MoDOT’s 3D Design Implementation, Electronic Deliverables, and E-Construction

Ashley Buechter, P.E.
MoDOT CADD Support Engineer

LADOTD Transportation Conference
February 29, 2016
General Information and Process

Bentley Power GEOPAK SS4

- Training material
  - MicroStation, GEOPAK Survey, GEOPAK Survey Conversion, GEOPAK Road (including Civil Cells), GEOPAK Road Conversion, Construction, Visualization

Training – CADD Staff

Implementation / Roll-out

Support

Policy update / Webpage update

Construction

Training – MoDOT District Design Staff

- Additional Training
  - Follow-up Trainings
  - Training for Consultants
  - Regularly Scheduled Trainings
MoDOT’s Implementation of 3D Design

- Start with training Program Delivery Staff.
  - New tools and workflows.
  - Flipping the switch.

- Roll-out and train in Construction.
  - New tools and workflows.
  - Flipping the switch.

- Train Consultants.
  - Current contract.
What’s Happened So Far?

<table>
<thead>
<tr>
<th>Training</th>
<th>Dates</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>District Design Mock Training</td>
<td>January 12-15, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>District Surveyor Training #1</td>
<td>January 26-28, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>District Surveyor Training #2</td>
<td>February 2-5, 2015</td>
<td>✓</td>
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<tr>
<td>District Designer Trainings:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central District</td>
<td>March 2-6, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>Southwest District</td>
<td>April 13-16, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>Northwest District</td>
<td>May 11-14, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>Southeast District</td>
<td>June 1-4, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>St. Louis District</td>
<td>June 22-25, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>Northeast District</td>
<td>July 20-23, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>Kansas City District</td>
<td>August 24-28, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>Bridge</td>
<td>July 15, 2015</td>
<td>✓</td>
</tr>
<tr>
<td>Remaining MoDOT users</td>
<td>Fall/Winter '15-'16</td>
<td>✓</td>
</tr>
</tbody>
</table>

*A few unexpected “road blocks” have pushed our schedule...*
What’s Coming?

• Trainings:

<table>
<thead>
<tr>
<th>Training</th>
<th>Dates</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>Consultants</td>
<td>Spring '16</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Spring '16</td>
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<td>Regularly Scheduled Trainings</td>
<td>Ongoing</td>
<td></td>
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<tr>
<td>Follow-up Trainings</td>
<td>TBD</td>
<td></td>
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<tr>
<td>Visualization</td>
<td>TBD</td>
<td></td>
</tr>
</tbody>
</table>

• Online Trainings.

• Support.

• Policy update / Webpage update…
EPG 237.14 Electronic Design Data Delivery is Changing

- Required Deliverables (as applicable per project):
  - Contents File Report.
  - Geometry File (alignments and profiles).
  - 3D Proposed Features.
  - 3D Existing Surface.
  - 3D Proposed Surface(s).
  - Survey Report and ASCII File containing control points.
  - 3D Engineered Model.
Electronic Deliverables in detail:

- **Contents File Report**
  - Summary of all electronic information provided.
  - Delivery = required on all projects.

- **Geometry File (alignments and profiles)**
  - Contains all final alignments used in the development of the contract plans.
  - Delivery = depends on type of project.

- **3D Proposed Features**
  - Contains 3D proposed features (EOP, shoulders, curbs, etc.).
  - Delivery = depends on type of project.
Electronic Deliverables in detail:

- **3D Existing Surface**
  - Represents the existing ground conditions as provided by survey.
  - Delivery = depends on type of project.

- **3D Proposed Surface(s)**
  - Represents the proposed surface(s) as designed (created using graphical filters).
    - Top of Subgrade.
    - Top of Base.
    - Proposed Finished Grade.
  - Delivery = depends on type of project.
Electronic Deliverables in detail:

- **Survey Report and ASCII File**
  - Summary of the project control metadata and the method in which the topography and terrain information if obtained for a project.
  - Control points as delivered from survey or photogrammetry.
  - Delivery = depends on type of project.

- **3D Engineered Model**
  - 3D model representing the entire project as designed for contract plans.
  - Delivery = depends on type of project.
Will 3D digital data be available for all projects?

<table>
<thead>
<tr>
<th>Type of Project</th>
<th>Survey Report</th>
<th>ASCII File (containing control points)</th>
<th>3D Existing Surface (TIN model)</th>
<th>Geometry File (alignments and profiles)</th>
<th>3D Proposed Surface(s)</th>
<th>3D Proposed Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Replacement</td>
<td>X</td>
<td>X</td>
<td>n/a</td>
<td>X</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>Bridge Rehabilitation</td>
<td>X</td>
<td>X</td>
<td>n/a</td>
<td>X</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Resurfacing (1R) (<a href="https://example.com/epg128.2">EPG 128.2</a>)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>• Contract leveling course (CLC).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Resurfacing and Restoration (2R) (<a href="https://example.com/epg128.2">EPG 128.2</a>)</td>
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<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>• Thin Hot Mix Asphalt Overlay.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Resurfacing, Restoration or Rehabilitation of Non-Freeway Roadways (3R) (<a href="https://example.com/epg128.3">EPG 128.3</a>)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>Resurfacing, Restoration, Rehabilitation or Reconstruction of Interstate or Freeway Roadways (4R) (<a href="https://example.com/epg128.4">EPG 128.4</a>)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Minor Routes Shouldering (<a href="https://example.com/epg">EPG</a>)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Guardrail</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>ADA</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Roundabouts</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>• Detailed intersection design that includes earthwork and pavement quantities.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Intersection Reconstruction</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>• Intersection improvement that requires detailed design that includes earthwork and pavement quantities.</td>
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<tr>
<td>Expansion/New Construction</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

* Required Formats: Native CADD File (.dgn), Generic CADD File (.dxf), LandXML, PDF
3D Models for Construction

- Software much better suited for 3D design.
- Powerful templates and civil cells for corridor and site design.
- Templates built for constructability.
- Better 3D digital data deliverables for construction staff.
What 3D digital data will Construction get?

Design data that provides $x, y, z$ information for different components of the design ready to upload to AMG equipment such as:

- Alignments and profiles.
- 3D breaklines (EOP, EOS).
- Surfaces/Digital terrain models (DTM’s).
DTM’s

- DTM’s = surfaces ready to upload into AMG equipment.
- DTM’s for each component.
- DTM’s = no need for cross-section sheets.
Rumor has it...
Cross section sheets “FIO”
Earthwork calculations shown on quantity sheets:

### Missouri Highways and Transportation Commission

#### Summary of Quantities

<table>
<thead>
<tr>
<th>Station ID</th>
<th>Station Location</th>
<th>Type A Shoulder</th>
<th>Length (ft)</th>
<th>Width (ft)</th>
<th>Area (sq ft)</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>18+00.00</td>
<td>22+00.00</td>
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<tr>
<td>19+40.50</td>
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<td>21+81.00</td>
<td>27+81.00</td>
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</tbody>
</table>

#### Earthwork (Calculated from 3D Model)

<table>
<thead>
<tr>
<th>STA</th>
<th>Class A (CY)</th>
<th>Class C (CY)</th>
<th>Embankment In Place (CY)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3+00</td>
<td>500</td>
<td>250</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6+00</td>
<td>300</td>
<td>450</td>
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</tr>
<tr>
<td>9+00</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>300</td>
</tr>
</tbody>
</table>
Other Upcoming Changes

- Bluebeam Revu
Other Upcoming Changes

- The digital data (or 3D model) itself.
  - MoDOT will provide the digital data/model.
  - The contractor can use the digital data for bidding purposes, load into equipment for automated machine guidance (AMG), and load onto survey equipment for surface preparation/construction.
  - The contractor cannot change the digital data/model without the engineer’s approval.
For the contractor this means:

- 3D data is easily converted for your CADD software.
- 3D data is easily uploaded to your machinery and survey equipment.
- Accurate data/information for bid preparation.
- Easier to catch avoidable mistakes; reduced rework.
- Minimum survey staking.
- Increased safety – workers less exposed to hazards.
- Reduced construction cost!
What’s next?

- Fully implement SS4.
- Fully implement policies.
- Continue piloting Bluebeam Revu for as-built plans.
- Pilot Projects for E-Construction.
  - we’ve done a couple stringless paving operations.
Keeping Everyone Updated

http://www.modot.org/business/standards_and_specs/geopakstandards.htm

- Subscribe to MoDOT’s Drafting Standards Update.
- Download MoDOT’s most current configuration and workspace.
- Draft Electronic Deliverables EPG article will be emailed to Drafting Standards email group and posted to the webpage for review and comment (survey).
THANK YOU!