Route Planning Using Autodesk® InfraWorks™: A "How To" by Autodesk and CDM Smith

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Agenda

8:00 – 8:05 AM:  Introductions
8:05 – 8:20 AM:  Autodesk InfraWorks – What is it?
8:20 - 8:45 AM:  Jake Thomas Road Extension (Tennessee)
8:45 - 9:10 AM:  CR-46/Wekiva Parkway (Florida)
9:10 - 9:20 AM:  Additional Functionality for Improved Route Planning
9:20 – 9:30 AM:  Q&A
### Business Challenges and Customer Painpoints in Infrastructure Industry

<table>
<thead>
<tr>
<th>Category</th>
<th>Challenges</th>
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| There is increasing investment in infrastructure projects worldwide | - Communicating design intents in 2D to stakeholders is difficult and confusing  
- Exploring infrastructure project alternatives is costly and time-consuming |
| Clients and the public want to better understand the potential issues surrounding projects | - Obtaining client and public buy-in for infrastructure projects is a slow process |
| Need for more collaboration between multiple stakeholders and remote team members | - Workflows that involve large geographically dispersed teams do not work well |
Autodesk InfraWorks 360 Pro | Transforming the Civil Infrastructure Industry

- Plan for and evaluate options quickly
- Rapidly model within the context of what is real
- Communicate design intent and accelerate approvals (i.e. win work)
Autodesk InfraWorks | Portfolio

InfraWorks 2014 R2
IDS-P | IDS-U | BDS-U

Core desktop conceptual sketching & visualization

InfraWorks 360 Pro

Modules

- Roadway Design for InfraWorks 360
- Bridge Design for InfraWorks 360
- Drainage Design for InfraWorks 360

For individual user working in suite desktop environment
- Data Aggregation
- Visualize
- Model Authoring
- Presentation
- Visual Thematics

For enterprise looking for seamless multi-office and multi-stakeholder collaboration
- InfraWorks plus...
- Collaborate
- Web & Mobile
- Cloud Services
- Design, Engineer, Manage
Collaboration
- Securely store and share large InfraWorks models in the cloud
- Manage access and publishing rights

Engagement
- Publish scenarios to mobile and web clients
- Capture feedback via Design Feed

Optimization & Analysis
- Optimize vertical alignments for cost, cut, fill, and constructability

Translation
- Efficiently translate GIS, CAD, and BIM data in the cloud
Autodesk® InfraWorks | Project Types

- Urban Planning / Land Planning
- Transportation Corridor Planning
- Energy & Water Utility Planning
Jake Thomas Road Extension (Tennessee)

Gordon Griffith
Roadway Designer, CDM Smith
Project Fly Through

Jake Thomas Extension Fly Through
Project Overview
Project Overview: Why InfraWorks

- Why InfraWorks?
  - Wanted to enable our client to visualize a tourist’s experience along the proposed roadway corridor
  - Wanted to provide our client with a tool for developing public/private partnerships and agency funding
  - Wanted to give our client the ability to visualize side road bridge and roadway connections and side slope impacts in steep terrain
Project Challenges

- Updating the base GIS terrain with recently built and proposed infrastructure
- Importing terrain models from other design packages
- Syncing these terrain model coordinates with GIS coordinates
- Creating buildings with complex roof lines
- Bringing in 3D models from external sources
- Producing a 3D flyover and renderings of the project
Addressing Challenges – Standard Functionality

- Importing GIS terrain and aerial imagery
  - More time than expected was spent obtaining the needed files from local GIS office
  - Used .adf file to import terrain
Addressing Challenges – Standard Functionality
Addressing Challenges – Standard Functionality

- Importing terrain data from Geopak
  - Exported from Geopak to LandXML and imported into InfraWorks
Addressing Challenges – Standard Functionality

- Importing terrain data from Geopak
  - Exported from Geopak to LandXML and imported into InfraWorks
Addressing Challenges – Standard Functionality

- Syncing the CADD project coordinates with GIS coordinates
  - Datum adjustment factor was removed from 3D model elements before being imported into InfraWorks
Addressing Challenges – Standard Functionality

- Importing 3D models from 3D Warehouse
  - This function was used to import little league baseball fields, zip line platforms, and some pavement markings
Addressing Challenges – Standard Functionality

- Developing a 3D flyover of the project with InfraWorks storyboards
  - Tracking around curves can be difficult
  - Not all captions could be added in the storyboards format
Addressing Challenges – Standard Functionality

- Vertical Alignment Optimization
  - Very interested in using this tool in the future
  - Tool is not useful in steep terrain at its current stage of development
Addressing Challenges – Nonstandard Functionality

- Creating buildings with complex roof lines

  - Used basic building creation function to create individual roofline elements
  - Combined individual buildings into more complex buildings
Addressing Challenges – Nonstandard Functionality

- Creating buildings with complex roof lines
Addressing Challenges – Nonstandard Functionality

- Creating gaps in roadway surface for bridges
  - First brought in proposed roadway cross section surface without gap for bridge
  - Created gap by placing roadway element over roadway surface and adjusting side slopes to create gap
Addressing Challenges – Nonstandard Functionality

- Issues when roadway styles meet
  - Where two roadway styles in InfraWorks meet strange things can happen
  - Created styles with offset center points for clean merge
Addressing Challenges – Nonstandard Functionality

- Pavement marking using street furniture method
  - Striping in InfraWorks did not reflect accurately roadway skip striping
  - Created skip stripes in Google SketchUp and imported into InfraWorks as road style street furniture
Addressing Challenges – Nonstandard Functionality

- Importing 3D Models from 3D Warehouse or SketchUp
  - If you download a collada file from 3D Warehouse
    - Have to move .dae file to same folder as color/texture files before importing into InfraWorks
  - If you download a .skp file from 3D Warehouse and export to a collada file
    - Have to move .dae file to same folder as color/texture files before importing into InfraWorks
Addressing Challenges – Nonstandard Functionality

- **Other uses for Google SketchUp**
  - Along with skip striping, used SketchUp to create:
    - Pavement marking for stop bars at intersections
    - A pavement patch for road style merge clean up
    - Bridge piers
  - Used SketchUp to edit existing 3D Warehouse models
Addressing Challenges – Nonstandard Functionality

- Other uses for Google SketchUp
Addressing Challenges – Nonstandard Functionality

- Adding features to fly through in Camtasia
  - Importing InfraWorks storyboard .avi into Camtasia and exporting to mp4 greatly reduced drive through jumpiness and file size
  - Camtasia allowed for much more versatile captions
  - Camtasia allowed for importation and versatile placement of logos
  - Camtasia allowed for music to be added to drive through
InfraWorks Benefits

- For the client
  - The client was able to visualize the experience of visitors to the area
  - The client received a visual tool for developing public / private partnerships and agency funding for project construction
  - The client could visualize side road bridge and roadway connections in steep terrain

- For the project team
  - The project team did not have to sub out the 3D visualization work
  - The project team added a new service line
Lessons Learned

- Allow time to work with local GIS agencies
- That Google SketchUp and Camtasia Studio can be very versatile in augmenting InfraWorks’s capabilities, and can be essential in developing the final deliverable
- Plan ahead
  - Road Styles
  - Data backup and storage
  - File Management
  - Limit number of proposals in the model for better performance
CR-46/Wekiva Parkway (Florida)

Heidy Brenes
Roadway Designer, CDM Smith
Project Overview: CR 46A Realignment

Wekiva Parkway Section 5 Fly Over
**Project Overview: CR 46A Realignment**

- The Wekiva Parkway (SR 429) is a 25-mile tolled expressway that would connect to existing SR 417, completing the beltway around Northwest metropolitan Orlando.

- This estimated $1.5B project.

- Relocating the CR 46A connection to SR 46 to provide improved wildlife connectivity and additional local road system benefits.
Project Overview: CR 46A Realignment

- Client: Florida Department of Transportation (FDOT), District 5
- Fee: $1.75M
- Schedule: February 2013 to February 2015
  - 3.2 miles in rural Lake County, Florida
  - Initial two-lane roadway with future expansion to four lanes
  - Includes multi-use path

- CR 46A Realignment is one of 14 Sections of the 25-mile Wekiva Parkway, which was identified by Florida’s governor as a top priority
- Ten sections are in Design Phase
- All 14 sections to be open in 2021
Why InfraWorks?

- We decided to use InfraWorks as a tool during preliminary meetings with stakeholders to illustrate the visual impacts of the road, which were minimized by maintaining existing trees and depressing the roadway profile.

- Great tool to analyze different alignments alternatives.
Why InfraWorks?

- Redtail subdivision was concerned about having a major arterial adjacent to their multi-million-dollar homes.
- Property owner to the east was concerned about the impacts to his orange groves and Arabian horse farm.
Project Challenges: CR 46A Realignment

The development of four different alternatives:

- Alignment 50 feet away from Redtail subdivision
- “T” Intersection design
- Alignment 50 feet away from Redtail subdivision
- Provides continuous movement for higher volume road
Project Challenges: CR 46A Realignment

The development of four different alternatives:

- Alignment 300 feet away from Redtail subdivision
- "T" Intersection design
- Impact on Taylor’s orange groves and Arabian horse farm

Alternative 3

Alternative 4

Alignment 300 feet away from Redtail subdivision
Provides continuous movement for higher volume road
Within each alternative alignment there are five typical sections alternatives, including the ultimate four-lane divided roadway design.

Resulting in the development of 16 proposals in InfraWorks.
Project Challenges: CR 46A Realignment

- Representation of the side ditches for each alternative and the corresponding typical section
Project Challenges: CR 46A Realignment

- The fact that the project is located in a forested rural area; therefore, we needed to show random trees
- Importing Civil 3D corridors into InfraWorks
- Addressing stakeholder’s concerns
- Creating pavement markings
- Developing video with storyboards
- Creating the final renderings
Addressing Challenges: Standard Functionality

- The development of four different alternatives with four different typical sections
  - Alignments were imported as SDF or LandXML from Civil 3D

Project was created in February 2013. In this period of time we were using Autodesk Infrastructure Modeler (AIM), which did not have the Vertical Alignment Optimization module available in current release.

With the vertical alignment optimization module in InfraWorks R3 we would be able to compare between alignments within InfraWorks.

Looking forward to use this tool in the future.
Addressing Challenges: Standard Functionality

- The representation of the side ditches
  - The standard functionally used to address the lack of having slopes on road styles was having more tracks with different width and elevation, creating a staircase effect.
Addressing Challenges: Nonstandard Functionality

- The representation of the side ditches of road
  - The selected alignment was developed in Autodesk Civil 3D and then imported in InfraWorks as an IMX file.
Addressing Challenges: Standard Functionality

- Randomize tree styles
  - The project surroundings have a variety of trees. A script was provided to apply a style rule based...
Addressing Challenges

- Importing Civil 3D corridors into InfraWorks
  - Corridor model in Civil 3D is created
Addressing Challenges

- Importing Civil 3D corridors into InfraWorks
  - Proposed corridor did not export right into InfraWorks
Addressing Challenges: Standard Functionality

- Addressing stakeholder’s concerns
- RedTail subdivision was concerned about having a major arterial adjacent to their multi-million-dollar homes.

We use the Select Visible tool in InfraWorks.
Addressing Challenges: Standard Functionality

- Creating pavement markings
  - A Barrier style palette was created to represent the double yellow stripping line
Addressing Challenges: Nonstandard Functionality

- Creating Pavement Markings
  - An offsets alignments were created in Civil 3D and then imported as SDF file for the solid edge of pavement white stripe
  - In InfraWorks we created a roadway style representing the white stripe
Addressing Challenges: Standard Functionality

- Developing the video with Storyboards
  - Size of file produced by InfraWorks are almost unplayable

[Image of video clip with file size: 13GB]
Addressing Challenges: Nonstandard Functionality

- Developing the video with Storyboards
  - We use a video editing software to reduce the size of file produced by InfraWorks
  - External Software also eliminated the jumpiness of video
Addressing Challenges

- Creating the final renderings
  - Render images from InfraWorks are not a real representation of the model
InfraWorks Benefits: CR 46A Realignment

Client

• FDOT, District 5 was very impressed with the quick turnaround on putting the animation of the different alternatives together

The FDOT District 5 Project Manager

• “That it would be beneficial if a similar model to the one we developed for our section was created for the other Wekiva sections.”

Stakeholders

• InfraWorks created simple and more effective visualization to communicate design intent to this nontechnical audience
InfraWorks Benefits: CR 46A Realignment

The Lake County Commissioners

- Were impressed by the model because it gave them a realistic perspective of the different alternatives

CDM Smith Team

- Be able to impress our main client and address every stakeholder’s concerns while maintaining a good client relationship
Summary

- Data driven between InfraWorks and Civil 3D
- Horizontal and vertical alignments optimization
Lessons Learned

- Needed information from Civil 3D to have a smooth proposed surface in InfraWorks
- Communicate your issues or challenges with others, this will lead you to ideas and workarounds
- Data backup and data management
Additional InfraWorks 360 Pro Functionality for Improved Route Planning
Engineer in Context

- Edit road geometry interactively and intuitively
- Automate creation of roadway intersections
- Dynamically lay out roads and update intersections
Powerful Intersection Features

- Create intersection geometry using standard design vehicles
- Automate the creation of intersection design proposals
- Use flexible curb return editing tools
Integrated Sight Distance Analysis

- Analyze stopping sight distance based on design standards
- Demonstrate desired and actual sight envelopes
- Help identify causes for driver sight obstructions, sight distance failure zones, and potential accident zones with terrain markers
Design Optimization

- Optimize vertical and horizontal road alignments
- Find best fit corridors
Detailed Design and Documentation

- Take geometry and road surfaces to Autodesk® AutoCAD® Civil 3D® 2014 software for detailed design work
- Create documentation with a cloud-based sheet set service