SECTIONING

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Simon Strez

Joanna Sadler

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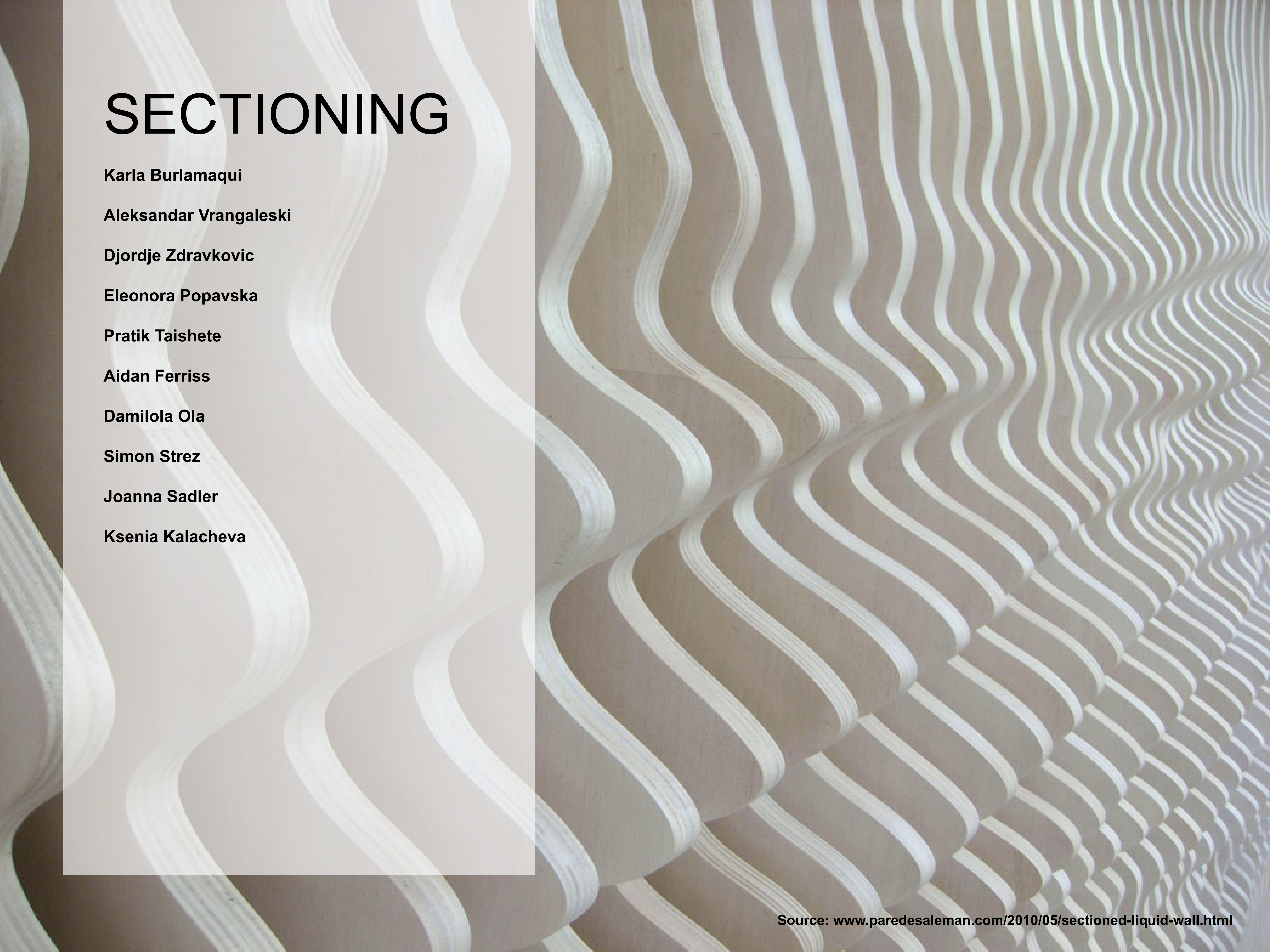


Source: www.paredesaleman.com/2010/05/sectioned-liquid-wall.html

SECTIONING

DEFINITION

Sectioning is a process of taking cuts through a three-dimensional object resulting in numerous cross sections of the form. Rather than constructing a complex three-dimensional surface of an object, sectioning utilizes a series of profiles that follow the surface geometry. Software instantaneously produces parallel, radial or adaptive sections through objects at user designated intervals, streamlining the process of making individual serialized sections.

Rather than constructing the surface itself, sectioning uses a series of profiles, the edges of which follow lines of the surface geometry.

Sectioning is also called “2D fabrication” as everything is produced out of two-dimensional, sheet materials, making sectioning one of the most affordable and easy-to-understand processes.

Today, sectioning and other Digital Fabrication techniques are widely used in the Architecture, Design and Engineering world. The advent of new, complex programs are allowing Architects and Designers to explore new and exciting forms in any given scale, function or program.

Source: www.huftonandcrow.com/projects/gallery/metropol-parasol-seville/

SECTIONING

EXAMPLES FROM NATURE

Sectioning can be found in many places in nature contributing to a form where a reduction in materials is reaquired. Many types of coral and aquatic life forms utilize sectioning to provide rigidity to a form wihile sti-ll conserving material. The human body also contains sectioning, for example the rib-cage gives form to the torso with each rib acting as a section. The spinal cord also functions in this way.

Source: fossilmuseum.net/Tree_of_Life/PhylumCnidaria/classanthozoa.htm

SECTIONING

HISTORY & ORIGIN

Sectioning as a construction technique has a long history in the aeronautic and shipbuilding industry prior to the development of computer aided software. For example, sectioning was used to create the curved and aerodynamic shapes required in both airplanes and ships by clading curved rips with a surface material. Aeroplane wings were made using sectioning to achieve a complex, lighweight, smooth 3D form.

It was used to build the first boat around 10,000 years ago, using wood logs (sections in this case) and animal skin. The section of wooden logs help achieve the desired form and give regidity to the structure.

This technique has also been used extensively in Architecture as a construction method before digital fabrication methods were known and used widely. Le Corbusier's Chappelle Notre Dam du Haut de Ronchamp, used a ribbed structure to help realize the projects curved roof in 1955.

Source: boatdesign.net/forums/boat-design/direct-female-mold-construction-6584.html

Source: http://wolfgangbrinck.com/boats/tales/canoe01.jpg

Source: shortfinals.wordpress.com/2013/12/02/the-bristol-f-2b-fighter-bare/


Source: www.archdaily.com.br/br/01-16931/classicos-da-arquitetura-capela-de-ronchamp-le-corbusier


Source: shortfinals.wordpress.com/2013/12/02/the-bristol-f-2b-fighter-bare/


Source: shortfinals.wordpress.com/2013/12/02/the-bristol-f-2b-fighter-bare/


Source: shortfinals.wordpress.com/2013/12/02/the-bristol-f-2b-fighter-bare/

SECTIONING

TYPOLOGY & CLASSIFICATION

Classification of a section technique is according to the direction / axis of the section planes. Sectioning can generally be classified into 5 categories:

Vertical Sectioning occurs when the geometry is sectioned according to the Y Cartesian axis.

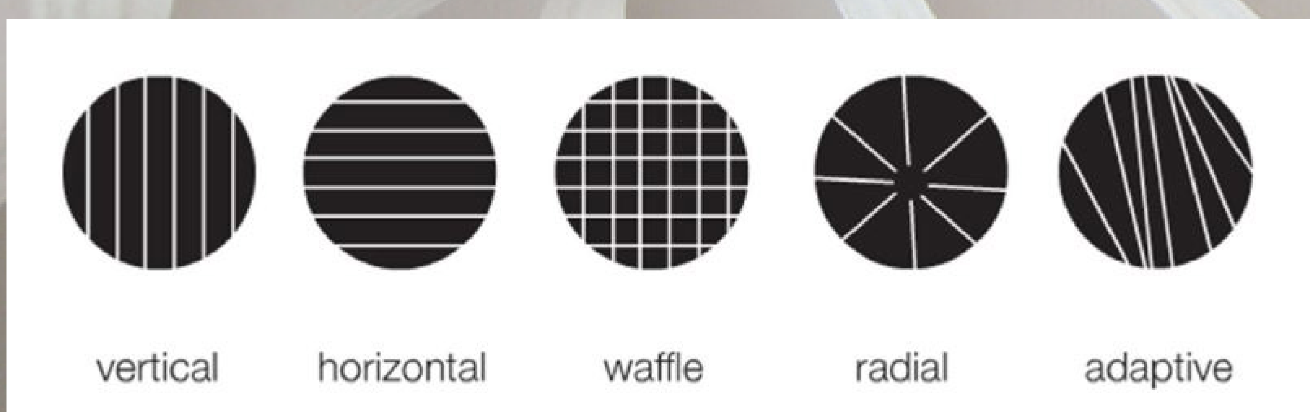
Horizontal Sectioning occurs when the geometry is sectioned according to the X Cartesian axis.

Waffle Sectioning otherwise called “egg crate” sectioning derives from the combination of vertical and horizonal sectioning.

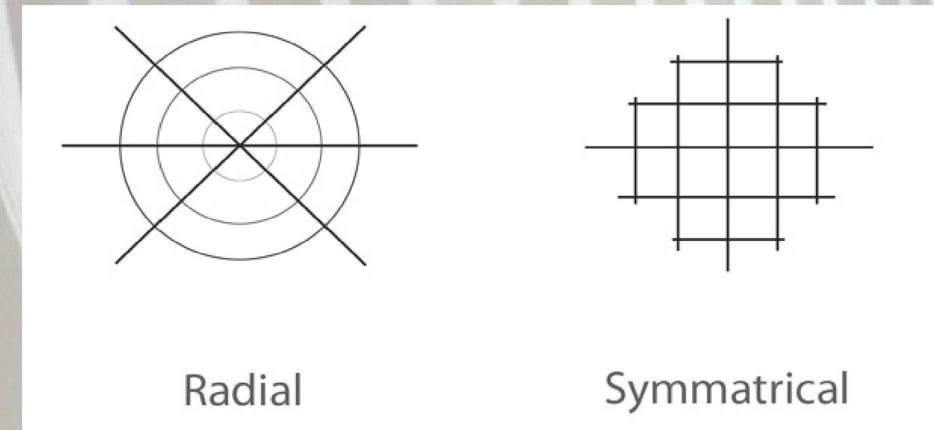
Radial Sectioning is when sections are created based on a circular path around the object.

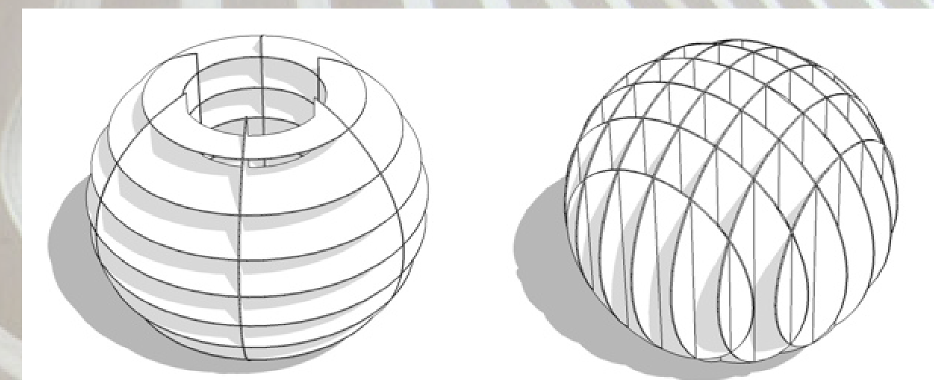
Adaptive Sectioning is a method which allows for the sections to follow the curvature and geometry of the object. Adaptive Sectioning is specific to the particular geometry of the object.

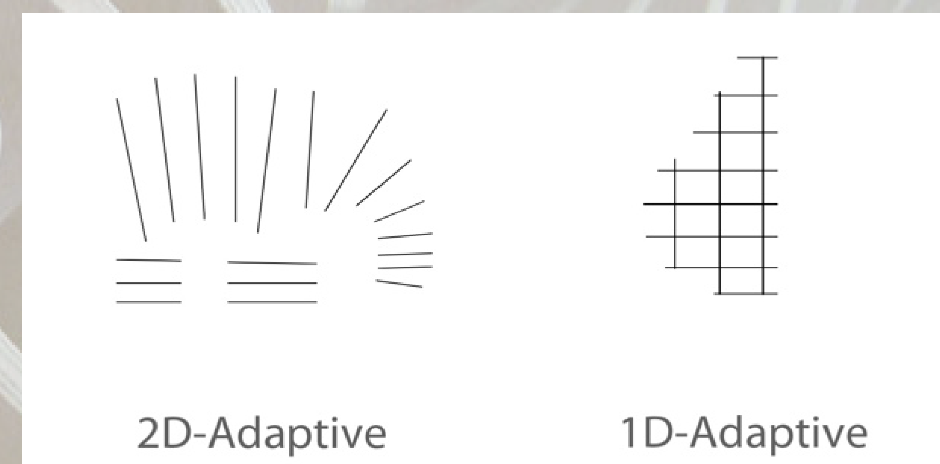
*Finally, there is the possibility of “random” sectionin, which happens when the section planes are chosen or given in any path or angle.

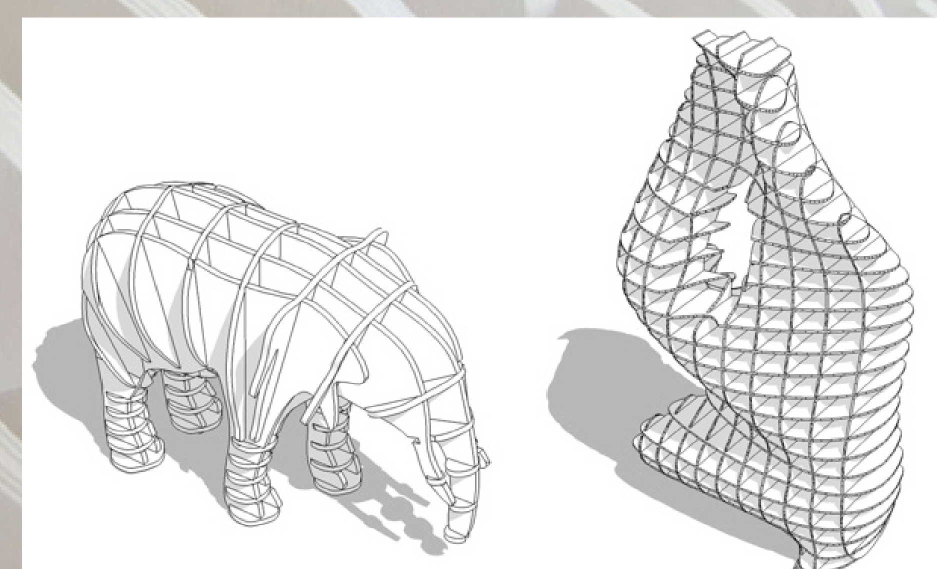


Source: talent.adweek.com/gallery/Ongoing-research-Sectioning-Design-Systems/3528751







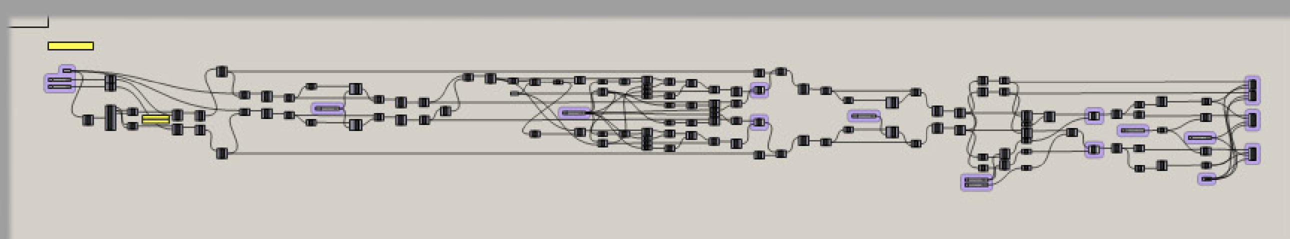


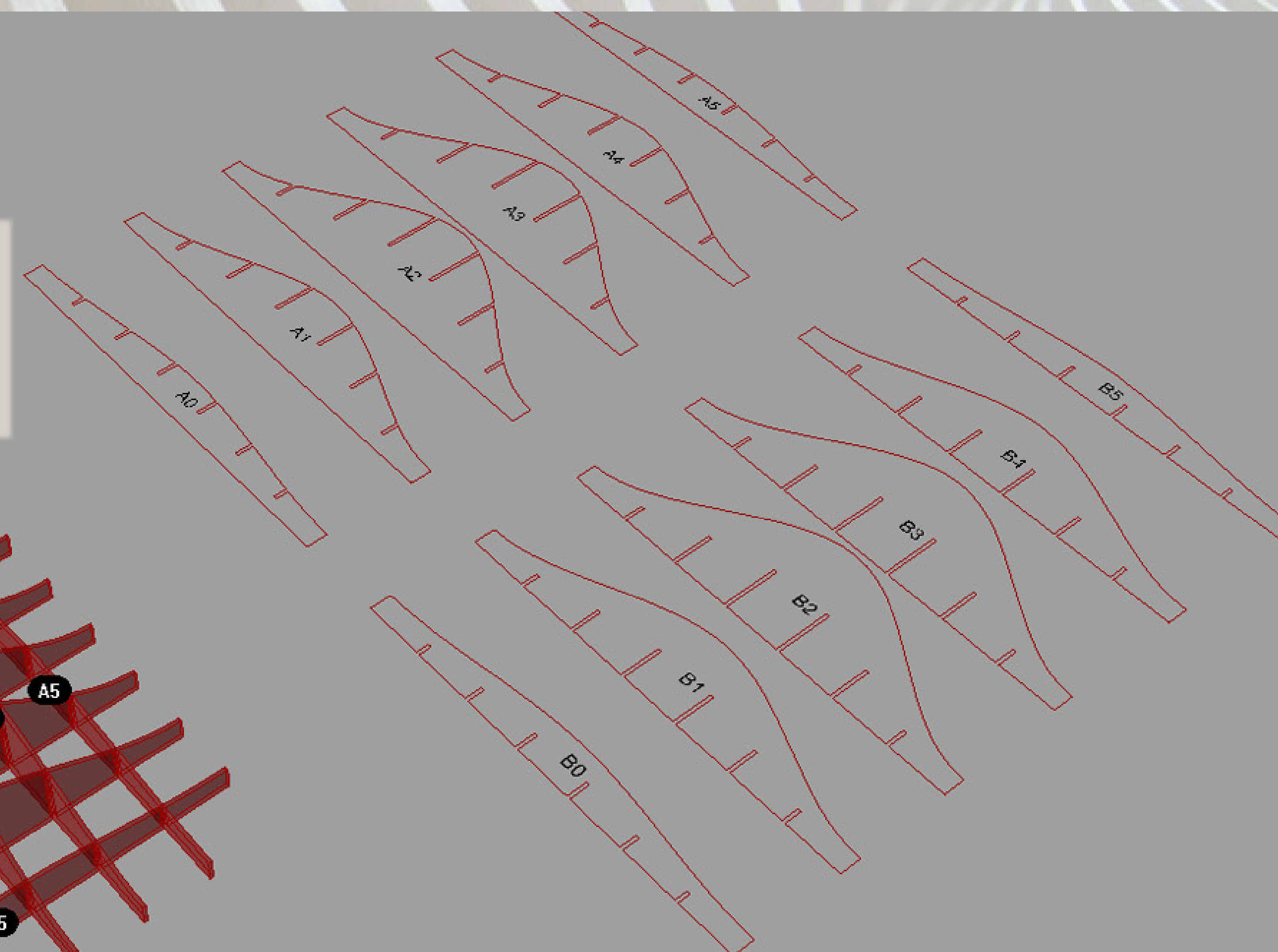
Source: www.paredesaleman.com/2010/05/sectioned-liquid-wall.html

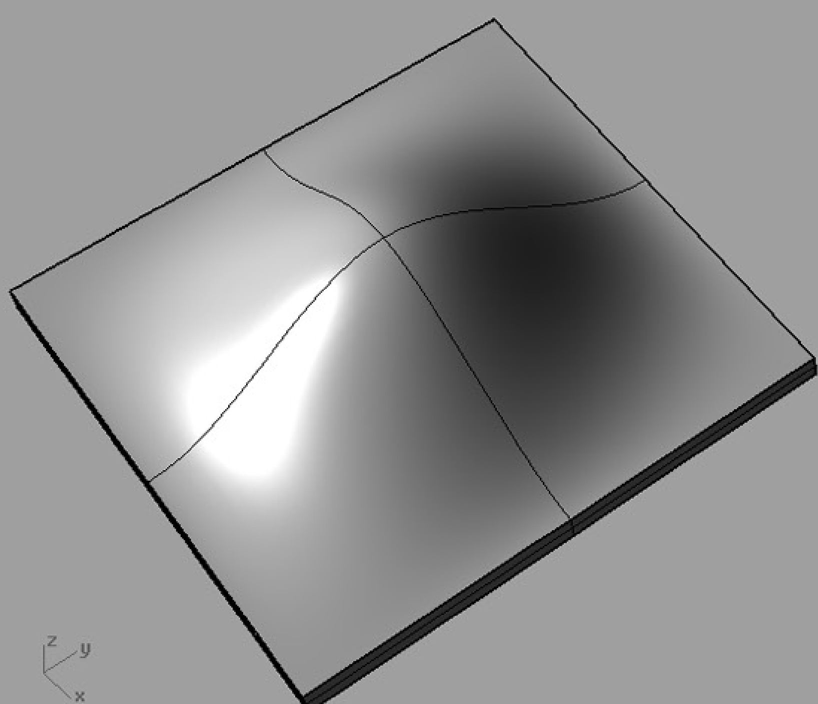
SECTIONING
DIGITAL FABRICATION

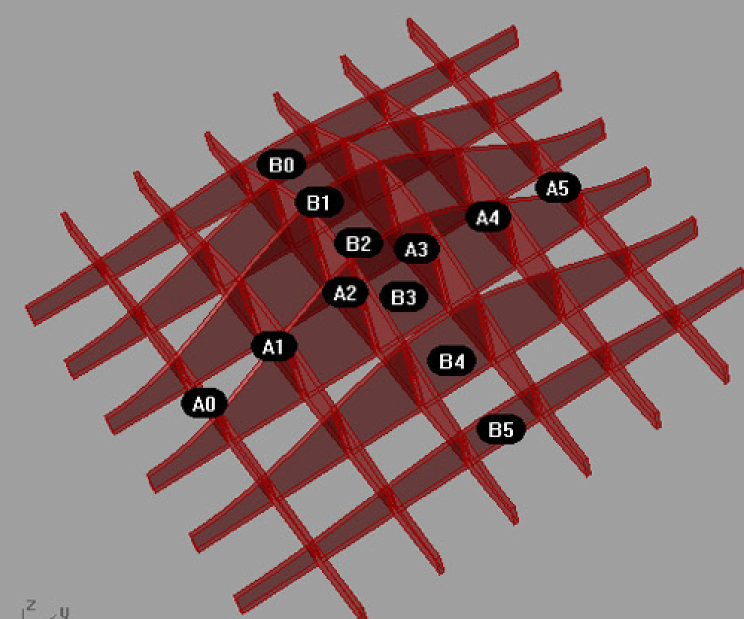
Sectioning can be accomplished in countless ways using Grasshopper. These definitions result in outputs whcih can easily sent to a CNC mill or a laser cutter. Both Waffle and Strips are Digital Fabrication techniques used in Sectioning.

DIGITAL FABRICATION







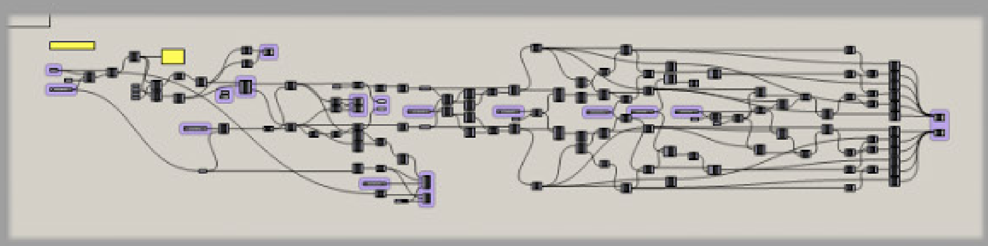


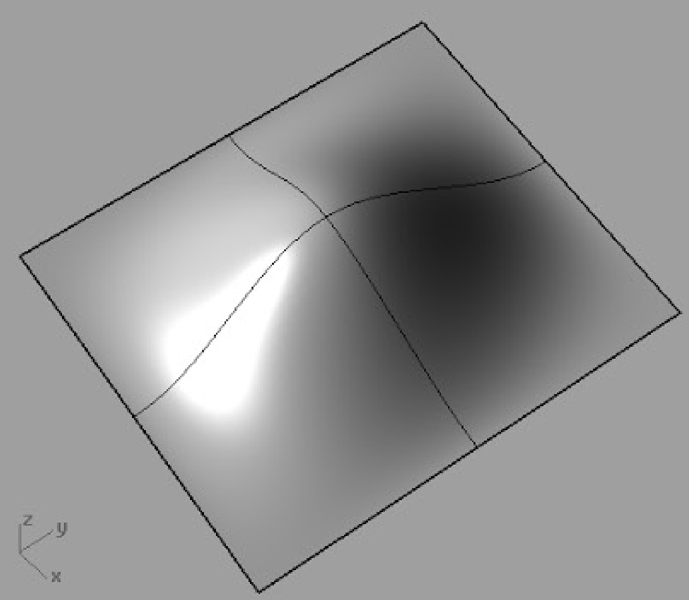
WAFFLE

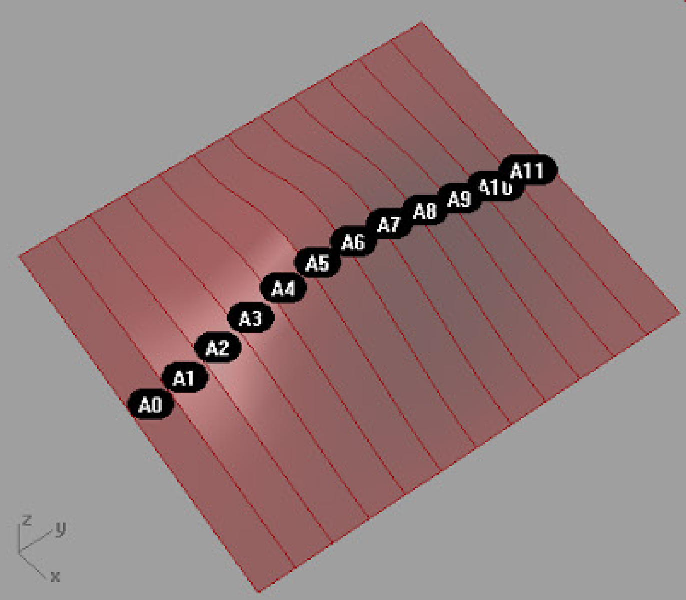
Source: http://antonioturiello.blogspot.co.uk/2012/05/digital-fabrication.html

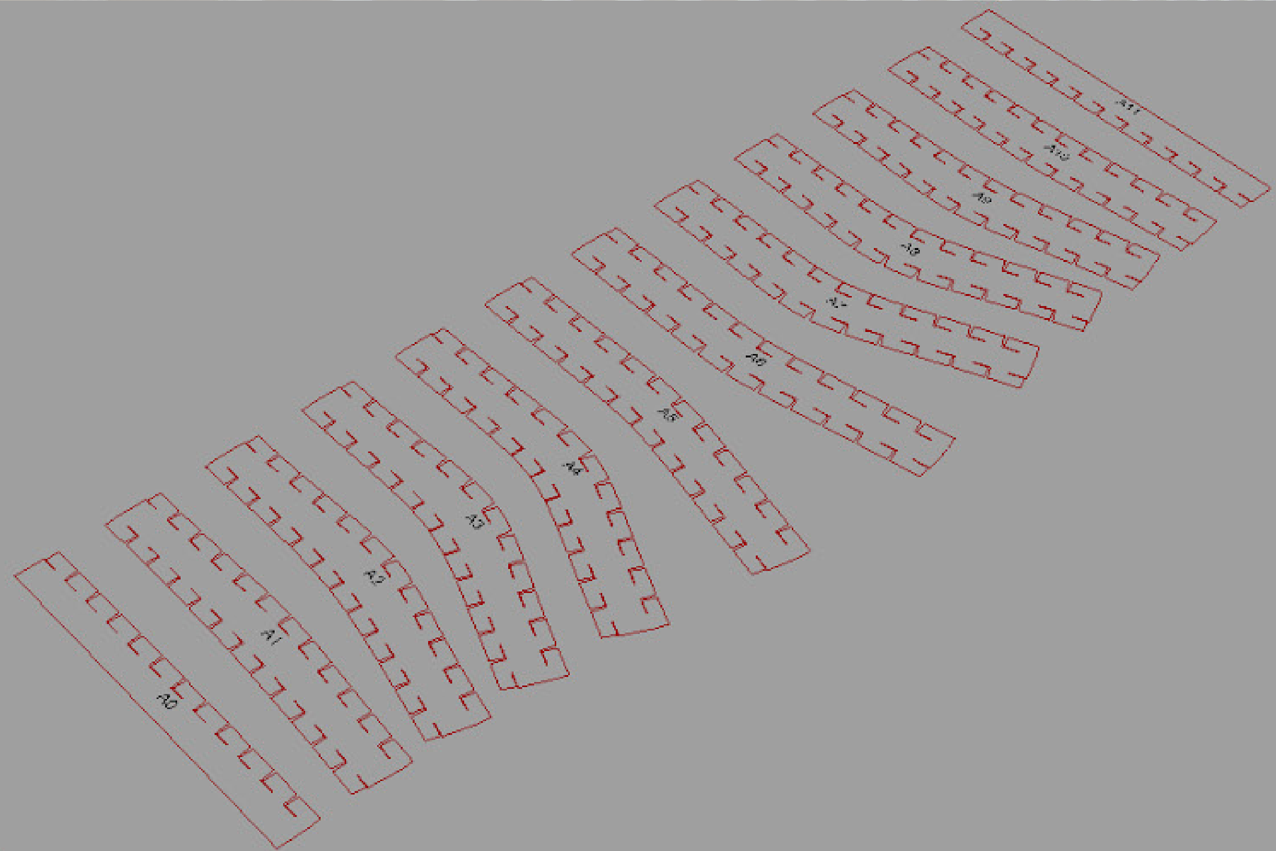
Source: www.paredesaleman.com/2010/05/sectioned-liquid-wall.html

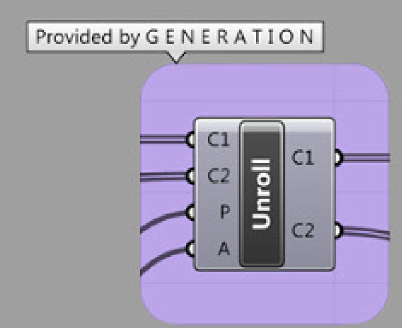
DIGITAL FABRICATION











STRIPS

Source: http://antonioturiello.blogspot.co.uk/2012/05/digital-fabrication.html

Source: www.paredesaleman.com/2010/05/sectioned-liquid-wall.html

SECTIONING
DIGITAL FABRICATION

Sectioning can use a series of arrays to achieve the desired effect or outcome. There are several different types of arrays.

Simple Arrays can follow an array and define the structure of a design through transformation: position, distance, twisting, scaling and so on.

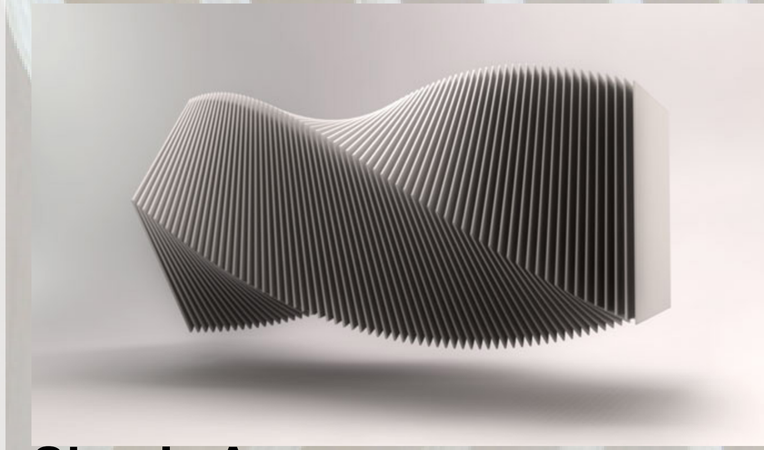
Parametric Arrays allow the user to control and define the parameters of the transformation of your array in a parametric way, shapes can define advanced and complex structures as sections.

Arrays following a path allows for the arrayw to define the structure of a design.

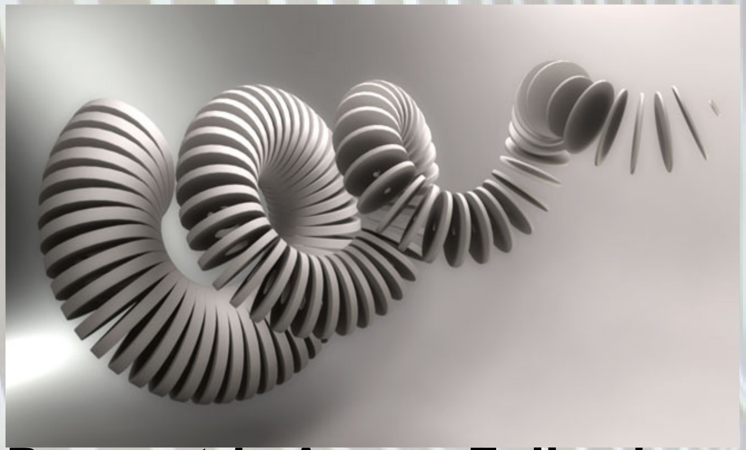
Parametric arrays follwing a path control the parameters of an arrya in a parametric way while following a path to define more complex structures in your designs.

Sectioning based on 3D objects take cuts through complex 3D objects, based on the method developed by David Fano.

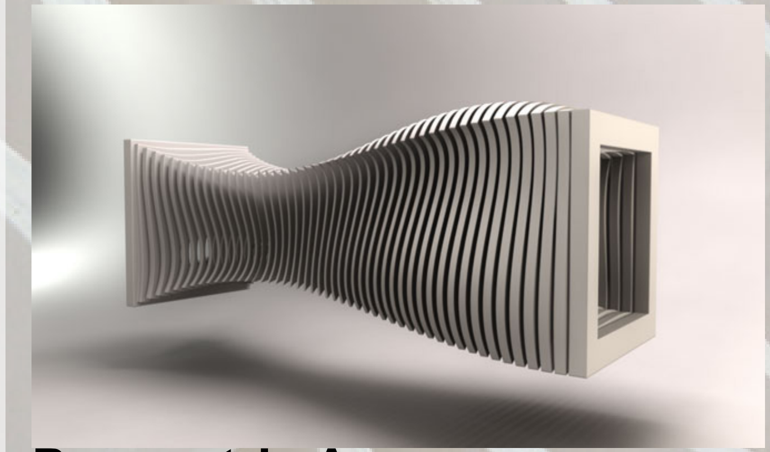
Parametric sectioning based on 3D objects create parametric sections in an easy way based on complex shapes with para 3D, plugin for 3ds max.



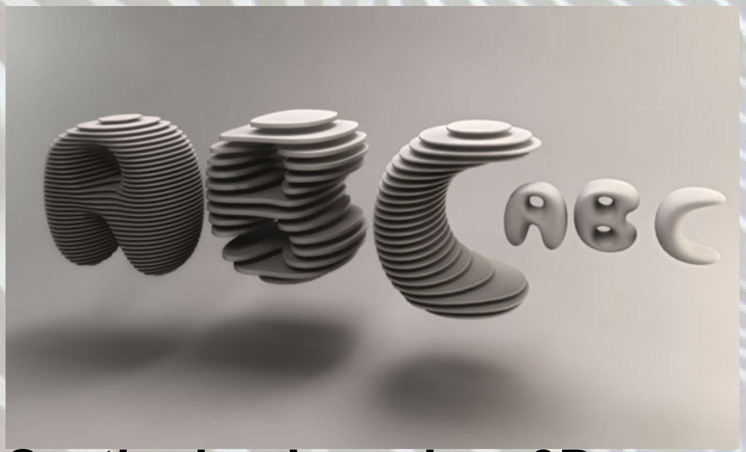
Simple Arrays



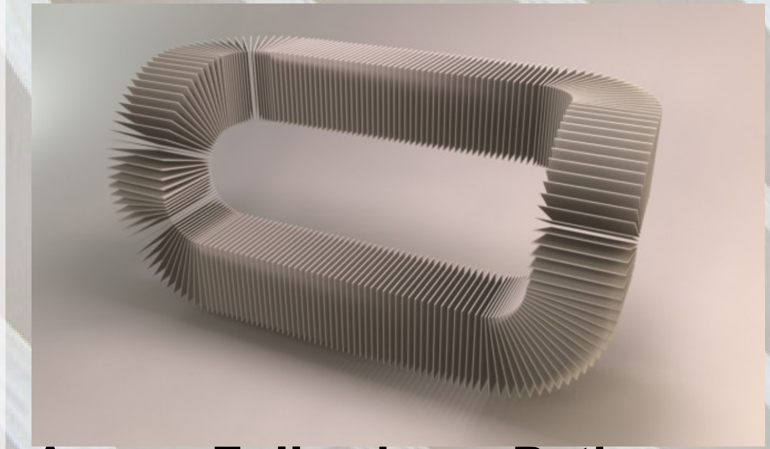
Parametric Arrays Following a Path



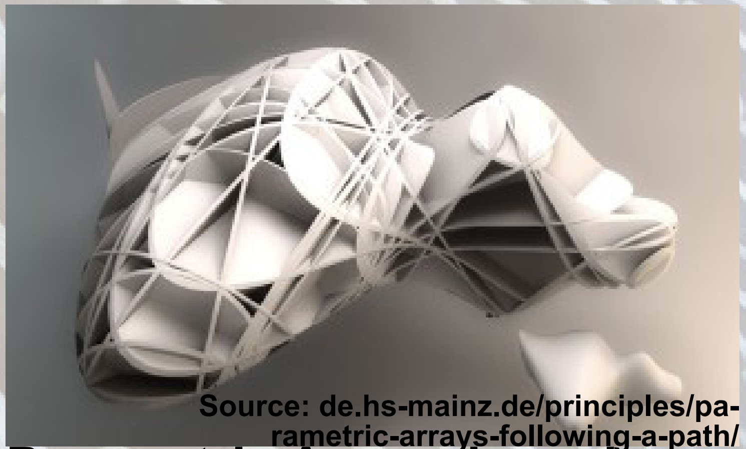
Parametric Arrays



Sectioning based on 3D Objects



Arrays Following a Path



Source: de.hs-mainz.de/principles/parametric-arrays-following-a-path/

Parametric Arrays based on 3D Objects

Source: www.paredesaleman.com/2010/05/sectioned-liquid-wall.html

SECTIONING

TOOLS AND MACHINES

Sectioning relies primarily on CNC machines and Laser cutting in order to realize the sections necessary to construct a sectioning project. Both the CNC machines and Laser cutting machines contribute to producing the complex sections which are then connected to create the section.

Source: http://www.cncmotion.com/titancanada3.jpg

SECTIONING
SOFTWARE USED

MODELLING SOFTWARE

Rhino3D

Grasshopper

Autodesk 123D Design

Autodesk 123D Design

FABRICATION SOFTWARE

MasterCAM

SolidCAM

TopSolid

CAMWorks

SECTIONING
POLYMORPHIC
GSAPP Students

Karla Burlamaqui

Source: Charlie Able

Polymorphic

Project OUTLINE

Project Architect / Artist: Students from Columbia University GSAPP (Charlie Able, Alexis Burson, Ivy Chan, Jennifer Chang, Trevor Hollyn Taub, Eliza Montgomery and David Zhai) with collaboration from Aaron Harris, Brian Lee and Vernon Roether.

Location: New York, New York, USA

Investor: Columbia University GSAPP

Function: Kinetic seating installation

Construction Year: 2011

Construction Team: Charlie Able, Alexis Burson, Ivy Chan, Jennifer Chang, Trevor Hollyn Taub, Eliza Montgomery and David Zhai

Materials Used: Plywood + raw materials

Budget: U$ 1.000 + a few hundred dollars for raw material, not taking into account design time, prototyping costs or labor

Major Fabrication Method Used: Vertical Sectioning

Fabricated By: CNC Milling Machine

Type Of Construction: Wood Frame

Modelling Software: Rhino + Grasshopper + MasterCAM + RhinoNest

Source: Charlie Able

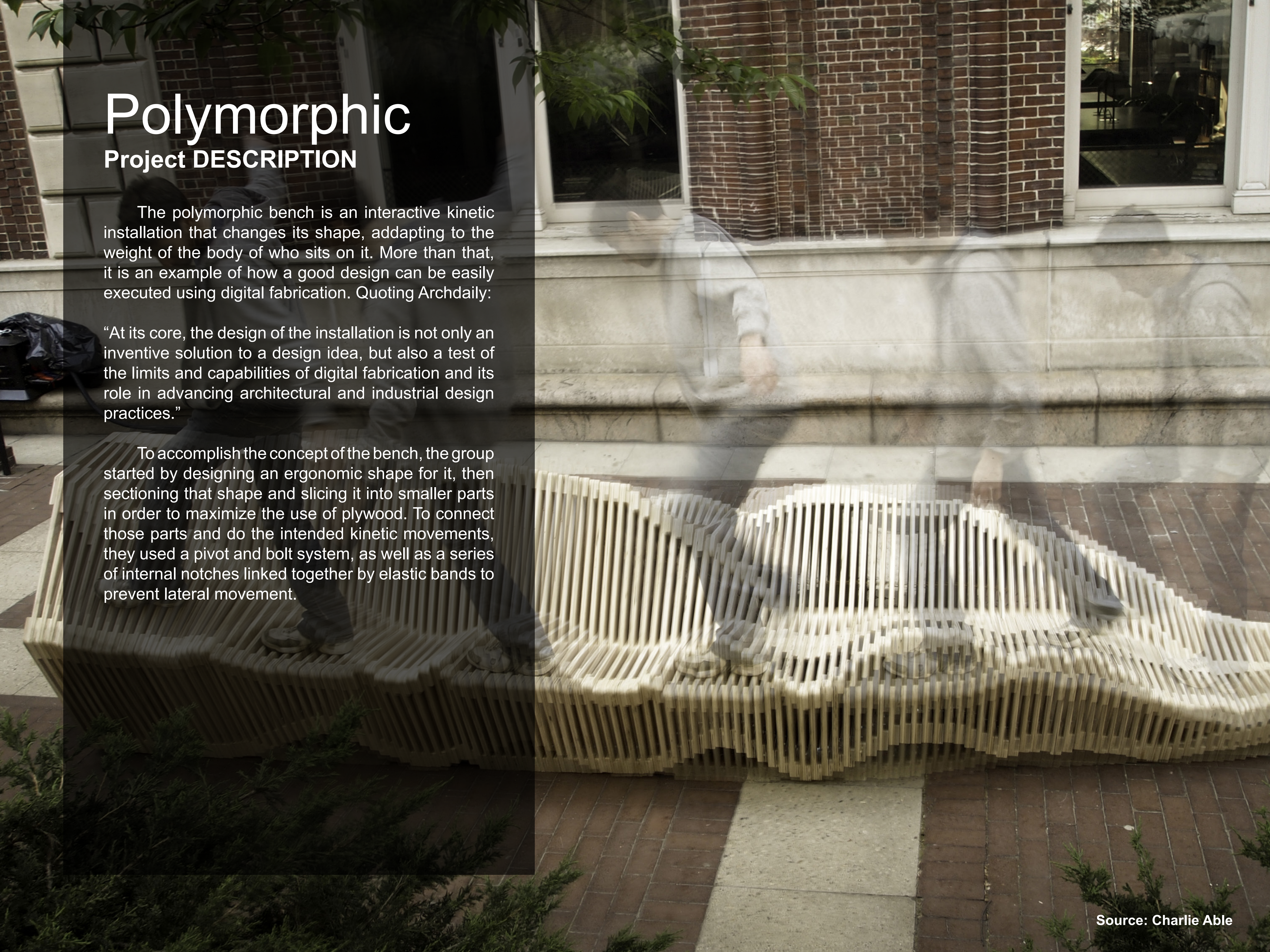
Polymorphic

Project DESCRIPTION

The polymorphic bench is an interactive kinetic installation that changes its shape, addapting to the weight of the body of who sits on it. More than that, it is an example of how a good design can be easily executed using digital fabrication. Quoting Archdaily:

“At its core, the design of the installation is not only an inventive solution to a design idea, but also a test of the limits and capabilities of digital fabrication and its role in advancing architectural and industrial design practices.”

To accomplish the concept of the bench, the group started by designing an ergonomic shape for it, then sectioning that shape and slicing it into smaller parts in order to maximize the use of plywood. To connect those parts and do the intended kinetic movements, they used a pivot and bolt system, as well as a series of internal notches linked together by elastic bands to prevent lateral movement.



Source: Charlie Able

Source: Charlie Able

Polymorphic

Project FABRICATION

The bench fabrication was basically made by hand. Except for the use of the CNC machine for cutting the pieces and drilling holes, all the other steps were made by the students themselves. The steps were: milling, sanding, sorting, pre-assembly, storing and final assembly.

1. Milling: they used six passes on the CNC mill to get the accuracy and detail in each section.

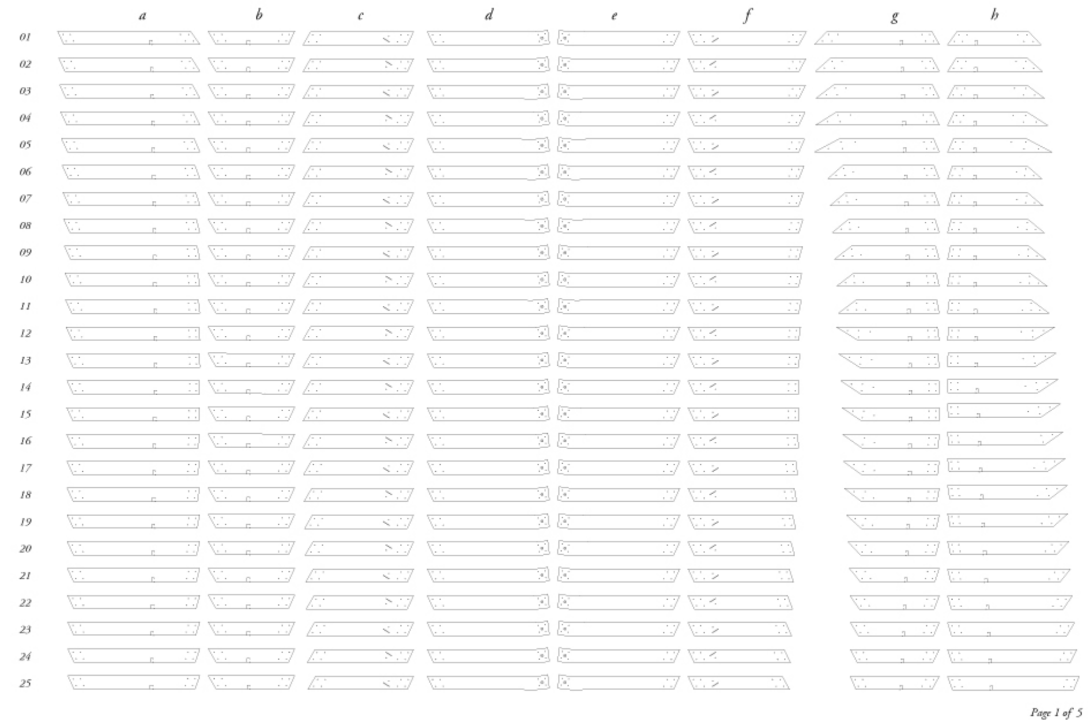
2. Sanding: using an assembly line of belt sander, rotational sander, and hand finishing, they sanded each segment to perfection so that no slinky seat users will get splinters.

3. Sorting: they sorted all the segments into all 109 section bundles.

4. Pre-assembly: they first dry assembled each section to check for errors, then they glued and clamped the sections with four dowels per joint.

5. Storage: finding storage space before final assembly was tricky.

6: Final assembly on the site.



Source: Charlie Able

Source: https://vimeo.com/23925803

Polymorphic

Project FABRICATION

Source: Charlie Able

Polymorphic

Project MATERIALS

The main used material was plywood - in a total of 18 sheets. But it was also necessary to attach the wooden parts together and achieve the kinetic mechanism. For that they used bolts and elastic bands, but the precise amount is unknown.

Sources: therebuttalfromuranus.wordpress.com - coimbatore.all.biz/ - www.alwayshobbies.com/

Polymorphic

Project MACHINE / SOFTWARE

The only machine used for cutting the pieces was the CNC Milling machine. As for the softwares used for the modelling and digital fabrication, they were the following:

1. Rhino: for designing the overall bench shape.

2. Grasshopper: to convert the simple line contours into mill-ready geometry.

3. MasterCAM: to create cut files for the CNC mill.

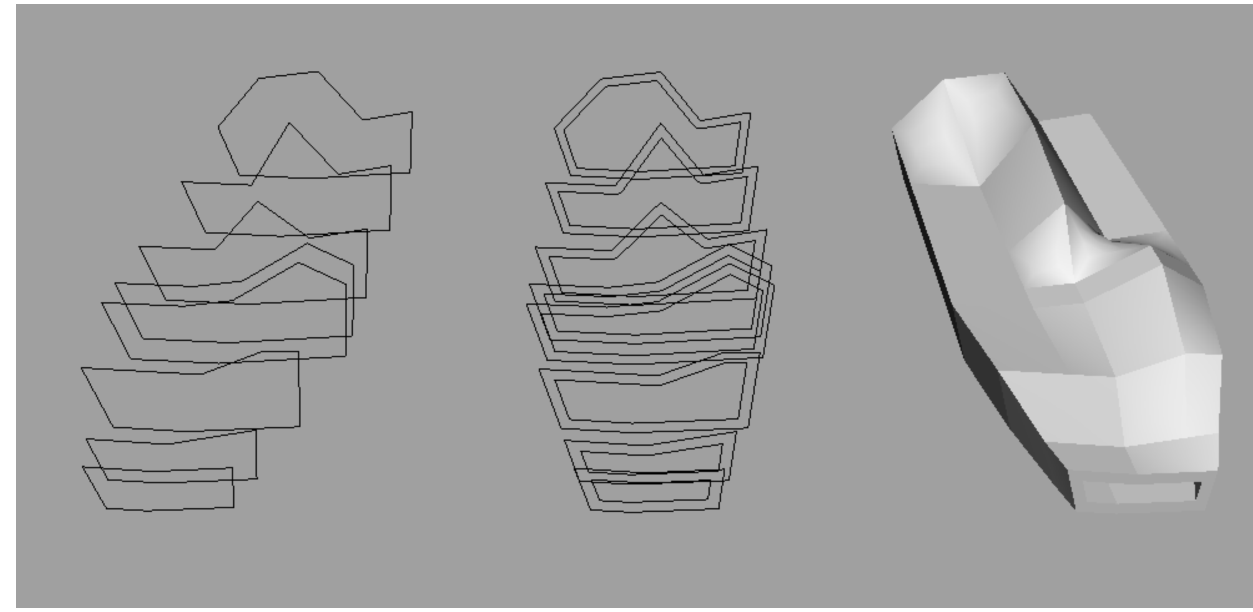
4. RhinoNest: each set of the sections was then nested for milling.

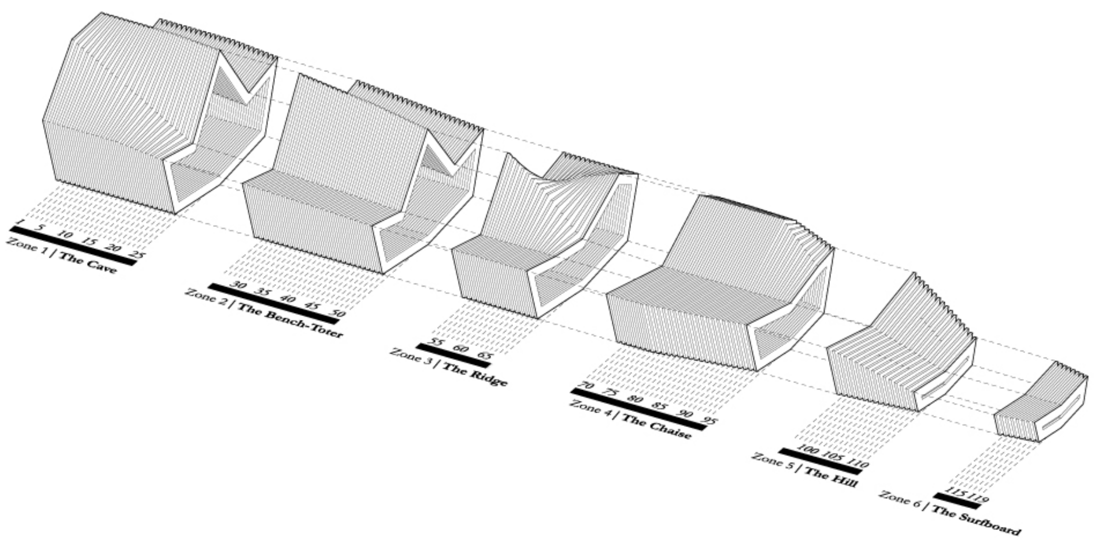
Source: http://www.directindustry.com/

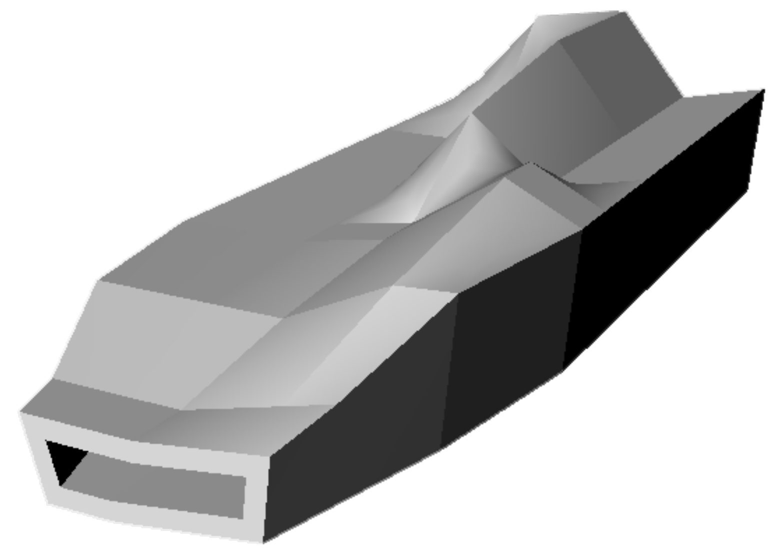
Sources: http://tonka3d.com.br/ - www.directindustry.com/ - www.mastercam.com - http://www.rhinonest.com/

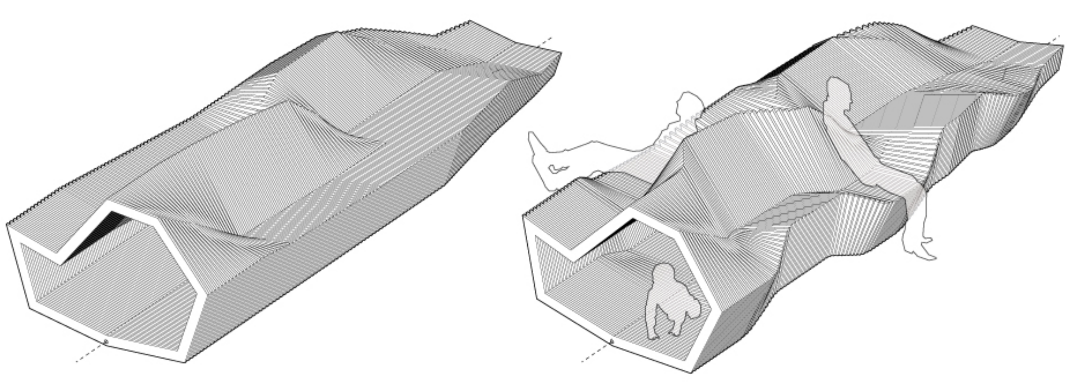
Polymorphic

RHINO
Modelling

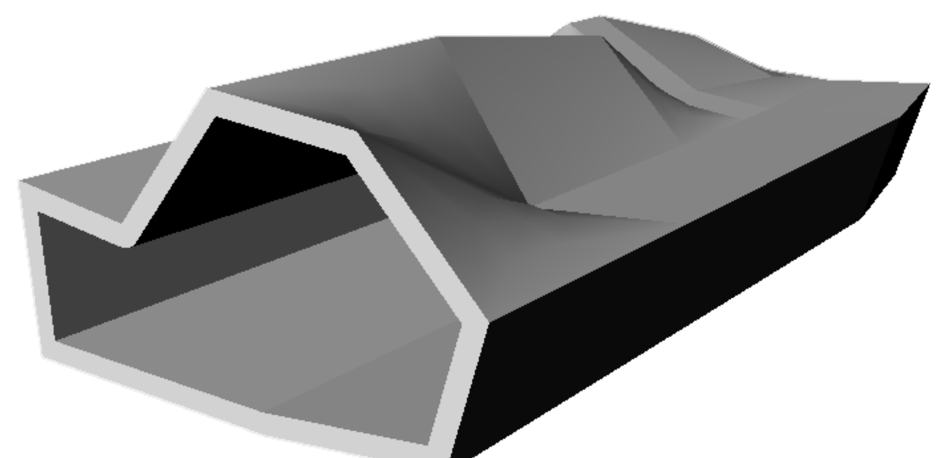








***Passive State** Seating* — ***Active State** Seating*



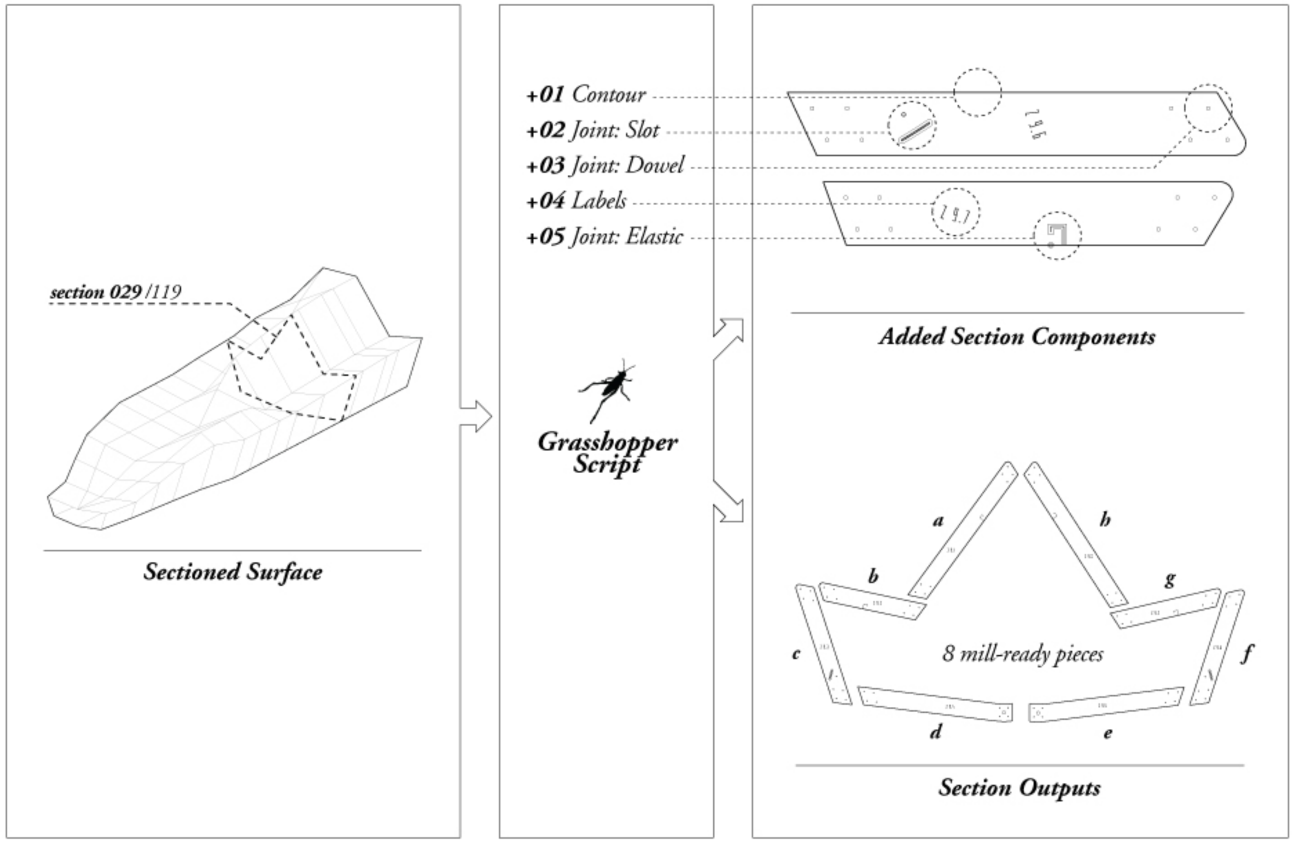
Source: Charlie Able

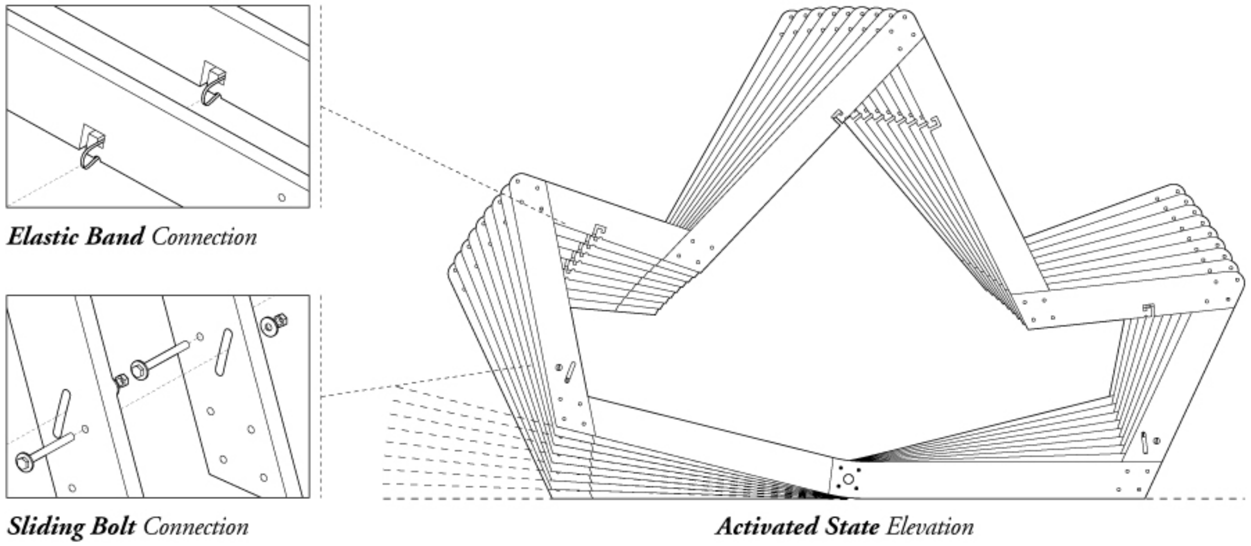
Source: Authorial images

Polymorphic

GRASSHOPPER
Fabrication Definition

The grasshoper definition was used for turning the overall shape of the bench into manufacturable elements. First by doing the vertical sectioning, then dividing those sections into smaller pieces. After that, they designed the shape of the segments and placement of hardware slots for accurate rotation of each section.



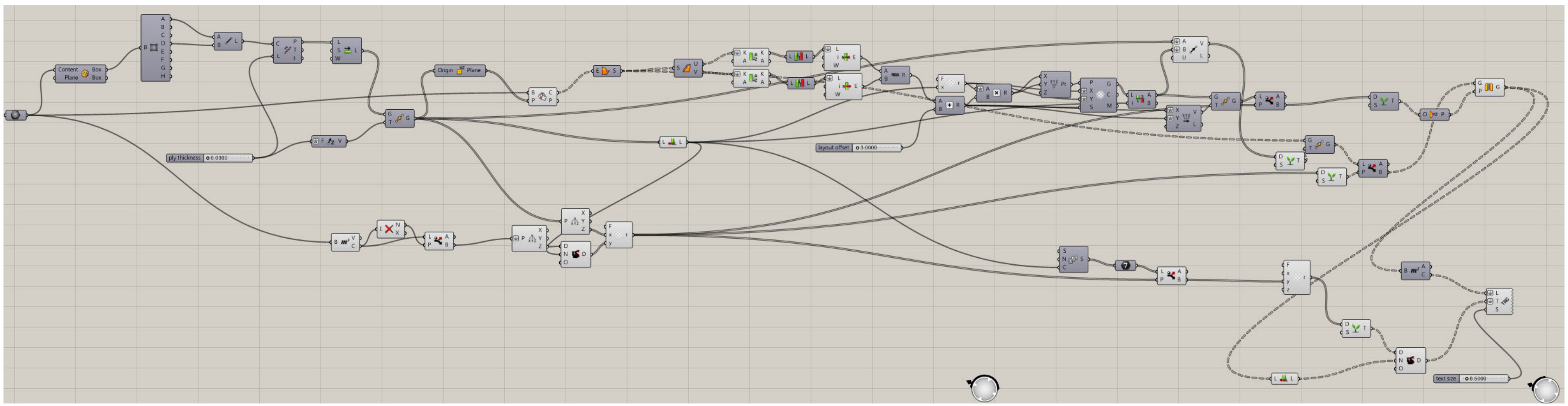


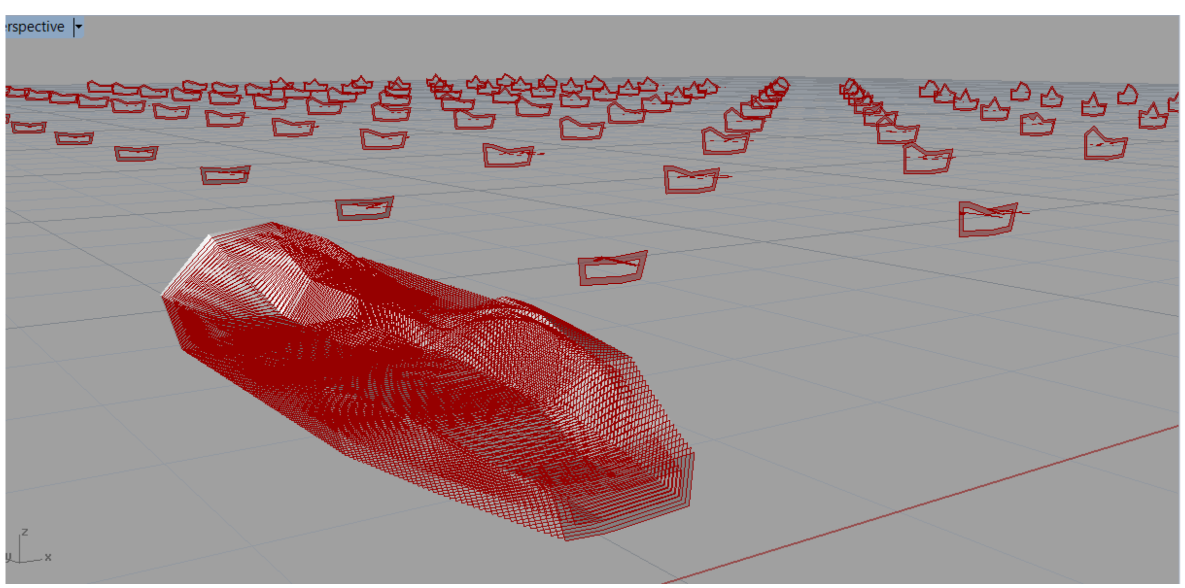
Source: Charlie Able

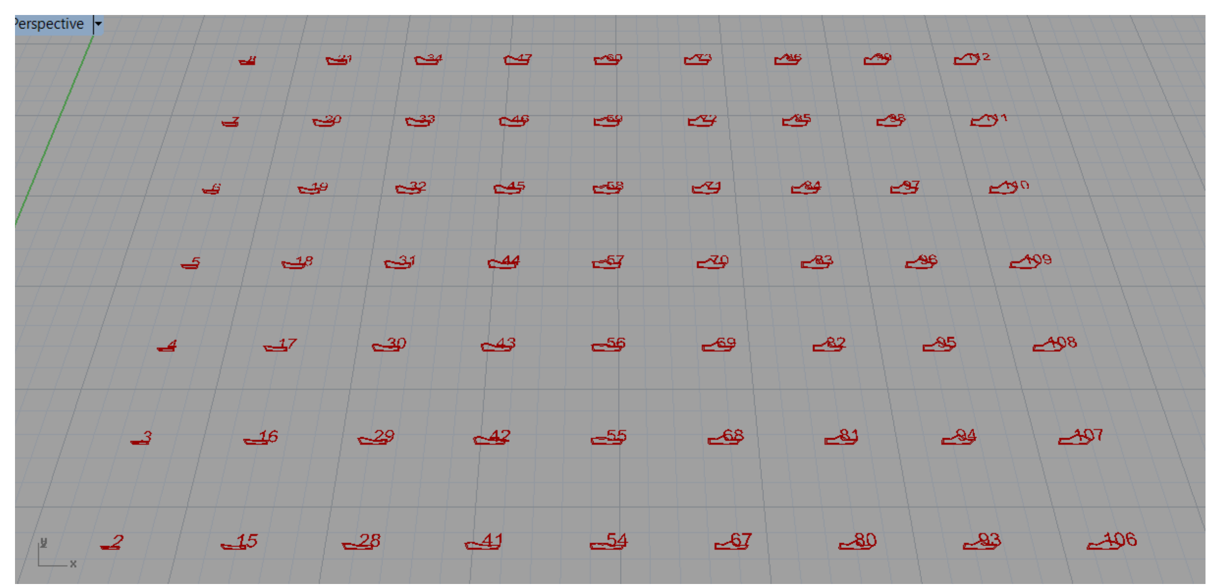
Polymorphic

GRASSHOPPER

Fabrication Definition



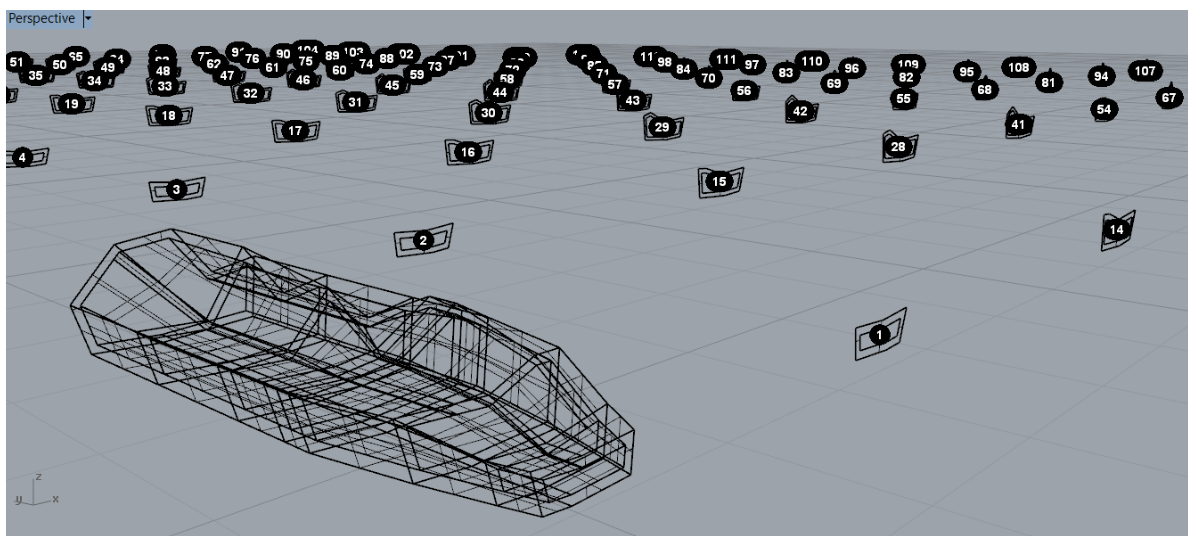


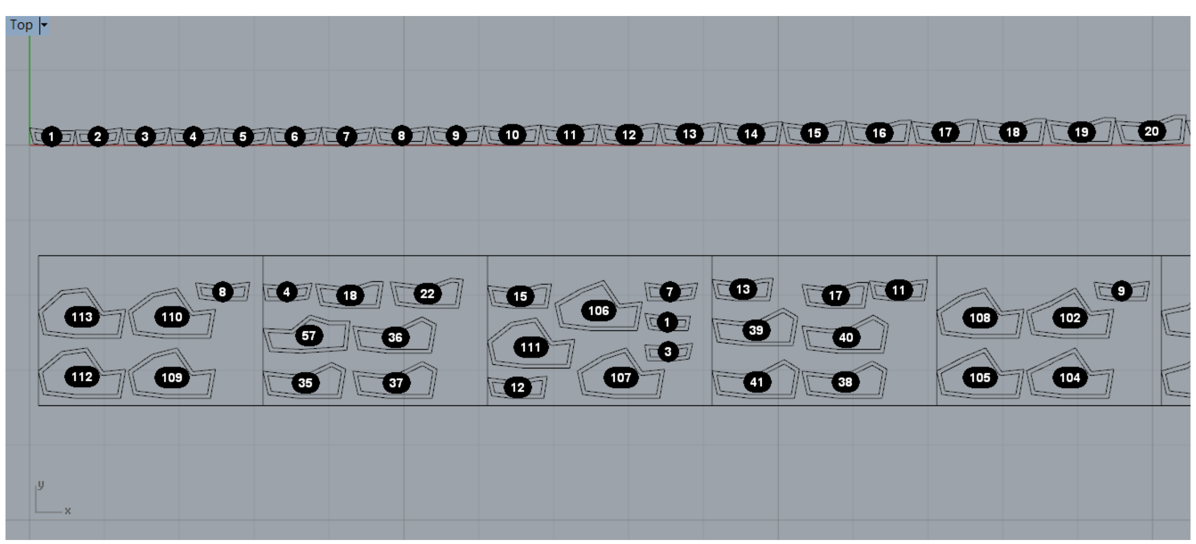


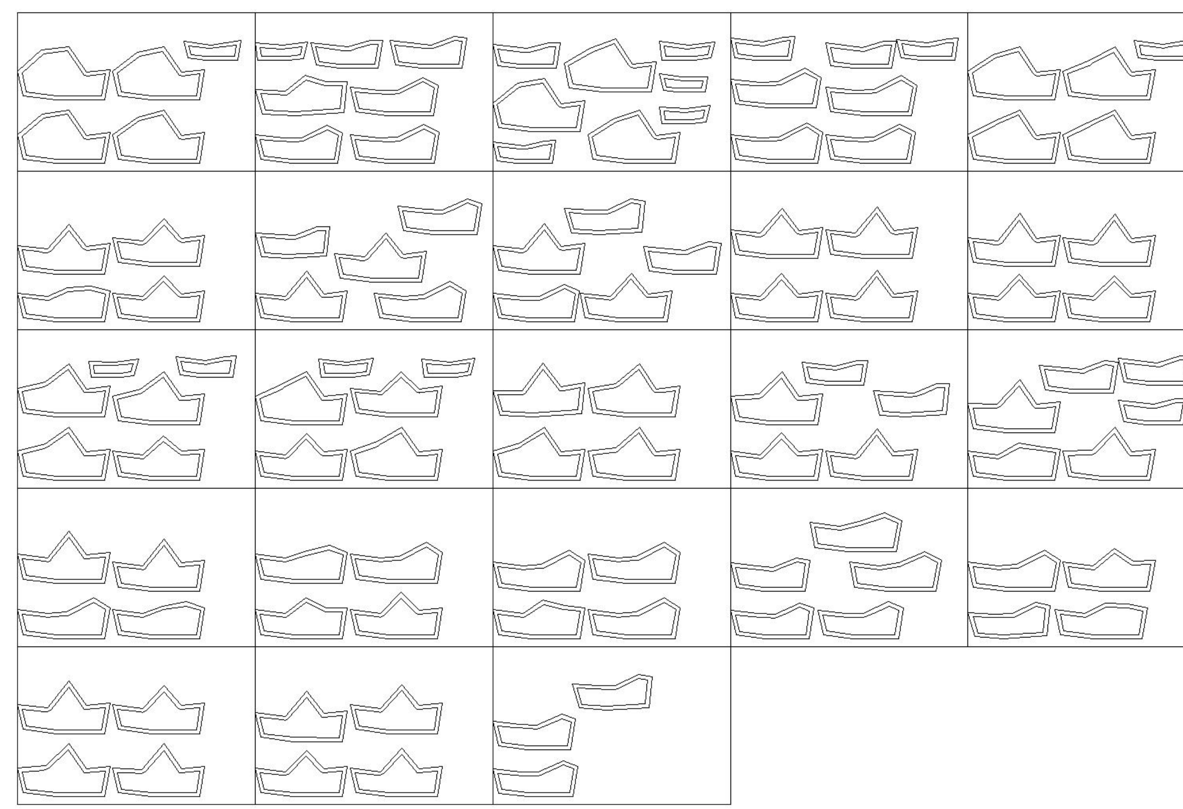
Source: Authorial images

Polymorphic

RHINONEST
Fabrication Definition







Source: Authorial images


SECTIONING
READING BETWEEN THE LINES
GIJS VAN VAERENBERGH
Aleksandar Vrangaloski

Reading between the lines

Project OUTLINE

Project Architect / Artist: Gijs Van Vaerenbergh
Location: Looz, Limburg, Belgium

Investor: Provance Limburg + Z33

Function: Pavilion

Construction Year: 2011 / opening

Dimmensions: 10m high, 6m wide, 18m long

Construction Team: Cravero bvba (steel) / MEG (fundaments)

Materials Used: Concrete (base, fundaments), steel

Budget: 100.000 Euro

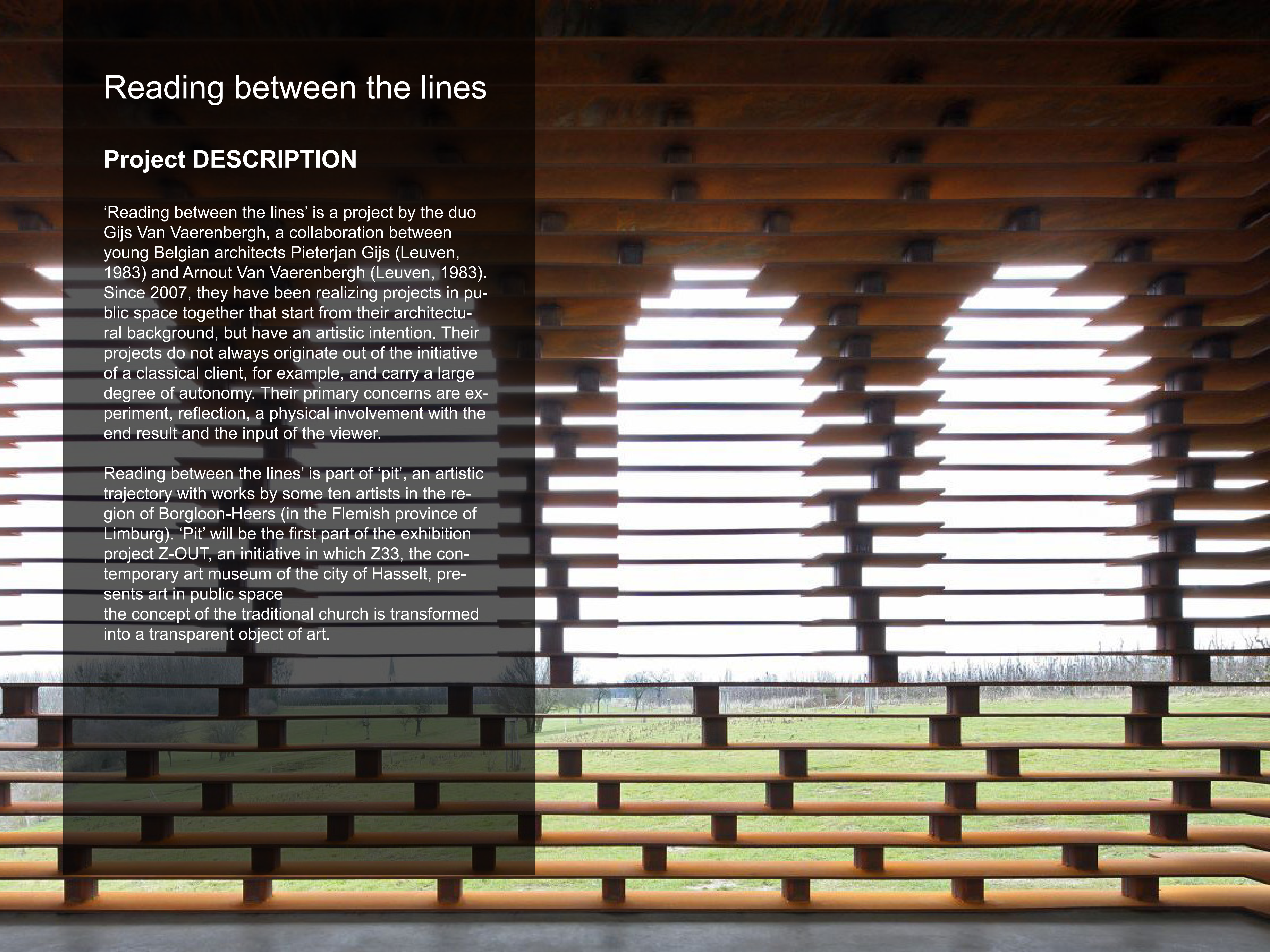
Major Fabrication Method Used: Horizontal sectioning

Secondary Fabrication Methods: /

Fabricated By: Plasma cutting + welding (by hand)

Type Of Construction: Steel sections over small columns

Modelling Software: Rhino + Grasshopper

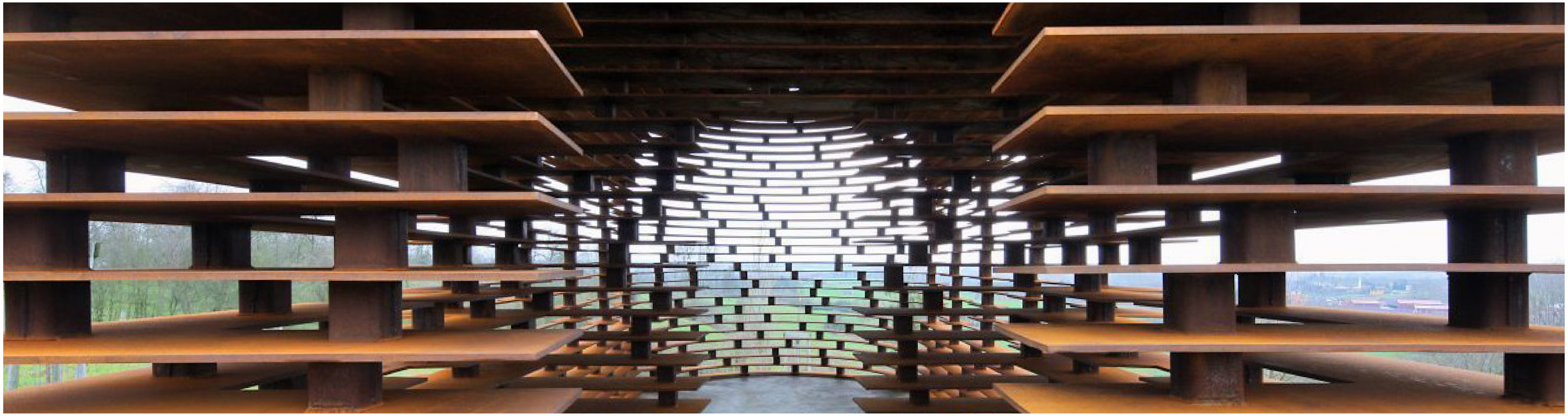


Reading between the lines

Project DESCRIPTION

‘Reading between the lines’ is a project by the duo Gijs Van Vaerenbergh, a collaboration between young Belgian architects Pieterjan Gijs (Leuven, 1983) and Arnout Van Vaerenbergh (Leuven, 1983). Since 2007, they have been realizing projects in public space together that start from their architectural background, but have an artistic intention. Their projects do not always originate out of the initiative of a classical client, for example, and carry a large degree of autonomy. Their primary concerns are experiment, reflection, a physical involvement with the end result and the input of the viewer.

Reading between the lines’ is part of ‘pit’, an artistic trajectory with works by some ten artists in the region of Borgloon-Heers (in the Flemish province of Limburg). ‘Pit’ will be the first part of the exhibition project Z-OUT, an initiative in which Z33, the contemporary art museum of the city of Hasselt, presents art in public space
the concept of the traditional church is transformed into a transparent object of art.

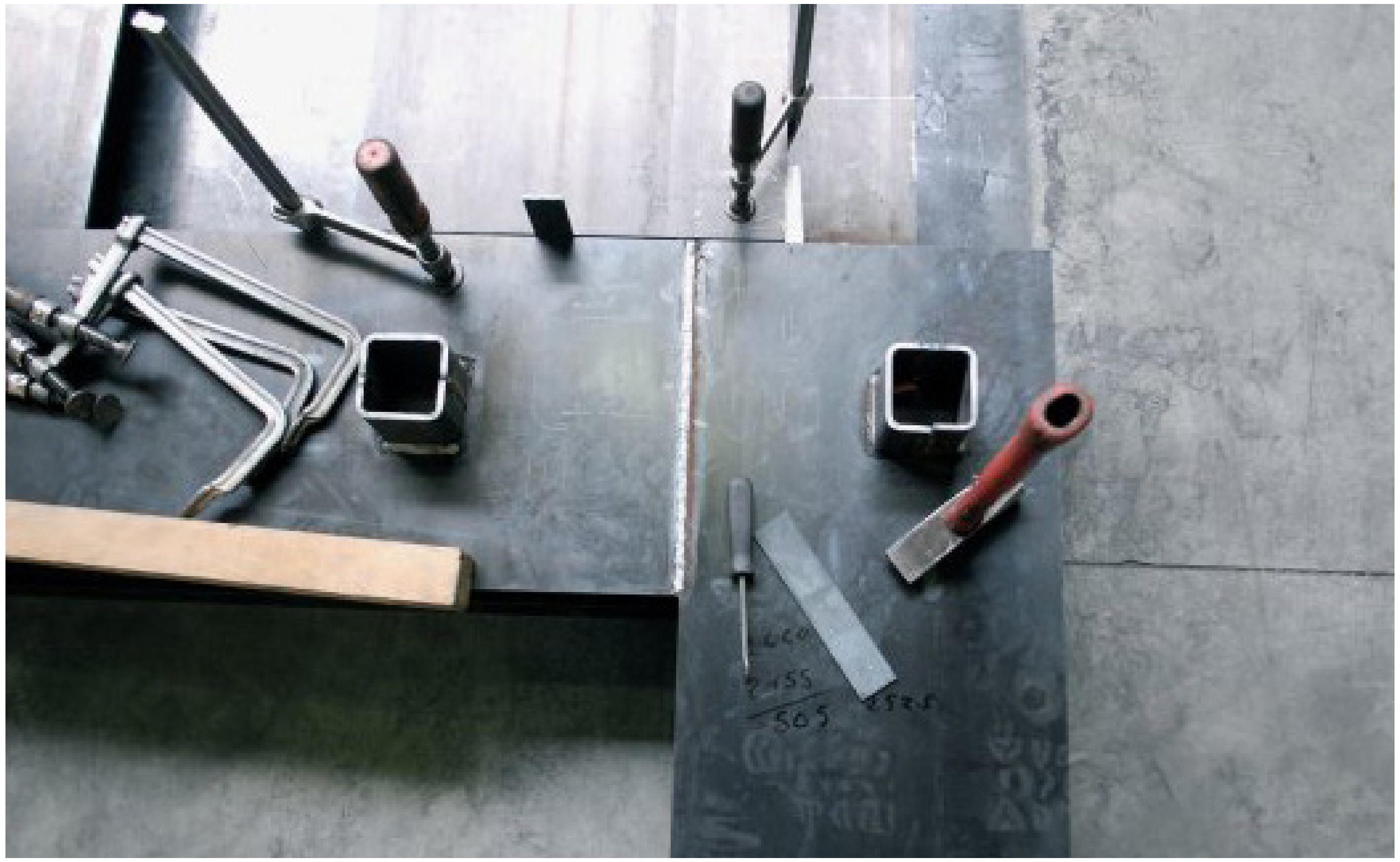


Reading between the lines

Project FABRICATION

This ‘church’ consists of 30 tons of steel and 2000 columns, and is built on a fundament of armed concrete. Through the use of horizontal plates, the concept of the traditional church is transformed into a transparent object of art.

Depending on the perspective of the viewer, the church is either perceived as a massive building, or dissolves — partly or completely — into the landscape. Those viewers that look from the inside of the church to the outside, on the other hand, witness an abstract play of lines that reshapes the surrounding landscape. In this way, church and landscape can both be considered part of the work — hence also its title, which implies that to read between the lines, one must also read the lines themselves. In other words: the church makes the subjective experience of the landscape visible, and vice versa.



Reading between the lines

Project FABRICATION

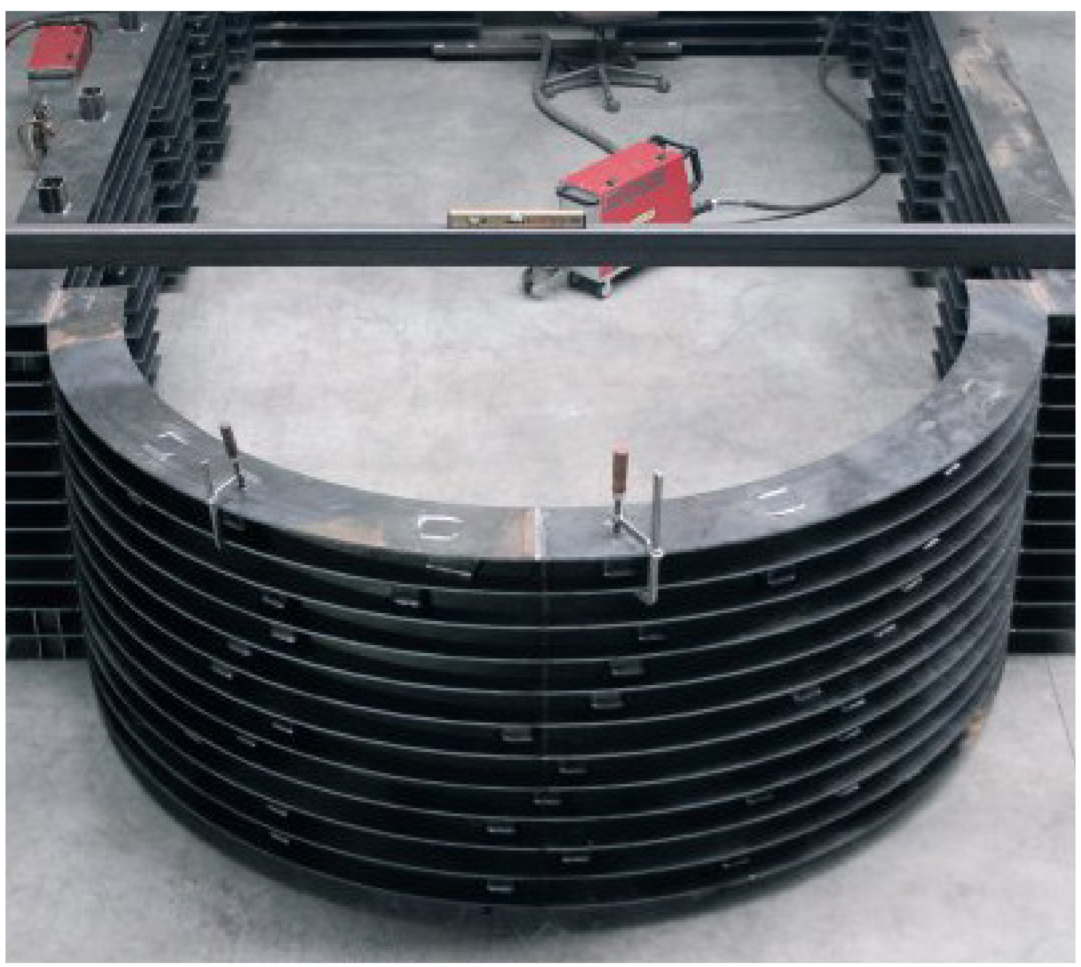
Reading between the lines

Project MATERIALS

Reading Between Lines Quantity Survey		
Steel		
	Material	**Quantity**
Steel plates	/	30tons
Main structure (steel columns)	5cm x 5cm	2000
Concrete		
Base, Fundaments		~180M^3

Reading between the lines

Project MATERIALS



Reading between the lines

Project MACHINE / SOFTWARE

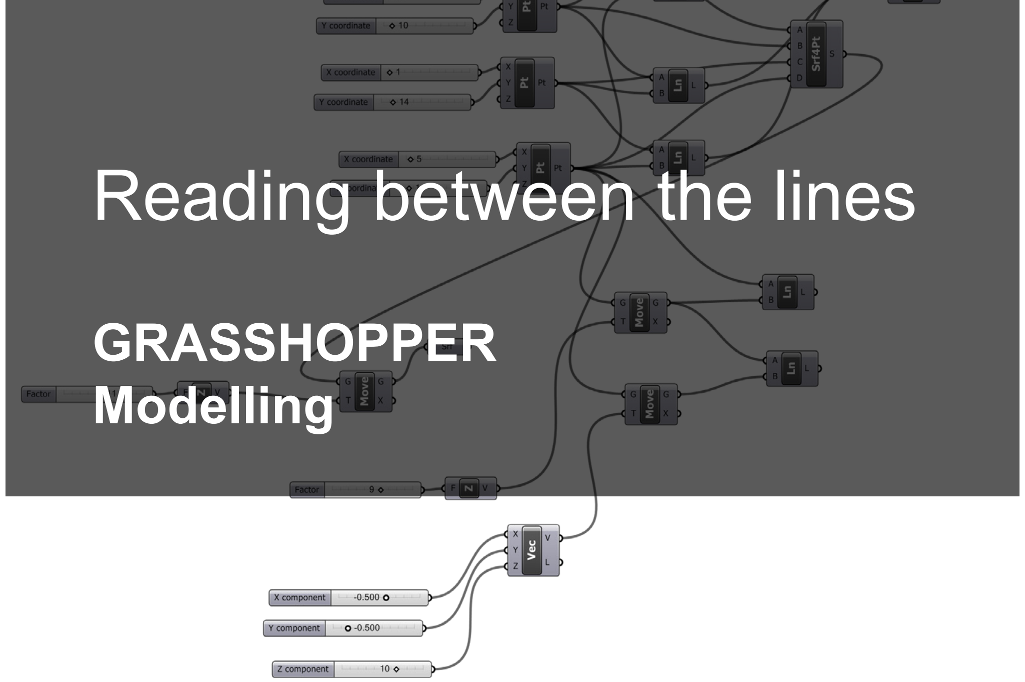
They used plasma cutter with previously prepared drawings to make the metal sheets. For the colums they used metal bars 5x5cm with 10cm lenght. The assemby process was done by hand welding this elements, and fixing them together on site in several parts and sequences.

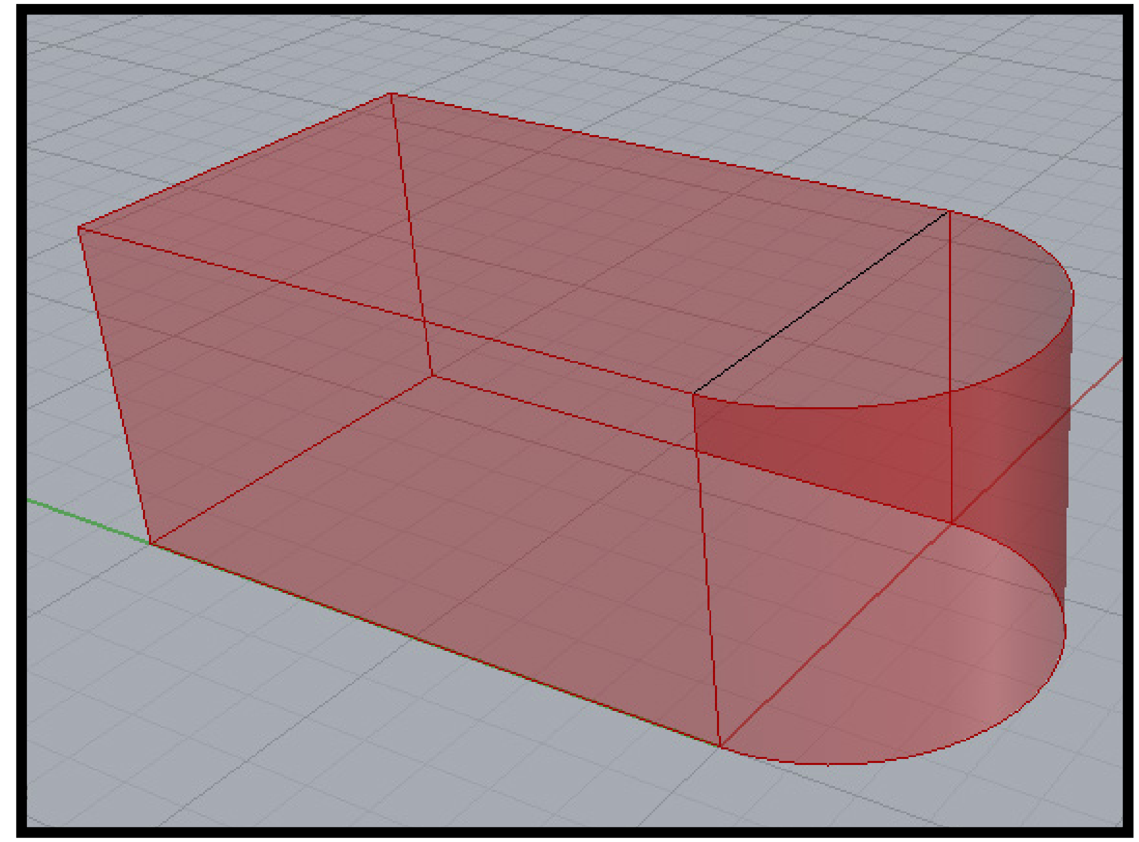
The software that they used is Rhino + Grasshoper to define the sheets, dimensions as well as for dividing them on exact needed size. The tehnique that thay used is horizontal sectoning.

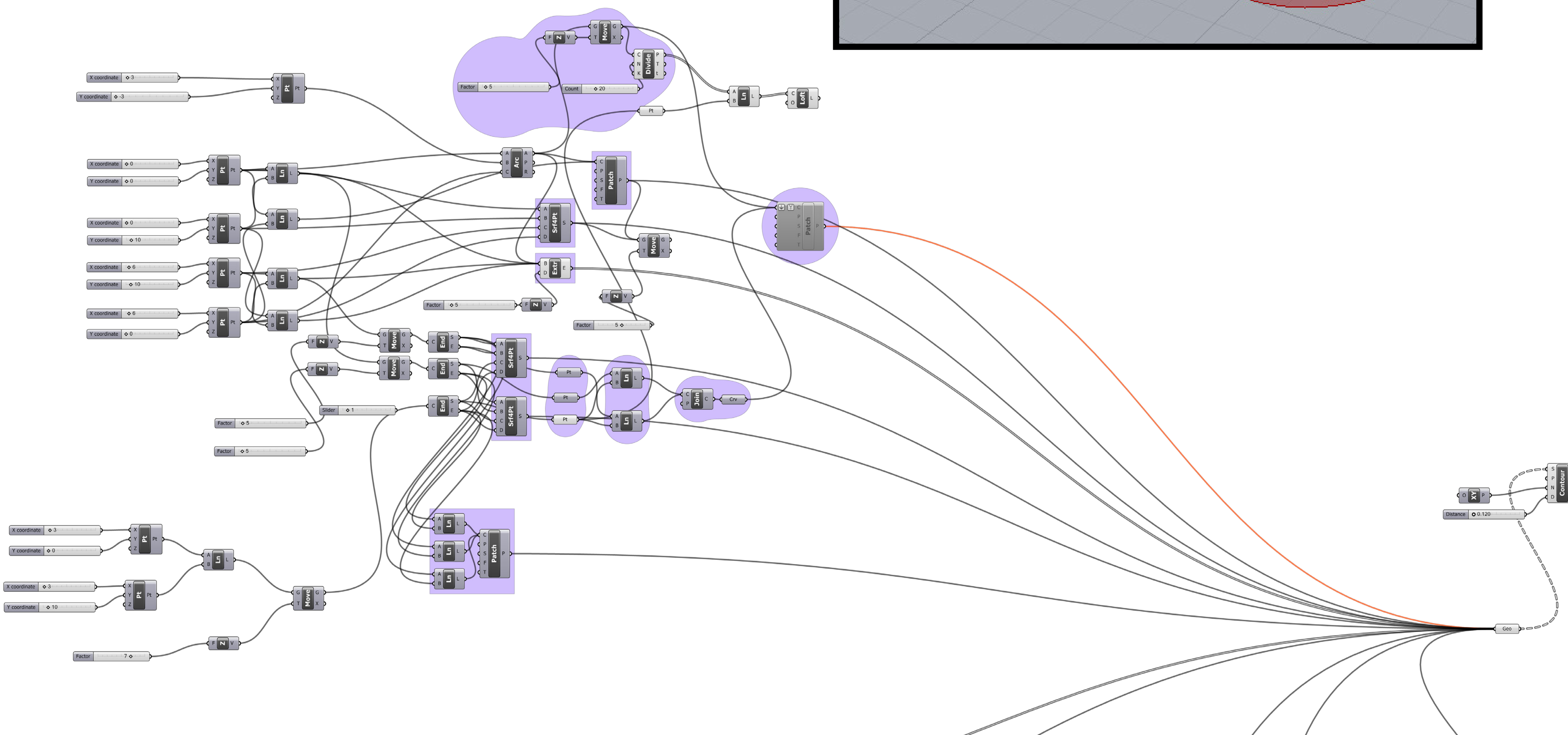
Rhinoceros

Reading between the lines

GRASSHOPPER Modelling







Reading between the lines

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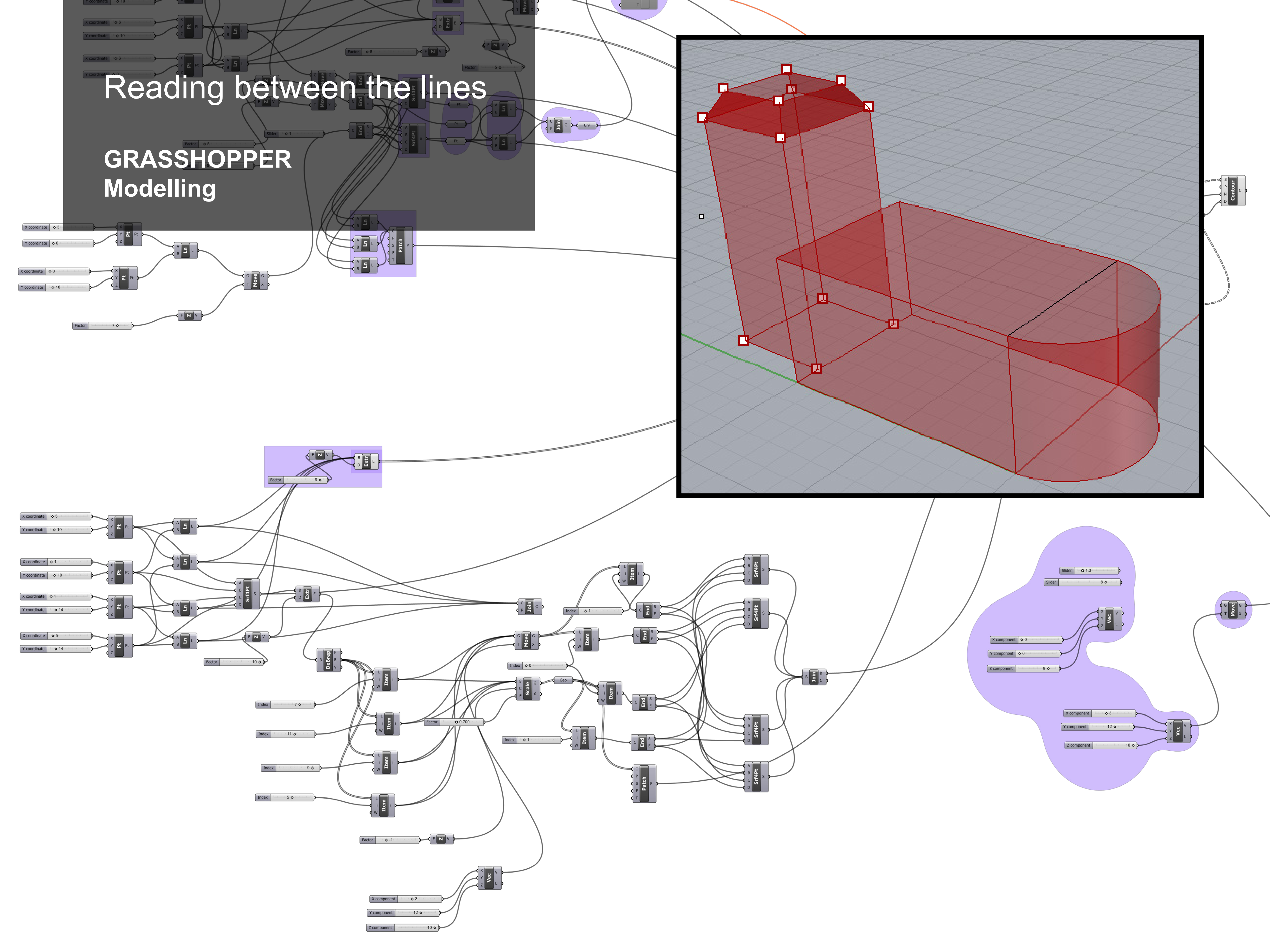

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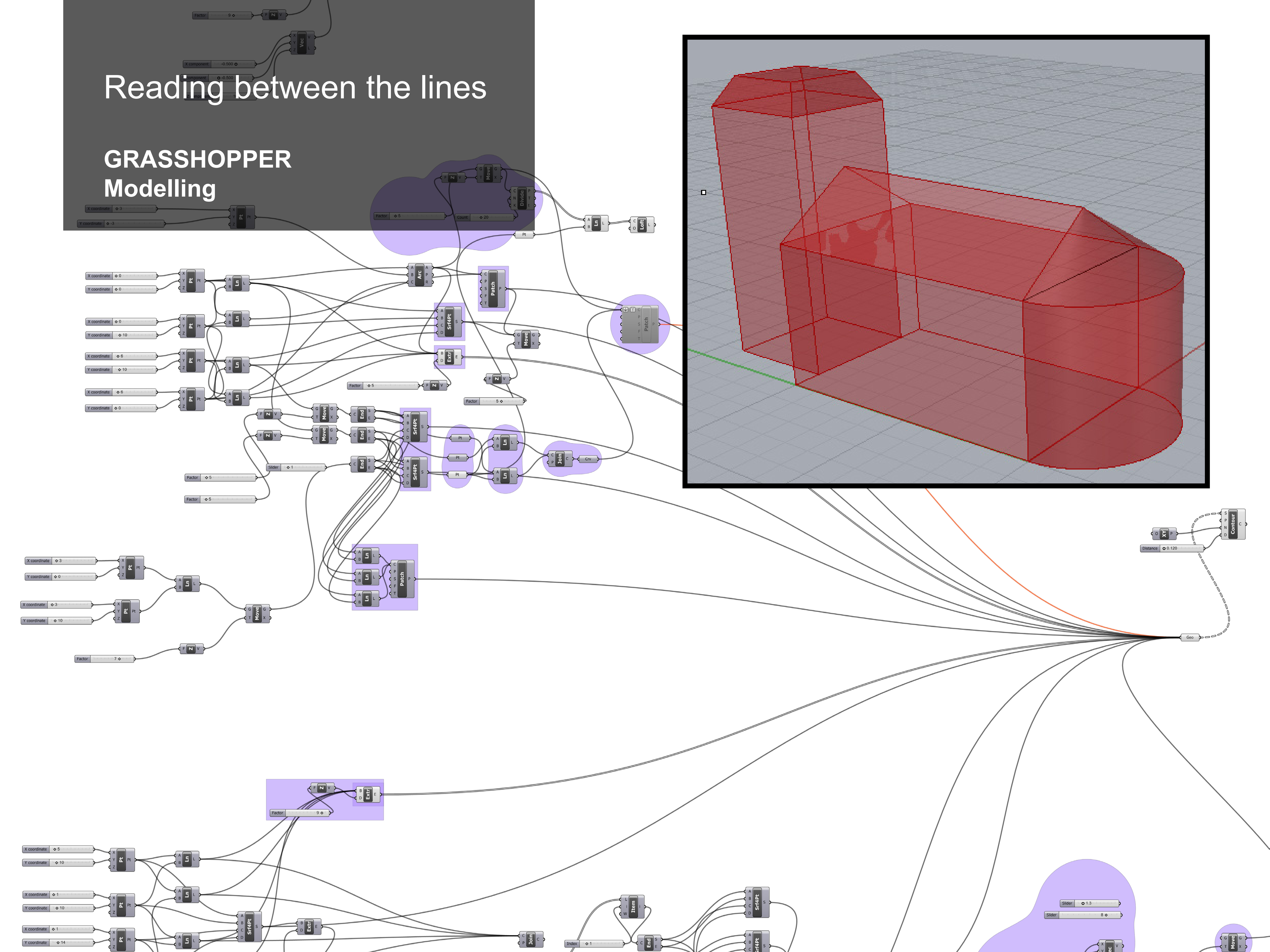

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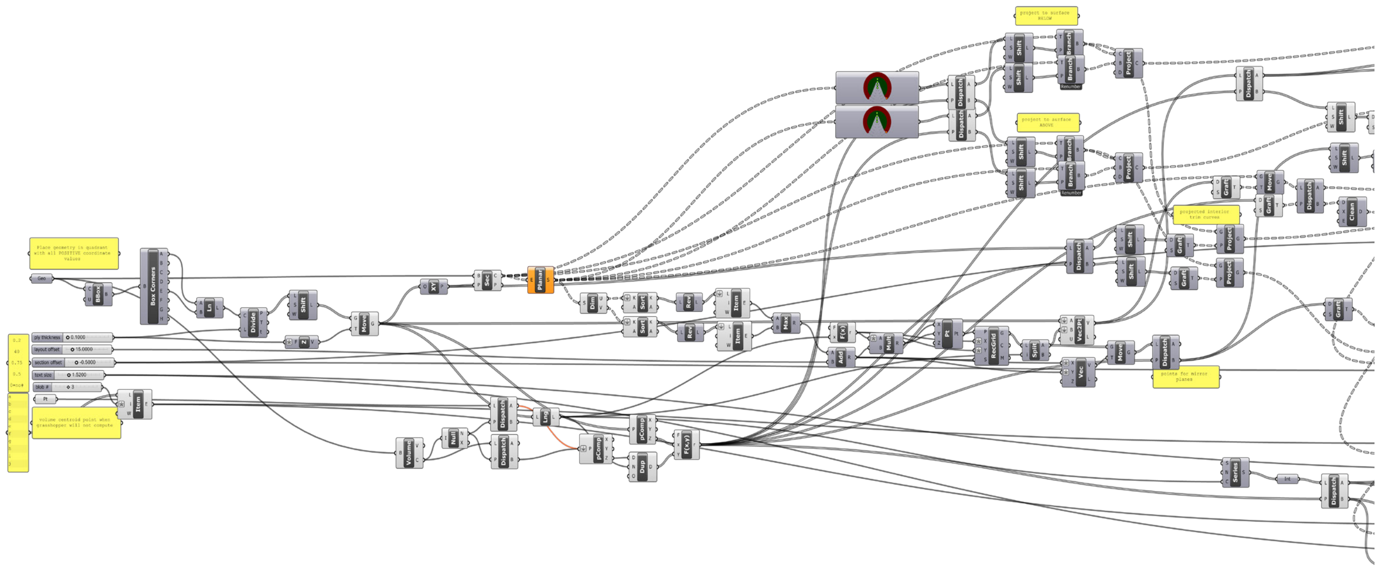

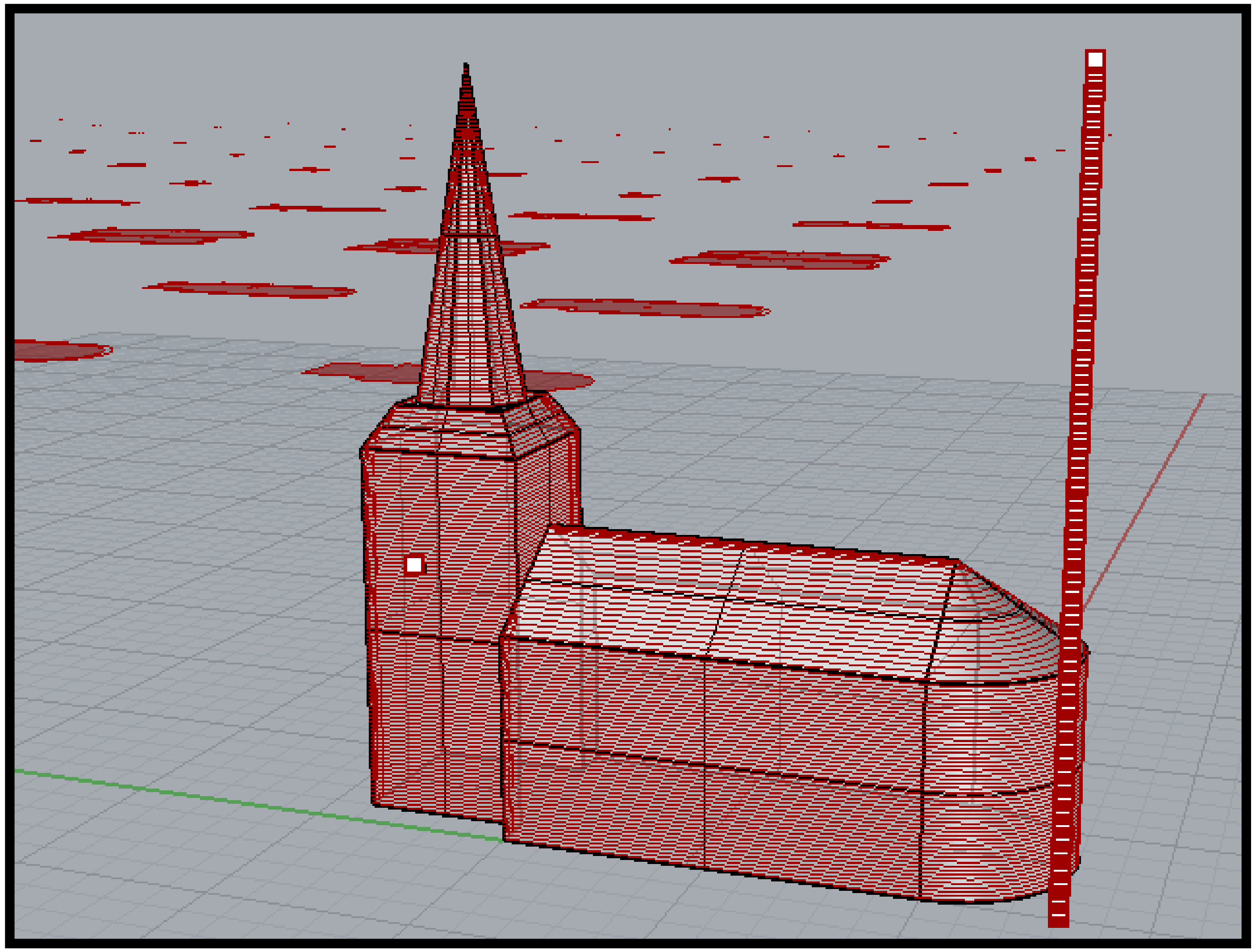

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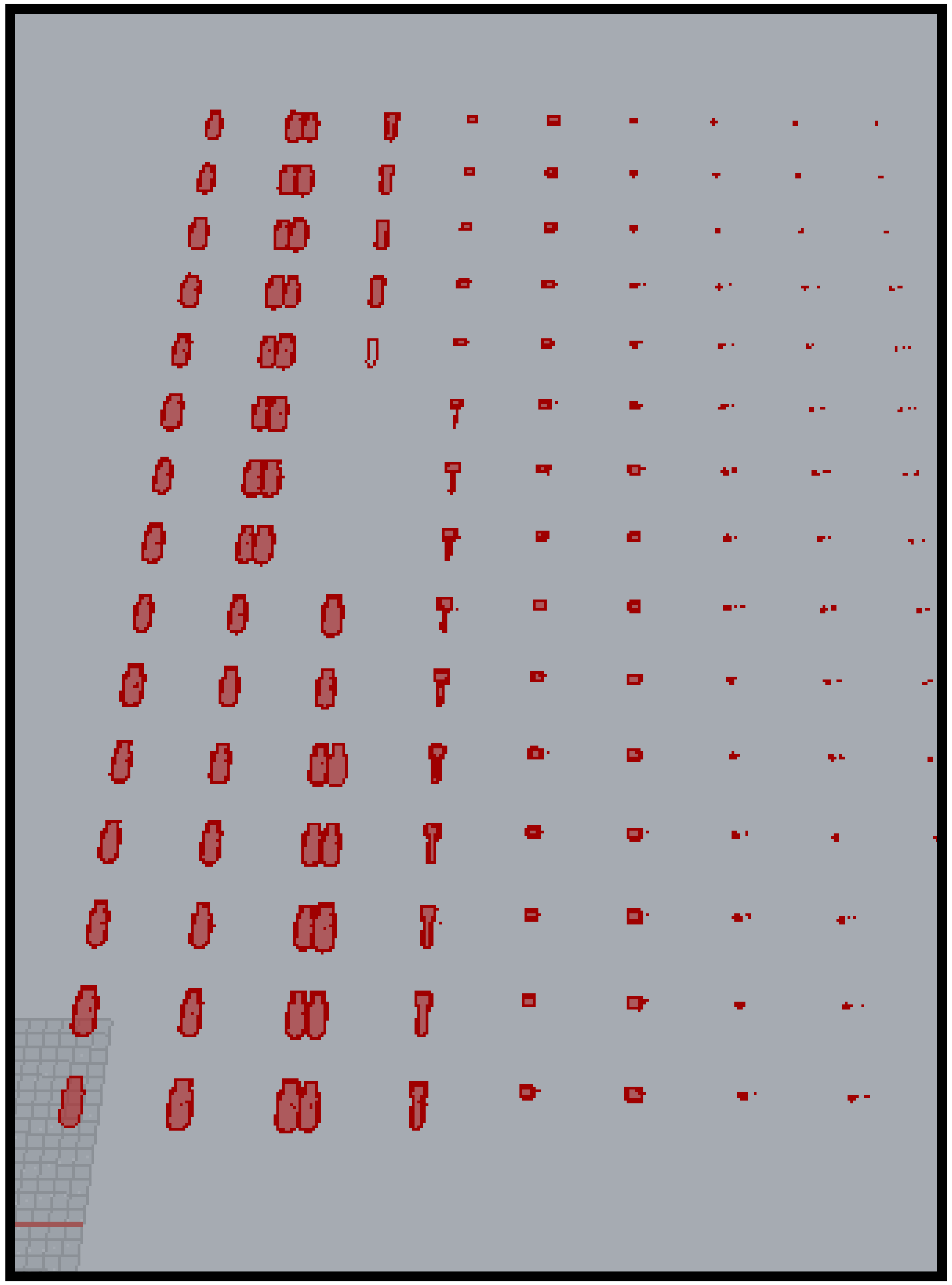

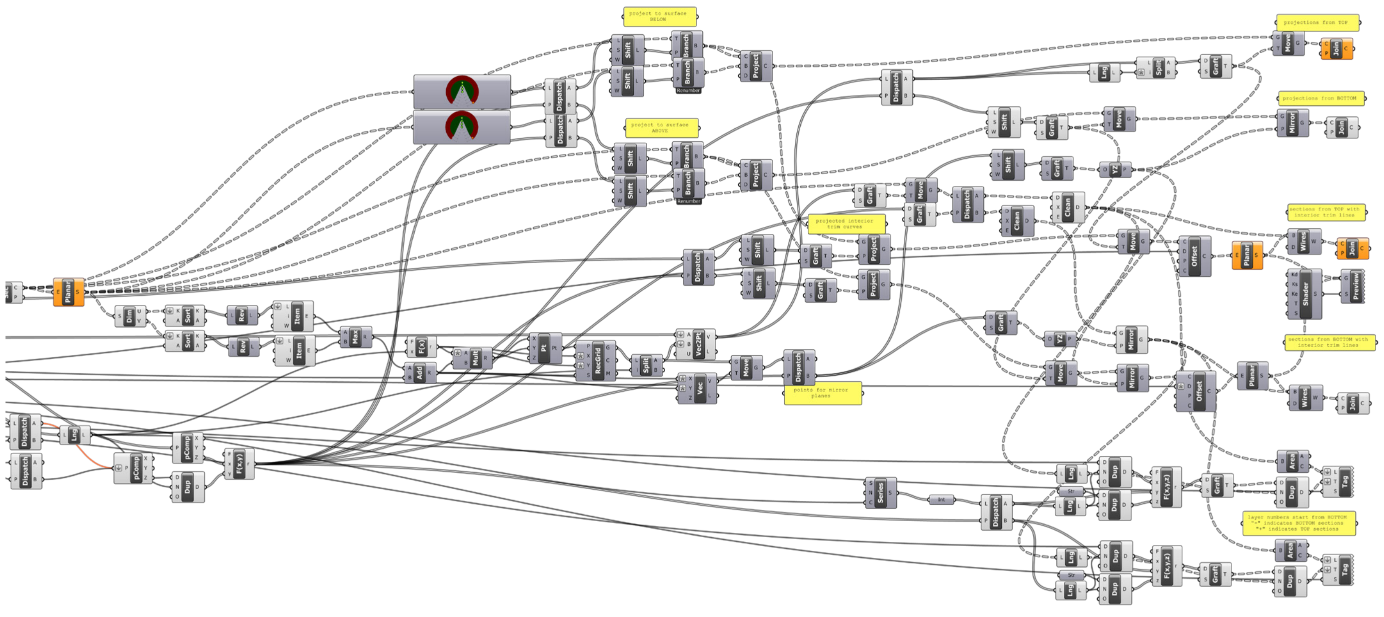

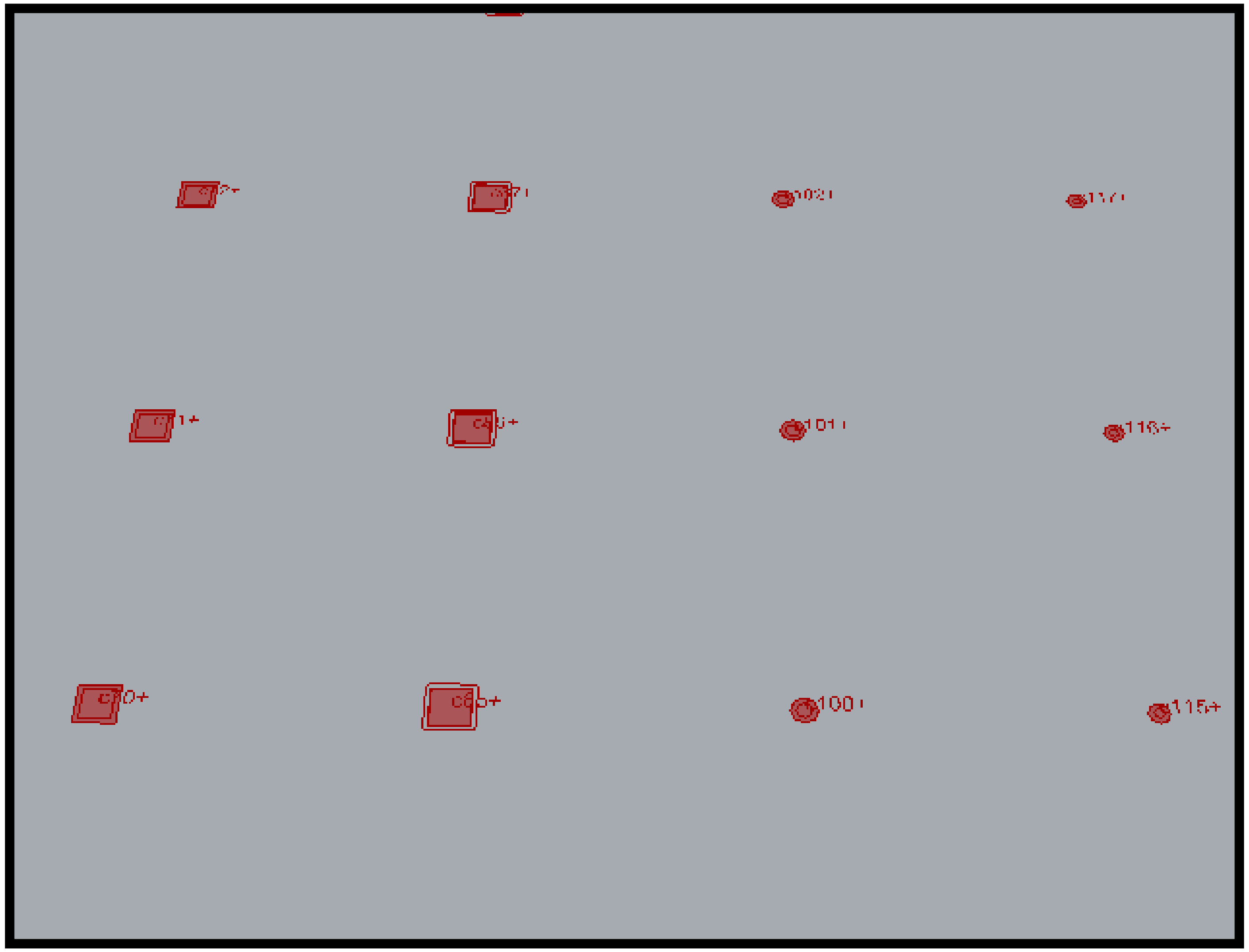

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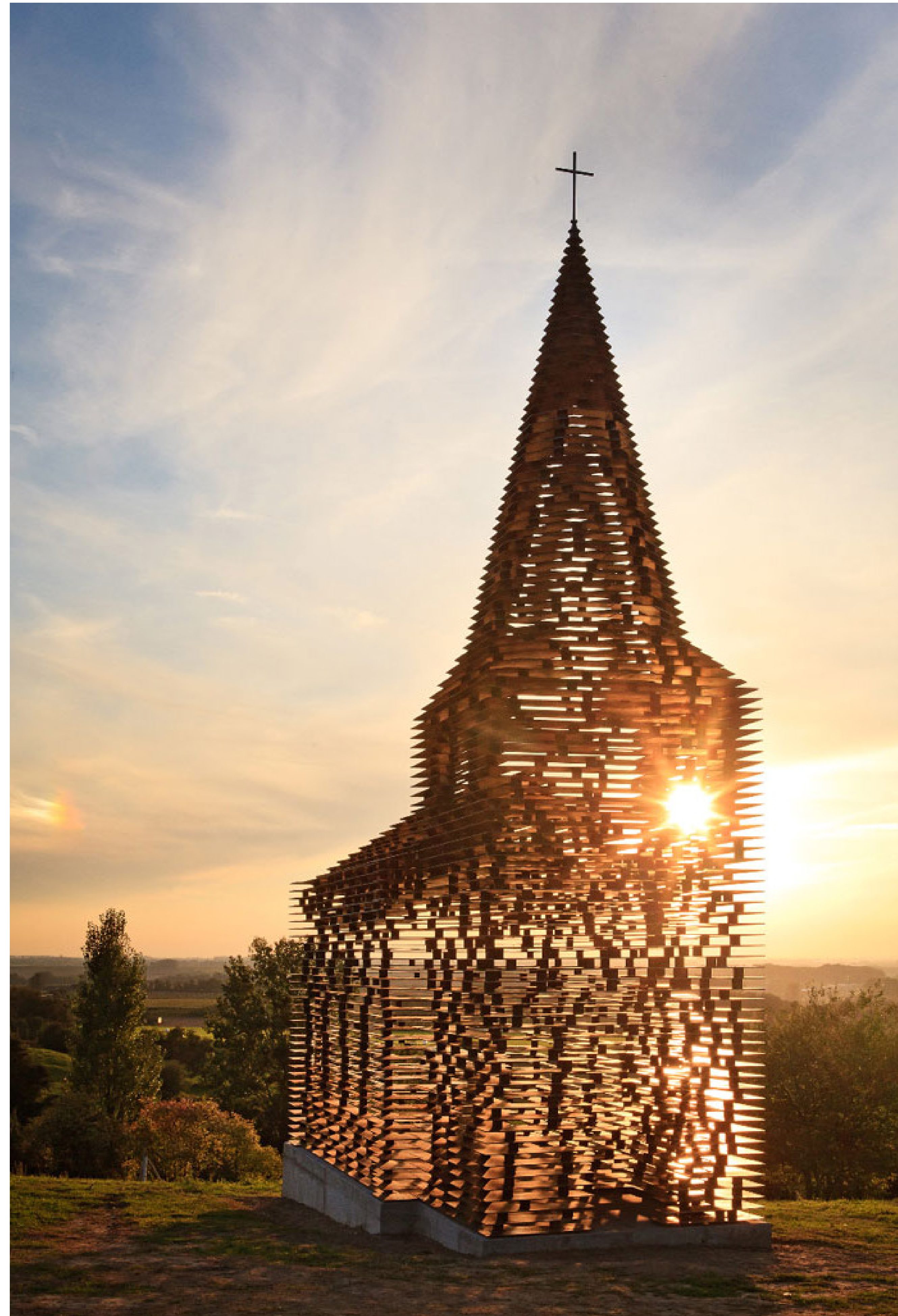
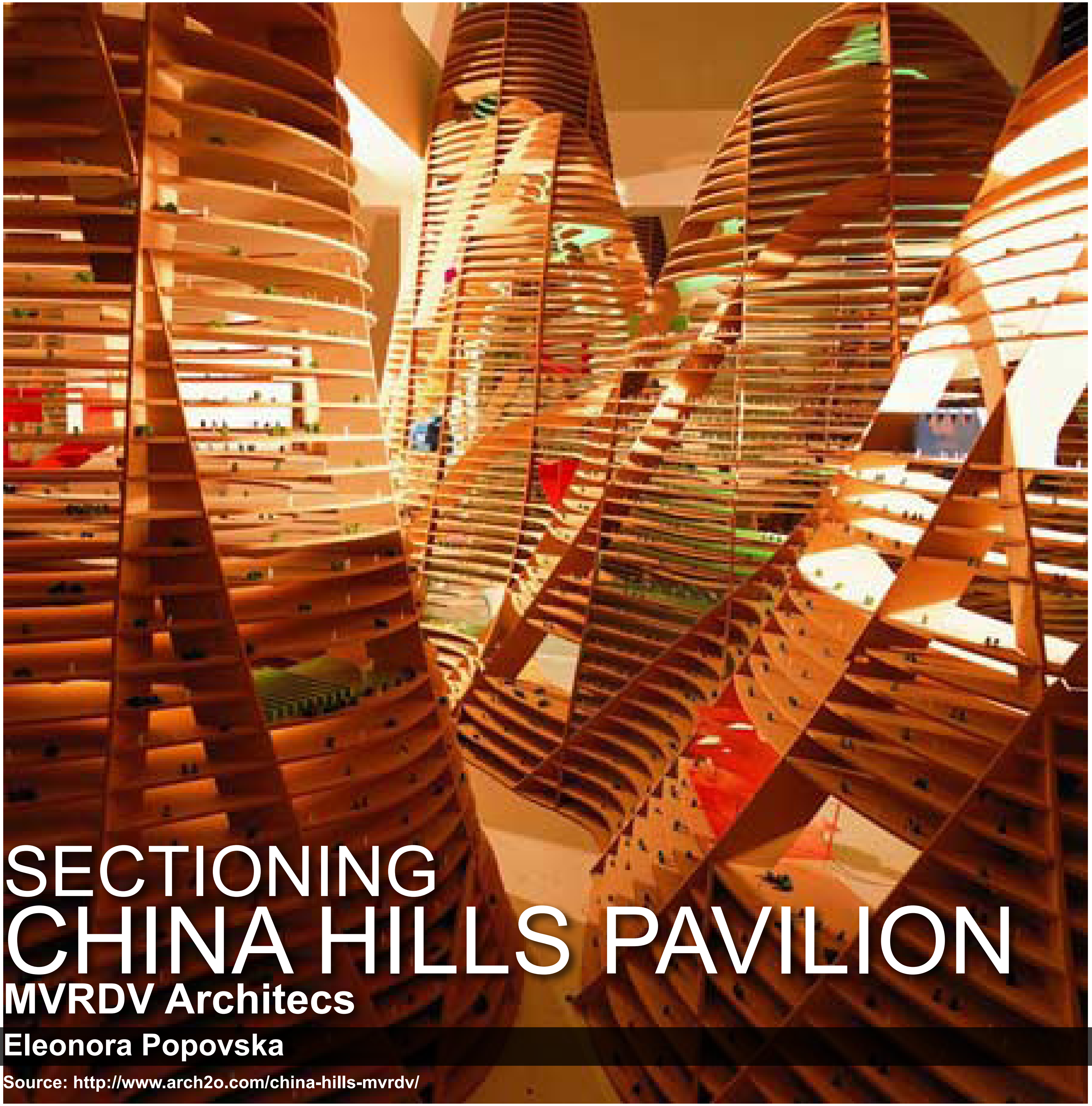




SECTIONING
CHINA HILLS PAVILION

MVRDV Architecs

Eleonora Popovska

Source: http://www.arch2o.com/china-hills-mvrdv/

China Hills pavilion

Project OUTLINE

Project Architect / Artist: MVRDV Architects

Location: Beijing Center for the Arts, Beijing, China

Investor: MVRDV Architects + Beijing Center for the Arts

Function: Exhibition Pavilion

Construction Year: 2010

Dimensions: ~ 4m High, 20 sqm

Exhibition design: Winy Maas, Jacob van Rijs and Nathalie de Vries with Wenchian Shi, Sabina Favaro, Paul Kroese, Oana Rades, Attilio Ranieri, Kyo Suk Lee, Filip Tittl, Ignacio Zabalo Martin

Materials Used: Pressure treated wood, Plywood board

Major Fabrication Method Used: Waffle Sectioning

Fabricated By: CNC machine, Milling machine

Type Of Construction: Wooden Arches

Modeling Software: Rhino + Grasshopper

Source: http://www.arch2o.com/china-hills-mvrdv/

China Hills pavilion

Project DESCRIPTION

The China Hills pavilion is a conceptual exhibition model for a future - city development project by Dutch architects MVRDV, entitled : “Green Projects II, Three Dimensional City: Future China” , featuring terraced buildings that resemble mountains.

The installation was a part of an exhibition show at the Beijing Center for the Arts in 2010. The pavilion does not rely on any form of binder or an adhesive which allows the repetitive construction and deconstruction of the structure.

Source: http://www.arch2o.com/china-hills-mvrdv/


Source: http://www.arch2o.com/china-hills-mvrdv/


Source:http://www.arch2o.com/china-hills-mvrdv/

China Hills pavilion

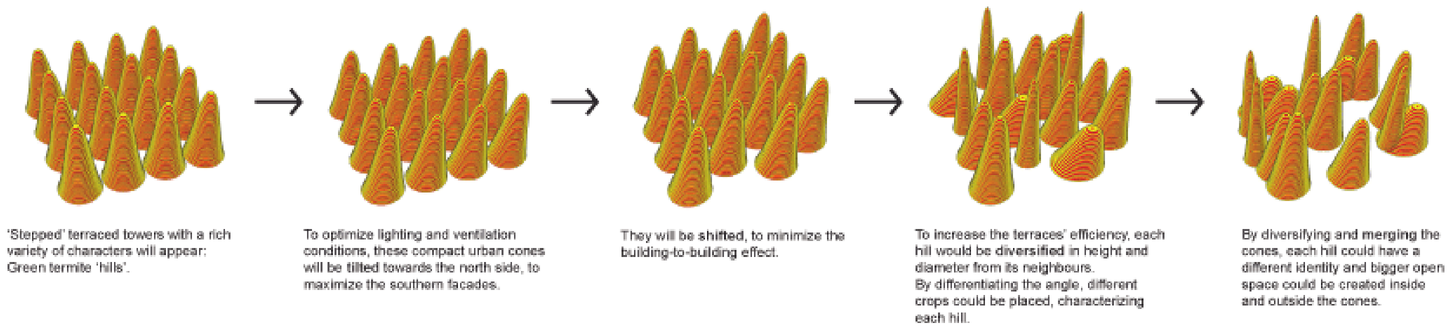
Project FABRICATION

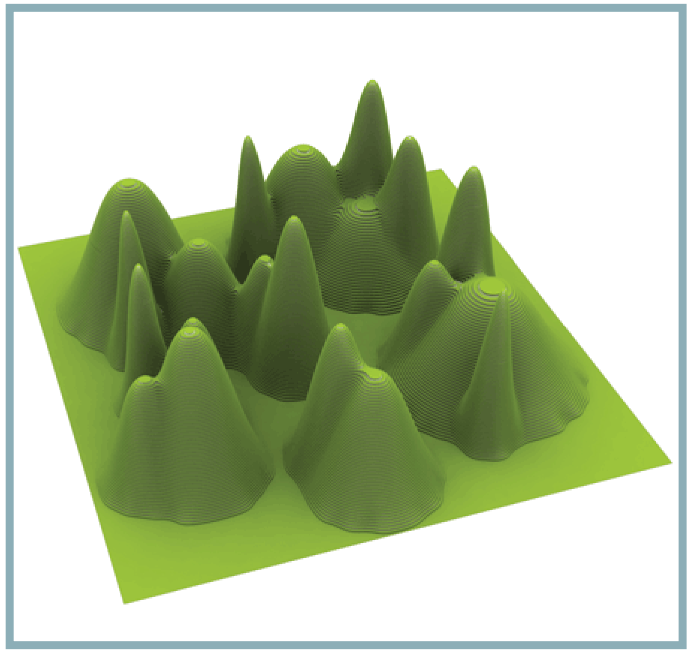
The China Hills pavilion is consisted out of 5 individual unique parts as reliefs(‘mountains’). The process of segmenting the production into ddifferent sections was used due to the complexity of the pavilion itself.

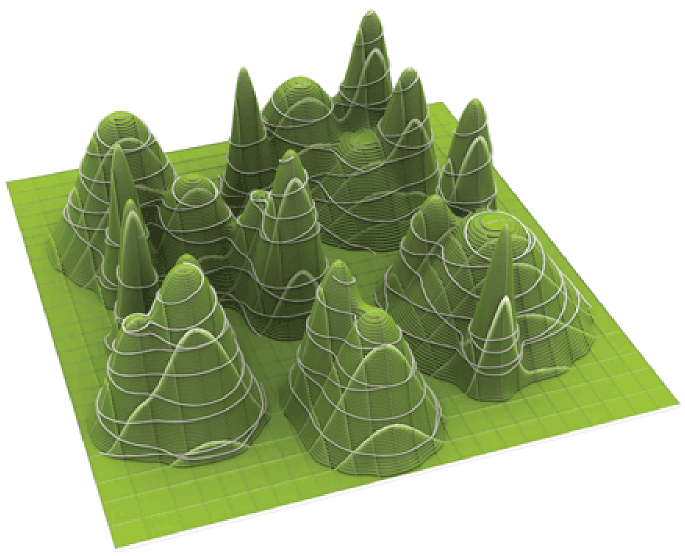
The design process was divided into two separate stages:

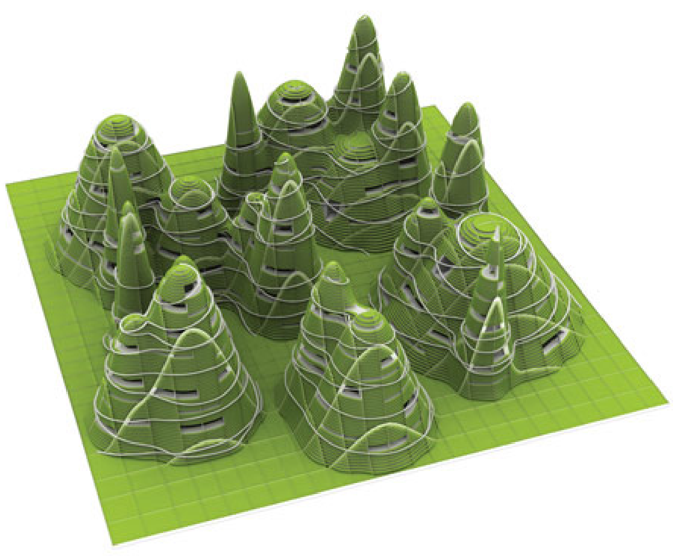
1. first, developing a script that would give the wanted form results,

2. second, creating a script for produsing the individual parts, their connections and perforations.









Source: http://www.dezeen.com/2010/01/05/china-hills-by-mvrdv/

China Hills pavilion

Project MATERIALS

The pavilion is consisted out of more then :

-60 horizontal sections of plywood sectioned contours
-40 vertical plywood arches in (x) axis direction, and
-36 vertical structural binding supports in (y) axis direction.

The construction is made up of more then 570 elements, so the construction team used wooden joints to avoid the need for extra binding. In total they used 200 square meters of 15mm plywood.
The puncture of each plywood piece evolves on as it increases in height and emphasizes the structural arches rooted in the pavilions design.

China Hills pavilion

Project MACHINE / SOFTWARE

For the pavilion production, a method of waffle sectioning was used to produce the individual components, thus using digital fabrication as a logical and economical way of manufacturing.

All the individual parts were cut-out of a 2D plywood boards by a CNC machine router and then later on assembled into the 3D physical pavilion.

1 .

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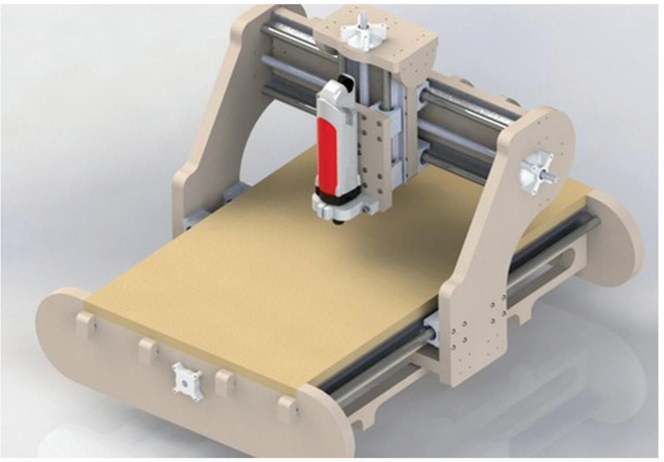
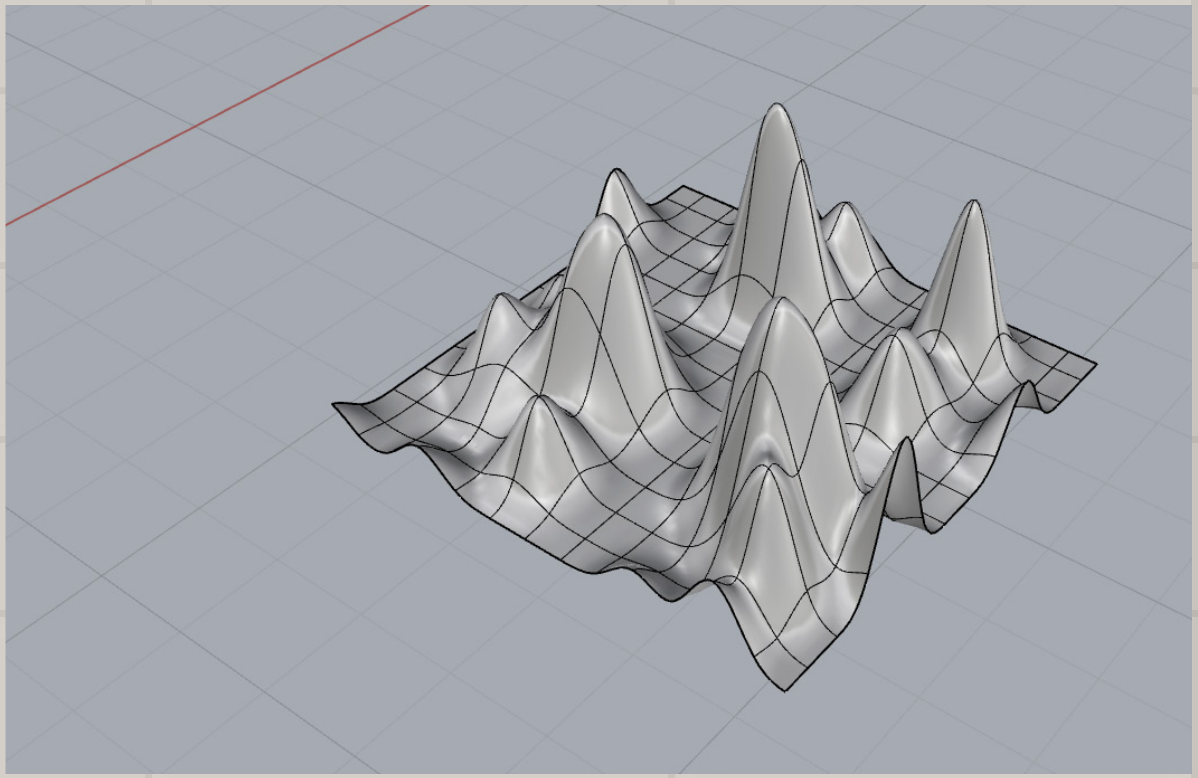
CNC PLYWOOD CUTTING ROUTER

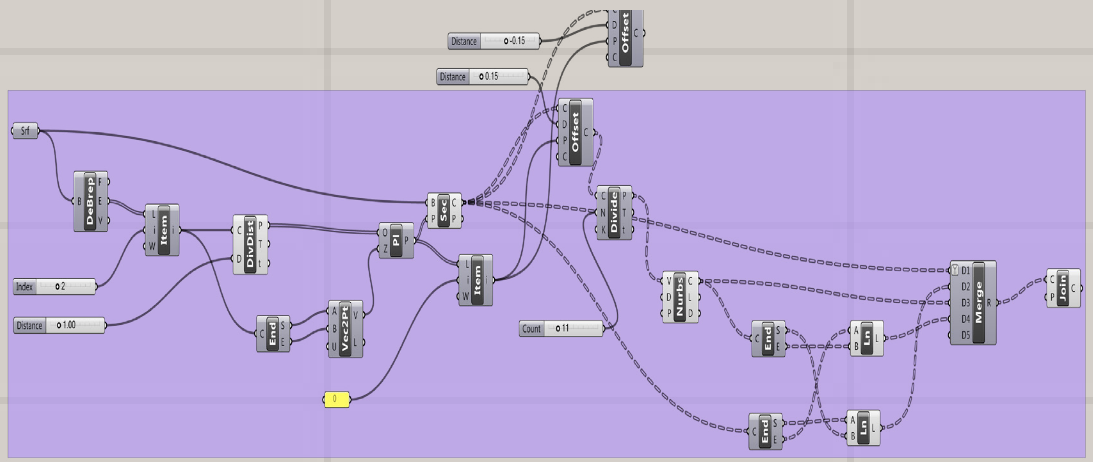


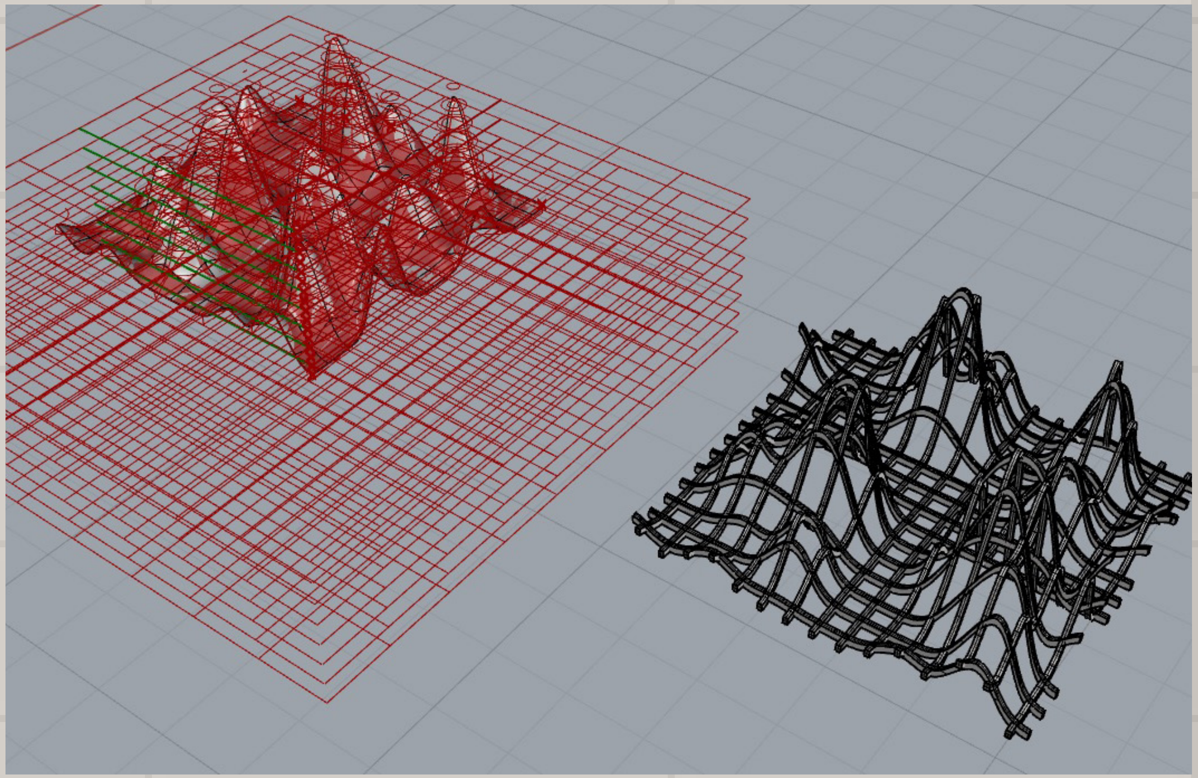
Source: http://www.arch2o.com/china-hills-mvrdv/

China Hills pavilion

GRASSHOPPER
Modelling

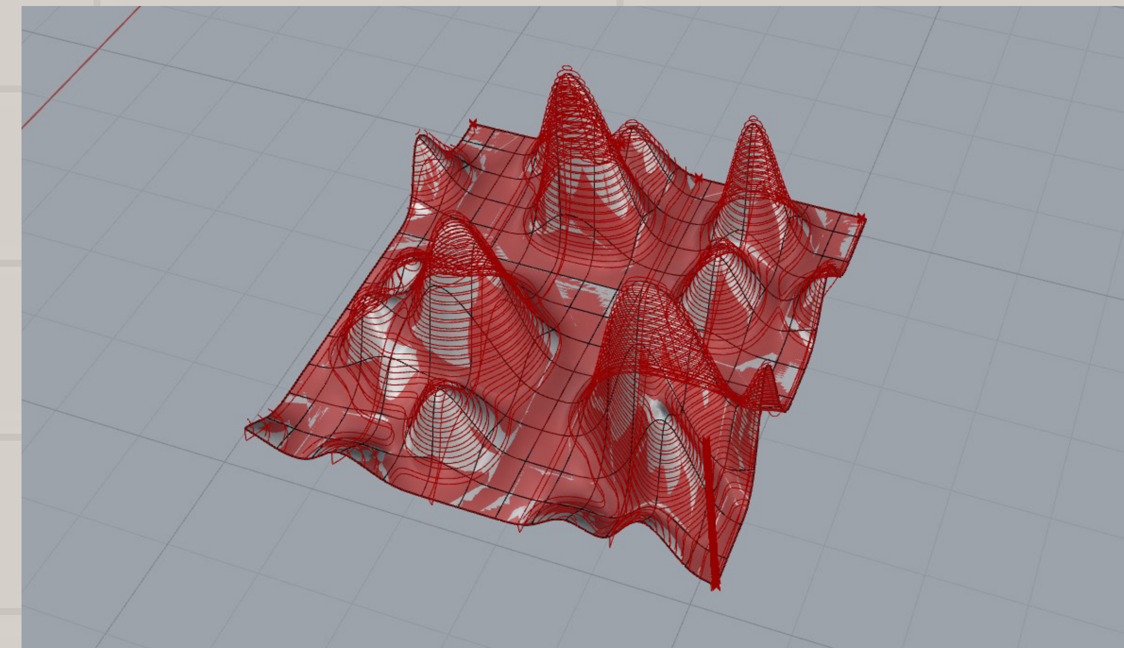


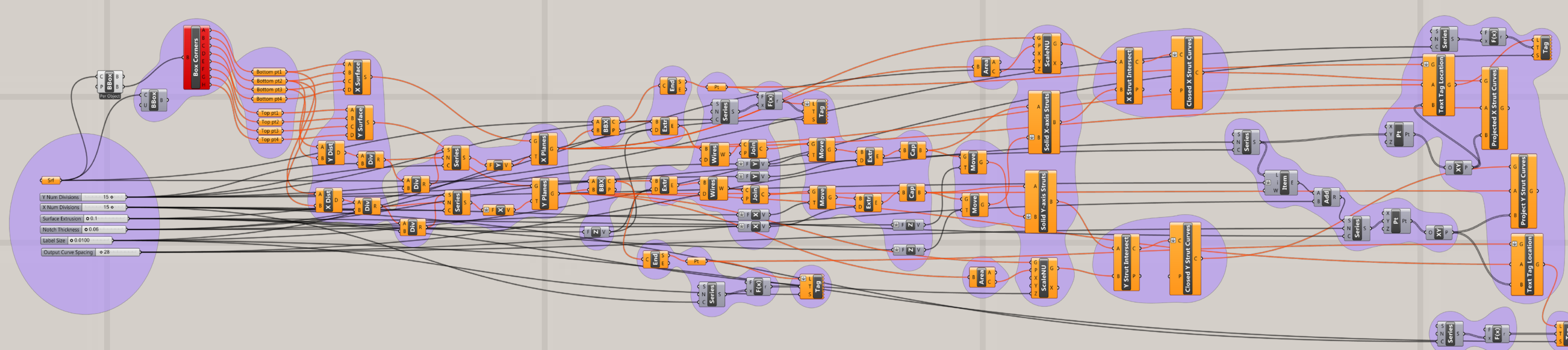


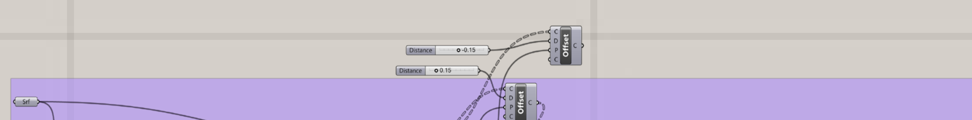


China Hills pavilion

GRASSHOPPER
Modelling

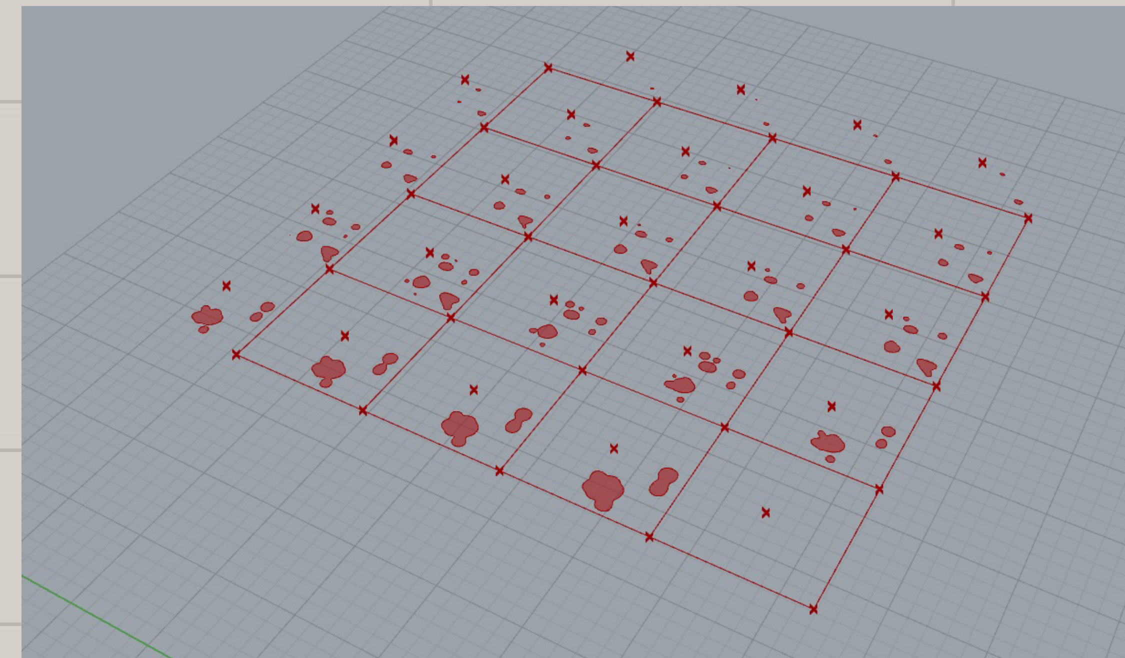


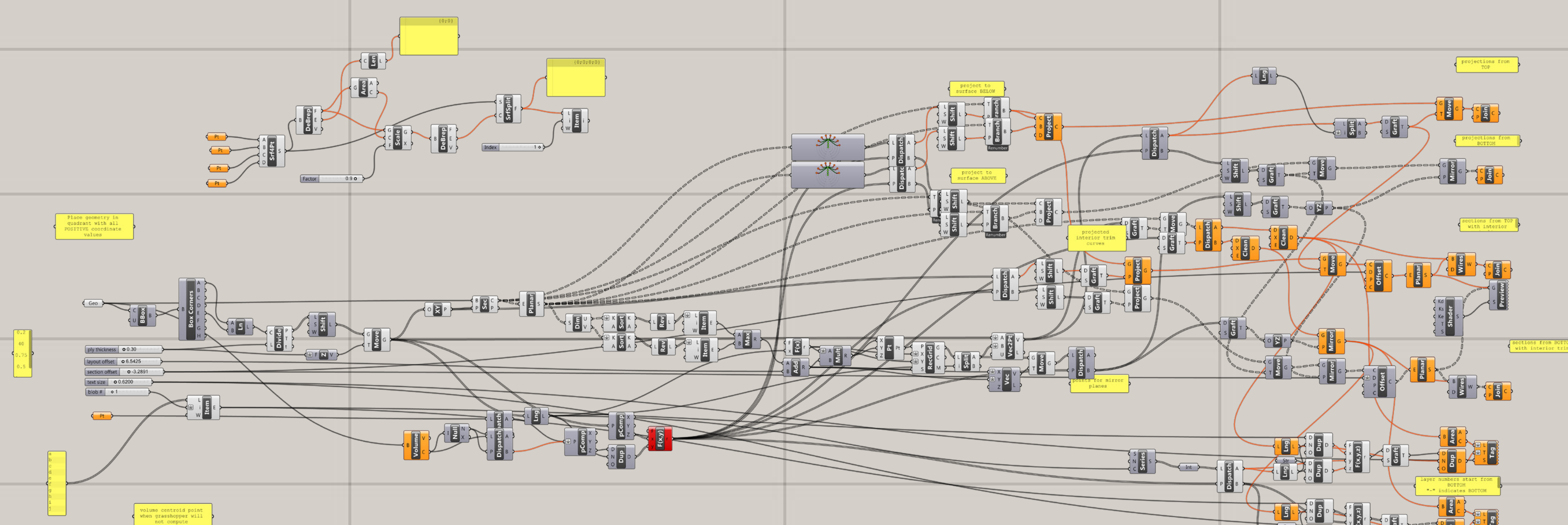




China Hills pavilion

GRASSHOPPER
Fabrication Definition





WAFFELING

PUDELMA PAVILLION

Columbia University and Olu University

Pratik Rajeev Taishete

http://cargocollective.com/charlieable/Pudelma-Paviljonki

PUDELMA PAVILION

Project OUTLINE

Project Architect / Artist: Columbia University and Olu University, coordinated by Phi lip Anzalone and Rainer Mahlamaki.

Location: Turku, Finland

Investor: **Schools**

Function: Pavilion

Construction Year: 2011

Dimmensions: 10.1m x 7.1m x 3.9m

Construction Team: Charlie Able, Joe Brennan, Therese Diede, Justin Fabrikant, Taneli Heikkila, Taavi Henttonen, Lotta Kindberg, Michaela Metcalfe, Victoria Monjo, Sampo Ojala, Jocelyn Oppenheim, Olli Parviainen, Alli Perttunen, Chris Powers, Roula Salamoun, Tuulikki Tanska, Helena Tasa, and Shuning Zhao.

Materials Used: Plywoods

Budget: XXXX

Major Fabrication Method Used: Waffle
Secondary Fabrication Methods: Mortis and Tennon joints

Fabricated By: CNC Machine

Type Of Construction: Wood mortis and tennon joints

Modelling Software: Rhinoceros + Grasshopper
AutoCAD

http://designplaygrounds.com/blog/pudelma/

PUDELMA Pavilion

Project DESCRIPTION

Pudelma is a pavilion inspired by the traditions of Finnish wood-working and created as part of the European Capital of Culture Program. “Pudelma” is a combination of the Finnish words puu (wood) and kudelma (web of), and is composed of 490 CNC shaped Kerto-Q wood beams which range from 2-6 feet in length. Originally erected in City Hall Park in Turku, Finland as a temporary installation, the pavilion has since become a permanent city landmark.

http://designplaygrounds.com/blog/pudelma/

PUDELMA Pavilion

Project FABRICATION

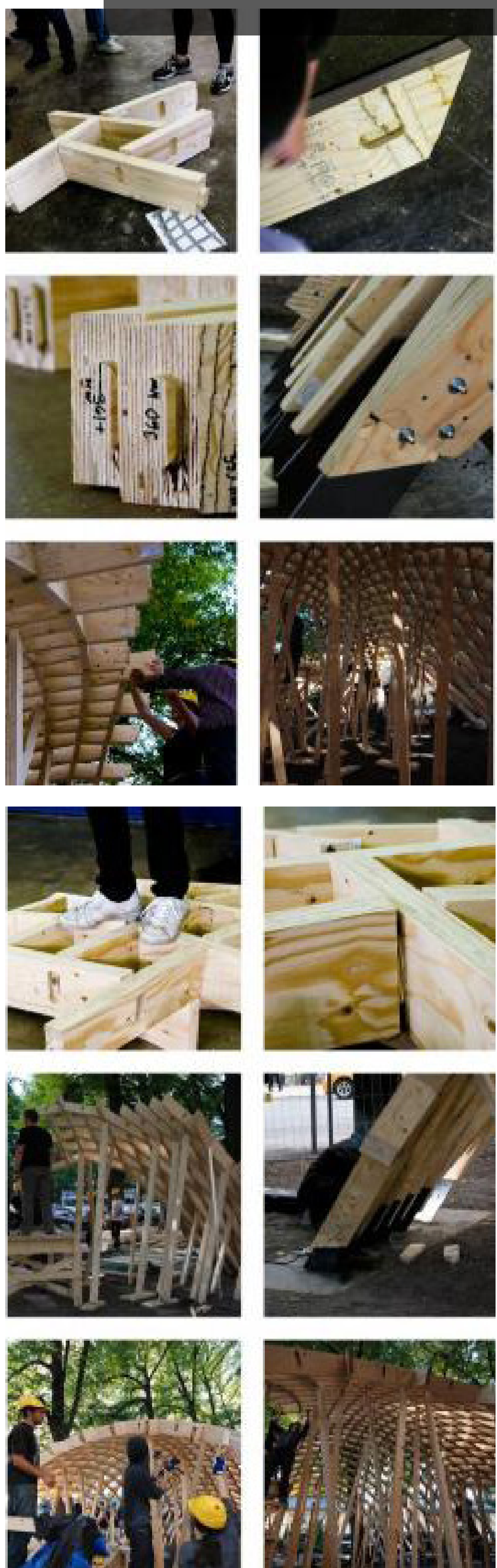
The project combines state-of-the-art computer-aided manufacturing methods as well as traditional wood-working techniques.
A basic mortise and tenon joint was utilized for almost every connection.
Each beam either receives of abuts to four other beams creating a highly stable weave pattern.
The use of CNC fabrication resulted in extremely high tolerance, allowing the entire structure to work in compression with no glue, and minimal screws.

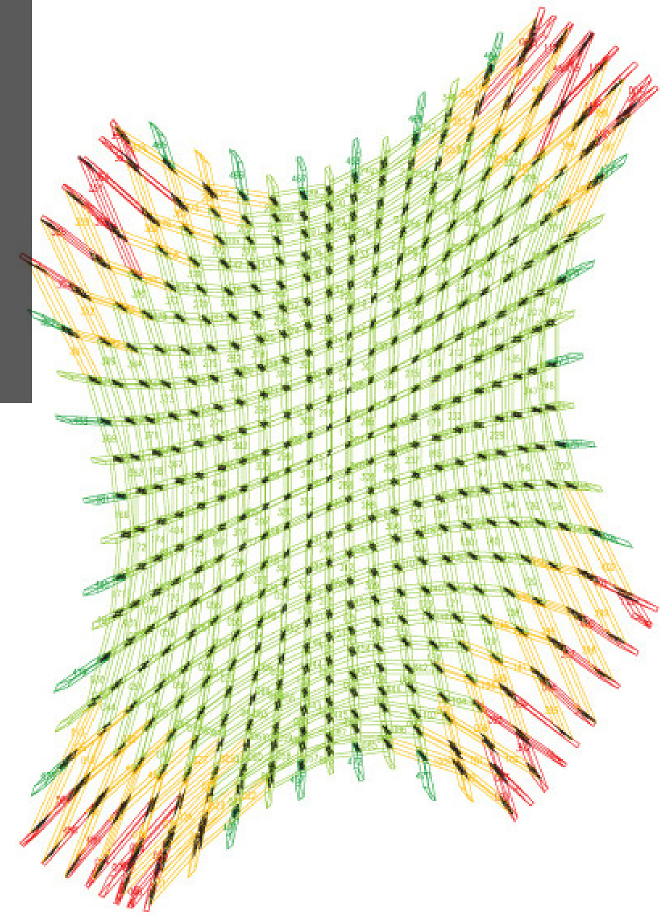
The Kerto laminated timber was provided by Finnforest.

http://www.archdaily.com/370542/custore-pavilion-anna-dobek-mateusz-wojcicki/

PUDELMA Pavilion

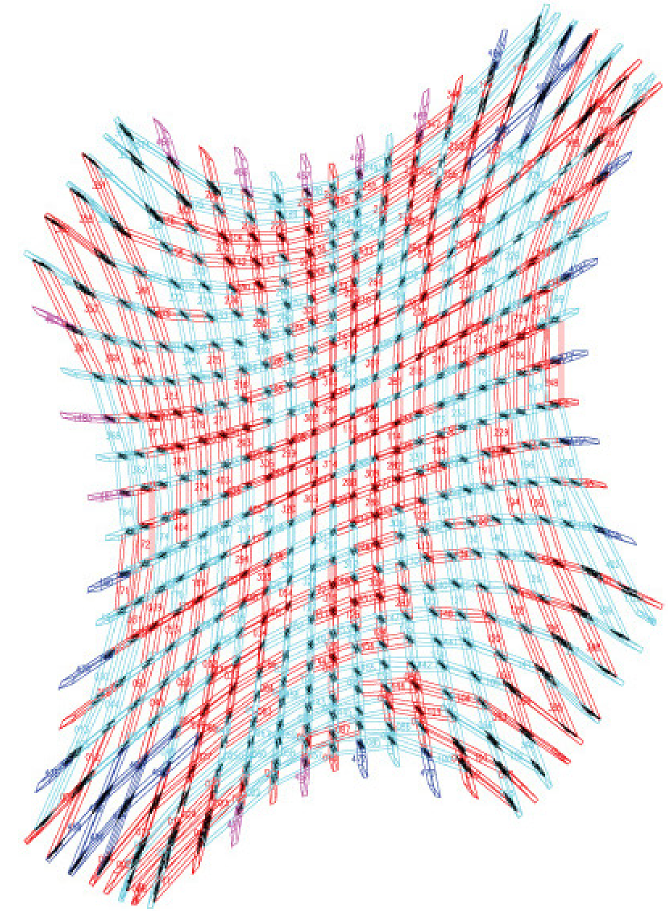
Project FABRICATION





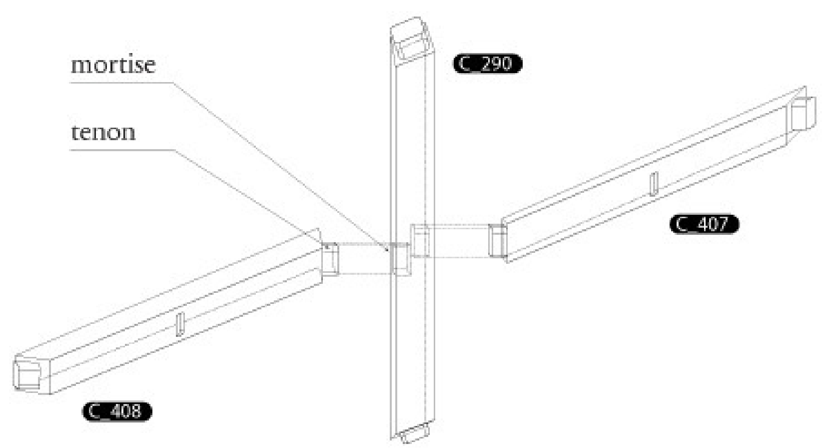
Joint Typology

- Mortise + Tenon | mono-directional
- Mortise + Tenon | bi-directional
- Shoulder | bi-directional
- Shoulder | base plate attachment



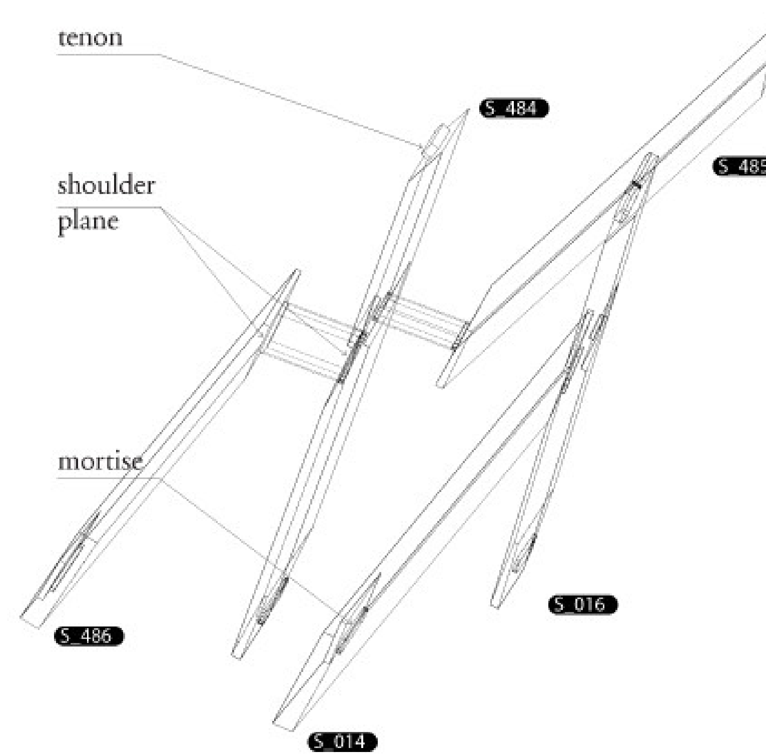
Directionality

- Joint Directionality a | 1
- Joint Directionality a | 2
- Joint Directionality b | 1
- Joint Directionality b | 2



Mortise + Tenon Joint

Basic connection method used to join each seam piece to the next. This basket weave connection type allowed for easier geometric rationalization.



Shoulder Joint (with mortise + tenon)

Connection used for acute angles and leg pieces. The mortise and tenon are used as locators for the less precise shoulder connection.

CUSTORE Pavilion

Project MATERIALS

Kerto laminated timber

M.S. Plates nuts and bolts.

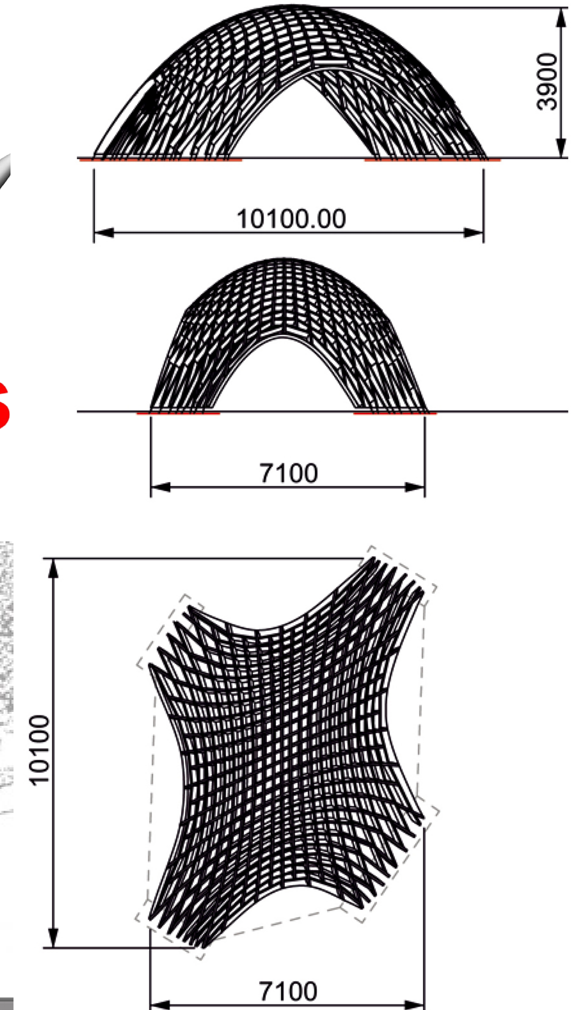
PUDELMA Pavilion

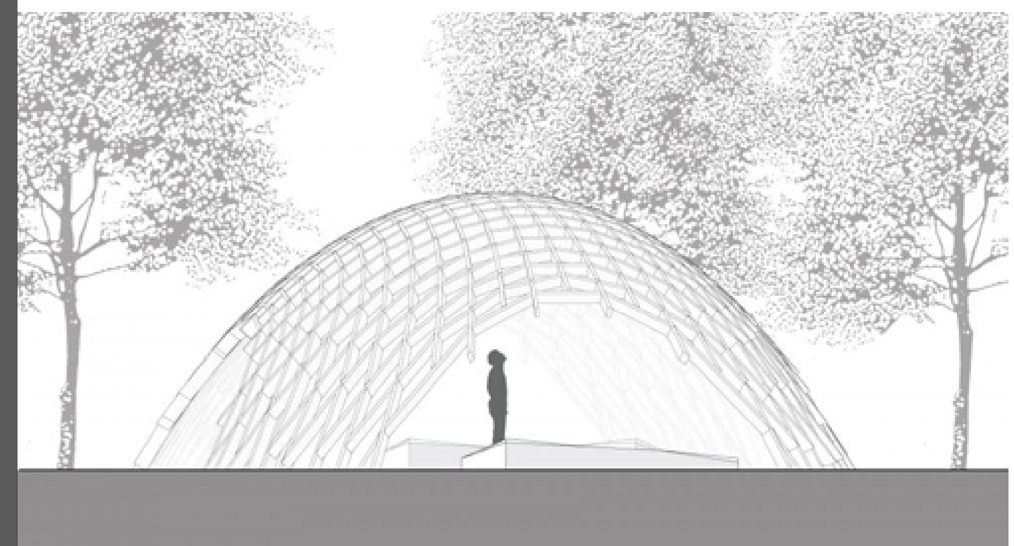
Project MACHINE / SOFTWARE

The fabrication was done at Woodpolis, in Kuhmo, Finland, where students wereable to use proprietary industrial software and run the industrial machinery themselves.

The mortise and tenon connections interlock in a compressive two-way pendentive dome structure.

The form was rationalized as a dome and subsequently modified to fit site conditions.





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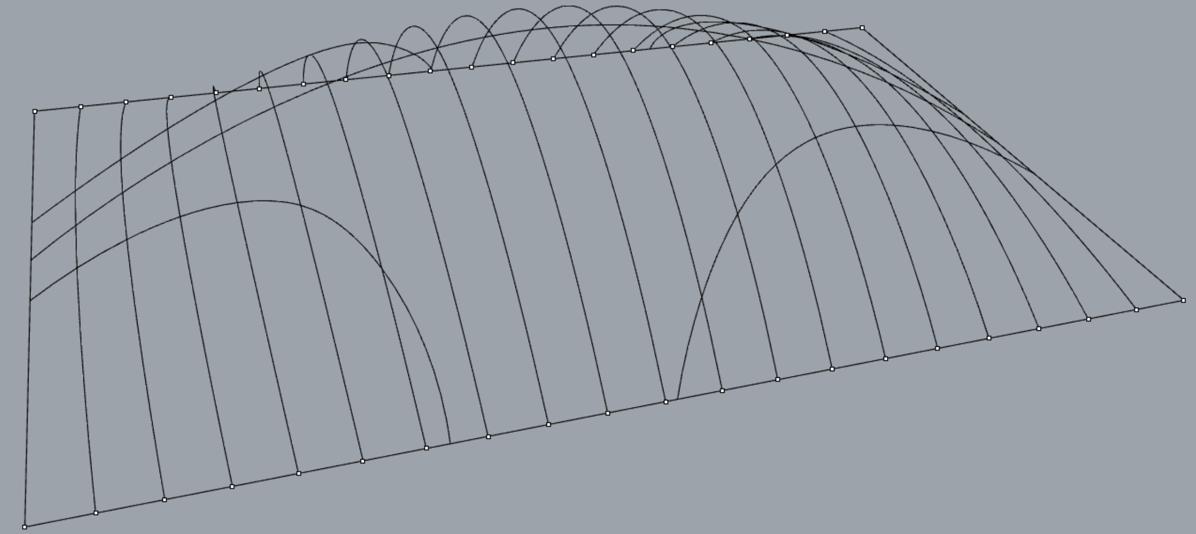
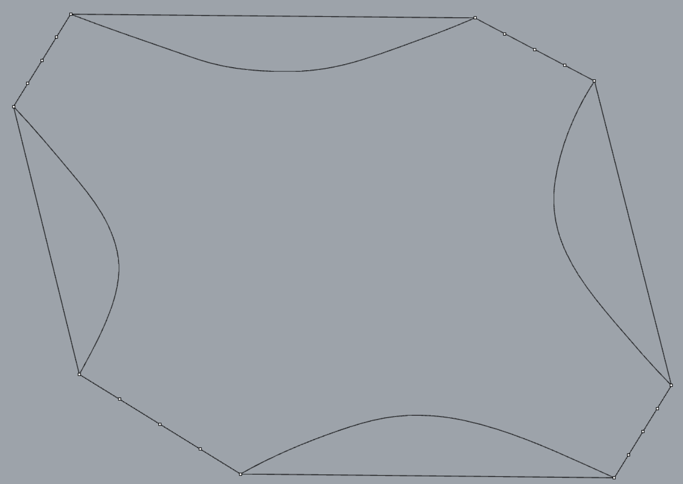
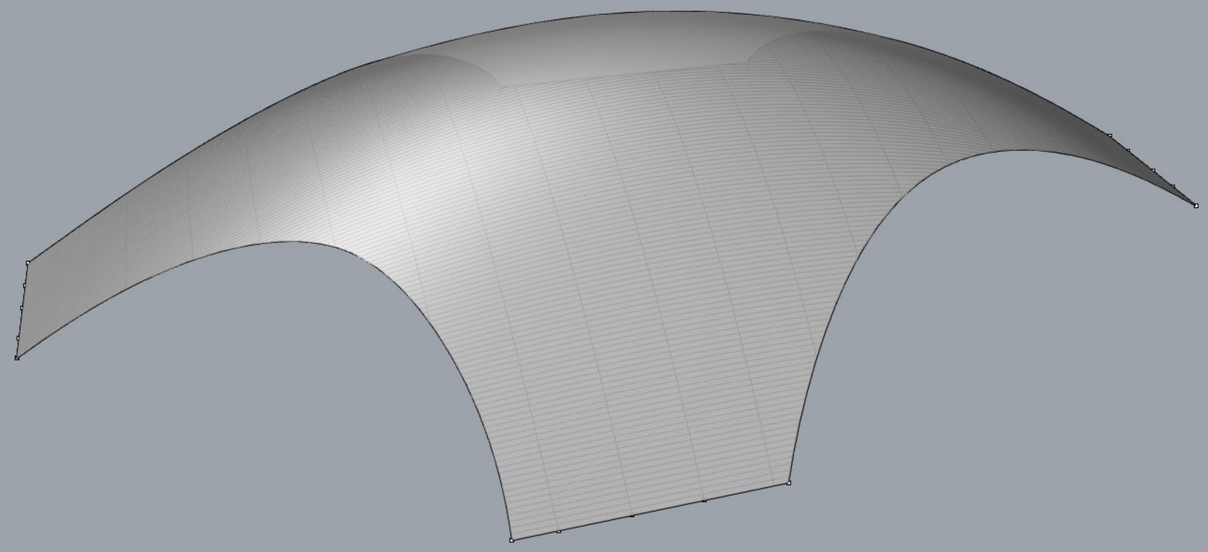
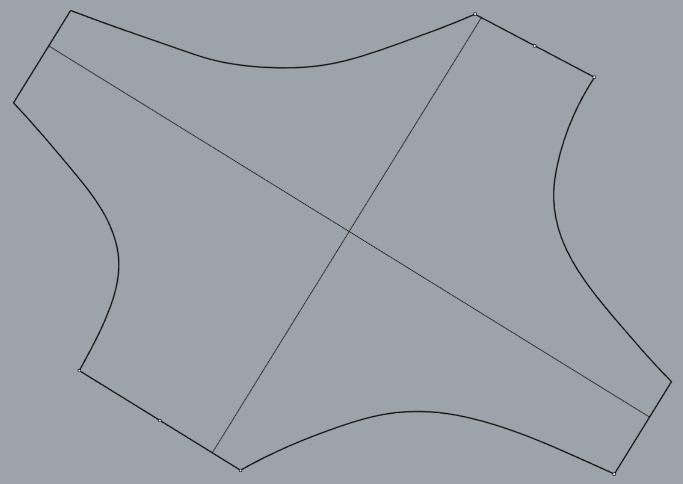
PUDELMA Pavilion

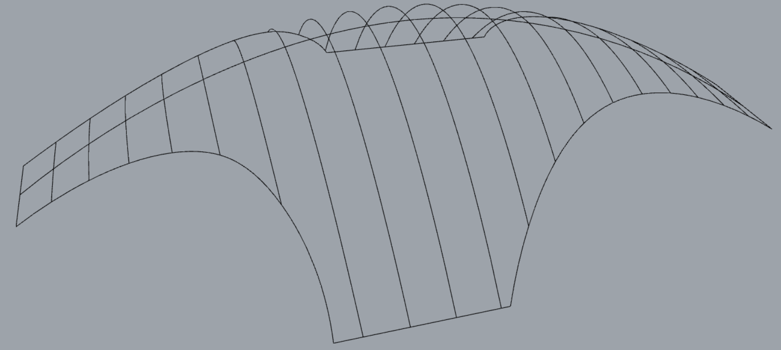
GRASSHOPPER
Modelling

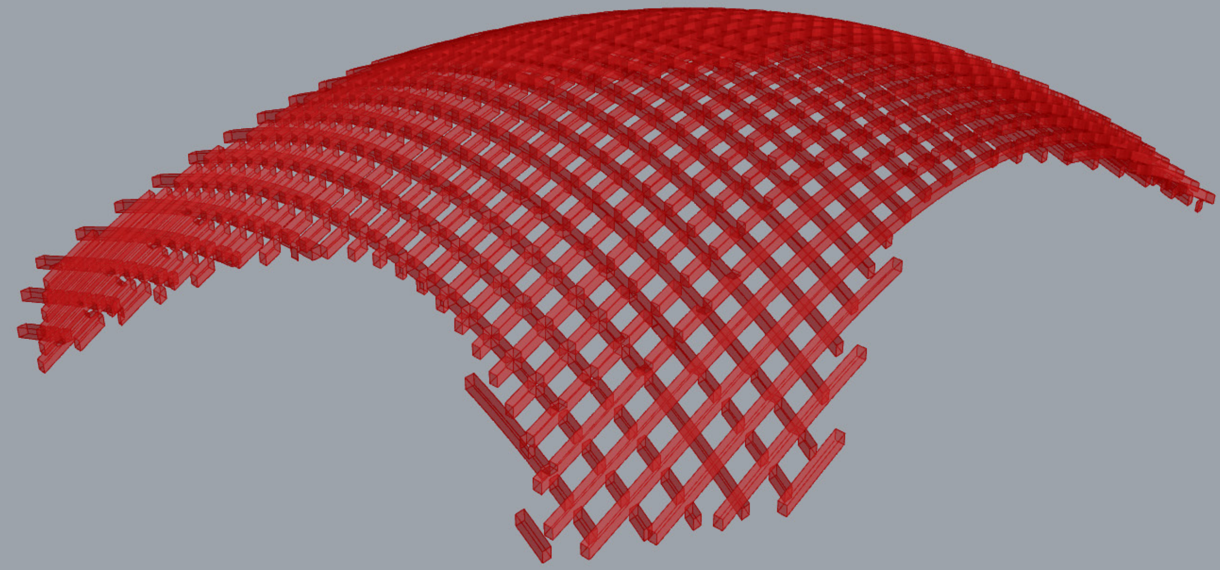






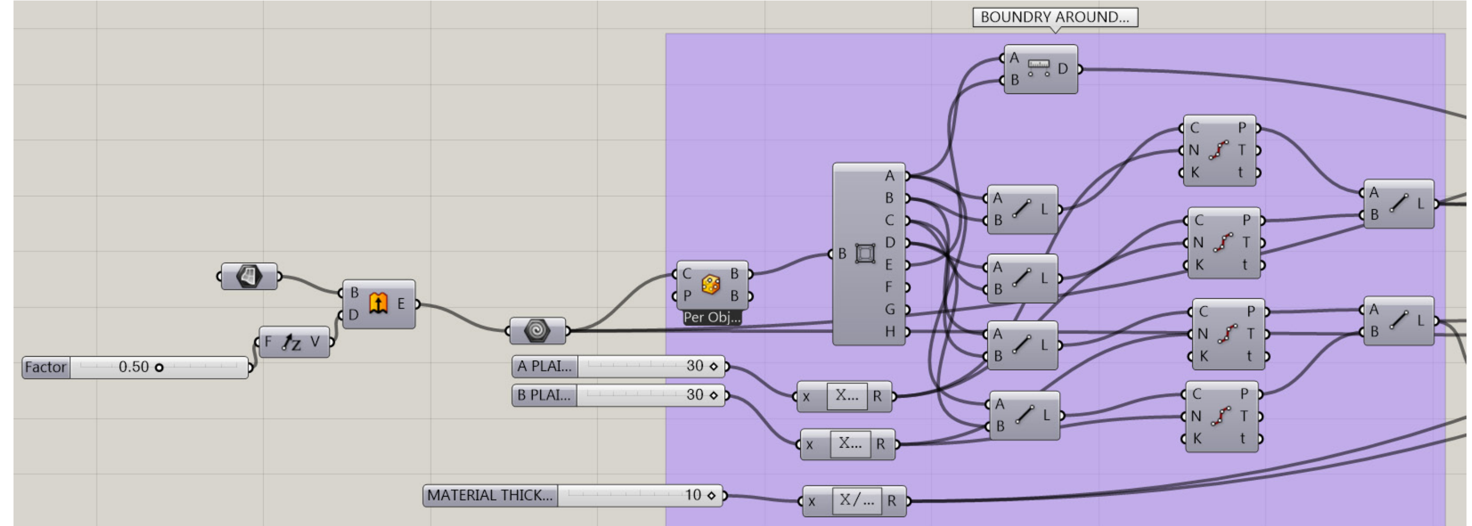


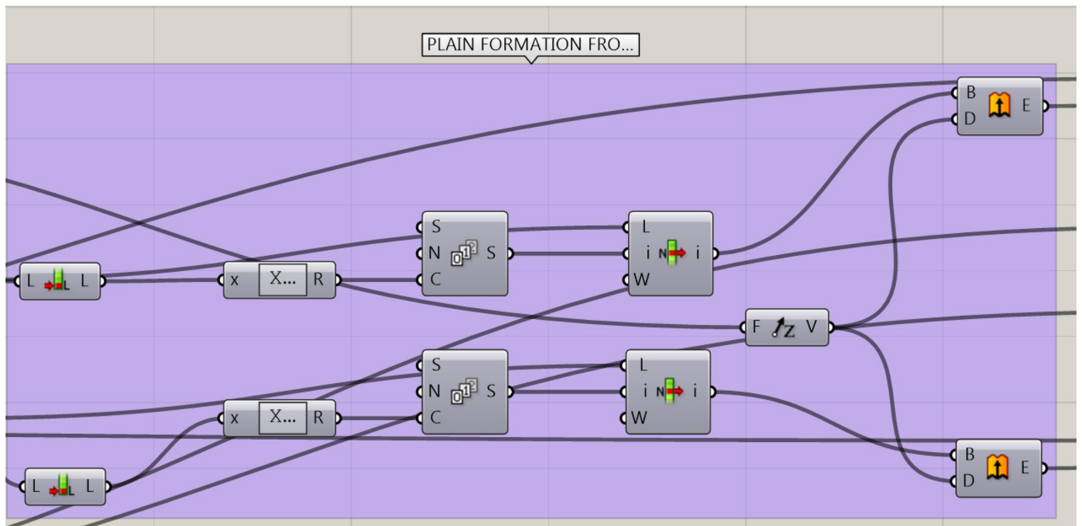


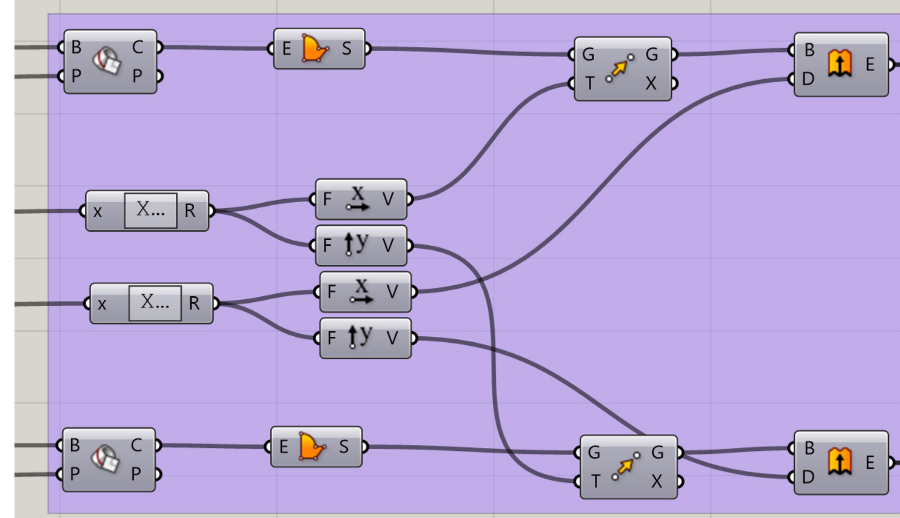


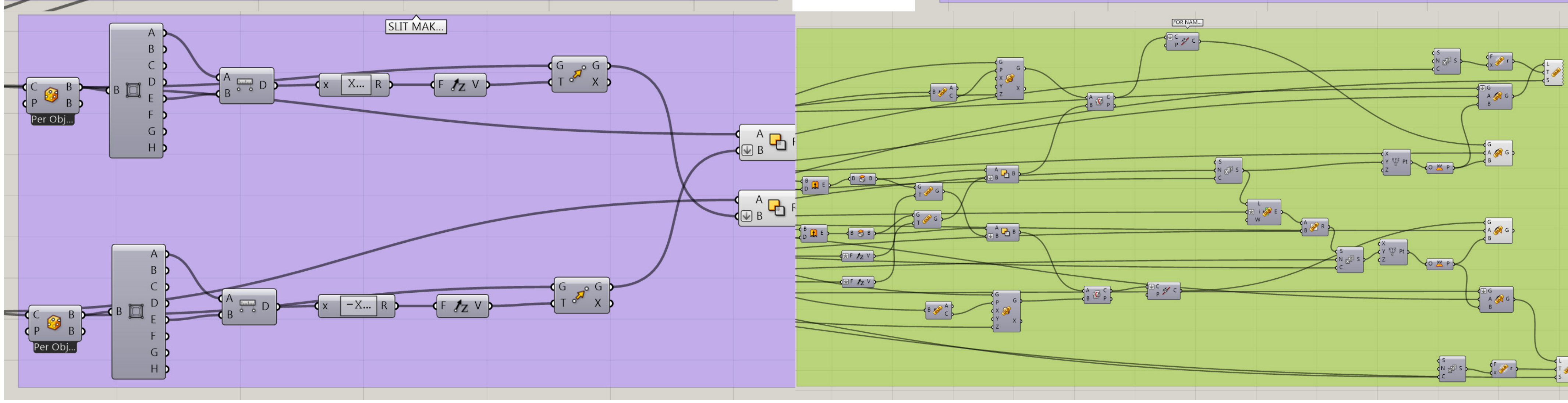
PUDELMA Pavilion

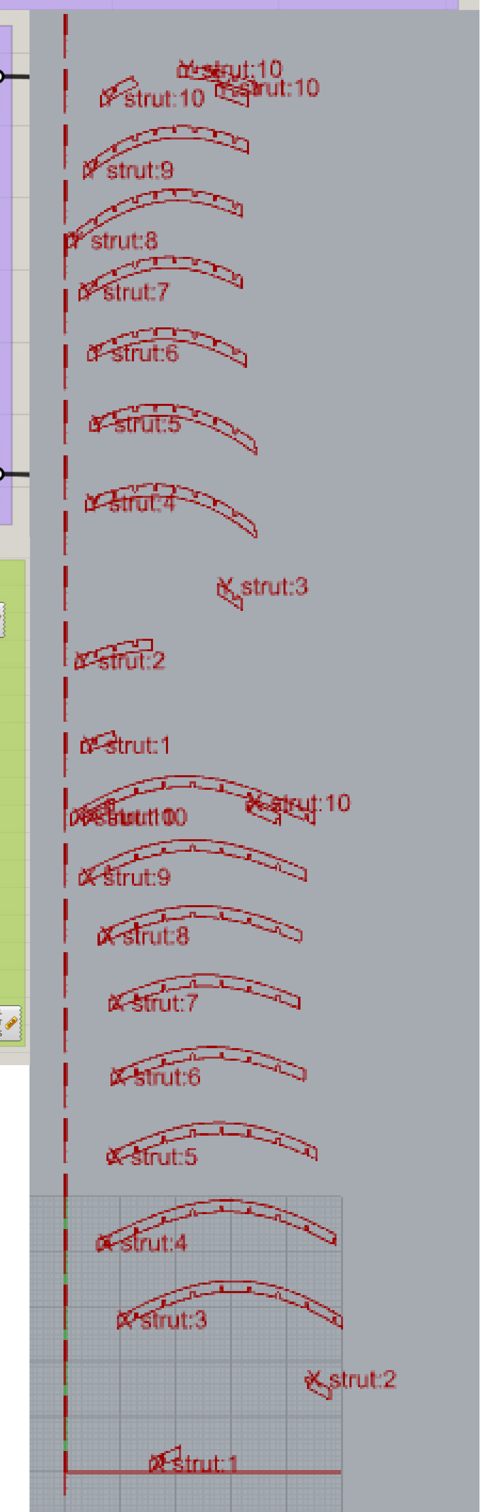
GRASSHOPPER
Modelling







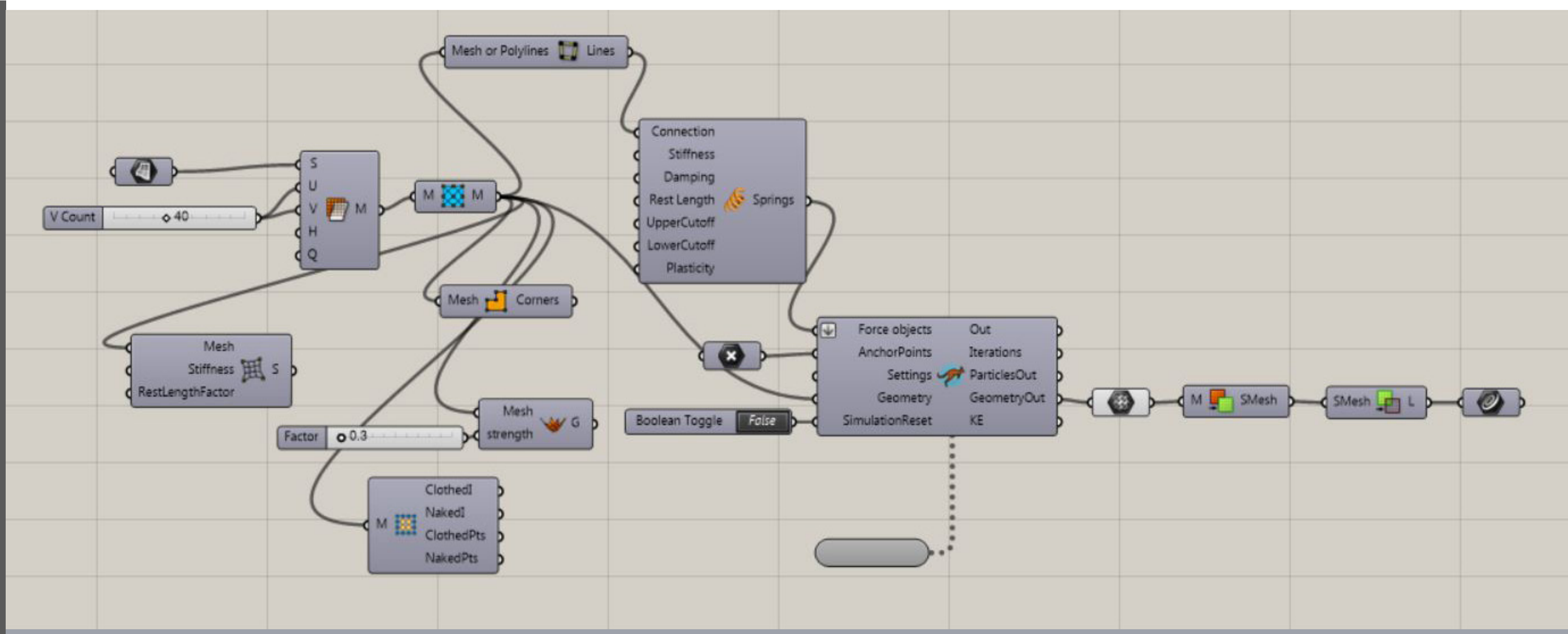


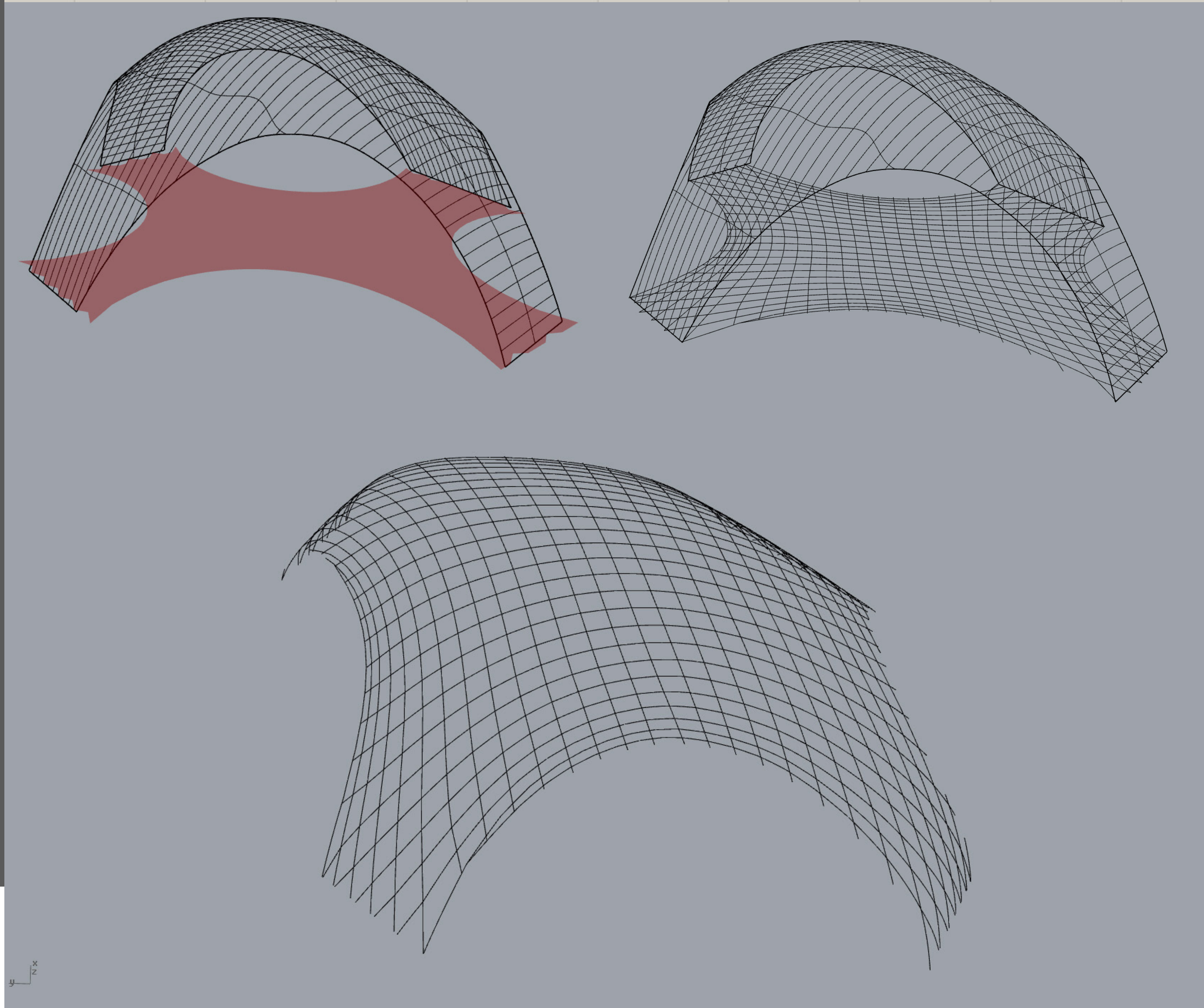


PUDELMA Pavilion

GRASSHOPPER

Modelling

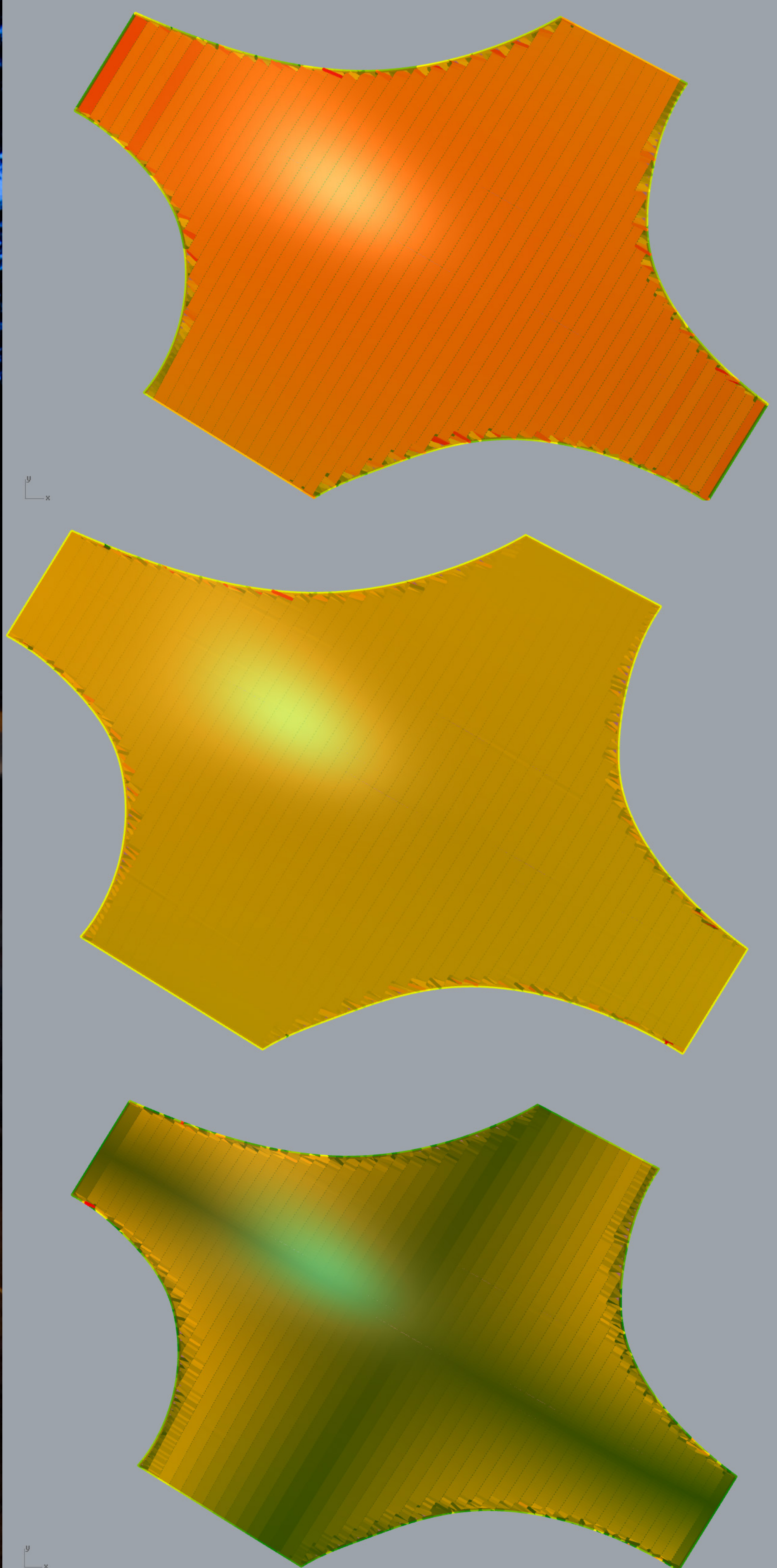




PUDELMA Pavilion

GRASSHOPPER

Structural Analysis



PUDELMA
Pavilion

SECTIONING
LIGNUM PAVILLION
FREI+SAARINEN ARCHITEKTEN

DORDE ZDRAVKOVIC

http://divisare.com/projects/225062-Frei-Saarinen-Architekten-Martin-Saarinen-Lignum-Pavilion

LIGNUM PAVILION

Project OUTLINE

Project Architect / Artist: Frei+Saarinen Architekten

Location: Zurich, Switzerland

Investor: Lignum, Holzwirtschaft Schweiz, Zürich

Function: Pavilion (wood design possibilities)

Construction Year: 2009/2010

Dimmensions: 347cm

Construction Team: Stefan Wülser, Martin Saarinen, Barbara Frei

Materials Used: Wood and nails

Budget: 114 500e

Major Fabrication Method Used: Horizontal Sectioning

Secondary Fabrication Methods: XXXXXXXXXX

Fabricated By: CNC machine

Type Of Construction: Wood Frame

Modelling Software: Rhino + Grasshopper

Source: http://www.archilovers.com/projects/89540/ekko.html

LIGNUM PAVILLION

Project DESCRIPTION

“Lignum” is the Swiss observatory for all issues related to wood. It is a training centre, the purpose of which is to inform the public about the possibilities of wood applications in the construction field. It organizes events, produces documentation and publications, operates implementation of research and leads expertise and consultations. Frei+ Saarinen Architekten were invited to submit a design for a pavilion, also displayed on occasion of the Swissbau 2010 exhibition in Basel, that would embody the expressive potential of wood in very modern key. Perhaps this is not a particularly complex investigation, but this small object seems to transpire a certain awareness that the modulation of rhythm is not concerned solely with form in itself, for ‘objects’ begin life as ‘songs’, as dances, as modulations of the body and the world in their constituent relationships.

http://divisare.com/projects/225062-Frei-Saarinen-Architekten-Martin-Saarinen-Lignum-Pavilion


http://www.freisaarinen.ch/News/News.html


http://www.freisaarinen.ch/News/News.html

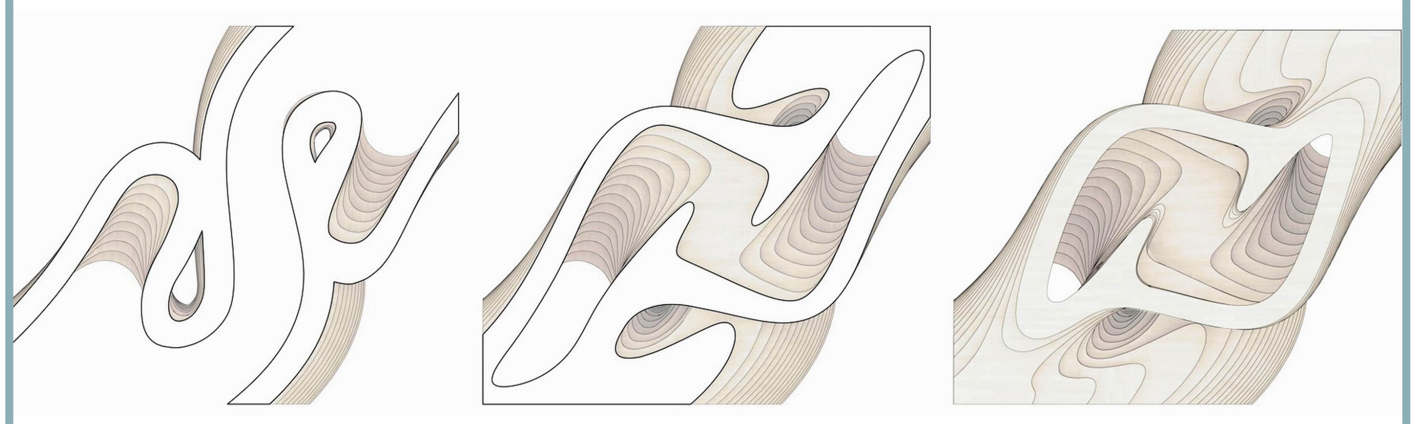

http://www.freisaarinen.ch/News/News.html

LIGNUM PAVILLION

Project FABRICATION

The fully digitalized production process made it possible to optimize both the quantity of material used and the assembly system, resulting in a considerable reduction of costs and making the most of the strength characteristics of wood. The resulting space goes beyond the dichotomy between the interior and exterior, instead acting on their reciprocal and benevolent relationship. In geometric terms, it is the result of the subtraction of a “figure-8 knot” from the original nucleus, which is then sectionedin horizontal layers.

http://www.archdaily.com/274331/lignum-pavilion-frei-saarinen-architekten/



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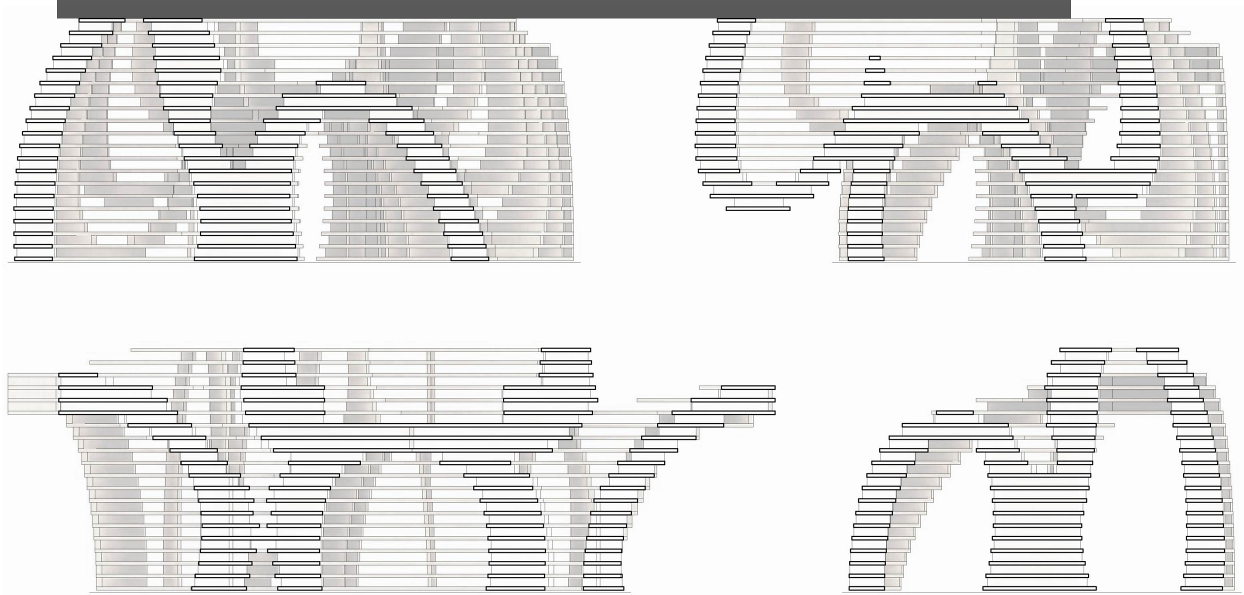
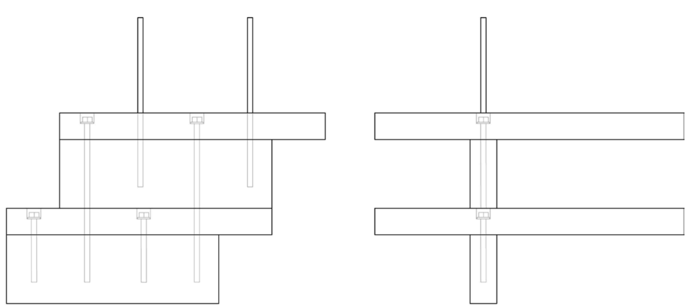
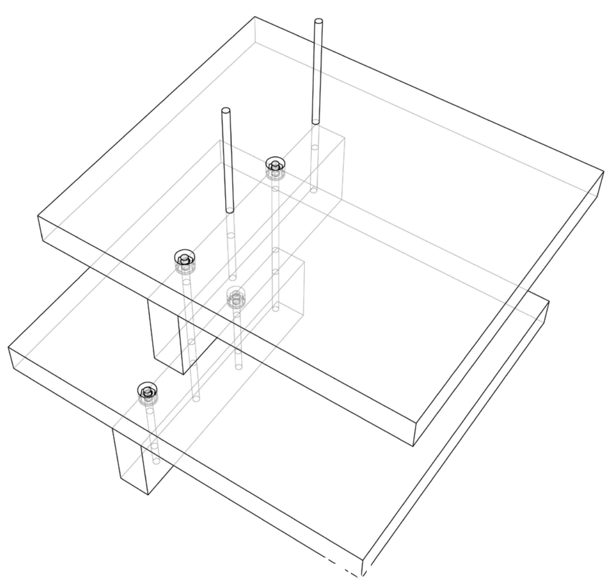
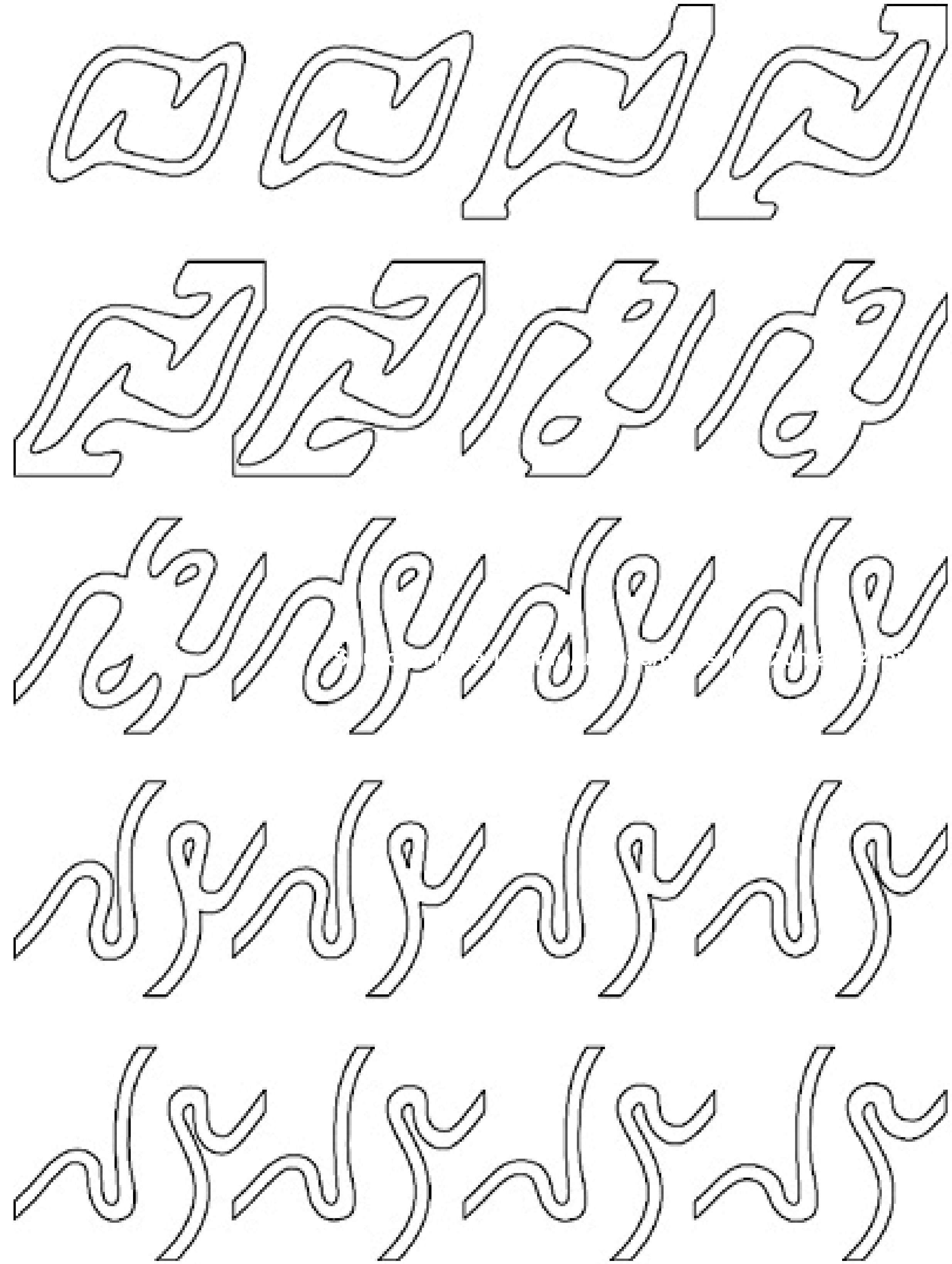
LIGNUM PAVILLI

Project FABRICATION









http://divisare.com/projects/225062-Frei-Saarinen-Architekten-Martin-Saarinen-Lignum-Pavilion

LIGNUM PAVILLION

Project MATERIALS

Lignum Pavilion Quantity Survey		
wood		
	Material	**Quantity**
main sheets 3x2m	300x200x5	541 (8t)
uprights	130mm high	841
metal		
nails	20cm	
total cost		**114 400e**

http://www.archdaily.com/274331/lignum-pavilion-frei-saarinen-architekten/

LIGNUM PAVILLION

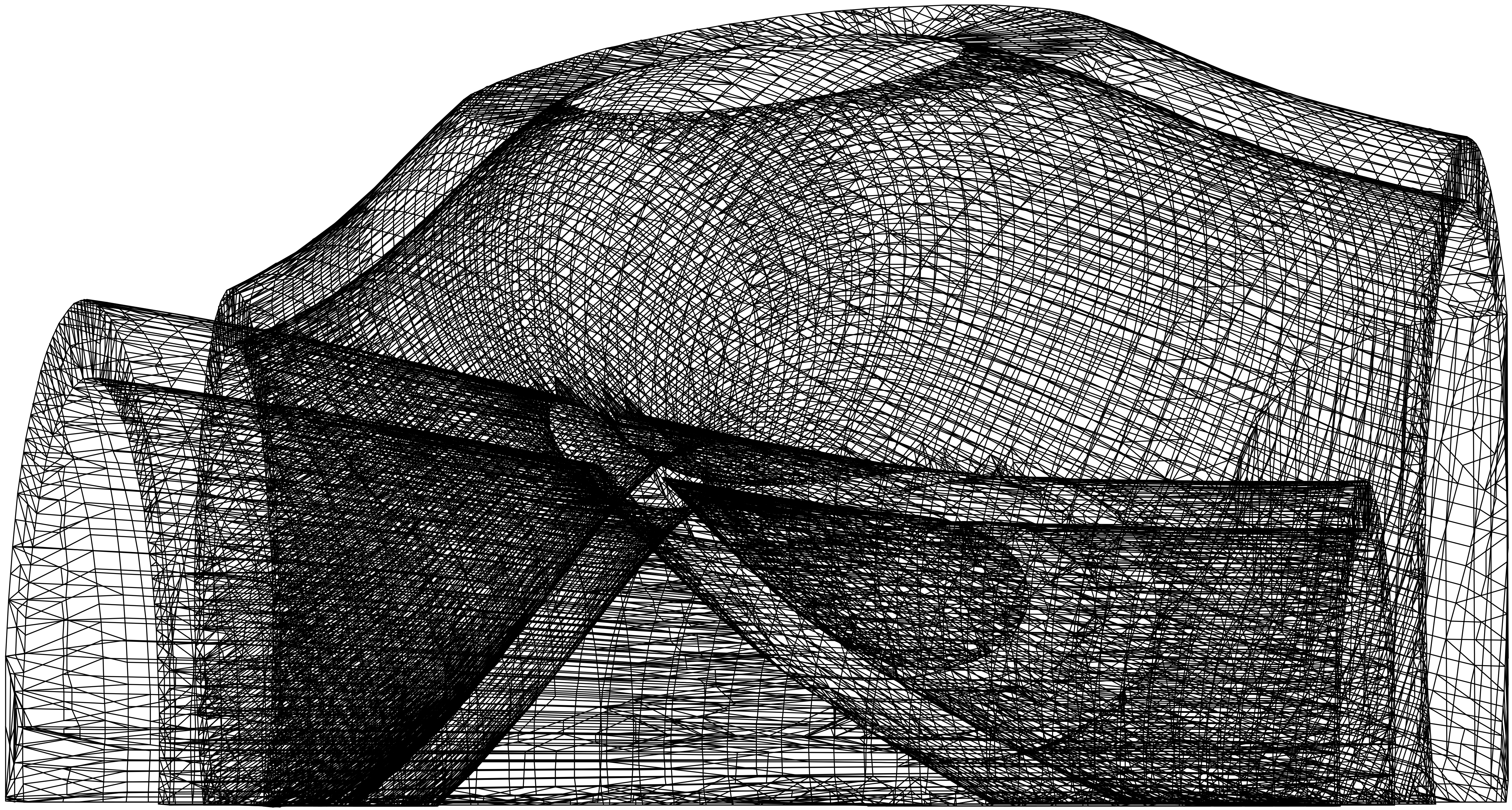
Project MACHINE / SOFTWARE

The pavilion was conceived as an organism generated by a sequence of layers, consisting of 50 mm thick panels assembled together and braced using 130 mm high uprights. Visitors are guided and accompanied along an architectural promenade of elements which, in addition to demonstrating a certain coherence between the expressive result and the creative and production processes, define and wrap the space, creating a strikingly organic image which springs from the fragmentary nature of the components. 541 different pieces of wood, cut by a CNC mill, were used for total weight of 8 metric tons. The pavilion will be used approximately 10 times over a period of three years. Instead of fixing elements with glue, prefabricated elements already have their slots for nails and screws. This way, complete construction is much more stable and fixed.

http://divisare.com/projects/225062-Frei-Saarinen-Architekten-Martin-Saari-

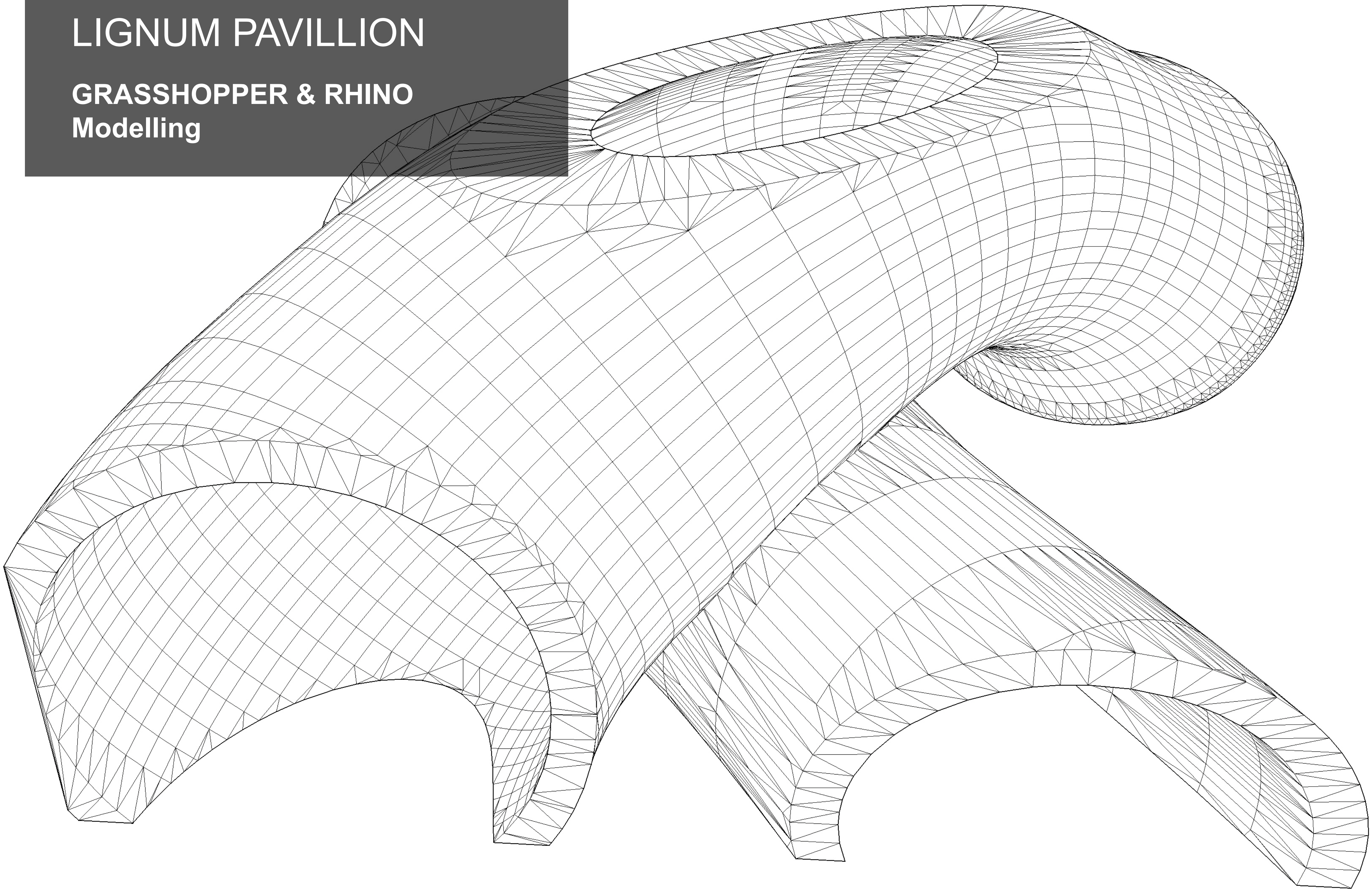
LIGNUM PAVILLION

GRASSHOPPER & RHINO
Modelling



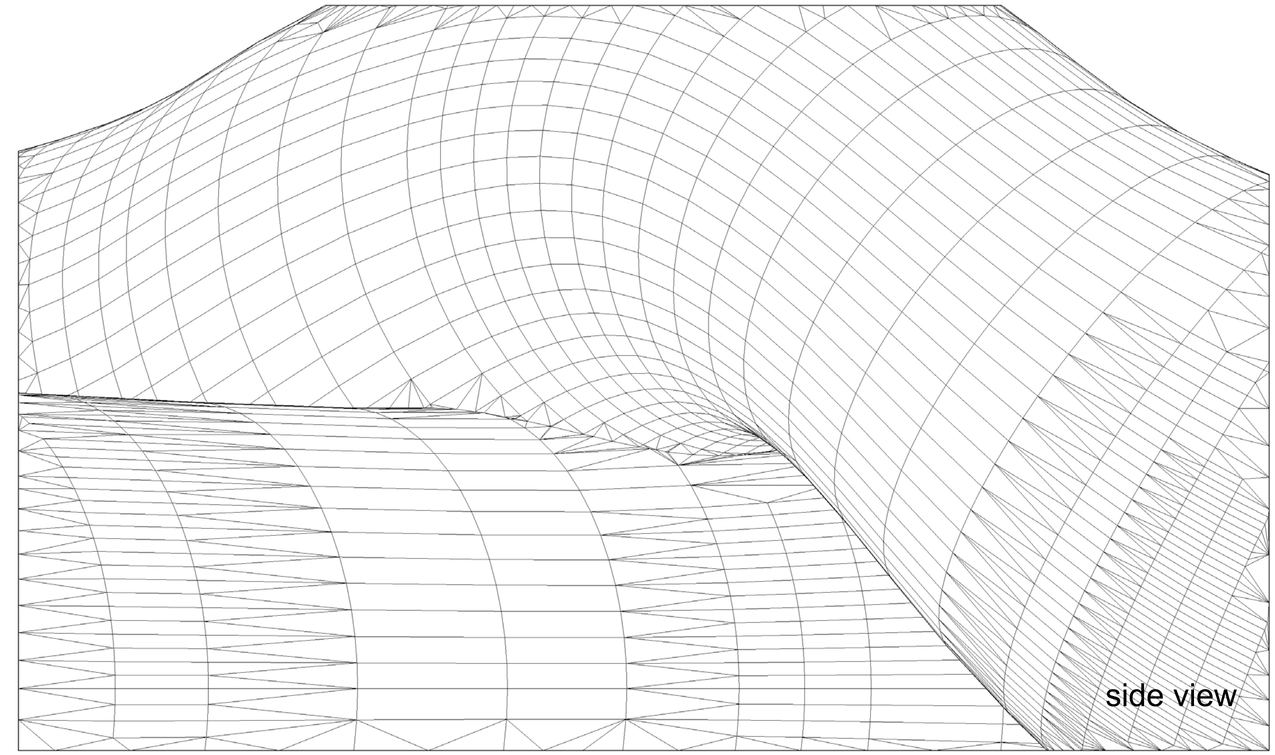
LIGNUM PAVILLION

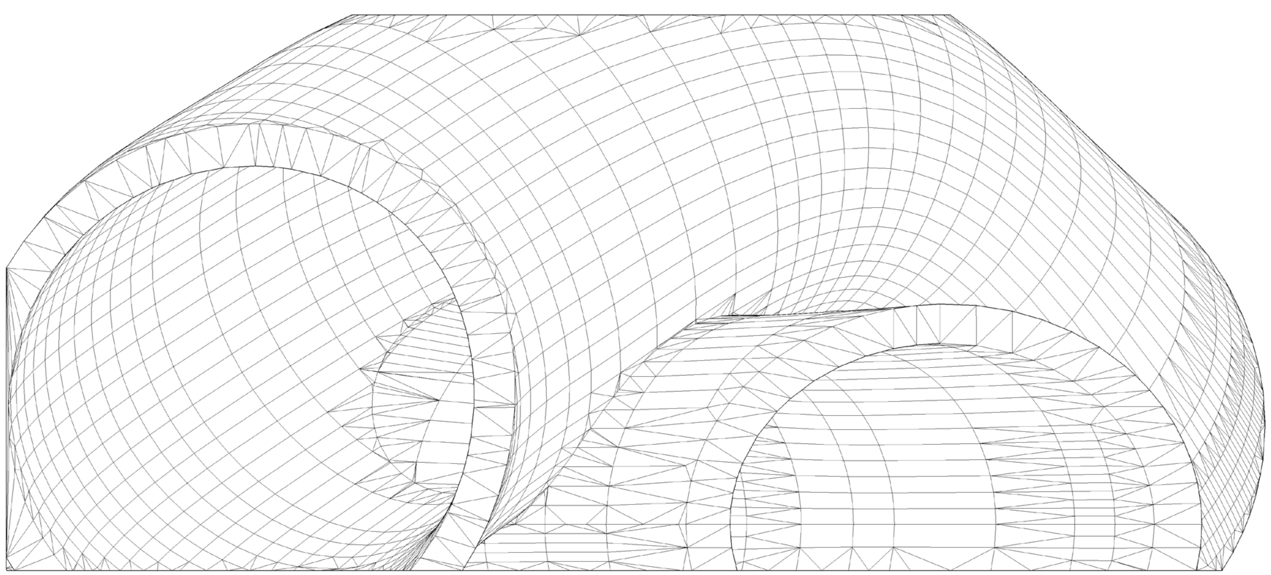
GRASSHOPPER & RHINO
Modelling



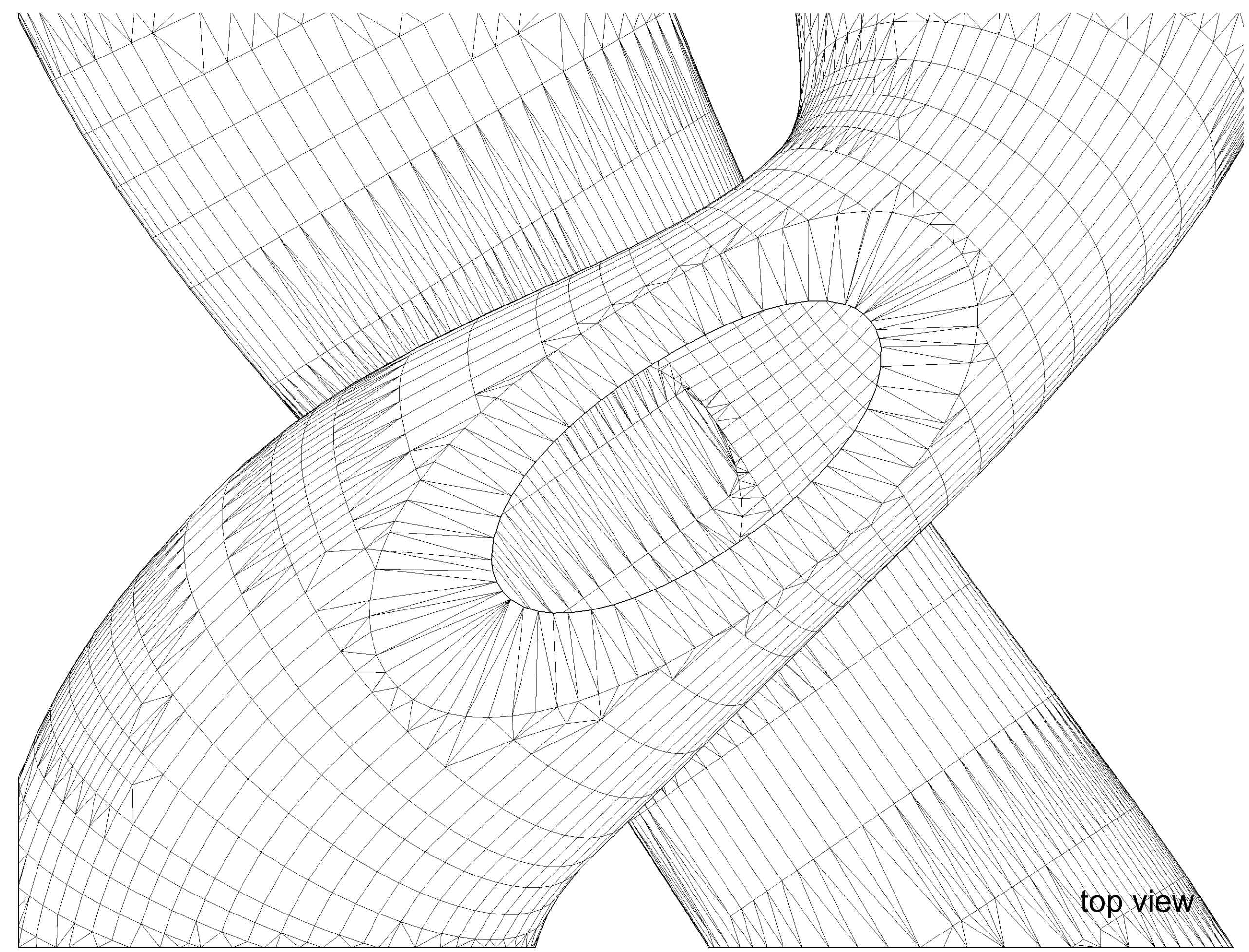
LIGNUM PAVILLION

GRASSHOPPER & RHINO
Modelling





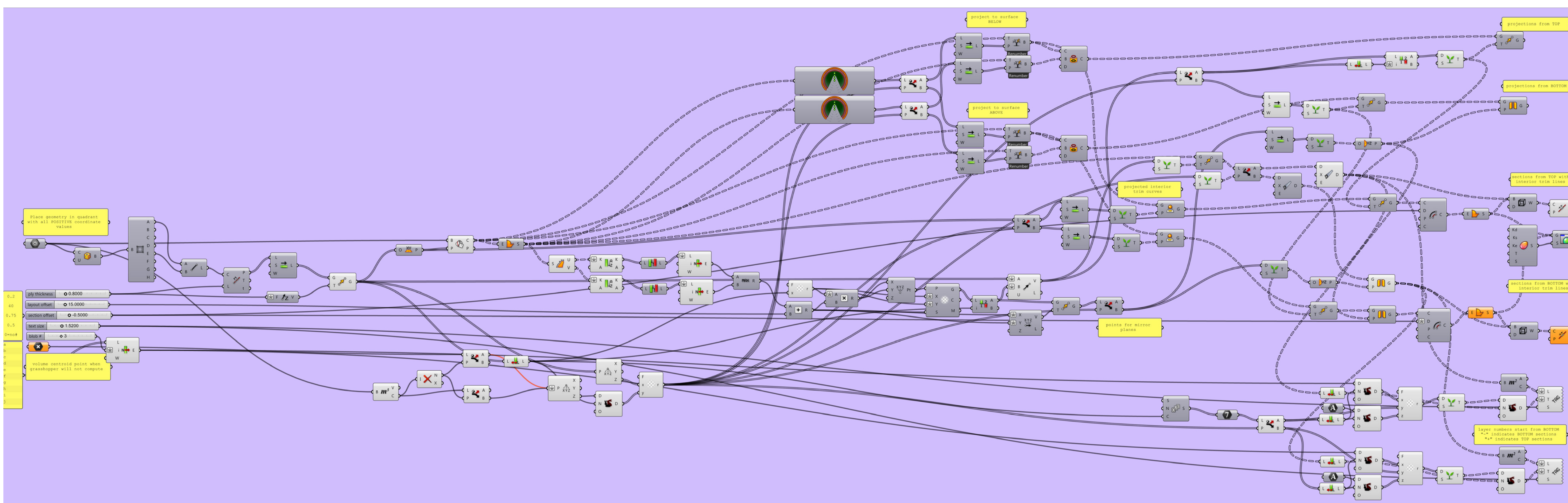
front view



LIGNUM PAVILLION

GRASSHOPPER & RHINO

Script for making horizontal sectioning and preparing for laser cutting machine (in this case CNC machine)



LIGNUM PAVILION

SECTIONING
EKKO PAVILION
THILO FRANK

Aidan Ferriss

Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

EKKO Pavilion

Project OUTLINE

Project Architect / Artist: Thilo Frank

Location: Hjallerup, Denmark

Investor: The Danish Art Council & the Danish Broadcasting Corporation

Function: Pavilion

Construction Year: 2012

Dimmensions: 3m High, 20m Diameter

Construction Team: unknown

Materials Used: Pressure treated wood, Stainless steel wire, Zinc coated steel, Aluminum, Concrete, Microphones

Budget: 250.000 Euro

Major Fabrication Method Used: Radial Sectioning

Fabricated By: (type of machine ie. CNC, Milling, etc)

Type Of Construction: Wood Frame

Modelling Software: Rhino + Grasshopper

Source: http://www.archilovers.com/projects/89540/ekko.html

EKKO Pavilion

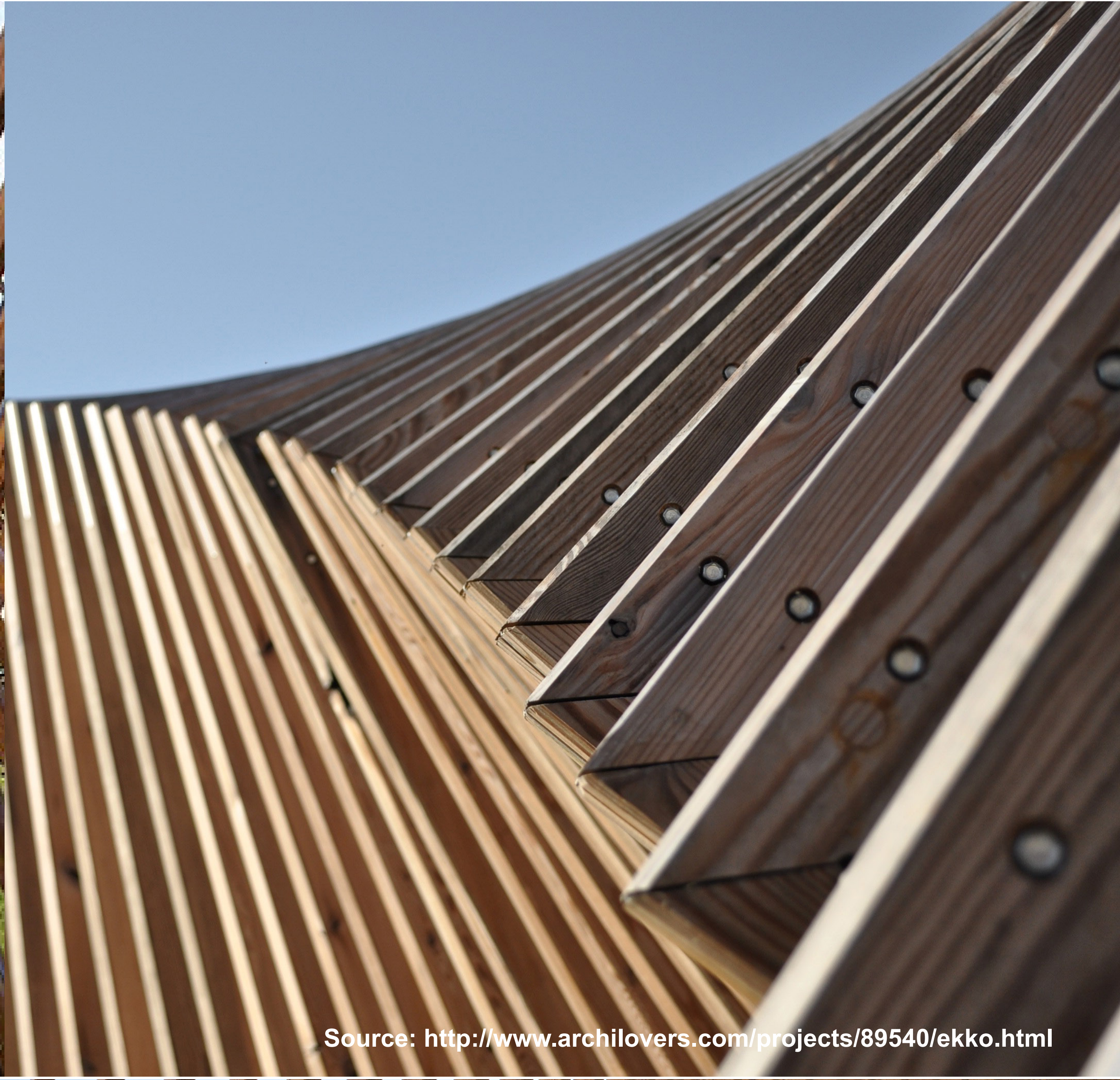
Project DESCRIPTION

EKKO, by Thilo Frank is a permanent wooden pavilion in Hjallerup, Denmark. It is composed of 200 rectilinear wooden frames revolving once around their own axes around a circular concrete path. This inner form is surrounded by a fencelike structure also consisting of another 200 wooden poles.

While the visitor explores the three-dimensional site built-in microphones pick up their sounds and a computer system filters and remixes the recorded sound and sends it to built-in electrodynamic resonators. Each visitor will experience a different musical experience tailored to how they are interacting with the pavilion. The pavilion is an instrument to be played and experimented with.

Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/


Source: http://inhabitat.com/ekko-pavilion-records-visitors-voices-and-footsteps-while-filtering-sunlight-in-denmark/


Source: http://www.archilovers.com/projects/89540/ekko.html


Source: http://www.archilovers.com/projects/89540/ekko.html

EKKO Pavilion

Project FABRICATION

EKKO Pavilion utilizes traditional wood framing techniques as well as poured concrete and a metal framework with hangers for the wood frame to tie into.

The site was first prepared for construction ensuring a level. A steel form was then created for for the concrete pathway to be poured into. Attached to this formwork are metal hangers which will allow the wood frame to be attached to the metal frame. The concrete was then poured and allowed to set. Folowing this, the wooden structure is constructed one frame at a time and attached to the metal frame. The surrounding fence is then added. Finally, the landscape is filled in around the site.

Source: http://inhabitat.com/ekko-pavilion-records-visitors-voices-and-footsteps-while-filtering-sunlight-in-denmark/

EKKO Pavilion

Project FABRICATION

EKKO Pavilion

Project MATERIALS

EKKO Pavilion Quantity Survey		
Lumber		
	Material	**Quantity**
Surrounding “fence”	78x98, 3M	200
Main structure	78x98, 2.5M	800
Concrete		
Pathway		$12M^3$
Metal Hangers		
“Fence” hangers		200
Stainless Steel Wire		
Wire	3x60-80M	200M

Source: http://www.archilovers.com/projects/89540/ekko.html

EKKO Pavilion

Project MACHINE / SOFTWARE

This project required for all of the lumber to be cut using a CNC machine.

There are numerous CNC manufacturers who produce machines which would be suitable for this project, however, this project would require a mill CNC or a wood router CNC machine. Both of these types of CNC machines would be able to cut the wood properly.

Mill CNC

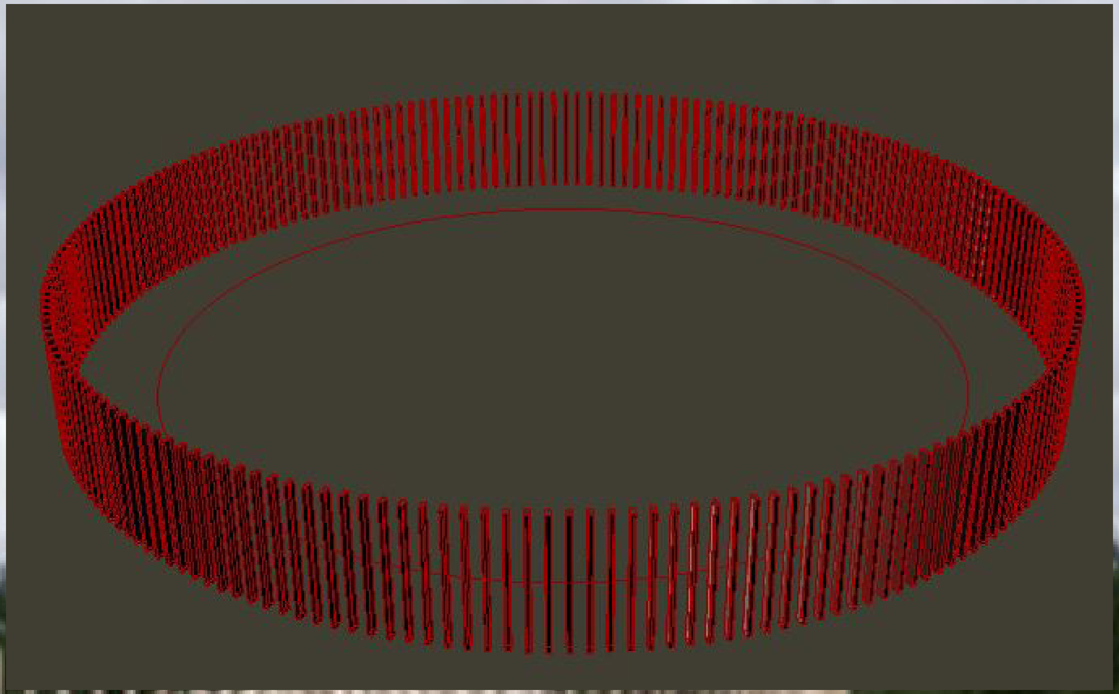
Wood Router CNC

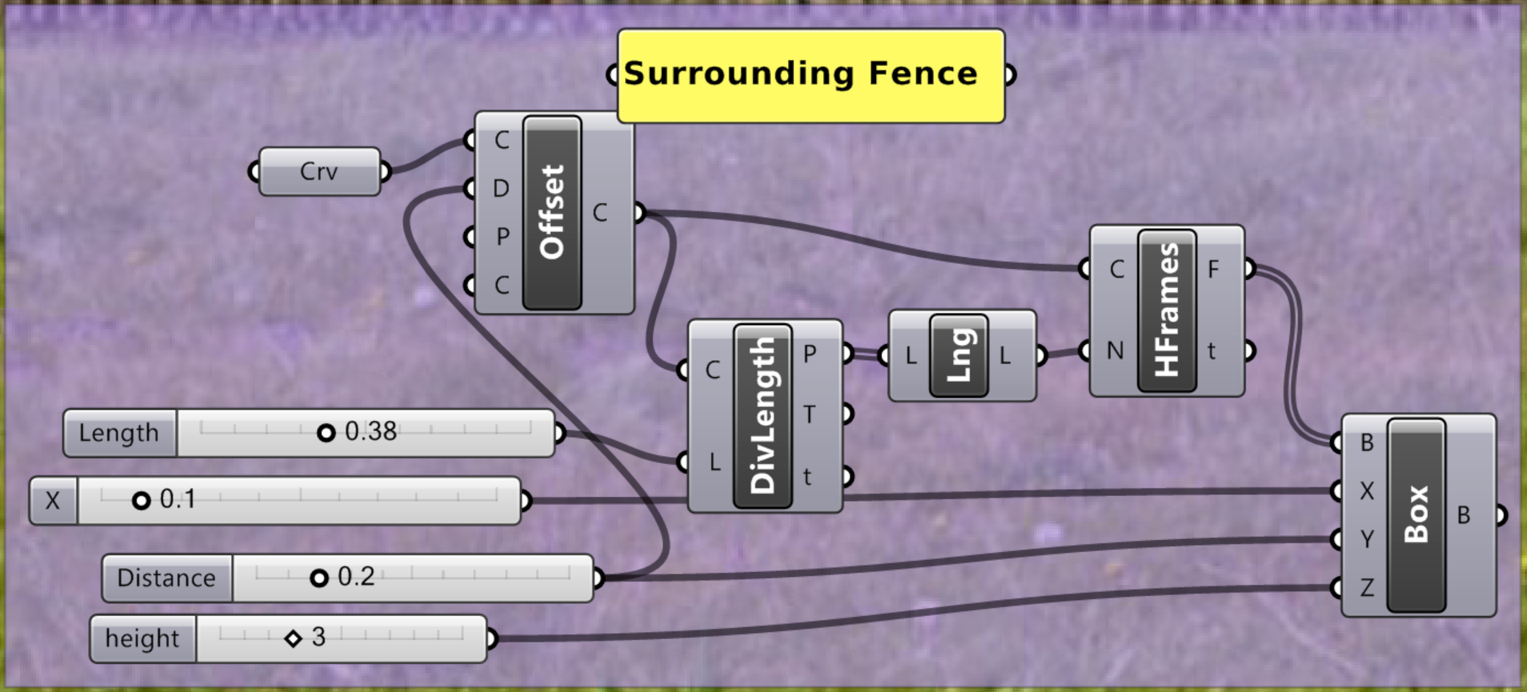
Source: taiwantrade.com/tw

EKKO Pavilion

GRASSHOPPER

Modelling - Surrounding Fence



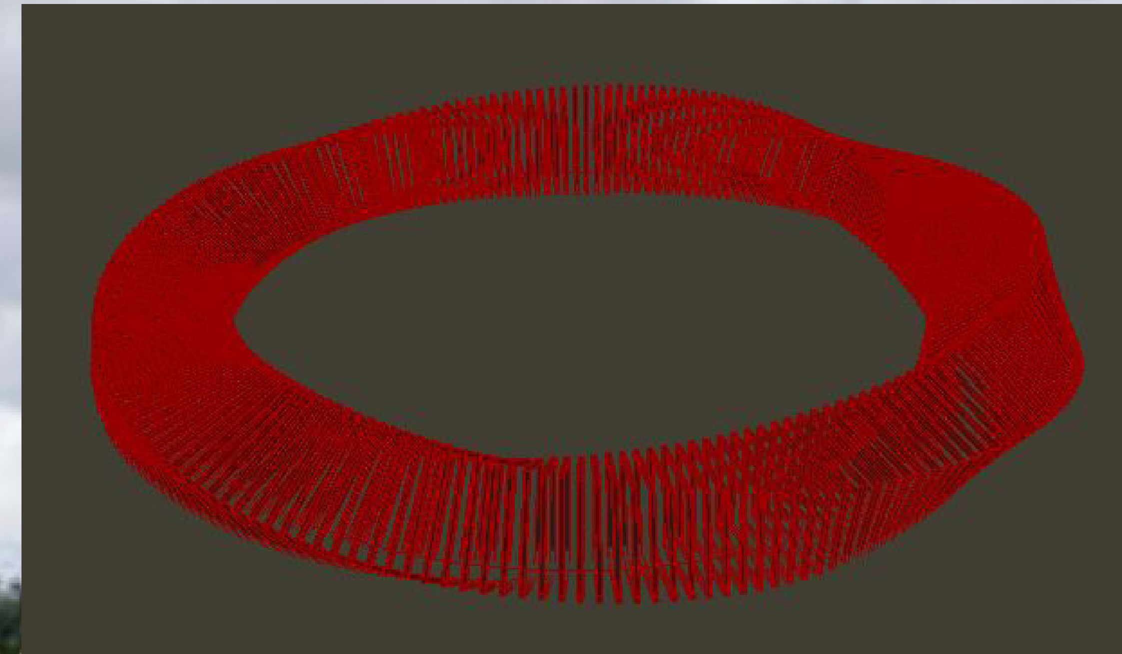


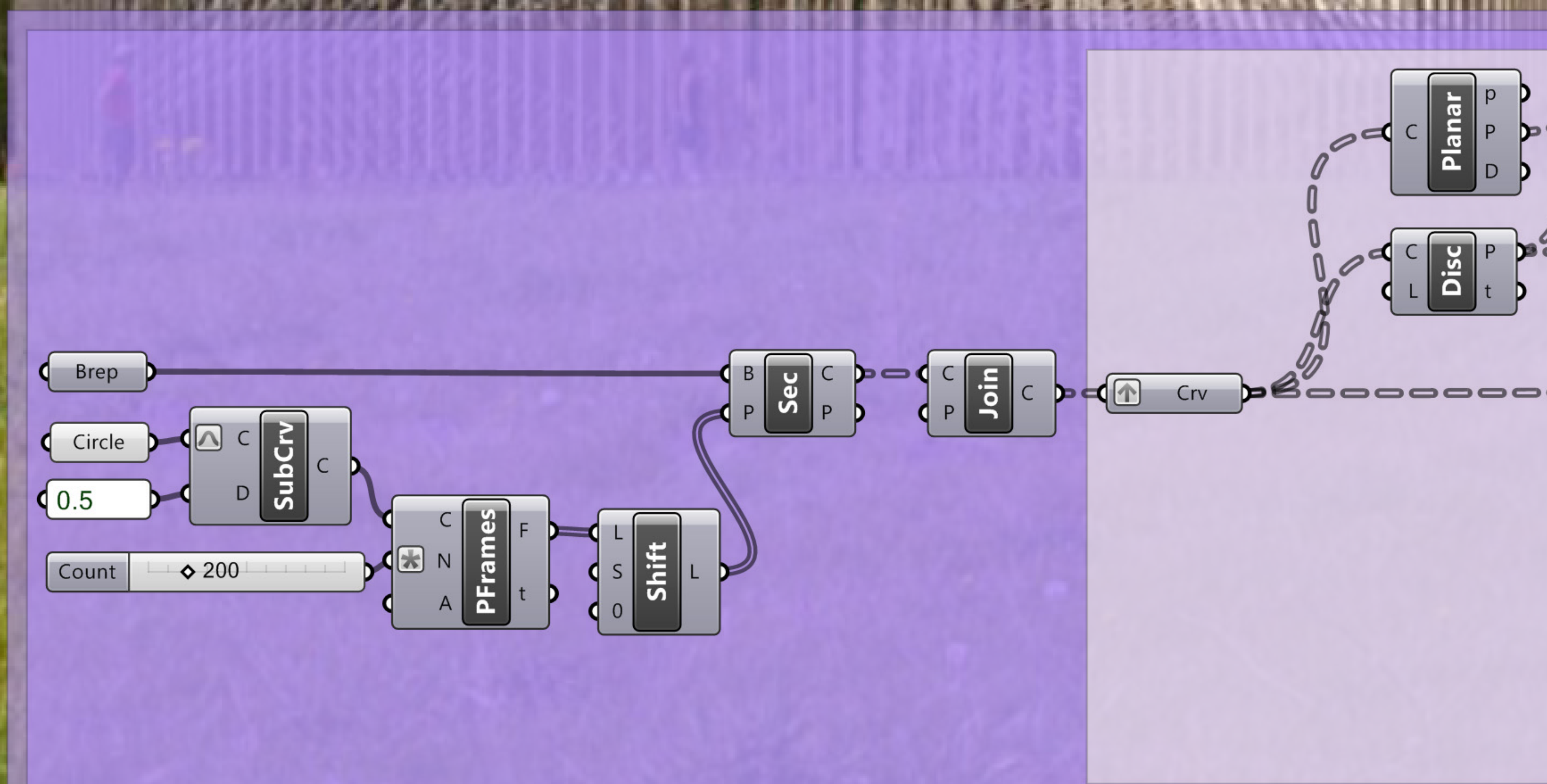
Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

EKKO Pavilion

GRASSHOPPER

Modelling - Main Structure



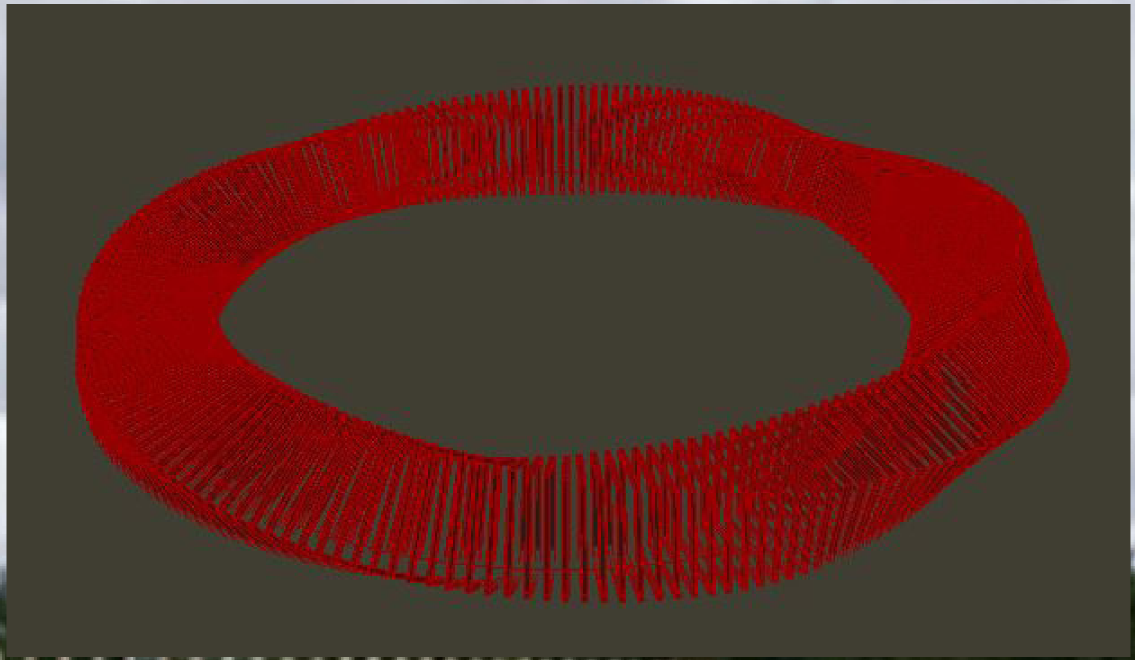


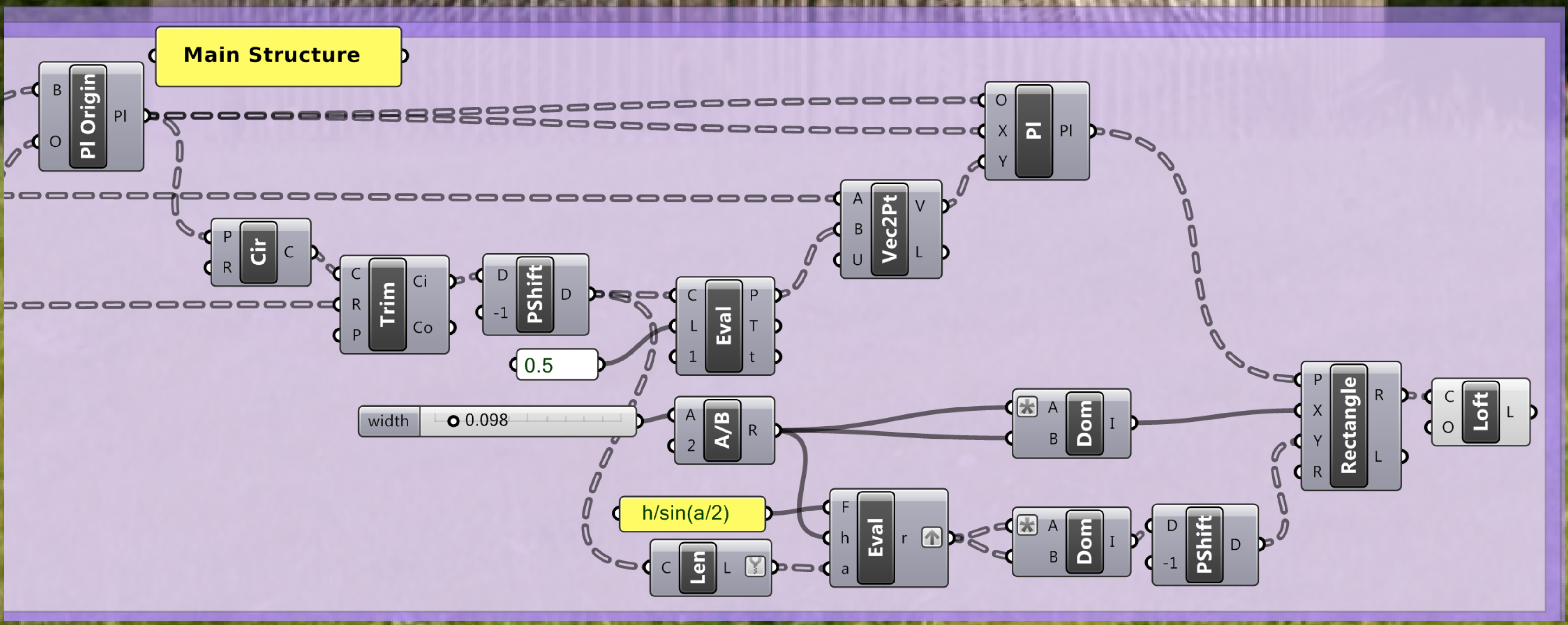
Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

EKKO Pavilion

GRASSHOPPER

Modelling - Main Structure



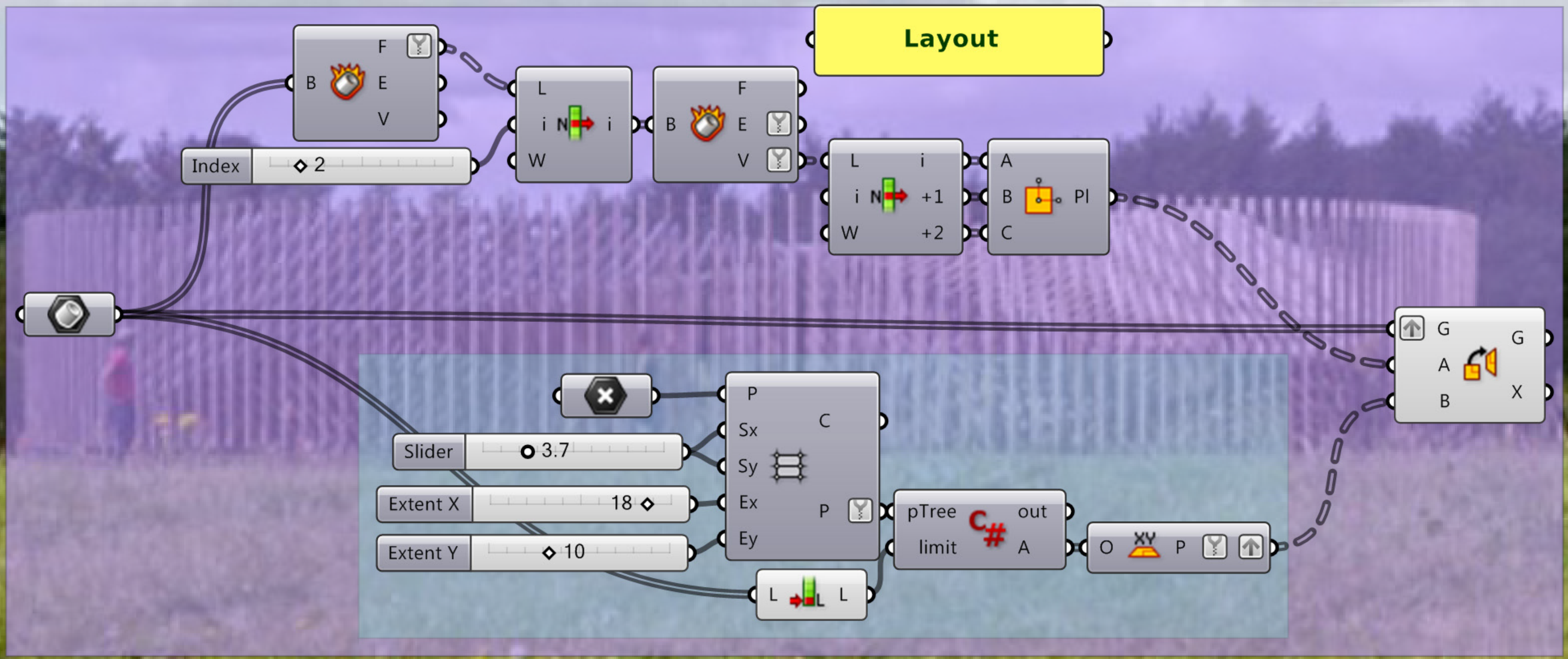


Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

EKKO Pavilion

GRASSHOPPER

Fabrication Definition



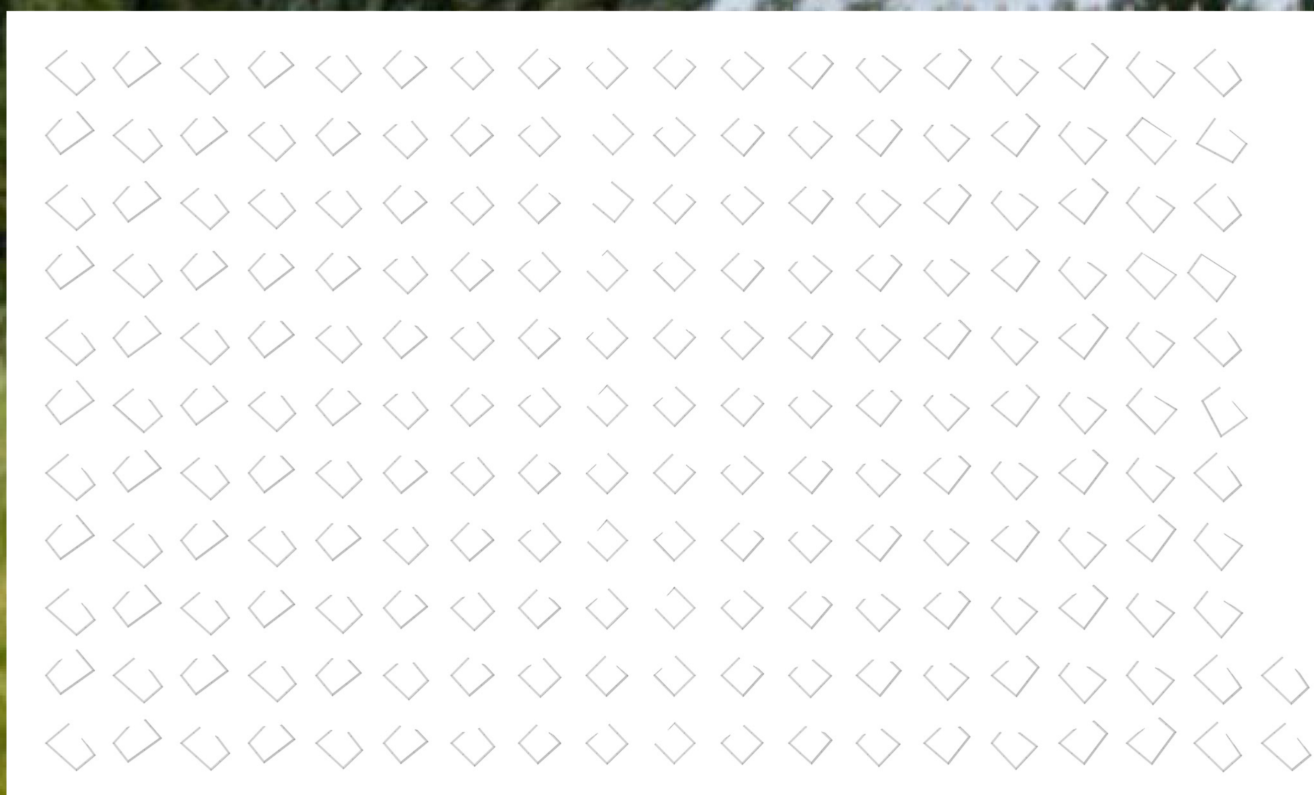
Full Layout for Fabrication

Detailed Layout for Fabrication

Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

EKKO Pavilion

GRASSHOPPER
Fabrication Definition



Full Layout for Fabrication

Detailed Layout for Fabrication

Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

EKKO Pavilion

Source: http://inhabitat.com/ekko-pavilion-records-visitors-voices-and-foots-teps-while-filtering-sunlight-in-denmark/

Source: http://www.s-hamacher.de/de/artproduction/thilo-frank-ekko-2012.html

Source: http://inhabitat.com/ekko-pavilion-records-visitors-voices-and-foots-teps-while-filtering-sunlight-in-denmark/

SECTIONING
CUSTORE PAVILION

Anna Dobek + Mateusz Wojcicki

Ola Damilola

http://www.archdaily.com/[illegible]/custore-pavilion-anna-dobek-mateusz-wojcicki/

CUSTORE Pavilion

Project OUTLINE

Project Architect / Artist: Anna Dobek
Mateusz Wojcicki

Location: Złote Tarasy Shopping Centre , Warsaw
Poland

Investor: Circus Digitalis Group

Function: Pavilion and Store

Construction Year: 2012/2013

Dimmensions: 5 x 4 x 3.6 Metres

Construction Team: xxxx

Materials Used: Birch Plywood and Beech Wood

Budget: xxxx

Major Fabrication Method Used: Horizontal Sectioning

Secondary Fabrication Methods: XXXXXXXXXX

Fabricated By: CNC Machine

Type Of Construction: Wood Frame

Modelling Software: Rhinoceros + Grasshopper
AutoCAD

http://www.archdaily.com/370542/custore-pavilion-anna-dobek-mateusz-wojcicki/

CUSTORE Pavilion

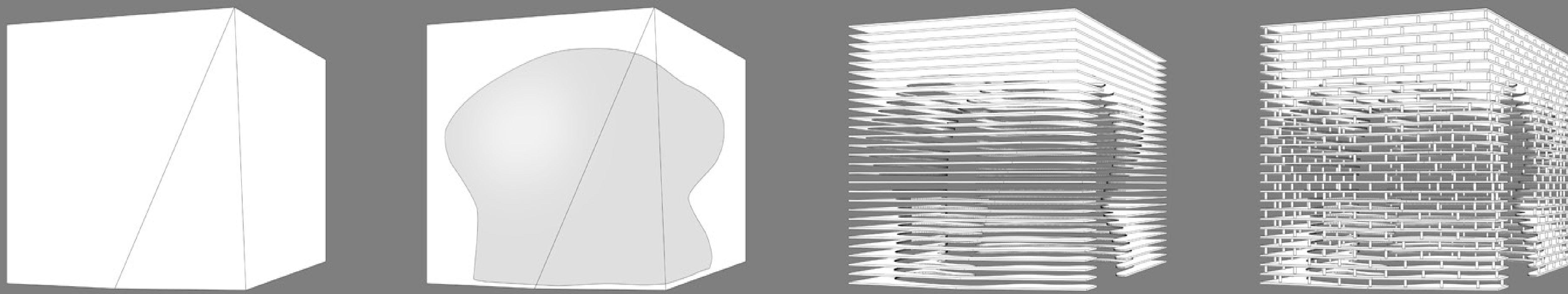
Project DESCRIPTION

CUSTORE, an expertmental project, a pavillion that uses parametric architecture in making a commercial market.
The design process was a result of dealing with computer generated forms and the aesthetic problems associated with building/executing the project in a commercial building. The main material used was Plywood and it was manufactued in Poland. Beachwood was also used for it's anchor sleeves and also mounting screws where used.
The brief was to create a pavilion with partial visual isolation while still being open to the surrounding space. The concept then was to create a transclucent barrier with a strongly defined geometrical exterior and a soft fluidlike interior. Inside the pavillion was located an information point and 4 stands with touchscreen monitors.
The design process required an arrangement of work to make modifications possible at any stage Rhinoceros and Grasshopper were used to genrate the algorithm and then AutoCAD was used to add soome missing drill holes to connect the thimbles which provided vertical joining of the structure. The structure was then cut into profiles which was converted into a format readable by a CNC machine which milled the parts.
One of the key objectives also was the possibility of re-assembling and transporting. The prototype installation had to be dismantled and re-assembled again with target modules. This process allowed for the structural stability to be tested and also for corrections which also had a big impact on the final form of the pavillion.

http://www.archdaily.com/370542/custore-pavilion-anna-dobek-mateusz-wojcicki/

http://www.archdaily.com/370542/custore-pavilion-anna-dobek-mateusz-wojcicki/

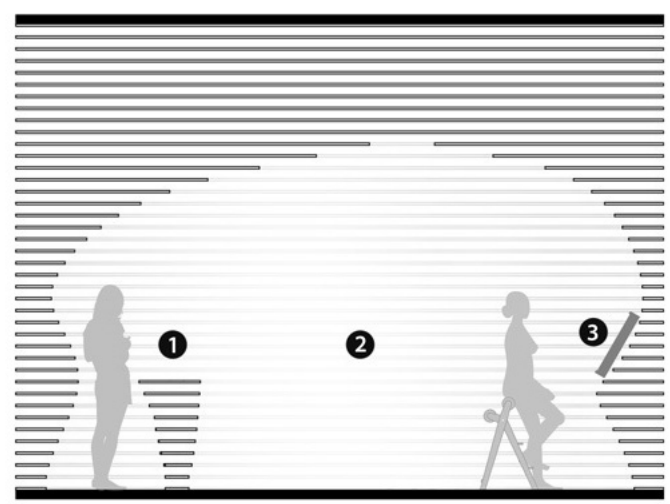
http://www.archdaily.com/370542/custore-pavilion-anna-dobek-mateusz-wojcicki/

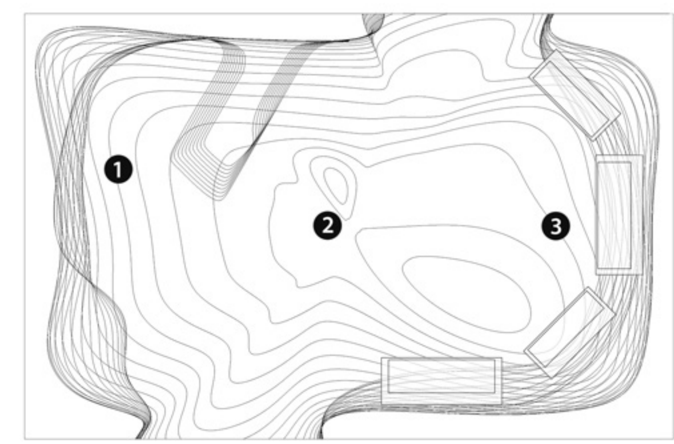


CUSTORE Pavilion

Project FABRICATION

One of the key objectives of the project was the possibility of re-assembling and transporting it by a van. Therefore, the pavilion after the initial prototype installation (with individual components such as sleeves and sections cut by the machine) had to be dismantled back to basic modules that could then be re-assembled again – with target modules. During this process it was possible to test the structural stability and make potential corrections. This process also had a big impact on the final form of the pavilion.





http://www.archdaily.com/370542/custore-pavilion-anna-dobek-mateusz-wojcicki/

CUSTORE Pavilion

Project FABRICATION

http://www.archdaily.com/370542/custore-pavilion-anna-dobek-mateusz-wojcicki/

http://www.archdaily.com/370542/custore-pavilion-anna-dobek-mateusz-wojcicki/

CUSTORE Pavilion

Project MATERIALS

http://www.woodworkerssource.com/beech.html

http://www.woodworkerssource.com/14balpack3.html

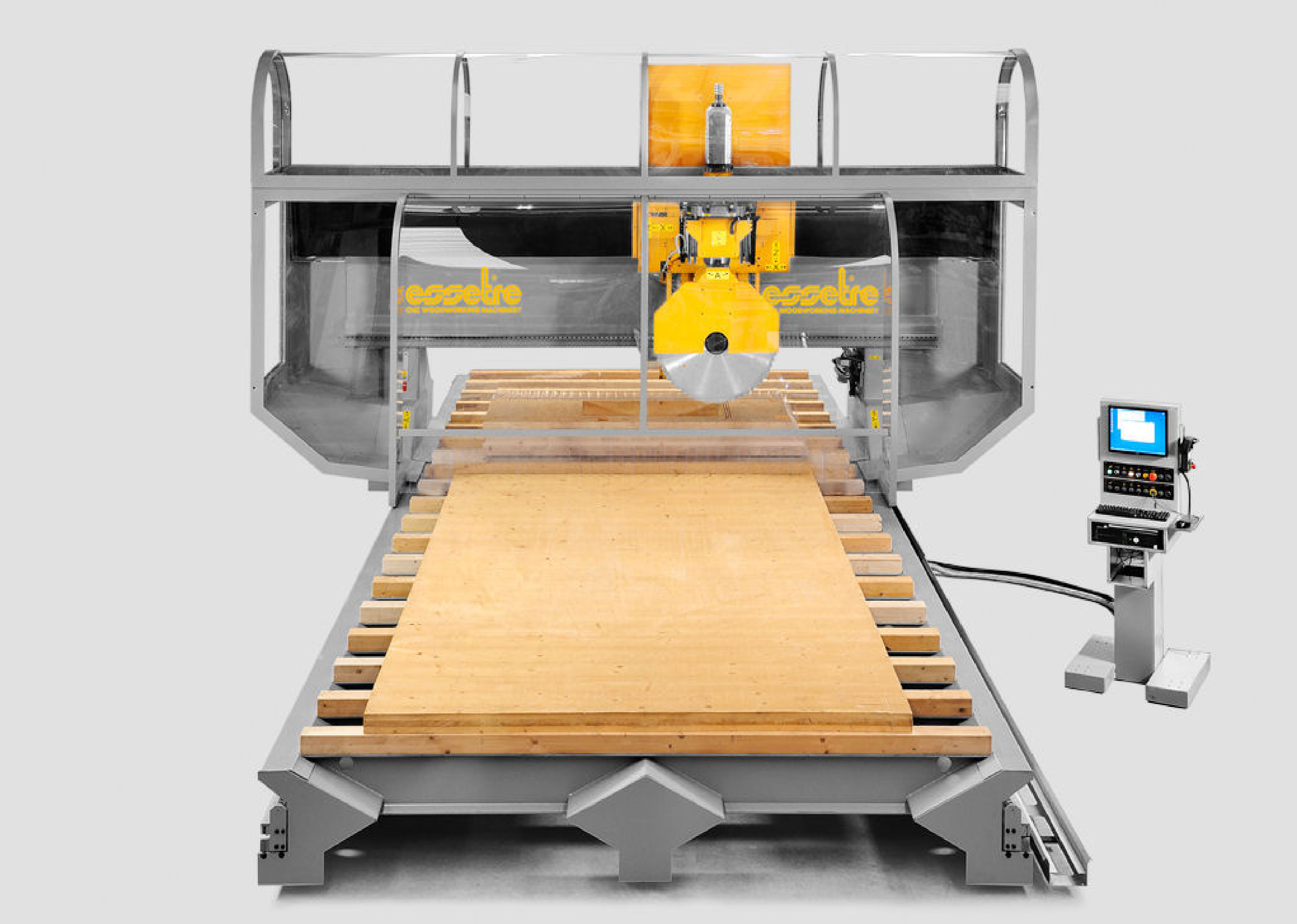
http://www.woodworkerssource.com/beech.html

CUSTORE Pavilion

Project MACHINE / SOFTWARE

TECHNO WALL is a CNC controlled, patented woodworking centre. It can process wall panels in widths of 3000 to 8000 mm (10 ft to 26 ft) wide, thickness up to 400mm (15 3/4”) and, because of its modular structure, unlimited length.

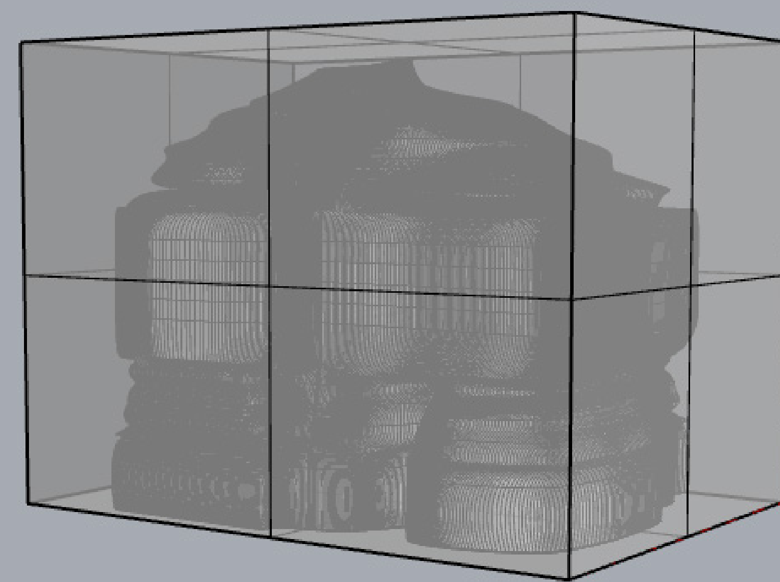
What makes this machine unique is a patented tool holder of exchangeable tools with a permanent saw blade of diameter up to 1000 mm (39”) and a 5-axis tool changer that can host large-dimension tools for processing just about any material.

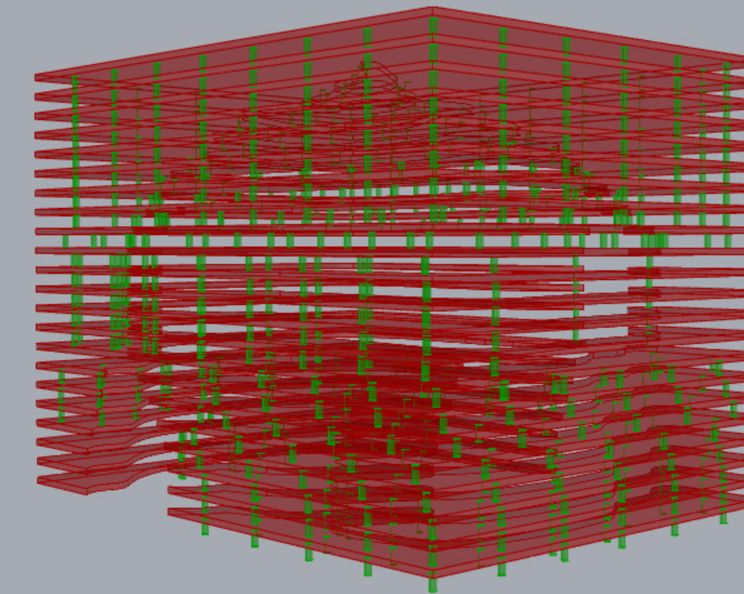


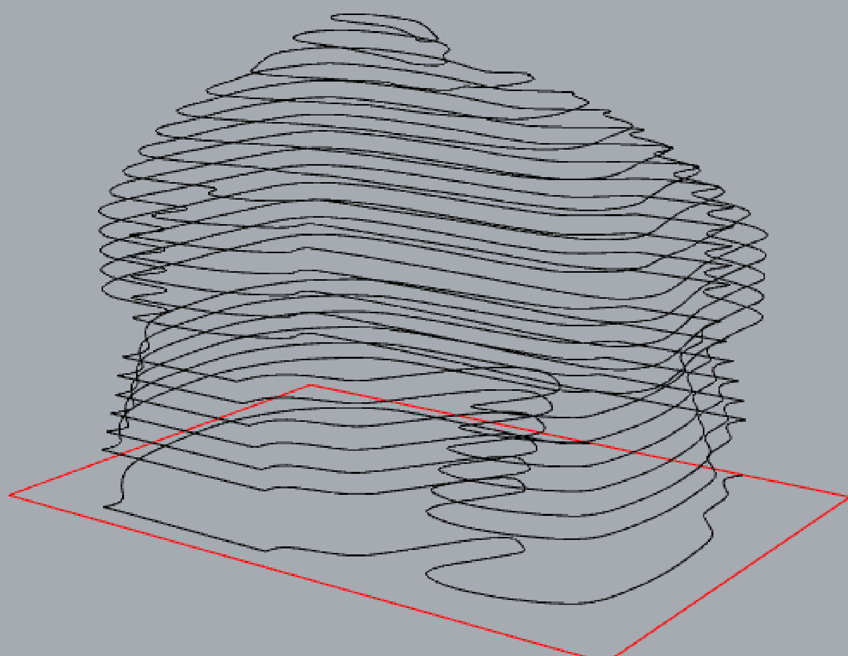
Source: xxxxxxxxxxxxxxxxxxx

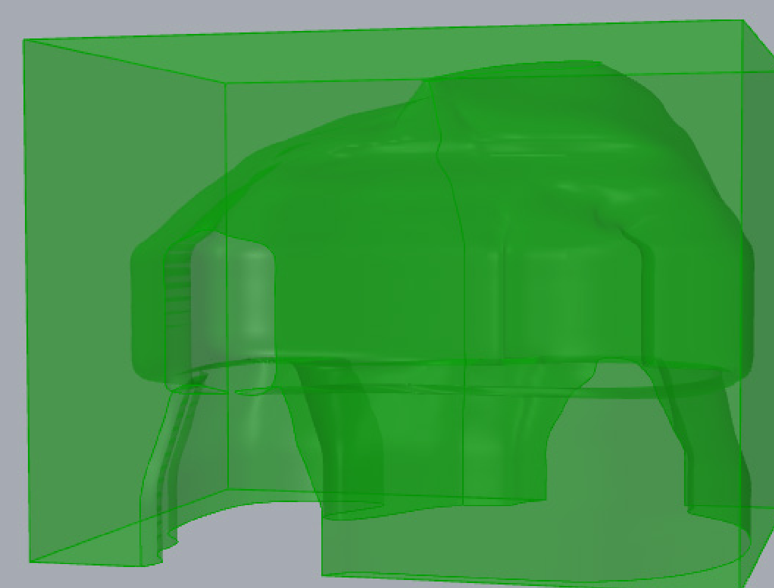
CUSTORE Pavilion

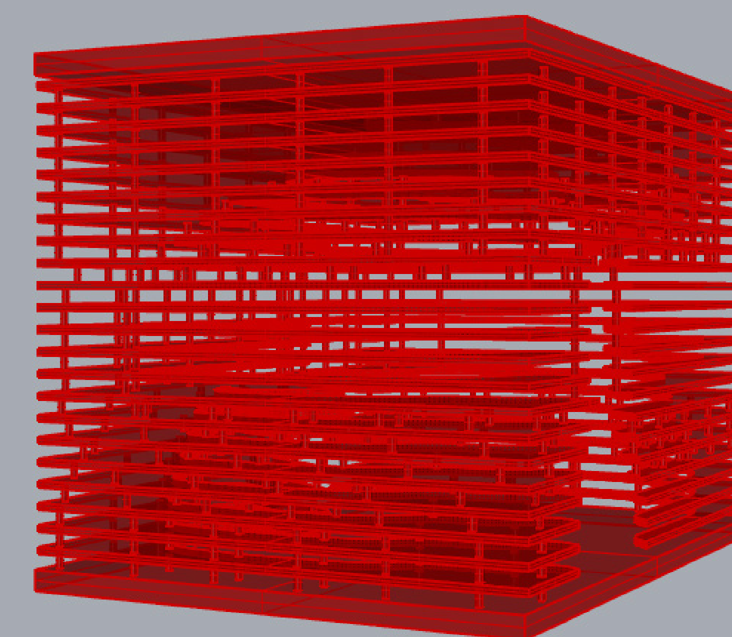
GRASSHOPPER Modelling

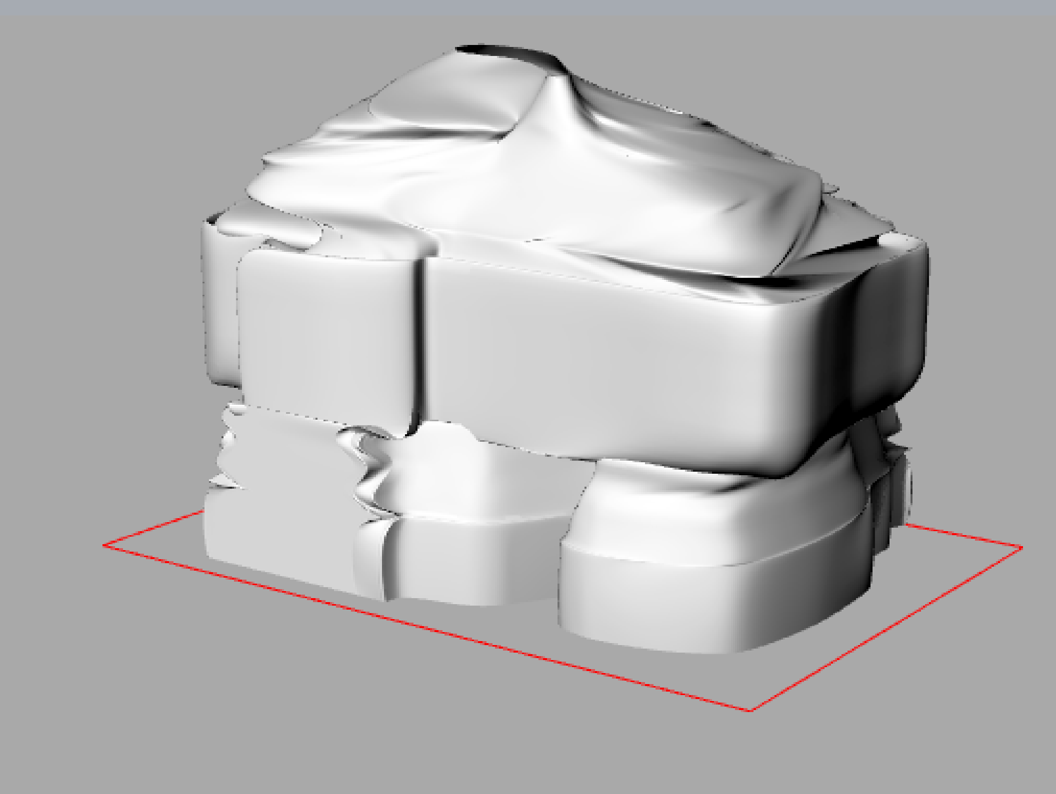


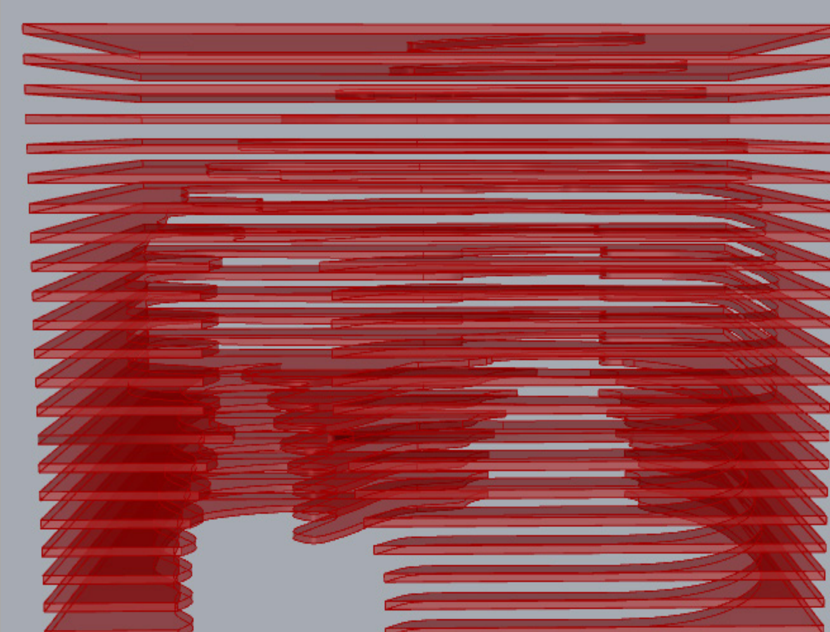


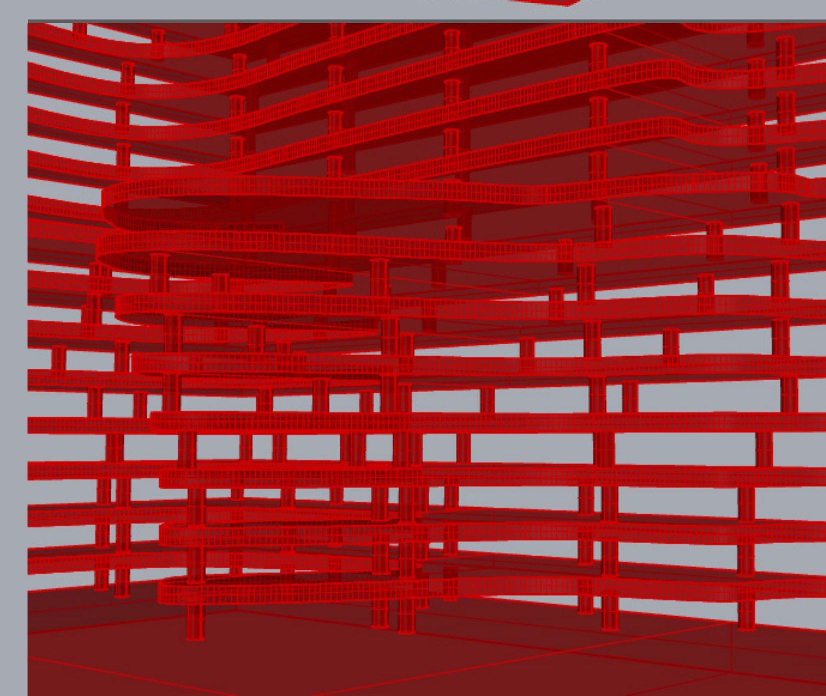








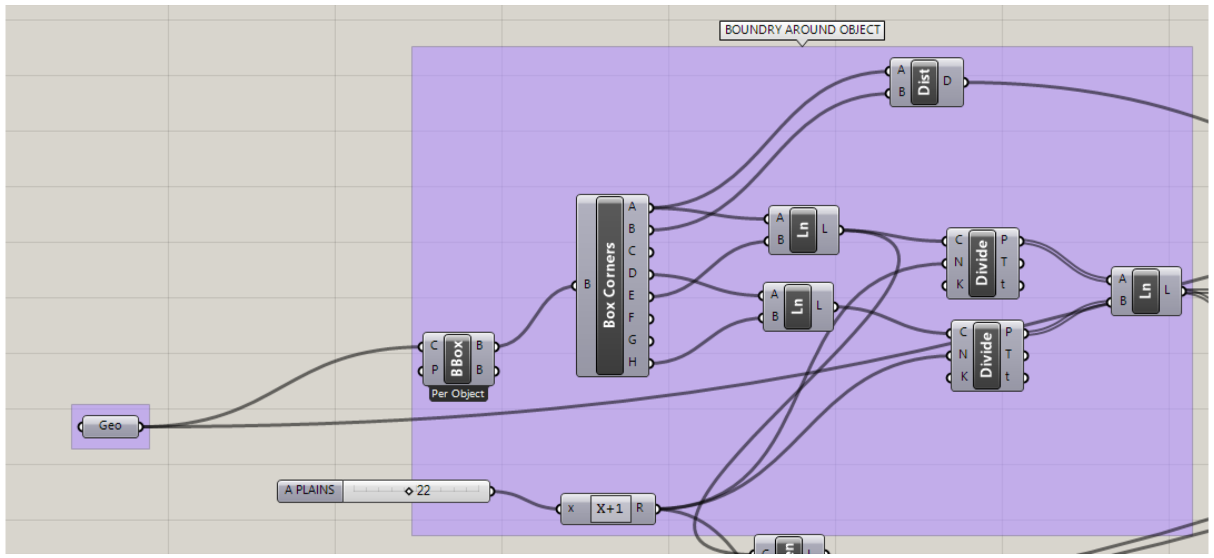




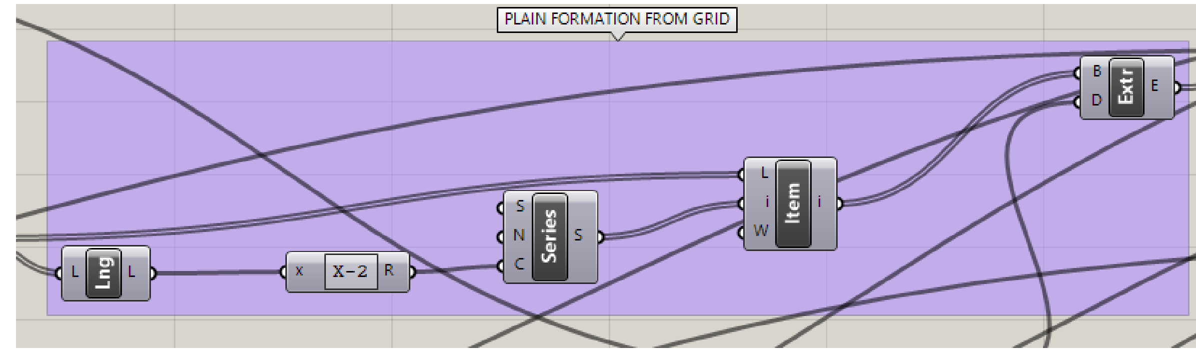
CUSTORE Pavilion

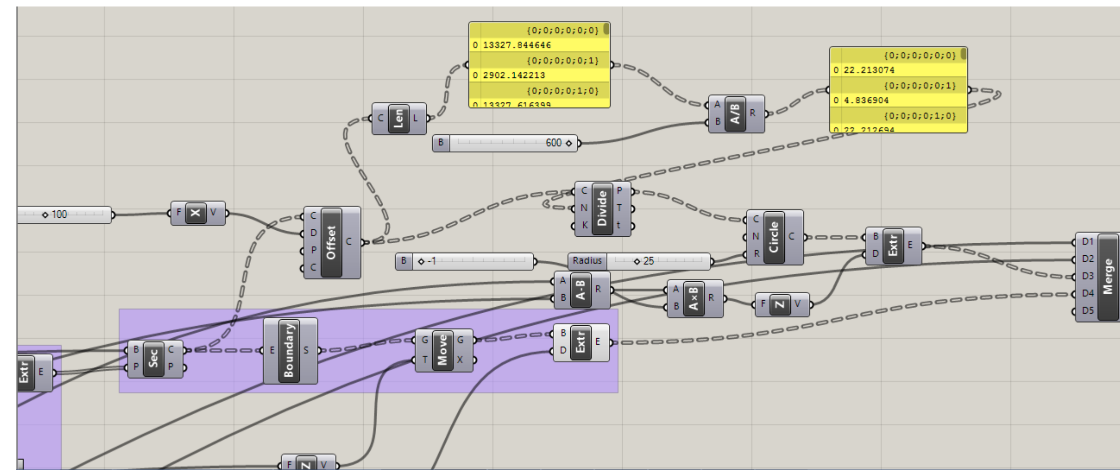
GRASSHOPPER

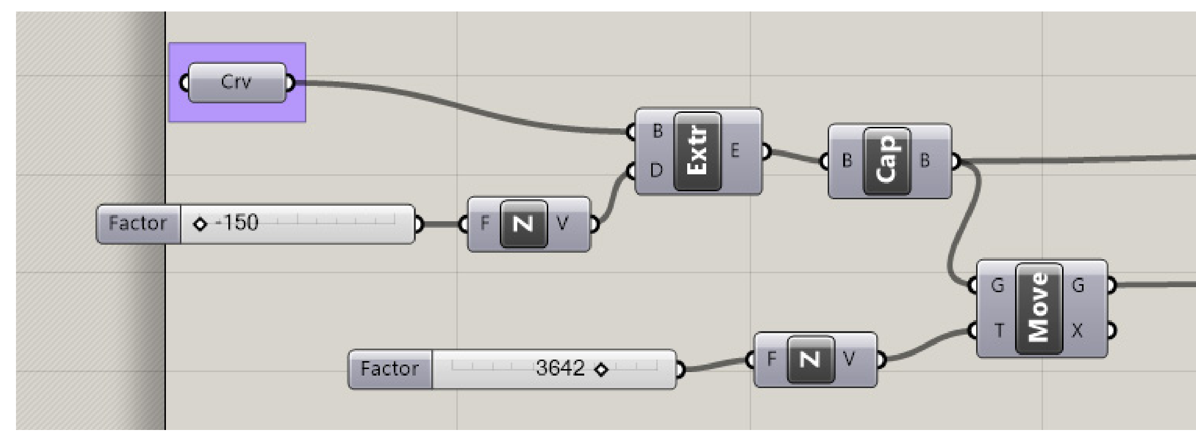
Fabrication Definition

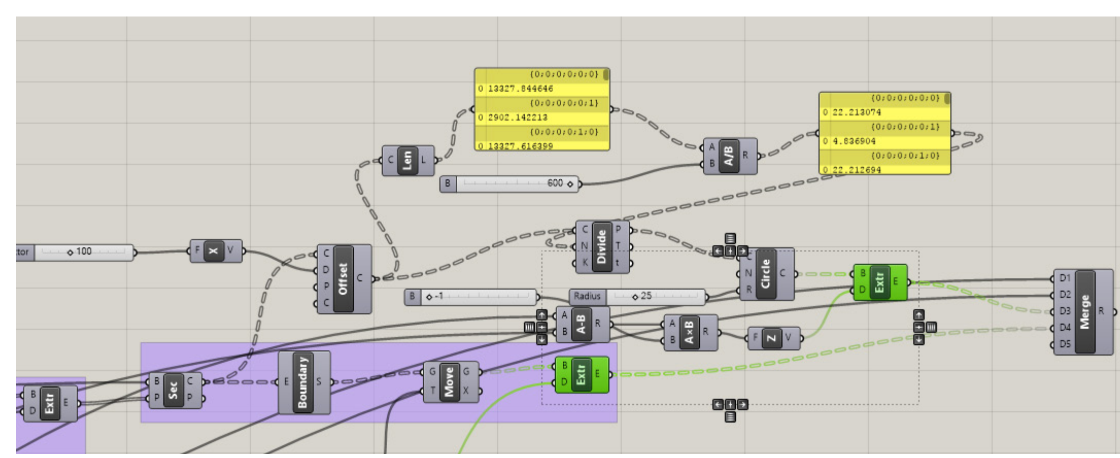


1. Create a Box with dimension 4x5x3.6m
2. Draw a cross section of the interior shape using the horizontal profiles
3. Loft the profiles created
4. Extrude Box and merge with the Loft
5. Cap both ends
6. Trim Openings for doorways out
7. Import Geometry into Grashopper
8. Create a Boundary Box and get Points
9. Make out the plain Horizontal Sections
10. Add a thickness to the sections
11. Divide each curve evenly and array the supports around it
11. Extrude the Horizontal supports
12. Create a curve, extrude and cap to serve as the base
13. Move above to form the roof also
14. Merge Both Caps and the Extrusions.









SECTIONING
FRENCH PAVILION
X - TU ARCHITECTS
SIMON STREZ

Source: http://www.inexhibit.com/wp-content/uploads/2015/02/France-pavilion-expo-2015-inexhibit-09.

FRENCH Pavilion

Project OUTLINE

Project Architect / Artist: X-TU & Atelien Architecture

Location: Milan, Italy

Investor: France Agri Mer

Function: Expo Pavilion 2015

Construction Year: 2015

Dimmensions: 40m W x 62m L x 12.5m H

Construction Team: Simonin Group

Materials Used: Jura Laminated wood, Resix fixings, Concrete,

Budget: 14 Million Euros

Major Fabrication Method Used: Waffle Sectioning

Secondary Fabrication Methods: Vertically sectioned Facade wrapping

Fabricated By: super-high precision digitally controlled robot

Type Of Construction: Epoxy Resin Wood Framing

Modelling Software: Cadwork

Source: http://www.dezeen.com/2015/05/06/france-pavilion-xtu-architects-milan-expo-2015/

FRENCH Pavilion

Project DESCRIPTION

The French pavilion at Expo 2015 was constructed entirely of wood from the Jura massif.
The glue-laminated structure is completely made of French wood: the interior in spruce and the exterior in larch. Every building element from the main and supporting structures and ceiling to the floorboards and façades is made of interlocked pieces forming a single unified edifice that simultaneously outlines the exterior casing and the interior expanse.

It is three storeys high and the ceilings hung with typical agricultural and food products, to recreate an “upside down” version of the land shaped by its farmers.

Inside the pavilion, the public path continues through the pillars supporting the great central vault, offering a wealth of sensory, tactile and olfactory experiences for the user.

Source: http://www.inexhibit.com/wp-content/uploads/2015/02/France-pavilion-expo-2015-inexhibit-10.

Source: http://www.designboom.com/wp-content/uploads/2015/04/

Source: http://www.dezeen.com/2015/05/06/france-pavilion-xtu-architects-mila
po-2015/

Source:http://www.dezeen.com/2015/05/06/france-pavilion-xtu-ar-

FRENCH Pavilion

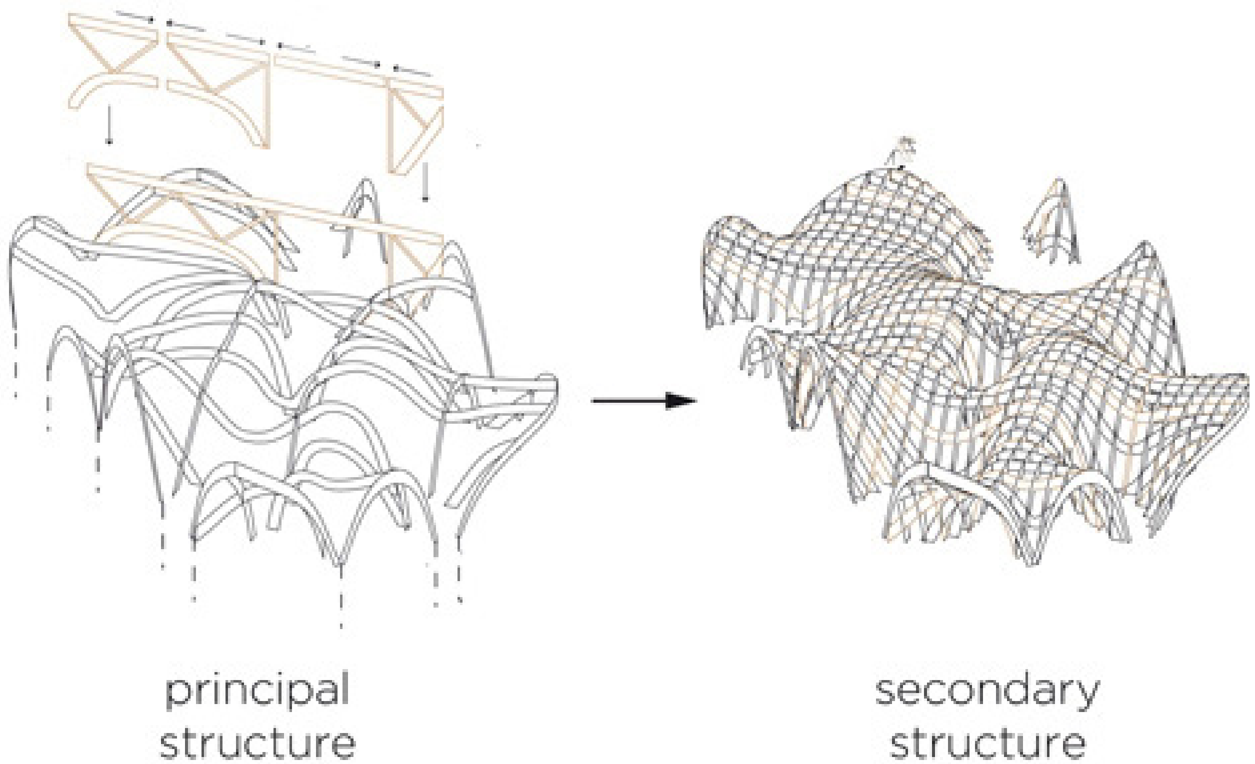
Project FABRICATION

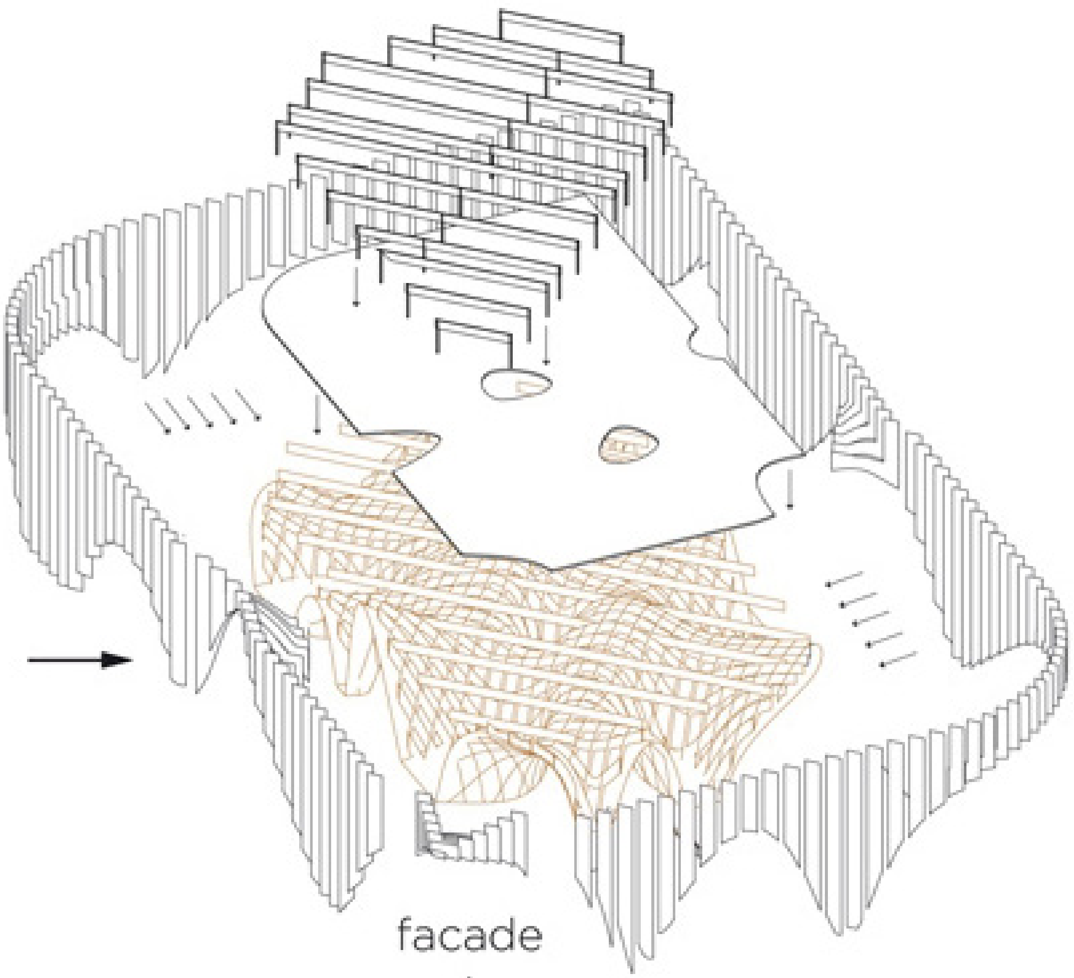
The main structure is made of lattice girders and pillars spaced at 4.5 m and braced by a supporting framework slotted in every 1.5 m. The result is a series of highly uniform right-angle cubicles. The project is ground-breaking because this orthogonal frame is
“cragged” (notched) into uneven shapes called “frees” that create a stunning vault-like effect. The complex geometry of the French Pavilion’s framework creates a roller coaster of curves that demonstrates wood’s ability to mould into unexpected organic contours. Beyond its dramatic form, this pavilion is a showcase for French innovation in wood architecture using fastening systems patented by Résix®.

The Résix® system is a discrete assembly process of high performance. Completely invisible and more resistant than traditional bolted joints.

This system uses three elements:
glulam
high performance epoxy resin
high strength threaded rods

http://www.archello.com/en/project/french-pavilion-ex-





FRENCH Pavilion
Project FABRICATION

Source: https://www.youtube.com/watch?v=qM2RhEa-Q60

Source: https://youtu.be/qM2RhEa-Q60

Source: https://www.youtube.com/watch?v=qM2RhEa-Q60

FRENCH Pavilion

Project MATERIALS

FRENCH Pavilion Quantity Survey		
Lumber		
	Material	**Quantity**
Main structure	Jura laminated	
different Curved	750 pieces	310m^3
Straight pieces	1,139 pieces	284m^3
Surface	172 (larch)	195m^3
Concrete		
Floor slab	In Situ	420m^3
Fixing		
Resix fixing	steel	unattainable

Source: http://www.archi-europe.com/news-2496-may-1-2015-offi-

Source: http://milanexpotours.com/_mamawp/wp-content/

FRENCH Pavilion

Project MATERIALS

FRENCH Pavilion

Project MACHINE / SOFTWARE

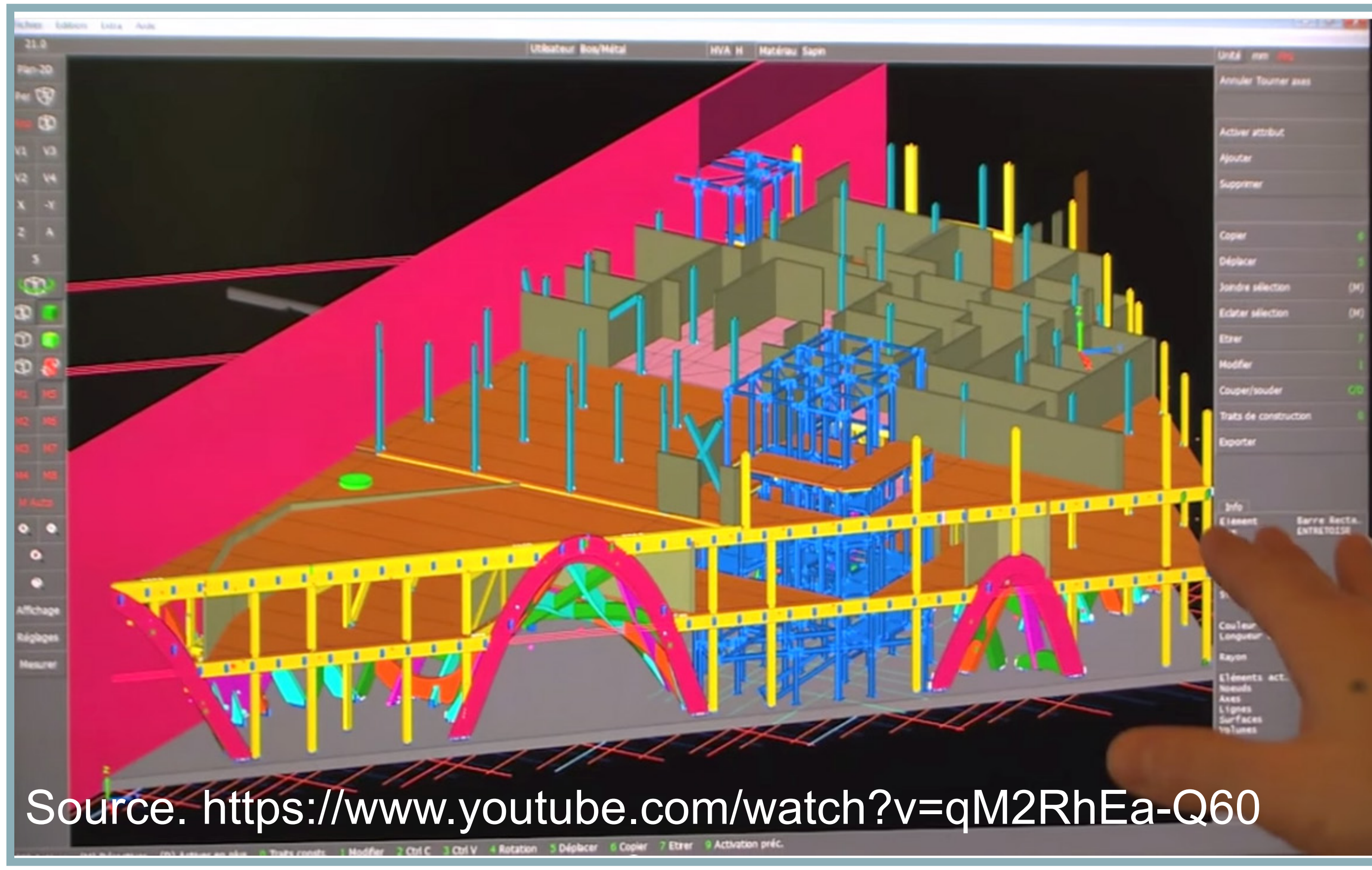
The carpentars Simonin used a super-high precision digitally controlled robot that was developed by a swiss company specifically for Simonin to tackle this project and is the only one in the world at the time. when combined with the architecture software cut out every angle of the framework.

Software used - CADWORK

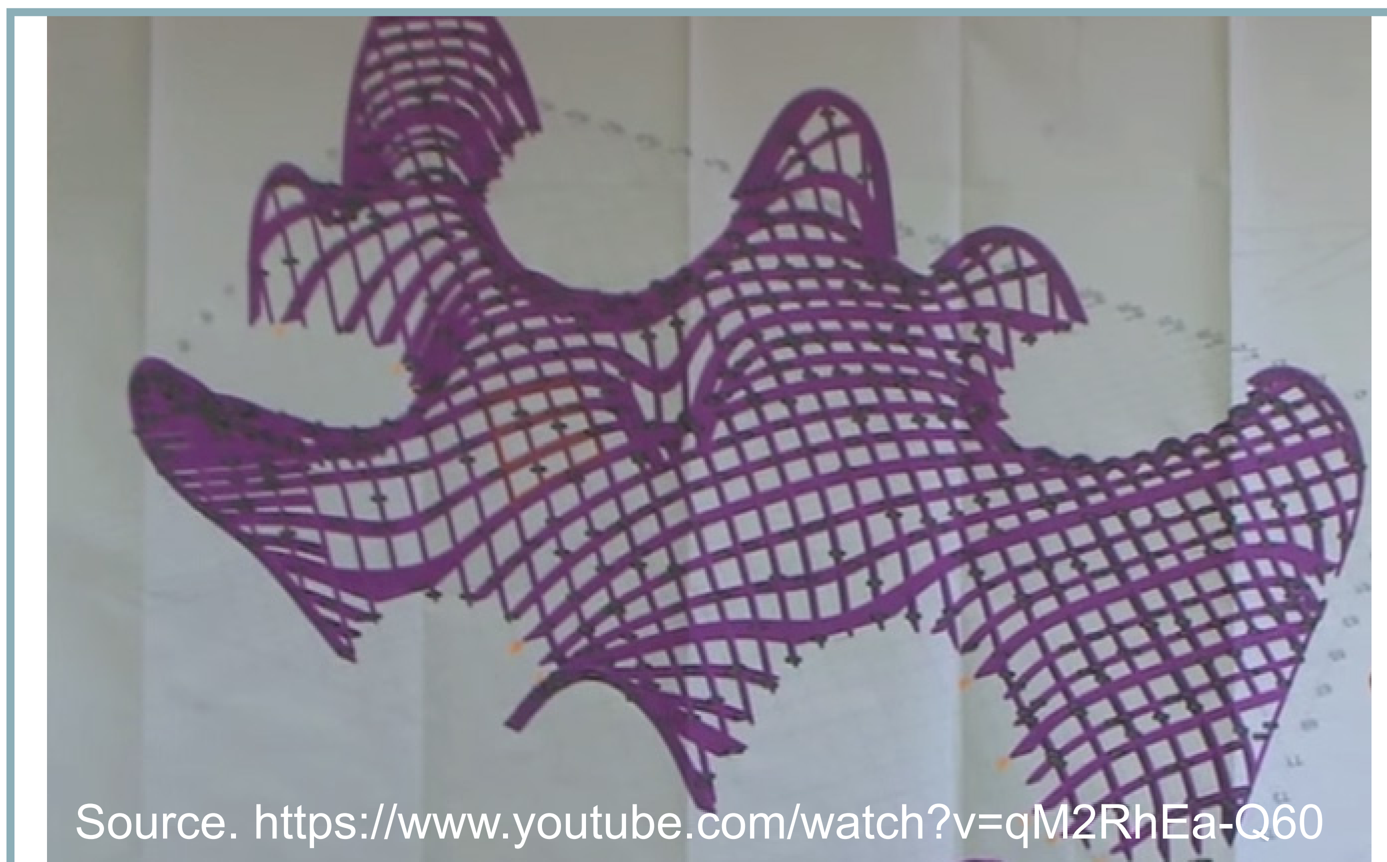
The cadwork Lamella module is integrated into cadwork. On the basis of the profile of any desired laminated beam, laminate divisions and laminate lists are automatically computed with the exact rough dimensions of the laminate.

The Illustration and measurement of the press bed is also generated automatically.

Each Laminate can be extended individually and is dynamically matched to the curved or developed view.



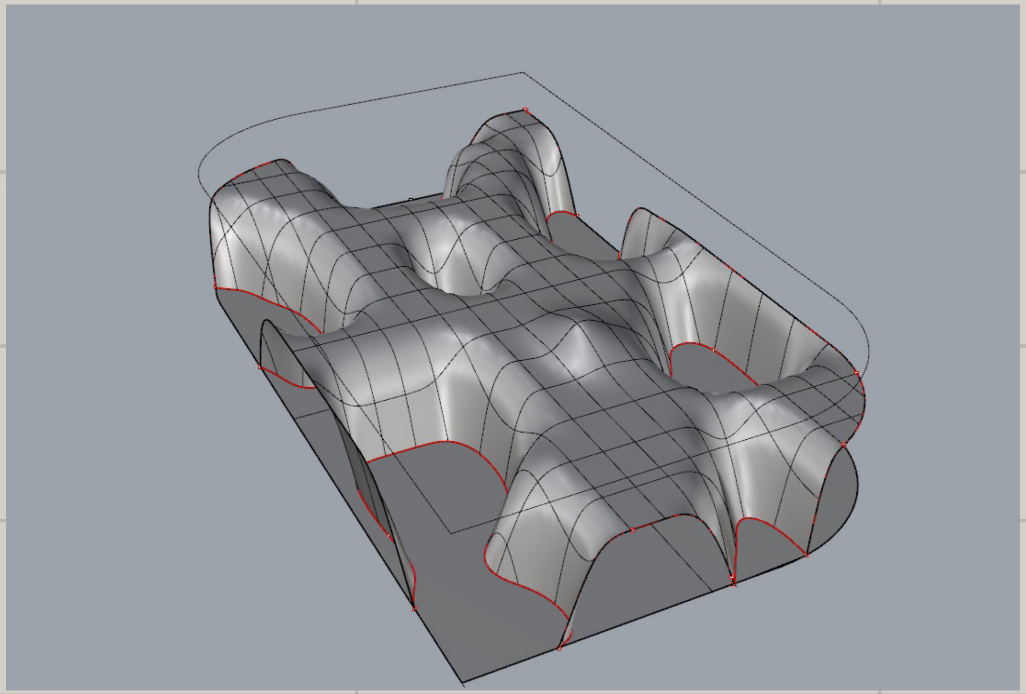
Source. https://www.youtube.com/watch?v=qM2RhEa-Q60

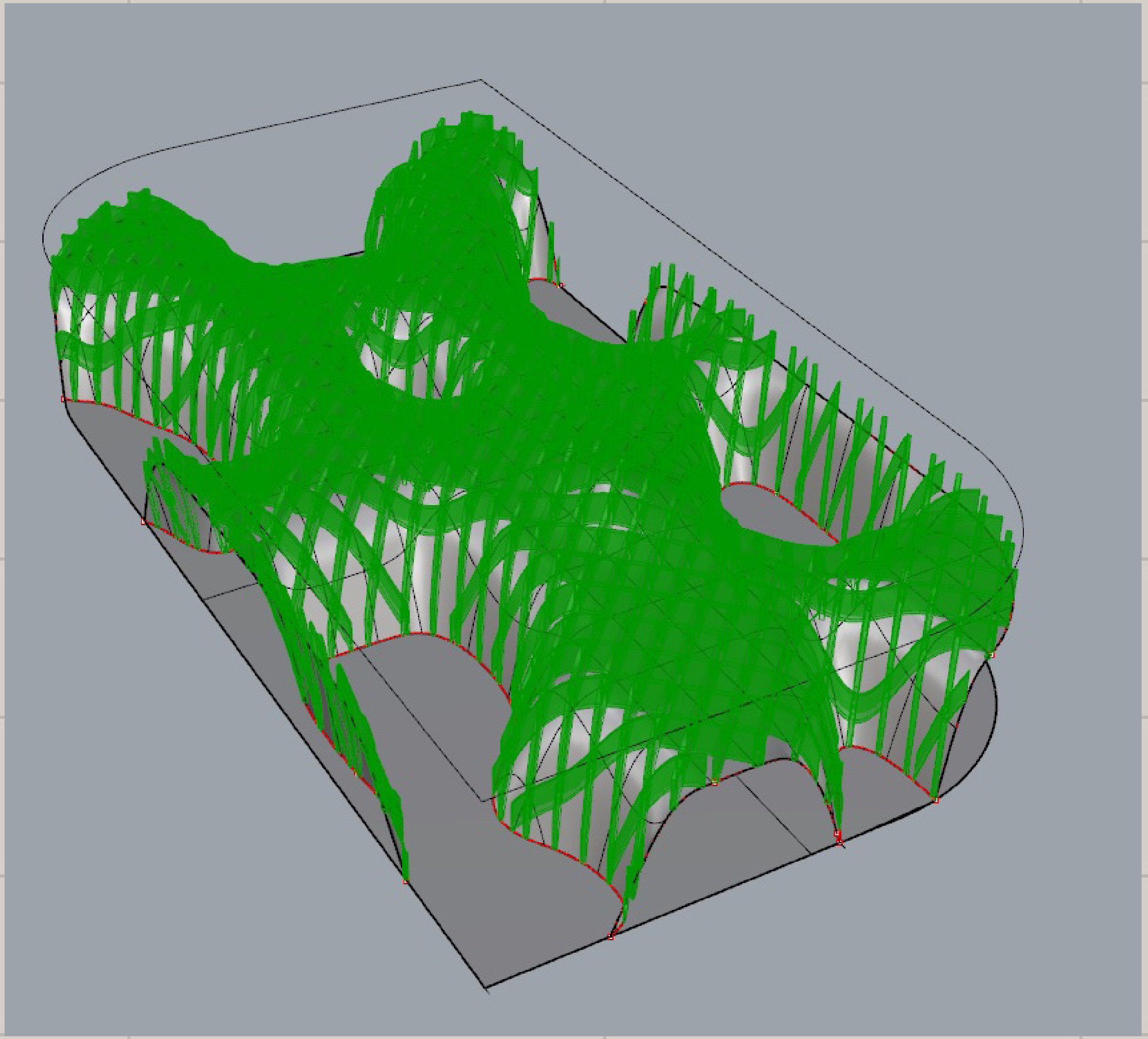


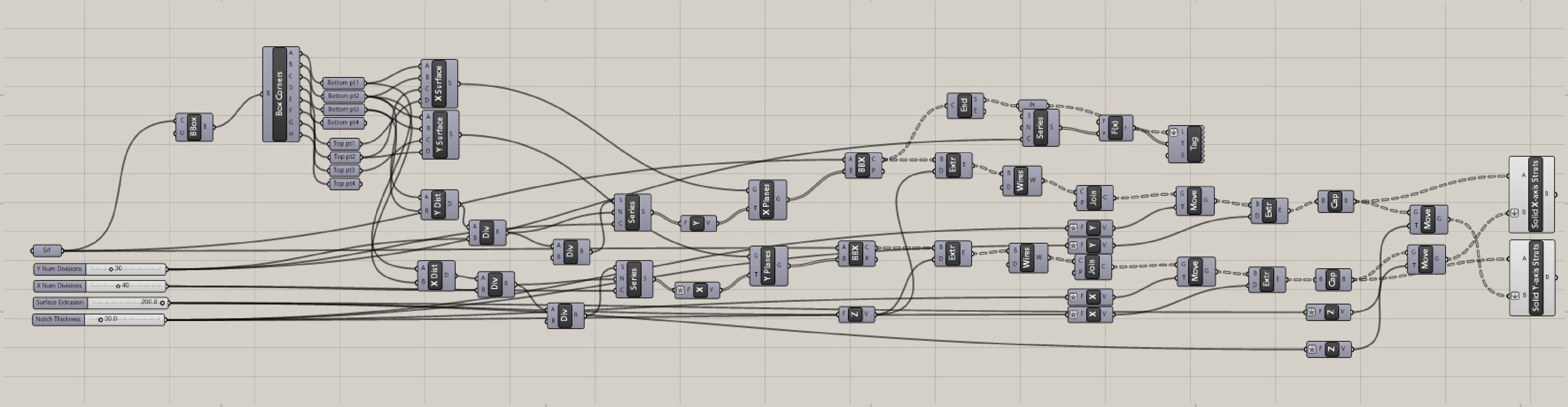
Source. https://www.youtube.com/watch?v=qM2RhEa-Q60

FRENCH Pavilion

Rhino + Grasshopper
Modelling - Terrane Waffle



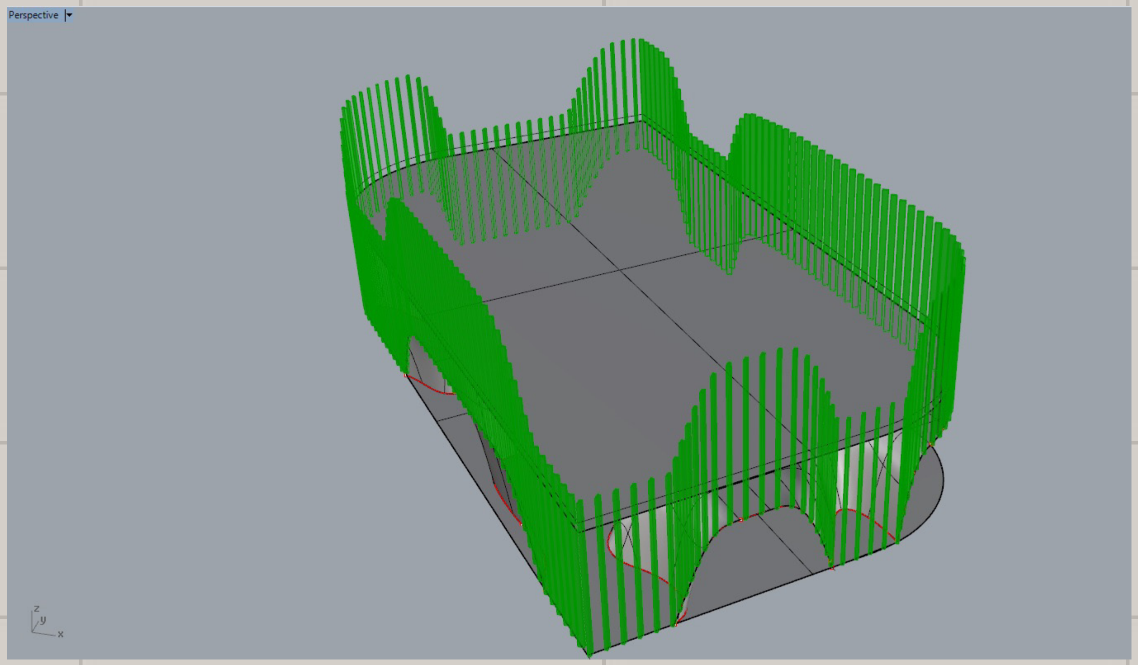


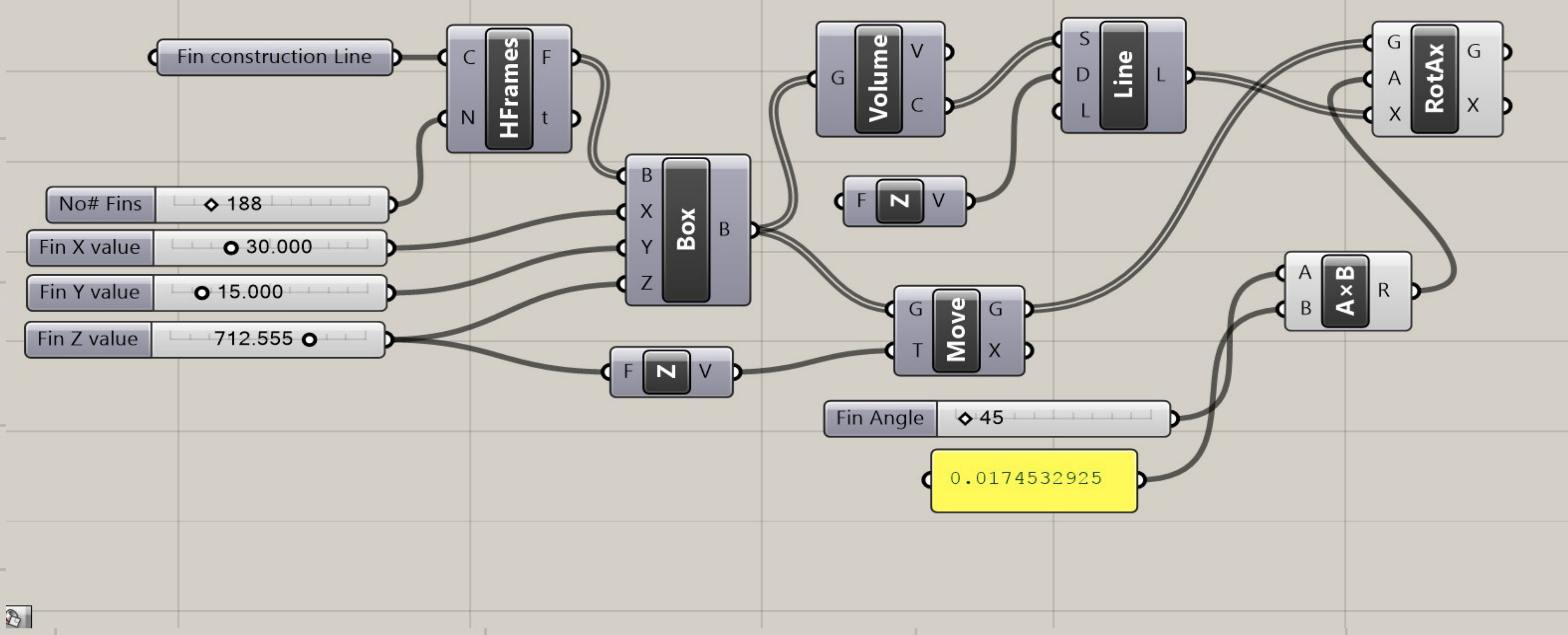


Source: Andrew Payne of LIFT architects

FRENCH Pavilion

Rhino + Grasshopper
Modelling - Facade

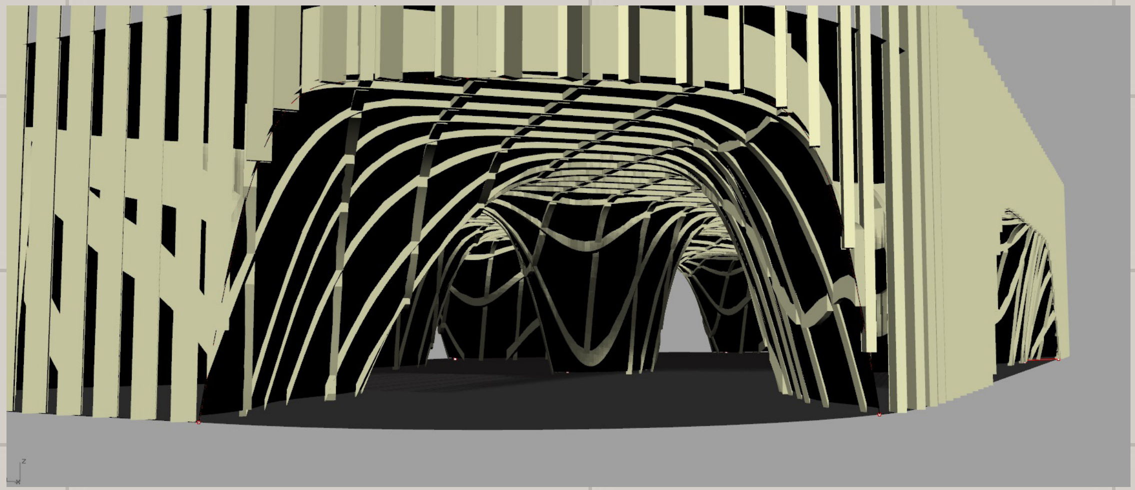


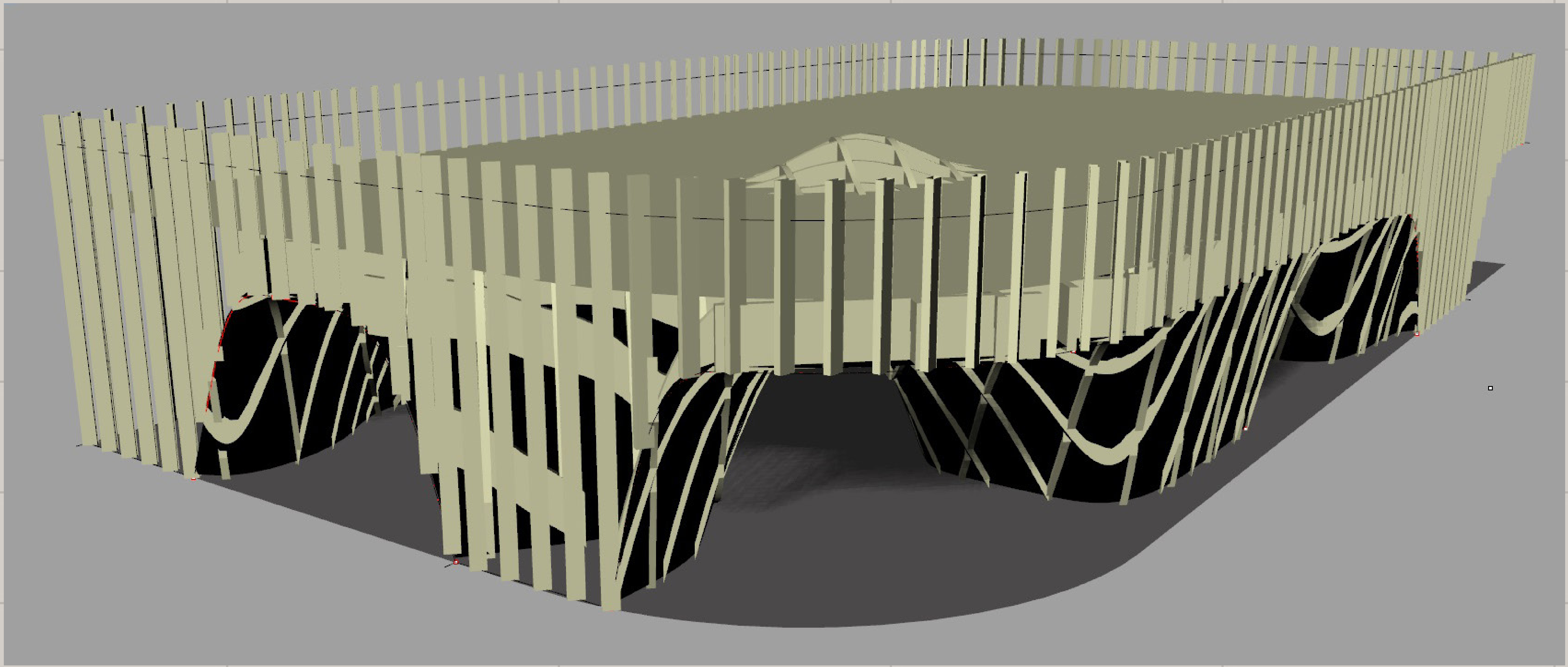


Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

FRENCH Pavilion

Rhino Model





Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

FRENCH Pavilion

Source: http://ffaasstt.swide.com/wp-content/uploads/see-all-the-expo-2015-pavilions/expo-2015-photos-of-the-pavilions-including-china-and-usa-France-Ex-

Source: http://www.inexhibit.com/wp-content/uploads/2015/02/France-pavilion-expo-2015-inexhibit-03.jpg

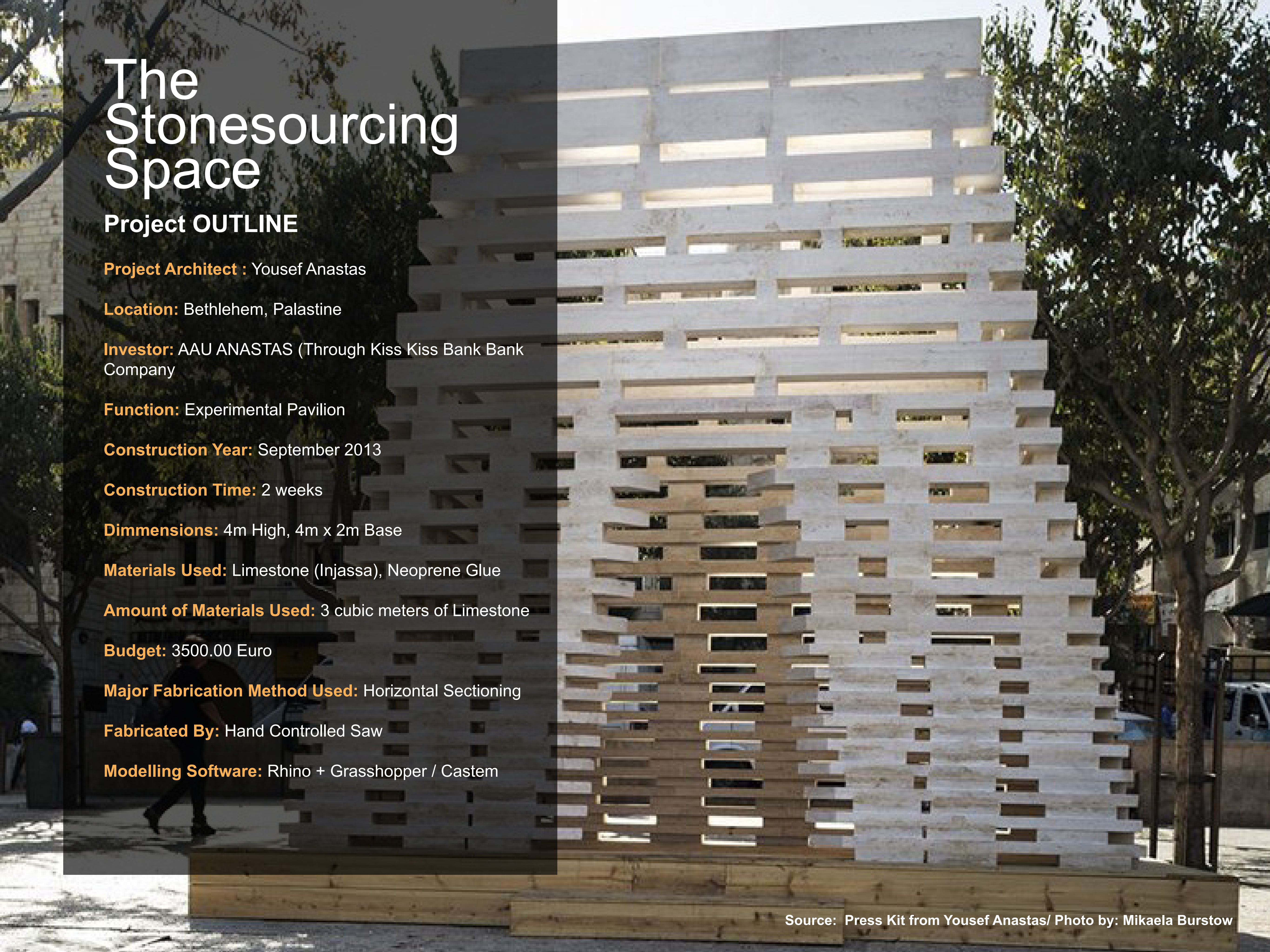
Source: http://www.dezeen.com/2015/05/06/france-pavilion-xtu-architects-milan-expo-2015/

SECTIONING THE STONESOURCING SPACE

Yousef Anastas

Joanna Sadler

Source: Press Kit from Yousef Anastas/ Photo by: Mikaela Burstow



The Stonesourcing Space

Project OUTLINE

Project Architect : Yousef Anastas

Location: Bethlehem, Palastine

Investor: AAU ANASTAS (Through Kiss Kiss Bank Bank Company

Function: Experimental Pavilion

Construction Year: September 2013

Construction Time: 2 weeks

Dimmensions: 4m High, 4m x 2m Base

Materials Used: Limestone (Injassa), Neoprene Glue

Amount of Materials Used: 3 cubic meters of Limestone

Budget: 3500.00 Euro

Major Fabrication Method Used: Horizontal Sectioning

Fabricated By: Hand Controlled Saw

Modelling Software: Rhino + Grasshopper / Castem

Source: Press Kit from Yousef Anastas/ Photo by: Mikaela Burstow

The Stonesourcing Space

Project DESCRIPTION

“A Stone Pavillion which adapts traditional techniques to the imperatives of resistance within the framework of the Palestinian public space.”

Stone is a fundamental part of the Palestinian way of life. Bethlehem fortunately was blessed wiith having stone as a readily avaible resource and it is a go to material when building homes because of its hardiness. The Stone Pavilion is meant to serve as a symbol of innovation which mixes traditional use with modern day technologies.

The Nativity Square was the most ideal location because it is where private meets public and where traditional Palestine go to exhibit its contemporary face.

The pavilion was influenced by the traditional Palestinian mountar which are countryside shelters found throughout the land. It manages to balance not interupting the beauty of the landscape wit.
being a part of the city’s development. It also answers the fundamental problem of the need of land.

There were three (3) major concepts for this pavilion. It was to:

1) Display innovative building techniques
2) Serve as a binder in a public space
3) Be a land consummer

Source: Press Kit from Yousef Anastas/ Photo by: Mikaela Burstow

Source: Press Kit from Yousef Anastas/ Photos by: Mikaela Burstow

The Stonesourcing Space

Project FABRICATION

Another interesting fact about this pavilion is that all the stone was cut with a hand controlled saw at a family business in Bethlehem.

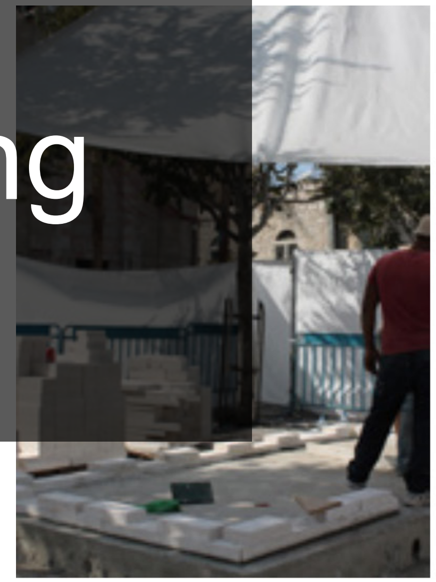
All construction was done on site and manually glued into place by people. Theoretically glue was not necessary but was used to make up for any hand cut tolerences and sliding between blocks.

The construction process took a total of 2 weeks.

Source: Press Kit from Yousef Anastas/ Photos by: Mikaela Burstow

The Stonesourcing Space

Project FABRICATION
















Source: Press Kit from Yousef Anastas/ Photos by: Mikaela Burstow

The Stonesourcing Space

Project MATERIAL

This pavilion is unique because it was an experiemental example of stone use. Palestine has varying temperatures with it being hot in the day and cold at night. This makes the use of stone ideal because its thermal properties allow the dew to be stocked in the stone at night and then diffused during the day.

Another important factor in the choice of material was that the type of stone used was very common and readily available in Palestine.

Stone Characteristics	
Name	Injassa
Density	2600kg/m3
Modulus of rupture	9,2 mpa
Compressive strength	96 mpa
Shear Strength	4,6 mpa
Water Absorption	2%

Source: Press Kit from Yousef Anastas/ Photo by: Mikaela Burstow

The Stonesourcing Space

Project MATERIAL

Source: Press Kit from Yousef Anastas/ Photos by: Mikaela Burstow

The Stonesourcing Space

Project MACHINE / SOFTWARE

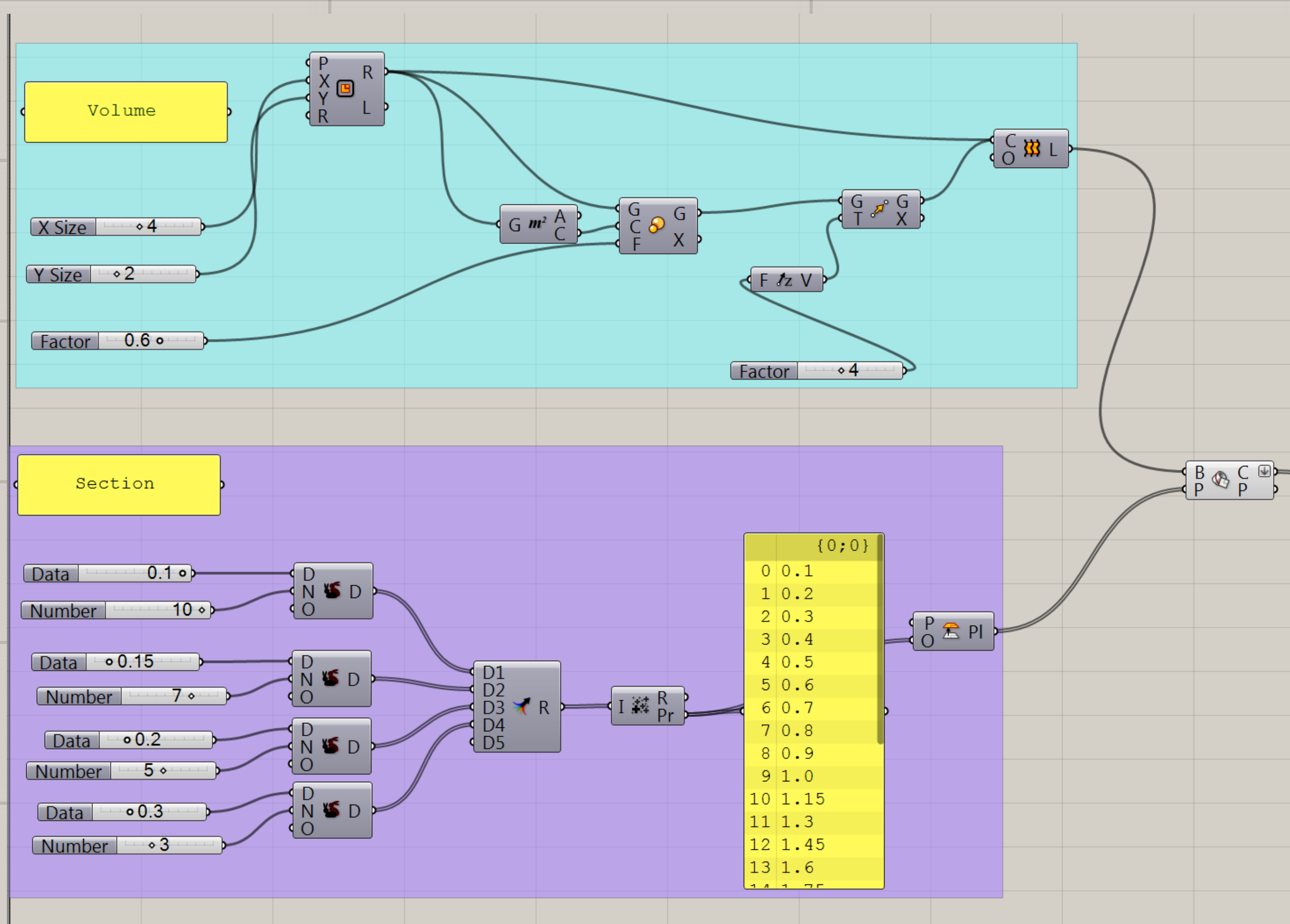
As mentioned before, all the stone was cut with a hand controlled saw at a family business in Bethlehem.

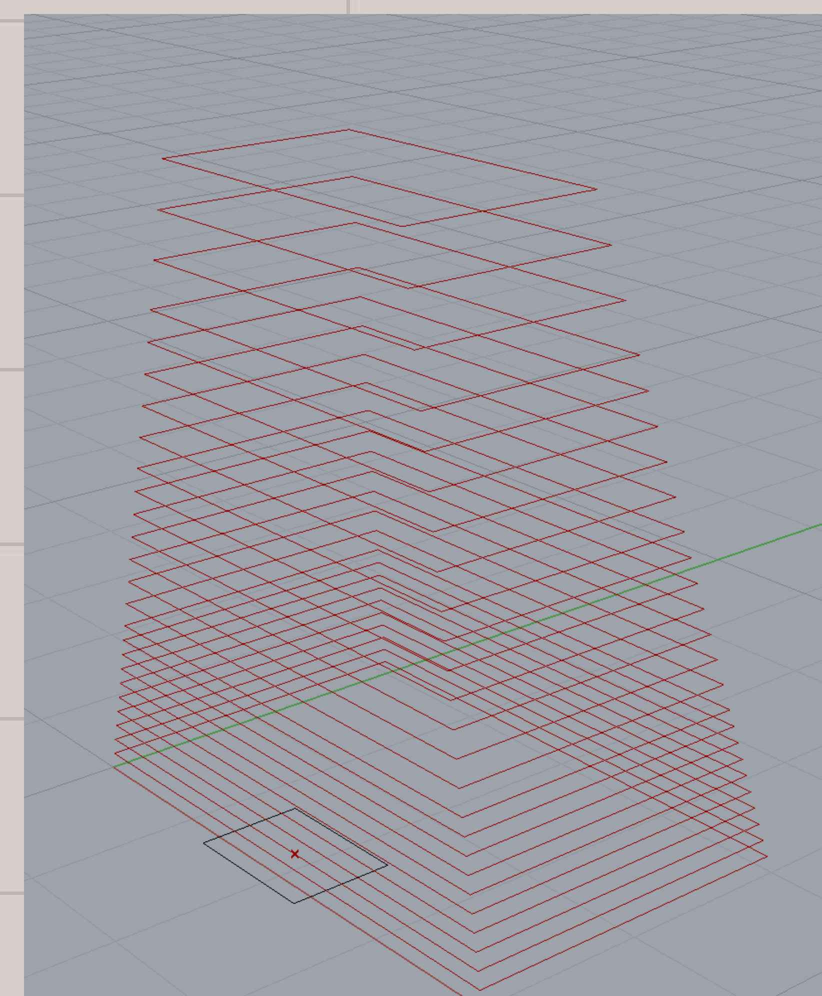
Rhino and grasshoppor were the primary softwares that were used to design geometry of the pavilion and Castem was used for the structural analysis.

Source: http://www.pavingexpert.com/cutting.htm

The Stonesourcing Space

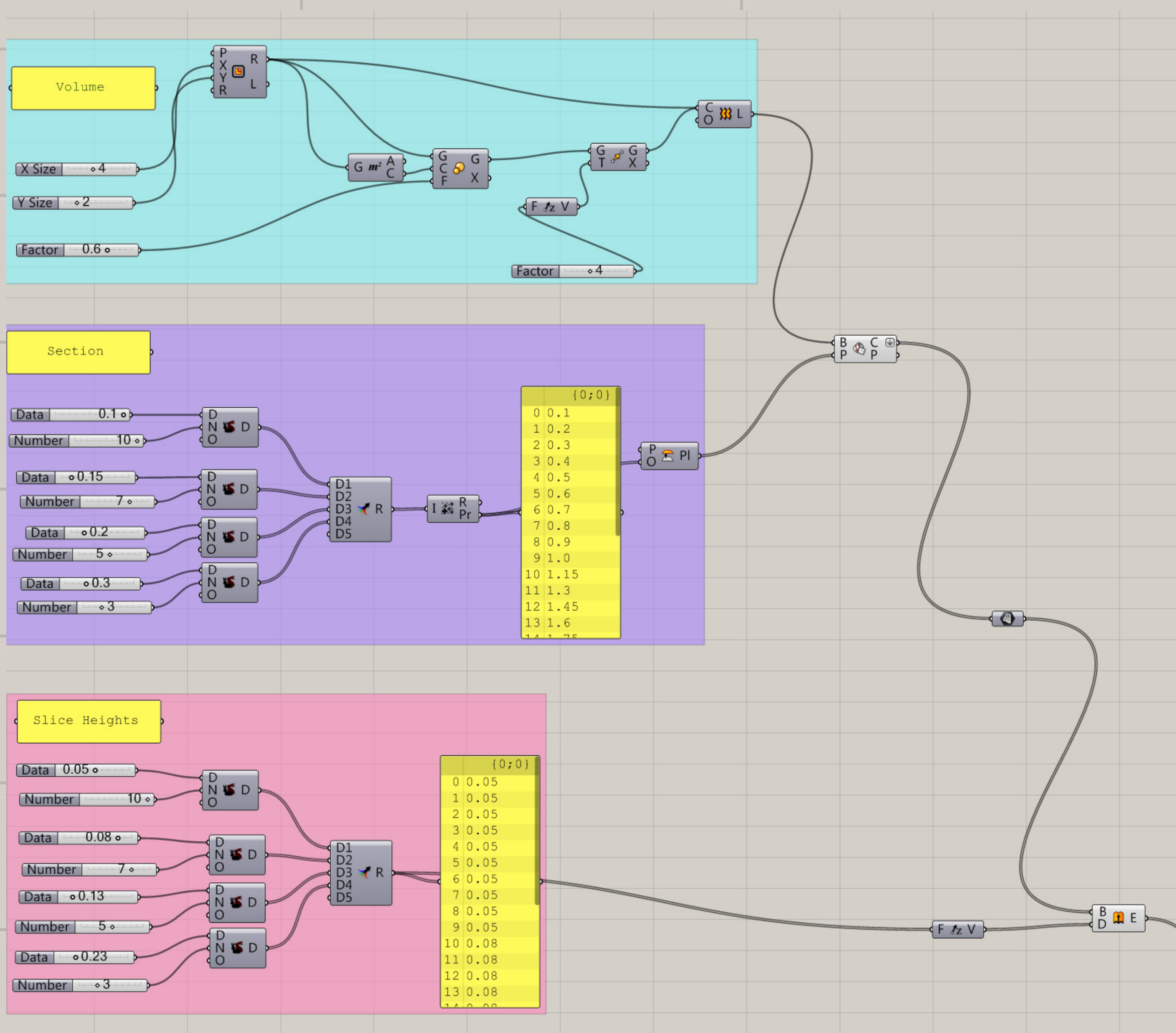
GRASSHOPPER
Modelling

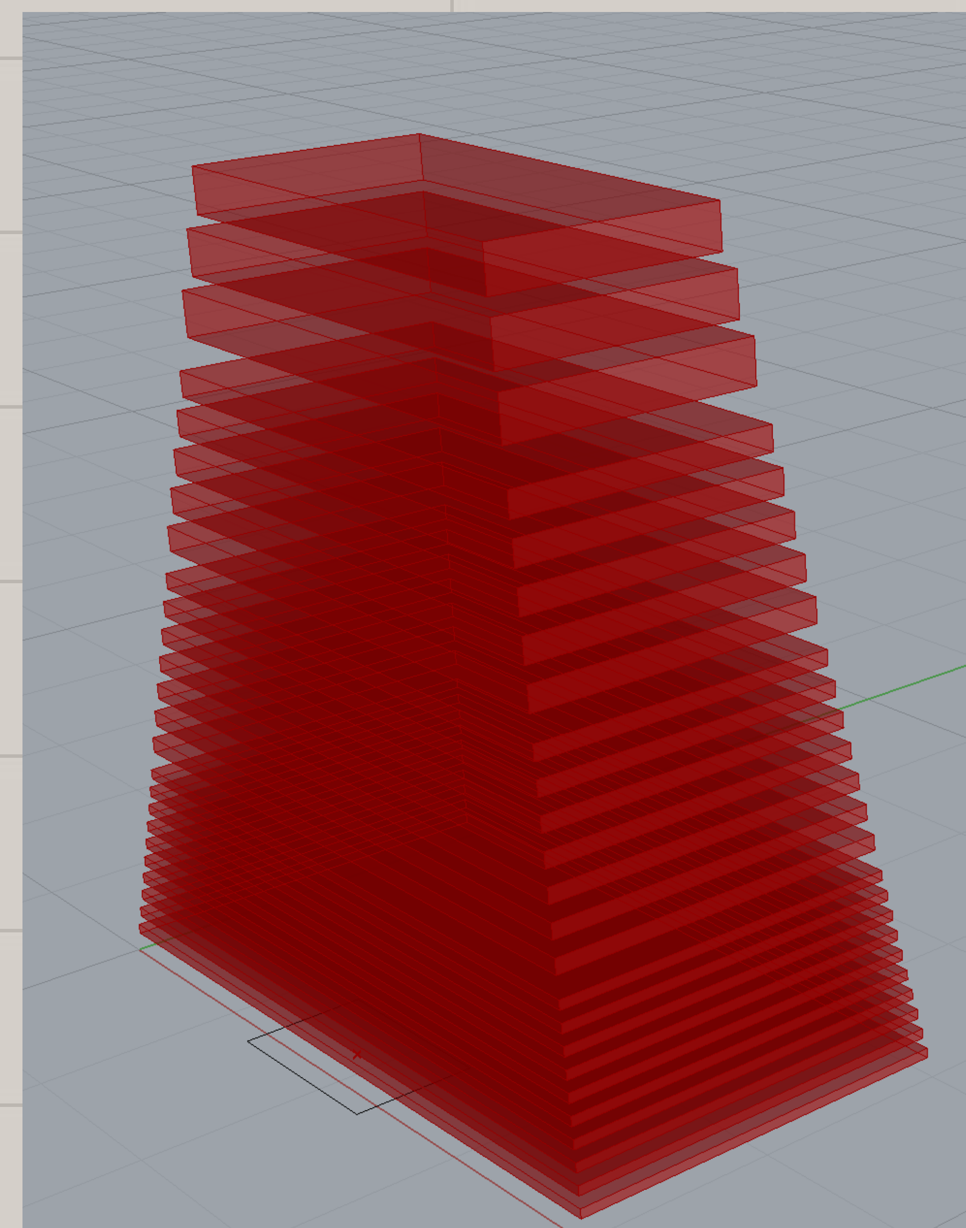




The Stonesourcing Space

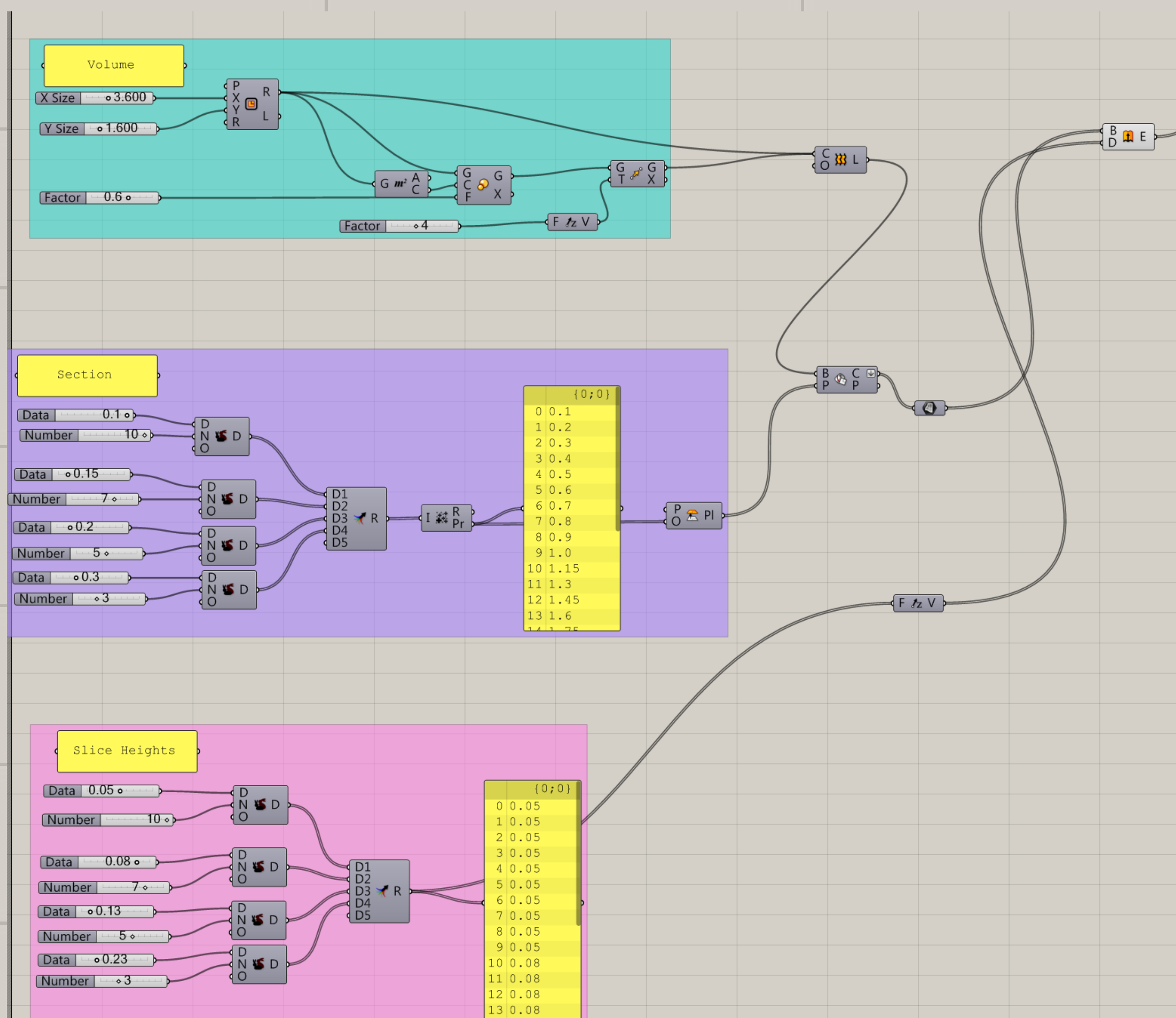
GRASSHOPPER
Modelling

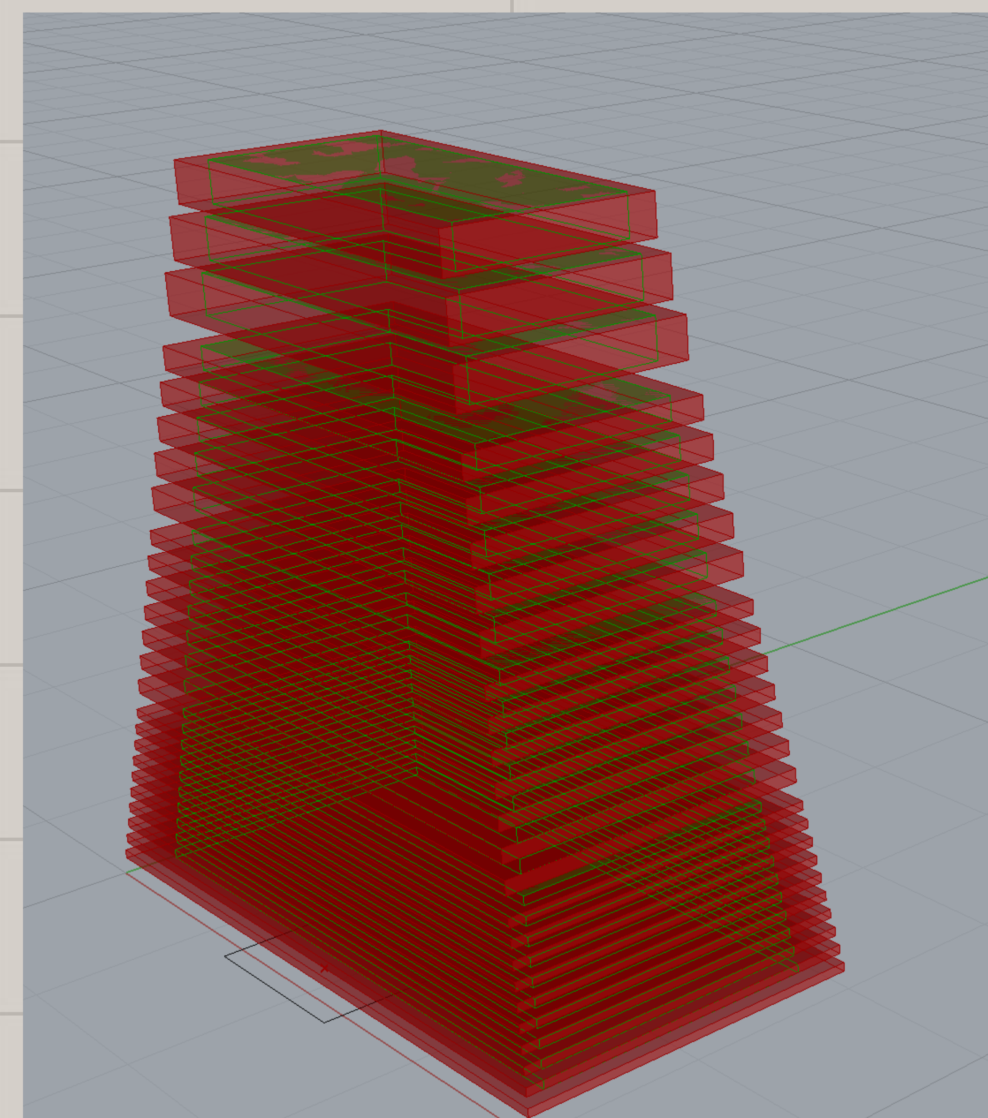




The Stonesourcing Space

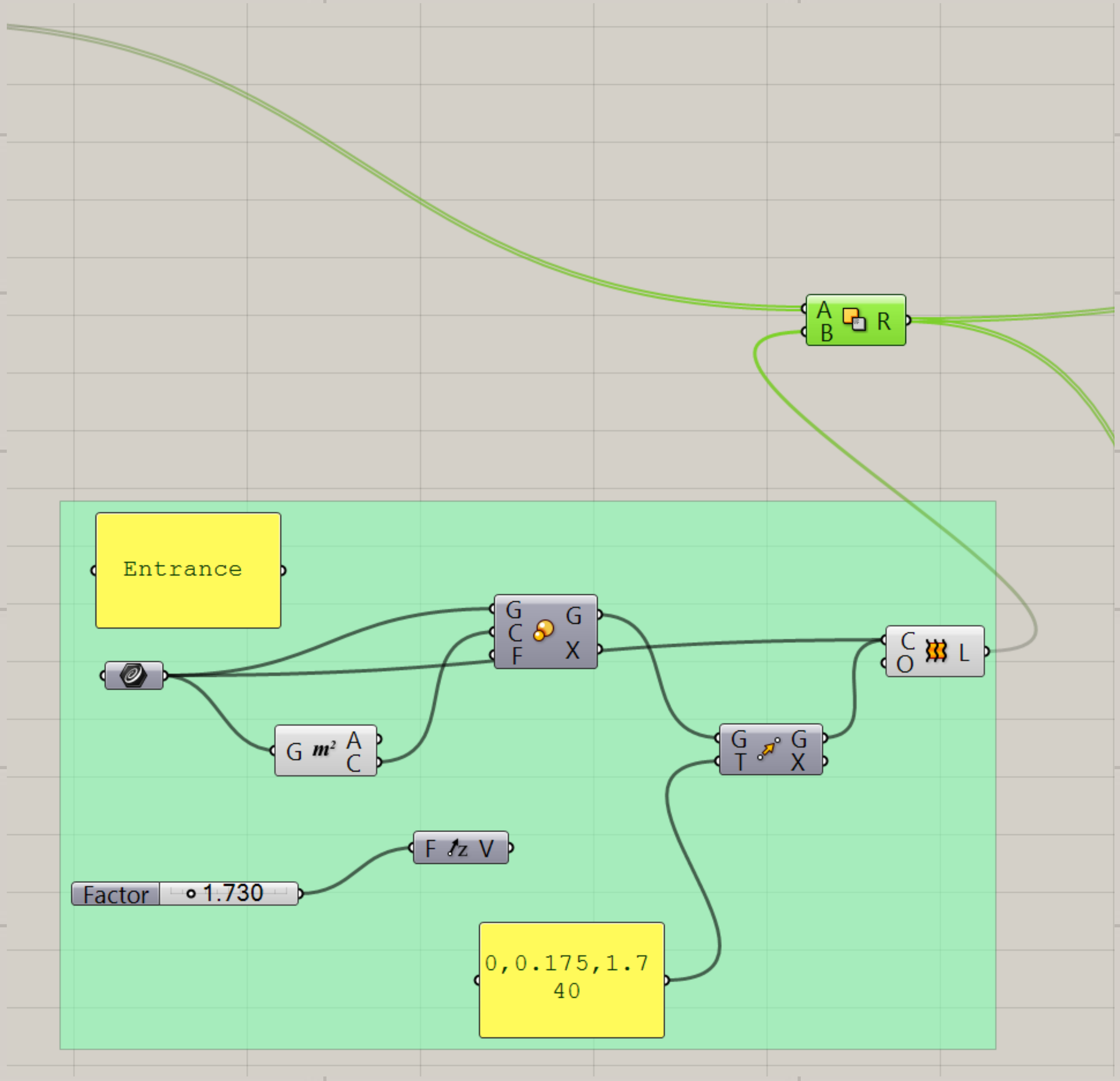
GRASSHOPPER
Modelling

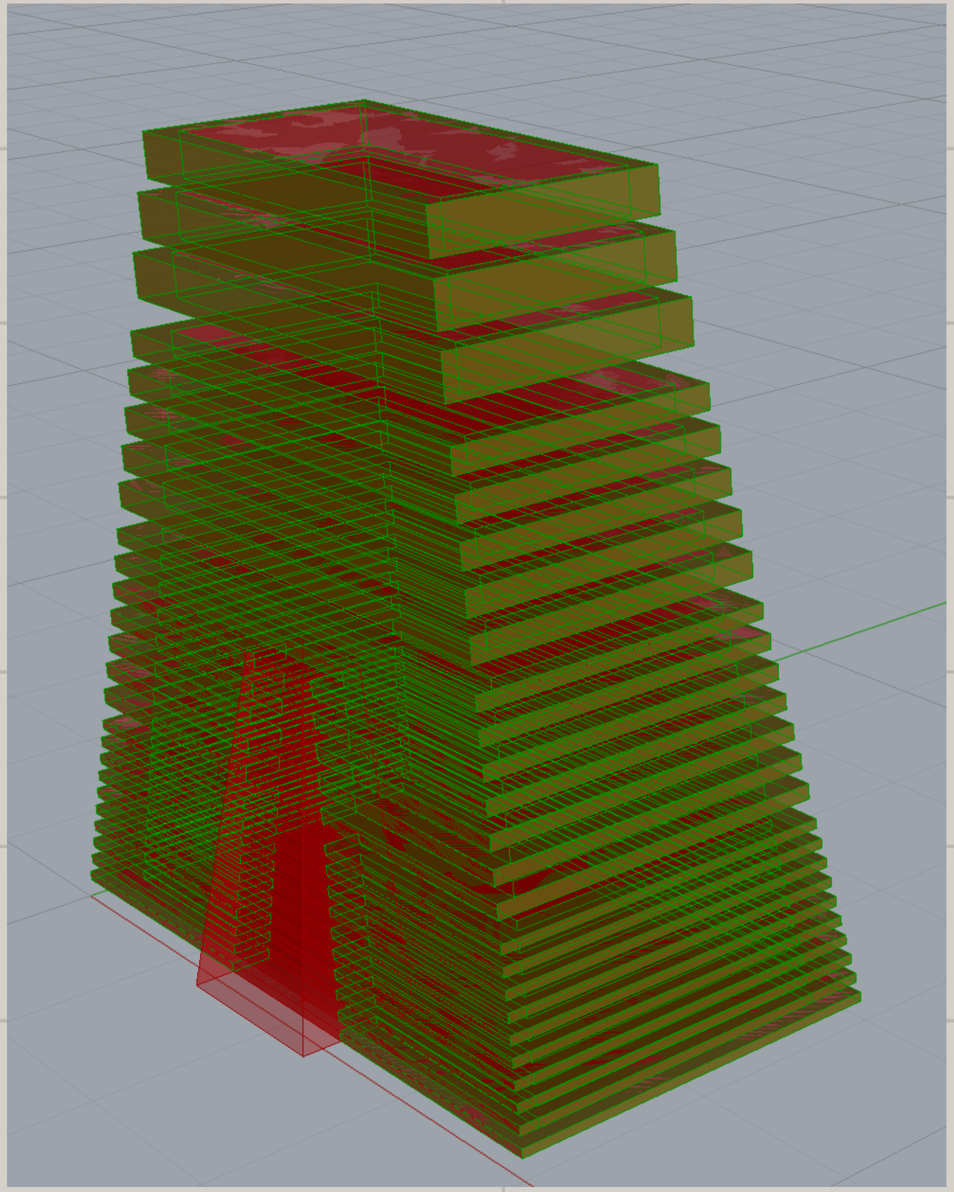




The Stonesourcing Space

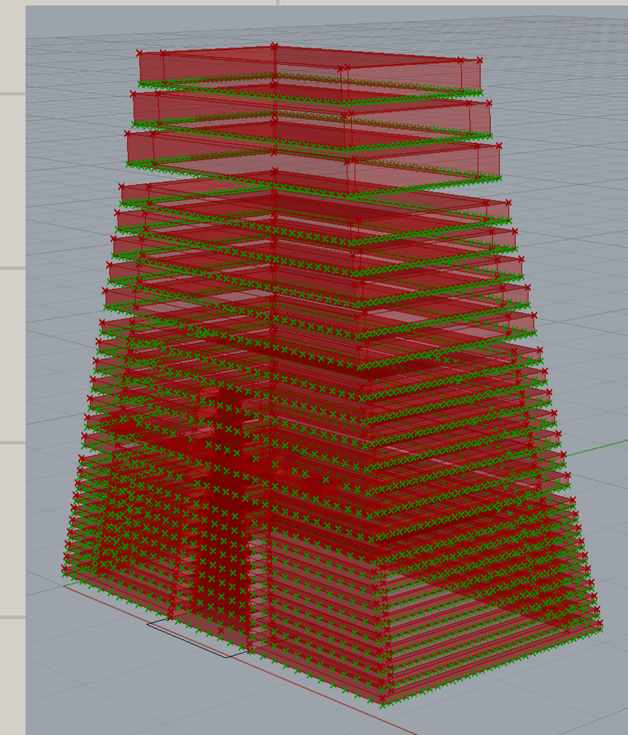
GRASSHOPPER
Modelling

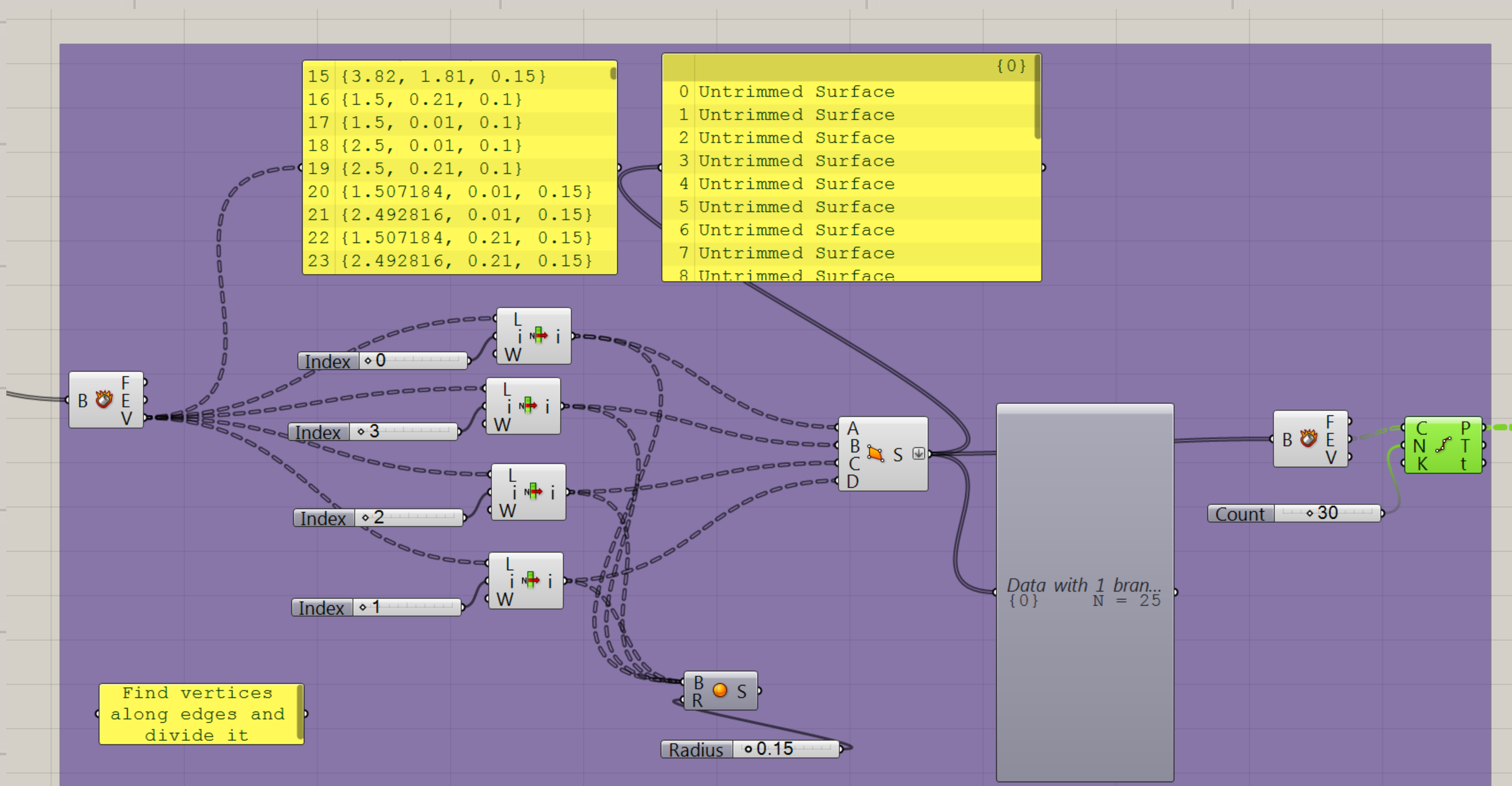




The Stonesourcing Space

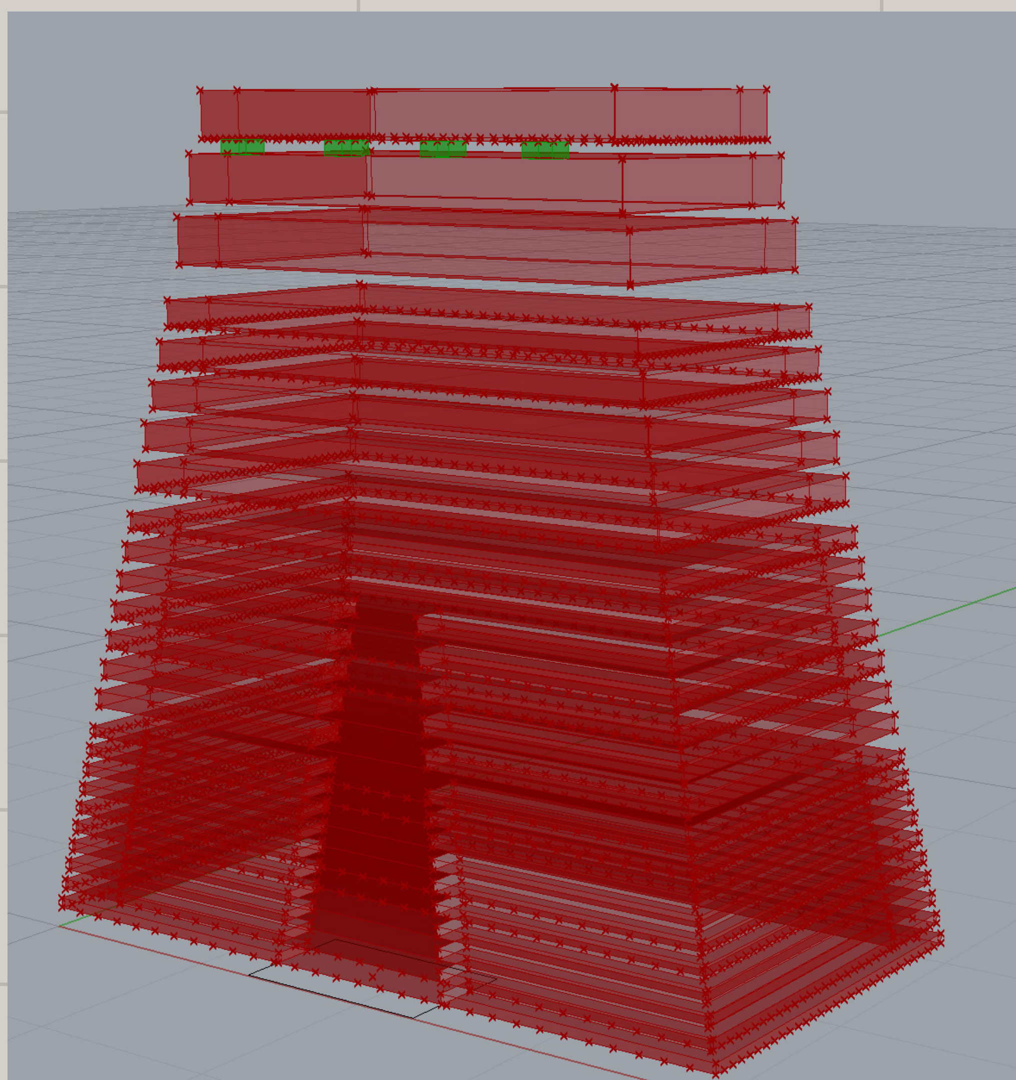
GRASSHOPPER
Modelling

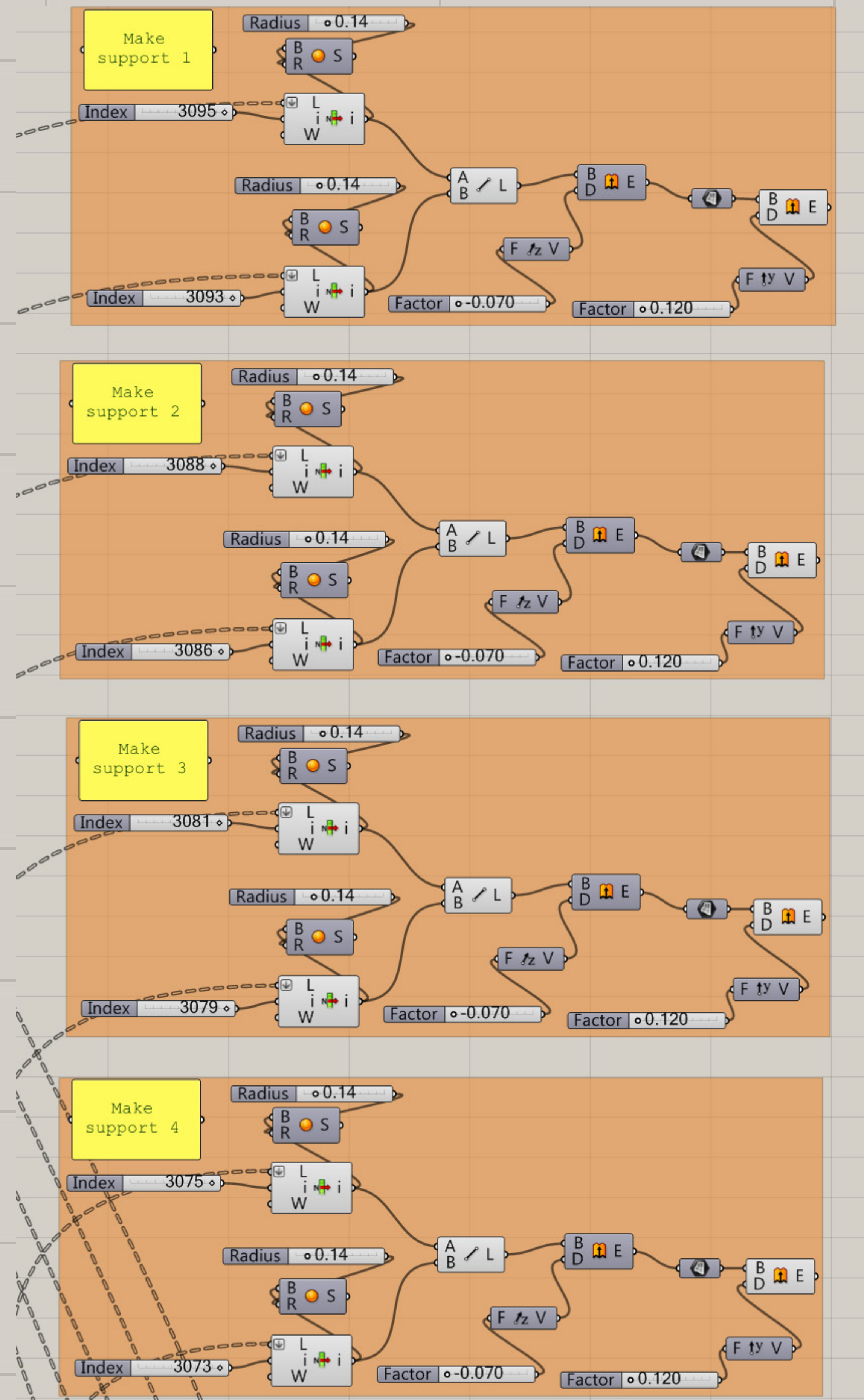




The Stonesourcing Space

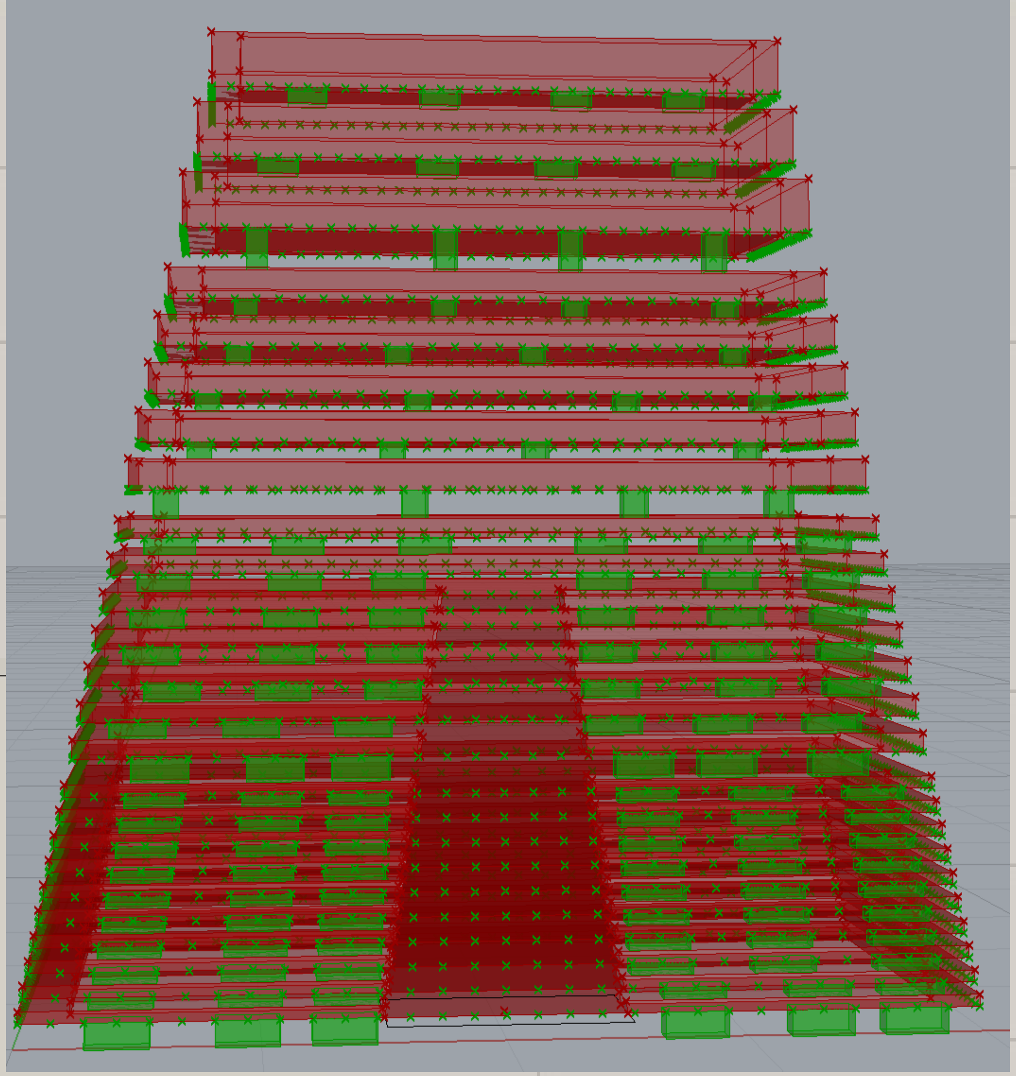
GRASSHOPPER
Modelling

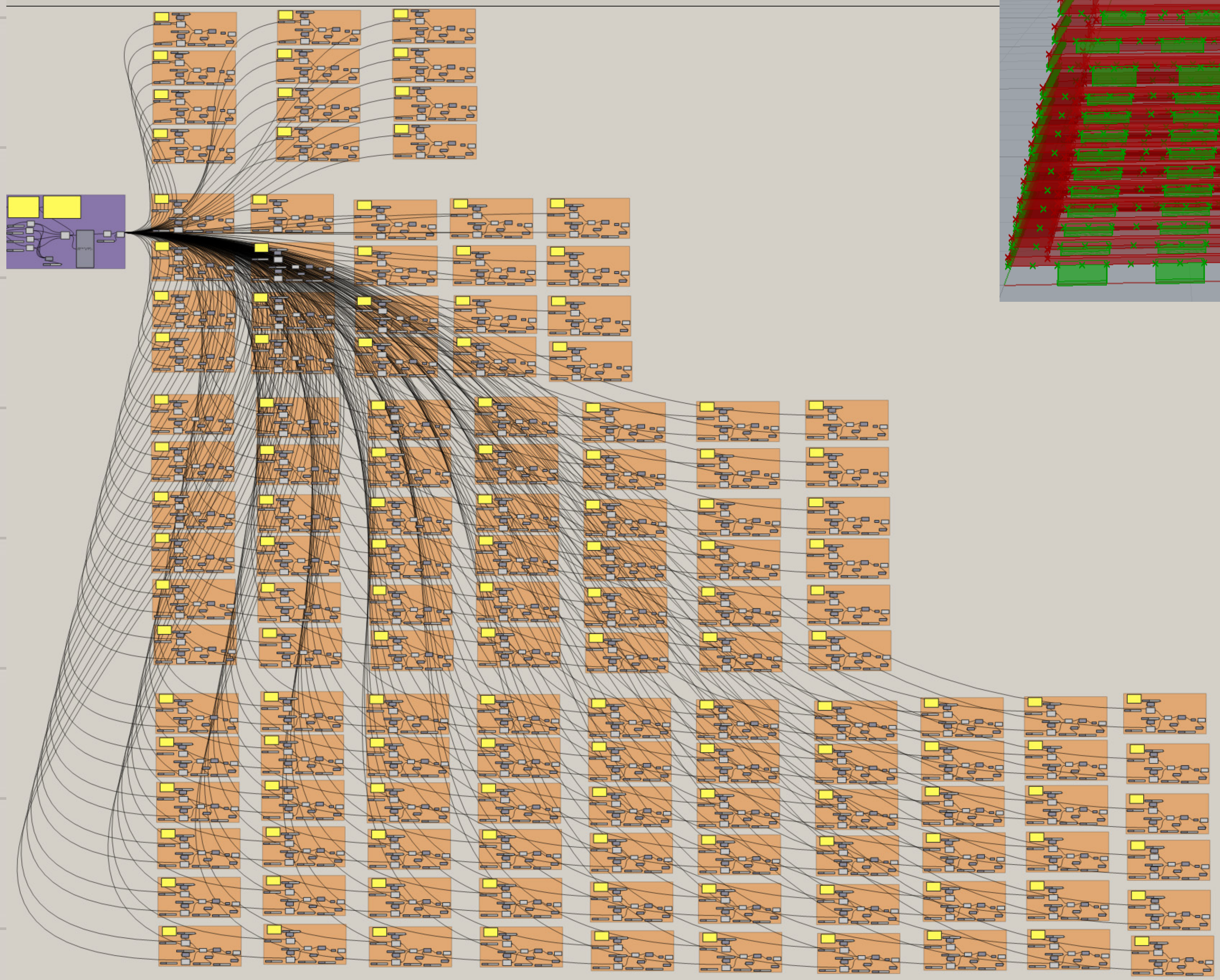




The Stonesourcing Space

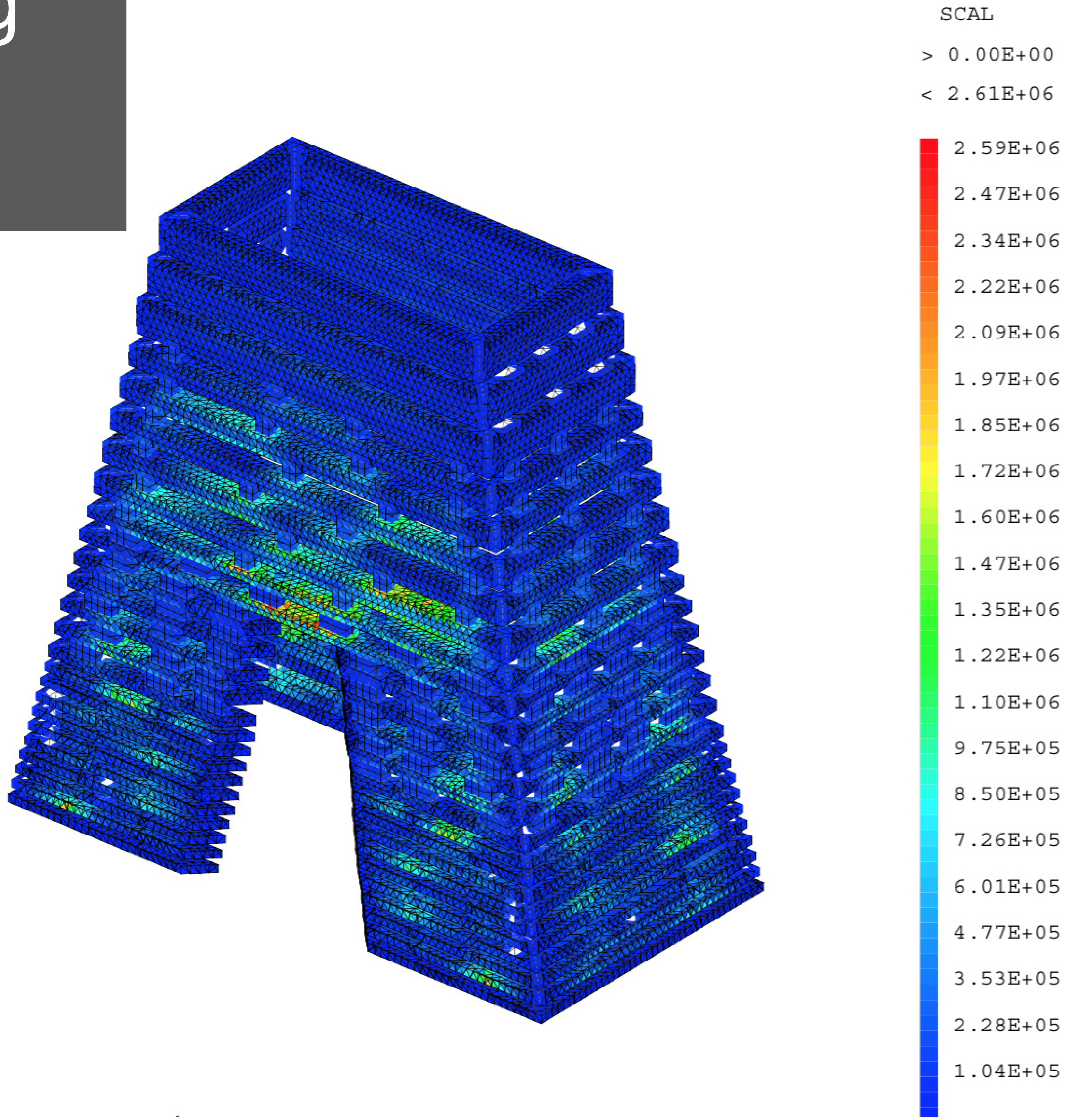
GRASSHOPPER
Modelling





The Stonesourcing Space

Structural Analysis



Source: Press Kit from Yousef Anastas

The Stonesourcing Space

Fabrication Definition

No fabrication definition was used for this pavilion because, as mentioned before, all the stone was cut with a hand controlled saw and all construction was done on site and manually glued into place by people.

Source: Press Kit from Yousef Anastas/ Photos by: Mikaela Burstow

The Stonesourcing Space

Source: Press Kit from Yousef Anastas/ Photos by: Mikaela Burstow

Source: Press Kit from Yousef Anastas/ Photos by: Mikaela Burstow

Source: Press Kit from Yousef Anastas/ Photos by: Mikaela Burstow

SECTIONING PARA-SITE PAVILION

Jordi Truco & Elisava 2011

Ksenia Kalacheva

Source: http://www.metalocus.es/content/en/blog/para-site

Para-Site Pavilion

Project OUTLINE

PARAsite Installation.

Collaboration with ELISAVA Escola Superior de Diseño. Barcelona

Direction: Prof. Jordi Truco

Project leaders: Andrés Dejarón, Francisco Tabanera

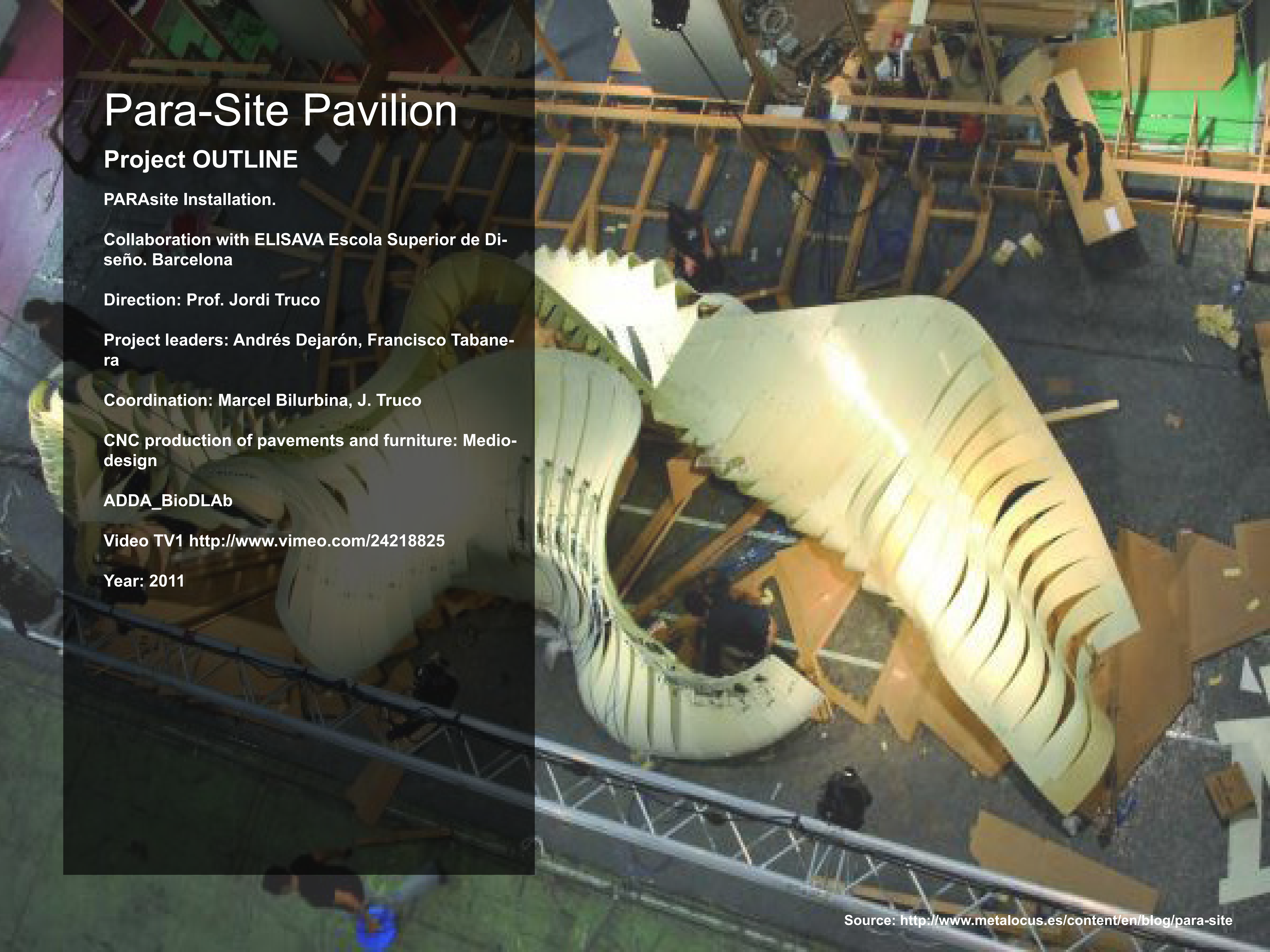
Coordination: Marcel Bilurbina, J. Truco

CNC production of pavements and furniture: Mediodesign

ADDA_BioDLAb

Video TV1 http://www.vimeo.com/24218825

Year: 2011



Source: http://www.metalocus.es/content/en/blog/para-site

Para-Site Pavilion

Project DESCRIPTION

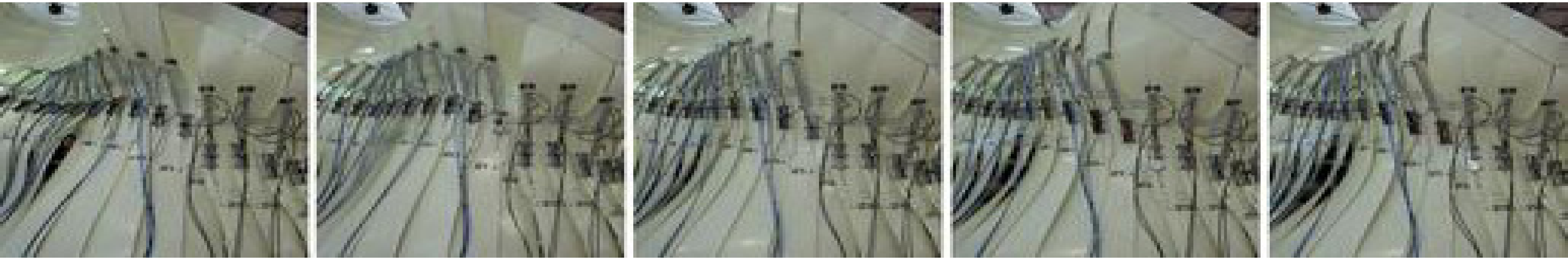
PARA-Site, the first dynamic and interactive architectural prototype designed and built in Spain.

It is fitted with sensors which react to the presence of visitors, expanding or reducing interior spaces.

It has been fully designed and developed at the ELISAVA school facilities by the students and teachers of its Master's Degree in Advanced Design and Digital Architecture (ADDA). The course, was carried out under the architect Jordi Truco's direction.

Bio Design Laboratory, which drove the creation of PARA-Site and is an international point of reference in the area of research on adaptive architecture systems, publishes Formaciones espaciales en el tiempo producidas por materiales inteligentes (Time-Based Spatial Formations Through Material Intelligence).

¿EL MEJOR DISEÑO
ES EL QUE SIRVE ?
QUÈ ÉS DISS
INTEMPORA
EL DISSENY POT
COM RECONEIXEM LA QUALITAT ?
QUÈ ÉS LA CONCIÈNCIA
CRÍTICA AL CAP I A LA
FI, SINÓ UNA IMPARABLE
PREDILECCIÓ PER LES
ALTERNATIVES ?
DESIGNSUCHT !
QUÈ DETERMINA UNA FORMA ?
DISSENY TÉ UNA MARCA ?
QUANTA
RESPONSABIL
TÉ EL DISSENY
COM REC
EL DISSE
COM POC, COM A
DISSENYADOR, EVITAR LA
INNOVACIÓ SENSE SENTIT
DEL MERCAT DE PRODUCTES ?

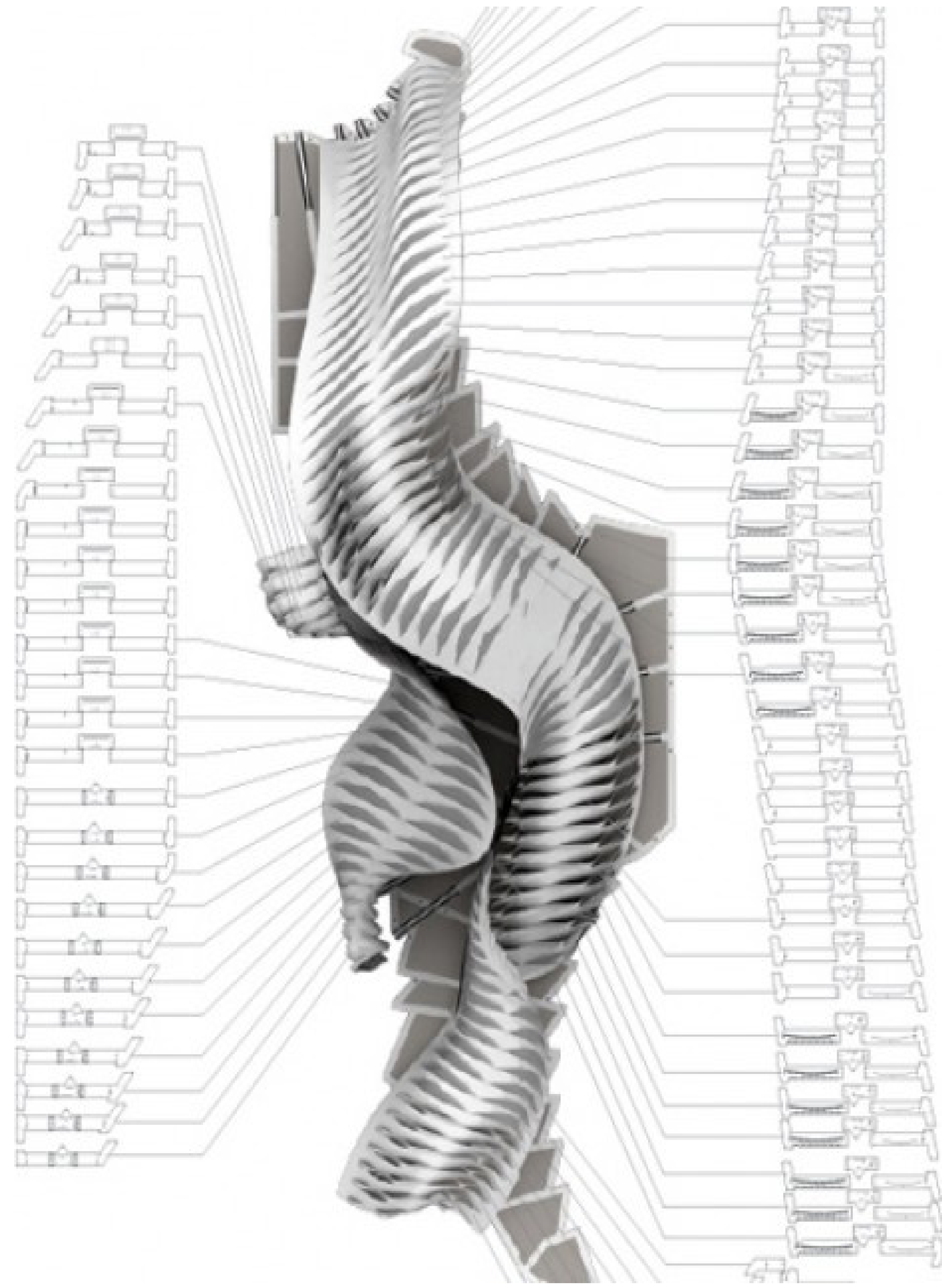


Para-Site Pavilion

Project FABRICATION

PARA-Site is the first life-size prototype of experimental interactive architecture of its type to be developed in Spain. It takes up a surface area of 60.75 square metres (13.5 metres long by 4.5 metres wide) and has been fully designed at ELISAVA's facilities, both in relation to its design and in relation to its computerisation and materialisation. Its assembly involves fitting together over 100 prefabricated non-standard parts and around 60 square metres of fibre-reinforced composite.

PARA-Site generates spaces by using materials' intrinsic characteristics, forming a structure which finds its own equilibrium by superimposing and displacing nodes on parallel bands (form finding). It can increase or reduce the area it takes up based on the number of visitors inside it, optimising space requirements and thus saving energy.

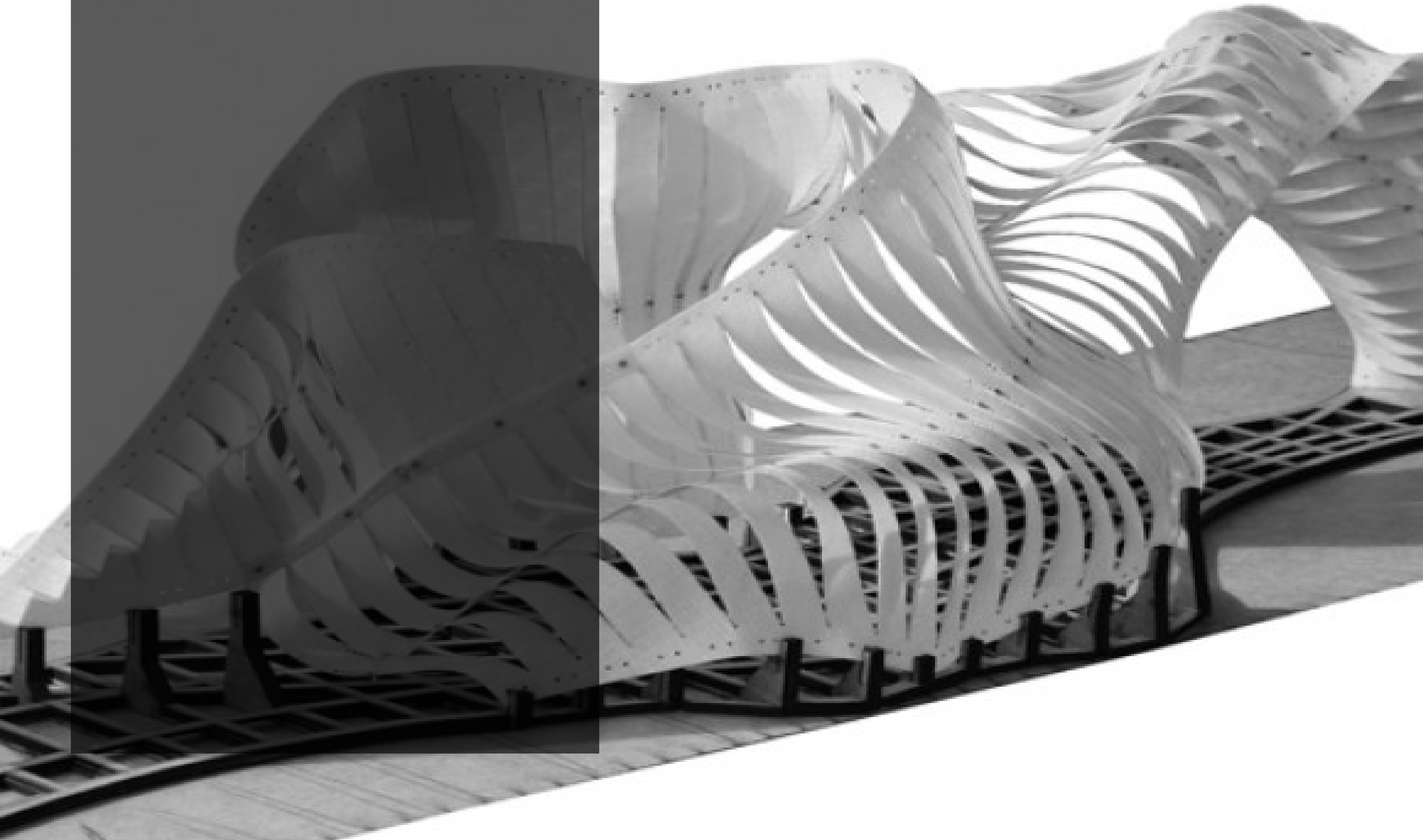


Para-Site Pavilion

Project FABRICATION

Para-Site Pavilion

Project FABRICATION

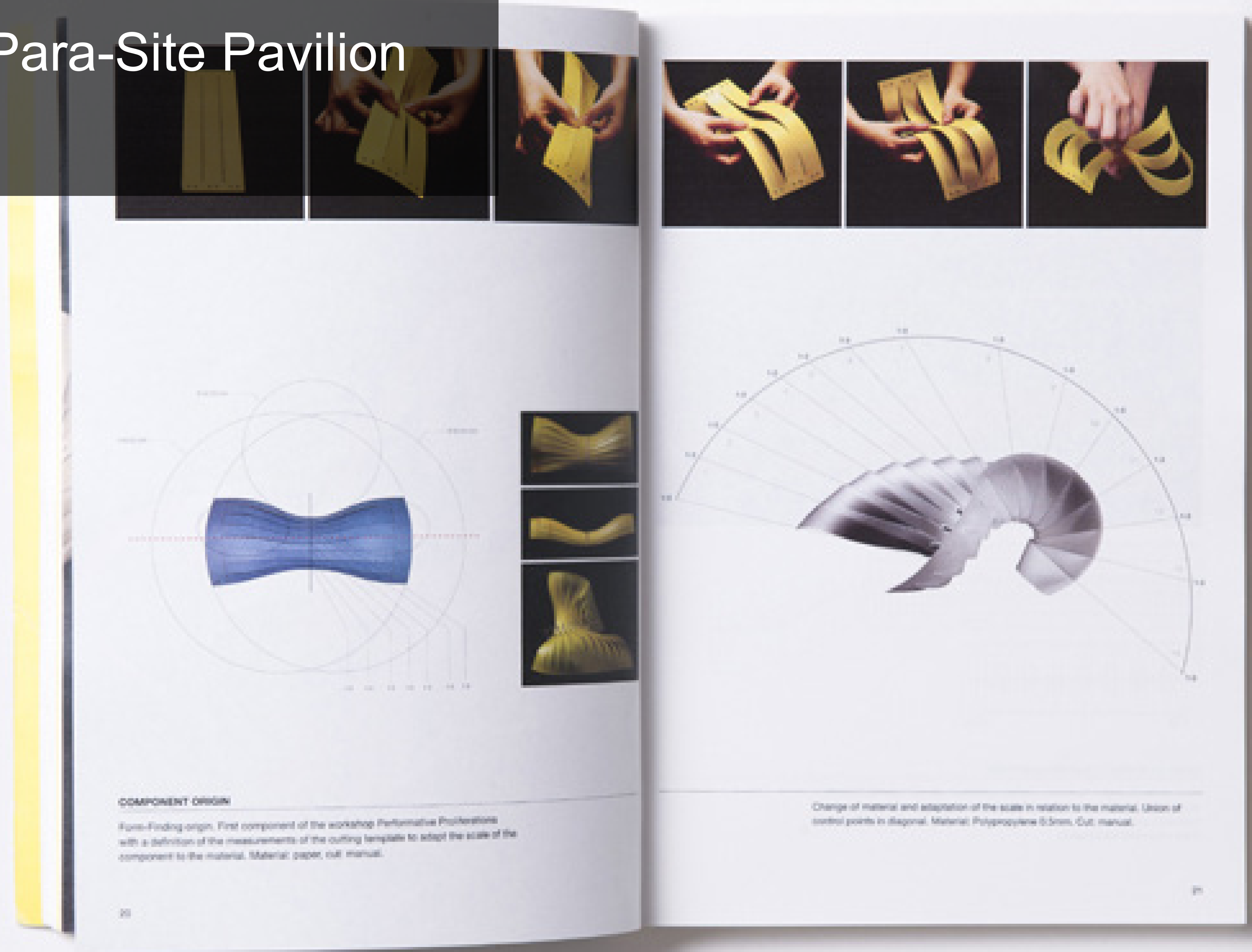



SER HUMANO
E SEGUIR
ÑANDO ?

Para-Site Pavilion

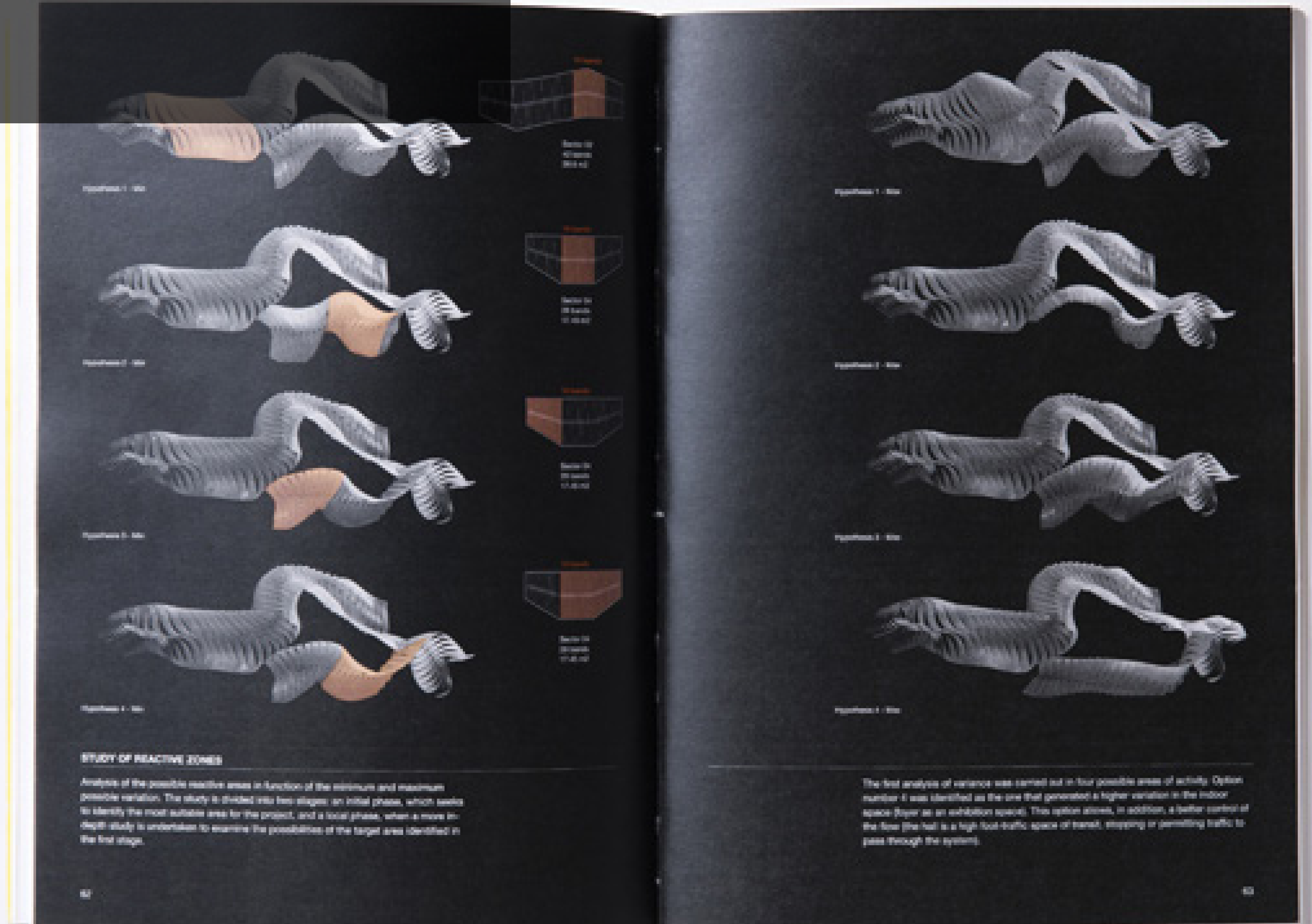
http://www.kaoscollective.com/portfolio/para-site-book/

Para-Site Pavilion



http://www.kaoscollective.com/portfolio/para-site-book/

Para-Site Pavilion



http://sistemaformal.com/portfolio/pabellon-para-site/

Para-Site Pavilion

Para-Site Pavilion

SECTIONING
Meditative Pavillion

Christina Zeibak and Daphne Dow

Ali Shujaat Naqvi

Source:www.archdaily.com/285997/sukkahville-design-competition-winning-exhibition-hegemoni-

PROJECT OVERVIEW

ProjectArchitects:
Christina Zeibak and Daphne Dow

Location:
Toronto

Investor:
Sukkahville Design Competition

Function:
Meditative space

ConstructionYear:
2012

Dimensions:
3.0 x 3.0 x 3.0 (metric)

ConstructorsTeam:
Daphne Dow and Christina Zeibak

MaterialUsed:
Plywood

MaterialSpent:
xxxxxx

Budget:
xxxxx

MajorFabricationUsed:
Sectioning

OtherFabricationUsed:
xxxxxxxxx

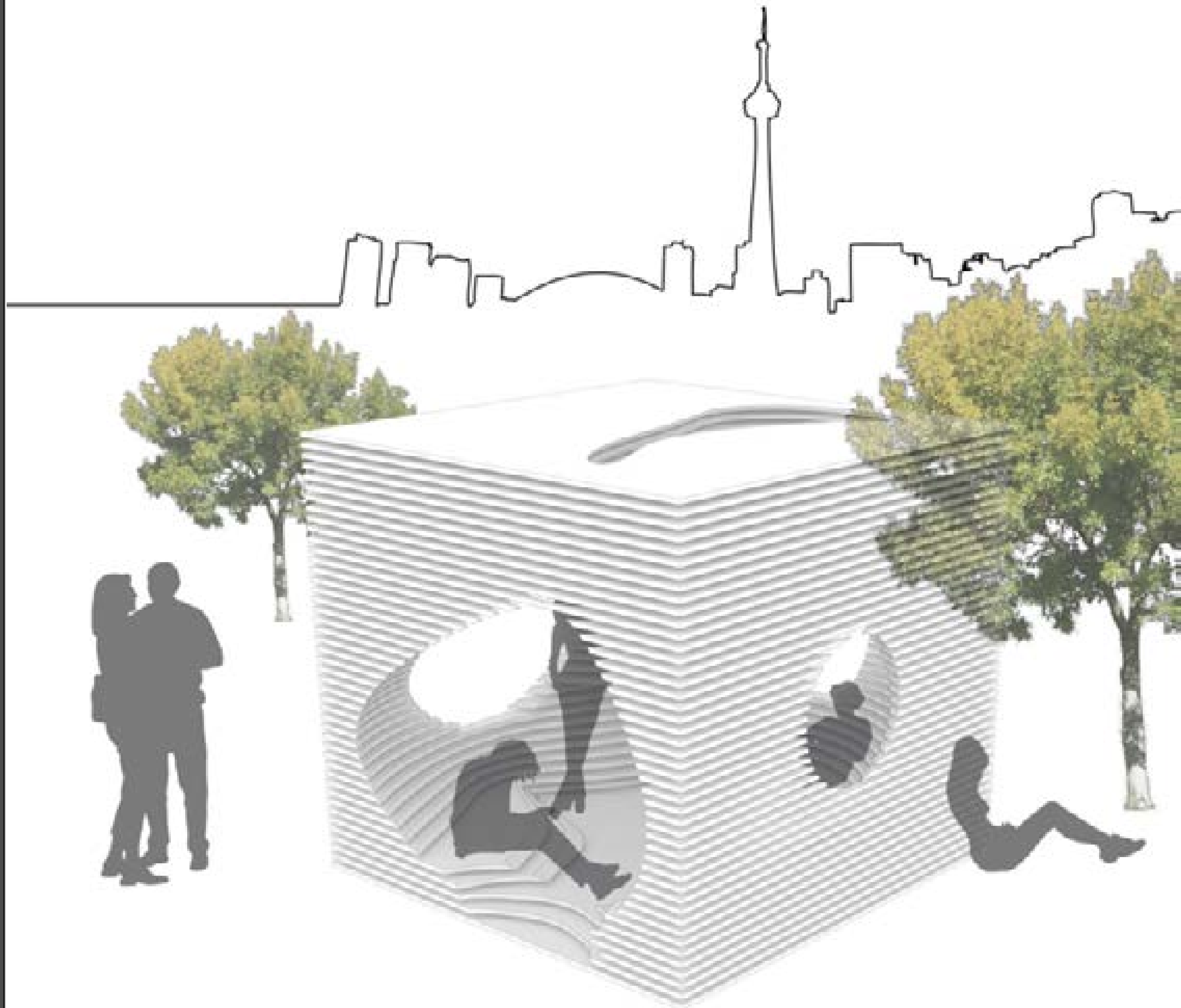
FabricationBy:
Hand-cut

SoftwareUsed:
Rhino - Grasshopper

http://www.archdaily.com/285997/sukkahville-design-competition-winning-exhibition-hegemonikon-christina-zeibak-and-daphne-dow

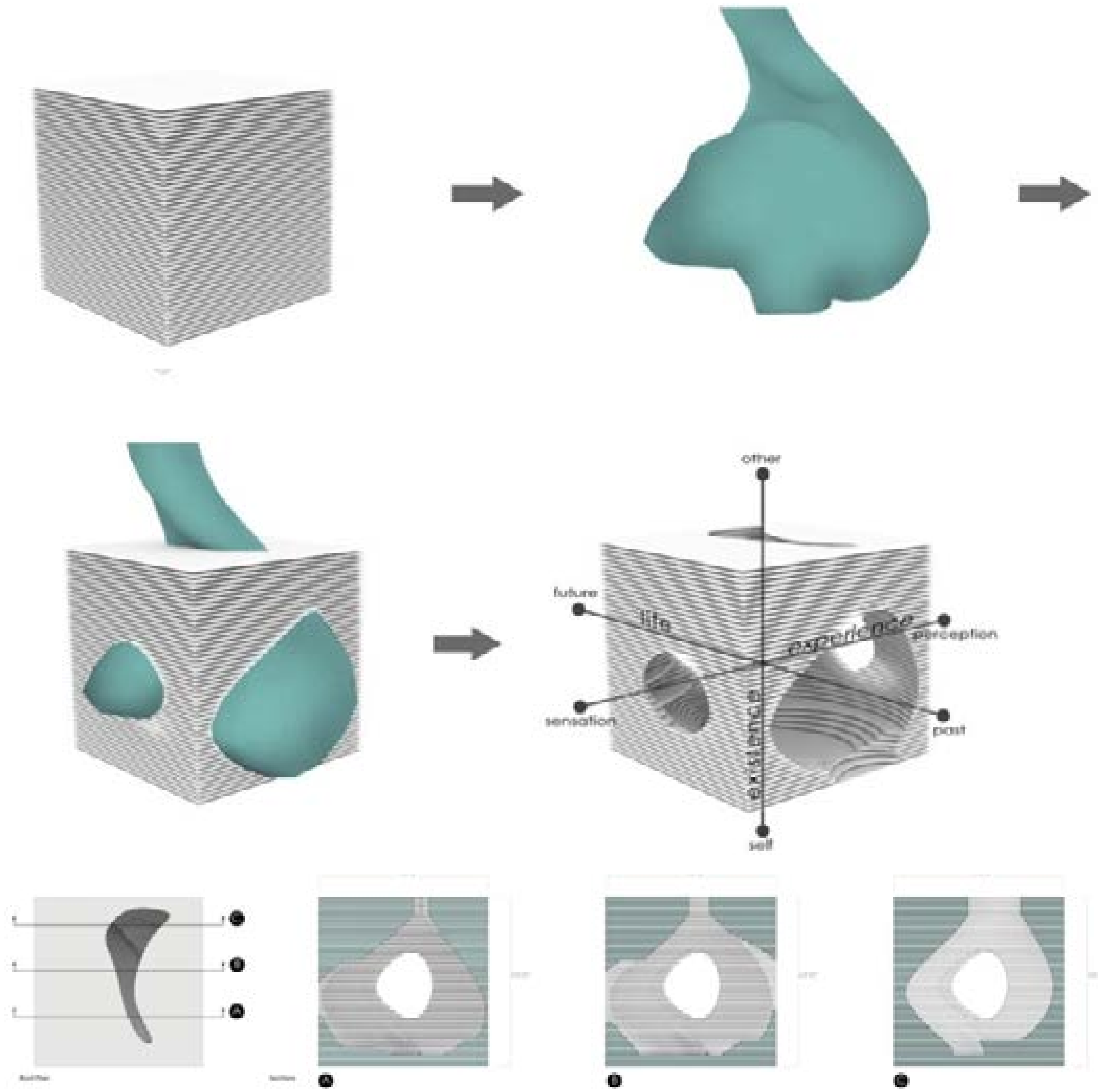
FABRICATION METHODS / process

The Sukkah is simply fabricated from a stack of plywood, spaced apart and hollowed, allowing enough transparency to be inclusive yet enough density to create a sense of being. This design captures the juxtaposition between the simplicity of the plywood and the complexity of the void. As per the Hegemonikon philosophy, once you enter the space, you have left your past: it offers a space in the present where one can mediate upon their future and reflect upon their experience.



MODEL

Stacked Plywood vs Void



EXAMPLE

SECTIONING
Living Pavillion

Behrang Behin and Ann Ha

Anjali Ramachandran

Source:www.behinha.com

PROJECT OVERVIEW

ProjectArchitects:
Behrang Behin and Ann Ha

Location:
Governer's Island, New York

Investor:
FIGMENT, ENYA, SEAoNY

Function:
Temporary green pavilion space

ConstructionYear:
2010

Dimensions:
9.1 x 6.0 x 4.2 meters

ConstructorsTeam:
Structural Analysis: Yunlu Shen
Green Wall Technology: Kari Katzander and Sarah Bray
Construction Foreperson: Daniela Morell
Fabrication: Tietz-Baccon
Plant Supplier: NYC Department of Parks and Recreation Green Thumb program

MaterialUsed:
Timber and plastic dairy crates

MaterialSpent:
437 recycleable plastic dairy crates

Budget:

MajorFabricationUsed:
Bolting

FabricationBy:
Drill and manual

SoftwareUsed:
Rhino - Grasshopper

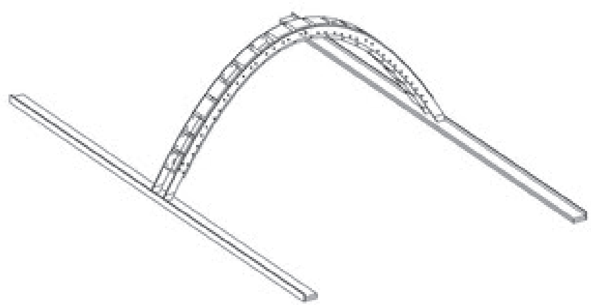
Living pavillion /www.behinha.com

FABRICATION METHODS / process

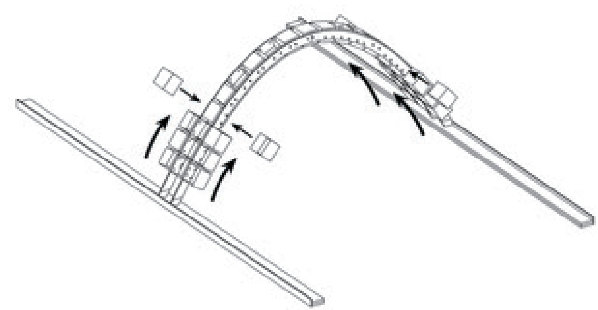
The pavilion's support structure consists of a series of exterior-grade plywood ribs, with 437 recycleable plastic dairy crates connecting the ribs to provide lateral stability.

The ribs are positioned on two plates that are fixed to the ground. The fixing of the ribs and the crates happen at the same time to maintain stability. Hence, the construction starts from the inner two ribs and after fixing three layers of adjacent crates, the outermost ribs are fixed. The inbetween ribs are then fixed and crates filled in until the entire structure is complete.

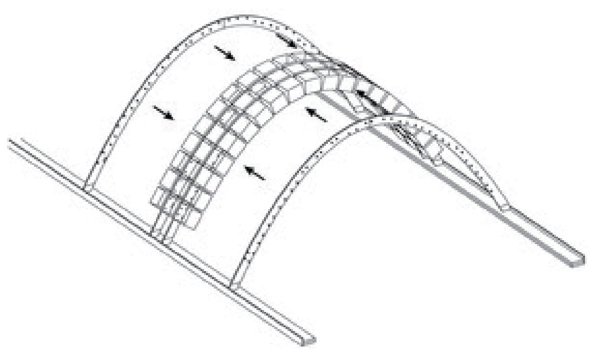
The two plates holding the foot of the ribs are then filled with earth.



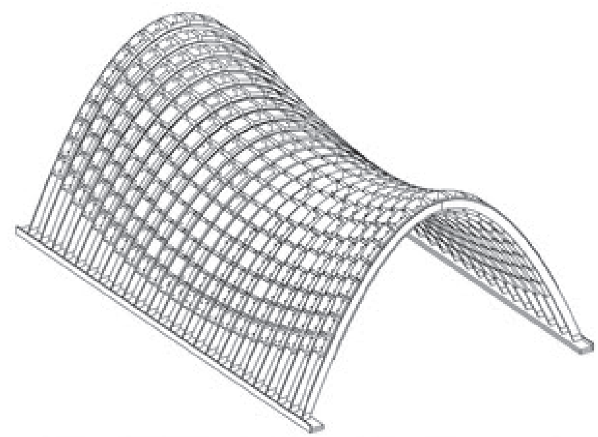
1. CENTRAL ROW OF CRATES AND ADJACENT RIBS ASSEMBLED ON GROUND AND TITLED UP INTO PLACE



2. CRATES FASTENED ONTO OUTSIDE FACE OF PLYWOOD RIBS.

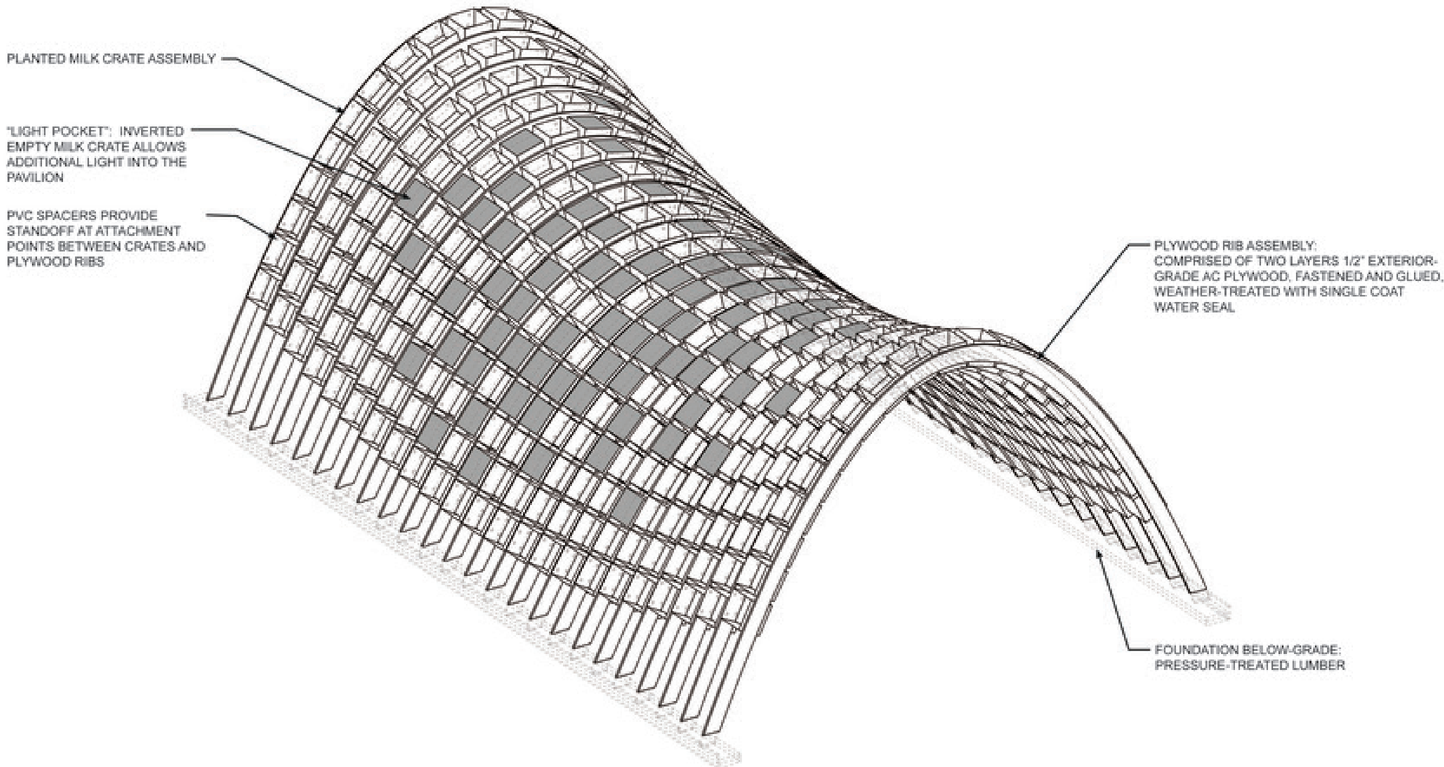


3. NEXT ROW OF PLYWOOD RIBS ASSEMBLED TO OUTSIDE FACE OF CRATES



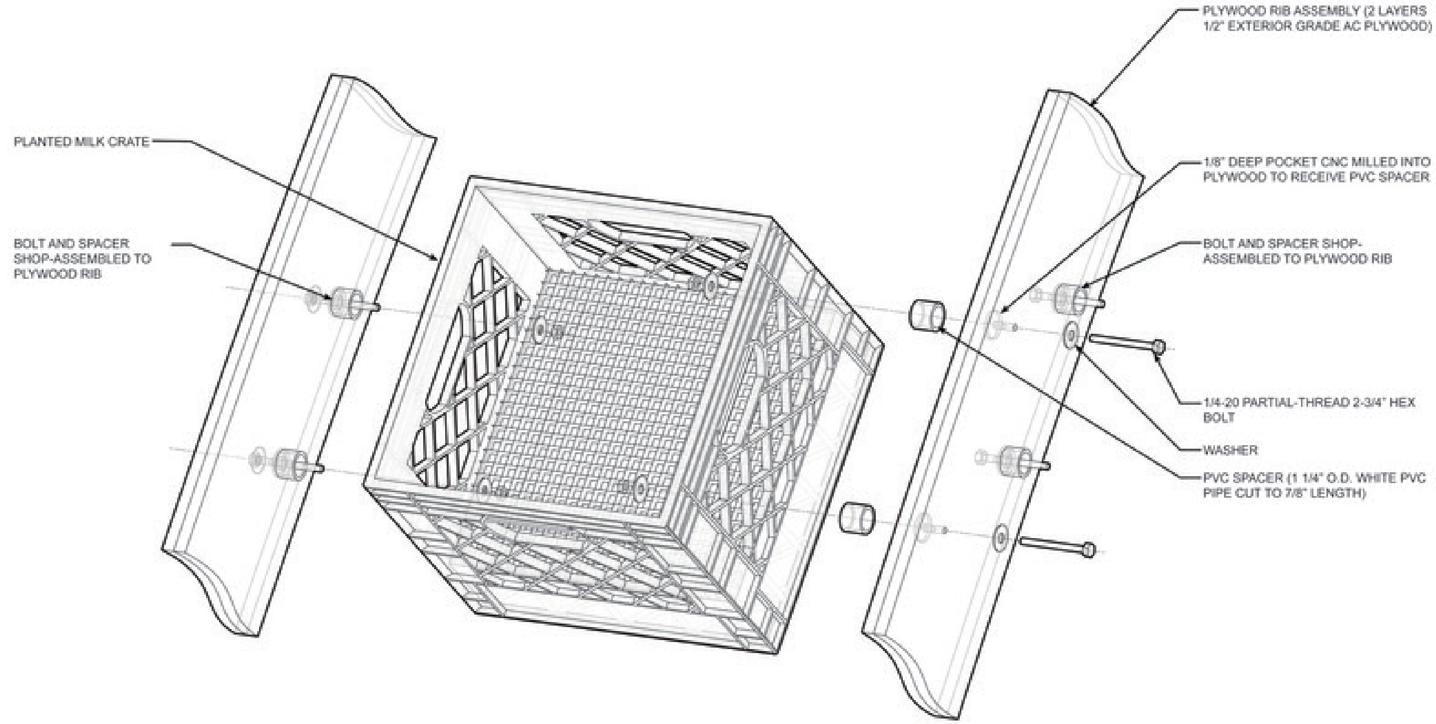
4. PROCEDURE REPEATED UNTIL ASSEMBLY IS COMPLETE. FOUNDATION TRENCHES ARE BACK-FILLED WITH EARTH.

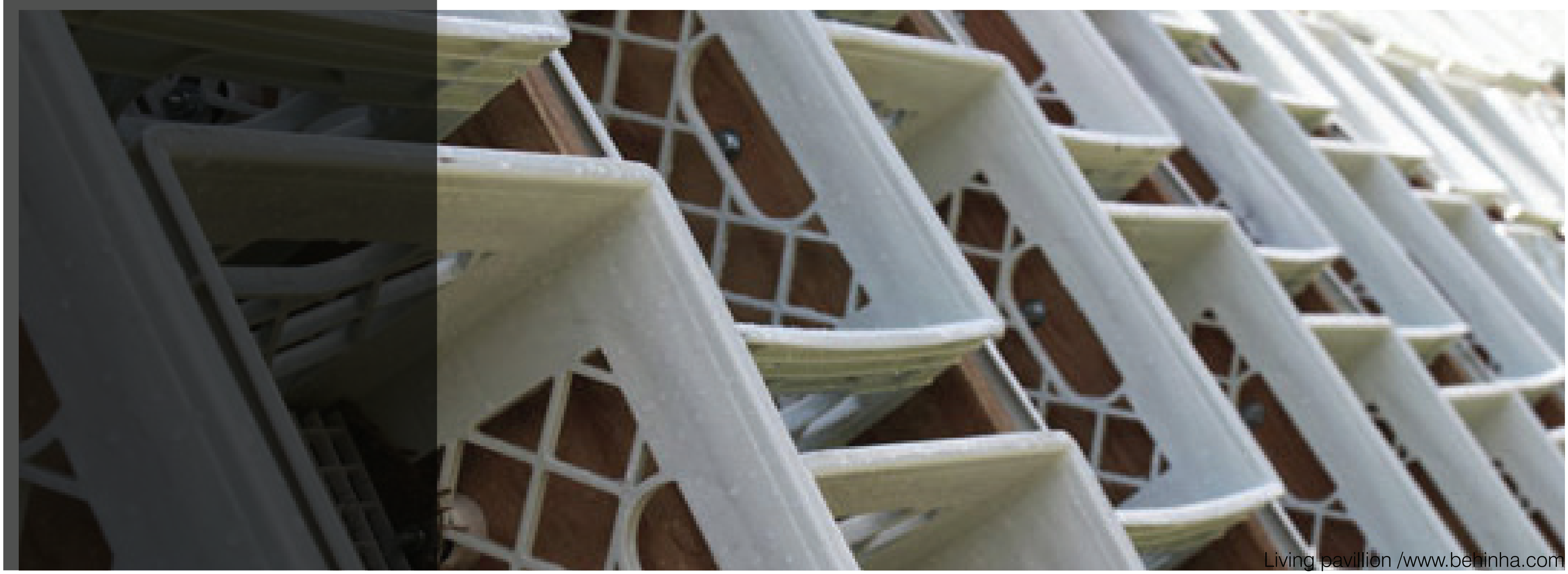
FABRICATION METHODS / process



FABRICATION METHOD / process

The milk crate is already planted while attaching it the first time. The planting method is explained on the next page. These pre-planted crates and then screwed onto the ribs.





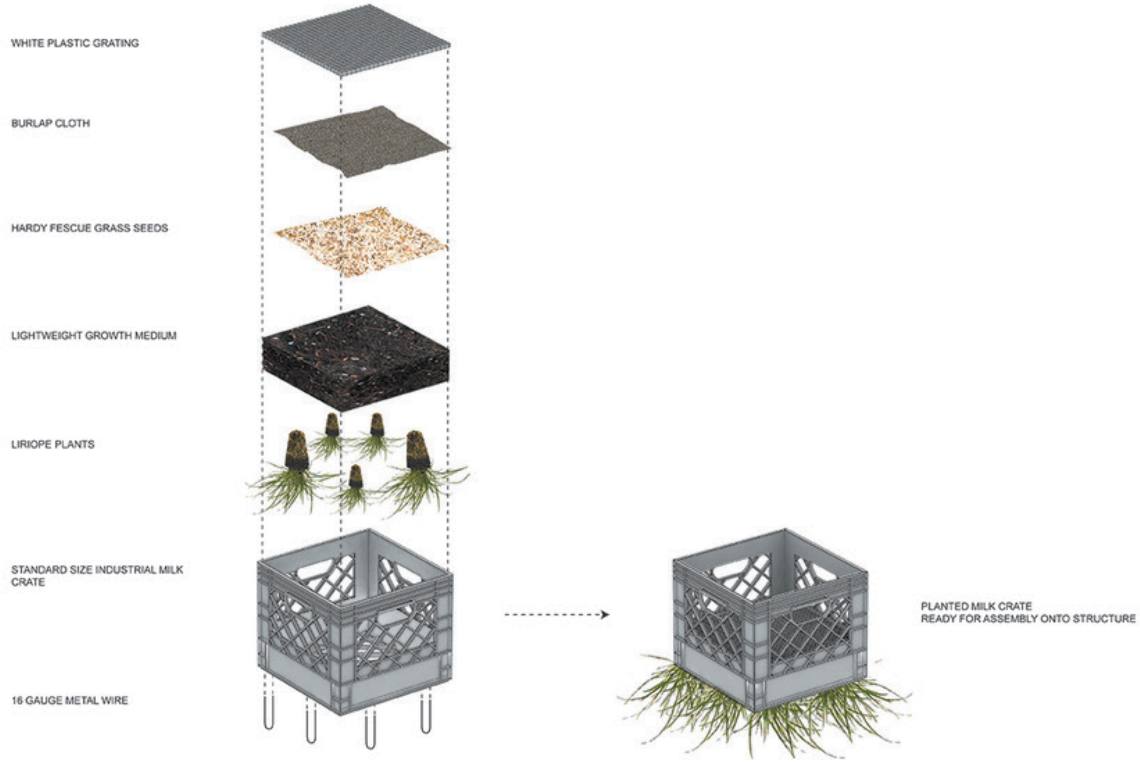
Living pavillion /www.behinha.com

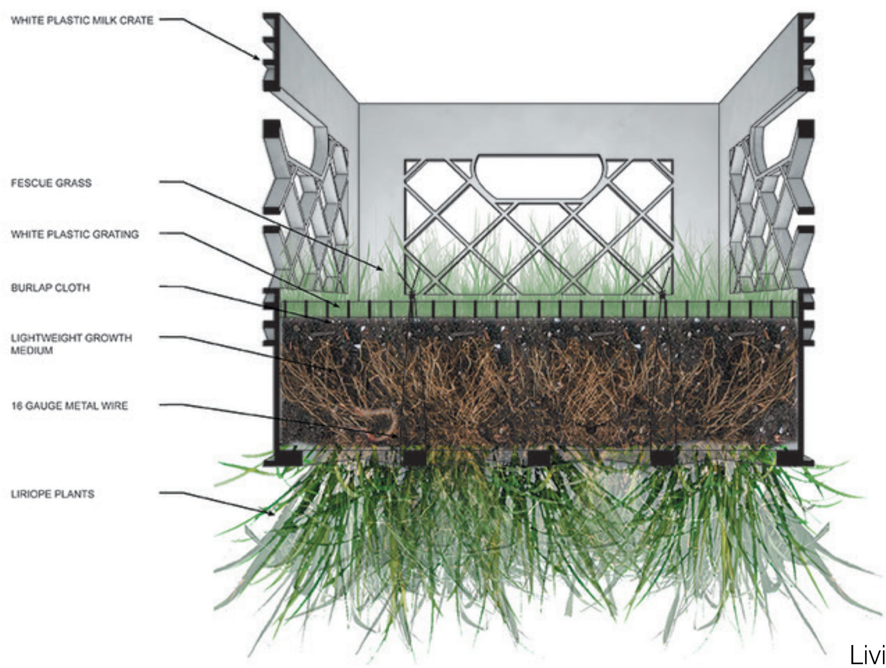
FABRICATION AND METHOD/ pro-
cess

The plants are first fixed onto the crate and a light- weight growth medium (something like mud, coir or a mixture of both that can contain moisture) is the laid on these plants.

The growth medium layer is followed by a layer of Burlap cloth (jute) and plastic grating to anchor the growth medium in place and finally Fescue grass to cool the roots during summer.

All these layers are fixed together by a 16mm gauge metal wire.

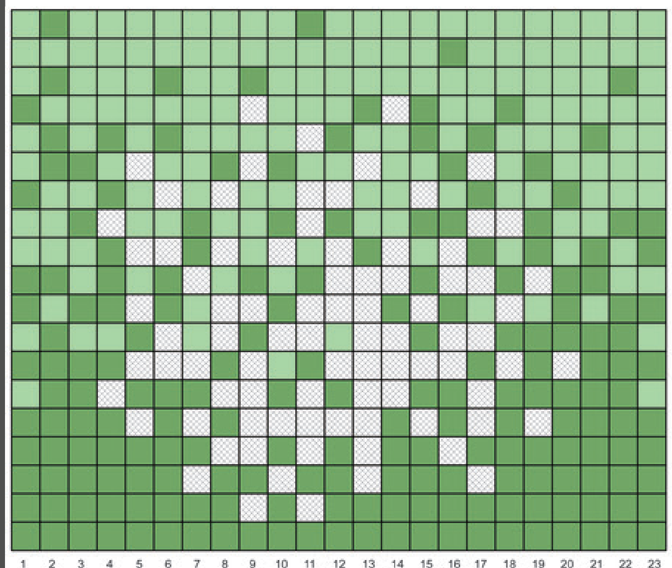




Living pavillion /www.behinha.com

FABRICATION METHOD/ process

The middle image shows the placement of openings (indicated by white) and two different types of plants (indicated by light and dark greens).



MATERIALS AND MACHINES

The project uses two main plain materials and are constrcuted with equal simplicity. The materials used are used milk crates and exterior grade plywood. The plywood ribs are pre-fabricated in a wood workshop and brought to site.

In Dessau:
Dessau has a wooden workshop that has the infrastructure to create a bent wooden form.

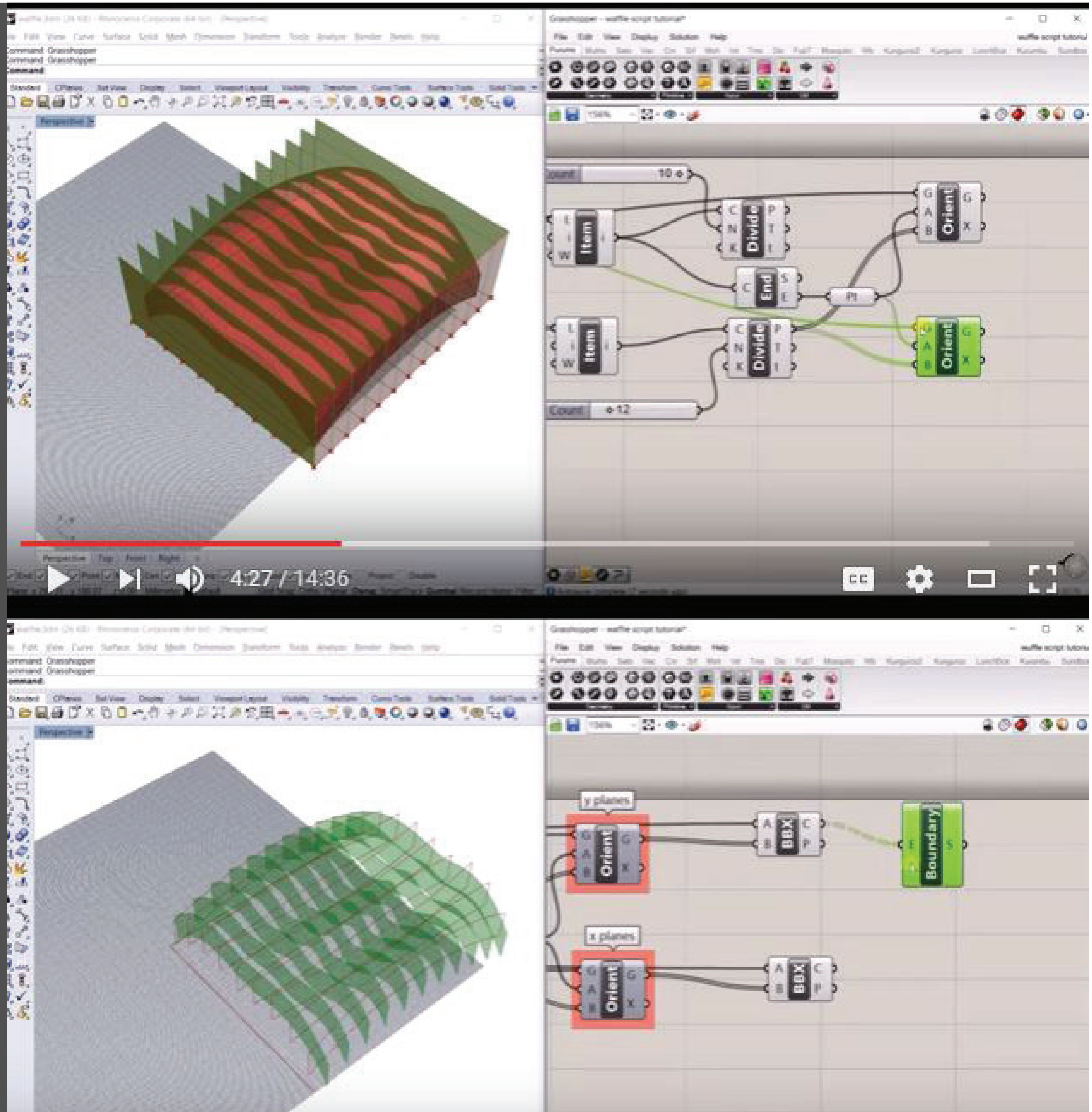
Waste materials like milk crates, egg boxes, cola bottles etc. are not hard to find.

Living pavillion /www.behinha.com

GRASSHOPPER MODEL / def.

The project used Rhino to model the shape and grasshopper to create the desired and accurate section layers.

The image shows a basic sectioning in grasshopper.



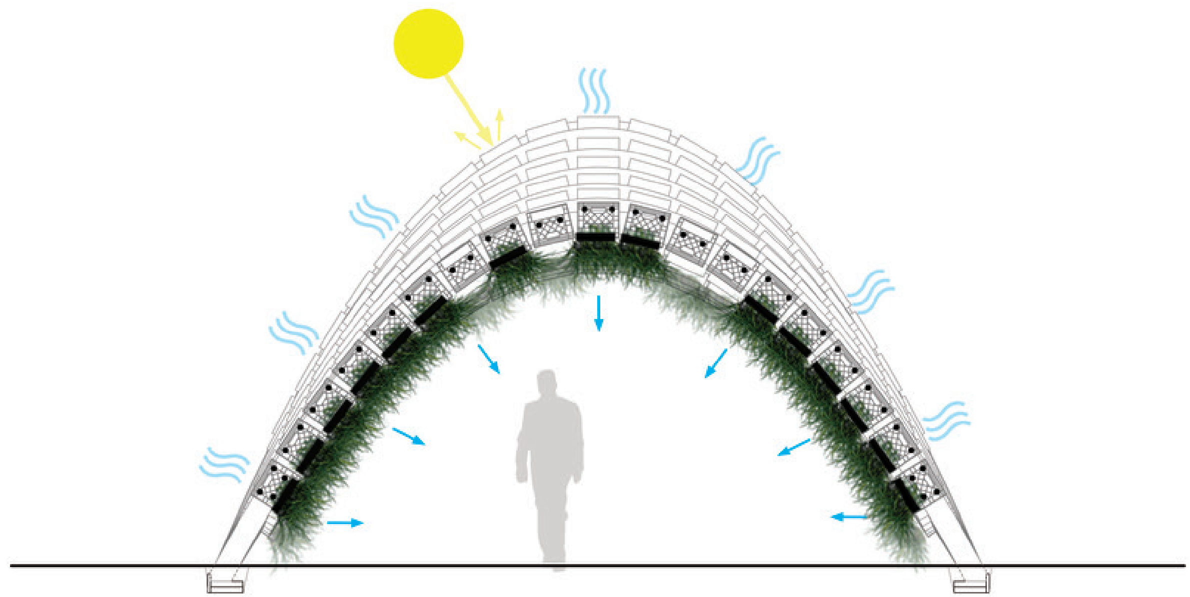
Living pavillion /www.behinha.com

ADVANTAGES

The pavilion is protected from harsh sun making the interior space cooler. The maitenance is also easier as the entire planting layers inside the crates are detachable.

In addition to using materials effectively in its construction, Living Pavilion strives to embody and communicate an ethic of re-use, recycling, and re-purposing.

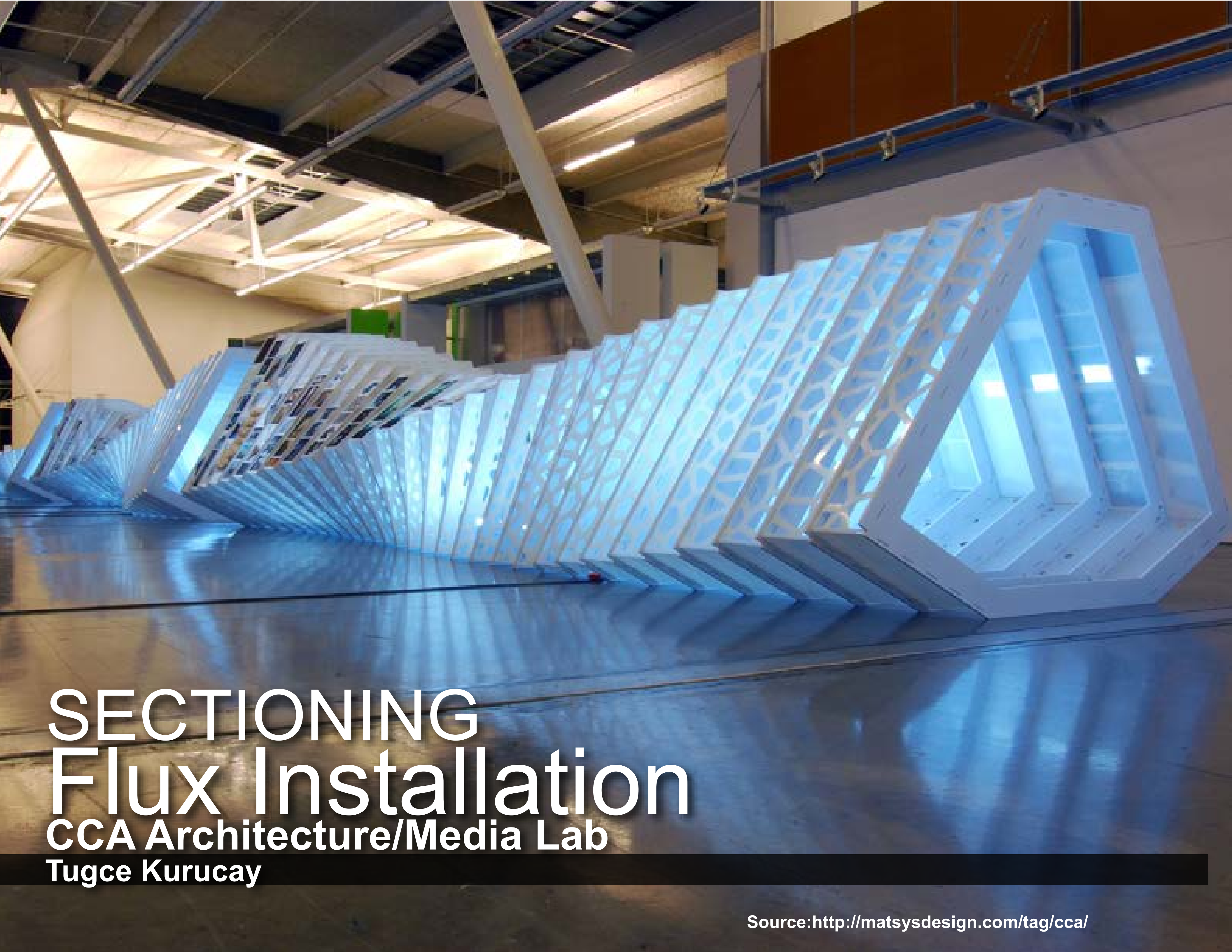
All of the milk crates and plants used in the pavilion were distributed to individuals, parks, and non-profit organizations throughout the New York metropolitan area after the pavilion's dismantling in October 2010. Many of the liriope plants from the Pavilion are currently thriving in various NYC parks.



CONCERTS AND EVENTS

The pavilion becomes a popular event venue during the summer times providing a cool and green space.

Living pavillion /www.behinha.com



SECTIONING
Flux Installation
CCA Architecture/Media Lab
Tugce Kurucay

Source:http://matsysdesign.com/tag/cca/

PROJECT OVERVIEW

ProjectArchitects:
CCA Architecture/Media Lab

Location:
San Francisco, CA United States

Investor:
SolidThinking, K Bieg Design, SUM Arch, Vogue Graphics

Function:
Exhibition Pavilion

ConstructionYear:
2009

Dimensions:
30.48 meter long

ConstructorsTeam:
Kory Bieg, CCA Flux Studio

MaterialUsed:
vertical MDF (medium density fiber-board) ribs and horizontal HDPE (high density polyethylene) panels for the armature.

MajorFabricationUsed:
Vertical Sectioning

FabricationBy:
CNC router

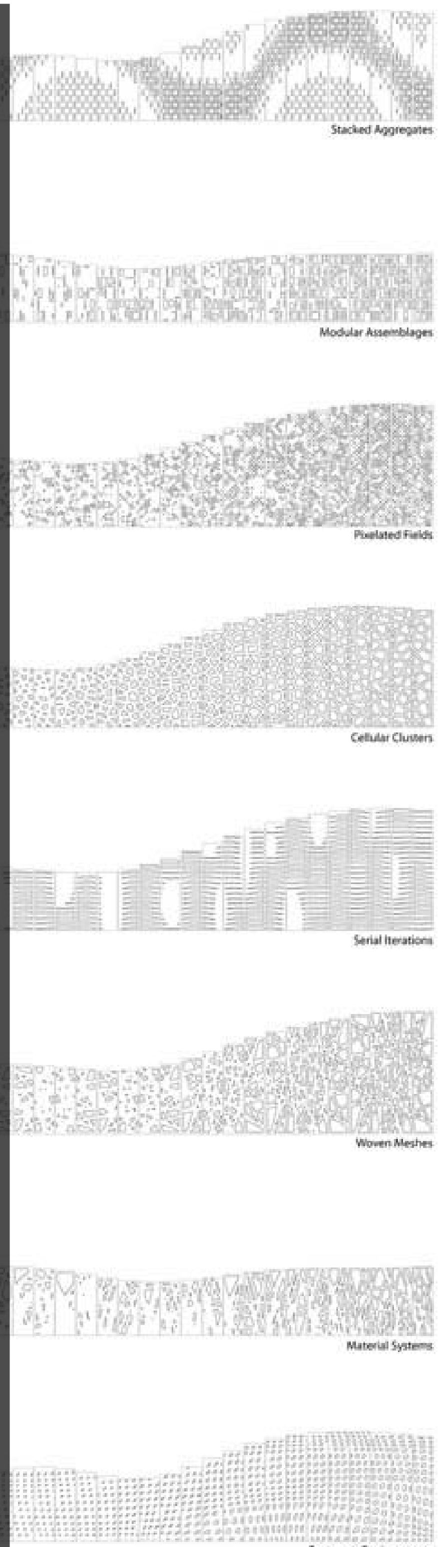
SoftwareUsed:
Rhino - Grasshopper

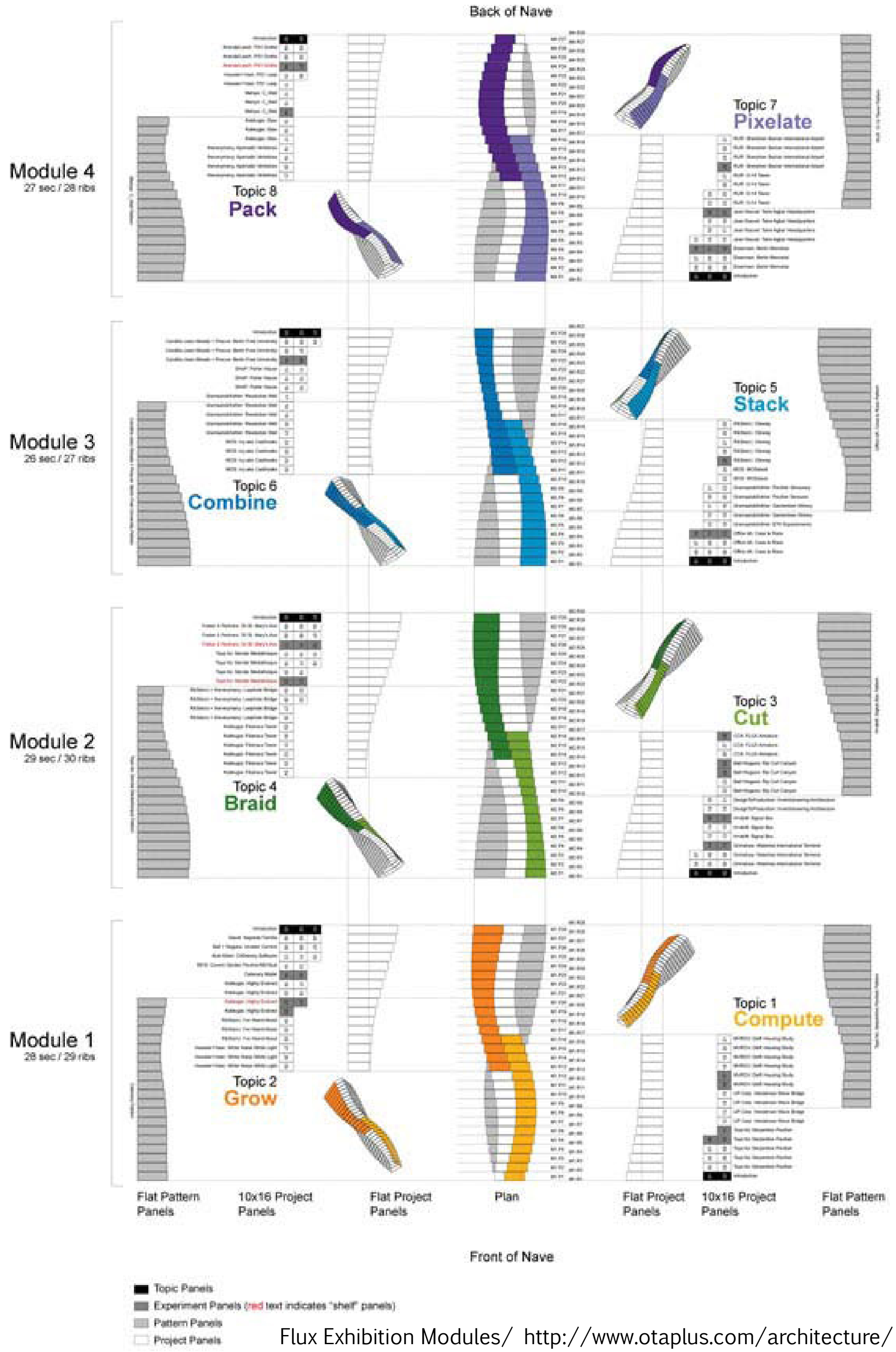
Flux Installation / http://matsysdesign.com/tag/cca/

FABRICATION METHODS / module

Through the use of parametric modeling and a series of custom designed scripts, the installation design can be quickly updated to address new design criteria. From the thickness of the ribs to the overall twisting geometry and perforated skins, the spatial form of the armature is controlled through a complex set of relationships defined by its formal, performative, and fabrication constraints.

Every section of the installation is unique and numbered in sequence, allowing the installation, which is over 30 meter long, to be easily assembled and disassembled in less than 3 hours.

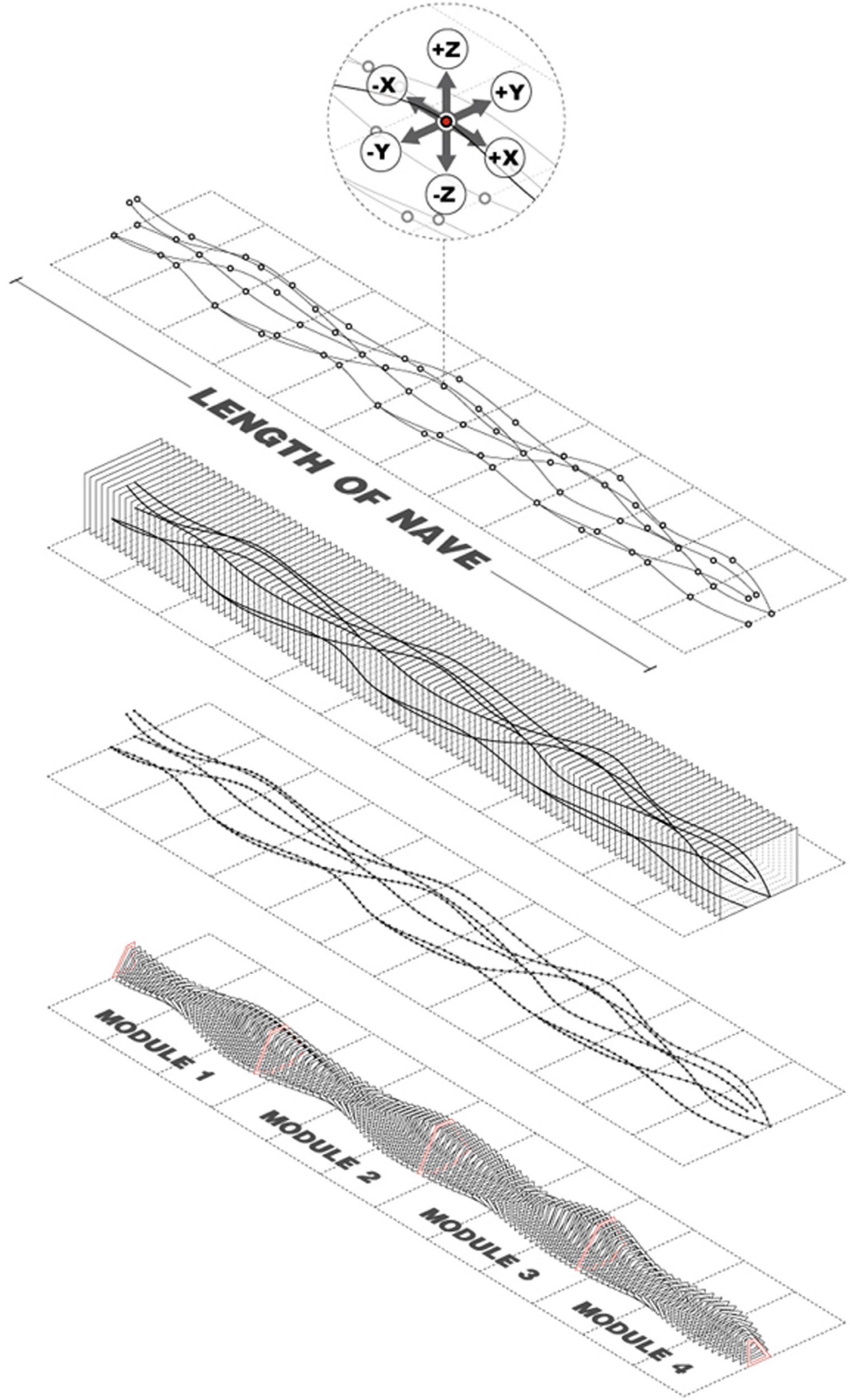




Flux Exhibition Modules/ http://www.otaplus.com/architecture/

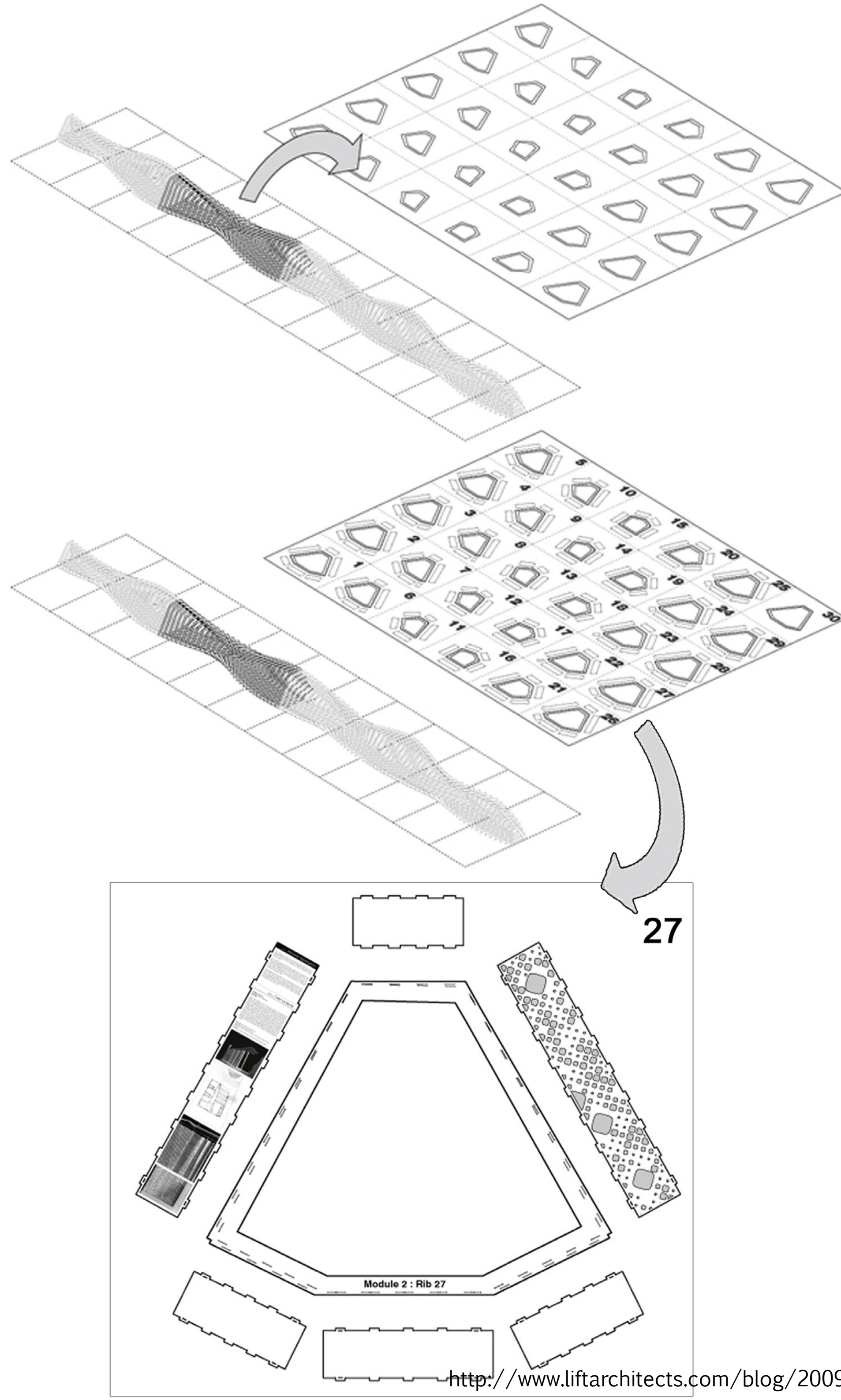
FABRICATION METHODS / module

To create modules, parametric software is used. After couple of steps, assembly module are provided and make the fabrication easier. A series of points, pre-definied in three dimensional space. The points can be controlled by a set of sliders that allow translation along any of the orthographic axes, ultimately driving the shape of each interpolated curve that passes through the control points.
A set of planes are created along the full length of the curve network. The distance between each plane, which controls the spacing between each rib, can be updated by changing a numeric slider.
Because some of the interpolated lines in the curve network do not run the full length of the nave, but instead of the two main lines, the topology of the curves would yield an unloftable surface. However, the software can solve the intersection between a plane and a curve which results in a point. A line can be created between each new intersection point to form the outlines of each rib.
The outside rib curves are offset 10 cm to create the inside of each rib curve. The ribs are then split into four modules for easier installation.



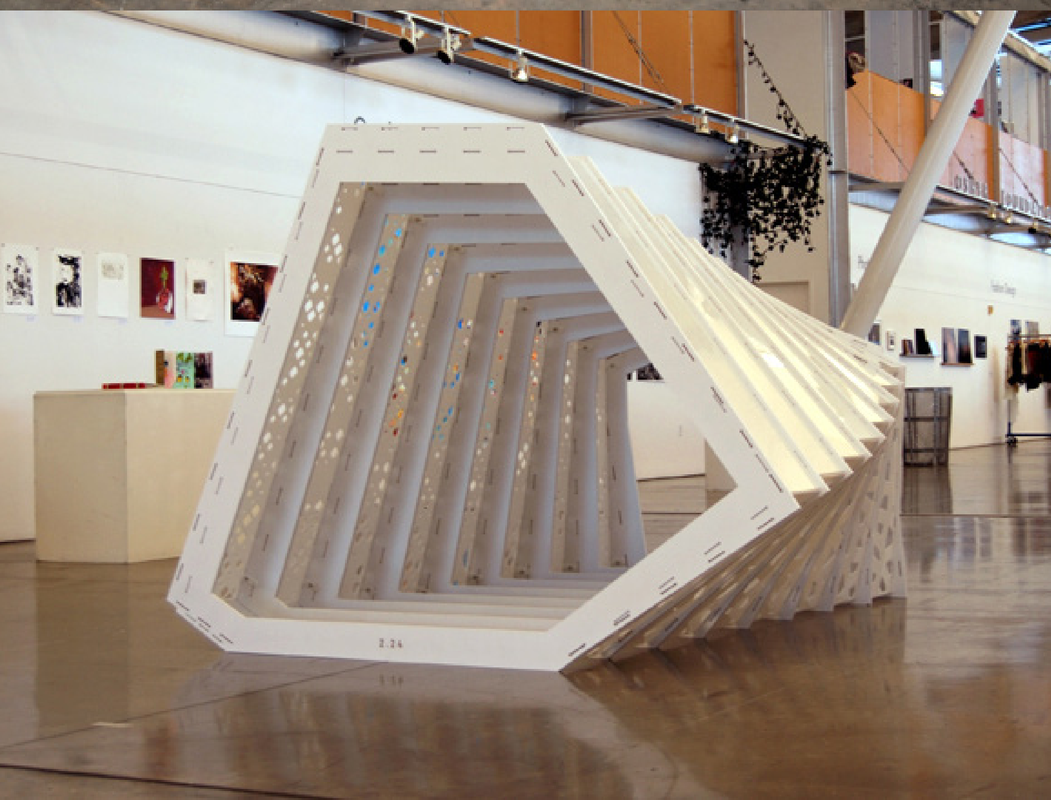
FABRICATION METHODS / module

Each rib set is then re-oriented to the XY plane to facilitate the CNC milling process.
Once the rib curves have been flattened, the outlines can be offset and subdivided to create a series of notches in the ribs and the corresponding tabs on each side of the plexiglass panels. The software evaluates the length of each piece of plexiglass and determines the number of subdivisions on each side, so that longer panels have more tabs and thus more support than smaller pieces.
At below is a detail view of a flattened rib and the corresponding pleixglass panels. The perforations that occur in some of the panels are created in Rhinoscript and are coordinated with one of the eight architectural topics represented in the exhibition.



http://www.liftarchitects.com/blog/2009/3/23/flux-parametrics

FABRICATION METHODS / process

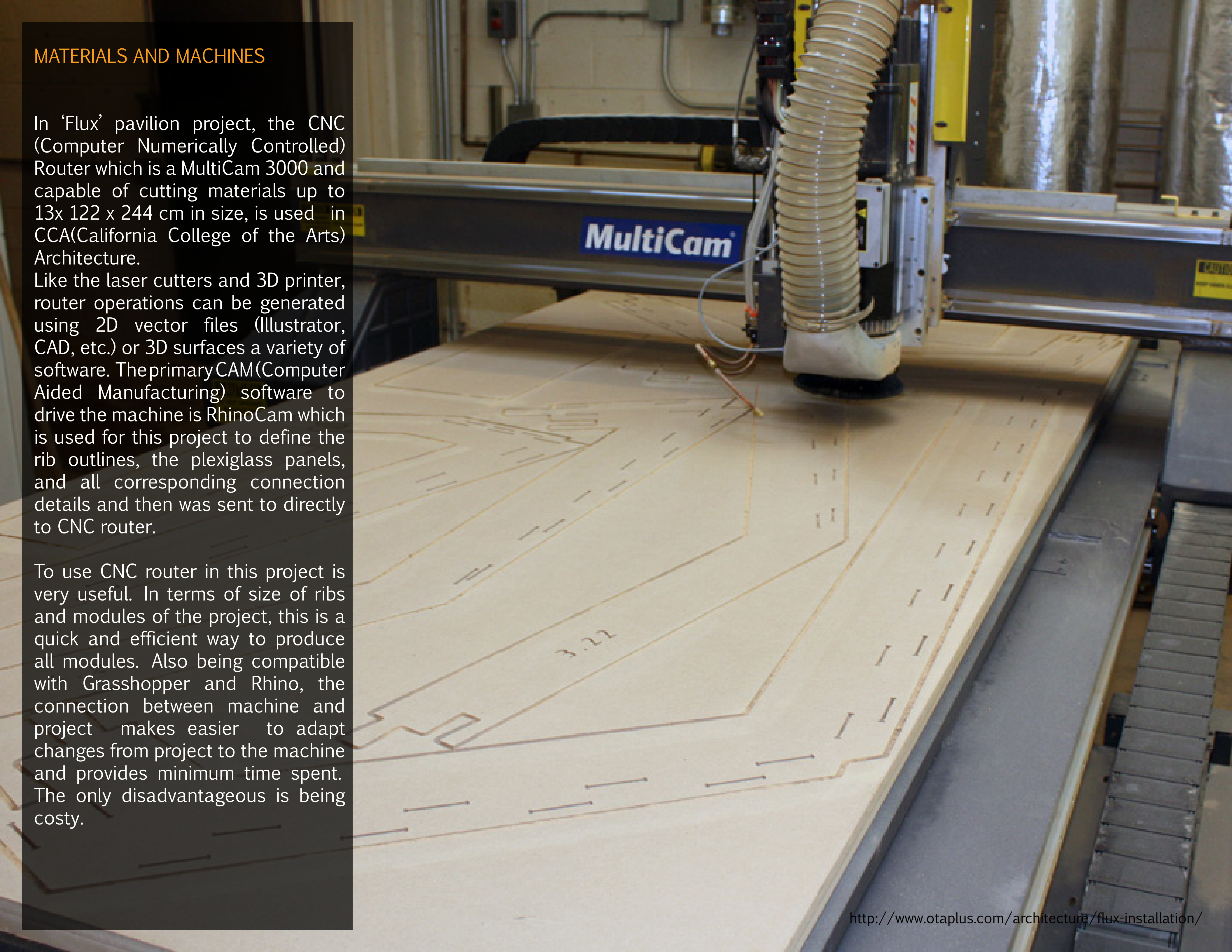


http://www.liftarchitects.com/blog/2009/3/24/flux-fabrication

MATERIALS AND MACHINES

In 'Flux' pavilion project, the CNC (Computer Numerically Controlled) Router which is a MultiCam 3000 and capable of cutting materials up to 13x 122 x 244 cm in size, is used in CCA(California College of the Arts) Architecture.
Like the laser cutters and 3D printer, router operations can be generated using 2D vector files (Illustrator, CAD, etc.) or 3D surfaces a variety of software. The primary CAM(Computer Aided Manufacturing) software to drive the machine is RhinoCam which is used for this project to define the rib outlines, the plexiglass panels, and all corresponding connection details and then was sent to directly to CNC router.

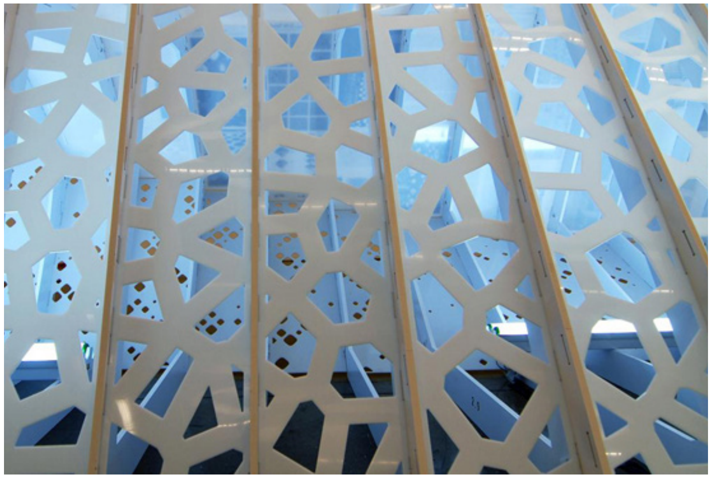
To use CNC router in this project is very useful. In terms of size of ribs and modules of the project, this is a quick and efficient way to produce all modules. Also being compatible with Grasshopper and Rhino, the connection between machine and project makes easier to adapt changes from project to the machine and provides minimum time spent. The only disadvantageous is being costy.

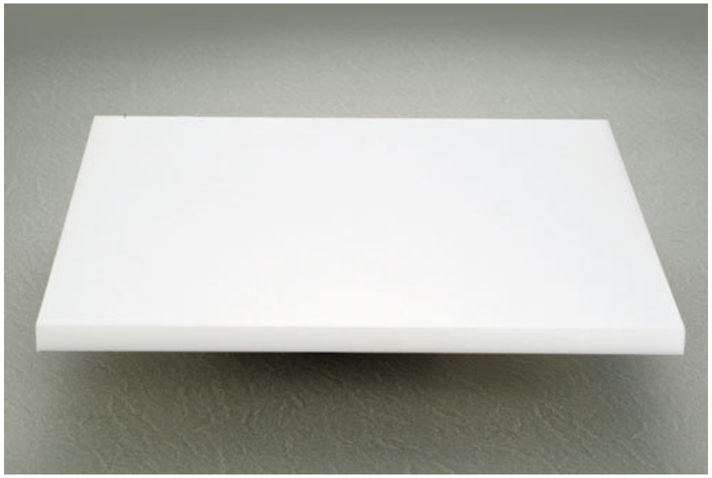


http://www.otaplus.com/architecture/flux-installation/

MATERIALS AND MACHINES

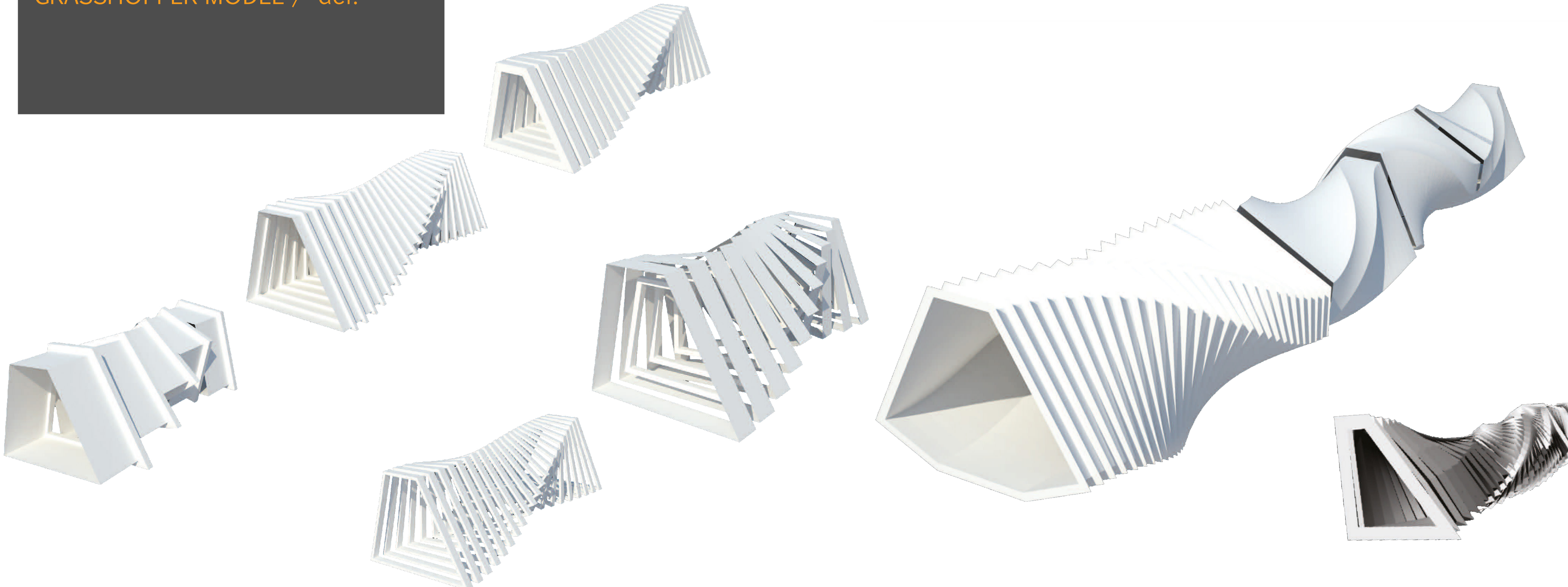
In the project, MDF (medium density fiber-board) for all vertical ribs and HDPE (high density polyethylene) plexiglass for the exhibition panels for the armature are used as materials. In the connection between plexiglass panel and MDf vertical ribs, there is a plexiglass piece attached to panels and connected to MDF with screw and wing or normal nuts.

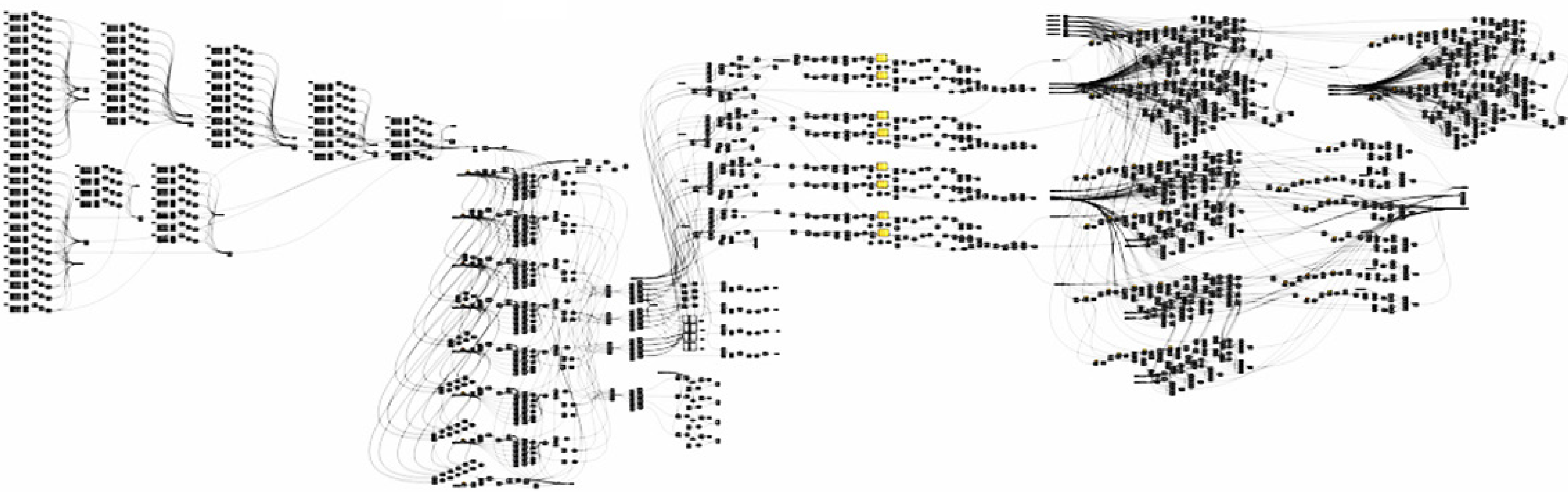




http://www.otaplus.com/architecture/flux-installation/

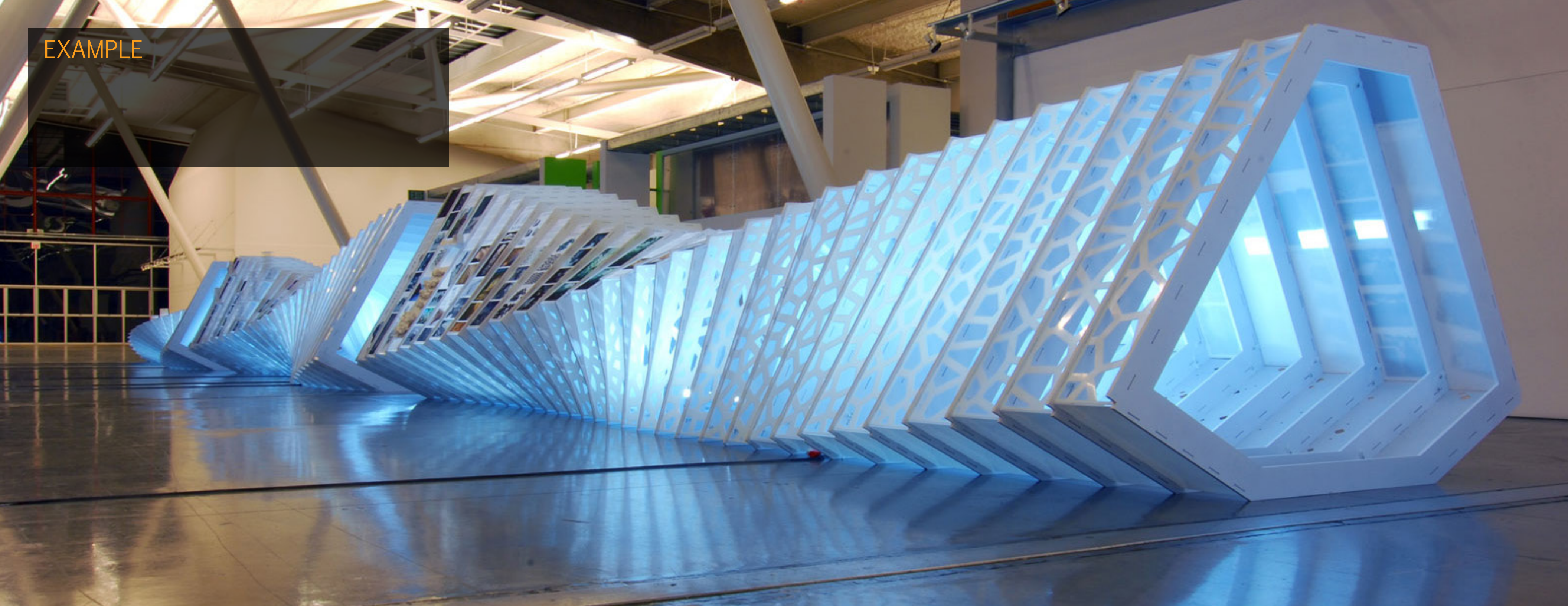
GRASSHOPPER MODEL / def.

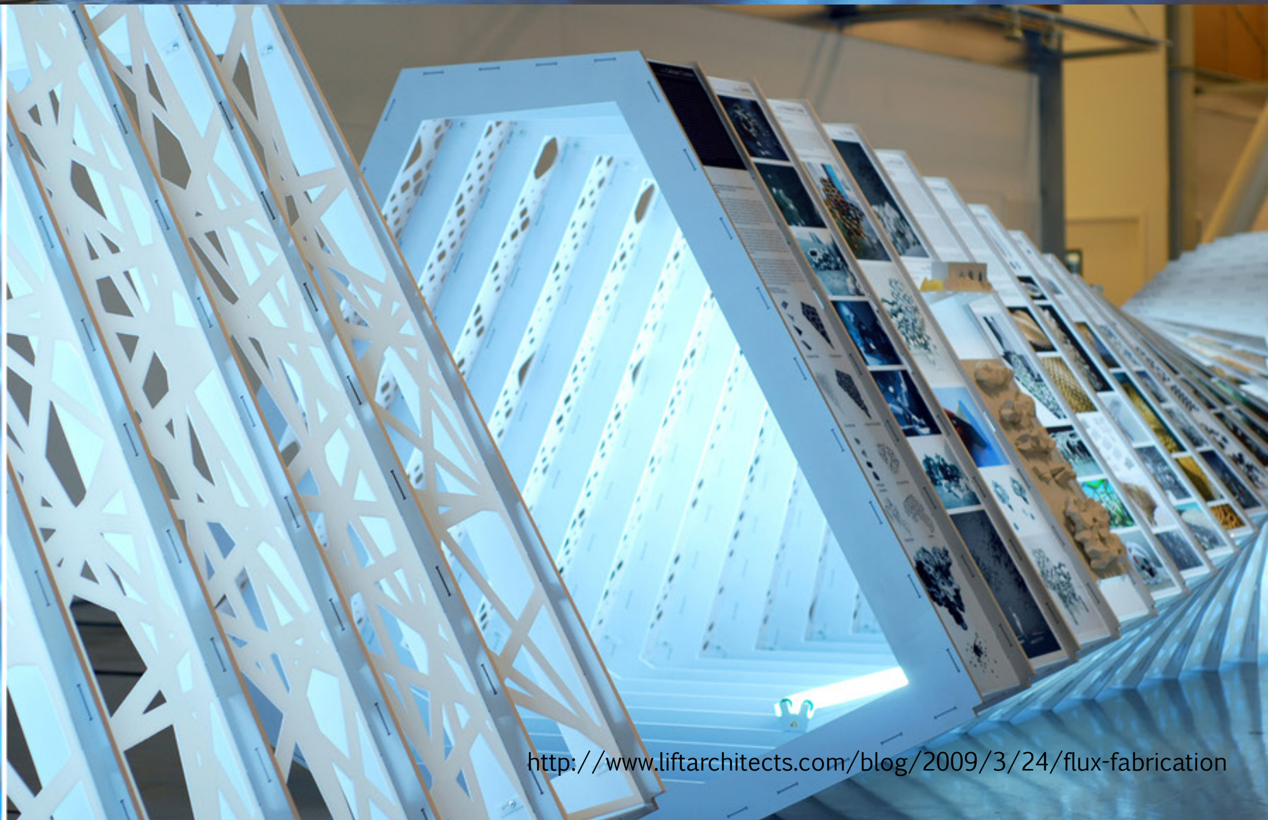




http://www.otaplus.com/architecture/flux-installation/

EXAMPLE





http://www.liftarchitects.com/blog/2009/3/24/flux-fabrication

EXAMPLE

http://www.liftarchitects.com/blog/2009/3/24/flux-fabrication


SECTIONING
Swoosh Pavilion
Architectural Association
Yigit Tuncel
Source: http://designandmake.aaschool.ac.uk/aa-summer-pavilions/

SWOOSH PAVILION

ProjectArchitects:
2nd & 3th year students s tutored by Charles Walker and Martin Self at the AA

Location:
Architectural Association, Bedford Square, London

Investor:
Arup, Finnforest, HOK and media partner BD

Function:
AA Summer Pavilion

ConstructionYear:
2008

Dimensions:
height 2,5-3,5m

ConstructorsTeam:
2nd & 3th year students tutored by Charles Walker and Martin Self at the AA

MaterialUsed:
Wood (a laminated veneer lumber, 27mm thick for the beams and 51mm thick for the columns)

MaterialSpent
653 Pieces of Timber

MajorFabricationUsed:
Waffle

FabricationBy:
CNC Machine

SoftwareUsed:
Rhino - Grasshopper & Autocad

swoosh pavilion/ http://designandmake.aaschool.ac.uk/aa-summer-pavilions/

FABRICATION METHODS / process

The Base

The structure sits on two steel bases, each made up of four interconnected parts, which are prefabricated and coated with black primer by manufacturer Sheetfabs.

The students designed the base to weigh over 6 tonnes in order to secure the cantilevered columns. The pavilion will be lifted on to the carefully positioned base once it has been built.

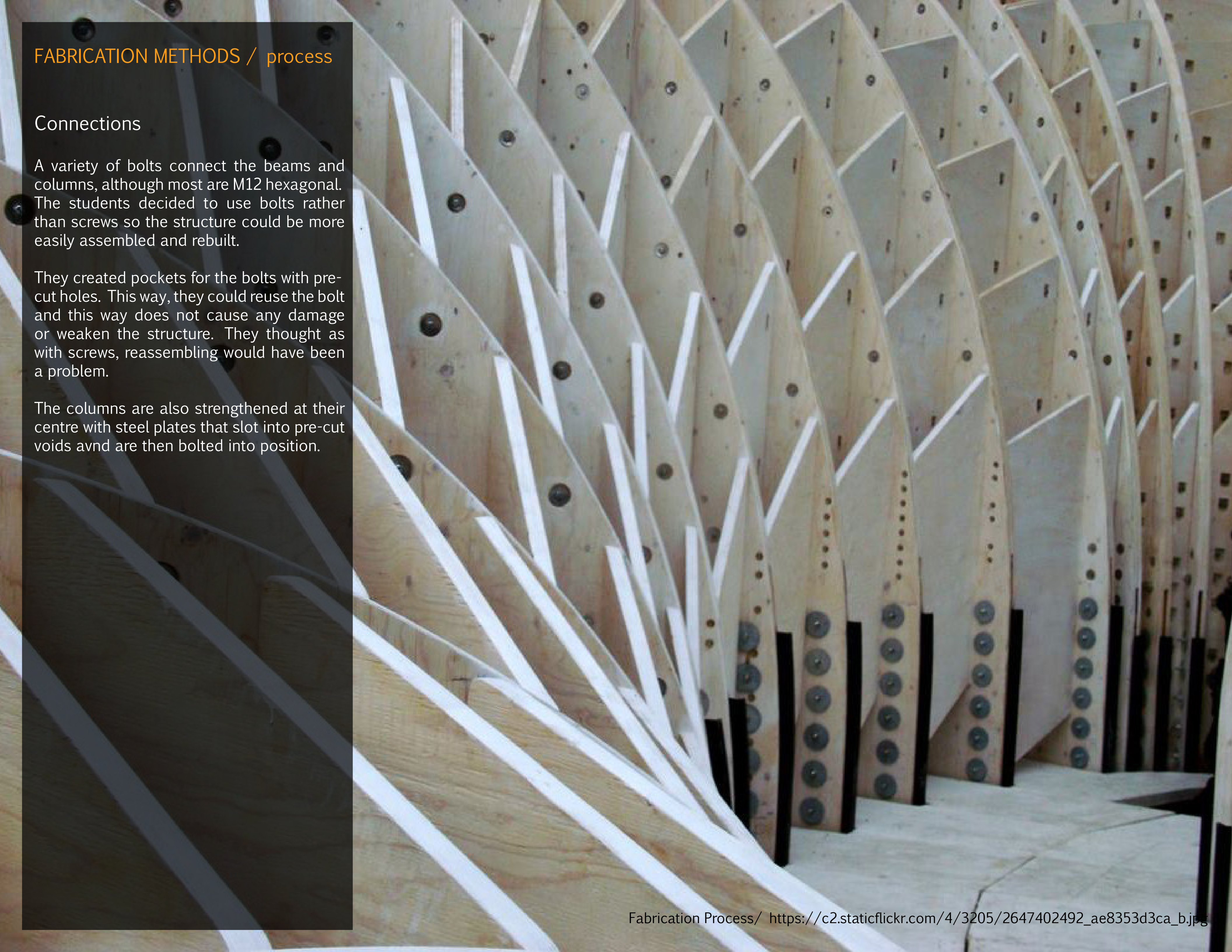
Vertical steel sheets slot into pre-cut voids at the base of each column and are bolted to set the steel ends flush against the timber. This is the only visible evidence of the base as the steel floor is covered by a timber stage and seating.

Only five sections are not connected to the base — those at the end of each tail, which act as benches. These don't require additional support; each bench is being made individually and bolted together.

Arranging the Beams and Columns

Each beam and column has been carefully labelled to correlate with the plan. For example, beam A-12-T05 corresponds to column A-12, and is slotted between beam A-12-T04 and A-12-T06. The labels, cut into the timber surfaces, have been clearly left on display. This means the pavilion can be easily assembled stored and rebuilt.

Fabrication Process/ http://www.bdonline.co.uk/swoosh-pavilion-swoops-into-view-at-the-aa/



FABRICATION METHODS / process

Connections

A variety of bolts connect the beams and columns, although most are M12 hexagonal. The students decided to use bolts rather than screws so the structure could be more easily assembled and rebuilt.

They created pockets for the bolts with pre-cut holes. This way, they could reuse the bolt and this way does not cause any damage or weaken the structure. They thought as with screws, reassembling would have been a problem.

The columns are also strengthened at their centre with steel plates that slot into pre-cut voids avnd are then bolted into position.

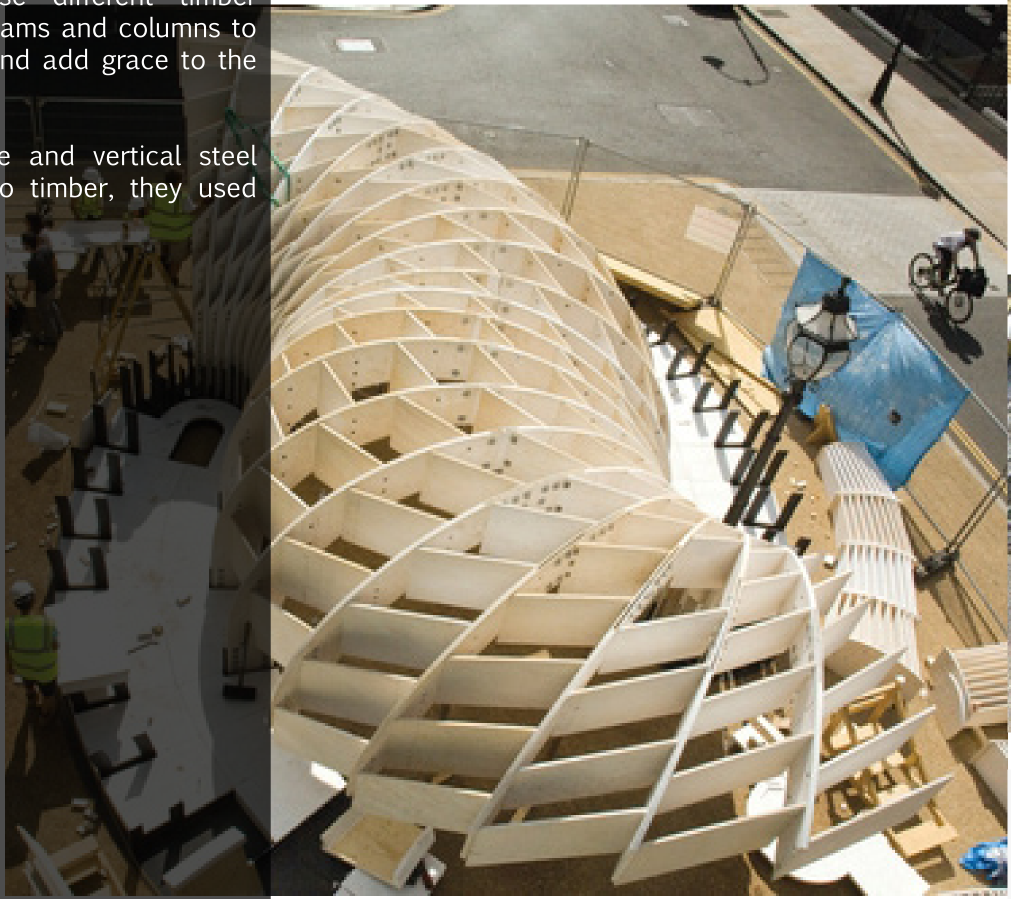
Fabrication Process/ https://c2.staticflickr.com/4/3205/2647402492_ae8353d3ca_b.jpg

MATERIALS AND MACHINES

The structure is made almost entirely out of Kerto, a laminated veneer lumber donated by Finnforest. The students specified sheets 27mm thick for the beams and 51mm thick for the columns.

They decided to use different timber thicknesses for the beams and columns to add a further detail and add grace to the pavilion.

They used steel base and vertical steel sheets. To connect to timber, they used bolts and nails.



MATERIALS AND MACHINES

The Machine

Students cut 549 beams from the 27mm sheets using a CNC machine. Since the 62 columns were too large to cut from one 51mm sheet, many were formed out of two or three separate pieces.

The design uses a lot of material, which inevitably led to a mountain of offcuts. Some of these have been ingeniously recycled to create tools such as a trolley and the library stands that stored batches of beams.

Using CNC machine has disadvantegous in this project in terms of sizes that machine can cut off. Because of the machine constraints, so many elements of the projects has so many pieces and that could make the job slower while assembling. On the other hand finishing to cut off in a short time is an advantegous of the machine.

CNC machine/ hhttp://i01.i.aliimg.com/img/pb/817/054/252/1275536337257_hz-fileserver3_1575559.jpg

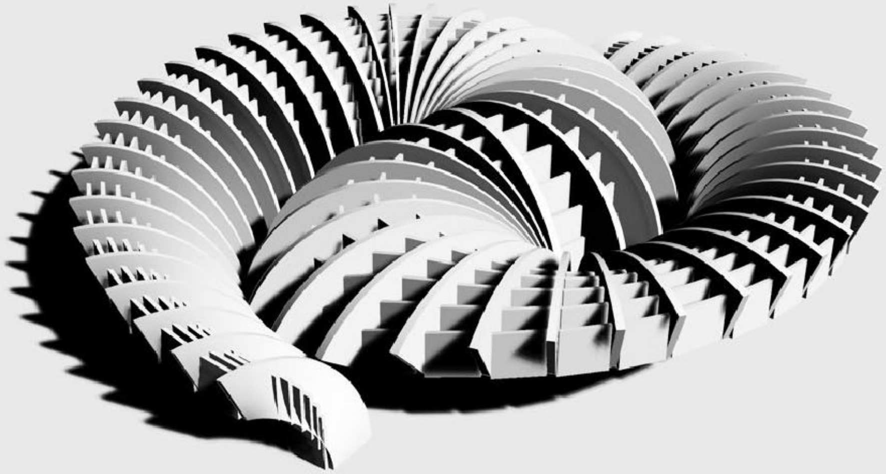
GRASSHOPPER MODEL / def.

Software programs Rhino and Autocad were used to design the original concept: Autocad mainly for measurements and labelling, and Rhino for quicker modelling and 3D visualisation.

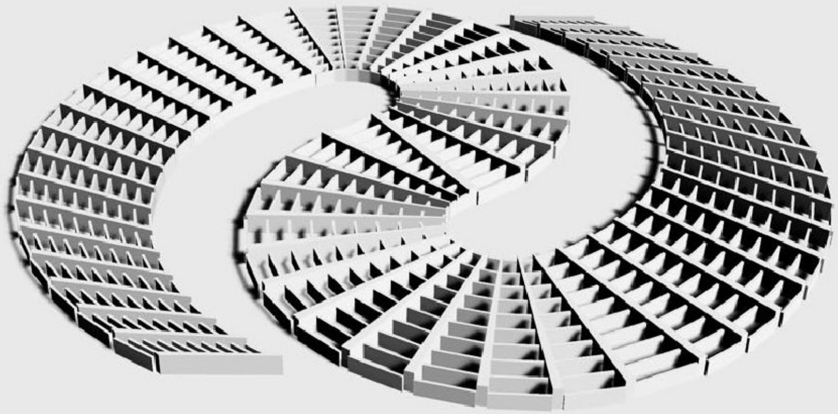
The plan is devised around two setting points, A and B, and two identical columns, A01 and B01, which run between the two. From the setting points, 30 more columns spiral outwards in each direction, creating a completely symmetrical form. Columns A01 and B01 form an archway, 3.3m in height. The remaining columns then get taller as they cantilever out to create a partly enclosed space.

At column B17 and A17, the pavilion reaches its highest point of 4.5m. From here, the beams reduce in height, eventually reconnecting with the floor to create benches at the tail end of each spiral. Ten equally spaced beams run in the voids between the columns, with the spacing becoming increasingly dense as the length of the columns reduce.

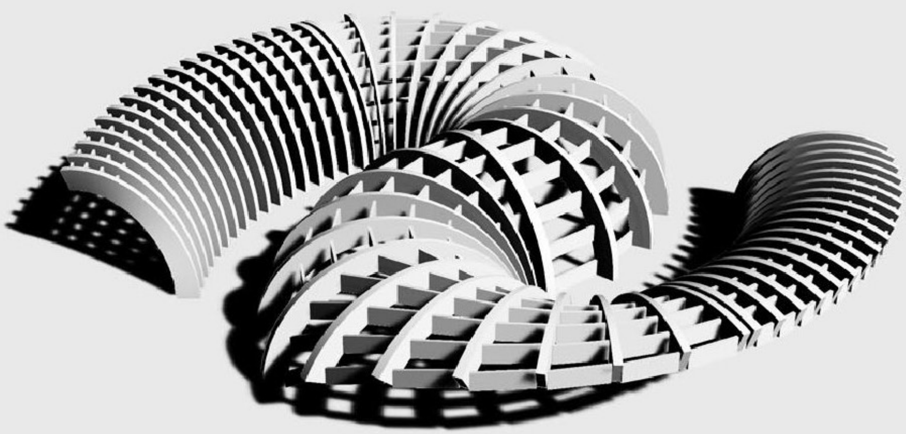
The beams get closer and closer together until eventually they are close enough to form a comfortable seat at the ends.



1st Iteration
Adjusting the thickness of columns

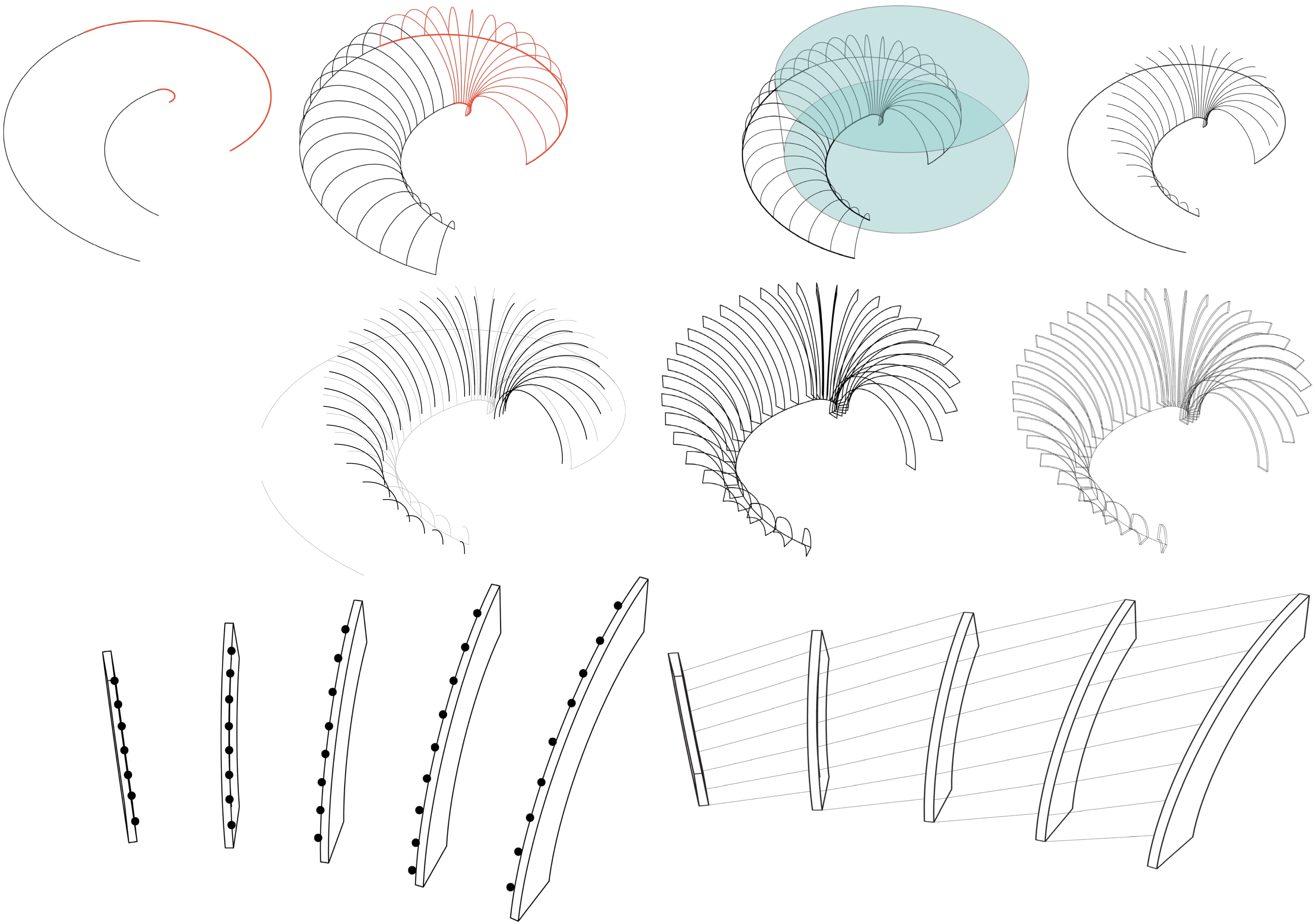


2nd Iteration
Adjusting the radius of columns

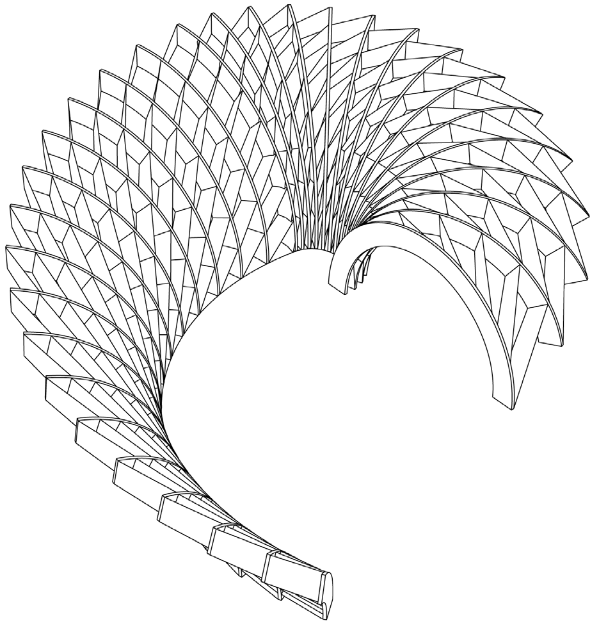


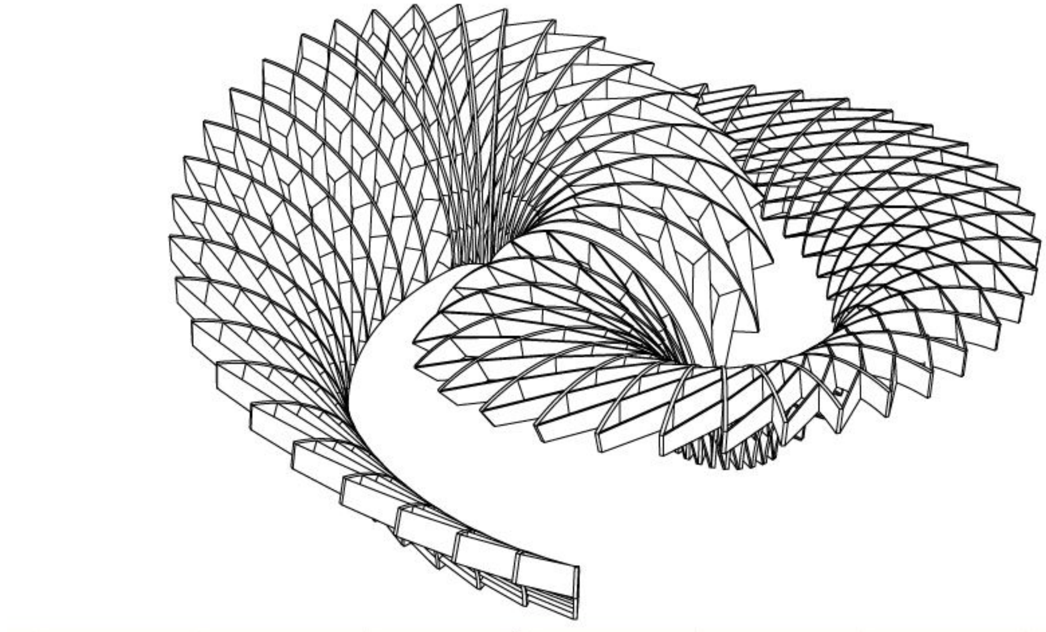
3rd Iteration
Adjusting the density of columns

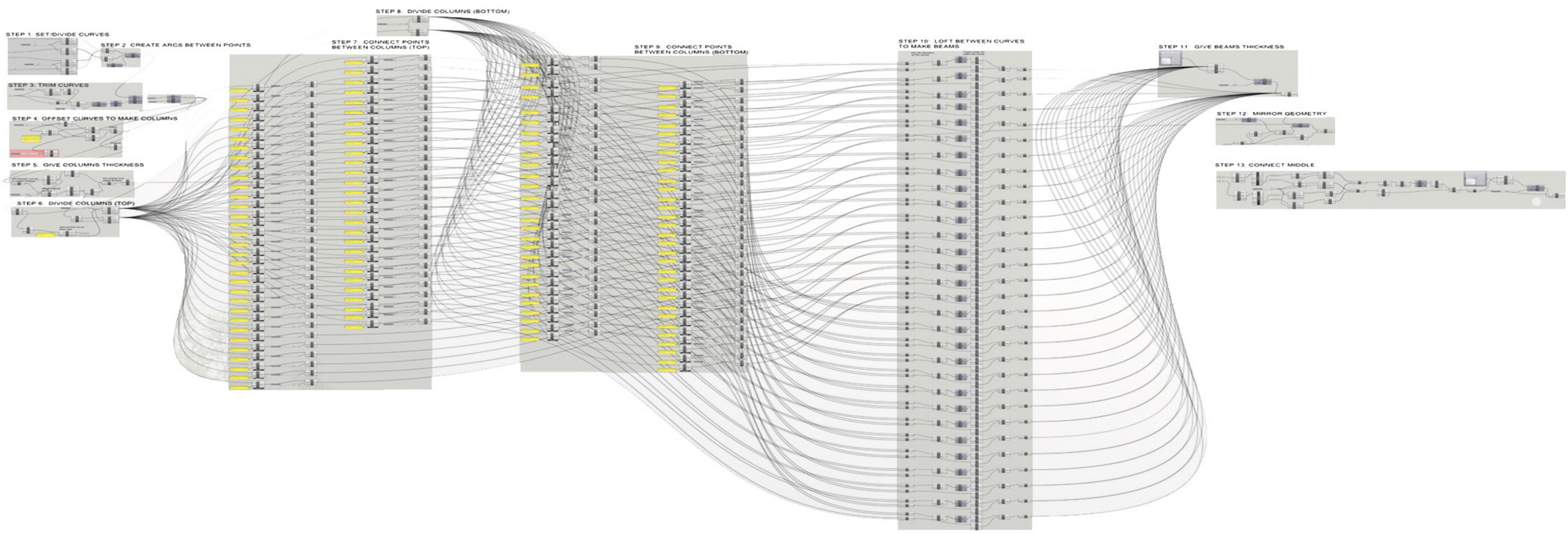
GRASSHOPPER MODEL / def.



GRASSHOPPER MODEL / def.







EXAMPLE

EXAMPLE

Swoosh Pavilion/ https://farm4.staticflickr.com/3030/2637648193_ffc25ca329_b.jpg

SECTIONING
Kierre Pavillion

Ana Rosa García Olmedo +Team

Teya Koleva

Source:https://kierrepavilion.wordpress.com/

KIERRE PAVILION

ProjectArchitects:
Ana Rosa García Olmedo, Andrés Rivadeney-ra, Ayana Naoi, Fahimeh Fotouhi, Ignacio Kaibel, Lorenzo Marconi, M. Emin Şişman, Margarida Andrade, Mark-Henri Decrausaz, Minwoo Seo, Nicolas Pratt, Sylvia De Angelis, Takahiro Minamino, Tuuliki Širokova and Zhang Shangshang, Antti Haapasalmi
Location:
Helsinki
Investor:
Technology Academy Finland

Function:
Entryway for the Millennium Prize Pavilion

ConstructionYear:
2014

Dimensions:
-

ConstructorsTeam:
Project Architects
MaterialUsed:
Transverse Beams – CNC cut Kerto Q
Edge Beams – 18mm Birch Plywood
Skin – Polyester Mesh
Finishing – Valtti Color Translucent White
MaterialSpent:
-

Budget:
-

MajorFabricationUsed:
Digital

FabricationBy:
CNCSoftwareUsed:
Rhino3D and Grasshopper

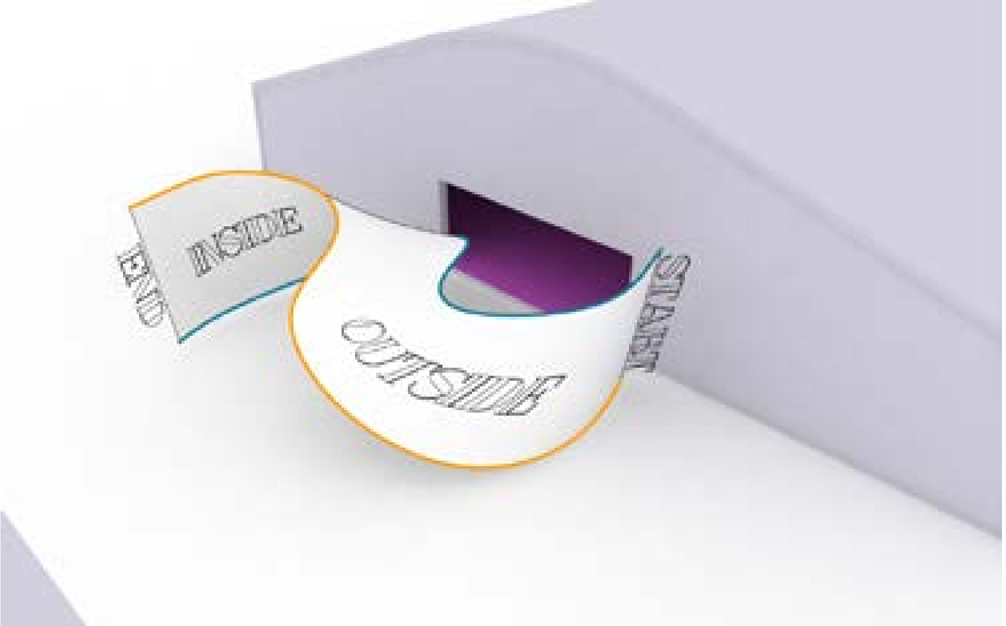
https://kierrepavilion.wordpress.com/

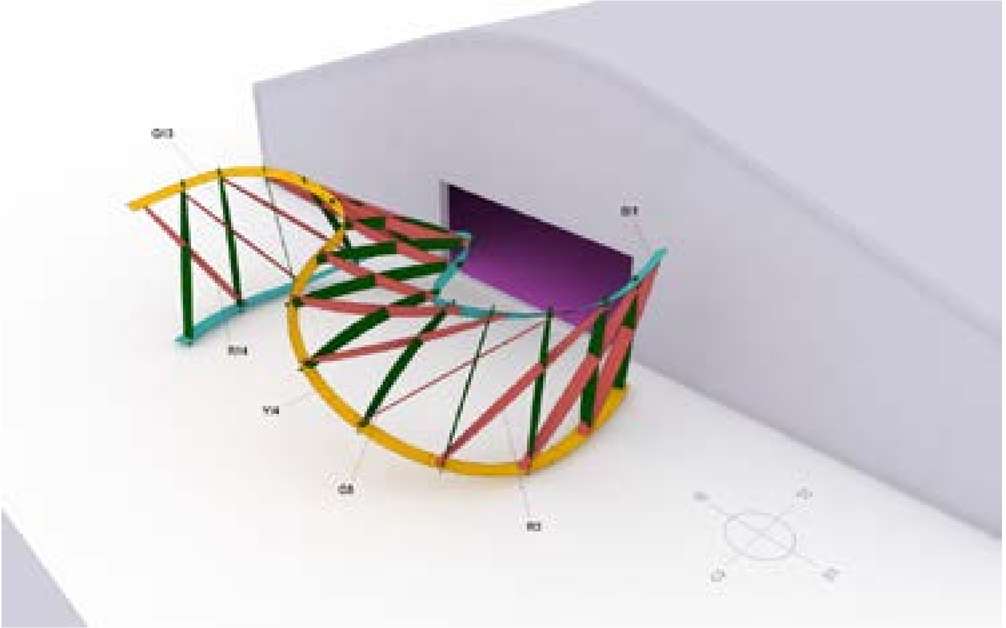
FABRICATION METHODS / process

Kierre

Kierre was built by for the Technology Academy Finland and the 2014 Millenium Prize ceremony. The wooden structure was served as an entryway and landmark for the Millennium Prize Pavilion in Central Helsinki. Using CNC cut LVL and plywood elements, the project creates a dynamic twist (Kierre in Finnish) that emphasizes the lightness and flexibility of the structural system as well as the formal possibilities of computational design.

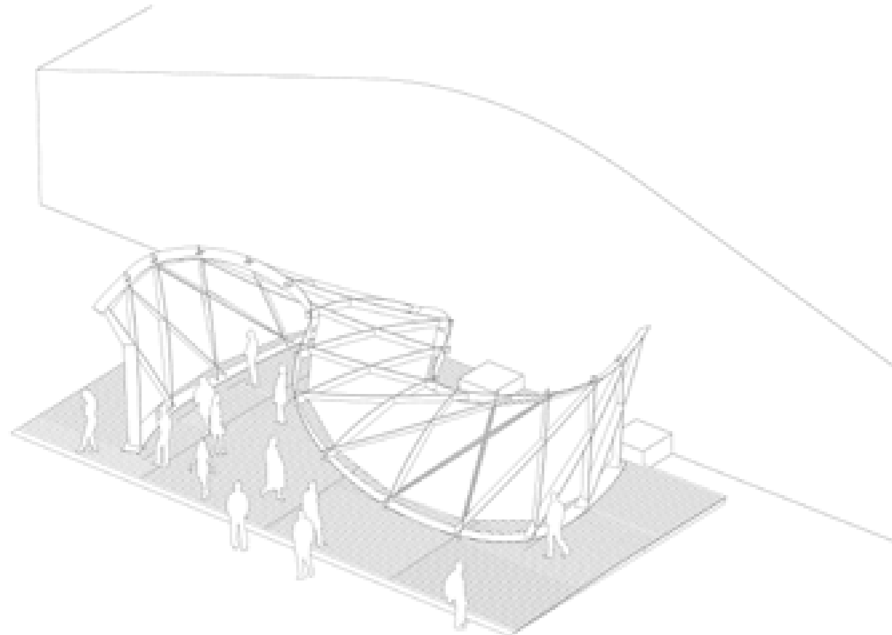
How do you describe an object that has no top nor bottom? No front, nor back? Something which is unintelligible in conventional architectural drawings? With the aid of Grasshopper and Rhino 120+ unique interconnecting pieces were created,labled and described their complex geometry.

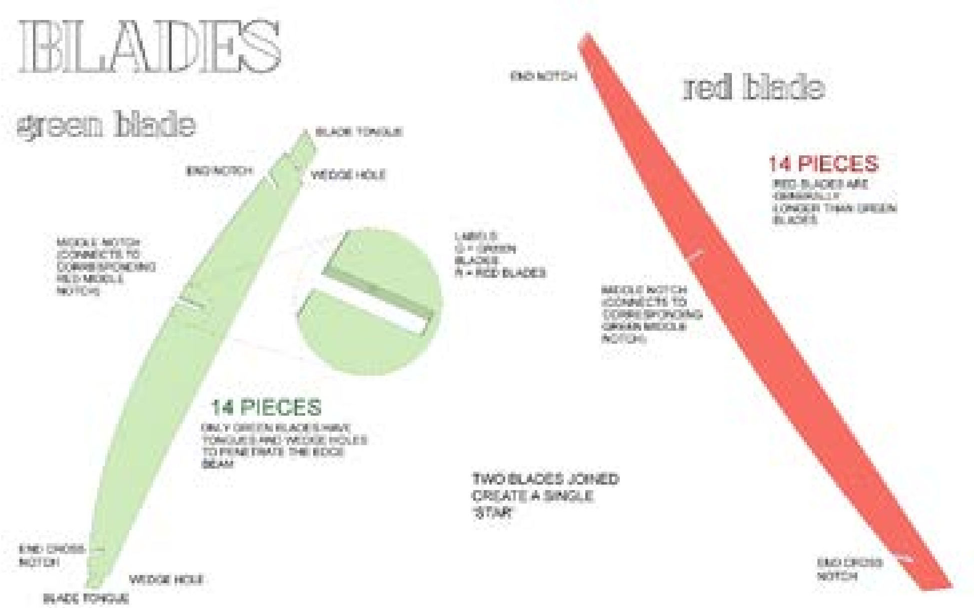




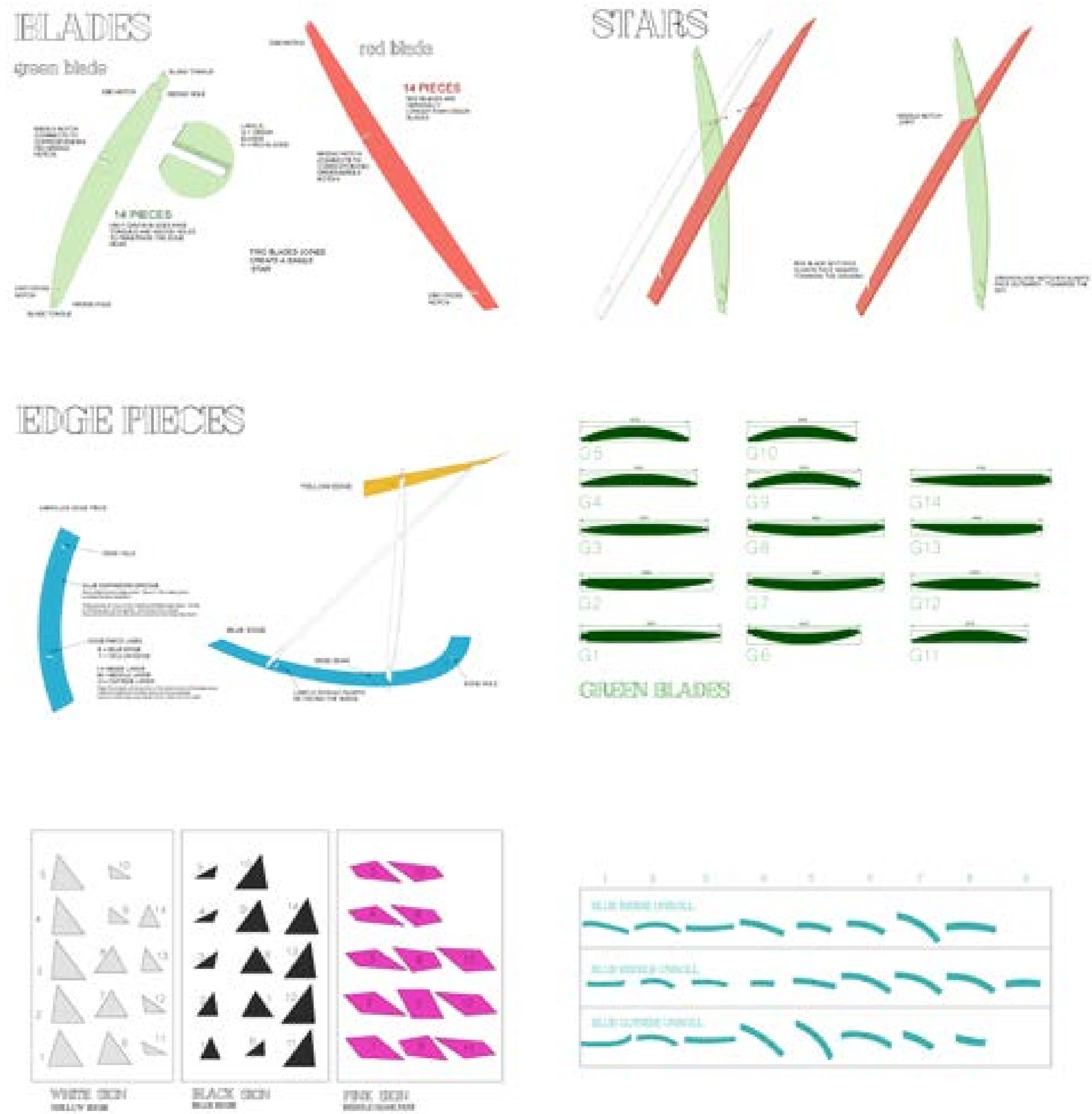
MATERIALS AND MACHINES

The drawings are used then imported to a CNC maschine. The cut pieces + offcuts are delivered to the workshop from the CNC warehouse. Then they are delivered by a truck to the site and assembled.



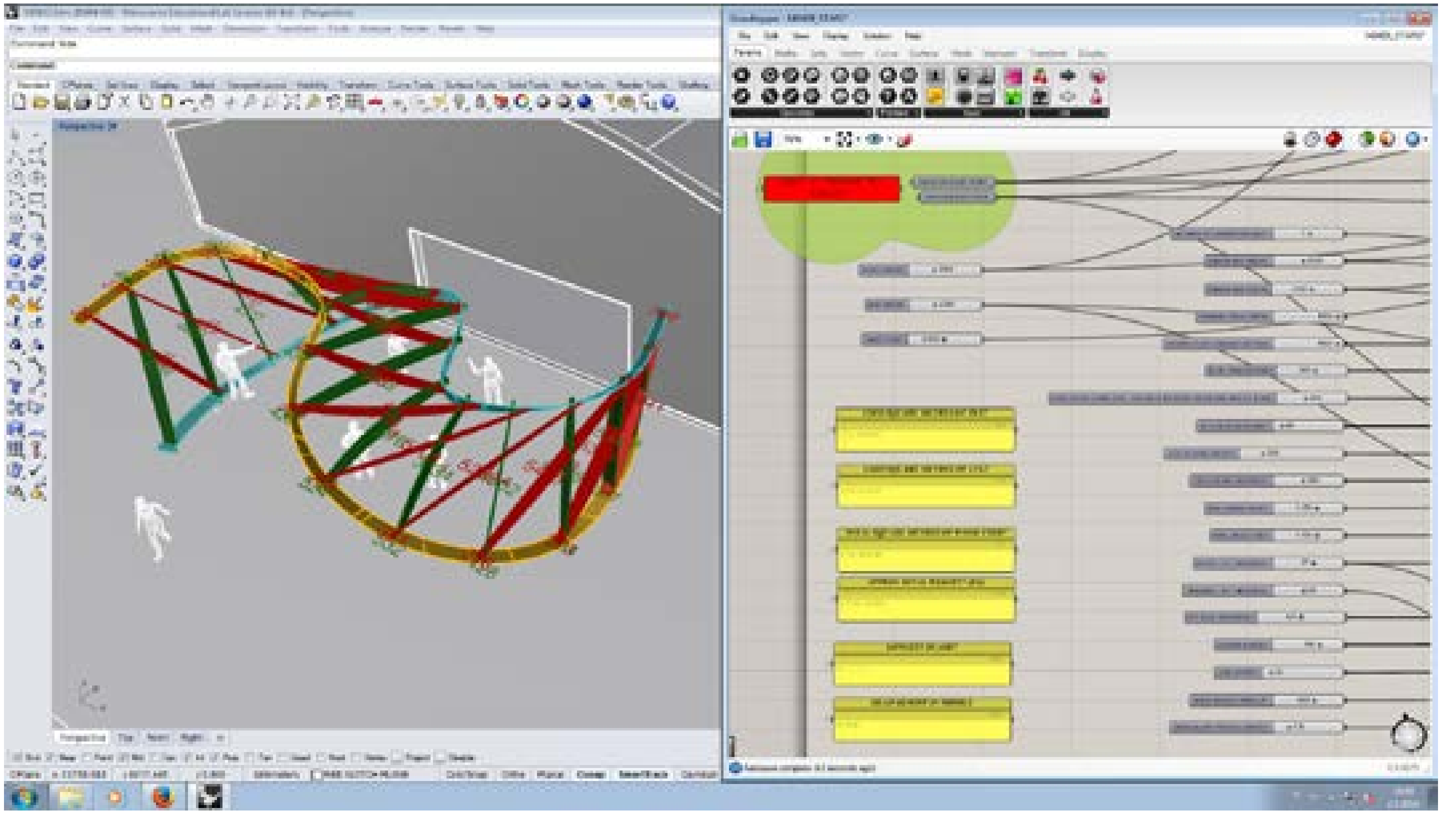


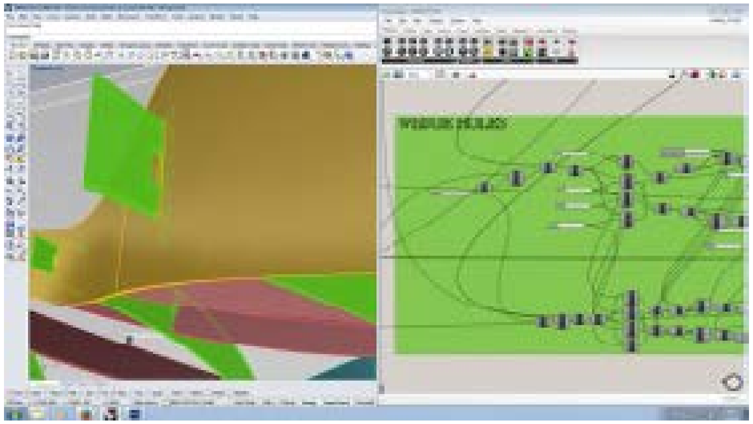
Example of components



Fabrication Process, Transportation and Assembly

RHINO and GRASSHOPPER MODEL example





KIERRE PAVILION

References:
http://woodprogram.fi/portfolios/ki-erre-entrance

/ https://kierrepavilion.wordpress.com/blog/