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Texas Department of Transportation

Center for Transportation Infrastructure Systems
CTIS

Product 5-1711-01-P3
Pavement Design and Analysis Web-Based Training

Pavement Design and Analysis Training

TxDOT Web-Based Training Site
for Software Developed at UTEP
http://ctis.utep.edu/training

Texas Department of Transportation, 2005

TxDOT

Overview

This website offers training for five computer programs pertaining mainly to the design and analysis of flexible pavements. The programs are: REPP2000, SMART, JIM, DFINE, and RECIPPE.

For each program, users may:

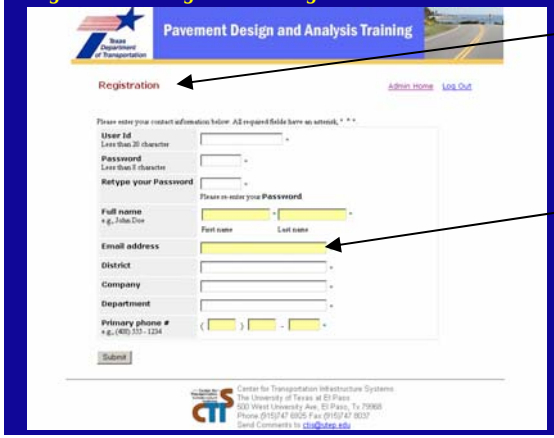
- Take a series of training modules, ranging from how to input data into the program to how to interpret the output,
- Keep a record of where they were in the training so that they may return at a later time and resume where they previously left off,
- Download the actual program to a PC after successfully completing the training,
- Print a certificate of completion, and
- Download any updates and manuals available for any of the programs.

System Requirements

To run the training programs, users will require only:

- A recent version of a web browser,
- An open internet connection.

Figure 1. Training Web Site Registration Menu



Users are required to register before they are able to access the training website.

Users need to be sure that they provide their TxDOT email address. This training web site will only allow access toTxDOT.

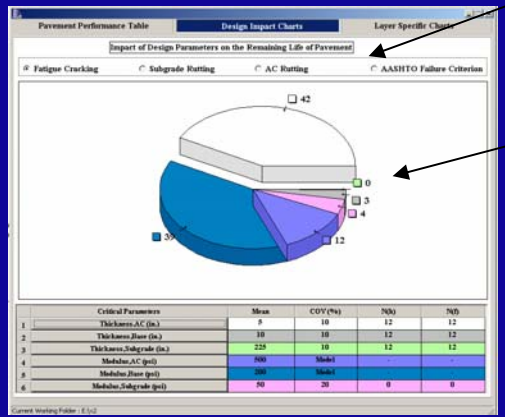
Three different fusion methods were incorporated into a program: a) Weighted Average, b) Statistical Weighted Average, and c) Fuzzy Logic.

RECIPPE

Rational **E**stimation of **C**onstruction **I**mpact on **P**avement **P**erformanc**e** (RECIPPE) is a tool to determine construction parameters that impact the variability of pavement performance the most. In essence this tool is designed to reconcile the results from pavement-performance models with statistical process control techniques and to determine project-specific parameters that should be used in construction quality management. RECIPPE uses two modes of analysis: a) pre-construction and b) post or during construction.

In the post construction mode, the software provides monitoring of the variability for each parameter using control charts that are generated based on in-situ and laboratory tests, which are performed for quality control (QC). The inspector or project engineer can easily monitor the variability of each parameter impacting performance thus maximizing effectiveness of inspection and testing resources during construction.

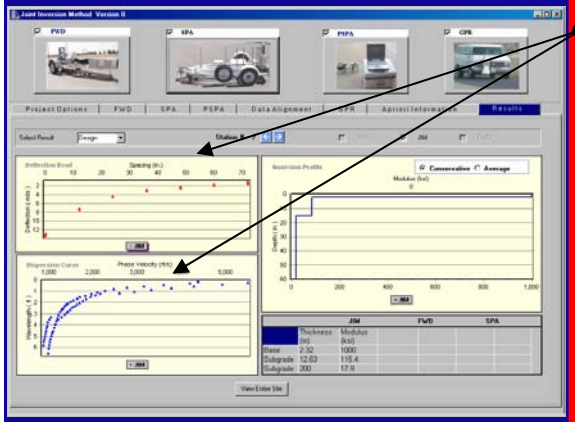
Figure 8. RECIPPE Impact Charts



Impact charts for four performance indicators are available in RECIPPE

Impact charts are used to identify construction parameters that are significant to performance variability.

Figure 6. JIM Results Menu (Results Per Station)



The theoretical estimated deflection bowl and dispersion curve are compared to the experimental data. The resutls menu allows users to view each station independently.

Also, presented in this menu is the pavement profile estimated based on the joint inversion process.

DFINE

Data **F**usion for **I**ntelligent **N**ondestructive **E**valuation of flexible pavement (DFINE) uses fusion techniques to reconcile the results from different analyses methods to arrive at consistent results. Data fusion is a process by which one source of data can be logically selected over another, or by which data from several available sources can be combined or "fused."

Figure 7. DFINE Results Menu Based on Fuzzy Logic

Membership functions, a feature of fuzzy logic, made up of fuzzy sets. The fuctions are used by the fuzzy rules to assign weights.

Results of DFINE are presented in two views: a) graphical and b) tabular.

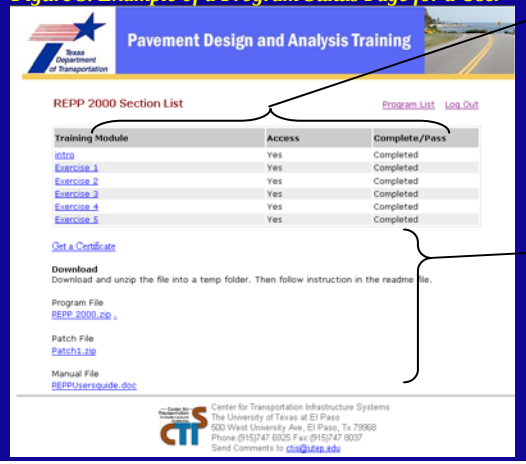
From the main web page, users are able to register and log in to their training page. Users can then choose to train in any of the programs on the list.

Figure 3. Program Listing

Once users are logged in, a listing of available programs are provided to select from. Users are required to complete training before downloading the software.

For each program, there will be a list of training exercises. After completing a training exercise, users will be granted access to the next exercise. Once all exercises are completed, users are able to print a certificate of completion and download the program and any additional updates to a PC.

Figure 3. Example of a Program Status Page for a User



For each program, a listing is provided for exercises and user's status is provided to allow users to continue from where they last stopped.

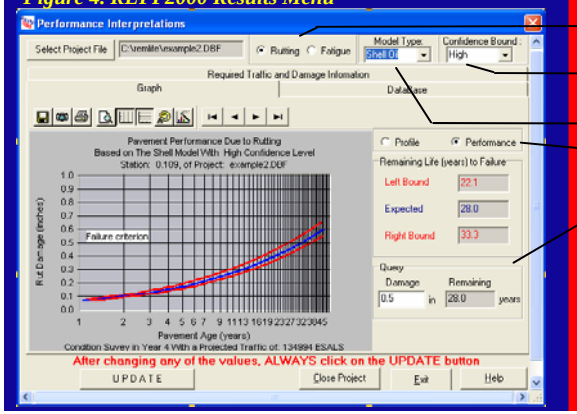
Users are able to download a certificate of completion, the program, and additional support files once the training is completed.

REPP 2000

Rational **E**stimation of **P**avement **P**erformance (REPP2000) is state-of-the-art software that combines artificial neural network (ANN) technology with uncertainty analysis to determine the performance of a flexible pavement using measurements from the Falling Weight Deflectometer (FWD) without using backcalculation. ANN models are used to estimate the critical strains, tensile and compressive strains at layer interfaces based on FWD data and layer thickness. The critical strains are used to compute the remaining life of the pavement in ESALs for two failure criteria: a) rutting and b) fatigue cracking.

The final outcome is a pavement performance curve generated to describe the pavement behavior based on both structural and functional distress.

Figure 4. REPP2000 Results Menu



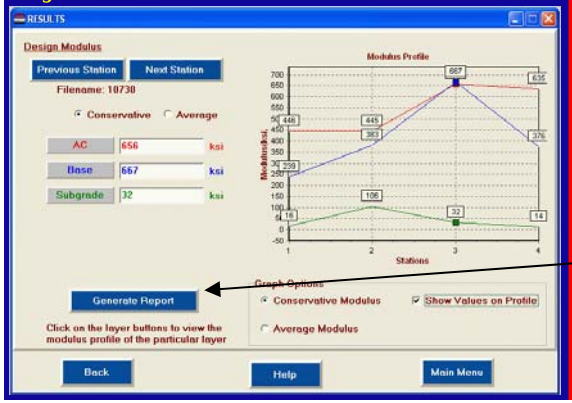
Users can:
- **toggle between failure models**
- **change confidence bound**
- **switch model type**
- **view site profile or performance curve at each station.**
- **query results**

SMART

Seismic **M**odulus **A**nalysis and **R**eduction **T**ool (SMART) is based on a theoretically-sound algorithm that uses seismic moduli (fundamentally-correct linear-elastic moduli) and well-substantiated nonlinear relationships and time-dependent models to provide moduli that can be used for pavement design and analysis.

The input parameters (seismic moduli) are used with a structural model to determine the design modulus for each layer of pavement. One of the unique features of the program is its flexibility to incorporate data at several levels. Also, several material models are available for each layer.

Figure 5. SMART Results Menu



SMART provides the design moduli both graphically and numerically. Users can view the data station by station.

Users can also generate a report document using this feature.

JIM

Joint **I**nversion **M**ethod (JIM) program incorporates data from different nondestructive testing devices to determine stiffness parameters of pavements. The rationale for this type of inversion or "backcalculation," is that the inherent strength of each backcalculation method dominates the analysis, resulting in a more robust and stable algorithm.

JIM processes the joint analysis of the raw data from the seismic-based and the deflection-based methods. JIM takes input from four devices of interest (FWD, SPA, PSPA and GPR) with FWD and SPA selected as the main source of NDT data. Data from the other two devices, PSPA and GPR, are used as complementary inputs to strengthen the joint inversion process. PSPA data are very stable for the top layer of a pavement system. Likewise, the GPR provides a good indication of the thickness of the ACP layer and in certain cases the base layer.