Lessons from Workshops
Research Report - Hidde Manders - Robotic Building

1. Bauhaus Pavilion

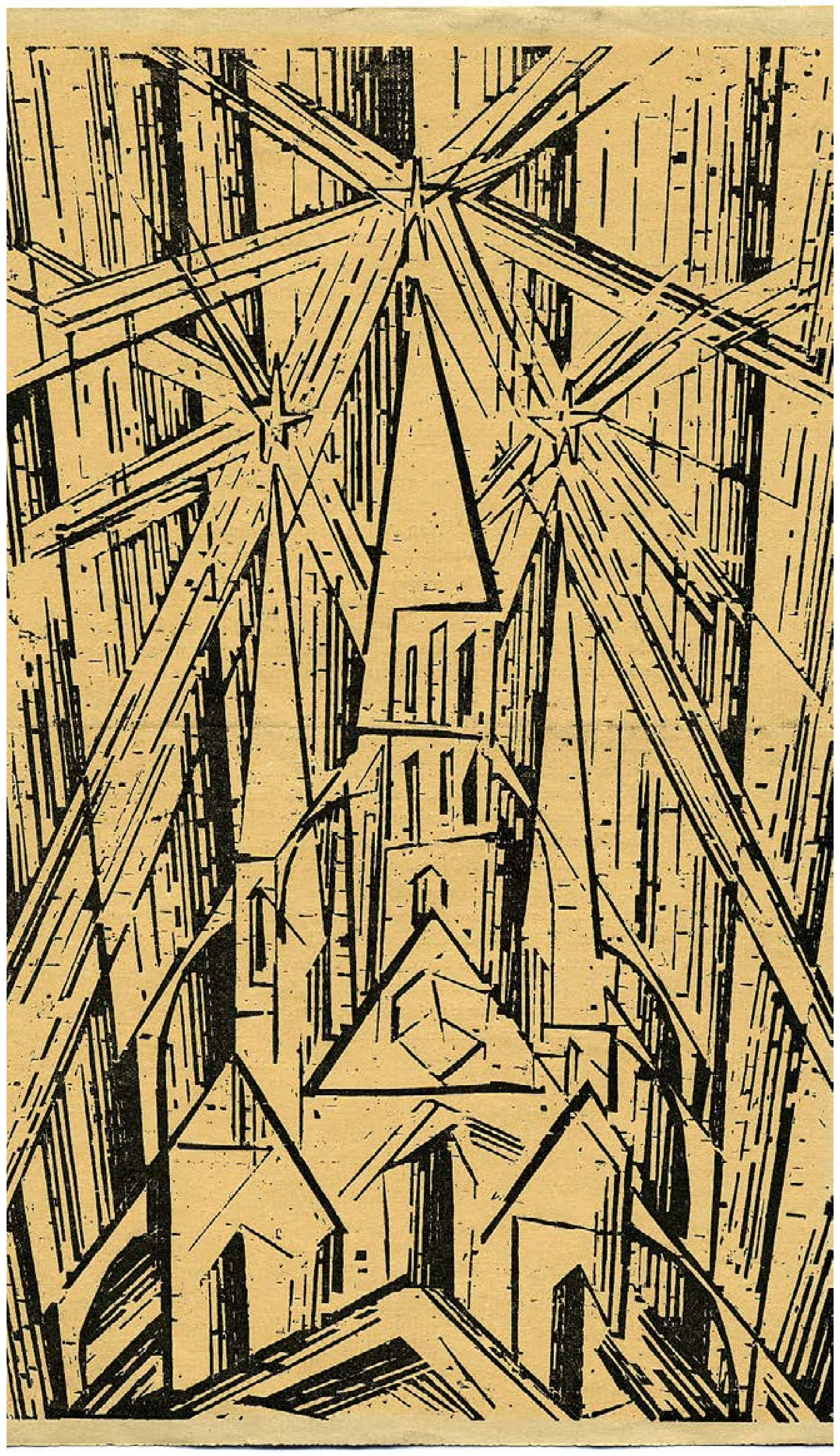
Goal

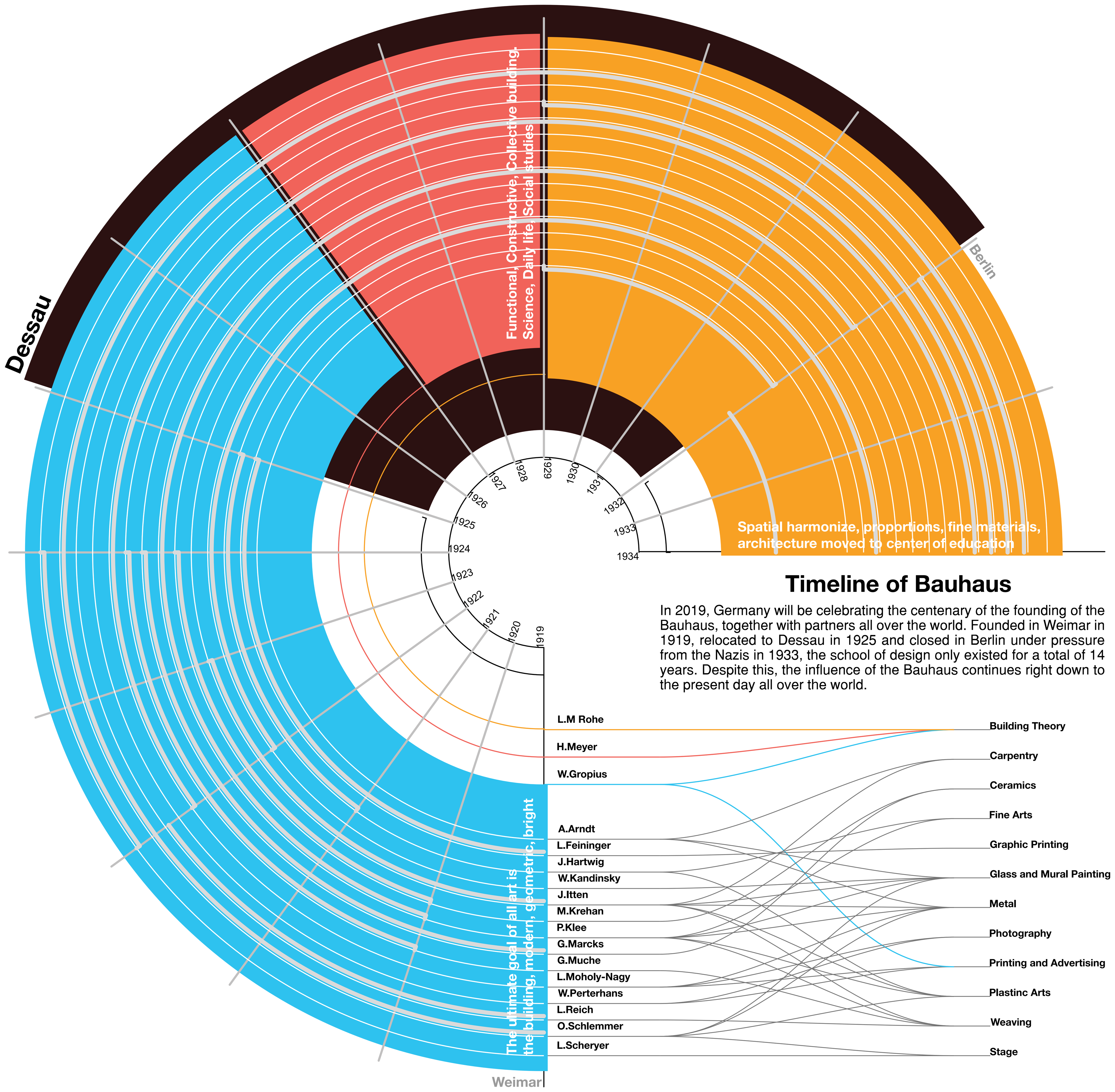
100
YBP

The first workshop or research topic that I have done is the 100 year bauhaus pavilion design. This was in collaboration with Heeyoun Kim, in which we made a proposal for the 100 year bauhaus pavilion. Multiple aspects have been part of this research. Starting from the history of the Bauhaus and the vision that Gropius designed, the context of Dessau, but also how a robotic pavilion can reflect or respond to Bauhaus principles. The goal of the pavilion was to not just be an object, but to respresent a building, so that it will house all its architectural components.

1. Bauhaus Pavilion

Historical Research

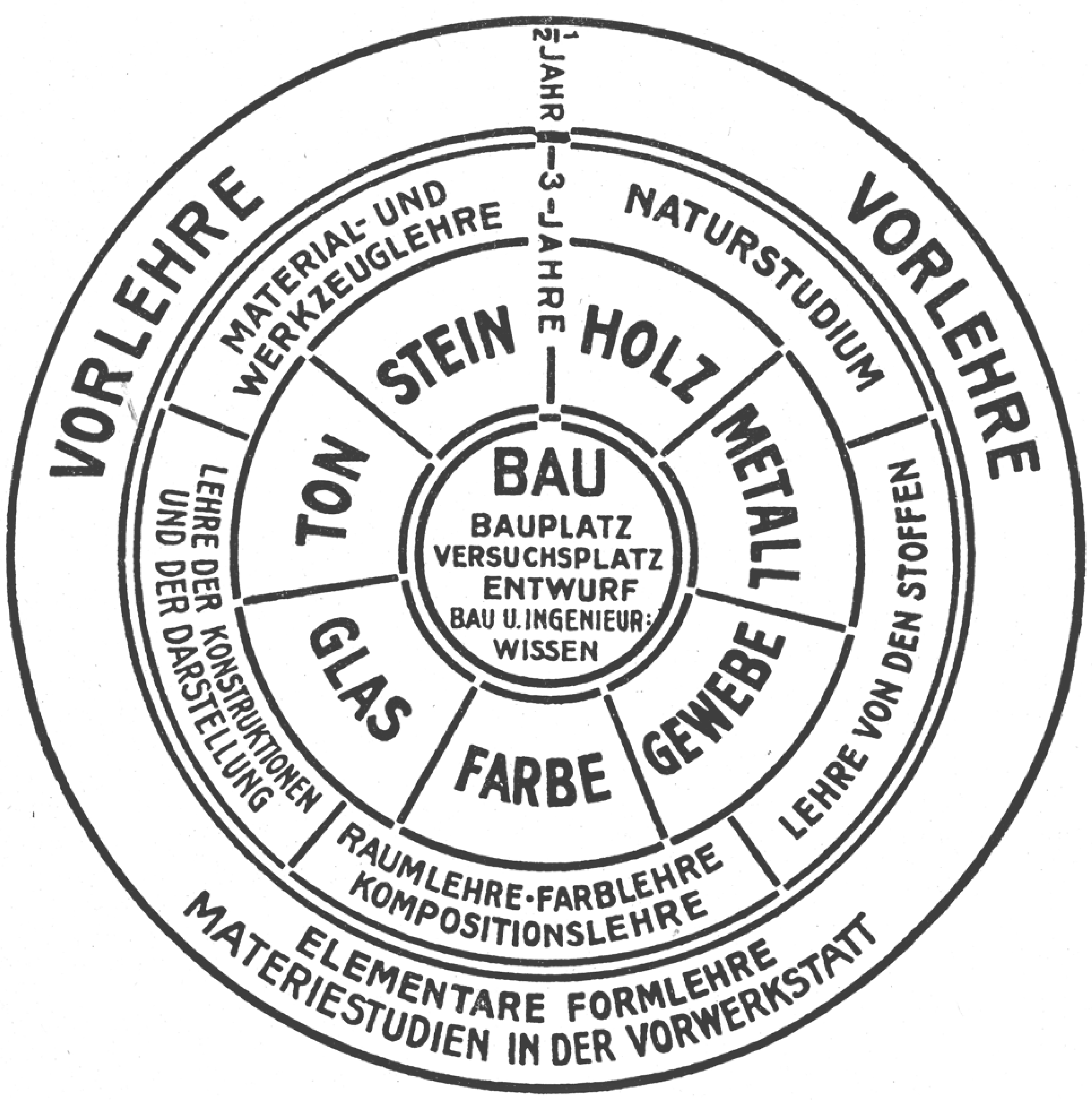


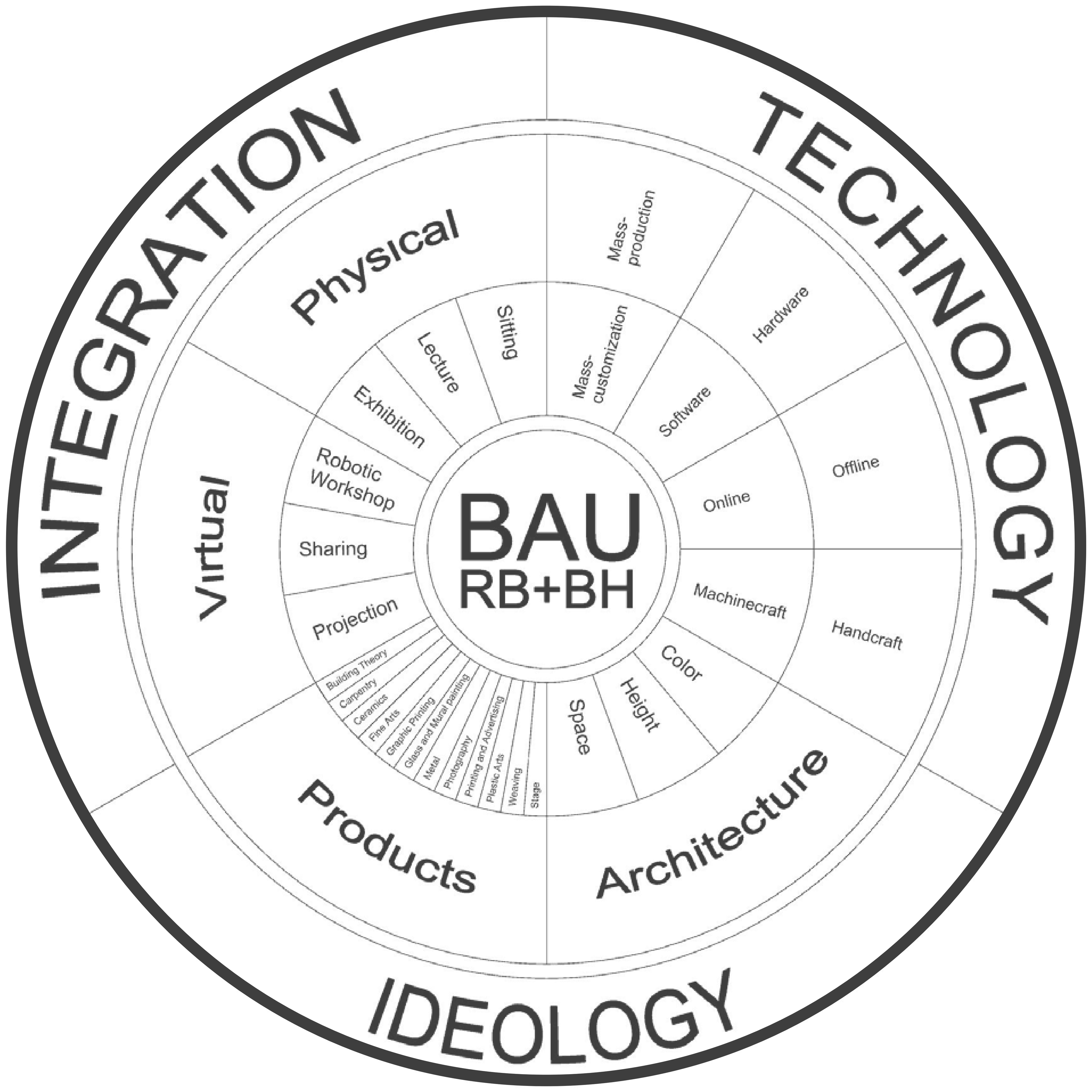


From the Bauhaus Manifesto by Walter Gropius, Bauhaus changed their curicullums several times. Those principles depended on the location of bauhaus, its masters, and the desire of society. They started with a respect on hand craft, but accepted machinery culture, from workshop, to collaboration with companies, they expanded the boundaries themselves.

1. Bauhaus Pavilion

Theoretical Research

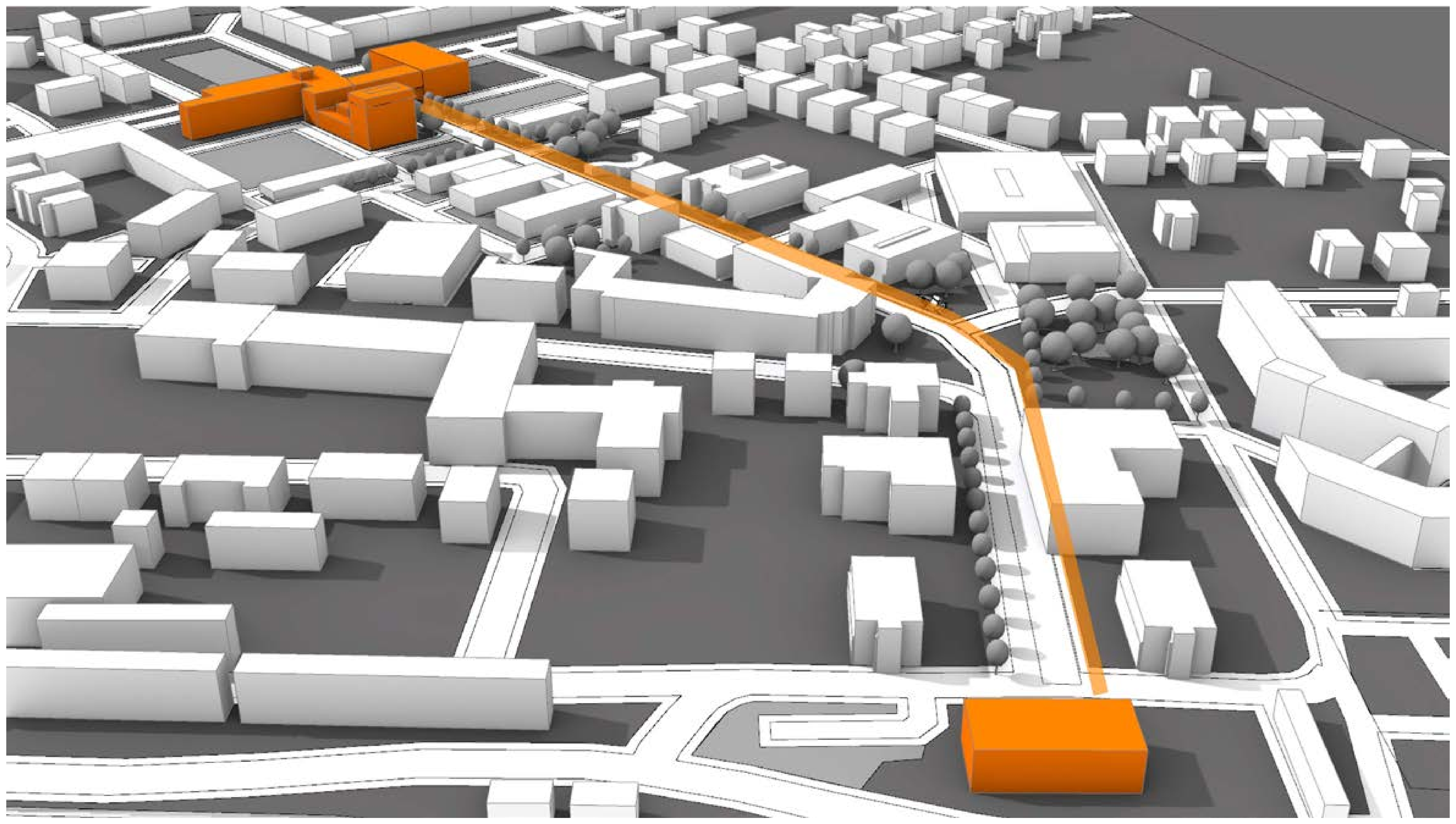


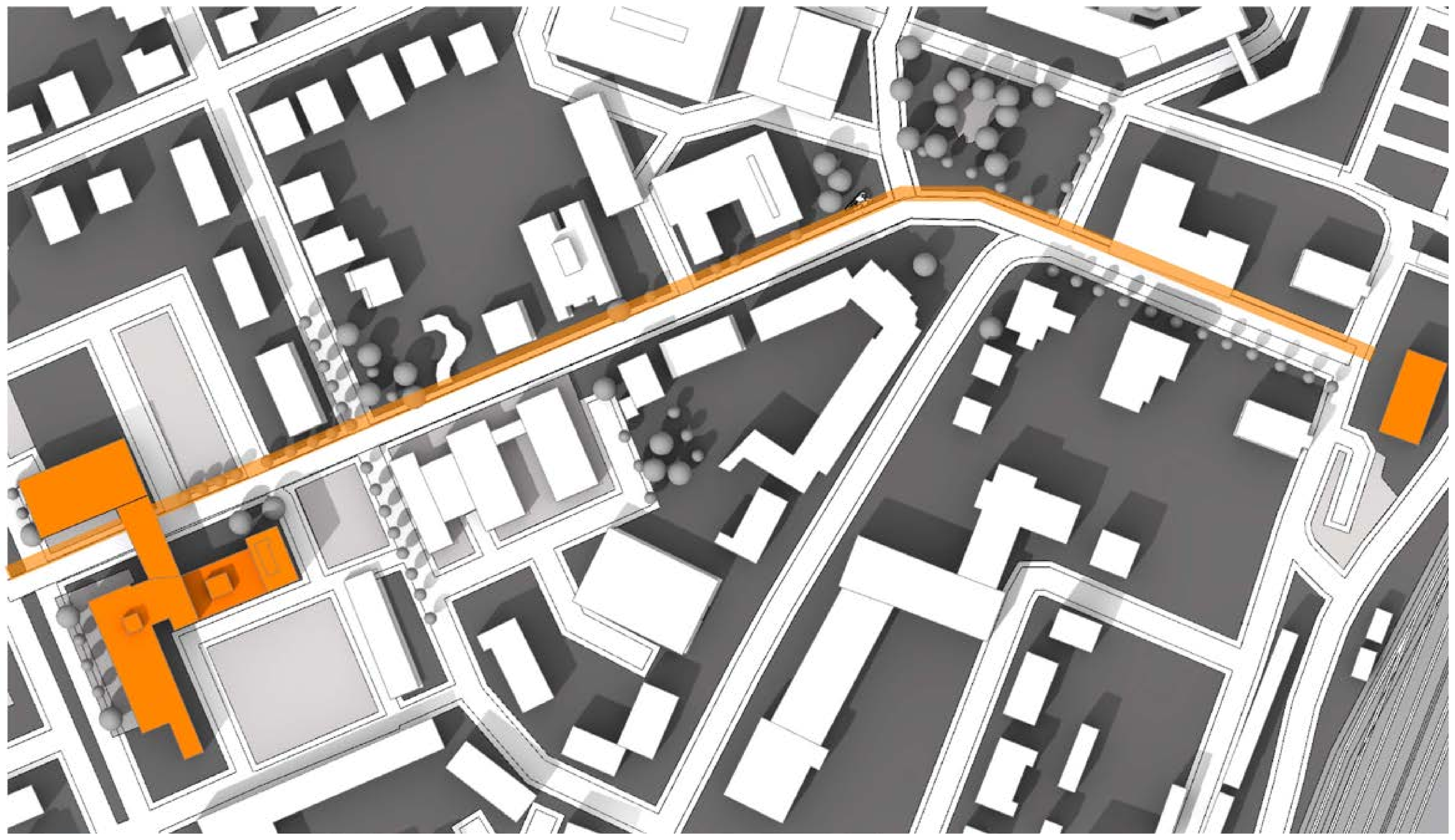


By continuing ideology, the connection with art and craft, art and machine, art and architecture, this project will take a method, robotic building. The education principle of bauhaus will be expanded as bauhaus and robotic building aspects. The main attitude is that implementing this ideology as an architecture or building, not a just installation, or structural objects. It should contain activities, spaces, architectural components. By doing that, the 100 year Bauhaus pavilion will be a ‘place’ to experience of the part of the Bauhaus, in the city, Dessau.

1. Bauhaus Pavilion

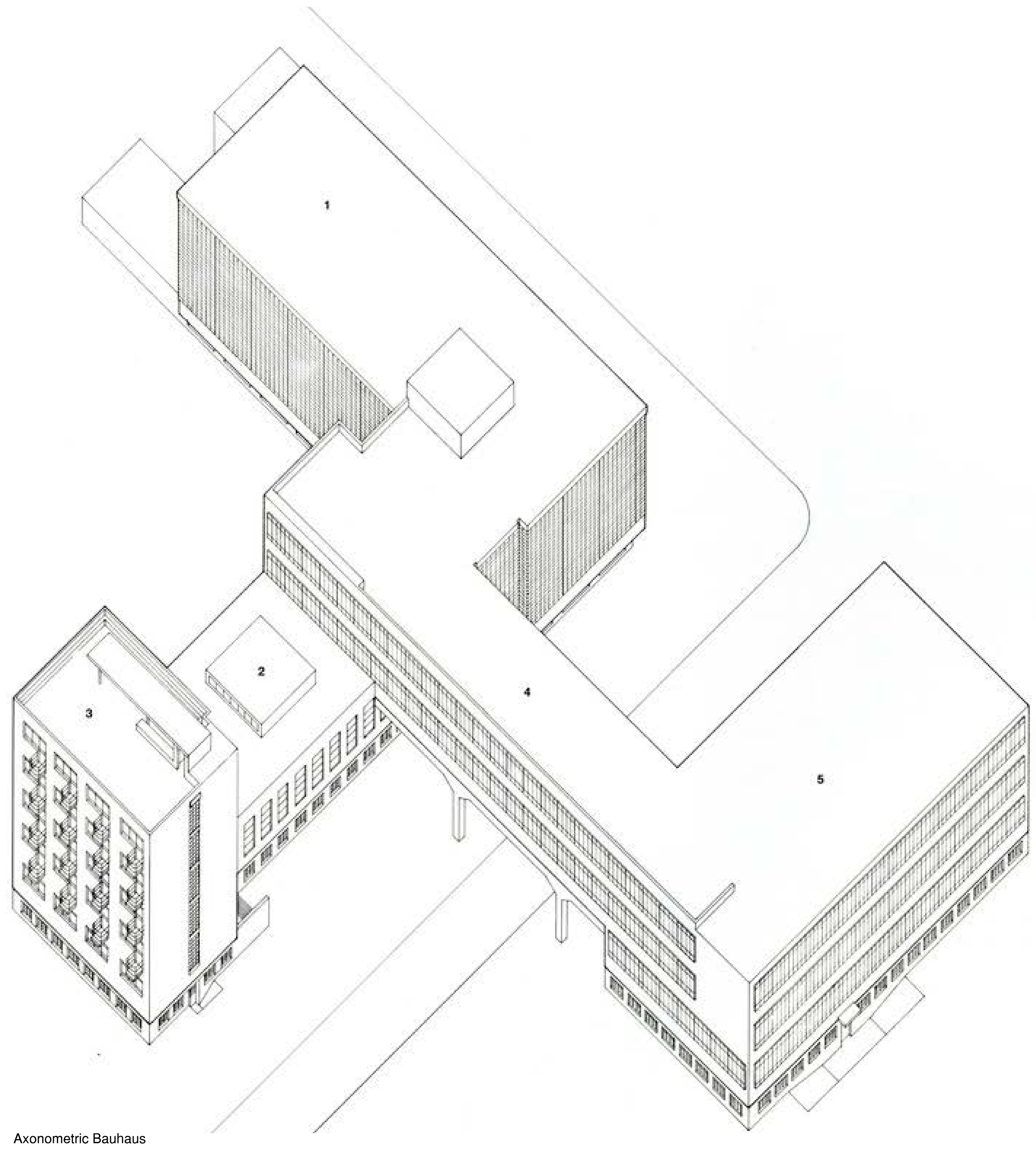
Contextual Research



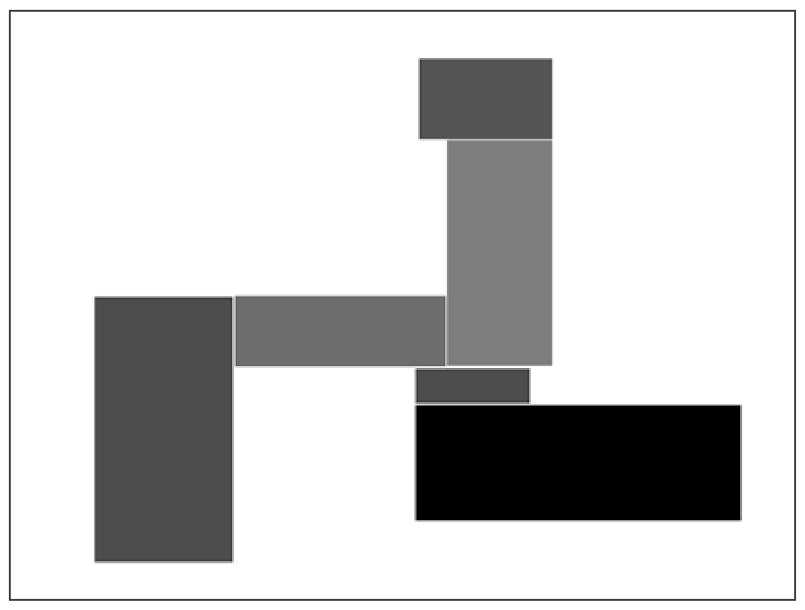


Visitors arriving from Dessau station will directly see the pavilion at the end of their sightline. From which the pavilion is functioning as a point of recognition for the 100 year Bauhaus visitors, pointing them towards the location of the Bauhaus university building. By locating the pavilion on the junction of the axis between the Dessau station and the Bauhaus University building it is extending the relation between these two buildings.

1. Bauhaus Pavilion
Architectural Research



Axonometric Bauhaus

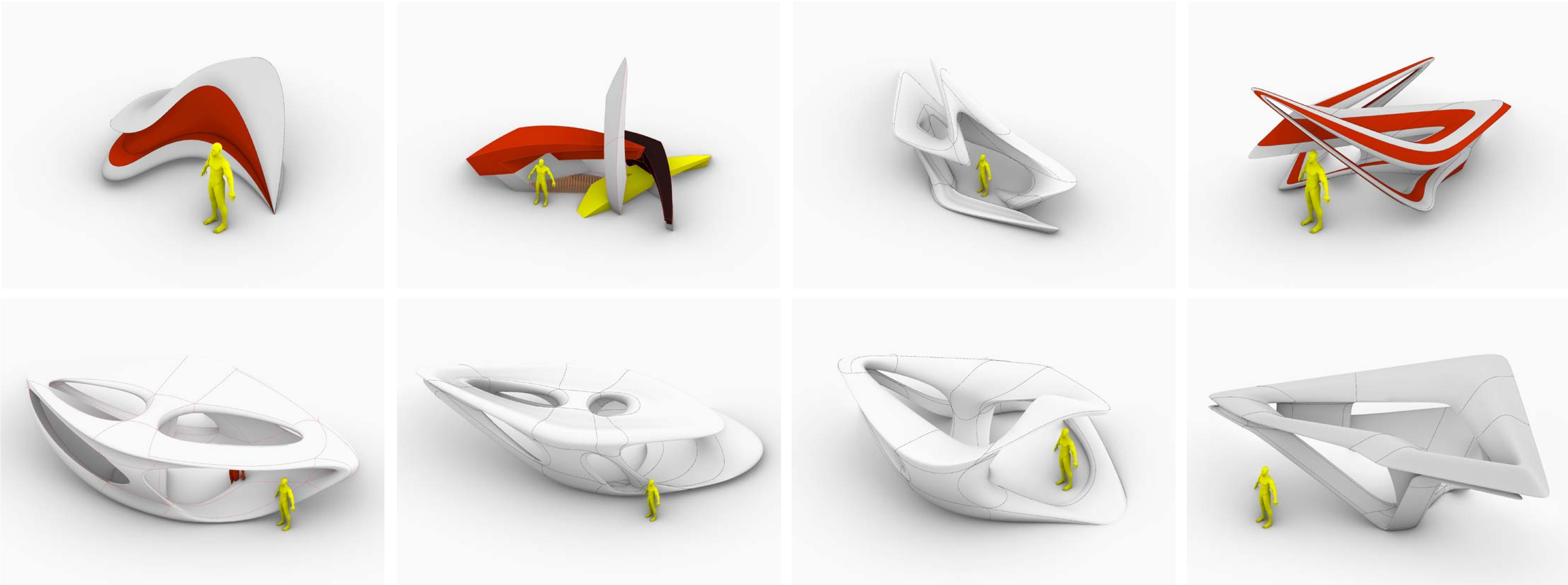

Components

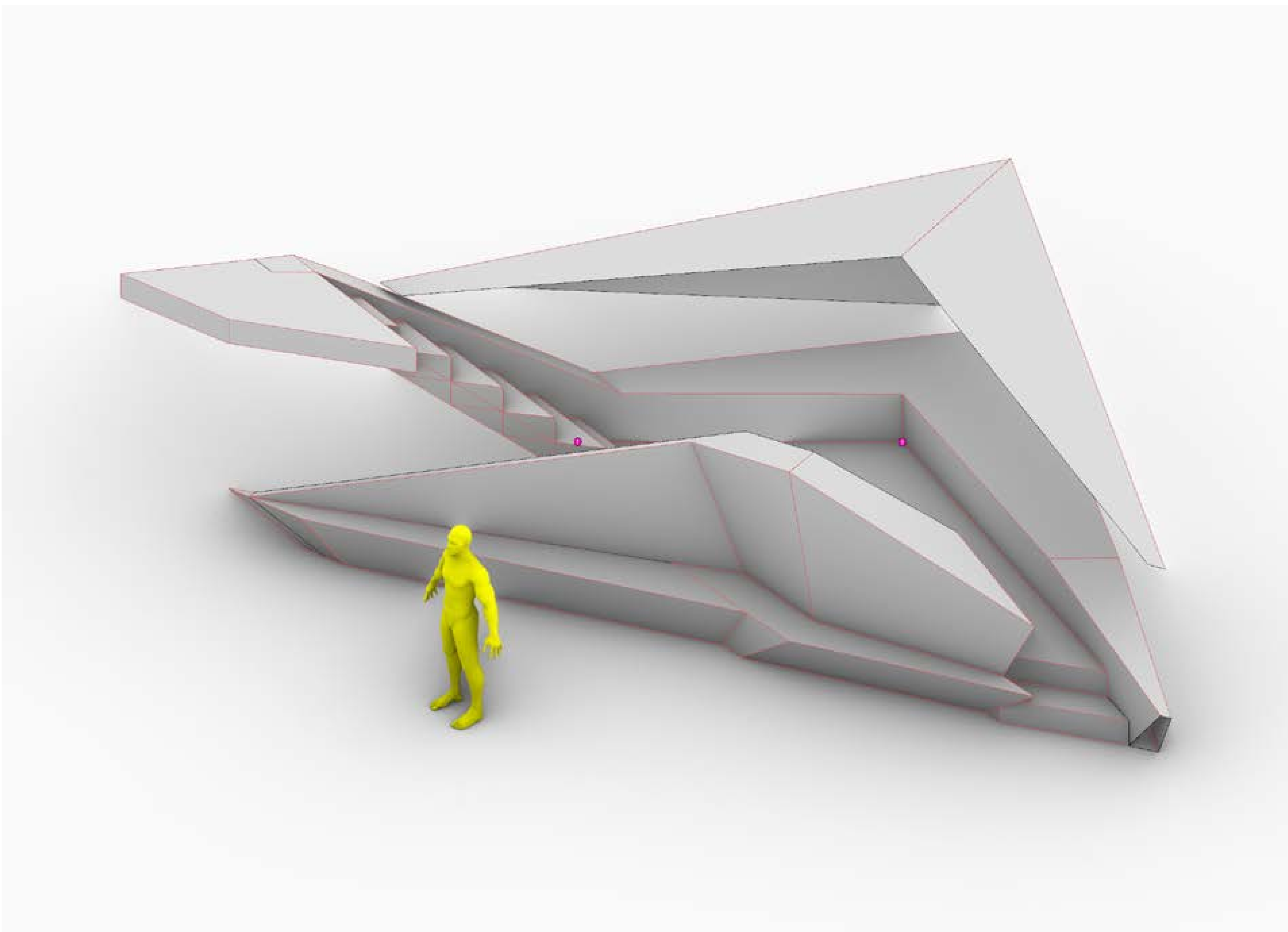

Height

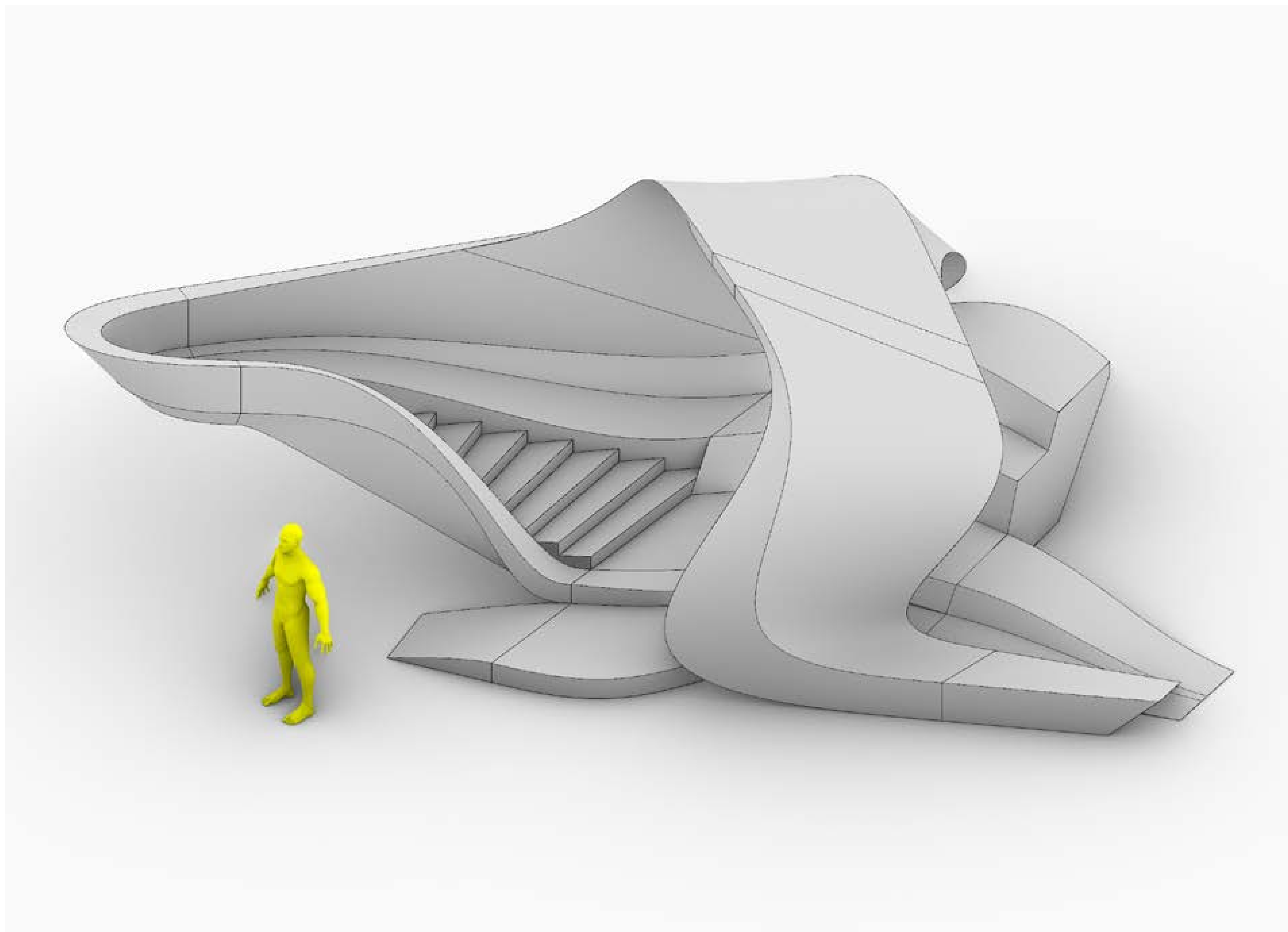

Material Hybridity

The Bauhaus building designed by Walter Gropius in 1926, in which his views of architecture are manifested. The building is composed out of three wings all connected by a bridge. Each of these components houses different functions part of the Bauhaus education. Where they were all designed seperately. This composition of different components is emphasized in the different height of each of them. Showing the distinction between the functions throughout the building. The use of different materials arises from the fascination of Gropius in including structural and technological advancements within the design. Some of the various progressions include a window glazing, a skeleton of reinforced concrete and brickwork, mushroom-like ceilings of the lower level, and roofs covered with asphalt tiles that were meant to be walked on.

1. Bauhaus Pavilion
Architectural Research





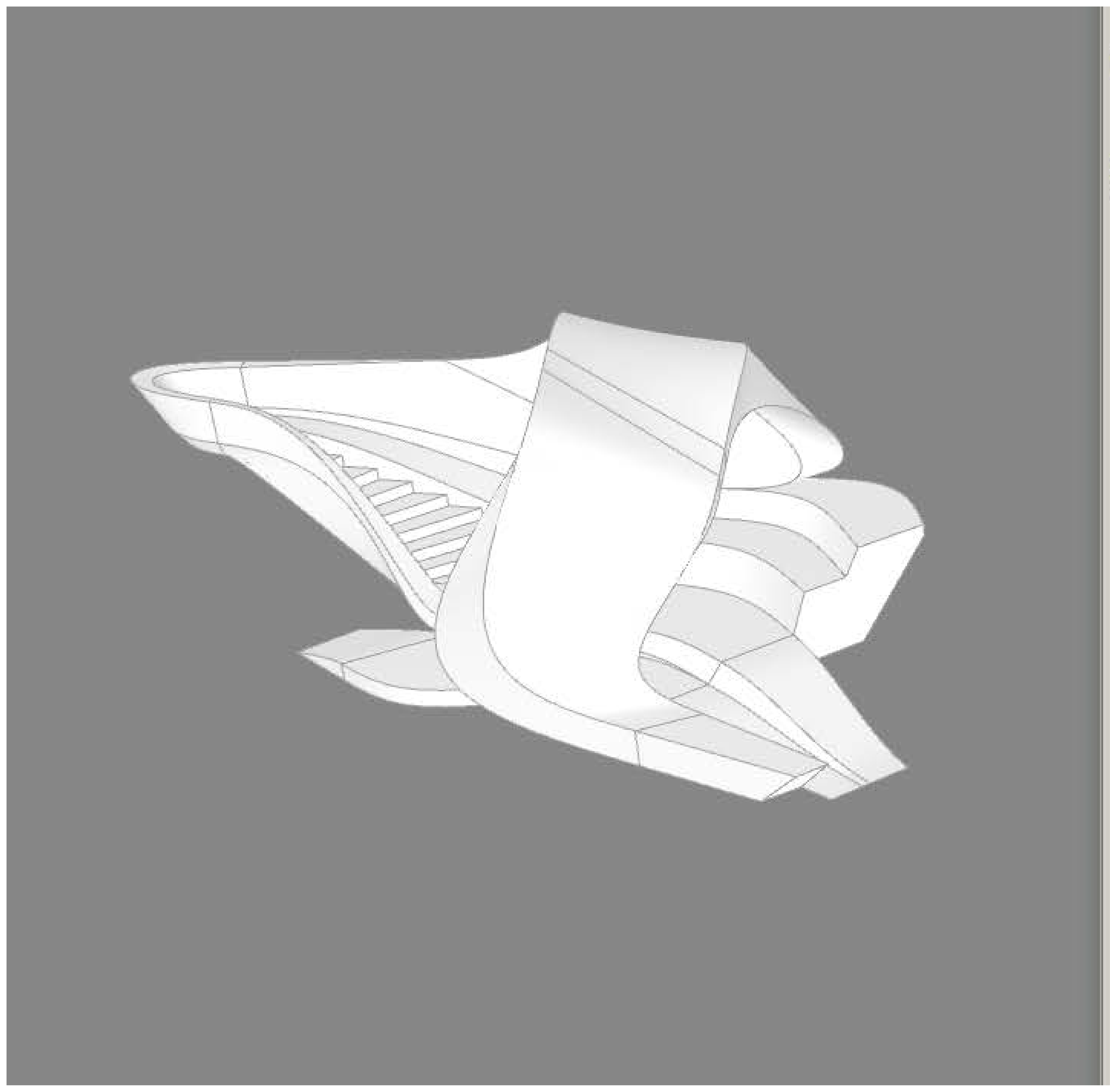


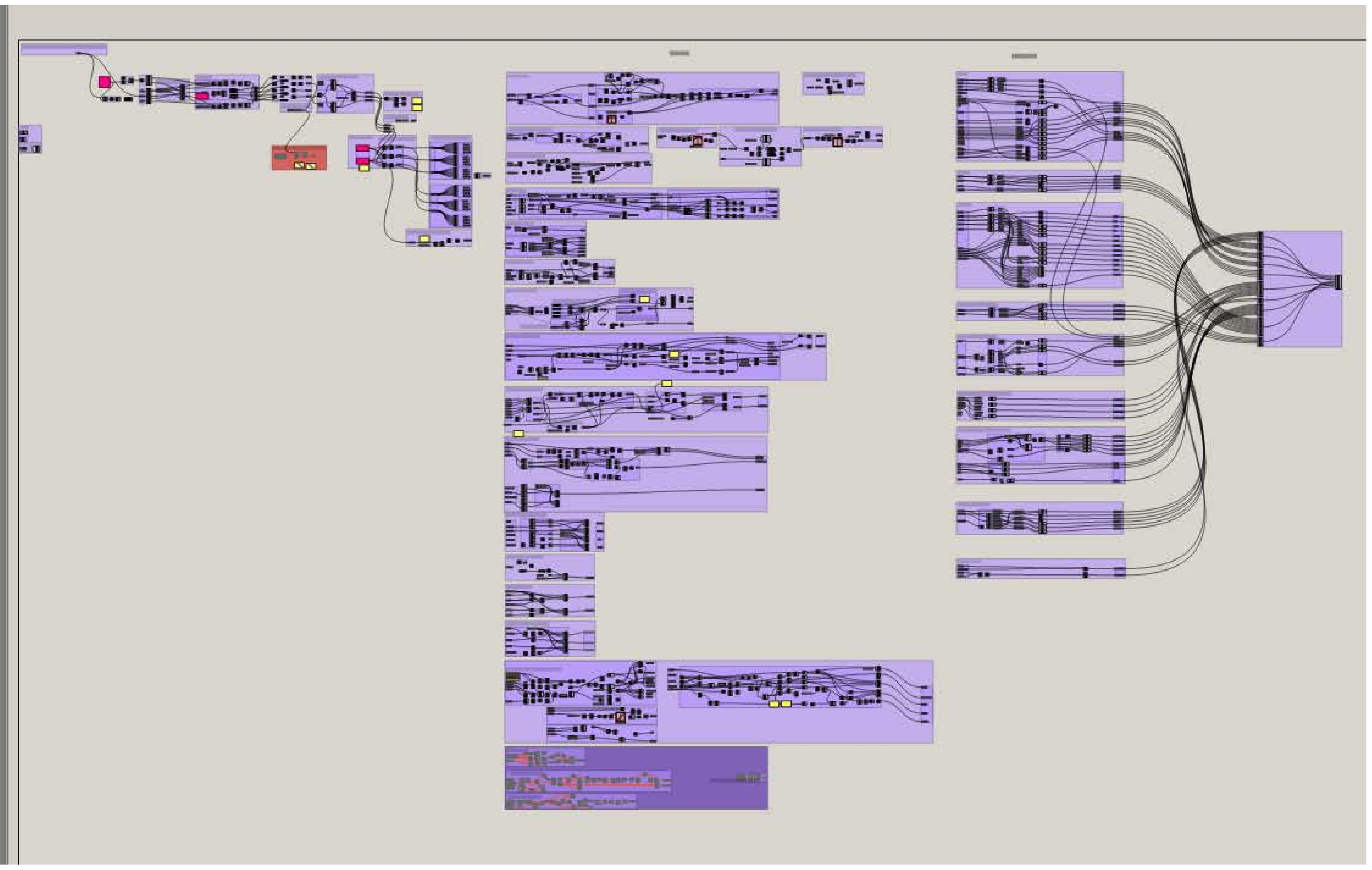
In order to implement the concept with design strategies, several design options were experimented. The first generation tested how to combine multiple functions with geometric laguaguages which came from robotic production methods. As the designs went on, double curved surfaces with subdivision modeling were included to implement the morphing of diverse architectural components with multiple functions as a 'building.'

The second generation considered to enclose the invisible path as a space. The enclosing included multiple functions with a double curved geometric language. By doing that whole architectural components can have a relationship between the urban context, the connection between the Bauhaus and Dessau station.

In the third generation, architectural profile originating from the experience of the Dessau Bauhaus building and station were inherited. Especially the architectural gestures from the Dessau Bauhaus, the verticality and the path under the structure is implemeted with the geometrical morphing. It means the old architectural aspects are being implemented with new technologies.

1. Bauhaus Pavilion
Procedural Research

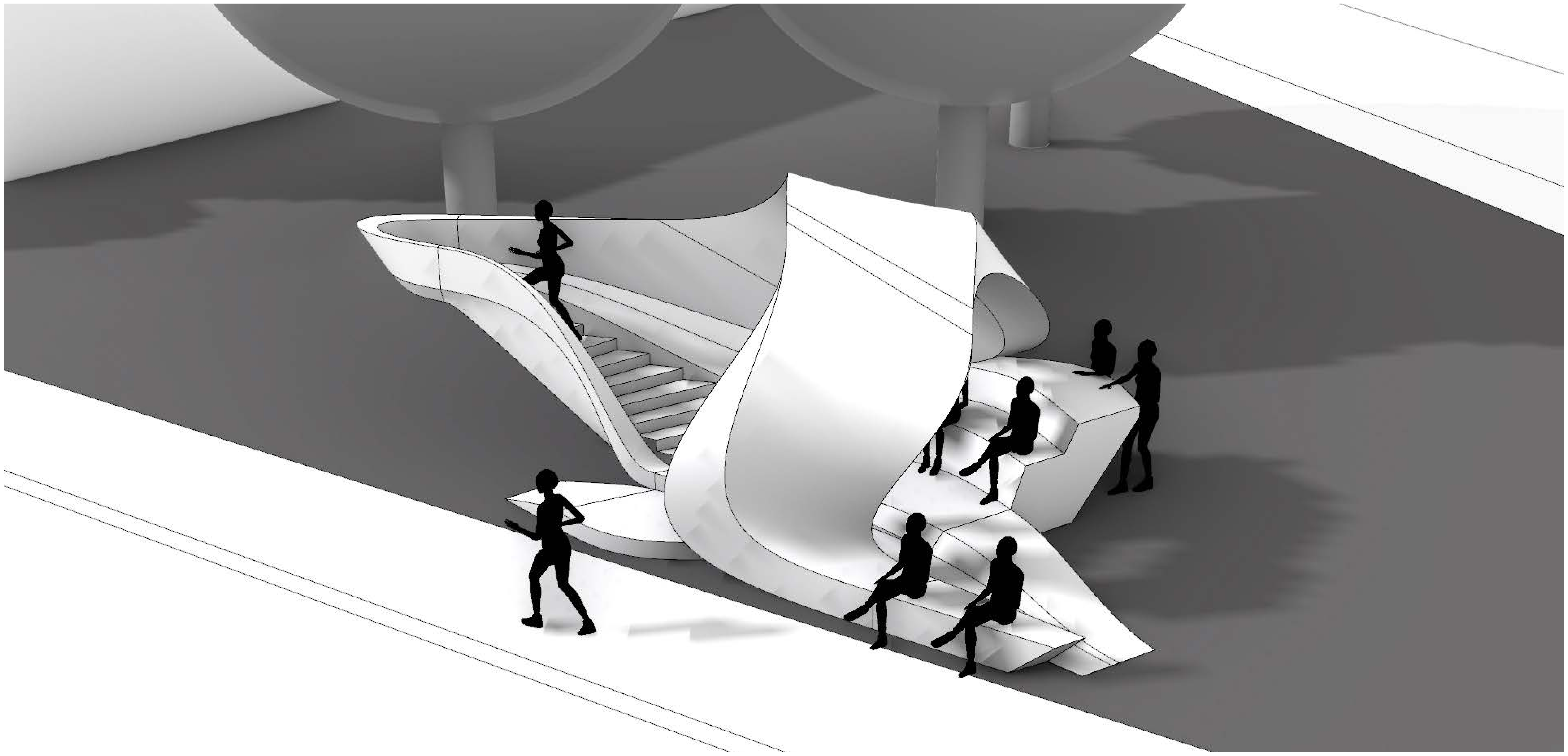


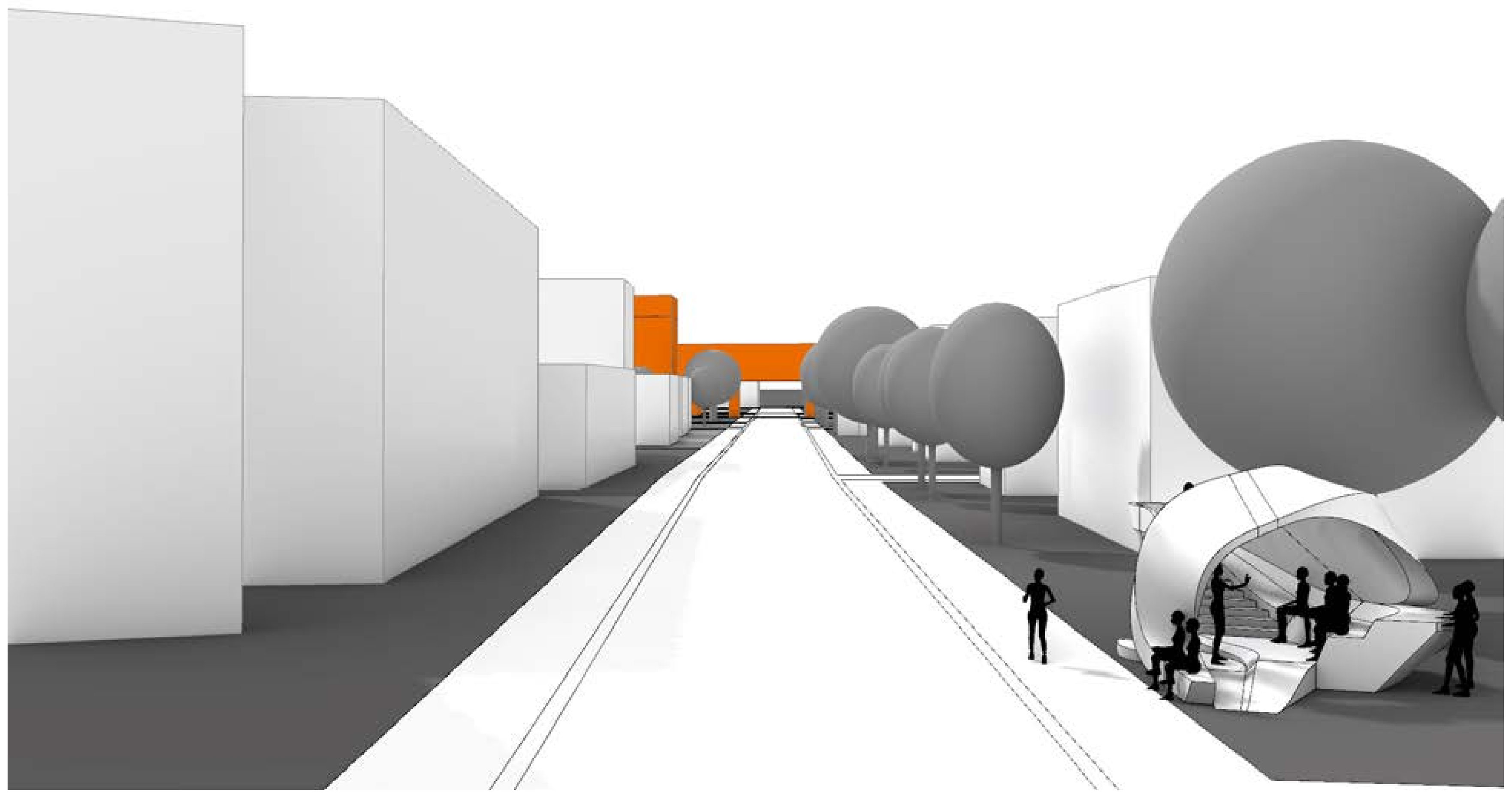


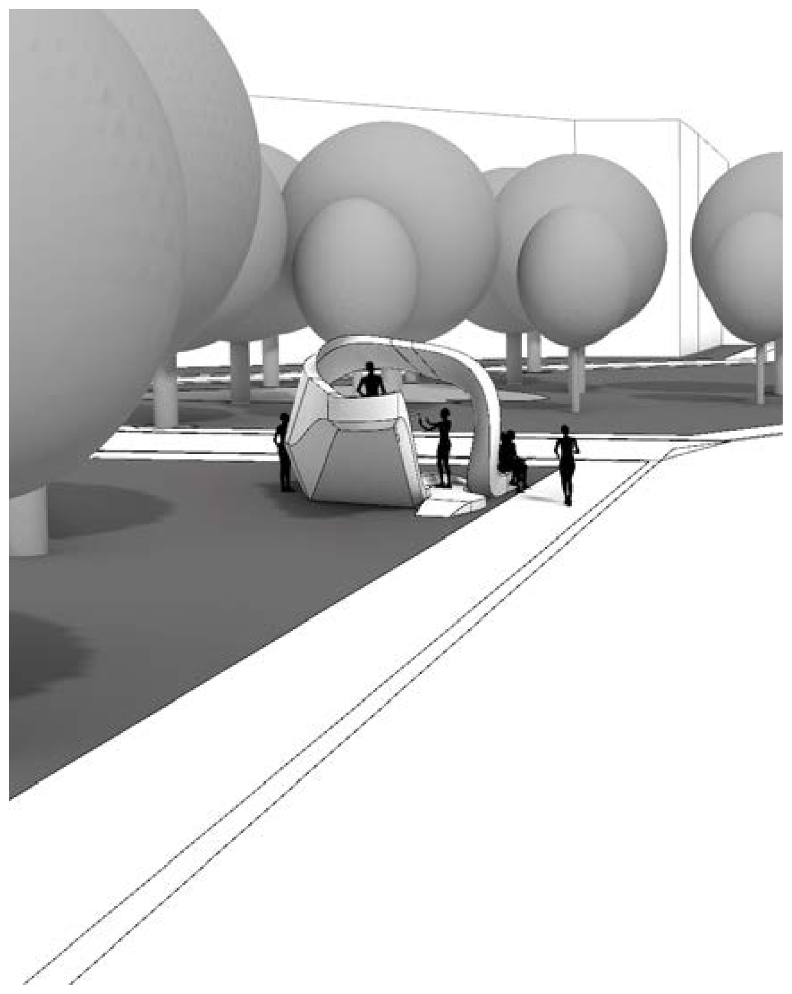
The design choice from the design experiments was generated through procedural modeling. Instead of modeling everything by hand, digital methods have been used to set up a design logic. Following the design concepts multiple parameters have been designed, so that the design process can be flexible but will stay within the concepts. Both the generation of the logic and designing the flexibility are parts that can be used within the graduation.

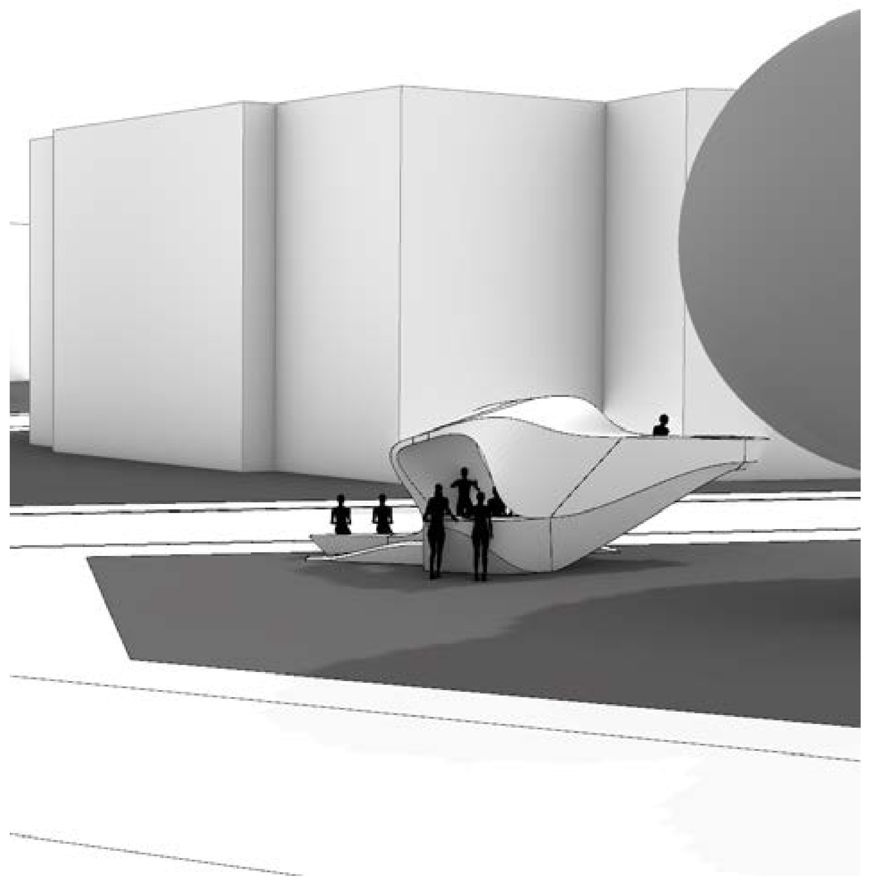
1. Bauhaus Pavilion

Design



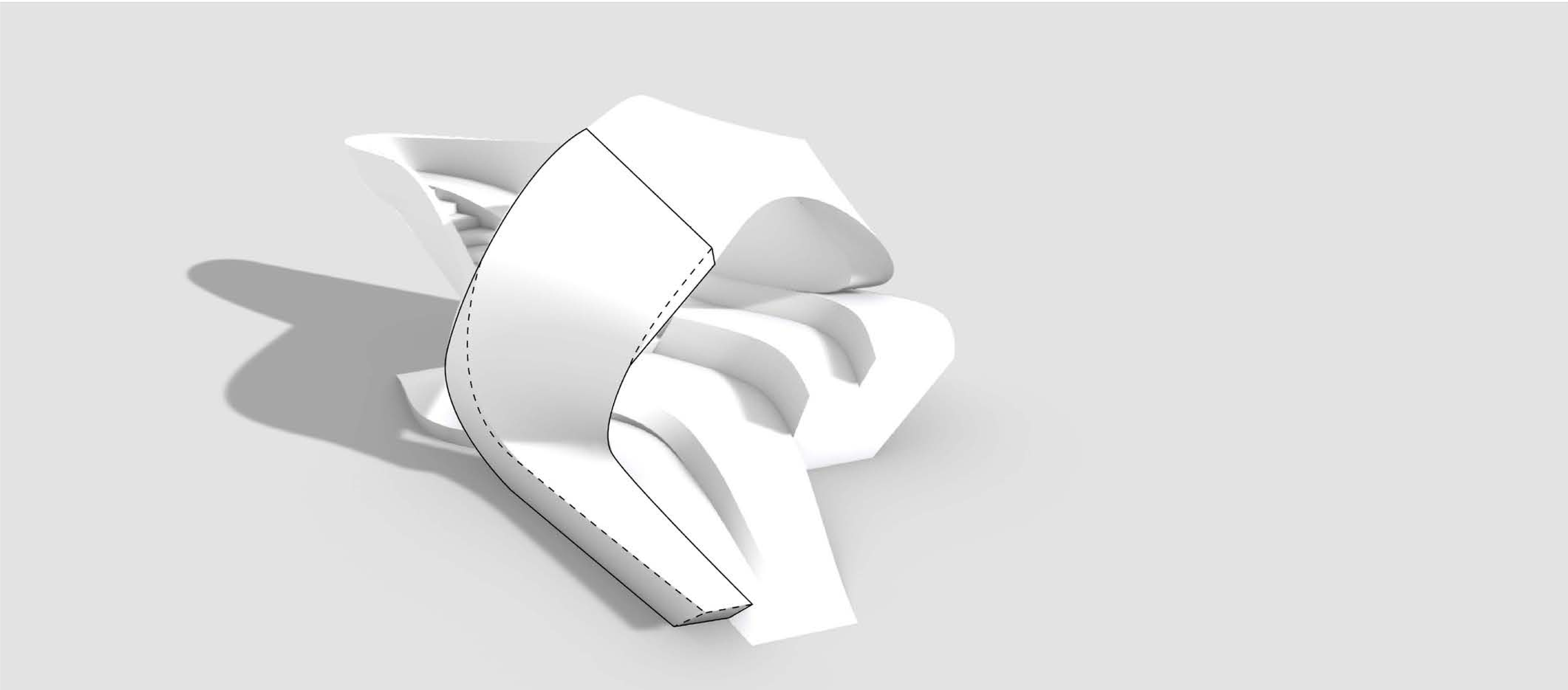






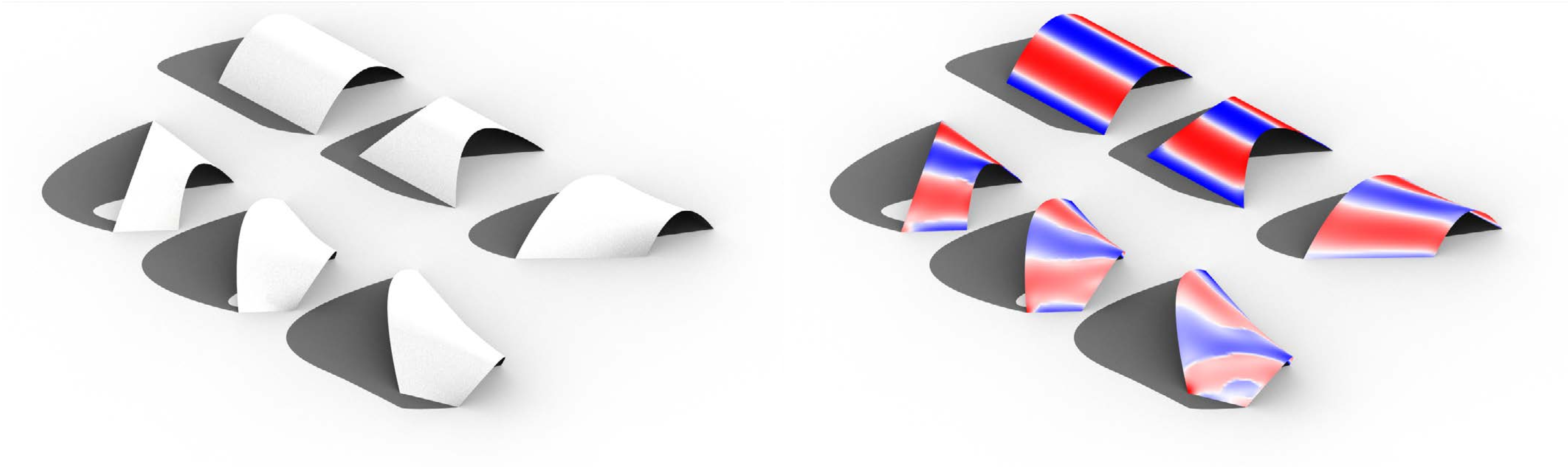
The pavilion is both a building and a space. Connecting the path from the Dessau station to the Dessau Bauhaus Building, in whcih visitors are able to use the pavilion in multiple ways. The concepts have been translated in to one single geometry, a 100year bauhaus pavilion that uses contemporary design and production methods. Combining all these aspects in to one design is what will help me in graduation. Interpreting Bauhaus history and aspects in to a design language, experimenting different geometric languages as a representational tool for the concept and generating a procedural modeling that follows all these aspects.

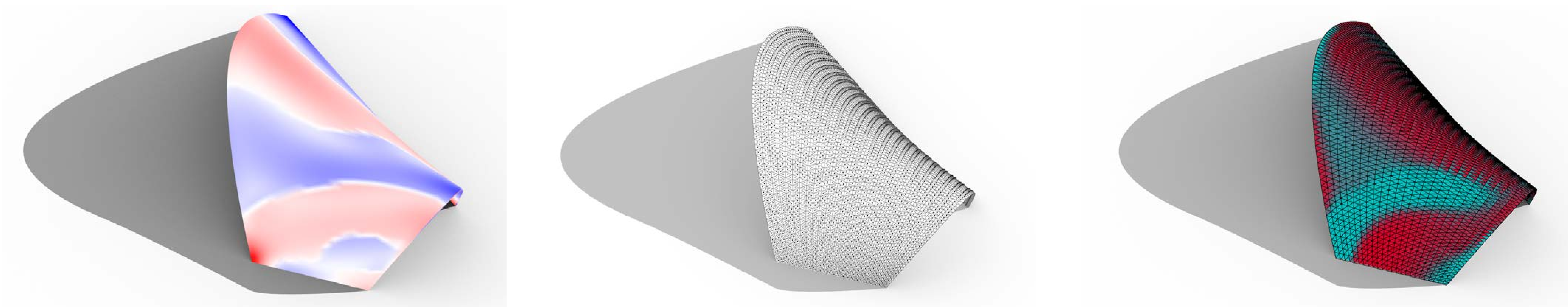
2. Dessau Workshop
Goal



The second workshop was a robotic production workshop in Dessau. The goal of this workshop was to take an element from the pavilion design and develop this so that it can be produced as a 1:1 prototype. The group that I was part of focused on the materials, EPS and Concrete. The bench + part of the arc have been chosen as the main element for the workshop, bringing a challenge in the curving surfaces and the forces that are acting on it. Through structural analysis and parametric modeling the element has been translated in to a 1:1 prototype.

2. Dessau Workshop
Structural analysis

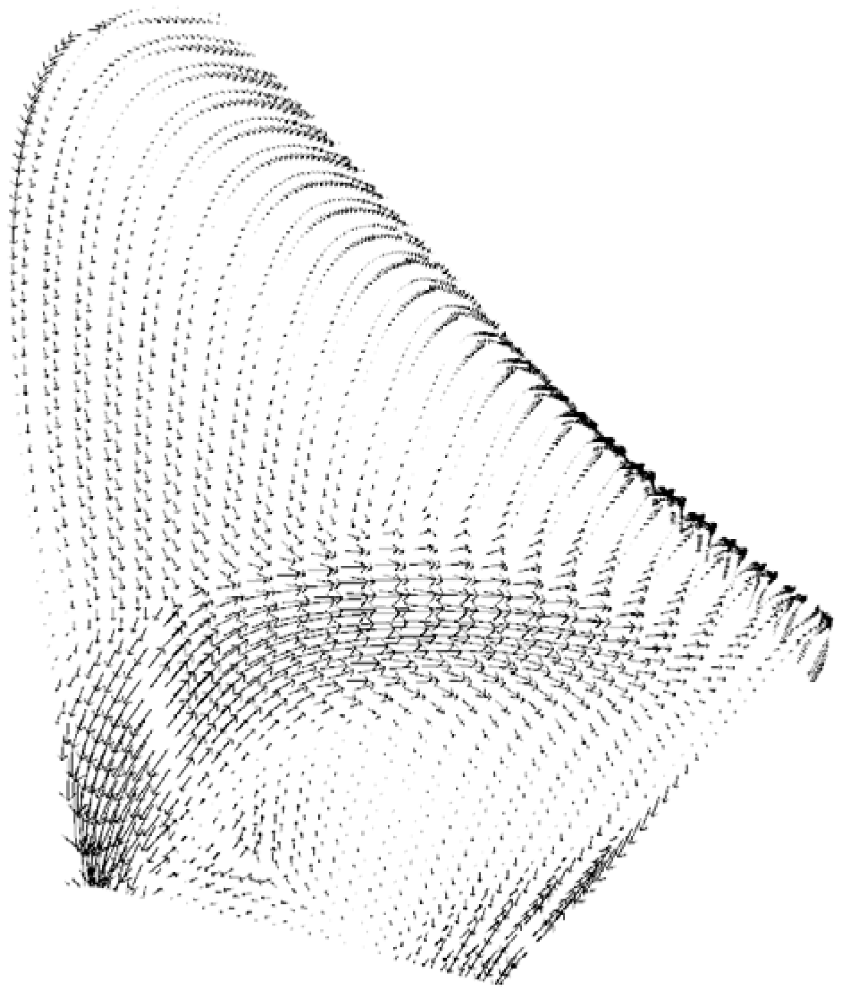


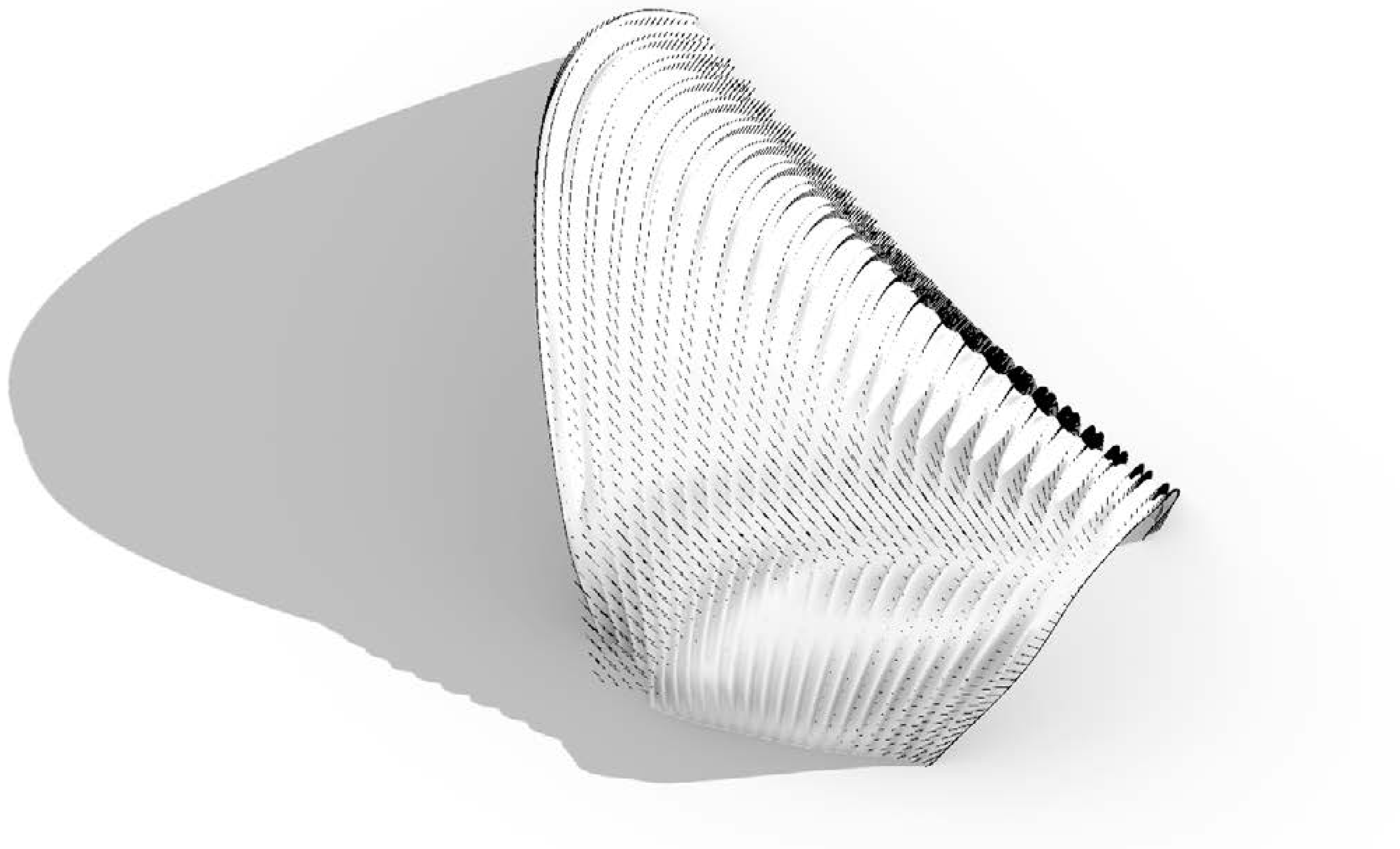


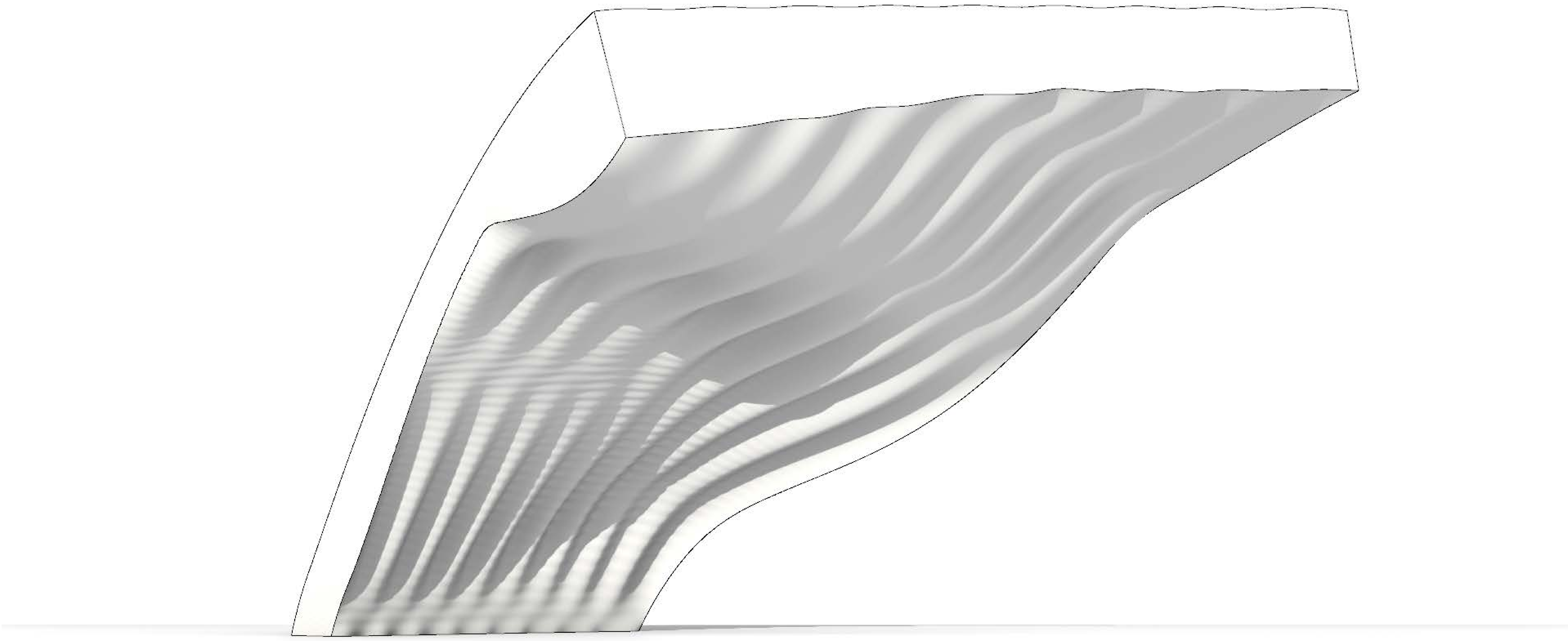
The selected fragment of the pavilion was too specific to be used within the one week workshop. The element has been interpretered in the topology of an arc, similar structural forces are acted upon this shape. Different arc have been designed from which one with the most similar qualities as the fragment has been selected. The arc has been generated through a custom mesh generation method, so that overall structural data could be translated on to local points. From the structural analysis to the generated mesh, each point received the amount of force that it received. Locally informing the whole geometry.

2. Dessau Workshop

Structural analysis



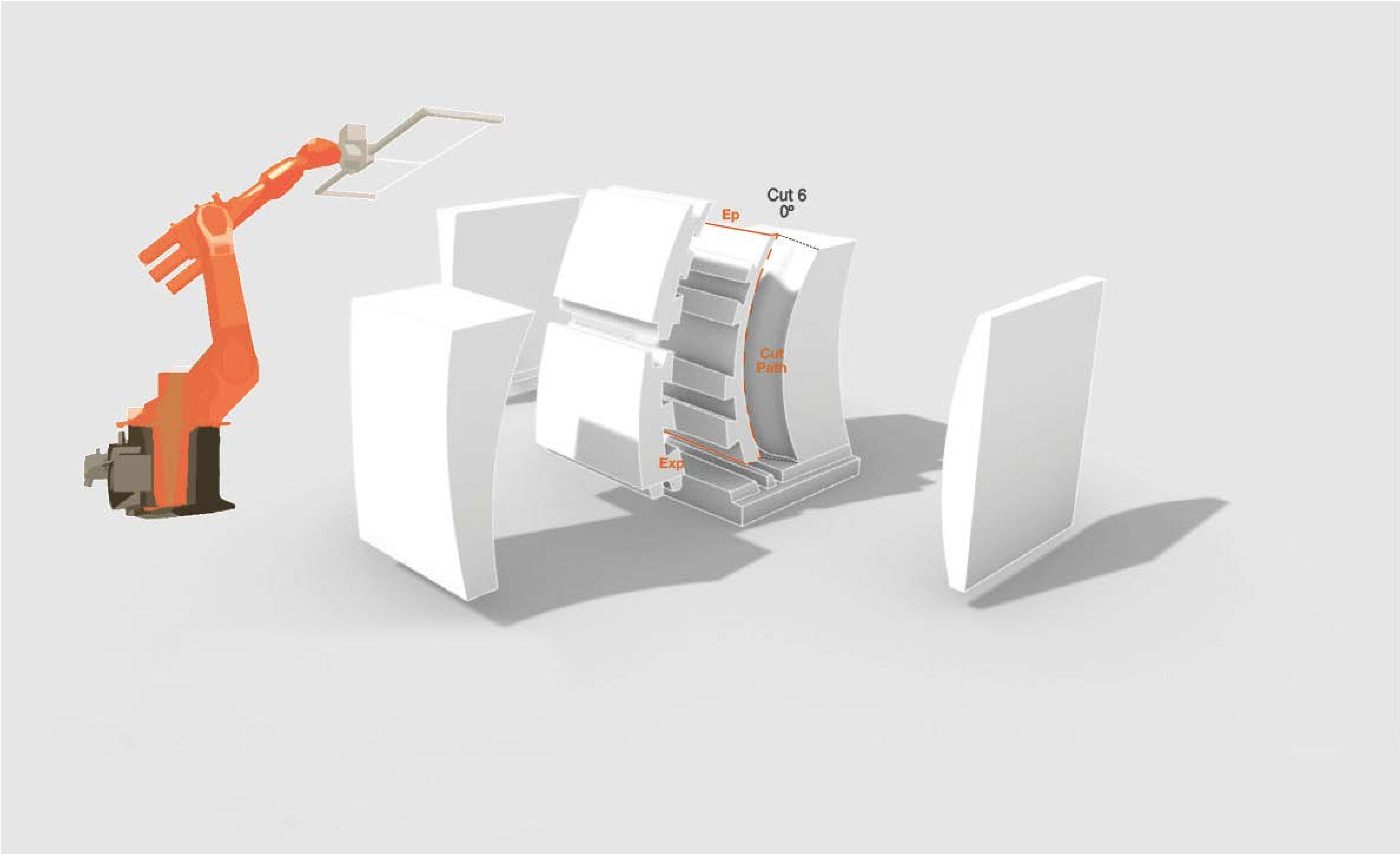


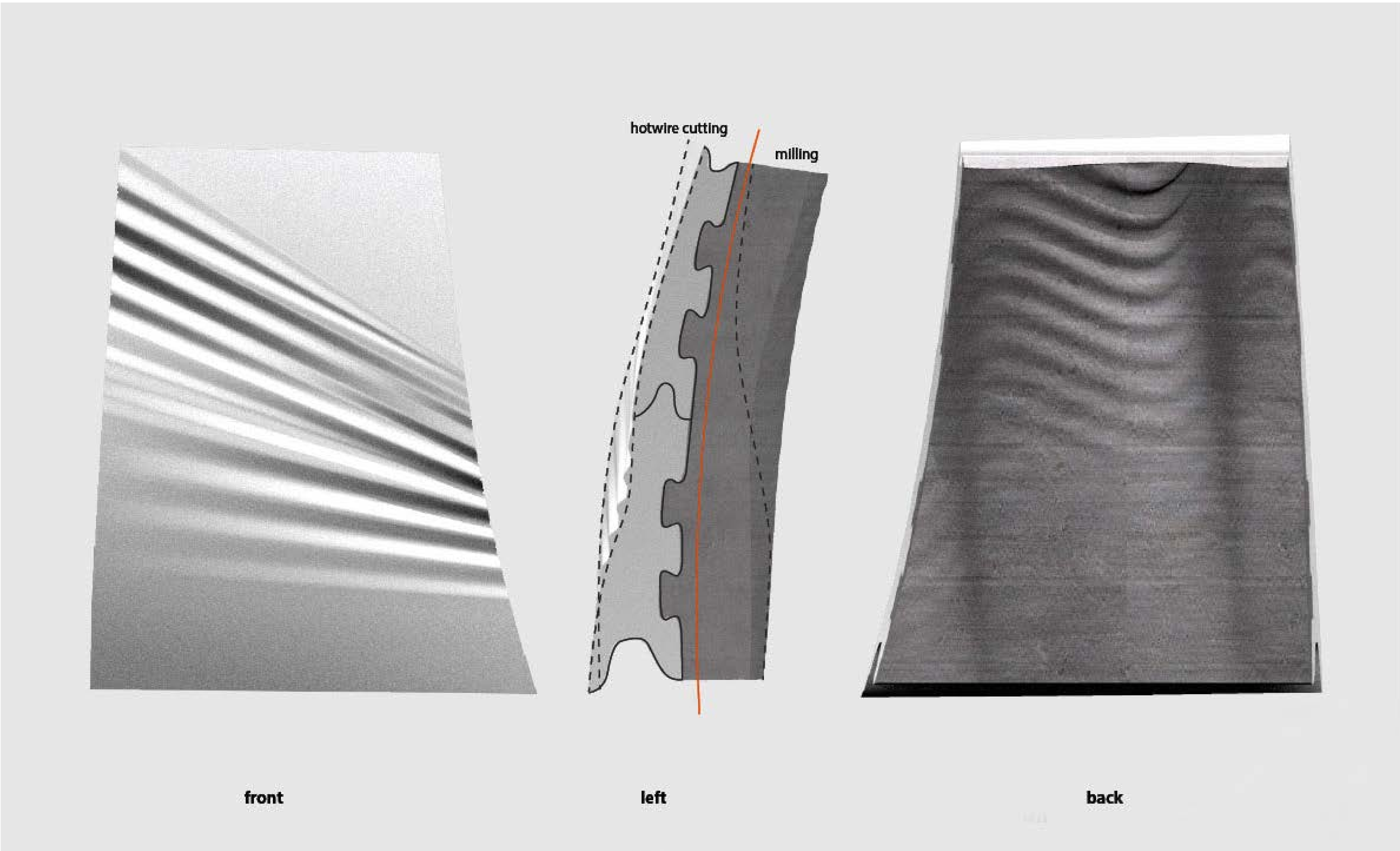


The data that was saved on these points was then translated in to vectors, showing the translation needed to house these forces. As said before the material for the fragment was concrete, so these translations are based on concrete properties. Either having tension or compression defining the width of the element. The goal was to use the properties of concrete, design by data and have an architectural translation based on the locally informed geometry.

2. Dessau Workshop

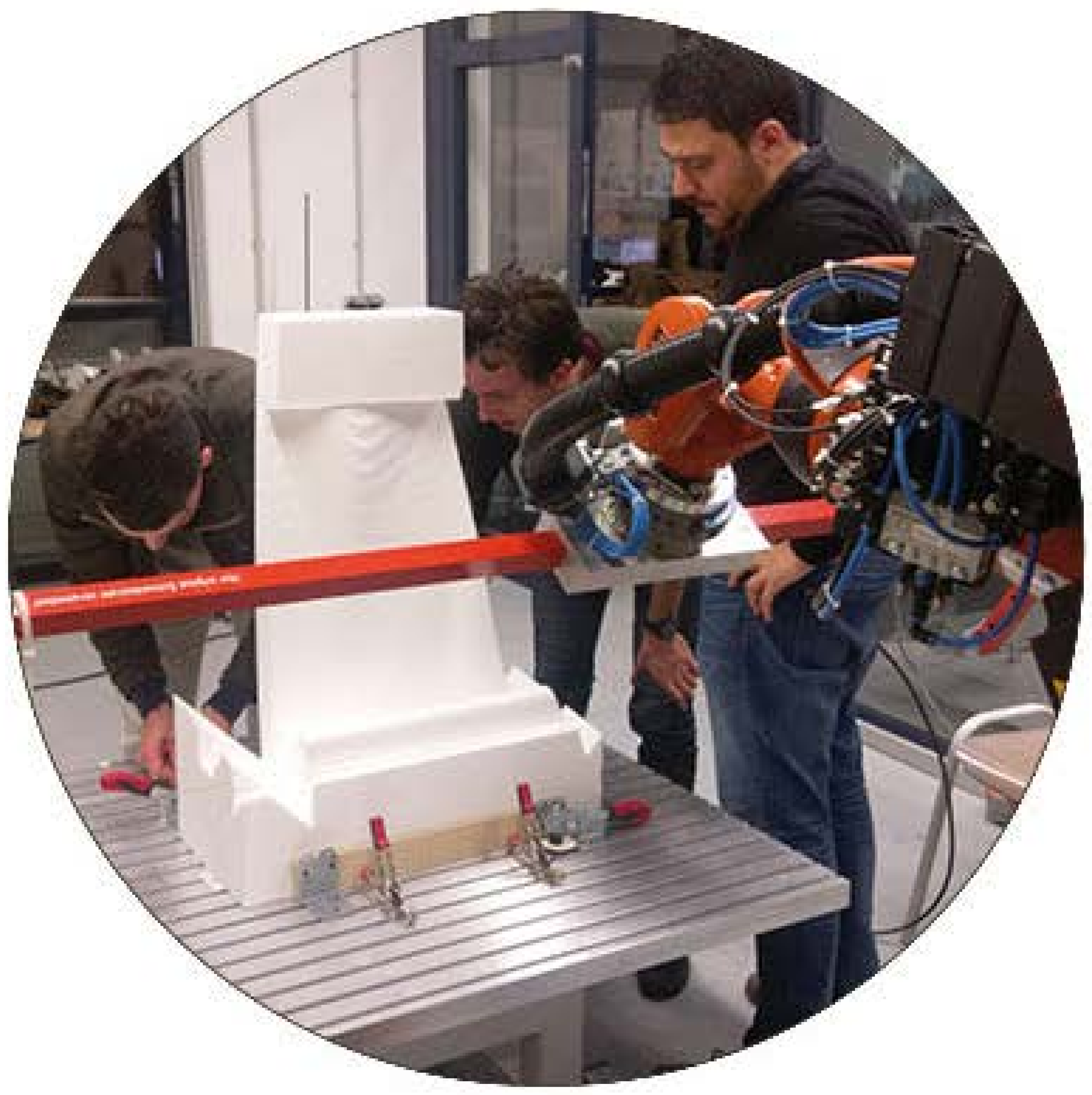
Componential logic





These architectural translations then had to be robotically produced. The whole arc was too big to produce 1:1 scale, so a componential logic had to be designed so that the arc can be built up from multiple elements. The construction method chosen was that of using the EPS as a mold and insulation, in which the concrete was to be poured. Using part of the EPS as insulation and interlocking system with the other components.

2. Dessau Workshop
Fabrication



Production

Preparing Cast

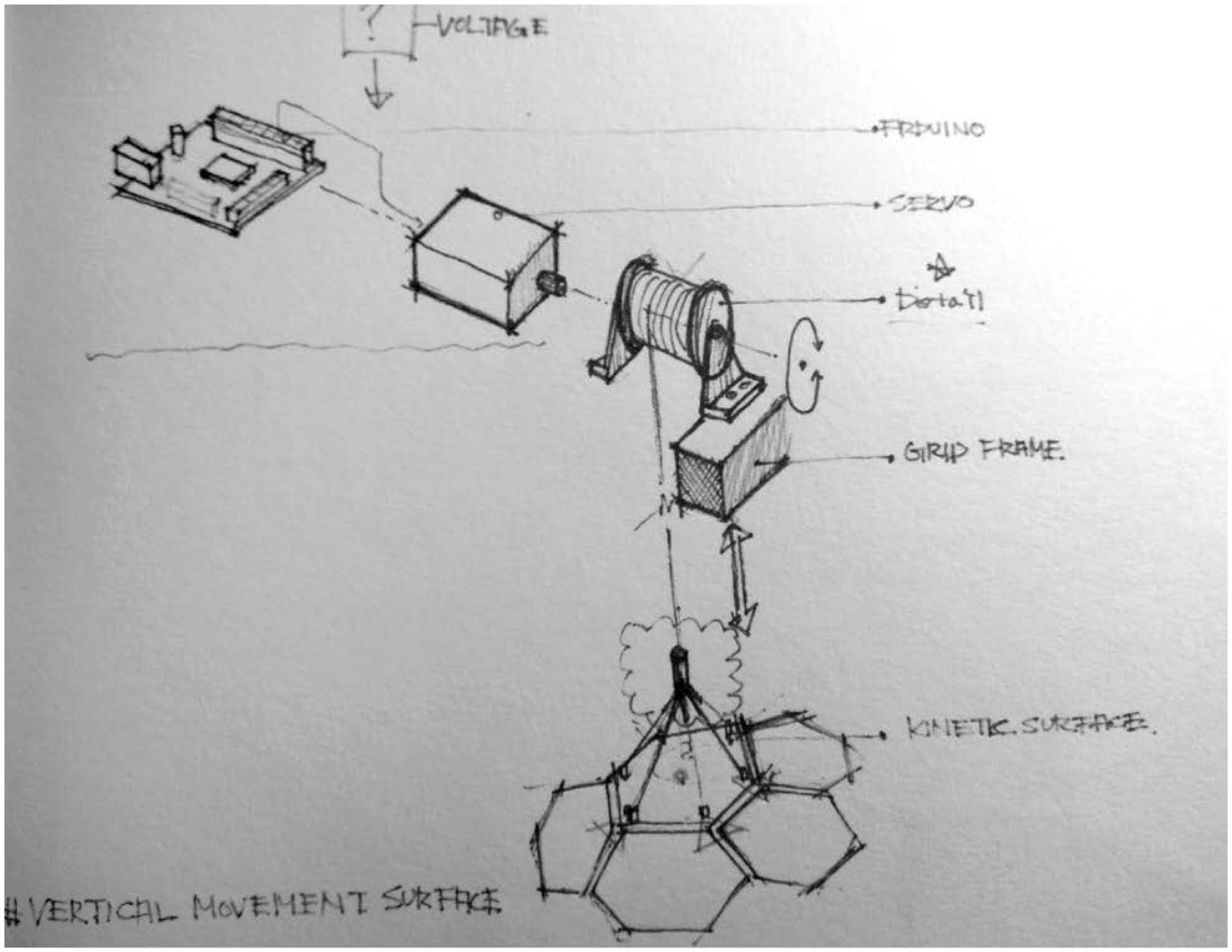
Closed Cast "Cat"

The interesting thing of this workshop was that almost everything was based on digital modelling, however the translation in to a physical model required physical work. The robotic production showed the constrains of using a specific robot with a certain reach, needing to rotate the model, overcutting certain parts or slight variations in accuracy. Next to that a system to support the casting was to be made by hand, giving new insights on the process of concrete casting and robotic production.

3. Philip Beesley Workshop
Goal

The third workshop was a collaboration with Philip Beesley, Crossing Parallels, Architecture & Built Environment Faculty and Industrial Design faculty. The goal was to produce a interactive installation based on Beesley's principles and student input. The installation moves based on its environment, so that visitors walking through the installation will have moving element all around them. As part of the Robotic Building studio we had a week of preparation in which we explored the potentials of interactive architecture.

3. Philip Beesley Workshop
System



Within the workshop the students were divided over groups concering production, software, robotics, components. I was part of the software group in which we were responsible for the translation of data in to movement or lighting. Taking the data from the environment, using this data to then inform the geometry to move in a certain way. This coding was done through C++ within an Arduino module. After having established the code a design was made on how to move parts of the installation. Translation the code into a rotor that moves, and by moving it would lift or lower the installation.

3. Philip Beesley Workshop

Coding

181115_teensy_sweep_multiple_servos | Arduino 1.8.7

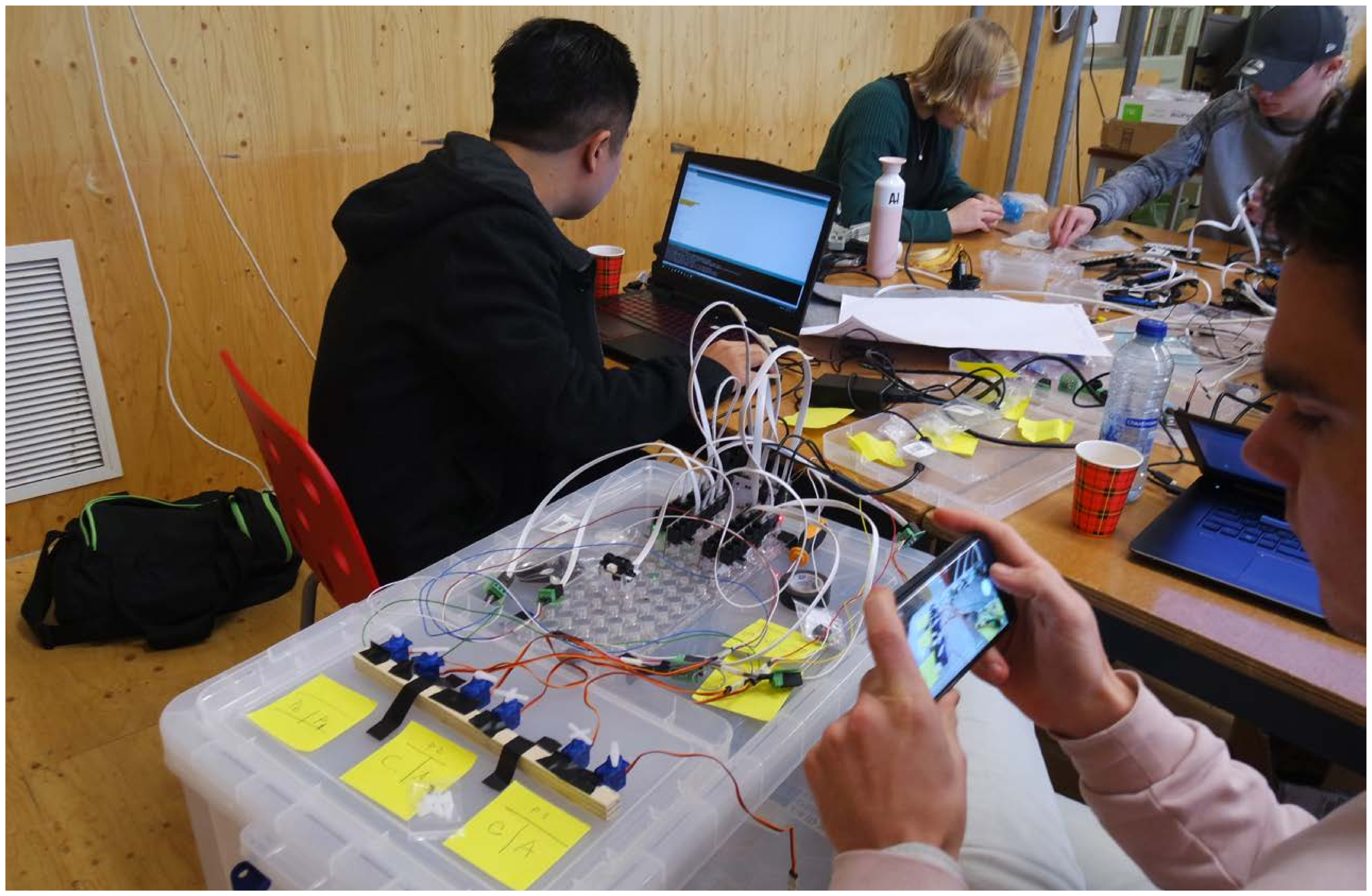
File Edit Sketch Tools Help

181115_teensy_sweep_multiple_servos

```
void setup() {
  pinMode(ir_pin1, INPUT);

  // attaches the servo on a specific pin to the servo object
  servo1.attach(4);   // A on P0

  servo2.attach(32);  // A on P1

  servo3.attach(10);  // A on P2
  servo4.attach(15);  // C on P2

  servo5.attach(8);   // A on P3
  servo6.attach(13);  // C on P3

  Serial.begin(9600);
}

void loop() {
  ir_value1 = analogRead(ir_pin1);
  delay(30);
  ir_trigger1 = ir_value1 > ir_threshold;


  if (ir_trigger1){
    for (pos = 0; pos < 720; pos += 1) { // goes from 0 degrees to 720
      // in steps of 1 degree
      servo1.write(pos);
      servo2.write(pos);
      servo3.write(pos);
      servo4.write(pos);
      servo5.write(pos);
      servo6.write(pos);

      delay(15);
    }
    for (pos = 720; pos > 0; pos -= 1) { // goes from 720 degrees to 0
      servo1.write(pos);
      servo2.write(pos);
      servo3.write(pos);
      servo4.write(pos);
      servo5.write(pos);
      servo6.write(pos);

      delay(15);
    }
```

Done compiling.

```
Sketch uses 11044 bytes (4%) of program storage space. Maximum is 26214
Global variables use 3552 bytes (5%) of dynamic memory, leaving 61984 b
```



The simulation was built up from multiple different components. To get these components moving they need to be informed, the act of informing was based on the translation of the code. So there was two aspects that influenced the process a lot. The wiring of the electronic components, such that the data that was received or exported was linked to the right component. The data used by the different components, some motors (servos) used different data, so that initial codes did not translate it in the right way.

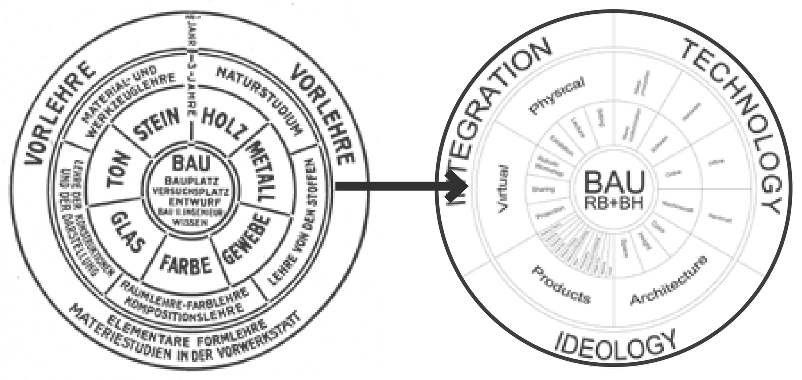
3. Philip Beesley Workshop
Conclusion

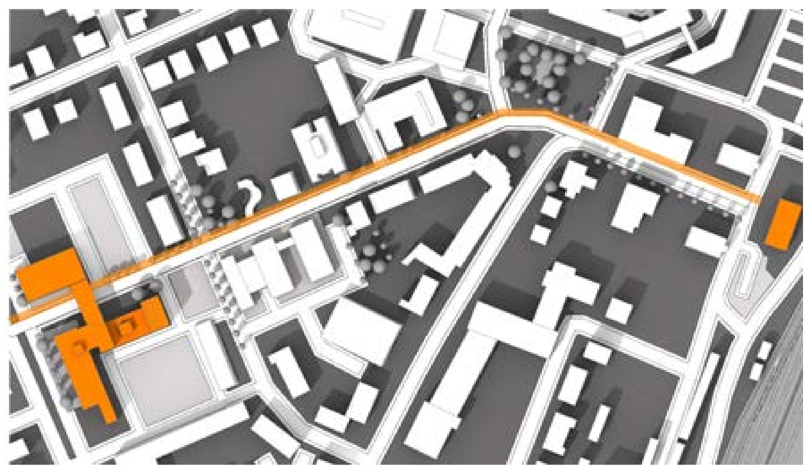
The workshop was based on the principle of collaboration, multiple groups of students working together to produce one coherent installation. It was interesting to see how the whole project was structured and how all discplines complimented each other. Having a relation between non-interactive and interactive components. With an overarching concept/structure while still giving freedom to the creatitivity of the students. Translating this to my graduation it fits with the concept of an overarching system that can be changed based on user-input.

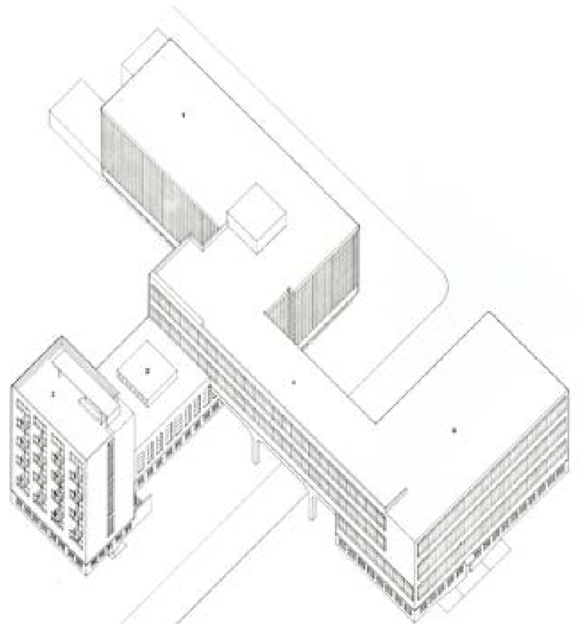
Next to that the translation of the physical in to the digital and back taught me a lot. The problems arising when hardware is broken or wrongly connected, or data has been translated in the wrong way. Learning by doing. Taking this interactive part in graduation it could be used in different ways, spatial interactivity in which some rooms are used or unused so that their climate systems are activated. Digital Interaction with the public or user, with moving facades or visual elements.

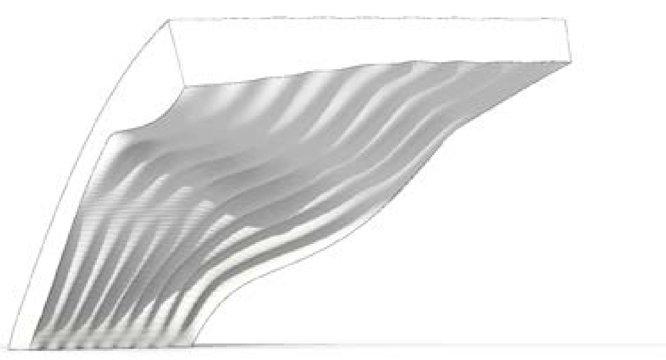
4. Conclusion

design

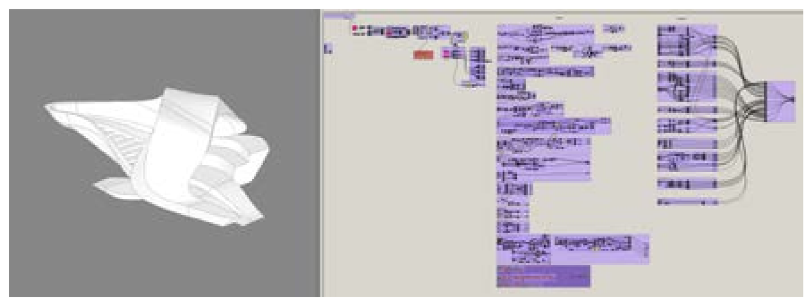


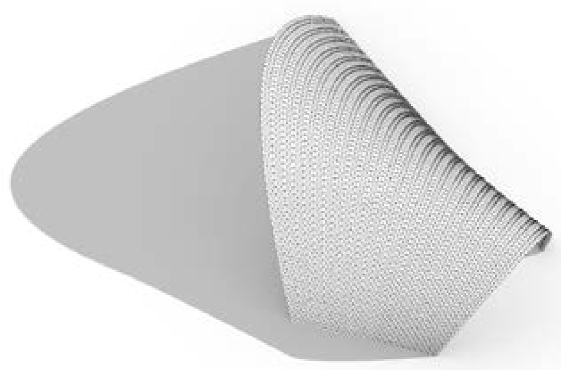


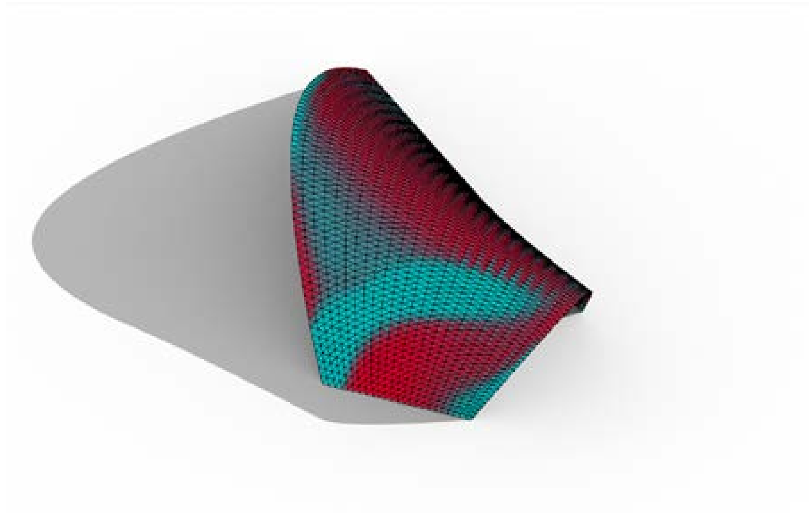


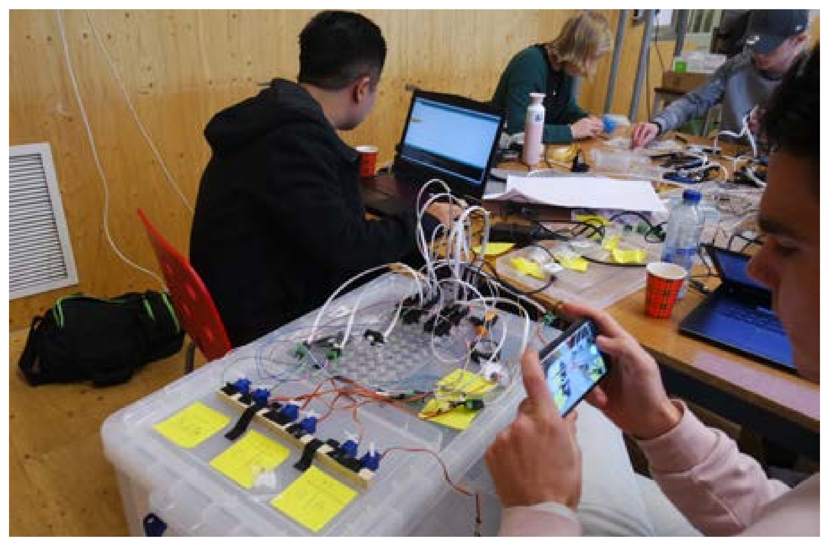


digital

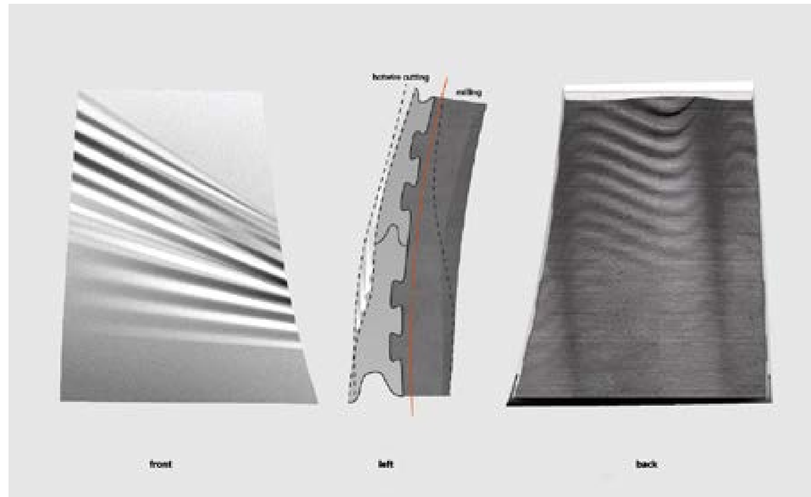


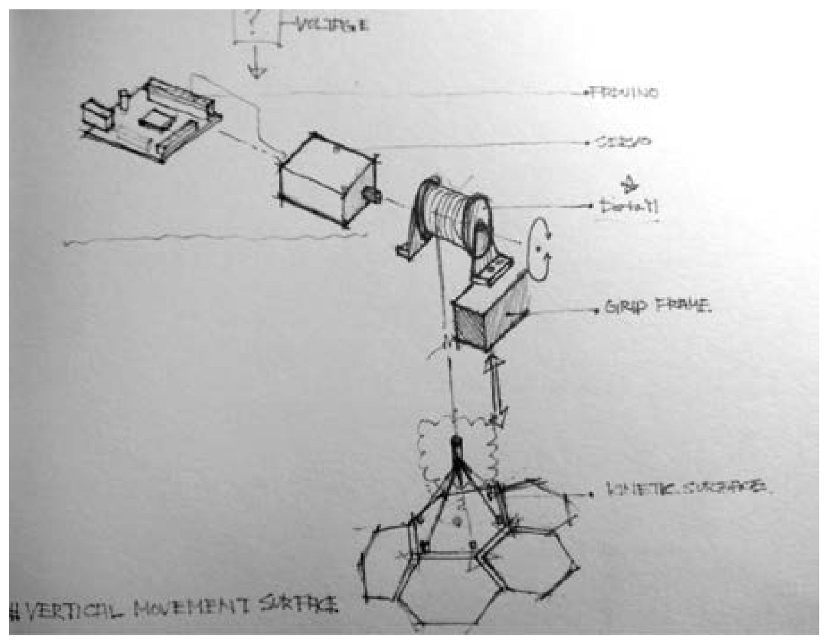






physical





Multiple aspects from the workshops can be used within my graduation.

Design: Tthe vision of the Bauhaus, the context of Dessau, the qualities of Bauhaus University, the translation of Bauhaus in to contemporary architecture
The architectural translation of structural analysis on to a component

Digital: Procedural modeling in which the concept is kept but design process is still flexible
Mesh generation of a geometry, locally informing stress analysis on to geometry and using this to inform design decisions
Coding of interactive components, communication between hardware and software

Physical: Robotic production of a hybrid between EPS and Concrete, the limitations of robotic production and process of producing components.
Mechanical translation of interactive system in to a physical system. Collaboration between multiple disciplines in to a single design.