PROGRAM DIRECTIVE

For the Technical Direction of the LTPP Program

Program Area: IMS **Directive Number:** I-103

Date: September 20, 2002

Subject: **Upgrade of IMS to Version 2002.09**

This directive implements the upgrade of the IMS from version 2002.07 to 2002.09.

Installation instructions, associated software change notice, and a reference guide for the new TST tables for SPS-9 SuperPave material tests are included as attachments to this document for reference. The current workstation software versions are included in files distributed with this document.

The upgrade of the database software to version 2002.09 shall be completed by October 4, 2002.

The software change notice lists all of the changes made to the IMS since the last upgrade in July of 2002. The majority of the changes are related to the SPS9 materials tables that are being added to the TST module in the IMS. Table creation scripts, entry forms, and QC programs are included. Resolutions to several miscellaneous SPRs are included in the software distribution.

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Approved by:

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LTPP Program Manager

Attachment 1

Instructions to Apply VR 2002.09 Release

1. Shutdown the Data Extraction Service.

2. Shutdown ORACLE in normal mode and backup Server.

3. Bring ORACLE up.

4. Create the subdirectory RELEASES\VR2002_09 (the directory RELEASES should already exist).

5. Copy and unzip the VR2002_09.ZIP file to the RELEASES\VR2002_09 subdirectory created in step 4 (password: vr2002_09).

6. From a DOS prompt in the RELEASES\VR2002_09 directory, type VR2002_09 *dbausername/dbapassword@service_name,* to begin the software update. This will run the VR2002_09.SQL update script. The batch file will also run the AddTRFToDataExtraction.sql, the CreatePGBinderTablesAndCodes.sql, and the PGBinderLTPPDD.sql scripts.

7. The VR2002_09 procedure makes some table changes. Verify VR2002_09.SQL and other scripts completed successfully by reviewing all *.lis files. Ignore unique constraint errors on LTPPDD inserts.

8. Copy the LTPP.ZIP file into the LTPP subdirectory. Right-click on the filename and choose “Extract to Here” to unzip (password: ltpp) the file into the LTPP subdirectory. Answer “Yes to all” to overwrite existing files. Delete the LTPP.ZIP file.

9. The OracleVersions.zip file is included for reference only. Create a new subdirectory named IMSVersions and use the “Extract to Here” option when unzipping. This will create a subdirectory named OracleVersions with the vr200209 directory under it.

Attachment 2

LTPP IMS
SOFTWARE CHANGE NOTICE
NO. 79

Version 2002.09 Superseding 2002.07 Effective Date: September 20, 2002

1. DBA: Sectmant.exe and Laymant.exe were updated to handle the new PG Binder tables.

2. DIS: Modified forms to remove experiment type validation upon entry; modified QC to include option to run only on computed parameter table. (SPRs 2-44, S-3048)

3. FWD: Form MON_02 modified to allow entry of MON_DEFL_DEV_SENSORS.CENTER_OFFSET_FLAG. (SPR P-3057)

4. MNT: Corrected MNT_05 form to lookup correct code. (SPR 4-409)

5. RIMS: SHRPRIMS form revised to update version number; deflection menu revised to remove MON_CATEGORY that is available from previous menu. (SPR 3-3064)

6. SPS9: Sheet 12 corrected to show correct sheet number in error message. (SPR 3-734)

7. TST: Modified UG09 form to allow entry of subgrade samples; modified SDS04 form to allow Top Depth entries greater than 96 inches; completed all forms, scripts and QC related to SPS9 PG Binder tables. (SPRs 1-94, 3-708, P-3127)

Attachment 3

Reference Guide to SPS-9 TST Related Tables

Eleven new tables were added to the IMS TST module to contain SPS-9 materials test results. These tables include explicit relationships in the form of foreign keys, and associated update and delete constraints. As this type of structure is at this time uncommon in the IMS, an in-depth discussion is presented. Further, some of the information needed to populate the tables is not available on all of the paper data forms.

Background

The SPS-9 Data Collection Guidelines introduced five new tests associated with SuperPave binders and mixes. These tests are shown in Table 1.

Table 1. PG Binder Tests

LTPP Designation	AASHTO Procedure[1]	Description
TST_AE07	TP5-98	Dynamic Shear Rheometer
TST_AE08	TP1-98	Bending Beam Rheometer
TST_AE09	TP3-00	Direct Tension Test
TST_SP01	PP28-00	Gyratory Compaction Test
TST_SP02	PP28-00	Volumetric and Gravimetric Properties of Gyratory Compacted Specimen

1. These procedures can be found in the AASHTO Provisional Standards, April 2000 edition

Materials on which these tests were to be performed originally came from the SPS-9 project only. However, some tests have been performed at Turner-Fairbanks on non SPS-9 materials from the MRL.

Tables are not provided for the shear test and indirect tensile tests originally designated for the SUPERPAVE regional laboratories.

The eleven tables that have been designed to contain the results of these tests are shown in Table 2.

Table 2. SuperPave Tables

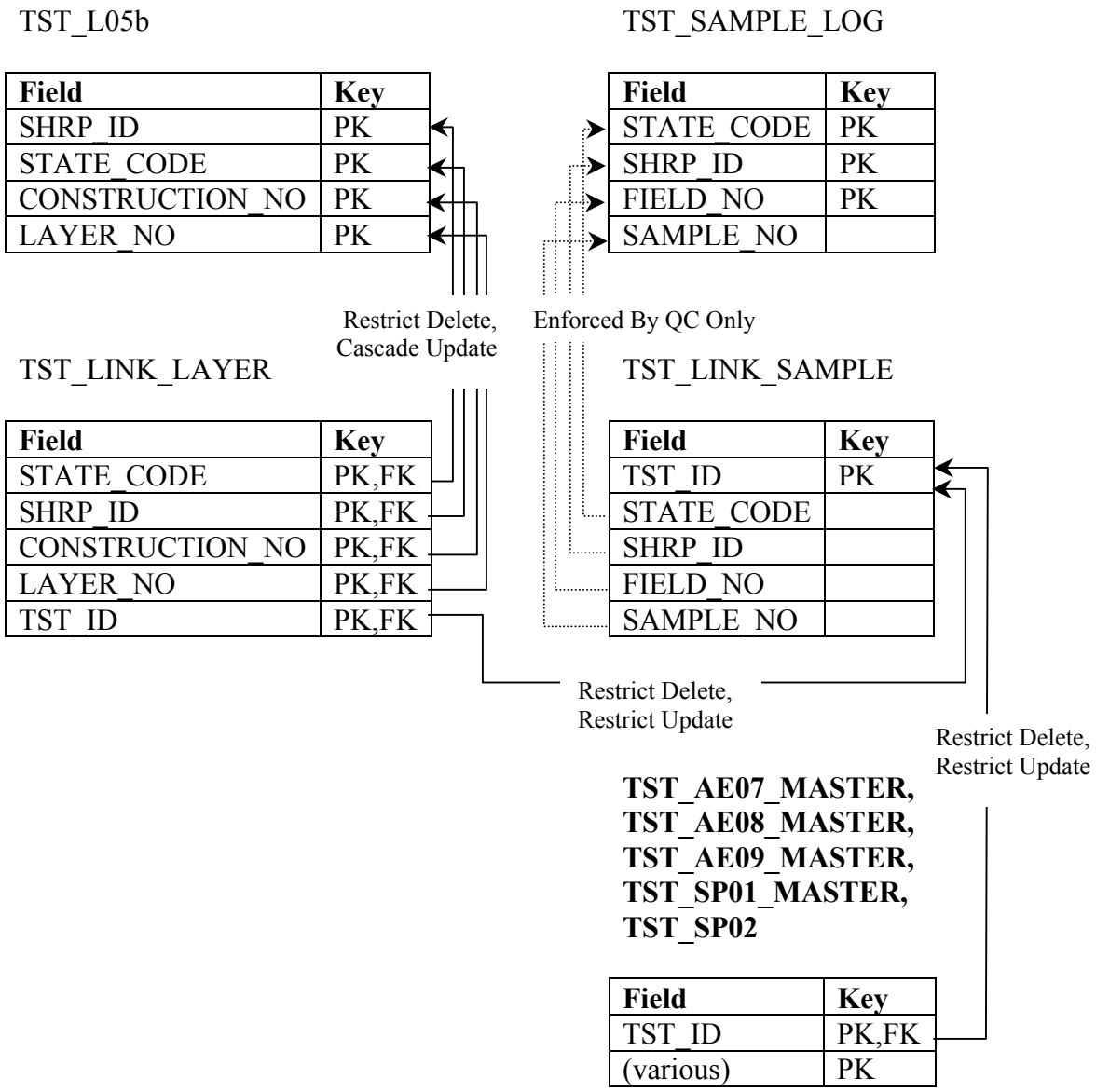
IMS Table Name	Contents
TST_LINK_LAYER	Links between TST_ID and layers in TST_L05b
TST_LINK_SAMPLE	Links between TST_ID and samples in TST_SAMPLE_LOG
TST_AE07_MASTER	Sample and configuration information for Dynamic Shear Rheometer (DSR) test
TST_AE07_DATA	Data from Dynamic Shear Rheometer (DSR) test
TST_AE08_MASTER	Sample and configuration information for Bending Beam Rheometer

IMS Table Name	Contents
	(BBR) test
TST_AE08_DATA	Data from Bending Beam Rheometer (BBR) test
TST_AE09_MASTER	Sample and configuration information for Direct Tension (DT) test
TST_AE09_DATA	Data from Direct Tension (DT) test
TST_SP01_MASTER	Sample and configuration information for gyratory compaction test
TST_SP01_DATA	Data from gyratory compaction test
TST_SP02	Asphalt mix volumetric and gravimetric information

The Link Tables

Incorporation of the PG binder data presents a problem that the TST module was not originally designed to handle. Material samples for these tests were collected prior to construction, and generally represent more than one layer in more than one SPS section. TST_SAMPLE_LOG (and every other table in the TST module, and virtually every other table in the IMS for that matter), however, includes STATE_CODE and SHRP_ID as key fields. This means that every record must be keyed to a specific section, and often a specific layer as well. To overcome this problem two 'link' tables were developed for the PG Binder tables. These link tables could also be used in conjunction with other tables in the TST module, although there are no plans to do so at this time.

The first link table, TST_LINK_SAMPLE, contains pointers to TST_SAMPLE_LOG. The second link table, TST_LINK_LAYER, contains pointers to TST_L05B. They are linked to each other and allied tables (for the time being only the PG binder tables) through the TST_ID field. These links are illustrated graphically in Figure 1. For more specific information, please see the table specifications. These link tables allow a single material sample to easily be referenced to all of the pavement layers it represents. These link tables could potentially be used to solve similar problems with other data items, such as theoretical maximum specific gravity on SPS sections.



Notes: Arrows indicating relationship point from the child to the master

PK stands for 'Primary Key', FK stands for 'Foreign Key'

Dotted lines show relationships not enforced by foreign key constraints

Figure 1: Graphical representation of relationships between link tables.

Foreign Keys

Because the link tables become useless if the information stored in them becomes out of sync with each other and TST_L05B, TST_SAMPLE_LOG, TST_AE0*_MASTER and TST_SP*_MASTER, foreign keys were introduced to enforce referential integrity.

Before going further, it should be noted that understanding of these concepts is not required in order to operate the data entry forms for the PG binder tables. However, knowledge of these concepts will be helpful in understanding why the forms are set up like they are, and during investigation of any QC or DAOFR related issues that touch upon these tables. Understanding these structures is mandatory, however, before executing any INSERT, UPDATE or DELETE SQL statements on these tables.

For a full description of what a foreign key is and what they do, please consult an SQL reference manual. In essence, a foreign key establishes an explicit link between a record in one table and a record in another table. This link is established by a shared value or set of values, in a specified field or set of fields in each table. This link is asymmetrical: one table is the master and one table is the child. The set of fields comprising the foreign key in the child table must correspond to the set of fields that comprise the primary key of the master table.

In order for a record to be inserted into the child table, its foreign key must match the primary key of a record that exists in the master table. The record in the child table can be deleted at any time, but in order for it to be updated, the foreign key after the update must still match the primary key of a record (not necessarily the same record) in the master table.

The behavior of UPDATE and DELETE on the master record is adjustable. If the master record has no corresponding child records, the action proceeds normally. If the master record does have child records, we have the option of two actions; **Restrict** and **cascade**.

If we have set UPDATE to **restrict**, no value in the primary key of the master record can be updated as long as there are corresponding child records. The child records must be deleted or reassigned to a different master record before the UPDATE will be allowed.

If we have set UPDATE to **cascade**, any UPDATE that affects a field or fields in the master record's primary key will also be applied the corresponding field or fields in the child record's foreign key.

If we have set DELETE to **restrict**, a master record cannot be deleted as long as it has one or more corresponding child records. The child records themselves must be deleted or reassigned to a different master record before the DELETE will be allowed.

If we have set DELETE to **cascade**, if a master record is deleted any and all corresponding child records will also be deleted.

Foreign keys are used to enforce referential integrity in all of the PG Binder tables, with the exception of the relationship between TST_LINK_SAMPLE and TST_SAMPLE_LOG (shown

in dotted lines in Figure 1). The reason for this omission is that some of the links from TST_LINK_SAMPLE will be to TST_SAMPLE_LOG_LAB, TST_SAMPLE_LOGP_SPS_3_4, TST_UNCOMP_BITUMINOUS, TST_ASPHALT_CEMENT and TST_FRESH_PCC instead. This dispersal of sampling information in the TST module is, in my opinion, a great weakness and hopefully will be addressed in the future. Because of this, the relationships between TST_LINK_SAMPLE and the various sampling tables are currently enforced only by 'E' level QC.

Paper Data Sheets and Missing Information

Table 3 shows the paper data forms that are the data source for these tables.

Table 3. IMS Tables and Paper Data Forms

IMS Table Name	Paper Data Form
TST_LINK_LAYER	None
TST_LINK_SAMPLE	None
TST_AE07_MASTER	T27
TST_AE07_DATA	
TST_AE08_MASTER	T28
TST_AE08_DATA	
TST_AE09_MASTER	T29
TST_AE09_DATA	
TST_SP01_MASTER	T71
TST_SP01_DATA	
TST_SP02	T72

The paper data forms listed above are missing two critical pieces of information: LAYER_NO and SAMPLE_NO. It is unclear whether this was an oversight, however the PG Binder tables were designed based on the experimental requirements, not on the paper data forms. The unfortunate side effect of that decision is that the regions will need to perform an investigation to determine these missing data items.

In the case where the material sampled can represent multiple sections and/or layers at a section, one section, layer and SAMPLE_NO should be chosen to be the "primary" record for that material in TST_LINK_SAMPLE. This will automatically cause a corresponding record to be inserted into TST_LINK_LAYER. The remaining corresponding records can then be inserted manually into TST_LINK_LAYER using it's data entry form.

IMS Table Specifications

The following IMS table specifications are provided as reference material.

TST_LINK_SAMPLE: Links between TST_ID and samples in TST_SAMPLE_LOG and TST_ASPHALT_CEMENT

Field Name	Units	Format	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK		*Unique sample identification number used to link samples to multiple layers in multiple sections*
RECORD_STATUS		VARCHAR2(1)			Use standard definition
STATE_CODE		NUMBER(2,0)	NN	STATE_PROVINCE	Use standard definition
SHRP_ID		VARCHAR2(4)	NN		*Use standard definition*
LAYER_NO		NUMBER(2,0)	NN		*Use standard definition*
FIELD_SET		NUMBER(2,0)	NN		*Use standard definition*
SAMPLE_NO		VARCHAR2(7)	NN		Use standard definition
LAYER_TYPE		VARCHAR2(2)			Use standard definition
CONSTRUCTION_NO		NUMBER(2,0)			Use standard definition

TST_LINK_LAYER: Links between TST_ID and layers in TST_L05B

Field Name	Units	Format	DICs	Codes	Data Dictionary Description
STATE_CODE		NUMBER(2,0)	PK, FK[1]	STATE_PROVINCE	Use standard definition
SHRP_ID		VARCHAR2(4)	PK, FK[1]		*Use standard definition*
LAYER_NO		NUMBER(2,0)	PK, FK[1]		*Use standard definition*
CONSTRUCTION_NO		NUMBER(2,0)	PK, FK[1]		Use standard definition
TST_ID		NUMBER(5,0)	PK, FK[2]		Use standard definition
RECORD_STATUS		VARCHAR2(1)			Use standard definition
LAYER_TYPE		VARCHAR2(2)			Use standard definition

1. Foreign Key in TST_L05B: Restrict DELETE, cascade UPDATE
2. Foreign Key in TST_LINK_SAMPLE: Restrict DELETE, Restrict UPDATE

TST_AE07_MASTER: Sample and configuration information for Dynamic Shear Rheometer (DSR) test

Field Name	Units	Format	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
AGEING_TYPE		VARCHAR2(1)	PK	BINDER_AGE_TYPE	Type of accelerated or field aging used in sample preparation
RECORD_STAUS		VARCHAR2(1)			Use standard definition
LAB_CODE		VARCHAR2(4)	NN		Use standard definition
TEST_DATE		DATE	NN		Date test performed
FIELD_AGE_TIME	months	NUMBER(4,1)			For field aged specimens, time elapsed between construction and sampling
TEST_CONTROL		VARCHAR2(1)	NN	DSR_TEST_CONTROL	Control method used by Dynamic Shear Rheometer equipment
DSR_MODEL		VARCHAR2(30)			Make and model of Dynamic Shear Rheometer equipment
DSR_SOFTWARE		VARCHAR2(30)			Name and version of Dynamic Shear Rheometer software
TEST_GAP	mm	NUMBER(5,3)			Gap between test plates during Dynamic Shear Rheometer testing
PLATE_DIAMETER	mm	NUMBER(4,2)	NN		Diameter of test plates used during Dynamic Shear Rheometer testing
COND_CYCLE_NO		NUMBER(2,0)			Number of conditioning cycles prior to data collection
COND_CYCLE_FREQ	radians/sec	NUMBER(3,1)			Frequency of conditioning cycles
TEST_FREQ	radians/sec	NUMBER(3,1)			Frequency of test cycles
TEST_STRAIN_AMP	%	NUMBER(4,2)			Target strain amplitude for strain

TST_AE07_MASTER: Sample and configuration information for Dynamic Shear Rheometer (DSR) test

Field Name	Units	Format	DICs	Codes	Data Dictionary Description
					control testing
TEST_TORQUE_AMP	mN-m	NUMBER(4,0)			Target torque amplitude for stress control testing
PG_HIGH_TEMP	deg C	NUMBER(2,0)	NN		High temperature performance grade
PG_LOW_TEMP	deg C	NUMBER(2,0)	NN		Low temperature performance grade
COMMENT_1		VARCHAR2(2)		COMMENT	Use standard definition
COMMENT_2		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_3		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_4		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_5		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_6		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENTS_OTHER		VARCHAR2(40)			Note used to record additional observations regarding test or test results

1. Foreign key in TST_LINK_SAMPLE. Restrict DELETE, Restrict UPDATE

TST_AE07_DATA: **Data from Dynamic Shear Rheometer (DSR) test**

Field Name	**Units**	**Field Type**	**DICs**	Codes	**Data Dictionary Description**
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
AGEING_TYPE		VARCHAR2(1)	PK, FK[1]	BINDER_AGE_TYPE	Type of accelerated or field aging used in sample preparation
TEST_TEMP	deg C	NUMBER(4,1)	PK		Temperature at which test is performed
RECORD_STATUS		VARCHAR2(1)			Use standard definition
COMPLEX_MOD	kPa	NUMBER(6,1)	NN		Complex Modulus (G*) calculated from Dynamic Shear Rheometer results
PHASE_ANGLE	deg (angle)	NUMBER(3,1)	NN		Phase angle (delta) calculated from Dynamic Shear Rheometer results

1. Foreign Key in TST_AE07_MASTER: Restrict DELETE, cascade UPDATE

TST_AE08_MASTER: Sample and configuration information for Bending Beam Rheometer (BBR) test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
AGEING_TYPE		VARCHAR2(1)	PK	BINDER_AGE_TYPE	Type of accelerated or field aging used in sample preparation
TEST_TEMP	deg C	NUMBER(3,1)	PK		Temperature at which test is performed
RECORD_STATUS		VARCHAR2(1)			Use standard definition
LAB_CODE		VARCHAR(4)	NN	LAB_CODE	Use standard definition
TEST_DATE	date	DATE	NN		Date test performed
BBR_MODEL		VARCHAR2(30)			Make and model of Bending Beam Rheometer equipment
BBR_SOFTWARE		VARCHAR2(30)			Name and version of Bending Beam Rheometer software
FIELD_AGE_TIME	months	NUMBER(4,1)			For field aged specimens, time elapsed between construction and sampling
SOAK_TIME	min	NUMBER(3,1)			Time specimen is conditioned in bath
BEAM_WIDTH	mm	NUMBER(3,1)			Width of specimen
BEAM_THICK	mm	NUMBER(3,1)			Thickness of specimen
PG_HIGH_TEMP	deg C	NUMBER(2,0)	NN		High temperature performance grade
PG_LOW_TEMP	deg C	NUMBER(2,0)	NN		Low temperature performance grade
REG_CO_A		NUMBER(5,3)	NN		Regression coefficient “A” from creep stiffness vs. time plot
REG_CO_B		NUMBER(5,3)	NN		Regression coefficient “B” from creep stiffness vs. time plot
REG_CO_C		NUMBER(6,4)	NN		Regression coefficient “C” from creep stiffness vs. time plot
REG_R_SQUARE		NUMBER(5,4)	NN		Coefficient of determination from creep stiffness vs. time plot

TST_AE08_MASTER: Sample and configuration information for Bending Beam Rheometer (BBR) test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
COMMENT_1		VARCHAR2(2)		COMMENT	Use standard definition
COMMENT_2		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_3		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_4		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_5		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_6		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENTS_OTHER		VARCHAR2(40)			Note used to record additional observations regarding test or test results

1. Foreign key in TST_LINK_SAMPLE. Restrict DELETE, Restrict UPDATE

TST_AE08_DATA: Data from Bending Beam Rheometer (BBR) test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
AGEING_TYPE		VARCHAR2(1)	PK, FK[1]	BINDER_AGE_TYPE	Type of accelerated or field aging used in sample preparation
TEST_TEMP	deg C	NUMBER(3,1)	PK, FK[1]		Temperature at which test is performed
TEST_TIME	sec	NUMBER(3,0)	PK		*Time since application of test load*
RECORD_STATUS		VARCHAR2(1)			Use standard definition
LOAD	N	NUMBER(6,4)			*Magnitude of test load applied to beam*
DEFL	mm	NUMBER(5,4)			*Deflection of beam*
STIFF_MEASURE	MPa	NUMBER(5,1)	NN		*Measured stiffness of the beam*
STIFF_ESTIMATE	MPa	NUMBER(5,1)			*Estimated stiffness of the beam*
STIFF_PCT_DIFF	%	NUMBER(5,4)			*Percent difference between measured and estimated stiffness of the beam*
M_VALUE		NUMBER(4,3)			*Rate of change of stiffness*

1. Foreign Key in TST_AE08_MASTER: Restrict DELETE, cascade UPDATE

TST_AE09_MASTER: Sample and configuration information for Direct Tension (DT) test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
AGEING_TYPE		VARCHAR2(1)	PK	BINDER_AGE_TYPE	Code indicating type of accelerated or field aging used in sample preparation
RECORD_STATUS		VARCHAR2(1)			Use standard definition
LAB_CODE		VARCHAR2(4)	NN		Use standard definition
TEST_DATE		DATE	NN		Date test performed
FIELD_AGE_TIME	months	NUMBER(4,1)			For field aged specimens, time elapsed between construction and sampling
DT_MODEL		VARCHAR2(30)			Make and model of direct tension test equipment
DT_SOFTWARE		VARCHAR2(30)			Name and version of direct tension test software
TEST_TEMP	deg C	NUMBER(3,1)	NN		Temperature at which test is performed
ELONG_RATE	mm/sec	NUMBER(3,2)			Rate of specimen elongation
SPECIMEN_AREA	sq mm	NUMBER(3,1)			Cross-sectional area of specimen
GAUGE_LENGTH	mm	NUMBER(3,1)			Effective gauge length of specimen used in direct tension testing
CONDITION_TIME	min	NUMBER(3,0)			Sample conditioning time
FRACTURE_TYPE		VARCHAR2(1)	NN	DT_FRACTURE_TYPE	Code indicating type of specimen fracture observed in the direct tension test
PEAK_LOAD_AVG	N	NUMBER(5,2)	NN		Average peak load
PEAK_LOAD_STD	N	NUMBER(4,2)	NN		Standard deviation of peak load
FAIL_STRESS_AVG	kPa	NUMBER(5,1)	NN		Average stress at specimen failure
FAIL_STRESS_STD	kPa	NUMBER(4,1)	NN		Standard deviation of stress at specimen failure
FAIL_ELONG_AVG	mm	NUMBER(4,3)	NN		Average elongation at specimen failure
FAIL_ELONG_STD	mm	NUMBER(4,3)	NN		Standard deviation of elongation at

TST_AE09_MASTER: Sample and configuration information for Direct Tension (DT) test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
					specimen failure
FAIL_STRAIN_AVG	%	NUMBER(3,2)	NN		Average strain at specimen failure
FAIL_STRAIN_STD	%	NUMBER(3,2)	NN		Standard deviation of strain at specimen failure
PG_HIGH_TEMP	deg C	NUMBER(2,0)	NN		High temperature performance grade
PG_LOW_TEMP	deg C	NUMBER(2,0)	NN		Low temperature performance grade
COMMENT_1		VARCHAR2(2)		COMMENT	Use standard definition
COMMENT_2		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_3		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_4		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_5		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_6		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENTS_OTHER		VARCHAR2(40)			Note used to record additional observations regarding test or test results

1. Foreign key in TST_LINK_SAMPLE. Restrict DELETE, Restrict UPDATE

TST_AE09_DATA: Data from Direct Tension (DT) test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
AGEING_TYPE		VARCHAR2(1)	PK, FK[1]	BINDER_AGE_TYPE	Type of accelerated or field aging used in sample preparation
REPEAT_NO		NUMBER(1,0)	PK		Sequential number identifying each test replicate
RECORD_STATUS		VARCHAR2(1)			Use standard definition
PEAK_LOAD	N	NUMBER(5,2)	NN		*Peak load*
FAIL_STRESS	kPa	NUMBER(5,1)	NN		*Stress at specimen failure*
FAIL_ELONG	mm	NUMBER(4,3)	NN		*Elongation at specimen failure*
FAIL_STRAIN	%	NUMBER(3,2)	NN		*Strain at specimen failure*

1. Foreign Key in TST_AE09_MASTER: Restrict DELETE, cascade UPDATE

TST_SP01_MASTER: Sample and configuration information for gyratory compaction test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
RECORD_STATUS		VARCHAR2(1)			Use standard definition
LAB_CODE		VARCHAR2(4)	NN		Use standard definition
TEST_DATE		DATE	NN		*Date tested*
PG_HIGH_TEMP	deg C	NUMBER(2,0)	NN		High temperature performance grade
PG_LOW_TEMP	deg C	NUMBER(2,0)	NN		Low temperature performance grade
AGGR_NOM_SIZE	mm	NUMBER(2,0)	NN		*Nominal aggregate size*
TRAFFIC_LEVEL	18kip MESAL	NUMBER(4,1)	NN		*Design traffic level*
DESIGN_H_AIR_TEMP	deg C	NUMBER(3,0)			*Design high air temperature*
MIX_TEMP	deg C	NUMBER(3,0)			*Temperature at which mix mixed*
COMPACT_TEMP	deg C	NUMBER(3,0)			*Temperature at which mix compacted*
ASPHALT_SPEC_GRAV		NUMBER(4,3)			*Specific gravity of the asphalt binder*
ASPHALT_CONTENT	%	NUMBER(4,2)	NN		*Percent asphalt binder content by mass of total mix*
AGG_EFF_SPEC_GRAV		NUMBER(4,3)			*Effective specific gravity of aggregate*
AGG_BULK_SPEC_GRAV		NUMBER(4,3)	NN		*Bulk specific gravity of aggregate*
SPECIMEN_DIAMETER	mm	NUMBER(3,0)			*Specimen diameter*
MIX_MAX_SPEC_GRAV		NUMBER(4,3)	NN		*Theoretical maximum specific*

TST_SP01_MASTER: Sample and configuration information for gyratory compaction test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
					gravity of HMA mix
GYRATE_ANGLE	deg (angle)	NUMBER(3,2)			*Angle of gyration of compactor*
GYRATE_VT_PRESS	kPa	NUMBER(4,0)			*Vertical pressure applied during gyration*
GYRATE_ROT_SPEED	rpm	NUMBER(2,0)			*Rotational speed of gyratory compactor*
GYRATE _N_INI		NUMBER(3,0)	NN		*Number of initial gyrations*
GYRATE _N_DES		NUMBER(3,0)	NN		*Number of gyrations for design traffic level*
GYRATE _N_MAX		NUMBER(3,0)	NN		*Number of gyrations for maximum traffic level*
AVG_REL_DENS_N_INI	%	NUMBER(3,1)	NN		*Average relative density at initial number of gyrations*
AVG_REL_DENS_N_DES	%	NUMBER(3,1)	NN		*Average relative density at design number of gyrations*
AVG_REL_DENS_N_MAX	%	NUMBER(3,1)	NN		*Average relative density at maximum number of gyrations*
BULK_SPEC_GRAV_1		NUMBER(4,3)	NN		*Bulk specific gravity of extruded specimen for specimen 1*
BULK_SPEC_GRAV_2		NUMBER(4,3)			*Bulk specific gravity of extruded specimen for specimen 2*
AIR_VOIDS_N_DES	%	NUMBER(3,1)	NN		*Percent air voids of specimen at design number of gyrations*
VMA_N_DES	%	NUMBER(3,1)	NN		*Percent voids in the mineral aggregate at design number of*

TST_SP01_MASTER: Sample and configuration information for gyratory compaction test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
					gyrations
VFA_N_DES	%	NUMBER(3,1)	NN		*Percent voids filled with asphalt at design number of gyrations*
COMMENT_1		VARCHAR2(2)		COMMENT	Use standard definition
COMMENT_2		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_3		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_4		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_5		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_6		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENTS_OTHER		VARCHAR2(40)			Note used to record additional observations regarding test or test results

1. Foreign key in TST_LINK_SAMPLE. Restrict DELETE, Restrict UPDATE

TST_SP01_DATA: Data from gyratory compaction test

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
GYRATE_NO		NUMBER(3,0)	PK		*Number of gyrations*
SPECIMEN_NO		NUMBER(1,0)	PK		*Replicate specimen number*
RECORD_STATUS		VARCHAR2(1)	NN		Use standard definition
BULK_SPEC_GRAV_RAW		NUMBER(4,3)	NN		*Uncorrected bulk specific gravity of specimen*
BULK_SPEC_GRAV_COR		NUMBER(4,3)	NN		*Corrected bulk specific gravity of specimen*
REL_DENSITY_COR	%	NUMBER(3,1)	NN		*Corrected relative density of specimen*

1. Foreign Key in TST_SP01_MASTER: Restrict DELETE, cascade UPDATE

TST_SP02: Asphalt mix volumetric and gravimetric information

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
TST_ID		NUMBER(5,0)	PK, FK[1]		Use standard definition
RECORD_STATUS		VARCHAR2(1)			Use standard definition
CONSTRUCTION_NO		NUMBER(2,0)			Use standard definition
LAB_CODE		VARCHAR2(4)	NN		Use standard definition
TEST_DATE		DATE	NN		*Date tested*
BINDER_SPEC_GRAV		NUMBER(4,3)	NN		*Specific gravity of asphalt binder*
BINDER_PCT	%	NUMBER(3,1)	NN		*Percent asphalt by mass of total mix*
AGG_COARSE_SPEC_GRAV		NUMBER(4,3)	NN		*Specific gravity of coarse aggregate*
AGG_COARSE_PCT	%	NUMBER(3,1)	NN		*Percent coarse aggregate by mass of total mix*
AGG_FINE_SPEC_GRAV		NUMBER(4,3)	NN		*Specific gravity of fine aggregate*
AGG_FINE_PCT	%	NUMBER(3,1)	NN		*Percent fine aggregate by mass of total mix*
AGG_FILLER_SPEC_GRAV		NUMBER(4,3)			*Specific gravity of mineral filler*
AGG_FILLER_PCT	%	NUMBER(3,1)	NN		*Percent mineral filler by mass of total mix*
AGG_COMB_SPEC_GRAV		NUMBER(6,5)	NN		*Specific gravity of combined aggregate*
AGG _EFF_SPEC_GRAV		NUMBER(5,3)	NN		*Effective specific gravity of*

TST_SP02: Asphalt mix volumetric and gravimetric information

Field Name	Units	Field Type	DICs	Codes	Data Dictionary Description
					combined aggregate
MIX_MAX_SPEC_GRAV		NUMBER(4,3)	NN		*Theoretical maximum specific gravity of mix*
MIX_BULK_SPEC_GRAV		NUMBER(4,3)	NN		*Bulk specific gravity of mix*
BINDER_ABS_PCT	%	NUMBER(3,2)	NN		*Percent asphalt absorbed by aggregate*
BINDER_EFF_PCT	%	NUMBER(3,2)	NN		*Effective asphalt content*
VMA	%	NUMBER(3,1)	NN		*Percent voids in the mineral aggregate*
AIR_VOIDS	%	NUMBER(3,1)	NN		*Percent air voids*
VFA	%	NUMBER(3,1)	NN		*Percent voids filled with asphalt*
COMMENT_1					Use standard definition
COMMENT_2		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_3		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_4		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_5		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENT_6		VARCHAR2(2)		COMMENT	*Use standard definition*
COMMENTS_OTHER		VARCHAR2(40)			Note used to record additional observations regarding test or test results

1. Foreign key in TST_LINK_SAMPLE. Restrict DELETE, Restrict UPDATE