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## NCCR Digital Fabrication

**Dr. Russell Loveridge**  
Managing Director NCCR DFAB

**FNS-NF**  
FONDS NATIONAL SUISSE  
SCHWEIZERISCHER NATIONALFONDS  
FONDO NAZIONALE SVIZZERO  
SWISS NATIONAL SCIENCE FOUNDATION

**ETH** zürich

**EPFL**

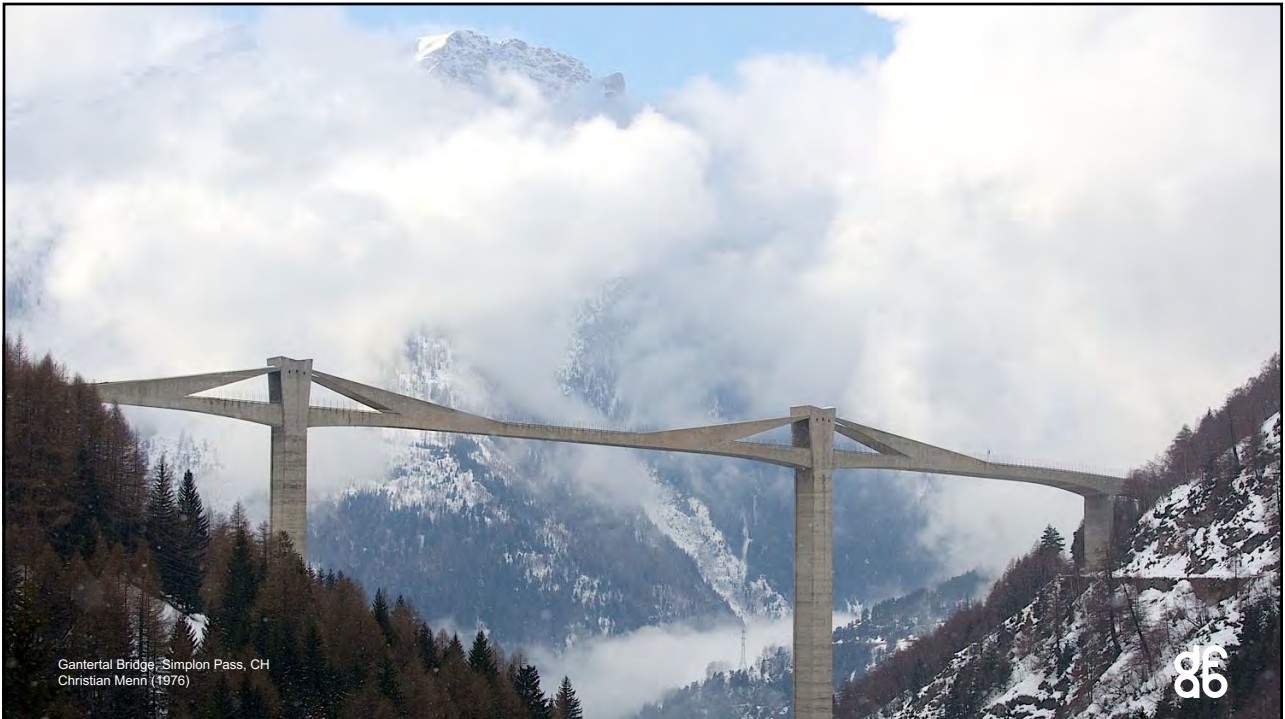
**EMPA**

**df**

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Gotthard Base Tunnel – 57km (35miles)  
(2016)



5



Stadelhofen Rail Station, Zurich, CH  
Santiago Calatrava, 1996



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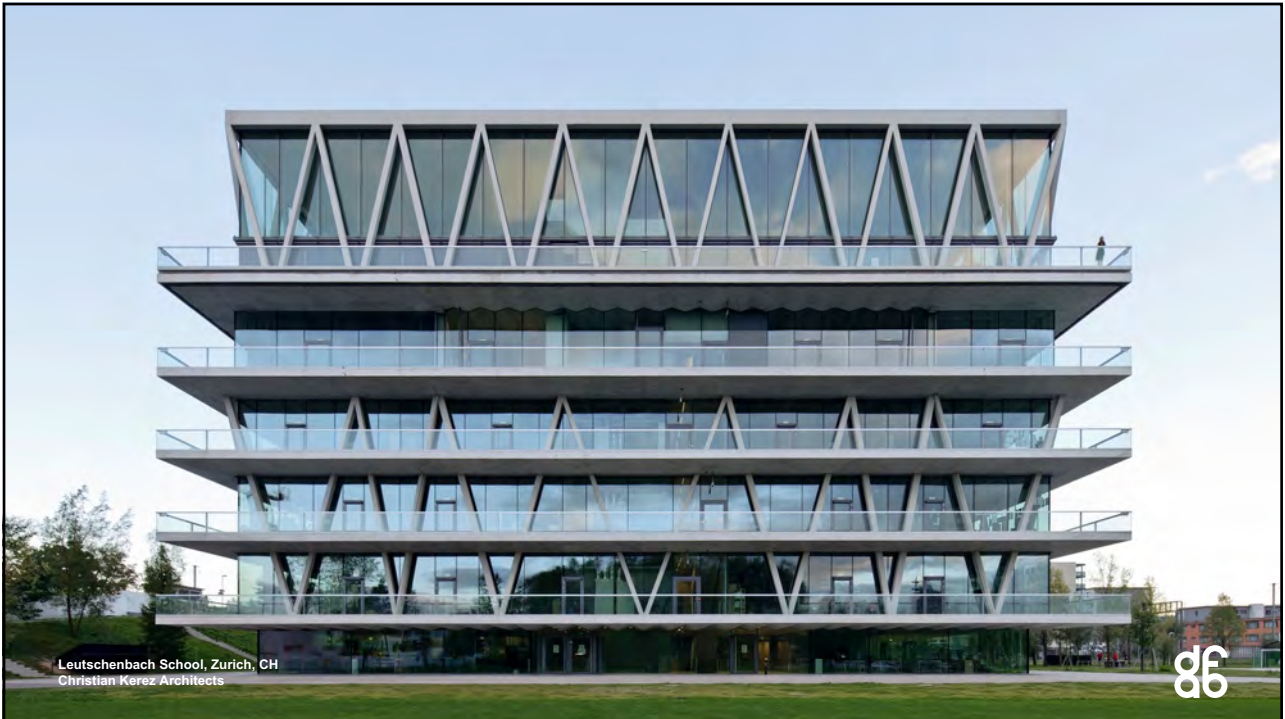


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Private House, Uster, CH  
Gramazio Kohler Architects (2010)

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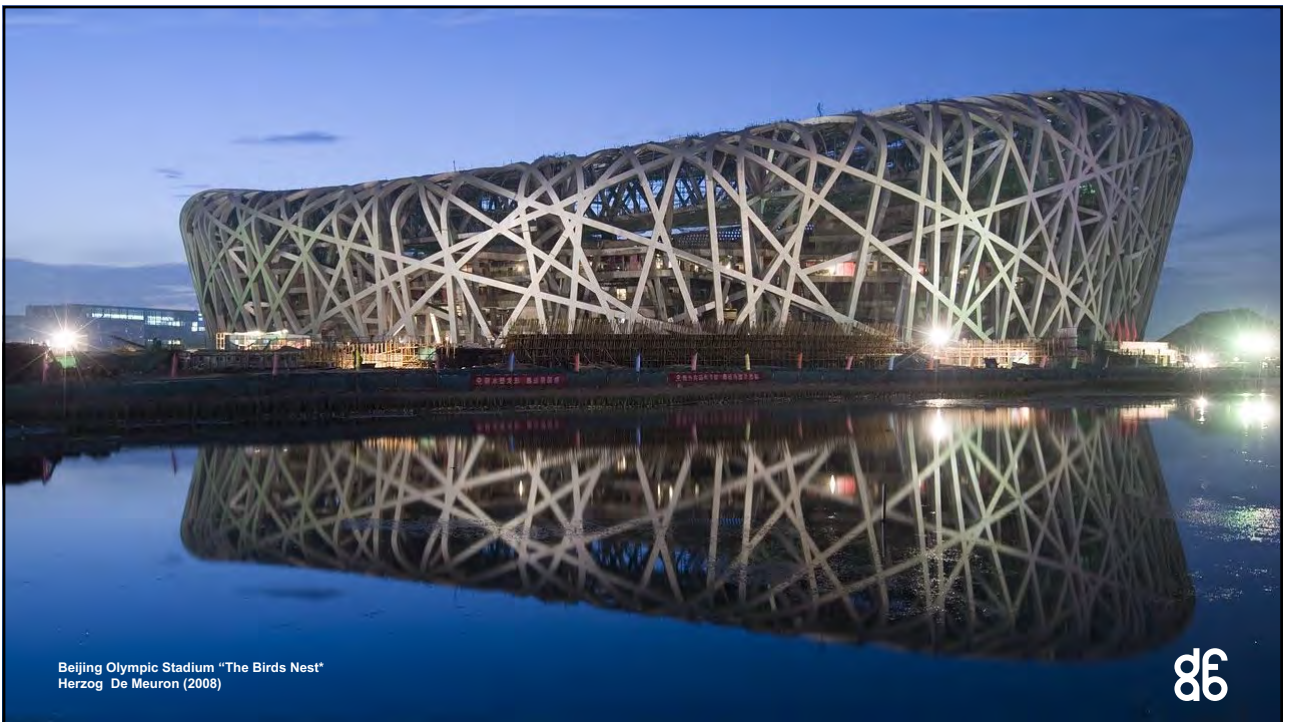


Leutschenbach School, Zurich, CH  
Christian Kerez Architects

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## Switzerland <> Canada

### Knowledge Economy – Resource Economy

- Regulation, codes, permitting
- Material + Constructive systems
- Financial
- Legal
- Cultural



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## Swiss National Centres of Competence in Research (NCCRs)

### Current NCCRs: 14

- NCCR AntiResist - University of Basel
- NCCR Automation - ETH Zurich
- NCCR Bio-Inspired Materials - University of Fribourg
- NCCR Catalysis - ETH Zurich, EPF Lausanne
- **NCCR Digital Fabrication - ETH Zurich**
- NCCR Evolving Language - University of Zurich, University of Geneva
- NCCR MARVEL – EPF Lausanne
- NCCR Microbiomes - University of Lausanne, ETH Zurich
- NCCR Molecular Systems Engineering - University of Basel, ETH Zurich
- NCCR On the Move - University of Neuchatel
- NCCR PlanetS - University of Berne, University of Geneva
- NCCR RNA & Disease - University of Berne, ETH Zurich
- NCCR SPIN - University of Basel
- NCCR SwissMAP - University of Geneva, ETH Zurich



### Completed NCCRs: 22

Geographical overview of all National Research Priorities in Switzerland  
Source: Swiss National Science Foundation (SNSF)



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## NCCR Digital Fabrication




























Group image of NCCR Digital Fabrication, 2019

### Over 130 participants

- 25 Principal and Associated Investigators
- 30+ Doctoral Researchers
- 28 Postdoctoral Researchers
- 12 Research Interns
- 18 MAS Students
- 8 Technicians
- 5 Management staff
- ...and over 20 associated researchers, scientific assistants, industry partners, and researchers in residence



## NCCR Digital Fabrication: 25 Investigators

|   |  |   |   |  |   |   |   |  |   |
|---|--|---|---|--|---|---|---|--|---|
| <br><b>Philippe Block</b><br>Architecture and Structures<br>ETH Zurich | <br><b>Robert Flatt</b><br>Building Materials<br>ETH Zurich                       | <br><b>Stellan Coros</b><br>Computational Robotics<br>ETH Zurich   | <br><b>Benjamin Dillenburger</b><br>Digital Building Tech.<br>ETH Zurich                 | <br><b>Fabio Gramazio</b><br>Architecture and Digital Fabrication<br>ETH Zurich | <br><b>Gudela Grote</b><br>Work and Organ. Psychology<br>ETH Zurich  | <br><b>Daniel Hall</b><br>Industr. Construction<br>TU Delft                 | <br><b>Marco Hutter</b><br>Robotic Systems<br>ETH Zurich       | <br><b>Walter Kaufmann</b><br>Structural Engineering<br>ETH Zurich          | <br><b>Matthias Kohler</b><br>Architecture and Digital Fabrication<br>ETH Zurich |
| <br><b>Catherine De Wolf</b><br>Circular Engineering<br>ETH Zurich     | <br><b>Agathe Koller-Hodac</b><br>Mechatronics and Automation<br>Ostschweizer FHS | <br><b>Silke Langenberg</b><br>Historic Preservation<br>ETH Zurich | <br><b>Ena Lioret-Fritschi</b><br>Fabrication +Material-Aware Architecture<br>USI Lugano | <br><b>Andreas Luible</b><br>Façade and Metal Construction<br>HSLU              | <br><b>Stefana Parascho</b><br>Creative Computation<br>EPF Lausanne  | <br><b>Arno Schlüter</b><br>Architecture and Building Systems<br>ETH Zurich | <br><b>Roland Siegwart</b><br>Autonomous Systems<br>ETH Zurich | <br><b>Kristina Shea</b><br>Engineering, Design and Computing<br>ETH Zurich | <br><b>Yves Weinand</b><br>Timber Construction<br>EPF Lausanne                   |
| <br><b>Eleni Chatzi</b><br>Structural Mechanics<br>ETH Zurich          | <br><b>Guillaume Habert</b><br>Sustainable Construction<br>ETH Zurich             | <br><b>Mark Pauly</b><br>Computer Graphics and Geometry<br>EPFL    | <br><b>Andreas Wieser</b><br>Geosensors and Engineering Geodesy<br>ETH Zurich            | <br><b>Melanie Zellinger</b><br>Dynamic and Systems Control<br>ETH Zurich       | <ul style="list-style-type: none"> <li>● Architecture</li> <li>● Civil Eng + Material Science</li> <li>● Mechanical Engineering</li> <li>● Computer Science</li> <li>● Socio Economic Analysis</li> </ul> |   |   |  |   |



## NCCR Digital Fabrication: Swiss Institutions

**ETH** zürich

**EPFL**

**Empa**  
Materials Science and Technology

**B** Bern University  
of Applied Sciences

**UNI  
FR**  
UNIVERSITÉ DE FRIBOURG  
UNIVERSITÄT FREIBURG

**U** **SI**  
Università  
della  
Svizzera  
italiana

**HSLU** Hochschule  
Luzern

**OST**  
Ostschweizer  
Fachhochschule

Zürcher Hochschule  
für Angewandte Wissenschaften  
**zhaw**

**df**

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## NCCR Digital Fabrication: Robotic Technologies

NCCR Digital Fabrication  
ETH Zurich



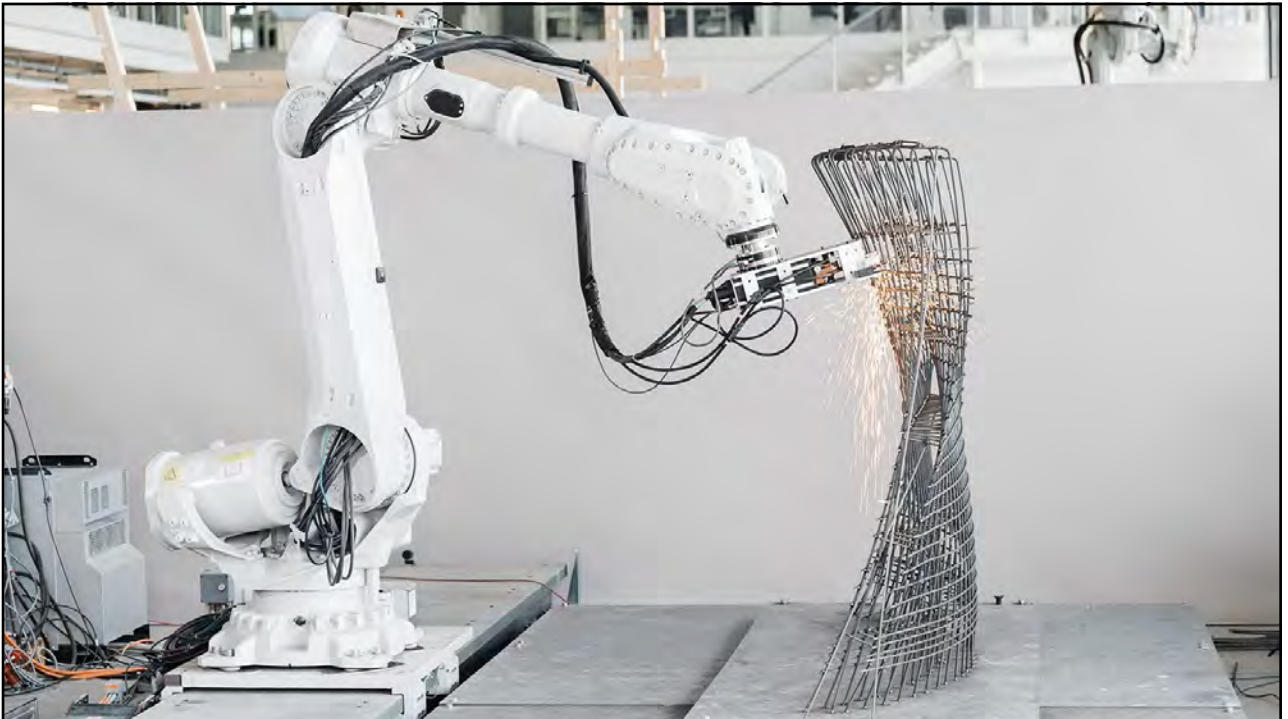
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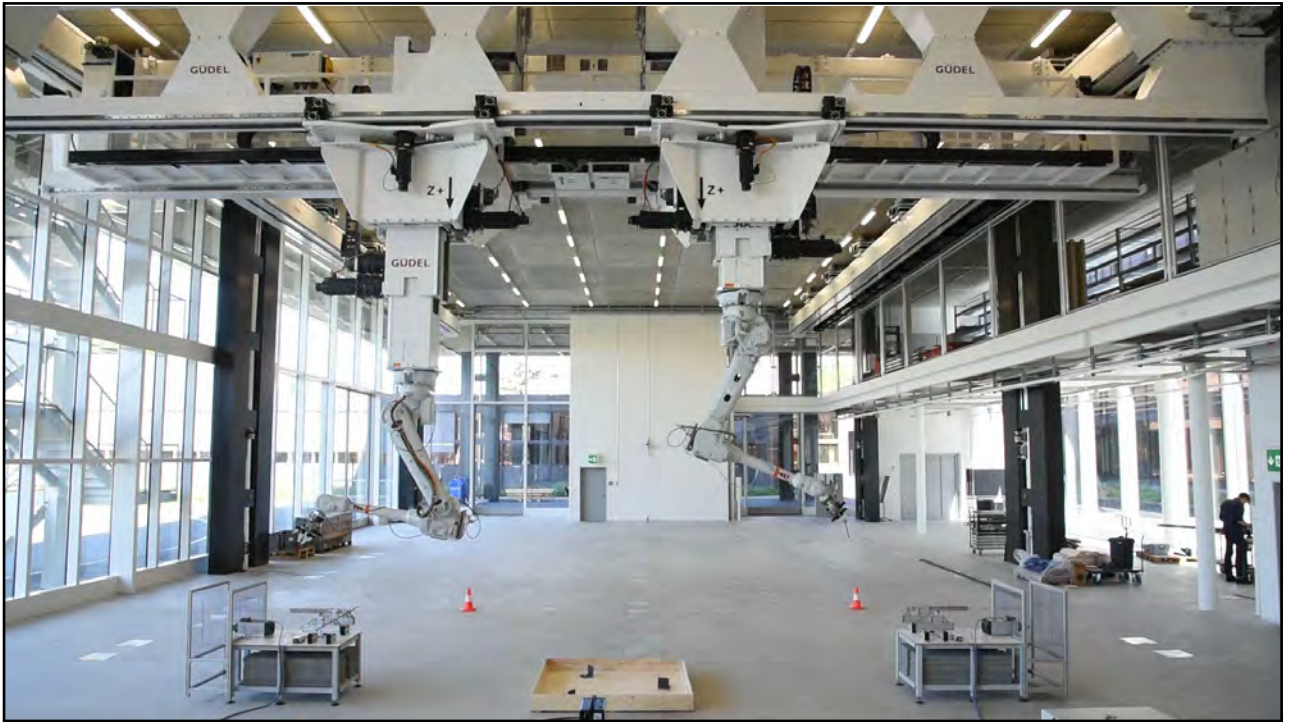
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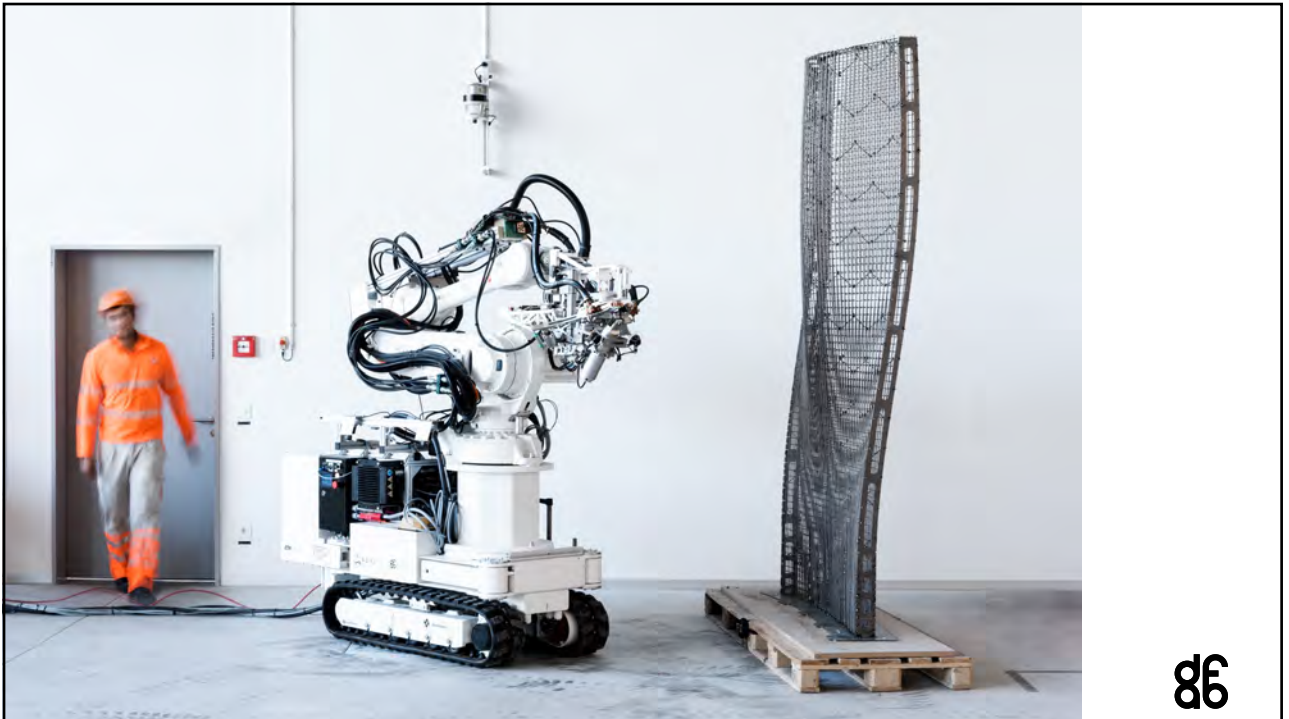
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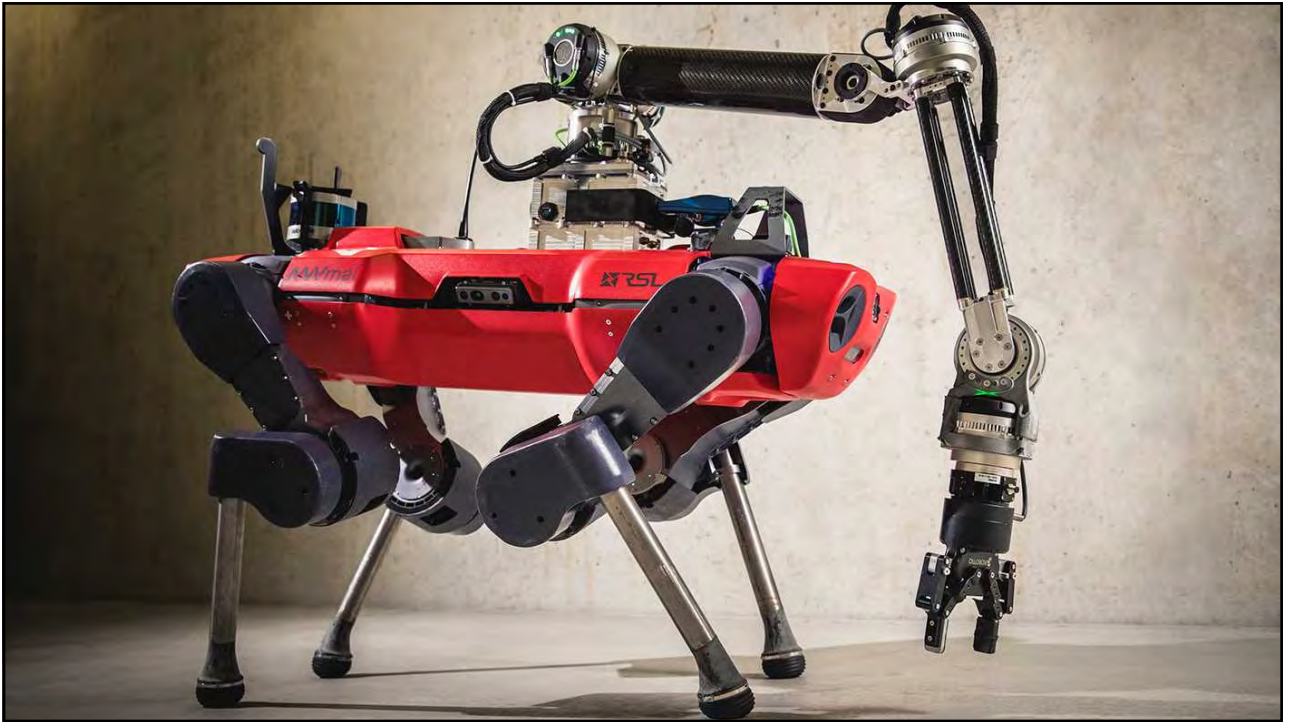


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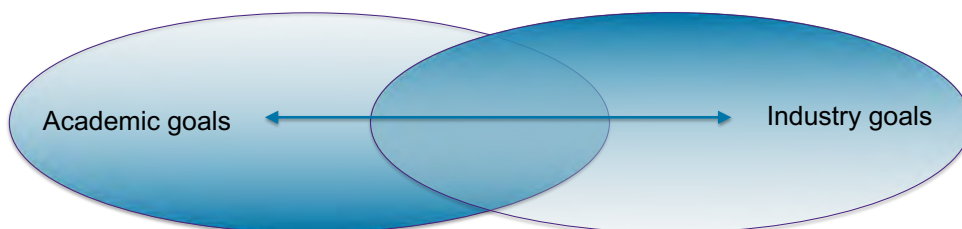


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### NCCR Digital Fabrication

- We are highly interdisciplinary
- People
- We develop real, physical, and feasible research for real-world application



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## Demonstrators



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## KnitCandela Pavilion

Block Research Group,  
ETH Zurich  
Zaha Hadid Architects

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## Digital Bamboo Pavilion

Digital Building Technologies,  
MAS Digital Fabrication, ETH Zurich  
Photo: M. Leschok

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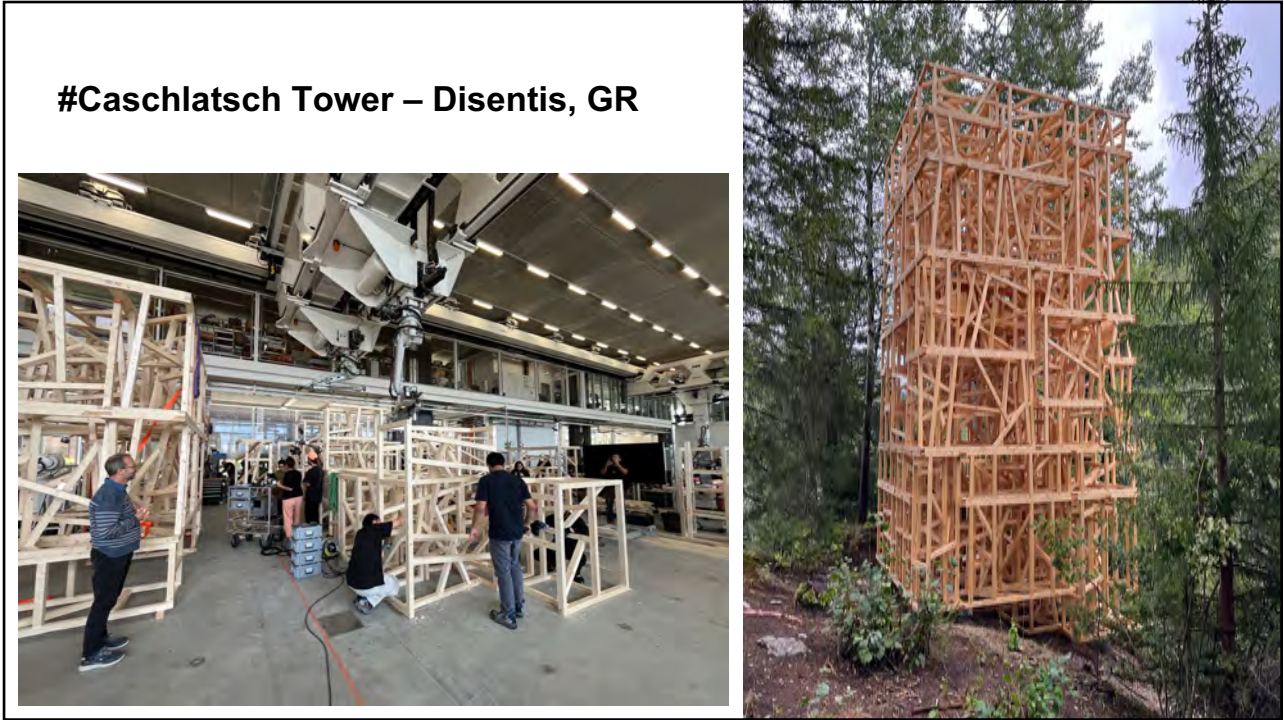
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HiLo  
EMPA NEST

Block Research Group  
ETH Zürich

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**Demonstrator: Arch\_Tec\_Lab Roof**  
**Digital Timber**

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## Arch\_Tec\_Lab



Institute for Technology in Architecture - ITA



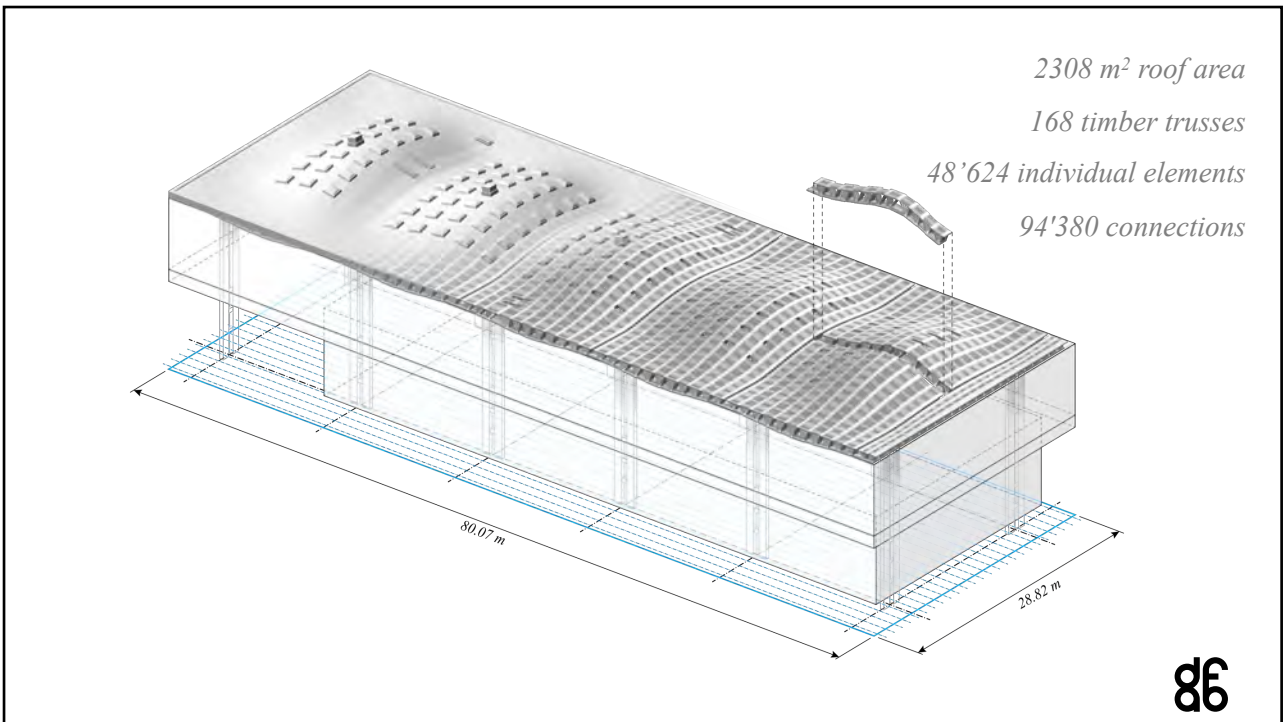
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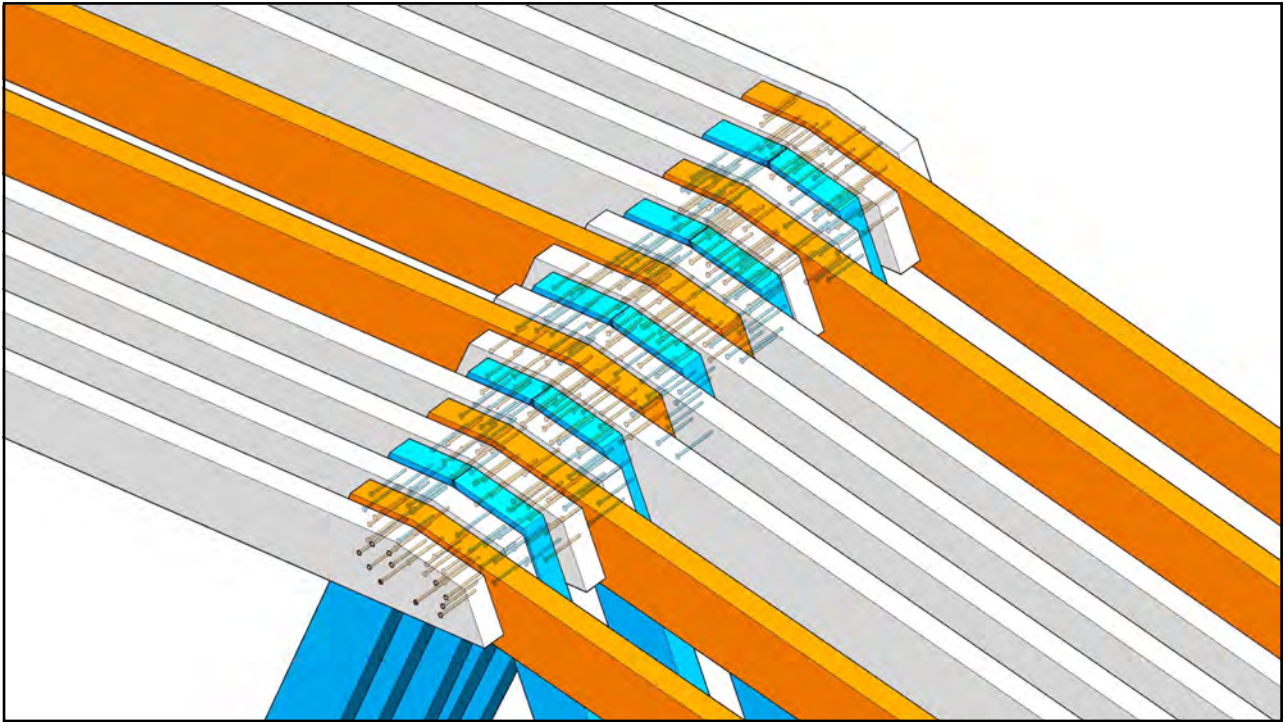
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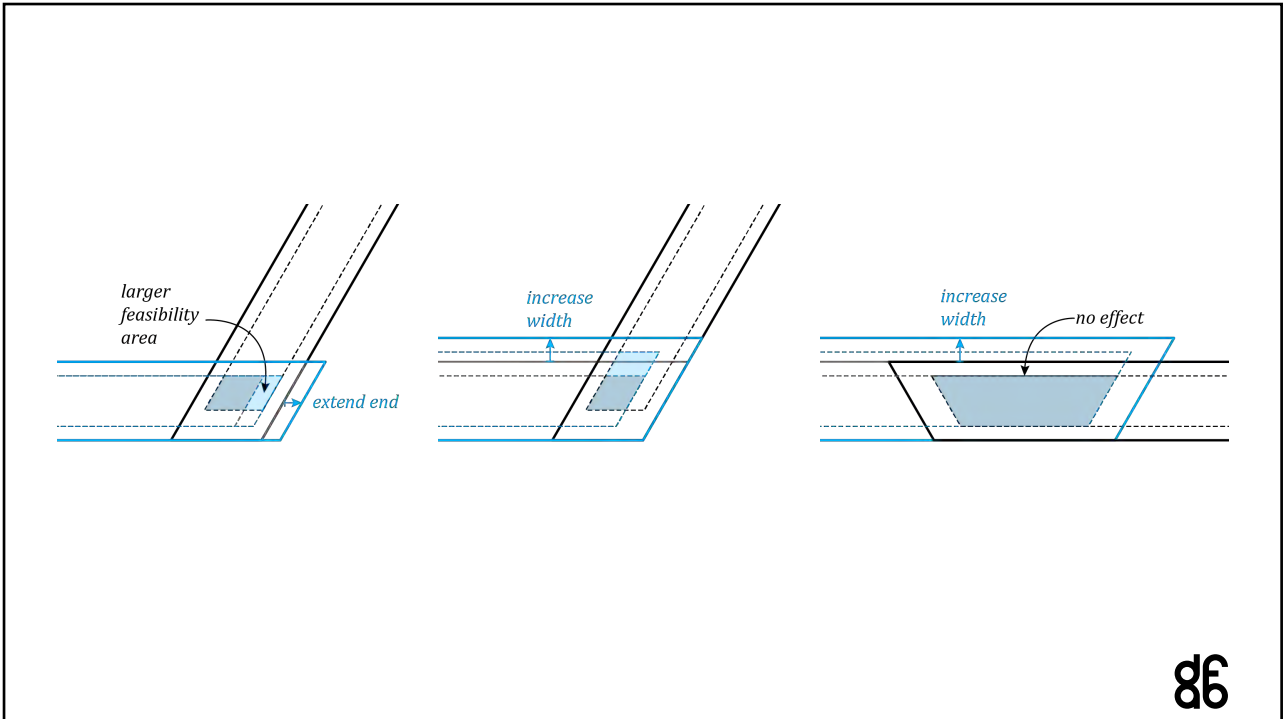
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*many sizes:*  
 Less wood volume  
 Less axial eccentricity

*fewer sizes:*  
 Faster fabrication

→ 3 sizes:

Gramazio Kohler Research  
ETH Zurich

**86**

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f5s16 Iteration 7

number of nails

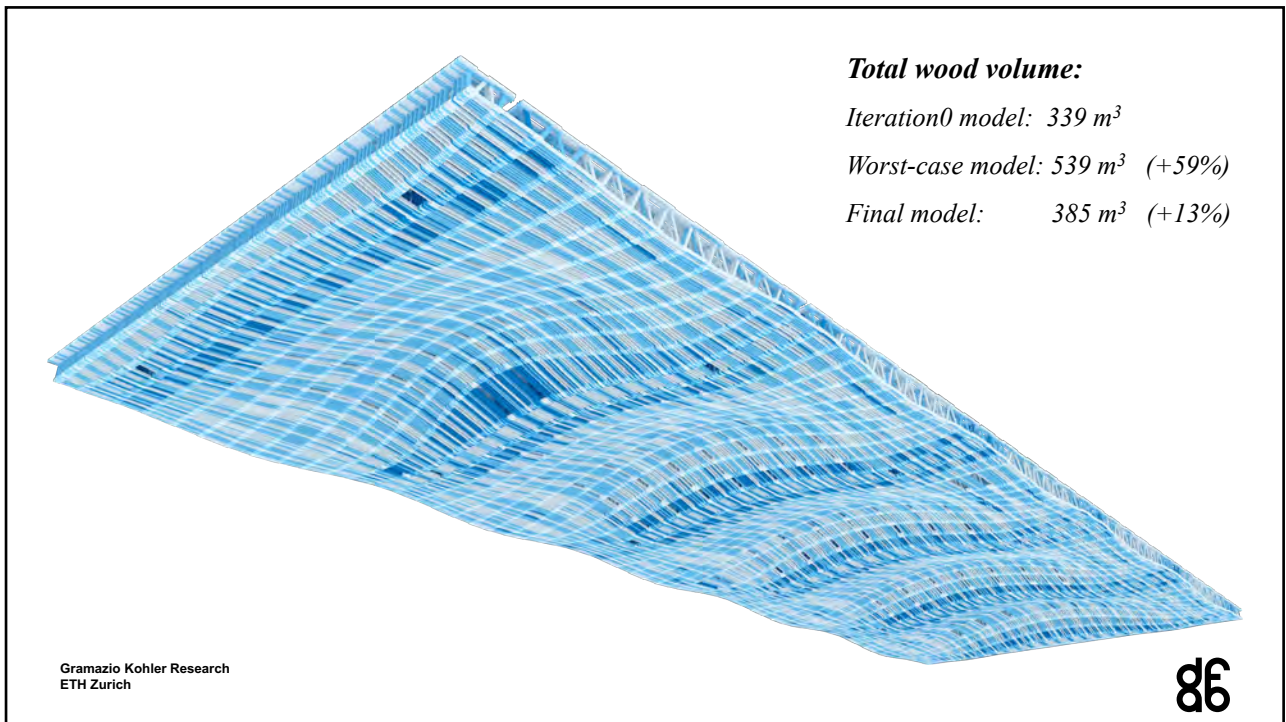
connectors

■ missing   ■ placed   ■ max. possible surplus

Gramazio Kohler Research  
ETH Zurich

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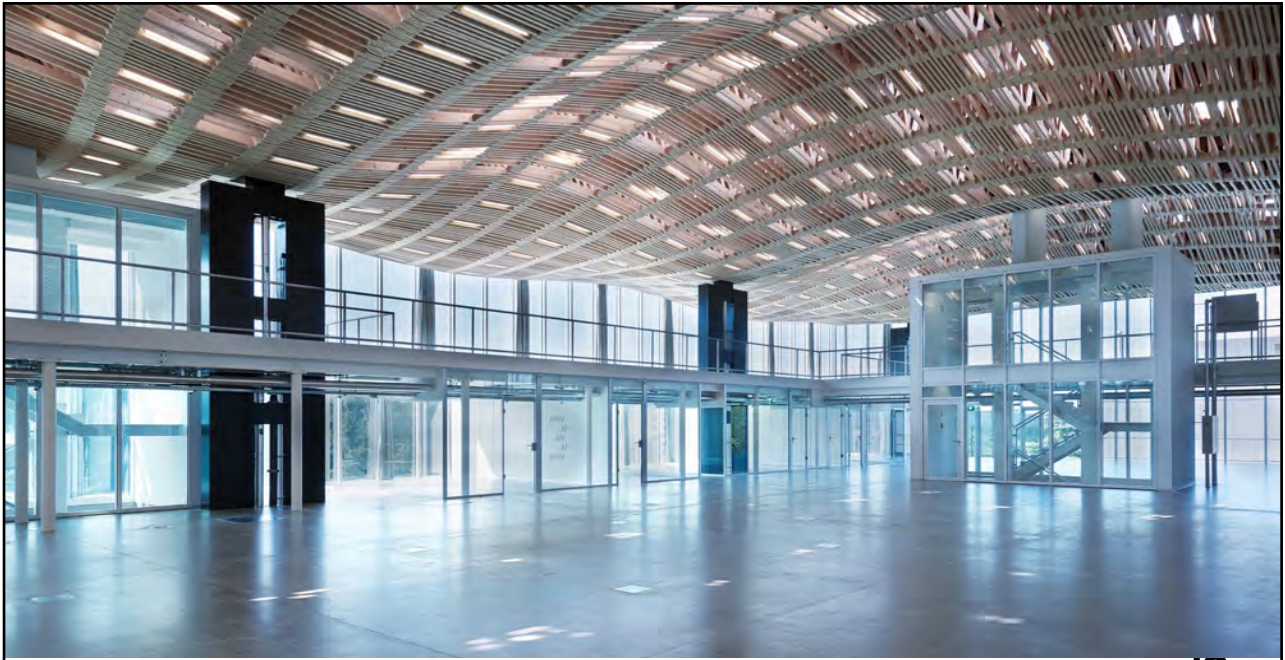
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Interior view of the Arch\_Tec\_Lab building with the completed roof. Photo: Andrea Diglas/ITA/Arch-Tec-Lab AG, ETH Zurich, 2016

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## The Sequential Roof

**Gramazio Kohler Research Team:**

Aleksandra Anna Apolinarska

Michael Knauss

Jaime de Miguel

**Client:**

ETH Zürich Infrastrukturbereich Bauten

**Key planners and contractors:**

Arch-Tec-Lab AG

ERNE Holzbau AG

Dr. Lüchinger + Meyer Bauingenieure AG

ROB Technologies AG

SJB Kempter Fitze AG

Prof. Dr. Josef Schwartz (ETH Zürich)

Prof. Dr. Andrea Frangi (ETH Zürich)

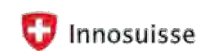
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## Demonstrator: Tor Alva Digital Concrete



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## Tor Alva Mulegns, GR



Conzett Bronzini Partner AG



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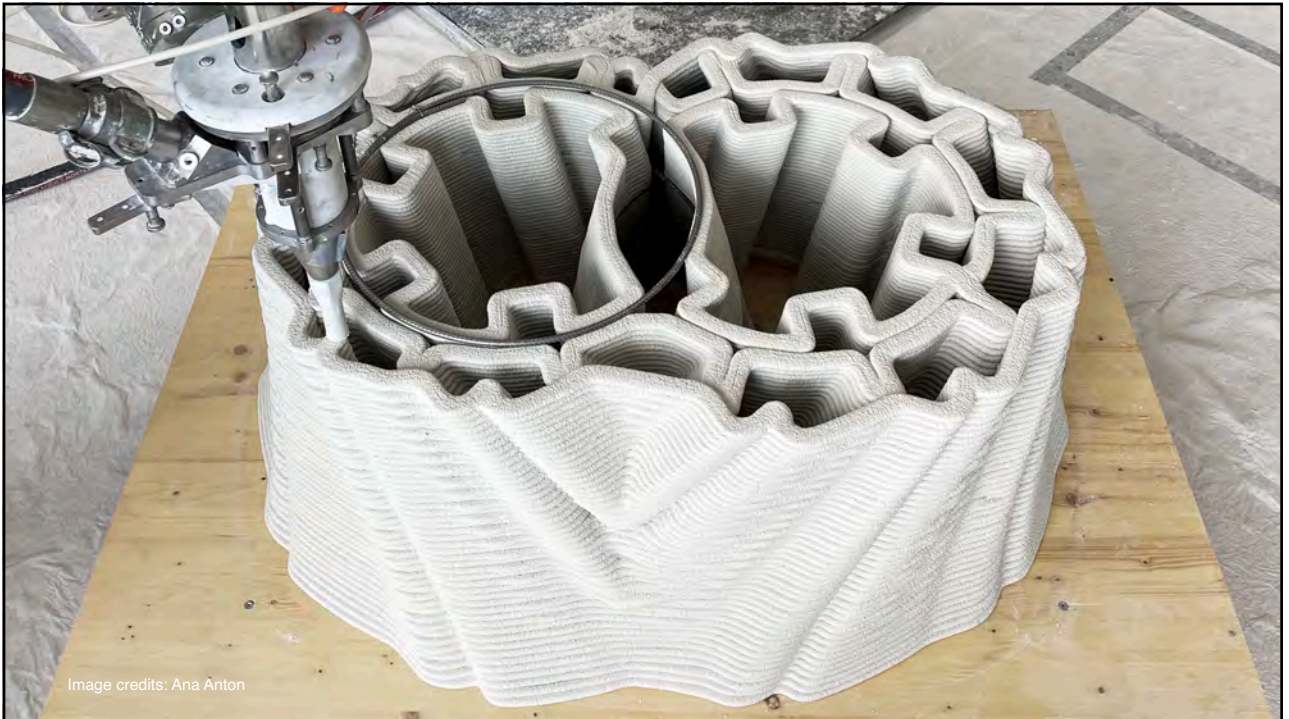


Image credits: Ana Anton

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## Tor Alva Project Credits

### Research:

#### Digital Building Technologies - Prof. Dr. Benjamin Dillenburger:

Dr. Ana Anton (Research Lead), Eleni Skevaki, Che Wei Lin, Ming-Yang Wang, Lena Kitani, Su Huang, Nijat Mahamalyiev, Dr. Konrad Graser (Project Coordination)

#### Physical Chemistry of Building Materials - Prof. Dr. Robert J. Flatt:

Dr. Timothy Wangler, Dr. Lex Reiter

#### Concrete Structures and Bridge Design - Prof. Dr. Walter Kaufmann:

Dr. Alejandro Giraldo Soto, Dr. Lukas Gebhard

#### NCCR Technicians:

Mike Lyrenmann, Philippe Fleischmann, Tobias Hartmann, Luca Petrus, Jonathan Leu

Client: Nova Fundaziun Origen

Architecture: Benjamin Dillenburger, Michael Hansmeyer

Construction: Invias

Structure: Conzett Bronzini Partner

#### Industry Partners:

Invias Zindel Uffer, BASF, Knauf, MESH AG, Saeki, Bieri, Aalborg White, Almatix, Creabeton AG

#### Funding:

**NCCR Digital Fabrication** - funded by the Swiss National Science Foundation (NCCR Digital Fabrication Agreement #51NF40-141853)

**Innosuisse** - Swiss Innovation Agency (3D Concrete Printing for Prefabricated Load-Bearing Columns #102.414.1 IP-ENG)

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**des**  
**ign** Center for  
Augmented Computational  
Design in Architecture,  
Engineering and Construction

Design++ - Centre for Augmented Computational Design in Architecture, Engineering and Construction  
ETH Zurich

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**des**  
**ign** Center for  
Augmented Computational  
Design in Architecture,  
Engineering and Construction

**Artificial Intelligence**

- Machine Learning
- Large Language Models

**Extended Realities**

- Virtual Reality
- Augmented Reality

**Human Machine Interaction**

- Augmented Computational Design
- Autonomous Digital Fabrication

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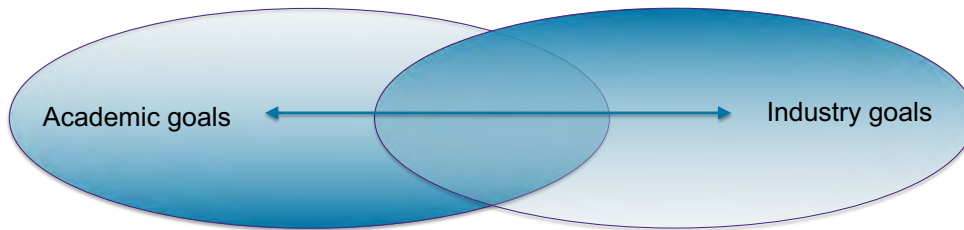


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## Digital Fabrication: research collaborations



NCCR Digital Fabrication  
ETH Zurich



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## NCCR Digital Fabrication

### DFAB: Research, Scale-Up, Develop, Test, Impement and Transfer

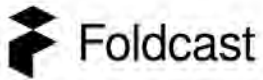
1. Interdisciplinary expert groups developing robust academic projects
2. Advanced research and development across a wide range of technologies for AEC
3. Actions for commercialisation, spin-off, and transfer of innovation into practice and industry

NCCR Digital Fabrication  
ETH Zurich



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## NCCR DFAB Spin-Offs



NCCR Digital Fabrication – SPIN OFFS  
ETH Zurich



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## NCCR Digital Fabrication

### Principal mandates of the NCCR DFAB

1. Innovative interdisciplinary collaboration
2. Develop sustainable and life cycle based solutions
3. Determine metrics and measures for feasibility
4. Scale-up development for real-world demonstrators
5. Commercialise and transfer innovation into industry and practice

NCCR Digital Fabrication  
ETH Zurich



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www.dfab.ch

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## NCCR DFAB – Project Videos and Websites

- **NCCR DFAB:** <https://dfab.ch/>
- **NCCR DFAB YouTube Chanel:** <https://www.youtube.com/@nccrdigitalfabrication8010/videos>
- **Arch\_Tec\_Lab:** <https://www.youtube.com/watch?v=s6adlyX5098> (click English subtitles)
- **Tor Alva:** <https://www.tor-alva.ch/en/>
- **DFAB House:** [https://www.youtube.com/watch?v=NNYxSo6h\\_vo](https://www.youtube.com/watch?v=NNYxSo6h_vo)
- **HiLo:** <https://www.youtube.com/watch?v=FTToismPgQk>

NCCR Digital Fabrication  
ETH Zurich



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