DFAB HOUSE
Factsheet Digital Fabrication

DFAB HOUSE is a collaborative demonstrator of the Swiss National Centre of Competence in Research (NCCR) Digital Fabrication (home institute ETH Zurich) on the NEST building of Empa and Eawag. The 200m² house is the result of a long-term collaboration between researchers in eight ETH Zurich professorships and industry experts and planning professionals from more than 30 companies. The result is a demonstrator showcasing how digital fabrication processes can revolutionise the way we design and build, with these processes exemplified by six highly original Innovation Objects. It is the first house in the world to be designed, planned and built using predominantly digital processes.

Lightweight Translucent Façade
Spatial Timber Assemblies
Smart Slab
Smart Dynamic Casting
Mesh Mould
In situ Fabricator
**In situ Fabricator**

The In situ Fabricator is a context-aware mobile construction robot for fabricating building elements directly on construction sites. Its integrated on-board sensing and computation system is developed to enable autonomous repositioning procedures, localisation of the end effector and the adaptation of fabrication data according to unforeseen material behaviour – without the need for external measurement devices.

Days spent building on-site: 22  
Total building time: 125 hours

**Mesh Mould**

The Mesh Mould combines formwork and reinforcement into one robotically fabricated construction system. As such the In situ Fabricator robot builds up a 3D mesh structure which acts as both formwork and structural reinforcement. Specially developed cement mortar is then poured into the mesh structure and trowelled off by hand, allowing the unique shape of the load-bearing wall.

Length of wall: 12m  
Height of wall: 3m  
Total number of welding knots: 22,300

**Smart Slab**

The Smart Slab showcases a new generation of a radically optimised digital building processes from design to fabrication. It uses large-scale 3D sand printing to automate and optimise the most labour-intense process in concrete construction: fabricating the formwork. The 295 unique 3D-printed formwork parts fully enable the plasticity of concrete to create a free-form, highly optimised building component featuring intricate ornamental structures which create a rich architectural experience.

Area: 78m²  
Max. Cantilever: ~4m  
Smart Slab Weight: 15.7t (~65% reduction compared to standard slab)  
On site assembly: 4 days
**Smart Dynamic Casting**

Smart Dynamic Casting enabled the production of 15 bespoke reinforced concrete mullions. Each mullion was produced by digitally controlled slip-forming, by which self-compacting concrete is fed into a flexible formwork that shapes the concrete as it hardens. This technique allows each mullion to be individually produced in the most suitable geometry for the load-bearing requirements for their exact location.

Number of reinforced concrete mullions installed in DFAB HOUSE: 15  
Total volume of concrete per mullion (average): 23 litres  
Time taken to slip-form one mullion: 4 hours

**Spatial Timber Assemblies**

An innovative robot-based fabrication process which uses the dual robot system in ETH Zurich’s Robotic Fabrication Lab (RFL) to prefabricate timber frame modules for the upper floors of DFAB HOUSE. By using the robots, the timber can be cut, held and positioned reference-free in space, based on the computer layout, allowing for novel and complex geometries.

Precision of beam placement when four or more transmitters can track the robot in the RFL: under 1mm  
Maximum weight of timber beams assembled by the robot: 55kg  
Number of beams in DFAB HOUSE with a completely unique geometry: 487  
Number of modules: 6  
Onsite installation time: 12 hours

**Lightweight Translucent Façade**

Aerogel granules are inserted and stabilized between specially developed membrane panels through a novel process. The result is a thin and double curved lightweight façade system with superinsulation properties that enables light to enter the building through the entire wall.

Thickness of façade: 80-120mm  
Percentage of energy saved: U-value 0.165
Research

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Architecture

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Structural design

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Client

Empa

Planning team

Architecture: NCCR Digital Fabrication
General planner: ERNE AG Holzbau
Structural engineering: Dr. Schwartz Consulting AG
Building physics: BAKUS Bauphysik und Akustik GmbH
Electrical engineering: Elektro Siegrist AG
HVAC/Sprinkler planner: Häusler Ingenieure AG
Building technology: Schibli Gebäudetechnik
Lighting design: Sommerlatte & Sommerlatte AG

Partners

Georg Ackermann GmbH
AGITEC AG
Bürgin Creations
Cabot Aerogel GmbH
Christenguss AG
ERNE AG Holzbau
Fischer Rista AG
Frutiger AG
Gom International AG
Lehni AG
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Pemat AG
Rudolf Glauser AG
Schibli
Schlatter Industries AG
best wood SCHNEIDER GmbH
seele cover GmbH
Sika Technology AG
Sommerlatte & Sommerlatte AG
Stahl Gerlafingen AG
Stahilton AG
voxeljet AG
Welti-furrer
Zühlke Engineering AG