Introduction
The Mechanistic-Empirical Guide for Design of New and Rehabilitated Pavement Structures (currently goes with the acronym MEPDG) is an uniform and comprehensive set of procedures for the design and analysis of new and rehabilitated flexible, rigid, and composite pavements. The MEPDG is based on mechanistic-empirical principles, where it assumes that pavement can be modeled as a multi-layered elastic structure.

Background
Since the adoption of the 1986 AASHTO Guide for Design of Pavement Structures, which was an improvement to the AASHO Road Test of the late 1950’s, it was realized that there is a dire need to move toward a mechanistically based pavement design procedures. This is to take the 1986 Guide to the next level of analysis and provide the capability to do rehabilitation designs. In order to meet this challenge, the AASHTO Joint Task Force on Pavements, the National Cooperative Highway Research Program (NCHRP), and the Federal Highway Administration (FHWA) sponsored the development of a Mechanistic- Empirical pavement design procedure under NCHRP 1-37A in 1996. The specific goal was to develop an AASHTO mechanistic-empirical pavement design procedure by the year 2002. That is the origination of the popular name, 2002 Guide.

The final report of the NCHRP 1-37a was completed in March 2004 and was released to the public for review and evaluation. An Independent Review of the NCHRP 1-37A was conducted by NCHRP under project 1-40A and it was completed by September 2006. The Independent review has resulted in a number of improvements, many of which are being incorporated into the MEPDG under NCHRP Project 1-40D. Two products are expected from the 1-40D project, namely a version 1.0 of the MEPDG software and an updated MEPDG document. The AASHTO format MEPDG document is scheduled for completion by June 2007. It is noted that a NCHRP Project 1-40B is expected to produce a MEPDG User Manual and Local Calibration Guide by spring of 2007. Additionally, NCHRP Project 1-40J “Provide Support for the Lead States Group” has been under way since December 2004. The Lead States Group mission is to promote and facilitate the refinement, implementation, and evolution of MEPDG in conjunction with AASHTO, NCHRP, and FHWA activities. The Virginia Department of Transportation (VDOT) has been a proud member of this group since its inception.

Situation
Currently VDOT utilizes the AASHTO 1993 Guide for Design of Pavement Structures, which is based on the AASHO Road Test that was completed in the late
1950’s. The several versions of AASHTO Pavement Guide including the 1993 version have provided satisfactory services to pavement designers. However there are a number of serious limitations, these are; being completely empirical and based on performance equations from one test location, one environment, one set of materials, limited span of two years, no sub-drainage consideration, and limited traffic with axle configuration and tire types representing the late 1950’s.

**What MEPDG has to Offer to VDOT**

The MEPDG provides a number of new approaches for characterizing materials to be used in 21st Century pavement design. The mechanistic characterization of paving materials allows for the application of the principles of engineering mechanics, namely stress and strain, to the pavement analysis. Being able to input different material characteristics in the design model will allow the engineer to predict the performance of the pavement, improved procedures to evaluate premature failures, and greatly aid in pavement forensic investigation. Another improvement offered by the MEPDG is the use of traffic input based on the number of axles by type and loading which is known as load spectra, while eliminating the use of ESAL’s. The MEPDG also considers the effects of temperature and moisture on a project basis using site-specific environmental data from nearby weather stations, and implementing the FHWA’s Enhanced Integrated Climate Model (EICM). Additionally, The MEPDG offers a system of hierarchical inputs permitting the engineer to devote efforts consistent with importance of the project under consideration.

These advances in the analytical approach to pavement design make it very attractive to VDOT to implement the MEPDG. As a matter of fact, the first marketing workshop of the MEPDG for the east coast of the United States was held in Sandston, Virginia in July 28-29, 1999. Since that time VDOT has been considering the MEPDG as the way to go for future pavement design and analysis.

**Objectives**

There are two major objectives in the implementation plan, these are:

1. Immediate utilization of applicable portions of the MEPDG to enhance the current AASHTO 1993 Guide for Design of Pavement Structures.


**Organization**

Meeting the above objective is very challenging and requires diverse talents and cooperation among several groups and individuals. This is in addition to the support of the upper management in VDOT. The organizational structure includes a Steering Committee and several Technical Committees.
Steering Committee:
The steering committee provides vision, guidance, monitoring the plan progress, and feedback to the technical committees.

Steering Committee Members
Andy Mergenmeier (State Materials Engineer), Chairman
Mohamed Elfino (Assistant State Materials Engr., ASME), Coordinator
Affan Habib, Pavement Design & Evaluation Program Engineer (PDEPE)
Allen Williams, Salem District Maintenance Engineer,
Gale Dickerson, Fredericksburg District Construction Area Engineer
David Lee, Salem District Materials Engineer
David Shiells, Northern Virginia District Materials Engineer,
Don French, Lynchburg District Materials Engineer,
Khaled Galal, Research Scientist, Virginia Transportation Research Council
Lorenzo Casanova, Programs & Technology Engineer, FHWA
Robert Long, American Concrete Pavement Association (ACPA)
Richard Schreck, Virginia Asphalt Association (VAA)

Technical Committees:
The technical committees are in charge of executing the preparation plan. The major components of the plan are; traffic, materials characterization, verification, calibration, validation, data management, implementation and training. A liaison member among all the technical committees is included to provide flow of communications, consistency, and avoiding duplication of efforts.

Traffic Committee:
The Traffic Committee is responsible for load spectra data collection and analysis. This is to include locating and installing WIM facilities to ensure state coverage is provided, and ensuring the traffic data meets the requirements of the Traffic Monitoring Guide (TMG).

Traffic Committee Members:
Trenton Clark (Asphalt Pavement Field Engineer), Chairman
Richard Bush Traffic Engineering
Ben Cottrell, Research Scientist, VTRC
F. Hamlin Williams, Traffic Engineering
William Hughes, Richmond District Pavement Management Engineer,
Tom Schinkel, Traffic Engineering
Mohamed Elfino, ASME, Liaison
Soils and Aggregate Committee:
The Soils and Aggregate Committee is responsible for characterizing and establishing a representative state-wide data base for the resilient modulus of soils and aggregates. An important role for the committee is providing guidance in performing the soils and aggregate testing, quality assurance, analysis of the collected data, and setting procedures for selecting the proper soils and aggregate input parameters for level I, II and III with values matching the stress level at the subgrade and subbase respectively.

Soils and Aggregate Committee Members:
Stan Hite, (ASME), Chairman
John Deusebio, Hampton Roads District Geologist
Ed Hoppe, Research Scientist, VTRC
Shabbir Hossain, Research Scientist, VTRC
David Robinson, Virginia Transportation Construction Alliance (Aggregates)
Chaz Weaver, Staunton District Materials Engineer
Mohamed Elfino, (ASME), Liaison

Concrete and Stabilized Materials Committee:
The Concrete and Stabilized Materials Committee is responsible for characterizing the properties of current VDOT paving concrete mixes by performing laboratory tests for the elastic modulus, modulus of rupture, compressive strength, and coefficient of thermal expansion. Additionally the committee performs quality assurance on the collected data, and establishing the concrete properties database for use as Level II & III input.

The committee also is responsible for characterizing elastic modulus of stabilized materials such as; cement treated aggregate, soil cement, and lime stabilized soils. The elastic modulus and the modulus of rupture of concrete will be used as default values in the 1993 AASHTO Guide for Design of Pavement Structures.

Concrete and Stabilized Materials Committee Members:
Celik Ozyildirim, (Research Scientist, VTRC), Chairman
Larry Lundy, Concrete Program Engineer
Alexander Teklu, Fredericksburg Assistant District Materials Engineer
Robert Long, ACPA
Mohamed Elfino, (ASME), Liaison

Asphalt Concrete Committee:
The Asphalt Concrete Committee is responsible for characterizing VDOT asphalt mixes (all layers) for their complex modulus and creep compliance properties. This is to include laboratory testing, Q/A the collected data, and establishing a
dynamic modulus database for use as Level II & III input in the analysis procedure.

**Asphalt Concrete Committee Members:**

**Bill Maupin, (Research Scientist, VTRC), Chairman**  
Bill Bailey, ASME  
Mike Wells, Pavement Design & Evaluation Engineer  
Mourad Bouhajja, Asphalt Program Engineer  
Haroon Shami, Culpeper District Materials Engineer  
Khaled Galal, Research Scientist, VTRC  
Stacey Reubush, Research Scientist, VTRC  
Richard Schreck, VAA  
Mohamed Elfino, (ASME) Liaison

**Verification, Calibration, and Validation Committee:**

The responsibility of this committee is to determine the validity of the analysis and national default values for Virginia conditions and materials. Perform calibration of the MEPDG which is the process of making adjustments to the theoretical models to account for model simplification and limitations in simulating actual pavement behavior. Additionally the committee performs validation of the MEPDG to determine whether the model provides a reasonable prediction of actual performance.

**Verification, Calibration, and Validation Committee Members:**

**David Kaulfers, (ASME), Chairman**  
Affan Habib, PDEPE  
Trenton Clark, Asphalt Pavement Field Engineer  
Mourad Bouhajja, Asphalt Program Engineer  
Tom Tate, Hampton Roads District Pavement Management Engineer  
Haroon Shami, Culpeper District Materials Engineer  
Don French, Lynchburg District Materials Engineer  
Khaled Galal, Research Scientist, VTRC  
Brian Diefenderfer, Research Scientist, VTRC  
Raja Shekharan, Pavement Management Engineer, Asset Management  
Robert Long, ACPA  
Richard Schreck, VAA  
Mohamed Elfino, (ASME) Liaison

**Implementation and Training Committee:**

The Implementation and Training Committee is responsible for “selling/marketing” the MEPDG to the stakeholders (upper management, field engineers, and the industry), and providing training to central office and field personnel. Training will be primarily conducted by members of the training committee. It is envisioned that pavement design using both the 1993 AASHTO
Guide for Design of Pavement Structures and the MEPDG will be performed during the time of calibration and validation. This approach will provide continuous gain of expertise in using the MEPDG software as well as the ability to compare results between the two pavement design approaches.

Implementation and Training Committee Members:

Mohamed Elfino, (ASME), Chairman  
Affan Habib, PDEPE  
Trenton Clark, Asphalt Pavement Field Engineer  
Robert Borter, IT Manager  
Duane Sayre, Training Program Manager  
David Lee, Salem District Materials Engineer  
Steven Mullins, Bristol District Materials Engineer  
Andy Babish, Richmond District Materials Engineer  
Tanveer Chowdhury, Pavement Management Engineer, Asset Management  
Khaled Galal, Research Scientist, VTRC  
Brian Diefenderfer, Research Scientist, VTRC  
Robert Long, ACPA  
Richard Schreck, VAA

Preparation Plan:

The plan is accomplished in two phases as follows:

**Phase I**

Immediate utilization of applicable portions of the MEPDG to enhance the input to the current AASHTO 1993 Guide for Design of Pavement Structures. These portions include updated Truck Factors, Subgrade Resilient Modulus, and Elastic Modulus, Modulus of Rupture, and Compressive Strength of concrete mixes.

**Task 1 Traffic Data Collection:**

- Traffic data needs to meet the Traffic Monitoring Guide (TMG) requirements. This was accomplished through research report # 04-R3 “A Traffic Data Plan for Mechanistic-Empirical Pavement Designs (2002 Pavement Design Guide)” which was completed 2003.

- The load spectra data collected from Weigh In Motion (WIM) sites shall be used to obtain axle loadings, then converting it to ESAL which leads to updated truck factors, and in turn provide more reliable traffic input for the AASHTO 1993 Guide for Design of Pavement Structures. A research project has been proposed to update the truck factors based on the data collected from the WIM sites with expected completion date of July 31, 2007.
Currently, traffic data is based on 12 operational WIM sites. Nine WIM sites with Tractor Trailer Traffic (TTT) >1000/day and three with Tractor Trailer Traffic < 1000/day. Six sites installed by VDOT and six sites by the Department of Motor Vehicles (DMV) as part of their weight enforcement. Nine locations are on interstates and three locations are on primary routes. At the present time, VDOT has adequate coverage on routes with average TTT >1,000 /day. Three additional WIM sites with TTT<1000/day are proposed for completion by June 2007.

VDOT WIM sites’ use Kistler in-pavement sensors with 3- 5 years life expectancy. The Kistler sensors are being placed in existing smooth pavement to provide Type I traffic data quality. Typically, potential sites are profiled and analyzed using software developed by FHWA-LTPP. If a site meets the smoothness requirements and the truck traffic requirements (>1000 Tractor Trailer Trucks /day), then it is considered as a WIM location. Originally, load cell technology was recommended for use at WIM sites. At the time, this was the only technology available to provide quality data and not pose a potential safety hazard to the traveling public. Load cells require extensive pavement construction/reconstruction during installation. To ensure quality data collection and long-service life, concrete pavement runways are recommended. Given the large initial cost with load cells, the Traffic Committee determined the Kistler technology with the smaller initial cost and shorter-service life was more economical.

The cost to install a two lane Kistler WIM station is $67,000 and the annual cost to operate, maintain and calibrate a site is $10,000 on average.

Traffic Engineering Division has hired 1 Full-Time Position to manage the WIM Program.

The level of the traffic input data is dependent on the availability of the WIM equipment in the area of the project, and whether the project is new alignment or rehabilitation. For example, reconstruction or rehabilitation projects can use level I traffic data, while new alignment will use level II traffic input. Level I traffic data from a near by location and same class highway can also be utilized for new construction. The use of Level I or II traffic data is valid, since the road does not exist yet to meet the site specific criteria for Level I as stated in the MEPDG.
Task 2 Materials Characterization:

Task 2.1 Soils and Aggregate Resilient Modulus:

Use subgrade resilient modulus as input rather than CBR correlation formulas for AASHTO 1993 Pavement Design Guide. VDOT equipment is available to perform the resilient modulus testing. As part of the Beta testing of MEPDG Version 1.000, the Pavement Design and Evaluation Section, and the Soils Section are planning to conduct a seminar (by June 2007) on selecting resilient modulus design input value(s). A total of 120 soil samples, from both project level pavement investigations and new construction projects have been tested as of December 2006.

Task 2.2 Concrete and Stabilized Materials Characterization:

All recent concrete projects have been characterized. The project at Battlefield Boulevard in Hampton Roads District is scheduled for testing for the elastic modulus, modulus of rupture, compressive strength, and coefficient of thermal expansion, and data collection in the spring to early summer of 2007.

Phase II

This phase involves finalizing a functional MEPDG and is dependent on AASHTO’s approval of the Guide (projected to be in 2008). Essentially Phase II will focus on:

- Securing quality input data and data base management
- Sensitivity analysis of the input data
- Applicability of the models
- Verification
- Local Calibration
- Validation
- Default values for Virginia’s conditions and materials
- Use of the software
- Training personnel

Task 1 Traffic Data

- Four WIMs sites in addition to phase I (5 if the SR 288 location truck volume grows as anticipated) are planned in the TTT<1,000 / day category.
- The current cost to install the four sites is approximately $268,000 with an annual maintenance and operation cost of $50,000. For the existing
VDOT WIM sites, the annual cost for maintenance, operation, is $100,000. In addition, approximately $200,000 is budgeted to replace WIM’s that go out of service.

- The Traffic Engineering Division has one full-time employee (FTE) to collect and screen the data. Additional work associated with the WIM program must/will be contracted.

- Traffic Data Committee plans to have a total of 15 WIM sites by December of 2007.

- At least five years worth of good traffic data is needed from all the WIM sites. This is expected to be available by December 2012 with most of the data available by December 2010.

**Planned Future Activities:**


- The Research Council will be analyzing the data and comparing information collected by VDOT to information in the MEPDG software to develop regional load spectra by Jan, 2010. (Contingent on Research Proposal acceptance.)

- The Research Council will be analyzing the axle load data and develop new truck factors for use in the 1993 AASHTO Pavement Design Guide by Jan 2008. (Contingent on Research Proposal acceptance.)

- Other sites will be explored for WIM installations by June 2007.

**Task 2 Materials Characterization:**

**Task 2.1 Soils Data:**

1. Level I soils data is based on site specific soil resilient modulus testing. Based on Level I definition, rehabilitation projects are reasonably qualified for level I input, since the road already exist. Additionally, soils data will be collected from new alignment projects (new construction) to establish soils resilient modulus data base for Level II for future new alignment projects. A continuous effort is under way to have a state-wide coverage for the predominant soils. Expected to be completed by December 2007.

2. Soils Data will also be available as a result of the FWD network level testing being conducted on Virginia’s Interstate system. Back calculated resilient modulus from FWD testing is the highest input level (level I) in the MEPDG for all rehabilitation projects on these routes, expected to be completed by December 2007.
Task 2.2 Aggregate Data:
Both aggregates type I, Size Number 21A, and 21B will be characterized for their resilient modulus. This is a one time characterization to be used with all three levels of input data. Anticipated completion is Sept 2007.

Task 2.3 Asphalt Concrete Data:
Determine which asphalt mixes need to be characterized for the dynamic modulus ($E^*$) and catalogued to meet Levels I, II and III. Preference is given to plant produced mixes and mixes from projects with thick asphalt pavement structure (> 8 inches). This is to establish an asphalt materials database, and assist in predicting the asphalt performance, as part of the validation and calibration tasks.

It is expected to execute a comprehensive testing plan to characterize asphalt mixtures produced throughout Virginia, including SMA mixtures (2007 through 2010). These efforts are expected to use different approaches: testing at VTRC, contracted testing through Virginia Tech, or combination of the two approaches. These efforts will most likely be conducted through the initiation of one or more research projects. The table below lists the proposed testing.

<table>
<thead>
<tr>
<th>Part I Surface Mixtures</th>
<th>Traffic level</th>
<th>PG 64-22</th>
<th>PG 70-22</th>
<th>PG 76-22</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NMAZ</td>
<td>Superpave</td>
<td>SMA</td>
<td>Superpave</td>
</tr>
<tr>
<td>PG 64-22</td>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PG 70-22</td>
<td>12.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PG 76-22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part II Intermediate Mixtures

<table>
<thead>
<tr>
<th>Part II Intermediate Mixtures</th>
<th>Traffic level</th>
<th>PG 64-22</th>
<th>PG 70-22</th>
<th>PG 76-22</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NMAZ</td>
<td>Superpave</td>
<td>SMA</td>
<td>Superpave</td>
</tr>
<tr>
<td>PG 64-22</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PG 70-22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PG 76-22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part III Base Mixtures

<table>
<thead>
<tr>
<th>Part III Base Mixtures</th>
<th>Traffic level</th>
<th>PG 64-22</th>
<th>PG 70-22</th>
<th>PG 76-22</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NMAZ</td>
<td>Superpave</td>
<td>SMA</td>
<td>Superpave</td>
</tr>
<tr>
<td>PG 64-22</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PG 70-22</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PG 76-22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Other Factors that will be considered:

1. RAP %, three levels (low – less than 15 %, intermediate- 15 – 25% and high – greater than 25%).
2. Aggregate sources, two levels (i.e. two sources).
3. Rich bottom asphalt bases, three designs
4. Open Graded Drainage layers, usual VDOT designs and FHWA recommended designs

Current Status:

This includes several completed research projects which are expected to provide great insight into the work to be performed, these are as follows:

1. VTRC project # 07-CR1 “Determination of the In-Place Hot Mix Asphalt Layer Modulus for Rehabilitation Projects Using a Mechanistic-Empirical Procedures,” was completed 2006. This study evaluated the procedures proposed by the MEPDG to characterize existing hot mix asphalt layers for rehabilitation purposes.

2. VTRC project # 05-CR9 “Field Investigation of High Performance Pavements in Virginia,” was completed 2005. The study evaluated 18 pavement sections located in high-traffic highways in Virginia to find a premium pavement design with life span of 40 years or more using current and past field experience.

3. VTRC Project # 05-CR22 “Laboratory Tests for Hot- Mix Asphalt Characterization in Virginia,” was completed in 2005. The study reviewed existing laboratory methods for accurately describing the constitutive behavior of the mixes used in Virginia.

4. VTRC Project # 06- CR1 “Fatigue Life Characterization of Superpave Mixtures at the Virginia Smart Road,” was completed 2005. The study included performing laboratory fatigue testing on six Superpave HMA mixes in use at the Virginia’s Smart Road.

5. VTRC Report # 06-R5 “Creep and Fatigue Characteristics of Superpave Mixtures,” was completed 2005. The study included laboratory creep and fatigue testing performed on five Superpave surface hot-mix asphalt mixtures placed at the Virginia Smart Road.
**Planned Activities:**

VTRC Project # 83149 “Validation of Modulus Backcalculation Methods using 3-D Finite Element Analysis,” was recently initiated to characterize pavement materials for two different pavement locations. The dynamic modulus, indirect tensile and creep testing will be performed on the in-situ asphalt materials. In addition, all underlying materials (including the subgrade) will be tested for resilient modulus and characterized for index parameters.

**Task 2.4 Concrete and Stabilized Materials Data:**

- VDOT concrete mixes for pavements will be characterized for Modulus of Elasticity, Modulus of Rupture, Compressive Strength, and Coefficient of Thermal Expansion for use as level II inputs. Additionally, mixes from new projects will be tested to enhance the Concrete Properties and Stabilized Materials database and to predict concrete pavement performance, as part of the validation, and calibration process. Several reports related to concrete mixes characterization have been published by VTRC including Report # 04-R22 “Evaluation of Continuously Reinforced Hydraulic Cement Concrete Pavement at Virginia’s Smart Road” completed 2004; Report # 05-R7 “Evaluation of High Performance Concrete Pavements in Newport News and Hampton, Virginia” completed 2004; and Report # 04-CR1 “Development of Concrete Shrinkage Performance Specifications” completed 2003.

- Stabilized Materials, including Cement Treated Aggregate (CTA) and Soil Cement (SC) will be tested for their modulus of elasticity. Districts will be asked to provide five samples of CTA and five samples of SC from existing projects to provide adequate coverage of the state. Background data can be obtained from VTRC Report # 06-CR7 “Evaluation of the Strength of Cement –Treated Aggregate for Pavement Bases” completed 2006. The collected data is used for calibration, and establishing both correlation and default values, work to be completed by Dec. 2007.

- The testing facility is operational.

- No additional resources are needed.

- Database for concrete and stabilized materials to be completed by June 2008.

**Current Status:**

- Samples have been obtained and tested in accordance with the MEPDG. The most recent project was CRCP (Madison Heights Bypass, Lynchburg District); testing was completed in 2005. The next project is
also CRCP (Battlefield Boulevard in Hampton Roads District) with testing planned during Spring/Summer of 2007.

- PCC Coefficient of Thermal Expansion testing was conducted at the Concrete Mobile Lab of FHWA. Data reduction to be completed by Dec 31, 2006.

**Task 3 Verification, Calibration, and Validation:**

A comprehensive plan will be developed to compile the necessary information for implementation. For example, several databases are being compiled as part of this implementation effort; material characterization database, traffic database, performance history database, rehabilitation histories database are the major databases that will be considered as a part of the implementation plan. The plan will include an assessment of what needs to be changed, whether or not the local databases can be utilized or converted and what are the most critical input parameters or distresses that should be taken into account. These efforts mimic the ongoing efforts by NCHRP project 1-40B. At present, the target time frame needed to complete this task is December 2012.

**Task 3.1 Verification:**

Running analysis on known pavement designs with accurate pavement performance data utilizing the new MEPDG software would provide assurance of the general reasonableness of the MEPDG output results. This work is being conducted at the VTRC in conjunction with some active research projects, such as US-58 special technical assistant project due in early 2007. Additionally, this effort will continue to be conducted through the initiation of one or more research projects for new and rehabilitated design for all types of pavement structures.

**Task 3.2 Calibration:**

- The calibration process can be defined as minimizing the difference between the predicted output values and the field observed distresses for both flexible and rigid pavements. This process will require the installation or the utilization of existing test sections, where the pavement sections and material characterization are known and distresses are monitored over a long period of time desirably between five to ten years. The calibration process will require extensive experimental studies including but not limited to field testing, laboratory testing and data analysis.

- Five to seven asphalt pavement structures that are 3 to 6 years old are being identified to be monitored during the next 3 years for the calibration process. Similarly, for each type of rigid pavement, five to
seven pavement structures 5 to 10 years old are being identified to be monitored during the next 3 years for the calibration process. Additionally, two to three new structures are being identified for each pavement type for this calibration process. This task is about 6-9 months effort and would require close coordination with the Pavement Design and Evaluation Section. Finite Element Modeling is being conducted to characterize the pavement layer(s) response under dynamic loading for use under MEPDG calibration plan.

**Basic Requirements for Calibration Plan**

- The current plan is to collect data from the LTPP (SPS1 site in Danville), new construction sites (with adequate state coverage), the Smart Road in Blacksburg, and pavement performance data from VDOT Pavement Management System (data available by June 30 2007). This is in addition to the matching sites from LTPP at large (i.e. Southeastern sites due to similar climate). This will allow VDOT to cross check the various levels of actual field distresses with the MEPDG predicted distresses. This effort should lead to either using the default values from the MEPDG or obtaining calibration factors. It is worth mentioning that the LTPP site and the Smart Road sections may not contain all the appropriate data required for the calibration. However, every attempt will be made to utilize available data in this effort.

- Identification of the asphalt and concrete pavement sections (about a mile long) highlighted above is urgently needed to start collecting performance data. A team from the Materials Division, VTRC and Asset Management will visit these sites and a plan will be developed to collect performance related data on these pavement sections. No rehabilitation work should be performed on these pavement sections for the duration of the calibration efforts. These pavement sections should be best identified and selected by the Materials Division & VTRC to represent typical rehabilitation and new designs in Virginia for both types of pavements. Selection of these sections will be completed by August 2007.

- Pavement performance data for asphalt and concrete pavements that are going to be included in the experiment are; visual or automated distresses, pavement ratings, FWD, and IRI. Preferably 5-7 existing pavement sections and 2-3 new pavement structures for both types of pavements. If no data is available, compilation of this data is essential during the next three years for calibration efforts (3 years of data is three points in the performance curve).
• All design information will be compiled on those pavement sections. In addition, coring and boring will be performed on those pavement sections. Materials collected will be characterized per the MEPDG protocol to further enhance the analysis and calibration efforts.

Task 3.3 Validation:

The validation process is used to confirm the accuracy of the models after calibration.

Current Status:

• The calibration activities should take place between 2007 through 2010 through the initiation of one or multiple projects for both types of pavements. These calibration activities are expected to use different approaches: research conducted at VTRC, contracted research through Virginia Tech, or a combination of the two approaches. It is also important to mention that the results from the initial phase of materials characterization (Phase I Task 2.3) will be used as design input to evaluate the MEPDG sensitivity to different asphalt mixtures constituents in designing new or rehabilitated asphalt structures. Similar data is being collected for concrete pavements for the MEPDG sensitivity of concrete pavement design.

• The MEPDG new release software (09.1.0 Version) is being used on selected number of on-going projects. The results should feed directly to the implementation of the MEPDG. This process is also extending to new projects where the use of the MEPDG is deemed reasonable.

Task 3.4 Data Management:

• Work is in the preliminary stages for re-writing the Materials Database System. This task will be completed by December 2008 will ensure all data/information collected to date and in the near future will be in a format that can be retrieved. Some of the major objectives, as related to the MEPDG, that have been identified are:

• The development of a web based system which will allow both VDOT and Contractors to input test results.

• Information collected should include all data required by AMRL.

• Expand the data sources to include field testing.

• Where appropriate include GIS data.
The data is currently stored in SQL Server. Data export will probably include comma-delimited formats and XML. This approach is very suitable for the MEPDG, where it ties data from the districts, and it is accessible to all committees working on the MEPDG. Each Committee is responsible as the custodian of their own data. This is planned as an internal effort where VDOT’s Information Technology (IT) Division would assist with the data management. Target completion date is December 2010.

**Task 4 Training:**

- AASHTO approval and adoption of MEPDG (possibly as an interim guide) is expected by the end of 2007. This target date is used as guide in scheduling the training.

- VDOT personnel have been exposed to pavement design using mechanistic approach through several NHI courses since 1989. Although VDOT personnel used mechanistic design procedures in a limited fashion, they have adequate base knowledge of the methodology, which should help in conducting MEPDG training. However training needs will be continually assessed.

**Task 4.1 Attending the NCHRP 1-40 Training:**

Representatives from the training committee are scheduled to attend the formal MEPDG introduction course to be held in March 2007. This is a two-day program involving representatives from the State DOT, and FHWA. Interaction and exchange of experiences regarding the MEPDG is very essential. It also provides a face to face discussion with the research team.

**Task 4.2 Personnel Training:**

This task is devoted to training both central office and field personnel. The training will be conducted by members of the Training committee. The training of the central office personnel would be conducted first. Three-day training during July 2008 is planned. Training of field personnel (essentially at the Districts) is planned for July 2009. This is to allow for the central office personnel to gain additional expertise with the software, and refine the training program where they become resources to field personnel. It is envisioned that pavement design using both the 1993 Guide and the MEPDG will be performed during the time of calibration (2007-2012). This approach will provide continuous gain of expertise in using the Guide, and comparing results between the 1993 Guide and the MEPDG.
Current Status:

- Through cooperative work with the TRB subsurface Drainage Committee, a workshop on “Investigation of Enhanced Integrated Climatic Model Issues Related to MEPDG”: was co-sponsored, January 22, 2006.

- Sponsored a workshop on “MEPDG: Climatic Considerations” on March 30, 2006. It was attended by 30 people in Virginia.

- Participated in the panel for Lead States meeting in Nashville, TN April 5&6, 2006 and presented VDOT progress of MEPDG implementation plan. Provided an update, on the progress from the NCHRP 1-40 the Independent Review Research Team, to the technical committee Chairs’.

- Reviewed the input data requirements for asphalt concrete rehabilitation level II, and submitted comments to the lead states and NCHRP on the inconsistency between Part II, Chapter 2, and Part III, Chapter 6. The comments were acknowledged by the FHWA, Design Guide Implementation Team (DGIT) August 2006.

- Sept 14, 2006, provided input in ranking of the Technical Briefs to be prepared by a consultant and sponsored by FHWA, DGIT.

- Sept 2006, preparing a response on a “Questionnaire for Implementation of Mechanistic Empirical Pavement Design”. The Questionnaire will be used to assess the state pavement design practices and implementation activities for the MEPDG. The information collected from this new survey will serve as a baseline measurement on the activities related to mechanistic-empirical pavement design procedures on a national basis.


- VDOT received three CD’s for MEPDG version 0.9.1.0, and have been distributed to the PD&E Section and VTRC Sept 2006.

- Version 1.0 of the MEPDG software is expected for release by January 2007.

- The first draft of the MEPDG user manual will be the document that accompany the software for AASHTO balloting. The final draft is due by March 31, 2007.
• The MEPDG workshop is planned for the Spring of 2007.

• The VTRC library has excellent collection of publications and reports related to MEPDG research in Virginia. All technical committee Chairs’ are encouraged to check them out.

• VDOT has volunteered to do beta testing of Version 1.0 of the MEPDG software as soon as it is released. It is expected by January 2007.

Task 4.3 Impact on VDOT Standards and Specifications:

This involves the adjustments needed to accommodate The Guide requirements. It is expected to be a dynamic process with continuing efforts from all parties.

• Level I design requires site-specific input data, but since our plans are prepared at least two years in advance, it is necessary to have close cooperation between the designer, and the contract preparation team. As an example, the Performance Prediction Model is based on the initial International Roughness Index (IRI) as built, thus it may be advisable that the contract consider such initial IRI value. This may result in a change in the way we do business. Consideration is needed to achieve in construction what was expected and input into the design. Performance specifications seem to lend themselves well to the goal for implementing the MEPDG. As an example, Cement Treated Aggregate (CTA) currently has prescriptive specifications i.e., use 4% cement by weight with Type I, size 21A aggregate. This prescriptive method may be re-assessed in light of the MEPDG and data collected from Task 4.4 Concrete and Stabilized Materials Data can be utilized as part of VDOT specifications.

• The above preparation plan is based on the available information to date. Several milestones in this plan are based on anticipated time for completion of the NCHRP 1-40 “Facilitating the Implementation of the Guide for the Design of New and Rehabilitated Pavement Structures” and the research panel review.

• The next milestone is when the latest version (1.0) of the software is presented, and the state DOTs training is done. This will provide the opportunity to ask more detailed questions to the National Research Team, and interact with other states to benefit from their approach, and in turn making adjustment to VDOT plan.