The BUGA Wood Pavilion 2019

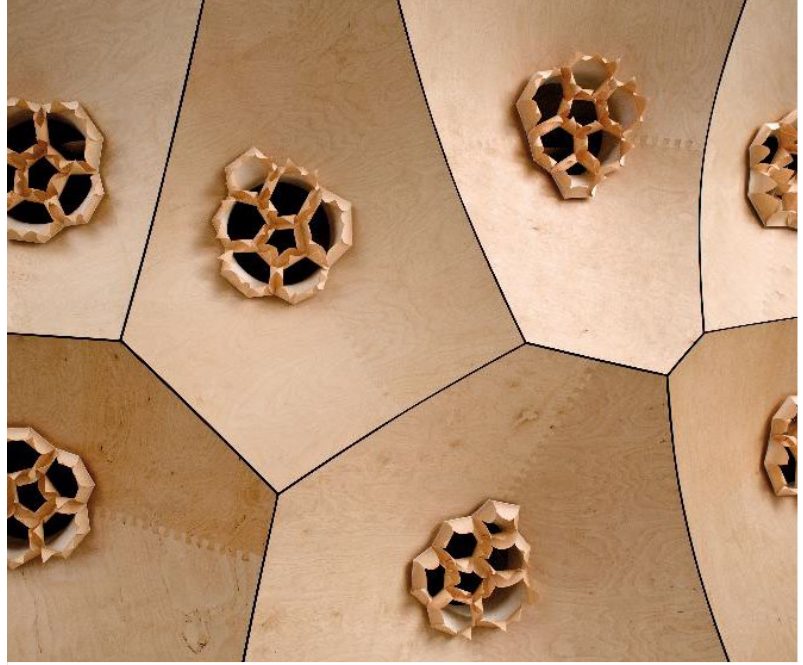
High Performance Timber Shell

Institute for Computational Design and Construction

Prof. Achim Menges

Research Interests

- Computational Design
- Robotic Fabrication
- Biomimetics in Building Design

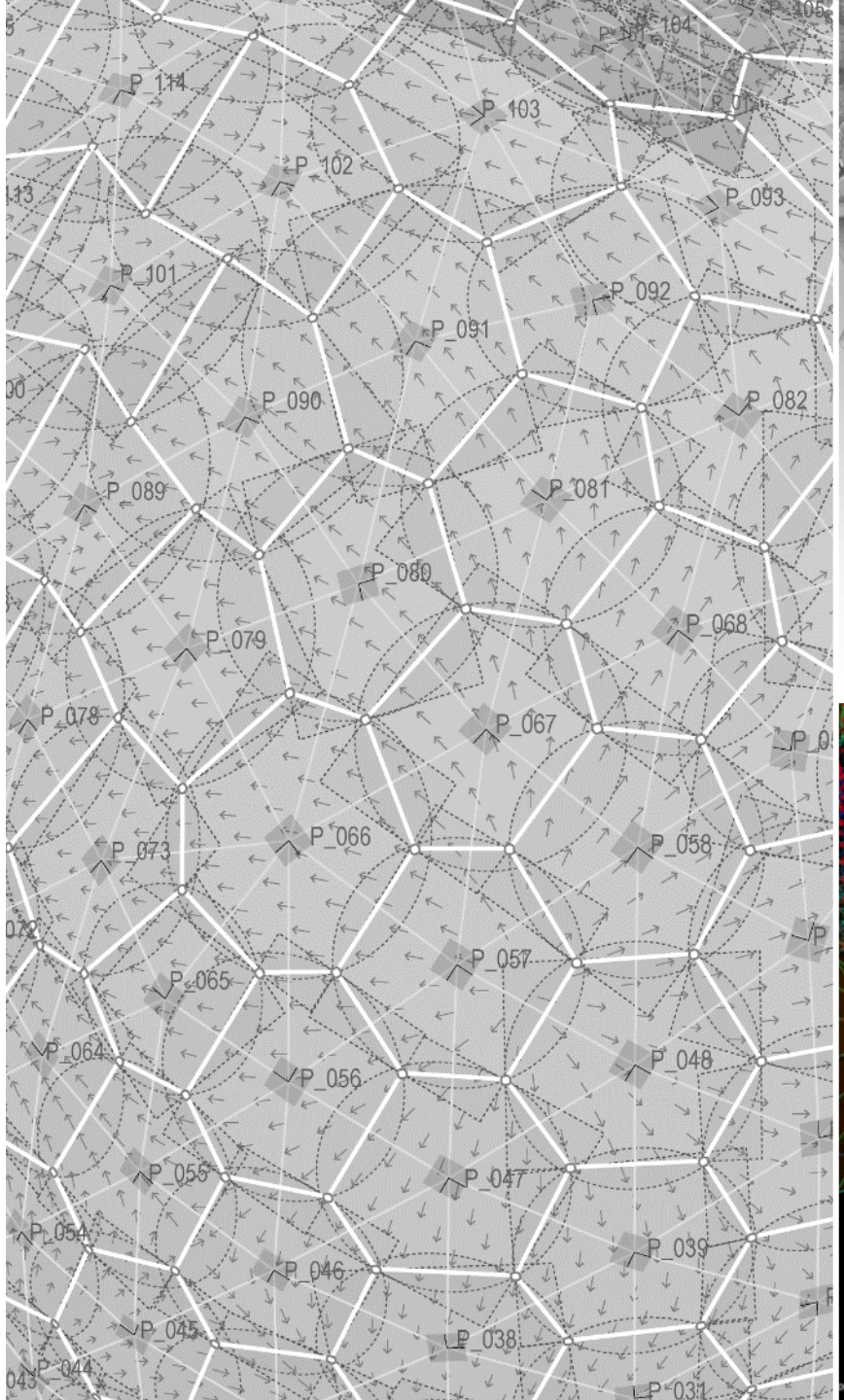


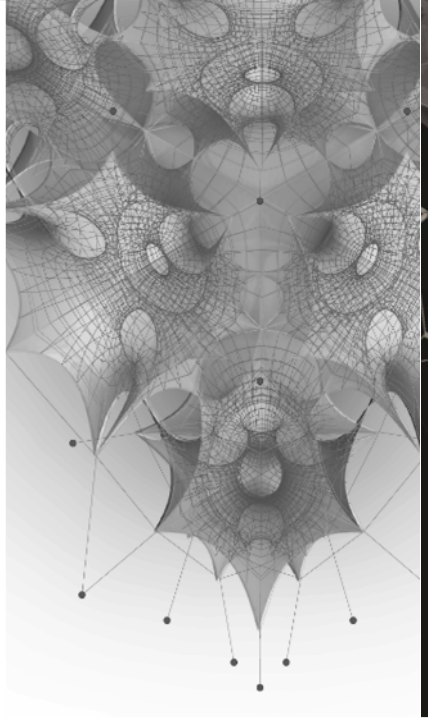
Institute for Computational Design and Construction

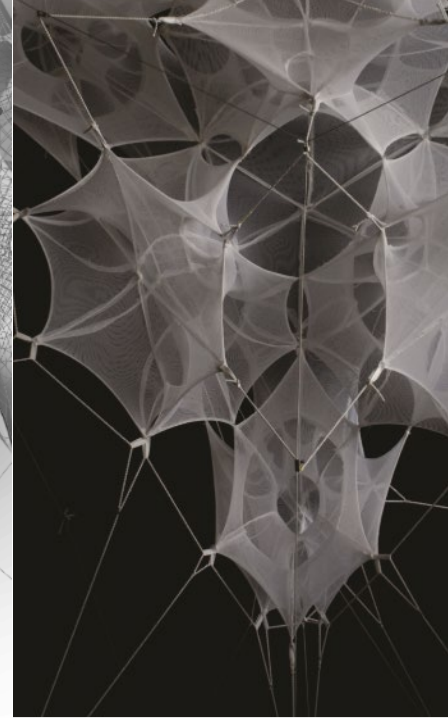
Prof. Achim Menges

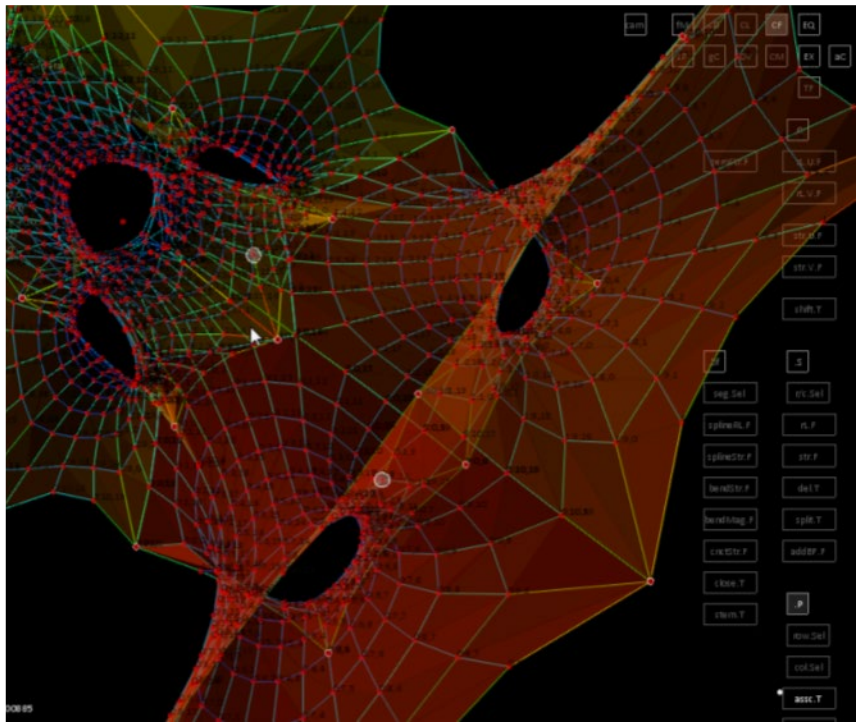
Computational Design

- Algorithmic modelling of complex geometry
- Integrative form generation
- Evolutionary design exploration and optimisation
- Agent-based modelling and simulation









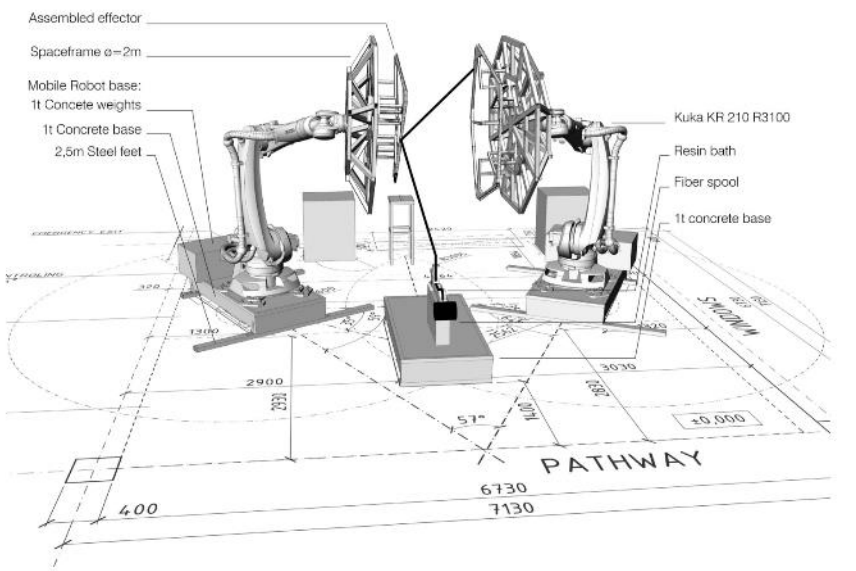
ICD **Institute for Computational Design**
Institut für Computerbasiertes Entwerfen

Institute for Computational Design and Construction

Prof. Achim Menges

Robotic Fabrication

- Processes for one-off production of populations
- Robotic pre-fabrication
- Design-for-Fabrication: from digital chain (file-to-factory) to digital loop (integrative design)



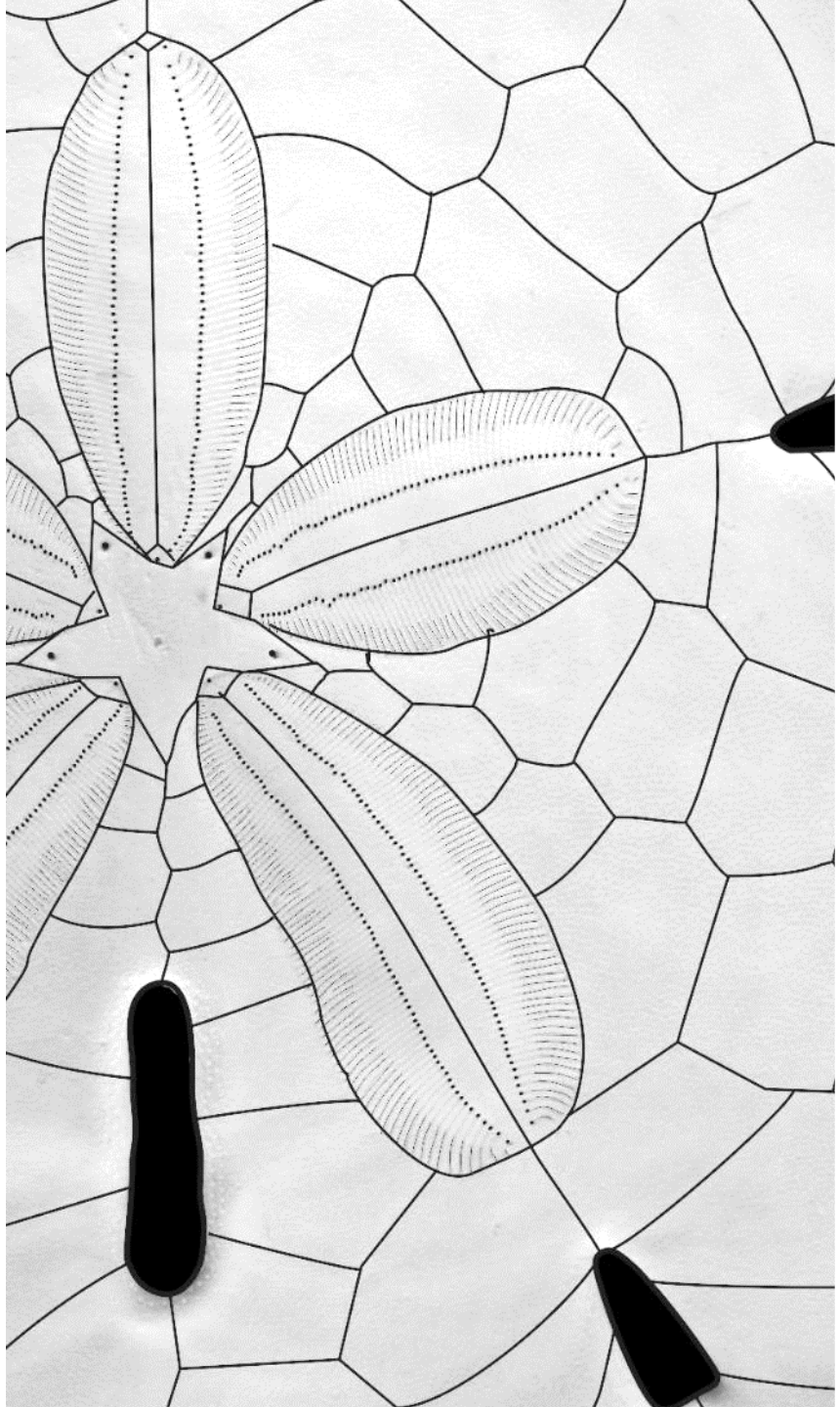
Institute for Computational Design and Construction

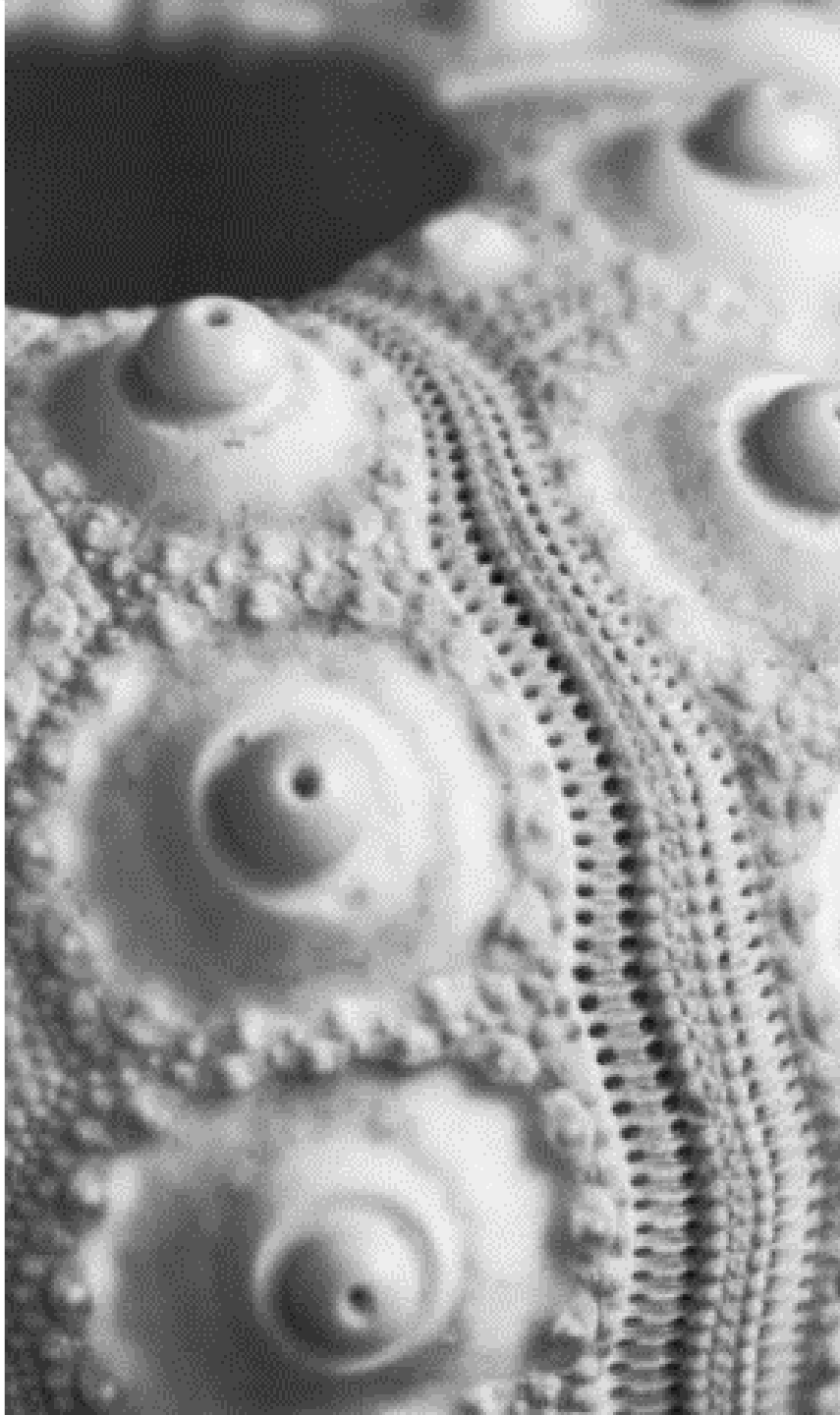
Prof. Achim Menges

Biomimetics in Building Design

- Biomimetics in Construction and Design
- Less resource consumption through more performative forms

"In biology material is expensive but shape is cheap. As of today the opposite was true in the case of technology." - Julian Vincent

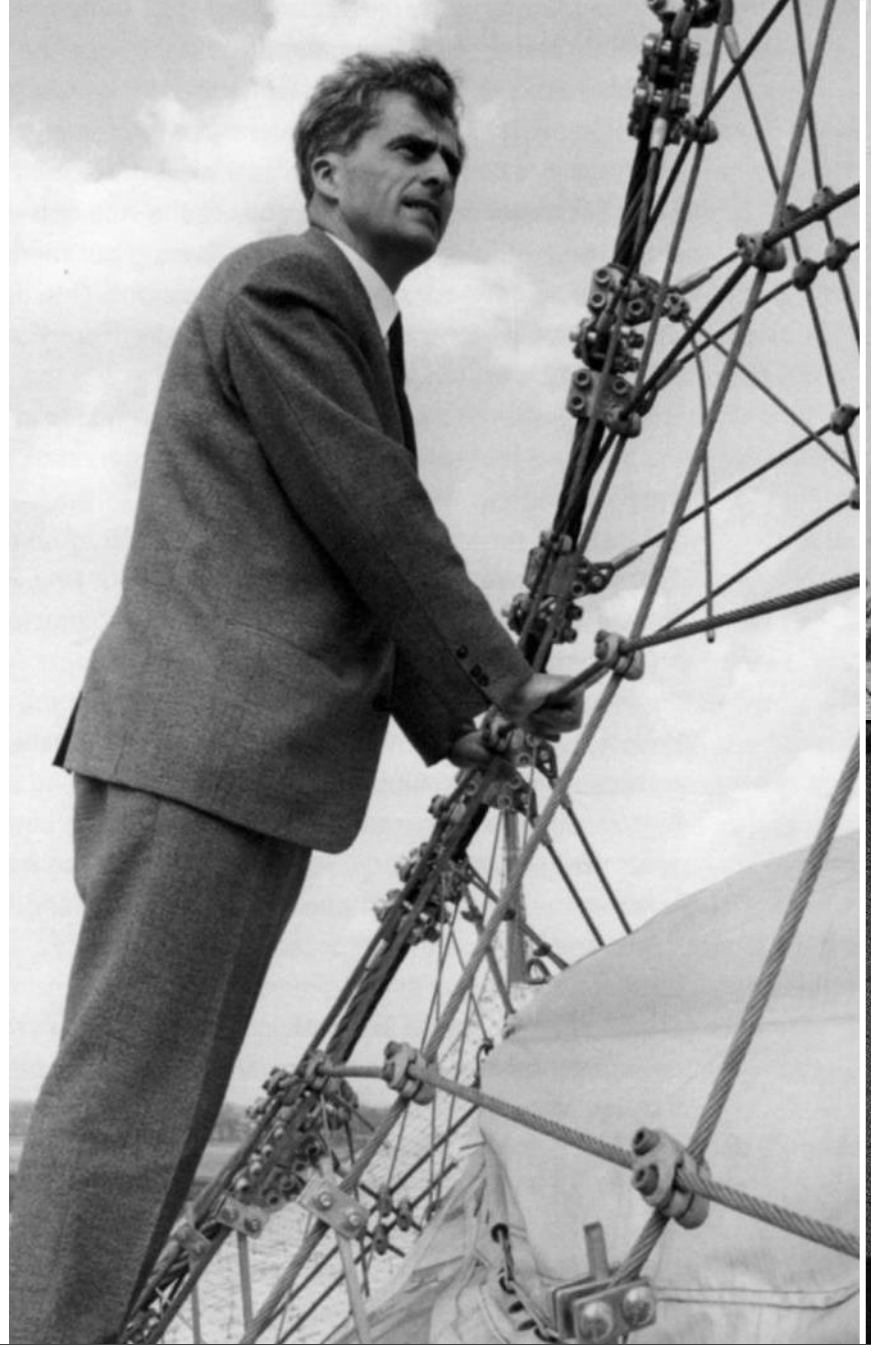


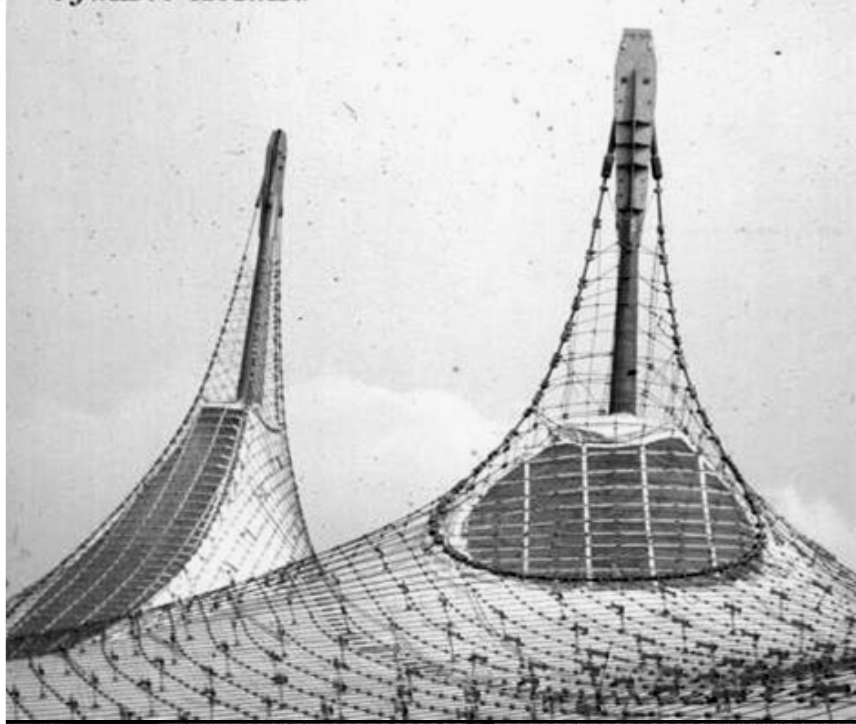


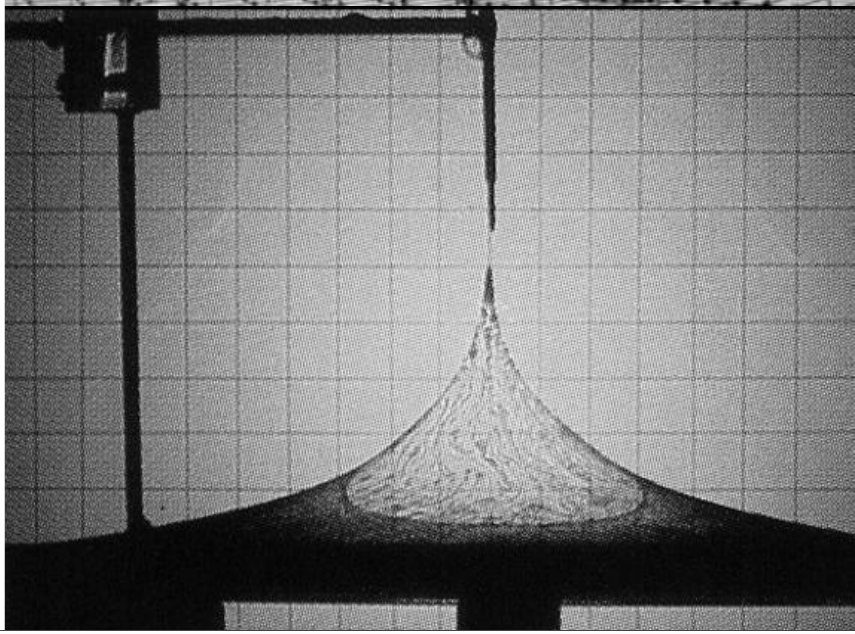
FORM FINDING
FREI OTTO

“The characteristic form results from the organisation of matter in space, the arrangement of elements according to a number of embedded rules. “

Frei Otto







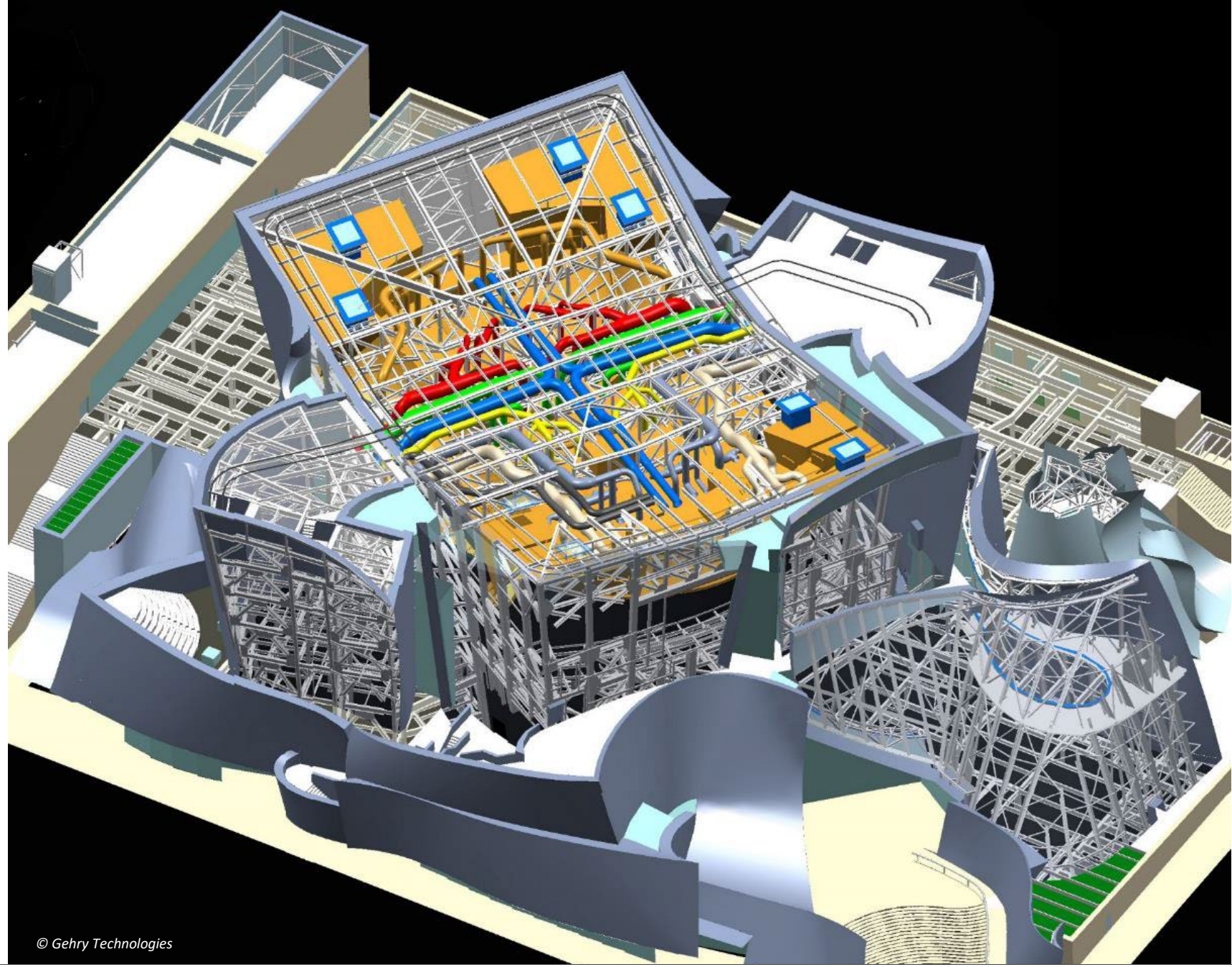
COMPUTERIZATION

Author: owns outcome
Abstraction: action of designing
Specificity: induced

COMPUTATION (ACT: COMPUTING)

Author: owns principle, not outcome
Abstraction: principle of designing
Specificity: deduced

Terzidis, Kostaz, 2011 (2003): Algorithmic Form, in: Menges, A, Ahlquist, S (eds): Computational Design Thinking, Wiley & Sons Ltd, Chichester, pp 94-101.



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COMPUTATION

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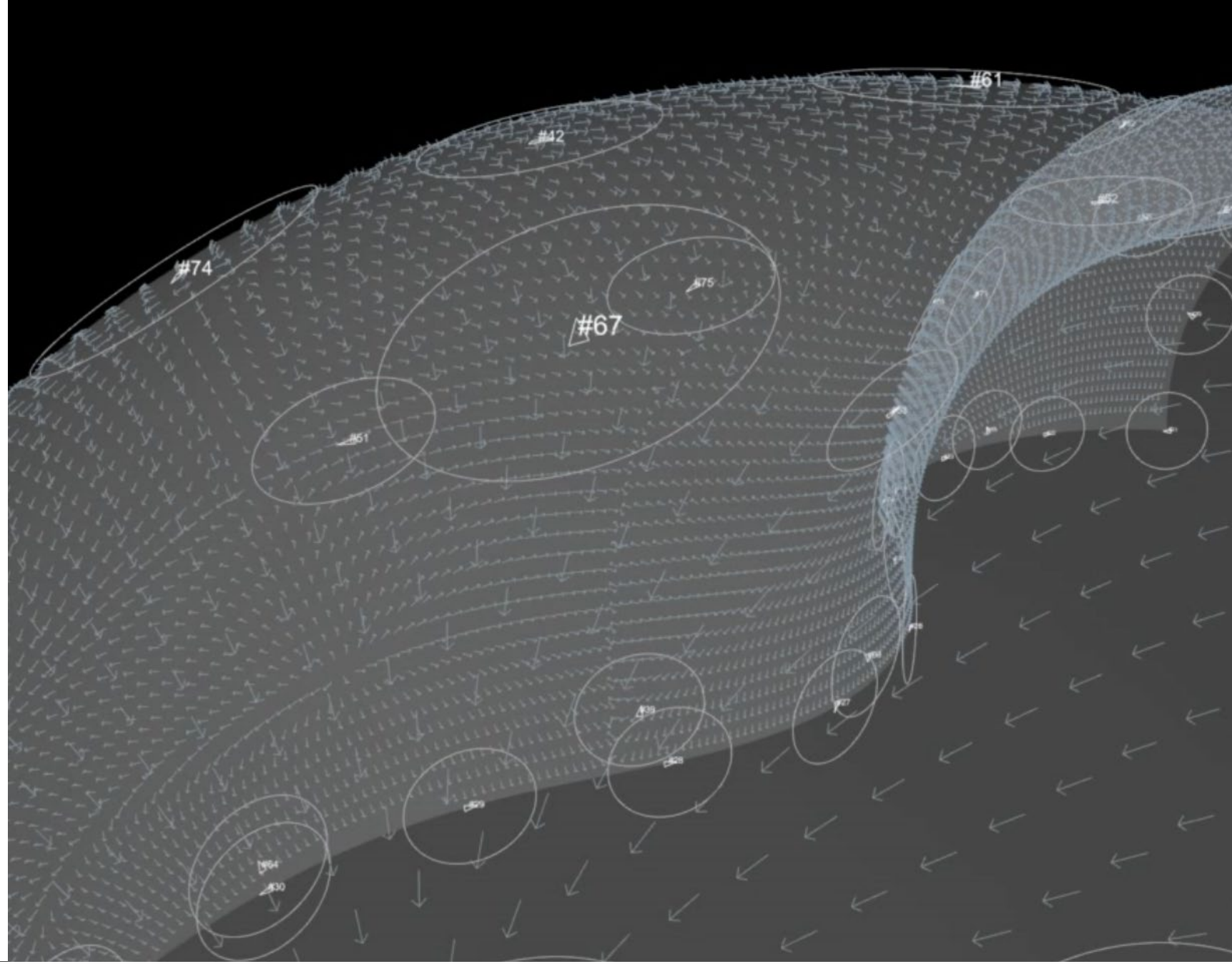

Terzidis, Kostaz, 2011 (2003): Algorithmic Form, in: Menges, A, Ahlquist, S (eds): Computational Design Thinking, Wiley & Sons Ltd, Chichester, pp 94-101.

BUGA WOOD PAVILION

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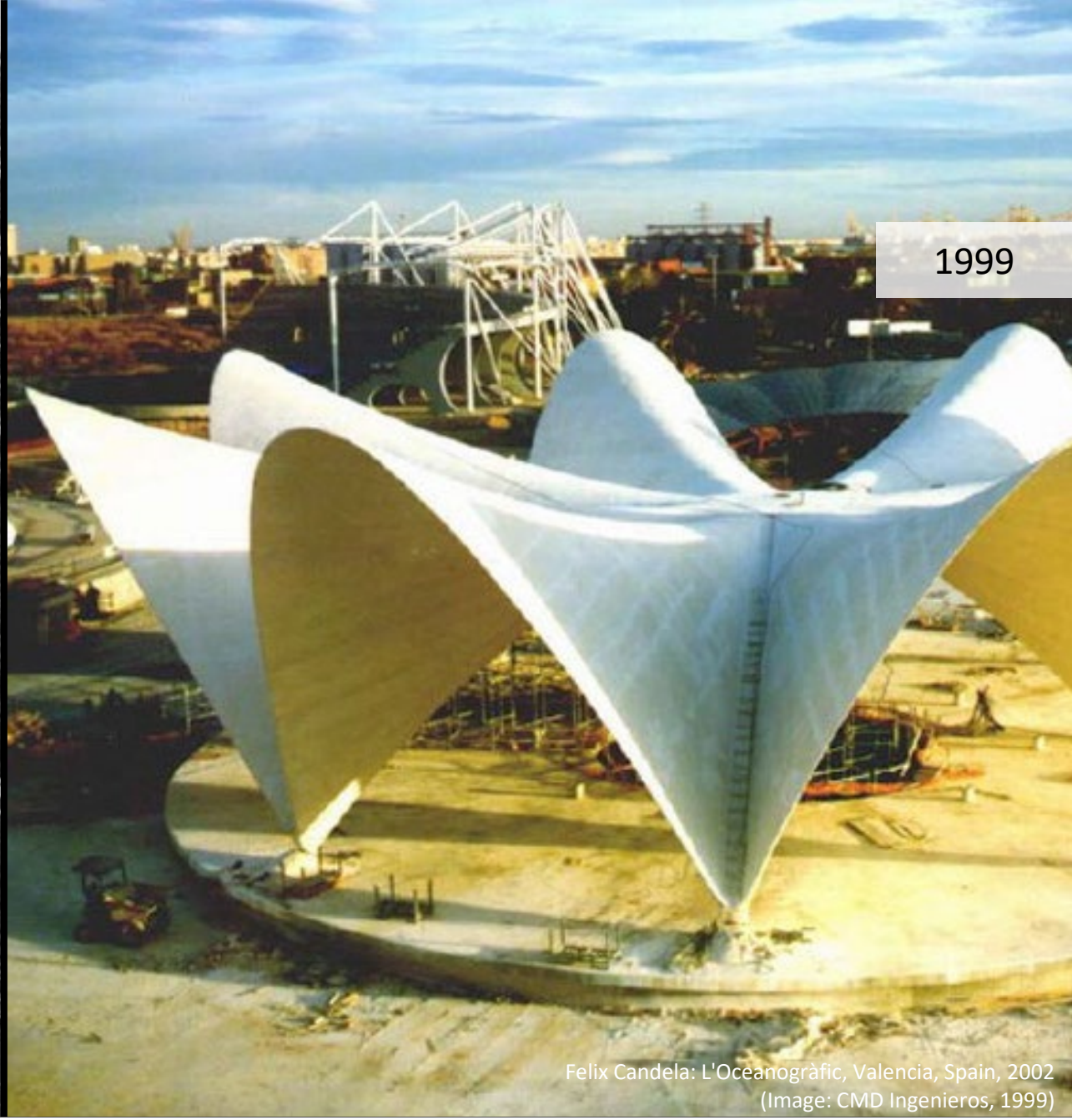
MÜLLERBLAUSTEIN BAUWERKE GMBH
Reinhold Müller, Oliver Fried, Daniel Müller

BUNDESGARTENSCHAU HEILBRONN 2019 GMBH

BEC GMBH
Matthias Buck, Zied Bhiri

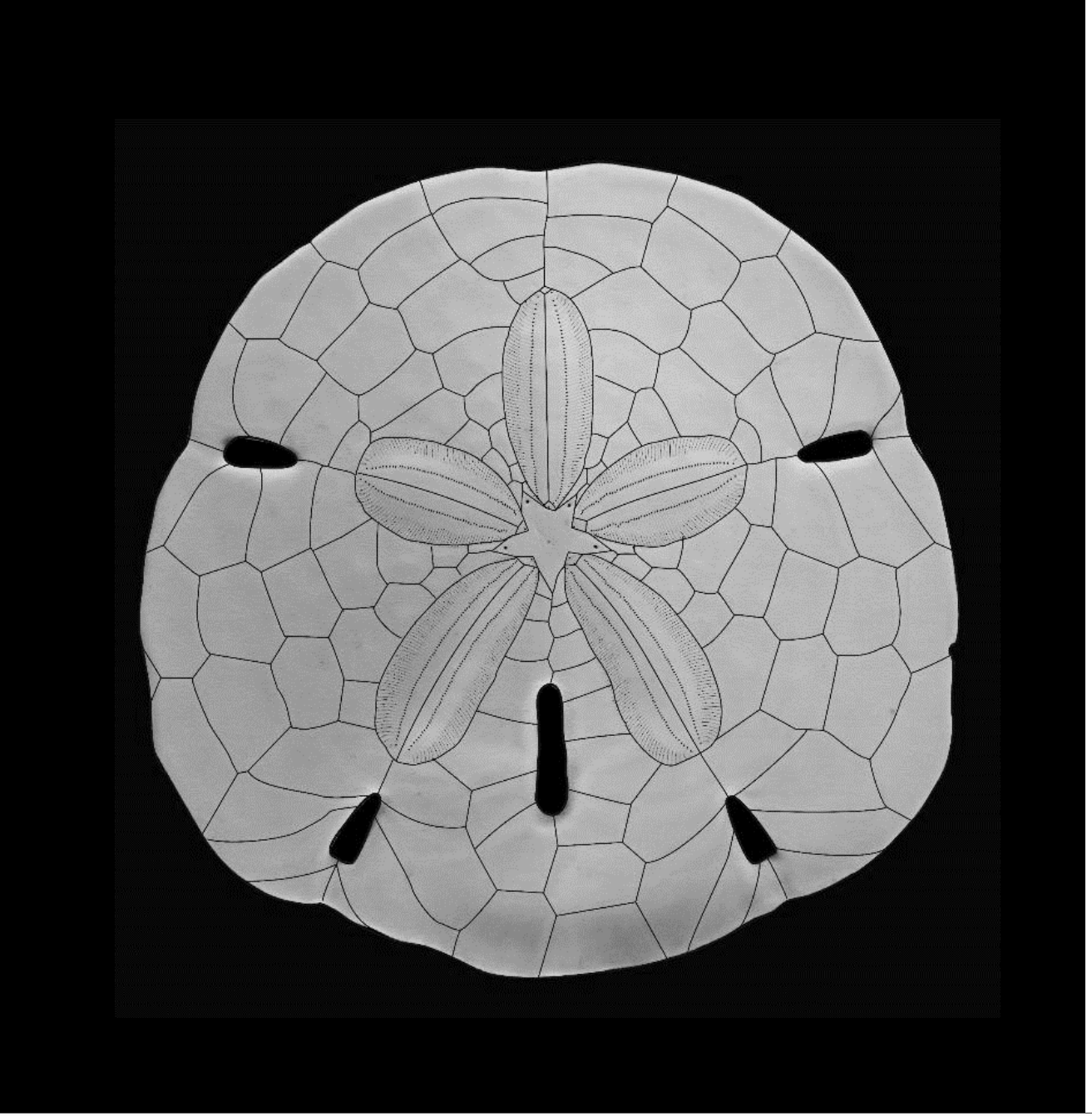
Felix Candela: Los Manantiales Restaurant, Xochimilco, Mexiko, 1958

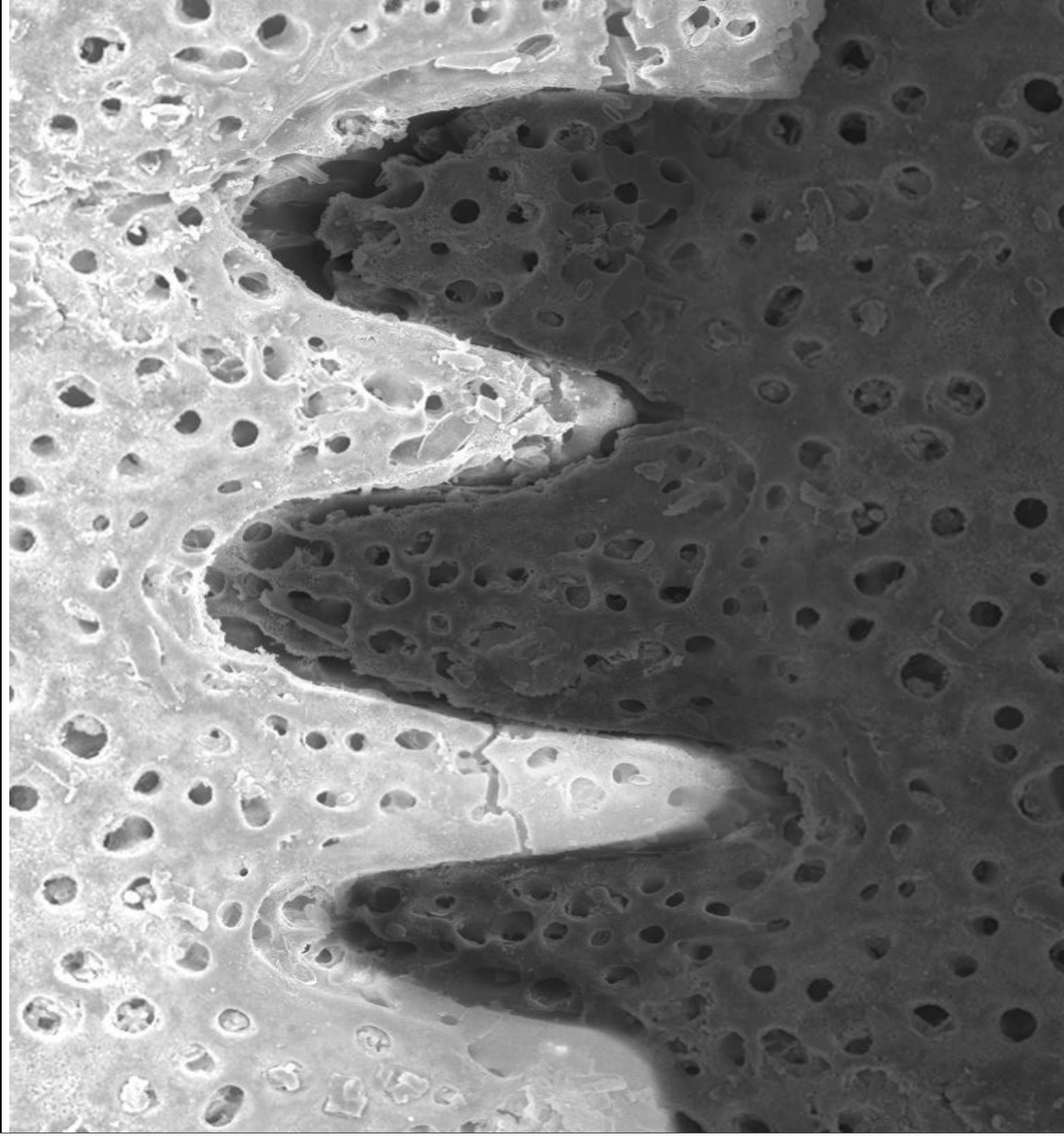


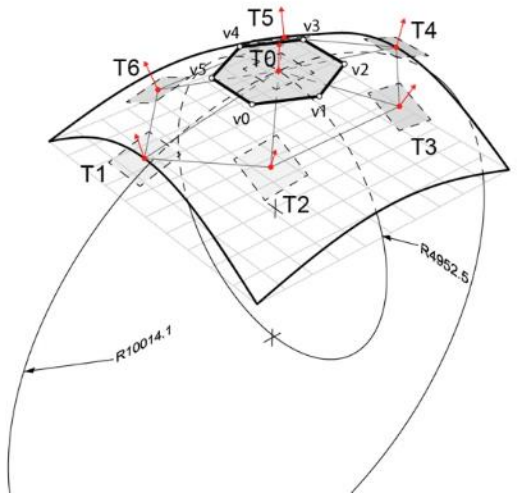
Felix Candela: L'Oceanogràfic, Valencia, Spain, 2002
(Image: CMD Ingenieros, 1999)

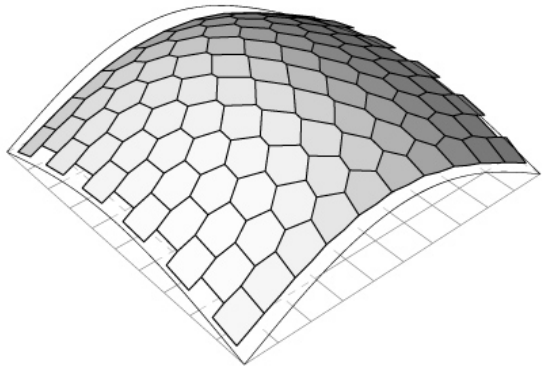
Felix Candela: Los Manantiales Restaurant, Xochimilco, Mexiko, 1958

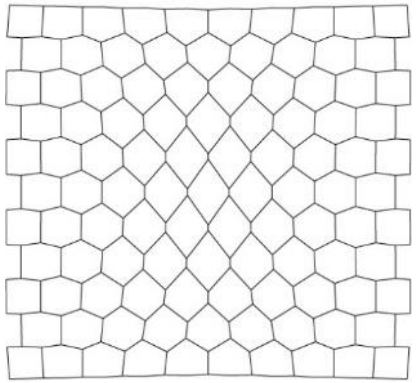
Felix Candela: L'Oceanogràfic, Valencia, Spain, 2002





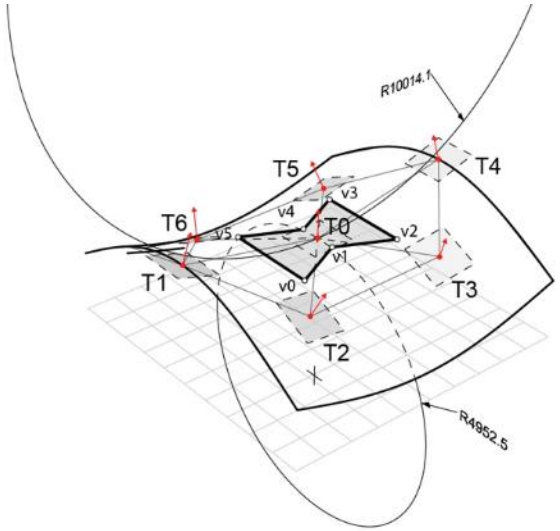


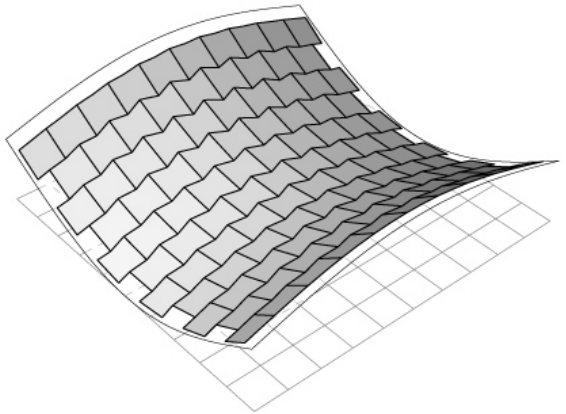


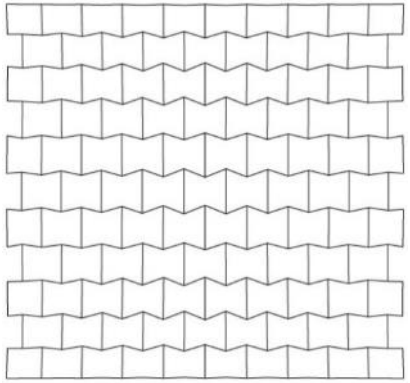


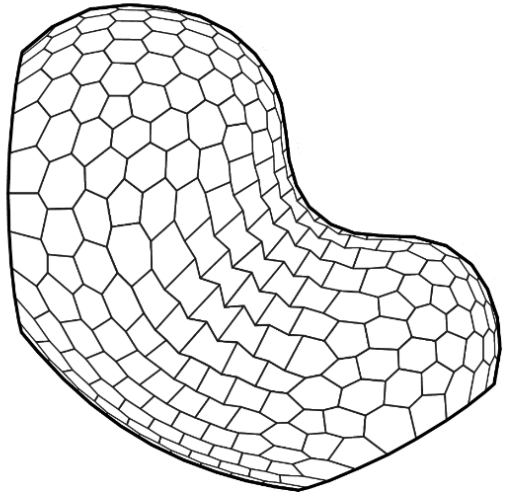
synclastic

anticlastic

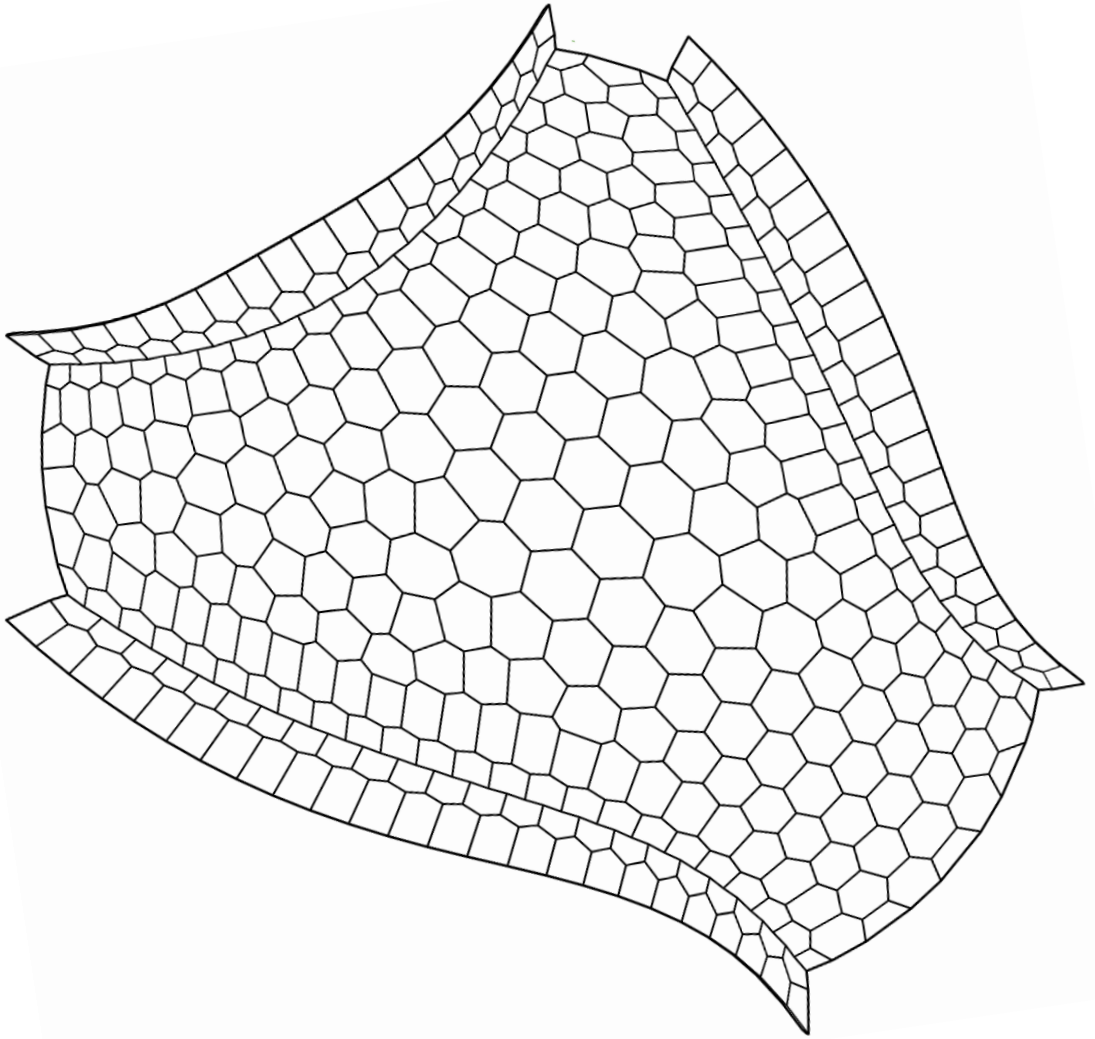






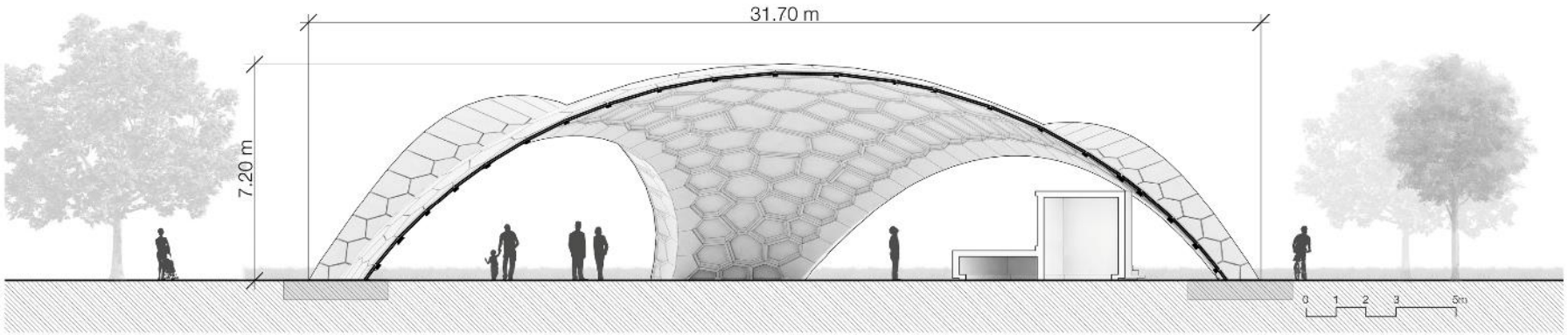


LANDESGARTENSCHAU 2014
Weight per Shell Area: 40 kg/m²

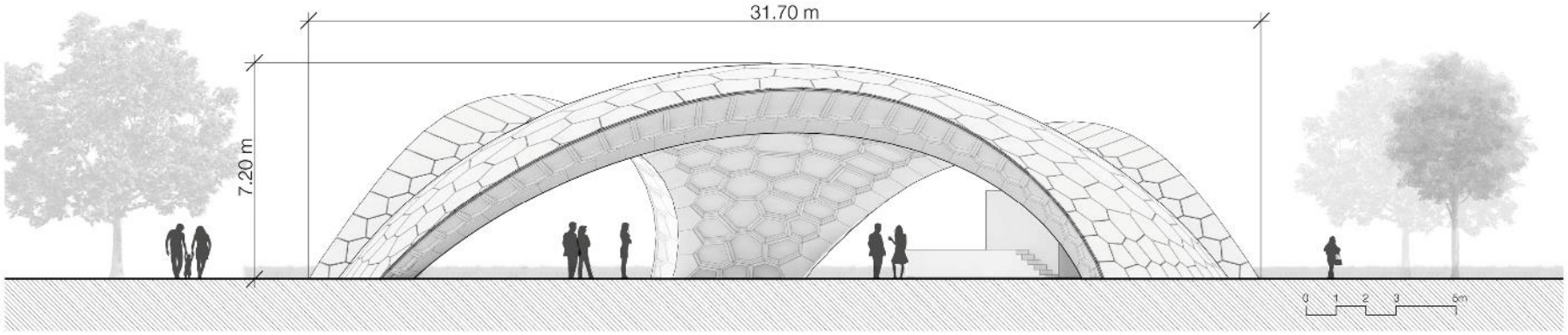


BUNDESSGARTENSCHAU 2019
Weight per Shell Area : 42 kg/m²

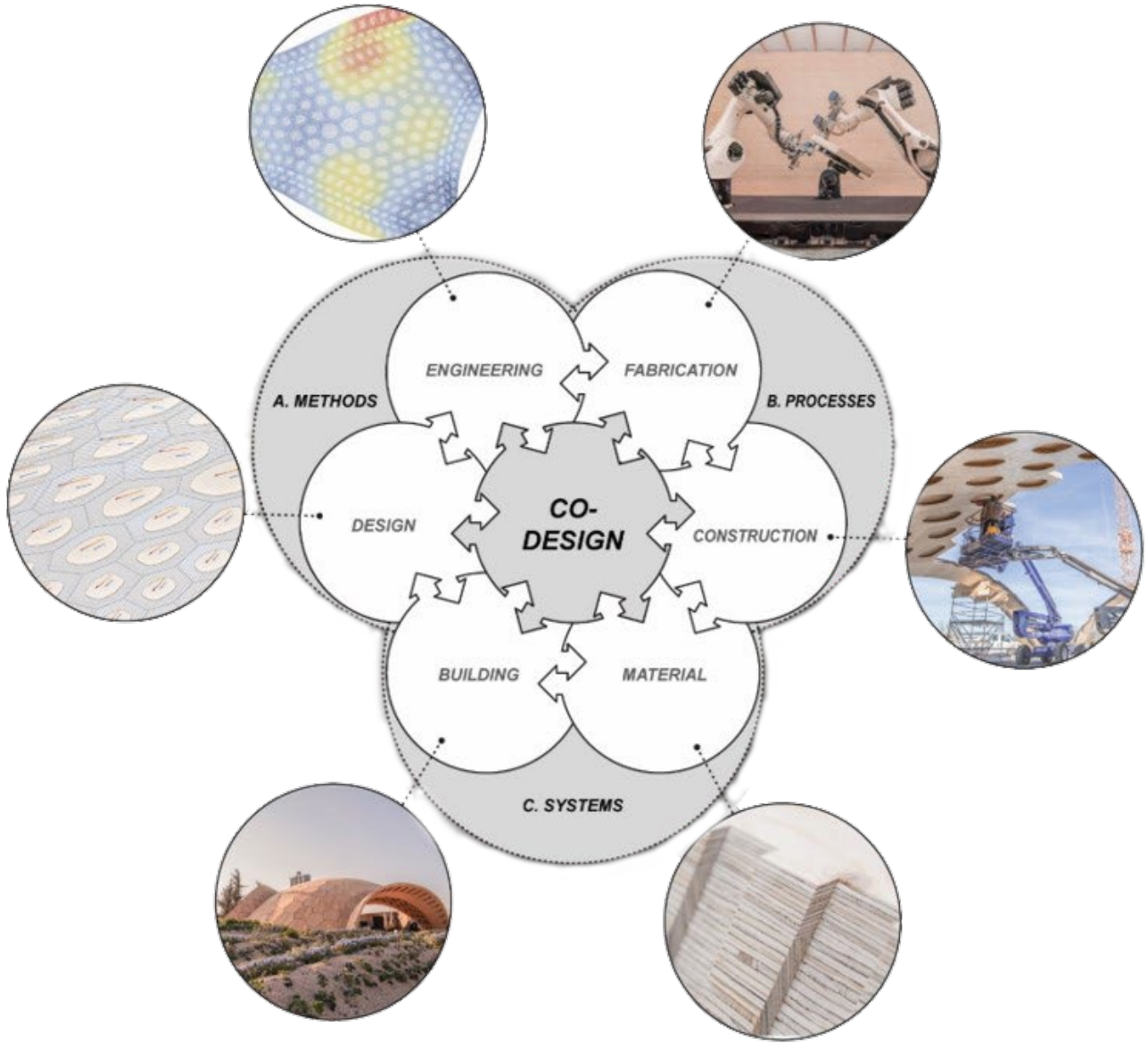
Section

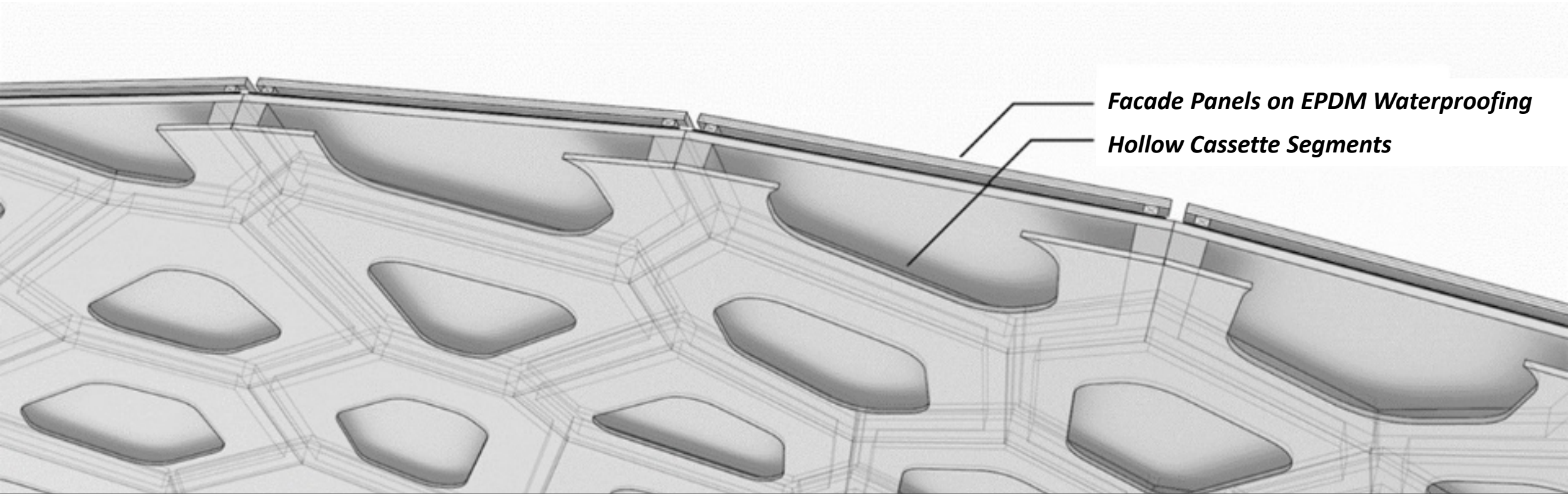


Schnitt A-A 1:200



Ansicht Südseite 1:200


ENGINEERING
FABRICATION
A. METHODS
B. PROCESSES
DESIGN
CO-
DESIGN
CONSTRUCTION
BUILDING
MATERIAL
C. SYSTEMS


Facade Panels on EPDM Waterproofing
Hollow Cassette Segments

Facade Panels
Larch 3-Ply

Battens in Direction of Water Flow
Purenitstrips 40x60mm

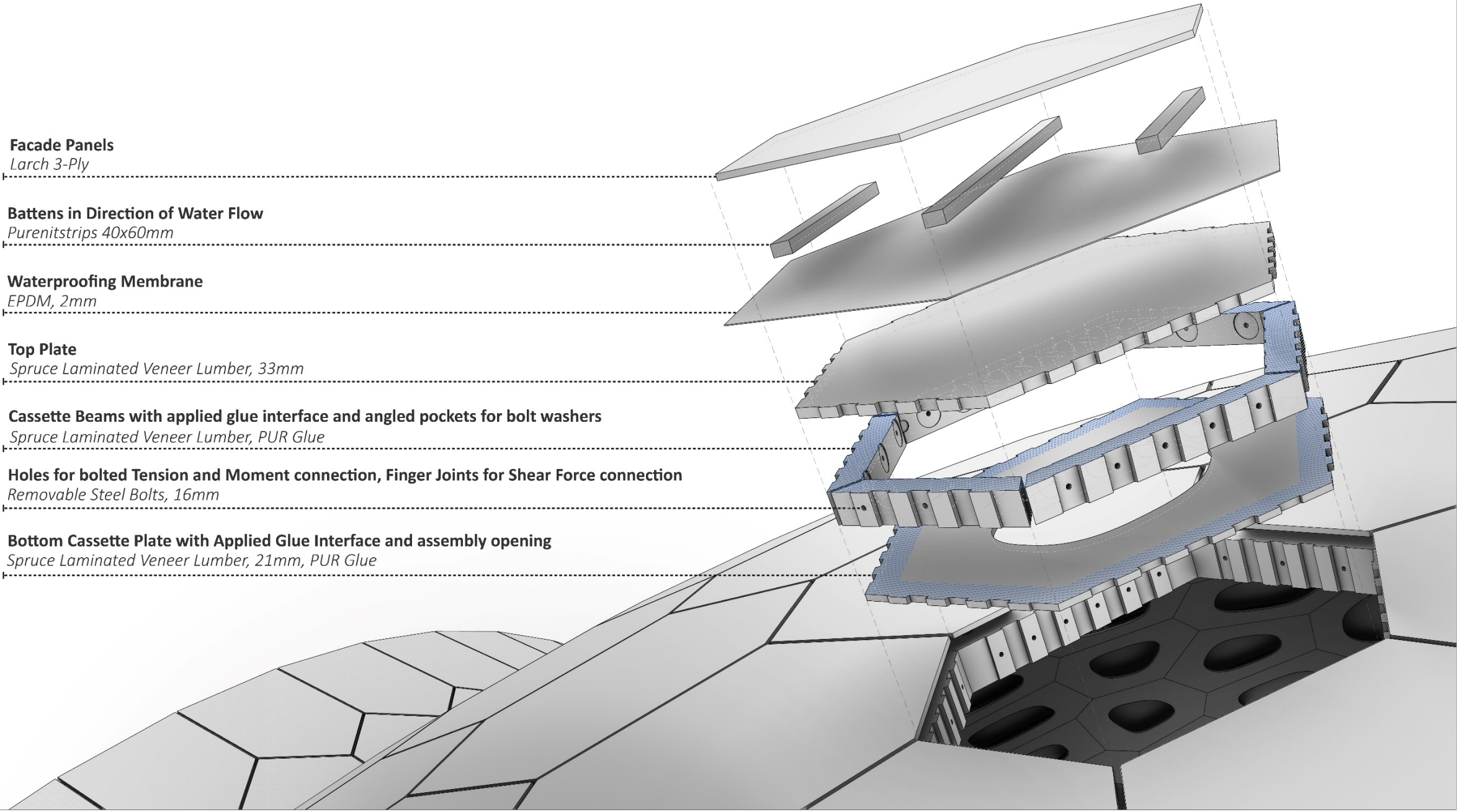
Waterproofing Membrane
EPDM, 2mm

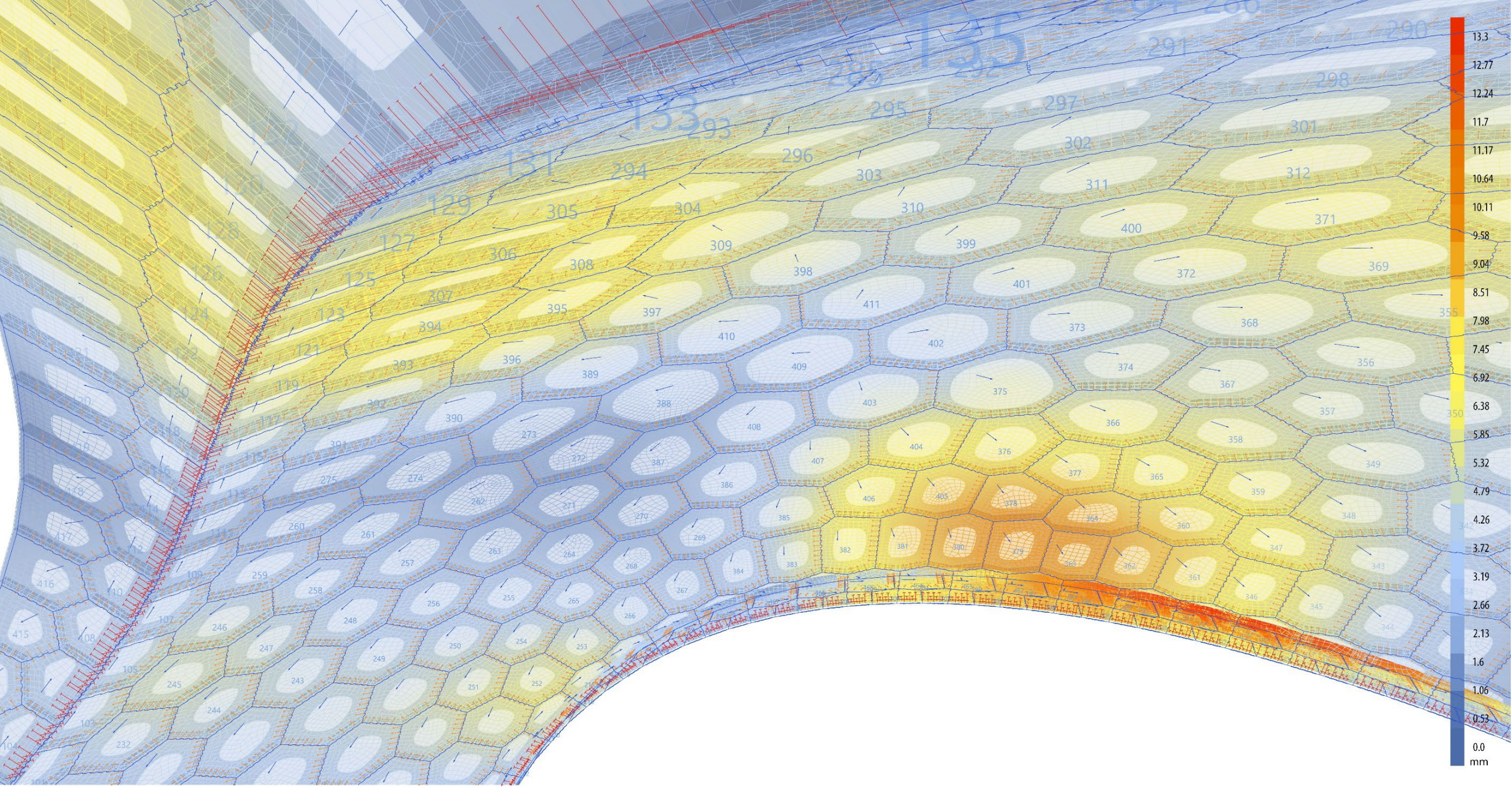
Top Plate
Spruce Laminated Veneer Lumber, 33mm

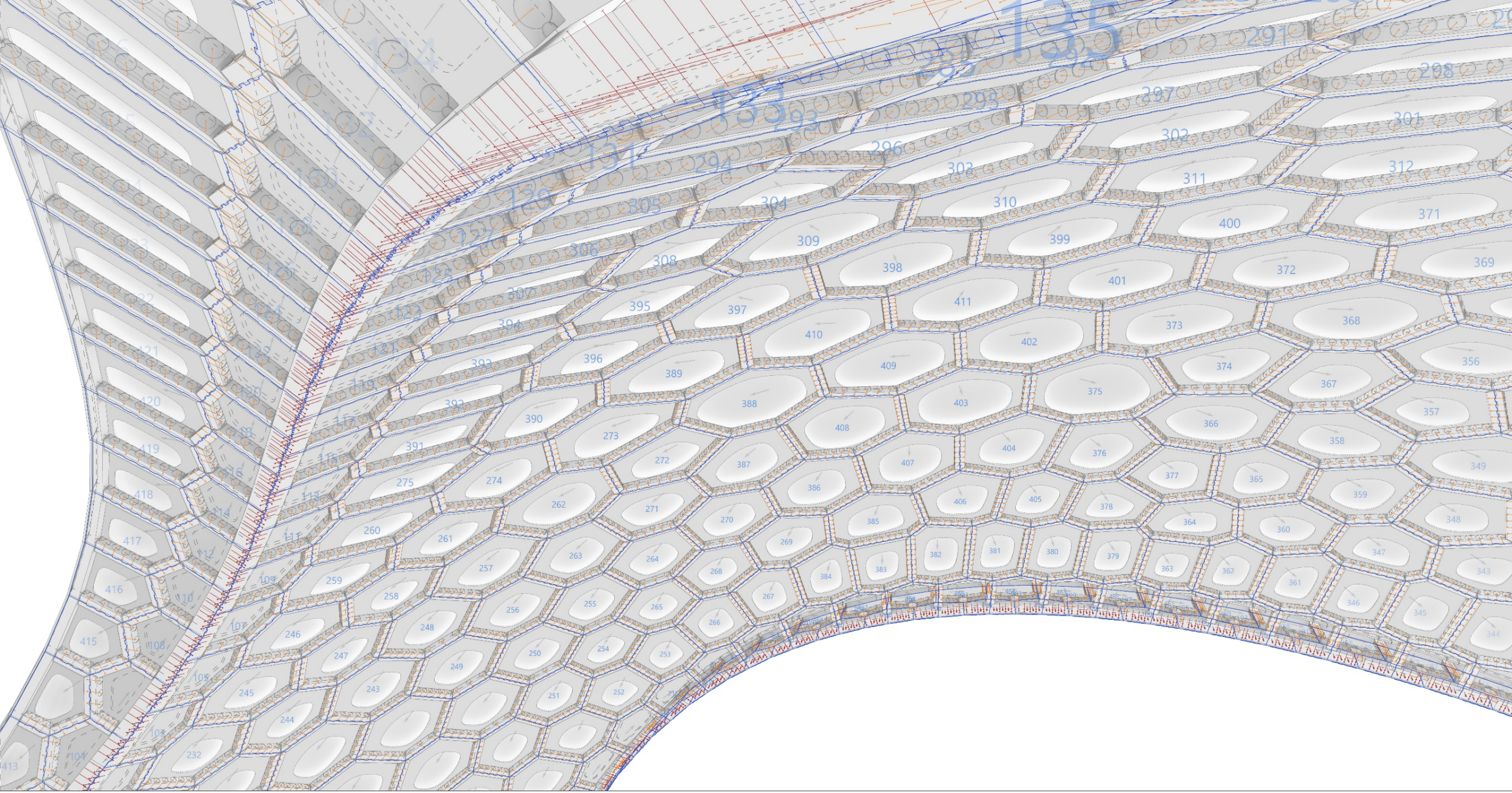
Cassette Beams with applied glue interface and angled pockets for bolt washers
Spruce Laminated Veneer Lumber, PUR Glue

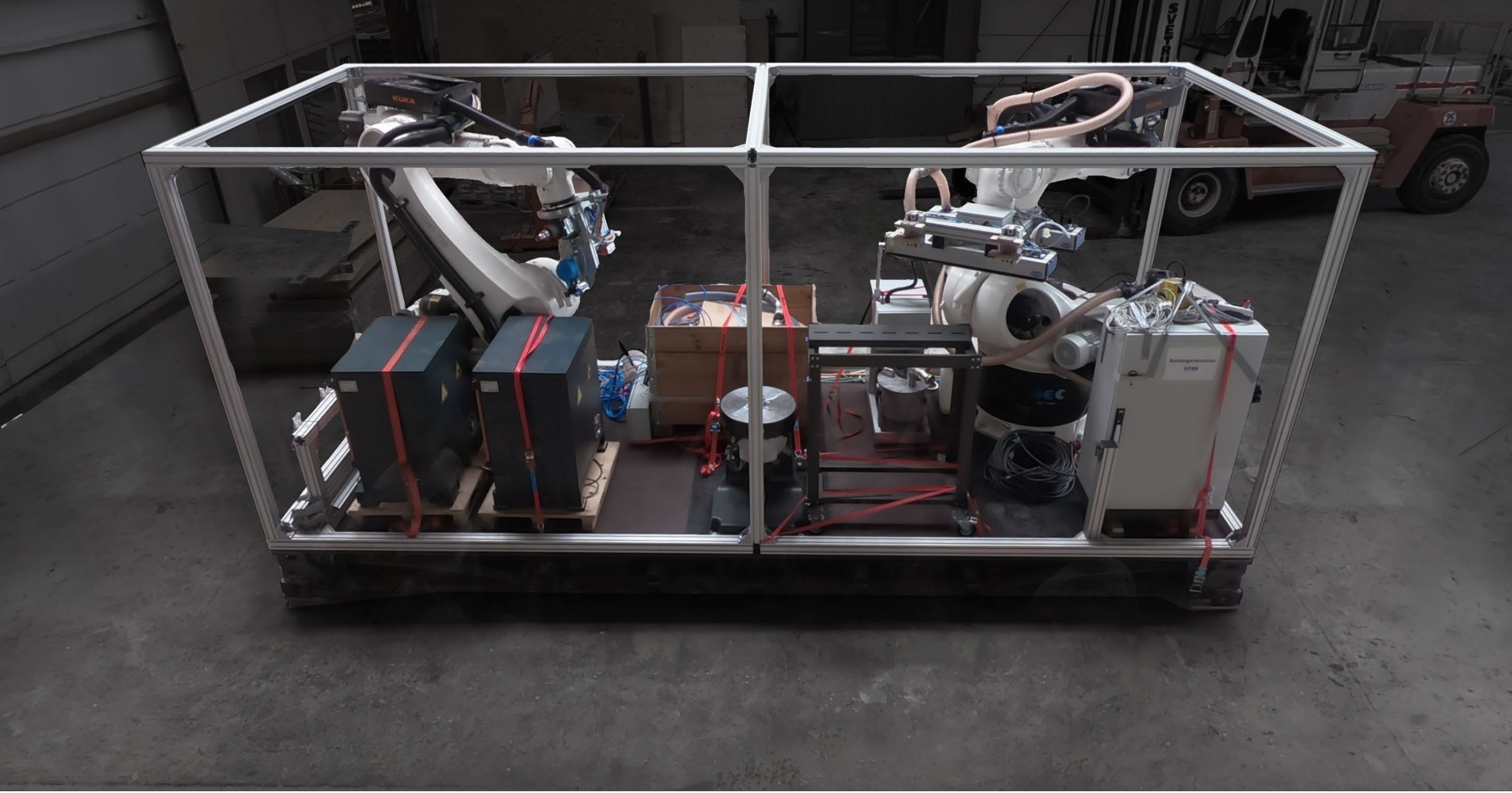
Holes for bolted Tension and Moment connection, Finger Joints for Shear Force connection
Removable Steel Bolts, 16mm

Bottom Cassette Plate with Applied Glue Interface and assembly opening
Spruce Laminated Veneer Lumber, 21mm, PUR Glue




13.3
12.77
12.24
11.7
11.17
10.64
10.11
9.58
9.04
8.51
7.98
7.45
6.92
6.38
5.85
5.32
4.79
4.26
3.72
3.19
2.66
2.13
1.6
1.06
0.53
0.0
mm

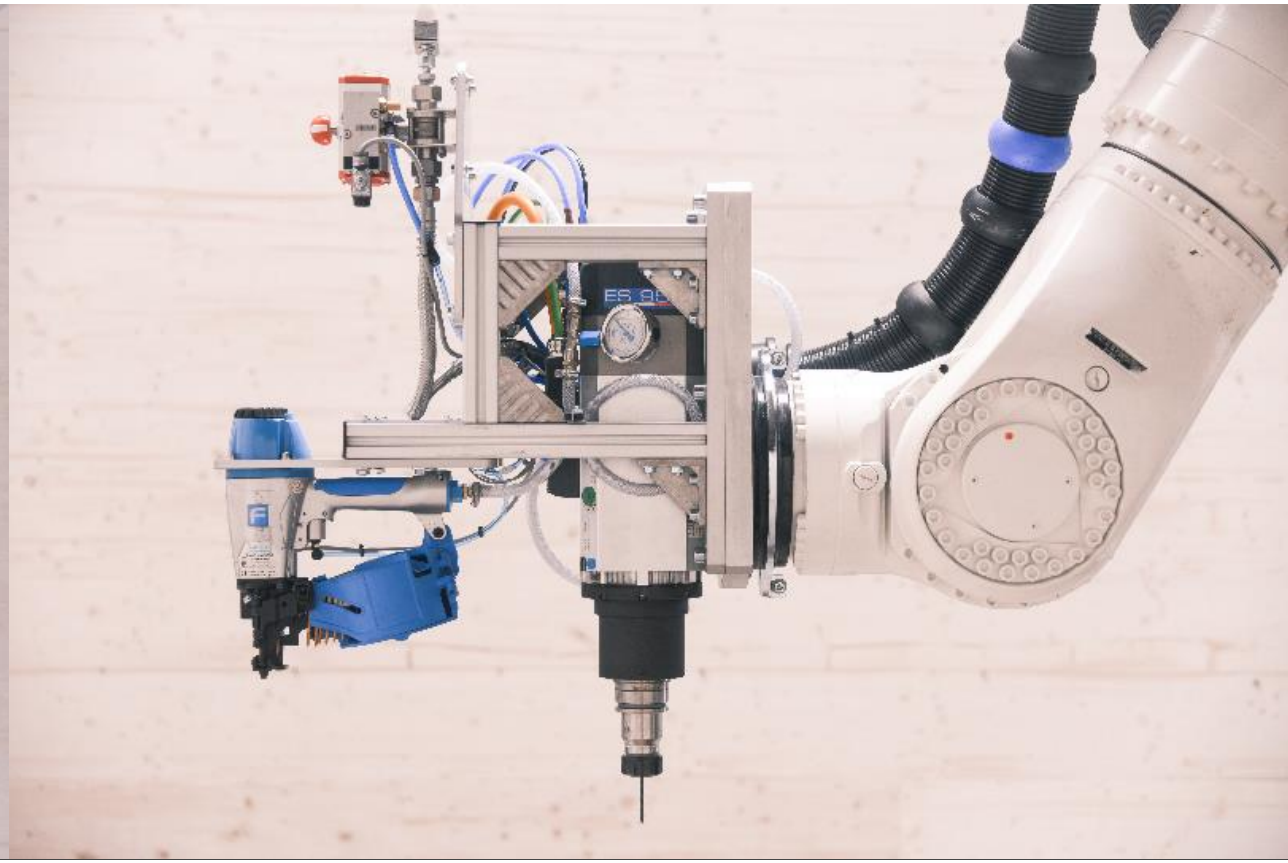



KUKA

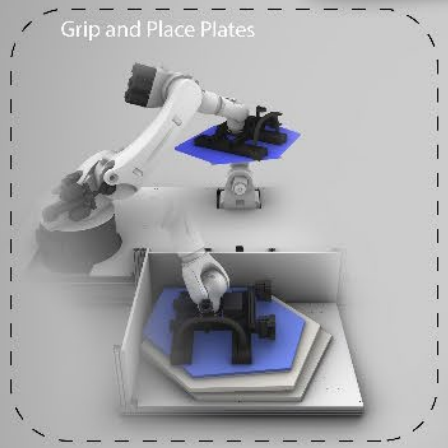
KUKA
KUKA
BEC GMBH

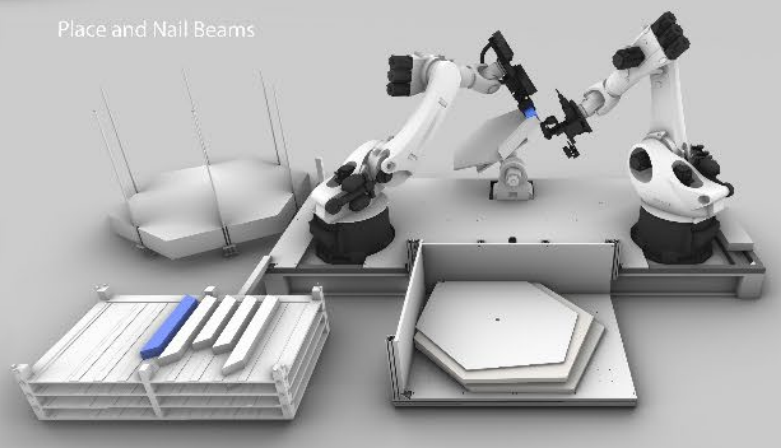
- Gripping Beams, Plates and Cassettes
- Proximity Sensors for Process Controll
- SmartCamera zur QualityControl

- Spindle, 4 Tools
- Automated Handnailgun
- Glue-Application Head



Process Simulation





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BUGA HOLZPAVILLON

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BEC GMBH
Matthias Buck, Zied Bhiri

Stuttgart University

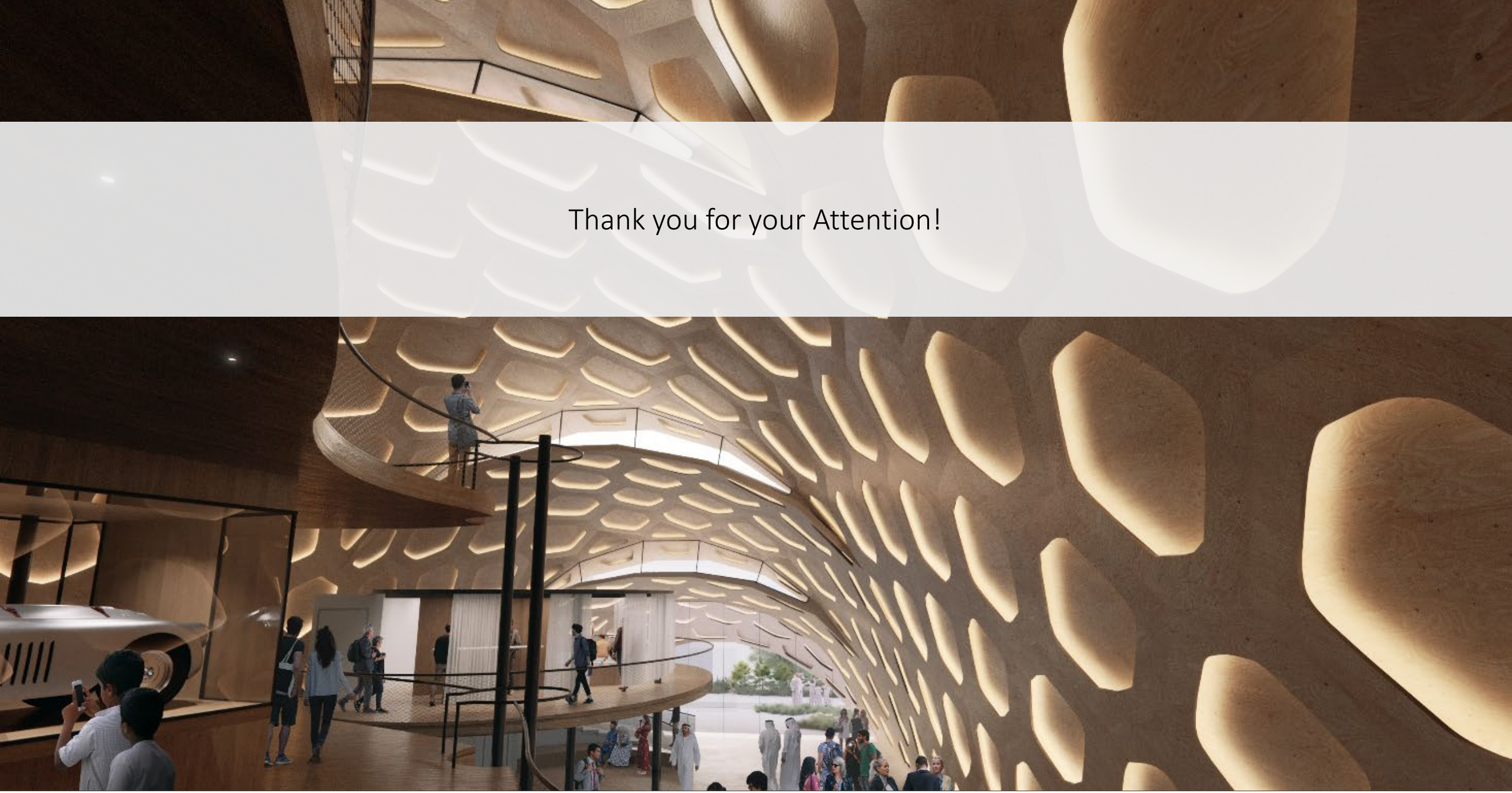
Cluster of Excellence
EXC 2120

Integrative Computational Design and Construction

DFG Deutsche Forschungsgemeinschaft

EXPO 2020 BW Pavilion Competition: 2nd Prize

Lederer Ragnarsdóttir Oei GmbH & Co. KG
Jan Knippers Ingenieure
DS-Plan Ingenieursgesellschaft GmbH
Menges Scheffler Architekten Part GmbH



Thank you for your Attention!