1:1 Interactive Architecture Prototypes Workshop

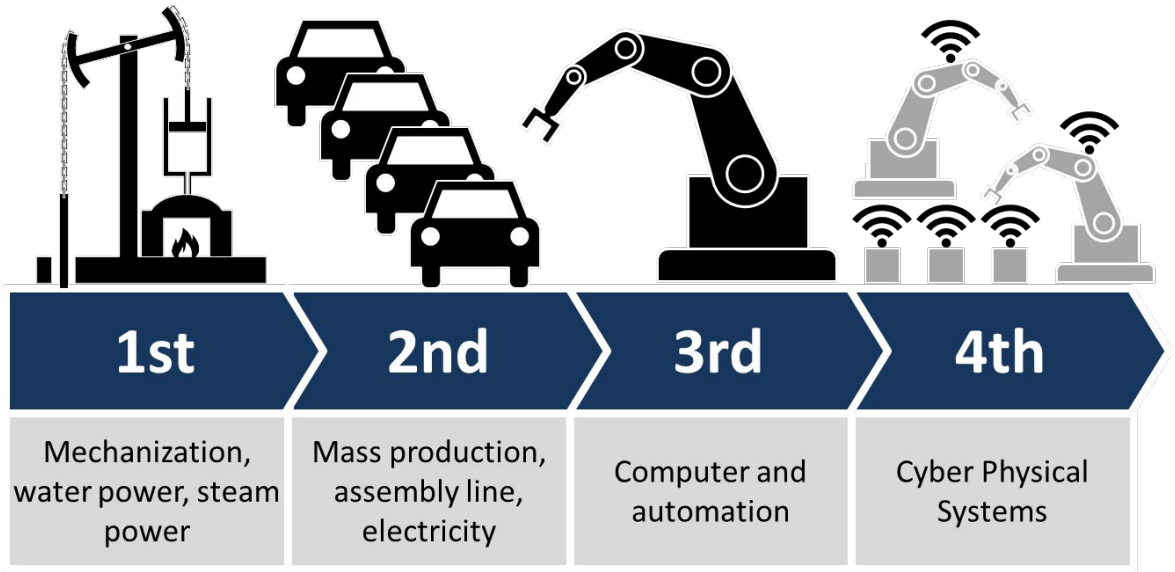
Content

- Research
  - Industrial revolutions
  - References
- Materialization Design
  - Concept
  - Structure
  - Acoustics
  - Rainpathing
  - Beampacking
- Production
- Feedbackloop
  - Within scope assignment
  - Outside scope assignment

Research Industrial Revolutions

Industrial revolution
Emulating old style
New style

Industrial revolutions 2-4



Industrial revolutions 2

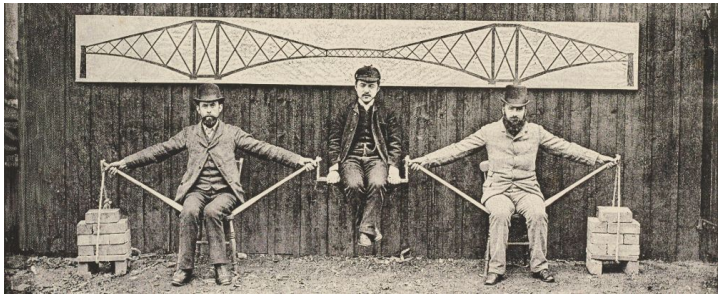
- 1870-1914
- a.k.a. Technological revolution
- Advancements in manufacturing and production technology -> mass production/assembly lines-> Rapid industrialization
- Telegraph and railroad network-> Globalization

Industrial revolutions 2 Emulating the old

- 1891: Wainwright Building - Chicago - Louis Sullivan
  - One of the first skyscrapers
  - Steel structure-> brick appearance
  - Imitating existing style

Industrial revolutions 2 New style

- 1890: Forth bridge - John Fowler en Benjamin Baker
  - Tension strength of steel is taken as advantage



Industrial revolutions 3.0

- Between the late 1950s and 1970s - present day
- a.k.a. Digital Revolution
- Use electronics and IT to achieve further automation of manufacturing
    - Electronics, computers
    - Automation, mass production
    - Information technology

Industrial revolutions 3.0 Emulating the old

- Sagrada Familia completing - Barcelona - Present architects/Antoni Gaudi
  - CAD&3D printing prototypes
  - Gaudi’s original design

Industrial revolutions 3.0 New style

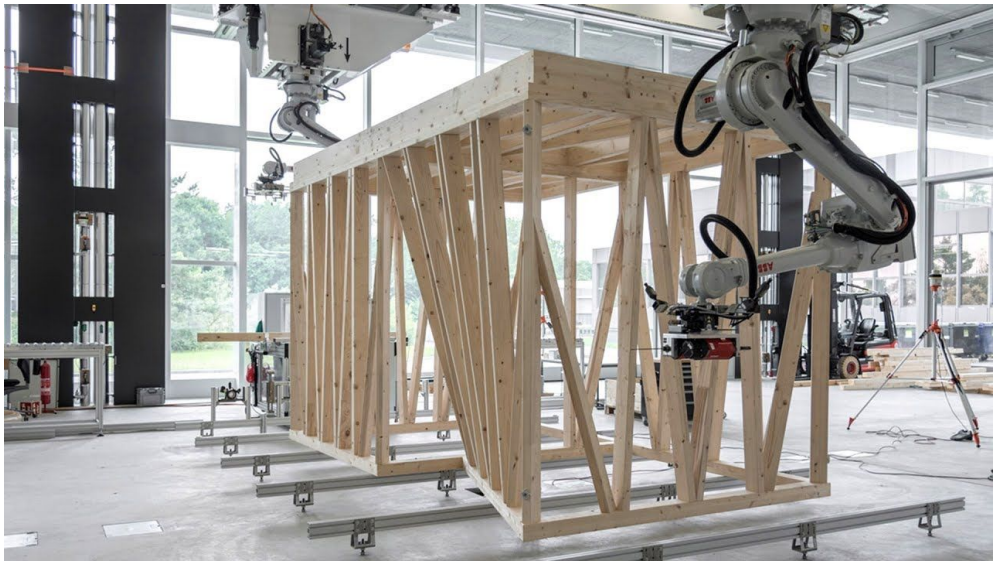
- 1997: Guggenheim Museum - Bilbao, Spain - Frank Gehry
  - a fusion of complex, swirling forms and captivating materiality that responds to an intricate program and an industrial urban context
  - Deconstructivism
  - CATIA V3 software

Industrial revolutions 4.0

- Now-future
- a.k.a. Industry 4.0 -> I4.0
- Trend of automation and data exchange in manufacturing technologies
- Design principles:
  - **Interconnection** between devices, sensors, machines and people
  - **Information transparency** to provide operators useful information
  - **Technical assistance** for visualizing information and physically support humans
  - **Decentralized decisions** by cyber physical systems to make decisions on their own and perform their tasks autonomously.

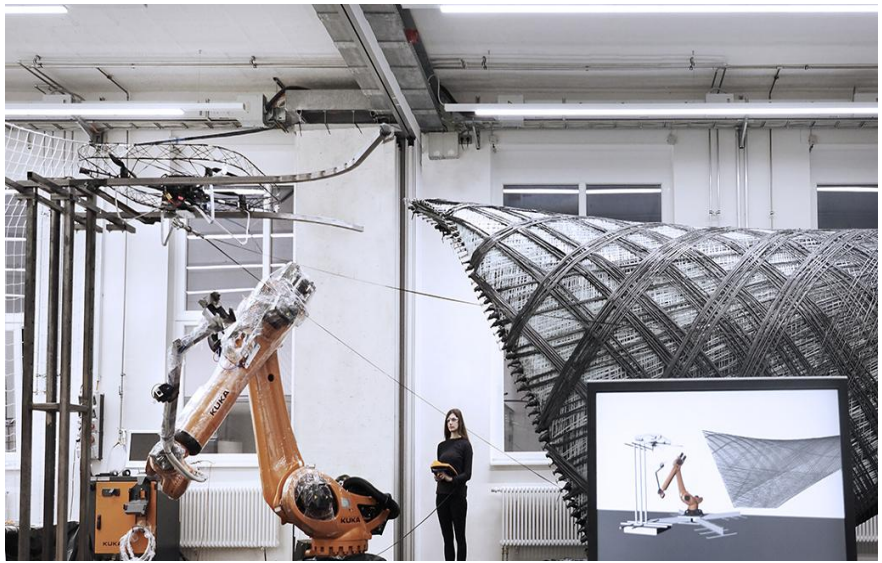
Industrial revolutions 4.0 Emulating the old

- Robotic collaboration in timber construction - ETH Zürich
  - Creating a form which can be handmade



Industrial revolutions 4.0 New style

- 2017 - ICD/ITKE Research Pavilion - ICD/ITKE
  - Interaction between robots



Research References

ICD/ITKE Research Pavilion 2011 UoS
Norwegian Reindeer Pavilion

References

- ICD/ITKE Research Pavilion 2011 UoS - principle
- Norwegian Reindeer Pavilion - production

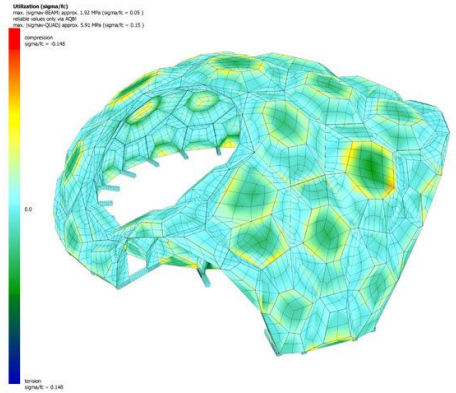
References ICD/ITKE Research Pavilion 2011 UoS

References ICD/ITKE Research Pavilion 2011 UoS

Design:

- Applying Bionic principles onto pavillion tessellation geometry through computational process

- Cell sizes are dependent on the curvature

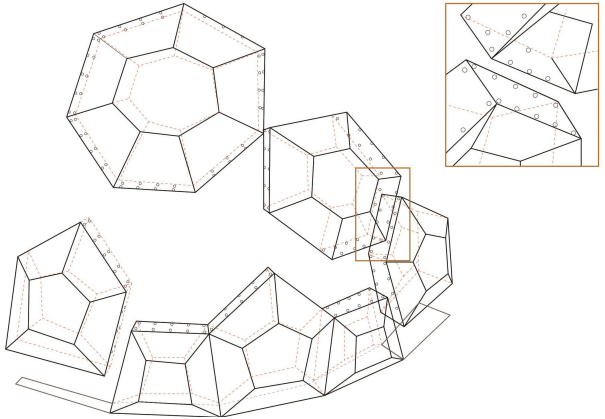


References ICD/ITKE Research Pavilion 2011 UoS

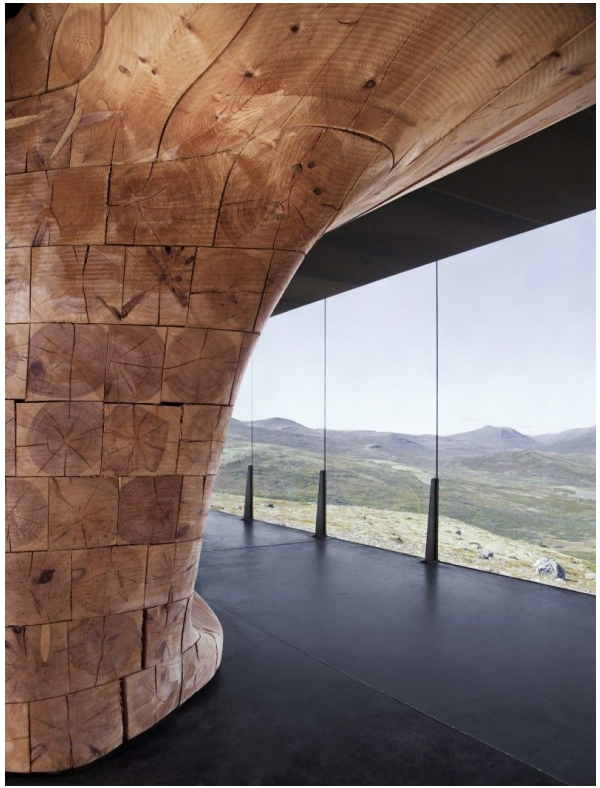
Structure:

- The **finger joints** of the plywood sheets, **glued** together to form a cell

- A simple screw connection inbetween cells, **allowing the assembling and disassembling** of the pavilion.

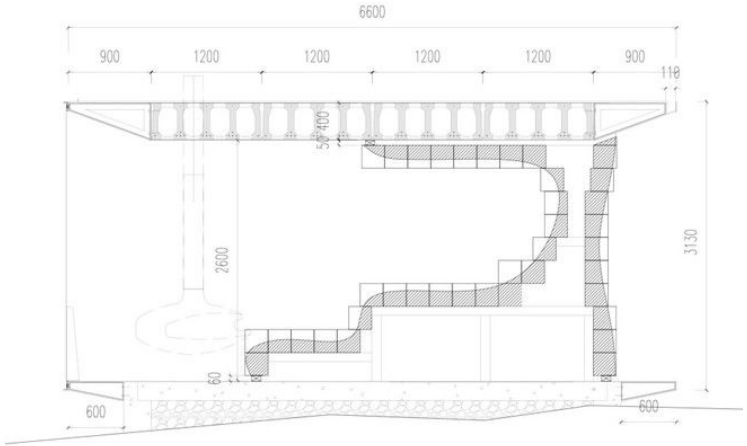


References Norwegian reindeer pavilion



References Norwegian reindeer pavilion

- 3D-Model to drive milling machines
- Wood dowels as fasteners



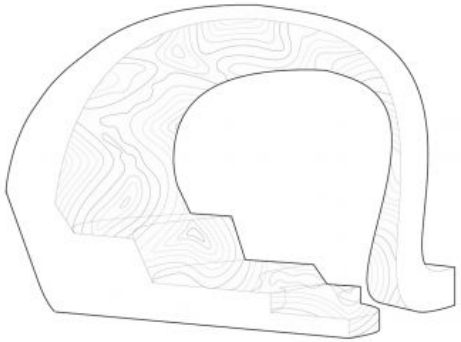
TYPICAL SECTION

Materialisation Design

Context
Concept
Construction
Acoustics
Rainpathing
Beampacking

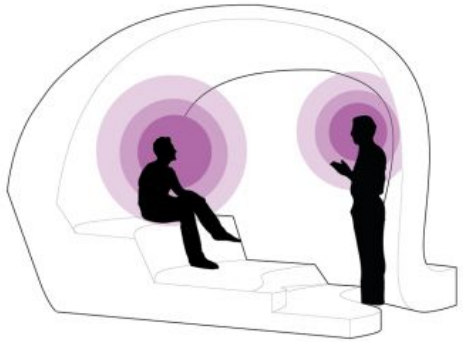
Context Dessau

Concept Functionality



WOODEN PAVILION

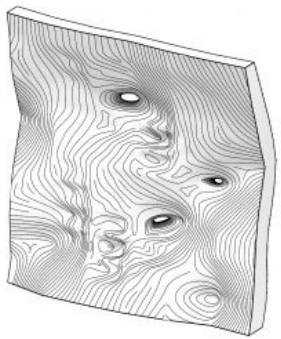
SHELTER FROM RAIN



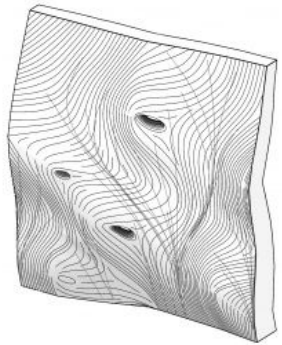
ACOUSTIC QUALITY

Concept Pattern

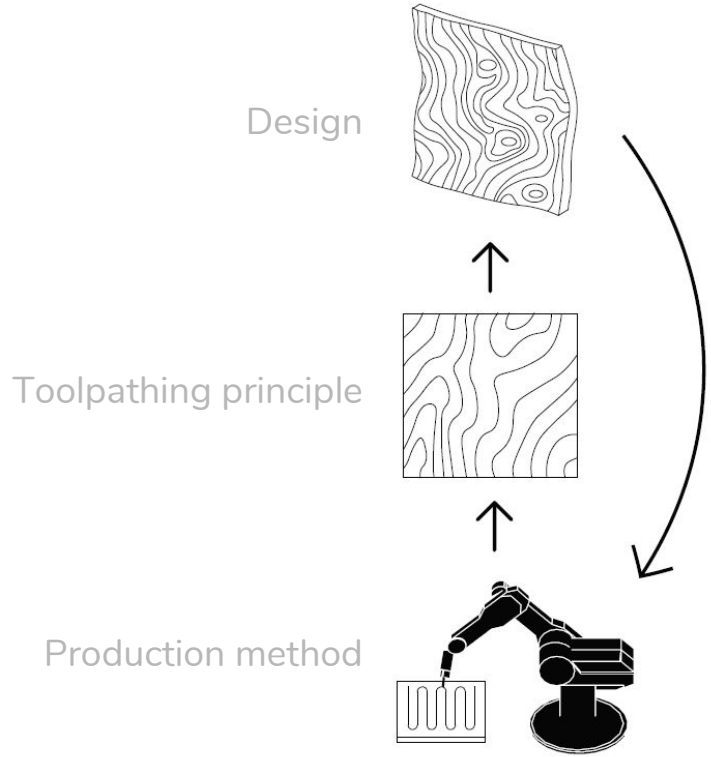
- Production and design considered as together



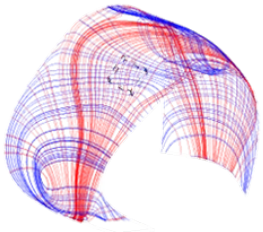
Interior-acoustics



exterior - rainpathing

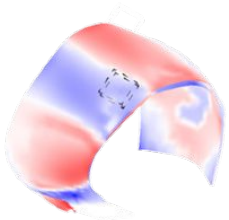


Structure



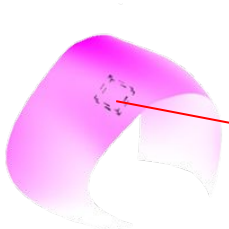
STRESS LINES

Density of stress lines is corresponding with the desired material thickness



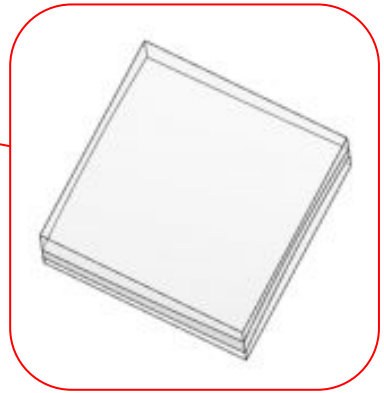
STRESS ANALYSIS

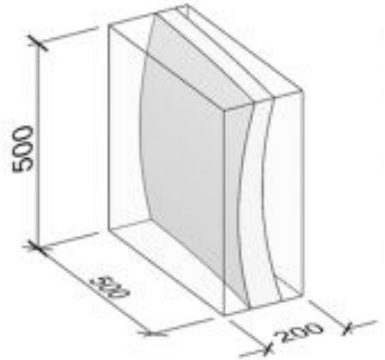
RED - compression
BLUE - tension



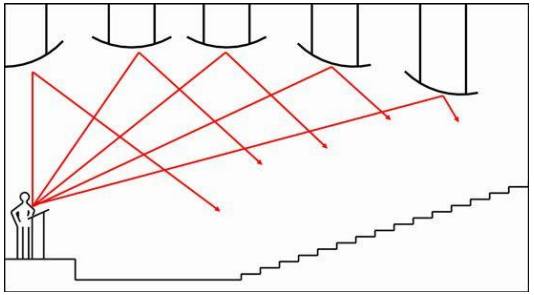
DEFORMATION

max. deformation: 20 mm

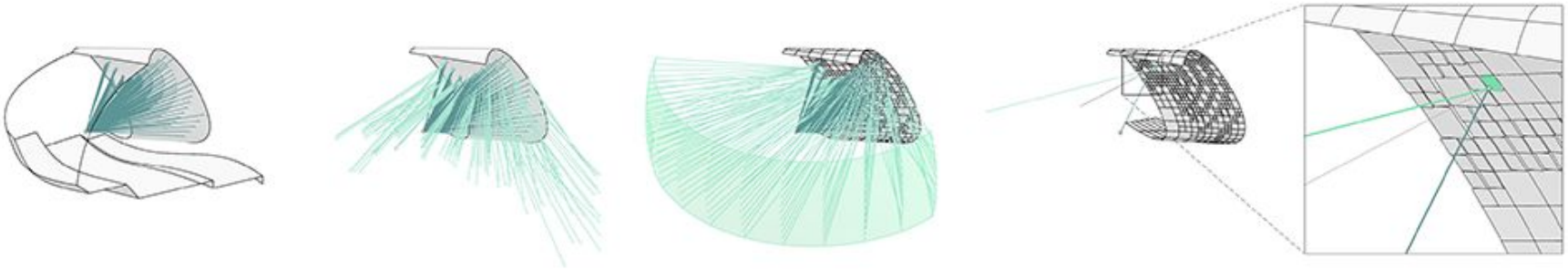




Acoustic Reflection



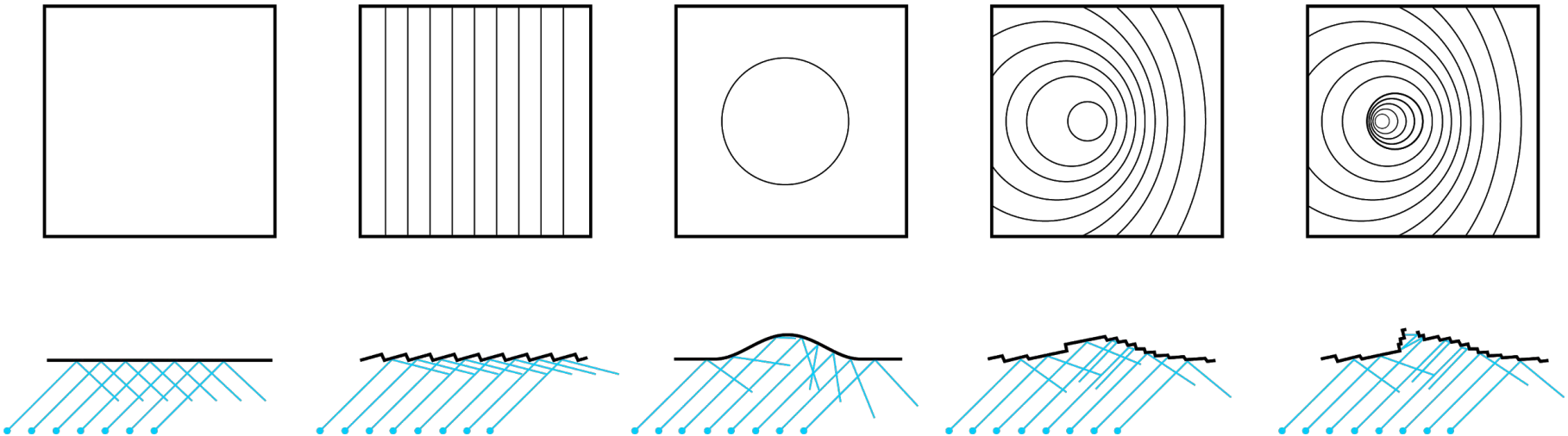
Music hall reflection



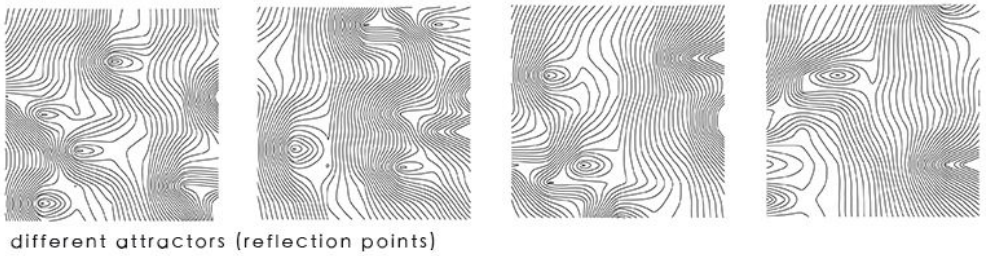
1. 2. 3. 4.

After simulating the acoustics of the pavilion with a point source (1), we plan to treat the surface of the pavilion so that the sound spreads evenly over the seat of the pavilion (2,3). To do so, the surface of the pavilion is subdivided and each subdivision has different angles on order to reflect the sound to different directions (3,4).

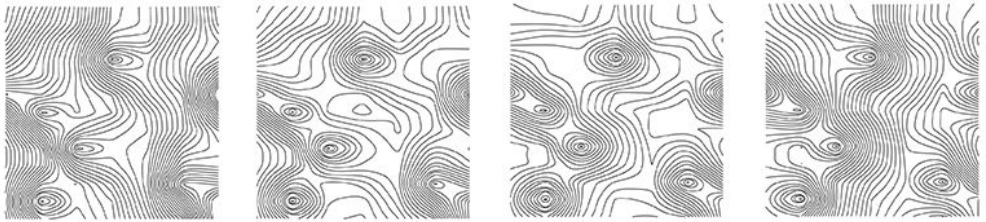
Acoustic Diffusion



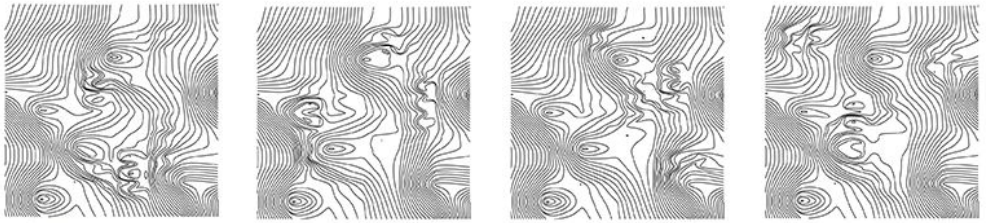
Acoustic Variations



different attractors (reflection points)

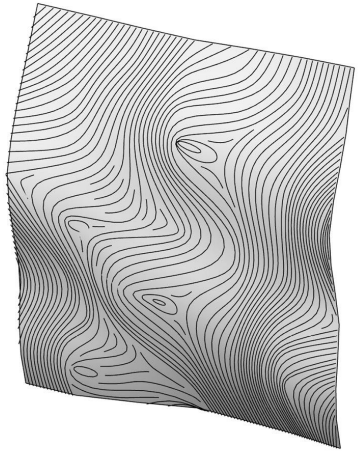


different surface normals

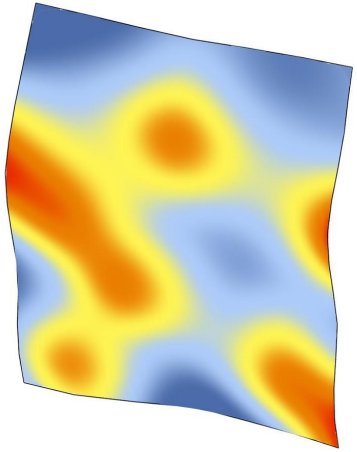


different perturbances

Rainpath

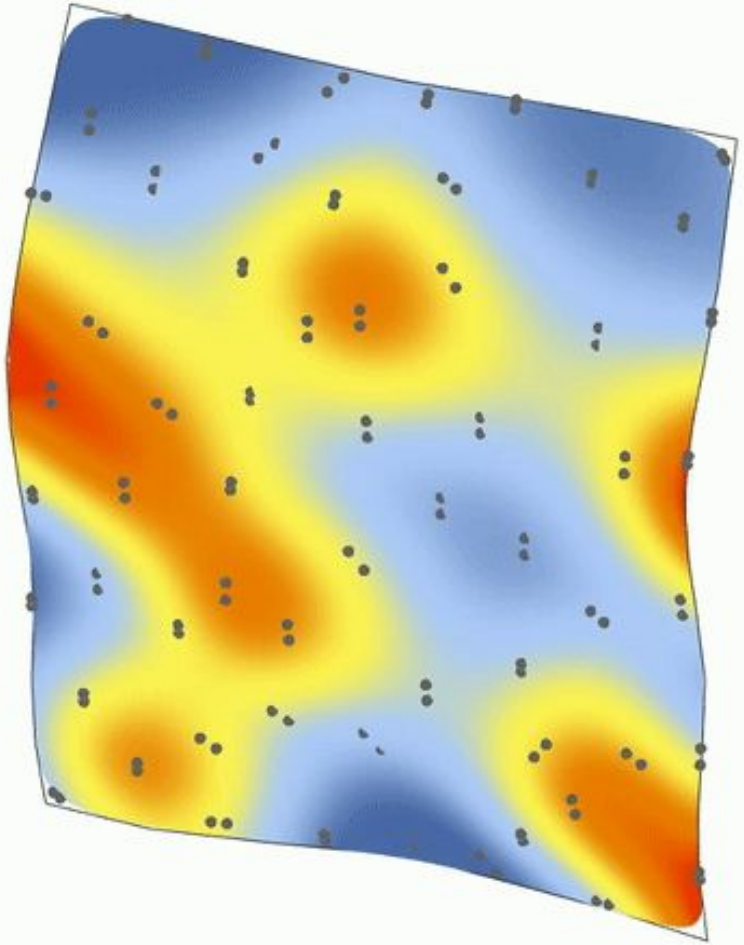


1. Original external pattern

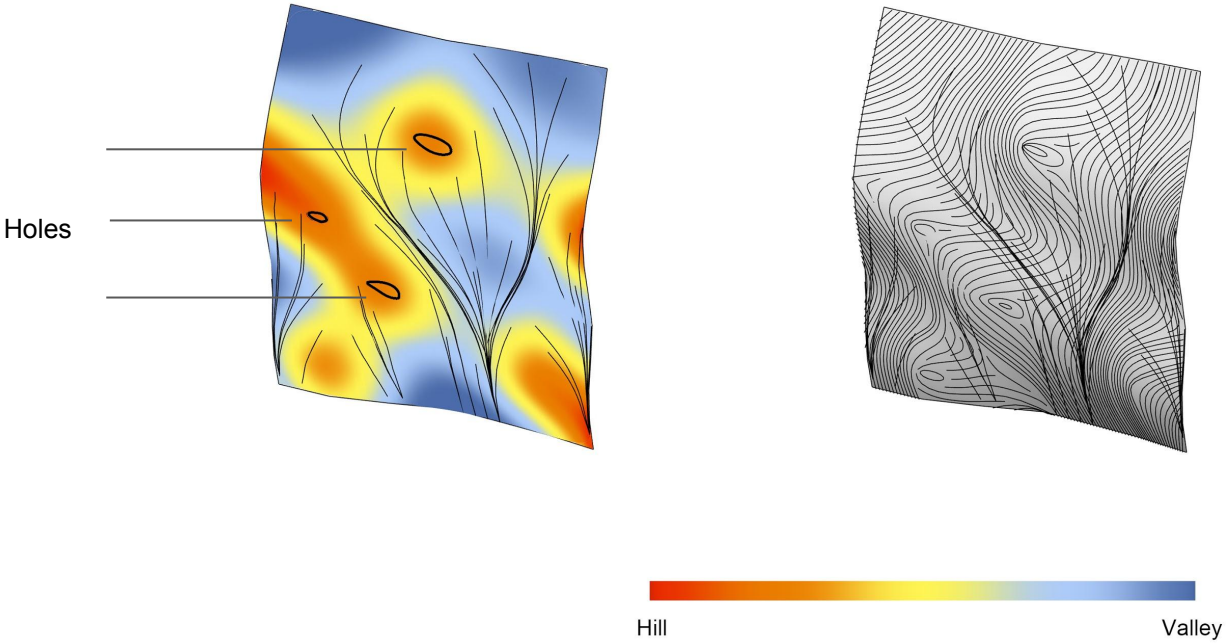


2. Elevation of exterior

Rainpath Simulation



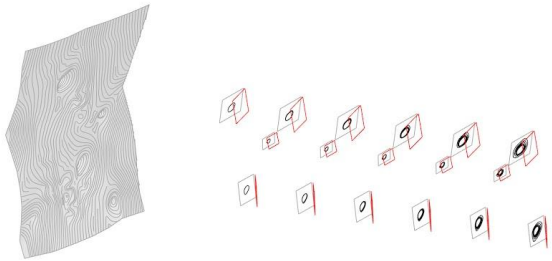
Rainpath



Toolpathing Overall

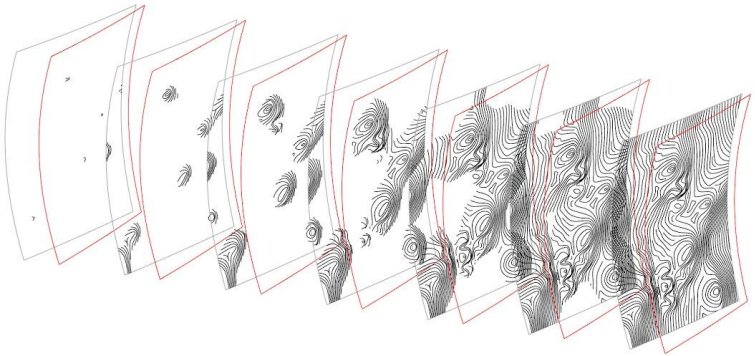
Step3_Holes

5 - 6 layers



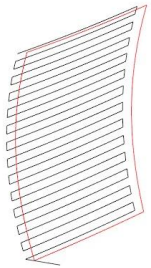
Step2_Patterns

7 layers



Step1_Material removal

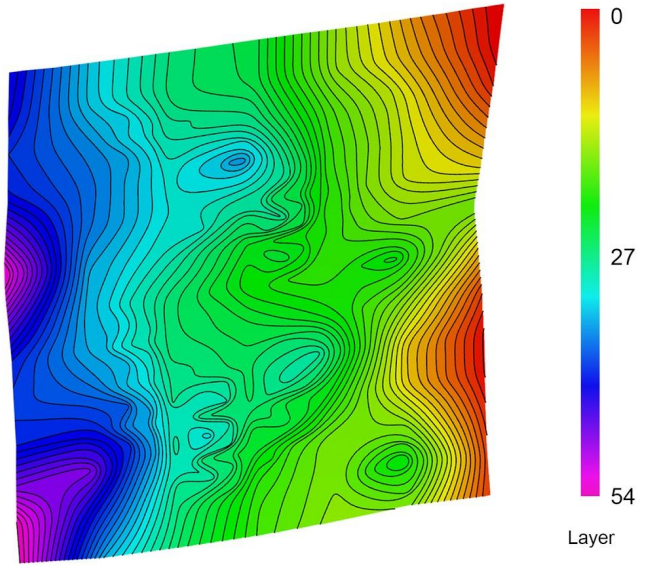
16 layers

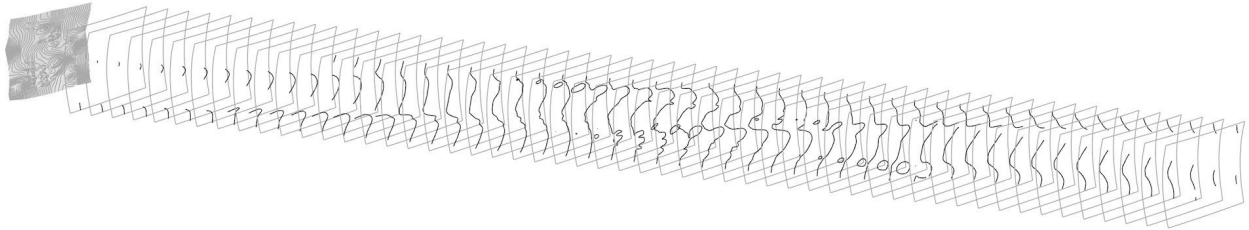


X16

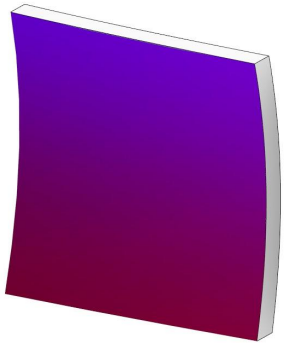
Milling reference surface

Toolpathing Pattern

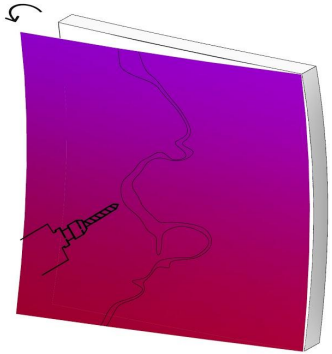




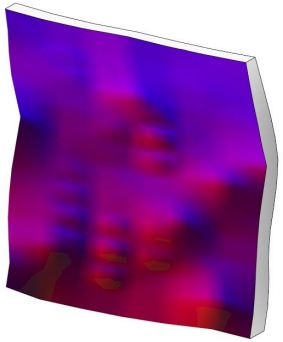
Toolpathing Normal



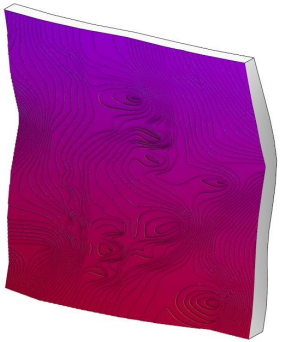
1. Fragment



3. Reference surface for milling

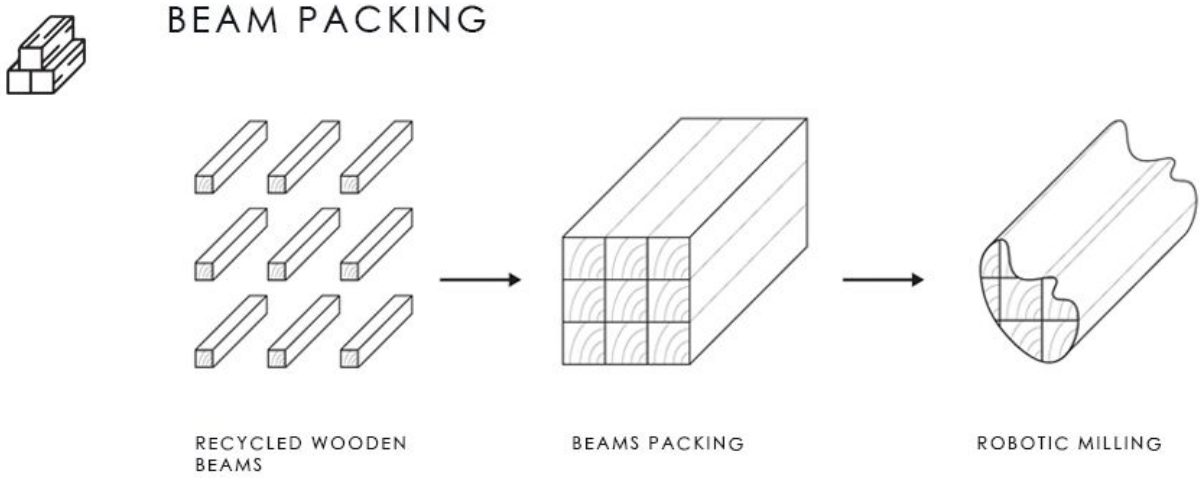


2. Mesh

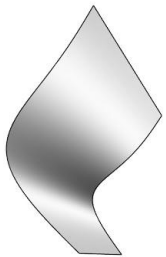


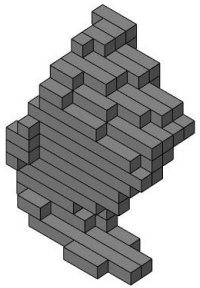
4. Final

Beampacking Principle

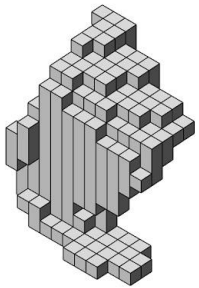


Beampacking Voxelization

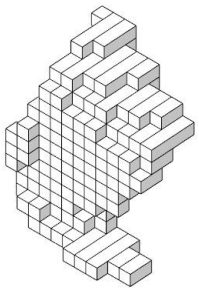




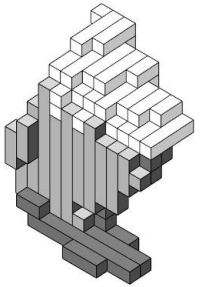
x-axis: 45



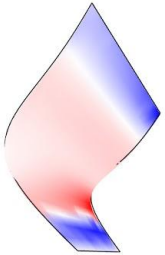
y-axis: 83



z-axis: 104

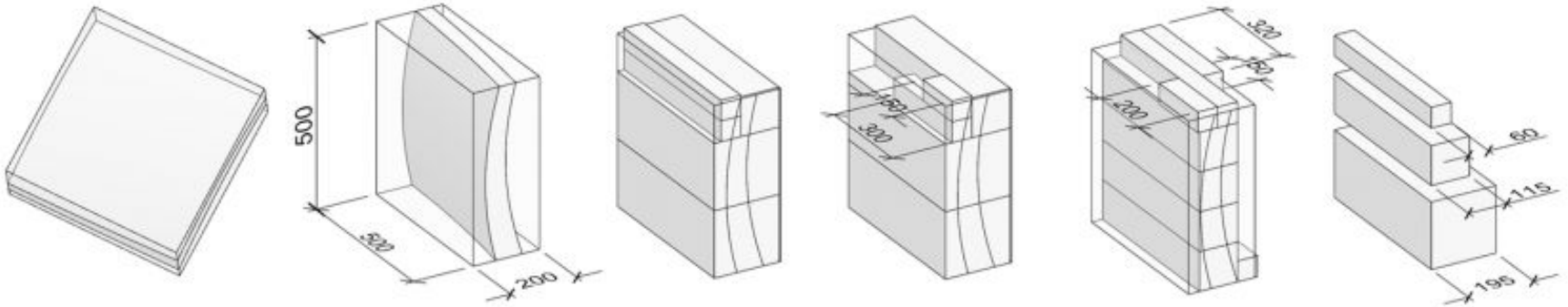


mix: 50



tension
comperssion

Beampacking Prototype



Fragment 1 2 3

Production

Production

DELFT

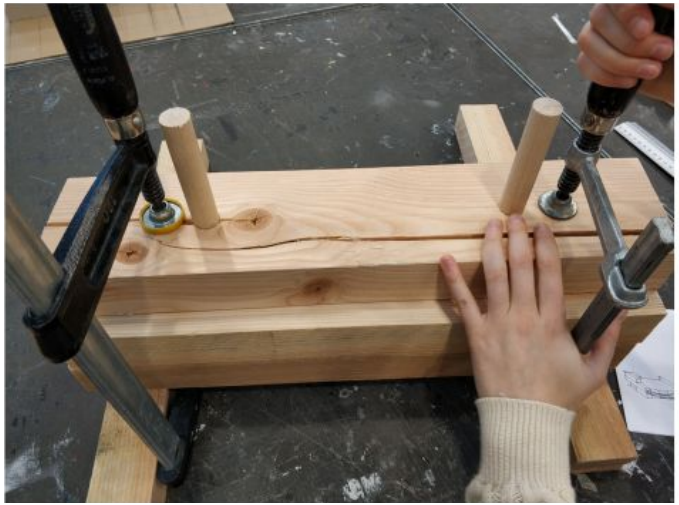
PREPARATION,
ASSEMBLY
COMPUTING

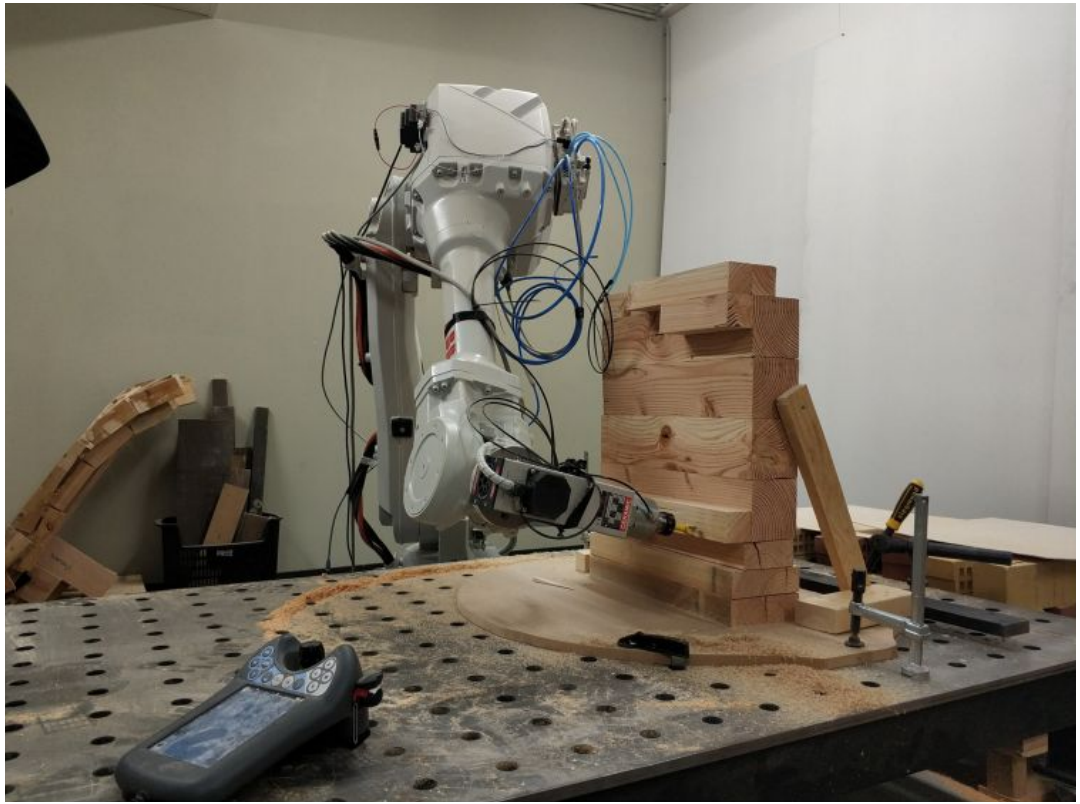
->

AMSTERDAM

ROBOTIC PRODUCTION

Production





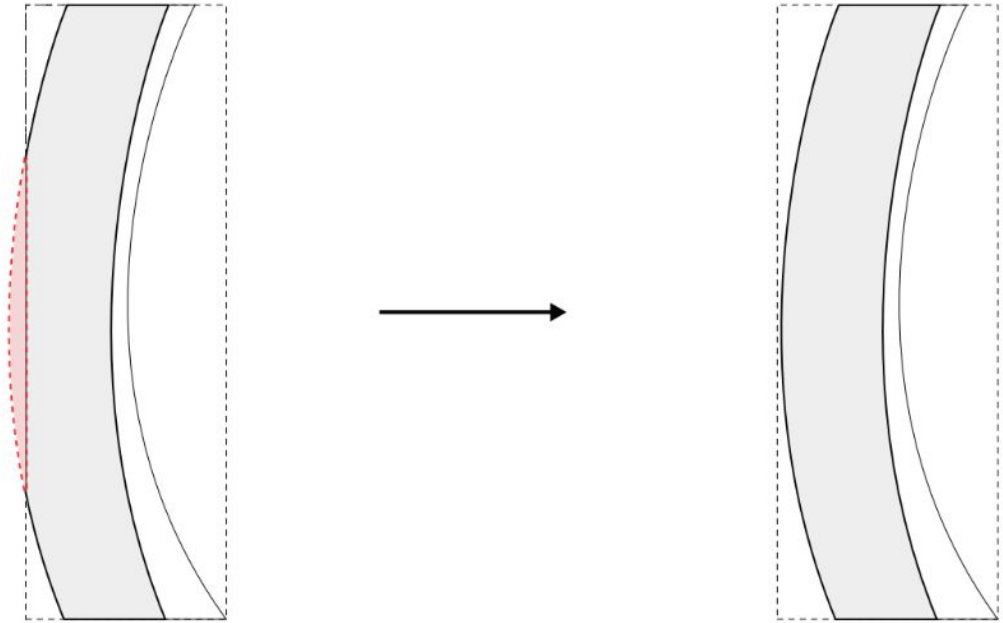
Production

Production

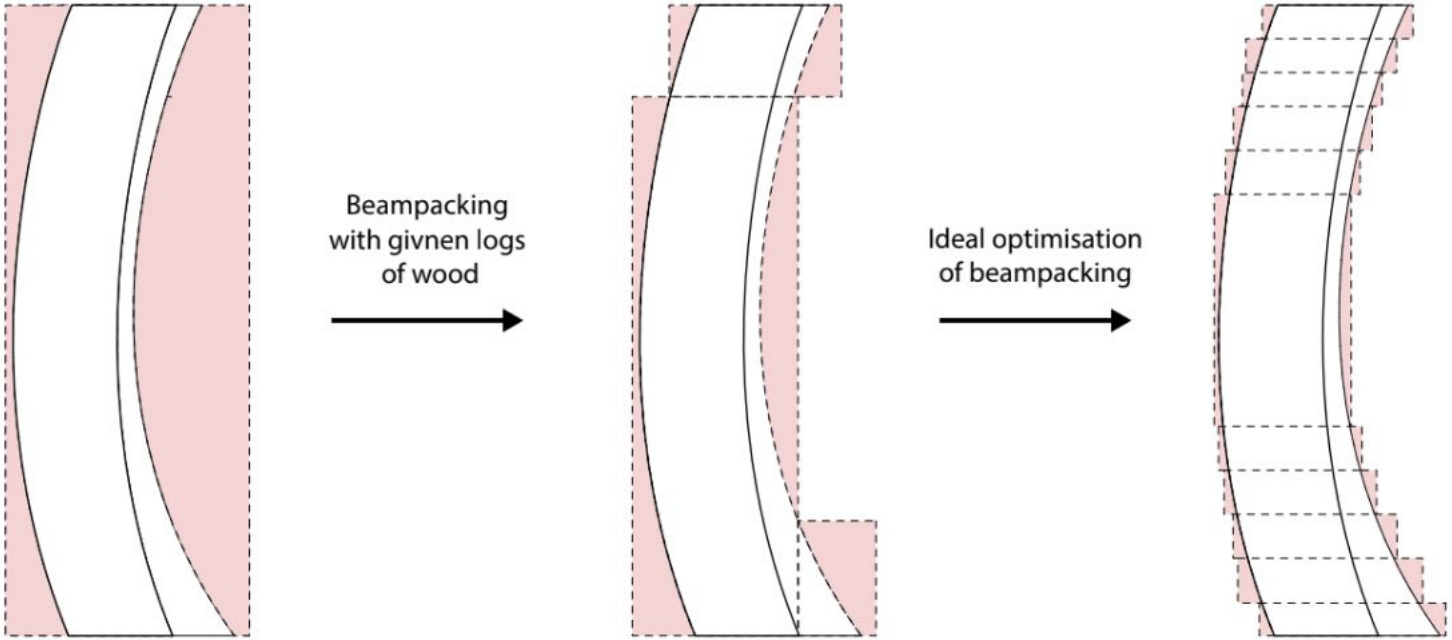
Feedbackloop

Within scope assignment
Outside scope assignment

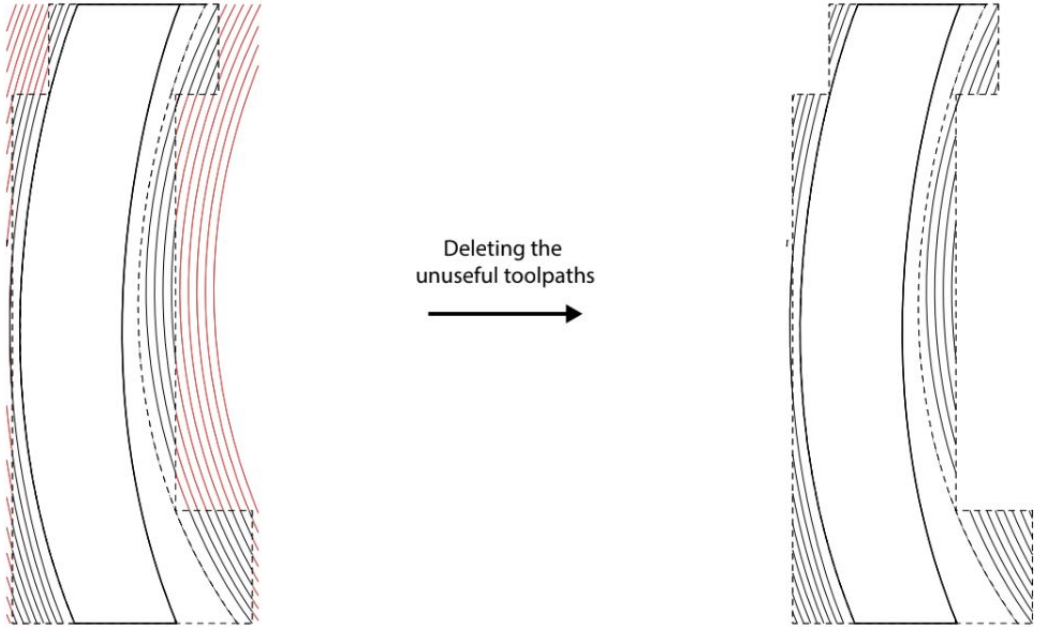
Within scope Bounding box



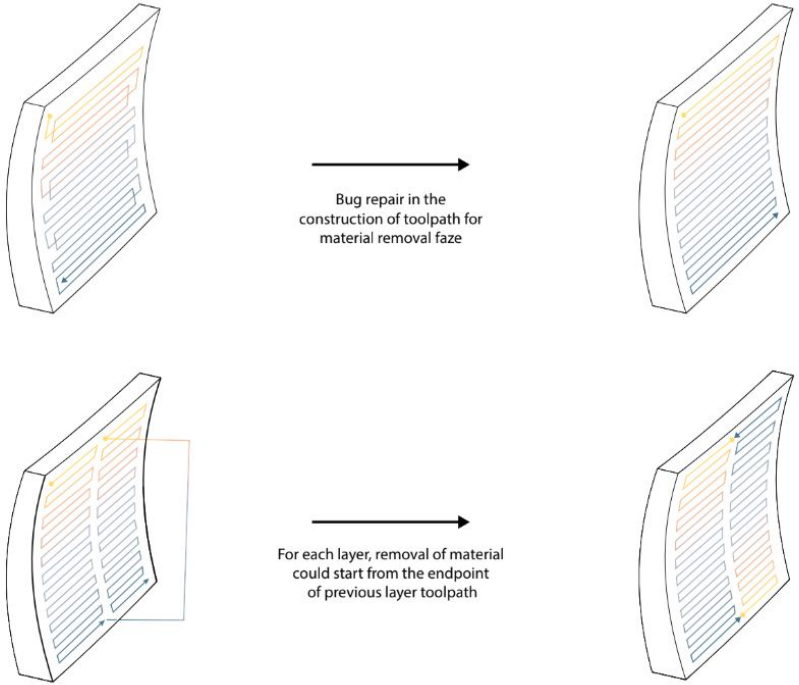
Within scope Optimization beampacking



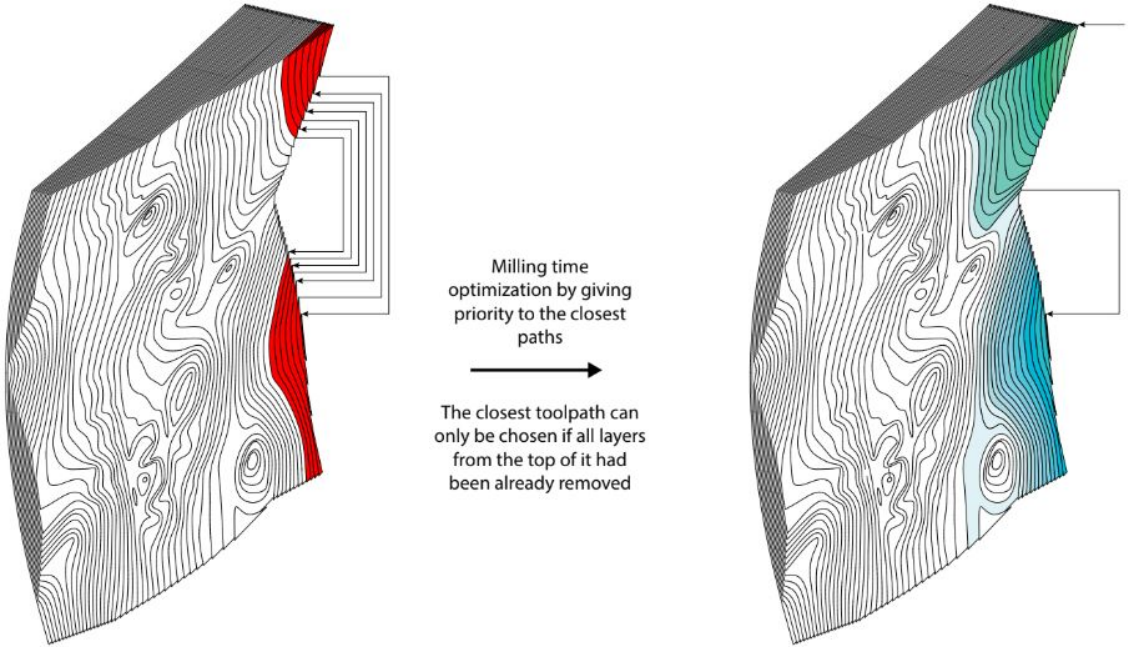
Within scope Optimization toolpathing



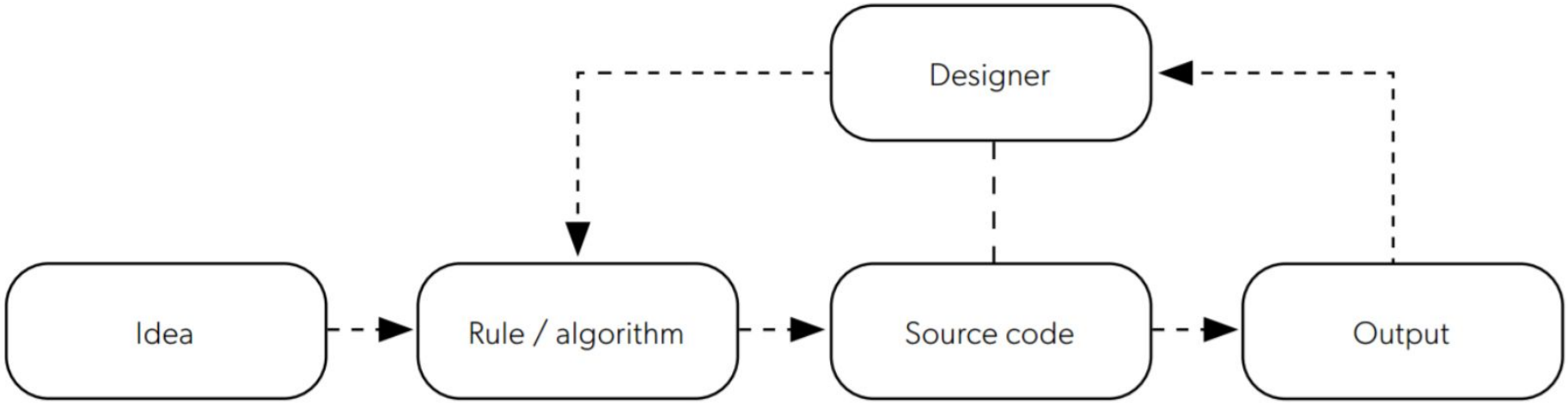
Within scope Optimization material removal



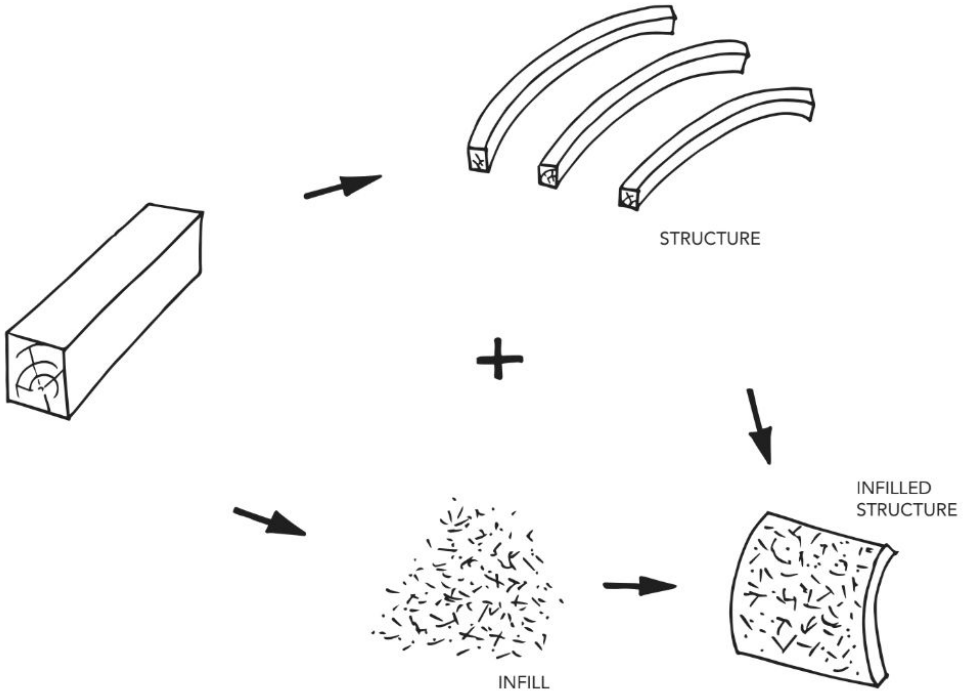
Within scope Optimization toolpathing



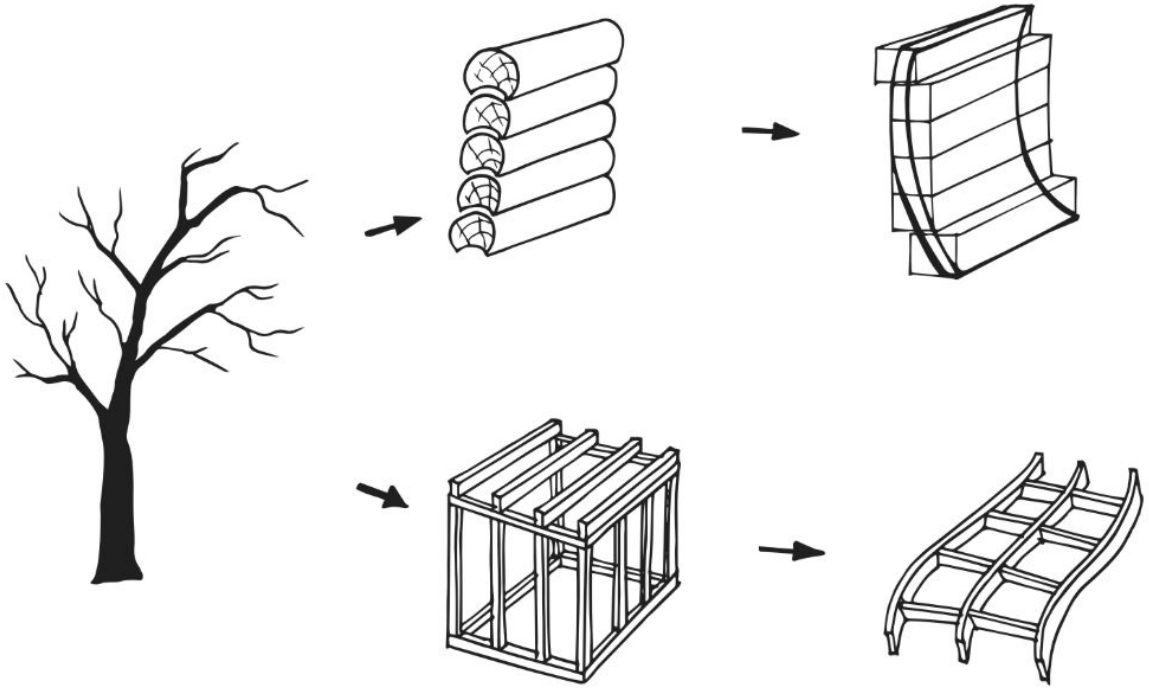
Outside Scope Workflow



Outside Scope



Outside Scope



End