INTEGRATION OF SCANNING TECHNOLOGY IN THE DESIGN PROCESS

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EVOLUTION OF SITE INVESTIGATION

IN THE BEGINNING..

EVOLUTION 1

PENCIL
& PAPER

EVOLUTION 2

CAMERA

EVOLUTION 3

TABLET

EVOLUTION 4

Go Pro

TODAY….POINT CLOUDS!

HD CAMERA

Point cloud generated via photogrammetry (passive sensor)

LIDAR

Point cloud generated via laser (active sensor)

Comparing Point Clouds...

ATTRIBUTE	CAMERA (Matterport Pro2)	LiDAR (Faro Focus S70)
Capture method	Line of sight	Line of sight
Source	Ambient light (passive)	Laser, independent of ambient light (active)
Color Resolution	134 megapixels, approx. 4 million points per scan	165 megapixel, up to 0.5 million points per second
Depth Resolution	3,600 points horizontal, 1,800 points vertical	40,960 points horizontal, 40,960 points vertical
Field of view	360° horizontal, 300° vertical	360° horizontal, 300° vertical
Scan time	31 seconds/scan position	5 minutes/scan position
Max range	15 ft	100 ft (w/no light)
Dim. Accuracy	+/- 1.8”	+/- 0.25"
Weight	7.5 lbs	9.25 lbs
Data Registration	Automatic – image recognition	Targeting or "cloud-to-cloud"
Features	Software permits Tags, Auto face blurring	
Data Transfer	WiFi transfer to iOS device	WiFi transfer to client device
Battery Life	8 hrs of scan time	5 hrs of scan time
Entry cost	Approx $5,000 in equipment cost	Approx $30,000 in equipment cost

WHAT … is Laser Scanning?

"3D Measurement for a 3D World…"

WHAT … Technology Brief

POSITION

Millions of Points in XYZ Coordinates, ¼” Accuracy
- Compare emitted & returned light pulse

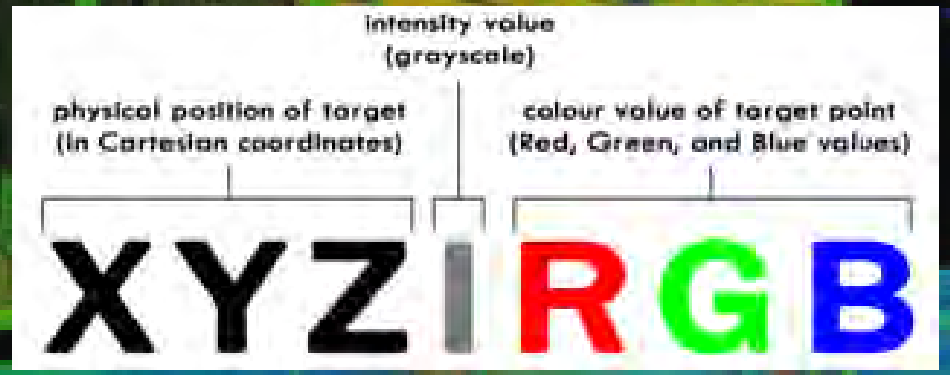
BUILT-IN CAMERA

Map Color to Each Point (RGB)

ENERGY

Returned Energy is Recorded (Intensity Value)
- Dependent on surface characteristics, angle to object, and distance to object
- Example: Shiny stainless steel (low returned energy, most is dissipated) vs. matte drywall (high)

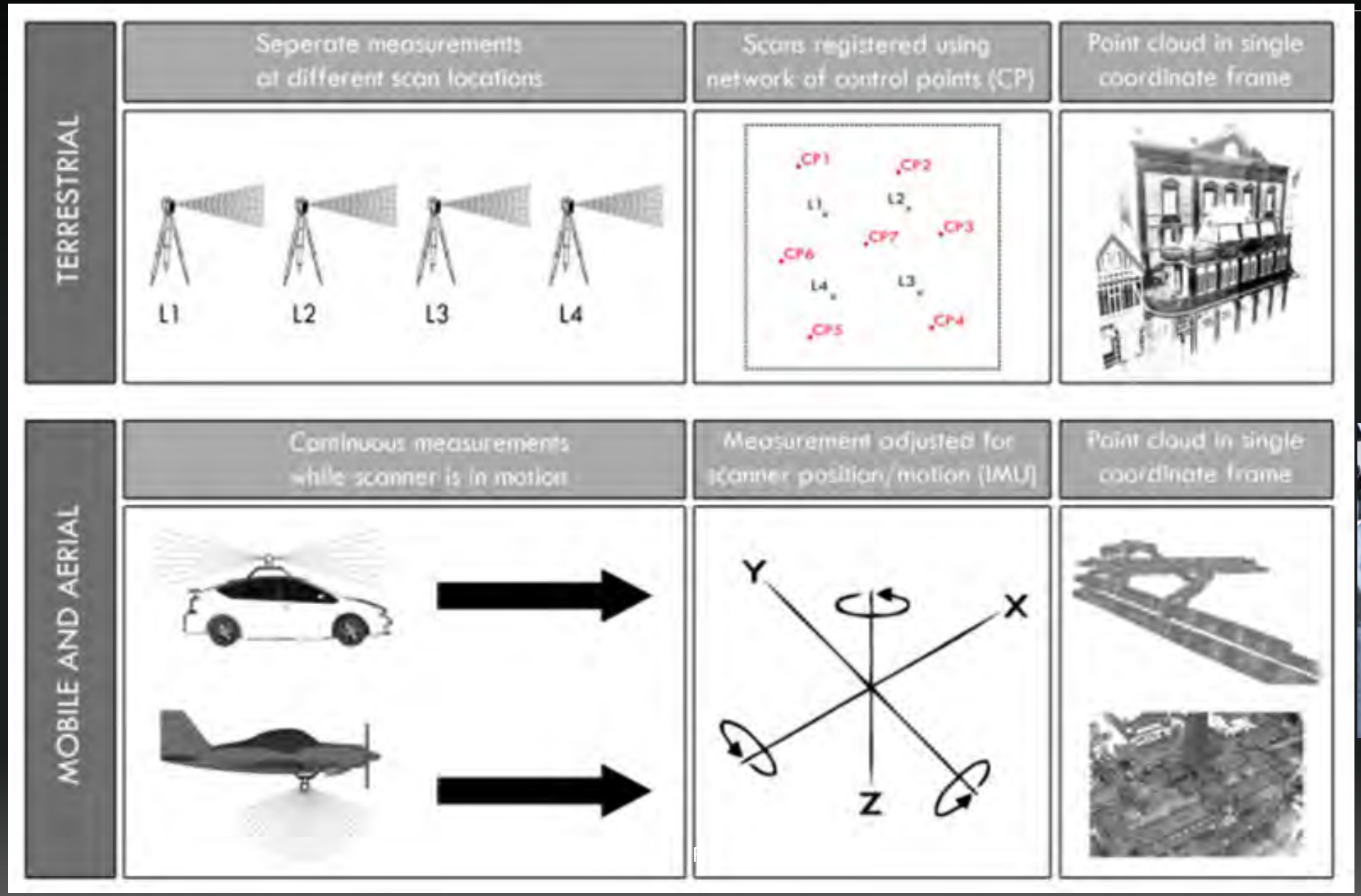
WHAT … **The Point Cloud**



Every single data point has (7) values

All of the points together compromise the point cloud

WHAT … **Terrestrial, Aerial, Mobile**



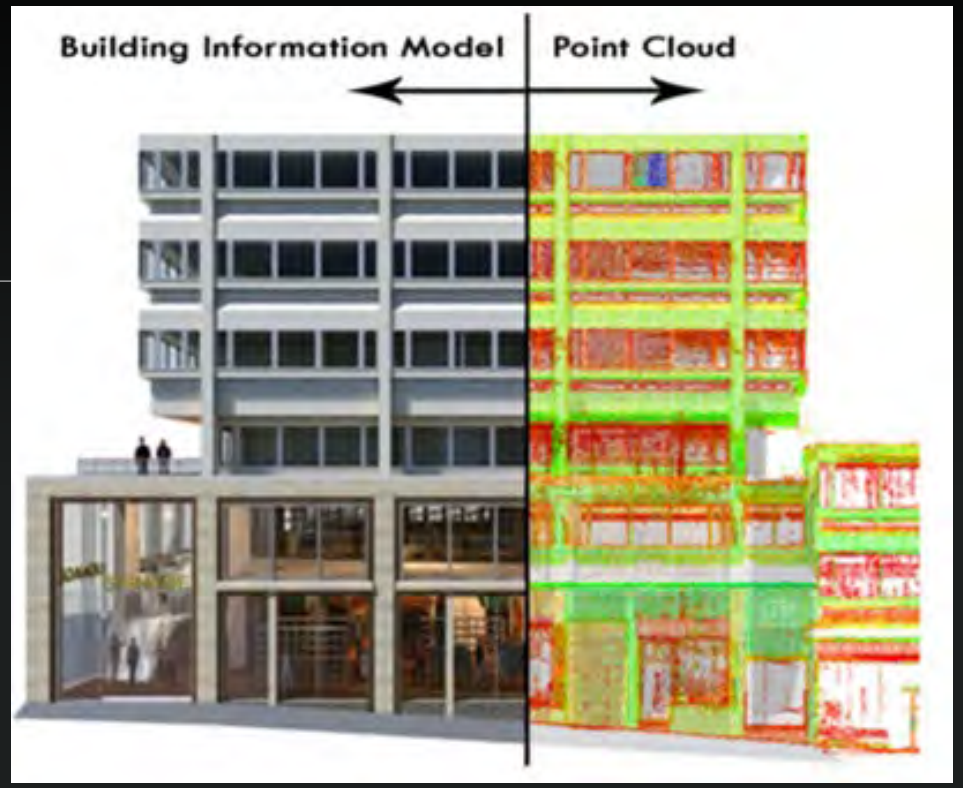
….Wearable!

WHEN …
Example – BIM Project Lifecycle

Laser Scanning and BIM Share Similar Goals:

1
Identifying conflicts **PRIOR** to construction

2
Maximize productivity during construction



3
Validate Construction Quality
Utilize for post occupancy & asset mgmt. strategies

WHEN … **To Utilize Applications – Plant & Process**

ANYTIME MEASUREMENT OF EXISTING ARE NEEDED:

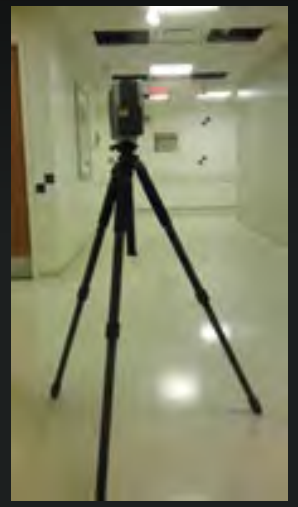
Existing Drawings are **LACKING**

Existing Drawings are **INACCURATE**

When Working in 3-Dimensions (2-D Line Drawings Do NOT Cut it)

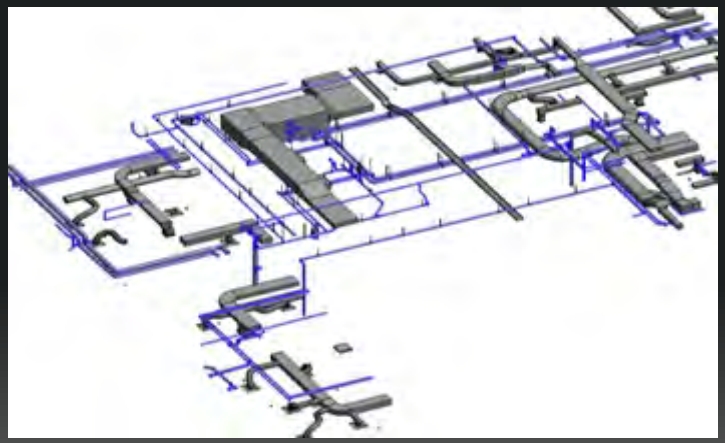
When **SAFETY** is a concern Scanning is done from a distance - **NON-CONTACT**

WHEN … **Ex. - Identifying Conflicts**



Hospital – Cincinnati, OH

A predictable upfront effort & cost (laser scanning) – to avoid field conflicts & $$$ during construction



When Plans are Lacking...

CONCLUSION – LASER SCANNING

1. **Broadly Applicable Technology**
2. **Much more than a technological advancement of surveying**
3. **Adoption in AEC sector is relatively nascent**
4. **Barriers to utilization are going away**

NOW WHAT?

REMOTE TOURS

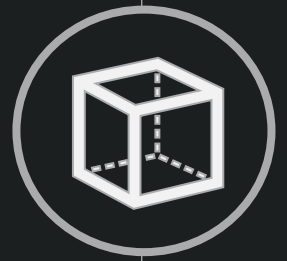
VERIFICATION OF EXISTING DRAWINGS

UNLIMITED VIRTUAL ACCESS (MAINTENANCE, OPERATIONS, ENGINEERING, CONTRACTORS)

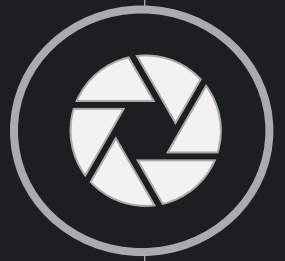
MODEL DEVELOPMENT

VIRTUAL REALITY

DEMONSTRATION



3D SCAN

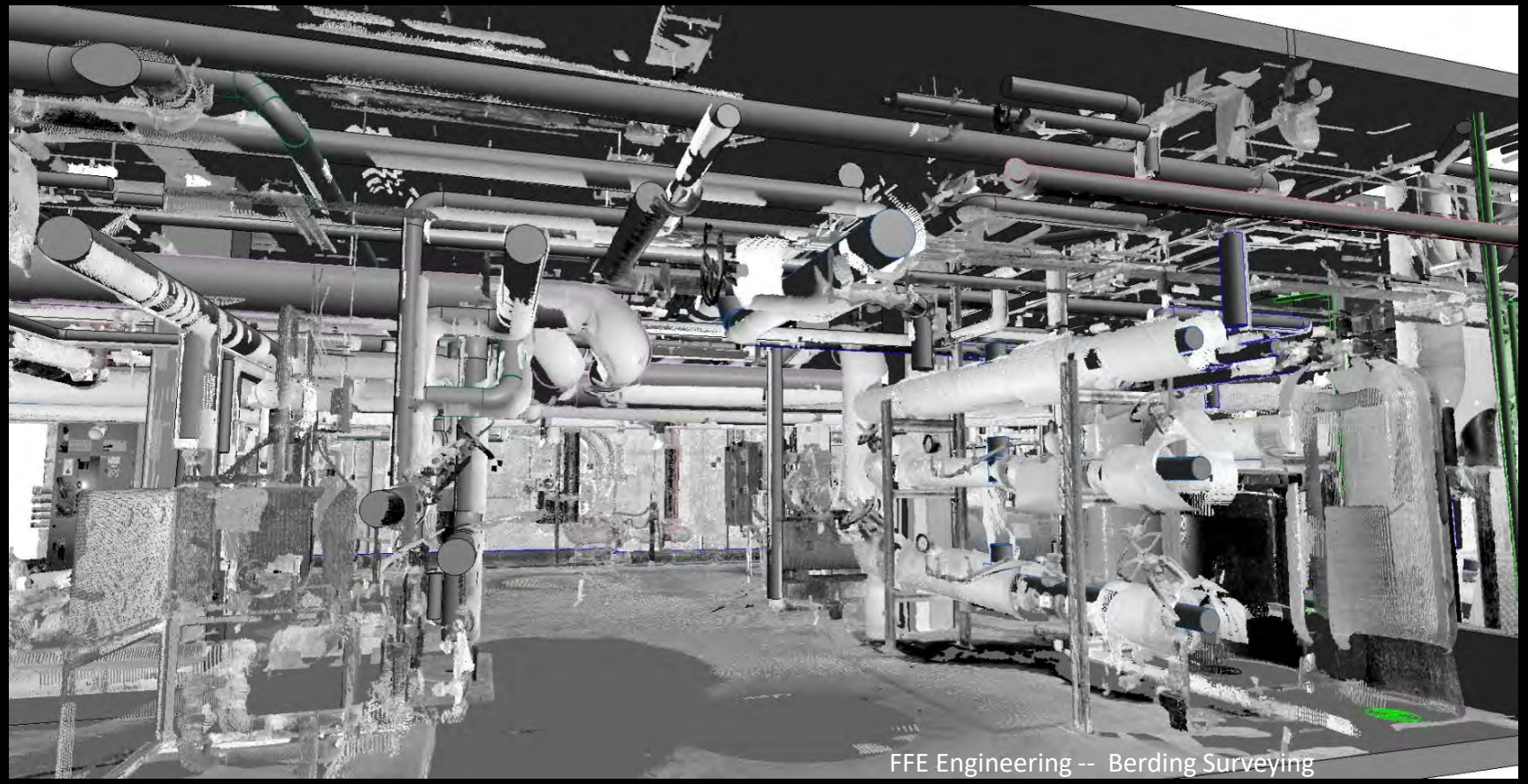


LIDAR SCAN

REVIT MODEL

VIRTUALIZATION

Adding Pipes, Ducts and Conduit to Revit Models using Point Clouds



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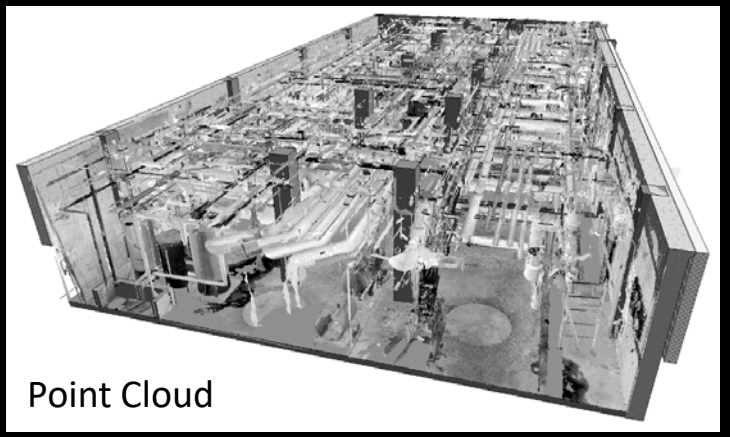
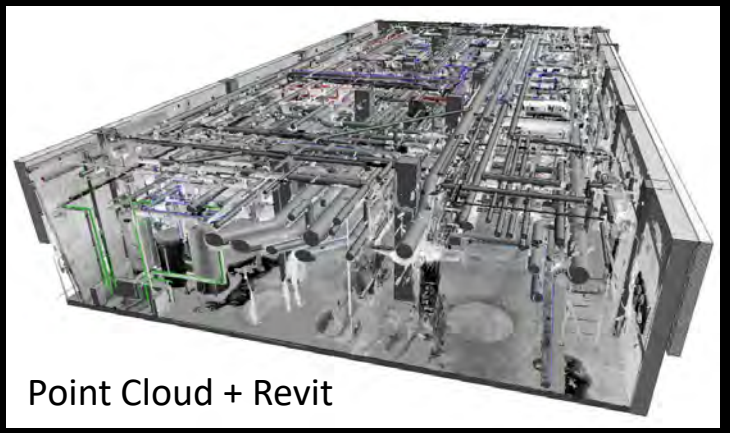
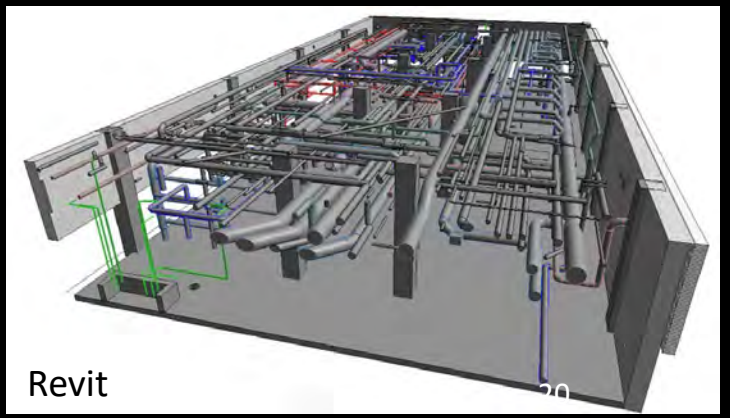


Point Cloud

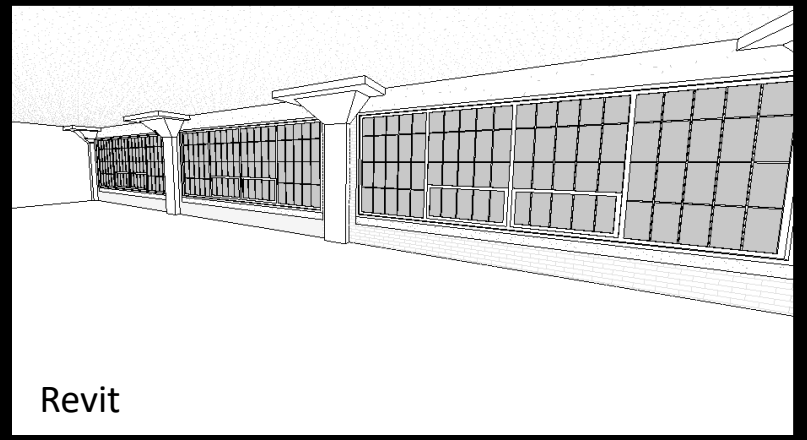


Point Cloud + Revit



Revit

Using Point Clouds to Model Architecture and Structure



Real vs. Model

Google Earth

Point Cloud Built Revit Model + Enscape

Real vs. Model

Site Photography

Point Cloud Built Revit Model + Enscape + Photoshop

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