

Site Management with Augmented Reality Technology (S.M.A.R.T.)

Monica Sosa, AIA

Project Manager | Senior Associate

Daniel Berghauser, AIA

Architect

CORGAN ■

 AUTODESK®
UNIVERSITY



About the speakers

Monica Sosa, AIA



- Monica is a registered architect in the state of Texas and California.
- Studied Architecture at the University of Texas - San Antonio
- Lead design BIM manager on a large aviation project at Los Angeles International airport (LAX).
- AU debut in 2017 with her talk in the AU Theatre on "Cities of The Future" with the topic of "Building in the Clouds".
- Thrives on innovative technology and how it can streamline her industry.



About the speakers

Daniel Berghauser, AIA

- Licenses in Arizona and California
- Studied Architecture at University of Arizona
- Worked on small scale tenant improvements to large scale new concourses at the LAX campus.
- Worked on projects in the education, interiors, and residential sector.
- Demonstrated a passion for technology through experiences as BIM Manager, AIA member, and advocate for SMART Technology.

S.M.A.R.T

*Leading the industry by incorporating forefront technology into
the construction workflow to create an efficient project delivery*

CONSTRUCTION

INNOVATE

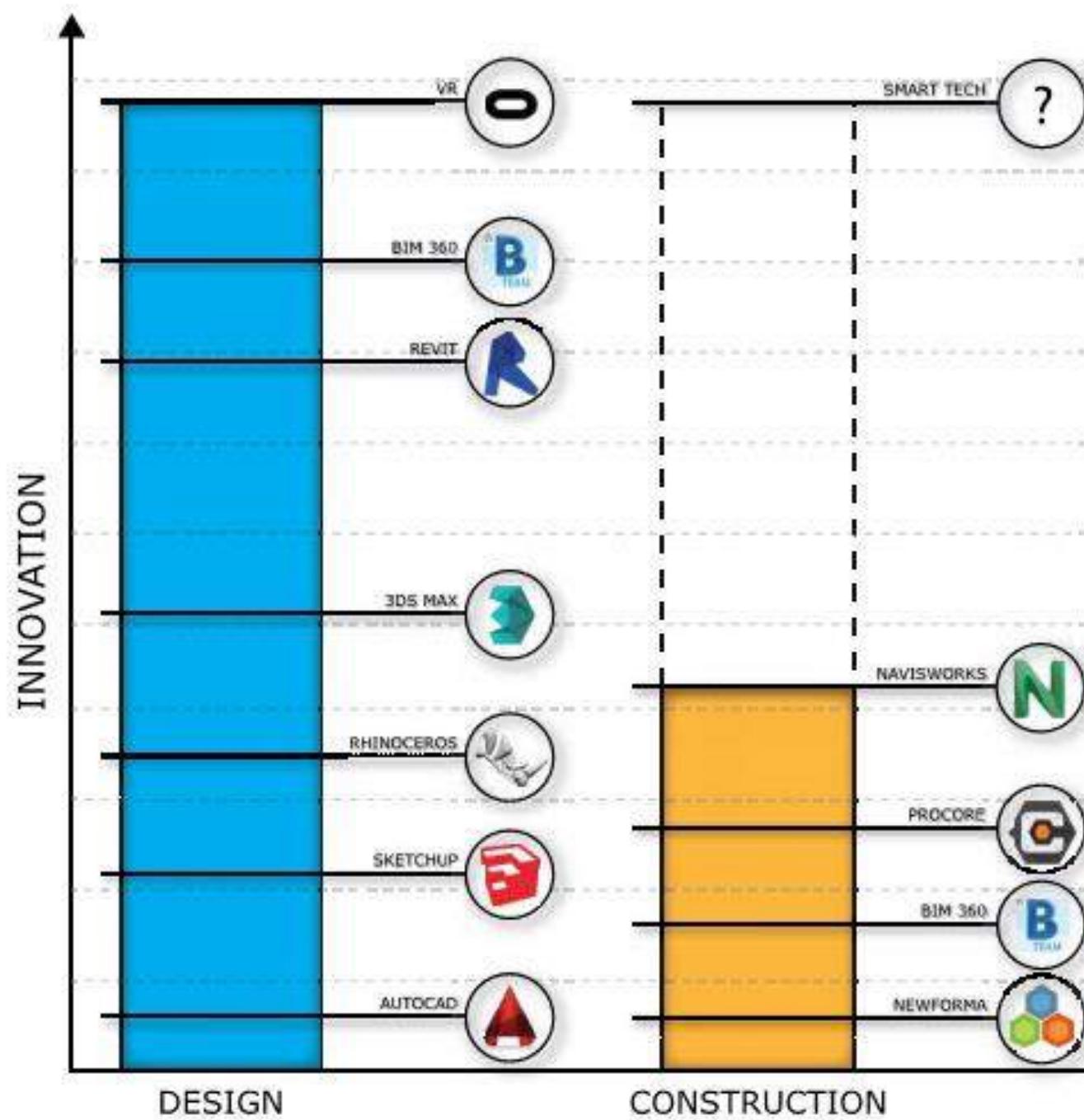
INTEGRATE

COORDINATE

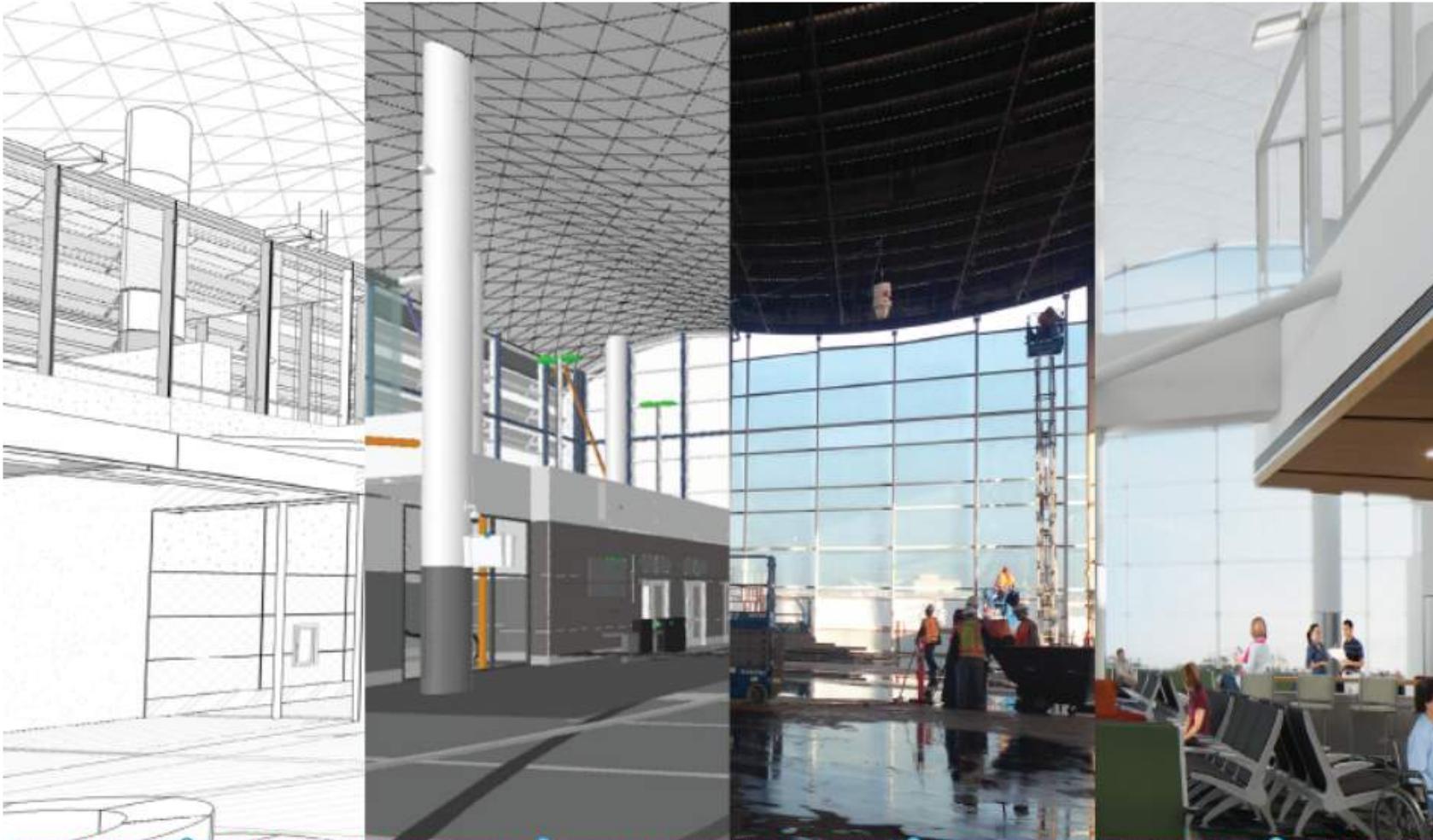
COLLABORATE

EXPEDITE

Industry Standard



Project Delivery Tools

			
	DESIGN	COORDINATION	CONSTRUCTION
CURRENT	<ul style="list-style-type: none">◦ REVIT◦ RHINO◦ AUTOCAD◦ SKETCHUP	<ul style="list-style-type: none">◦ C4R◦ NAVISWORKS◦ BIM 360◦ GLUE 360	<ul style="list-style-type: none">◦ FTP/VEO◦ PROCORE
S.M.A.R.T	<ul style="list-style-type: none">◦ SMART CAMERA	<ul style="list-style-type: none">◦ SMART GLASSES◦ SMART CAMERA	<ul style="list-style-type: none">◦ SMART GLASSES◦ SMART CAMERA



MIDFIELD SATELLITE CONCOURSE- LAX

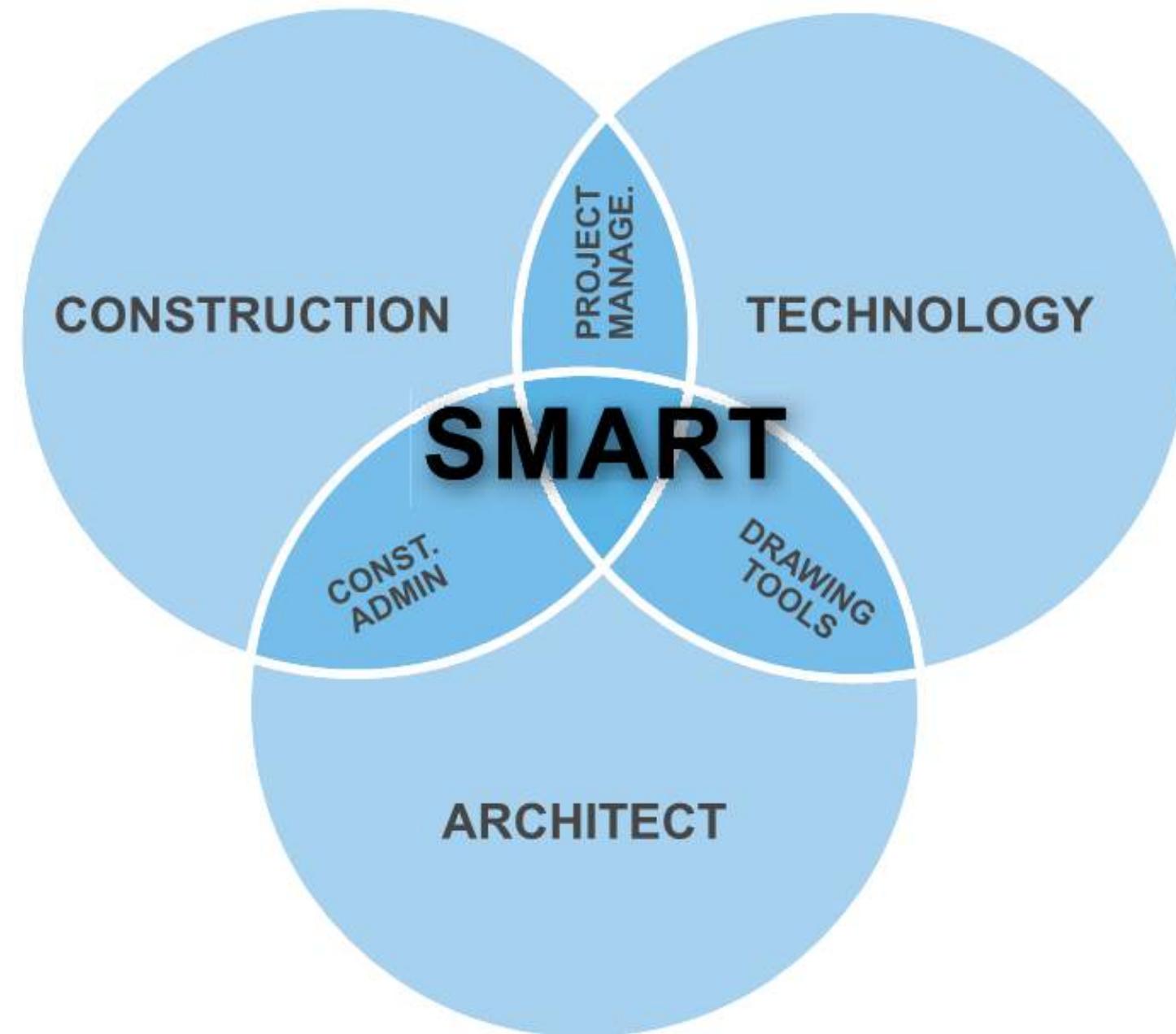
The Midfield Satellite Concourse (MSC) is a new 12-gate terminal addition to the Bradley West International Terminal.

Learning Objectives

1. UNDERSTAND THE EFFICIENCY OF SCANNING AS BUILT CONDITIONS INCLUDING OVERHEAD CEILING
2. UNDERSTAND THE EFFICIENCY OF PUNCH LISTS THROUGH VIRTUAL DOCUMENTATION
3. UNDERSTAND THE IMPORTANCE OF RECORD DOCUMENTATION
4. UNDERSTAND THE IMPORTANCE OF INTEGRATING BIM 360 MODELS IN FIELD COORDINATION
5. UNDERSTAND THE USE OF REMOTE WORK ASSISTANCE
6. UNDERSTAND THE BENEFITS OF DATA VISUALIZATION

S.M.A.R.T.

[Site Management with Augmented Reality Technology]

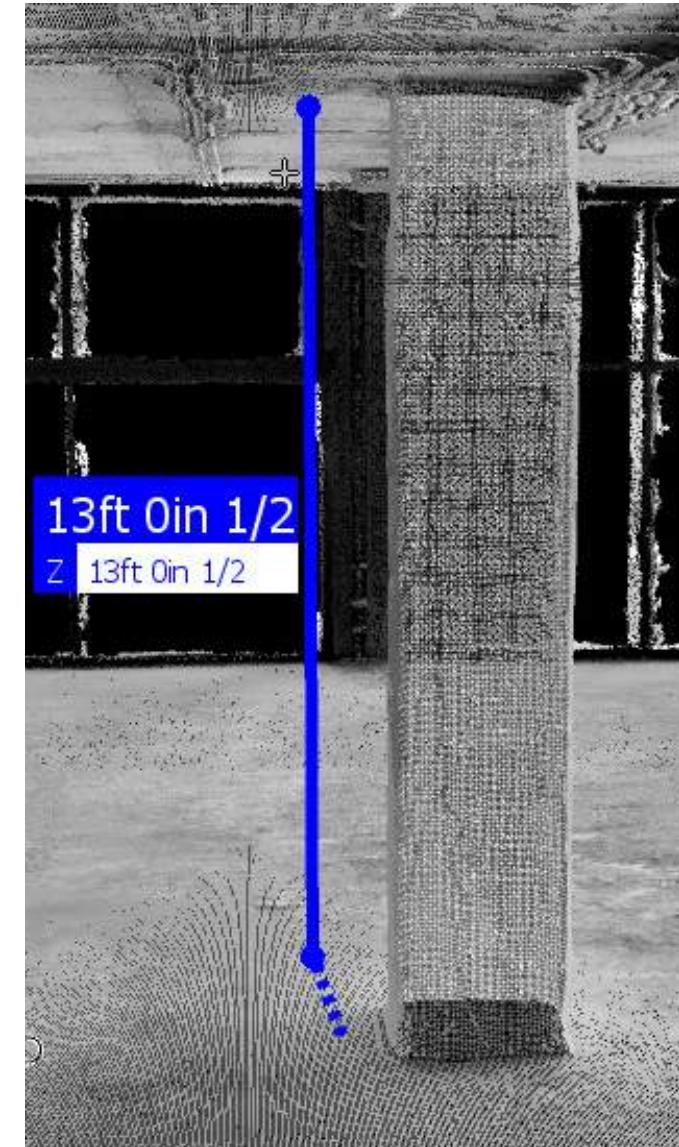


S.M.A.R.T. CAMERA

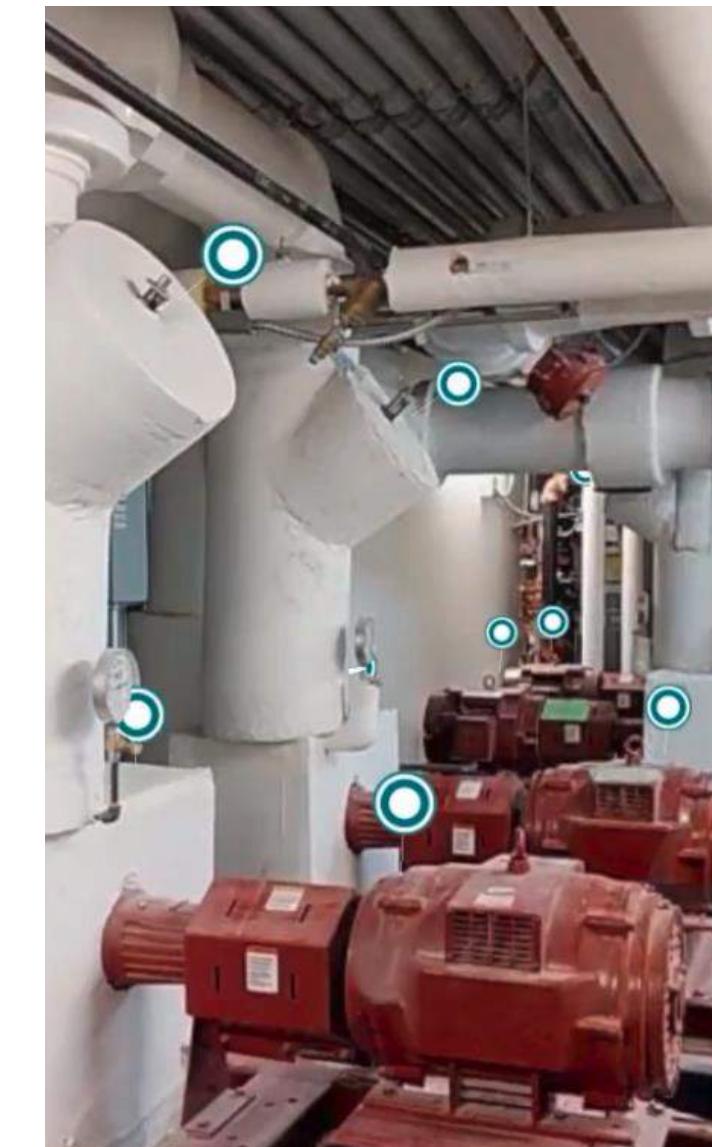
VIRTUAL DOCUMENTATION



FIELD VALIDATION



COLLABORATION



SMART CAMERA DEMO

1:56 PM Thu Oct 25

matterport

Sort Select ?

Add New Job

MSC
Uploaded September 7, 2018

MSC 2.2
Uploaded August 10, 2018

TUTL with BHS
Uploaded August 7, 2018

Above Ceiling V.2
Uploaded July 27, 2018

MSC
Uploaded July 26, 2018

Test 2
Created July 25, 2018

Above Ceiling Study
Uploaded July 2, 2018

Corgan C3 Office

Corgan

TUTL Phase 1

Breakroom

CLASSROOM SCAN

Learning Objective #1



LEARNING OBJECTIVE #1A

Understanding The Efficiency Of Scanning As-built Conditions



PROBLEM TO SOLVE:

- Field measuring
- Validate
- Coordinate



IDEAS:

- Scan project site before turnover to tenant
- Scan would document as built conditions
- Measure from scan
- Share with project team and future tenant



EXPLORATION:

- Shared link to project team
- Generated point cloud
- Explored all software like AutoCAD, Navisworks, Revit and Recap

PROCESS

- 46 scans less than an hour (18,000 SF)
- Each scan about 7-8 feet apart
- Processing time: 7.5 hours



LAX- UTILITY TUNNEL SCAN WITH ICS



<https://my.matterport.com/show/?m=WBYSnRa86Sx>



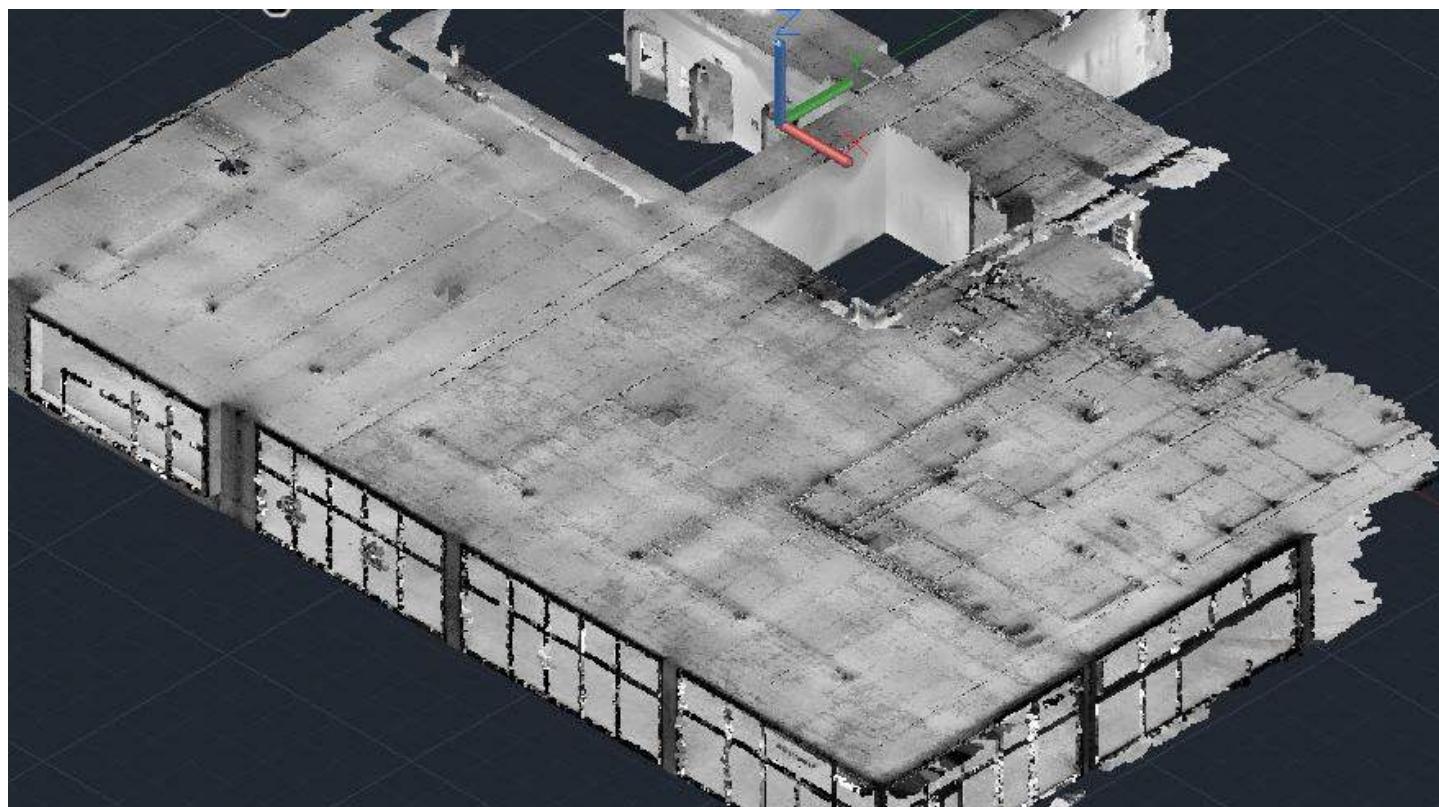
S.M.A.R.T. SCAN

Scan of the Utility tunnel at LAX before the turn over to the future baggage handling tenant.



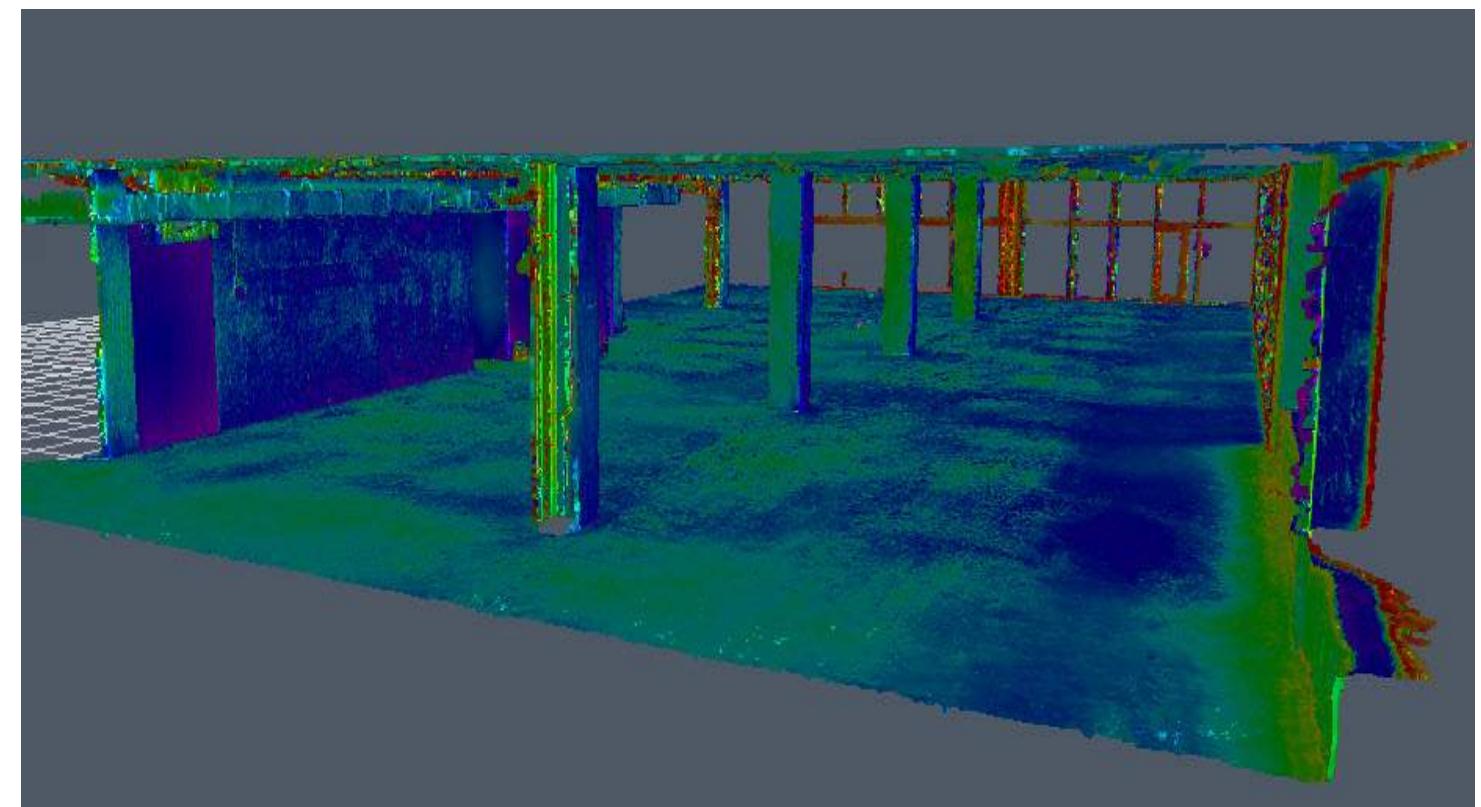
POINT CLOUD

Generated point cloud that was linked into our design models and could be shared with future tenant for validation



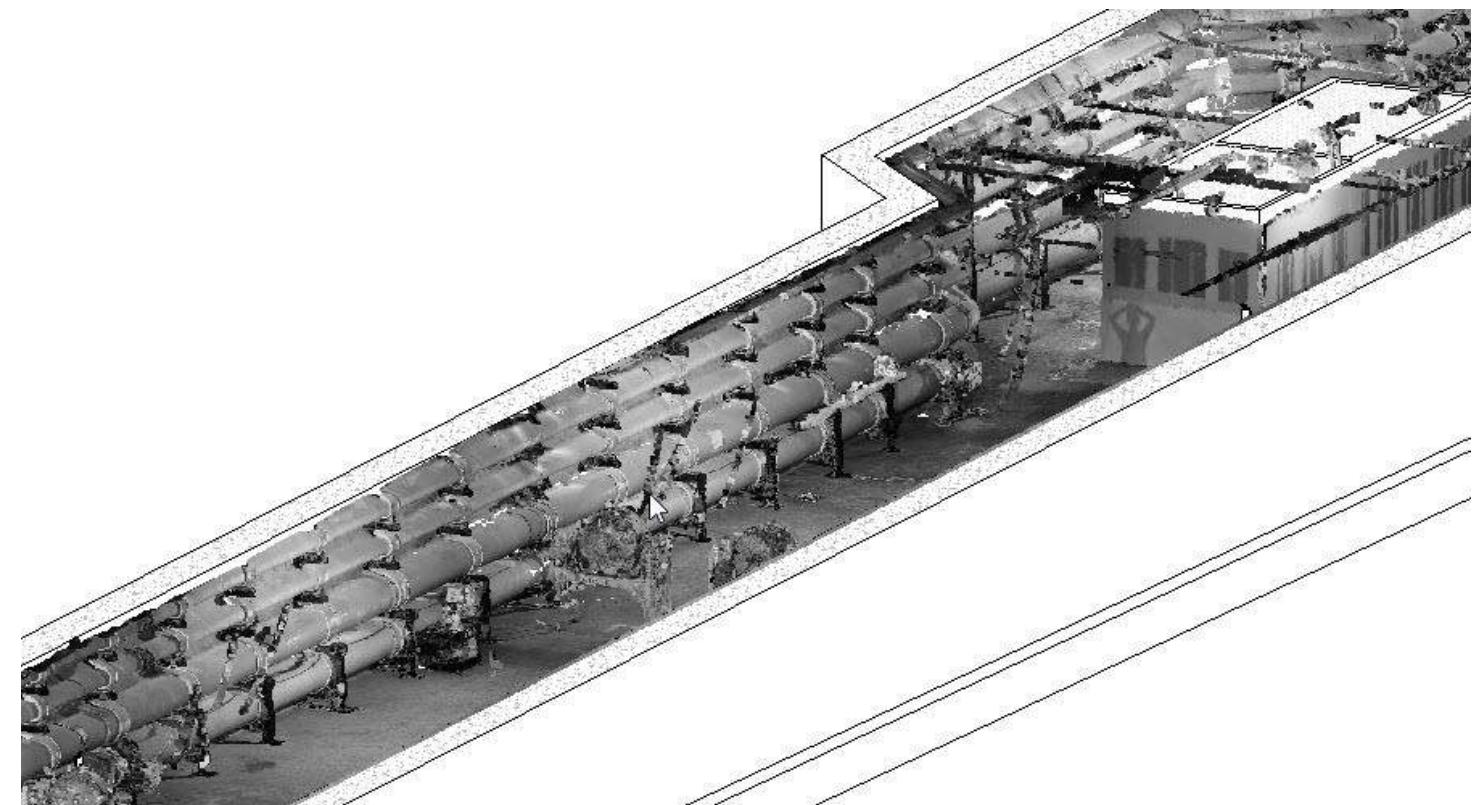
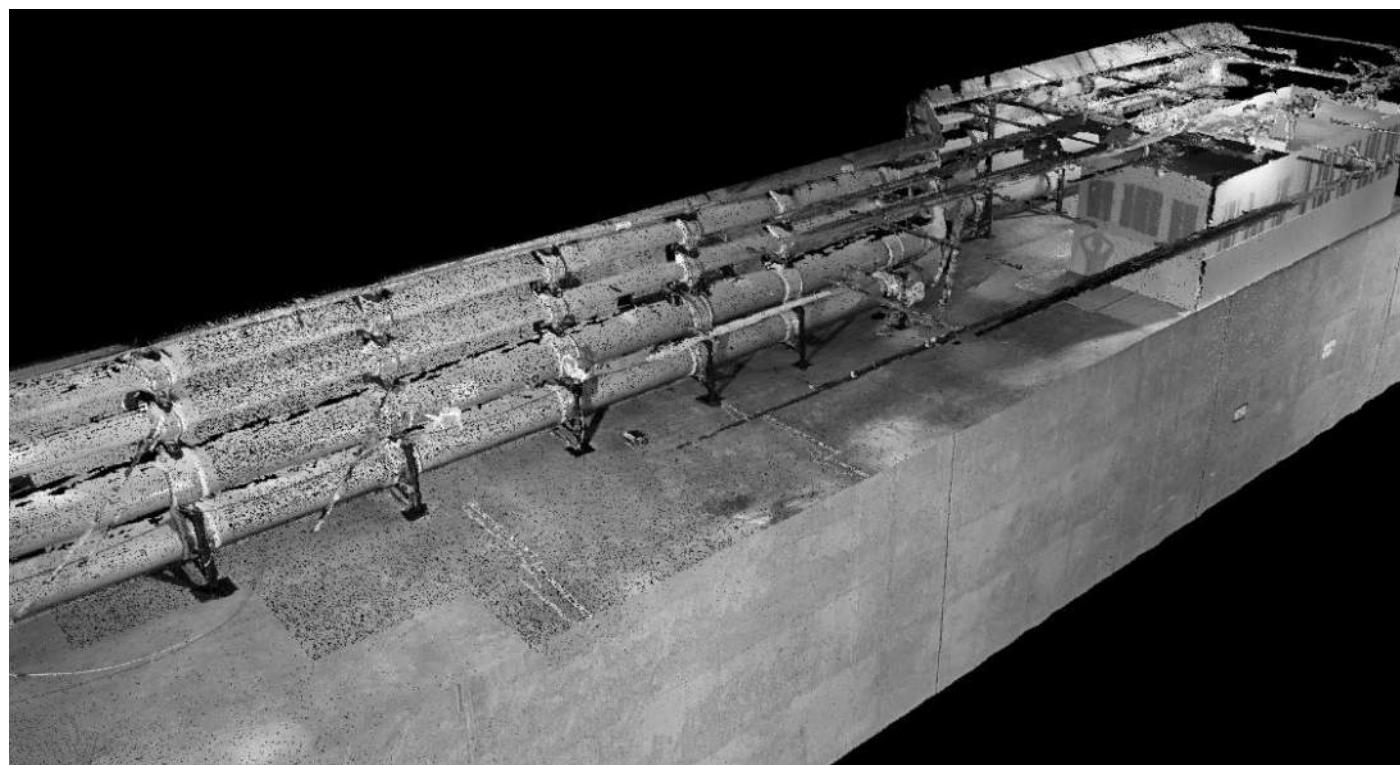
AUTOCAD

AutoCAD can import the .rcp file or you can link up to Recap and index a file. AutoCAD has user friendly options to cut planes in the point cloud. This method could be used for those using AutoCAD format such as Civil 3D.



RECAP

Autodesk Recap can read the raw data .XYZ file and generate the .rcp file. Within the program, you are able to place an origin point so you can easily place into another program as well as crop down the scope extents of the point cloud. The other features include measuring, color modes for displaying points, lighting settings and changing background colors.



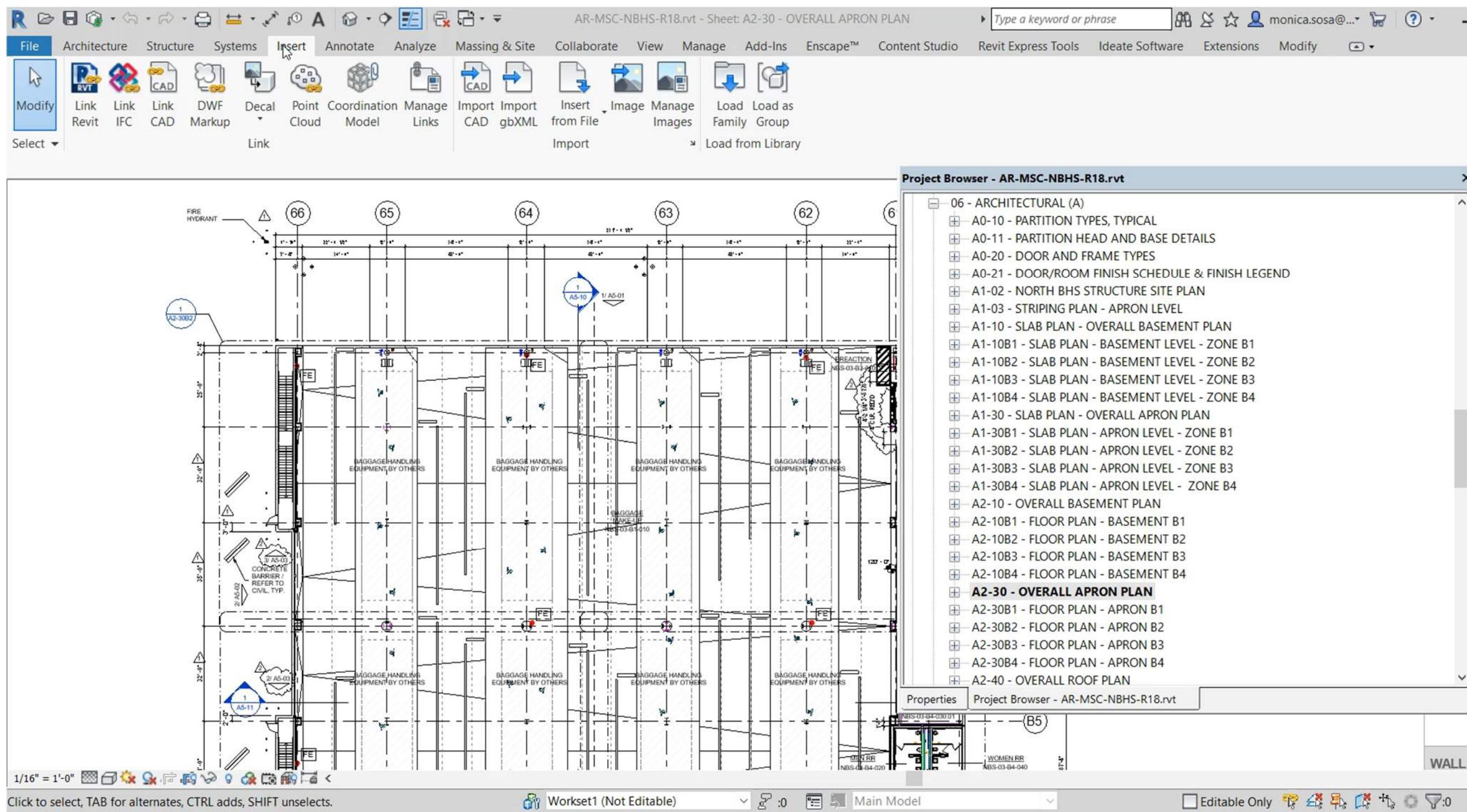
NAVISWORKS

Autodesk Navisworks will append the .rcp and .rcs file. It will find some planes of points so you are able to measure. When it comes to orbiting around and cutting section views, this program does an excellent job because it's quicker than the other programs. Also, you can validate against all other design or construction models.

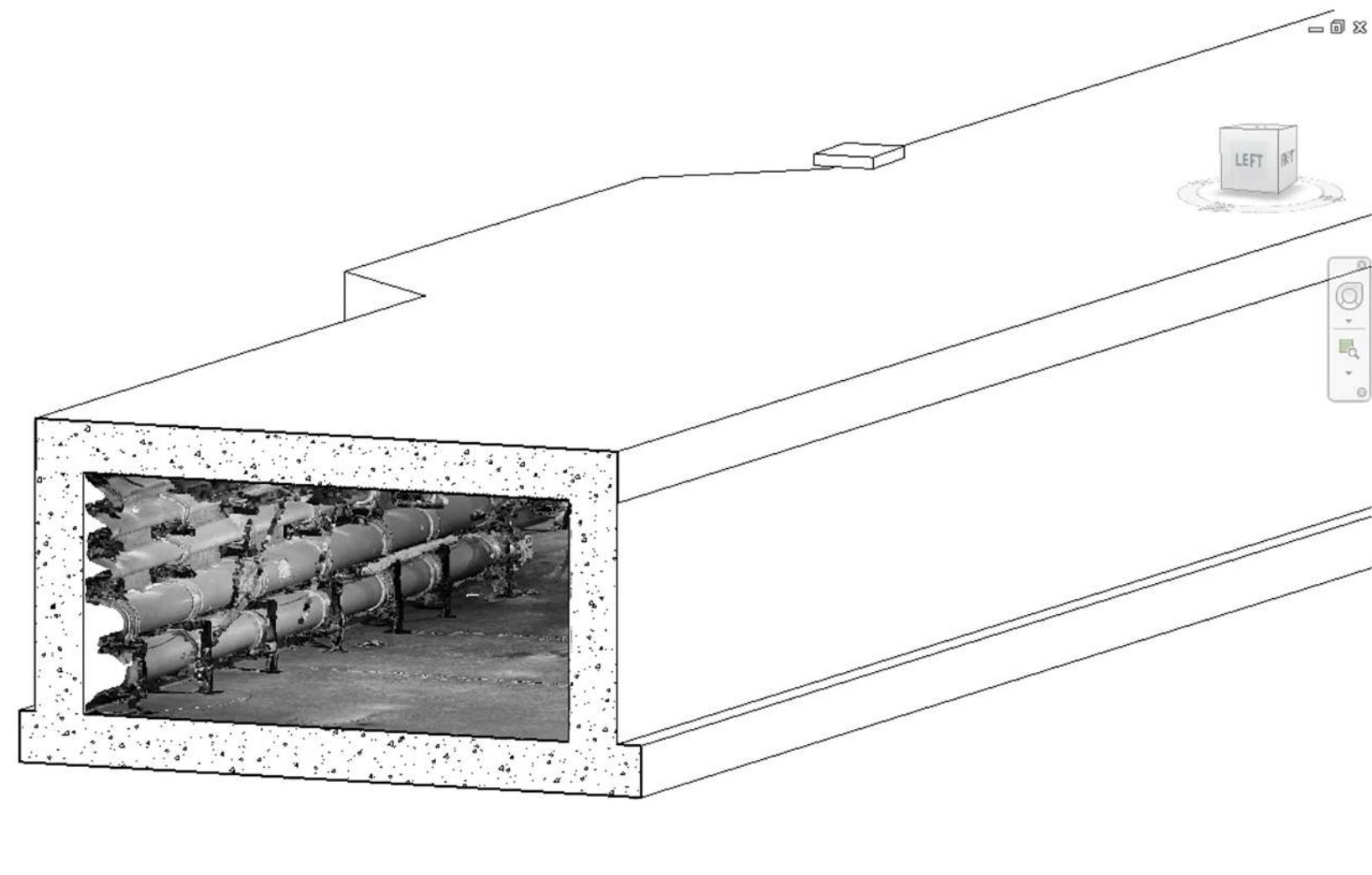
REVIT

Autodesk Revit can import the raw data .XYZ file and it will index you a .rcp file that you can then import into the model. The file size is small enough to maneuvering around within your model. The actual file will come in at feet and inches but you will have to place the model for location.

REVIT- INSERTING POINT CLOUD



REVIT- INSERTING POINT CLOUD



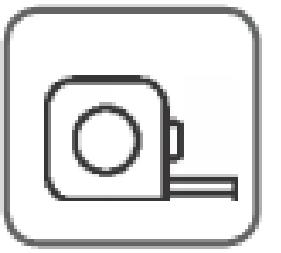
TAKE AWAYS:



TIME



COORDINATION



MEASURE

EFFICIENCY:

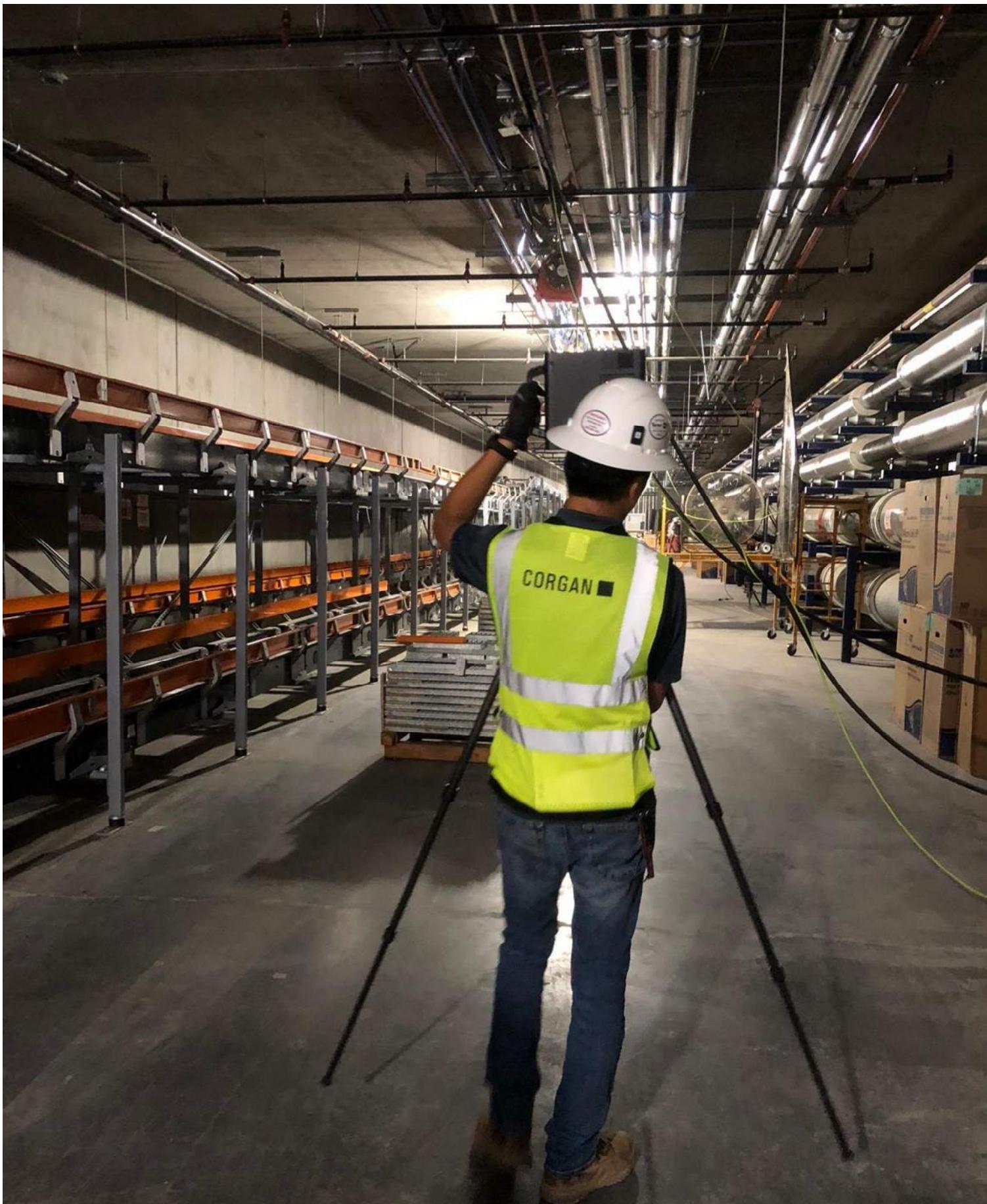
- By scanning the as-built conditions, we were able to minimize trips back to the site

SHARE:

- We could share the scans to the project team to verify for our consultants who were not local

VALIDATE:

- Point cloud overlay with design models helped us communicate with the tenants that the space built was validated to our design models and construction models



LEARNING OBJECTIVE #1B

Understanding The Efficiency Of Scanning Overhead Ceiling



PROBLEM TO SOLVE:

- Validation
- Time- Saving
- Coordination



IDEAS:

- Remove ceiling tiles and prop up camera into the ceiling
- Test out lighting options



EXPLORATION:

- Tested idea at project site office
- Explored different lamp attachments
- Measured, identified and shared link with team

PROCESS

- Move Acoustical ceiling tile
- Prop up the camera to the correct height
- Add headlamp
- Move out of the camera's way
- Process up in the cloud
- View scan in the cloud
- Identify building systems in the scan
- Measure existing conditions as needed
- Share with project team



LAX- ABOVE CEILING SCAN



<https://my.matterport.com/show/?m=a2BaHZt2suE>



ILLUMINANCE

We explored scanning above ceiling with room lights on and off and then a headlamp mounted to the camera. Worked best with room lights on.



FLOOR PLAN

As we scanned around the ceiling tiles, we realized it was also generating a floor plan for the room as well.



IDENTIFY

In the cloud, we were able to identify the systems. We would be able to send these links out to the project team.

MEASURE

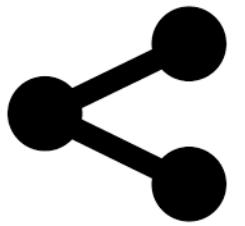
In the cloud, we were able to measure between systems and to structural systems.

TAKEAWAYS:



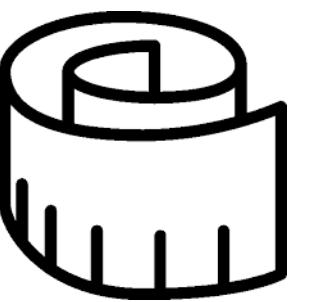
IDENTIFY:

- By scanning above the ceiling, we were able to document all building systems.



COORDINATE:

- We were able to share the scan to the entire project team.



MEASURE:

- We were able to measure building systems and structural systems.



Learning Objective #2



LEARNING OBJECTIVE #2

UNDERSTANDING THE EFFICIENCY OF PUNCH LISTS THROUGH VIRTUAL DOCUMENTATION



PROBLEM TO SOLVE:

- Organization
- 3D Documentation



IDEAS:

- Scan the project
- Create color coding system of tags
- Tag the issues
- Share with project team



EXPLORATION:

- Walked the scan virtually and tagged issues
- Sent out to consultants for feedback and review

LAX-TUTL PHASE 1 SCAN

CORGAN ■



<https://my.matterport.com/show/?m=a2BaHZt2suE>

COORDINATION

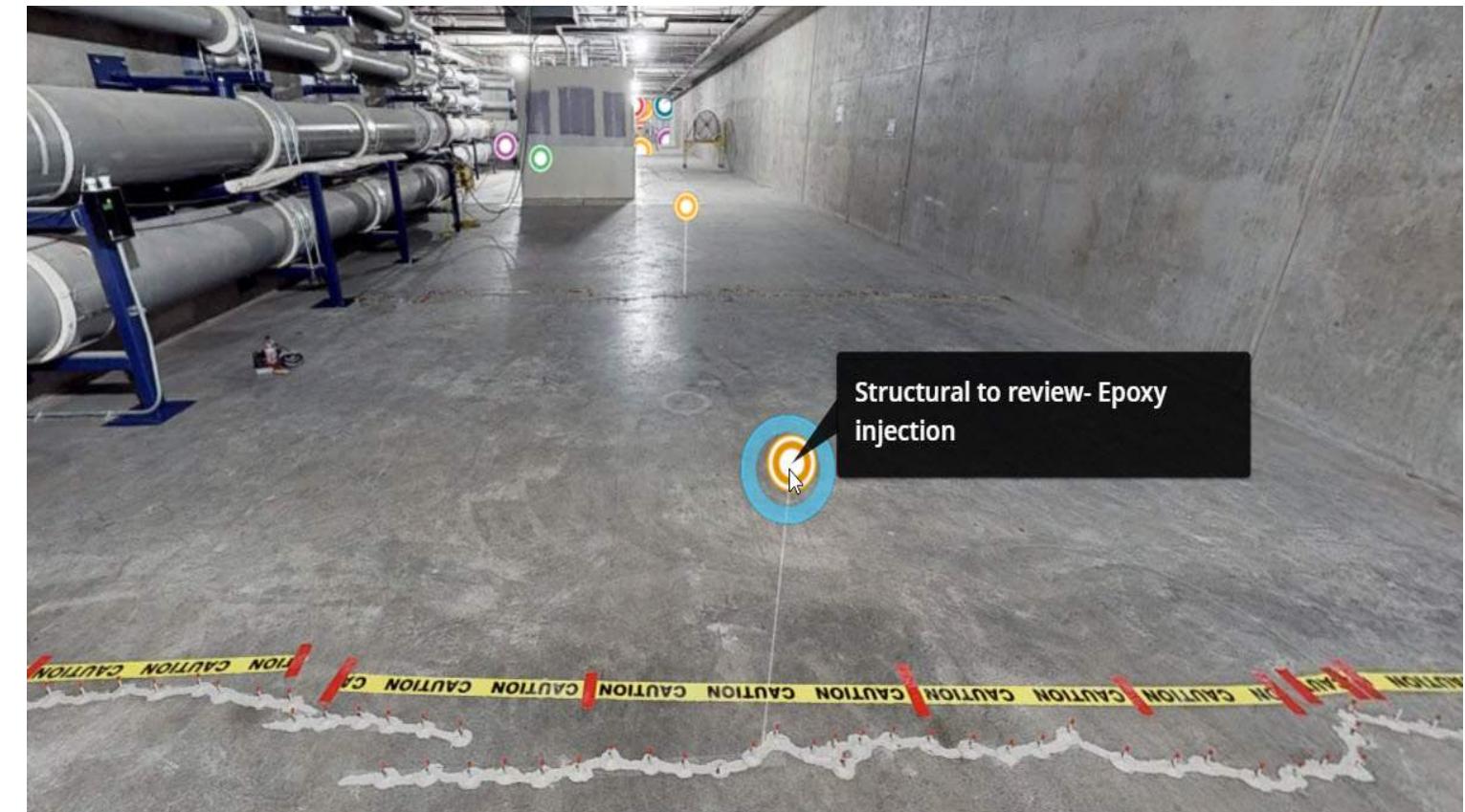
Red - Fire
Orange - Structural
Yellow - Plumbing
Green - Electrical
Blue - Mechanical
Purple - Architect

PUNCH LIST

Red - Open Issue
Orange - Complete for Review
Purple - Closed

COLOR CODE

Created a color coding system for coordination and for punch walks. The colors can be used to help identify or draw attention to specific issues.



IDENTIFY

Tagged the structural crack in orange for Structural to review through the link we provided. Once the tag is clicked, it can pull up a link directly to the RFI related to the issue.

TAKE AWAYS:



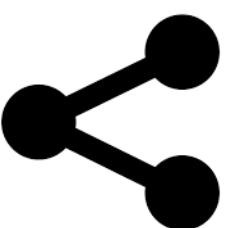
IDENTIFY:

- Color code systems helped us identify the issues and was useful to the project team



COORDINATE:

- We were able to coordinate the field issues with project team which saved them site field trips



SHARE:

- Ability to share issues in project team meetings which avoided site visits to the field



Learning Objective #3



LEARNING OBJECTIVE #3

Understanding The Importance Of Record Documentation



PROBLEM TO SOLVE:

- 3D Documentation
- Progression
- On-Boarding



IDEAS:

- Scanned a project area
- Waited for a few weeks to scan same area
- On – board a new team

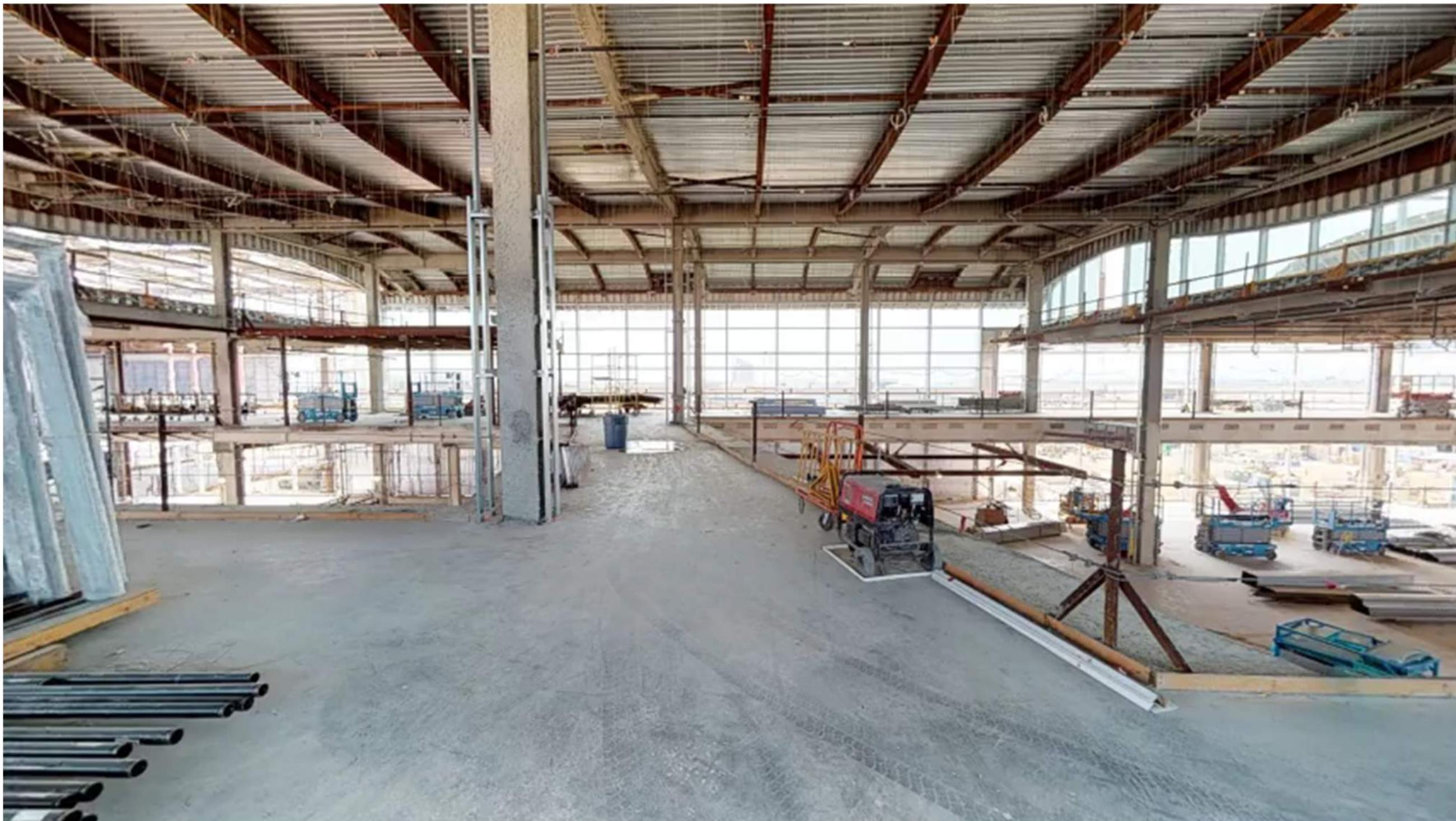


EXPLORATION:

- The second scan to show progress was new team
- Shared scans with new project team members

LAX- MSC PROGRESSION SCAN

CORGAN ■



<https://my.matterport.com/show/?m=Y7mw1u2dZxY>

CORGAN ■



AUGUST 2018

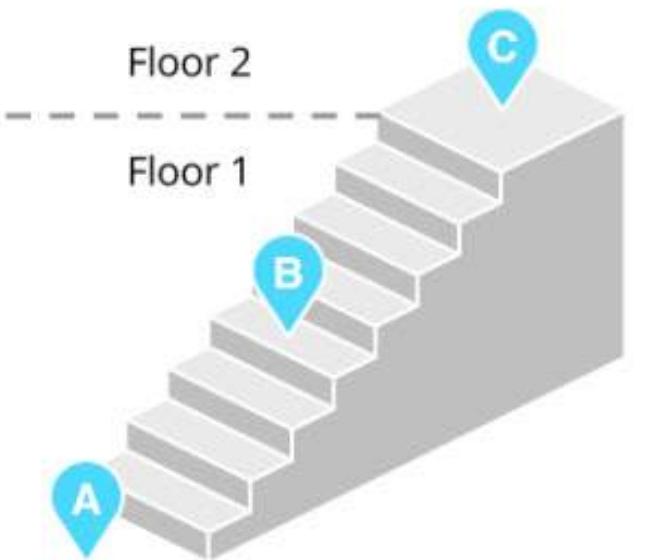
Captured the site conditions in the month of August



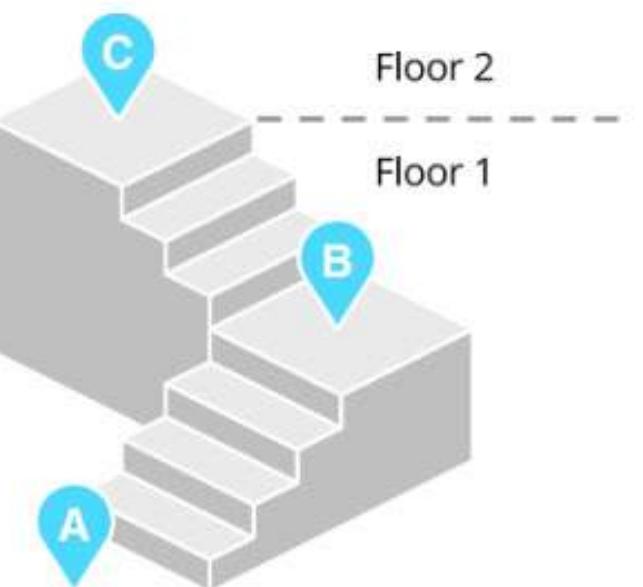
SEPTEMBER 2018

Capture the progression 4 weeks later. As you can see, plumbing for the restrooms has started.

MULTI- LEVEL PROCESS



Straight run (standard) stairs



Stairs with a simple landing



ON-BOARDING

New Users to the PROJECT TEAM:

- Ability to get new team members up to speed on the construction progress.

New Users to the SMART TEAM:

- Provided user guide to new users.
- Ability to have new users scan the project efficiently without assistance.



TAKE AWAYS:



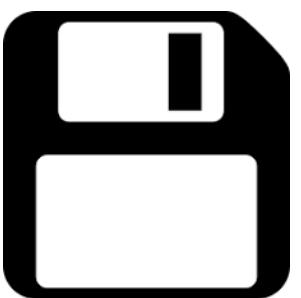
DOCUMENTATION:

- Multi-level scanning helps document and capture more accurately that area of scanning



PROGRESSION:

- Scanning bi weekly, construction progress can be seen in the multiple scans and shared with the project team or stakeholders to inform them of the progress



RECORD:

- Scans were able to be used for company documentation to be viewed as needed for current use or future use

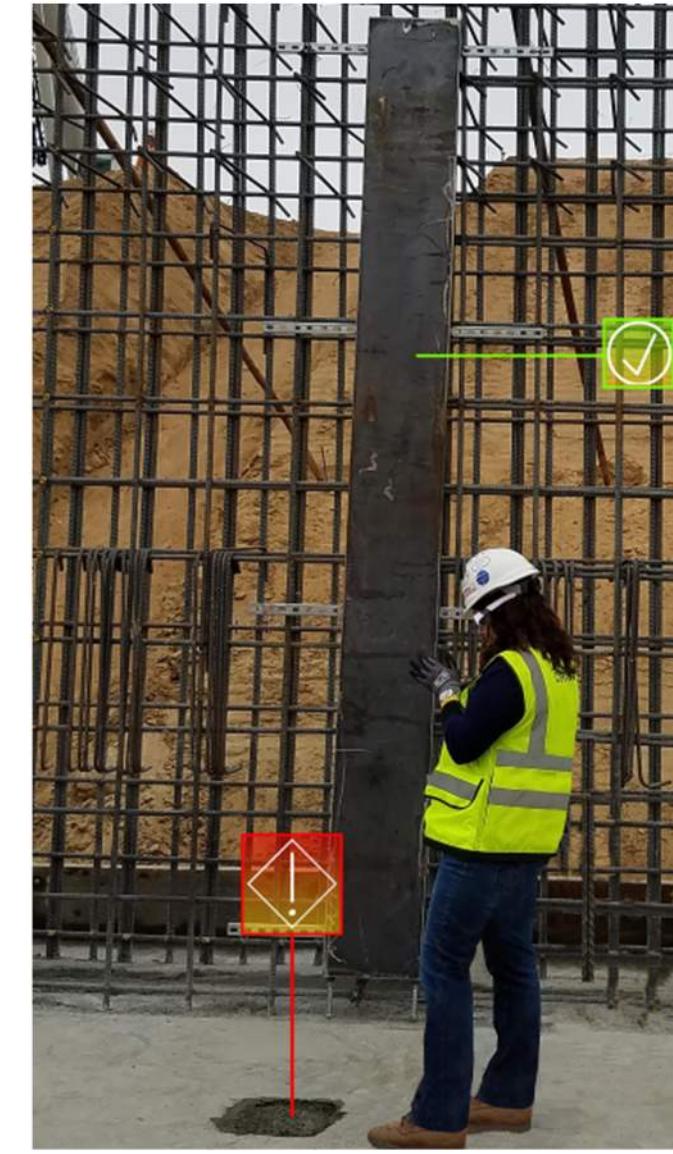


S.M.A.R.T. GLASSES

AUGMENTED CONSTRUCTION



DATA VISUALIZATION



REMOTE MENTORSHIP



SMART GLASSES DEMO

Learning Objective #4



LEARNING OBJECTIVE #4

Understanding The Importance Of Integration BIM 360 Models In Field Coordination



PROBLEM TO SOLVE:

- Verification
- Visualization
- Coordination



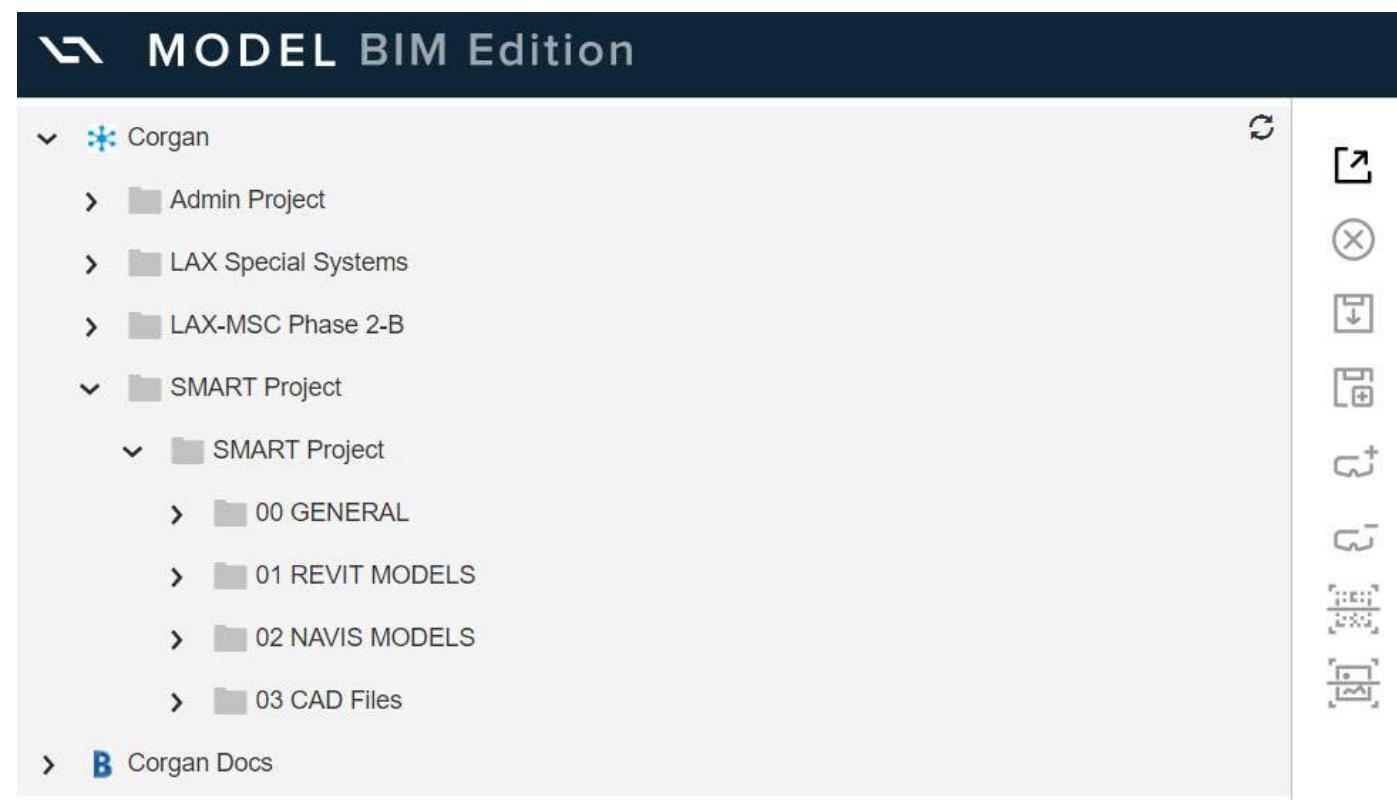
IDEAS:

- Compare the existing field conditions against the design models
- Find issues early through clash coordination before trades arrive on site



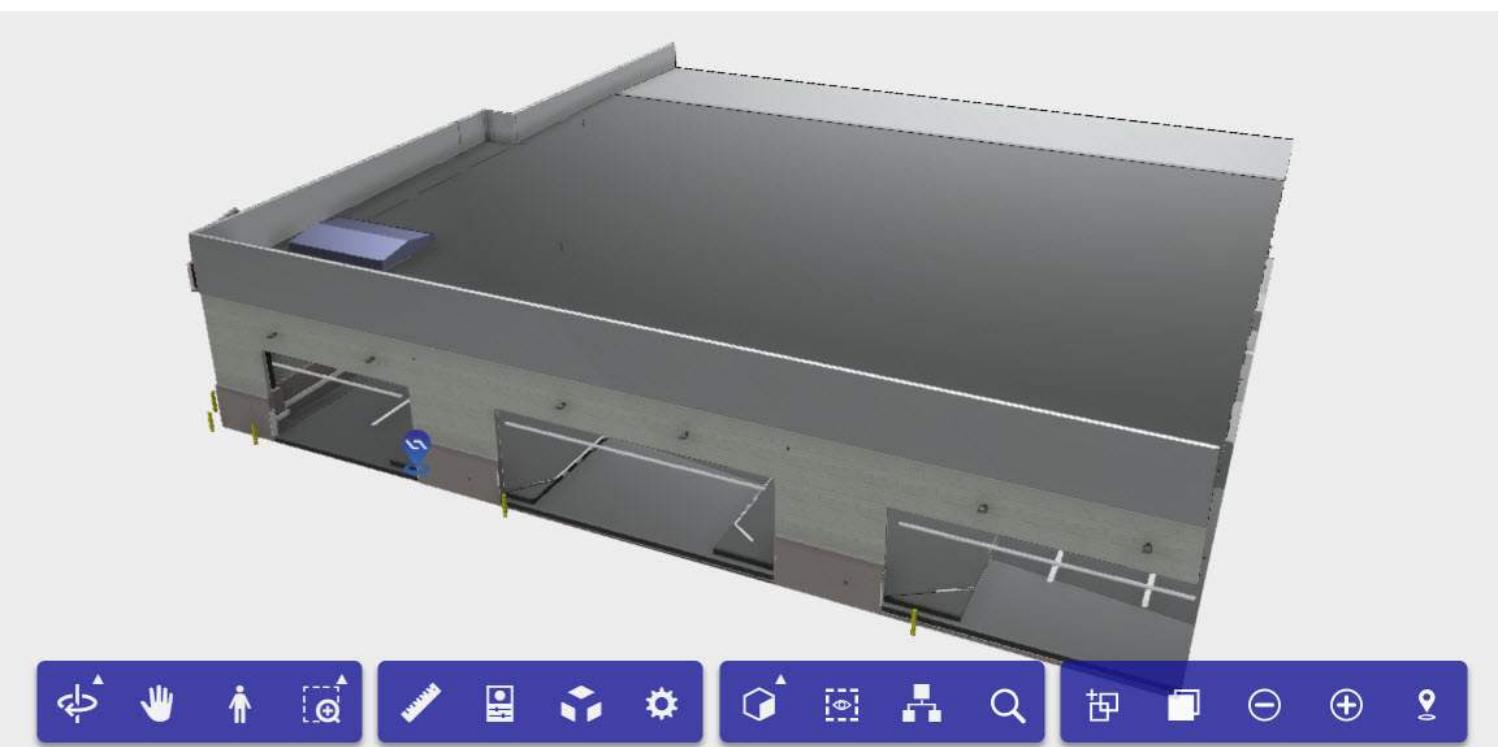
EXPLORATION:

- View the BIM model in the field
- Link the SMART glasses to Autodesk account



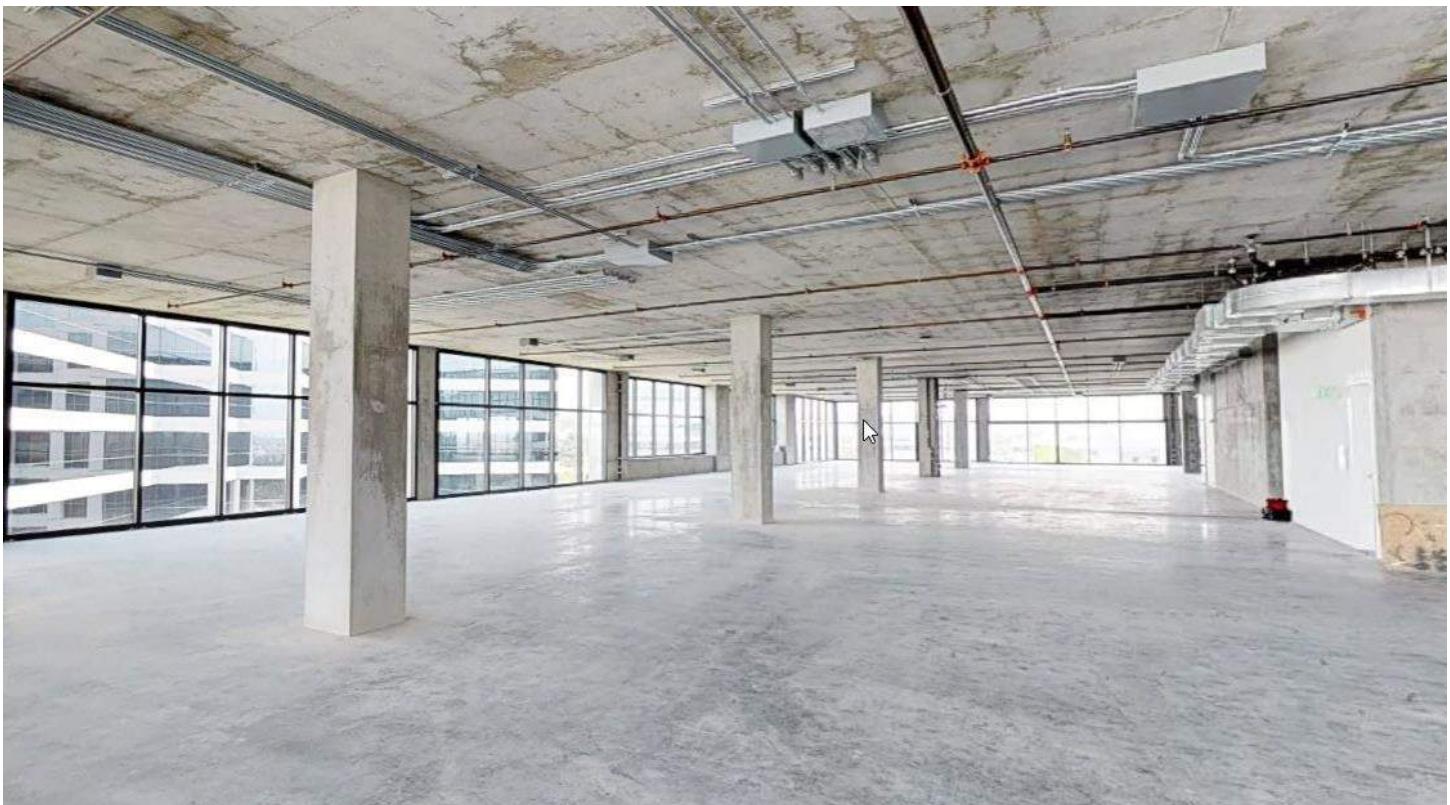
BIM 360 TEAM / DOCS

Using Forge, integrate your BIM 360 Team and Docs with the smart glasses interfaces



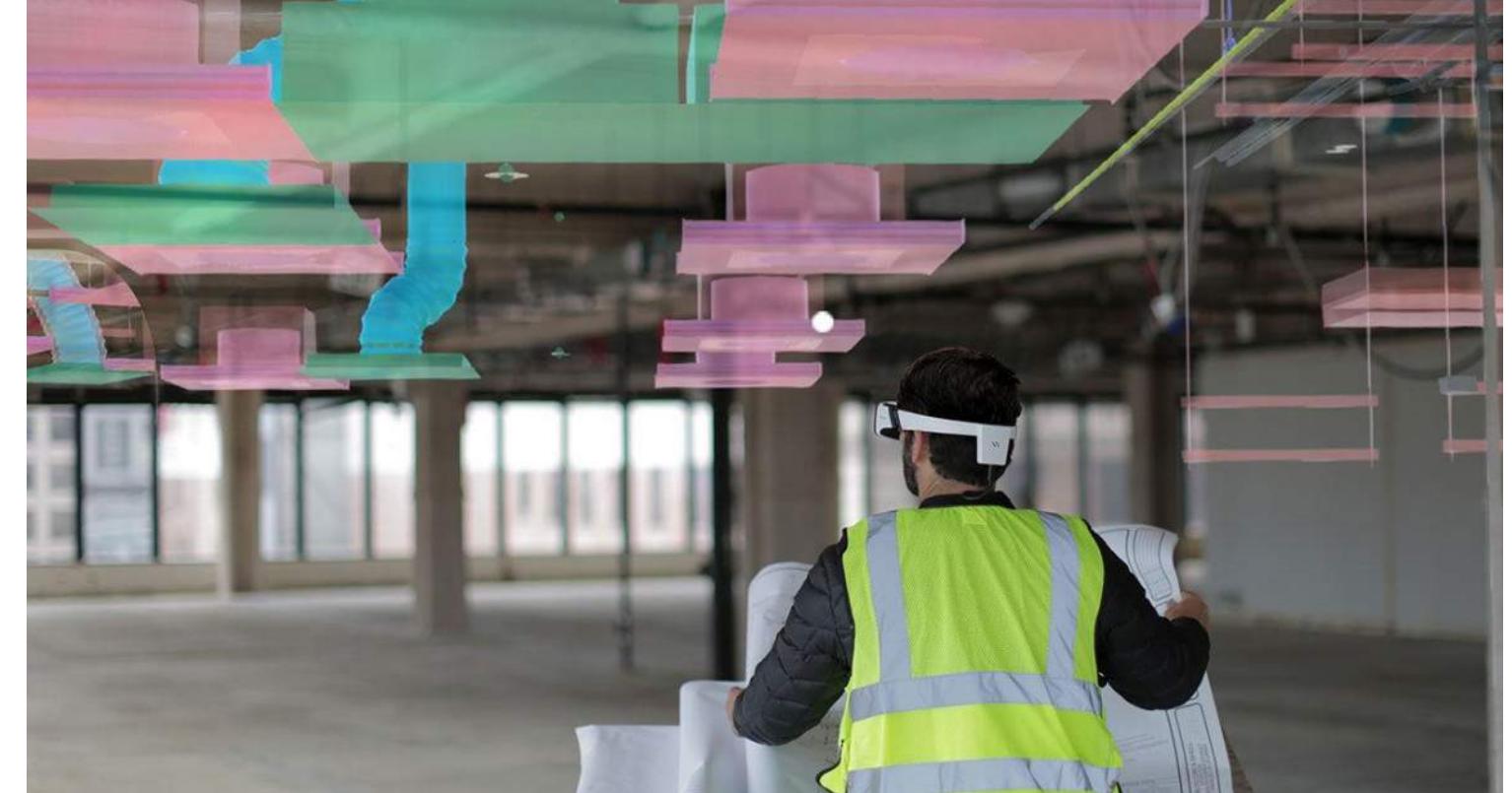
PUBLISH

After sectioning down portions of the models, you will want to create new scenes as shown above, set up landmark locator and then publish to the glasses.



CORE AND SHELL

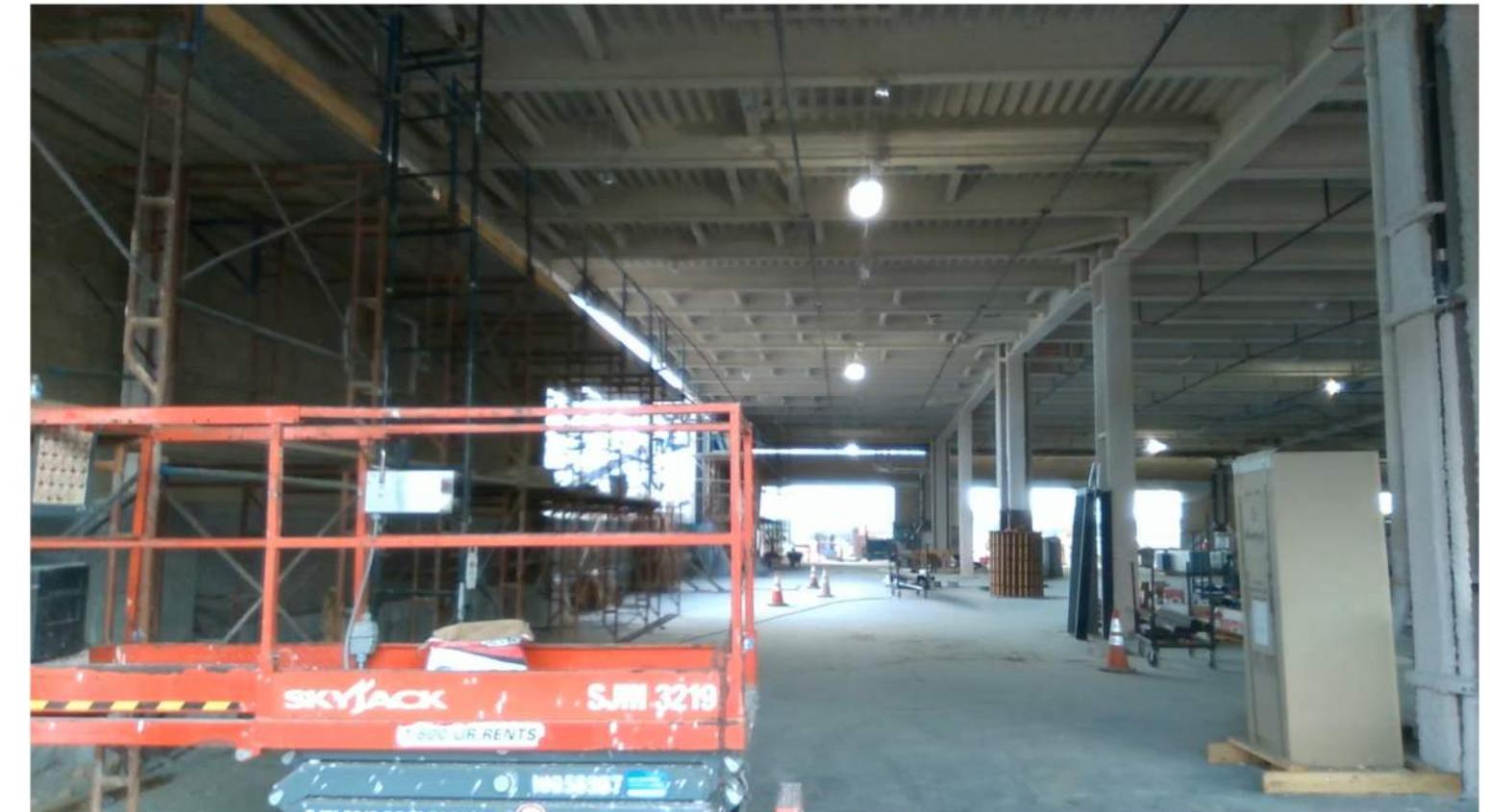
The core and shell complete for MEP and interior trades to began work.



BIM INTEGRATION

SMART Glasses can be used overlay BIM model with existing conditions. This can be used to catch clashes with existing structure or between trades.

LAX- NBHS SMART GLASSES AND PROJECT SITE



TAKE AWAYS:



REVIEW

- Comparing the virtual BIM model in the field to catch issues before final installation of equipment.



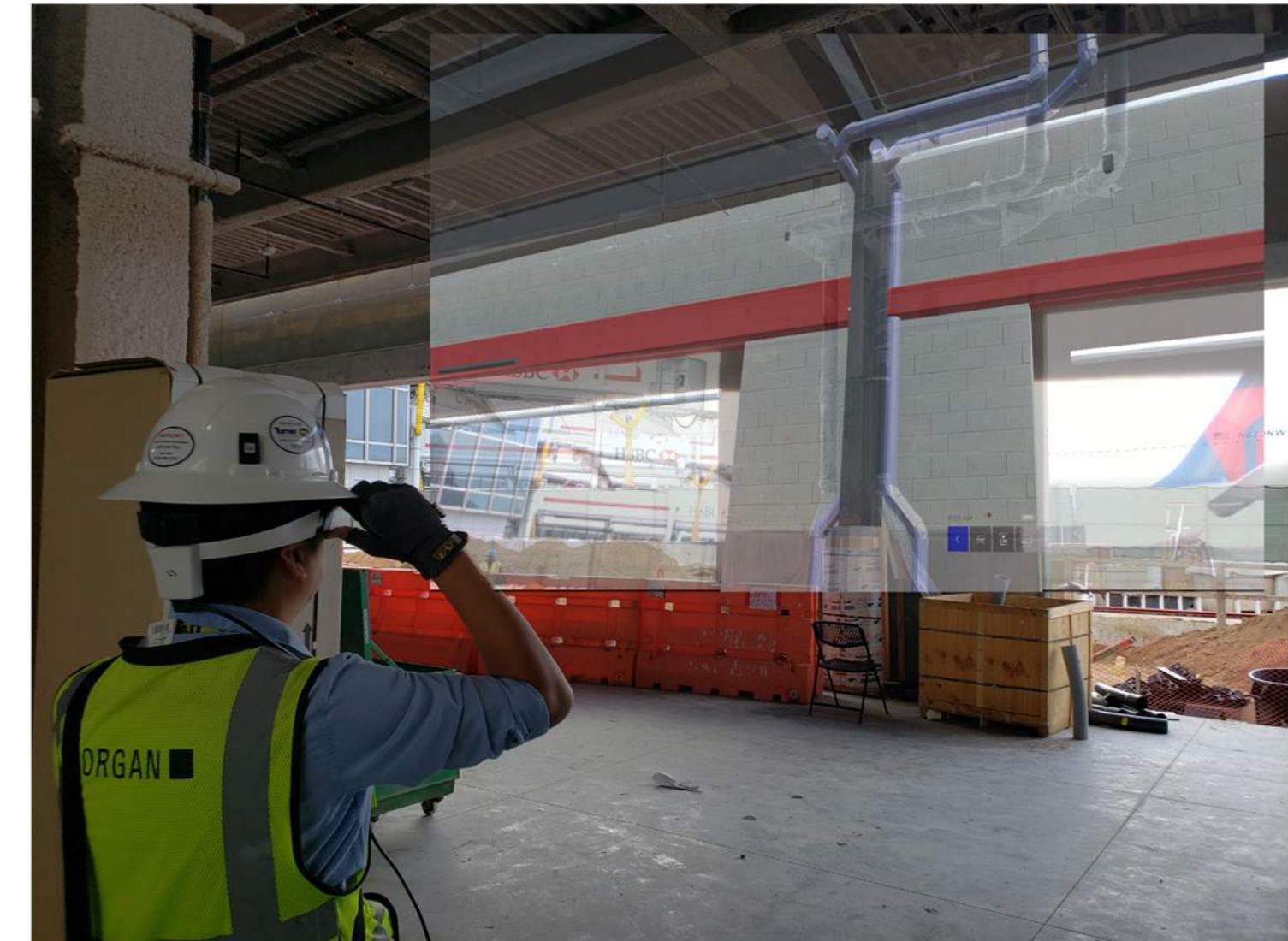
COORDINATION

- MEP trades were able to coordinate design models in the field



DOCUMENTATION

- Validates the design against the current as-built condition to prevent unforeseen conditions or issues.



Learning Objective #5



LEARNING OBJECTIVE #5

Understanding The Use Of Remote Work Assistance



PROBLEM TO SOLVE:

- Remote
- Inaccessible
- On - boarding



IDEAS:

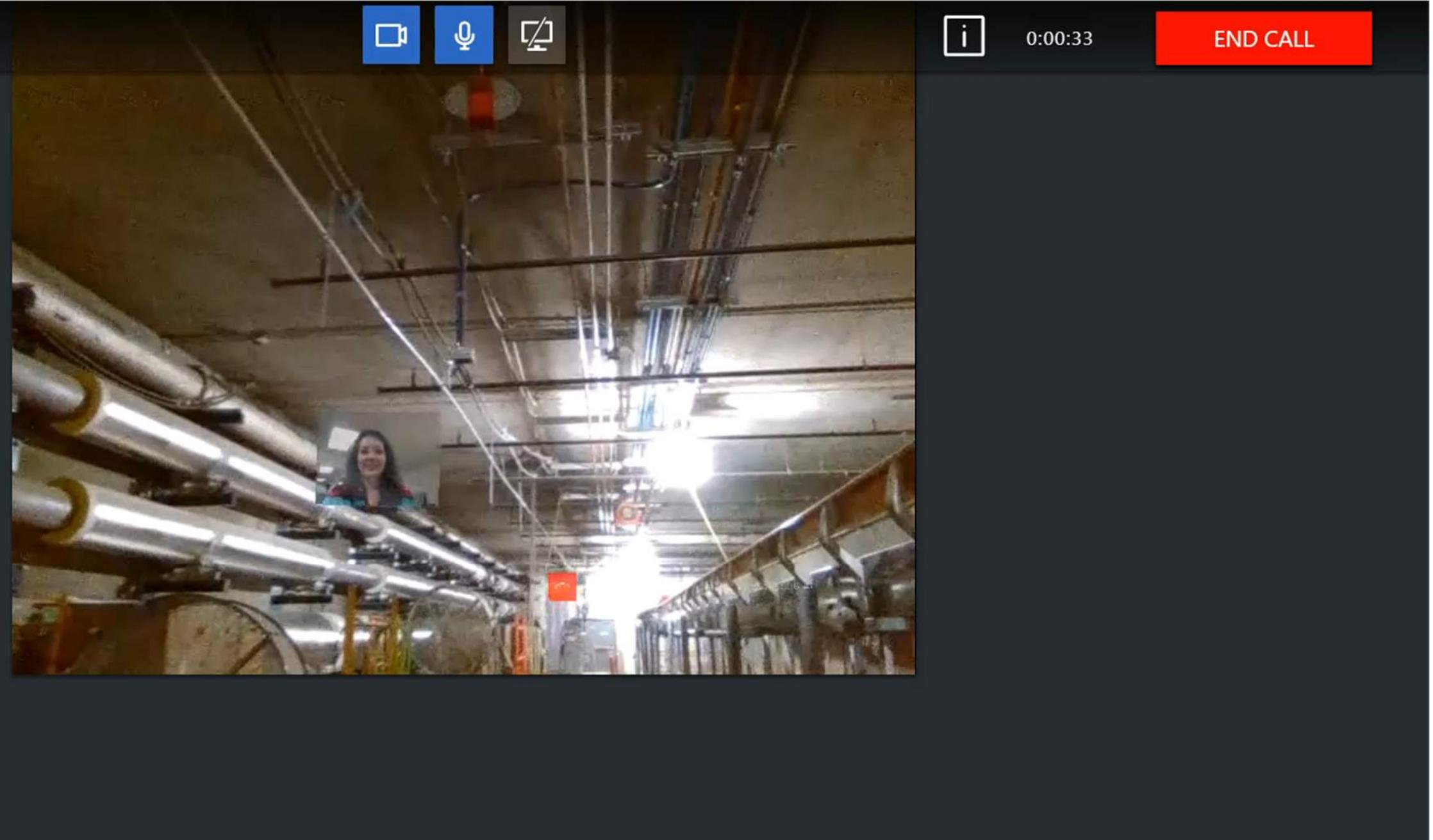
- Live stream from the project site with expert on the call
- Live stream with inaccessible co-worker
- Record to share for future on-boarding



EXPLORATION:

- Took glasses on site and remoted back to experts in the office as well as project team
- Live streamed on site and recorded from project office

LAX- REMOTE WORK ASSISTANCE

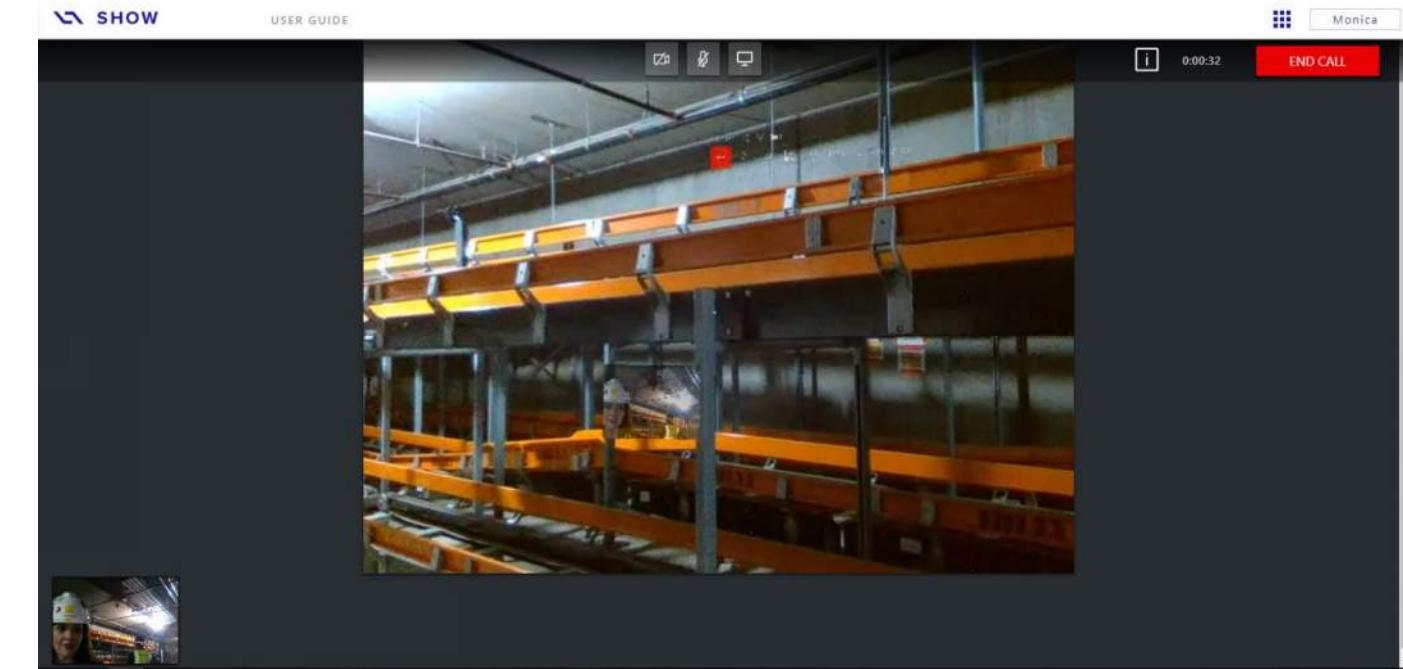


Incoming Call...



REMOTE WORK ASSISTANCE

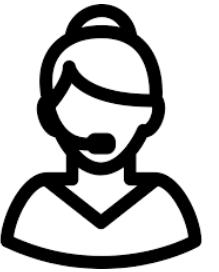
Was able to call in from project site to a team member or expert at an office



LIVE STREAM GLASSES

Was able to live stream thru the smart glasses with team members or expert at an office. Ability to record these sessions as well

TAKE AWAYS:



REMOTE:

- Remote expert work assistance from project team members or actual experts



LIVE STREAMING:

- Live streaming via the smart glasses so remotely can see the 3D models in conjunction with the construction project site



INACCESSIBLE:

- Remote work assistance for the inaccessible



Learning Objective #6



LEARNING OBJECTIVE #6

Understand The Benefits Of Data Visualization



PROBLEM TO SOLVE:

- Documentation
- Management
- Linking



IDEAS:

- Used Virtual Tags to mark issues on field walks.
- Link to open RFIs, drawing details, and additional images
- Track the progress of the issue



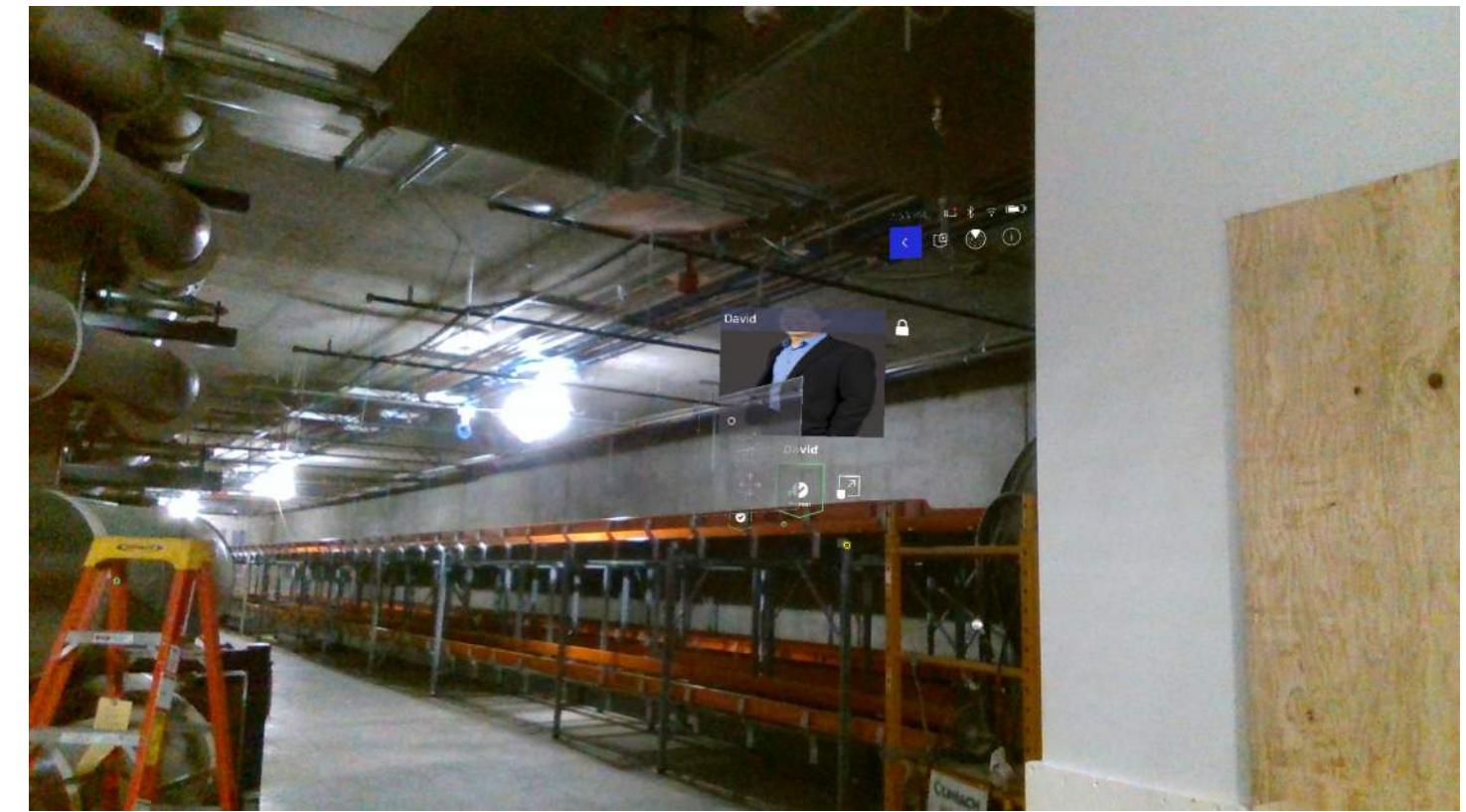
EXPLORATION:

- Created pre-designed template tags for use when out in the field
- At each issue, the team used one of the preset tags to mark the new-found issue.
- Back at the office, the tags were updated to provide additional information to the mark.



RUNNING TAG LIST

During long projects, issues can be collected, coordinated, tracked, and corrected instead of a typical project of fixing at the end.



COORDINATION

SMART Glasses use augmented reality to display external data that will be critical to construction, installation, or repair. For example, these tools can link to open RFIs, Product Data, Drawing Details, and sketches.

TAG WALK THROUGH



TAKE AWAYS:



VALIDATING

- External data can be extracted from real-world systems, and visually presented through an intuitive augmented reality display.



SUPPORTING

- Provide additional information and links to external sources for team to reference out in the field like construction drawings or sketches.



DOCUMENTATION

- Track issues and the progression of the repair in a 3D Virtual Environment. This data can be extracted, edited, and archived.



COST ANALYSIS

EXAMPLE PROJECT: DOCUMENTATION

COST ESTIMATE FOR CASE STUDY #3

Total Scan Time: 60 Min # Scans: 50 Area: 18,000 SF

Matterport Scan	People	Positions	\$/Hr	Additional Services	Final Cost
S.M.A.R.T. TEAM	3	<ul style="list-style-type: none"> • Senior Associate • Architect • Arch. Staff 	<ul style="list-style-type: none"> • \$180 • \$130 • \$120 	<ul style="list-style-type: none"> • Scan Processing - \$20 	\$450
PROFESSIONAL	1	<ul style="list-style-type: none"> • Professional 	<ul style="list-style-type: none"> • \$0.16 SF 	<ul style="list-style-type: none"> • Mattertags - \$65 • Cloud Host - \$45/year 	\$2,880
FUTURE CORGAN	1	<ul style="list-style-type: none"> • Intern Architect 	<ul style="list-style-type: none"> • \$120 	<ul style="list-style-type: none"> • Scan Processing - \$20 	\$140
			Total Saving		~ \$2,610

"This would be good for Stakeholder presentations"

"TIME IS THE BIG IMPACT FOR THE DESIGN TEAM. IT WILL BE MINIMIZING THE NUMBERS OF SITE VISIT ALONG WITH TAKING TIME FOR MEASUREMENT."

"I was impressed by how quickly the scanner processes the images and allows you to review on the iPad."



OWNER



CONTRACTOR



ARCHITECT



CONSULTANT



NEW USER

"It would help the punch list process if we could add another scan at the end which would be used to show completion of work, and verify repairs and remediation completed."

"this technology could increase efficiency of the individual completing a site visit / inspection"

More S.M.A.R.T, Less STRESS

QUESTIONS

THANK YOU

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DAN BERGHAUSER

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