

Federal Highway Administration
Every Day Counts
Innovation Initiative



Summary Report for the 3D Engineered Models for Stringless Paving Workshop

Hosted
Missouri Department Transportation
FHWA Missouri Division



Summary Report
National Concrete Pavement Technology Center

National Concrete Pavement
Technology Center



Project Description:

“Every Day Counts Initiative 1½ Day Demonstration Workshop on 3D Engineered Models for Stringless Concrete Paving” funded by the Federal Highway Administration (FHWA) and hosted by the Missouri Department of Transportation (MoDOT).

Objectives:

The demonstration workshop training event focused on the proven technology of 3D engineered models for concrete stringless pavements. The first day focused on presentations of workflows, implementation, and project examples using the technology. The field demonstration, a construction project using the technology, took place in the morning of the second day.

Goals:

1. Provide an informational sharing process and training concerning the usage of 3D engineered models for construction of concrete pavements.
2. Provide the foundation for MoDOT to start the development of guidelines to implement 3D workflows contract administration and inspection processes.
3. Provide training about current proven tools and methods that are available to accelerate the delivery of highway projects.

The targeted audience was transportation agencies, consultants, and contractors involved in highway project delivery.

Task Completion:

Task 1: Event Development and Administration.

- Hotel Arrangements

Arrangements were made for a block of hotel rooms and meeting space at the Sheraton Westport Hotel Lakeside Chalet, 191 Westport Plaza, St. Louis, MO

The meeting was held in the Zurich/Geneva rooms with ample space for the attendees to be seated classroom style. The room had sufficient space for the breakfast and break items to be in the back of the room. The hotel refreshed beverages throughout the day. The room had a large patio space overlooking the pond making for relaxing break-times. Lunch was served in the Matterhorn room.

The hotel was located in the West Port Plaza within easy walking distance of a number of restaurants. The majority of the participants joined small groups and ate dinner on Wednesday evening at one of the outdoor venues in the plaza.

- Field Transportation

The field demo site was arranged between MoDOT and Millstone Weber for a paving site on the St. Louis Route 364/Page Ave Phase 3 project.

Project Website: http://www.modot.org/stlouis/major_projects/Route364upgrade.htm

Two 44 passenger buses from Mid-American Coaches were used for transportation during the field demonstration. Each bus had MoDOT and construction personnel on-board to give an overview of the project and answer questions.

Registrants coming to the conference were reminded to bring personal safety items (hard hat, safety vest, safety glasses); the CP Tech Center provided these items for individuals unable to bring their own (i.e. those flying in).

- Agenda

The CP Tech Center and MoDOT committee developed an agenda using agendas from previous 3D workshops sponsored through EDC as a guide. The sessions were led by subject matter experts from consulting firms and other DOTs as well as MoDOT personnel and project contractor representatives.

Day 1: Presentation Session

- | | |
|-------|---|
| 8:00 | Welcome – Tom Cackler, National Concrete Pavement Technology Center <ul style="list-style-type: none">• Welcome & Desired Goals - Dave Ahlvers, MoDOT State Construction & Materials Engineer• Kevin Ward - FHWA Missouri Division Administrator |
| 8:30 | Overview of 3D Engineered Models for Highway Construction – Gabe Nelson, Snyder and Associates <ul style="list-style-type: none">• State of Practice and Why Implement this Technology• Level of Details in 3D Models• How to Get Started |
| 10:00 | Capturing Existing Conditions in 3D Engineered Models – Joe Bruno, ESP Associates <ul style="list-style-type: none">• Overview of survey methods & technology to meet desired level of accuracy• Deliverables from 3D Surveys (LIDAR)• Managing large data sets |
| 10:45 | Working with 3D Models in Design and Construction, Part 1 – Alexa Mitchell, MoDOT <ul style="list-style-type: none">• Creating 3D Design Model – Level of detail, calculating quantities & visualization• 3D Model – Level of detail matrix• Deliverables for bidding – alignments, profiles, surfaces, components, formats, and method of delivery to contractor• Contractors' needs to support 3D models for AMG and stringless paving – Joel Richardson/Mathew Poston, Millstone Weber |
| 12:45 | Electronic Data & the Law - John Koenig, Regional Counsel MoDOT; Gabe Nelson, Snyder |
| 1:30 | Working with 3D Models in Design and Construction , Part 2 <ul style="list-style-type: none">• Project example: I35 Unbonded Concrete Overlay – John Donahue, MoDOT• Modern Survey Technology for Quality Assurance- John Lobbestael, Michigan DOT• Using 3D Models in the Field – What is useful to the contractor? – Robbie Pope, Gomaco• Quality Process – Eric Kopinski, MoDOT |
| 4:00 | Creating a Plan to Implement 3D Engineered Models – Jason Littleton, Kentucky DOT <ul style="list-style-type: none">• Identifying and establishing vision, goals, roles, responsibilities and accountability measures• Identifying baseline challenges• Share success stories and learned lessons |
| 4:30 | Q & A Speakers Panel – Tony Babcock, National CP Tech Center moderator |
| 5:00 | Adjourn for the Day |

Day 2: Project Example & Demonstration of Technology

8:00	Project Overview - Eric Kopinski, MoDOT
9:00	Board buses and travel to project site <i>Project tour/Quality procedures (Paving, MIT scan, etc.)</i>
11:30	Board buses and return to hotel
Noon	Adjourn

Task 2: Invitational Travel

A flyer was developed and sent out electronically to a list supplied by MoDOT. States around Missouri were offered invitational travel for two representatives. Illinois, Kansas, Nebraska, and Kentucky were represented. In addition, the Michigan DOT was represented as John Loebbestael was one of the SME's asked to present on modern survey technology for quality assurance.

The total attendance at the workshop was 80; made up of:

32	Missouri DOT
18	Consultants/industry
14	Other DOTs
13	FHWA headquarters and division offices
3	National CP Tech Center

Flights were arranged, hotel rooms secured and reimbursements for meals were made for invitational travel and SMEs; 15 individuals.

In addition, 10 MoDOT individuals were reimbursed for their travel expenses.

Task 3: Event Organization

A notebook containing the PowerPoint slides from the presentations, background material on 3D modeling, a map and information on the demonstration site, a roster of attendees and evaluation form were distributed to all attendees. Certificates verifying attendance and allowing for PDHs to be claimed were given to all attendees. The flyer, agenda and PowerPoint slides are available at <http://www.cptechcenter.org/events/archive/MoDOT3DModelsWorkshop>

Task 4: Event Documents

The material from the workshop is available in hard copy by request from the National Concrete Pavement Technology Center, Iowa State University, 2711 S. Loop Dr, Ste 4700, Ames, IA 50010.

The CP Tech Center captured the question & answer sessions from each of the presentations. In an addition topics to be considered for implementation guidelines have been outlined, and the participant evaluations have been summarized.

1. Question and answer sessions

Gabe Nelson – Overview of 3D Engineered Models

- When constructing PCC overlays, are contractors reducing their thickness or yield?
Contractors have been able to reduce the thickness of the constructed pavements to plan or incentivized thickness. This in turn reduces the yields. An example was given of a 6" unbonded PCC overlay in Iowa, where yields typically average 106% to 108%, that had yields in the 102% to 103% and full thickness incentive was achieved.
- Tell us more about the webinars that will be available?
Webinars for 3D Engineered Models will be available on the FHWA website in September. The webinars can be found at: www.fhwa.dot.gov/3d

Joe Bruno – Capturing Existing Conditions in 3D Engineered Models

- How does the mobile LIDAR technology perform in heavily forested, mountainous terrain?
Mobile LIDAR has been used extensively in mountainous areas of the Virginias and the Carolinas with excellent results. It is able to be used around and through many types of obstructions including multi-level interchanges, dense forests, and tunnels.
- How are your surveyors sealing the data?
There is a capability to sign the metadata and lock the files.

Alexa Mitchell – Working with 3d Models in Design and Construction

- What is the timeframe for MoDOT to implement 3D Engineered Models?
MoDOT has begun implementing 3D Engineered Models on a project level basis. Training for design staff in the districts will begin in 2015.
- What is the timeline for MoDOT to require 3D Engineered Models from their consultants?
MoDOT's policy will not require 3D Engineered Models until all of the MoDOT staff have been trained. MoDOT will allow consultants to supply 3D Engineered Models prior to that.
- Are libraries for Microstation SS3 available from MoDOT?
MoDOT has completed their libraries, but are in the process of testing them. MoDOT wants to be confident in the accuracy and reliability of the libraries prior to release.
- What QC is MoDOT using for their models?
MoDOT is not performing any QC as of yet on their models. Millstone-Weber indicated that they perform their own QC by using the paper plans.
- Is MoDOT modeling drainage structures?
Yes, but mainly in the districts with more urban drainage structures.

2. Outline with topics to be considered for implementation guidelines for 3D construction inspection, quality assurance, and payment of quantities.

- FHWA EDC2 has developed a website to assist owners, designers, and contractors in understanding the benefits of, and how to implement 3D modeling technology. New web page www.fhwa.dot.gov/3d (search “fhwa 3D”)
 - Specs, Standards, Details, Tech Briefs, Case Studies, etc.
- Technical Support Service Center (TSSC)
 - Accessible via web page
 - Provides technical assistance & personal responses to specific questions
 - Staffed by national subject matter experts
 - Provides initial response within 24 hours of inquiry
- Web-based training (available October 2014)
 - The focus is on critical topics that support new users’ implementation of 3D modeling
 - Four, 90-minute online modules; available 24/7, at users’ convenience
 - Users can start, stop, and then pick up where they left off
- Implementation Manual for 3D Engineered Models for Construction (January 2015)
 - Common definitions, standards, and process steps for 3D modeling;
 - Design procedures on how to properly generate accurate 3D models for downstream use in bidding and construction;
 - Standards for 3D digital terrain model and 3D engineered models;
 - 3D data density standards focused on the frequency of data points for 3D models;
 - Changes in office workflow to convert from a 2D to 3D process;
 - Project selection guidelines for use of 3D models;
 - Data needs for various circumstances and types of projects;
 - Practices for presenting/storing/recovering large amounts of electronic data; and,
 - Method of storing 3D plans/data for long term recovery/reuse.
- The most important first step is a discussion between agency and contractor associations as to what the needs are and applications available. The following items may facilitate the discussion leading up to the implementation plan.
- Automated Machine Guidance (AMG) and Automated Machine Control (AMC) Systems
 - Understand the difference between AMG and AMC systems
 - AMG for grading
 - AMC (often synonymous with AMG, but it is a different system)
 - Equipment Applications
 - New equipment can have AMG factory installed, existing equip can retrofitted
 - Understanding the capabilities and limitations of:
 - ◆ Grading Equipment
 - ◆ Excavators
 - ◆ Compaction Equipment (Intelligent compaction)
 - ◆ Milling and Paving Machinery
 - Stringless Technology
 - Understanding the difference in stringless controlled operation

- Computer Inputs
 - Proprietary software and equipment are unique
 - AMG systems can only accept certain file types
 - Important to understand needs & limitations of a system to use it effectively
 - Grading and Excavation
 - Paving and Milling Machines (Inputs differ compared to AMG grading and milling)
- AMG User Guidelines
 - Training – needed for Owner/Agency and Contractor/Operator
 - Error Checking: critical for data transformation
 - File Management: include review checklist
 - Contractor Creation of 3D Engineered Model
 - ◆ Contractor needs to have ability to upload the 3D engineered model
 - ◆ Survey base station/GPS base station
 - Survey Control and Machine Control for Stringless Operations
 - ◆ Different than GPS base station for grading
- Challenges and Limitations
 - Difficult sites (hilly terrain, obstructed satellite windows, congested space)
 - ◆ Adequate satellite strength is needed to use GPS-controlled AMG construction. Lack of adequate signal strength may necessitate the use of total stations
- Scheduling, Cost Estimating and Project Management Applications
 - Digital Terrain Models (DTMs) and Earthwork Quantity Estimation.
 - With a DTM and the detailed site survey collected by expanding survey technologies, contractors are able to precisely and accurately calculate the project quantities using the 3D model. The methods of earthwork calculation between two 3D surfaces has significant advantage over the end-area method
 - 4D and 5D Modeling
 - While typically only used currently in very complex projects where modeling effort produces a return on investment, advanced models can be constructed using the 3D model as a base.
- Facilities Management
 - Civil Integrated Management (CIM)
 - Collection, organization and managed accessibility to accurate data related to highway facility including planning, environmental, surveying, design, construction, maintenance, asset management and risk assessment.
 - Similar to Building Information Modeling (BIM) used by architectural industry
- Quality Assurance and Post Construction Applications
 - Applications in Construction Observation and Inspection
 - Increased schedule efficiency & cost savings
 - Handheld GPS equipment to spot-check elevations and horizontal offsets
 - Accurately gather utility location during and after construction
 - Improved Quality
 - Ability to update the 3D engineered model using a mobile computer system.
 - 3D model becomes the record drawing without the need to obtain an additional as-built survey

3. Workshop Evaluation (Evaluations were in the participants' packets; 25 were completed.)

	Average	Very Good	OK	Needs Improvement		
1. Topics covered	1.4	1 - 13	2 - 11	3 - 1	4	5
2. Organization of the program	1.3	1 - 18	2 - 6	3 - 1	4	5
3. Speakers knowledgeable	1.3	1 - 17	2 - 8	3 - 4	5	
4. Facilities were accommodating	1.6	1 - 16	2 - 6	3 - 1	4 - 1	5 - 1
5. Program met expectations	1.4	1 - 15	2 - 9	3 - 1	4	5

6. What were the most worthwhile parts of this program?

- Design aspects & specs
- Variety of topics
- John Lobbestael's presentation was most beneficial to me as a construction inspector
- Working with 3D
- Section on LIDAR
- John Koenig
- See what other states are doing (2)
- Interactive discussions with the group
- Contractor's perspective
- Info on what DOTs have had work and not work (2)
- Project tour (2)
- The legal aspect of the electronic files was excellent

7. What were the least worthwhile parts of this program?

- Not enough from the construction viewpoint of 3D modeling
- The first two presentations: overview & LIDAR were somewhat boring/un-informational
- Modern survey techniques for QA
- Some too complicated
- Intro too long
- Specific details about equipment
- Lots of information for just one day
- Somewhat repetitive

8. What other topics were you hoping would be included in today's program?

- More QC/QA between contractor & state agency in all aspects of 3D modeling
- How is MoDOT handling contractors using 3D models on their own?
- How are state DOT's inspectors handling 3D projects where contractor is using AMG
- More on actual lessons learned
- Curious about overall cost savings
- More info on pros/cons of why this technology is important