AASHTO Committee on Construction 2019 Annual Meeting

Electronic Contract Documents

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Survey by the Subcommittee on Construction of 3D Engineered Models for Construction

Q3 Does your state utilize 3D Engineered Modeling in the Design process?

- Yes: 81.25% (26 responses)
- No: 18.75% (6 responses)

Total: 32 responses
Our universe is changing
Our universe is changing
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Our universe is changing

- eConstruction
- Automated Machine Guidance
- LIDAR
- Visualization
- Animations
- 3D Highway Design

- 3D Bridge Design
- Paperless Business Models
- Asset Management Data Collection Efforts
- UAV’s
How We Got Started

- We initiated our AMG effort in 2003, with the goal to our first AMG project in 2 years.
- We met with contractor McAninch Corp who went to win the 2005 Award of Excellence from ENR for their work in AMG.
- We met with Caterpillar, Topcon, and Trimble
- Our first AMG project was in 2006, a 2.6-mile section of the 4-lane reconstruction of IA 60, in northwest Iowa.
- We had 3 contractors, two used Trimble equipment and one used Topcon. It gave us experience providing files and working with both systems which was extremely valuable.
How We Got Started: First AMG Project
How We Got Started: IA 6o Limits Map included in the Plan
How We Got Started:

• From 2006 until 2015 we provided files pre-letting along with the regular bidding documents for the contractors use.

• The files remained for information only.

• **Electronic information shall not be considered a representation of actual conditions to be encountered during construction.** Providing the Contractor this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered, including but not limited to site visits, and basing the bid on information obtained from these investigations and professional interpretations and judgment. Contractor assumes the risk of error if the information is used for any purposes for which the information was not intended. Assumptions the Contractor makes from this electronic information or manipulation of the electronic information is at their risk.
A. Contractor may use equipment with AMG that results in meeting the same accuracy requirements as conventional construction as detailed in the Standard Specifications.

B. Use this section in conjunction with Section 2526 unless construction survey is being provided by the Engineer.

C. Electronic files.

1. Available electronic files will be provided by the Contracting Authority with the Proposal Form. This information is available at the Office of Contracts’ website.
. Additional Contractor Responsibilities.

1. **Provide a rover, readily available for Engineer to use,** during duration of contract.
2. **Provide Engineer up to 8 hours of formal training** on Contractor’s AMG systems.
3. **Contractor bears all costs,** including but not limited to cost of actual reconstruction of work that may be incurred due to errors in application of AMG techniques. Grade elevation errors, rework resulting from errors or failures of AMG system, and associated quantity adjustments resulting from Contractor’s activities are at no cost to Contracting Authority. Delays due to late submittals or satellite reception of signals to operate AMG system will not result in adjustment to contract unit prices or justification for granting contract extensions.
4. **Check and recalibrate, if necessary, AMG system at beginning of each work day.**
1105.04 CONFORMITY WITH AND COORDINATION OF THE CONTRACT DOCUMENTS.

A. In case of a discrepancy between contents of the contract documents, the following items listed by descending order shall prevail:
1. Addendum
2. Proposal Form
3. Special Provision
4. Plans
6. Developmental Specifications
7. Supplemental Specifications
8. General Supplemental Specifications
9. Standard Specifications
10. Materials I.M.
11. Notice to Bidders

B. Electronic support files, if available, will be provided prior to letting and are for information only. Should there be a discrepancy between an electronic support file and a contract document, the contract document shall govern.
2. Convert electronic data provided by the Contracting Authority into the format required by AMG system. Files made available will be in a generic format. For **naming conventions and file formats refer to Office of Design’s online design manual**. Note that additional files, such as storm sewer design files, may be included in the original design software format. Files provided may include:

a. **CAD Files**: Primary CADD (Computer Aided Design and Drafting) design file that may include:
   - CADD cross section files.
   - CADD Right of Way file.
   - CADD Topography files.
   - 3D Design break line files in an industry standard format.
b. Machine Control Surface Model Files (including topsoil placement where required on the plans): Documentation file describing all of surface models, typically in LandXML format. Areas where a surface model is not provided, Contractor may, at no additional cost to Contracting Authority, develop required surface models to facilitate AMG.

c. Alignment Data Files: Documentation file describing alignment information both horizontal and vertical, typically in LandXML format.
What We Learned

• Create a partnership with the AGC. We met with them when we started and we continue to meet with them once or twice a year to evaluate how we are doing, and where they are going.

• Transitioning for your designers is key.
  • Reviewing 3D deliverables
  • Signing and Sealing Electronic Documents
  • Understanding how the files are used by the contractor, what adjustments are they making.

• Trust is an aspect often overlooked.
  • Contractor
  • Designers
  • Contract Administration Staff
From 2006 to 2015

- 2006: First AMG Project
- 2009: Moved to first true 3D Software for Design
- 2015: The Next Step
The Next Step
The Next Step: Electronic Files as the Controlling Document

- Change the perception and use of the electronic document. Move from At-risk to Value Added.
- How do we preserve the integrity of the electronic documents.
- We needed to find the right project, in this case that was one that had both grading and paving.
- How would this impact contract administration
- Industry readiness
- We needed to learn more about what happens to the files once they leave our hands.
  - How do you control changes to the model
  - Can we incorporate some of that into our process
The Next Step: Electronic Files as the Controlling Document

- We selected a project that we thought had all of the elements that would give us good feedback and included several disciplines.
- We added a Special Provision by addendum elevating the electronic files above the paper\pdf plans.
- We indicated that if any changes needed to be made that the Department would be responsible for making the necessary changes.
- We made it mandatory for machine guided grading and optional for paving.
- We did not change our process for this project.
The Next Step: Excerpts From SP- 120279
SPECIAL PROVISIONS FOR CONFORMITY WITH AND
COORDINATION OF THE CONTRACT DOCUMENTS

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by descending order shall prevail:
1. Addendum
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3. Special Provision
5. Plans
7. Developmental Specifications
8. Supplemental Specifications
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The Next Step: Excerpts From SP- 120279
SPECIAL PROVISIONS FOR CONFORMITY WITH AND
COORDINATION OF THE CONTRACT DOCUMENTS

A. With the exception of small or irregular areas, **Automated Machine Guidance** according to Article 1105.17 will be required for the grading and paving on this project.

B. Digital Contract Files.
   1. Digital Files contained within the 81-1691-021_E_Files_(DataFiles).zip file package listed below (files are listed in descending order of precedence):
      a. LandXML Geometry file: hv_dsn_021.xml within the "Alignment_Data_Files" subfolder.
      b. LandXML surface files: All LandXML files within the "Machine_Control_Surfaces" subfolder.
      c. Three dimensional line string CADD files: All DXF files contained within the "DXF_Files" subfolder.
   2. See Appendix A for names, time stamps, and sizes of official files.

3. The digital files are available for download at the following web site for the project listed above: http://www.iowadot.gov/contracts/lettings.html
1105.04, D.

Replace the Article:

The Contractor shall not take advantage of any apparent error, omission, or discrepancy in the contract documents. The Engineer will be permitted to make such correction in interpretation as may be deemed necessary for the fulfillment of the intent of the contract documents subject to compensation as provided in Articles 1109.03, 1109.04 and 1109.16. Written notice of changes in the contract documents will be given to the Contractor by the Engineer. Field adjustment of digital contract files, if necessary, will be completed by the Engineer.
The Next Step: The Project IA 196 in Sac County

Grade and Pave

- Project Information
  - Length: 8 miles
  - Earthwork Quantity: 432,651 Cubic Yards
  - Paving Quantity 148,618 Square yards
  - Two Bridge Replacements: Over the Raccoon River and Cedar Creek
  - Replacement of a Single Box Culvert

- In conjunction with the completion of the US 20 Corridor in Northwest Iowa
Project runs from the Junction of IA 196 and US 71 north to approximately 1 mile north of US 71 in Sac County, Iowa.
Junction of IA 196 and US 71
IA 196 at the Raccoon River
IA 196 at the Raccoon River
Single Box Culvert
Cedar Creek Bridge
Cedar Creek Bridge
The Results

- The successful low bidder was a joint venture between Peterson Contractors Inc. and Godbersen-Smith. Cedar Valley Corp. was selected as sub for the Paving.

- Letting Results: (Grade and Pave Project only)
  - Programmed Amount: $18,915,000
  - Awarded Amount: $18,854,801.68

- No adjustments in electronic files needed by the contractor
- Contractor typically transfers risk to the engineering consultant on traditional GPS projects.
- Reduced costs for contract survey.
- No difference in their bid, if anything it reduced costs.
- The contractor preferred this approach. Less risk.
- No difference or issues for the contract administration staff. Although initially concerned now supportive.
What We Learned: Readiness Is Key

- **Designers**
  - Software
  - Processes
  - Staff

- **Consultants**
  - Software
  - Processes
  - Staff
  - Post letting

- **Contractors**
  - Equipment
  - Investment
  - Experience/Trust
  - Staff

- **Contract Administration**
  - Equipment
  - Investment
  - Experience/Trust
  - Staff
What We Learned: Contractor Readiness

- This represents a significant investment in equipment, software and training.
- Is your agency putting out for bid enough grading and paving projects to warrant then investment?
- What is their level of experience working with AMG?
- Is the contractor developing their own models, or modifying the models provided by the transportation agency?
- Have the contractors requested the electronic files?
- The industries may be at different level in terms of their adoption of AMG
Where We Are Today:

• In 2016 we let 6 projects were the files were the controlling document, if the contractor elected to use AMG for either grading or paving.

• In 2017 we added a supplemental specification to all in-house designed projects that indicated that if a contractor elected to use AMG that the files were the controlling document.
Where We Are Today:

- For in-house designed projects only, all grading, grade and pave, and paving projects are let with the Special Provision elevating the electronic files over the plans if the contractor elects to use AMG.
- We have not transitioned Consultant designed projects at this time, although we hope to have a couple of pilots next year.
- We are in the process of transitioning from Bentley SS4 to Open Roads Designer.
- Our goal is to let our first pilot of an electronic plan next years in conjunction with our transition to Open Roads Designer.
- Transition the plan for a contract document to an asset management tool
Moving Forward

- Staging
- Constructability
- Renderings
- Animations
- Virtual Reality
Improving the Quality of our 3D Designs
Interstate 80/380 Interchange Reconstruction
Interstate 80/380 Interchange Reconstruction
Interstate 80/380 Interchange Reconstruction
3D Renderings
Animation

prepared for a public hearing to show the operation of a j-turn intersection
VR as a Design Tool
Examples
I-35/US 30 Interchange
Unique Theme
I-35/US 30 Interchange

- The concern was the ability to find acceptable gaps to merge with northbound I-35 traffic with the new berm and piers.
The Project Combined the VR Experience with This Driving Simulator

Iowa DOT Director Mark Lowe taking the simulator for a spin
Virtual Reality Drive Through of Southbound I-35 to Westbound US 30 Ramp
Use of VR to Perform Project Walk Throughs Proof of Concept

US 30 and US 218 Intersection in Benton County Iowa
Use of VR to Perform Project Walk Throughs Proof of Concept

US 30 and US 218 Intersection J-Turn Proposal

• Our test was to use the animation we used for the Public Information Meeting to create a VR walk through of the property circled above, which involved the Youngville Cafe
The objective is to demonstrate the ability to create a virtual reality walk through for a perspective property owner impacted by a project.
Questions?