

CS323778

Applications of Augmented Reality Integrations for Construction and Design

Allison Yanites
Arcadis

Anna Figueroa-Soldner
Arcadis

Learning Objectives

- Describe three different AR solutions for design and construction
- Recognize how AR can minimize cost, improve collaboration, and transform how we experience information
- Identify multiple types of hardware and software that can support AR solutions for design and construction
- Understand lessons learned from applying emerging technologies on active projects

Description

Emerging technologies, such as augmented reality (AR), reality capture, and wearable technology, are reducing project costs, improving communication and collaboration with remote teams, and allowing us to experience information in a way never possible before. In this presentation we will share experiences from a large natural and built asset firm in how we are using AR to deliver enhanced value to our clients in multiple ways: 1) hands-free remote communication and documentation; 2) 360-degree reality capture; and 3) on-site, full-scale AR design visualization. Attendees will learn the workflows for each application and value captured by clients and staff. Our examples include integrations with Revit, Navisworks, BIM 360 and utilization of hardware and software like Microsoft HoloLens, Realwear HMT-1, 360-degree cameras, VisualLive, Librestream Onsite Connect, and HoloBuilder.

Speakers:

Allison Yanites

Allison Yanites is the Immersive Technology Lead at Arcadis, North America, where she collaborates with global leaders to advance immersive technology (AR/VR/MR) solutions across design and consultancy work in infrastructure, building, water, and environmental industries. These solutions include on-site AR design visualization, hands-free remote assistance, 360-degree virtual asset data models, mobile AR, and VR design visualization. Allison is focused on identifying and implementing immersive and wearable technologies to create intuitive and interactive experiences for our project teams, clients, and stakeholders to improve communication, collaboration, understanding, and health and safety. In addition to immersive

technology, she is a subject matter expert in the area of 3D data visualization. She has extensive experience creating 3D visualizations of complex datasets. Allison holds a B.A. in in Geology from Hamilton College and a M.S. in Geosciences from the University of Arizona.

Anna Figueroa-Soldner

Anna Figueroa-Soldner is a BIM Coordinator for Arcadis North America, in their Toledo, Ohio office. She obtained her Bachelor's and Master's degree in Architecture from Savannah College of Art and Design, in Savannah, GA. She worked in the Architectural field for 11 years, but her career path took her into the BIM Coordination and management direction. Her main focus is on coordinating multiple disciplines while working in REVIT, Navisworks, Civil 3D and BIM 360. She helped in the office transition from CAD to BIM and continues to help implement and develop standards, template creation and mentoring new REVIT modelers. She is now applying AR/VR/MR to her projects to assist in the design process and during construction.

Overview of Augmented Reality Technology

Augmented Reality (AR) superimposes digital information in a user's view of the real world, allowing you to see real and digital worlds together. These new tools reduce the need for travel, streamline how you access and interpret data, and allow you to remotely analyze a project's progress. In this presentation, we will present three types of AR technology, all of which combine reality + digital in different ways.

1. **Remote Expert:** field-to-office videoconferencing
2. **Reality Capture:** capture and augment reality with 360-degree photo virtual site tours
3. **3D Design Visualization:** view an overlay of full-scale 3D-design in real-world location

Value

Across different uses of AR technology, we consistently see the following value added:

- Increased safety
- Cost reduction
- Speed of decision-making
- Enhanced stakeholder communication

1. Remote Assistance

Connect field and office staff through live videoconferences with features to annotate live-video with augmented reality.

Why

- **Increased safety:** Teams can quickly and safely identify and mitigate safety concerns or complete safety assessments. Hands-free headsets for field personnel provide a safe way of communicating while being able to walk, work, and wear PPE (gloves, safety glasses, hardhat).
- **Cost reduction:** Replace costly and time-consuming physical site visits with virtual site visits.
- **Speed of decision-making:** Connecting a team of office and field staff via videoconference supports efficient and thorough communication of site risks, issues to discuss, questions, change in conditions, etc. in a single call.
- **Enhanced stakeholder communication:** Participants in a video call can 'be' at the site virtually, participating in a discussion as if they were there. Virtual site visits offer stakeholders a new way to learn about and interact with the site.

How

Librestream Onsite Connect is one example of a software to create this experience. Anyone joining a call needs to have a username/login for the Onsite Connect App as well as the App downloaded onto any phone, PC, or supported hands-free device. Once setup is complete, field or office staff can place calls to any available contacts. With the ease of making a phone call, remote staff can feel like they are on-site – able to see clearly and thoroughly the site conditions as if they were there.

Key Features of Onsite Connect

- Real-time video collaboration
- Annotate real-time video with augmented reality text, shapes, and arrows
- Capture in-call high resolution pictures
- Share documents
- Group calls (e.g., 5 users from across the world can join in a call)
- Floating licenses offer flexibility to share between project team individuals
- Security: no data stored in the cloud; captured pictures/video are saved on local devices
- Hands-free 'Realwear' headset: Waterproof, dust-tight, drop-proof, PPE compatible

Technology Limitations

- Remote Assistance requires a Wi-Fi connection for the caller in the field (cell phone hot spots work well, but cell coverage is variable)
- Requires downloading the app (*there are options to avoid this)

Link to Librestream Onsite Connect: <https://librestream.com/>



Remote Assistance connects field and office staff, supporting in-call AR markups and photo capture (photo source: Librestream Onsite Connect).

2. Reality Capture

Capture, organize, and augment 360-degree photos to create a virtual site model.

Why

- **Increased safety:** Virtual site models allow whole project teams to visit the site virtually, minimizing risk of staff visiting the site in-person who are less familiar with site hazards. Virtual access to the models also increases number of project team members who can identify or resolve risks present on site. Virtual site models can also be used as Health and Safety guides, or for safety training.
- **Cost reduction:** 360-degree photos capture the site so thoroughly, it's possible to replace some costly and time-consuming physical site visits with virtual site visits.
- **Speed of decision-making:** Any decisions about construction progress, issues, safety, etc. can be understood quickly and clearly by viewing the site model virtually. Project team members can track and communicate issues in the virtual site model, making the model a collaborative project platform.
- **Enhanced stakeholder communication:** 360 photos don't leave any part of the picture missing! Stakeholders can check in on construction progress on their own schedule – completing a virtual site visit from anywhere, anytime.

How

HoloBuilder is one example of a software to create this experience. Using a mobile app (“Jobwalk”), field personnel capture and place photos relationally on a site plan. The capture process is quick and simple, and as soon as the project is synced to the cloud, all new images and markups are available to the project team to review (in almost real-time). The project team and stakeholders have access to a virtual model similar to ‘google street view’, where the viewer can self-navigate from one photo to the next, virtually walking through a project site. The virtual model can be augmented with digital information, 3D design, and synced with BIM360 for issue tracking – making the virtual site tour a shared workplace for the project team and stakeholders to collaborate.

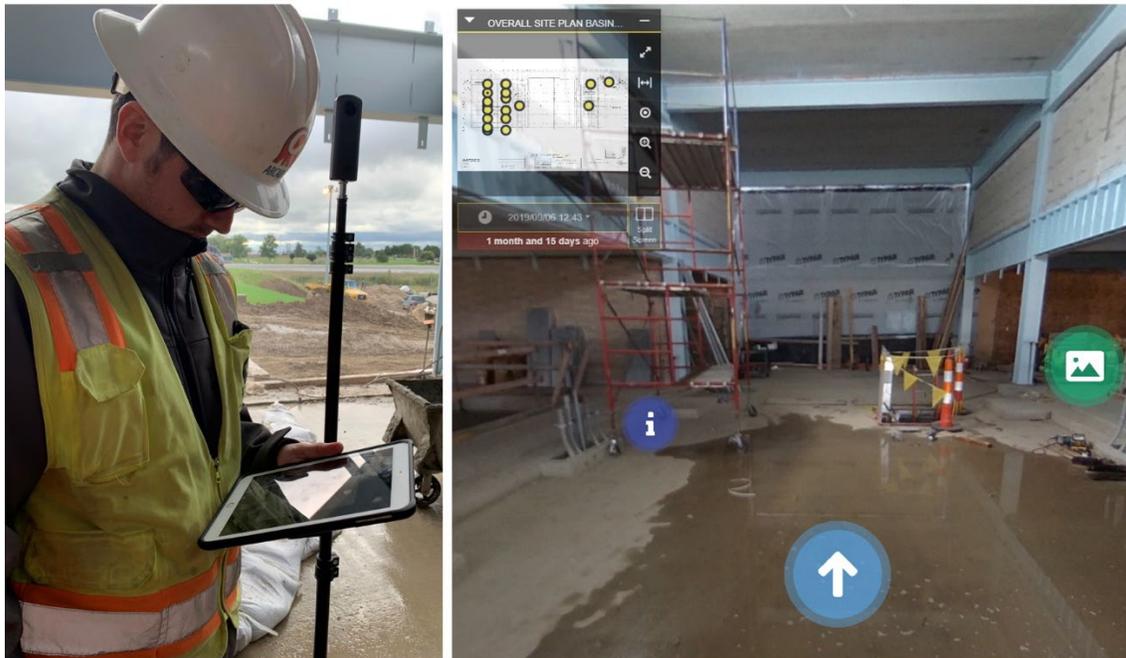
Key Features of HoloBuilder

- Unlimited photos within space
- Mobile app makes field capture streamlined
- Augment photos with text, drawings, PDFs, 2D photos, 3D objects, video, and weblinks
- Measurement tools
- Integrate 3D model from Revit or Navisworks into HoloBuilder project
- Split-screen mode supports viewing time-lapse photos and/or 3D models side-by-side
- View HoloBuilder portal on any PC, mobile device, or compatible VR headset
- Option to download final product for archiving
- Integrations: BIM360, Revit, Navisworks, Google Maps, and more
- SpeedMode automates photo capture at pre-defined locations, using augmented reality technology to track your location on the project site to ensure photos are taken at the same location each time.

Technology Limitations

- Consistent height and spatial placement of camera at each collection point (“waypoint”) relies on field personnel to measure height of camera and placement of photo location.
- Calibration of camera can affect photo orientation (but photo orientation can be modified after capture within HoloBuilder)

Link to HoloBuilder: <https://www.holobuilder.com/>



Capture and augment photos in the field; entire team can have a virtual site visit anytime, from anywhere.

3. Design Visualization

View 3D designs in augmented reality (mobile devices) or mixed reality (HoloLens): full-scale digital models positioned accurately in their real-world positions.

Why

- **Increased safety:** Safety features can be evaluated in 3D models by viewing and placing 3D models digitally in their real-world space prior to construction work beginning. AR offers the ability to walk around and interact with a full-scale digital model that no other technology can.
- **Cost reduction:** New quality assurance tool for inspectors to detect and resolve issues quickly, minimizing rework and associated costs.
- **Speed of decision-making:** Issues can be understood and communicated clearly – by viewing the digital model onsite, or by capturing a photo or video of the AR overlay to distribute to the project team.
- **Enhanced stakeholder communication:** AR visualization offers stakeholders a new way of seeing, understanding, and experiencing designs.

How

VisualLive is one example of a software to create this experience. A plugin available for Revit, and Navisworks (and some additional formats) converts models into AR models that can be loaded at full-scale, positioned to align with real-world conditions (or downsized to view at tabletop scale). Viewed in full-scale, a user can walk through the site with digital information draped over real-world surroundings or a user can use the technology to simulate walking through the site from anywhere (e.g., an office setting). In addition, while walking through the model, users can interact with the digital features to access and visualize asset information. VisualLive has an app for viewing AR models on the Microsoft HoloLens (HoloLive), and an app for viewing models on a tablet (MobiLive). AR 3D design visualization can be applied across multiple stages of a project lifecycle, including planning, QA/QC of a 3D model, construction management, operation and maintenance tasks, facility management, and remote or on-site training opportunities.

Key Features of HoloLive/MobiLive

- “See the unseen” (not-built, asset information, behind drywall)
- Locate and verify assets
- Flexibility to visualize with the HoloLens or a mobile device
- Capture and share photos, videos
- Issue tracking connected to BIM360
- Measuring tools
- Turn model layers on/off to isolate specific model layers for optimal on-site visualization
- Options to adjust (and save) alignment, and account for model drift across a larger area
- Sync AR models to HoloLens or mobile device to view in offline mode

Technology Limitations

- Viewing 3D models on the HoloLens offers the most realistic, 3D experience of the 3D model – but the HoloLens is difficult to see outside or in brightly lit areas. HoloLens also requires more training to learn to use.
- Viewing 3D models on a mobile device makes it easier to view the model collaboratively with one or more people and can be viewed in brighter conditions – but you are viewing a 3D model through a 2D screen.
- VisualLive is optimal for workflows from Navisworks or Revit.
- HoloLive and MobiLive are intuitive apps to use, but typically require more training to get a new user familiar with using the technology 'out of the box'.
- Models may need to be re-aligned in the field to perfect the alignment. There are options to save that adjusted alignment for future site visits.

Link to VisualLive: www.visuallive.com



With HoloLens or iPad, view digital 3D designs overlaid in the real world.