ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS
ALABAMA SECTION

MONTGOMERY BRANCH
www.montgomery-asce.org

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

Tate Jones
President
LandAir Surveying

12.09.2014

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

LANDAIR
SURVEYING COMPANY
"Quality from the ground up"

Future of Aerial Data Capture

Quad copter Photographic System

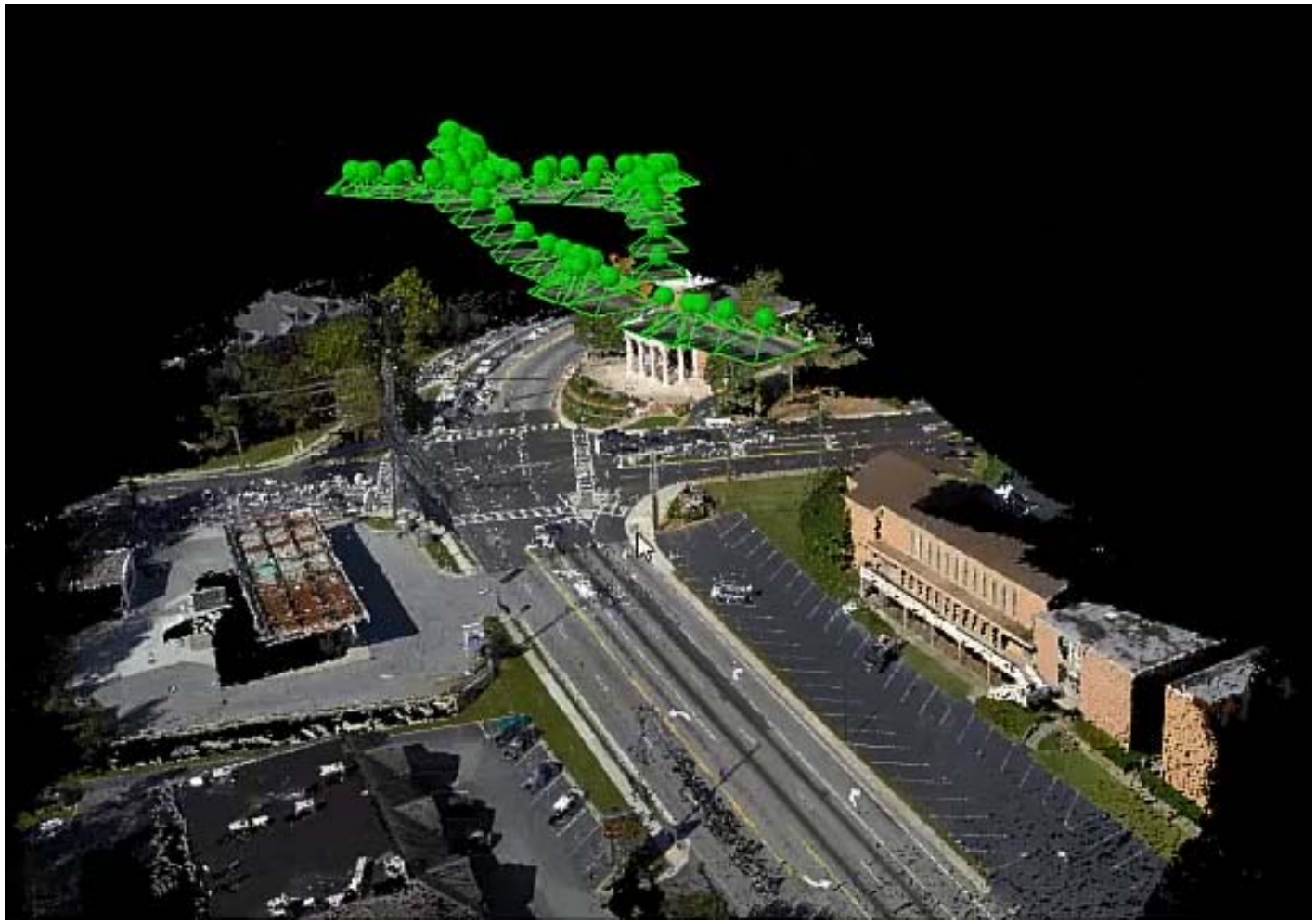
Fixed Wing System Terrain Mapping

Hex copter Bridge
Inspection Platform

Hex Copter Vertical Inspection Close Range Photography

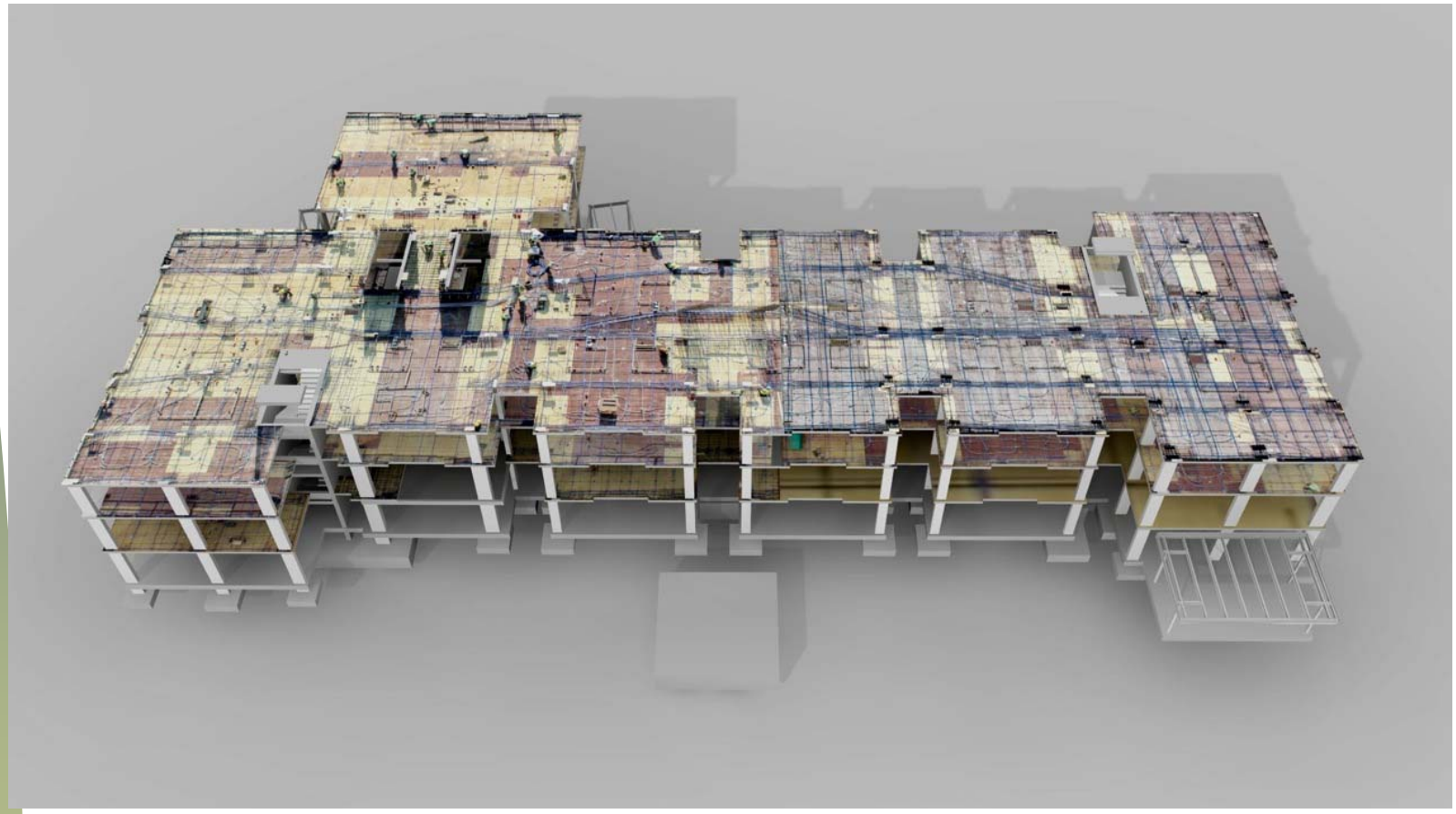
Fix Wing Mapping System

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)

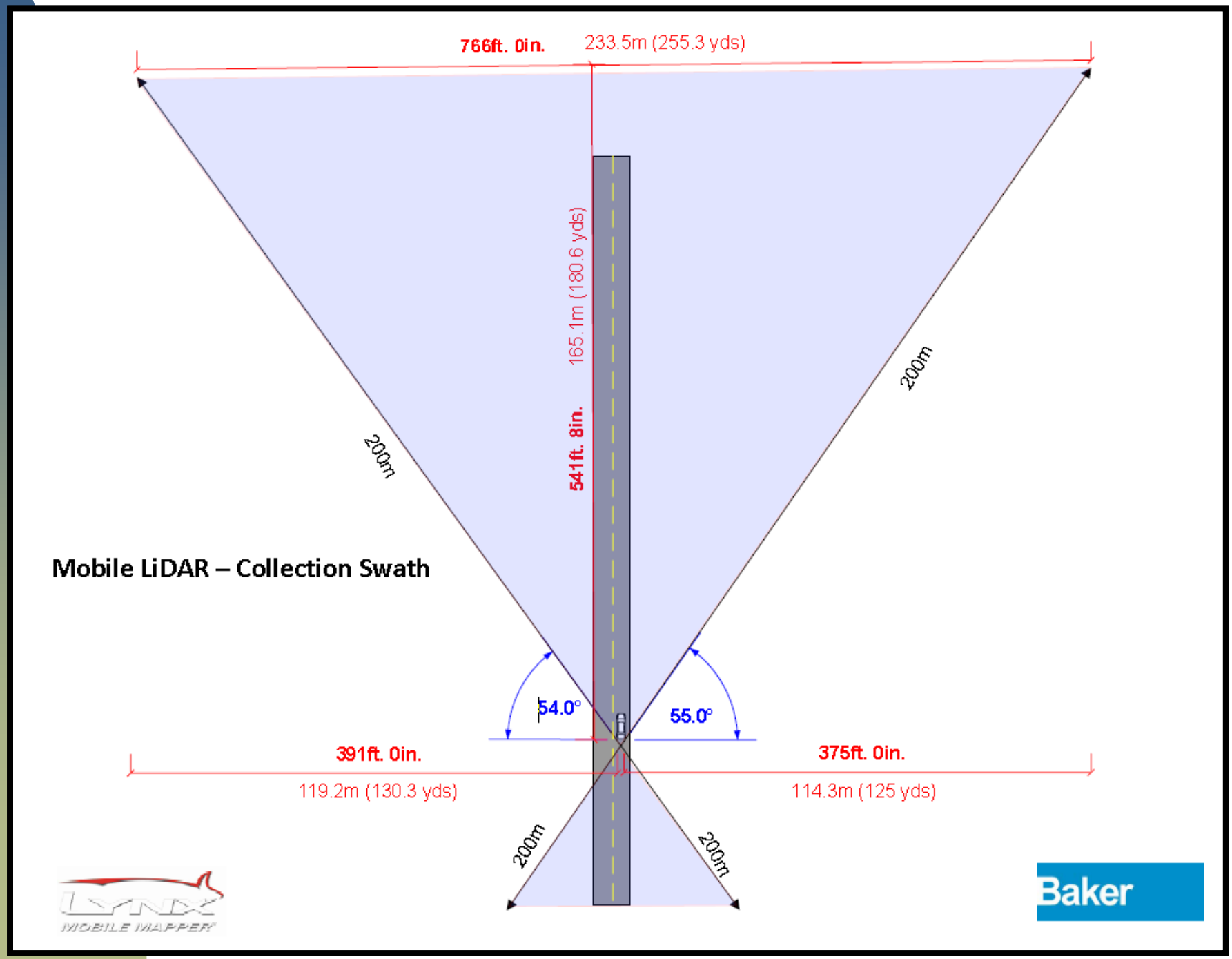
Mobile Units

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.


766ft. 0in.
233.5m (255.3 yds)
165.1m (180.6 yds)
541ft. 8in.
200m
200m
Mobile LiDAR – Collection Swath
54.0°
55.0°
391ft. 0in.
119.2m (130.3 yds)
375ft. 0in.
114.3m (125 yds)
200m
200m
LYNX
MOBILE MAPPER
Baker

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

Z&F 5010

Riegl VZ 400
Versatile Scanner

Current State of the Science Laser Scanners

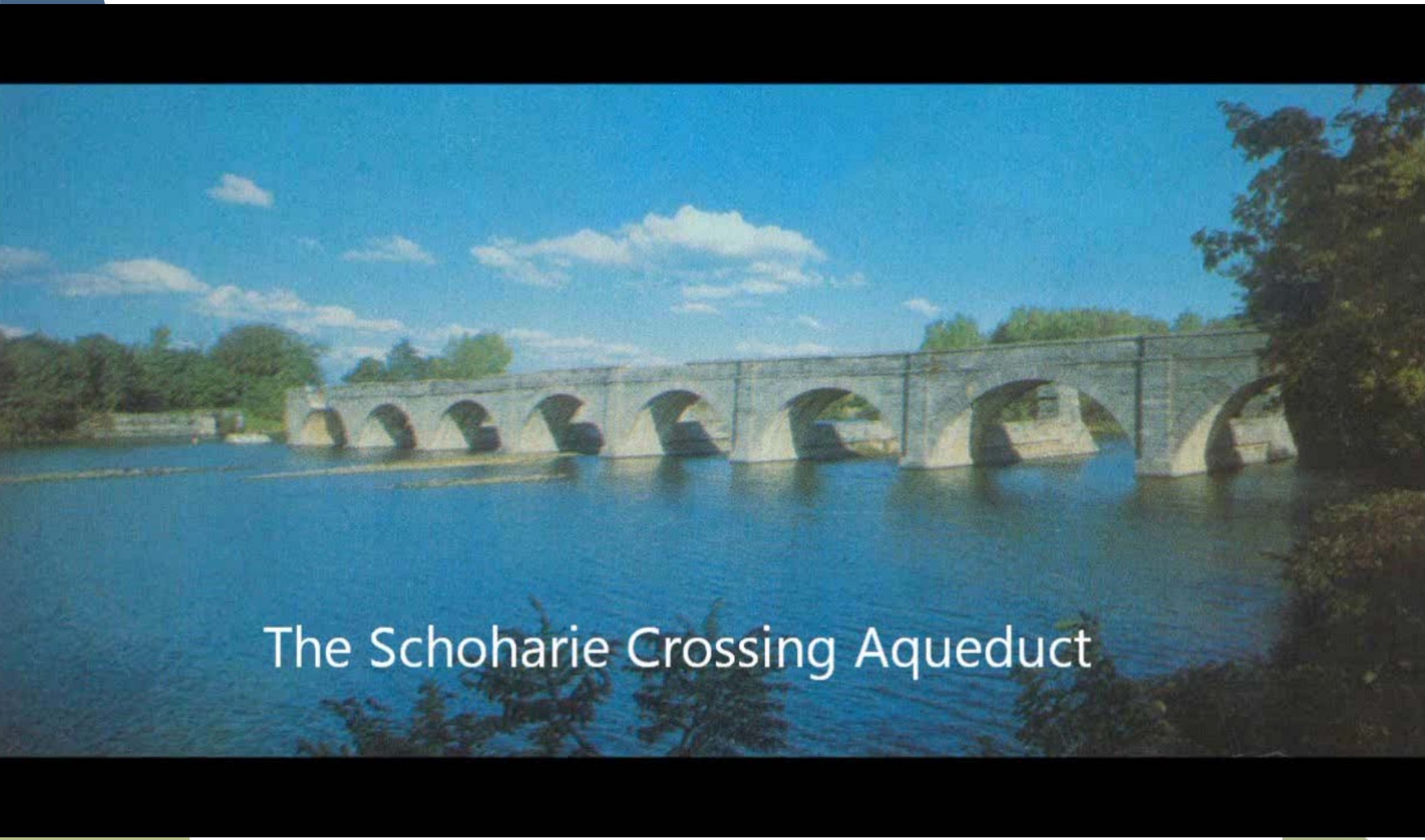
Phase Based Scanner
High Speed Laser
Used Inside

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

Time of Flight
Long Range Laser
Used outside & Inside

C10 Laser Scanner
50,000 PPS
Effective range 100 meters

Bridge Scan Terrestrial Lidar

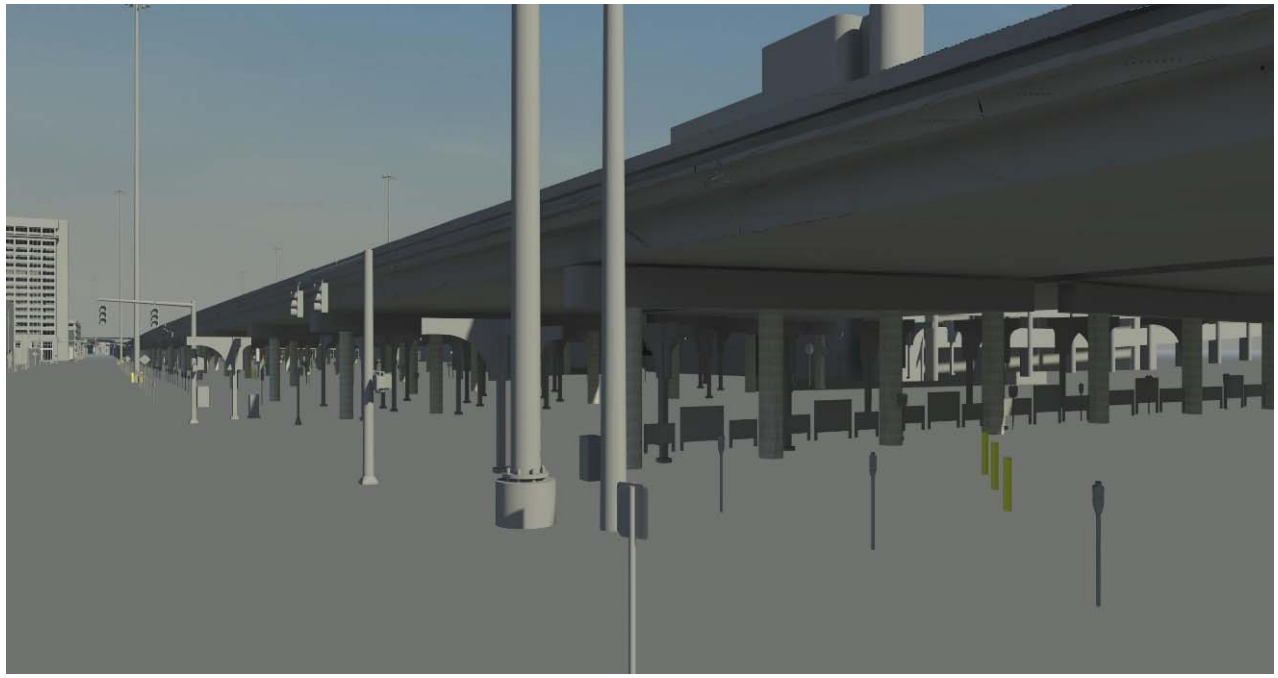


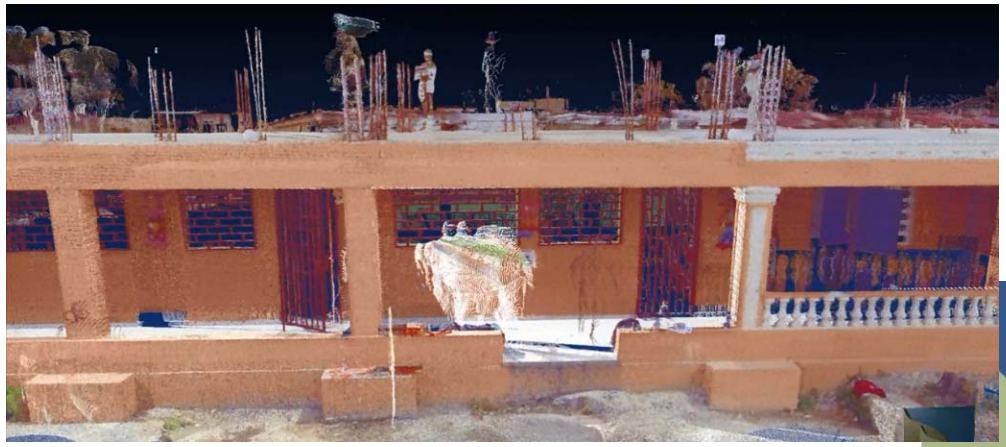
Is laser scanning and point cloud technology right for your project?

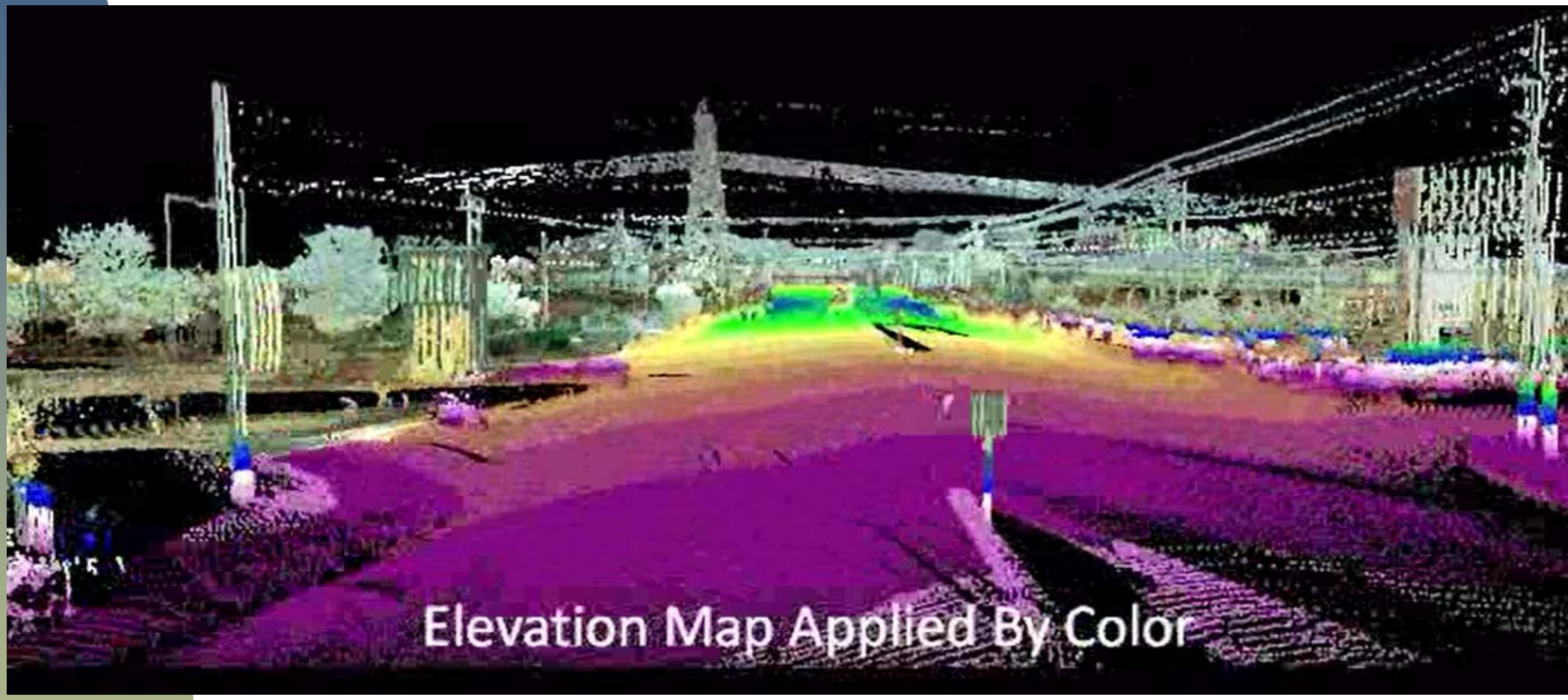
- Are you documenting a complex environment?
- Are you documenting something you cannot physically touch like a tower, structural beams or tall building?
- Is this a pipe room, conveyor system or manufacturing process that is extremely complex and mistakes could be costly?
- Is the interior architectural 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?







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 ± .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

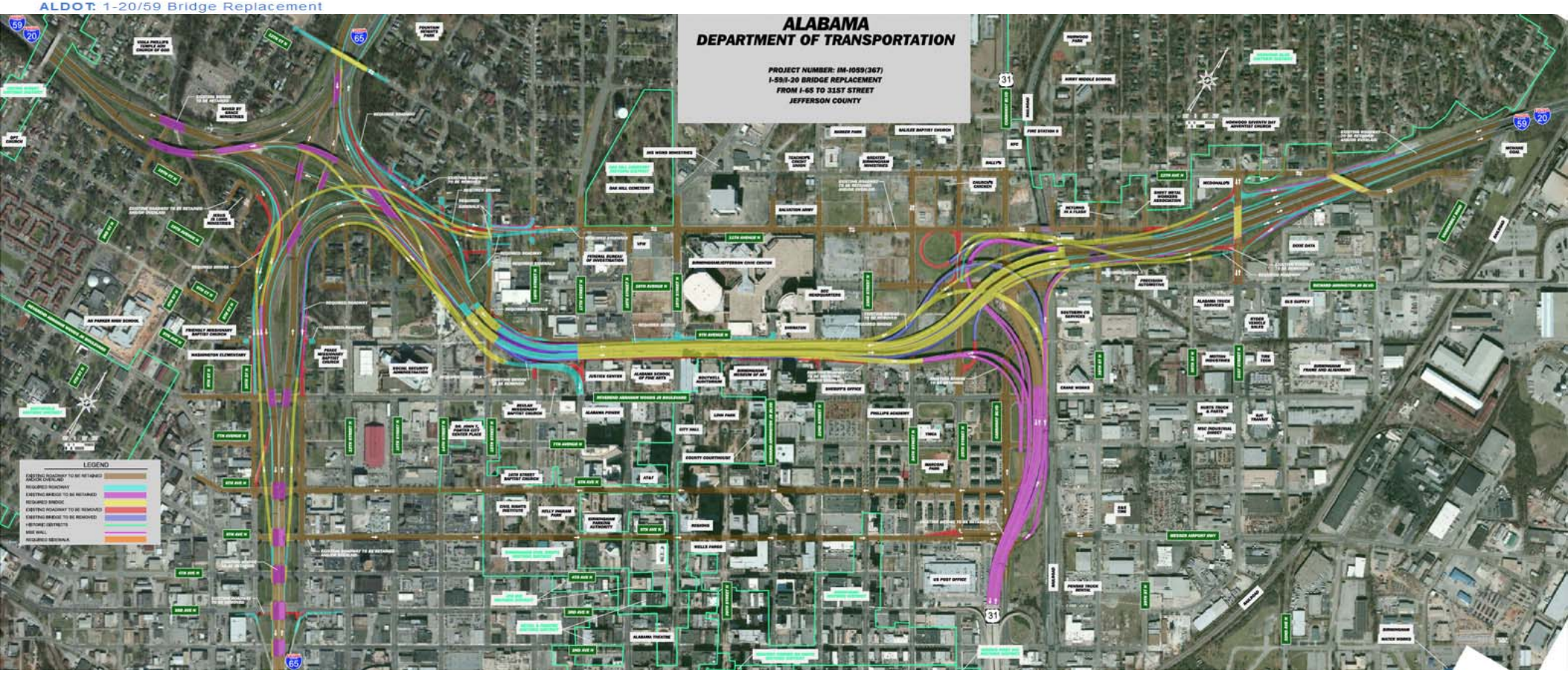
- 1400 bridges columns,
- 8 miles of bridges, 1 tunnel,
- 100's of light poles,
- miles of underground utilities,
- adjoining buildings and improvements within the design envelope.

The Project:

Improving Birmingham's Interstate Assets

I-20/59
Central Business District Bridge Replacement
Birmingham, Alabama

ALDOT: 1-20/59 Bridge Replacement



BUILT TO FACILITATE

80,000

VEHICLES PER DAY

OVER 160,000

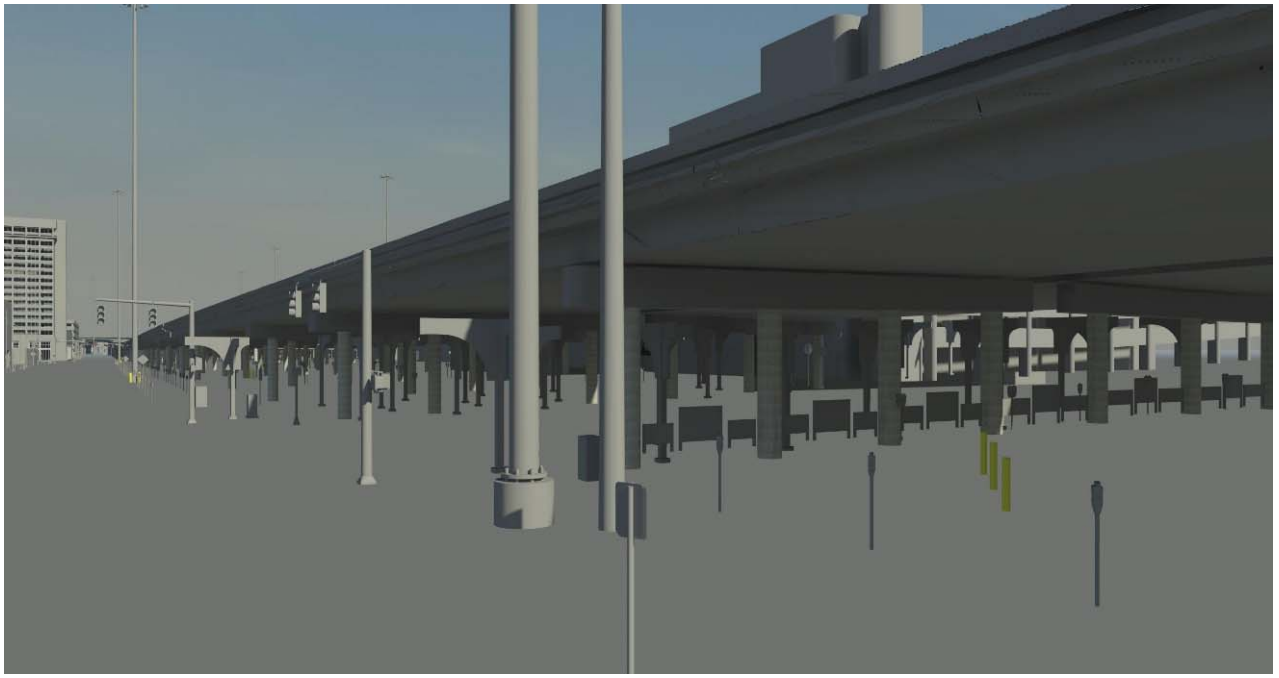
VEHICLES PER DAY

OVER 225,000

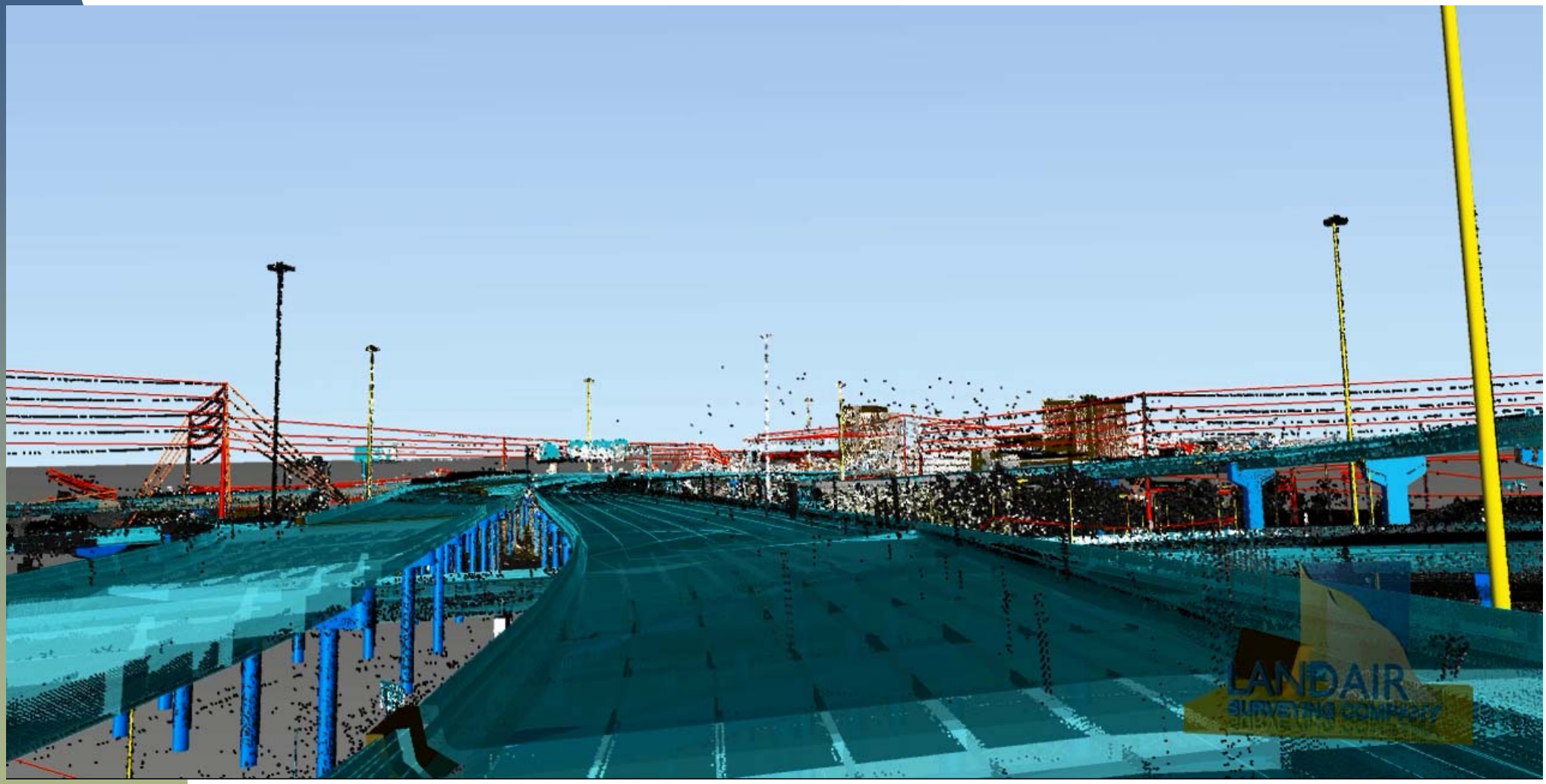
VEHICLES PER DAY

THE 1960S | TODAY | BY 2035


Sheraton



Models



Current Model of CBD Project

The 3D Design Advantages

You can drop a 3D pointcloud into in to 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

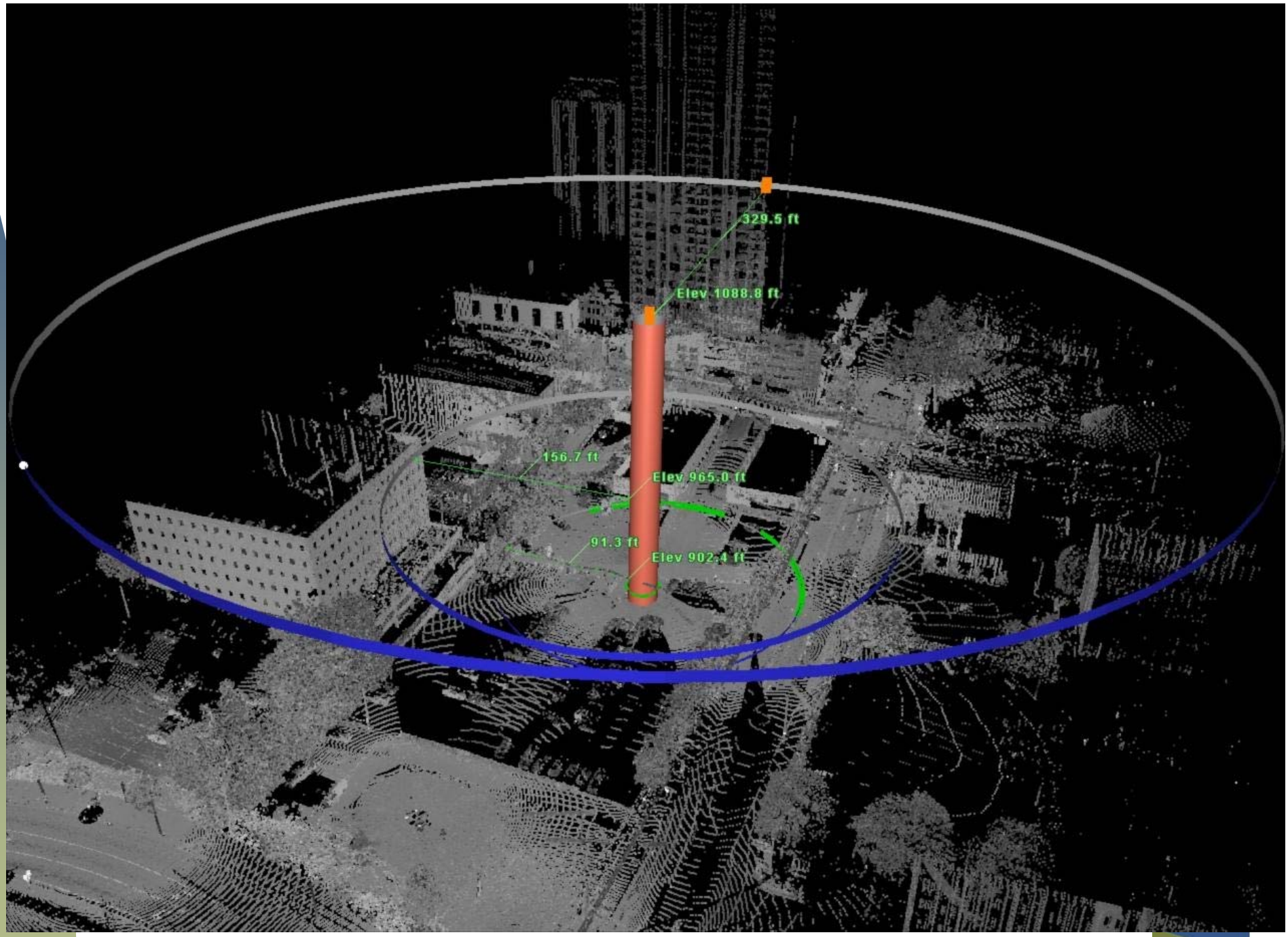
Mitchell Interchange I 94

Mitchell Interchange I 94

Total Cost Savings from Pre Construction 3D Analysis
$9.5 Million Dollars!

DIN Category	Estimated Percent of Reduction	Total Cost ($ millions)	Average Cost Per I ssue
General Structures	30.5%	6.8	$45,674
Roadway Drainage	25.5%	5.7	85,631
Wet Utilities/D r ainage	11.1%	2.4	27,120
Bridges	8.0%	1.8	15,557
Noise Wall	8.0%	1.8	125,909
Retaining Wall	7.7%	1.7	21,818
Earthwork	4.5%	1.0	59,220
Electrical/IT S/FT MS	2.6%	0.6	15,557
Traffic	2.1%	0.5	18,174
Sign Structures	0.1%	0.02	738

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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- LandAir Surveying's YouTube Channel