



# IDEA2022

## Building Connections

June 6-9 | Sheraton Centre Toronto Hotel | Toronto, ON



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# Advantages of Point Cloud Mapping and 3D BIM Modeling

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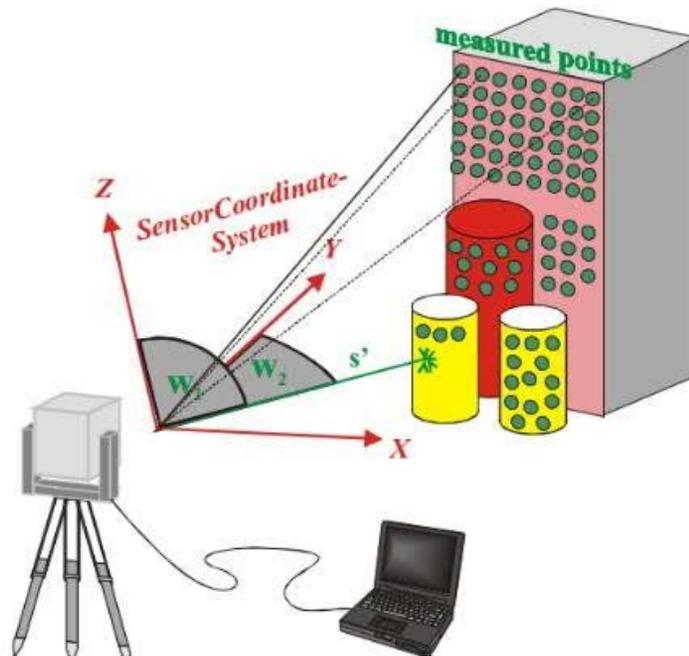


# Overview

- Definitions
  - Point cloud mapping (laser scanning)
  - 3D BIM modeling
- Applications for point cloud mapping
- Typical questions about point cloud mapping
- Advantages of implementing point cloud mapping during either the design or construction phase
- Issues associated with point cloud mapping (laser scanning)
- Integration of a point cloud map in the BIM model
- Coordination advantages for final project turnover
- Case studies

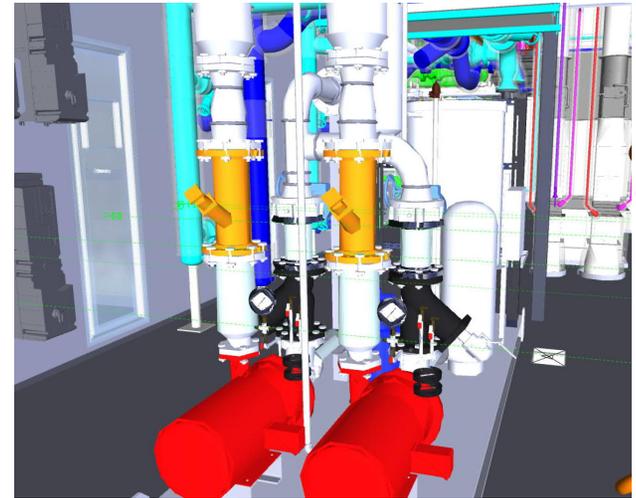
# Point Cloud Mapping (Laser Scanning)

- A LIDAR (Light Detection & Ranging) scanner emits a laser over an area that is desired to be modeled.
- The laser locates a number of points of the modeled object on a coordinate plane. The scanner can be moved around to create more detailed models.
- A point cloud model can be created from one or several scans. This model can be imported into CAD/BIM software for coordination by the design/construction team.



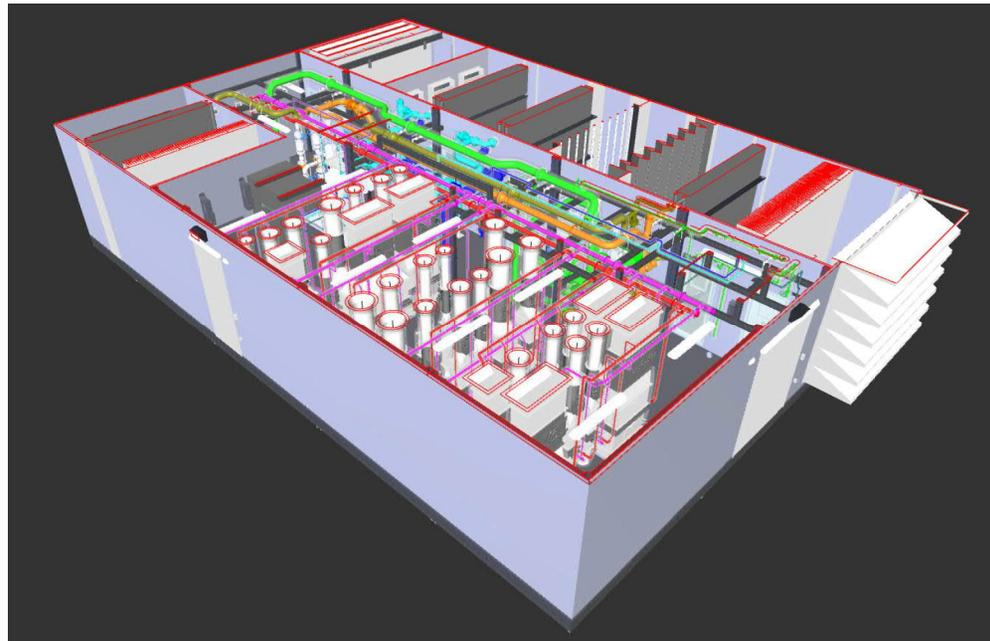
# Building Information Modeling (BIM)

- ISO 19650-1:2018 defines BIM as:  
Use of a shared digital representation of a built asset to facilitate design, construction and operation processes to form a reliable basis for decisions.
- The US National Building Information Model Standard Project Committee has the following definition: Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.



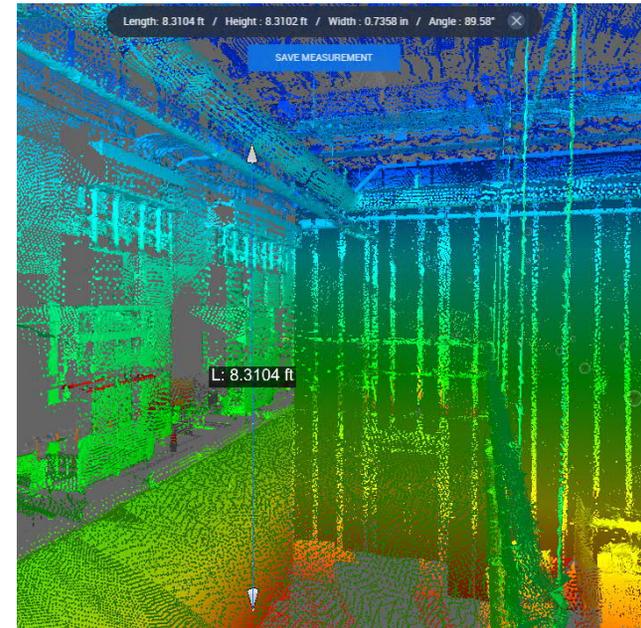
# Applications for Point Cloud Mapping (Laser Scanning)

- Complex existing piping and ductwork layouts requiring high levels of coordination with new work.
- Accessibility is a key driver of design.
- Construction must occur during a short shutdown window and must be done correct the first time.
- Project is under a tight budget, and costly mistakes must be avoided.



# Typical Questions - Point Cloud Mapping (Laser Scanning)

- Is it accurate?
  - New technology is accurate to within 1/32 of an inch
  - Improved accuracy when multiple scanning locations are combined
- Manual survey required?
  - May eliminate need for manual survey while saving time
  - Measurements can be taken directly from point cloud map without the need to revisit the survey site if information is missed
- Limitations of point cloud mapping?
  - Reflective surfaces can impact the accuracy
  - Smaller objects may not be clear in scan if digital noise exists (i.e., 1/2" piping or conduit)
  - All components need to be visible to scanner location
- Cost?
  - Typical cost for point cloud mapping is comparable to the cost associated with manual survey of the project area
  - Added cost to have point cloud converted into a BIM model (not required)

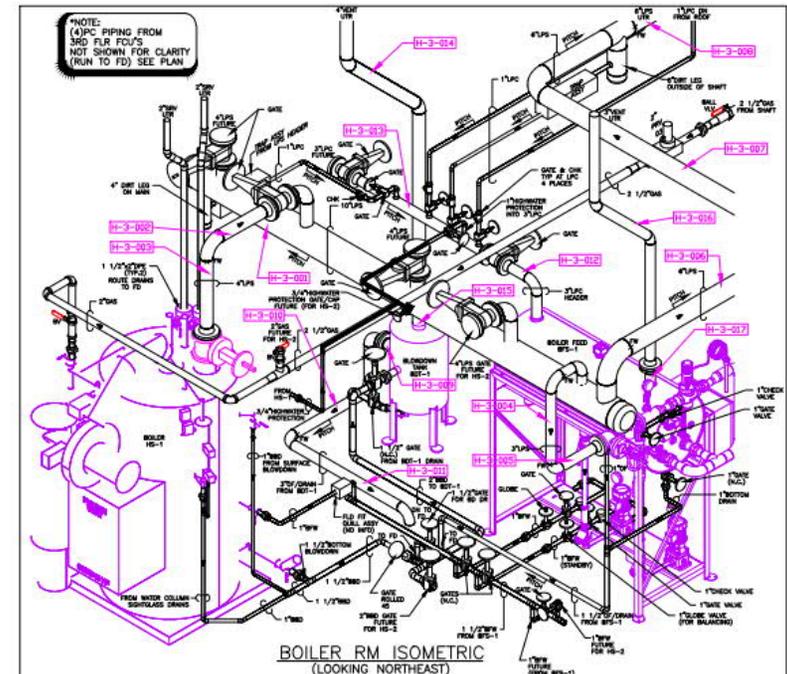


# Point Cloud Mapping Implemented During Design

- Reduces site survey time and limits additional site surveys as the point cloud scan will contain all information on existing conditions
- Design will be based on highly accurate existing conditions
  - Eliminates risk of inaccurate record drawings (if record drawings exist)
  - Eliminates risk of inaccessible or elevated working conditions during survey to document accurate existing conditions
- Reduces the chances of change orders or redesign once construction begins
  - Costs associated with actual conditions will be included in contractor bid packages
- Allows for coordination with existing equipment or components that are to remain (clearance requirements, maintenance access, etc.)

# Point Cloud Mapping Implemented During Construction

- Shop drawings and contractor coordination will be based on highly accurate existing conditions
  - Reduces time for shop drawing creation in congested areas
- Allows for coordination with existing equipment or components that are to remain (clearance requirements, maintenance access, etc.)
  - Changes may be required to be made by contractor to meet requirements versus project design drawings



# Issues with Point Cloud Mapping (Laser Scanning)

- Access to the entire project area is required to allow for a complete model
  - Line of sight required to accurately show all objects
  - Objects hidden from scanner will not be visible unless additional scans from multiple angles are completed
  - Complexity of project area determines the quantity of scans required to be completed
- Lighting levels can impact the detail of the point cloud creating a grainy image with increased signal noise
- Manual survey will be required to determine pipe, duct, equipment, etc. sizes if insulated when reliable record drawings do not exist

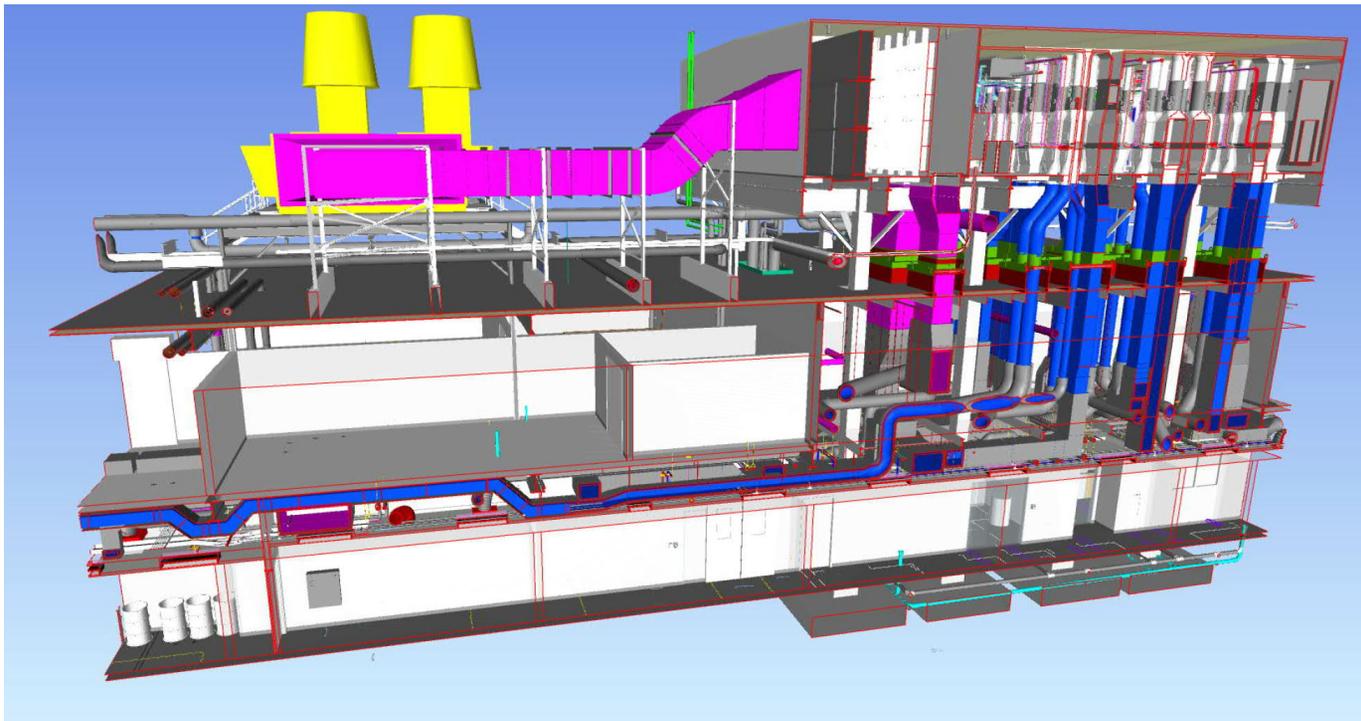
# Integration of Point Cloud Mapping and 3D BIM Model

- Allows for accurate existing conditions to be shown in the design or contractor coordination model
- Clash detection can be utilized to determine if any conflicts exist with existing conditions
- Items/components in the point cloud can be set as demolished eliminating inaccurate conflicts in the clash report
- Integration can be completed during the design or as part of the shop drawing development



# Coordination – Contractor Installation

- Streamlines coordination efforts between multiple trades and the existing conditions
  - Clash detection will include all existing conditions that are to remain
- Reduces upfront schedule to complete a full survey by the contractor to determine existing conditions allowing for a quicker turnaround on shop drawings



# Coordination - Owner

- Ability to verify installation locations for all equipment or components that require routine maintenance are acceptable to owner
- Allows for virtual walkthrough to be completed prior to installation
  - Modifications can be made to layout based on owner review
  - Identify all valves that require chainwheels if unable to locate below 6'-0"
  - Verify access via ladder and or lift if required for equipment or components
- Scan can be completed as part of project turnover to document the as-built conditions



# Case Study – SE PA Pharmaceutical Company – Utility Rack & Chiller Installation

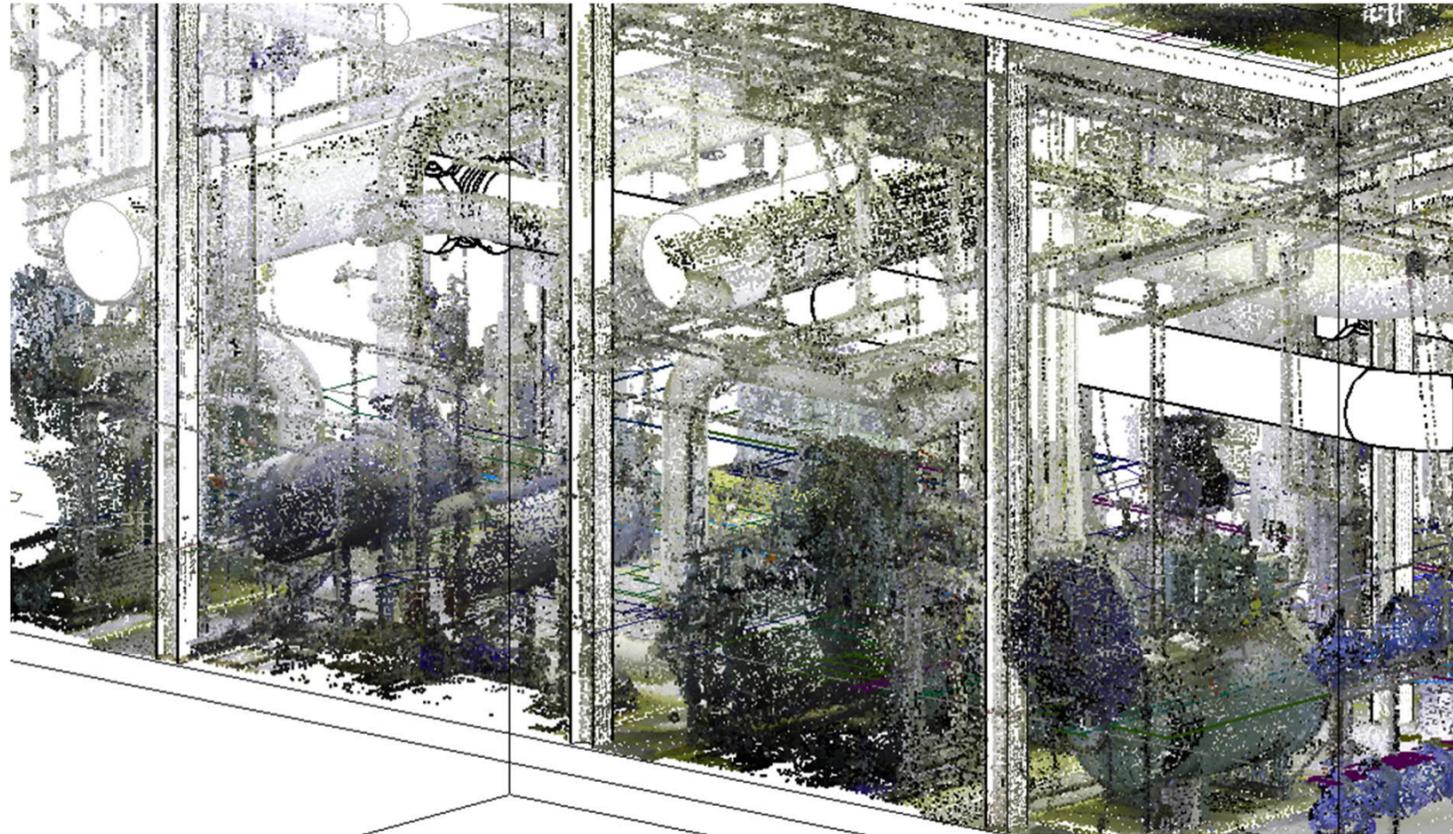


Figure – Point Cloud Map Chiller Plant 1<sup>st</sup> Floor – 30" CHWS Pipe Connection to Existing Coordination

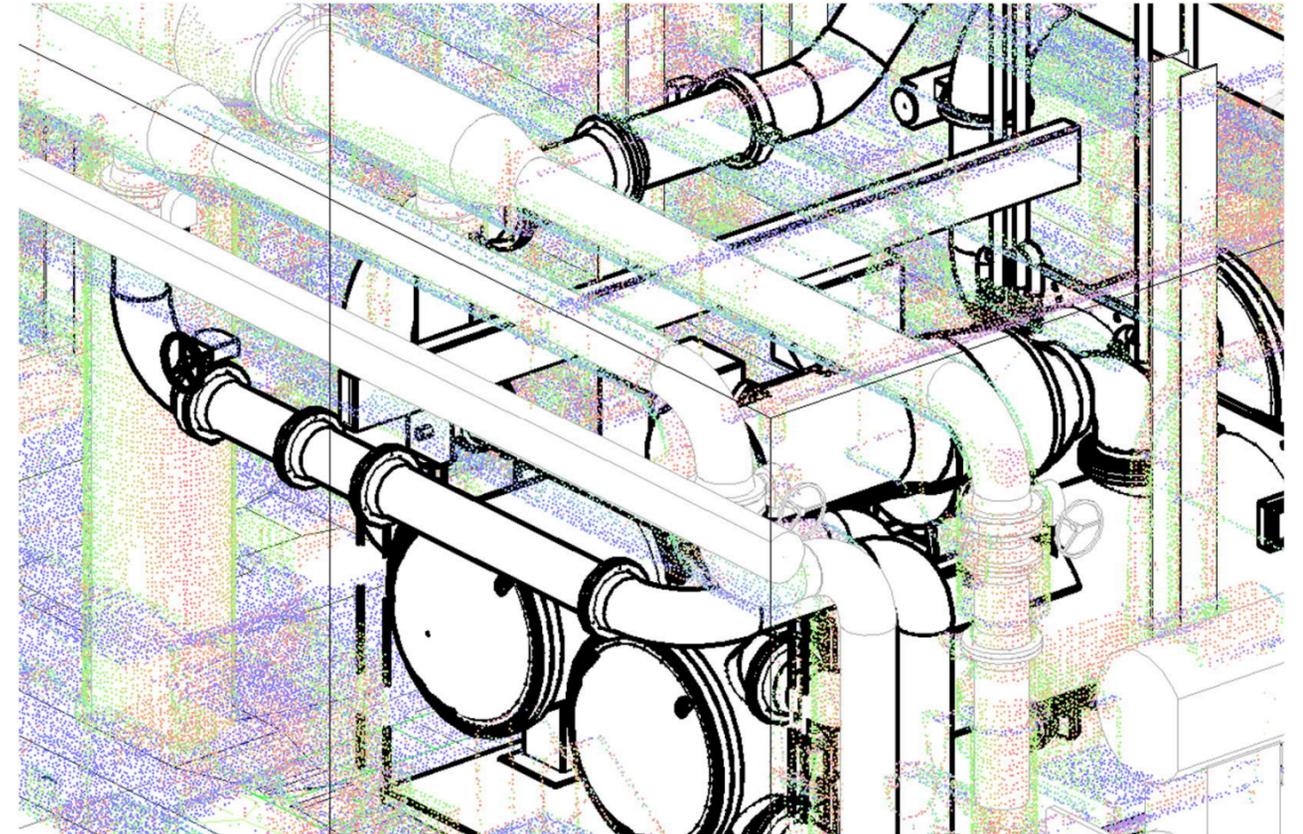


Figure – Point Cloud Map Chiller Plant 2<sup>nd</sup> Floor – 2,000-ton Chiller & Hoist Beam Installation Coordination

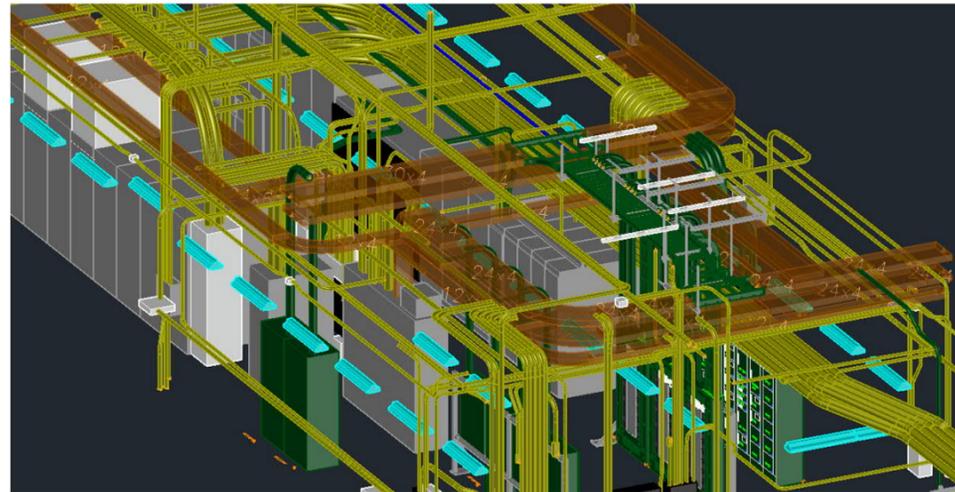
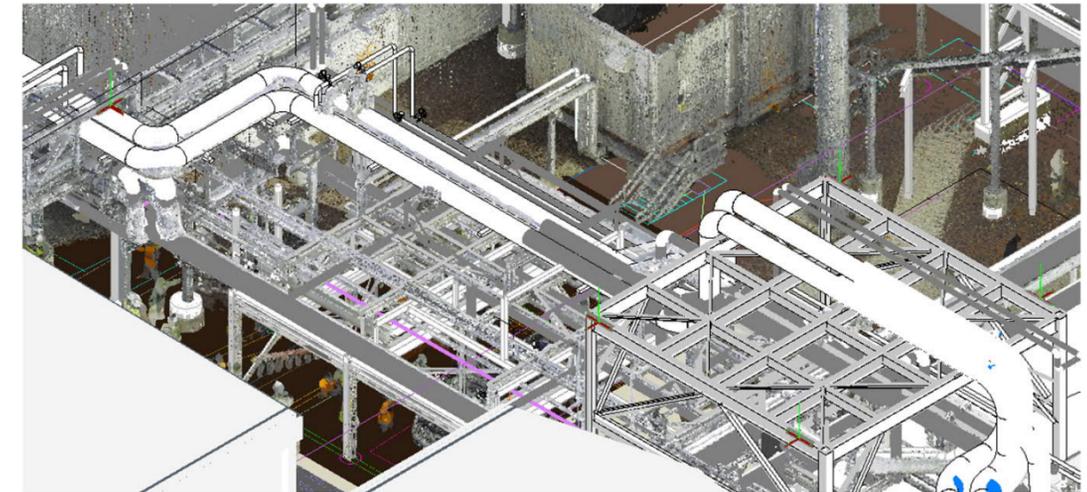
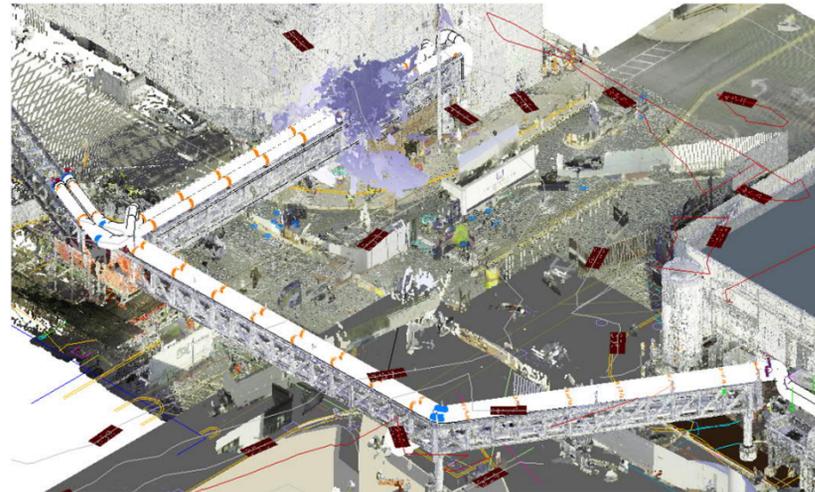


Figure – Point Cloud Map Electrical Room – New Medium Voltage Chiller Feed



Figures – Point Cloud Map Utility Rack– Coordination of New CHWS/R, HPS, and PC Piping on Existing/New Utility Rack

# Case Study – Philadelphia Pharmaceutical Company – Fit-out

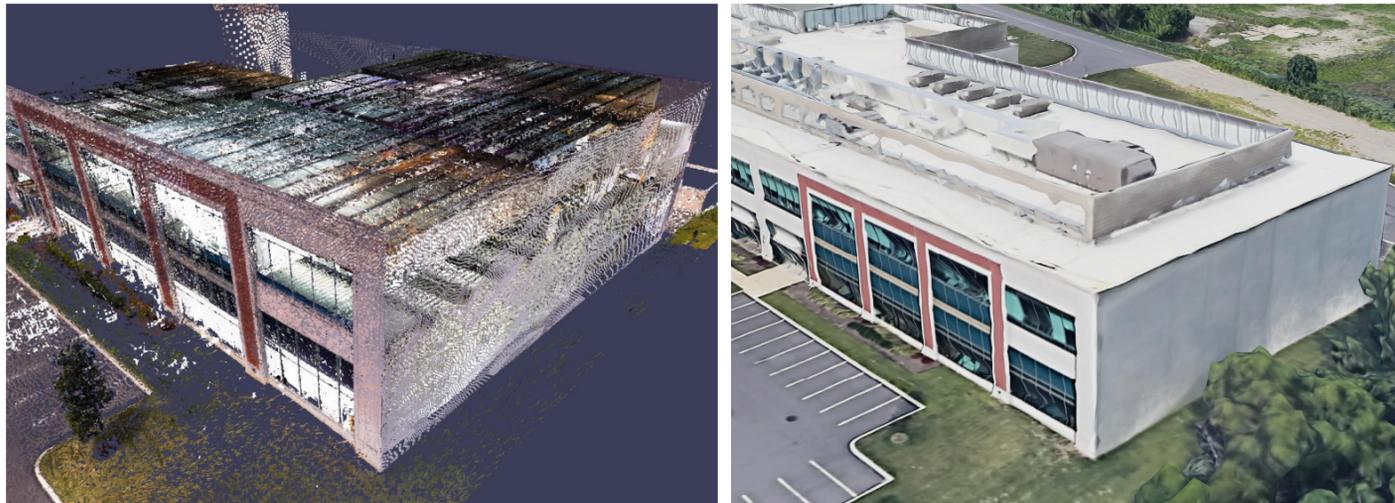


Figure – Building Exterior - Laser Scan (Left) and Google Earth Image (Right)



Figure – Electrical Panels on Walkable Ceiling - Laser Scan (Left) and Photograph (Right)

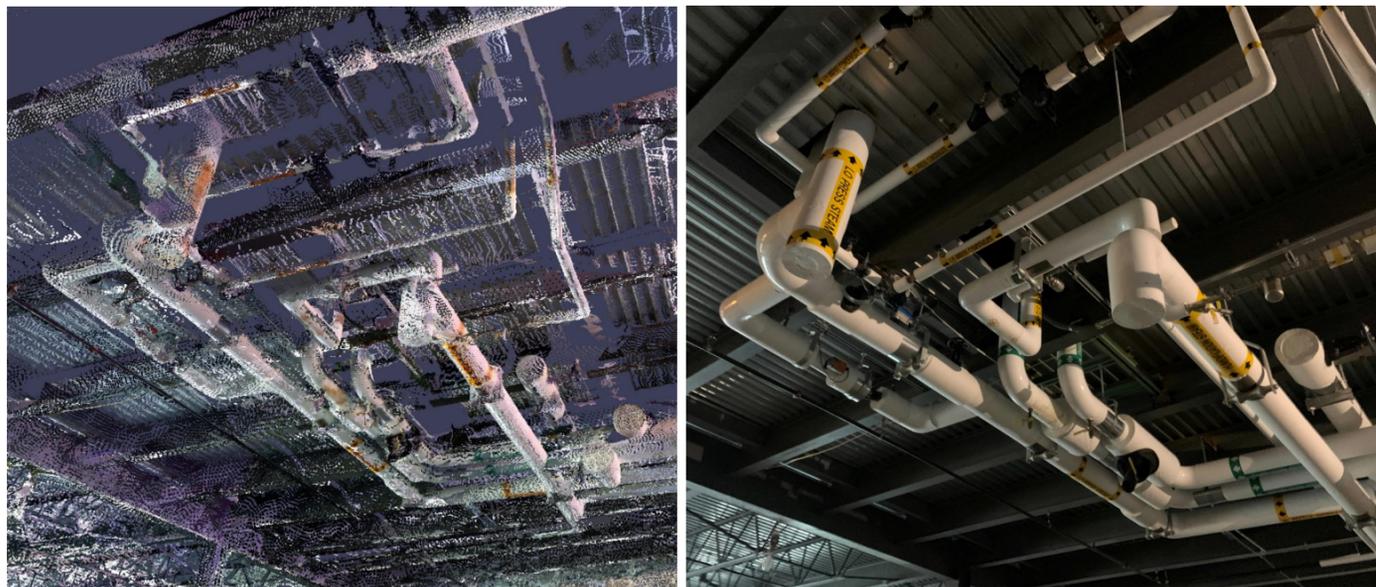


Figure – Chilled Water Piping - Laser Scan (Left) and Photograph (Right)

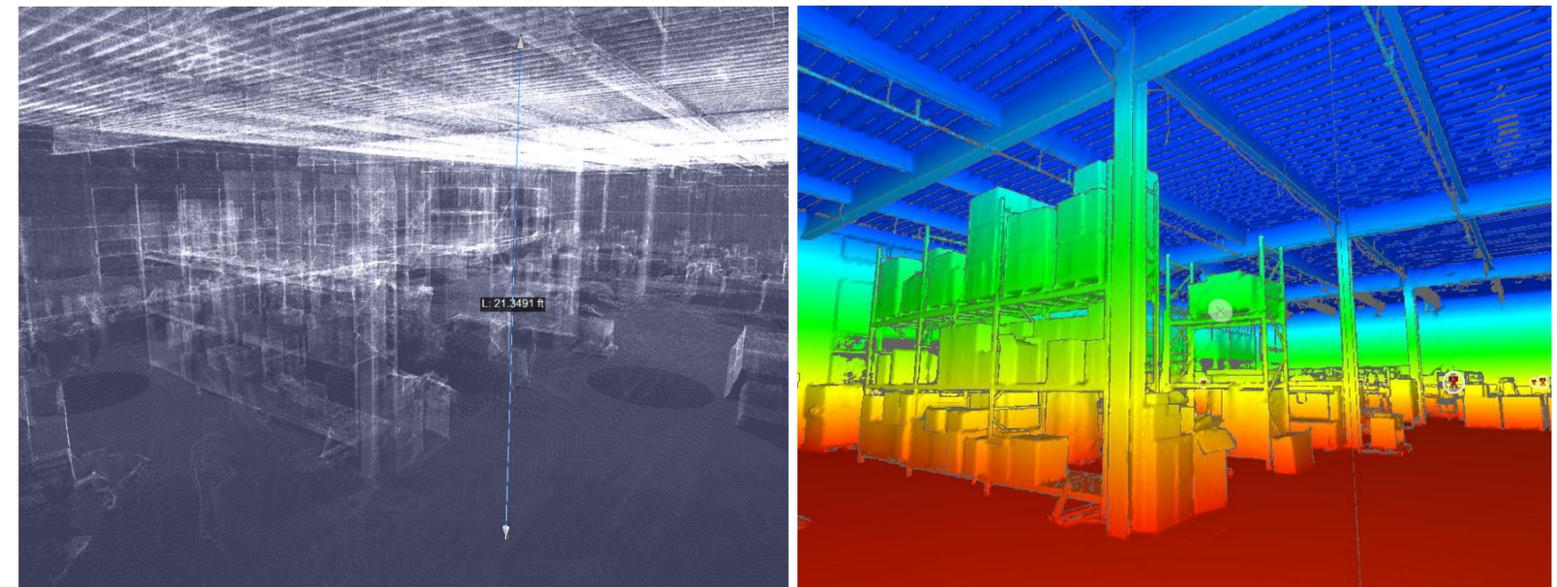
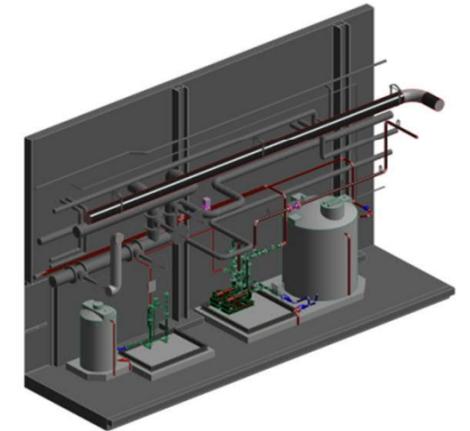
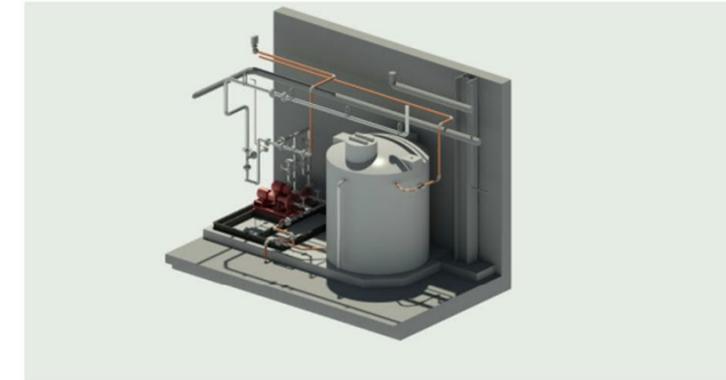
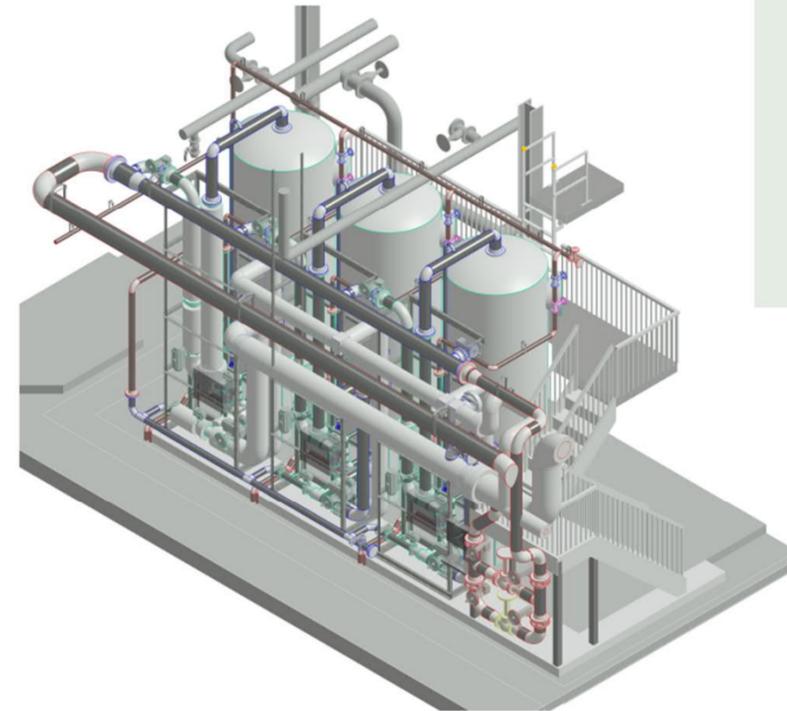


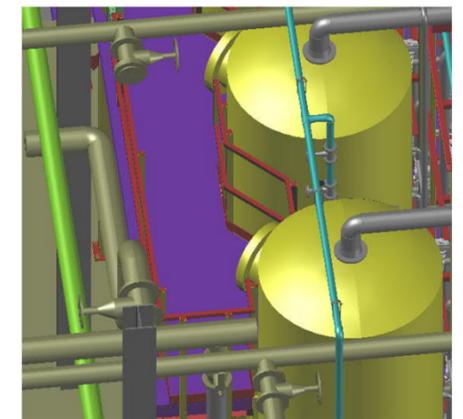
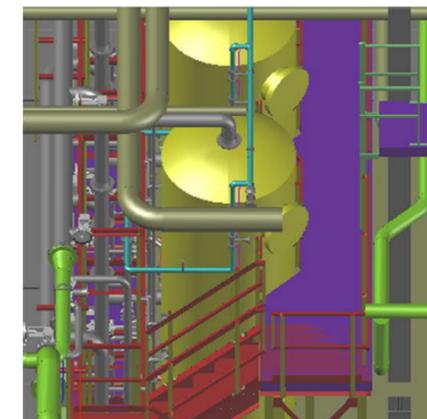
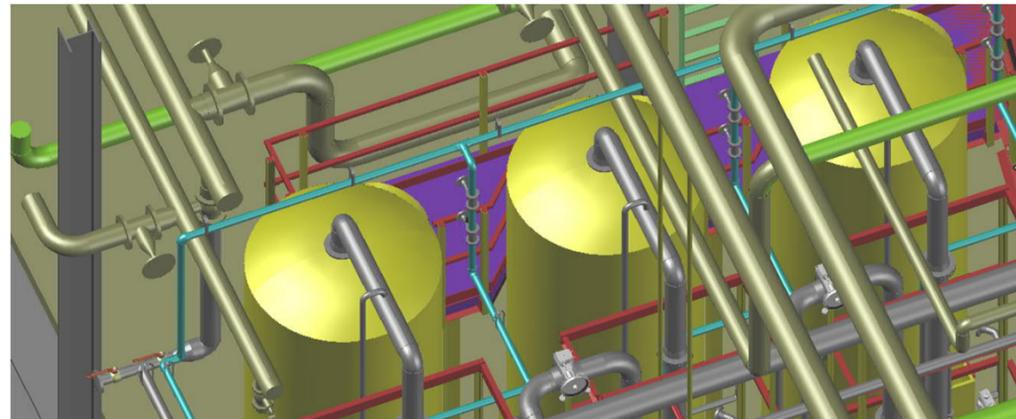
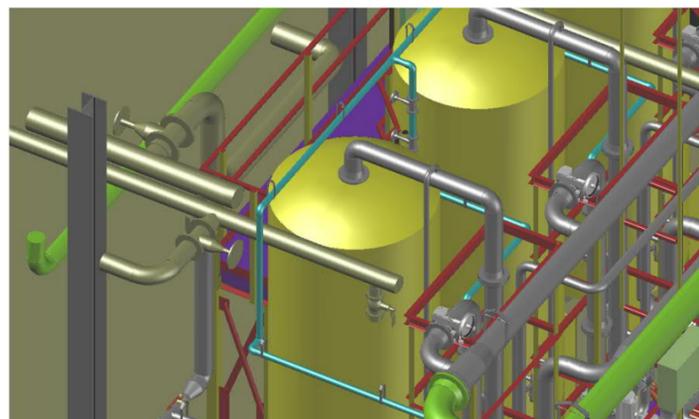
Figure –Shell Space – Point Cloud (Left) and 3D Heightmap View (Right)

# Case Study – SE PA Pharmaceutical Company – Condensate Polisher



Figures – BIM Model and Final Installation

Figures – BIM Model - Final Design



Figures – Coordination with Existing Conditions (from Point Cloud Map)

Figures – Coordination with Existing Conditions (from Point Cloud Map)

# Thank You!



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