Technology Changing the Construction Industry

Image: Albany Business Review

Pike

- The construction industry has historically been slow to embrace technology and innovation with construction sites still looking similar for years. There's also resistance to change within the industry, where traditional methods are deeply ingrained.

- Numerous reasons for the construction industries need to improve:
  - Decline in skilled work force and trades
  - More complicated demands from clients
  - Need for more efficient and time saving methodologies

BIM / VDC

- Technology is significantly transforming the construction industry by improving efficiency, safety, and productivity. Innovations like drones, augmented reality, and 3D printing enable precise site surveys, enhanced visualization, and rapid prototyping.
- Additionally, software and data analytics are revolutionizing project management through real-time tracking and predictive analytics. These advancements are helping to overcome traditional challenges such as project delays and costs, labor shortages, and safety concerns.

Modeling Visualization: 2D & 3D computer-aided design services to assist in the visualization & planning of a project.

Spatial Coordination: Managing the process of 3D MEP trade coordination.

Geo-Spatial: Process of relaying data and model content to and from the field.

Virtual 3D Model

In Field Execution

Modeling Visualization: 2D & 3D computer aided design services to assist in the visualization & planning of a project.

- **Schedule Simulation**

  3D animation linked to a project schedule to help plan and visualize construction sequences through the project duration.

- **Quantity Extraction**

  Extracting data from a 3D model such as doors, windows, walls and square footages into an excel file in order to assist with takeoffs.

- **Rendering**

  A visual representation of a view or model on how a space will look once completed.

- **Site Logistics Planning and Communications**

  Creating a 2D/3D site logistics plan showing the layout of construction work on a project site.

- **Augmented Reality & Virtual Reality**

  The ability to take a 3D model of a building and virtually walk throughout the building using a VR headset.

- **Small Scale 3D Printing**

  Ability to 3D print scaled models to be used as a visual aid on site and during presentations.

- **Animation**

  Creating a 2D/3D videos of a model showcasing the construction sequence and how it relates to a projects schedule.

Geo-Spatial: Process of relaying data and model content to and from the field

- **HDLS Collection/Data Analysis**

  Utilize 3D laser scan data to verify and identify existing conditions to reduce the risk of unforeseen conditions.

- **360 Walkthrough**

  A process of taking a virtual tour of any structure, through the medium of internet connectivity, from anywhere at any time.

- **Floor Flatness Analysis**

  Drainage Utilize 3D laser scan data to verify concrete floor flatness and floor slopes for proper drainage.

- **sUAS Capture**

  2D & 3D Aerial photography maps for the use of capturing existing site conditions before during and after construction.

- **Ground Penetrating Radar Analysis**

  Utilize a GPR sub for locating rock and existing utilities. The data can then be used to create 2D & 3D plans of existing conditions.

- **Stub-up Analysis**

  Stub-up Analysis Utilize robotic total station to verify underground utility stub-up locations prior to concrete pours.

- **Thermal Imaging**

  Detect heat loss failures in building, detect roof failures, pour insulation, and or building envelope issues.

- **Civil Surface Analysis**

  3D Mapping of current site conditions for the use of right Site analysis and stockpile quantification.

Site Logistics Animation

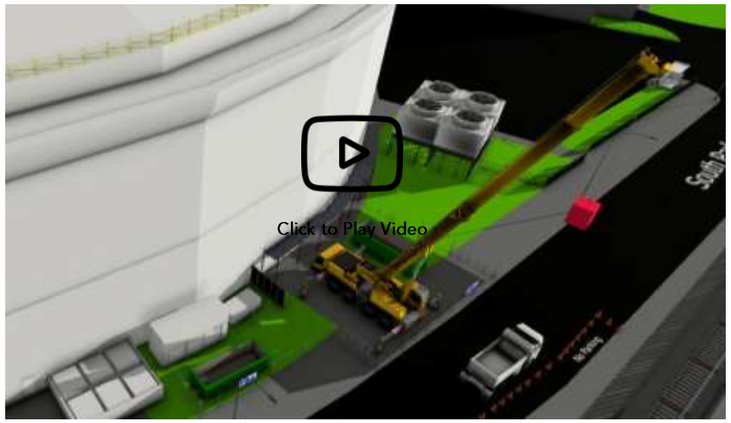
An animation of how the roof of the KeyBank will be replaced. Showing Material Removal, Safety, Material Delivery & Staging, Crane operations and a focus on the construction traffic flow. This video animation took 2 days to model and another 3 days to animate the sequence with the crane team. The challenge was getting the material to the lower roofs from the delivery and staging area. The solution was to use a Unic Spydercrane to lower materials and remove waste from the high roof around the top of the arena.

Process

3D modeled the building in SketchUp

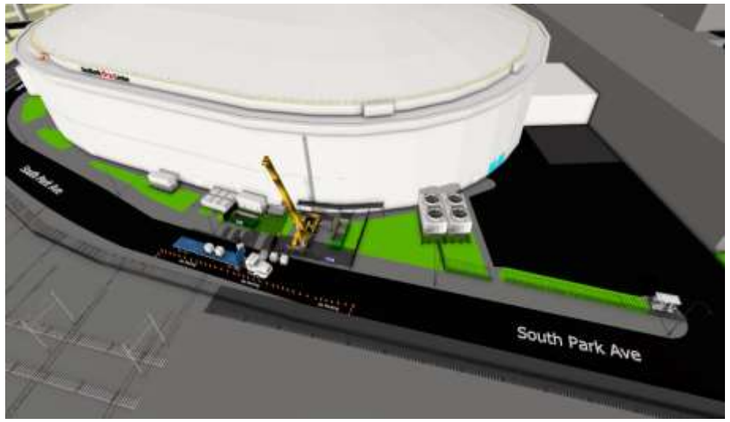
Animated using Fuzor

Presentation using BlueBeam

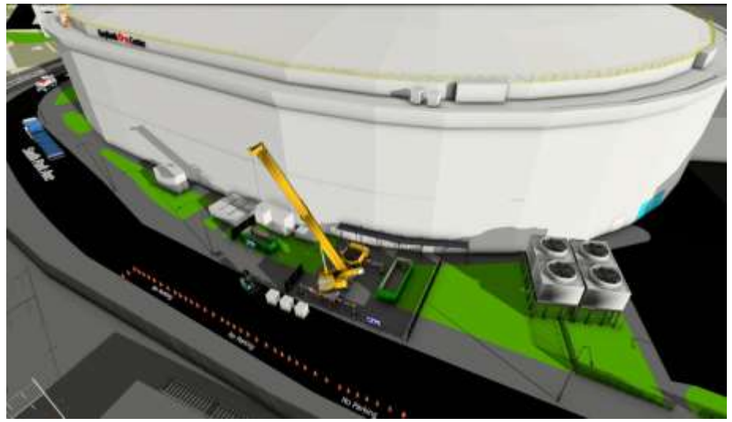


Material Removal

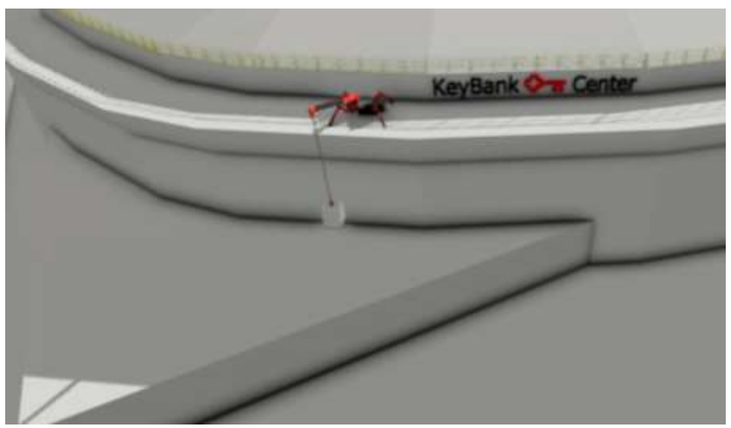
Material Delivery & Staging



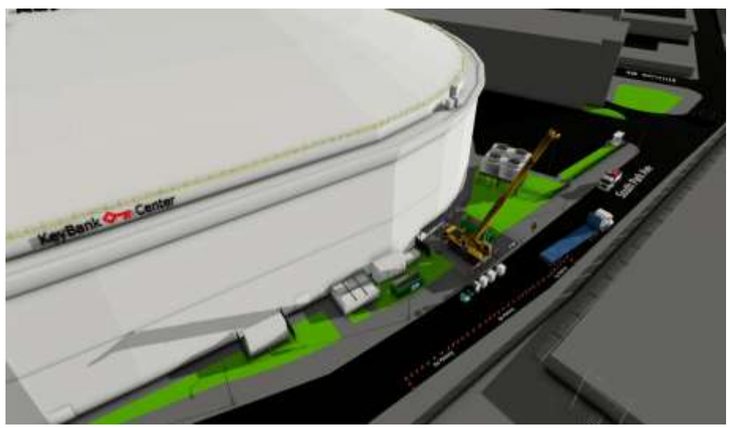
Overall Site Logistic Plan



Crane Operations



Unic Spydercrane

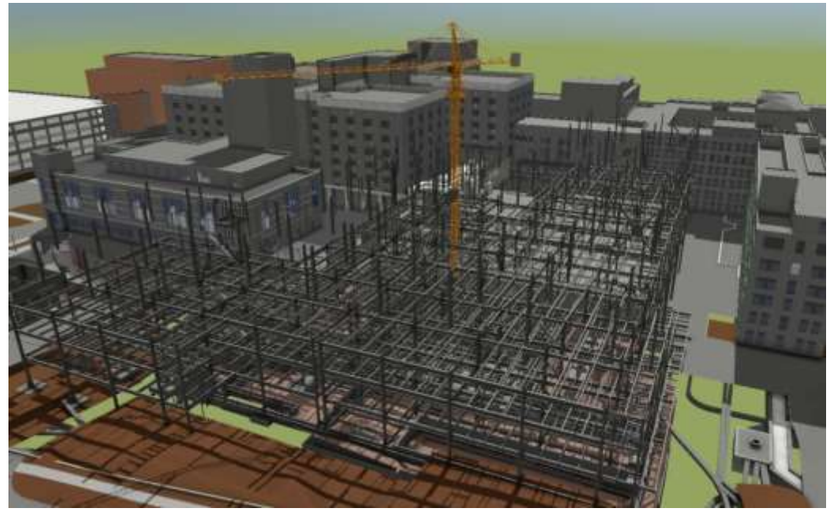


Construction Traffic Flow

Full 4D Schedule Simulation

BIM created a 4D simulation of the fit out of the 8th floor of the URMC tower, providing a 3D video of everything being installed after steel and slabs are in. The bathrooms were going to be prefabricated and delivered as pods to be moved into place. Another 4D simulation completed for this project was to show the shoring sequences, surface changes over the different shoring sequences, the crane location, and the sequence of the steel erection.

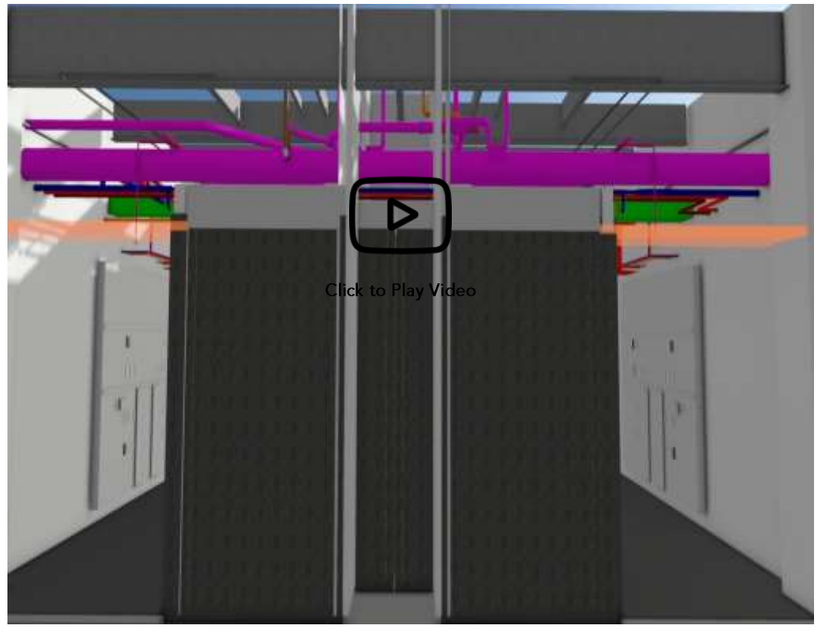
URMC-EDIT_PHASE-2_4D-SIMULATION



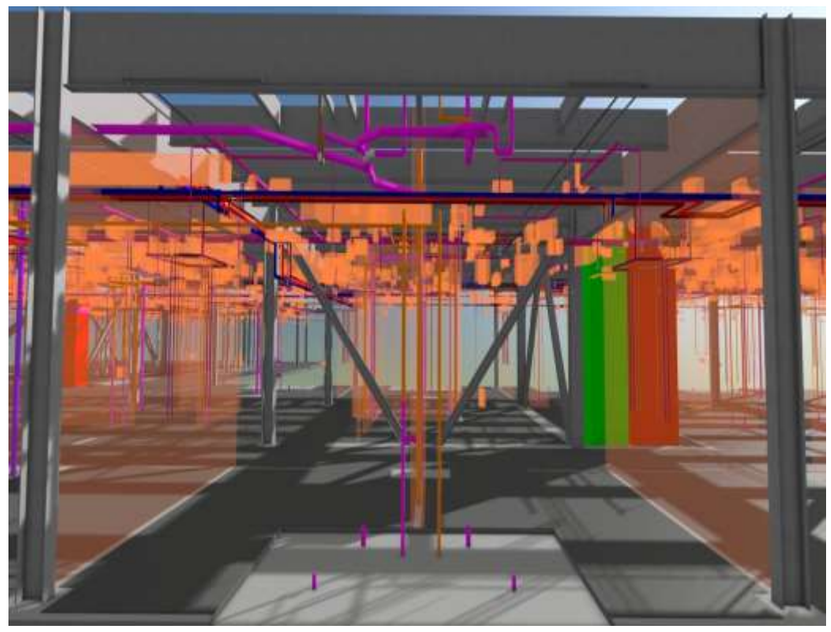
Process

The Revit design models were exported to create the two videos.

The models were brought into Fuzor and Linked to the project schedule.



URMC-Tower_8th Floor_4D Simulation_R5



FLEET LANDING

Atlantic Beach, Florida

This new complex in Atlantic Beach was modeled in Revit so that we could upload the schedule created to Fuzor and begin the process of creating a planned 4D simulation. As the project continued, BIM constructed yet another 4D simulation representing the actual process that was taking place out on site. Numerous issues and changes were made, so as did the actual simulation to represent these. This process become essential for this project to maintain their schedule and understand the project with a advanced visual aid.

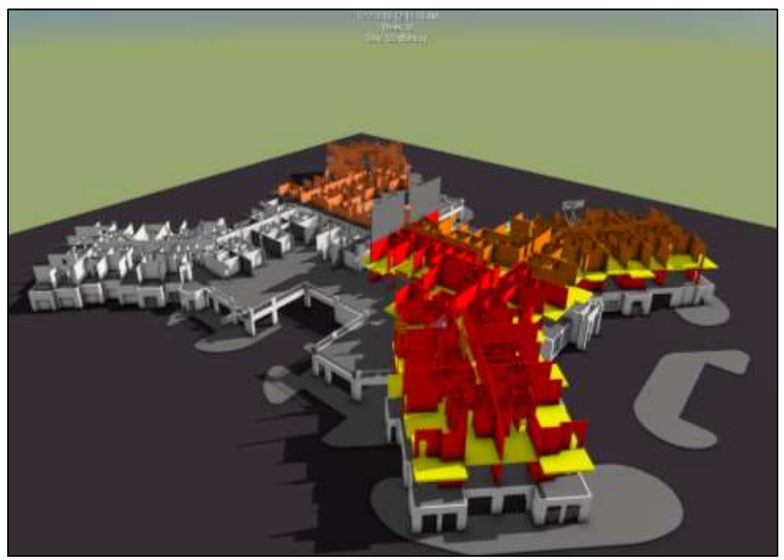
Process

Fuzor was the software used to create 2 sperate 4D Simulations.

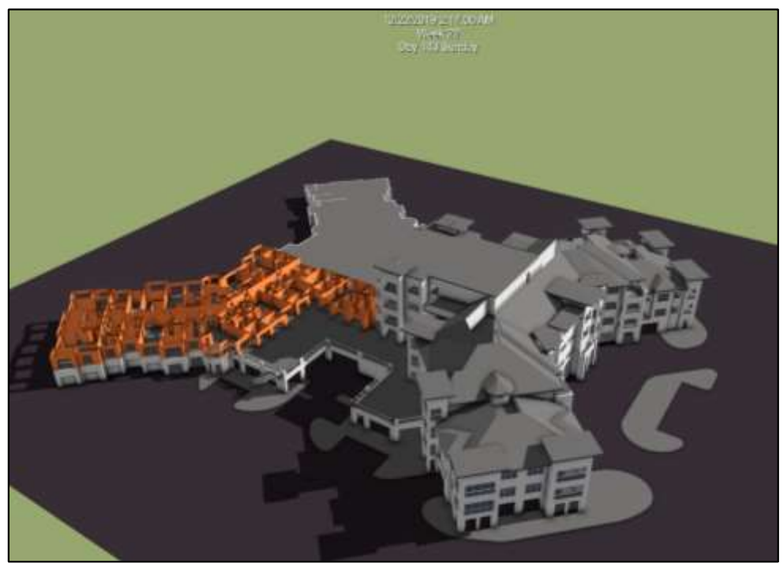
Adobe Premier Pro was utilized to combine the two 4D Simulations into one side-by-side video.

Revit was used to model the buildings and add anything extra.

Bluebeam was used to edit some of the snap-shots of the videos & editing some of the drone photos.



Actual



Planned

Artspace Lofts

In addition to modeling the foundation and performing a thorough QAQC analysis, modeling the PERI formwork was requested as well. Our Utica team already had someone for the foundations, so they didn't require the services of Pikes self-perform crew. Although they were interested in using the PERI formwork on the job. The PERI formwork system is lightweight and very user friendly.
Pike's BIM department has the capabilities of modeling in the PERI formwork just as the self-perform crew would put it up on site. After a pour schedule is created, an overall count per piece can be extrapolated to determine the amount of formwork to send to that site.

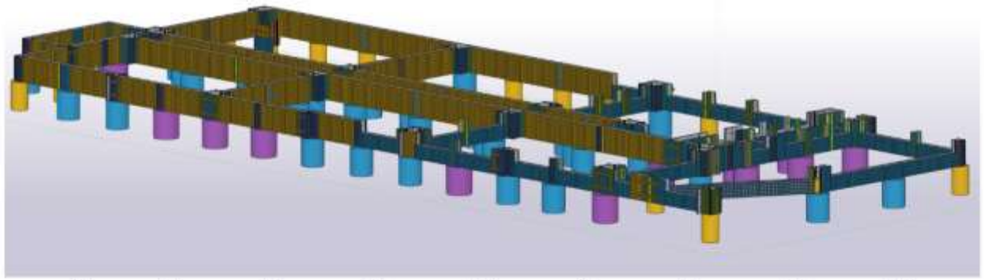
Process

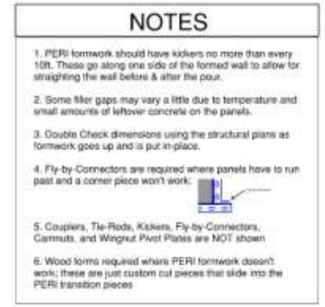
Model the Structural plans in Tekla while completing a full RFI process. As well as modeling all the PERI formwork

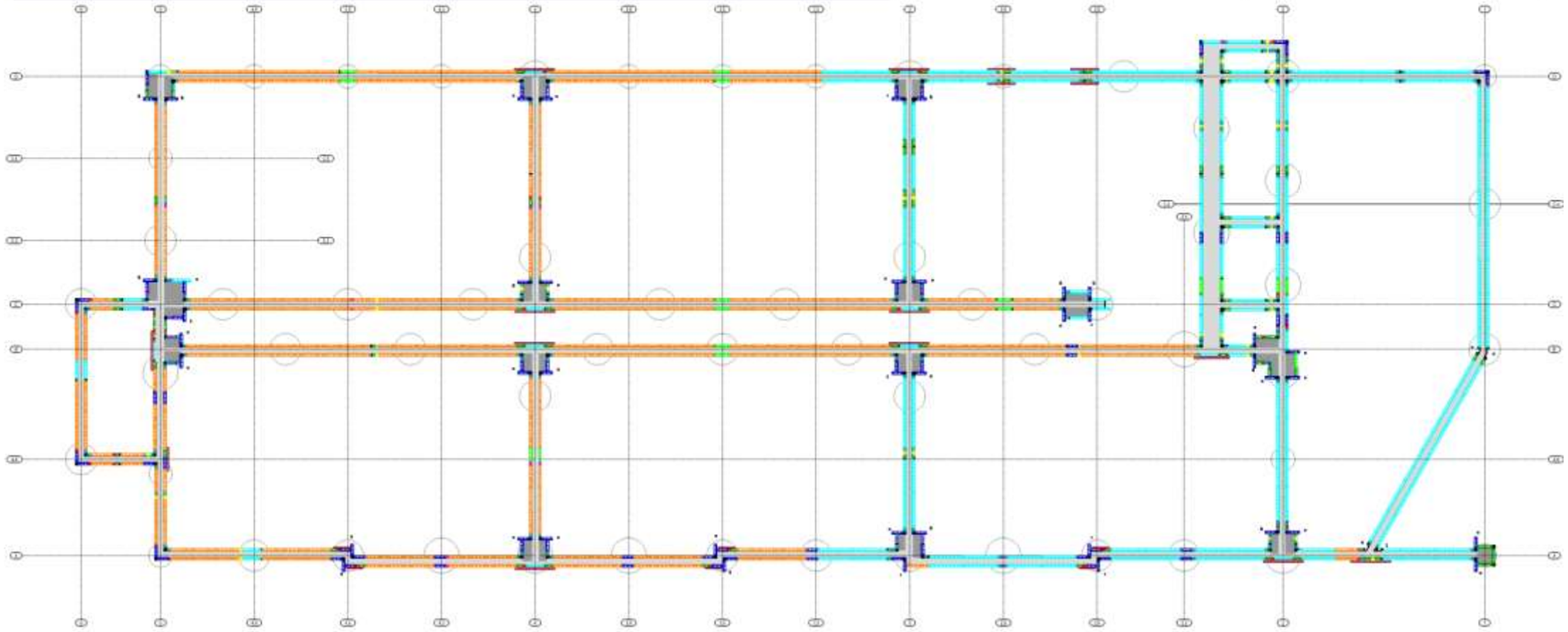
Autodesk Civil 3D is used to get the model on the correct coordinate system, add in 2D part locations, and export files to the field tablets

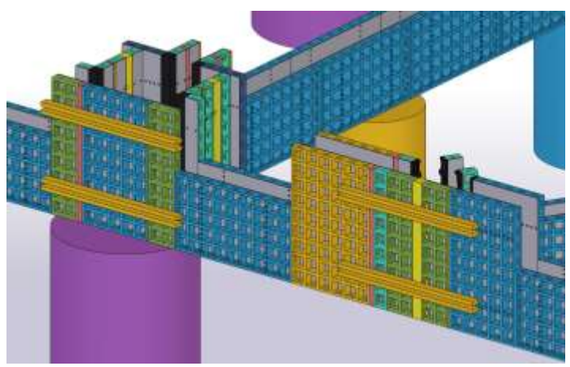
Trimble software allows us to tie in the DXF layout files from Civil 3D to real world applications

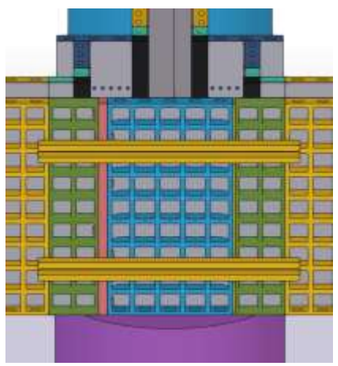
Bluebeam was used to edit the formwork drawings and create a nice set of drawings for the team

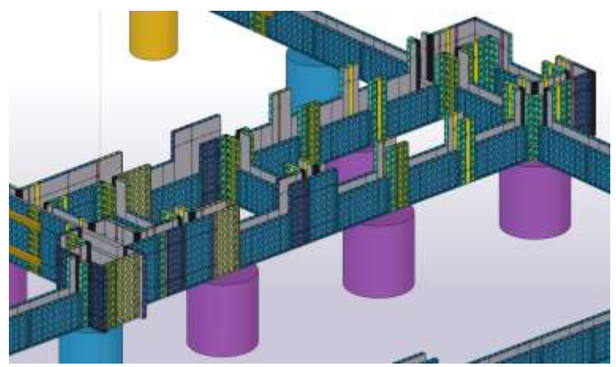












The Pike Company utilizes the latest technology to view model content through the entire construction process.

Process

A Revit model is created from the MEP drawings.

N

The models are then brought into Navisworks and exported to the 3D viewer.

We viewed models in the field.

MEP Spatial Coordination

The fourth-floor mechanical floor of URMC tower is a approximately $80 million dollars of mechanical scope out of a $500 million dollar project. The completion of coordination on this floor marks a huge milestone. Our team began work on this starting in April of 2022 with design assist, we helped our design team to develop contract documents, purchased all of the electrical equipment and switchgear and are looking forward to getting this into fabrication.

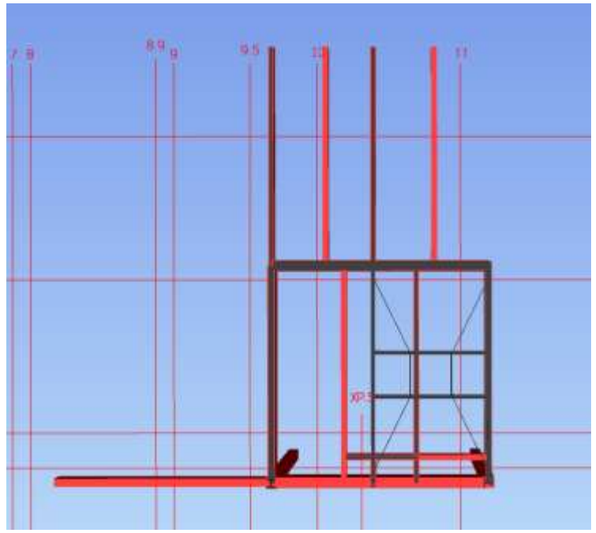
Process

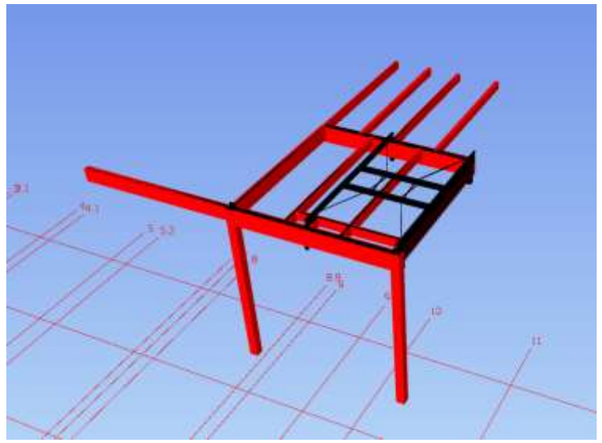
The Revit MEPs model was exported for the subcontractors use.

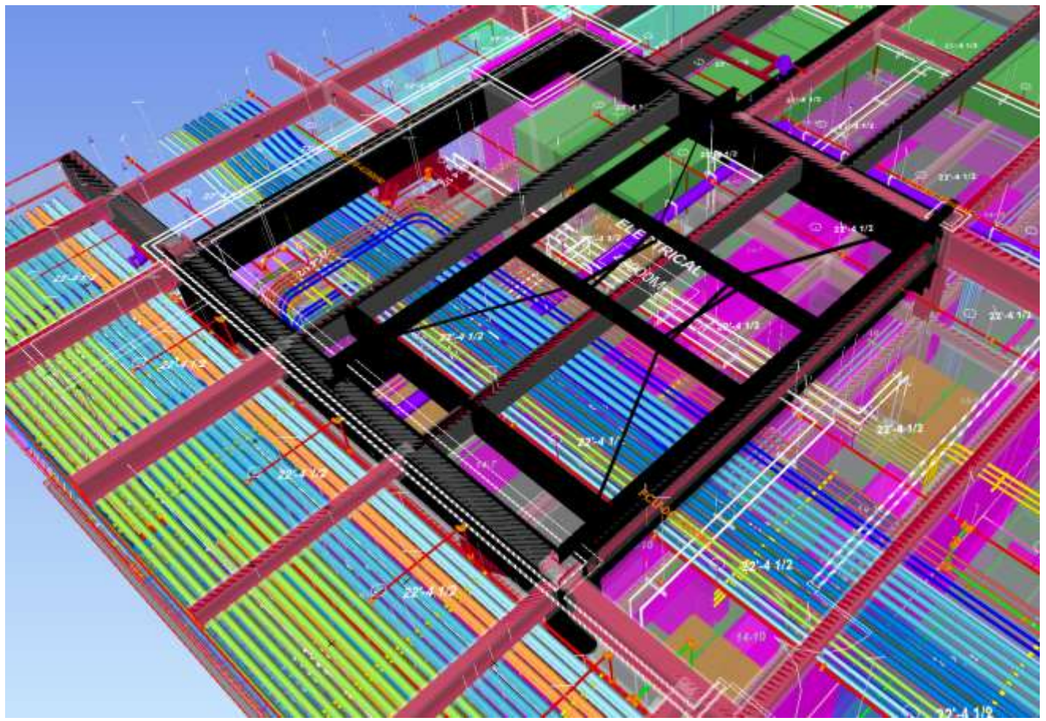
N Navisworks was used to resolve clashes between the MEPs.

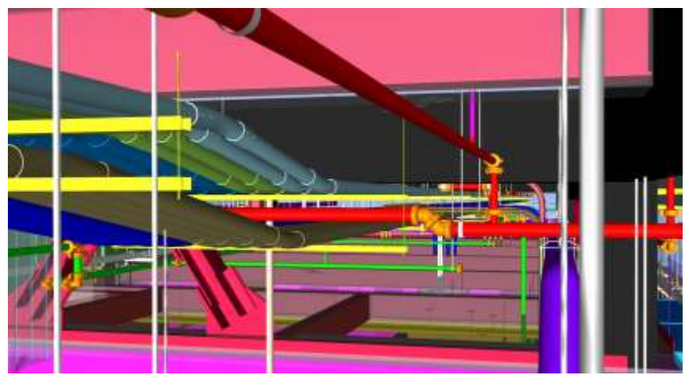
A Uploaded the model to Autodesk for viewing & file transfer.

2D signoff documents were created after the model was clash free.









Benton Center

Pikes BIM team worked with the project team through the BIM Coordination at Colgate. During this time Pike lead the collaboration between Architect, Subcontractors, Owners and Facility maintenance to submit, document and update the 380 RFIs into a coordination model. After this process was finished per floor, signoff was conducted, and the as built model was uploaded for the entire field team to view while the building was being constructed.

Process

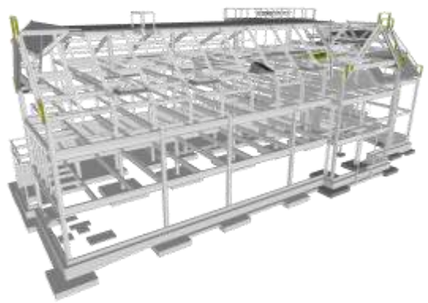
R — The Revit Architectural and Steel model was exported for the subcontractors use.

N — Navisworks was used to resolve clashes between the MEPs.

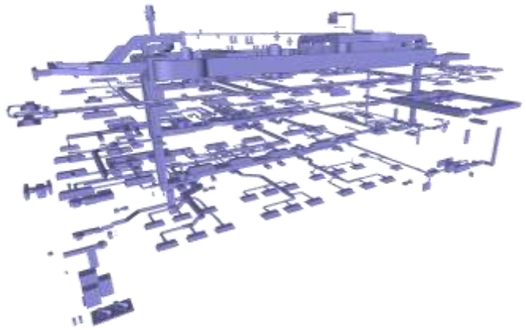
DWG — 2D signoff documents were created after the model was clash free.

A — Uploaded the model to Autodesk One Drive for viewing.

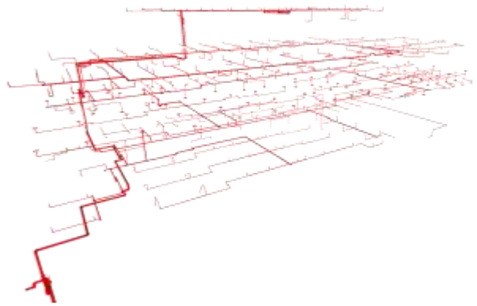
Architectural



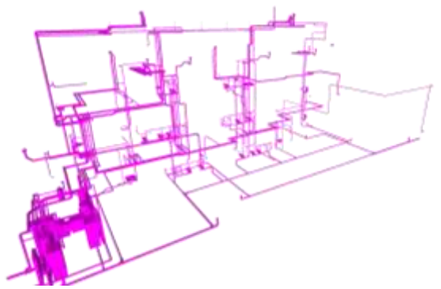
Structural



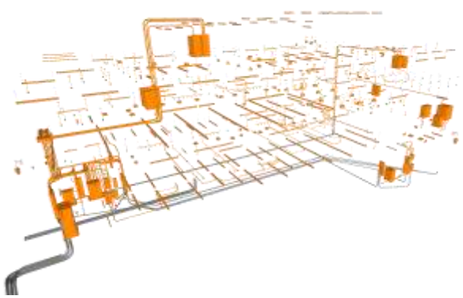
Duct Work



Fire Protection



Plumbing



Electrical

Signoff Document

Model Viewer

Spatial Coordination

A full 3D coordination effort was underway for Rochester's new Bus Was station. This project had a unique moving bus washing system where the buses would stay stationary. No fly zones were added to the model to show the space required for the moving bus wash machines, which helped the coordination team relocate major duct runs within the master BIM model.

3D Navisworks Coordination Model

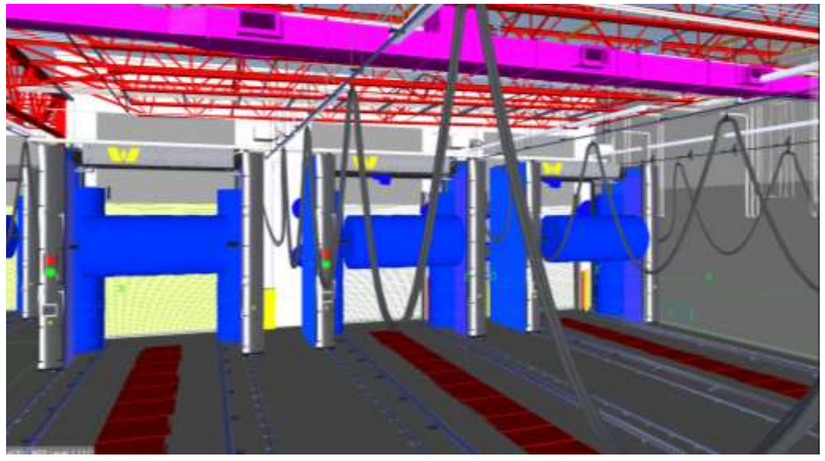
Process

Revit was used to ensure the design model matched the contract documents.

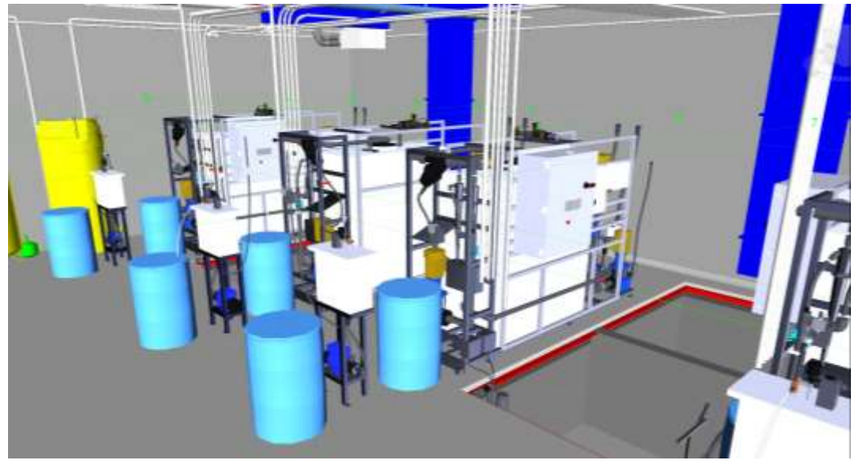
Naviworks was used during coordination to work with the design team on ordering custom shower drains.

The building was scanned using a Faro Laser Scanner and the Trimble X7. to locate and verify in-floor radiant tubing

2D signoff documents were signed across all trades for approval before install.



Bus wash Bay



Wash Equipment

3D Scan to BIM

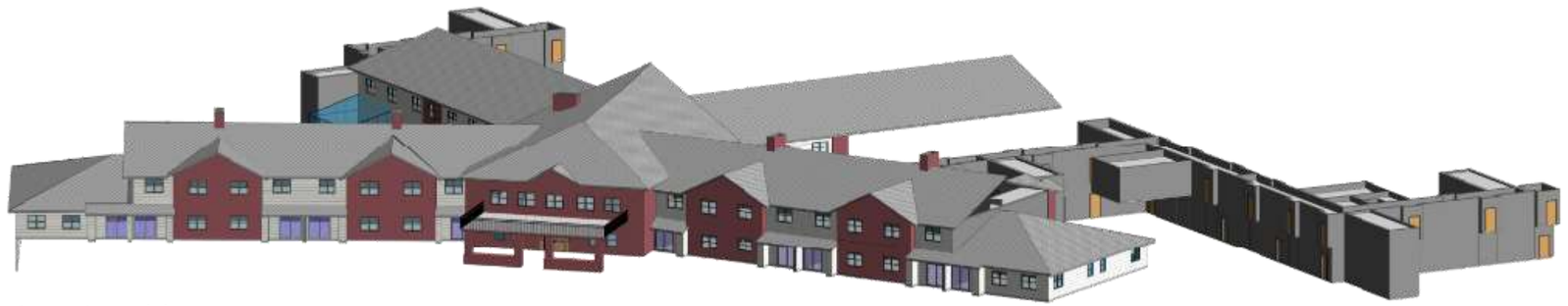
A request from the Architect was to document and provide an existing conditions model of the complex in order for the Architect to update the facility. The entire building was scanned in 3 days and took 2 days to register. After registration the scan data was brought into Revit to model Ceilings, Doors, Windows, Walls, Roofs,

Scan Data

3D Scanned the building using a Trimble X7.

Modeled the Scan data to show the Existing conditions.

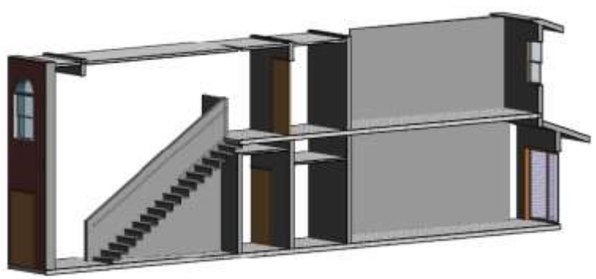
Bluebeam was used to provide drawings with dimensions.



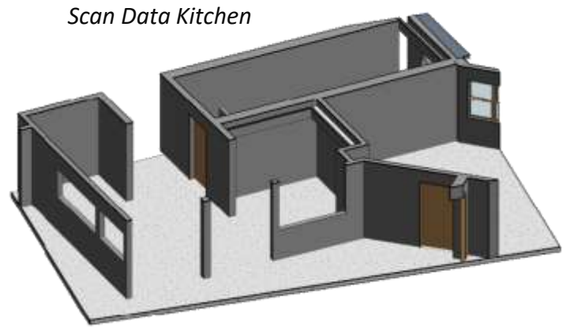
3D Revit Model

Scan Data Stairs

Scan Data Kitchen



3D Revit Model



3D Revit Model

CROSSROADS AT GENESEE

The Crossroads at Genesee included reuse of historic warehouse space. Pike's BIM team was able to scan the existing timber frame building using a High Definition Laser Scanning (HDLS) in order to create a highly detailed 3D coordination model. The timber structure was a major design feature for the client to have exposed. Extracting the point cloud data from the scans gave Pike's BIM team the ability to model the exact placement of each column and beam, which was critical in order to coordinate the new MEP systems to be installed.

Process

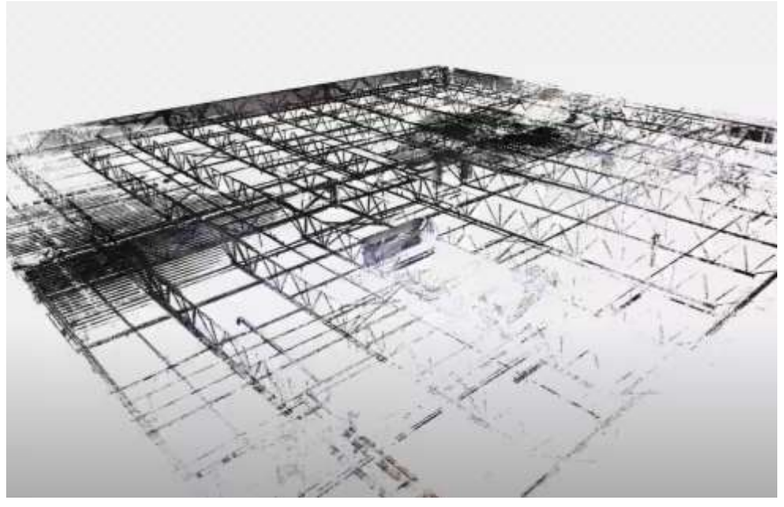
The 5-level timber framed building was scanned using a Faro Laser Scanner.

The point cloud derived from the scan data was then brought into Revit in order to model the existing timber structure members of the building.

The model was Exported from Revit into 2D CAD files for coordination.

High Definition Laser Scan (HDLS)

An existing office was being renovated. The BIM team laser scanned the facility in areas such as the clean room and office spaces. Once the scan data was refined, it showed the equipment and ductwork in the clean room, giving the architect a 3D visual to understand the existing conditions.



Laser Scan of Building Structure

Building Point Cloud

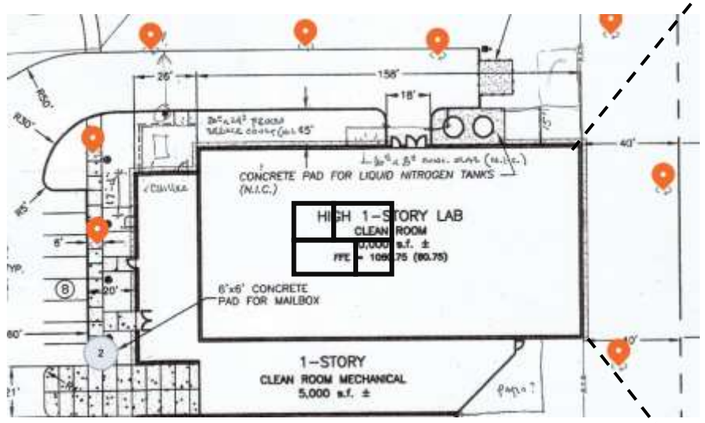
Process

3D Scanned the clean room and office spaces

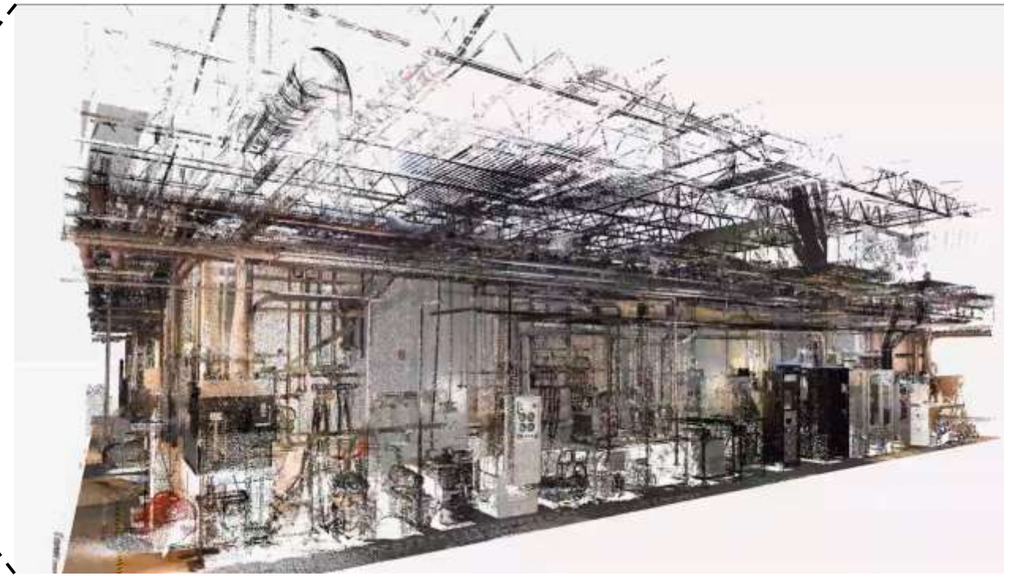
Registered scan data using Trimble.

A video animation was captured using ReCap Pro.

Uploaded to Structionsite for reference and review

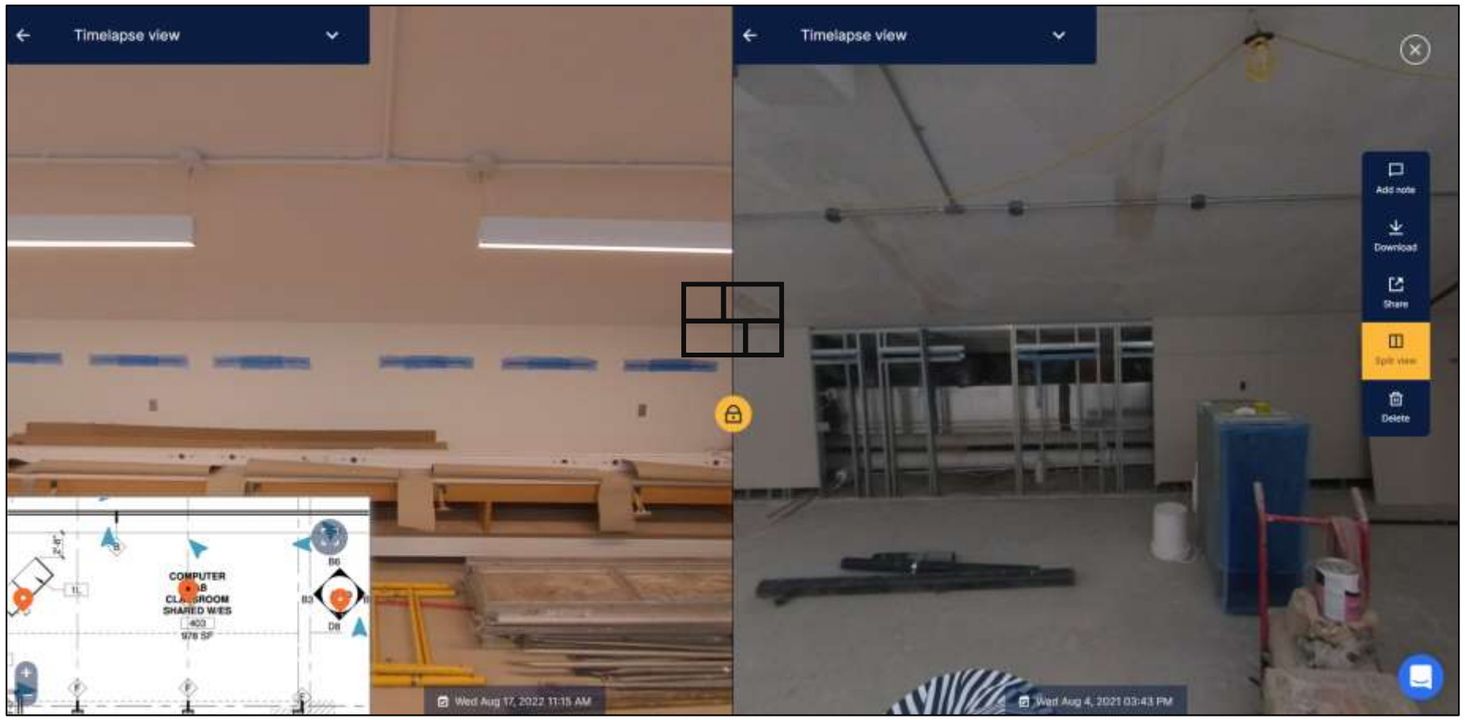


Structionsite Floor Plan

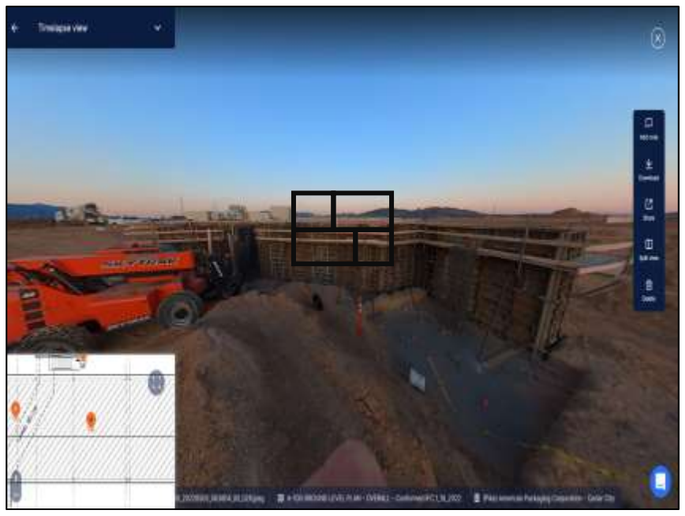


StructionSite

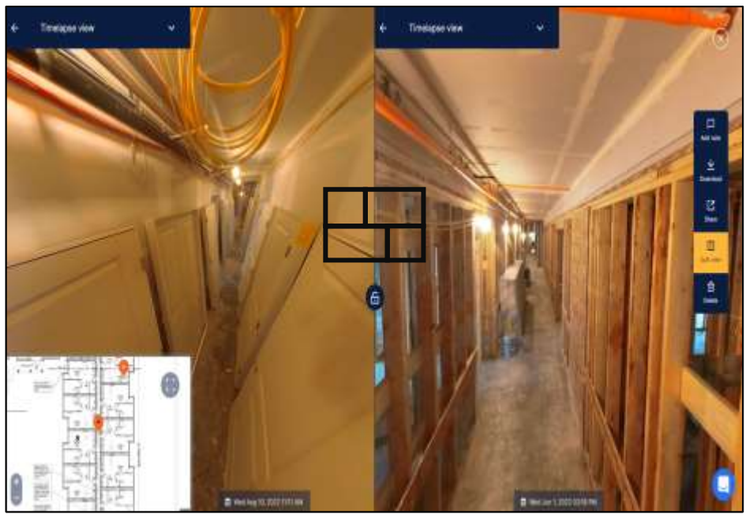
Through site documentation, it's easy to get an overview of current and planned work. StructionSite allows you to monitor the safety of the jobsite, identifying risks as—or even before—they arise so you can address them quickly, keeping your team safe. Structionsite allows the user to easily take and update weekly 360 photos by using a 360 issued camera.



Marshall Hall



American Packaging



Sennett Apartments

Process

Project members taking weekly 360 photos using the latest Insta One X 360 Camera.

The 360 photos are uploaded and hosted to the StructionSite app for sharing across all team members involved.

Anyone can export the 360 images which are linked to the PDF for easy sharing and documentation.

Plumbing Stub Up Analysis

Island Cove Apartments

Delray Beach, Florida

A new sixty-unit affordable housing apartment complex was being constructed. Before the foundations were poured the BIM team Laser scanned the newly placed plumbing layout in the field. Once the scan data was overlayed with the design model, it was showing that the plumbing stacks were not falling in placement of the finished layout. Before backfill and the foundations were poured the BIM department was able to create a deliverable to review with the plumbing subcontractor on site in order to adjust and fix the discrepancies. This saved time and money by reassuring the layout is correct before the foundations were poured.

Trimble X7 Laser Scanner

ReCap view of Point Cloud

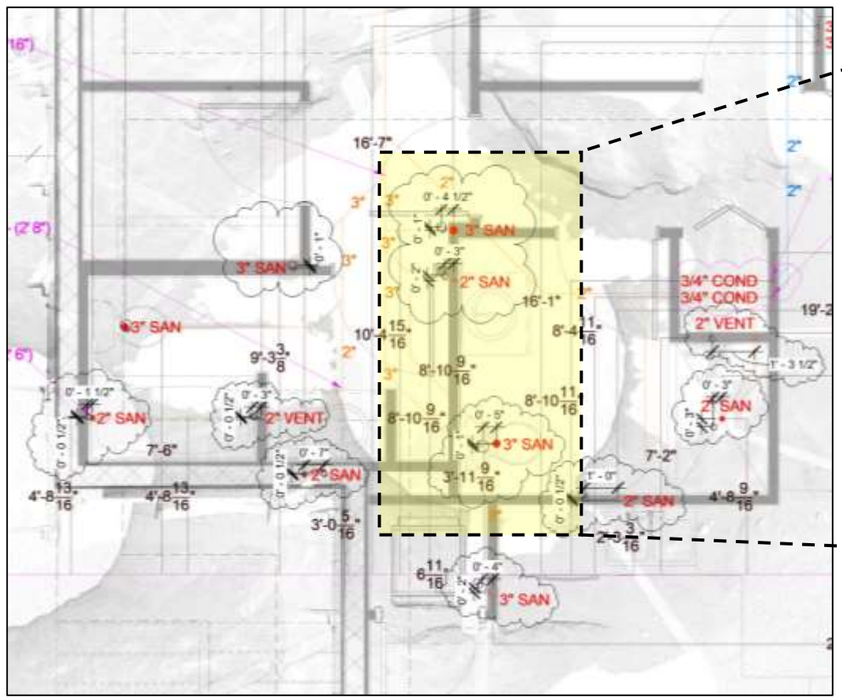
Process

3D Scanned the plumbing stacks before backfill.

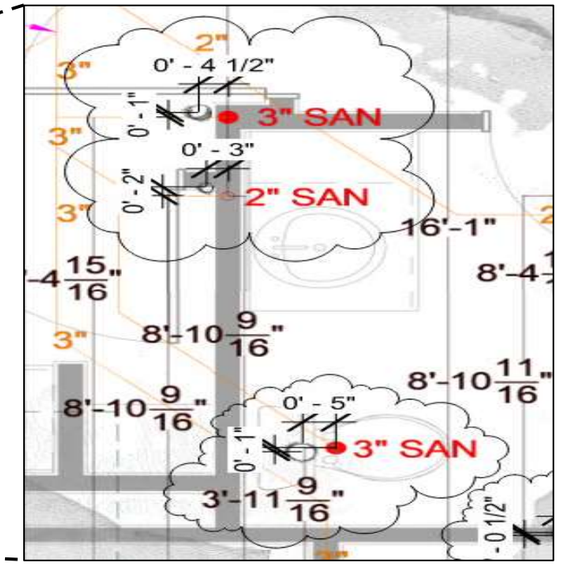
Registered scan data using Trimble.

Overlaid Scan data and design plans in Revit.

Exported overlays in BlueBeam.



Design Plan & Point Cloud Overlay

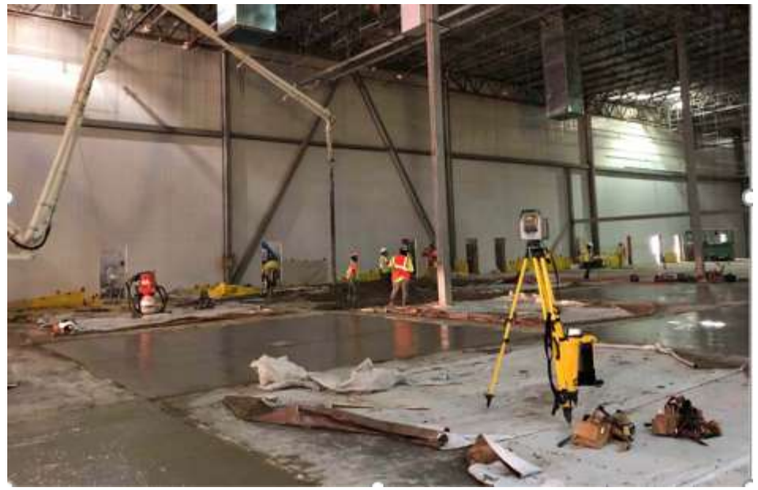


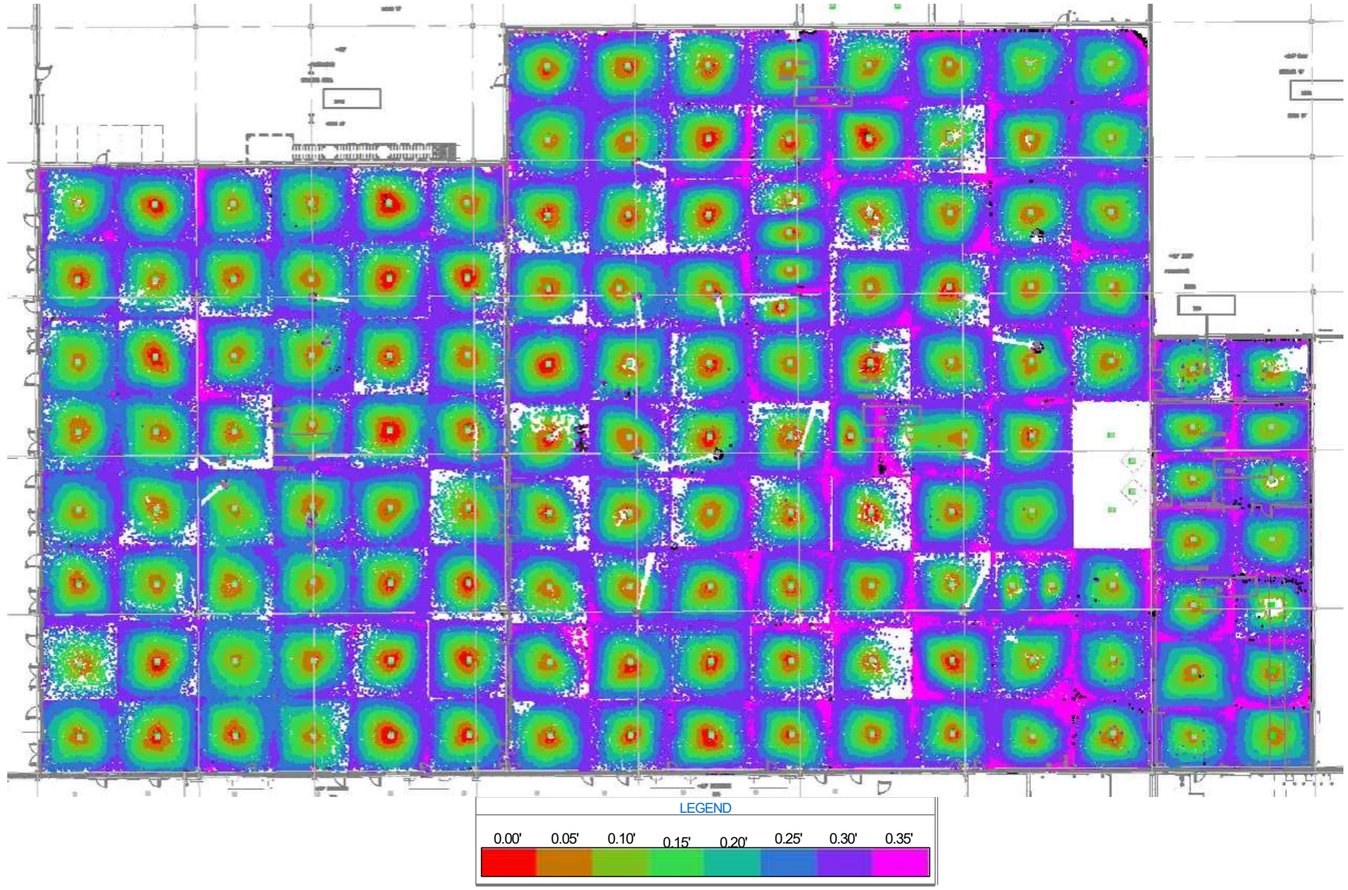
Discrepancies

Floor Flatness Analysis

Thomasville, Georgia

There was concern over pooling of waste on the floor. PIKE Company BIM department surveyed floor drain locations prior to pour to confirm layout was per plan. The Pike Company BIM department laser scanned the concrete while it was still wet and conducted floor flatness analysis to spot and communicate locations to the concrete contractor areas that needed to be fixed while the concrete was still able to be reshaped.





Process

3D Scanned the as-built steel with our 3d laser scanner

Registered and created deliverable using Trimble Realworks

Floor Flatness Analysis

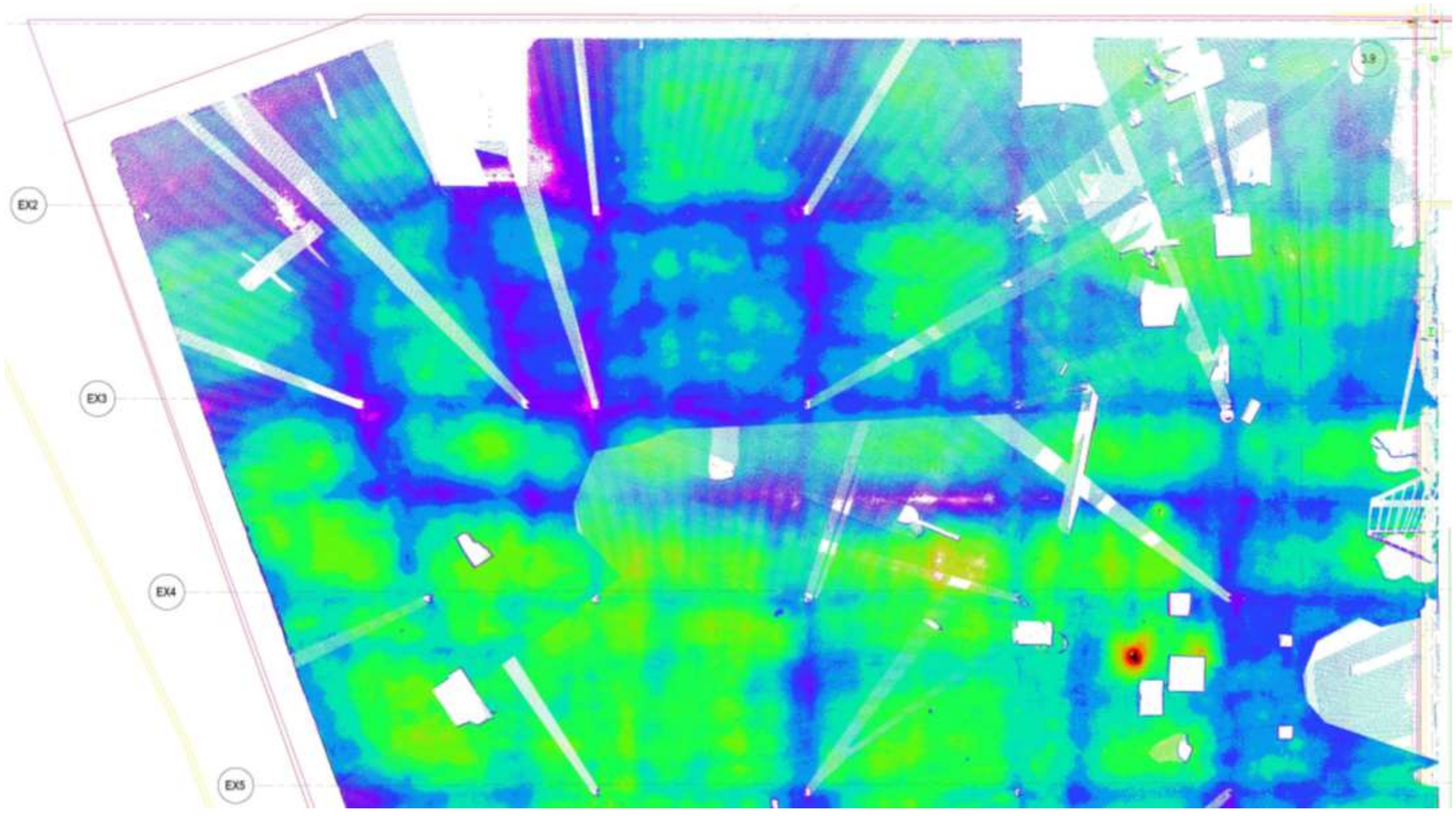
The PIKE Company's BIM department performed a floor flatness analysis in order to inure that the concrete floors were level after pouring. This data shows the accuracy of the pitch and sloping on the 3rd floor of the building.

Process

3D Scanned done with a Robotic Total Station

Registered and created deliverable using Trimble Realworks

The data was overlaid and viewed in Bluebeam.



Level 3

Elevation Key

Stockpile Analysis

The Lockport Memorial Hospital was in need of a drone flight in order to provide an accurate measurement of the Clean fill and the percentage of Topsoil the project had on left site. This data was used in order to review if the project needed more or less and will meet its goals. Taking stockpile volume measurements in bulk was beneficial to both the scheduling and estimating department for this project.

DJI Phantom 3

Site Plan

Area:	60898.00 ft²
Cut:	25438.38 y³
Fill:	188.23 y³
Net Volume:	-25250.15 y³
Material Volume:	25438.38 y³

Area:	65519.00 ft²
Cut:	18101.60 y³
Fill:	390.72 y³
Net Volume:	-17710.89 y³
Material Volume:	18101.60 y³

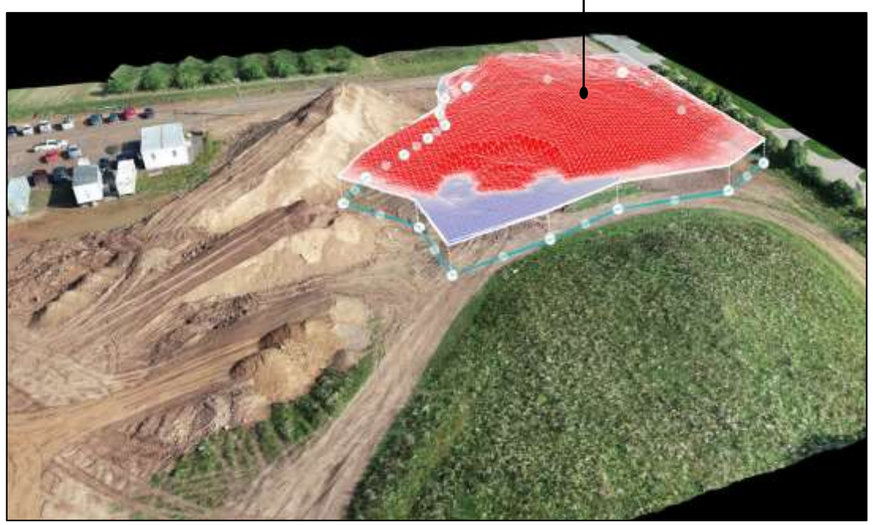
Process

An in-house licensed drone pilot performed a drone survey.

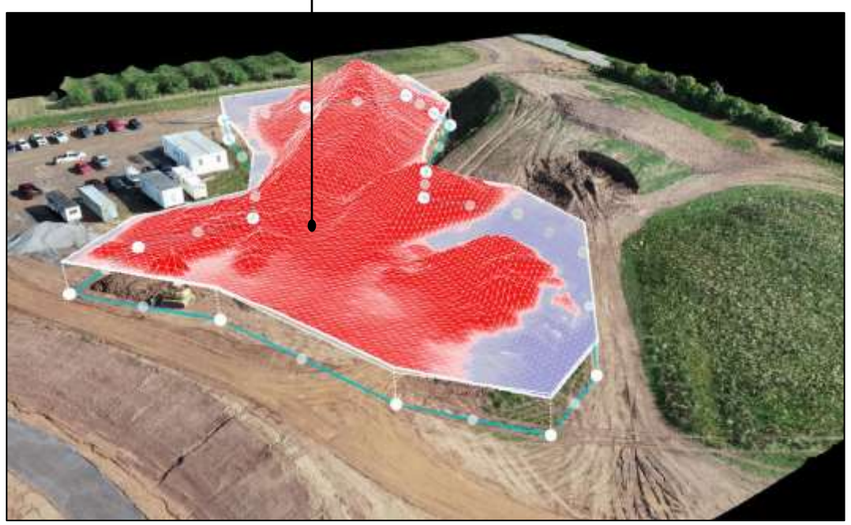
A DJI Phantom 3 drone was used.

Images were captured and uploaded to Drone Deploy.

The deliverable was exported to BlueBeam and sent to the team.



Clean Fill



Topsoil

Boston Dynamics

Spot Robotic Dog

Spot is an agile mobile robot that navigates terrain with unprecedented mobility, allowing you to automate routine inspection tasks and data capture safely, accurately, and frequently.

Boston Dynamics

Process

Spot has a Trimble X7 Laser Scanner mounted on the top and can walk a site using automation.

Once Spot is complete. The scanner will automatically upload to the cloud for registration.

The scan data can be exported to files like ReCap for viewing and point cloud sharing.

The point cloud can be linked into programs like Naviworks for quality control check and coordination.

Pool MEP Coordination

3D Concrete Printing

3D concrete printing (3DCP) is a form of cementitious, additive manufacturing used to fabricate buildings, houses or construction components in completely new shapes not previously possible with traditional concrete formwork.

The rise of 3D printers comes with several pros such as less material consumption, no need for molds and formwork, 24/7 operation on site, and mitigates delays such as labor shortages and supply chain issues.

Company's such as Perri have 3D printers and crews that can come out to a jobsite and run the printer in coordination with the General Contractor to add unique elements and design processes to the project's scope

Process

Slicer software reads traditional CAD software files to format a print sequence.

The generated code is uploaded to a 3D concrete printer which is set up by crews on site. The printer then begins to run creating the 3D structure.

A Brief Introduction to 3D Printing of Concrete

3D printed Bridge in Shanghai

COBOD Printer doing a Two-Story House Print

Example of Finishing Versus no Finishing

Questions ?