Augmented Reality:
Bricklaying
Fologram begins development of mixed-reality software tools suited for a wide variety of fabrication and construction tasks, and collaborates with various academic and industrial partners to explore potential techniques and implementations.

Microsoft releases the first generation HoloLens in March 2016, which is made available in Australia in October. The HoloLens is a state of the art mixed-reality headset which offers inside-out tracking, high resolution optics and 3D scanning capabilities.
Colin Barratt worked with the UTAS Architecture & Design studio to include brickwork as a medium within the Architecture course. Later, All Brick Tasmania would work with UTAS to build a feature wall from each of the student’s assessments, involving the Architecture students in the construction process.

The Architecture & Design (A&D) school were early adopters of AR technologies for visualization and construction applications and one of the first architecture schools in Australia to invest in AR hardware, procuring twelve Microsoft HoloLens AR headsets. Fologram ran an introductory workshop, introducing the school to mixed reality applications in fabrication and visualization.
The first real-world application of standalone AR headsets for brick construction was at the residence of the All Brick CEO, in a collaboration between All Brick and Fologram. Inspired by the design of a UTAS Architecture student, it performs a functional role while providing a suitable prototype project for the use of mixed reality templates for brickwork.

In 2018, University of Tasmania’s Architecture & Design began collaborating with Fologram to practically implement AR technologies in Tasmanian design and construction processes using a series of workshops and studios to test the limits of the technology. This included the construction of, at the time, the world’s tallest structure constructed entirely using AR without traditional drawings.
Timeline

REAL WORLD BUILD: ROYAL HOBART HOSPITAL

2019

The success of the hospital build and previous engagements was extended to a live demonstration of AR brick construction coordinated and supported by Brickworks Building Products at the Australian Institute of Architecture (Tasmania) awards at Hobart's Odeon Theatre on July 6. All Brick Tasmania and Fologram lead the practical demonstration with UTAS researchers in attendance to support the collaboration.

AUSTRALIAN ARCHITECTURE AWARDS DEMONSTRATION

2019

After a number of subsequent prototypes and further software development, work began on the Royal Hobart Hospital, implementing Fologram as mixed reality templates for curved benches spanning up to 15 meters each. Fologram are on site to refine the processes and system, and UTAS are intending to analyze the project in retrospect.
All Brick Tasmania has a pipeline of projects featuring more complex brickwork designs. Fologram and All Brick Tasmania remain in collaboration, working to continually improve the technology and are investigating further projects to collaborate with UTAS.
In December 2018, All Brick Tasmania and Fologram collaborated in a world first AR bricklaying construction. A feature wall inspired by a UTAS architecture student’s design was built at the All Brick CEO’s home. The wall captures and filters sun to the room behind throughout the day and year-round.

The complex design, in which no two bricks were placed in the same vertical or horizontal plane, would have taken up to two weeks for experienced bricklayers to construct.

The precision and quality of the end result achieved with use of Fologram’s software and Augmented Reality (AR) headsets is outstanding. The build took 2 bricklayers 6.5 hours, resulting in a time saving of approximately 90%.
All Brick Tasmania and the Australian start-up software developer Fologram collaborated to use AR technology to design and construct a series of curving brick bench seats on several balconies in the new K block of the Royal Hobart Hospital.

The bricklayers wore AR headsets to help guide the cutting and placement of complex brickwork. Using the technology cut the total construction time by 20% (a portion of the build was regular brickwork which didn’t require the use of the headsets) and achieved an exceptional level of quality.

This project will be a world-first published use of AR technology for bricklaying on a commercial build of significant scale and complexity. The John Holland Fairbrother Joint Venture - lead contractors for the project - were very supportive of trialling AR onsite. UTAS researchers are analyzing the results and potential impacts on the industry.

Image credit: All Brick Tasmania
The success of the hospital build and previous engagements was extended to a live demonstration (min 5:07) of AR brick building, coordinated and supported by Brickworks Building Products at the Australian Institute of Architecture (Tasmania) awards at Hobart’s Odeon Theatre on 6th July 2019.

All Brick Tasmania and Fologram lead the practical demonstration with UTAS researchers attending to support the collaboration.

The complex design would have taken four days for two experienced bricklayers to construct (one to set out and one to lay the bricks). Instead, with use of the software and Augmented Reality (AR) headsets, the beautiful, eye-catching and complex design was expertly constructed by three bricklayers in only three hours.
The architect / designer builds the architectural model in their modelling tool of choice – for example, Rhino, Revit, ArchiCAD or SketchUp.

The region of the model containing the brickwork to be built with AR, is imported into Rhino. Detail such as the position of each brick, the layout of each course of bricks, and cutting templates, is added to the parametric model.

Interactions are then defined using Fologram within Grasshopper. Interactions include a spatial button that allows the bricklayer to progress through each course of bricks, and the ability to see the cutting templates with how many of each type of cut is required.

The detailed model, relevant site data and interactions are hosted onsite via a local WiFi. This provides the opportunity to adapt to unforeseen conditions and gather data during the construction process.
QUALITY & PRECISION – close to design perfection can be achieved with regularly skilled bricklayers

NO SET OUT – set out is essentially built into the parametric model, whereas a typical complex job would have one person supervising and managing the set out process throughout the job

CUT LISTS – cut patterns and numbers of bricks in each pattern can be seen through the software, making the process of brick-cutting simple and very quick

FASTER – time savings of between 20% and 90% have already been realised

AUTONOMY – previously a bricklayer would have to start at one end of each course of bricks and follow through to the other end, and 2nd or 3rd bricklayers could only follow the first’s lead; with AR, several bricklayers can be working autonomously anywhere within the model, knowing that their work will fit perfectly when meeting another’s

CREATIVITY – more complex and creative designs can be imagined because the technology is available to build them

ISSUE RESOLUTION – architects and designers are able to see exactly what the bricklayer can see through the software, so progress can be followed in real time and issues resolved quickly

Pros & Cons

IN DEVELOPMENT – as the technology is new, feedback and development to improve the software and process is ongoing

COMFORT & SAFETY – the goggles are quite heavy and a little cumbersome, affecting safety onsite, though Microsoft are continuously improving the goggles through feedback from users

CLEANING – the headsets need to be cleaned at the end of each day to maintain good performance
**Rails**
Show the future location of cinderblocks as a reference.

**Interactive Buttons**
Used to move up and down courses and to toggle the display of the completed bench.

**Previous Course**
Shown as ghosted to ensure alignment of the current course.

**Cutting Templates**
Show quantities and precise cut locations, matching the current course outlines.

**Relevant Context**
Used to verify existing conditions and hologram placement.

**Current Course**
Precise outline of each brick shows the level and orientation. Colours and tags indicate brick type.

**Setout Points**
Known reference points to ensure accurate hologram placement.
Cut patterns are colour coded in each course of bricks, to help with placement.

This also allows more than one bricklayer to work on the course at a time, while easily maintaining the precision of the design.

The layout for each course is easily read from anywhere in the space, and is maintained as people move around the site.

It is immediately evident when there are set out issues from the very beginning of the process – the pipe in this picture appears to be intersecting the brick seat. This issue can be identified and resolved quickly.
Cut patterns and the numbers of bricks of each pattern are visible at any time through the headsets.

This allows the bricklayers to quickly and easily make a template and start cutting.

Royal Hobart Hospital balcony seating under construction.

This sort of complex design would take weeks to set out and build without the help of AR technology onsite.
Royal Hobart Hospital balcony seating nearing completion.

Time elapsed between the photo above and the one to the right is only days, as opposed to weeks.

Image credit: Fologram

Royal Hobart Hospital balcony seating under construction. Multiple bricklayers share the same Hologram and can work concurrently on the same or separate regions.

The intricate cut patterns are visible here as the top course of bricks is laid.

Image credit: Fologram
Contact Us

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