

AS223632

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

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Learning Objectives

- Understand the efficiency of scanning as built conditions including overhead ceiling
- Understand the efficiency of punch lists through virtual documentation
- Understand the importance of record documentation
- Understand the importance of integrating BIM 360 models in field coordination
- Understand the use of remote work assistance
- Understand the benefits of data visualization

Description

Standard construction management technologies are an inefficient utilization of modern tools for coordination, documentation, and acceleration during construction. S.M.A.R.T technology allows efficiency and enables communication with the team anywhere in the world.

This class will showcase the case study of a \$1.6 billion airport project and how smart technology was implemented to streamline the construction process through Virtual and Augmented reality. Attendees will see first-hand how a 4K, 360 degree camera was used to scan and produce point clouds for existing conditions, virtually document punch lists and record imaging for archiving. In addition, attendees will learn how smart glasses were integrated with Autodesk BIM 360 tools to review 3D models in current field conditions while virtually collaborating with designers, engineers, contractor, and clients concurrently.

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AU Expert(s)

Monica Sosa, AIA Project Manager | Senior Associate

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Monica is a registered architect in the state of Texas and California. She studied Architecture at the University of Texas - San Antonio where she received her Bachelor's. Her interest in architectural technology started early with Revit 3.0 when she started exploring it at a small architectural firm. She later moved to a larger firm where she helped train and implement Revit firm wide. Monica is a Certified Professional in Revit Architecture. She has taught AutoCAD, Civil 3D and Inventor at a local technical college. With the knowledge of these software's, Monica became the lead design BIM manager on a large aviation project at Los Angeles International airport (LAX). She made her AU debut in 2017 with her talk in the AU Theatre on "Cities of The Future" with the topic of "Building in the Clouds". She spoke on the success of using cloud collaboration for a 1.2 million square foot expansion at LAX. Monica thrives on innovative technology and how it can streamline her industry.

Daniel Berghauser, AIA Architect

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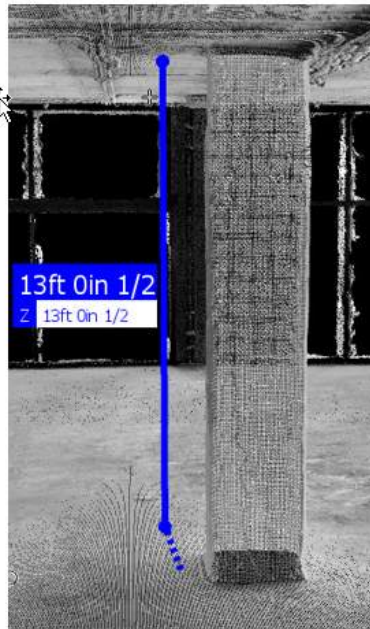
Daniel Berghauser is an experienced Architect with a demonstrated history of working in the architecture & planning industry with an architectural license in Arizona and California. Currently with Corgan since 2014, he is focused on aviation architecture in the Los Angeles area. He has worked on small scale tenant improvements to large scale new concourses at the LAX campus. Proficient in Revit, Navisworks, Rhinoceros, Sketch Up, Adobe Suits, and BIM 360, he has demonstrated a passion for design and technology through experiences as BIM Manager, AIA member, and advocate for SMART Technology.

S.M.A.R.T. CAMERA

VIRTUAL DOCUMENTATION



FIELD VALIDATION



COLLABORATION



OBJECTIVE 1A - As-built Existing Conditions

Preview Case Study Scan: <https://my.matterport.com/show/?m=G4dFi4HH4cV>



IMAGE 01A - 4K RESOLUTION AND 360 IMAGE SCAN OF MSC: UTILITY TUNNEL



IMAGE 01B - POINT CLOUD EXTRACTED FROM THE GEOMETRY IN THE SAME SCAN

Project Description

Currently under construction at Los Angeles World Airports (LAX), a new 1,235 LF Utility Tunnel will bridge between existing international concourse Bradley West to the new 12 gate Midfield Satellite Concourse, housing all the utilities for the new concourse as well as the first ICS baggage handling system in the United States.

The Utility Tunnel was the first portion of the phased project to be turned over to the client to install the baggage handling system. This made it the perfect test candidate to do an as-built scan for the client's use.



IMAGE 02: AS-BUILT TUNNEL FOR TURNOVER

Problems to solve

- **FIELD MEASURING** – With all projects turned over to a new designer, transferring the as-built conditions is the largest hurdle to starting the next step of designing. It is important to get accurate information to save time and money to prevent as many unforeseen conditions as possible.
- **VALIDATE** – It is important for quality control to ensure existing field conditions align with the design and construction models accurately in the current world of virtual design coordination.
- **COORDINATE** – With large teams of consultants and subcontractors, a need for efficient sharing accurate as-built conditions with project team to minimize site visits
- **SMART** – The construction industry is behind the technology curve in employing new tools. By utilizing the forefront of technology for the construction phase, it will make the overall team more efficient and engaged to deliver a better product.



IMAGE 03: FIELD VISITS AND MEASURING



IMAGE 04: SMART CREW SCANNING AWAY

Case Study

The Case Study's goal was to scan an existing condition after construction and share information with another project team to eliminate time and effort for an in-person site visit. The scan would need to provide a point cloud after the scan, so it could be verified against current design models. Also, the scan was used for future tenants use to start designing to the as-built conditions.

S.M.A.R.T. Process

- 46 Scans of the tunnel in **under an hour**.
- Scans were **processed in the cloud**. A link was sent to the local and remote project teams.
- Scan extracted raw data for a **point cloud** file.
- Raw data file was indexed in Revit / Recap.
- A RCP file was imported into Revit / Navisworks
- Point cloud was **validated to design models** and shared with tenant.

Recommended Project Use

- Projects that interface with existing buildings.
- Phased projects that will have turnover areas.
- Tenant Improvement Projects
- Recording turnover conditions

Takeaways



By scanning the as-built conditions, we were able to solve having to make numerous trips back to site



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



Point cloud overlay with design models helped us communicate with the tenants that the space built was validated to our design models and no unforeseen they will come across.



IMAGE 05: S.M.A.R.T. CAMERA IN ACTION



IMAGE 06: POINT CLOUD IN RECAP

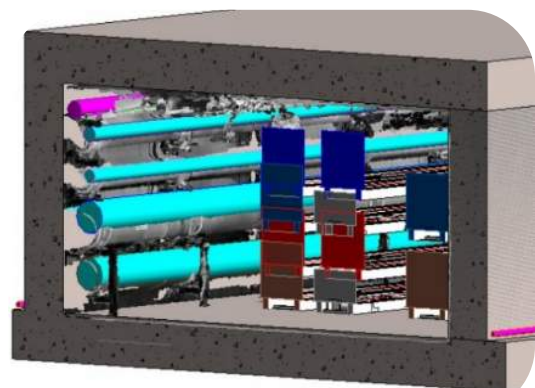


IMAGE 07: DESIGN MODEL OVERLAID WITH POINT CLOUD

OBJECTIVE 1B: Existing Overhead Ceiling

Preview Case Study Scan - <https://my.matterport.com/show/?m=a2BaHZt2suE>



IMAGE 08: 4K SCAN ABOVE CEILING WITH LAMP SHOWING IDENTIFICATION TAGS



IMAGE 09: 4K SCAN ABOVE CEILING WITH LAMP SHOWING MEASURING TOOL

Case Study

The Case Study looked at the capabilities of scanning above the existing ceiling to capture all existing building systems. Also, the scan needed the ability to measure and share with a larger project team.

Problems to Solve

- **VALIDATION** - Efficient way to validate as-built drawings with existing conditions in difficult to measure areas.
- **TIME-SAVING** - Minimizing trips backs to investigate existing conditions as investigations can be intrusive on active sites.
- **COORDINATION** - Share validation scans with project team that will utilize the overhead space.

S.M.A.R.T. Process

- Relocate necessary Acoustical ceiling tiles.
- Prop up the camera to the correct height with a headlamp attached for proper lighting.
- Complete scanning on the area and process up in the cloud.
- View scan in the cloud, identify building systems, and measure existing conditions as needed.
- Share scanning information with project team.

Recommended Project Use

- Projects with existing conditions
- Tenant improvements
- MEP coordination with existing systems

Takeaways




-  By scanning above the ceiling, the team was able to document all existing building systems and validate to the as-builts drawings provided by the client.
-  The scan was shared to the entire project team for coordination between consultants that needed to utilize the overhead space.
-  From the photogrammetry provided by the scan, the team could measure building systems and structural systems.



IMAGE 10: ADD LAMP TO SCANNER

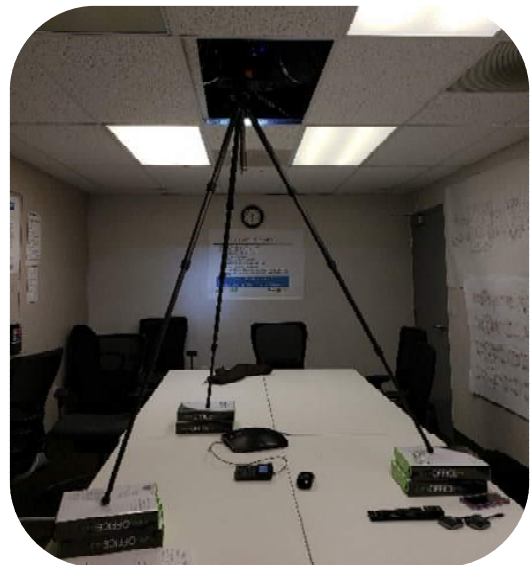


IMAGE 11: GETTING THE HEIGHT TO SCANNER

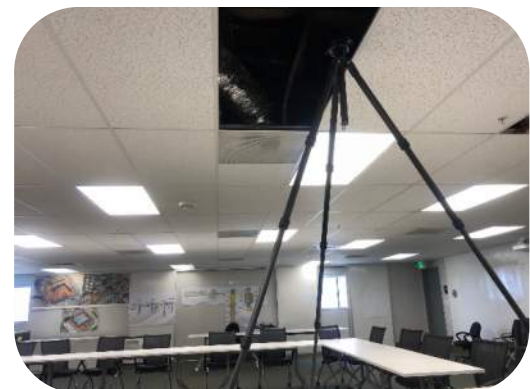


IMAGE 12: EASY TO RELOCATE

OBJECTIVE 2: Punch Walk

Preview Case Study Scan - <https://my.matterport.com/show/?m=G4dFi4HH4cV>

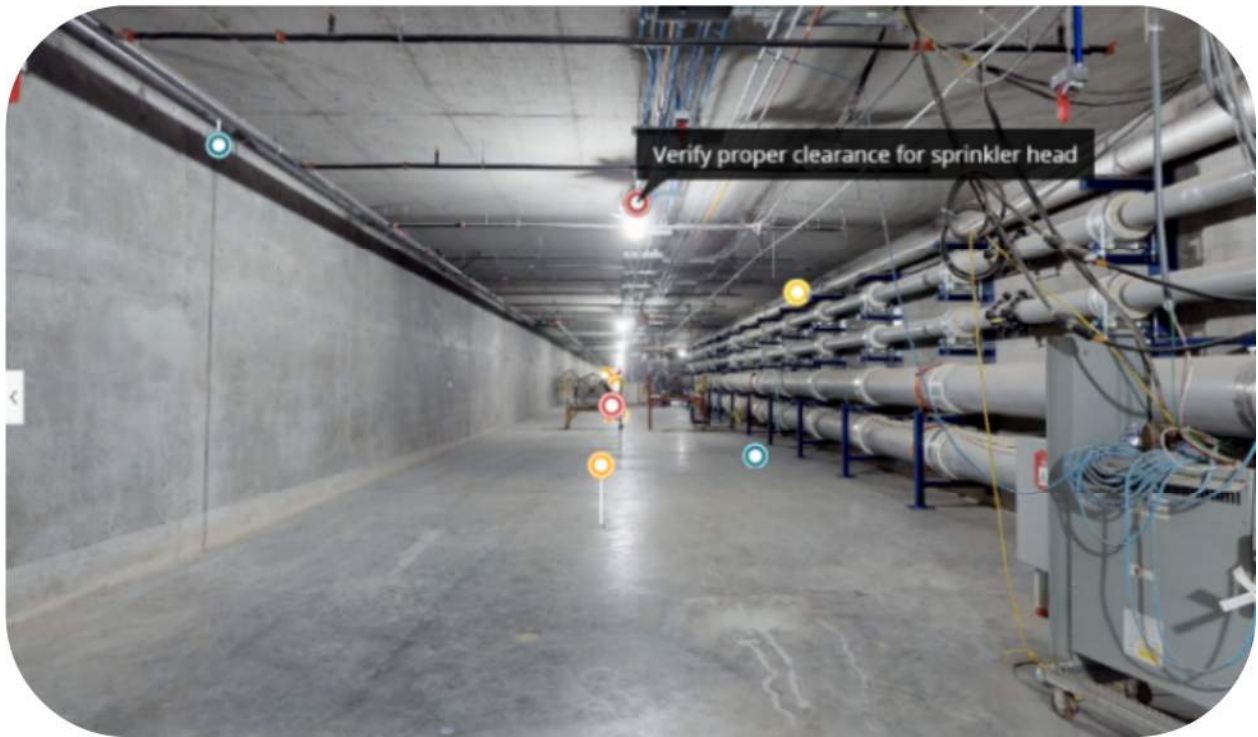


IMAGE 13: SHOWS PROCESS OF TAGGING THE SCAN WITH PUNCH LIST ISSUES

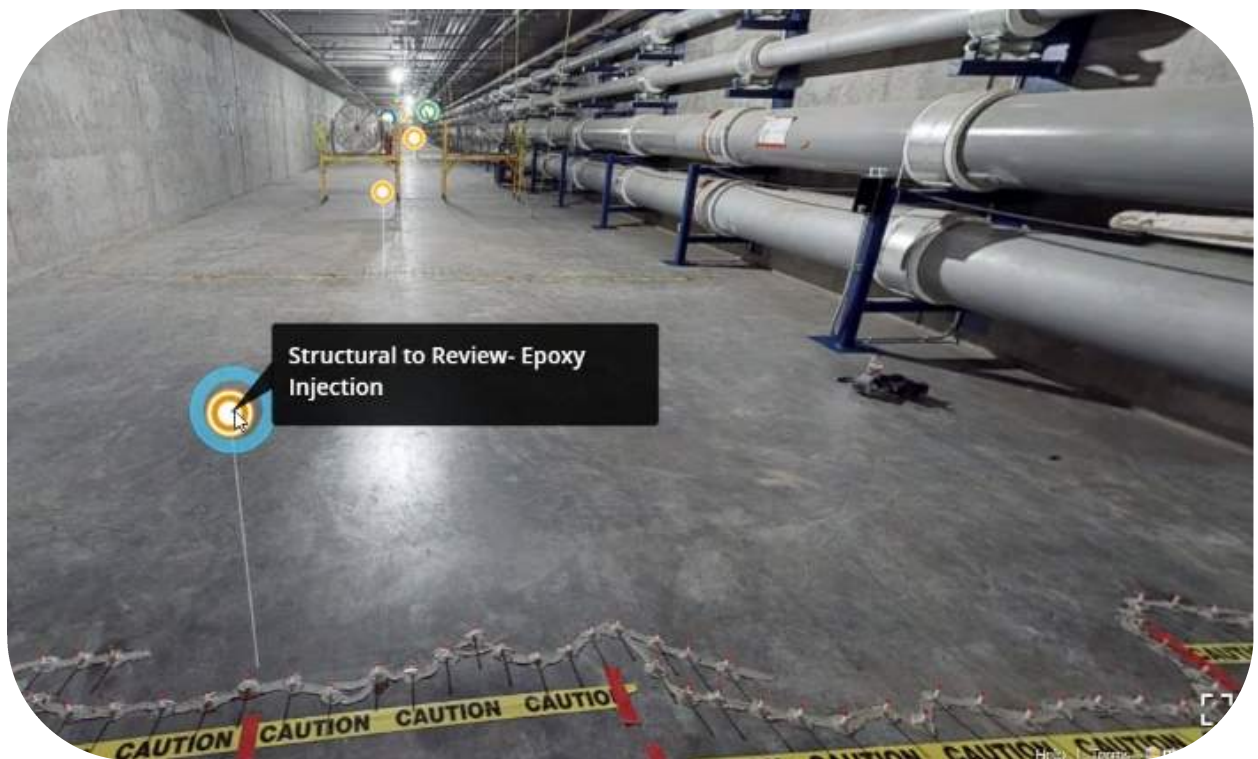


IMAGE 14: SHOWS PROCESS OF TAGGING THE SCAN WITH ISSUES FOR CONSULTANT REVIEW

Project Description

At LAX, the new 1,235 LF Utility Tunnel that bridges between an existing international concourse (Bradley West) to the new Midfield Satellite concourse. This tunnel is the first portion of the campus project to be turned over requiring the architects to prepare for a “punch list”.

Problems to Solve

- ORGANIZATION - Document field issues and share to project team without them having to make a site visit
- 3D DOCUMENTATION - Punch walk items and share with project team

Case Study

The Case Study consisted of scanning as-built conditions, so issues can be tagged. The Issue Tags served as punch walk items shared with contractor for review. Also, Coordination Tags were used to define field clashes between consultants and marks were used for the remote team to review.

SMART Process

- The area to be turned over/coordinated was scanned under an hour and Cloud processed.
- Workshop was used in the cloud to virtually mark with color-coded tags in a 3D space.
- Scan link with tags was sent out to project team to share issues to coordinate.

Project Use

- Any large project with planned large punch lists or wants to do a running punch list.
- Projects that are phased, fast tracked, or have partial turnovers.

Takeaways




-  Color code systems helped us identify the issues and was useful to the project team.
-  We were able to coordinate the field issues with project team which saved them site field trips.
-  Ability to share issues in project team meetings which avoided site visits to the field.



IMAGE 15: SMART PROCESS IN EFFECT

COORDINATION MATTERTAG CODES

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

PUNCH LIST MATTERTAG CODES

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

IMAGE 16: COLOR CODE LEGEND

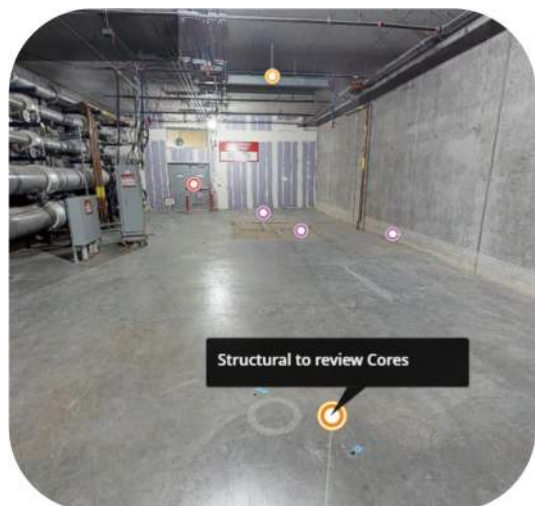


IMAGE 17: COORDINATION TAG

OBJECTIVE 3: Documentation

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



IMAGE 18: DOCUMENTATION ON 08/10/2018



IMAGE 19: DOCUMENTATION ON 09/07/2018

Project Description

The Midfield Satellite Concourse (MSC) is a new 12-gate terminal addition to the Bradley West International Terminal. The MSC will serve an increase in demand for international gates.

Problems to Solve

- DOCUMENTATION - Ability to document project for record documentation and for future use
- PROGRESSION – Ability to document the progression and share with project team
- ON-BOARDING – New team members can view previous scans

Case Study

For this case study, we wanted to document the progression of construction to have as our record documents. We also tested scanning multiple levels. In addition, we wanted to have a new user go back a few weeks later to capture not only the progression but their document their time for scanning an area for the first time.

SMART Process

- Scanned a 16,000 SF area of the project with 68 scans which took 90 minutes
- Waited about 4 weeks to bring out a new team to document their ability to learn the process and to also document the construction progress in that month
- Shared with project team and saved for future use

Project Use

- Any project for documentation
- Projects with tenants
- MEP Coordination

Takeaways



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



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



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



IMAGE 20: SMART PROCESS IN EFFECT



IMAGE 21: MULTI LEVEL PROCESS



IMAGE 22: NEW USERS

S.M.A.R.T. GLASSES

AUGMENTED CONSTRUCTION



DATA VISUALIZATION



REMOTE MENTORSHIP



OBJECTIVE 4: Integrating BIM 360 Models In Field Coordination

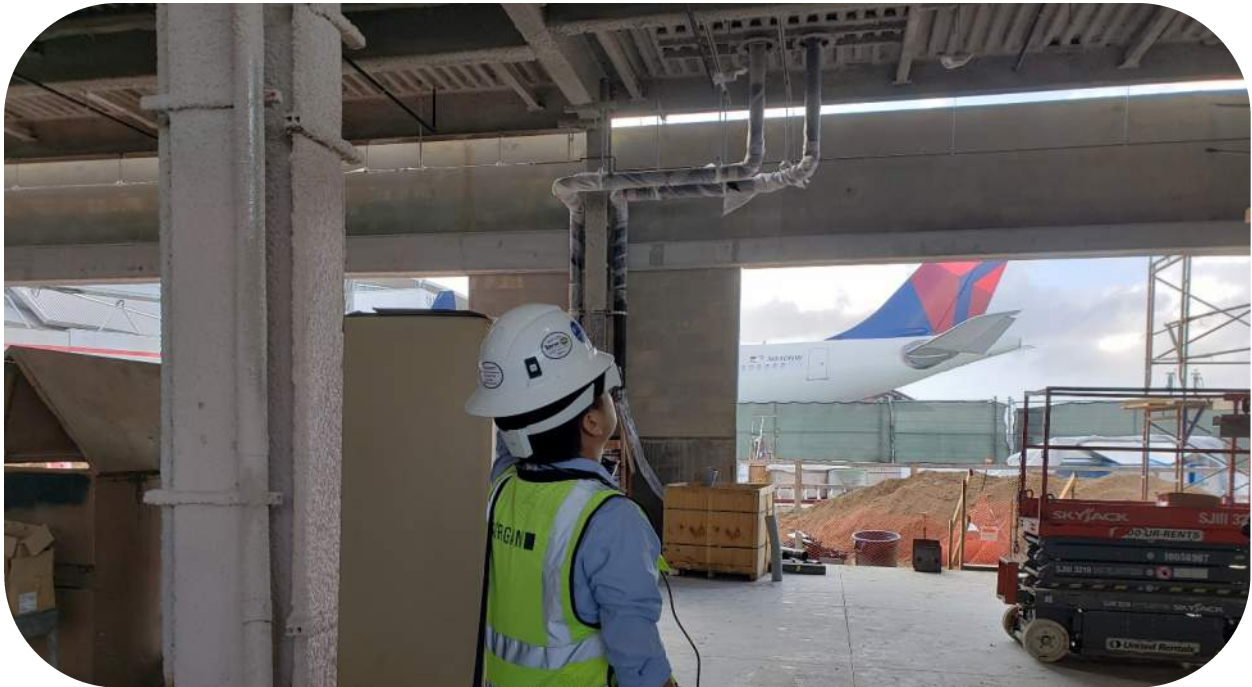


IMAGE 23: NORTH BHS BUILDING- DAVID REVIEWING THE BIM 360 MODEL IN FIELD



IMAGE 24: : NORTH BHS BUILDING- DAVID COORDINATING THE BIM 360 MODEL WITH FIELD CONDITIONS

Project Description

North Baggage Handling Structure is part of the LAX Midfield Satellite Concourse project campus. The multi-level building will handle the first US ICS BHS system with 16 sort piers for outbound baggage and Early Baggage Storage.

Problems to Solve

- VERIFICATION - Ability to compare the 3D design model to field conditions accurately.
- VISUALIZATION – Ability to show the design intent in a 3D environment to the contractor or client.
- COORDINATION – Ability to compare designs of multiple trades in a 3D area.

Case Study

For this case study, we wanted to compare the existing field conditions against the design model in a 3D review, unlike the standard way of using 2D drawings. This would help find issues early through clash coordination before trades arrive on site.

SMART Process

- Uploaded the Revit Model to BIM 360 Docs for DAQRI to access. Set the Landmark location.
- Linked the SMART glasses to Autodesk account and opened model on site. Scanned landmark to orient 3D model on project site.

Project Use

- Any project in Construction
- Projects with existing conditions to verify
- MEP Coordination

Takeaways



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



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



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



IMAGE 25: VIEWING 360 MODEL IN SMART GLASSES



IMAGE 26: AUGMENTED REALITY



IMAGE 27: TEAM SETTING LANDMARK

OBJECTIVE 5: Remote Work Assistance

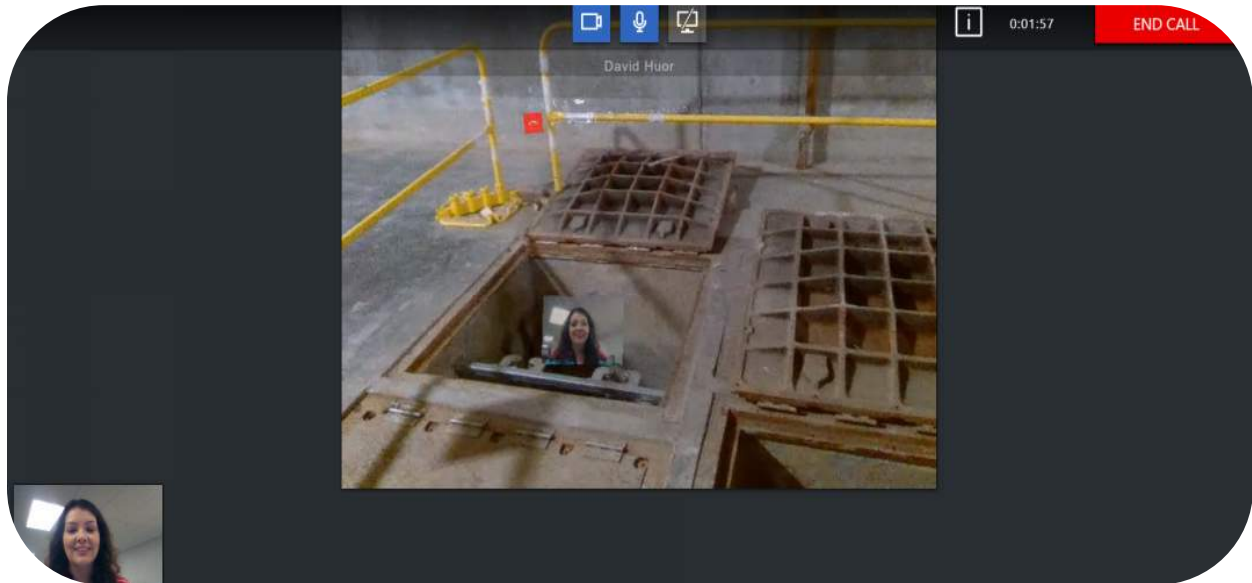


IMAGE 28: SHOW- REMOTE FROM OFFICE

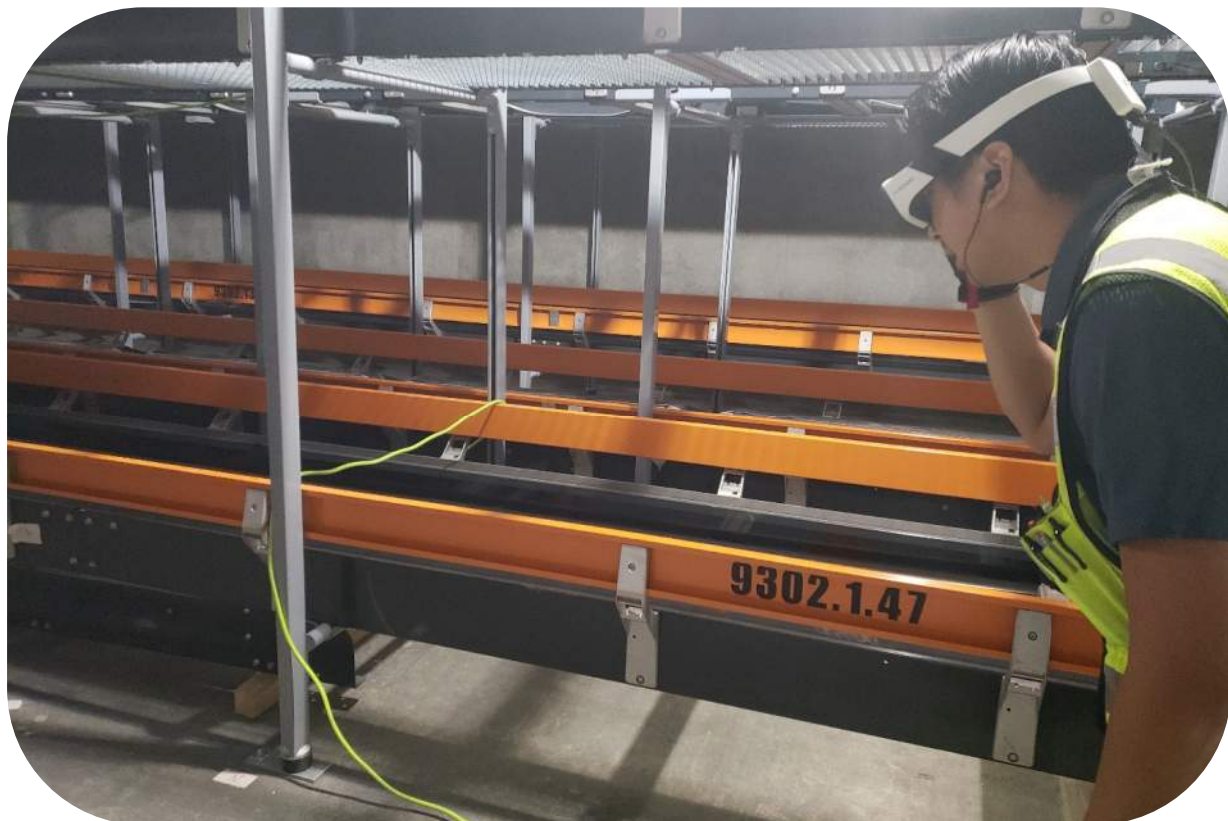


IMAGE 29: SHOW- REMOTE TO PROJECT SITE

Problems to Solve

- REMOTE – Ability to bring in expert experience without having to bring them out on site.
- INACCESSIBLE – Those injured that are not able to wear the proper safety gear
- ON-BOARDING – Record Training videos

Case Study

For this case study, we wanted to be able to live stream from the project site to an expert at an office as well as our project team. In addition, we wanted to be able to record to share for future on-boarding

Smart Process

- Set up Show with contacts
- Smart glasses on Wifi
- Visit project site
- Call in expert or have them call in
- Live stream

Project Use

- Any new project
- Any existing project

Takeaways



Remote expert work assistance



Live streaming



Remote work assistance for the inaccessible

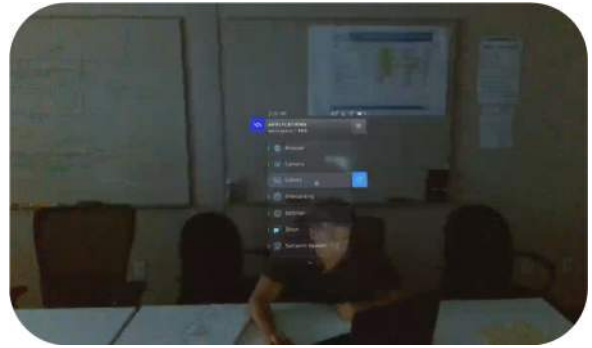


IMAGE 30: SHOW- LIVE STREAMING



IMAGE 31: SHOW- CONTACTS



IMAGE 32: SHOW- EXPERT

OBJECTIVE 6: Data Visualization

IMAGE 33: RUNNING PUNCHLIST WITH DATA TAGS

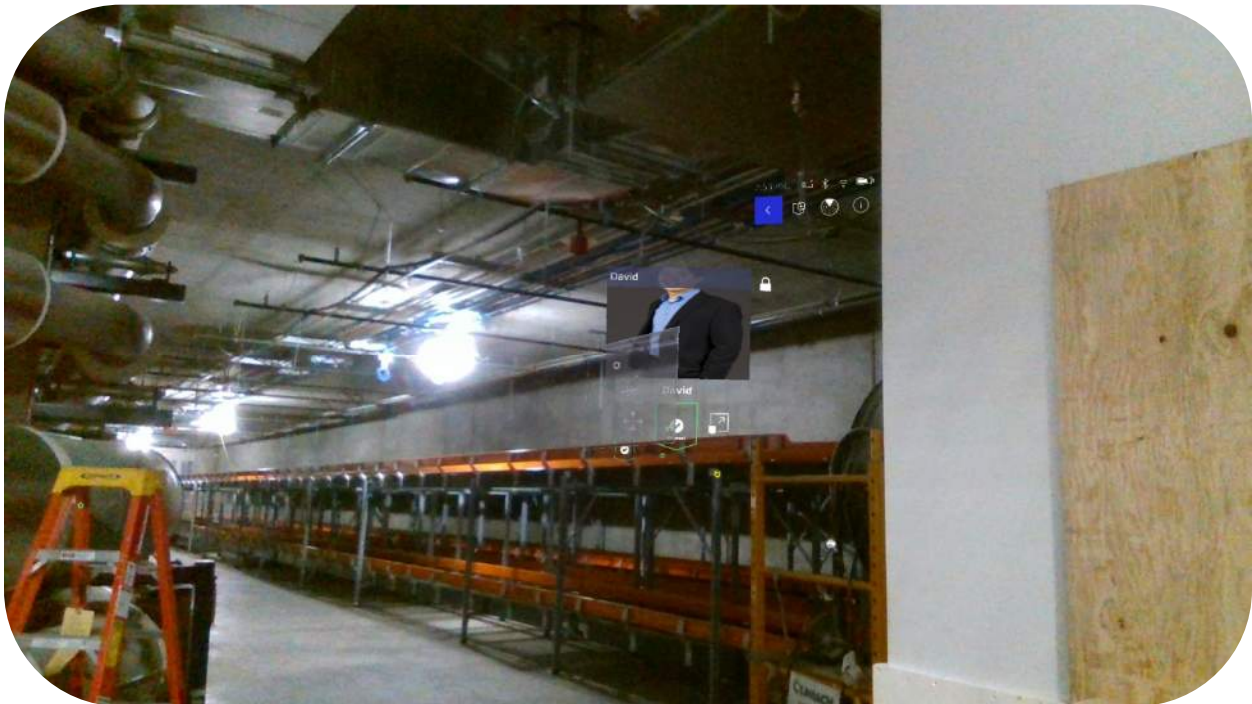


IMAGE 34: MSC TUTL PROJECT WITH TAGS FROM DAQRI GLASSES

Project Description

At LAX, the new 1,235 LF Utility Tunnel that bridges between an existing international concourse (Bradley West) to the new Midfield Satellite concourse. This tunnel is phased to be under construction for 2.5 years. Maintaining a running list of issues is important for tracking over this long construction time.

Problems to Solve

- DOCUMENTATION - Ability to document project issues for record and for future use
- MANAGEMENT – Ability to set the status of tags to monitor the progress of systems.
- LINKING – Ability to provide critical information, documents for in field use.

Case Study

For this case study, the team used Virtual Tags to mark issues on field walks. These Tags linked to open RFIs, drawing details, and additional images. Each tag had a status for the team to track the progress of the issue.

SMART Process

- Set up a project and created pre-designed template tags for use when out in the field.
- On each field walk, the team set the landmark for each walk, so the glasses could orient the project. 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.

Project Use

- Any phased project
- Long construction schedule
- Project including Facility Management

Takeaways




-  Documenting issues and the progression of the repair in a 3D Virtual Project. Tagging can be used to track open issues.
-  Providing additional information and links to external sources for team to reference out in the field.
-  Tagging live with the team to immediately review and see tags instantaneously and concurrently.



IMAGE 35: DATA TAGS ON SITE

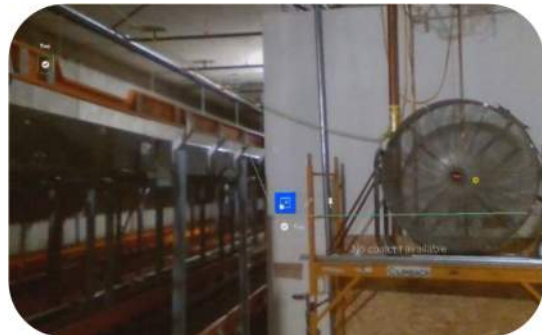


IMAGE 36: DATA TAG SHOWING INFORMATION

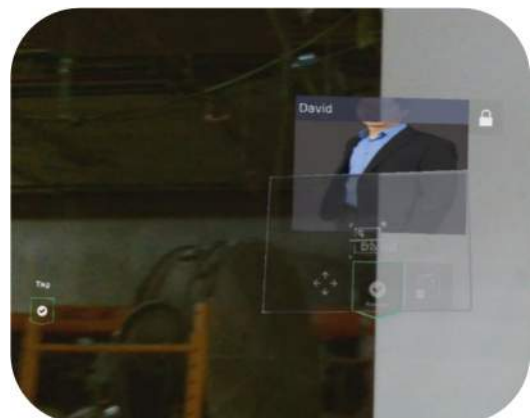


IMAGE 37: TAG VISUALIZATION