

'Seeing' the design in 3-D

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Published: June 12th, 2013

At U of M's virtual reality lab, architects and students can peer into the future

In the middle of an indoor courtyard at [Rapson Hall](#), Aaron Westre is walking with his arms outstretched while sporting headgear that covers his eyes.

Under a set of wide, opaque goggles, the University of Minnesota design research fellow is walking through a 3-D interactive projection of a suite in an intensive care unit at a children's hospital in California. The suite has yet to be built: Until its completion in 2016, it exists only in virtual reality.

Welcome to the Virtual Reality Design Lab at the U of M's School of Architecture, considered the largest, most advanced architecture and design virtual reality environment in the nation.

The lab, established in concept by architecture professor Lee Anderson in 1998, appears to be the only one of its size open to architecture and engineering professionals and students. The lab has proved a boon to both groups since opening in early 2012.

The lab, which is funded through a \$1.5 million gift from the Digital Design Consortium, is also a showpiece for virtual reality equipment provider Phase Space. Milton Garcia, national sales manager for the California-based company, said the only virtual reality environments larger than the U's are dedicated to movies and animation.

The lab's realistic and real-time virtual setting is its primary selling point.

While building the university's Fourth Street Student Residence Hall & Dining Facility, Minneapolis-based Mortenson previewed bathroom and dorm rooms for the project in the virtual reality environment. Rick Kahn, Mortenson's director of integrated construction, said the realistic depiction of the spaces enabled his team to catch a design error in the placement of bathroom lighting.

"Had we not utilized this virtual environment, we probably would have had to move some light fixtures," Kahn said.

The impact to the client's bottom line? Catching the error early avoided at least \$15,000 in direct change-order costs and a two-month impact on the project, said Ken Sorensen, Mortenson's vice president and general manager. (Mortenson is one of the professional collaborators involved with the lab.)



Aaron Westre, a research fellow at the University of Minnesota's College of Design, walks through a virtual reality architectural space projected into his goggles. The Virtual Reality Design Lab is in an indoor courtyard of Rapson Hall in Minneapolis. (Photo: Matt M. Johnson)

For contractors, architects and engineers, virtual reality may be the next big thing when it comes to attracting clients. Last fall, with the help of virtual reality, Minneapolis-based HGA Architects and Engineers won the design contract for Fairview Southdale Hospital's 89,000-square-foot expansion.

Amy Douma, an associate vice president with HGA, said Fairview required that virtual reality be used in the project. The firm, another professional collaborator involved in the U of M lab, used the environment to test how hospital staff would maneuver in new emergency department spaces.

"There's definitely an advantage to firms that have access to it," she said.

Bigger and better

The U of M is taking virtual reality beyond the curiosity phase. Elsewhere in the nation, students and professionals typically access the technology in 10-by-10-foot virtual reality "caves." These environments allow little movement and tend to be limited in their accuracy, according to Renee Cheng, head of the U's School of Architecture.

At the Virtual Reality Design Lab, users roam free inside a 25-by-25-foot grid of motion-capture cameras. They carry the laptop computer and sensors that run the system on their backs and heads. The binocular graphics projected into the headset rival movie special effects.

While 3-D projections and computer design flyovers on flat computer screens are good, they don't come close to being able to walk free inside a space.

"You bring it into this and you immediately see 100 things you should've or could've changed in the design," said Westre, the research fellow.

Such virtual environments that are as large or larger than the U of M's lab are either inaccessible to the public or are dedicated to use in the defense, film and aeronautics industries, Cheng said.

In developing the U of M system, Anderson enlisted help from the university's computer science department. Progress was incremental, until the availability of more powerful, portable computers took the lab around the corner last year. That's when it moved into Rapson Hall, at 89 Church St. SE in Minneapolis.

Software improvements made a difference, too. While it might have taken six months to bring a computer-designed simulation to life a year ago, the same work can now be done in a week.

Still, there is room for improvement. Anderson is working to smooth the video system, which often jerks like the picture on a broken television. Planned improvements include expanding the environment to more than 2,000 square feet and adding gloves that would allow users to "feel" surfaces.

Most important, Anderson wants to set the system up so multiple users can be in a virtual room at the same time. Both students and the lab's professional partners list this as a top demand.

Virtual world for the real world

Anderson and Cheng said the school isn't setting up its virtual reality system for wide commercial use or distribution. It is a tool primarily intended for student use. Graduates, not the school, will spread the technology.

"They tend to bring technology to the market with them," she said.

The market already seems to want it.

Douma at HGA said that while she sees virtual reality being a standard tool for architects and engineers 10 years from now, it's already an indispensable tool in some circumstances.

While it does not yet replace full-scale, physical mockups that can cost upward of \$1 million, virtual reality allows her firm to show clients large spaces that are too expensive to build as mockups.

"Being able to look down a hall, even if you can't walk down a hall, is still beneficial," she said.

On the construction side, Mortenson's Sorensen said virtual reality has great potential for evaluating construction techniques. Eventually, he sees his company using such a system to test construction methods before breaking ground on projects and for holding virtual job site meetings.

"This is our next step," he said.

A video tour of the University of Minnesota's Virtual Reality Design Lab is [available here](#).

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