KDOT's Evaluation of Sharing Electronic Data with Contractors and GPS Construction Processes

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INTRODUCTION

KDOT's electronic processes were evaluated in response to advancing technology in the construction industry. State Transportation Agencies were beginning to share electronic design data between consultants, contractors and other project partners. A popular use of this data by contractors was for GPS machine controlled grading and construction staking. Requests for additional electronic design files became more frequent as contractors sought files to assist in the creation of 3D models.

Goal of Initiative

- Evaluate Release of Electronic Design Files
  - Determine Type and Format of Files to Provide
  - Determine Appropriate Time to Release Files
- Evaluate Impacts to Construction Inspection and Design Processes
- Address Legal Considerations

DATA COLLECTION

Partnering was a major component of the data collection. Practical experience was obtained through a pilot project and projects constructed under an interim policy

Practical Experience

- Initial Electronic Deliverables Policy Created
- Electronic Design Files Released for Pilot Project
- Pilot Project Feedback Meetings
- Interim Policy Established
- Construction Staking Specification Updated
- New Policy and Disclaimer Effective

Data Collection

- Surveyed Contractors
- Obtained Input from Industry Experts
- Attended GPS Demonstration
- Obtained Input from KDOT Surveyors
- Surveyed KDOT and Consultant Designers
- Obtained Input from Internal Designers
- Collected Input on Timing of File Release
- Type of Files and Method for Releasing Files Determined

ELECTRONIC DELIVERABLES POLICY

Existing Policies

KDOT's initial electronic deliverables policy released **alignment repot files and cross section report files** to contractors. These files were provided to contractors prior to letting via KDOT's website.

Pilot Project

Additional electronic files released
- Base File (plan view of entire project) (Microstation format)
- Cross Section Files (Microstation format)
- Existing Ground Survey (tin format)

Contractor perceived benefits of releasing electronic files
- Contractor could use CAD files to immediately incorporate plan changes through e-mail and create value engineering proposals using established plan data
- Existing ground survey can be used to verify plan information during pre-construction, find suitable borrow locations, develop a more efficient work plan and create an erosion control plan.

Consultant designer felt the electronic cross section files were expected to have a higher level of accuracy then what was necessary when the files were only used for printed plans.

Contractor Input (9 Contractors Responded to Survey)

Survey Question	Contractor Responses
Use of existing electronic deliverables	• Check quantities • Build 3D model • Layout project (survey) • Exchange information • Acquire more accurate information
Additional electronic files preferred by contractors	• Plan view (6) • Cross-sections (5) • Existing survey (4) • Profile view (3)
Preferred format for additional files	• Autocad (4) • Autocad or Microstation (3)
Benefits of providing additional files	• Cost savings • Time savings • Improved product quality • More accurate bids • Quicker identification of errors • More accurate 3D models
3D model preference	• Contractor created (4) • KDOT created (4)

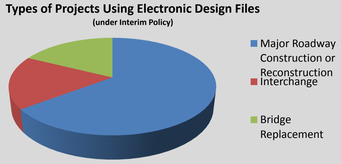
Designer Input

(6 KDOT Road Design Squads and 7 Consulting Firms Responded to Survey)
- Minimal work to provide electronic design files typically created during design
- Additional quality control necessary
- Preferred to have paper plans control
- Recommended a disclaimer to protect KDOT and consultant

Interim Policy

Files provided under Interim Policy
- **Base File**
- **Cross Section Files**
- **Existing Ground Survey**
- **Plan and Profile Sheet Files** (sheets as shown in plans in Microstation format)

Files were provided for 17 KDOT projects and overall the projects were larger than KDOT's average project size. There were concerns about the accurate use of the electronic design files and liability, after two and a half years these issues had not arisen.



Surveyor Input

Coordinate data was provided along the perimeter of the project. These data were valuable to construction staking, because it allowed the surveyor to provide critical calibration points for GPS.

Additional files provided to aid in GPS construction staking:
- **Right-of-Way Staking Package** (coordinates for all the right-of-way points)
- **Section Corner Coordinate Detail Sheet** (coordinates for all section corners located during the project survey)

Final Policy

Files released under the final policy included those from the existing policy, the interim policy and identified through surveyor input.

Releasing Files Prior to Letting
- Contractors can more accurately and efficiently bid project
- Highest potential cost savings

Releasing Files After Letting
- Alleviates liability concerns of contractors using files for bid preparation

KDOT decided to release the electronic files before letting, the files continue to be available on KDOT's website.

Creation of 3D Models: At the time, KDOT did not design in 3D and 3D models were not required to be created during the design process. Under the current policy contractors are required to create their own model to use GPS machine controlled grading.

GPS MACHINCE CONTROLLED GRADING

The most significant barrier to implementation of GPS grading was found to be the lack of agency specifications for GPS machine controlled grading.

Benefits of Machine Controlled Grading

(Indentified in Literature Review)
- Reduced Staking
- More Efficient Processes
- Lower Bids
- Lower Fuel Consumption and Emissions
- Safer Work Environment
- Greater Accuracy / Higher Quality Product

Quantifying the benefits of GPS grading was difficult and it was unclear what portions of the benefits were passed on to the State Transportation Agencies.

Affects on Construction Inspection

Construction inspectors working on the **pilot project** recommended revising construction specifications to clearly identify expectations when GPS grading is used and provide training on 3D models and GPS grading.

Two methods were presented by **industry experts** to verify earthwork and take advantage of GPS grading benefits including less frequent staking and contractor provided rovers and training for construction inspectors.

KDOT Surveyors felt that increasing stake spacing to 300 to 400 feet was appropriate and noted that a contractor provided rover would not provide an independent check.

Construction Staking Specification

The construction staking specification was revised to clarify expectations of the contractors when using GPS equipment.

Contractor Use of Electronic Files: **Printed plans controlled** over the electronic design files and contractors were required to notify KDOT of any errors. Contractors were required to provide KDOT with a copy of the 3D model created. Presently KDOT did not review and approve the contractor's 3D model.

GPS Training for Construction Inspectors: Contractors provided a GPS rover and training to the construction inspectors.

Reduced Staking: The contractor was required to place centerline stakes, slope stakes and grade stakes at 500 foot intervals on tangents and 250 foot intervals on curves, transitions and breakpoints.

Finish Grading and Paving: GPS controlled grading equipment **did not have the vertical accuracy** to be used for finish grading and paving at this time. KDOT had accepted stringless paving using Total Stations, on a trail basis.

LEGAL CONSIDERATIONS

The most significant legal issue considered was whether the release of the files increased the agency's liability. To limit the agency's liability, KDOT treated the electronic design files as non-contract documents, designated that the KDOT-printed plans control over the electronic drawings and required the contractor assume the risks of using these files. This was accomplished through language on KDOT's website, construction contract specifications and professional services contracts.

SUMMARY OF CHALLENGES

Challenge	Input	Decision
Lack of knowledge and experience	• Surveys • Industry Expert Input • Pilot Project	• Provide construction inspectors with GPS rover • Provide inspector training
Fear of releasing electronic data/legal concerns	• Literature Review • Surveys • Industry Expert Input	• Paper plans control • Liability covered by specifications and disclaimer
Source of 3D model	• Literature Review • Surveys • Industry Expert Input	• Provided 2D design files • 3D files created by contractor
Quantifying Benefits	• Literature Review • Surveys • Industry Expert Input • Pilot Project • Interim Policy	• Not practical to obtain quantitative benefits • Qualitative benefits were identified

CONCLUSION

Documents Created

- Updated **construction staking specification** addressing GPS machine controlled grading and liability of releasing electronic design files
- New **road design policy** for the release of two-dimensional CAD files created during the design process to contractors prior to letting
- Updated Exploratory and Project Documents website **disclaimer** and bidding contract specification to cover the release of electronic design files.

Future Recommendations

KDOT has continued to evaluate the use of electronic deliverables by contractors and possible improvements to the policy.