Understanding how 3D Technology and UAV's are changing the workflow of Highway Design,”

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What is a Point Cloud?
Presentation Objectives

Understand Benefits of 3D Preconstruction Data Analysis

Understand the 3D Data Capture Process

Modeling Process

Clash Detection Process

Benefits & Cost

See some really COOL drones!

We do not sell any specific brand of software or hardware this presentation.
3D Data Collectors  Lidar & Photography
Future of Aerial Data Capture

Quad copter Photographic System

Fixed Wing System Terrain Mapping

Hex copter Bridge
Inspection Platform
Hex Copter Vertical Inspection Close Range Photography

Take Off
Aerial Data Test Project
Joe Harrington’s Hex Copter
Photograph taken by his Quad Copter
Joe’s Photograph Mapped on to a Revit Model
Software Considerations

Very few CAD packages were effectively running point clouds inside their software prior to 2011.

Autodesk and Bentley are the most common packages, but there are many others that are task-specific including 3D Reshaper (micro-mesh), Inventor (for machines applications), or ClearEdge 3D (for auto-modeling).

- Revit
- AutoCAD
- MicroStation
- Navisworks
- 3D Reshaper
- AutoDesk Recap
- ClearEdge 3d
- Sketch up
- Bentley Descartes
- TopoDOT
- TrueView
- Faro Software Products (for scan data)
- Z&F Software Products (for scan data)
- Leica Software Products (for scan data)
Mobile Units
Various Systems Available
Overview

Optech LYNX Mobile Mapper™

- Accuracy: <0.1’
- Precision: <7mm
- Range: 200m (corridor varies)
- Field of View: 360°
- Laser rotates: 9-15,000 RPM
- Measurement Rate: 50, 100 or 200 kHz
- Returns per Shot: 4 (1st, 2nd, 3rd, Last)
- Simultaneous LiDAR & imagery capture
- Digital Cameras: 2x - 5 Mega-pixel
- Images Capture: ≤3 frames/sec.
Multiple Survey Platforms

- Motor Vehicle
  - Highways
  - Levees
  - Developed Environments
- Karst Topography
- Beaches
- Trails
- The Water
  - Coastal Environments / Streams
  - Bridges
What is 3D Laser Scanning?

- “LiDAR”
- High speed lasers
- 50,000 – 1,000,000 points per second
- Collecting geometric data point
- Precisely registered in space
- “Point Cloud”
Scanners
What are they and
What do they look like?

Faro
Focus Scanner
Light weight close
range scanner

Riegl VZ 400
Versatile Scanner

Z&F 5010
Current State of the Science Laser Scanners

Phase Based Scanner
High Speed Laser
Used Inside

Time of Flight
Long Range Laser
Used outside & Inside

6200 Close Range scanner
300,000 PPS
Effective Range 30 meters

C10 Laser Scanner
50,000 PPS
Effective range 100 meters
Bridge Scan Terrestrial Lidar

The Schoharie Crossing Aqueduct
Is laser scanning and point cloud technology right for your project?

- Are you documenting a complex environment?

- Are you documenting something you cannot physically touch like a tower, structural beams or tall building?

- Is this a pipe room, conveyor system or manufacturing process that is extremely complex and mistakes could be costly?

- Is the interior architectural detail very ornate and intricate?

- Do you want the ability to test the new design against existing conditions scientifically, empirically and visually?

- Do you want to be able to go back and measure areas that you didn’t think you would need initially, but that are now critical to the project?

Generally, the more valuable and complex the project, the greater the need for precision data – and the greater likelihood of multiple trips to the jobsite, the more value laser scanning will provide. Laser scans quickly pay for themselves!
When is laser scanning the right choice?
Elevation Map Applied By Color

Interstate Laser scan
Simple 1 day Bridge Scan
3D Visualization
Birmingham Al. CBD
Reconstruction Project
3D Analysis by
ALDOT&LandAir Surveying Company
The Project Flow

- 3D Data Collection using…
- Helicopter, Laser Scanner, Fixed Wing, County GIS.

- Process and check the data $\pm 0.07$ all data combined.

- Produce Standard Micro Station In Roads Plans.

- Model the existing data into useable 3D cad files.

- Model the future design plans in 3D cad format.

- Compare the existing and proposed and check for Interference Clash

- Give information to the designers and contractors

- Start with 3D Data Capture!
CBD Project

Entities in the model;
Existing roadway and bridges, adjoining mainline, light poles, power lines, roadway elements, columns, bents, footings.

We used Revit to model substructure and Descartes to model the bridge deck surfaces. *This workflow was chosen due to the expertise of the existing cad techs.*

Modeled areas included
- 1400 bridges columns,
- 8 miles of bridges, 1 tunnel,
- 100’s of light poles,
- miles of underground utilities,
- adjoining buildings and improvements within the design envelope.
The Project:

Improving Birmingham’s Interstate Assets

I-20/59
Central Business District Bridge Replacement
Birmingham, Alabama
Models
Current Model of CBD Project
The 3D Design Advantages

You can drop a 3D pointcloud into Micro Station and design thru the data.

You can check the data and the design against the existing conditions.

You get all the data not just a 25’ grid that is the standard.

You don’t have to return to the field to view the actual conditions.

3D Design files can be built into models and videos to assists in public presentations.

The Cost to you

Training  Computer Software  Learning Curve
What is the ROI of 3D Preconstruction Analysis?

Wisconsin Study

Write up by FHWA
Mitchell Interchange I 94
Mitchell Interchange I 94
Total Cost Savings from Pre Construction 3D Analysis
$9.5 Million Dollars!

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<th>DIN Category</th>
<th>Estimated Percent of Reduction</th>
<th>Total Cost ($ millions)</th>
<th>Average Cost Per Issue</th>
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Design issue notices (DINs) are changes to the design that become necessary due to conflicts or issues identified during construction.
Crain Radius Clash Detection
Questions or Comments?

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See more at:  
- www.LandAirSurveying.com  
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