PENNDOT 3D MODELING FOR STRUCTURES WORKSHOP

Presented by: Steven Pletcher and Chris Daniels, P.E.
October 21, 2014
Agenda

• Introduction
• G.A. & F.C. Wagman History
• Process used to prepare 3D models
• Estimating and bid preparation; cost and constructability
• Construction planning and project management
• Error checking and/or conflicting information
• Sharing 3D information
• Closing and open for questions
3D Modeling Software and Tools

- AutoCAD & Carlson Software
- Micro Station for conversion of DOT plans
- AutoCAD DWG viewer for 3D sharing
- Google Earth for spatial placement and sharing
Paper Plans to Digital Model Files

• Entering horizontal alignments and project coordinates
• Entering vertical alignment and elevations
• Entering bridge deck surface geometry slopes and widths
### SUMMARY OF PROJECT COORDINATES

**Based on the Pennsylvania State Plane Coordinate System**

<table>
<thead>
<tr>
<th>STATION</th>
<th>COORDINATES</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+00.00</td>
<td>244636.350, 2717774.284</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>0+15.00</td>
<td>244783.079, 2717624.953</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>0+30.00</td>
<td>244929.807, 2717475.622</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>0+45.00</td>
<td>245076.535, 2717326.291</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>0+60.00</td>
<td>245223.263, 2717176.959</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>0+75.00</td>
<td>245369.991, 2716927.627</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>0+90.00</td>
<td>245516.719, 2716678.295</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>1+00.00</td>
<td>245663.447, 2716428.963</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>1+15.00</td>
<td>245810.175, 2716179.632</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>1+30.00</td>
<td>245956.903, 2715930.301</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>1+45.00</td>
<td>246103.631, 2715680.969</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>1+60.00</td>
<td>246250.359, 2715431.638</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>1+75.00</td>
<td>246397.087, 2715182.306</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
<tr>
<td>1+90.00</td>
<td>246543.815, 2714933.974</td>
<td>35°18’47” N, 81°30’24” W</td>
</tr>
</tbody>
</table>

**Horizontal Alignment - Coordinates**

**GEOMETRIC DATA**

---

*Note: The coordinates are for computational purposes only and do not imply precision beyond two decimal places.*
Paper Plans to Digital Model Files

- Horizontal Alignment - Baselines
Paper Plans to Digital Model Files

- AutoCAD View Horizontal Alignment - Baselines
Paper Plans to Digital Model Files

- Vertical Alignment – Roadway Profiles
Paper Plans to Digital Model Files

- AutoCAD View Vertical Alignment - Profiles
Paper Plans to Digital Model Files

- Cross Slope – Typical Sections
Paper Plans to Digital Model Files

- AutoCAD View Cross Slopes – Typical Sections
Adding Bridge Elements
- Footings, Piling, and Girders

• Working point coordinates entered from plan table
• Substructure line work created from working points
• 2D girder lines drawn
  ◦ Spans checked for consistency and compared to plan distances
• Girder Shapes drawn and attached to 3D Girder Lines.
Example - ECMS 79686 Philadelphia GR1

The description and location of the project is as follows:

Reconstruction and relocation of S.R. 2001; reconstruction of S.R. 2008 and rehabilitation of the bridge over S.R. 2009; construction of four single-span railroad bridges and four retaining walls; extension of the Somerset Street sewer; reconstruction of the associated interceptor chamber; two traffic signal installations; ITS devices; utility relocations; and other miscellaneous construction (All as indicated on approved drawings for State Route 0095, Section GR1, in Philadelphia County, City of Philadelphia, from approximately Dyott Street at segment 0130 offset 2384 to approximately Ann Street at segment 0160 offset 1147)
GR1- Contract Substructure Plans
GR1- Contract Substructure Plans
GR1 Frame 3D Plan
GR1 Frame 3D Plan
GR1 3D Animation Showing Piling Locations
GR1 3D Model Showing Existing Bridge Beams and Proposed Piling
Estimating, Planning, and Project Management

- Construction access
- Material handling
- Crane sizing and setup
Estimating

- Dominion Boulevard, Chesapeake, VA

The need for replacement of the existing bridge and the construction of a four-lane on-off-lane facility between Interstate 664/64 and old U.S. Route 17 in the City of Chesapeake was initially identified in the Hampton Roads 2050 Regional Transportation Plan and the February 1990 City of Chesapeake Master Road Plan. The project is currently the City of Chesapeake’s number one transportation priority. The need for improvements within the project limits arises from the fact that the existing Dominion Boulevard/US 17 corridor is characterized by:

- A substantial bridge height over the Southern Branch of the Elizabeth River which requires numerous bridge openings,
- Increasing traffic volumes, and
- Traffic safety concerns.

Through potentially several phases of design and construction, the proposed improvements would ultimately convert existing Dominion Boulevard/US 17 to a limited access four-lane toll facility throughout project limits. These improvements would reduce or eliminate the number of bridge openings and would address present and future traffic and safety concerns through the year 2020.

The information presented here represents advancement of the design for the segment of the project from Cubed Road to the Oak Grove Connector, as well as preliminary information related to the entire project corridor. Alternatives for the various segments of the project were presented at a Citizens’ Information Meeting held on October 12, 2006. Based on comments received at that meeting, as well as the alternative analysis documented in the EA, the design of the segment from Cubed Road to the Oak Grove Connector is presented in greater detail this evening, as recommended.

The Federal Highway Administration must approve the need for the proposed improvements, as well as the EA, plans, specifications, cost estimates, right-of-way acquisitions and construction procedures. The participation of the decision-making process provides an additional check to assure that federal, state and local goals are met and that opportunity for public input is provided. Federal and state regulations require that a range of factors and impacts are considered and that final decisions are made in the best overall public interest.

Project Impacts

Environmental: The environmental impacts and mitigation measures associated with construction of the project are detailed in the EA which is available upon request. In addition, a cultural resources survey was conducted to determine the potential effects of the project on historic properties listed or eligible for listing in the National Register of Historic Places. The results of this survey are also available for review.

Right of Way Impact Statement: The proposed improvements will require acquisition of land for right-of-way and easement purposes. Construction of the project is anticipated to affect 193 acres, and is anticipated to result in 179 residential displacements and 6 commercial displacements. None of these displacements are non-profit organizations. These impacts are identified on the public hearing plans and project displays. As we further coordinate and finalize project development, utility easement locations will be shown. Prior to the rights-of-way acquisition process and construction, all required right-of-way and easements will be shown on the plans. For right-of-way or relocation assistance information contact Ms. Colette Copek (757) 382-4000.

Construction Costs:

The current cost estimate for the segment of Dominion Boulevard from Cubed Road to the Oak Grove Connector Interchange is $351.6 million. This cost is broken down as follows:

- Construction - $207.1 million
- Right-of-Way/Utilities - $44.1 million
- Preliminary Engineering (PE) - $1.1 million

The total cost estimate for the segment of Dominion Boulevard south of Cedar Road is approximately $23.9 million. As the preliminary engineering for this segment of the project has not been advanced to the same level of detail as the northern segment, a cost breakdown is not yet available.

Design Year/Projected Traffic:

This Design Year for the project in 2030. The projected Average Daily Traffic (ADT) in Dominion Boulevard in the design year is approximately 41,200 vehicles per day. The current ADT is approximately 20,000 vehicles per day.
Estimating

- Crane Positioning and Setup

Dominion Boulevard, Chesapeake, VA
Estimating

- Crane Positioning and Setup – Plan View

Dominion Boulevard, Chesapeake, VA
Estimating

NC 12 Pea Island, Dare County N.C.
Estimating

- Pile and Footing – Plan View to 3D View

NC 12 Pea Island, Dare County N.C.
Estimating

• Crane Positioning and Setup – Plan View

NC 12  Pea Island, Dare County N.C.
Estimating

- Crane Positioning and Setup – Plan View

NC 12  Pea Island, Dare County N.C.
Estimating

- Crane Positioning and Setup – Elevation View

NC 12  Pea Island, Dare County N.C.
Job Planning Construction Analysis

- Garden State Parkway, Great Egg Harbor, NJ
Job Planning Construction Analysis

- Garden State Parkway, Great Egg Harbor, NJ
Job Planning Construction Analysis

• Visual aids for complex designs
Job Planning Construction Analysis

- Visual aids for construction

PA Turnpike, M.P. 245 over Susquehanna River
Job Planning Construction Analysis

- Bridge substructure with causeway placement

PA Turnpike, M.P. 245 over Susquehanna River
Plan Conflict Identification

- I-95/I-695 Sec 100, MD – Owner’s Rendering
Plan Conflict Identification

- I-95/I-695 Sec 100, MD
Plan Conflict Identification

- Wire Frame Model S-8 Pier5- Cap Redesign
Plan Conflict Identification

- Money and time savings... redesign with minimal impacts
Plan Conflict Identification

- Money and time savings

Example of subterranean conflict
Plan Conflict Identification

- Money and time savings

Example of subterranean conflict
Plan Conflict Identification

- Money and time savings

Example of subterranean conflict
Sharing/Distributing 3D Information

- Export using Google Earth - Dulles Metro
Sharing/Distributing 3D Information
• Export using Autodesk DWG Design Review
Closing Ideas

• Owner information supplied in digital format will reduce the amount of time spent converting paper plans into useable digital 3D information

• Need for deliverables to be in real world coordinate systems or specific project grid... Nad83 North or South for PennDOT projects.

• Ideas for formats to share digital files AutoCAD/MicroStation