TEXAS FLEXIBLE PAVEMENTS OVERLAYS: REVIEW AND ANALYSIS OF EXISTING DATABASES

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LIST OF NOTATIONS AND SYMBOLS

AASHTO	American Association of State Highway and Transportation Officials
CTIS	Center for Transportation Infrastructure Systems
FHWA	Federal Highway Administration
GIS	Geographical Information System
GPS	General pavement studies
FWD	Falling weight deflectometer
HMA	Hot-mix asphalt
LTPP	Long-Term Pavement Performance
M-E	Mechanistic Empirical
MS	Microsoft©
PMIS	Pavement Management Information System
PP	Perpetual Pavement
SPS	Specific pavement studies
TFPDB	Texas Flexible Pavement Database
TSFP	Texas Successful Flexible Pavement
TTI	Texas Transportation Institute
TxDOT	Texas Department of Transportation
UT	University of Texas at Austin
UTEP	University of Texas at El Paso

CHAPTER 1: INTRODUCTION

Proper calibration of pavement design and rehabilitation performance models to conditions in Texas is essential for cost-effective flexible pavement design. The degree of excellence with which TxDOT's pavement design models is calibrated will determine how optimally literally billions of dollars of future roadway investment capital will be spent. The magnitude of benefits and consequences involved make this research project one of the more important research efforts the department has undertaken recently.

Collection of quality and reliable pavement performance data on a sustained basis is the main goal of this project. Inevitably, this presents a perfect opportunity to calibrate and validate the current design methods and models for both flexible pavement and overlays. The calibration of these models to the Texas local conditions will result in pavement designs that are more economical in the long term and that have an increased likelihood of performing as expected.

OBJECTIVES AND SCOPE OF WORK

The primary goal of this five-year project is to collect materials and pavement performance data on a minimum of 100 highway test sections around the State of Texas. Besides being used to calibrate and validate the mechanistic-empirical (M-E) design models, the data will also serve as an ongoing reference data source and/or diagnostic tool for TxDOT engineers and other transportation professionals. Towards this goal, the specific objective of this task, documented here, was to review and analyze the various existing databases, among others, for the following reasons:

- To achieve a better understanding of the currently existing databases, state of the development, strengths, and weaknesses.
- To aid in the development of the data collection plans, including the data type and format.
- To aid in the formulation of the data analyses and reporting plans such as the table or graph formats.

- To aid in the development of the data storage format and reporting system. For this study, MS Access© was selected as the appropriate data storage system.
- To evaluate if the data contained in the current databases could be used or serve as reference for this study.

To achieve these objectives, the scope of work incorporated a detailed review and analyses of four databases, namely: 1) the UT Texas Flexible Pavement Database (TFPDB or Product 0-6275-P1), 2) the Texas Perpetual Pavement (PP), 3) the Texas Successful Flexible Pavement (TSFP), and 4) the Long-Term Pavement Performance (LTPP). Review results of these databases are discussed in Chapter 2 of this report. Chapter 3 then concludes with a summary of key findings and recommendations. Some appendices of the detailed evaluation of the databases are also included at the end of the report along with a CD of the review results in MS Excel© spreadsheet formats.

SUMMARY

In this introductory chapter, the background and the research objectives were discussed. The scope of work was then described, and a description of the report's contents followed. Specifically, this report provides a documentation of the review results and analyses of some of the existing databases, namely: 1) the TFPDB (Product 0-6275-P1), 2) the Texas PP, 3) the TSFP, and 4) the LTPP.

CHAPTER 2: REVIEW AND ANALYSIS OF EXISTING DATABASES

As a prime prerequisite and integral part of this study, a comprehensive review of some of the currently existing databases in Texas and other state agencies was conducted to aid the researchers to plan for the most appropriate data storage system and reporting format. That is, these existing databases served as a reference guide for developing the data collection plans and data storage system including assessing the data type and format of collecting the data for this study.

Additionally, this review task was also necessary to evaluate if some of the information from these existing databases could be utilized in this study. Accordingly, the following four databases were reviewed and are discussed in the subsequent text:

- The UT Flexible Pavement Database (TFPDB) (Product 0-6275-P1).
- The Texas Perpetual Pavement (PP) database.
- The Texas Successful Flexible Pavement (TSFP) database.
- The Long-Term Pavement Performance (LTPP) database.

Detailed review results are included in Appendix A through D of this report. A CD with detailed review results in MS Excel, PowerPoint©, and PDF formats is also included as an integral part of this report.

THE UT FLEXIBLE PAVEMENT DATABASE (TFPDB)

A comprehensive review of the UT database (TFPDB), namely Product 0-6275-P1, was conducted (Prozzi, 2010). Figure 1 shows the main user interface screen for this database.

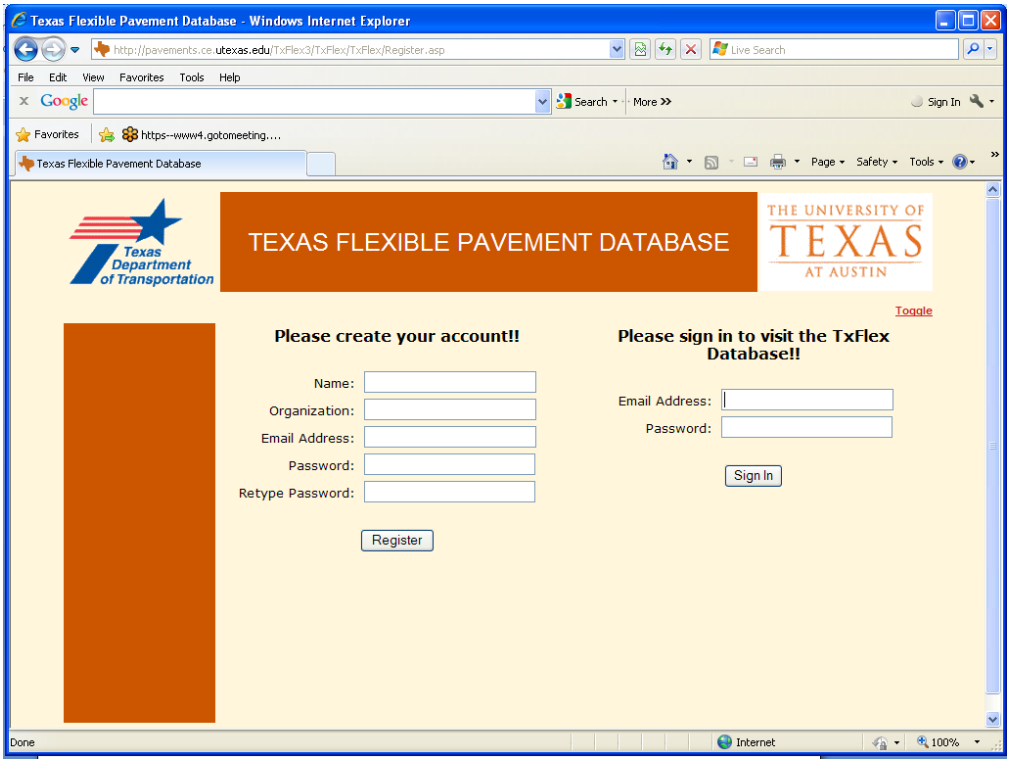

Figure 1. The User Interface Screen for the UT FPDB Database.

While the detailed review results are included in Appendix A, the key attributes of this database include the following:

- The database is web-based and GIS oriented.
- The database has 38 sections, with 32 directly imported from the LTPP database.
- The database covers only six Texas districts, namely Austin, Bryan, El Paso, San Antonio, Tyler, and Waco.
- The database covered four climatic regions, namely Wet-Cold, Dry-Warm, Wet-Warm, and Mixed. Dry-Cold was not covered.
- Most of the basic information such as design data, construction data, material properties, periodic performance data, etc., is either nonexistent or incomplete.

Overall, while the database interfacial framework and accessibility attributes may be of help to this study, the actual data content or highway sections will be of little value. Nonetheless, periodic references will be made for any potential information that may be helpful to this study.

THE TEXAS PERPETUAL PAVEMENT (PP) DATABASE

Developed by TTI, this database has 10 PP sections with comprehensive data content including design, climate, traffic, construction, material properties, periodic performance, and raw data files; see Appendix B (Walubita et al., 2010). Figure 2 shows the user-interface screen for the Texas PP database.

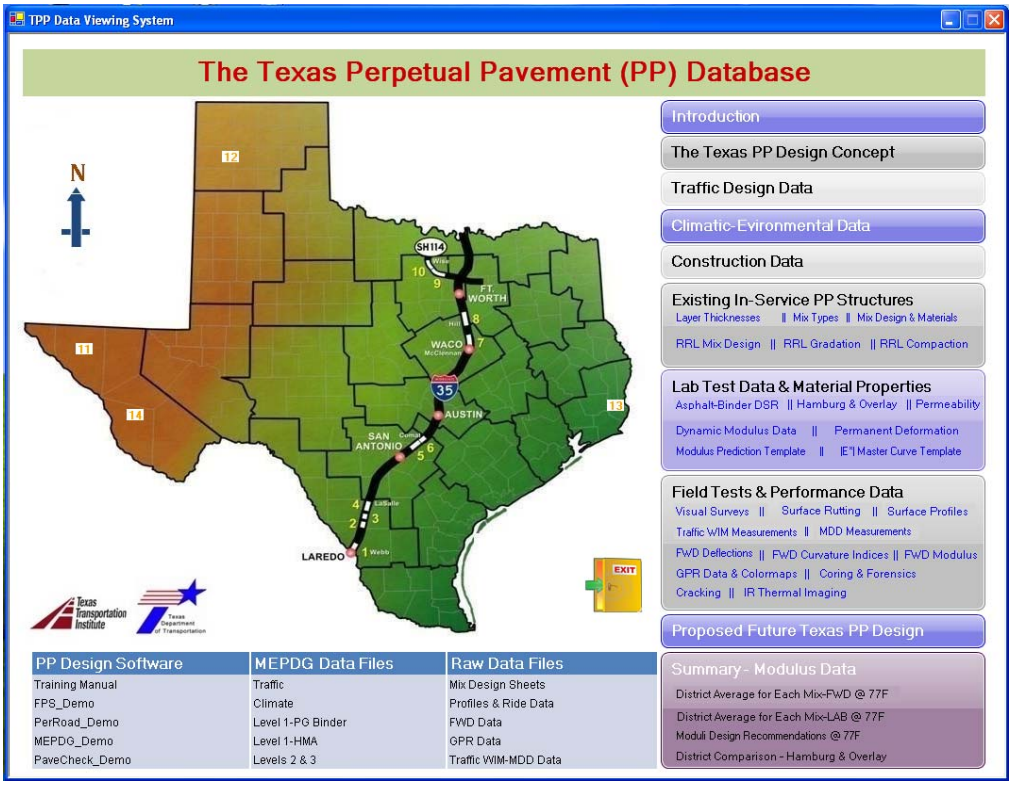

Figure 2. The User-Interface Screen for the Texas Perpetual Pavement Database.

Overall, this database contains very valuable information that is also useful to this study. The highway sections, namely PP structures, will be integrated into this study as existing field test sections. Specifically, these PP sections are very critical in the calibration and validation processes of the TexM-E models and its associated software, to be undertaken in Year 3 of this study. However, the use of highway sections from this database, which are primarily located on IH 35 and SH 114, may require additional work, particularly on the base/subgrade soil sampling and testing along with continued periodic performance monitoring. So, liaison with the respective districts will be a critical aspect for the integration of some of the highway sections from this database into this study.

THE TEXAS SUCCESSFUL FLEXIBLE PAVEMENT (TSFP) DATABASE

This database is web-based with a total of 80 highway sections, of which only 26 were approved and 54 were nominated by the local TxDOT district offices; see Figure 3 (Krugler et al., 2007).

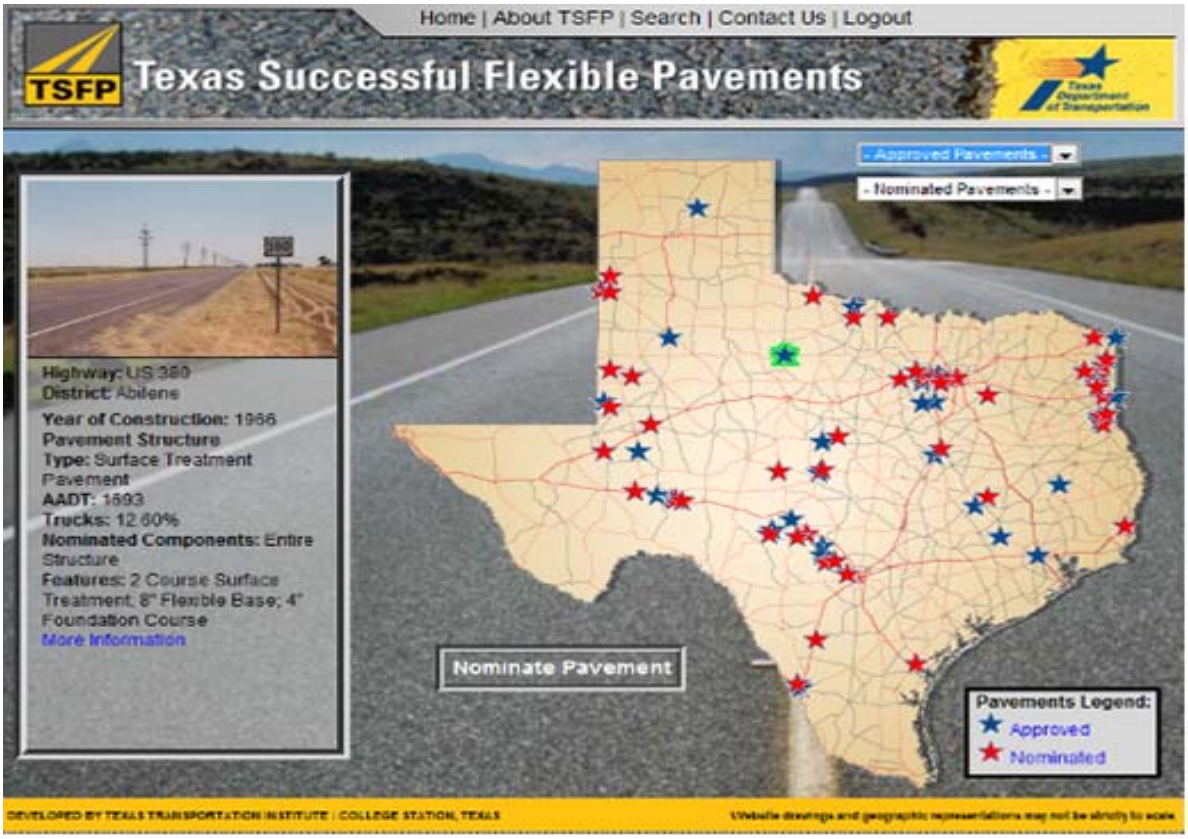

Figure 3. The User Interface Screen for the TSFP Database.

Appendix C shows this database has very scant data that will provide only minimal input to this study. For instance, it has no laboratory test data or periodic performance data, such as rutting, other than the condition scores obtained from the PMIS. However, the interfacial framework may be of help when formulating the database framework for this study.

THE LONG-TERM PAVEMENT PERFORMANCE (LTPP) DATABASE

This database is web-based with 58 GPS and 127 SPS highway sections scattered across the nation. Appendix D shows the database has limited data with several critical items (i.e., design) unavailable. Nonetheless, both the interfacial framework and some highway sections

such as SH 94 (Angelina County with sufficient data), which are located in Texas may be helpful to this study. Figure 4 shows an example of the LTTP online data content.

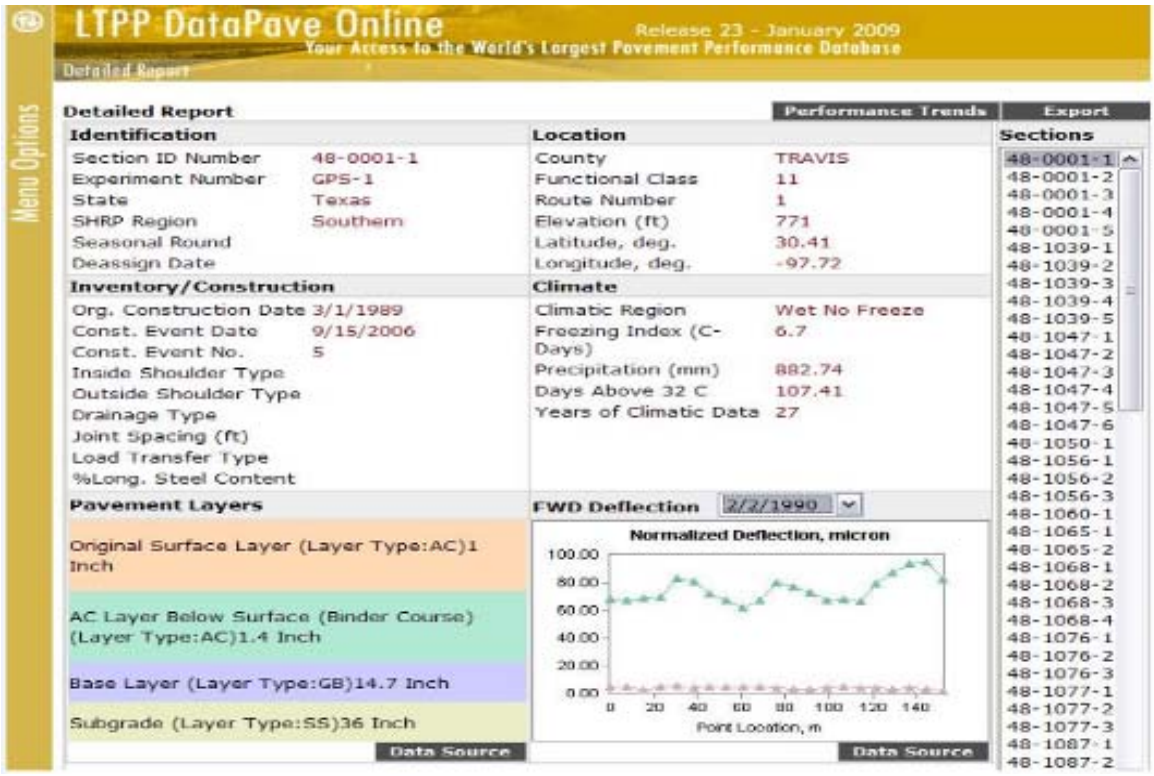

Figure 4. The LTPP Database.

Figures 5 and 6 show the LTTP highway sections in Texas. If sufficient data is available, some of the highway sections shown in these figures may be considered for incorporation into this study. As aforementioned, some highway sections such as SH 94 have useful data (i.e., FWD, resilient modulus, creep, tensile strength, etc.) that may benefit this study.

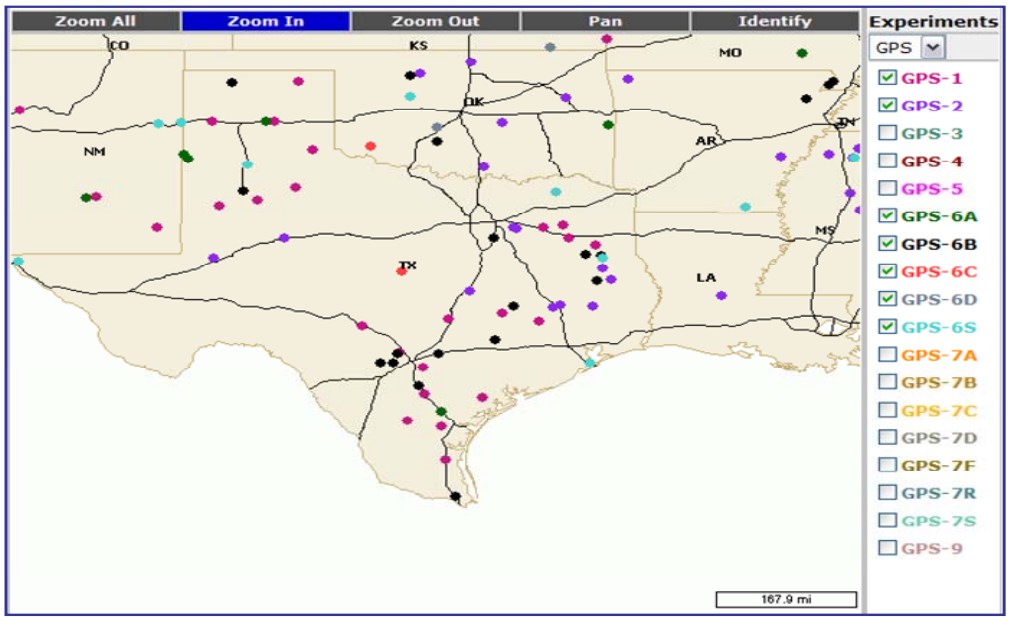

Figure 5. LTPP GPS Flexible Pavement Sections Located in Texas.

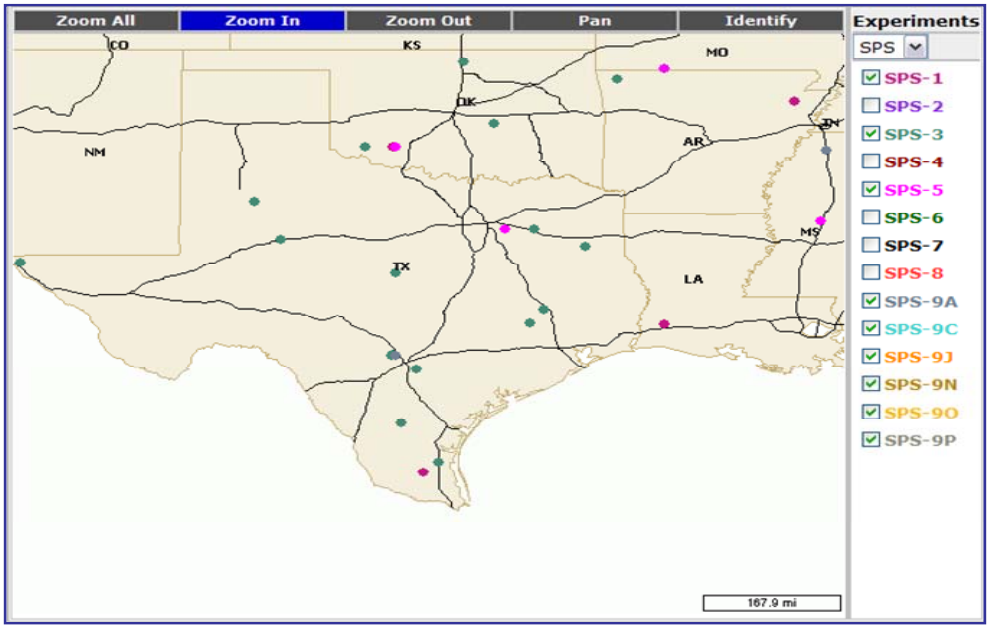

Figure 6. LTPP SPS Flexible Pavement Sections Located in Texas.

All these existing databases discussed in this chapter will be periodically referenced and constantly reviewed during the course of this study for any potential data that will be found valuable. Appendix A through D shows detailed Excel spreadsheets of the review results of these databases.

SUMMARY

This chapter provided a discussion of the review results and analysis of four existing databases, namely:

- The UT TFPDB (Product 0-6275-P1).
- The Texas PP database.
- The TSFP database.
- The LTPP database.

Other than the Texas PP databases, the rest of the reviewed databases were found to be of minimal input to this study. Nonetheless, all these databases will be periodically reviewed during the course of this study to serve as a reference guide and to search for any potential data that may be extremely helpful.

CHAPTER 3: SUMMARY AND KEY FINDINGS

This chapter provides a summation of this report and highlights the major findings from an extensive review and analyses of the existing databases that was conducted, namely: 1) the UT TFPDB (Product 0-6275-P1), 2) the Texas PP, 3) the TSFP, and 4) the LTPP. Below are the recommendations made in terms of using these databases as input to this study.

- The Texas PP database contains substantial data (both processed and raw) with highway sections that are critical to Study 0-6622. This database will be helpful to this study, albeit some base/soil sampling and testing may be necessary for some highway sections. Also, the raw data may need to be re-analyzed to suit this study.
- The LTPP has some useful data such as FWD, resilient modulus, creep, and tensile strength. So, where applicable, data and some highway sections from the LTPP database may be considered.
- Except for the interfacial framework and other accessibility attributes, both the TFPDB and TSFP lack most of the critical data and will not be of significant help to this study.

Nonetheless, researchers will periodically reference and constantly review all the existing databases during the course of this study for any potential data that will be found valuable. Where applicable, data maybe imported from these databases.

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APPENDIX A: THE UT DATABASE

Table A-1. Example List of Available Data in the UT Database.

			Texas 38 Sections ID						
#	Item	Description	TXTF09001	TXTF09002	TXTF09003	TXTF24036	TXTF24037	TXTF24020	TXTF24021
1	General Information	AADT_ALL_VEHIC_2WAY	✓	✓	✓	✓	✓	✓	✓
		AADT_TRUCK_COMBO_2WAY (4/38)	X	X	X	✓	✓	✓	✓
		Aggregate gradation	x	✓	✓	✓	✓	✓	✓
		Aggregate source of material	X	✓	✓	✓	✓	✓	✓
		Aggregate type of current layer	X	✓	✓	✓	✓	✓	✓
		Air temperature	✓	✓	✓	✓	✓	✓	✓
		ANL_KESAL_LTPP_LN_YR (4/38)	X	X	X	✓	✓	✓	✓
2	Peformance	Beginning point lateral	✓	✓	✓	✓	✓	✓	✓
		Beginning point longitudinal	✓	✓	✓	✓	✓	✓	✓
		Beginning term (24/38)	✓	✓	✓	✓	✓	✓	✓
		Beginning term displacement (24/38)	✓	✓	✓	✓	✓	✓	✓
		Climate	✓	✓	✓	✓	✓	✓	✓
		Construction ID	✓	✓	✓	✓	✓	✓	✓
		Control Section job number (28/38)	X	X	X	✓	✓	✓	✓
		County ID	✓	✓	✓	✓	✓	✓	✓
		Crack ID	✓	✓	✓	✓	✓	✓	✓
3	FWD (normalized deflection based on 9 kips)	Date of FWD test (minus)	✓	✓	✓	✓	✓	✓	✓
		Deflection 1-7 (minus)	✓	✓	✓	✓	✓	✓	✓
		Distance from origin	✓	✓	✓	✓	✓	✓	✓
		District name	✓	✓	✓	✓	✓	✓	✓
		End point lateral	X	X	X	✓	✓	✓	✓
		End point longitudinal	X	X	X	✓	✓	✓	✓
4	Traffic	End term (12/38)	X	X	X	✓	✓	✓	✓
		End term displacement (12/38)	X	X	X	✓	✓	✓	✓
		Facility type	X	✓	✓	✓	✓	✓	✓
5	Material	FWD ID	X	✓	✓	✓	✓	✓	
		IRI AVERAGE	X	✓	✓	✓	✓	✓	✓
		IRI ID	✓	✓	✓	✓	✓	✓	✓
		IRI VALUE (LEFT WHEEL PATH)	✓	✓	✓	✓	✓	✓	✓
		IRI VALUE (RIGHT WHEEL PATH)	✓	✓	✓	✓	✓	✓	✓
		Lane ID	✓	✓	✓	✓	✓	✓	✓
		Layer construction date	X	X	X	X	X	X	X
		Layer detail	✓	✓	✓	✓	✓	✓	✓
		Layer number	✓	✓	✓	✓	✓	✓	✓
		Layer opened to traffic date	X	X	✓	X	X	X	X
		Layer removal date	X	✓	✓	✓	✓	✓	✓
		Layer thickness mean	✓	✓	✓	✓	✓	✓	✓
		Layer thickness standard deviation	✓	✓	✓	✓	✓	✓	✓
6		Layer type	✓	✓	✓	✓	✓	✓	✓
		LLH_DEPTH	✓	✓	✓	✓	✓	✓	✓
		Load dropped on pavement	X	X	X	✓	✓	✓	✓
		MAX_MEAN	✓	✓	✓	✓	✓	✓	✓
		Layer number	✓	✓	✓	✓	✓	✓	✓
		Number of layers after construction	X	✓	✓	✓	✓	✓	✓
		Number of layers before construction	✓	X	X	✓	✓	✓	✓
		Number of lifts	✓	✓	X	✓	✓	✓	✓
		Number of new layers	✓	✓	✓	✓	✓	✓	✓
		Number of removed layers	✓	✓	✓	✓	✓	✓	✓
		Original database	✓	✓	✓	✓	✓	✓	✓
		Pavement temperature at 1in depth	X	X	✓	✓	✓	✓	✓
7		PROFILE DATE	✓	✓	✓	✓	✓	✓	✓
		Project type (16/38)	X	X	X	✓	✓	✓	✓
		RLH_DEPTH	✓	✓	✓	✓	✓	✓	✓
		Roadway number	✓	✓	✓	✓	✓	✓	✓
		Roadway type	✓	✓	✓	✓	✓	✓	✓
		RUT_TST_METHOD	✓	✓	✓	✓	✓	✓	✓
		Section	✓	✓	✓	✓	✓	✓	✓
		Sieve analysis	✓	✓	✓	✓	✓	✓	✓
		STOP DISTANCE	✓	✓	✓	✓	✓	✓	✓
		Structure type	✓	✓	✓	✓	✓	✓	✓
		Surface temperature	X	X	✓	✓	✓	✓	✓
		Survey date	✓	✓	✓	✓	✓	✓	✓

Note: Detailed reviews are included in the CD.

Table A-1. Example List of Available Data in the UT Database (Continued).

#	Item	Description	TXTF09001	TXTF09002	TXTF09003	TXTF24036	TXTF24037	TXTF24020	TXTF24021
8		Total alligator cracking	✓	✓	✓	✓	✓	✓	✓
		Total block cracking area (22/38)	✓	✓	✓	✓	✓	✓	✓
		Total length of longitudinal cracks	✓	✓	✓	✓	✓	✓	✓
		Total number of transverse crack	✓	✓	✓	✓	✓	✓	✓
		Total number of block crack (22/38)	✓	✓	✓	✓	✓	✓	✓
		Traffic ID	✓	✓	✓	✓	✓	✓	✓
		Year record	✓	✓	✓	✓	✓	✓	✓
		No backcalculation modulus results	X	X	X	X	X	X	X
		No crushing failure data	X	X	X	X	X	X	X
		No DSR data	X	X	X	X	X	X	X
		No dynamic modulus, resilient modulus, and suction	X	X	X	X	X	X	X
		No Hamburg rutting or repeated loading test data	X	X	X	X	X	X	X
9		**No lab crack or fracture data**	X	X	X	X	X	X	X
		No LTE data	X	X	X	X	X	X	X
		No Overlay data	X	X	X	X	X	X	X
		No skid or texture data	X	X	X	X	X	X	X
		~~Atterberg limits~~	X	X	X	X	X	X	X
		~~Axle count by KESALs~~	X	X	X	X	X	X	X
		~~Traffic count (AADT & AADTT)~~	X	X	X	X	X	X	X
		~~State default axle load spectra~~	X	X	X	X	X	X	X
		~~SCI~~	X	X	X	X	X	X	X
		~~Route number~~	X	X	X	X	X	X	X
		~~Maximum dry density and optimum moisture content~~	X	X	X	X	X	X	X
		~~HMA mix properties (VMA, Gmm, Gmb, and air void)~~	X	X	X	X	X	X	X
		~~Functional class~~	X	X	X	X	X	X	X
		~~BCI~~	X	X	X	X	X	X	X
		~~BDI~~	X	X	X	X	X	X	X
		~~Problem #~~	X	X	X	X	X	X	X
		~~Highway~~	X	X	X	X	X	X	X
		~~Control~~	X	X	X	X	X	X	X
		~~Length of Analysis period~~	X	X	X	X	X	X	X
		~~Min time to first overlay (yrs)~~	X	X	X	X	X	X	X
		~~Min time between overlays (yrs)~~	X	X	X	X	X	X	X
		~~Design confidence level 95.0%~~	X	X	X	X	X	X	X
		~~Intial serviceability index~~	X	X	X	X	X	X	X
		~~Final serviceability index~~	X	X	X	X	X	X	X
		~~Serviceability index after overlay~~	X	X	X	X	X	X	X
		~~Interest rate (%)~~	X	X	X	X	X	X	X
		~~Max funds/Sq. YD, INIT Const~~	X	X	X	X	X	X	X
		~~Max thickness, INIT Const~~	X	X	X	X	X	X	X
		~~Max thickness, all overlays~~	X	X	X	X	X	X	X
		~~ADT begin (veh/day)~~	X	X	X	X	X	X	X
		~~ADT end 20 Yr (veh/day)~~	X	X	X	X	X	X	X
		~~Avg App Speed to OV Zone~~	X	X	X	X	X	X	X
		~~Avg Speed OV Direction~~	X	X	X	X	X	X	X
		~~Avg Speed Non-OV Direction~~	X	X	X	X	X	X	X
		~~Percent ADT/HR Construction~~	X	X	X	X	X	X	X
		~~Percent trucks in ADT~~	X	X	X	X	X	X	X
		~~Min Overlay thickness (in)~~	X	X	X	X	X	X	X
		~~Overlay const. time, Hr/Day~~	X	X	X	X	X	X	X
		~~ACP comp. density, Tons/CY~~	X	X	X	X	X	X	X
		~~ACP production rate, Tons/Hr~~	X	X	X	X	X	X	X
		~~Width of each lane, ft.~~	X	X	X	X	X	X	X
		~~First year cost, RTN Maint.~~	X	X	X	X	X	X	X
		~~Ann. Inc. Incr in Maint. Cost~~	X	X	X	X	X	X	X
		~~Detour Model during Overlays~~	X	X	X	X	X	X	X
		~~Num open lanes, overlay direction~~	X	X	X	X	X	X	X
		Num open lanes, NON OV direction	X	X	X	X	X	X	X
		~~Dist. Traffic slowed, OV direction~~	X	X	X	X	X	X	X
		~~Dist. Traffic slowed, Non-OV direction~~	X	X	X	X	X	X	X
		~~Detour distance, overlay zone~~	X	X	X	X	X	X	X
		~~Material Name~~	X	X	X	X	X	X	X
		~~Cost per CY~~	X	X	X	X	X	X	X
		~~Modulus E (ksi)~~	X	X	X	X	X	X	X
		~~Min Depth~~	X	X	X	X	X	X	X
		~~Max Depth~~	X	X	X	X	X	X	X
		~~Salvage PCT~~	X	X	X	X	X	X	X
		~~Poisson's ratio~~	X	X	X	X	X	X	X

Note: Detailed reviews are included in the CD.

APPENDIX B: THE TEXAS PP DATABASE

Table B-1. List of Data Available in the Texas PP Database.

#	Data Item	#	Available Data in the Texas PP Database	Available Data Characteristics in the Texas PP Database Include the Following:	Comment
1	General information	1	**10 PP Hwy sections in total**	a) 8 on IH 35 (4 in Laredo, 2 in San Antonio, & 2 in Waco) b) 2 on SH 114 (Fort Worth)	
		2	Project location details	CSJ#, project#, project limits, district/county, TRM location, GPS location, geographical location, etc	
		3	Section length	Avg. ≅ 4.5 miles	
		4	Section age	Avg. ≅ 4.5 yrs	
		5	Last data collection date	Sumer 2009	Was done by LUBINDA
2	Design data	1	Traffic data	ADT, ESALs, etc	WIM stations on IH 35 (Laredo) & SH 114
		2	Structural design data	Design concept, layer thicknesses, materials, etc	
		3	HMA mix-design data	Typical TxDOT mix-design sheets for all layers	
		4	Moduli values	For each material type/layer	
3	PVMNT structure data	1	PVMNT type	Perpetual	
		2	HMA material	PFC, SMA, ¾" SFHMA, 1" SFHMA, RBL	
		3	HMA thickness	Avg. ≅ 22 inches	
		4	Base material	Typical ≅ 6% lime treatment	
		5	Base thickness	Avg. ≅ 8 inches	
		6	Subgrade	All Hwy sections - natural compacted soil material	
		7	Total PVMNT structure thickness	Avg. ≅ 30 inches	
4	Construction data	1	Project details	CSJ#, project#, project limits, district/county, TRM location, etc	
		2	Contractor name	All Hwy sections	
		3	Date of construction	All Hwy sections	
		4	IR thermal data	SH 114 only	
		5	Compaction data	Mostly for Rut-Resistant Layers (RRL)	
5	Climatic & environmental data	1	Climatic region	Covered three: Dry-warm (Laredo & San Antonio), Moderate (Waco), & Wet-cold (Fort Worth)	
		2	Pavement temperatures	As a function of PVMNT depth, season, & district	
		3	EICM temperature data	Fort Worth - Alliance Airport	
6	Traffic data	1	ADT	Begin - end (20 yr projection)	
		2	Growth rate	All Hwy sections	
		3	%Trucks	All Hwy sections	
		4	ESALS	20 yr estimates	
		5	**WIM data**	**IH 35 (Laredo near Cotulla) & SH 114 (Fort Worth)**	
7	Lab testing & material properties data	1	Asphalt-binders	PG grade, DSR @ 10 rad/s @ multiple temperatures, etc	Lab includes samples from: a) raw materials; b) plant-mix; & c) field cores
		2	Aggregates	Gradations including extractions	
		3	Volumetrics	Rice, AC cotent, extractions, etc	
		4	Hamburg - rutting data	Rut depth & number of load passes for each HMA material/layer	
		5	Overlay - cracking data	Number of cycles to failure for each HMA material/layer	
		6	Dynamic modulus (DM)	For all HMA materials/layers	
		7	Repeated load permanent deformation test data	For SH 114 only	
		8	Permeability data	For all HMA mix types	
8	Field performance & response data	1	Visual survey data & photographs	Periodic data along entire section	Last field testing and performance data collection on all 10 PP sections was conducted by LUBINDA in Summer 2009
		2	Crack survey data	Periodic data along entire section	
		3	Surface rutting (with straightedge)	Periodic data along entire section	
		4	Surface profiles (ride quality)	IRI - periodic data along entire section	
		5	FWD deflections	Periodic data along entire section	
		6	FWD curvature indices	Periodic data along entire section	
		7	Backcalulated FWD modulus	For all layers: HMA, bases, & subgrade	
			District avg. FWD moduli values	Avg. value for each layer	
		8	Cores & forensics (X-Ray CT data)	On all Hwy sections at selected locations	
		9	GPR data & colormaps	Periodic data along entire section	
		10	Traffic WIM measurements	On IH 35 (Laredo) & SH 114 (Fort Worth)	
		11	MDD measurements	IH 35 (Laredo, Cotulla)	
9	Other available data in the Texas PP database	1	Raw data files	a) HMA mix-design sheets b) Raw data include profiles & ride data, FWD data, GPR data, traffic WIM-MDD data, etc	Users can re-process the data if they want
		2	MEPDG data files	Traffic, climate, Level-1 PG binder data, Level-1 HMA data, & Levels 2 & 3 data	
		3	PP Design Software	Training manual, FPS_Demo, PerRoad_Demo, MEPDG_Demo, & PaveCheck_Demo	

Note: Detailed reviews are included in the CD.

APPENDIX C: THE TSFP DATABASE

Table C-1. List of Data Available in the TSFP Database.

#	Data Item	#	Available Data in the TSFP Database	Available Data Characteristics in the TSFP Database Include the Following:	Comment
1	General information	1	26 Approved & 54 Nominated Hwy sections		
		2	Project Location Details	Highway/District/County, GPS Location, Beginning TRM, Distance from beginning TRM, End TRM, Distance from end TRM.	
		3	Roadway function		
		4	Nominated components		
		5	Nomination year		
		6	Features		
		7	Number of through lanes		
		8	Lane width		
		9	Lane evaluated		
		10	Total section length		
		11	Pavement structure type		
		12	Inside Shoulder		
		13	Surface type		
		14	Paved width		
		15	Outside Shoulder		
		16	Surface type		
		17	Paved width		
2	Design data	1	Layer Information	Depth, Pavement layer, Specifications.	
		2	Shoulder information	Base type, Base thickness, Surface type, Paved width, Total width (for inside & outside shoulder)	
		3	Design traffic		
		4	Pavement design reports		
3	PVMNT structure data	a.	Included in Item #2 (design data)		
4	Construction data	a.	General Information	Contractor, Year of construction, Control section Job no, Pavement structure type	
		b.	Layer information	Depth, Pavement layer, Specifications.	
		c.	Test Reports		
		d.	Mixture design reports		
5	Climatic & environmental data	a.	Avg. Max Temperature for Hottest Month		
		b.	Avg. Min Temperature for Coldest Month		
		c.	Avg. Annual Rainfall		
6	Traffic data	a.	AADT		
		b.	Trucks		
		c.	Cumulative Traffic		
		d.	Traffic data source		
		e.	Year		
7	Lab testing & material properties data	a.	DCP Testing	For Base/Subgrade	
		b.	Elastic modulus		
		c.	Elastic modulus Avg.		
		d.	CBR		
		e.	CBR Avg.		
		f.	mm/Blow		
		g.	mm/Blow Avg.		
8	Field performance & response data	a.	Condition Scores	From TxDOT's Pavement Management Information System (PMIS)	
		b.	Distress Scores		
		c.	Ride Scores		
		d.	International Roughness Index		
		e.	GPR testing		
		f.	FWD Modulus value	For Base/Subgrade	
		g.	Modulus standard deviation	For Base/Subgrade	
		h.	Measured Deflections Plot		
		i.	Back Calculated Moduli values		
9	Other available data in the TSFP database - Maintenance Data	a.	Responsibility	Maintenance office	
		b.	Expenditures	3 Year Lane Mile Cost	
		c.	Last pavement overlay		
		d.	Last pavement seal		

Note: Detailed reviews are included in the CD.

APPENDIX D: THE LTTP DATABASE

Table D-1. Example List of Data Available in the LTTP Database.

Data Item	#	Available Data in the LTPP Database	TXLT01001	TXLT04001	TXLT04002	TXLT05001	TXLT05002	TXLT05003	TXLT08001	TXLT21003~ TXLT21021	TXLT21015	TXLT17017	TXLT17018
General information	1	58 GPS & 127 SPS Hwy sections	SH19@ Lamar Co.	SH40@Carson Co.	US83@Ochiltree Co.	SH62@Terry Co.	SH289@Lubbock Co.	FM445@Hale Co.	IH20@Mitchell Co.	US281@Hidalgo	US281@Hidalgo	FM2223@Brazos	FM2223@Brazos
	2	Section ID No.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	3	Experiment No.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	4	State	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	5	SHRP Region	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	6	Seasonal Round											
	7	Deassign Date	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	8	County	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	9	Functional class	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	10	Route Number	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	11	Elevation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	12	Lane evaluated	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	13	GPS Location	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PVMNT structure data (thickness, material type)	a.	Original surface layer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	b.	AC layer below surface	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	c.	Base layer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	d.	Subgrade	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construction data	a.	Org. Construction date	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	b.	Const. Event date	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	c.	Const. Event No.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	d.	Inside shoulder type											
	e.	Outside shoulder type											
	f.	Drainage type											
Climatic & environmental data	a.	Climatic region	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	b.	Freezing index											
	c.	Precipitation											
	d.	Days above 32 °C											
	e.	Years of climatic data											
Traffic data	a.	Traffic count (AADT & AADTT)	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X
	b.	Axle count (KESALs)	✓	✓	✓	✓	✓	✓	✓	X	✓	X	X
	c.	Axle load spectra	state default	state default	state default	state default	state default	state default	state default	state default	state default	state default	state default
Lab testing & material properties data	AC	a. core examination & thickness	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		b. bulk & maximum specific gravity	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	X
		c. asphalt content	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	✓
		d. gradation	✓	✓	X	✓	✓	✓	✓	X	✓	✓	✓
		e. resilient modulus, tensile strength, and creep compli	✓	X	X	X	✓	X	X	✓	✓	✓	✓
		f. DSR	X	X	X	X	X	X	X	X	X	X	X
		g.viscosity, penetration	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Base & Soil	a. particle size distribution	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
		b. atterberg limit	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
		c. moisutre-density relations	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
		d. resilient modulus	X	X	✓	✓	✓	✓	X		✓	✓	✓
		e. permeability of granular base/subbase											
		f. natural moisture content											
		g. specific gravity											
Field performance & response	1	FWD Deflection	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2	IRI	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	3	Longitudinal crack	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	4	Transverse crack	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	5	Alligator crack	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	6	Rutting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Other available data in the LTPP database													

Note: Detailed reviews are included in the CD.