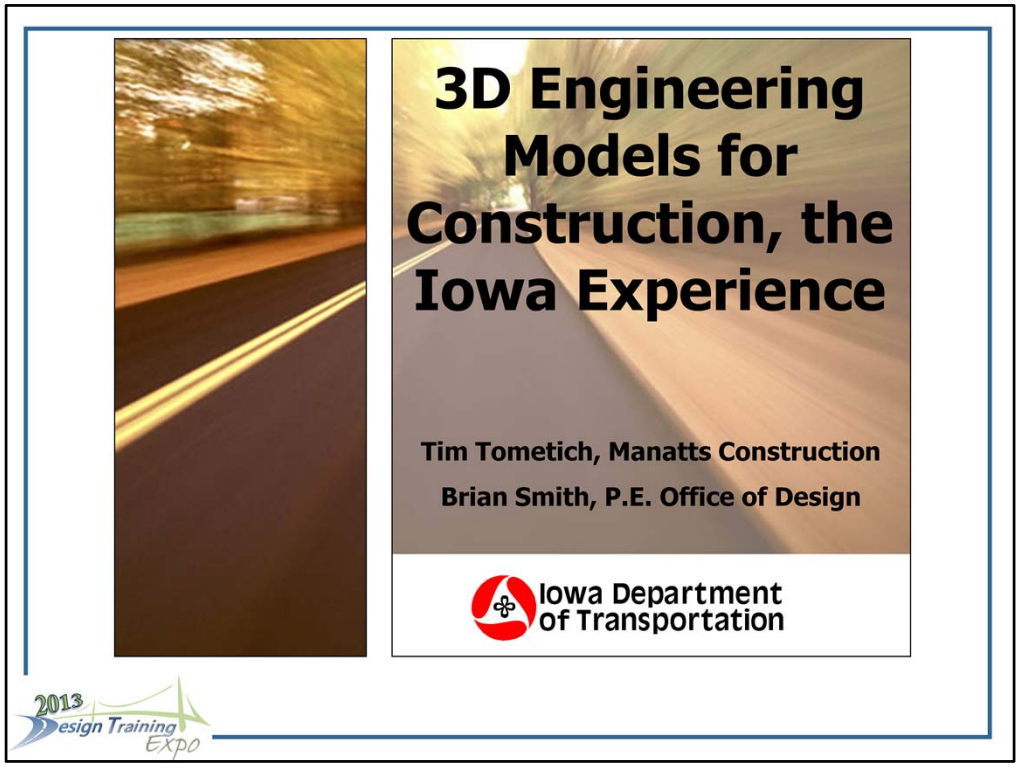
2013 Design Training Expo




I would like to thank everyone for giving the Iowa DOT time to share some of the things we have been working on.

# Presentation Outline

## The Iowa DOT experience with 3-D Design

- Iowa's goals for 3-D design
- Initial steps towards 3-D design and machine guidance
- Flaws with the initial design and letting process
- Process that we are currently using for design letting and long term storage of 3-D files
- Things made simpler by the new process
- LiDAR and point cloud use by the Iowa DOT
- Video Clip

## We will also touch on these topics

- Why should you do 3D Design?
- Importance of 3-D Design Standards
- Owner/Designer professional responsibility and accountability for 3-D data
- Successes resulting from using 3-D Design
- Making 3-D data available to bidders while minimizing risk of contract claims and disputes

## Iowa's goals for 3-D design

Goals:

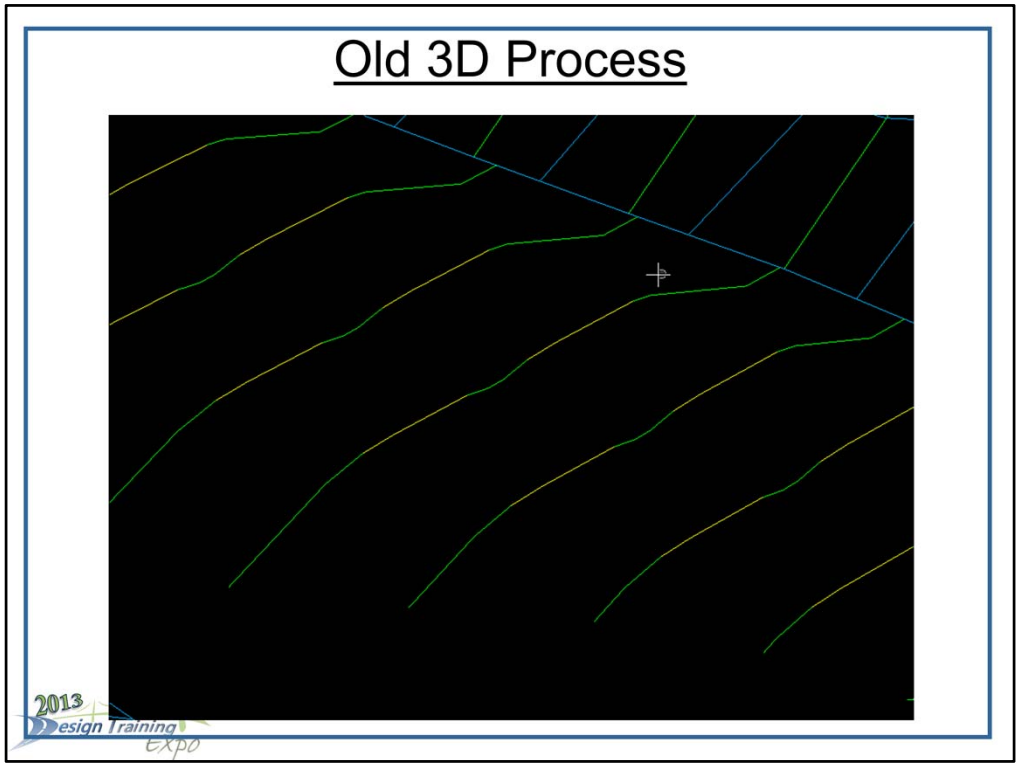
- Improved Design
  - You can easily review areas that could be missed in a 2-D view
- Project Visualization
  - A 3-D walk through is a good way to present your design to stake holders.
- Set up for Machine Guidance Files
  - To create the digital terrain surfaces needed for machine guidance, 3-D design is required

•Our Road Design office has made 3D design a top priority.
•A few of the slides coming up will demonstrate how 3D models help improve the review of designs
•For project visualization and Machine guidance files, 3D design is a must.

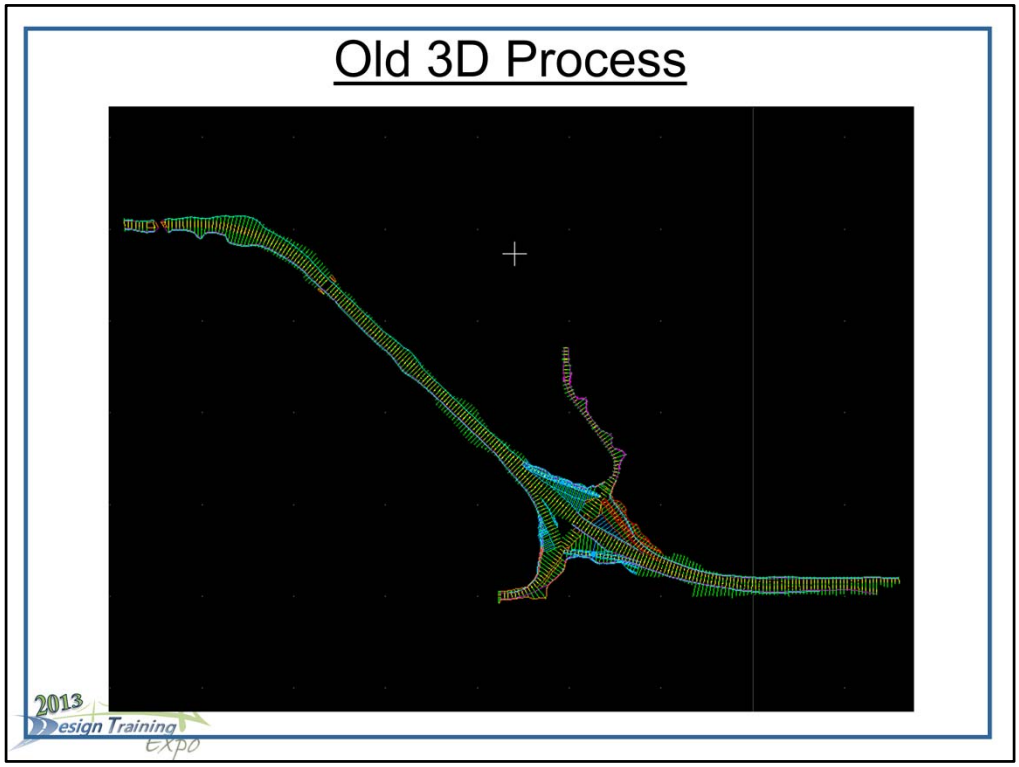
## Initial steps towards 3-D design and machine guidance

- Initially, pulled 2D cross sections into a 3-D file
- Tried to satisfy contractor's many file type needs
- Initial process voided many difficult areas
- Files were only provided after the letting
- Paper plans took precedence

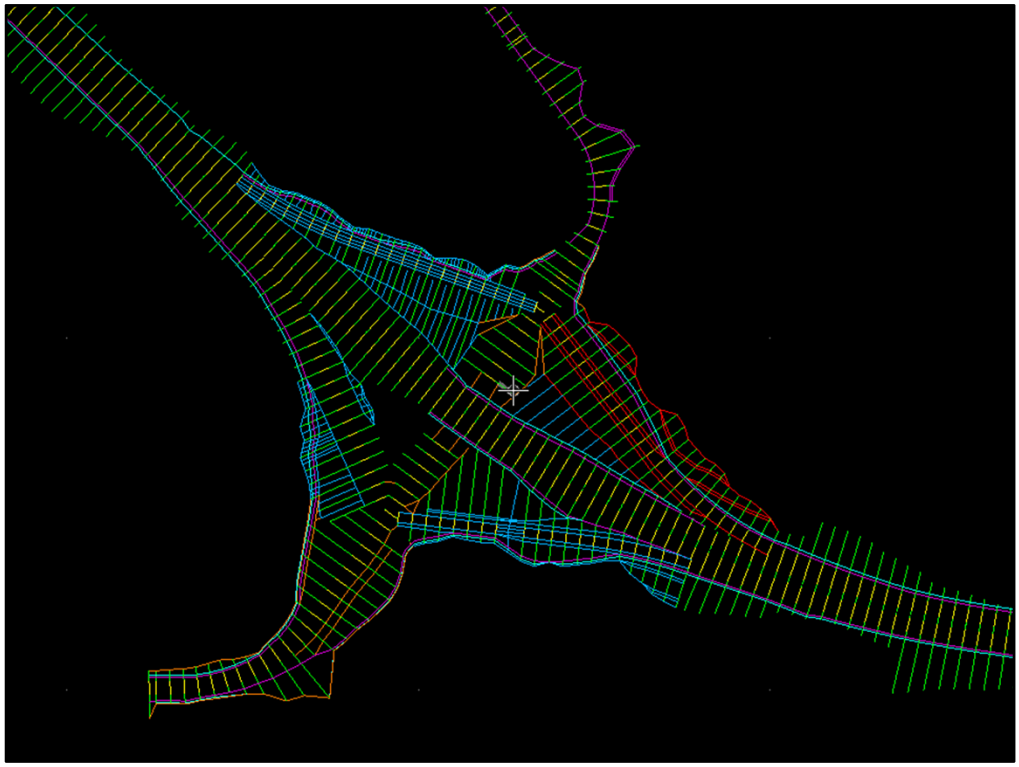
- Files were provided after the letting to the awarded contractor.



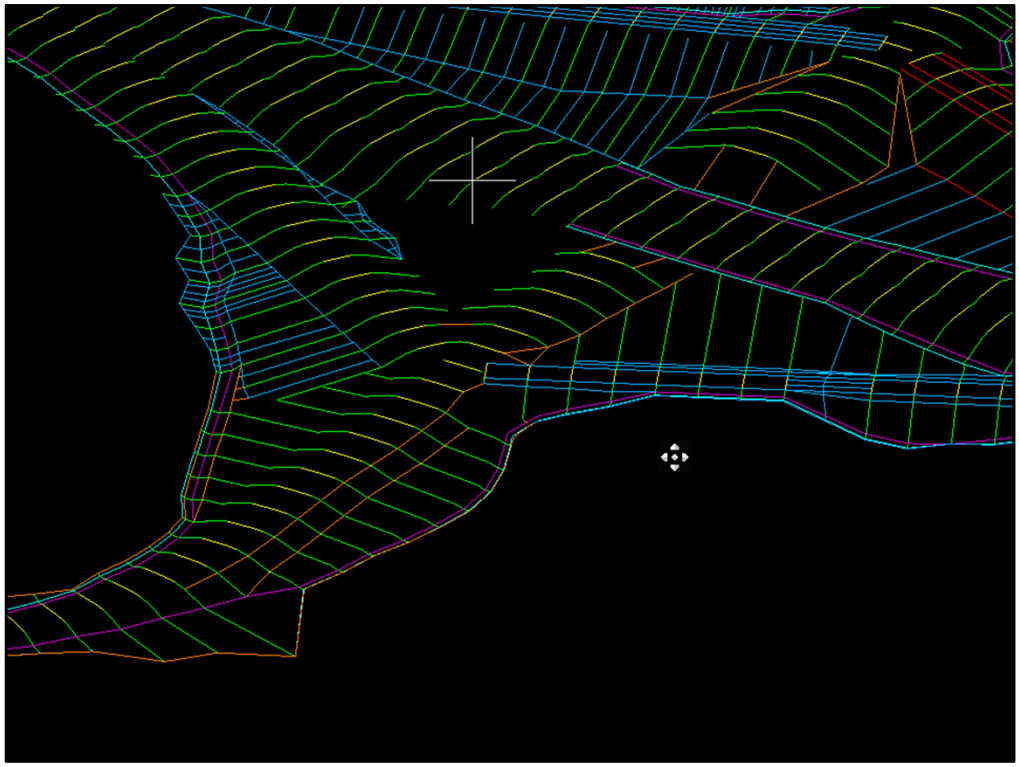

The following slides show an example of one of our early attempts at creating design surfaces. The green and yellow lines represent the 2D cross sections imported into a 3D design file. The blue and orange lines were added to help create the surface more accurately.



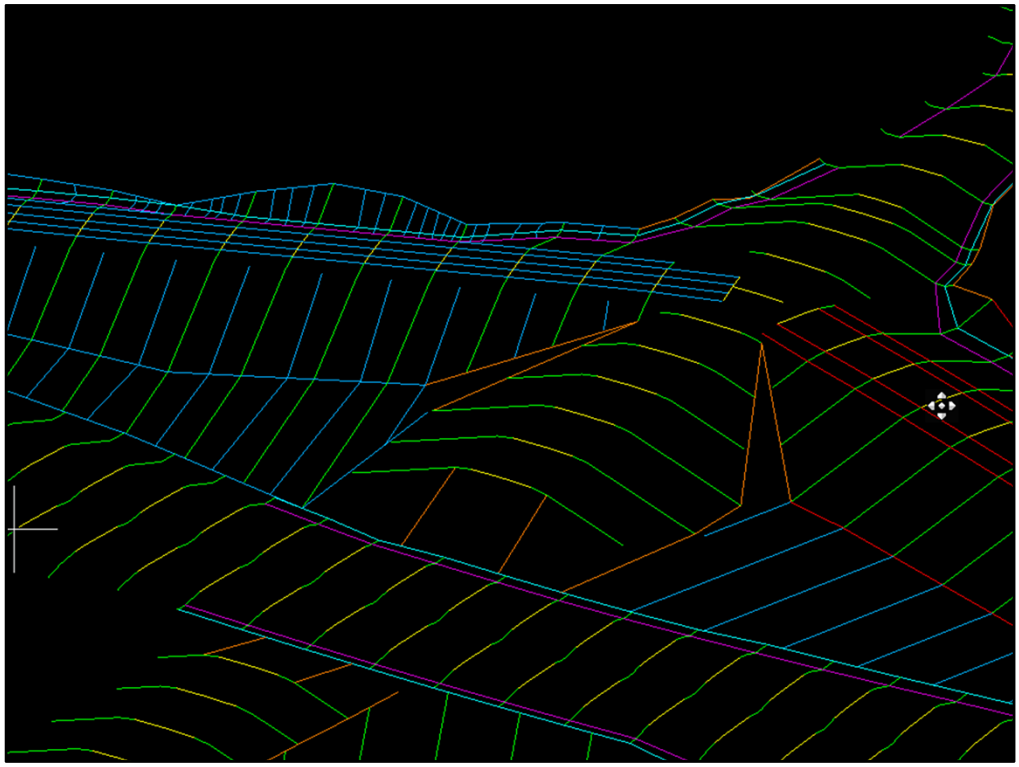

You can see the great distance between the cross section in comparison to models you will see later.



The lack of detail at the returns and bridge berms is very evident



The details skipped over in the 3D design leave a lot of work for someone else to complete in the field.

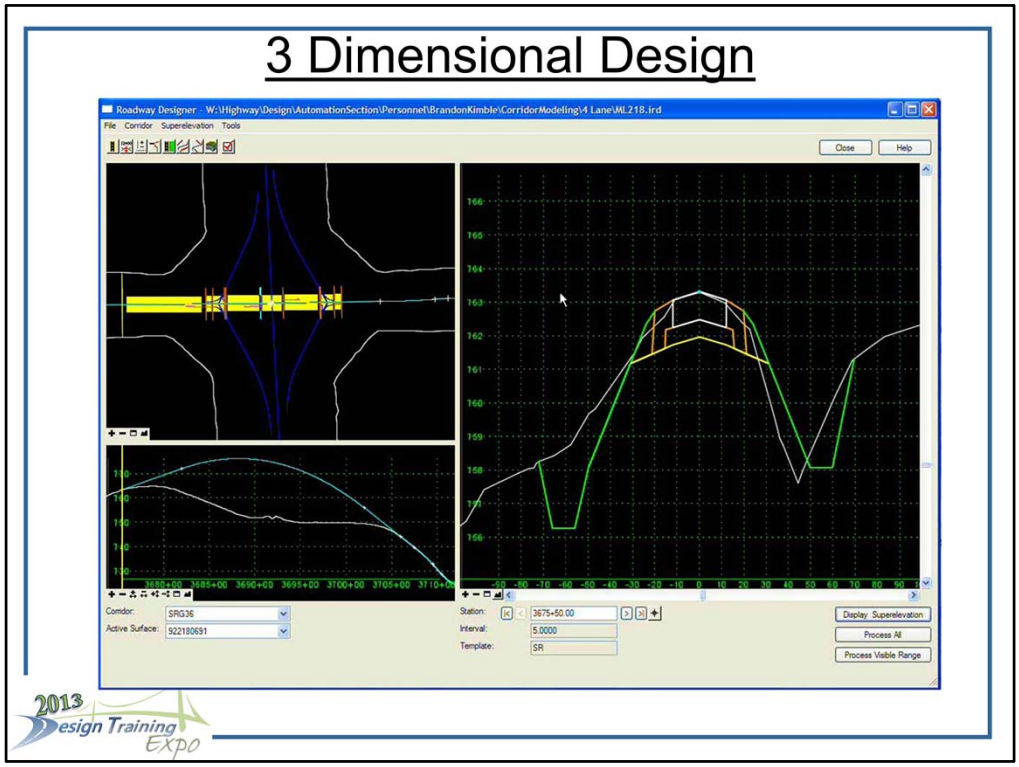


# Current Process

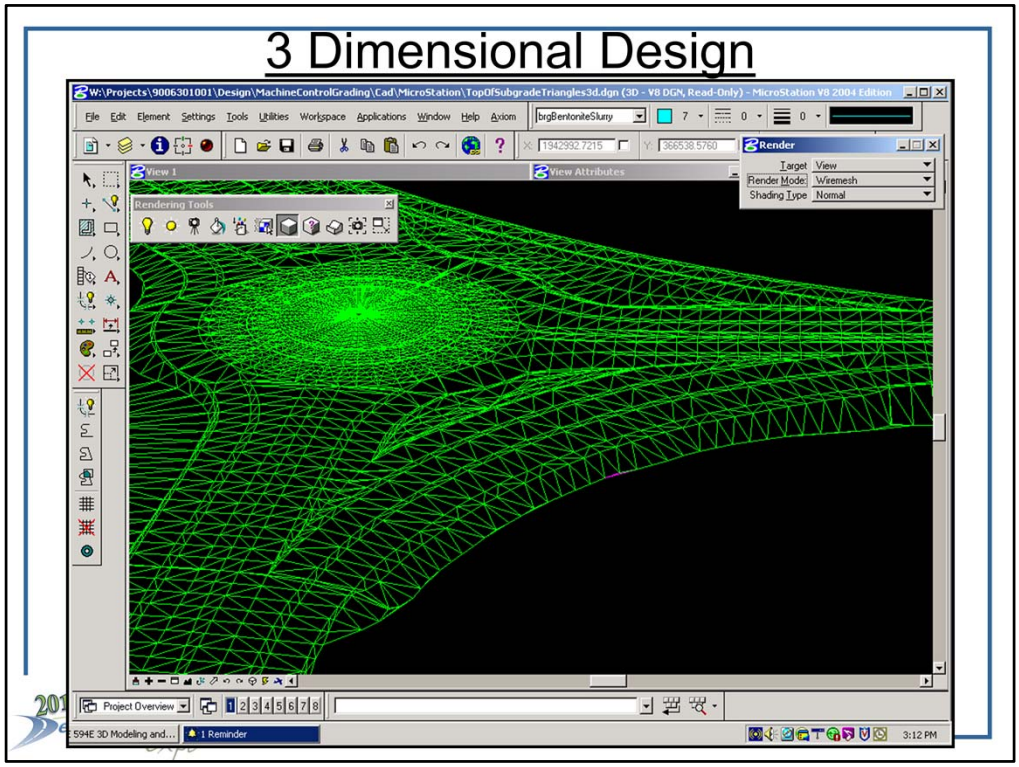
- Our work flow creates the 3-D model first
- The 3-D design is as complete as possible
- Files are provided in a generic format including Land XML
- Files are now provided pre-letting on our website
- Our field personnel access the files at same location
- All files that are available are provided pre-letting

## Current Process continued

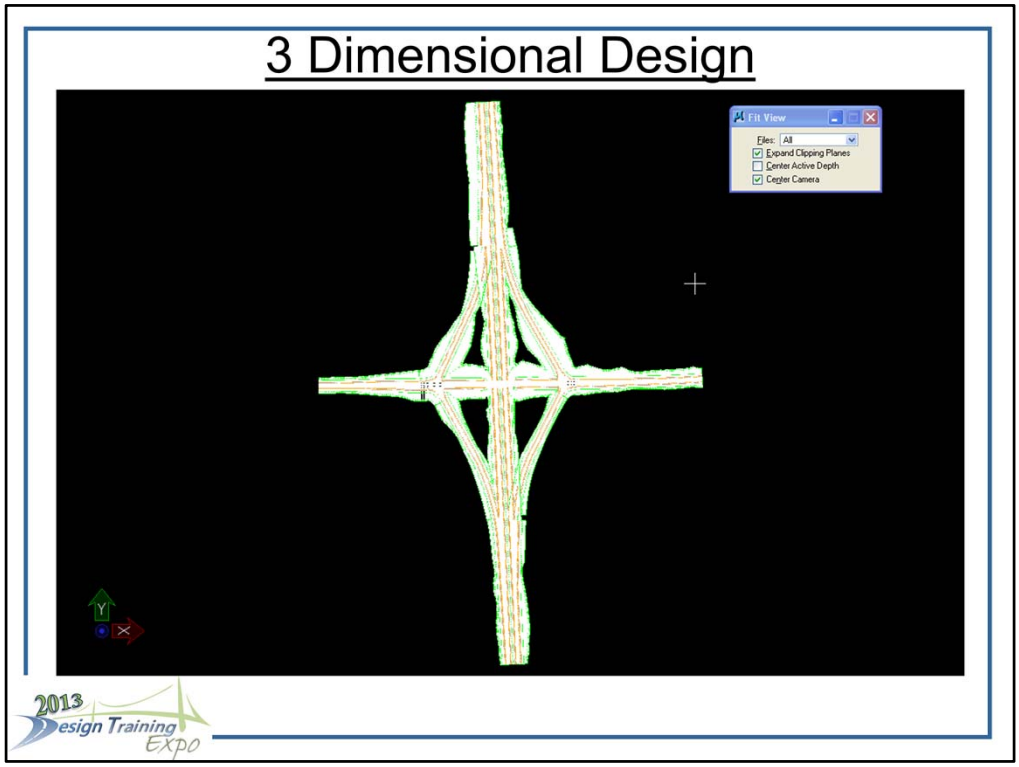
- 3-D break lines are provided in a .dgn and .dxf format
- Intuitive level names were used for the 3D break lines
- File naming and content is in the on-line Design Manual
- Standard details updated to reflect 3D design
- The letting process submits all files to our electronic records management group for long term storage



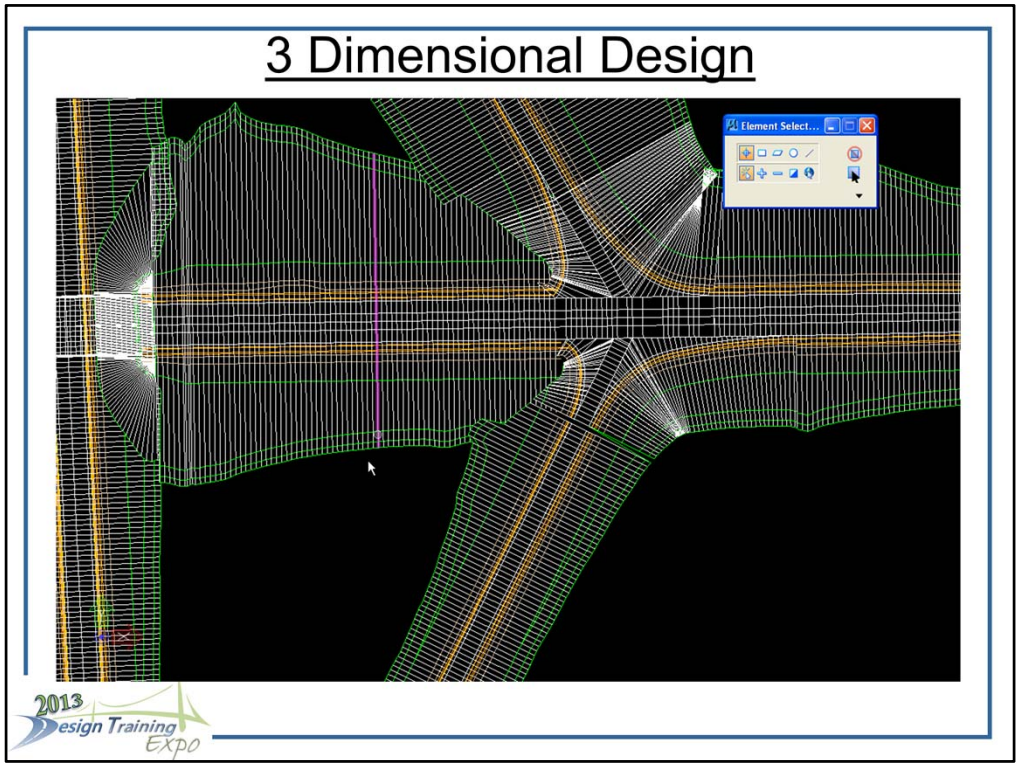

This slide demonstrates the Geopak/Inroads tool that we qre using for our 3D designs. This tool generates the 3D surface first, then 2D cross sections are generated later for sheeting and earthwork process. This tool also allows the interaction of multiple roadways that was not possible with our previous process.



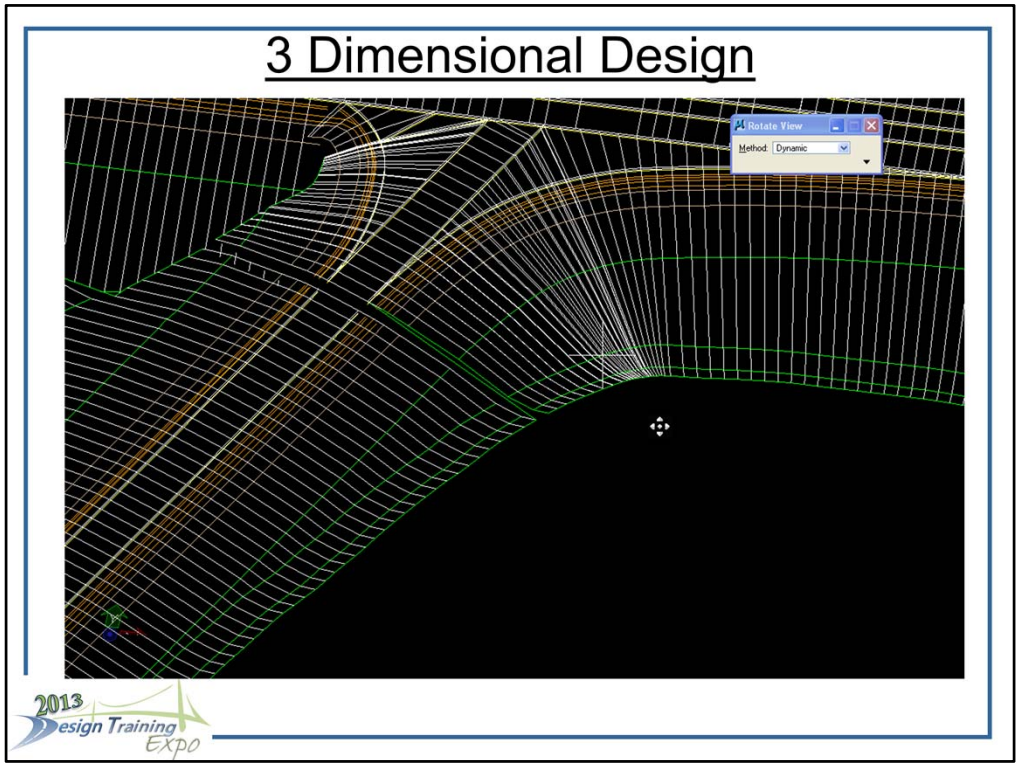

It is difficult to review designs that have many different pieces that need to tie together correctly. The picture above shows how quickly you can see if your design connects together properly.



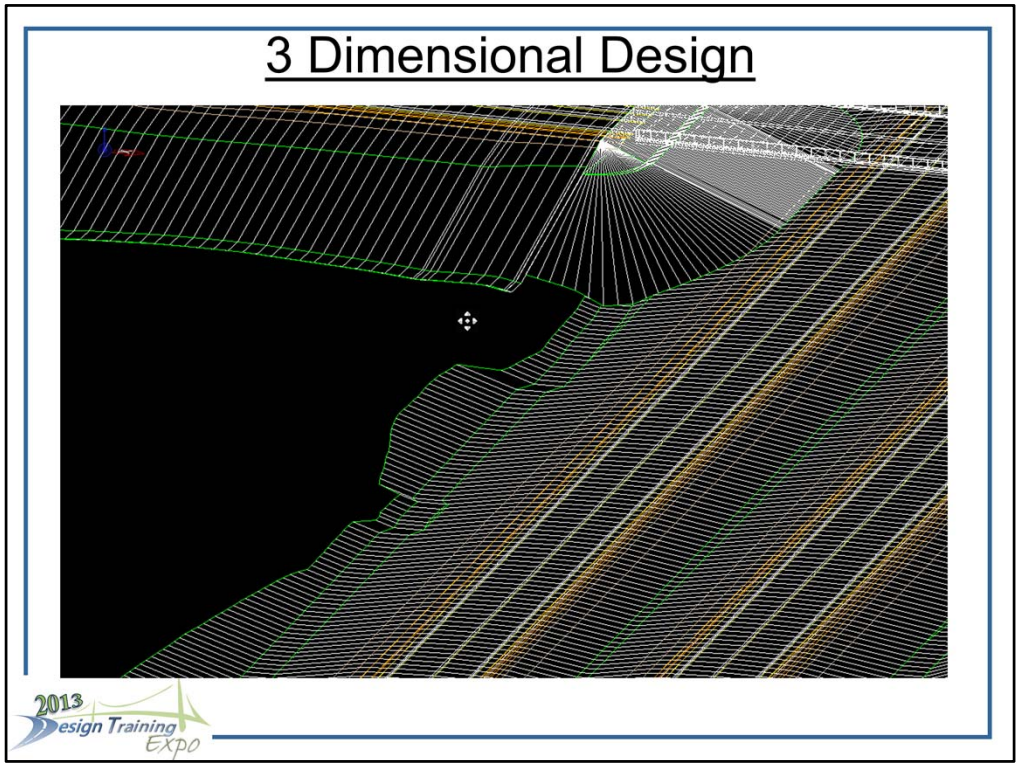

The following slides show how you can check to see that the side road and ramp ditch grades tie in correctly. You can also review the interaction of the bridge berms and main line ditch grades and clear distance to the berms.



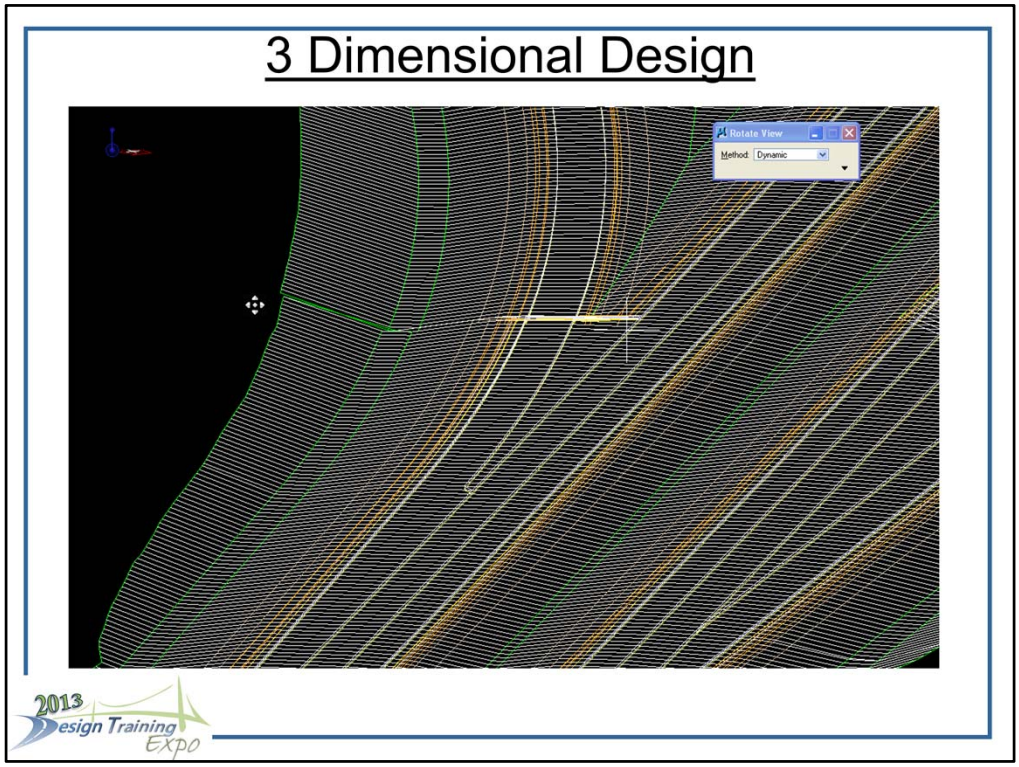

See how the ditch grade on the right side of the ramp cleanly ties into the side road.



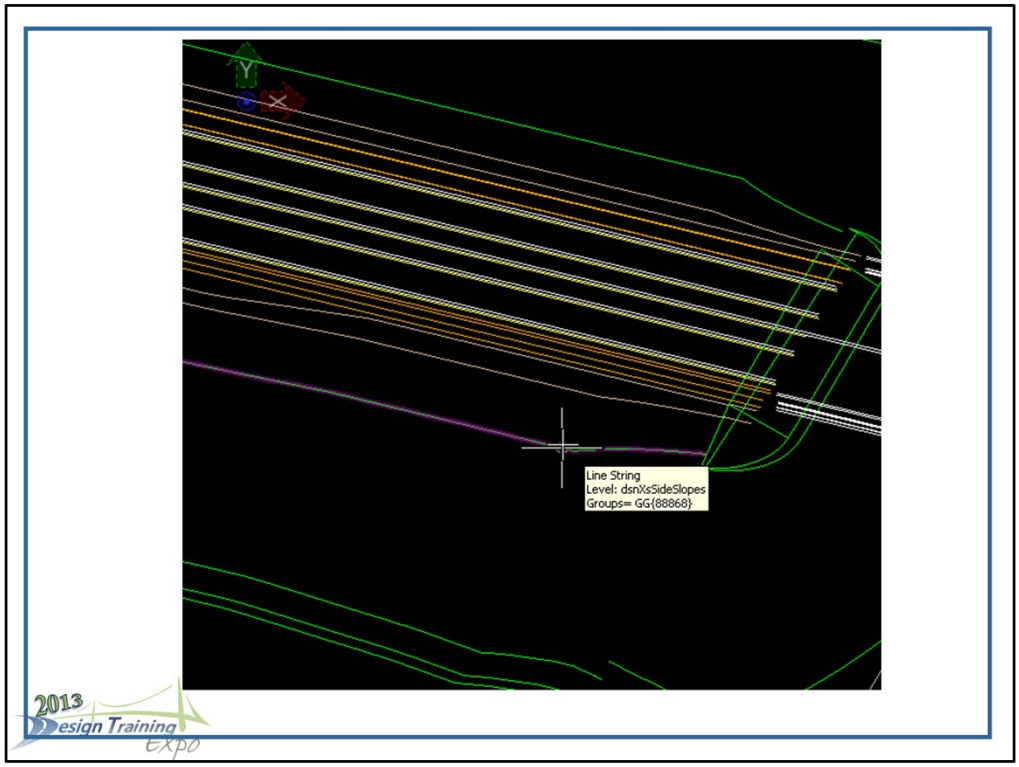

Another slide to demonstrate the same thing




This view allows you to review the interaction of the bridge berm and the mainline roadway features




This video shows how you can check to see that the side road and ramp ditch grades tie in correctly. You can also review the interaction of the bridge berms and main line ditch grades and clear distance to the berms.

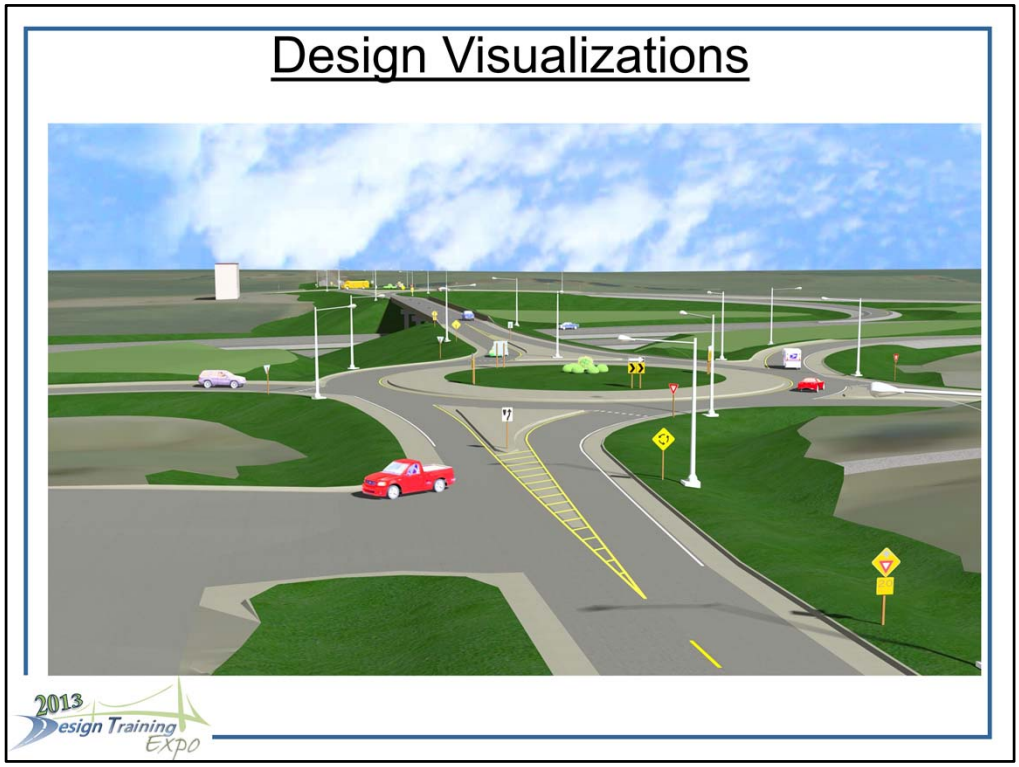



This is an example of the 3D break lines that we make available

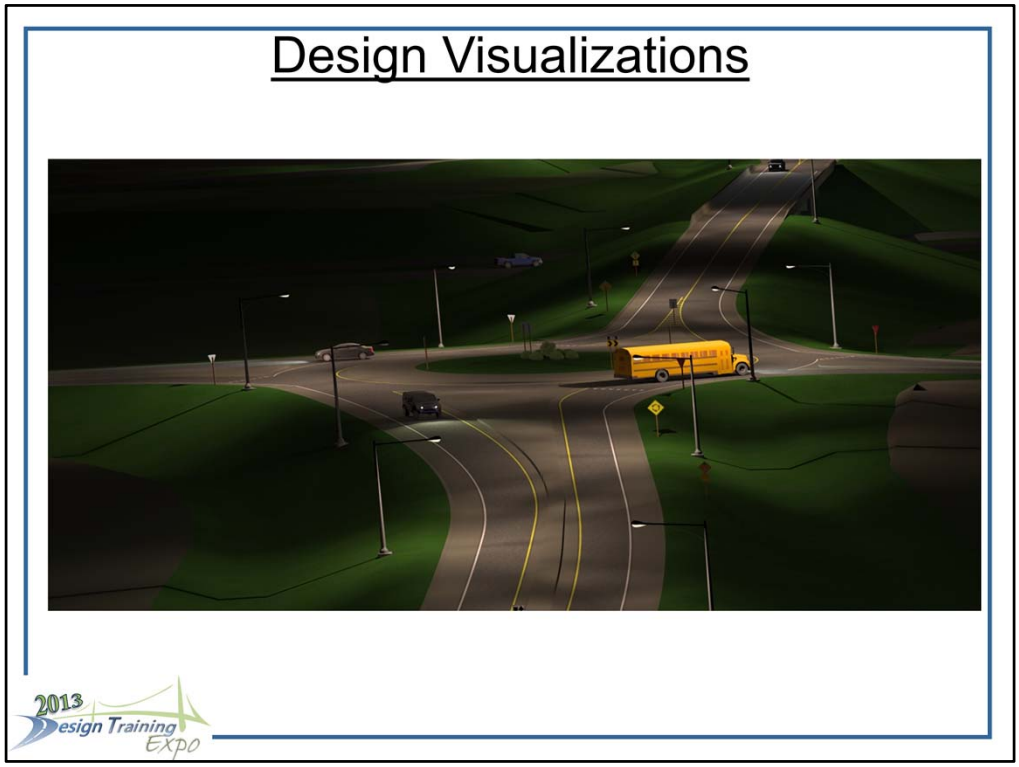
# Design Visualizations

Goals:

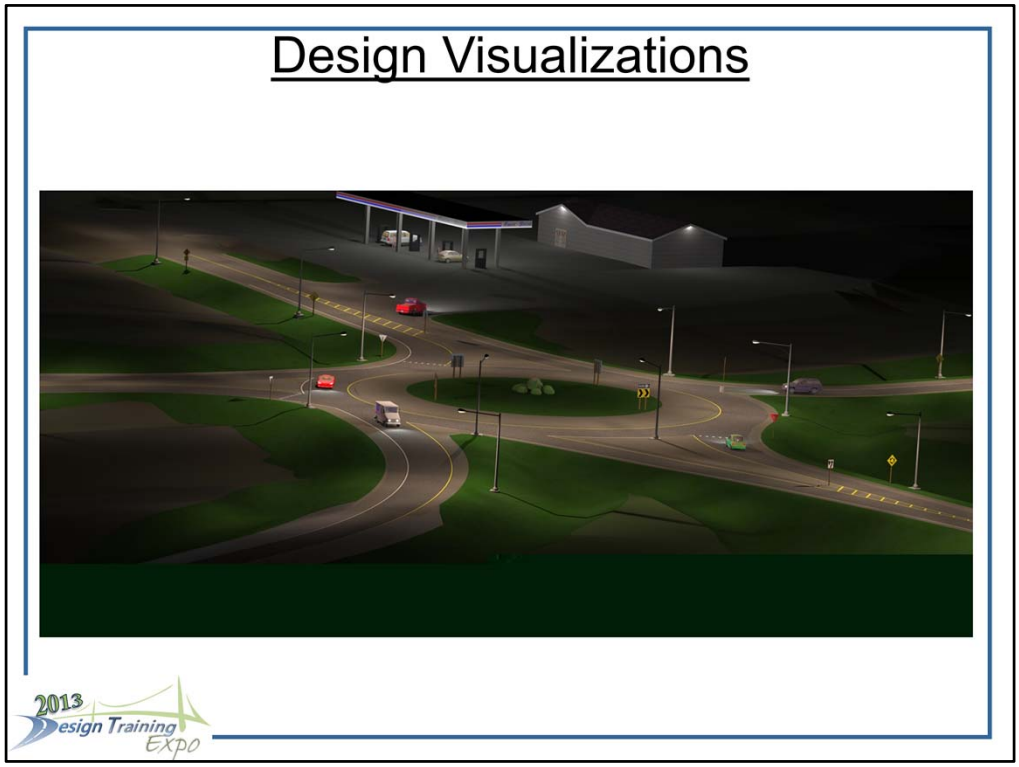
- Improved Design
- Improved Communication Tool




This is an image that could be used at a public meeting to more clearly represent the design to the public.  It also helps review sign and lighting placement.

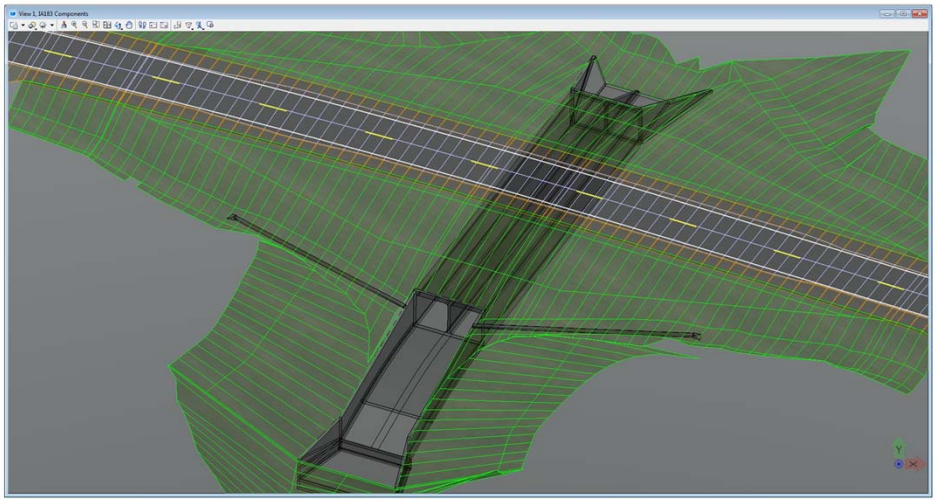



The model also allows you to review night time operations.




This is another example of the lighting on the same project

# Design Visualizations



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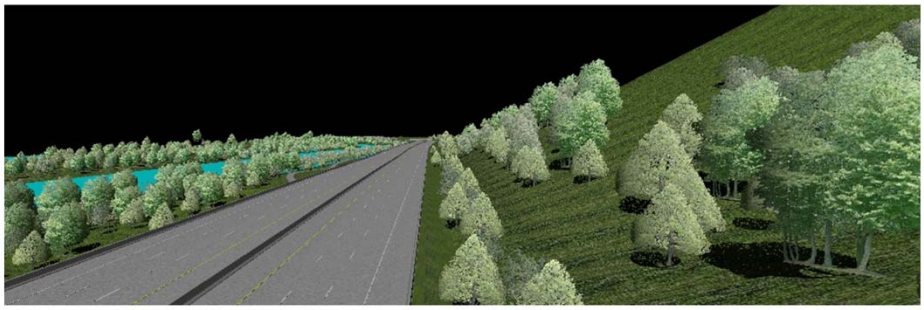

# Design Visualizations

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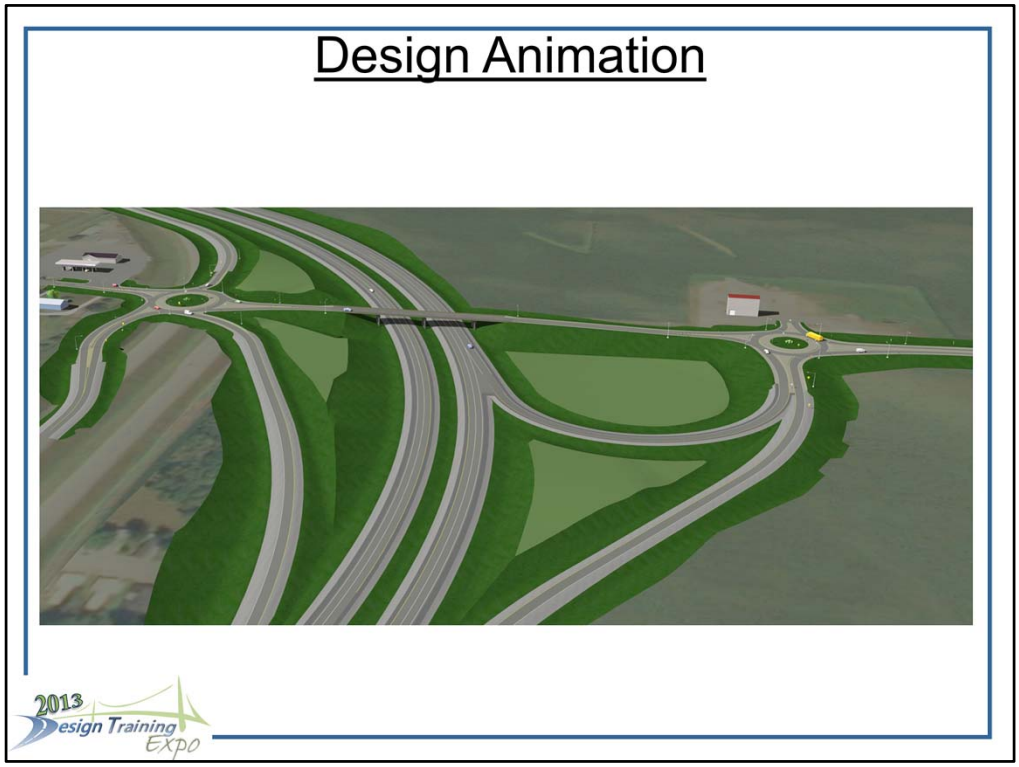
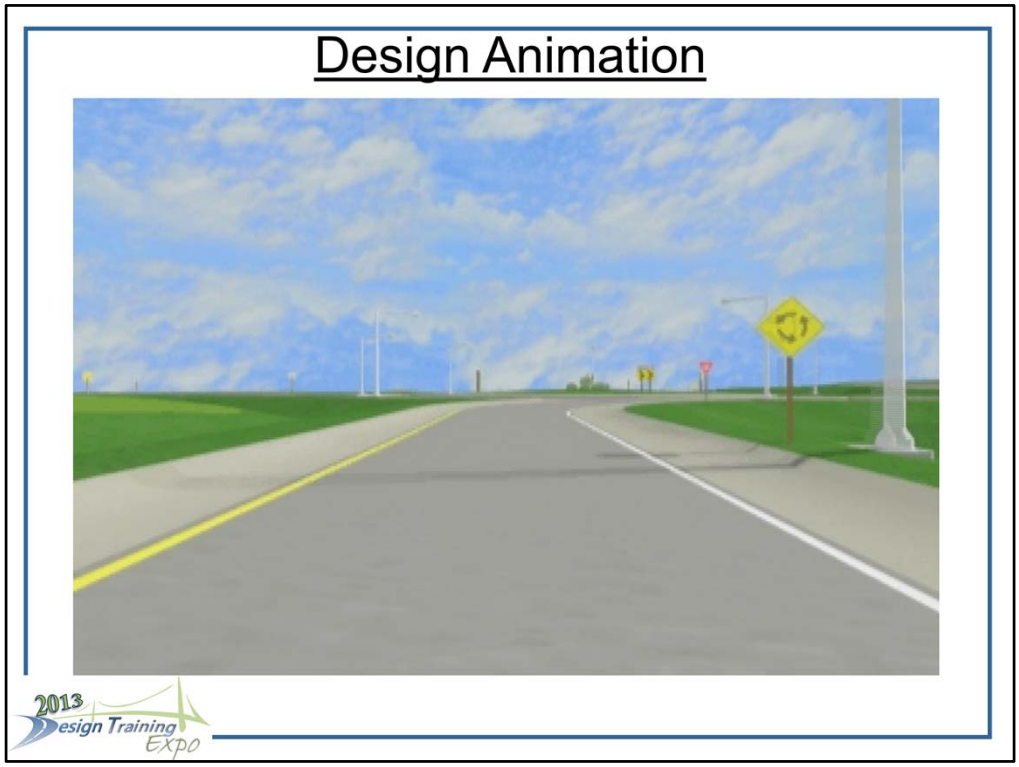



A flyover movie is also very helpful at public meetings to more clearly represent the design to the public




A rendered drive through can help identify sight distance issues and identify any conflicts with signing

# Design Animation

# Design Animation 4-D

# Design Files for Automated Machine Guidance

## Goals:

- Reduce Construction Costs
- Improve safety for Surveyors
- Shorten the project start up time, due to less preparation needed by surveyors
- Find the critical files needed for construction and survey
- Produce generic file formats that can be used by the majority of the construction and survey equipment.

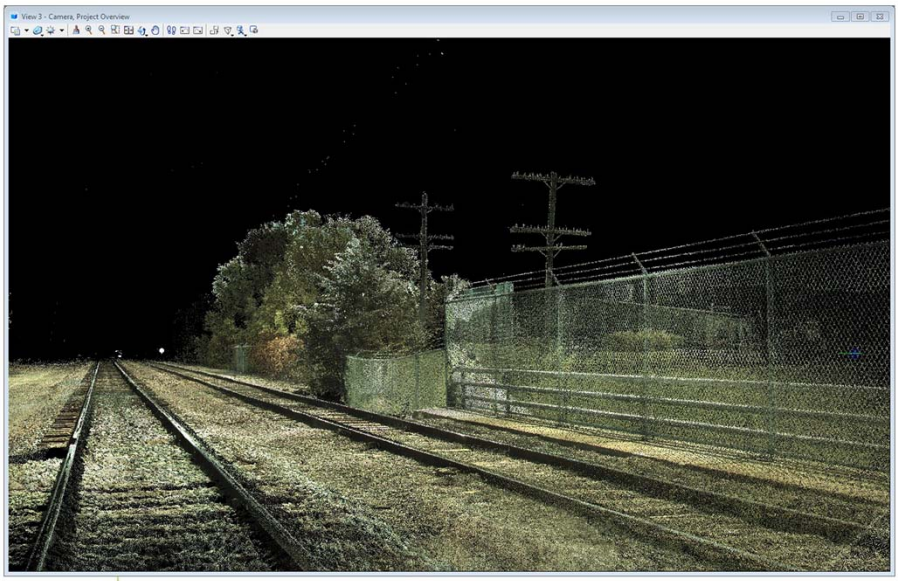
# Iowa DOT Machine Guidance Grading History

- The first machine guidance project was let in January of 2006 , on IA 60 in Osceola county.
- We have let approximately 60+ machine guidance projects.

## Flaws with initial design and letting process

- Initially used 2-D Cross section spacing, not 3-D
- Translating from 2-D to 3-D was difficult
- Satisfying specific contractor file needs was time consuming
- Contractors hired designers to complete the model
- Providing post-letting files was troublesome
- We used a bid item and applied special specifications to select projects

# LiDAR and Point Clouds



# LiDAR and Point Clouds

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# LiDAR and Point Clouds

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## Answers to questions

- Importance of 3-D Design Standards
- 3-D design standards are crucial for a consistent product and easier modeling
- Owner/Designer professional responsibility and accountability for 3-D data
- The paper plans remain as the control for any discrepancies.

- How and where to begin the transition

- Importance of 3-D Design Standards

- Owner/Designer professional responsibility and accountability for 3-D data

## Answers to questions continued

- Successes resulting from using 3-D Design
- 3-D drive-through movies used at public meetings
- Making 3-D data available to bidders/proposers while minimizing risk of contract claims and disputes
- Due to the time it saves, contractors will take the risk with our files, and be responsible to verify they are correct
- **Tim Tometich, Manatts Construction**

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- Successes resulting from using 3-D Design

Making 3-D data available to bidders/proposers while minimizing risk of contract claims and disputes