



Windows-Based Flexible Pavement Design Tools for TxDOT

In Project 0-1869, improvements were made to the Texas Department of Transportation's (TxDOT's) existing flexible pavement design and analysis programs. The new systems are all Windows®-based and contain several enhancements over the current DOS systems. Each

of the developed programs is described below.

What We Did...

FPS 19 for Windows (Report 0-1869-1)

FPS 19 is the approved flexible pavement thickness design system used by TxDOT. Project 0-1869

made several enhancements to this system, including:

- transferring FPS 19 to the Windows platform,
- automating the current Texas Triaxial system to provide a thickness checking system,
- incorporating a stress and strain computational

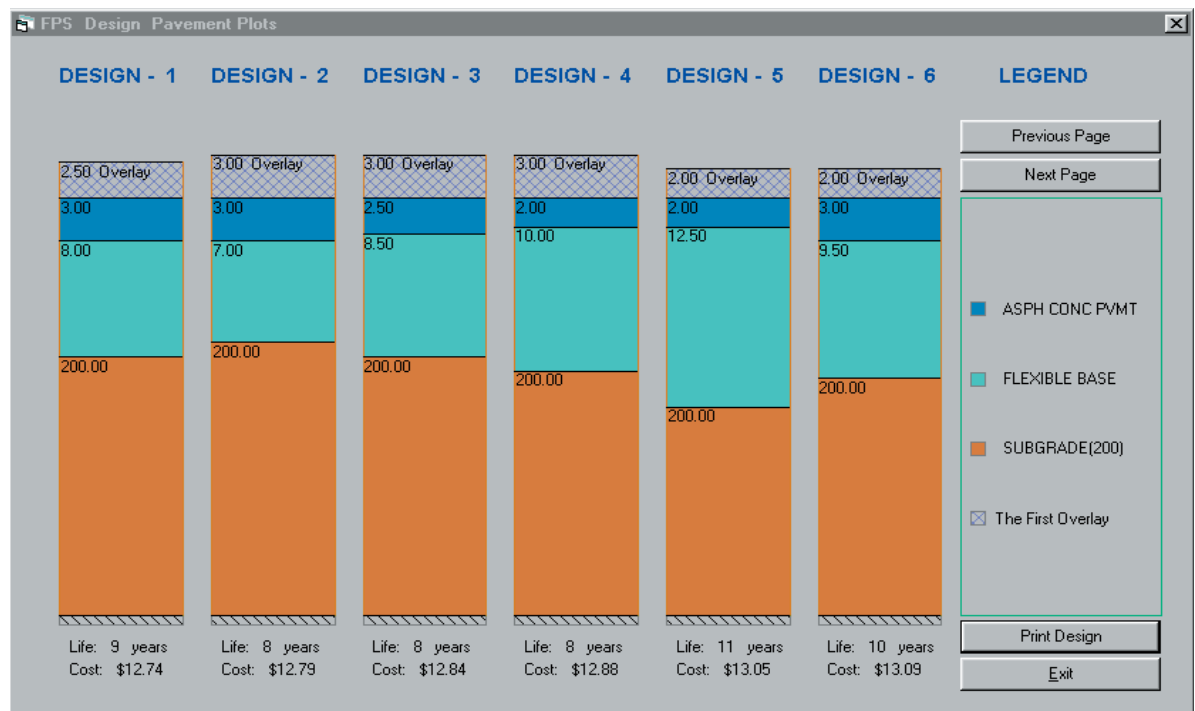


Figure 1. An Example of the Graphic Display of Feasible Pavement Designs Available within FPS 19.



subsystem so that classical fatigue and rutting lives can be estimated for the designed pavement, and

- incorporating an extensive online help system.

In this project the models within FPS 19W were further calibrated. New approaches were incorporated for handling designs on pavements with very thick flexible bases. The new system makes full use of the graphic capabilities available in Windows. Figure 1 shows one of the results screens from the new system.

MODULUS 6.0 for Windows (Report 0-1869-2)

TxDOT uses the MODULUS program to process falling weight deflectometer (FWD) data. This system has been used since the early 1990s to perform structural evaluation of the pavements and to provide layer moduli values for structural design. Project 0-1869 expanded the analysis and design capabilities of this system.

Report 0-1869-2 provides a user's manual for the new Windows version of MODULUS 6.0. The basic features of the DOS MODULUS 5.1 system have been transferred to Windows. Substantial

improvements have been made to the program's data editing and segmentation routines. Figure 2 shows the method of specifying layer thickness and acceptable moduli ranges within MODULUS 6.0.

Modified Triaxial Design (Report 0-1869-3)

As part of Project 0-1869 a new computer program was developed by Dr. Emmanuel Fernando to check the adequacy of the FPS 19 design. This procedure uses the Mohr-Coulomb yield criterion and uses shear strength properties of materials as measured in a standard laboratory test. The Modified Triaxial Design

Modulus Input

Distance to plate: 1 [0.0] 2 [12.1] 3 [24.1] 4 [36.1] 5 [48.1] 6 [60.1] 7 [72.1]

Layer: ☐ One ☐ Two ☒ Three ☐ Four

☐ Semi-Infinite

E4/Stiff Layer Ratio [98.0]

Thickness (in):

Layer	Thickness (in)	Material	Asphalt Temp.
Surface	4.00	Asphalt	71.2
Base	2.20	Other Material	
Subgrade	116.57	Other Material	

MODULI RANGE (ksi)

	Minimum	Maximum	Poisson's Ratio
Surface	582.0	982.0	0.40
Base	32.0	345.0	0.32
Subgrade	Most Probable Value 15.2		0.29

☒ Set as default value

Exit Run

Figure 2. Data Input Screen within MODULUS 6.0.



(MTRX) Program incorporates the following features:

- 1) characterization of pavement materials using layer moduli backcalculated from the FWD deflections and strength properties obtained from Texas Triaxial laboratory tests or other appropriate procedures,
- 2) modeling of single and tandem axles to evaluate pavement damage potential under different axle configurations,
- 3) application of layered elastic theory to predict stresses under applied wheel loads, and
- 4) application of the Mohr-Coulomb failure criterion to check for pavement damage in either the pavement base or subgrade layers.

A user's manual for the new program is provided in Report 0-1869-3. The introductory screen for this new system is shown in Figure 3.

What We Found...

These new tools are the next step in TxDOT's continuing



Figure 3. New Texas Triaxial Design System for Windows.

effort to develop and implement improved mechanistic-empirical pavement design procedures. The new procedures make analysis simpler and provide designers with many options to cross-check their designs with other structural design systems.

The Researchers Recommend...

The FPS 19 system has been fully implemented within TxDOT. No problems were encountered in the transition from the old DOS system to the new program. The transition to the new MODULUS program will take a little

longer. The new program has many additional data editing and handling options. As a first step, TxDOT should organize a one-day seminar to introduce the pavement design engineers in Austin to all of the new features available within MODULUS 6.

The first step in implementing the new Texas Triaxial procedure will require laboratory testing of a range of existing Texas base materials. It will be important to run triaxial strength tests on both treated and natural base materials.



For More Details...

This research project is documented in the following reports:

0-1869-1, *Flexible Pavement Design System FPS 19W: User's Manual*

0-1869-2, *MODULUS 6.0 for Windows: User's Manual*

0-1869-3, *The Texas Modified Triaxial (MTRX) Design Program*

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TxDOT Implementation Status—March 2005

The software developed by the project has been implemented on the Web-based training site of the Texas Transportation Institute. The URL for this site is <http://pavementdesign.tamu.edu>. The password to access this site is "1869-1." Users can access this site to receive training in the use of the software and also to download a version of the software. TxDOT employees have access to this training through a cross-link at RTI's Intranet site.

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