volume highways and recommended screening criteria for an alternate bid contract.
- The new policy for alternate pavement design was added.

- Under subsection Life-cycle Cost Analysis (LCCA) the term tool is replaced with an analysis in the third paragraph. In the last paragraph is modified to mention LCCA is only one of many processes.

Chapter 2, Section 6, Approved Pavement Design Methods

- Information was moved from Chapter 2, Section 5.
- Under subsection, "Introduction," modified the bulleted list: combined the AASHTO design methods from two items into one and removed the experience bullet.
- Under subsection, "Flexible Pavement System - Window version (FPS-19W)":
  - in the first paragraph, added information about the preferred method for designing flexible pavements on higher volume highways (>10,000 ADT, 5 M ESALs) and added information about the availability of design procedure training
  - in the third bullet, added recommended data value to enter into the program for Central Texas climate
  - in the seventh bullet, added reference to graphs contained in the archived version of "Tex 117-F, Triaxial Compression for Disturbed Soils and Base Materials"
  - added bullet about the use of a mechanistic design check
- Added new subsection, "Other Acceptable Design Procedures":
  - Moved three paragraphs about the FPS-11 and 1993 AASHTO design procedure from "Flexible Pavement System - Window version (FPS-19W)" and created a new section. Added information on Pavement Design staff availability to consult on AASHTO design procedures.
- Under subsection, "Basic Design Types," added information on Type 4 design.
- Under subsection, "AASHTO Design Procedure":
  - title changed to "AASHTO Design Procedure (for flexible and rigid pavement designs)"
  - under second level subsection, "Rigid Design," added projected retirement and scheduled replacement of DARWin™ 3.10
- Added new subsection and corresponding content for, "Experience-Based Design.."

Chapter 2, Section 7, Pavement Design Categories

- Information was moved from Chapter 2, Section 6.
- Updated Figure 2-8. Design process for a new pavement or full reconstruction of pavement
- Updated Figure 2-9. Design process for flexible pavement rehabilitation.
- Updated Figure 2-10. Design process for rigid pavement rehabilitation.

Chapter 2, Section 8, Pavement Design Reports

- Informaton was moved from Chapter 2, Section 7.
- Under subsection, “Traffic Loads”:
  - Under second level subsection, “Tire Loads,” deleted the equation and equation definitions
  - Under second level subsection, “Traffic Projections”:

    added note about 20 yr. traffic projections and rigid structures

    added instructions to use Form 2124, Request for Traffic Data, for design purposes

    added “caution” note to complete Form 2124 for quick turnaround and other data options

    added paragraphs labels, “Units of Measurement” and “Loading Estimates” to existing content

    added new information labeled, “Projections and Special Factors.” This section highlights Form 2124, Request for Traffic Data, and includes instructions to complete the form. Also included, other tools recommended to verify or determine traiffic data.
- Under subsection, “Serviceability Index,” updated Figure 2-12. Pavement Performance Relationships
- Changed the status of “Reliability (confidence level)” from second level subsection to first level subsection.
- Under subsection, “Reliability (confidence level)”:
  - added the types of pavements the department reliability of 90 to 95 % is usually applied
  - added information about the type of pavements lower reliability may be applied
- Under subsection, “Drainage Characteristics”:
  - in the second level subsection, “Internal (Positive) Pavement Drainage,” added a paragraph label, “Department Policy,” to the sentence beginning, “Aspects of the department’s policy are evident. . .”

Chapter 2, Section 9, Pavement Design Reports

- Information was moved from Chapter 2, Section 8
- Under subsection, “Pavement Design Report and Other Documentation”:
  - added new bullet item on PVR mitigation
  - added new bullet item on identification of the base grade chosen
  - added new second level bullet about alternate pavement design to the bullet item, “Design input values and output.”
- Under subsection, “Completing the Pavement Design Report”:
  - In the table, “Completing the Pavement Design Report,” added bullet to step 1 to provide information on District Engineer’s responsibility. In step 2 of this table, actions were

added and defined for district staff, district pavement engineer (DPE), and District Engineer (DE).

Chapter 3, Section 2, Geotechnical Investigation for Pavement Structures

- Under subsection, "Preliminary Investigation":
  - In the second paragraph starting, "Site inspections are frequently conducted. . ." changed text to encourage frequent site inspections in this stage.
  - In Table 3-1: Existing Data Sources, under column "External Data Sources," changed the bullet order from second level to first level for items: Commercial Internet and Topographic. Change the bullet item, "university library files," to "engineering library files" and changed the bullet order for this item from second level to first level.
  - Under Table 3-2: Reconnaissance Areas of Interest:, in the bullet named, "Surface Soil Exploration," after the last second level bullet in the list, added reference to the test procedure required if sulfur-bearing compounds are detected in the soil.
  - In the second level subsection, "Preliminary Evaluation," under bullet, "Structural Support," added information on the condtions to use triaxial classification
- Under subsection, "Subsurface Exploration":
  - in the second level subsection, "Material Evaluation," under bullet, "Swell potential":

    added guidance and reference information on the use of potential vertical rise (PVR)

    added the recommended test procedure for determining PVR

    added recommendations for best conditions to determine PVR

    added specific criteria that determine whether a pavement structure design proposing to include PVR reduction strategies will require Construction Division review and approval or review only

    added a list of items pavement designers should address in their submission for review and approval in conjunction with the pavement design.

    added criteria that would allow designs incorporating PVR mitigation.

Chapter 3, Section 3, Flexible (Unbound) Base Selection

- Added new reference, "Flexible Base Selection Guide," along with corresponding description of the guide and its contents. Added reference to memo, "Use of Grade 1 Flex Base," along with the memo's effective date. Describes conditions when use of Grade 1 flexible base will require justification.
- Added new subsection, "Flexible Base Description."
- Under subsection, "Flexible Base Description":
  - moved information referencing Item 247 from "Flexible (Unbound) Base Selection." The number of different grades changed from four to five. Added Grade 5 to the sentence, "Grade 1 and Grade 2 base materials are the primary base material grades for base course

performing as a structural layer in a pavement structure." Added guidance on use of Grade 4.

- reorganized and formatted information of each grade of flexible base, from 1 through 5, into a bullet list. Added new information describing the characteristics and best use of each grade.

- Added new subsection, "Base Selection."

Chapter 3, Section 5, Hot Mix Asphalt Concrete Pavement Mixtures

- Under subsection, "General":
  - added temperature parameters for creating warm mix asphalt (WMA)
  - added information on benefits of using warm mix asphalt (WMA)
- Under subsection, "Use of Perpetual Pavements":
  - reformatted the information about stone matrix asphalt. Added conditions when RBL should be considered.

Chapter 3, Section 8, Hydraulic Cement Concrete

- Reformatted the information in this section and created four subsections:
  - Primary Ingredients
  - Determining Ingredient Proportions
  - Creating Workability, Durability, and Adequate Strength - Changed wording for the sentence, "For the concrete to have good workability, durability, and adquate strength, two conditions are to be met:" to ". . . two condtions must be met:"
  - Three Concrete Classes - reformatted the information for concrete classes P, K, and HES into a table.

Chapter 3, Section 9, Geosynthetics in Pavement Structures

- Under subsection, "Geosynthetics for Geotechnical Reinforcement," in the third paragraph, removed "and will concluded in late 2006." from the sentence beginning "Addtional research on the contribution of geogrid. . . "

Chapter 5, Section 1, Overview

- Reorganized the information

Chapter 5, Section 2, Types of Flexible Pavements

- Under subsection, "Types of Hot Mix Asphalt-Surfaced Pavements," in the last sentence of the last paragraph, added "cement" to the list of typical stabilizers.
- Under subsection, "Perpetual (HMA) Pavement":
  - removed reference to "heavy duty" mixes and its uses

- added conditions for the use of stone matrix asphalt and the approval required for this substitution.

Chapter 5, Section 3, FPS-19W Design Parameters

- Reorganized the information and created two subections, Program Tools and Data Input Components.
- Under subsection, “Program Tools,” added information to indicate the manual information supersedes the guidance provide on the program “Help” screen.
- Under subsection, “Data Input Components,” added new table, Table 5-1: FPS-19W Design Input Requirements.
- Under subsection, “General Inputs”:
  - in the second level subsection, “Program Main Menu,” the information was reformatted to numbered list. A caution note to prevent program crashing was added
  - in the second level subsection, “Basic Design Criteria (Card #3),” and in the paragraph named, “Analysis Period,” corrected format of the caution note.

    In the paragraph named “Minimum Serviceability Indes,” changed the value of ESALs for highways of higher importance from “exceeds 1,000,000” to “5 M.” For the highways with moderate traffic, changed the ESAL value from “500,000 to 1,000,000” to “1 M to 5 M ESALs.” Changed the definition of low volume highways from “less than 1,000 vehicles per day (vpd)” to “less than 3,000 vehicles per day.” Changed the value of cumulative ESALs from “less than 500,000” to “less than 1,000,000.” Changed the terminal serviceability of low volume highways from “2.5” to “2.0 to 2.5”

    Updated Figure 5-1. Added an interpretation of Figure 5-1. Pavement Performance Relationships. Added information on factors that shorten the serviceability over time and how it can be restored.

    In the paragraph named, “Design Confidence Level,” added confidence level recommendations by ESAL values.
  - Table 5-2. Output Variations was originally Table 5-1. This table’s contents were completely updated. Under column header, “Traffic Volume,” a “High” designation was added and each traffic volume level was defined by an ESAL value. Column headers, “Initial SI” and “Termin SI” were added. Column headers, “Initial Performance Period” and “Overlay” were modified with “T1” in the units of measurement.
  - in the second level subsection, “Program Controls (Card #4),” defined output pages further
  - in the second level subsection, “Construction and Maintenance Data (Card #7),” in the paragraph named, “Initial Serviceability Index,” added recommended index values based on pavement condtions.

In the paragraph named, “Serviceability Index after Overlay,” changed the index value of 2-3 in. overlays from “4.0” to “4.0 - 4.2.” For thick overlays, changed the index value from “a higher value” to “up to 4.5.”

- in the second level subsection, “Detour Design for Overlays (Card #8),” added caution note to prevent program crashing. Added Pavement Design Task Force’s recommendation for removing possible cost bias in accounting for user costs on low- to medium-volume highways.

- Under subsection, “Traffic Inputs”:
  - added reference to internal Form 2124, Request for Traffic Data, for design traffic requests. Added guidance noted by the Pavement Design Task Force (PDTF, 2009) to districts to review traffic analysis for highway design report to verify data reasonableness.
  - in the second level subsection, “20-Yr. 18-kip ESALs (One Direction), added information that describes when lane distribution factors are appropriate
  - in the second level subsections, “Average Speed in the Overlay Direction” and “Average Speed, Non-overlay Direction,” added recommended value to enter to avoid computation of associated user costs in the overall estimate of project costs.
- Under subsection, “Environment and Subgrade”:
  - updated the information on this feature’s effectiveness and added best use of this feature. Added recommendation of the use of Tex 124-E, Determining Potential Vertical Rise, for evaluation of mitigation of soil movement. Added reference to Chapter 3, “Materials Investigation and Selection Information,” for more information on approval requirements for soil movement mitigation.
  - in second level subsection, “District Temperature Constant,” added default value which corresponds to a Central Texas value. Added specific guidance for use of the default value in program FPS-19.
  - in second level subsection, “Swelling Probability,” added default value and provided conditions when the default value should not be used
  - in second level subsection, “Potential Vertical Rise,” explained the consequence of using zero in “Swelling Probability” and added reference to Chapter 3, Section 2, Geotechnical Investigation for Pavement Structures, for designs to mitigate potential rise and provides conditions on how and when it should be used.
  - in the second level subsection, “Swelling Rate Constant,” added the effect of this field when zero is entered for Potential Vertical Rise or for Swelling Probability.
- Under subsection, “Material Parameters”:
  - in the second level subsection, “Modulus, E (ksi),” in Table 5-3: Recommended Material Design Modulus Values, the following changes were made:

    Table 5-3 was moved from Table 5-2.

Material Type name, Dense-graded Hot (Warm) Mix Asphalt, was updated by adding "(Warm)." For the Dense-graded Hot (Warm) Mix Asphalt, the Design Modulus content and values were modified.

Material Type name, Permeable Friction Course, the Comment field was updated.

Material Type, Performance Design Mixtures, the Design Modulus values were modified. The Comment field was modified, included changing the ksi value from 350 ksi to 500 ksi.

Material Type, Stone-Matrix Asphalt, the Design Modulus content was modified.

Material Type, Flexible Base, modified Comment field.

Material Type, Cement Stabilized Base, modified Comment field.

Material Type, Lime or Cement Stabilized Subgrade, modified Comment field.

Material Type, Subgrade, modified Poisson's Ratio and Comment fields.

- in the second level subsections, "Minimum Depth" and "Maximum Depth," modified the last bullet starting, "For subgrade, use the average depth to bedrock. . ."
- in the second level subsection, "Poisson's Ratio," added more guidance for selecting a value to enter
- in the second level subsection, "Check (CHK) Column," changed the designated job title from "responsible engineer" to "project engineer" for the last sentence starting, "Leeway is granted to. . . "

◆ Under subsection, "Modified Texas Triaxial Check":

- part of the information was reformatted into step-action Table 5-4: Texas Triaxial Design Check. Steps 6 and 7 are new content.
- the other part of the information was reformatted into second level subsection, "Subgrade Triaxial Class Number." Added details about specific archived versions of the Tex-117-E reference. A table was created to display information on the design check routine.

Chapter 5, Section 4, Pavement Detours and Pavement Widening

◆ Under subsection, "Pavement Detours":

- content was reformatted, included the addtion of a bullet list for some content. Added information on estimating traffic loading when a detour is in effect and provides guidelines to request traffic data for detours.
- in second level subsection, "Structural Design of Detours," added suggestion to use the falling weight deflectometer (FWD). Added proven design strategies the districts may employ. Added an alternative option of the modified TTC check. Added suggested routine, TRAFFIC6, or similar routine to estimate cumulative ESALs over the detour design life. Parts of this section were used to create "Material and Construction Considerations for Detour Structures."

- in second level subsection, " Material and Construction Considerations for Detour Structures," added details about preparing subgrade and the resulting pavement structure. Added a new construction consideration for detour structures that involve placing 4 in. of flexible base and provides the resulting condition. Added instructions to recycle detour structures when no longer needed.

Chapter 5, Section 5, Perpetual Pavement Design and Mechanistic Design Guidelines

- Under subsection, "Designing a Perpetual Pavement using FPS-19W":
  - reformatted content into Table 5-6: Designing Perpetual Pavement Using FPS-19W and created a list of corresponding guidance for each step

    At step 6, added new information about a minimum "time to first overlay."

    At step 7, added new information about renewing the surface at periodic intervals and added new note "Analysis period is not pertinent to perpetual design."
- Under subsection, "Checking the Proposed Design for Compliance with Limiting Strain Criteria":
  - changed the value for "the maximum tensile strain at the bottom of all HMA layers" from "52 μ-strain (< 70)" to "46 μ-strain (< 70)"
  - changed the value for "the maximum compressive strain at the top of the subgrade" from "124 μ-strain (<200)" to "115 μ-strain (<200)"
  - added recommendation to check strain levels from ATHWLD with computuations outside the current FPS-19W program

Chapter 8, Section 4, Recommended Input Design Values

- Under subsection, "Input Values," removed "subbase" from the third bullet. The item originally read "Effective Modulus of Subbase/Subgrade Reaction, pci"
- Under subsection, "Effective Modulus of Subgrade Reaction: k-value":
  - reformatted the information and created two second level subsections, "TxDOT-Required Base Layer Combination" and "Selecting Appropriate Strength"

    In "TxDOT-Required Base Layer Combination," added an option for designers to use a higher k-value. Added instructions to determine and respond to k-value.
- Under subsection, "Load Transfer Coefficient," in Table 8-1: Load Transfer Coefficients, modified the coefficient value when the answer is "yes" to both criteria.
- Under subsection, "Reliability, %":
  - added design ESALs value after the phrase, "a reliability of 95% should be used for rigid pavement. . ."
  - added information for "a reliability of 90%"

Chapter 8, Section 5, Determining Concrete Pavement Thickness

The first sentence in the first paragraph, changed the phrase from "round the thickness up to the next higher whole inch" to "round the thickness up to the nearest full or half inch." Changed the values in the example.

In the bulleted items, values were changed. These changes are explained in the two paragraphs following the bulleted list.

Chapter 8, Section 6, Concrete Pavement Design Standards

In the first bullet, the beginning value changed from "8" to "6."

Chapter 8, Section 7, Bonded and Unbonded Concrete Overlays

Under the main section, a large part of the content was rewritten and updated.

- The new subsection, "Overlay Thickness Design," was added.
  - The new second level subsection, "Determination of Effective Slab Thickness by Condition Survey Method," was added.
- The new subsection, "Joints and Cracks Adjustment Factor, F_{jc}," was added.
- The new subsection, "Durability Adjustment Factor, F_{dur}," was added.
- The new subsection, "Fatigue Damage Adjustment Factor, F_{fat}," was added.
  - The second level subsection, "Steel Design," was added.
- The new subsection, "Unbonded Concrete Overlays," was added.
  - The second level subsection, "Overlay Thickness Design," was added.
  - The second level subsection, "Determination of Effective Slab Thickness by Condition Survey Method," was added.
  - The second level subsection, "Steel Design," was added.

Chapter 12, Section 6, Super Heavy Load Evaluaton Process

In the first sentence in this section, the value for the "trailer tire load" changed from "exceeding 5,000 lb." to "exceeding 6,000 lb."

Contact

Contact the Construction Division, Materials & Pavements Section (CST-M&P) at (512) 465-3686 for further information regarding the methods in this manual.

Archives

Past manual notices are available in a pdf archive.

Manual Notice 2008-1

From: Thomas R. Bohuslav, P.E., Director, Construction Division

Manual: *Pavement Design Guide*

Effective Date: November 01, 2008

Purpose

This manual notice is intended to transmit changes to the content of the *Pavement Design Guide*.

Changes

This manual has changed from fifteen chapters to twelve.

Chapter 1, Section 1, Guide Overview

- Under subsection, Purpose, added new subsection, Comprehensive Development Agreement.
- Subsection, Organization, in the first sentence, changed the number of chapters from fifteen to twelve.
  - In bullet reference to Chapter 9, deleted mix transport; added concrete mix design and delivery of concrete; added concrete to describe plant operation
  - In bullet reference to Chapter 10, reordered rehabilitation options to parallel the section table of contents. Changed "full depth patches" and "partial depth patches" to "full depth repair" and "partial depth repair"; deleted "reducing rigid pavements"; added "diamond grinding."

Chapter 2, Section 2, District Pavement Engineer's Role

- Subsection, History, added content to provide more details of the DPE's responsibilities in various roles.
- Subsection, Responsibilities
  - Under the second set of bullets, deleted sentence "In addition, the DPE serves as the district expert in differentiating when preventative maintenance options are more pertinent than structural rehabilitation options."
  - The first paragraph under the second set of bullets, changed the wording in the sentence beginning "The DPE will often . . ." to "The DPE may be. . ."
  - The last sentence under this subsection changed from "Because of the importance of understanding material properties and evaluation of materials used in pavements, the position of DPE has been consolidated under the district lab engineer in several districts." to "Because of the importance of understanding material properties and evaluation of materi-

als used in pavements, some districts have assigned DPE duties to the district lab engineer“

- Changed subsection name from District Pavement Engineer (DPE) Certification to District Pavement Engineer (DPE) Skills. Changed the corresponding content under this subsection; provides DPE guidance for development and review of pavement designs instead of DPE certification requirements.
  - In table, Recommended and Required Training for the District Pavement Engineer, changed the wording under column heading, “Comment” from “Required for certification” to “Required for flexible pavement design” for the “Training” classes, MODULUS and FPS-19W; deleted “Required for certification” from “Training” class, PMIS Concepts for Administrators CON107; for the “Training” class TSLAB86, DARWin™ 3.1, changed “Comment” from “Required for certification” to “Required for rigid pavement design”
  - Under the table, Recommended and Required Training for the District Pavement Engineer, the procedure to certify pavement designs was deleted. Added “PMIS and pavement design assistance from CST-M&P will be provided upon request.”

Chapter 2, Section 3, Pavement Types

- Second level subsection, Perpetual Pavement, end of second paragraph added “Detailed construction considerations are available through this link.”
- Second level subsection, Continuously Reinforced Concrete Pavement, modified and added characteristics of acceptable cracking.

Chapter 2, Section 5, Approved Pavement Design Methods

- Subsection, Flexible Pavement System - Windows version (FPS-19W), in the tenth paragraph, deleted “design check procedure” and replaced with “Modified Texas Triaxial Design Method”
- Subsection, AASHTO Design Procedure, first paragraph changed date range from “in 1959-1960” to “from 1958-1960”
- Second level subsection, Flexible Design, in second paragraph:
  - Added “The AASHTO procedure for flexible design is automated in the DARWin™ 3.1 software.” to the beginning of the paragraph
  - Added “and one design option using the DARWin software is to input layer resilient moduli instead of layer coefficients.” to the end of the last sentence.

Chapter 2, Section 7, Information Needed for Pavement Design

- Subsection, Traffic Loads:
  - Second level subsection, Traffic Distribution, after the first set of bullets, deleted paragraph “The Transportation Planning and Programming Division (TPP) estimates the directional distribution in the Traffic Analysis for Highway Design report, but this distribution number is for the entire traffic stream. If the designer anticipates that the truck

distribution number is different from that of the entire traffic stream, then this should be indicated in the request submitted to TPP for project level traffic data." and replaced it with "The Transportation Planning and Programming Division (TPP) posts the directional distribution in the Traffic Analysis for Highway Design report, but this distribution is related to peak ADT distributions (the 30th highest hourly volume) that affect level of service for geometric design versus loading for structural design."

Added paragraph "The assumption made in the Traffic Analysis for Highway Design report is traffic loading is equivalent in both directions. If the designer anticipates the truck directional distribution to be different from 50/50 or loads to be significantly greater in one direction, then this concern should be indicated in the request submitted to TPP for project level traffic data."

Chapter 2, Section 8, Pavement Design Reports

- Subsection, Projects Requiring Pavement Design and Pavement Design Reports:
  - Deleted three bulleted items, 1) "rehabilitation (2R) projects, where upgrading as defined in Chapter 5 (reconstruction and rehabilitation design criteria) of the Roadway Design Manual is performed, 2) projects that involve removal of water trapped in the pavement structure (underdrains, edge drains, restoration of drainage systems), and 3) "hot mix asphalt (HMA) overlays greater than 2 in. thick"
  - For bullet beginning "hydraulic cement" added "unbonded" before "overlays of existing pavements"
  - Under the first set of bullets added two paragraphs: 1)"Tie-ins, such as bridge approaches, do not require pavement designs when following department or district proven standards."

    2) "A new design is not necessary. Previously approved design can be used if through an analysis, considering traffic, environmental and subgrade conditions, the pavement design analysis yields the same thickness. However, adjustments to designs thicknesses and specific conditions, even within a project, should be considered in the design process for economic purposes."
  - Near the beginning of the fourth paragraph, inserted word "approximately" in front of "2-in thick and less. . ."
  - In the sixth paragraph beginning, "The following list provides. . ." added "for projects greater than 500 ft long" to the end of the sentence.
  - In the second set of bullets, deleted three bulleted items: 1)addition of shoulders, 2) addition of a travel lane and 3) matching the existing or the adjacent section. Added one bulleted item, "pavement widening including shoulder."
- Subsection, Pavement Design and Other Documentation:
  - In the second bullet starting "Narrative discussing. . ." inserted the term "for 3-R projects" after "PMIS data analysis/pavement condition surveys." In the sentence beginning "The narrative should. . ." deleted "section's construction and maintenance history, identifying"

The sentence now reads "The narrative should include a discussion of the factors that significantly affect pavement performance, and a summary of laboratory tests conducted on any materials extracted from the existing structure."

- In the fifth bullet beginning "Soil map of. .." added sentence to the end of the item "Provide information pertaining to shrink/swell potential and plasticity.
- Added bullet item, "The study of the presence of sulfate bearing compounds and organic content."

Chapter 3, Section 2, Geotechnical Investigation for Pavement Structures

- Moved content from Chapter 4, Section 6, Geotechnical Investigation for Pavement Structures
- Subsection, Introduction:
  - In the second level subsection, Scope of Guidelines, at the beginning of the section, added "This guideline is intended solely for pavement applications."
- Subsection, Preliminary Investigation:
  - In the numbered list, item 3, added "to" between "geometrics" and "predict"
  - Second level subsection, Project Intiation, "Project Type" bullet, first sub-bullet, at the end of the item, added " A review of existing data can indicate what information is readily available."

    Second sub-bullet, deleted, "Review of Existing Data can help in defining what information is readily available." from the beginning of the item. Now reads "It is necessary in all cases to determine what influence the roadbed soils will have or have had on the performance of the pavement structure."
  - Second level subsection, Field Reconnaissance, first bullet, Surface Soil Exploration, changed the following eight first level bullets to second level bullets, beginning with "Size and percentage. . ." ending with "Presence of certain. . ."
  - Second level subsection, Field Reconnaissance, second bullet, replaced text, "Presence of certain sulfur-bearing compounds such as gypsum or lignite can indicate further testing is required. There are common occasions where two material types are present and are" with "When two material types are present, it is common for the materials to be"
  - Second level subsection, Field Reconnaissance, third bullet, Physical layout and alignment, at the beginning of the first sub-bullet, deleted "An idea about the terrain" and replaced content with "Terrain features"
  - Second level subsection, Preliminary Evaluation, first sub-bullet under item, Structural Support, second sentence changed from "Soil Conservation Service (SCS) maps" to "The older Soil Conservation Service (SCS) maps or online USDA, Natural Resources Conservation Service Web Soil Survey"
- Subsection, Subsurface Exploration:

- Second level subsection, Material Evaluation, fourth bullet, Feasability of chemical modification, first sentence, inserted "potential for" to describe "detrimental effects";

  Second sentence, changed "Stabilization Guidelines" to "Guidelines for Modification and Stabilization of Soils and Base for Use in Pavement Structures" and added a link;

  Third sentence, changed from "The protocol evaluates the potential for the occurrence of detrimental reactions after a soil has been placed and compacted." to " The protocol evaluates the potential for the occurrence of detrimental reactions after the introduction of a calcium based stabilizer.

- Subsection, Stabilization Guidelines:
  - In the second paragraph, the fourth sentence starting, "In order to achieve. . ." deleted "by treating with modifiers, such as asphalt, cement, fly ash, or lime."
  - Added third paragraph "Most materials are made suitable by incorporating chemical additives, such as asphalt, cement, fly ash, or lime. Each of these additives is effective when the material is designed and applied properly. Proper design and application of materials with additives will minimize premature failures of the material and pavement structure."
  - In fourth paragraph beginning "The Guidelines for Modification. . ." deleted the last sentence "Please contact the Geotechnical, Soils & Aggregates Branch of the Construction Division, Materials & Pavements Section (CST-M&P)."

    Added content to the end of the paragraph "When soils and base contain soluble sulfates, use the "Guidelines for Treatment of Sulfate-Rich Soils and Bases in Pavement Structures" to identify the feasibility for treatment and construction consideration for incorporating chemical additives."

Chapter 3, Section 4, Performance Graded Binders (PG Binders)

- Subsection, Selecting a PG Binder, third paragraph, changed the test reference from ("Tex-539-C, Measurement of Elastic Recovery of Tensile Deformation Using a Ductilometer") to (ASTM 6084, Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer)

Chapter 3, Section 5, Hot Mix Asphalt Concrete Pavement Mixtures

- Subsection, HMA Mix Design, split the first paragraph at the end of the second sentence; added a new second level subsection title, Performance Concerns; moved content under the new subsection starting at sentence beginning "Mix design seeks to address. . ."
  - Second level subsection, Performance Concerns, under the bullet list, the paragraph beginning "Design is facilitated by . . ." and ending with the sentence beginning, "Mixture designs using the SGC. . ." was reformatted to seven paragraphs.

    In the sixth paragraph beginning, "Mixture designs using the SGC. . ." changed the content at the end of the sentence from "Depending upon the mix type, an N design (Ndes) related to design air voids initial N (Nini) related to mix workability, and maximum N

(Nmax) related to maximum desirable densification may be established (see "Tex-241-F" and "Tex-204-F," Part IV)." to "Depending upon the mix type, an N design (N_{des}) related to design air voids will be established (see "Tex-241-F" and "Tex-204-F," Part IV)."

Added sentence to the end of the sixth paragraph, "N_{des} can be adjusted to ensure sufficient asphalt cement content and mix workability."

- Added second level subsection title, Voids in the Mineral Aggregate, before paragraph beginning, "Another mix design parameter. . ."
- Added second level subsection title, Evaluating Mix Stability, before paragraph beginning, "Historically, mix stability. . ."
- Added second level subsection title, Tools to Improve HMA Mixes; added new paragraph at the beginning of the section, "Research project 0-5123 developed a methodology to design a balanced HMA mixture, considering both rutting (Hamburg) and fatigue (Overlay Tester) properties."

  In the second paragraph, at the end of the first sentence, added, "found in Tex-248-F." and deleted second sentence, "A current research project (0-5123, scheduled for completion in August 2007) combines the testing of a mix design for rutting using the Hamburg tester and for cracking using the Overlay Tester."
- In Table 3-6: Tex-204-F Mix Design Options, Part IV, column heading, Must Meet, changed criteria from, "Must ensure stone on stone contact. . ." to "By plan note, designate stone on stone contact. . ."

◆ Added subsection, Use of Perpetual Pavements

Chapter 4, Section 6, Geotechnical Investigation for Pavement Structures

◆ Moved content to Chapter 3, Section 2

Chapter 5, Section 1, Overview

◆ Under the first set of bullet items, added "These pavement design procedures were briefly described in Chapter 2 and will not be further addressed here."

Chapter 5, Section 2, Flexible Pavements

◆ Subsection, Types of Hot Mix Asphalt-Surfaced Pavements:

- In the second level subsection, Perpetual (HMA) Pavements, deleted, "The idea of a structurally designed deep HMA pavement that would give high assurance of a long pavement life was studied by the Flexible Pavement Design Task Force (FPDTF) in 2001 with the expressed intent of addressing the increased structural demands on heavy truck traffic facilities. The FPDTF was composed of pavement and construction experts from TxDOT and industry. Their study resulted in the establishment of department guidelines for materials to be used, the general ("conceptual") structural design format, and the locations where these structures should be considered (2001)." and replaced with:

"In 2001, the Flexible Pavement Design Task Force (FPDTF) studied structurally designed deep HMA pavement; a type of pavement typically associated with high assurance of long pavement life. The intent of the FPDTF study was to address the increased structural demands on heavy truck traffic facilities. The task force was composed of pavement and construction experts from TxDOT and industry.

As a result of the 2001 study, the following guidelines were established: department guidelines for materials to be used, the general ("conceptual") structural design format and the locations where these structures should be considered (2001)."

- Second level subsection, Perpetual (HMA) Pavements, deleted the last paragraph "Exceptions to the use of these improved performance mixes for heavy truck traffic routes must be granted by the executive director or designated representative. These mixes are designated as performance-designed or stone matrix asphalt (SMA) mixes under the 2004 Specifications (Items 344 and 346). A pavement structure composed of an RBL with multiple lifts of performance and/or SMA mixes is commonly referred to as a perpetual pavement structure that is not subject to traditional bottom-up fatigue damage but will eventually experience surface distresses and will require surface renewal." and replaced with:

  "Special attention is required in designing a durable foundation by investigating the underlying soils to determine the appropriate type and level of stabilization needed. In lieu of subgrade stabilization, a high quality granular base, cement-treated base, or other engineered foundation should be used."

Chapter 5, Section 3, FPS-19W Design Parameters

- Subsection, Traffic Inputs
  - Second level subsection, Ending ADT (vehicles/day), last sentence replaced "uniformly" with "linearly."
  - Second level subsection, 20-Yr. 18-kip ESALs (One Direction), replaced "exist in both directions" with "exist in the design direction."

Chapter 6, Section 2, Base and Subgrade Preparation

Moved content from Chapter 6, Section 8, Base and Subgrade Preparation

Chapter 6, Section 3, Pavement Surface Preparation

Moved content from Chapter 6, Section 2, Pavement Surface Preparation

- Changed the name of the first subsection from "Introduction" to "Surface Condition"
- Subsection, Existing Surface Preparation for Overlays
  - Second level subsection, Application, changed the third bullet from "type of tack coat according to standard TxDOT specifications from item 300." to "type of tack coat accord-

ing to standard TxDOT specifications on Limestone Rock Asphalt Pavement, Item 330, and hot-mix items 334, 340, 341, 342, 344, and 346."

Chapter 6, Section 4, Special Considerations for the Construction of Perpetual Pavement

This is a new section.

Chapter 7, Section 10, Alternate Pavement Rehabilitation Options

This is a new section.

Chapter 8, Section 1, Rigid Pavement Design

- Subsection, Selection of Rigid Pavement Type, removed the effective date from the first paragraph and added paragraph under the bullet list.

Chapter 12, Section 3, Emergency Load Zones on Roads

- Subsection, Setting Emergency Load Zones on Roads, Table 12-2, Emergency Load Zones on Roads:
  - Step 1, Required Action, bullet 4, changed number of days from 60 to 120.
  - Step 2, Required Action, bullet 2, changed the number of days from 60 to 120.

Chapter 12, Section 6, Super Heavy Load Evaluation Process

First paragraph changed from "CST-M&P will perform analyses for GVW over 500,000 lb. or a trailer tire load exceeding 6,000 lb. with input data supplied by the affected districts and the Pavement Management Information System (PMIS)." to "CST-M&P will perform analyses for GVW over 800,000 lb. or GVW over 500,000 lb. and a trailer tire load exceeding 5,000 lb. with input data supplied by the affected districts and the Pavement Management Information System (PMIS)."

Chapter 13, Pavements and Materials Research

This chapter was deleted.

Chapter 14, Trade Organizations

This chapter was deleted.

Chapter 15, Other Related References and Links

This chapter was deleted.

Supercedes

The revised manual supersedes prior versions of the manual.

Contact

Contact the Construction Division, Materials & Pavements Section (CST/M&P) at (512) 465-3686 for further information regarding the methods in this manual.

Archives

Past manual notices are available in a pdf archive.

Table of Contents

Chapter 1 — Introduction

Section 1 — Guide Overview 1-2
Purpose 1-2
Comprehensive Development Agreements 1-2
Organization 1-2
Section 2 — Training 1-4
Overview 1-4
Section 3 — Contacts 1-6
Contacts for Questions and Comments 1-6

Chapter 2 — Pavement Design Process

Section 1 — Introduction 2-2
Section 2 — District Pavement Engineer's Role 2-3
History 2-3
Responsibilities 2-3
District Pavement Engineer (DPE) Skills 2-4
Section 3 — Pavement Types 2-7
Flexible Pavement 2-7
Rigid Pavement 2-8
Rigid and Flexible Pavement Characteristics 2-11
Section 4 — Pavement Type Selection 2-13
Principal Factors 2-13
Life-cycle Cost Analysis (LCCA) 2-14
Section 5 — Approved Pavement Design Methods 2-15
Introduction 2-15
Flexible Pavement System – Windows version (FPS-19W) 2-15
AASHTO Design Procedure 2-18
Modified Texas Triaxial Design Method 2-19
Section 6 — Pavement Design Categories 2-20
Definitions 2-20
Example of Conditions for Each Pavement Design's Usage 2-20
Section 7 — Information Needed for Pavement Design 2-23
Overview 2-23
Traffic Loads 2-23
Serviceability Index 2-28
Material Characterization 2-29
Drainage Characteristics 2-34

Evaluating Existing Pavement Condition 2-37
Section 8 — Pavement Design Reports 2-38
Projects Requiring Pavement Design and Pavement Design Reports 2-38
Pavement Design Report and Other Documentation 2-39
Completing the Pavement Design Report 2-40
Pavement Design Report Review and Archive 2-41

Chapter 3 — Materials Investigation and Selection Information
Section 1 — Introduction 3-2
Section 2 — Geotechnical Investigation for Pavement Structures 3-3
Introduction 3-3
Preliminary Investigation 3-4
Subsurface Exploration 3-11
Stabilization Guidelines 3-14
Geotechnical Summary Report for Pavement Design Development 3-15
Section 3 — Flexible (Unbound) Base Selection 3-18
Section 4 — Performance Graded Binders (PG Binders) 3-21
General 3-21
Selecting a PG Binder 3-21
Section 5 — Hot Mix Asphalt Concrete Pavement Mixtures 3-23
General 3-23
HMA Mix Design 3-25
Guidelines for Selecting HMA Mixtures 3-30
Use of Perpetual Pavements 3-30
Selecting Surface Aggregates to Comply With the Wet Weather Accident Reduction Program (WWARP) 3-31
Section 6 — Hydraulic Cement 3-33
Section 7 — Reinforcing Steel 3-35
Section 8 — Hydraulic Cement Concrete 3-36
Section 9 — Geosynthetics in Pavement Structures 3-38
Introduction 3-38
Description of Materials and Applications 3-38
Geosynthetics for Surface Layer Reinforcement 3-39
Geosynthetics for Geotechnical Reinforcement 3-40
Geosynthetics for Drainage Applications 3-41
Specifications and Testing 3-42

Chapter 4 — Pavement Evaluation
Section 1 — Overview 4-2
Visual Condition Surveys 4-2

Non-destructive Testing. 4-2
Destructive Testing 4-3
Section 2 — Visual Pavement Condition Surveys 4-4
Overview 4-4
Flexible Pavement Visual Survey Condition Categories. 4-4
Rigid Pavement Visual Survey Condition Categories. 4-8
Section 3 — Non-Destructive Evaluation of Pavement Functional Properties 4-13
Roughness 4-13
Skid Resistance 4-14
Section 4 — Non-Destructive Evaluation of Pavement Structural Properties 4-16
List of Non-Destructive Tools in Order of Availability 4-16
Falling Weight Deflectometer (FWD). 4-18
Dynamic Cone Penetrometer (DCP) 4-21
Air-coupled Ground Penetrating Radar (GPR) 4-23
Ground-coupled Penetrating Radar (GPR) 4-26
Seismic Evaluation Tools 4-27
Rolling Dynamic Deflectometer (RDD) 4-29
Section 5 — Destructive Evaluation of Pavement Structural Properties 4-31
Trenching and Coring 4-31
Trenching Procedure 4-32
Coring Procedure. 4-33
Shelby Tube. 4-35
Section 6 — Geotechnical Investigation for Pavement Structures 4-37

Chapter 5 — Flexible Pavement Design
Section 1 — Overview 5-2
Section 2 — Types of Flexible Pavements 5-3
Definition of Flexible Pavement 5-3
Types of Hot Mix Asphalt-Surfaced Pavements 5-3
Section 3 — FPS-19W Design Parameters. 5-5
General Inputs 5-5
Traffic Inputs 5-10
Environment and Subgrade 5-11
Material Parameters. 5-12
Modified Texas Triaxial Check. 5-17
Section 4 — Pavement Detours and Pavement Widening 5-19
Pavement Detours 5-19
Pavement Widening. 5-20
Section 5 — Perpetual Pavement Design and Mechanistic Design Guidelines 5-23

General 5-23
Designing a Perpetual Pavement using FPS-19W 5-23
Checking the Proposed Design for Compliance with Limiting Strain Criteria 5-24

Chapter 6 — Flexible Pavement Construction
Section 1 — Introduction 6-2
Section 2 — Base and Subgrade Preparation 6-3
Introduction 6-3
Section 3 — Pavement Surface Preparation 6-4
Surface Condition 6-4
Prime Coat - Flexible Pavements 6-4
Underseals 6-4
Existing Surface Preparation for Overlays 6-4
Other Tack Coat Aspects 6-10
Section 4 — Special Considerations for the Construction of Perpetual Pavements 6-12
Foundation 6-12
Other Considerations 6-12
Section 5 — Plant Operations 6-13
Batch Plants 6-13
Drum Plant 6-14
Section 6 — Mix Transport 6-15
Introduction 6-15
Truck Types 6-15
Operational Considerations 6-18
Summary 6-24
Section 7 — Placement 6-25
Introduction 6-25
Placement Considerations 6-25
Asphalt Paver 6-27
Material Transfer Vehicles (MTVs) 6-39
Section 8 — Compaction 6-44
Introduction 6-44
Compaction Measurement and Reporting 6-44
Compaction Importance 6-47
Factors Affecting Compaction 6-48
Compaction Equipment 6-51
Roller Variables 6-55
Summary 6-61
Section 9 — Ride Quality 6-62

Ride Quality Parameter (IRI) 6-62
Equipment for Measuring Ride Quality 6-62
Pay Schedule 6-63
Smoothness Opportunity 6-63
Analysis of Ride Data 6-63

Chapter 7 — Flexible Pavement Rehabilitation

Section 1 — Overview 7-2
Section 2 — In-place Surface Recycling 7-3
Hot In-place Recycling (HIPR) 7-3
Cold In-place Recycling (Bituminous Layers Only) 7-4
Section 3 — Geosynthetics 7-5
Geosynthetics in Hot Mix Asphalt (HMA) Applications 7-5
Geosynthetics in Pavement Bases (non-HMA Applications) 7-6
Section 4 — Flexible Base Overlay and Flexible Base Thickening 7-8
Flexible Base Overlay 7-8
Flexible Base Thickening 7-8
Section 5 — Full Depth Reclamation/Recycling (FDR) 7-9
Section 6 — HMA Overlays 7-11
Structural Overlays 7-11
Non-structural Overlays 7-12
Section 7 — Surface Treatments 7-14
Underseals 7-15
Section 8 — Concrete Overlays 7-16
Section 9 — Reducing Rigid Pavements 7-17
Break and Seat 7-17
Crack and Seat 7-18
Rubblizing 7-18
Multi-head Breaker (MHB) 7-19
Section 10 — Alternate Pavement Rehabilitation Options 7-21
Alternate Options to Hot In-Place Recycling 7-21
Alternate Options to Ultrathin Bonded Hot Mix Wearing Course (UBHMWC) 7-21
Alternate Options to Thin Bonded PFC (TBPFC) 7-22
Alternate Options to Reflection Crack Relief Interlayer (RCRI) 7-22

Chapter 8 — Rigid Pavement Design

Section 1 — Overview 8-2
Rigid Pavement Types 8-2
Selection of Rigid Pavement Type 8-3
Performance Period 8-3

Section 2 — Approved Design Method 8-5
AASHTO Rigid Pavement Design Procedure 8-5
Section 3 — Rigid Pavement Design Process 8-6
Section 4 — Recommended Input Design Values 8-7
Input Values 8-7
28-day Concrete Modulus of Rupture, M_r 8-7
28-day Concrete Elastic Modulus 8-7
Effective Modulus of Base/Subgrade Reaction: k-value 8-7
Serviceability Indices 8-9
Load Transfer Coefficient 8-9
Drainage Coefficient 8-10
Overall Standard Deviation 8-11
Reliability, % 8-11
Design Traffic 18-kip ESAL 8-11
Section 5 — Determining Concrete Pavement Thickness 8-13
Section 6 — Concrete Pavement Design Standards 8-14
Section 7 — Bonded and Unbonded Concrete Overlays 8-15
Section 8 — Thin Concrete Pavement Overlay (Thin Whitetopping) 8-16
Preliminary Guidelines for Thin Whitetopping (TWT) 8-16

Chapter 9 — Rigid Pavement Construction
Section 1 — Overview 9-2
Section 2 — Concrete Mix Design 9-3
Section 3 — Concrete Plant Operation 9-5
Central-mixed Plants 9-5
Shrink-mixed Concrete 9-10
Truck-mixed Concrete 9-10
Section 4 — Delivery of Concrete 9-13
Section 5 — Steel Placement 9-14
Reinforcing Steel 9-14
Storing Reinforcing Steel 9-14
Splicing Longitudinal Steel 9-15
Splice Locations 9-15
Holding the Reinforcing Steel in Place 9-17
Section 6 — Paving Operations 9-19
Fixed-form Paving 9-19
Forms 9-20
Setting Forms 9-20
Checking Forms 9-22

Paving Operations 9-23
Removing Forms 9-25
Slip-form Paving 9-25
Alignment and Grade. 9-26
Overview of Slip-form Paver. 9-26
Vertical Alignment Control 9-29
Horizontal Alignment 9-31
Paver's Forward Speed 9-31
Augers 9-32
Vibrators 9-33
Pan Float 9-35
Inserting One-piece Tie Bars into the Edge. 9-35
Finishing Operations 9-36
Section 7 — Joints. 9-49
Terminal Anchors 9-56

Chapter 10 — Rigid Pavement Rehabilitation
Section 1 — Overview 10-2
Section 2 — Full-Depth Repair. 10-3
Pavement Distress Types that Require Full Depth Repair (FDR). 10-3
Full Depth Repair (FDR) Procedures 10-5
Section 3 — Partial Depth Repair 10-12
Pavement Distresses that Require Partial Depth Repair (PDR) 10-12
Partial Depth Repair (PDR) Procedures 10-12
Section 4 — Bonded Concrete Overlay 10-16
Bonded Concrete Overlay (BCO) Procedures. 10-16
Section 5 — Unbonded Concrete Overlay 10-24
UBCO Procedures 10-24
Section 6 — Stitching 10-26
Pavement Distresses that Require Stitching 10-26
Types of Stitching 10-27
Section 7 — Dowel Bar Retrofit. 10-28
DBR Procedures 10-29
Section 8 — Joint Repair 10-34
Pavement Distresses that Require Joint Repairs 10-35
Load Transfer Devices. 10-36
Section 9 — Diamond Grinding 10-37
Pavement Distresses that Require Diamond Grinding (DG). 10-38
Other Issues with DG. 10-38

Section 10 — Thin ACP Overlays 10-39
Section 11 — Retro-fitting Concrete Shoulders 10-41

Chapter 11 — Forensics
Section 1 — Overview 11-2
Section 2 — Objectives. 11-3
Section 3 — Pavement Forensics Team's Composition and Specialization. 11-4
Section 4 — Requesting Pavement Forensic Team Assistance 11-5
Section 5 — Pavement Forensics Team Investigation Procedures. 11-6
Section 6 — Obtaining Copies of Pavement Forensics Studies 11-8

Chapter 12 — Load Zoning and Super Heavy Load Analysis
Section 1 — Overview for Load Zoning. 12-2
Background 12-2
Minute Orders 12-2
What is in This Chapter? 12-2
Section 2 — Changing Load Zones on Roads 12-3
Adding 12-3
Removing. 12-3
Changing 12-4
Section 3 — Emergency Load Zones on Roads 12-5
Setting Emergency Load Zones on Roads. 12-5
Section 4 — Changing Load Zones on County Roads and Bridges 12-6
Law Ruling 12-6
Coordination between County and District 12-6
Required Information and Supporting Documentation 12-8
Section 5 — Super Heavy Load Analysis Background 12-10
Section 6 — Super Heavy Load Evaluation Process 12-13
Section 7 — Damage from Super Heavy Load Moves. 12-14
Section 8 — Damage Claim Procedure. 12-17

Manual Notice 2006-1

From: Thomas R. Bohuslav, P.E., Director, Construction Division

Manual: *Pavement Design Guide*

Effective Date: October 01, 2006

Purpose

This manual notice is intended to transmit changes to the content of the *Pavement Design Guide*.

Changes

This manual update includes significant changes throughout the manual. The changes include the significant growth in manual content from six chapters to fifteen chapters.

Supercedes

The revised manual supersedes prior versions of the manual.

Contact

Contact the Construction Division, Materials & Pavements Section (CST/M&P) at 512/506-5807 for further information regarding the methods in this manual.

Archives

Past manual notices are available in a pdf archive.

Manual Notice 2004-1

To: Users of the *Pavement Design Manual*

From: Thomas R. Bohuslav, P. E., Director, Construction Division

Subject: *Pavement Design Manual*

Date: July 1, 2004

Purpose

This manual notice is intended to transmit changes to the content of the Pavement Design Manual.

Overview of Changes

Revisions made to Chapter 3, Section 4, "Recommended Input Design Values":

- subhead, "28-day Concrete Modulus of Rupture, M_r" changed 650 psi to 620 psi
- subhead, "Load Transfer Coefficient" added column header text
- subhead, "Design Traffic 18-kip ESAL" added text to table for 8 lanes

Revisions made to Chapter 3, Section 6, "Concrete Pavement Design Standards":

- bulleted list under subhead, "Design Standards" updated the information in the second and third bullets *from current:*
  - CPCR (1)-94, Concrete Pavement Details for CRCP, One-Layer Steel Placement - applies to CRCP that is from 8 to 13 inches thick.
  - CPCR (2)-94, Concrete Pavement Details for CRCP, Two-Layer Steel Placement - used for CRCP that is from 13 to 15 inches thick.
    to new:
  - CRCP (1)-03, Continuously Reinforced Concrete Pavement, One-Layer Steel Bar Placement - applies to CRCP that is from 8 to 13 inches thick.
  - CRCP (2)-03, Continuously Reinforced Concrete Pavement, Two-Layer Steel Bar Placement – applies to CRCP that is from 14 to 15 inches thick.

Contents

The manual change issues the above changes and additions online.

Instructions

Access the new version through the TxDOT Online Manual System.

Contact

For more information or questions regarding the revised section above, please contact:

- Materials and Pavements Section—512/467-5926.

Manual Notice 2003-1

To: Users of the *Pavement Design Manual*

From: Thomas R. Bohuslav, P. E., Director, Construction Division

Subject: *Pavement Design Manual*

Date: December 1, 2003

Purpose

This manual notice is intended to transmit changes to the content of the *Pavement Design Manual*.

Overview of Changes

- Various revisions made to chapters 1, 2, and 3.
- Divided Chapter 4 into the following new chapters:
  - Chapter 4 describes the procedure for changing load zones on highways (including county roads and bridges).
  - Chapter 5 provides the guidelines on the Wet Weather Accident Reduction Program (WWARP).
  - Chapter 6 provides information about other pavement-related activities such as super heavy load analysis and how to create a pavement forensic team.

Contents

The manual change issues the above changes and additions online.

Instructions

Access the new version through the TxDOT Online Manual System.

Contact

For more information or questions regarding the revised section above, please contact:

Materials and Pavements Section — 512/467-5926.

Manual Notice 2001-1

To: All Districts, Divisions, and Special Offices

From: Thomas R. Bohuslav, P. E., Director, Construction Division

Subject: *Pavement Design Manual*

Date: March 1, 2001

Purpose

The purpose of this manual is to provide the Texas Department of Transportation (TxDOT) and consultant pavement designers with a uniform, streamlined process for designing pavements on TxDOT-approved projects. The manual also addresses related topics that a pavement designer needs for effective pavement management.

Contents

This manual is organized into four chapters.

- Chapter 1 – Introduction. This chapter explains the purpose of the manual and discusses how it may be used, describes the pavement design process, and discusses pavement documentation requirements, signature, and approval authority. This chapter also describes the information needed for pavement design.
- Chapter 2 – Flexible Pavement Design. This chapter describes acceptable procedures to be used for flexible pavement design.
- Chapter 3 – Rigid Pavement Design. This chapter describes acceptable procedures for rigid pavement design (Portland Cement Concrete).
- Chapter 4 – Other Pavement Related Issues. This chapter provides information about other pavement-related issues such as load zoning and forensic studies.

This manual also contains online links to other project development procedural manuals currently available online as well as those under development.

Action Required

This manual is the department policy for pavement design. A pavement design needs to be performed during the early phase of project development. The pavement section needs to be established in order to facilitate the further design of the project. This step also ensures that pavement design is used to calculate the project cost rather than project cost dictating the pavement design.

Contact

Contact the Pavements Section of the Construction Division at (512) 465-3674 for general comments and suggestions for future revisions of this manual.