DESIGNING NEW REALITIES

FOR THE BUILT ENVIRONMENT

AN **EXCLUSIVE REPORT**
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VIRTUAL AND AUGMENTED REALITY PRESENT OPPORTUNITIES TO IMPROVE EVERY STAGE OF A BUILDING PROJECT'S LIFECYCLE.

Earlier this year, Anthony Cortez, who leads visualization for Arup's North and South America region, went to downtown Los Angeles to capture a 3D scan of a site where the architecture firm is working on a museum expansion. The city shut down due to COVID-19 shortly thereafter, leaving the project team unable to access the site.

But technology provided a workaround: Cortez used his scan to create a virtual model of the building that designers can access on their laptops, allowing them to continue their work without interruption. "We're able to still go out there and visit the site and talk about the details of the project—virtually," Cortez said.

The global health crisis has given new urgency to finding solutions that allow AEC professionals to access sites remotely. But the industry's investment in virtual experiences isn't new, nor is it limited to a single technology or use case. Firms have been steadily building these capabilities over the past decade—and tantalizing new breakthroughs lie just over the horizon.

Arup engineers explore a model of a kitchen space in the Immersion Lab. Credit: Arup.

VR, AR, MR, XR

Virtual reality (VR) is one component of extended reality, or XR: an experience that uses technology to combine the real and digital worlds. XR also encompasses augmented reality (AR), which layers digital content onto the real world—think Pokémon Go or Snapchat Lenses. A third technology, mixed reality (MR), integrates virtual objects (e.g., holograms) into real spaces.

VR, AR, and MR are in different stages of evolution and market penetration, and their definitions and lines of demarcation can get somewhat blurry. Taken together, however, there's no question that they offer exciting possibilities for every stage of a building project. As the hardware and software powering these technologies improve, and as designers develop creative new uses, XR is increasingly becoming integrated into AEC workflows.

"A MASSIVE LITERACY CAMPAIGN"

Within the last few years, VR, in particular, has become common at large firms. According to Megan Lubaszka, an associate at global architecture firm Gensler who works extensively with the technology, clients now expect architects to use it on their projects—so much so that failure to discuss VR capabilities during the proposal phase could cause firms to lose commissions.

When talking about VR, Lubaszka often references a medical condition called aphantasia: the inability to conjure up mental imagery. Aphantasia afflicts only a small percentage of the population, but the general concept is all too familiar to architects, who often struggle to help clients and stakeholders understand their design vision. "We work in three dimensions," she said. "But when it comes to communicating that design product, for thousands of years we've had to communicate it in two dimensions."

Some major retail brands—stores or banks with hundreds of locations, for example—pay contractors to build full-scale models of their proposed spaces for architects and clients to tour during the design process. After the walk-throughs are complete, the faux rooms are demolished, and the foam used to construct them is thrown away.

But as VR has gained traction in the AEC industry, costly, material-intensive physical mockups are becoming less common. At Gensler, all projects are now modeled in VR. Clients weigh in on design options by donning headsets and immersing themselves in digital models.

"I think this is the same as a massive literacy campaign," said Lubaszka. "For clients to be able to just borrow your brain for a second to see the space, it's like people being able to read for the first time, and not just relying on someone else telling them what was in a contract they signed."

Large firms like Gensler with dedicated visualization teams aren't the only ones using VR to communicate with project stakeholders. Companies throughout the AEC industry hire communications consultants like Theia Interactive and SONNY+ASH to develop immersive VR environments that help them share ideas with non-specialists.

"Ultimately, you're relying on the visuals, be it a rendering or a VR experience, to really be the only item in an entire presentation that the average person may understand," said Mike Gajdorus, a vice president at SONNY+ASH. "Floorplans,

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> **MEGAN LUBASZKA**
> Associate, Gensler

Customers at Arup use VR technology to design virtually and collaborate with teams globally. Credit: Arup.

Arup's Travis Rothbloom conducts AR site-investigation research, with the view from his headset shown below. Credit: Arup.

drawings, elevations, all the technical stuff—the average person may not understand all of that."

Gajdorus cites the example of a senior living developer that commissioned a VR experience to showcase the different kinds of rooms available in an upcoming building. To help the developer achieve its goal of attracting tenants who would stay for longer than the standard year or two, his team created a model that allowed prospective residents to customize their spaces by viewing different options for finishes such as paint, flooring, and backsplash, complete with pricing information for each.

NEW OPPORTUNITIES FOR PROJECT TEAM COORDINATION

Beyond client communication, VR can also help AEC professionals test and refine their ideas as projects evolve.

"What we're able to do in creating these photorealistic visuals really allows designers to go back and look at their design. And the blessing and the curse with VR is you get to see absolutely everything," Gajdorus said. "So that does require designers, and our clients, to really flesh out all those details as well." Over the course of a typical VR project, the architectural design usually goes through multiple iterations, he said.

Not long ago, team collaboration via VR was cumbersome due to the difficulty of syncing AEC software with technologies that originated in the video game industry. But over the past few years, a robust ecosystem has developed to help designers take advantage of VR's potential. Startups like Trezi, IrisVR, and InsiteVR now offer plug-and-play solutions for linking software such as Revit, Navisworks, and SketchUp to VR.

"The challenges of bringing heavy BIM data into VR have largely been solved. Now the focus has shifted to connecting geographically dispersed teams to design buildings together—conceptually—or for collaborative design review," said Greg Corke, founder of UK-based building information modeling (BIM) publication AEC Magazine. "A fully immersive experience with a VR headset offers an unparalleled sense of scale and immersion, but wider teams can also participate using a tablet with an AR window into the model."

At Gensler, before COVID-19 drove the firm to implement working from home, Lubaszka had hosted more than 80 VR

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Jams—weekly informal gatherings in which firm staffers and invited guests from around the globe meet in virtual space to tour a project model. The jams aren't structured as design reviews per se, but they often result in helpful advice from fellow designers—a natural consequence of bringing together people with a diverse set of experiences and perspectives. "Say you're in the London office and you're walking through a design that the Tokyo office has done. You can give them feedback they wouldn't have gotten from their normal colleagues," Lubaszka said.

At Arup, a purpose-built space in the New York City office allows experts from different backgrounds to come together in a VR environment to understand how various parts of a design relate to one another. For a project that involved rethinking New York's Grand Central Station subway stop—a high-traffic, spatially complex space—internal experts gathered in the Immersion Lab to step into a model of the station, gaining a visceral understanding of the proposed acoustics, lighting, and signage systems.

"Getting the whole design team inside this Immersion Lab allows them to have collaborative conversations on the current design of the project, because there's certain things that you may miss when you're viewing things from a traditional site plan or elevation drawing," said Cortez. For example, the ability to view the design at scale from different heights might reveal that visitors using wheelchairs would be unable to see important wayfinding signage. "Being able to experience all of that before the actual construction phase of the project allows us to be able to recognize certain problems that might appear."

CONSTRUCTION AND BEYOND

VR can also help AEC professionals troubleshoot problems after construction has begun. Travis Rothbloom, a security and BIM engineer at Arup, has been developing AR applications that allow designers to access a project's BIM model virtually during site visits, enabling them to ensure that the design is being built according to the project team's specifications.

For example, a mechanical engineer who has concerns about a particular air-handling unit could use an AR-enabled device to call up the relevant information instantaneously. "They could really just point to something and say, 'Hey, what is this? What did I design this to be, and is it actually that?'" Rothbloom said. "Further, they're able to take notes and push that back to the BIM model once they're back in the office and say, 'Hey, this wasn't installed correctly. We need to actually raise this as a punch list item, or go back to the construction manager and make sure they replace this right away.'"

This work is still in the research phase, although Rothbloom has tested it on several construction sites. But when the technology is mature enough to be adopted widely within the company, AR-powered site inspections have the potential to reduce the number of project change orders drastically, thereby saving clients substantial amounts of time and money. He believes that in the future, this could even become a new service offering—and, therefore, revenue stream—for AEC firms.

Working together across all of Gensler's offices, staff members are able to collaborate efficiently using new design technology tools. Shown here are project teams from the firm's Newport Beach office costing a VR Jam with the San Diego and Los Angeles offices. Credit: Gensler.

Opportunities for VR coordination during the construction phase will become even more exciting with the coming of technologies like 5G networks and Internet of Things. For example, engineers will likely one day be able to use VR to access the building services control system on site visits. This will allow them to realize the potential of a digital twin: a computational model of a complex system (e.g., a building) that enables designers to test different equipment settings in a virtual environment to determine which ones perform best.

40%

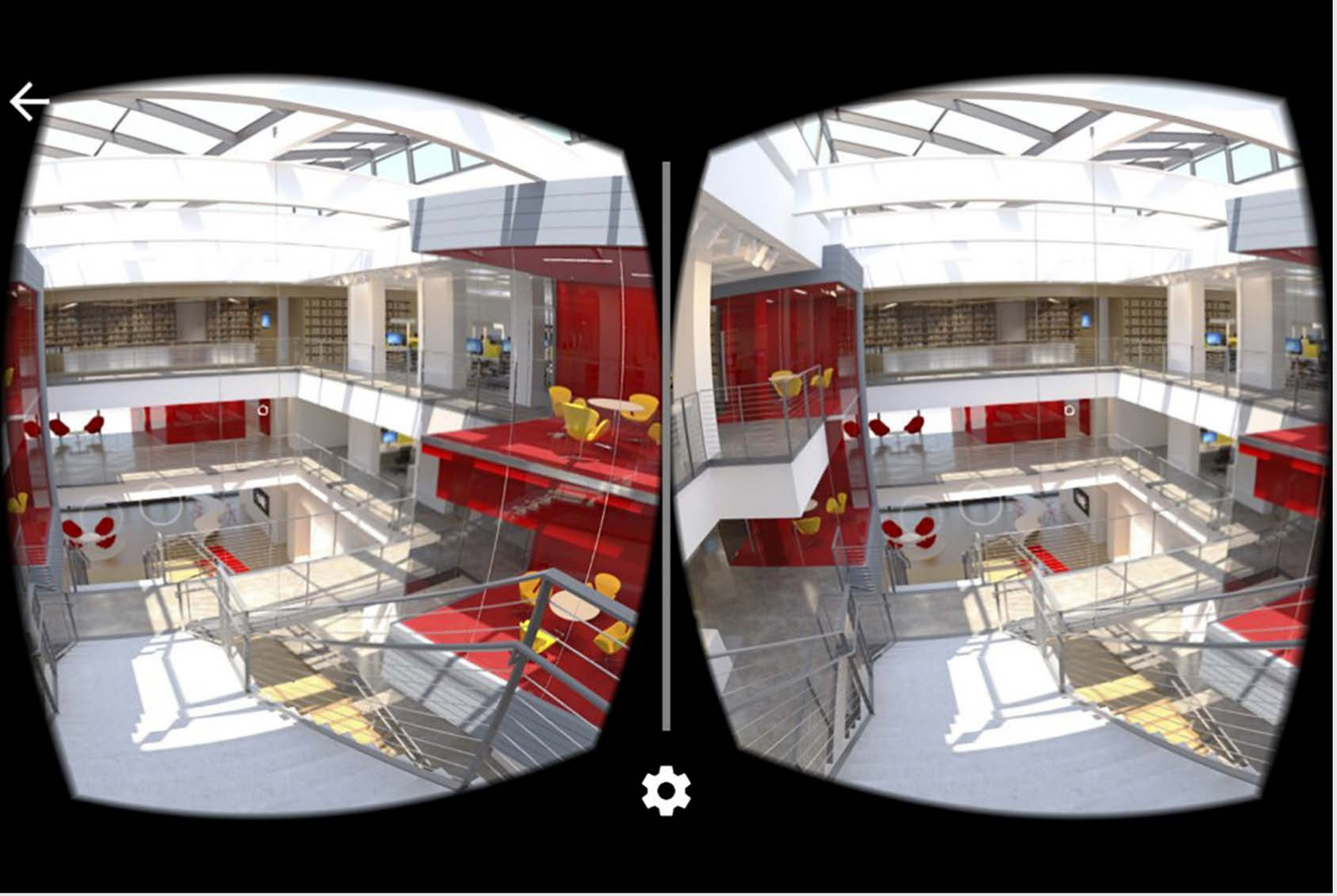
ALMOST 40% OF BUSINESSES IDENTIFY XR AS A TOP PRIORITY[1]

2/5

TWO IN FIVE BUSINESSES HAVE A FORMAL XR STRATEGY[1]

<1YR

THE MAJORITY OF ALL XR INITIATIVES ARE LESS THAN ONE YEAR OLD[1]



A Gensler employee views the firm's downtown Los Angeles office through an AR/VR headset. Credit: Gensler.

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"The ability to connect different bits of technology all together into a virtual platform is going to be key," Cortez said. "Being able to connect building services information through multiple sensors, computing capability, and being able to access all of that data in real time is something that I'm pretty excited about."

But the benefits of integrating VR and BIM extend far beyond the construction phase. In fact, these technologies could help BIM realize its full potential, according to Rothbloom. "Right now, [BIM] is being used mostly to make sure that, you know, a duct doesn't interfere with a pipe," he said. But in an ideal world, it would be used to ensure optimal performance through every stage of a building's lifecycle, not just during the initial design phase. "How do we actually make this useful for the people that live in that building, or who maintain that building, or even the people that demolish that building?"

AR tools could make it simple for non-experts to access and make use of the data contained in the model, Rothbloom said. "You could have somebody put their phone up to some sort of machinery, and it'll recognize what piece of machinery it is. It'll know which one it is in the system and understand what actually needs to be done to maintain it, or where is it malfunctioning."

ARCHITECTS WITHOUT ARCHITECTURE

For Lubaszka, one of the most exciting possibilities VR offers architects has nothing to do with built space. Instead, she believes that some of her colleagues might increasingly turn their attention to designing digital environments.

As people spend more of their time in computer-generated spaces, AEC professionals have a great deal to offer in terms of ensuring that these environments enrich our lives rather than detract from them, she believes. "We don't want the creators of these virtual worlds to be the same ones that have given us horrible pop-ups when we try to go to a website, or that are just trying to trick us into staying in an environment for a long time that sucks our energy and makes us feel depleted," she said. "If we're going to be spending time in these virtual worlds, we want them to be beautiful."

NO TIME LIKE THE PRESENT

While many AEC companies have already incorporated VR into their workflows, on the whole, commercial applications are still in their infancy. In a 2019 survey of 577 organizations that are working or experimenting with VR, the Consumer Technology Association found that the majority of initiatives were less than 12 months old.

For designers and builders wanting to take advantage of these tools, now is a perfect time to start. Hardware has improved dramatically in recent years, enabling practitioners easy access to lightweight, extremely high-resolution headsets that offer spatialized audio as well as immersive imagery. Computer manufacturers offer workstations customized for VR, with powerful central processing units (CPUs) and graphics cards (GPUs) tailored for the production and deployment of high-quality virtual environments.

In addition to better hardware, today's AEC professionals have easy access to online communities and conferences that offer accessible entry points for learning more about VR and its potential uses.

"Right now, the VR / AR / XR community is in this really beautiful period of sharing tools and techniques," Lubaszka said. "People are not hoarding their knowledge, or afraid to give a competitor a hand."

Z equips creators with the powerful tools they need to fuel their creative evolution. **Check out more at hp.com/aec.**

Arup customers utilize HP VR technology during the workflow and design process. Credit: Arup.

Sources
1. Consumer Technology Association, September 2019, "XR Enterprise Trends," https://shop.cta.tech/products/xr-enterprise-trends

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