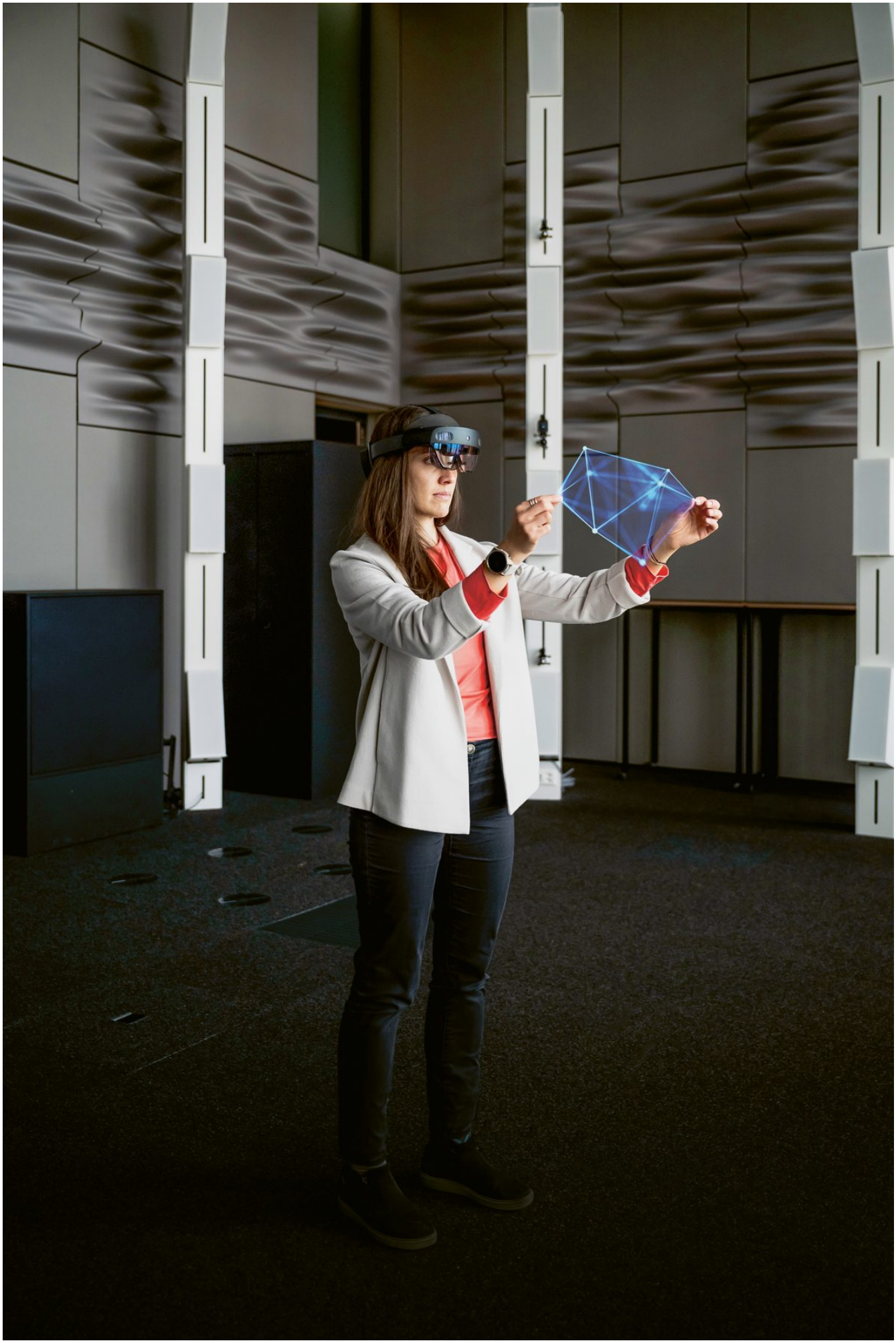
Virtual design for real-world buildings



“We want to empower future engineers and architects to reshape processes in the construction industry with the help of digital technologies.”

At the Center for Augmented Computational Design in Architecture, Engineering and Construction (Design++), ETH is looking at new ways to innovate the construction industry. Executive Director Danielle Griego tells us more.

Who are the people behind Design++ and how does the initiative help accelerate a shift in the construction industry towards more resource efficient and productive methods?

DANIELLE GRIEGO – Design++ bridges the domains of architecture, civil engineering and computer science at ETH Zurich. In total, more than fifty professors, scientists and staff members teach courses and conduct research in projects across the interdisciplinary network. For example, a new lighthouse project – which examines how extended reality for inspection, assembly and operations in the buildings and construction sector creates new emission-reducing opportunities – combines the expertise of professors Robert Flatt, Catherine De Wolf, Bernd Bickel, and many more. The purpose of our activities is to reduce the ecological impact in the construction sector and increase systematic construction productivity while simultaneously ensuring high quality standards in the built environment.

What methods do you use to pursue these aims?

Our work focuses on developing digital methods and tools using artificial intelligence and extended reality to advance the architecture, engineering and construction (AEC) industry. An important resource is our – globally unique – Immersive Design Lab, pioneered by Gramazio Kohler Research. Here we can merge immersive visualisations and 3D spatial acoustics and test extended reality in architectural and civil engineering projects in an interactive way. This could be a virtual walk-through of a building project, for example, or intuitive interaction with a 3D design model using gestures or voice commands. Equally important are regular exchanges with industry partners to share information and align objectives.

What form do these exchanges take?

For our research to make a difference to society, it must be firmly anchored in the AEC industry. Important platforms in this regard are events such as the Future of Construction symposium or our seminar series, which we also publish on our YouTube channel. We host exchanges with each of our strategic partners Basler & Hofmann, Hexagon and Halter AG where both sides provide updates on new technological developments from their perspective.

Why is this collaboration with partners necessary?

It’s thanks to them that we can build and grow Design++! For example, their support made it possible for us to appoint Bernd Bickel, Professor of Computational Design, and to start a fellowship programme for postdocs.

At the same time, both parties benefit when the industry can make good use of the results of our projects on digital design, planning and construction. Building projects are usually tightly calculated in terms of time and costs. This often means that innovation falls by the wayside, because new technologies and processes typically require additional time and money when newly introduced. Companies like our strategic partners, who are willing to take risks and support innovation in the AEC industry, are indispensable for driving sustainable construction.

In concrete terms, what applications could emerge from Design++ research?

Take the very promising development of the AI design co-pilot to support bridge design, a collaborative project between Professor Walter Kaufmann’s group and the Swiss Data Science Center. The deeplearning-based software tool isn’t bound to a specific structure and supports engineers in the early design stages. By combining AI’s computational power with human creativity and an immersive user interface, the design co-pilot contributes to the development of efficient and reliable future structures. This was applied in a real project for a pedestrian girder bridge located in St. Gallen in collaboration with Basler & Hofmann. Another example is the 7DayHouse project, which explores solutions for the exceptionally high demand for housing in urban areas. The overall goal is to create

a fully customised home design in just one day while maintaining supply-chain continuity for fabrication and delivery within seven days. The team, led by professors Daniel Hall and Benjamin Dillenburger, is working on AI design methods which incorporate the fabrication and construction process, collaborative AI, and mixed reality. The research utilises digitally fabricated cross-laminated timber (CLT) elements and benefits from the experience and knowledge of Erne AG Holzbau.

Why is ETH the right place to drive innovation in the construction industry?

The potential of digital technologies for the architecture and construction industry is huge, but implementation is still in its infancy. When it comes to infrastructure and expertise, ETH has some of the best resources worldwide. This is also reflected in its graduates. If we can empower ETH's future engineers and architects to challenge conventional design and building processes and use digital technologies to achieve pioneering breakthroughs, we can make a significant difference.

Design++

At the ETH Center for Augmented Computational Design in Architecture, Engineering and Construction, innovative digital methods and tools for a more sustainable construction industry are being developed, supported by strategic partners Basler & Hofmann, Hexagon and Halter AG. Danielle Griego has been the Executive Director of Design++ since its foundation in June 2020.

Learn more