

MNSEA Conference

MAY 2019

UAVs, Mixed Reality, and 3D Laser Scanning and how to
integrate into your workflow

Presenters

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 - Trimble Buildings Field Technology Group
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- Matt Schwartz
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 - Territories of Minnesota and North Dakota
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Who is Frontier?

Frontier Precision, Inc. is an employee-owned company that has experience serving survey, mapping, engineering, construction, GIS, forestry, water resources, mosquito and vector control, public safety, and natural resources professionals throughout the western United States since 1988. Headquartered in Bismarck, ND, Frontier Precision also has offices in Minnesota, Colorado, Alaska, Montana, Hawaii, South Dakota, Oregon, Washington and Idaho. We pride ourselves on offering exemplary customer service; and our industry professionals are here to help you find a solution to fit your needs.

Who is Frontier?

Trimble® Certified Service Centers

We have seven Trimble Certified Service Centers in North Dakota, Minnesota, Colorado, Alaska, Hawaii, Oregon, and Washington.

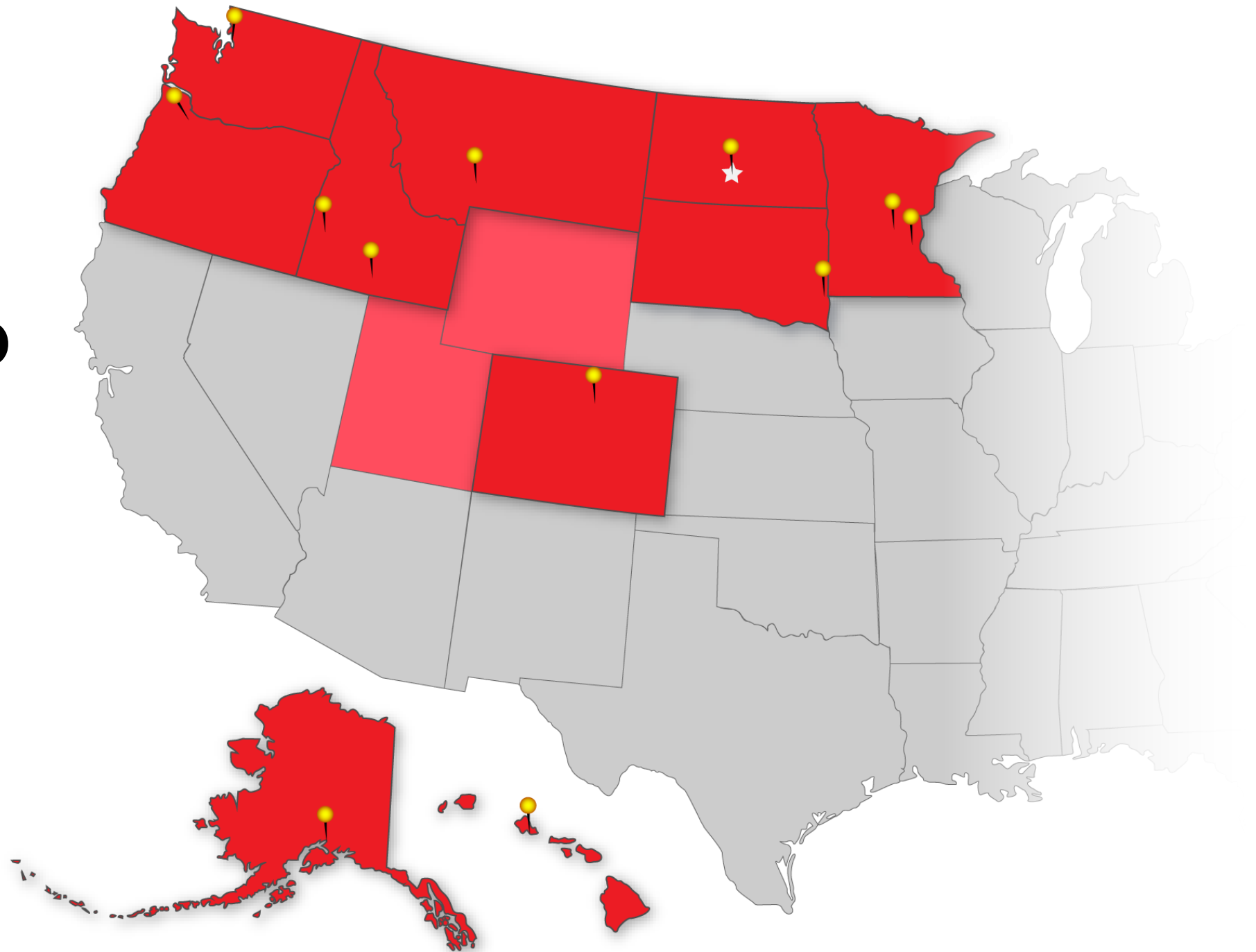
Retail Locations

We have eleven retail locations that you can purchase equipment, accessories, and rent your conventional or specialty equipment.

Technical Support & Training

As a Trimble Priority Support partner, we offer in-depth technical support for Trimble mapping, construction and survey products. We have several Trimble Certified Trainers on staff that offer Trimble and Esri® training courses.

Where are we?



Who is Trimble?



Company



NASDAQ:
TRMB



\$3.1B
In Revenue



31%+
Building & Infrastructure



Innovation



2,000+
Patents



360 Construction Workflow
& Technology Patents



14%
R&D re-invested



People



10k+ Employees
in 35 Countries



800+ Construction
Professionals



Global Customers
in **150** countries

Core Business Franchises

Our core industries are global trillion \$ industries which operate in demanding environments, with technology adoption in the early phases



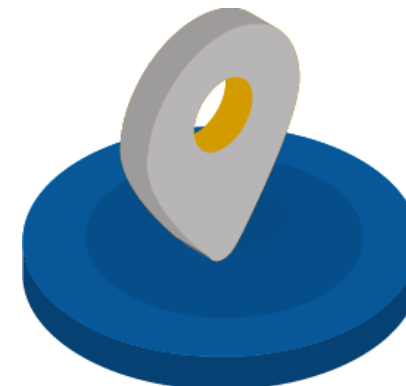
Agriculture



Buildings



Civil Engineering
and Construction



Geospatial



Transportation
and Logistics

The Trimble Buildings Group

We are :

- 2000 people+
- 18+ acquisitions in 10 years (Meridian the oldest)
- 60+ products

5 main business channels:

- ARCHITECTURE
- STRUCTURAL
- MEP
- GC/CM
- REWS(Owners)



A BROAD SOLUTIONS PORTFOLIO

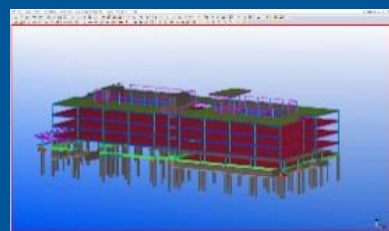


CONCEPT



 **SketchUp**
modelogix

ENGINEERING
& DESIGN



 **TEKLA**
BIMsight

ESTIMATING



winest

PROJECT
PLANNING



 **VICO**
PROLOG

CONSTRUCT



OPERATE



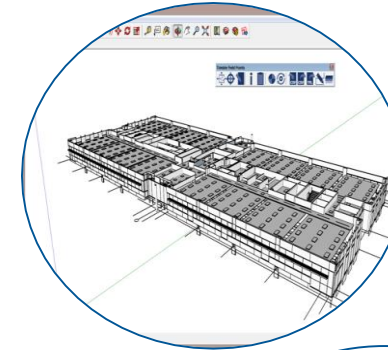
MANHATTAN
ATRIUM

Trimble Buildings Field Technologies

Rapid Positioning Systems



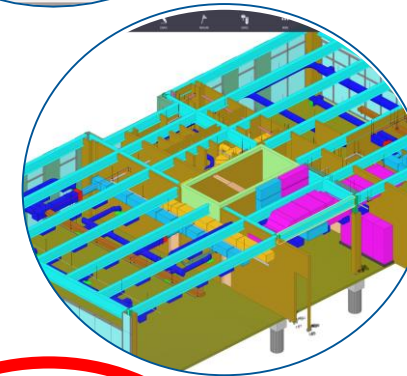
Data Preparation



Robotic Total Stations



Field Software



GNSS



Trimble
Connect



Personnel
Management



3D Scanning



UAS



Unmanned Aerial System

Not all drones are created equal

- **Drones come in 2 main styles**
 - Multi-rotor
 - Fixed Wing
- **DJI is the world's most popular manufacturer of multi-rotor aircraft**
 - In 2017 roughly 70% of new aircraft sold were DJI
 - Range in size from the small, entry level Mavic to the very large Matrice 600 Professional series
- **Fixed wing market is more open**
 - Fixed wing solutions are designed for large open areas
 - Typically a professional surveying solution instead of consumer use

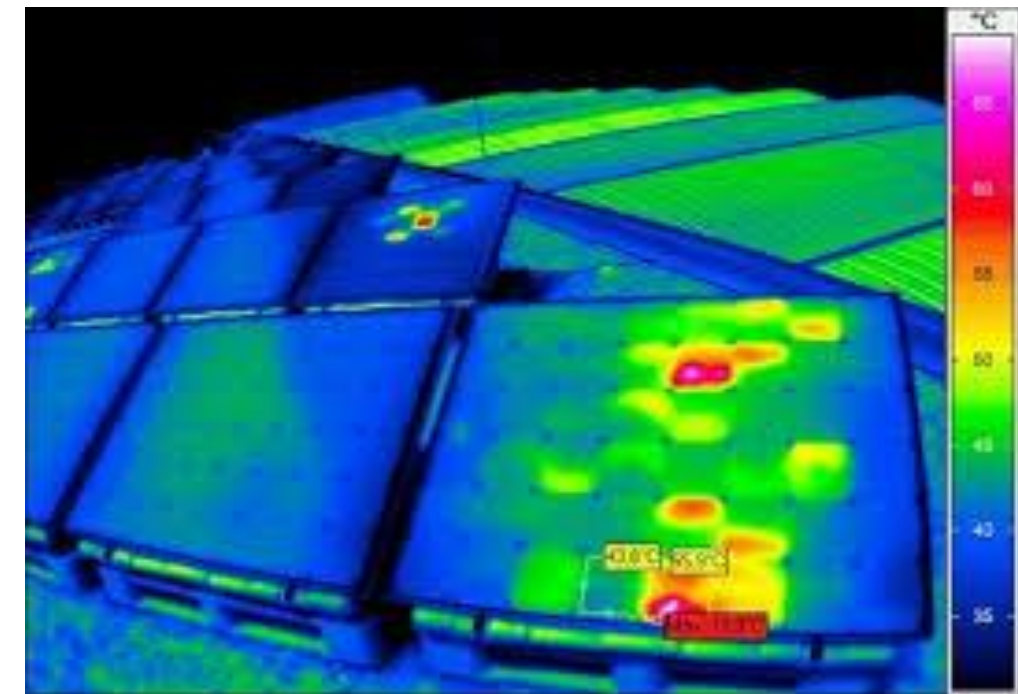
Geospatial Applications

- Asset Data Collection or Inspection
- Terrain Modeling (higher accuracy)
- Volumetric Measuring
 - Stockpiles
 - Mining
- Forestry
- Corridor Surveys (roadways)



Construction Deliverables

- Progress Documentation
- Project Inspection
- Thermographic Inspection
- High Resolution Orthomosaics
- 3D Fly Through Video's
- 3D Point Clouds in LAS format



Geospatial Mapping

- Solutions
 - Asset Data Collection
 - Project Inspection
 - Asset Inspection
 - Urban Planning
 - Terrain Modeling

UAS Challenges

- **Make sure you have the right tool for the job**
- **You will likely need multiple types of aircraft**
- **Management of large data sets and processing time**
- **Potential legal issues**
- **Potential regulatory “red tape” at the state and city level, public sentiment**
- **Public concerns about safety, security and privacy**

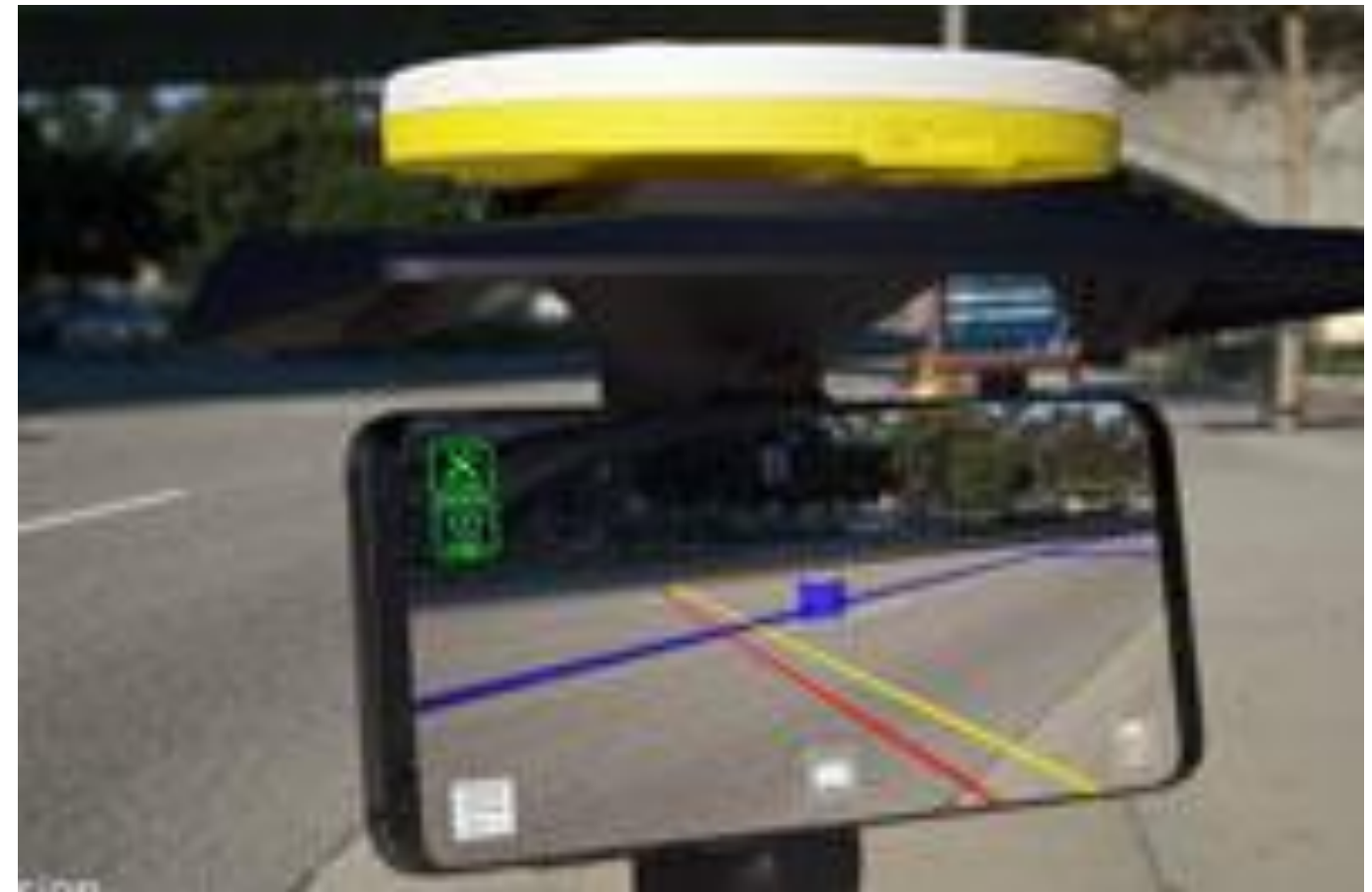
Find a technology partner and develop a plan

Small UAS – Part 107 Regulations

DO	DO NOT
Get Remote Pilot Certificate	Fly beyond visual line of sight (BVLOS)*
Register aircraft	Fly over people*
Pre-flight inspection	Fly over 400 ft AGL, or beyond 400 ft of structure
Fly in good weather (3 mi vis.)	Fly in controlled airspace without ATC permission*
Keep records	Visual Observer not required
Report accidents (exceeding \$500 damage)	



Mixed Reality



Big Money

There are several major players in the Mixed Reality field. Products continue to be released and improved. Smaller, faster devices, with less cables, better battery life.



oculus



Microsoft®



VIVE



magic
leap

Meta



DAQRI



What is Mixed Reality?

- **Mixed Reality is the combination of VR and AR**
 - VR is Virtual Reality
 - Completely digital environment
 - Immersive experience of somewhere else
 - AR is Augmented Reality
 - Real world experience
 - Devices overlay the digital information in the real world

What is Mixed Reality?

Mixed Reality links the real world and virtual world by providing a more immersive experience than AR but in your actual surroundings. Digital information can be readily available for use in a variety of ways.

What can it do?

Conceptualize



Conceptulize



Visualize



Inspect



Trimble
Connect



Collaborate



Operate



Connected Mine

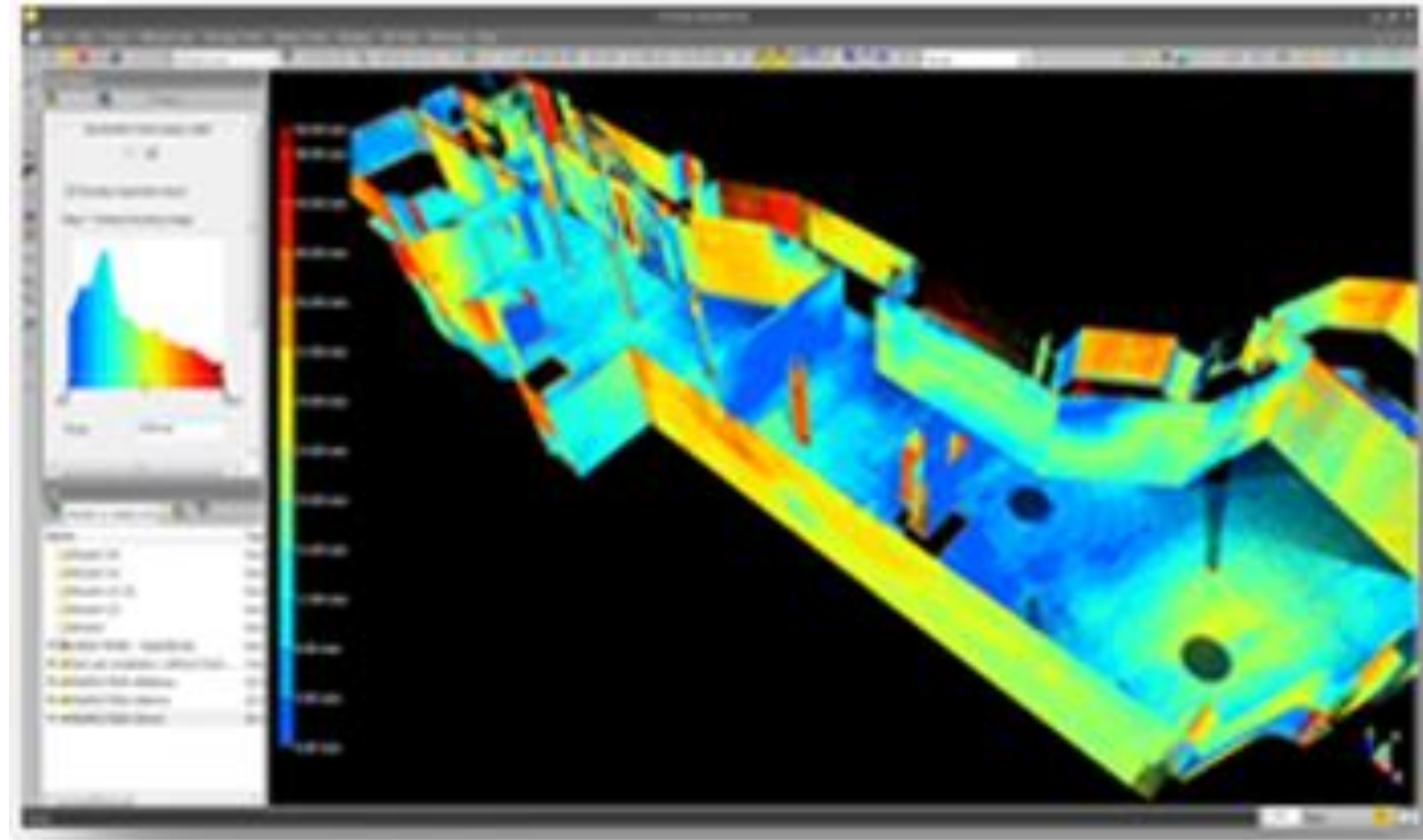
Where do we want to go?



Coming Sooner



3D Laser Scanning



3D Laser Scanning

- The technology has been around for many years but it was prohibitively slow and expensive for use on most projects
- Technological advances have changed that
 - Devices gather data faster and more accurately
 - Computers can handle large data sets
 - AI is now able to automate workflows
- Laser scanning has quickly become the better way to gather information

Scanning Systems

- Hardware
 - Scanner Device
 - Accessories such as Batteries, Charger, Cables, Tripod, or Targets
- Processing Software
 - Manage the data (BIG Data – GB and TB size)
 - Create deliverables
- Costs
 - Mobile Scanning systems can cost over \$1,000,000
 - Tripod based Static systems vary between 18k and 140k
 - Due diligence is recommended for this investment

3D Laser Scanners

- Scanners come in 2 main operating styles
 - Mobile – slightly less accurate-positionally
 - Static Position – more accurate
- Mobile Scanners track their position as they scan
 - Typically mounted on vehicles or drones
 - More often used in Geospatial applications like roadways or large sites
- Static Scanners
 - Scanner collects points from a single location
 - Individual scans can be combined(Registered) together
 - Easily the fastest, most complete way to measure something



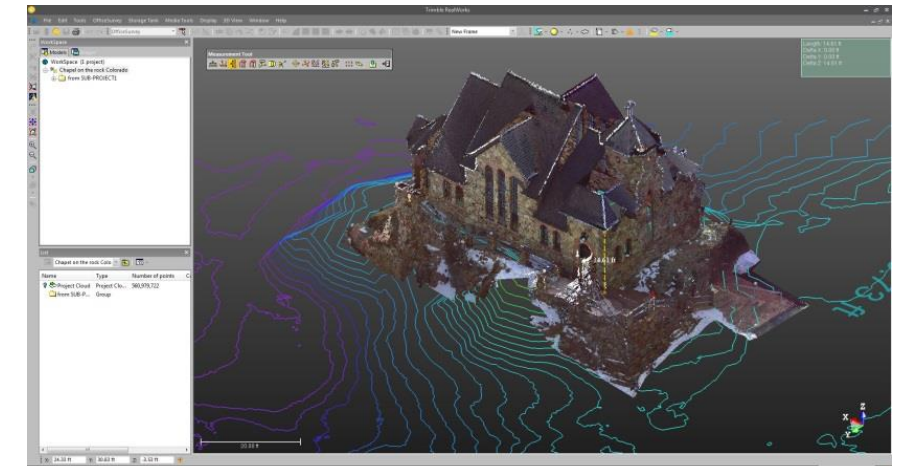
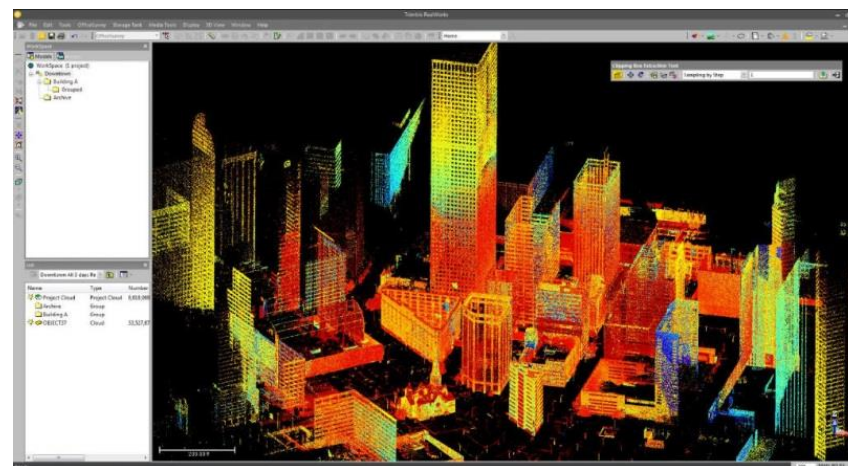
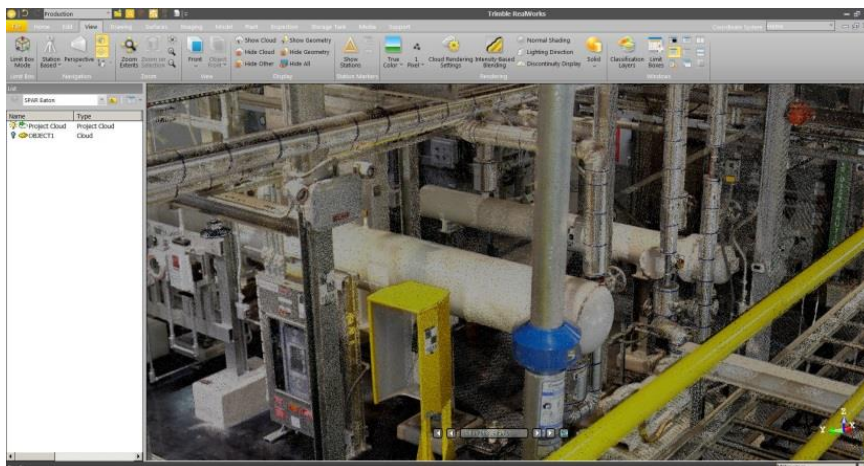
3D Laser Scanning

- High speed measurement
 - True 1 million points per second
 - Typical 3 minutes scan time
- Consistent accuracy
 - 2mm range standard deviation up to 120m with Standard Precision mode
 - 1mm range standard deviation up to 80m with High Precision mode
 - 120-340m range with Extended Range upgrade
- Indoor and Outdoor performance
 - Consistent data capture throughout range even on dark / difficult objects

Point Cloud Software

How do I work with 2 billion points???

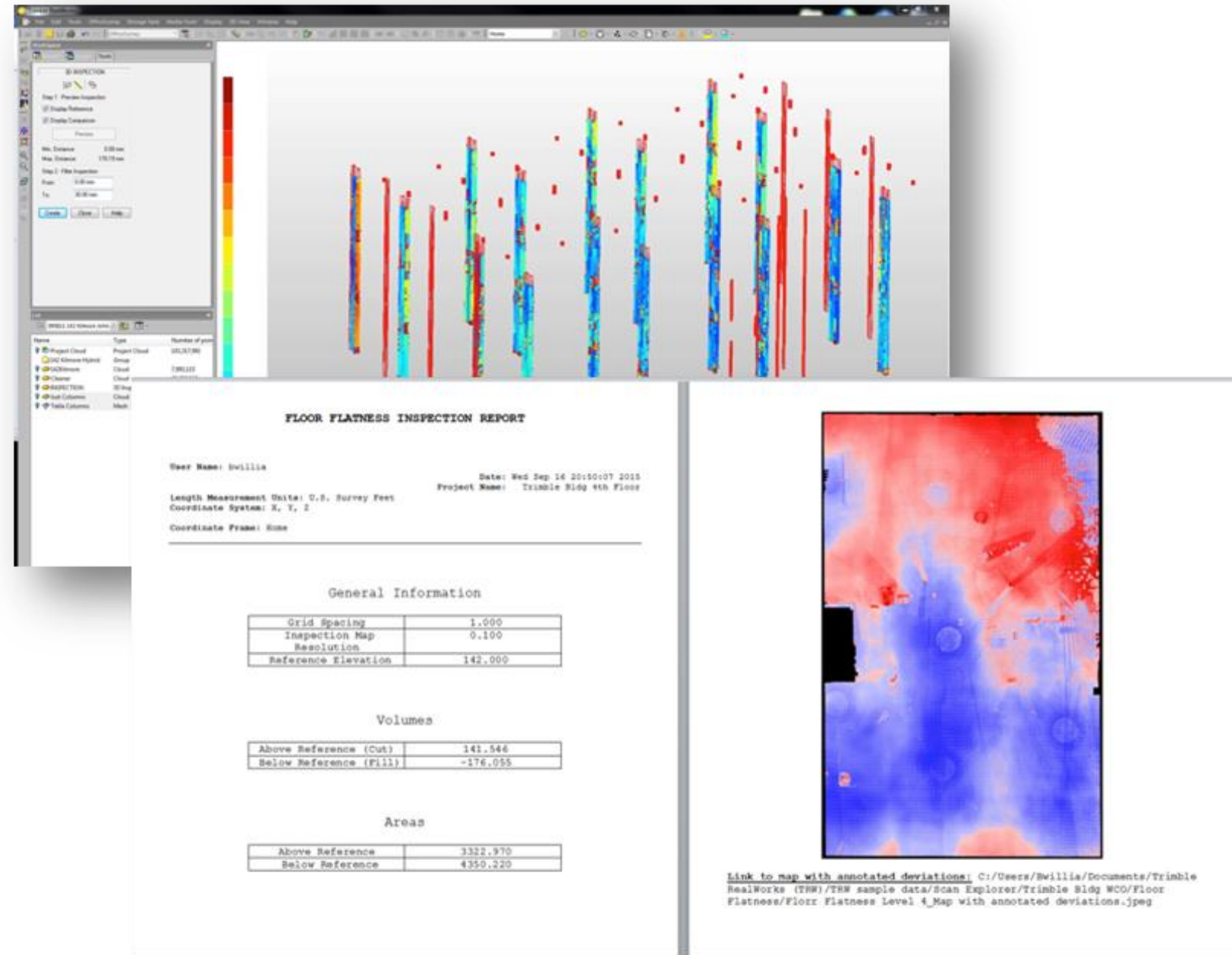
- Automatically process, register and colorize scans
- Analyze, inspect and model directly in the point cloud
- Generate in-depth reports and compelling deliverables
- **Pair with Tekla for point cloud modeling**
- Share, collaborate and deliver with free viewer
- Export data to other popular CAD programs



Point Cloud Software

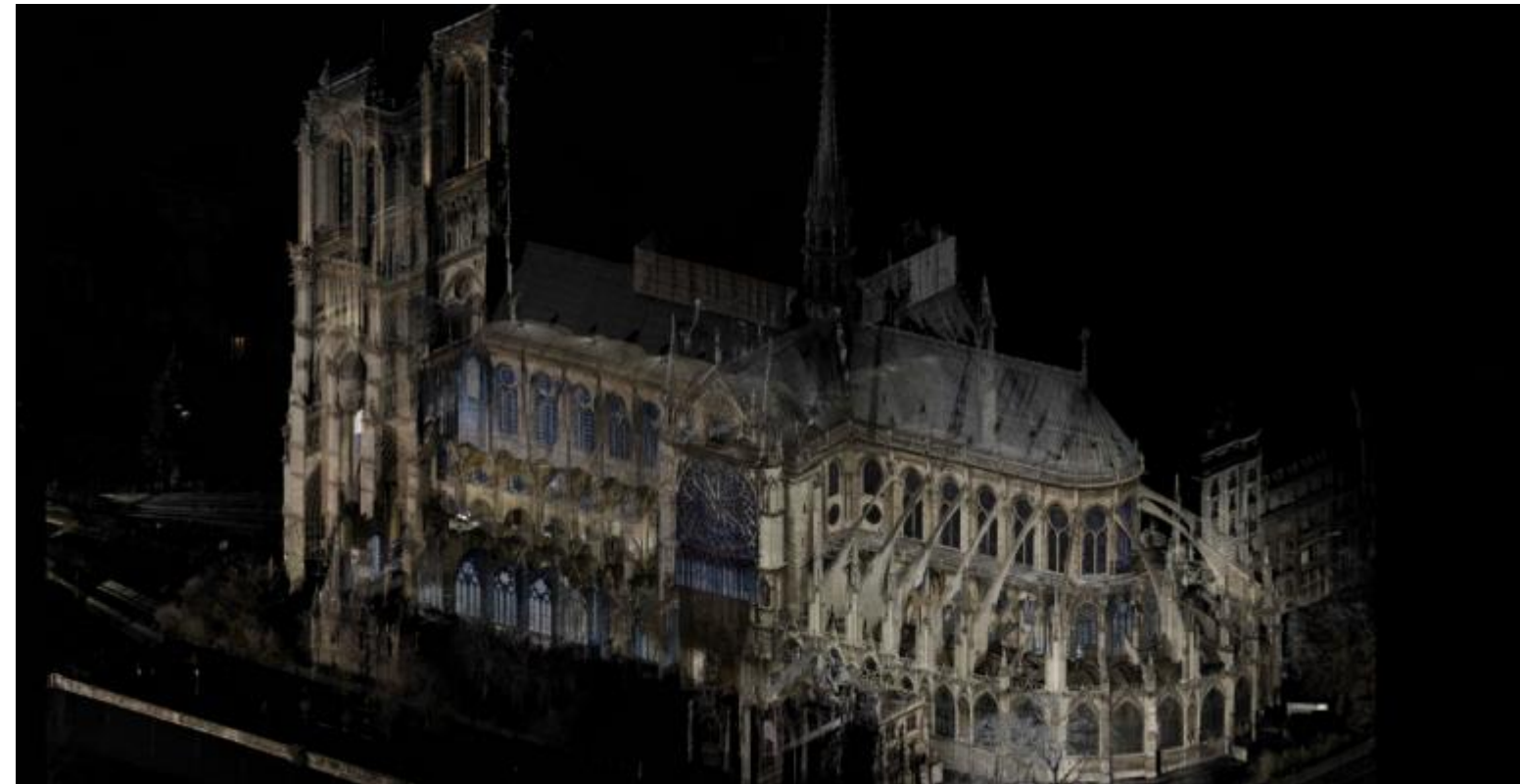
Analytic Tools

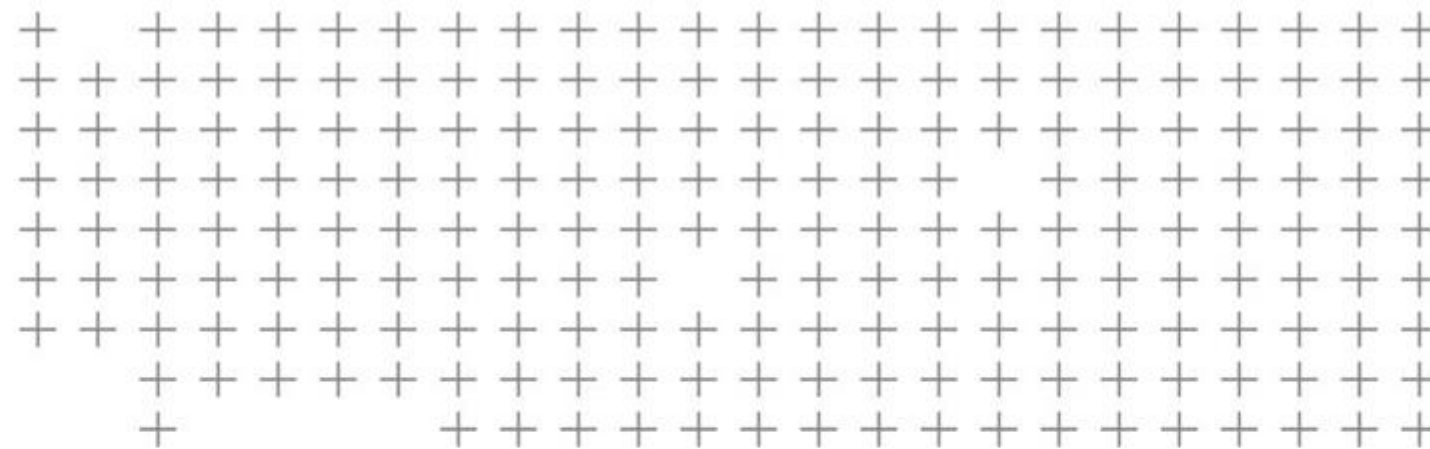
- Floor Flatness
- Core Verticality
- Compare to Model
- Beam Deflection
- Material in Place
- Quantities



Notre Dame Cathedral

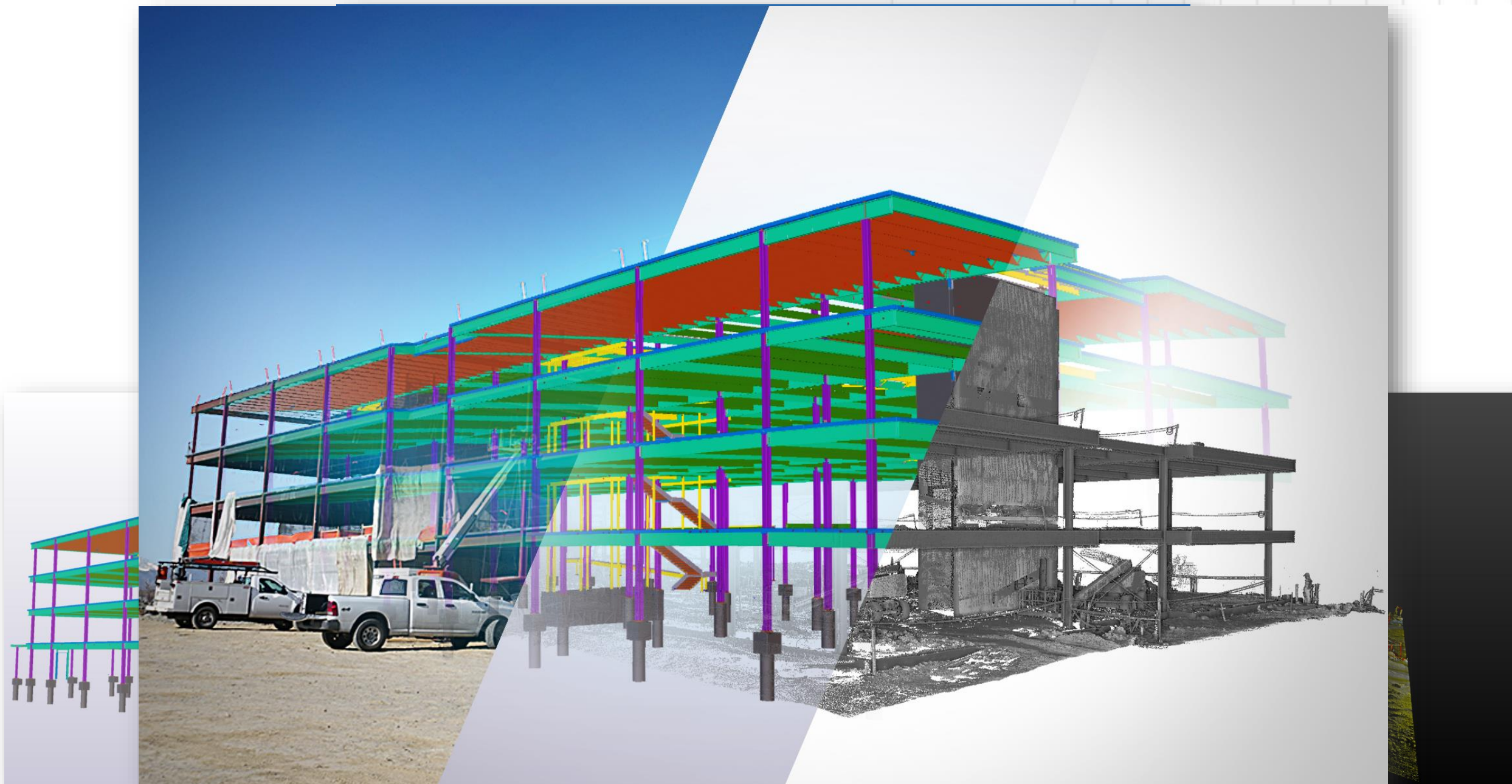
In 2015 over 1 billion points were captured in the 13th-century building. This data will provide reconstruction efforts with an excellent start point.



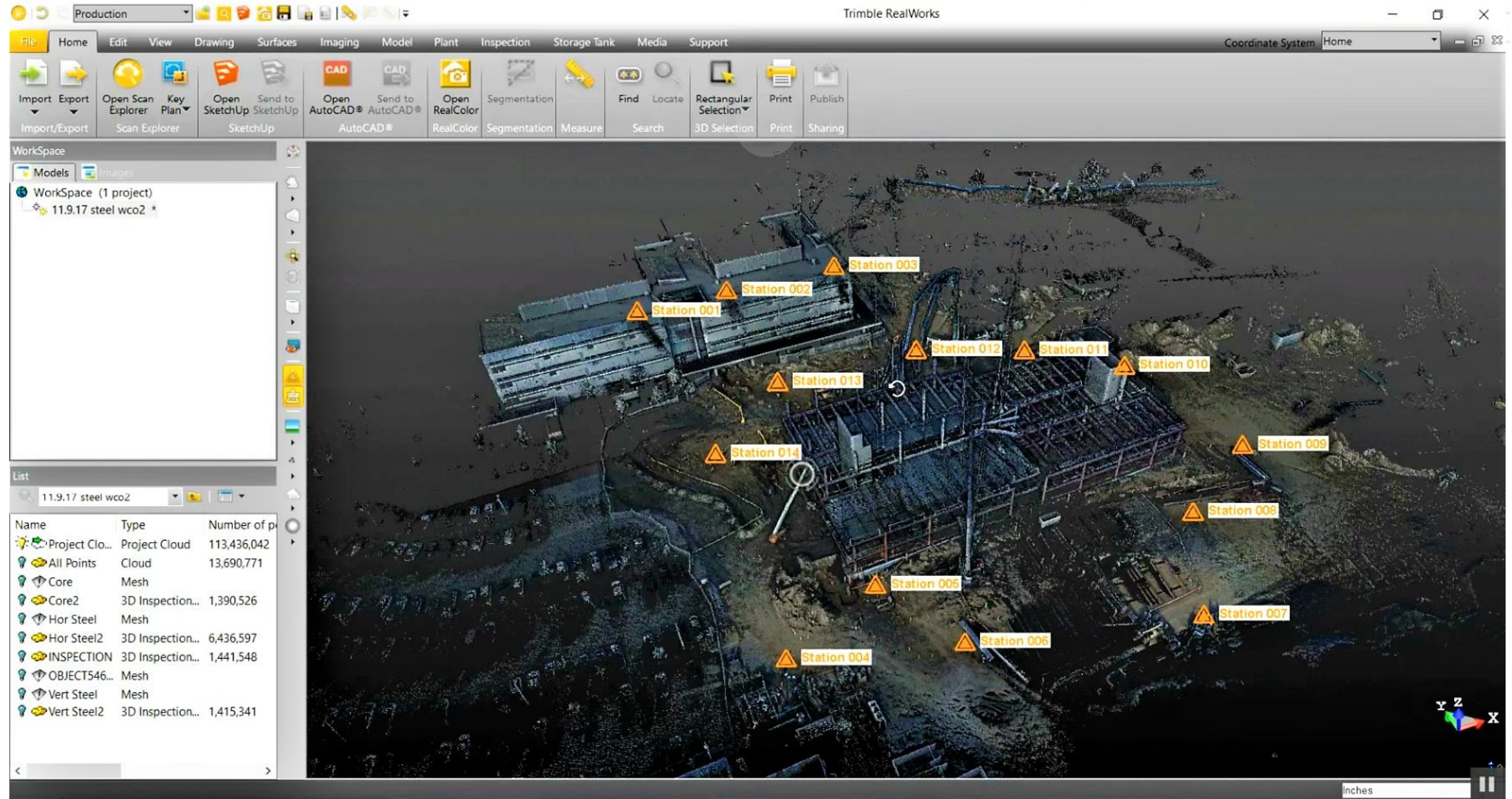


Scanning Workflows

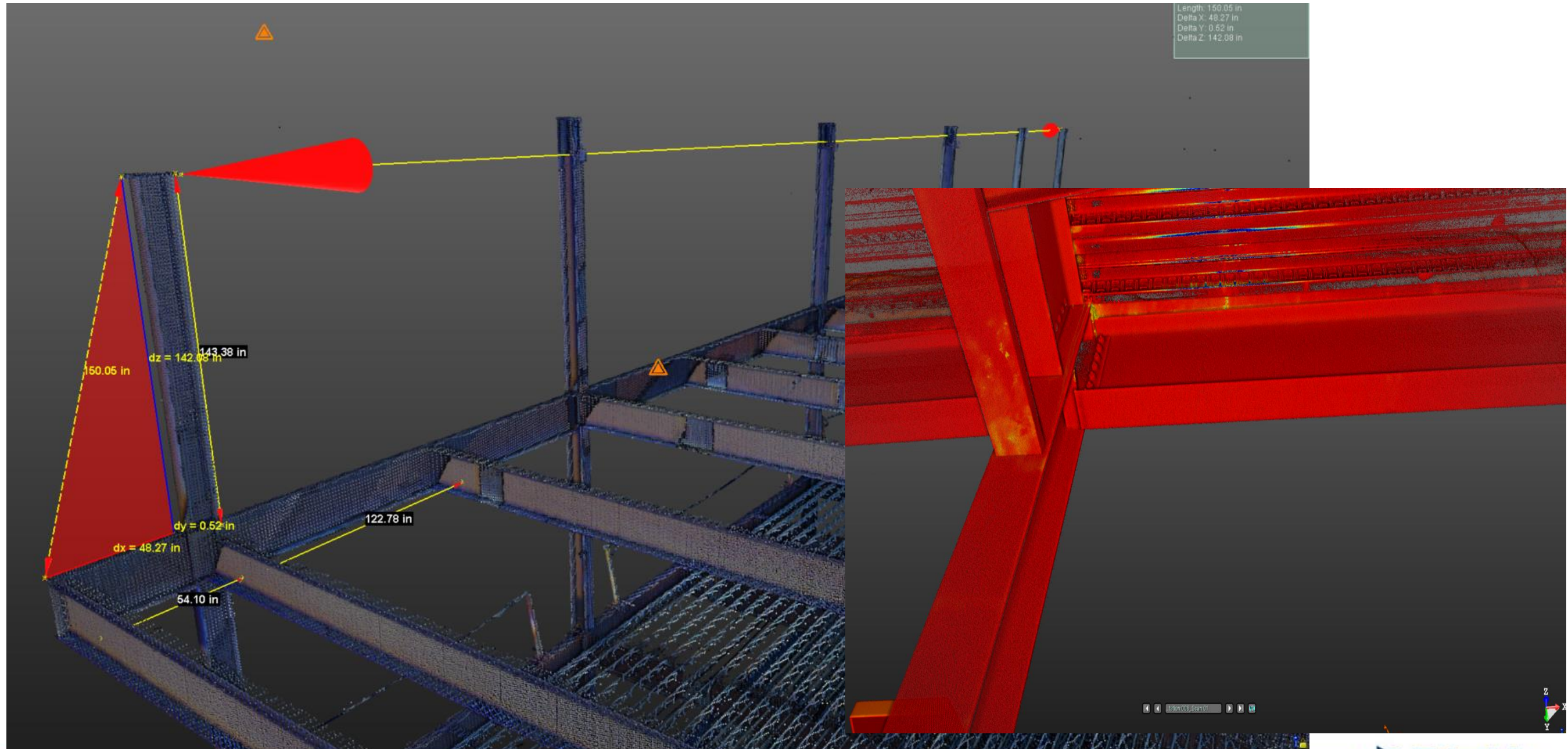
Trimble RealWorks Structural Analysis



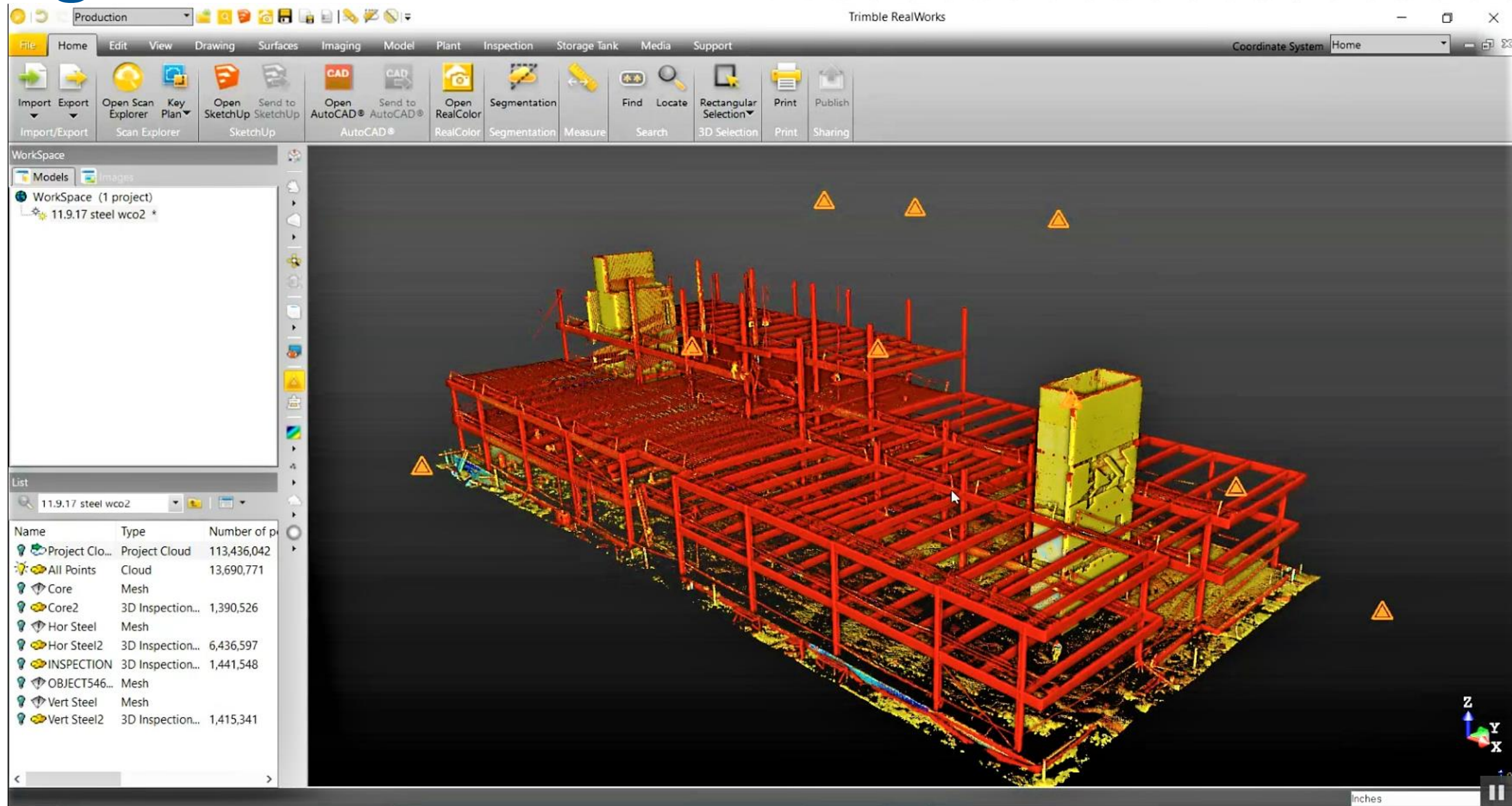
Project Overview



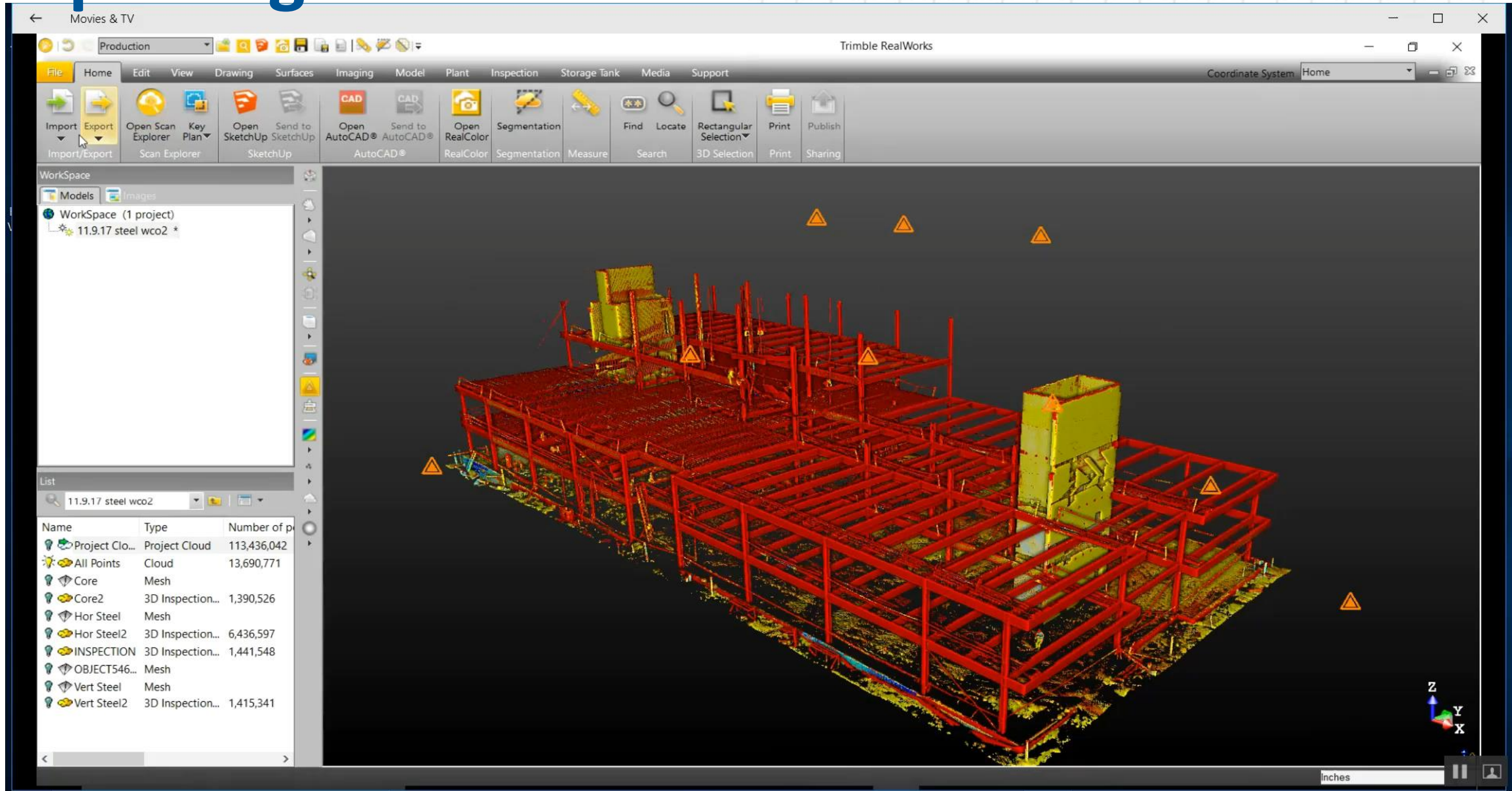
Accurate Field Measurements



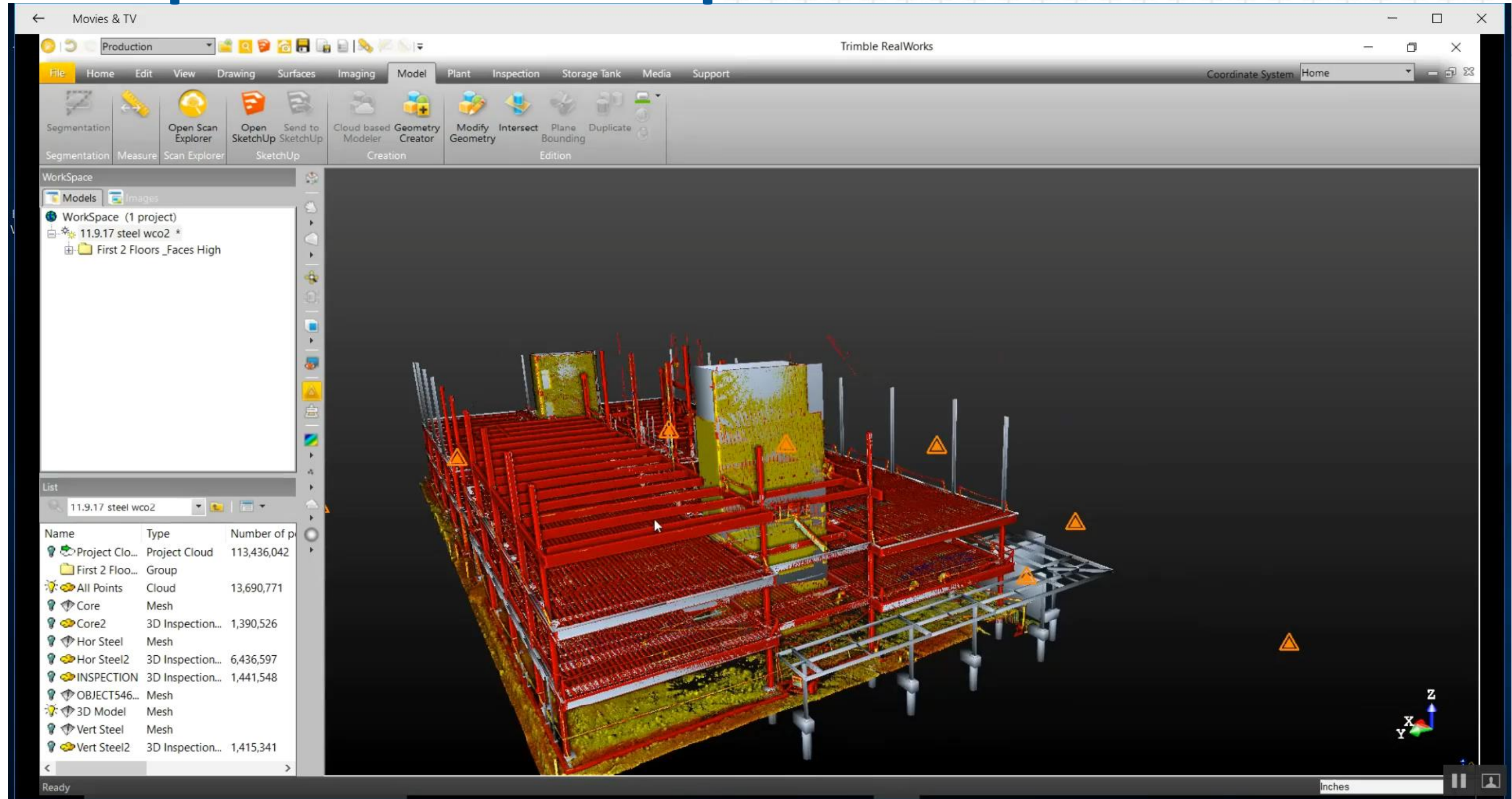
Segmentation



Importing the 3D Model

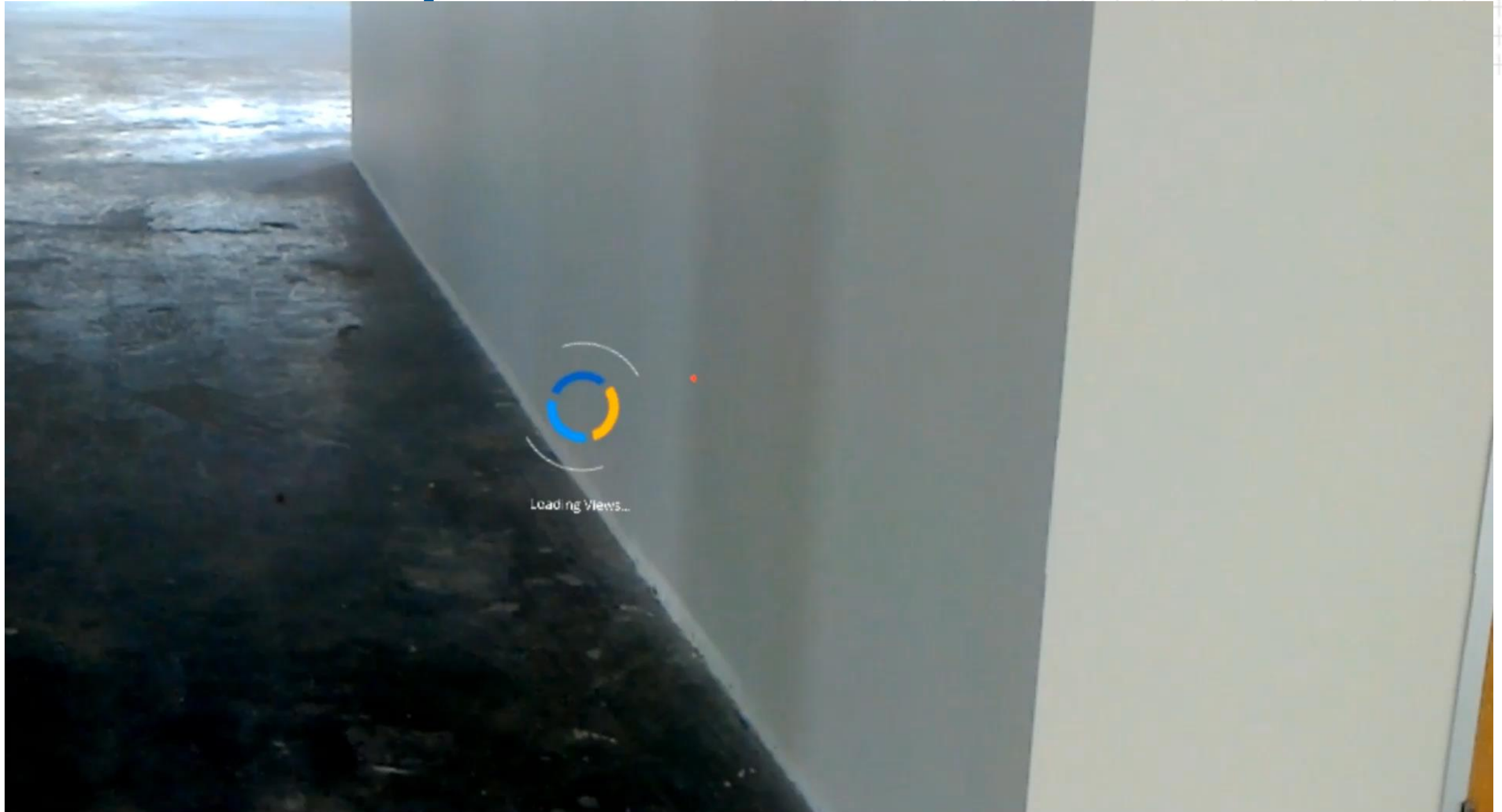


3D Inspection Heat Map Steel



Concrete Level Workflow Timelapse

Floor Heat Map



Elevator Core Wall 3D Inspection

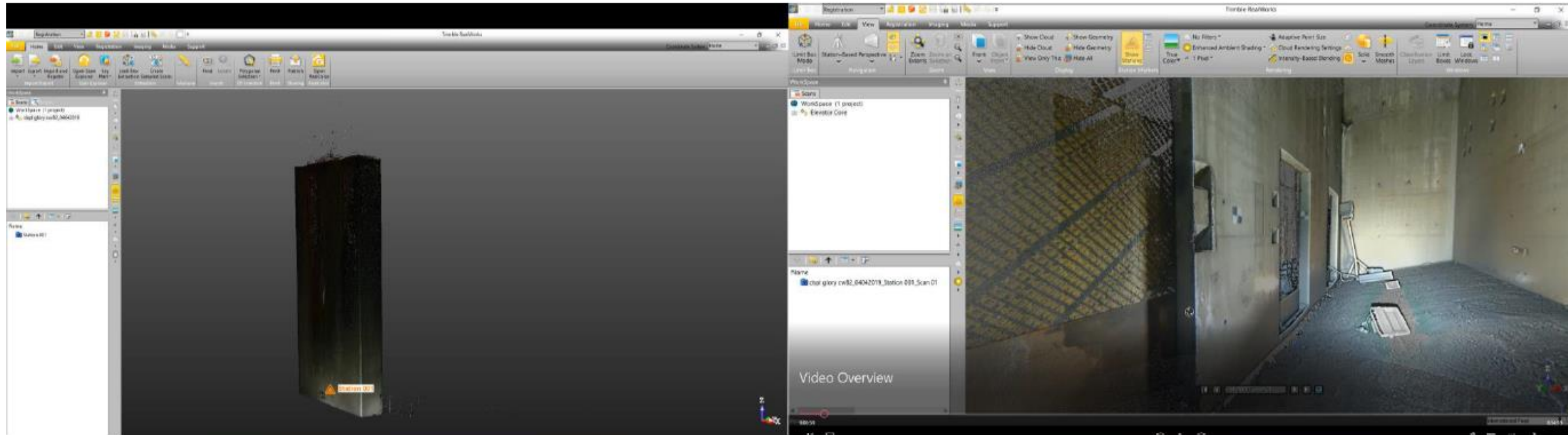


Elevator Core 3D Laser Scan



Function of 3D Laser Scanner TX8:
To ensure elevator lift core wall
inner alignment are within +/-
25mm tolerance throughout 250m
height.

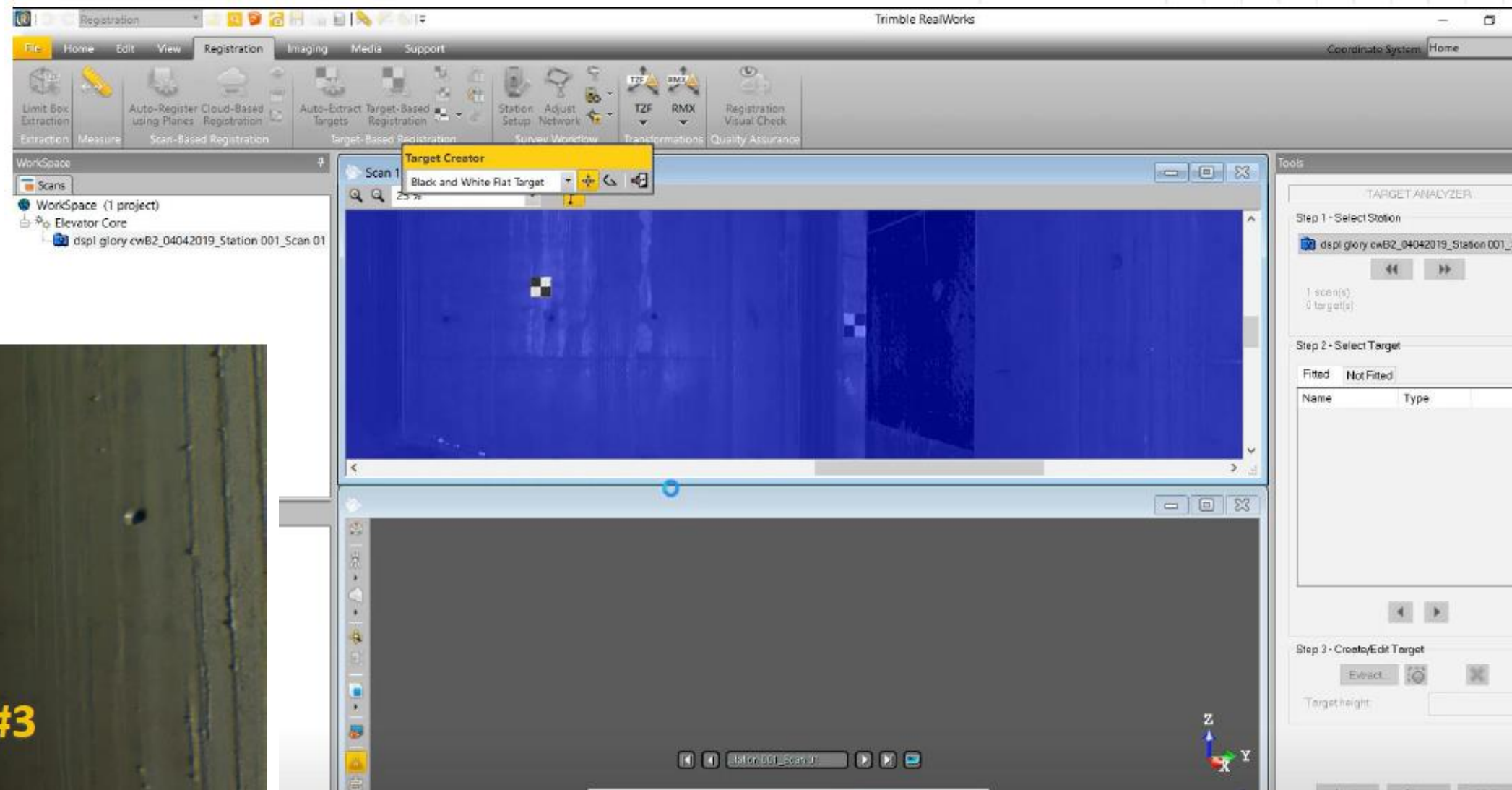
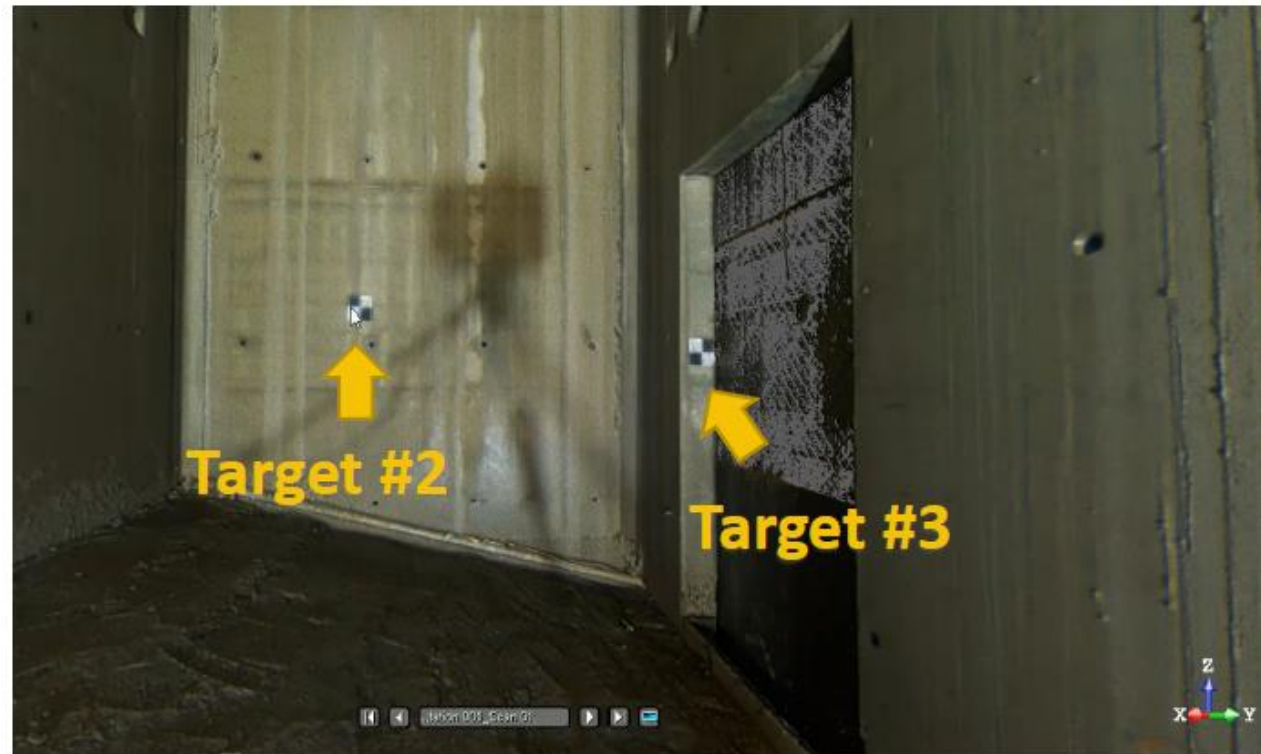
Elevator Core 3D Laser Scan



Point Clouds, before process
(Perspective view)

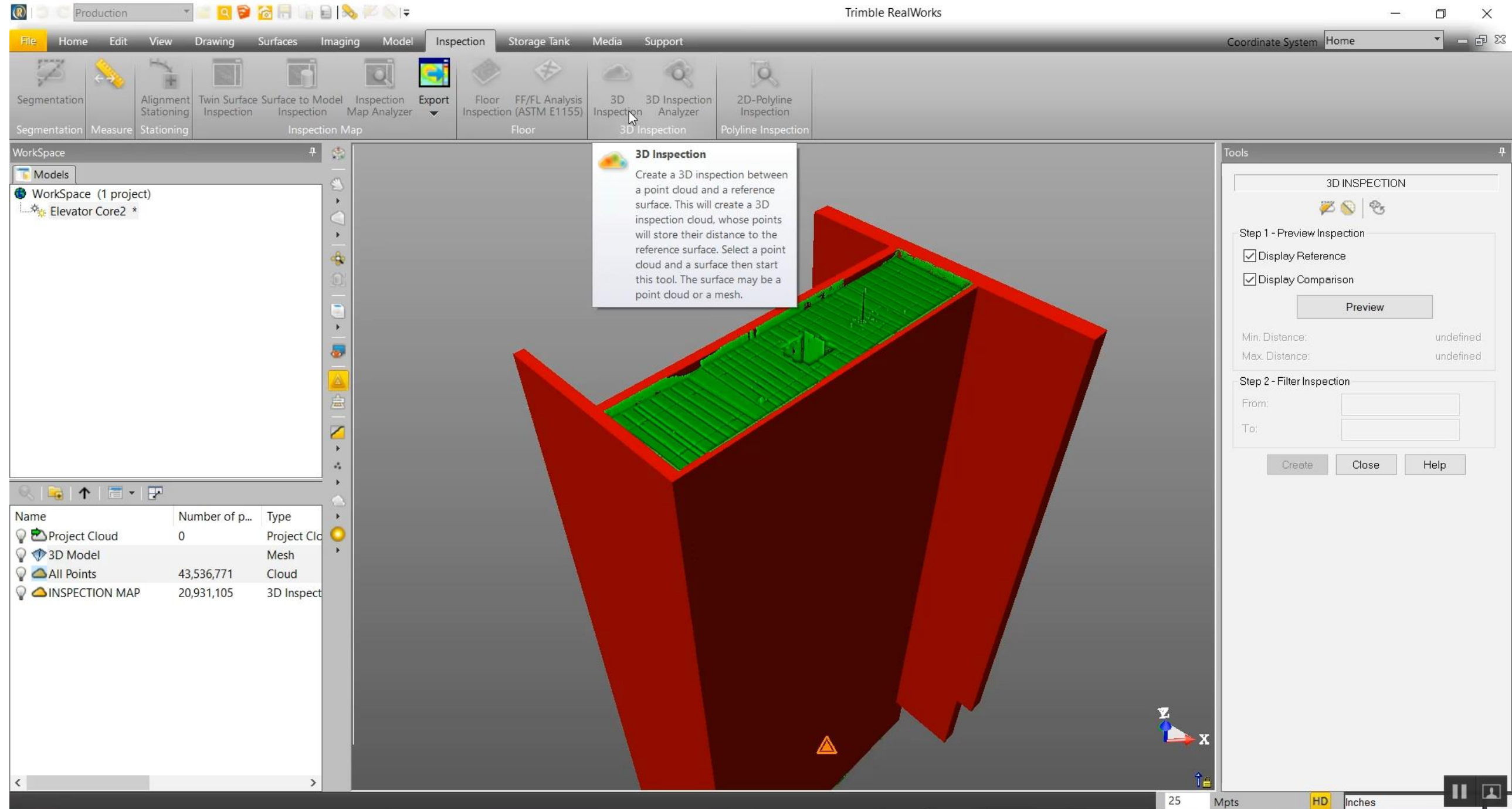
Point Clouds, before process
(Internal)

Elevator Core 3D Laser Scan

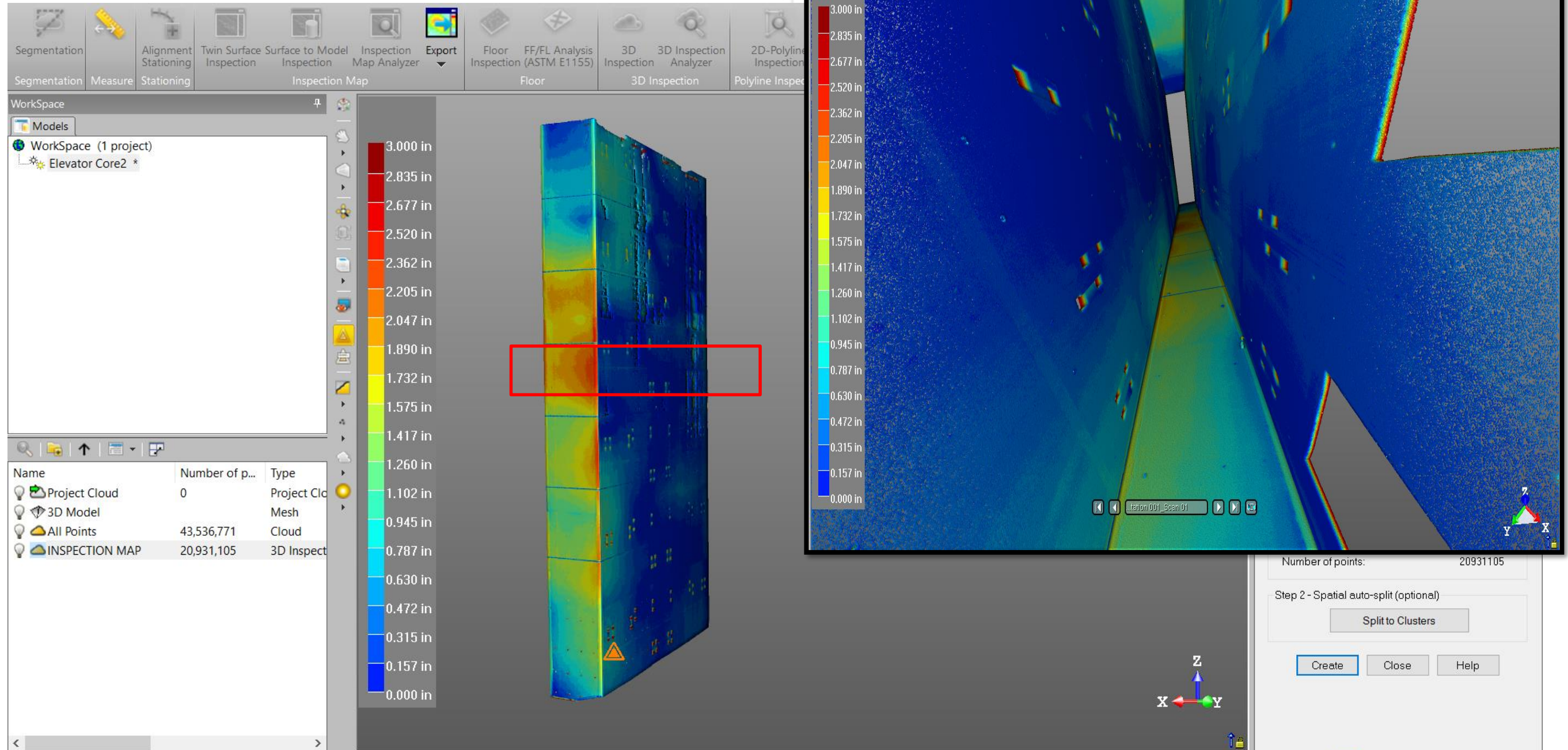


Min. 3 targets are required for Geo-Reference

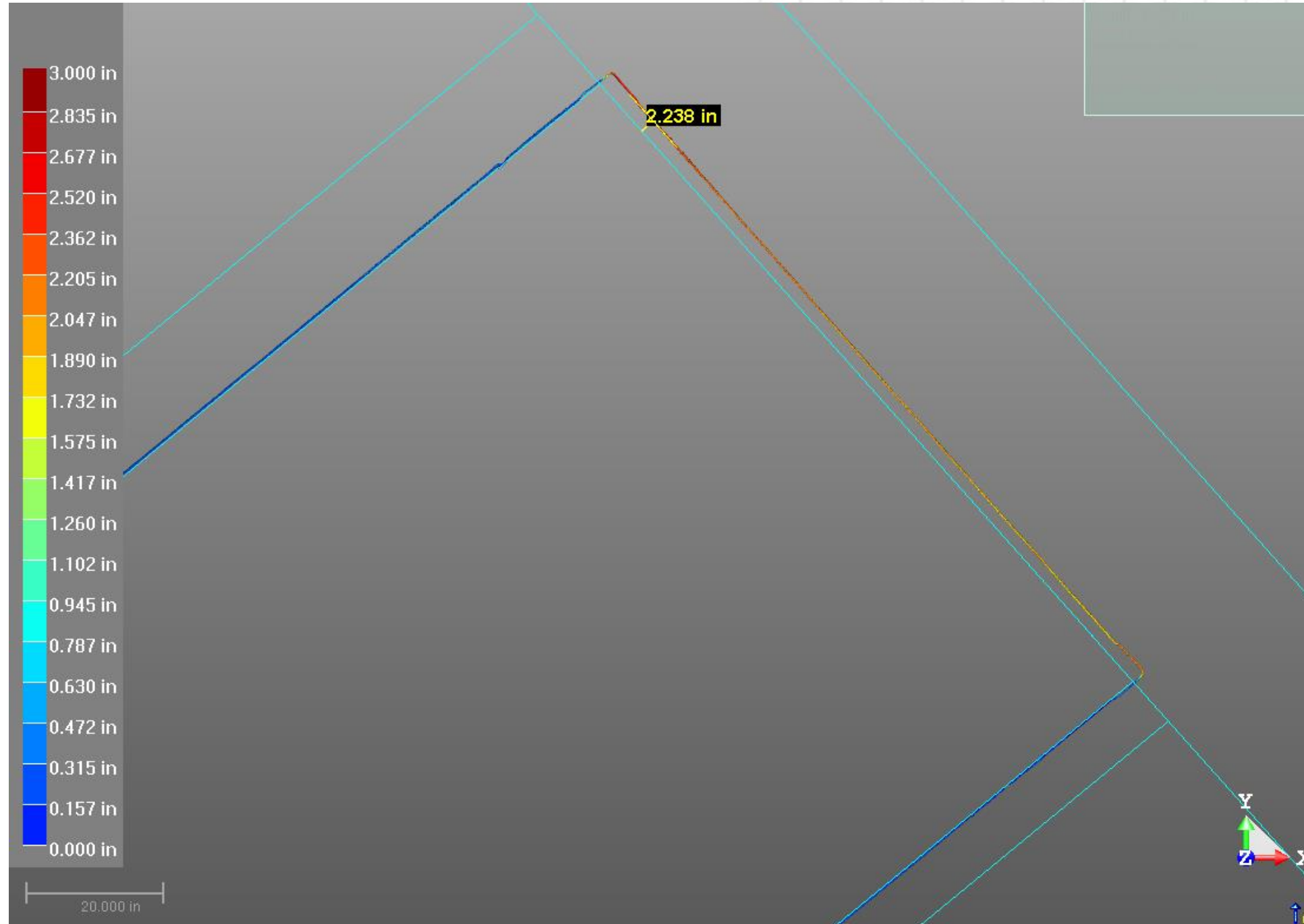
Elevator Core 3D Laser Scan



Elevator Core 3D Laser Scan



Elevator Core 3D Laser Scan



Question & Answer





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