Model Based Contracting at NYSDOT

Pilot Project Discussion
AASHTO Committee on Bridges and Structures T-19

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Director Structures Design Bureau - NYSDOT
June 24th, 2019
Agenda

• What is Model Based Contracting?
• Proposed Implementation
• Contract Deliverables
• Questions and Discussion
What is Model Based Contracting?

- Specify **contractual work** with relevant 3D CADD models or electronic information
- Reduce or eliminate corresponding 2D plans

By providing all the information that is traditionally contained in the 2D plans with 3D models, the 2D plans become unnecessary.
Proposed Implementation

Project Location
Town of Shandaken
Rt. 28. over Esopus Creek
Catskill Mountains
Proposed Implementation
Pilot Project

Current Project Status
• Advanced Detail Plans: June 2019 (distributed last week)
• PS&E: September 2019
• Pre-bid Meeting: December 2019
• Letting: January 2020 (6 week ad)
• Construction: 2020 and 2021

Project is being designed completely with in-house staff
• MO Structures Design Bureau
• MO Design Services Bureau

Existing Bridge – 4 spans – 335 ft long
Proposed Bridge – 5 spans – 801 ft long
NYSDOT goals for Pilot Project:

1. Create a process to include models as part of the legal contract documents for NYSDOT projects
2. Leverage technology to explore more efficient ways for NYSDOT to do business (design to construction)
Highway Design – Model Based Contracting Deliverables

**Typical Sections** – Model
**Horizontal Geometry** – Model and Data Reports
**Vertical Geometry** – Model and Data Reports
**Superelevation** – Data Reports
**Miscellaneous Details** – Model and or Plan Sheets
**General Plans** – Model
**Notes** – Plan Sheets
**Miscellaneous Tables** – Plan Sheets
**Other Plans** (WZTC, Traffic Signals, Drainage, etc. – Plan Sheets)
**Bridge – Model Based Contracting Deliverables**

- **Earthwork** – Model
- **Substructures** – Model
- **Structural Steel (geometry)** – Model and Data Reports*
- **Slab Details** – Model
- **Reinforcement Details** – Model and Data Reports
- **Notes** – Plan Sheets
- **Standard Details** – Plan Sheets

*Will be providing horizontal alignment for each girder with an attached vertical alignment for the top and bottom flange

**Superstructure Information:**
- Superstructure Model is in final deflected position
- Horizontal Curvature in first span
- Superelevation in first span
- Haunched girders
Proposed Implementation

Required Changes

1. A plan sheet will list all the electronic files identified as plans and notes addressing use of the electronic files.

2. A special note will be added to the proposal modifying the definition of “plans” and providing detailed information on how to utilize models.
# Proposed Implementation

## Electronic Files Plan Sheet

### Electronic Files Identified as Plans

<table>
<thead>
<tr>
<th>File Name</th>
<th>File Description</th>
<th>Date/Time Modified</th>
<th>Engineer of Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>D264XX_FEA_RWY_ALG.XML</td>
<td>ROADWAY GEOMETRY</td>
<td>5/31/19 9:53 AM</td>
<td>ERIC R. COULTER</td>
</tr>
<tr>
<td>D264XX_FEA_RWY_FG.XML</td>
<td>FINISHED GRADE SURFACE</td>
<td>5/31/19 9:54 AM</td>
<td>ERIC R. COULTER</td>
</tr>
<tr>
<td>D264XX_FEA_SUPER1212.XLSX</td>
<td>ROUTE 212 SUPERELEVATION</td>
<td>5/31/19 9:53 AM</td>
<td>ERIC R. COULTER</td>
</tr>
<tr>
<td>D264XX_FEA_SUPER1212.XLSX</td>
<td>ROUTE 28 SUPERELEVATION</td>
<td>5/31/19 9:53 AM</td>
<td>ERIC R. COULTER</td>
</tr>
<tr>
<td>D264XX_FEA_RWY_CONTRACT1.DGN</td>
<td>HIGHWAY MODEL</td>
<td>6/14/19 11:45 AM</td>
<td>ERIC R. COULTER</td>
</tr>
<tr>
<td>D264XX_FEA_GEO_CONTRACT_GINTI.DGN</td>
<td>GEOTECH MODEL</td>
<td>6/14/19 11:47 AM</td>
<td>STEPHEN L. BORG</td>
</tr>
<tr>
<td>D264XX_FEA_BRD_70_CONTRACT_BRIDGE.I.DGN</td>
<td>BRIDGE MODEL</td>
<td>6/14/19 11:47 AM</td>
<td>GEORGE W. SENFT</td>
</tr>
<tr>
<td>D264XX_FE_BRD_70_CONTRACT_GIRDERS_OBM.I.DGN</td>
<td>SUPERSTRUCTURE MODEL</td>
<td>6/14/19 1:20 PM</td>
<td>GEORGE W. SENFT</td>
</tr>
<tr>
<td>D264XX_CPB_TBL_CAM.XLS</td>
<td>CAMBER TABLE</td>
<td>6/7/19 7:55 AM</td>
<td>GEORGE W. SENFT</td>
</tr>
<tr>
<td>D264XX_CPB_TBL_HAUXLSX</td>
<td>HAUNCH TABLE</td>
<td>6/7/19 7:55 AM</td>
<td>GEORGE W. SENFT</td>
</tr>
<tr>
<td>D264XX_CPB_TBL_MOM.XLS</td>
<td>MOMENT TABLE</td>
<td>6/7/19 7:55 AM</td>
<td>GEORGE W. SENFT</td>
</tr>
</tbody>
</table>

### Federated Review File - Supplemental Information Only

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
<th>Date/Time Modified</th>
<th>Engineer of Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>801846_MBC_FEDERATED.I.DGN</td>
<td>FEDERATED FILE</td>
<td>6/14/19 1:20 AM</td>
<td>NOT APPLICABLE</td>
</tr>
</tbody>
</table>
Proposed Implementation

Electronic Files Special Note

The Electronic Files Special Note will address the following:

- Definition of Terms
- Electronic File Content
Proposed Implementation
Electronic Files Special Note

Contract Document Components.
... declining order of precedence ...

1. Plans.
2. Proposal - Special Notes.

I. Definition of Terms

Current Definition in Section 101-02:

**Plans.** The official contract drawings and applicable standard sheets, which show the location, character, dimensions and details of the work to be performed.

Proposed Definition in Special Note:
The official contract drawings and applicable standard sheets, which show the location, character, dimensions and details of the work to be performed. The Plans will also include any electronic files identified as Plans. This may include engineering models, spreadsheets, CAD files or other electronic files used to convey design intent.
Proposed Implementation

Electronic Files Special Note

The contract will utilize both traditional 2D plans and electronic files to convey the required work.

Each element of work will be provided in only one format! “Plans” or “Electronic Files Identified as Plans”
For each component of work with electronic files identified as plans, descriptions and explanations are provided so that the contractor knows how to access the information.

Provide the same level of information given on traditional plans in an electronic format (models, spreadsheet, or report)

Example: Substructure Concrete

Each pour of substructure concrete is modeled as one solid 3D element. The level name coincides with the pour number. The 3D solid element is geospatially located using the appropriate State Plane Coordinate System.
Proposed Implementation

Electronic File Content
Example: Substructure Concrete

The following can be directly obtained from the 3D solid model:

- Elevations
- Northing/Easting coordinates
- Component lengths
- Distances between points
- Volume of pours
- Surface areas

The following is not contained in the 3D solid model:

- Keyway details
- Waterstop details
- Chamfer details

This information can be found on the project plan sheets:
Example: Bar Reinforcement for Concrete Structures

Bar reinforcement is modeled using 3D Line Bar models. Information is given by:

- Graphics (quantity, location, and geometry)
- Item Types (Tags)
- Barlist
# Proposed Implementation

## Electronic Files Special Note

Table in Special Note informs user how to obtain information required to fabricate bars.

<table>
<thead>
<tr>
<th>Information Provided</th>
<th>Description</th>
<th>3D Line Bar Model</th>
<th>Barlist (Plan sheets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Identification</td>
<td>Unique number ordering the bar sets in each structure element</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bar size</td>
<td>Diameter of the bar reinforcement in the bar set</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Bar Coating</td>
<td>Corrosion protection of the bar set</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bar Quantity</td>
<td>Total count of bars in the set</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Bar Geometry</td>
<td>Leg lengths and bends of bar is the set.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Element</td>
<td>Type of structural element the bar set is in</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pour</td>
<td>Structural pour number that the reinforcement originates in.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bar Location</td>
<td>General location of bars in the substructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Cover</td>
<td>Min. required clear cover for all bars in the set. Actual cover will vary by</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>ply.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Position of the bars relative to min.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Shop Drawings – Structural Steel/Precast Concrete

NYSDOT would like fabricators to take advantage of contractual electronic data and submit model based shop drawings.

Benefits:
• Increased efficiency for fabricator
• Increased accuracy – no data re-entry

Challenges:
• New process
• Software compatibilities
• Learning curve

Contractual Information Provided in Pilot Project
• 3D model of girders/diaphragms in final deflected position – OBM file
• Data reports
  o Top of web and bottom of web geometry – xml file
  o Camber – excel file
Shop Drawings – Structural Steel/Precast Concrete

Potential Contractual Note – Structural Steel
“ALTERNATIVE MODEL BASED SHOP DRAWING SUBMISSIONS WILL BE CONSIDERED WITH APPROVAL FROM THE DCES. APPROVAL OF ALTERNATIVE METHODS TO TRADITIONAL SHOP DRAWINGS SHALL BE OBTAINED FROM THE DCES BEFORE SHOP DRAWING DATA IS GENERATED. ALL RELEVANT SHOP DRAWING INFORMATION STIPULATED IN THE NYS SCM IS STILL REQUIRED IN THE SUBMITTAL PACKAGE.”

Potential Contractual Note – Precast Concrete
FOR THE PRECAST CONCRETE BOX CULVERT, ALTERNATIVE MODEL BASED SHOP DRAWING SUBMISSIONS WILL BE CONSIDERED WITH APPROVAL FROM THE DCES. APPROVAL OF ALTERNATIVE METHODS TO TRADITIONAL SHOP DRAWINGS SHALL BE OBTAINED FROM THE DCES BEFORE SHOP DRAWING DATA IS GENERATED. ALL RELEVANT SHOP DRAWING INFORMATION STIPULATED IN §704-03 IS STILL REQUIRED IN THE SUBMITTAL PACKAGE.
Contract Deliverables: What should the contractual file type be?

New Software
- OpenBridge Modeler
- OpenRoads Designer
- gINT – Geotechnical Software

New Terminology
- i-model (Bentley)
- Federated Model

Choices for contractual files:
1. .dgn files
   - Everyone is familiar with
2. i.dgn files
   - Have not used
   - Difficult to develop process for creation
   - Can embed documents
   - Read only
i-Model Workflow

**Federated Model is for user convenience**

**Structures Files**
- 801846_fea_brd_70_supplemental_girders_obm.dgn**
- D264xxx_fea_brd_70_contract_obm.i.dgn*
- 801846_fea_brd_70_supplemental_bridge.dgn**
- D264xxx_fea_brd_70_contract_bridge.i.dgn*

**Geotech Files**
- 801846_fea_geo_supplemental_gint.dgn**
- D264xxx_fea_geo_contract_gint.i.dgn*

**Highway Files**
- 801846_fea_rvy_supplemental.dgn**
- D264xxx_fea_rvy_contract.i.dgn*

**Create Saved Views**
Create Item Types (Applies to all .dgn files)

**Create Embedded Links**

- 801846_mbc_federated.dgn**
- 801846_mbc_federated.i.dgn**

*Contractual
**Supplemental Info
Communicating Information within Model

How do we deliver the traditional 2D plan information in the model?

- Item Types
  - Extended element information (100% Customizable)

- Saved Views
  - Preset views to call attention/showcase

- Embedded Documents
  - .pdf’s/.doc/.xls, etc.
Item Types - Example

Pile Information
- Pile #: 8
- Section: CIP
- Min. Pile Section Moduli
- Batter: 6 on 1

Item Information
- Item #: 551.11
- Item Desc.: Cast In Place Concrete Piles
- Comment: 14" OD
Jumping into the full model can be overwhelming!
Saved Views – Example #1
Saved Views – Example #2
Embedded documents can be either contractual or supplemental.
Embedded Documents - Example

Extended Element
Level: O_Details_Callout Cloud_P

Links to:
Joint_Details.pdf
Railing_Details.pdf
Bearing_Details.pdf
Pile_Details.pdf
How will the models be reviewed by bidders prior to the letting or by outside agencies?

Bentley View is a free CADD viewing software that is available online. Any contractor/fabricator can access the contract models for free.
Model Ownership

Who owns the 3D model?

NYSDOT Designer retains ownership of model (Design-Bid-Build). The contractor is a user of the model. They are not responsible for design changes. Any amendments or field revisions needed will be the responsibility of the designer.

In Short: No changes to the current process!
Training will be provided to:

• Design Reviewers (NYSDOT and FHWA)
• Construction Inspection Staff – Staff will be trained the winter prior to project start
• Contractor
  • Outreach to AGC prior to letting (4 information meetings)
  • Pre-Bid meeting
  • Partnering Item to be included in contract
  • Training/coordination after letting as needed
Questions and Discussion