TESSELLATION

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http://designplaygrounds.com/wp-content/uploads/2013/11/ArboSkinFacade_01.jpg

TESSELLATION
DEFINITION

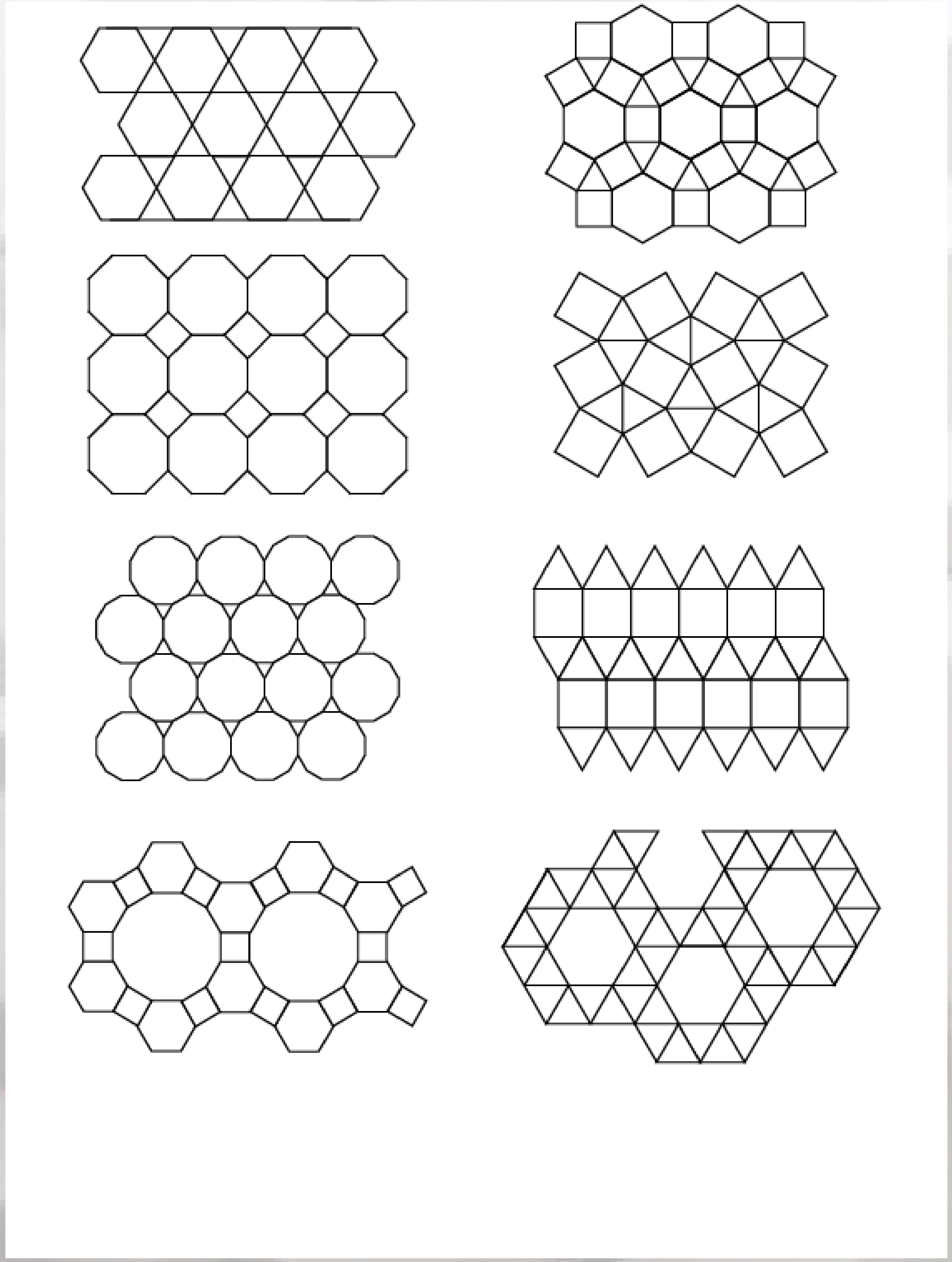
Tessellate (v) /ˈtɛsəleɪt/

Cover (a plane surface) by repeated use of single shape, without gaps or overlapping.

-definition by Oxford Dictionary-

The word ‘tessera’ in latin means a small stone cube. They were used to make up ‘tessellata’ - the mosaic pictures forming floors and tilings in Roman buildings The term has become more specialised and is often used to refer to pictures or tiles, mostly in the form of animals and other life forms, which cover the surface of a plane in a symmetrical way without overlapping or leaving gaps.

http://www.csun.edu/~lmp99402/Math_Art/Tesselations/tesselations.html

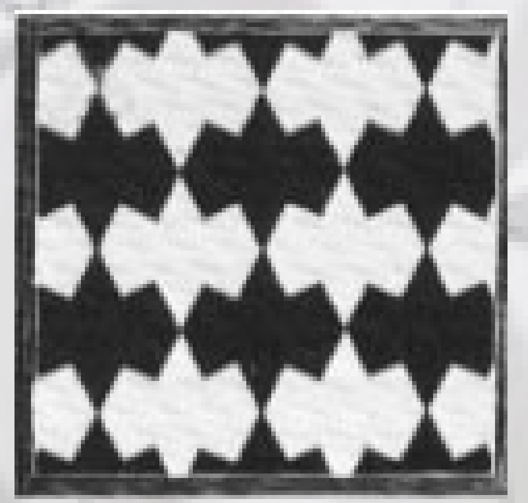


mathworld.wolfram.com

TESSELLATION

PATTERN LOGIC

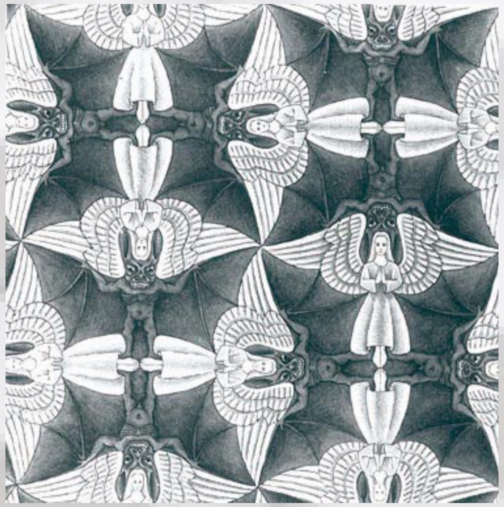
There are 4 basic ways to generate and applying pattern on a surface according to mathematicians, **Maurits Cornelis Escher**



TRANSLATION

A translation is a shape that is simply translated, or slid, across the paper and drawn again in another place.

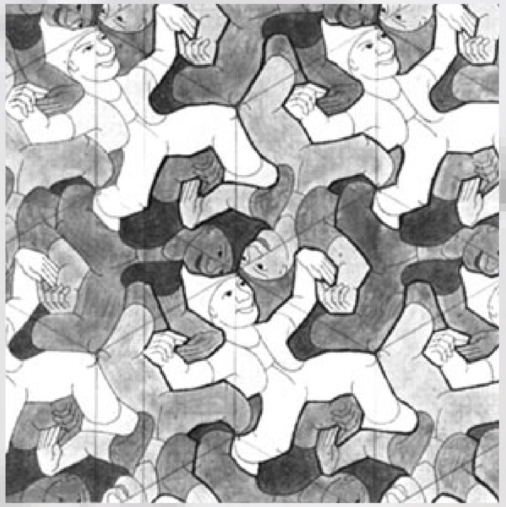
The translation shows the geometric shape in the same alignment as the original; it does not turn or flip.



REFLECTION

A reflection is a shape that has been flipped. Most commonly flipped directly to the left or right (over a “y” axis) or flipped to the top or bottom (over an “x” axis), reflections can also be done at an angle.

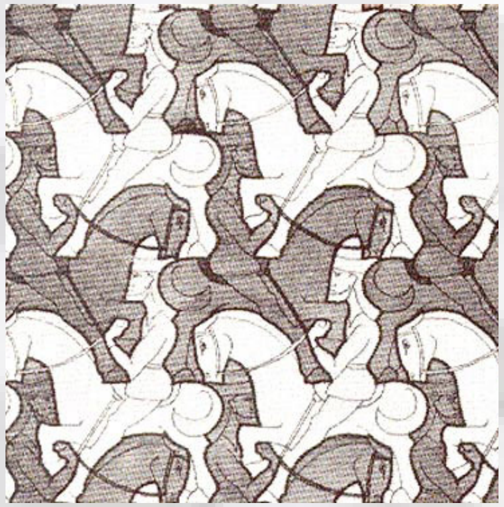
An imaginary line right through the middle, and the two parts will be symmetrical “mirror” images. To reflect a shape across an axis is to plot a special corresponding point for every point in the original shape.



ROTATION

Rotation is spinning the pattern around a point, rotating it. A rotation, or turn, occurs when an object is moved in a circular fashion around a central point which does not move.

A good example of a rotation is one “wing” of a pinwheel which turns around the center point. Rotations always have a center, and an angle of rotation.



GLIDE REFLECTION

In glide reflection, reflection and translation are used concurrently much like the following piece by Escher, Horseman. There is no reflectional symmetry, nor is there rotational symmetry.

http://www.csun.edu/~lmp99402/Math_Art/Tesselations/tesselations.html

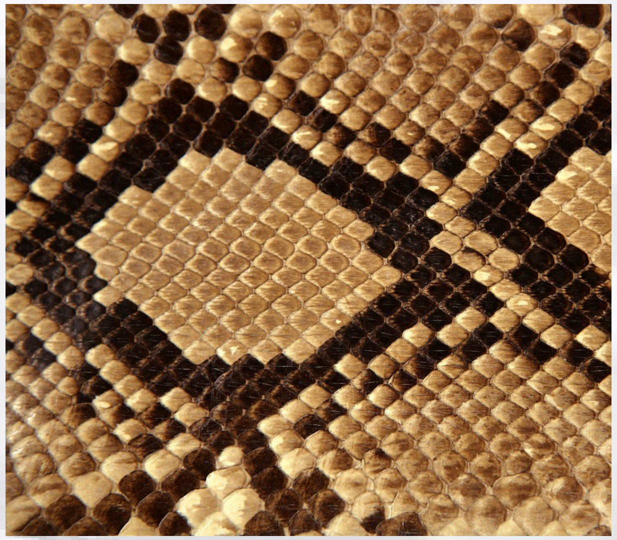
TESSELLATION

EXAMPLES FROM NATURE

There is a variety of tesselation in nature. It can be found in plants, animals, honey combs, bugs and shells, etc. Majority of tessallation examples in nature are not mathematically precise. The typical ones are random tessallation.

The most well known examples of tessellation in nature is honeycomb which is made of hexagonal cells. Some patterns are created more from random cracks, which are described by Gilbert Tessellation. Another example of tessallation in nature are foams.

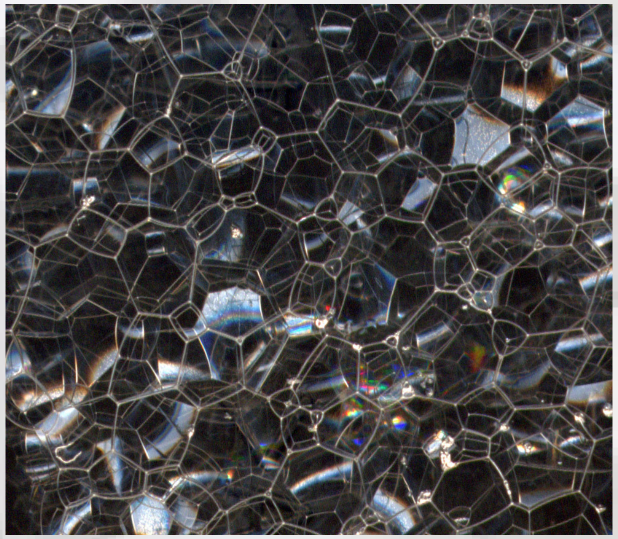
Division of a surface having no gaps makes tessellations suitable for divisions of shells and skins.



source: https://s-media-cache-ak0.pinimg.com/236x/8a/0e/eb/8a0ee-b46e986314a2a0e24d9be536c60.jpg

source: http://farm4.static.flickr.com/3049/2591093721_678b6026fd.jpg

Source: https://upload.wikimedia.org/wikipedia/commons/f/f4/Foam_-_big.jpg



Source: https://upload.wikimedia.org/wikipedia/commons/f/f4/Foam_-_big.jpg

source: http://rawdiet.com/wp-content/uploads/2011/01/Raspberry.jpg

source:http://generic.pixmac.com/

TESSELLATION

HISTORY & ORIGIN

Earliest exmples of tessellating techniques can be referenced to early Roman mosaics.

A 3D representation of a tessellating mosaics can be seen in Gaudi’s sculptural forms in Barcelona.

Paving as 2 dimensional expression forms a pattern through repetition of an element with a change in angle. Connected densely, a figure emerges. The surface can follow an irreular contour according to the initial shape adaptability.

A kaleidoscope as a collection of prisms, light play and illusion occuring due to the material properties- reflection; transparency.

Ulysess, Roman mosaics

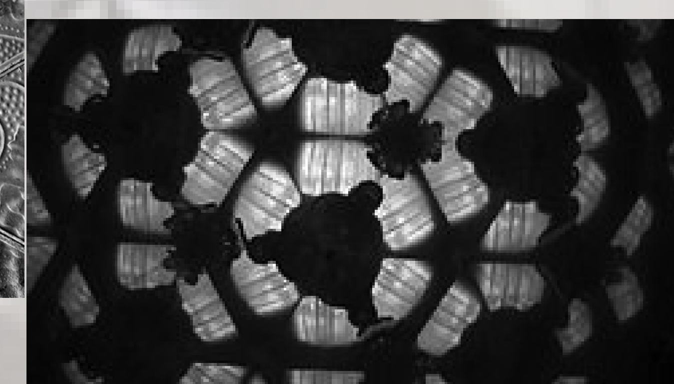
source: http://culturebox.
francetvinfo.fr/sites/de-
fault/files/styles/article_dia-

Antoni Gaudi, Park Guell, Mosaic salamander, 1914

source: http://www.wri-
tedesignonline.com/
Prompts/Gaudi.html

source: http://europaenfotos.
com/barcelona/pho_bcn_79.

Antoni Gaudi,Batlo house paving, 1904

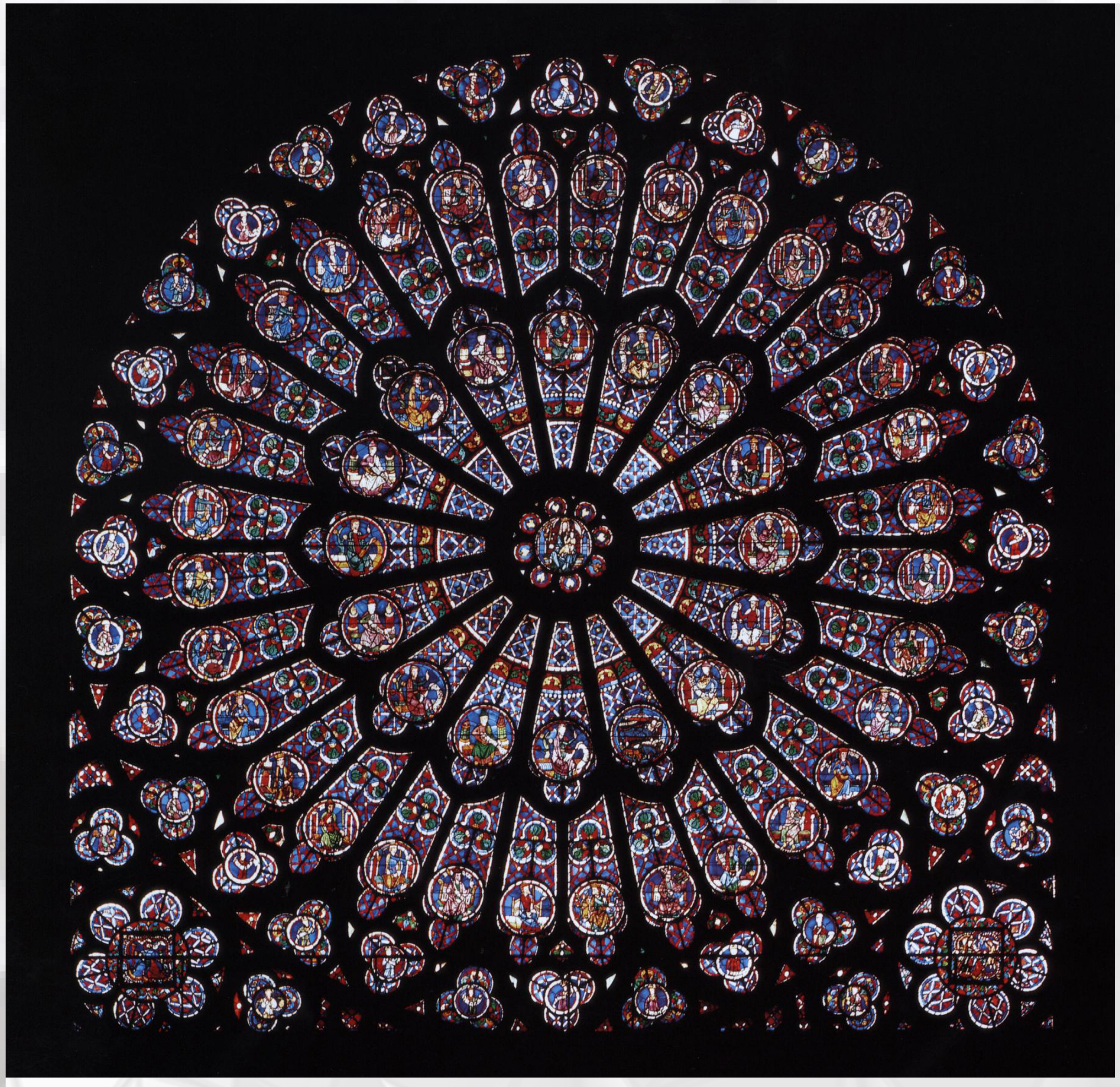


source: https://upload.wikime-
dia.org/wikipedia/commons/
thumb/6/62/Kaleidoscope.web-
m/320px--Kaleidoscope.webm.jpg

Kaleidoscope

TESSELLATION
HISTORY & ORIGIN

Surface shapes directly related to connecting elements form. Assemblage in segments; regular and irregular surface examples. Thematic relation to the function of the space.



01

North Outter Rose House
Paris, Notre-Dame Cathedral

02

Otto III and Konrad II
Strassburg, Minster of Our Lady

03

The Holy Archbishop Thomas Becket
Canterbury, Cathedral of Christ Church

Source: http://designplaygrounds.com/wp-content/uploads/2013/11/ArboSkinFacade_01.jpg

TESSELLATION

HISTORY & ORIGIN

The Holy Archbishop Thomas Brecket
Canterbury, Cathedral of Christ Church

TESSELLATION

HISTORY & ORIGIN

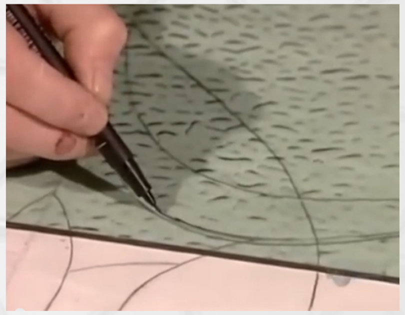
2D Tessellation example- stained glass technique.

Varied irregular surfaces connected to form an image.

Differences occur regarding shapes, connecting mate-rials, surface treatment.

Thematic relation to the function of the space.

Design the composition 01



Apply design on glass 02

Cut glass accordingly 03

Draw necessary detail 04

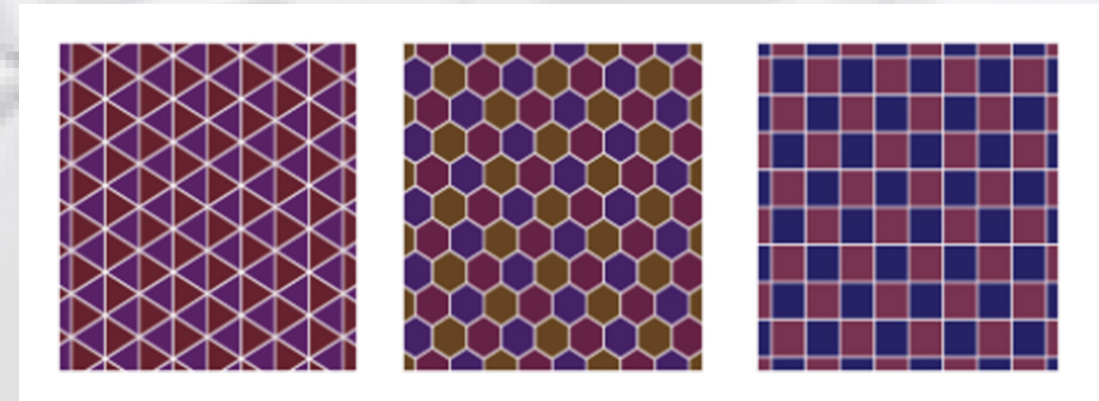
Assemble glass with lead 05

Solder every joint of lead 06

Apply finishing 07

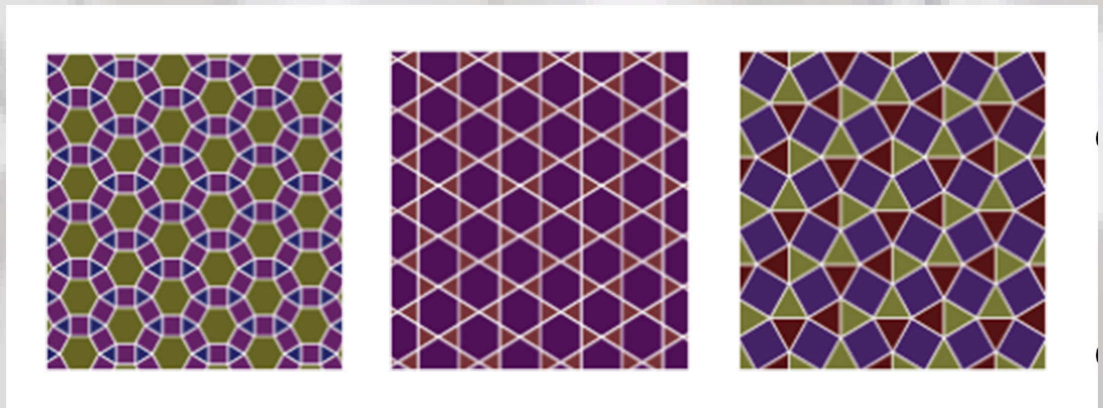
Frame the piece 08

TESSELLATION
TYPOLOGY & CLASSIFICATION



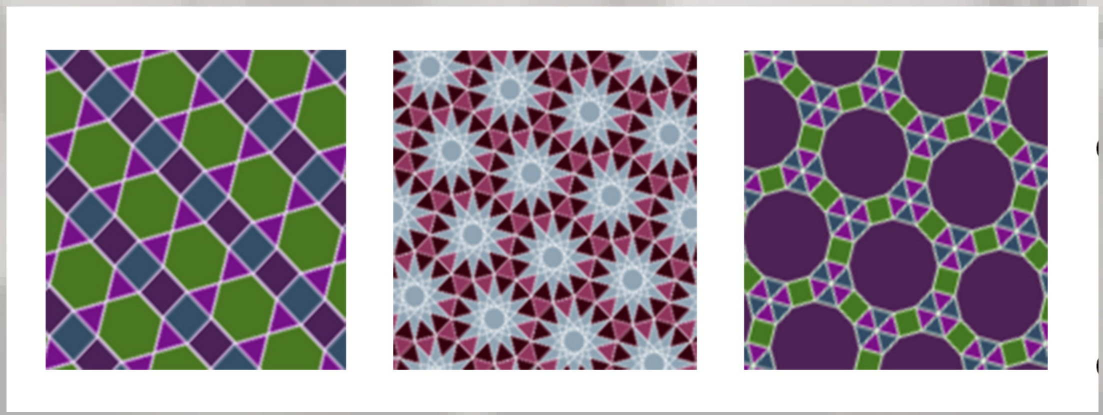
REGULAR TESSELLATION

Regular tilings with regular polygonal tiles all of the same shape.



SEMI-REGULAR TESSELLATION

Semi-regular tilings with regular tiles of more than one shape and with every corner identically arranged.



DEMI-REGULAR TESSELLATION

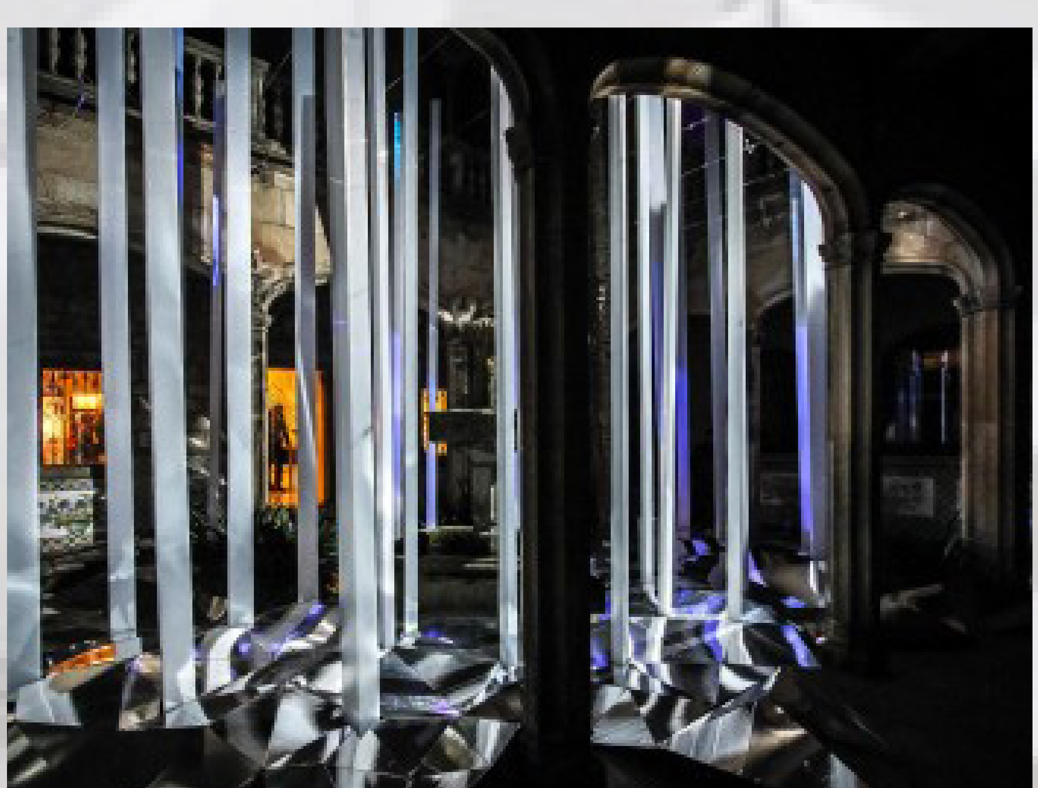
Aperiodic/demi regular tiling uses a small set of tile shapes that cannot form a repeating pattern.

http://www.funmaths.com/fun_math_projects/what_is_a_tessellation.htm

TESSELLATION

MATERIALS

EXAMPLES

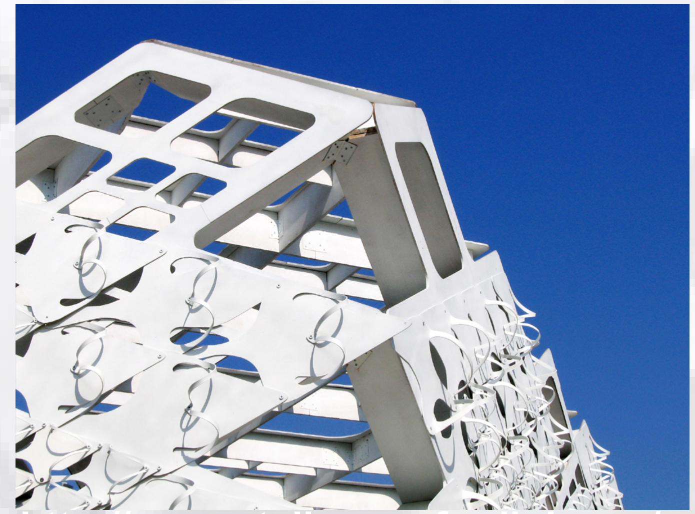


source: http://www.iaac.net/projects/pluja-de-llum-luminescent-rain-bcn-llum-2015-37

Pluya de Llum, 2015, Barcelona, IaaC

Reflecting surface, light effects

source: http://www.iaac.net/projects/pluja-de-llum-luminescent-rain-bcn-llum-2015-37



http://www.ateliermanferdini.com/

West coast pavilion, Atelier Manferdini, Beijing

Metal sheet prefabrcated panels, lasercutting technique

source: http://www.techni-colorbloom.com/

Technicolour Bloom, Brennan Buck

Plywood lasercut pannels, double side overlapping, painted,grouped for assemblage.

source: icd.uni-stuttgart.

Research Pavilion 2011

Plywood

Landesgartenschau Exhibition Hall, 2014

Wood construction, lightweight optimisation

source: http://icd.uni-stuttgart.de/

TESSELATION

SOFTWARE AND LANGUAGES USED BY THESE MACHINES

CNC machine

In general, CNC involves the following kinds of software from start to finish:

- CAD Software: Used to design the parts. The output of CAD are drawings and solid models.

- CAM Software: CAM software analyzes the CAD drawing, takes input from the machinist or programmer, and outputs g-code for the machine controller.

- Other CNC Programming Software: A variety of other kinds of g-code software helpful to CNC programmers is available including G-Code Simulators, G-Code Editors, and G-Code Verification Software.

- Machine Controller Software: The Machine Controller may be stand alone software, or it may be a proprietary combination of software and hardware. It’s job is to take g-code and produce the right electrical outputs to make the machine move.

- CNC Utilities: There are a variety of CNC Utilities available for calculating feeds and speeds and many other functions.

- Other Shop Floor and Manufacturing Software: Software is available to help manage tooling inventory, estimate job costs, and perform many other functions associated with managing the operations and maximizing the profi-

Source: https://en.wikipedia.org/wiki/Numerical_control

TESSELLATION
TOOLS & MACHINES

LASSER CUTTER MACHINE

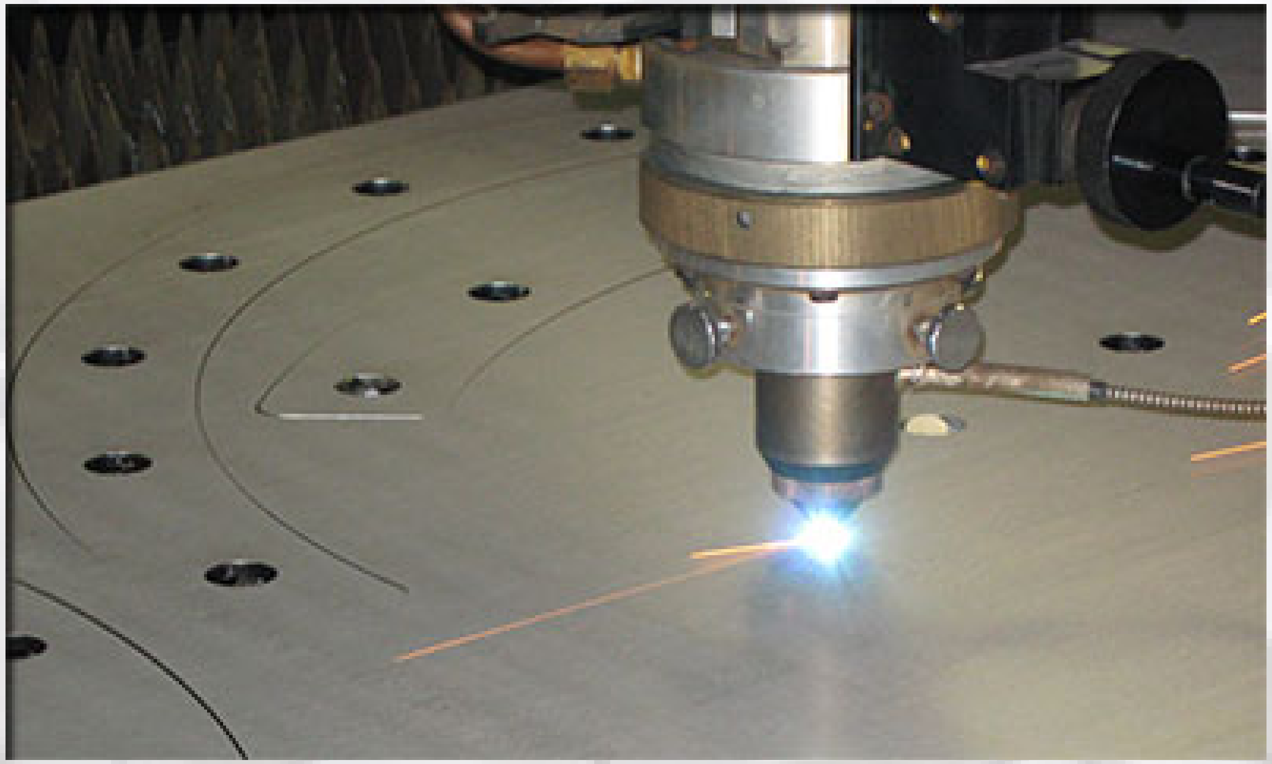
LASER CUTTING is a HIGH-ENERGY-BEAM MANUFACTURING technology that uses a laser to cut materials, and is typically used for industrial manufacturing applications. In LASER BEAM MACHINING (LBM), a laser source focuses optical energy on the surface of the workpiece. Laser cutting directs the highly focused and high-density output of a high-power laser, by computer, at the material to be cut. The targeted material then either melts, burns, vaporizes away, or is blown away by a jet of gas, in a controlled manner leaving an edge with a high-quality surface finish.

USAGE AND CAPABILITY

The laser cutter is a machine that uses a laser to cut materials such as chip board, matte board, felt, wood, and acrylic up to 3/8” (1 cm) thickness. The laser cutter is often bundled with a driver software which interprets vector drawings produced by any number of CAD software platforms.

The laser cutter is able to modulate the speed of the laser head, as well as the intensity and resolution of the laser beam, and as such is able both cut and score material, as well as approximate raster graphics.

Objects cut out of materials can be used in the fabrication of physical models, which will only require the assembly of the flat parts.



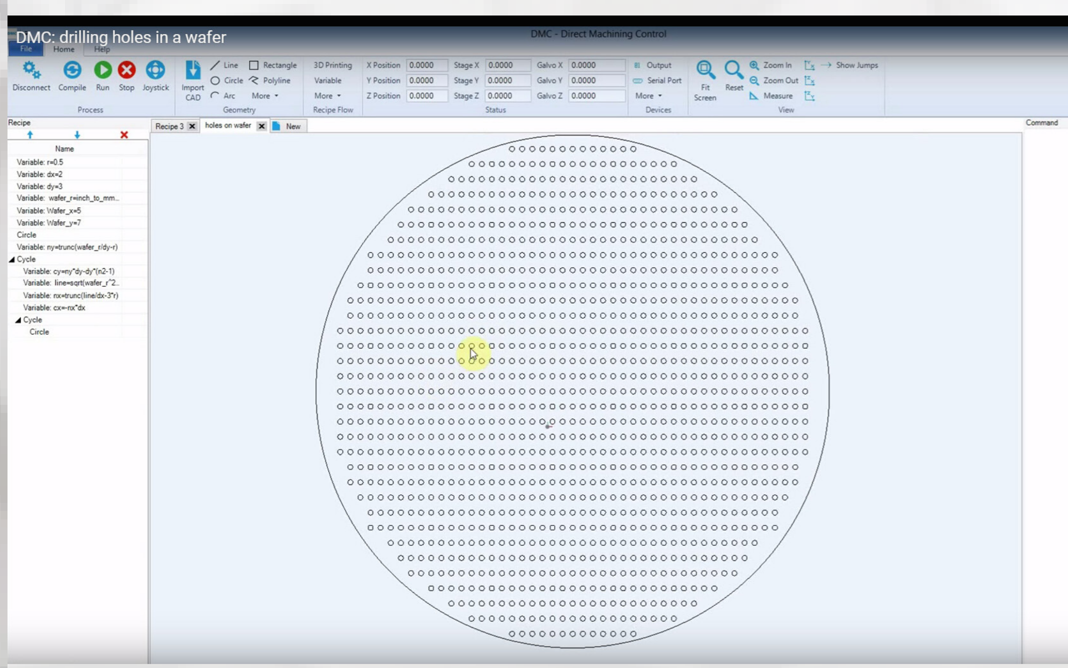
TESSELLATION
SOFTWARE FOR MACHINE

DMC SOFTWARE

DMC software is used for various laser machining appli-cations

DMC software is a great tool to pre
pare and control laser additive manufacturing / 3D printing processes like Selective Laser Sintering SLS, stereolithography and others.

DMC laser machining software controls both, galvano-metric scanners and positioning stages, so processes can be optimized for large field and high speed.



DMC
DIRECT MACHINING CONTROL

Sourchttp://www.google.de/imgres?imgurl=http://svr14.sitecube.com/builder/users/ags-

TESSELLATION
SOFTWARE USED

MODELLING SOFTWARE

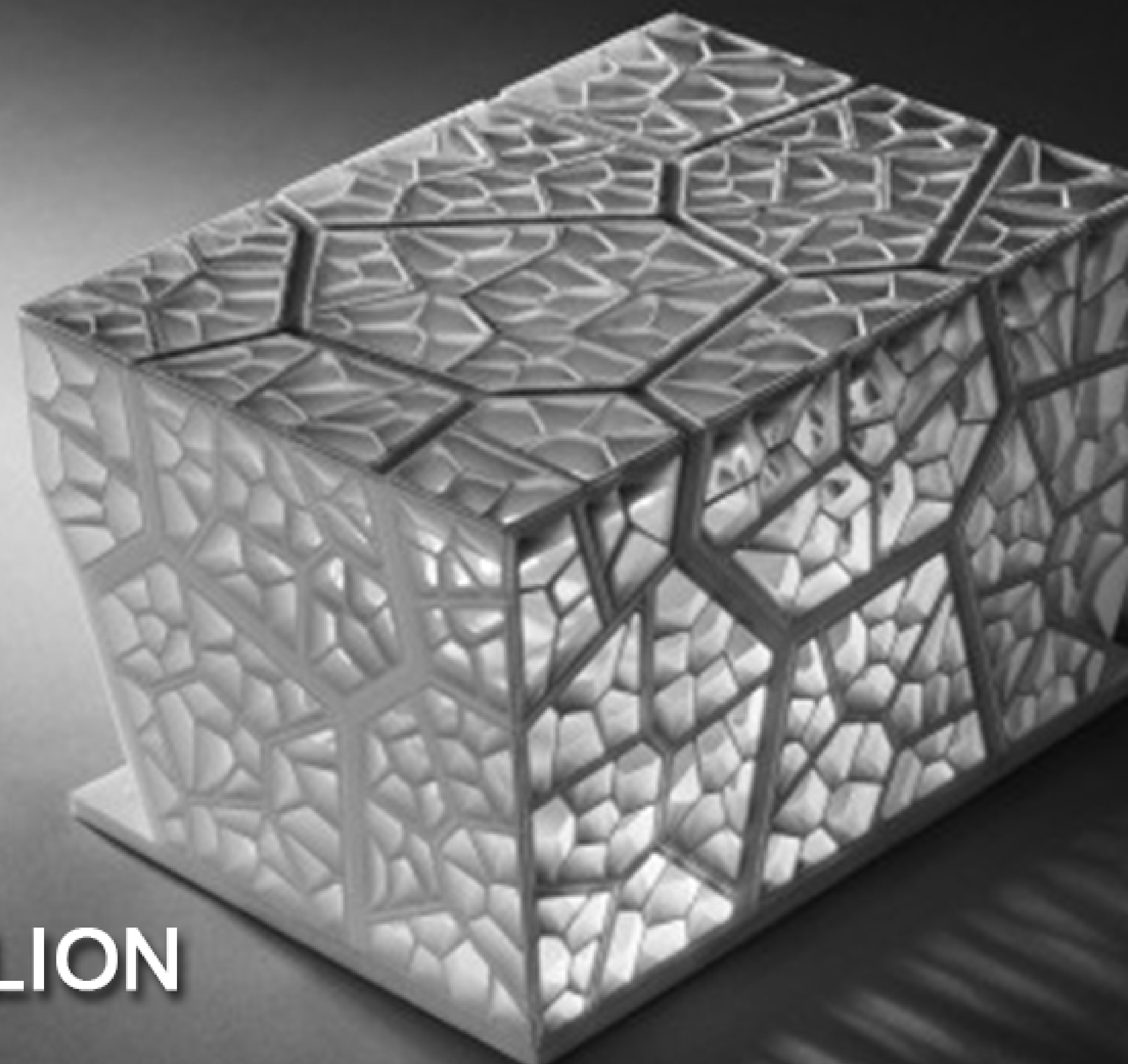
Rhino3D

Grasshopper

Autodesk 123D Design

Autodesk 123D Design

http://designplaygrounds.com/wp-content/uploads/2013/11/ArboSkinFacade_01.jpg



TESSELLATING

TIMES EUREKA PAVILION

NEX ARCHITECTURE

CHRISTIAN PURWADIHARDJA

SOURCE: http://www.nex-architecture.com/projects/times-eureka-pavilion/

TIMES EUREKA PAVILION

PROJECT OUTLINE

Location
Royal Botanic Garden at Kew, Richmond
Surrey, TW9 3 AB, United Kingdom

Project Architects
NEX Architecture
- *Alan Dempsey*
- *James Chung*
- *Michal Piasecki*
- *Paul Loh*
- *Tomas Starczewski*

Landscape Design
Marcus Barnett

Structural Engineer
Buro Happold

Clients
Royal Botanic Gardens Kew
The Times Newspaper

Main Contractor
Outdoor Room

Structural Engineer
Blumer Lehmann

SOURCE: http://michalpiasecki.com/2011/05/16/nex-architecture-times-eureka-pavilion/

TIMES EUREKA PAVILION
PROJECT **DESCRIPTION**

Function

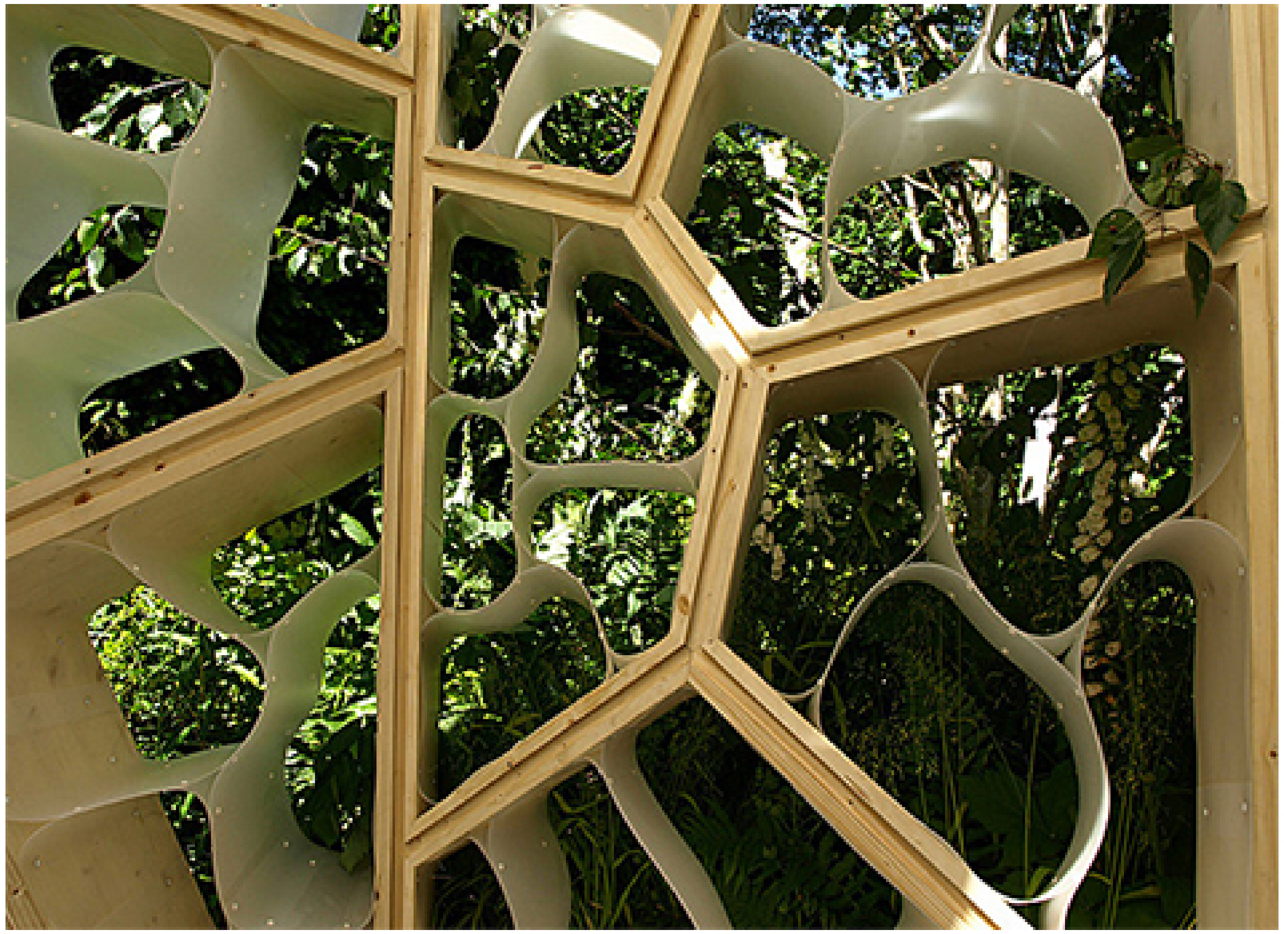
As part of small garden which designed to communicate the significance of plants to science and society

By the principles of biomimicry, the translucent pavilion is developped by using algorithms which replicates leaf capillaries.

The final structure was designed using computer algorithms that mimic natural growth and is intended to allow visitors to experience the patterns of biological structure at an unfamiliar scale

Construction Year

May 2011 - June 2011



SOURCE: http://inhabitat.com/beautiful-times-eureka-pavilion-mimics-the-cellular-structure-of-plants/

SOURCE: http://michalpiasecki.com/2011/05/16/nex-architecture-times-eureka-pavilion/

TIMES EUREKA PAVILION

PROJECT **FABRICATION**

Dimensions

Floor area : 26 m^2

Dimension : 5500 mm x 4000 mm x 3000 mm

Materials

136 timber cassettes

586 plastic cells - recycled translucent polypropylene

Glass panelled roof

Budget

£ 70.000

Fabrication Classification

Double layered voronoi tessellation

Implementations of L-system, algorithms simulating the growth of trees in processing.

Controlling form by ‘voronoi diagram’

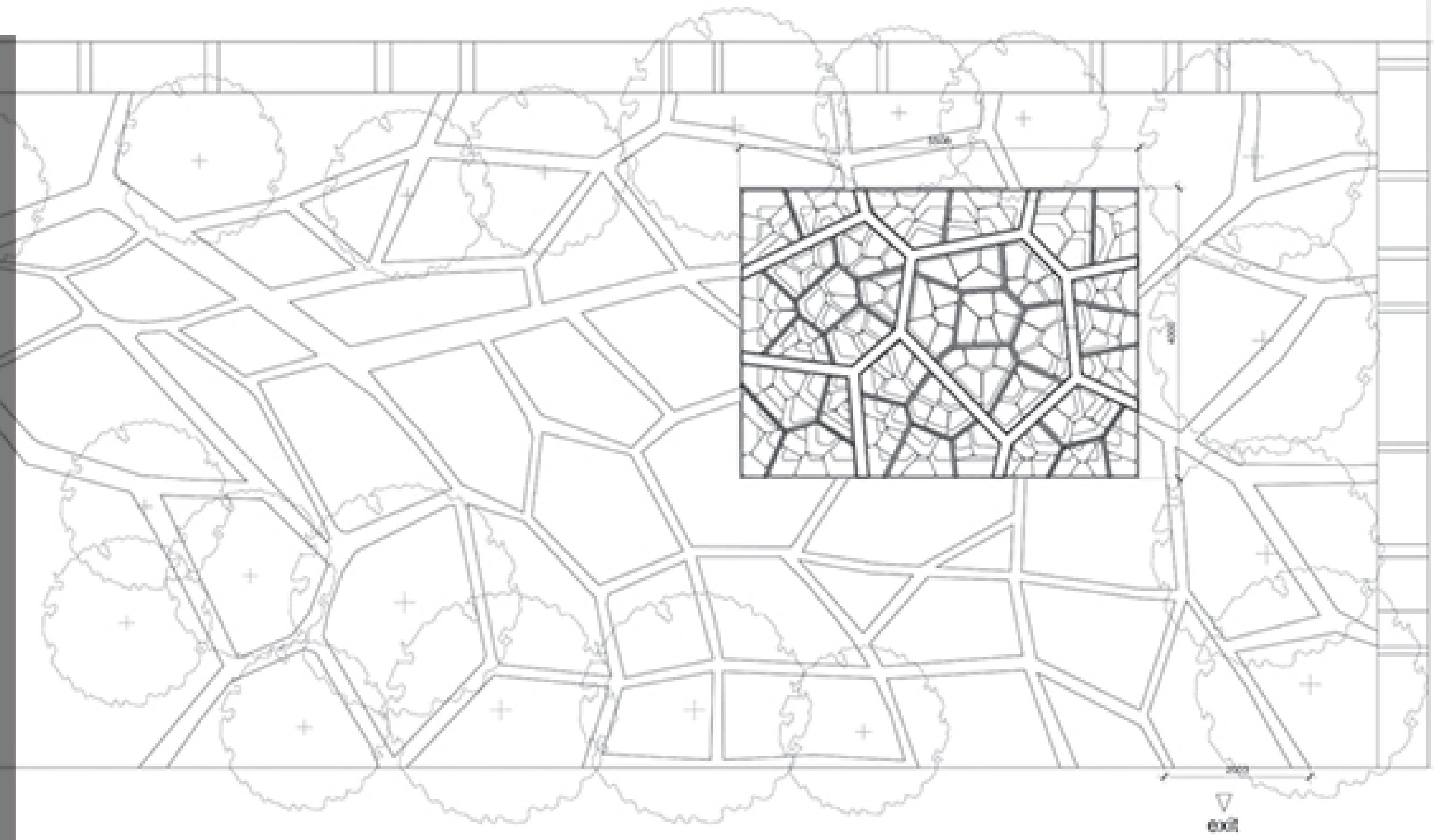
Fabrication Machine

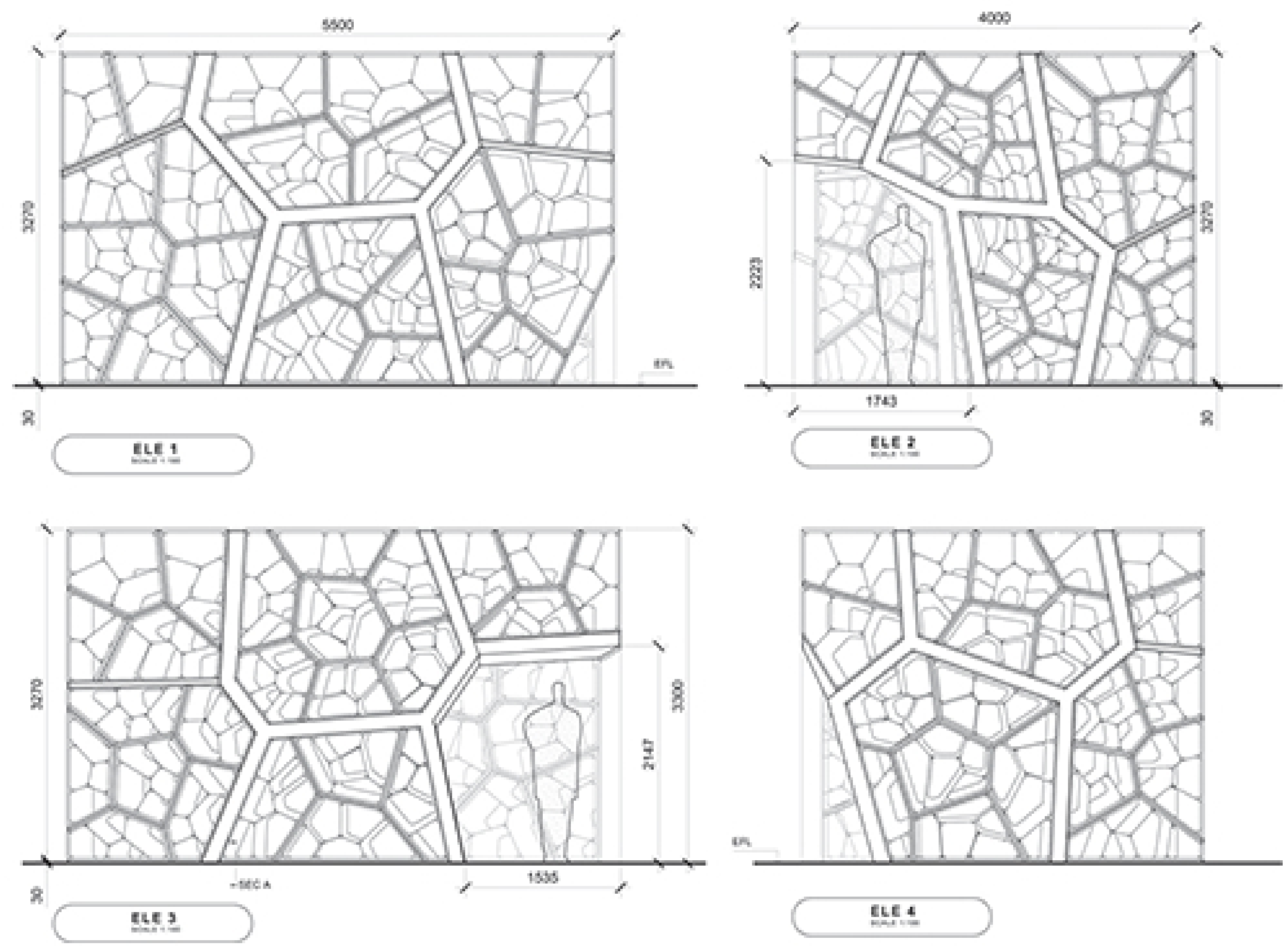
5 Axis CNC milling for timber structure

Laser cutting for plastic infill

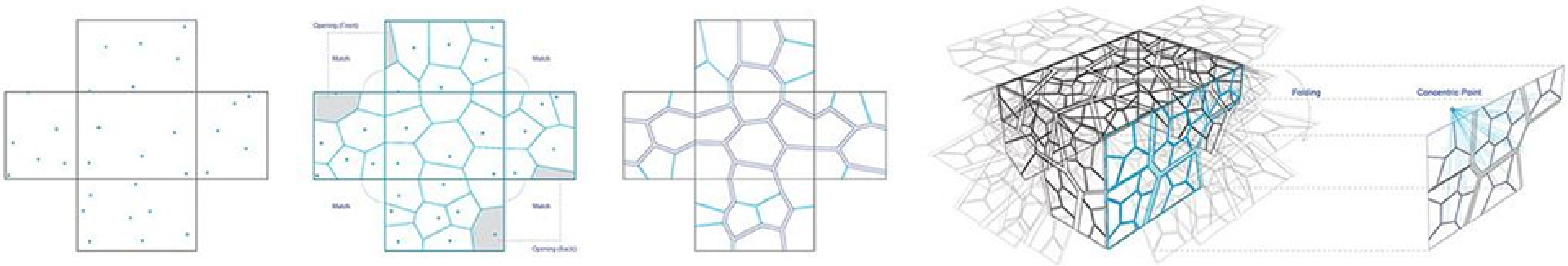
Modelling Software

Grasshopper for ‘voronoi diagram’, final fabrication data, including layout and labelling





SOURCE: http://www.archdaily.com/142509/times-eureka-pavilion-nex-architecture/



01) Voronoi Points for Main Structure

02) Voronoi Pattern & Adjustment

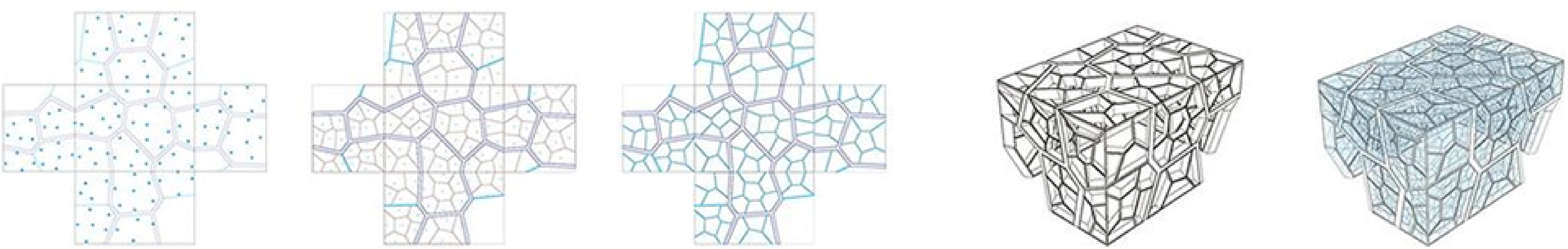
Voronoi Pattern created
Determining Openings
Adjusting Matching Lines

03) 1st Amendment

Main Structure (140mm)
Secondary Structure A (50mm)

A) Folding Generated Patterns

B) Concectric Extrusion



04) Voronoi Points for Secondary Structure & Cassette

05) Voronoi Pattern & Adjustment

06) 2nd Amendment

Main Structure (140mm)
Secondary Structure A (50mm)
Secondary Structure B (20mm)
Secondary Structure (20mm)

C) Main & Sub Structures + Cassette Extrusion

18) Cell Division & Curve Filleting

SOURCE: http://www.archdaily.com/142509/times-eureka-pavilion-nex-architecture/

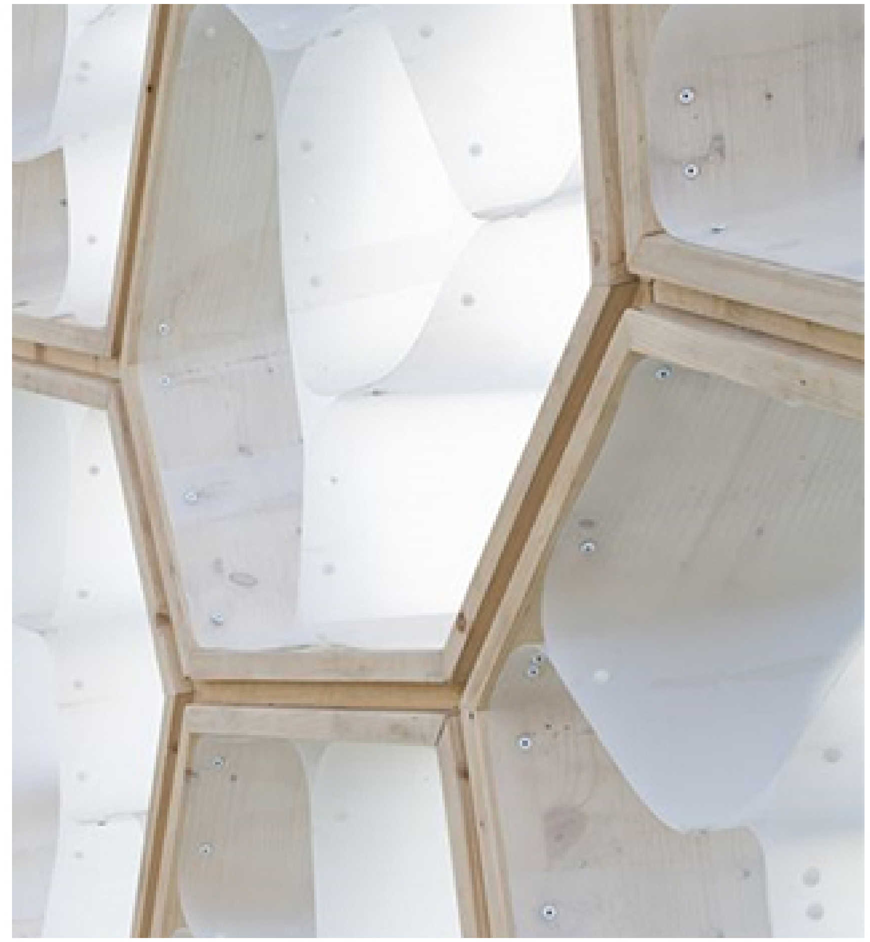
TIMES EUREKA PAVILION
PROJECT **MATERIAL**

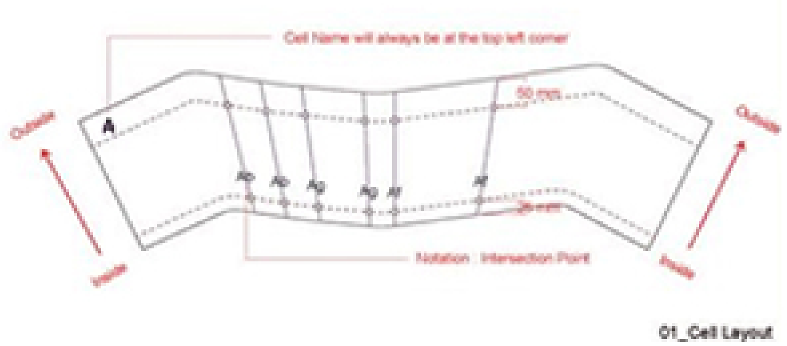
Materials

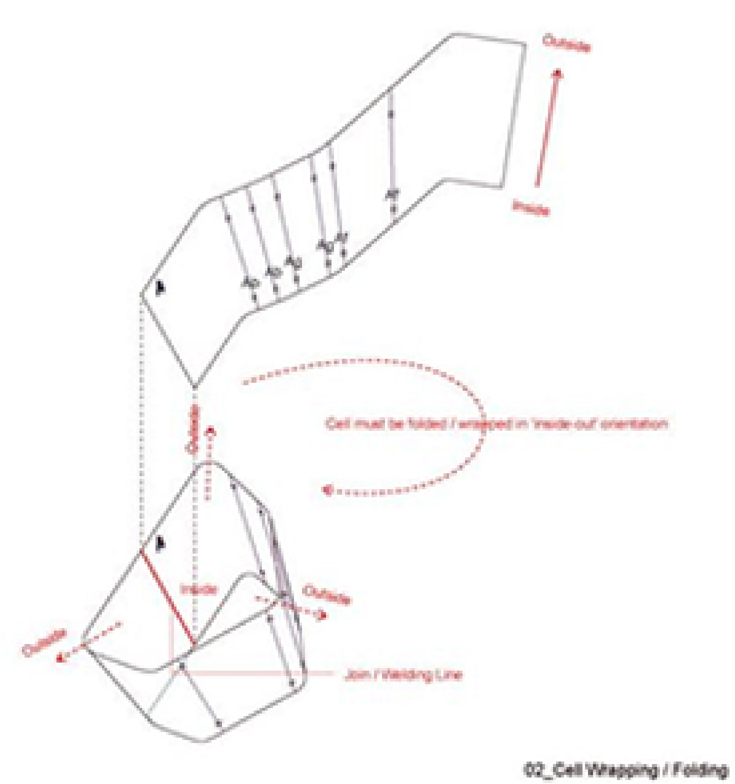
136 timber cassettes

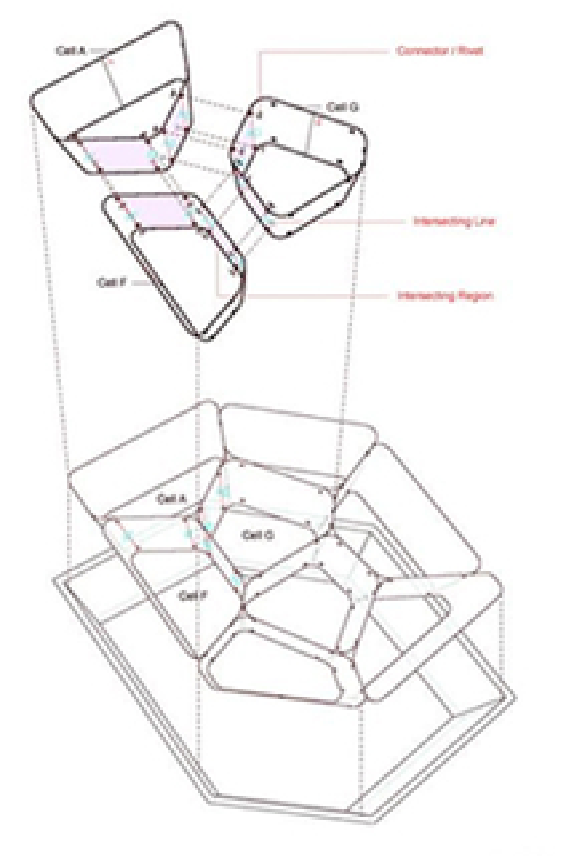
586 plastic cells - recycled translucent polypropylene

Glass panelled roof







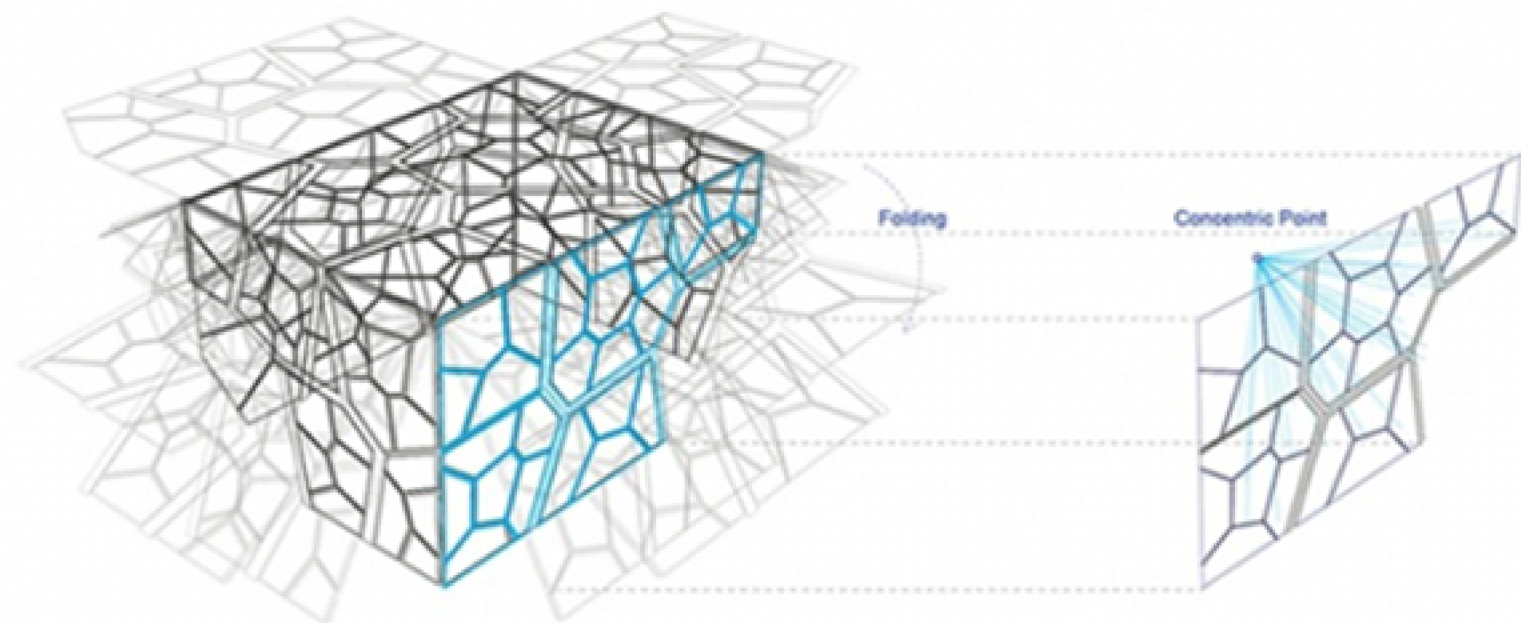


SOURCE: http://www.archilovers.com/projects/54312/times-eureka-pavilion.html#drawings

TIMES EUREKA PAVILION
PROJECT **MODELLING**

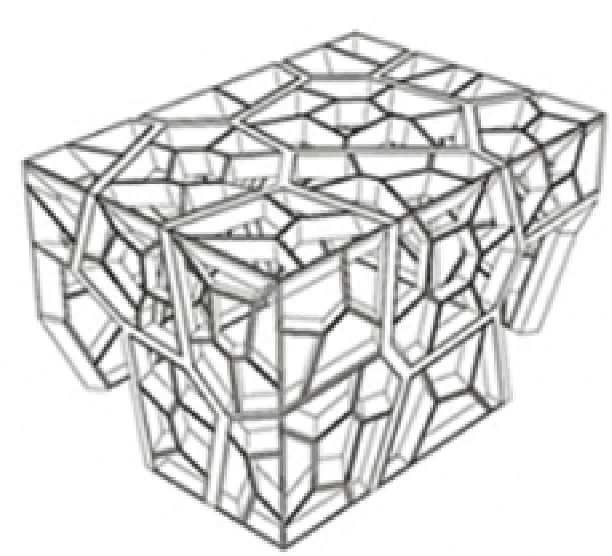
Modelling Software
Grasshopper for 'voronoi diagram', final fabrication data, including layout and labelling

Fabrication Machine
5 Axis CNC milling for timber structure
Laser cutting for plastic infill

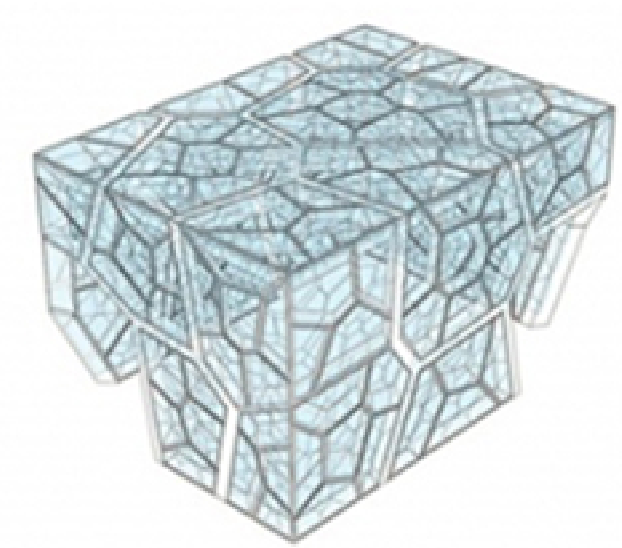


1st Generated Voronoi

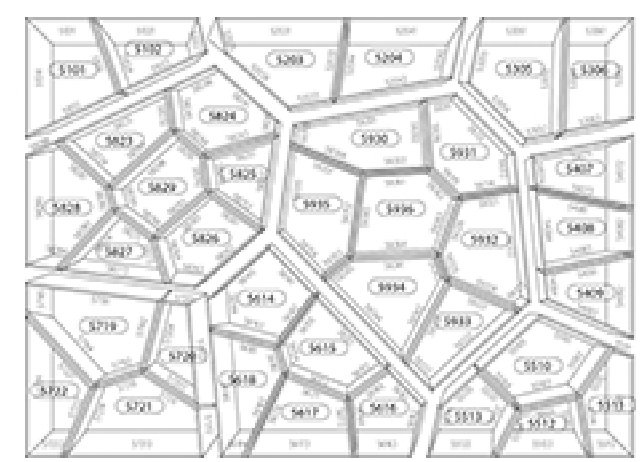
2nd Projection of Voronoi,



Folding and selecting structural components



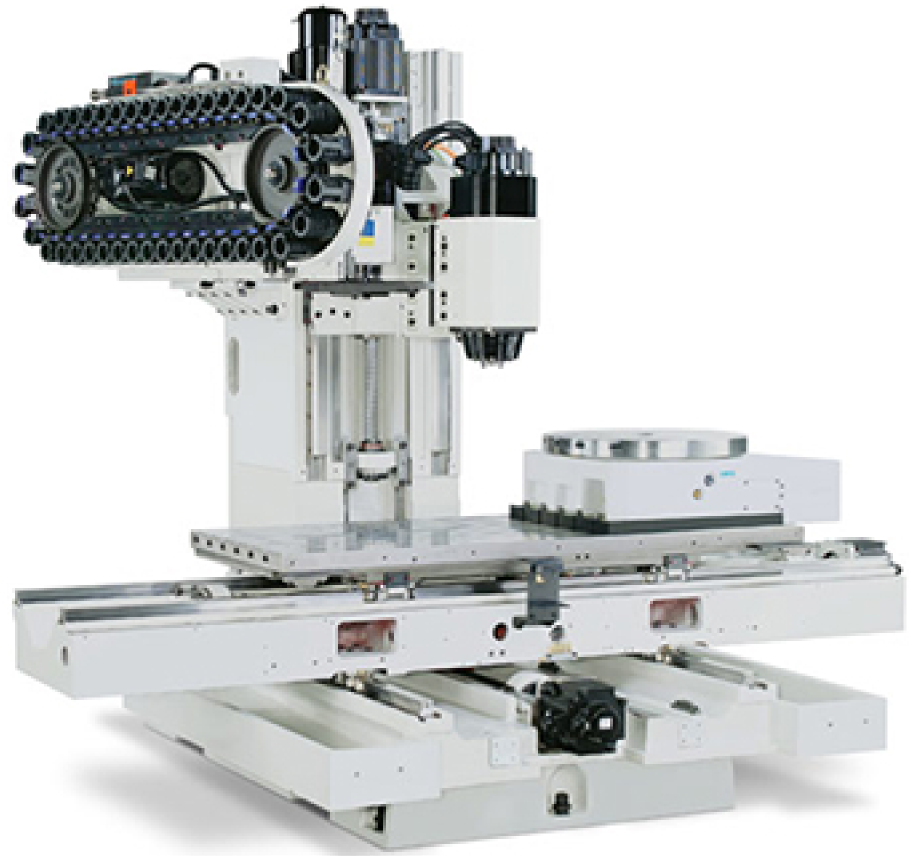
1st Voronoi as spatial boundaries



Components labelling

SOURCE: http://www.archilovers.com/projects/54312/times-eureka-pavilion.html#drawings

TIMES EUREKA PAVILION
PROJECT **SUPPORTING TOOLS**



5 AXIS CNC MILLING MACHINE
for cutting the timber cassettes

Rhinoceros®
NURBS Modeling for Windows

grasshopper
GENERATIVE MODELING
FOR RHINO

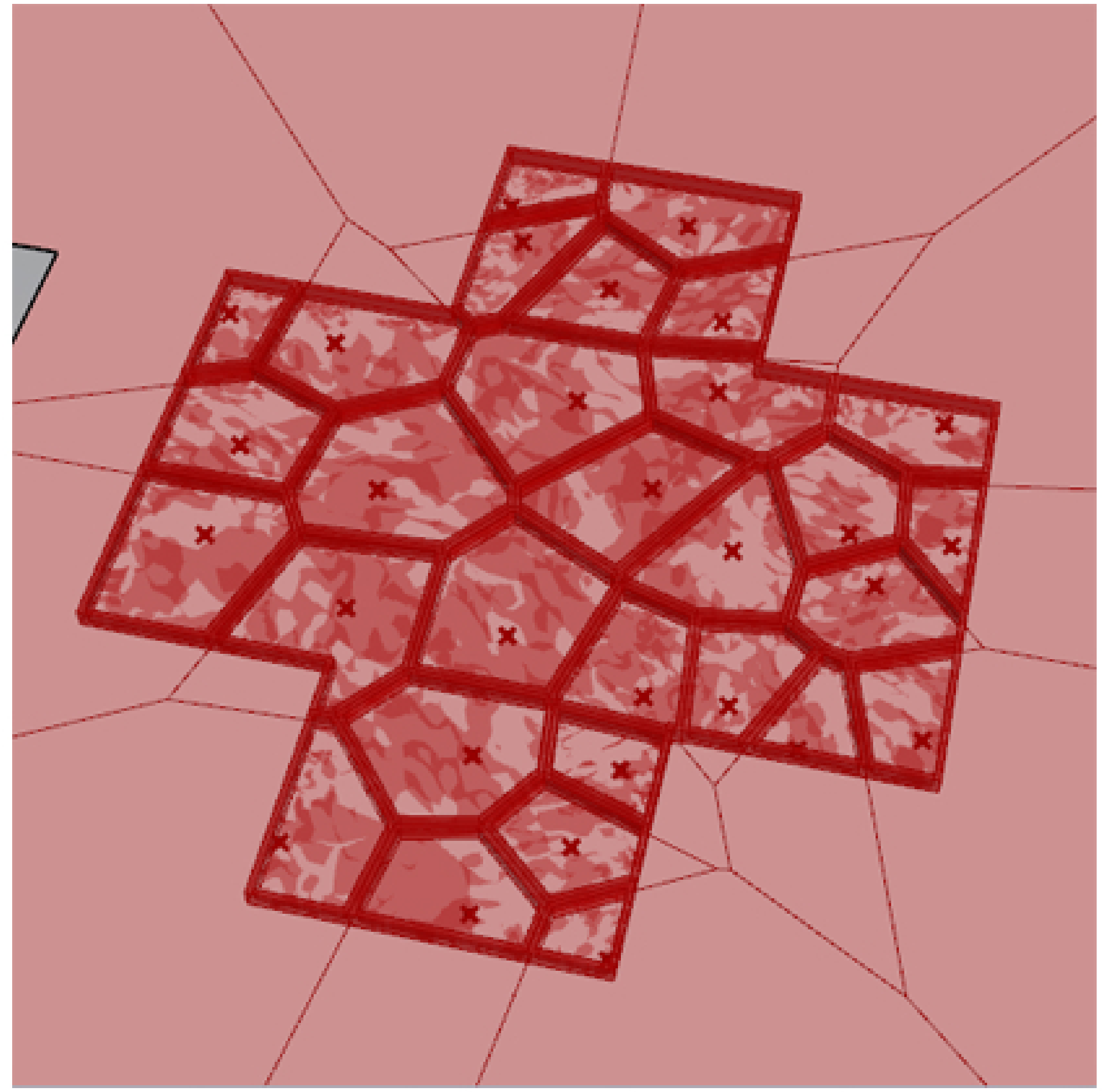
LASER CUTTING MACHINE
for cutting the plastic cells

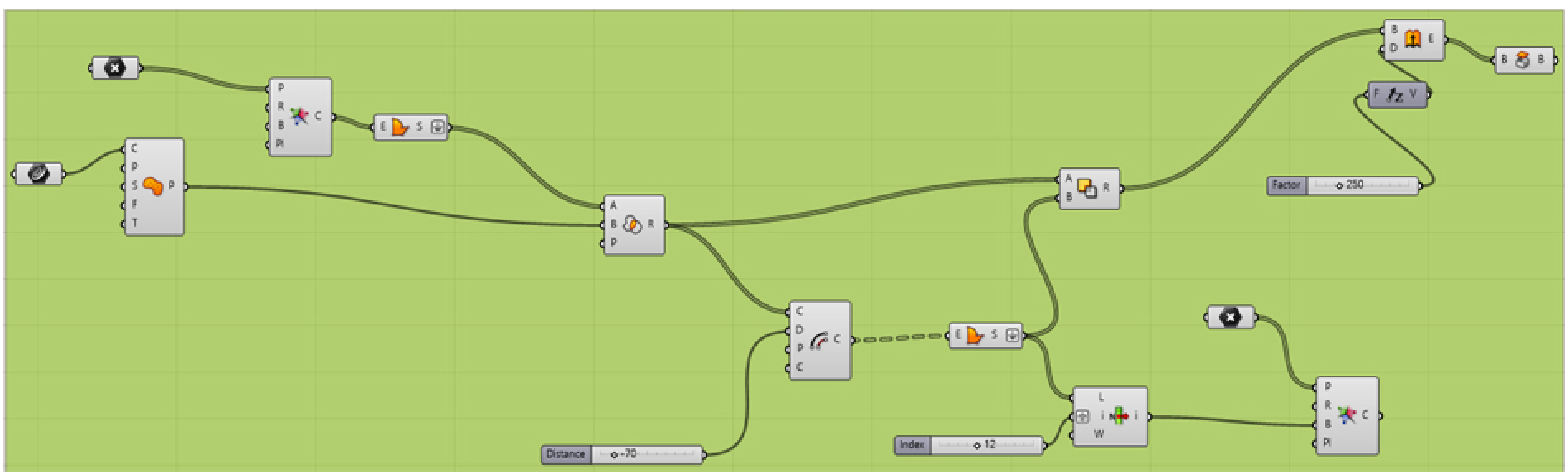
TIMES EUREKA PAVILION

PROJECT **COMPUTATIONAL**

Timber Cassettes

1st Voronoi diagram to make the timber structure.



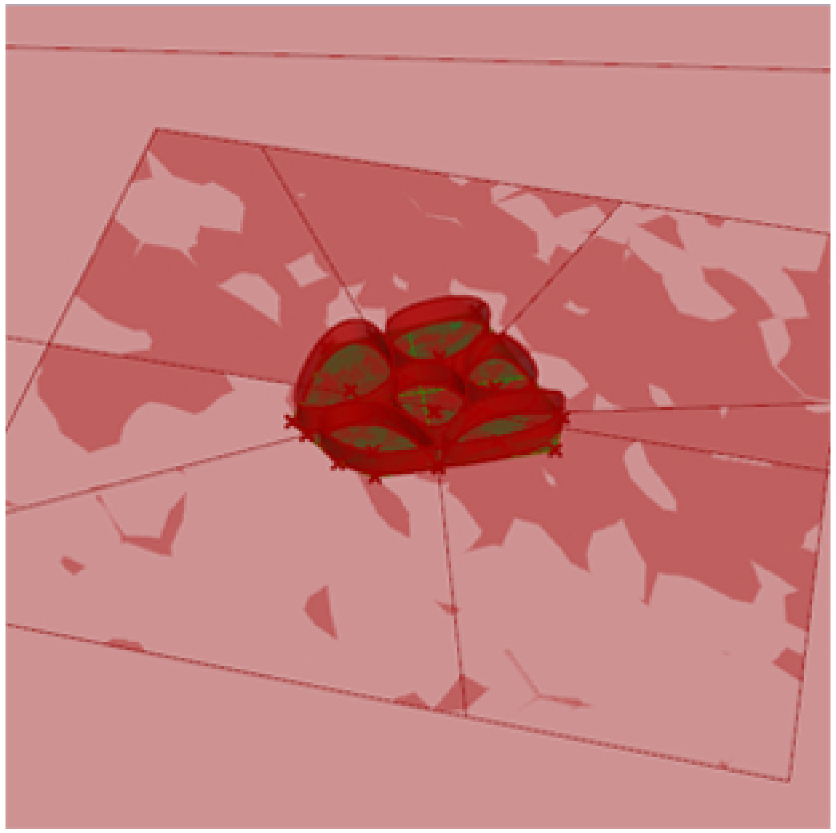


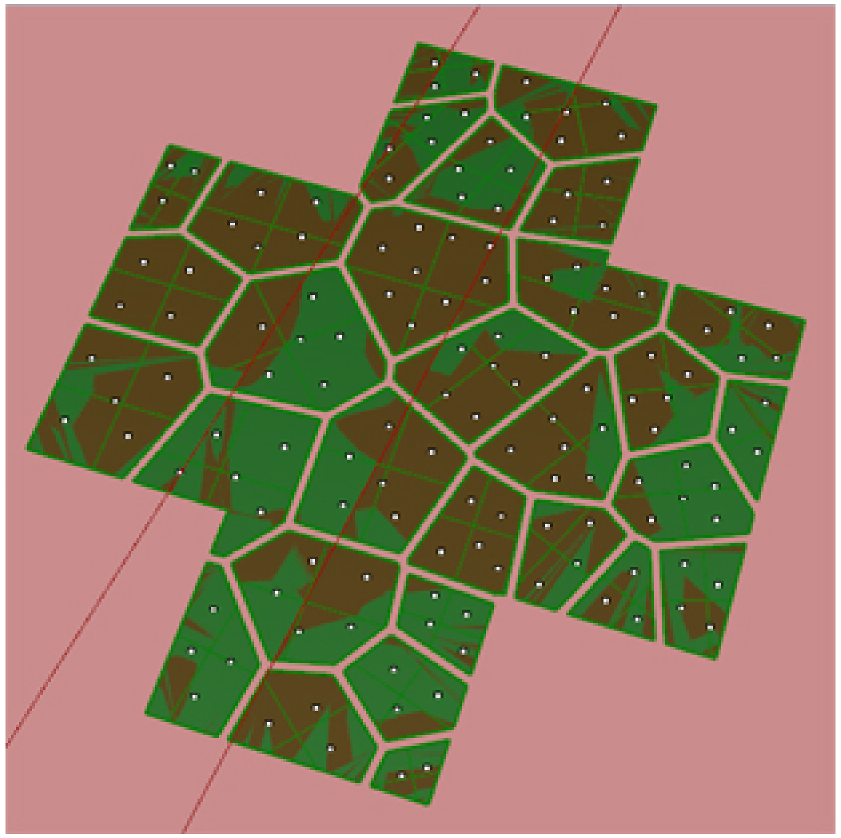
TIMES EUREKA PAVILION

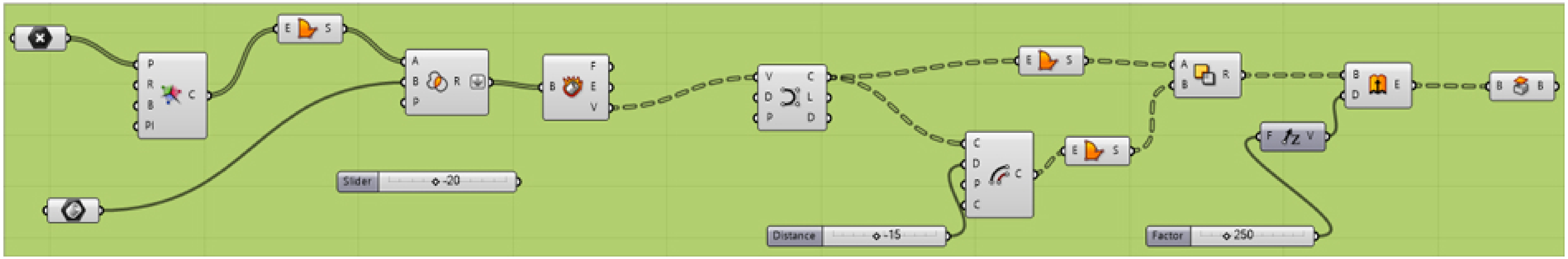
PROJECT **COMPUTATIONAL**

Plastic Cells

Plastic Cells infill are created by voronoi diagaram by using surface created from first voronoi as boundaries

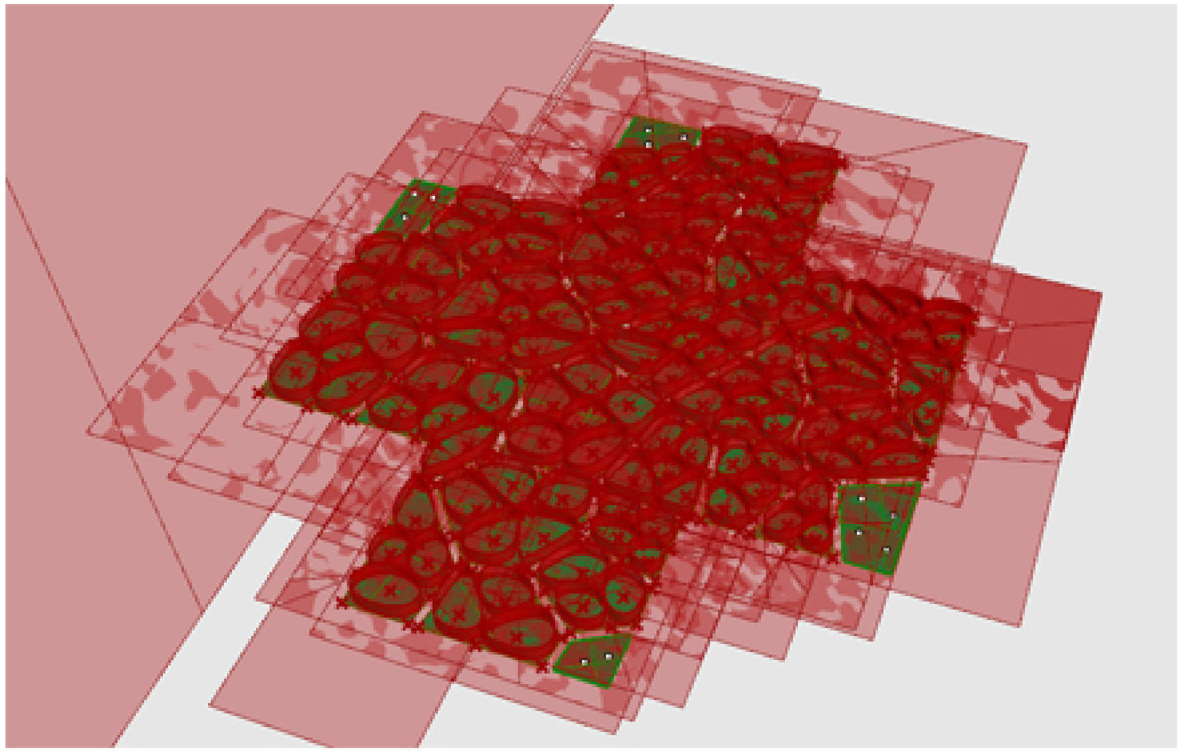


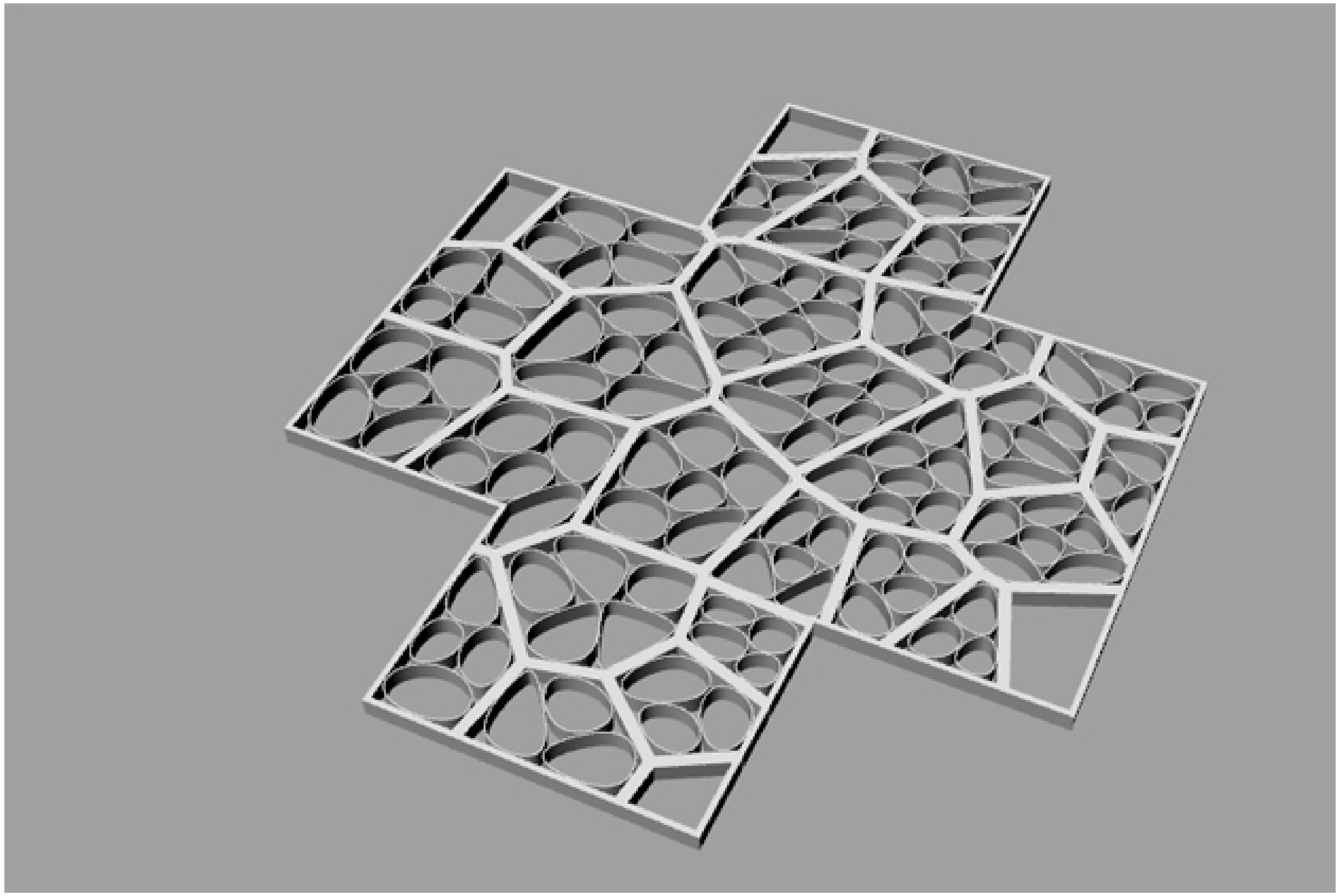




TIMES EUREKA PAVILION

PROJECT **COMPUTATIONAL**





TIMES EUREKA PAVILION

RHS CHELSEA FLOWER SHOW

SOURCE: http://michalpiasecki.com/2011/05/16/nex-architecture-times-eureka-pavilion/

TESSELLATION
Seattle Public Library
OMA

Teuta Hasani

Source: http://ad009cdnb.archdaily.net/wp-content/uploads/2009/01/2019138879_spl-exterior-dusk-rualt-528x420.jpg

Seattle Library

Project OUTLINE

Project Architect / Artist: OMA, Rem Koolhaas

Location: Seattle, Washington, United States

Investor: Seattle Public Library

Function: Library

Construction Year: 1999-2004

Dimmensions: 38,300m2 (footprint)

Structural engineer: Magnusson Klemencic Associates, Arup

Materials Used: Glass, steel, concrete

Budget: $111.9 million

Type Of Construction: Steel frame

Source: http://c1038.r38.cf3.rackcdn.com/group1/building1297/media/66.jpg

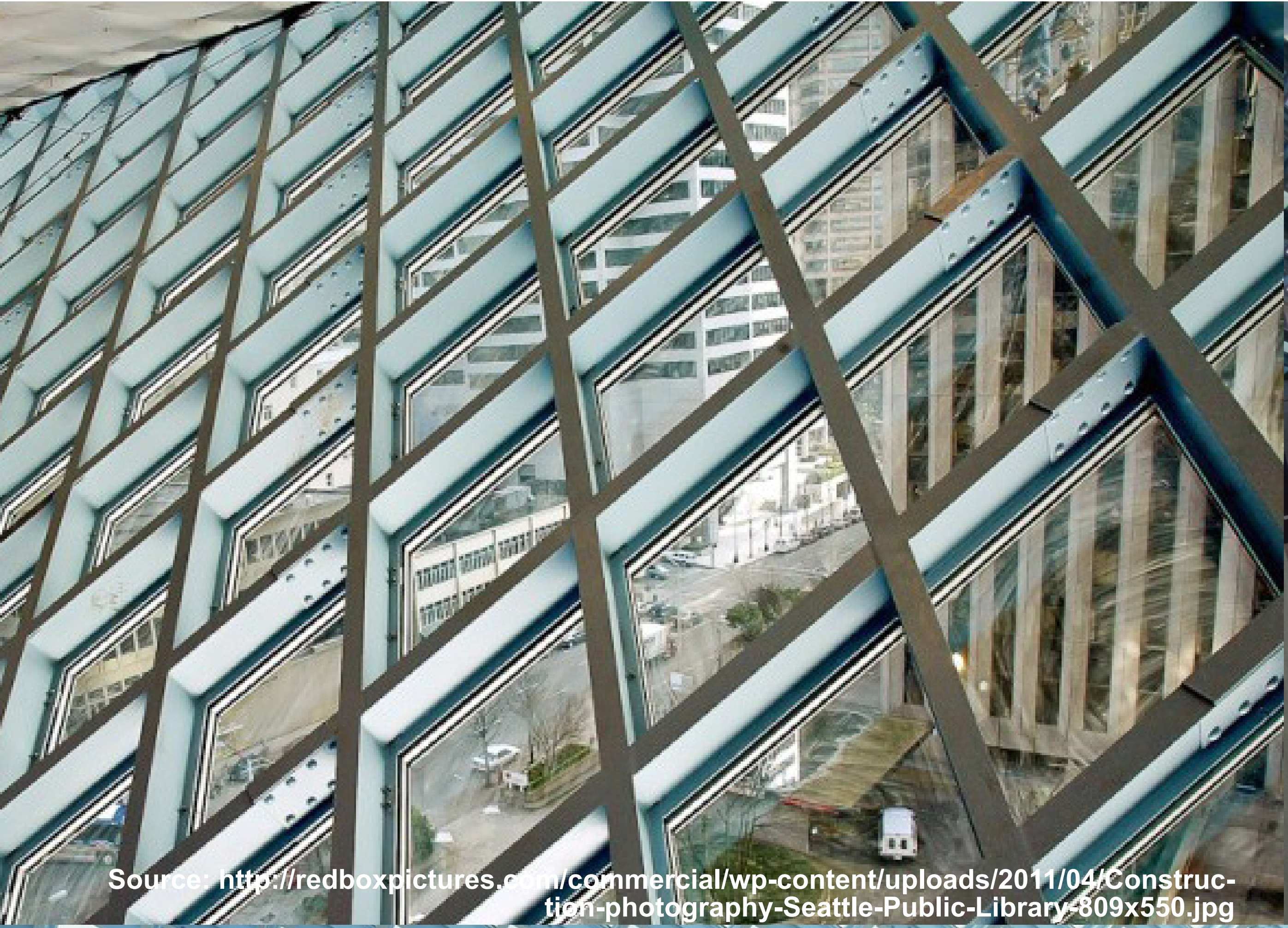
Seattle Library

Project DESCRIPTION

Seattle Public Library has a simple concept of separation of the skin from the main platforms of program spaces, in this way creating open interconnecting spaces in between.

The envelope of the building is a glass and metal skin which has a simple diamond module mullion framing across it. This is a consistent pattern repeating all over the building.

Source: http://www.cochraninc.com/sites/default/files/portfolio-images/SeattleCentralLibrary-SW-elevation-web.jpg



Source: http://redboxpictures.com/commercial/wp-content/uploads/2011/04/Construc-tion-photography-Seattle-Public-Library-809x550.jpg

Source: https://whatsupsmiley.files.wordpress.com/2012/04/seattle-public-library.jpg

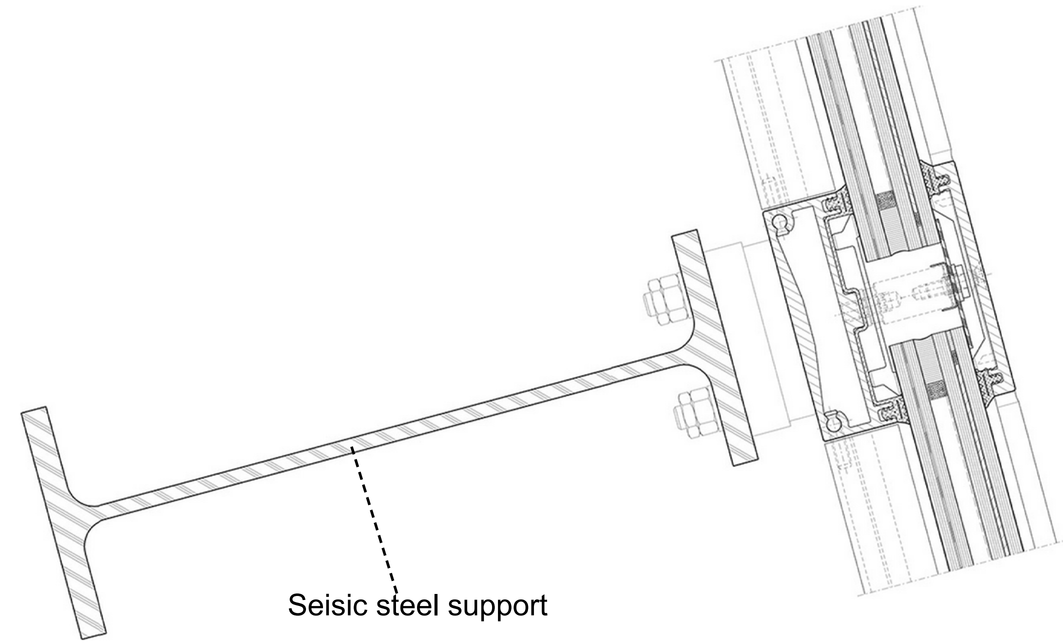
Source: http://bridgepark.org/sites/default/files/09_OMA_Seattle%20Public%20Library,%20Seattle.jpg

Seattle Library

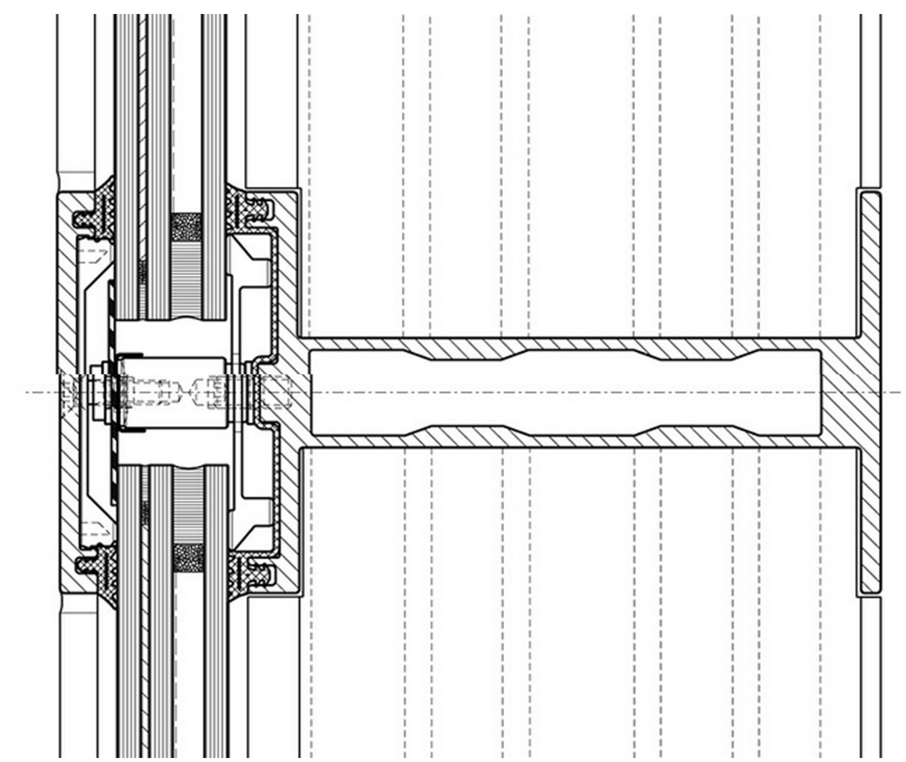
Project FABRICATION

The envelope was entirely prefabricated in Germany and then installed on site in Seattle. The building has two structural systems:
-the layered system (seismic system)
-the central block of concrete as the core structure

The layered system (seismic system) is composed of two mullion types: the typical (slope) mullion which is supported by seismic steel structural support and vertical mullion which is supported by I beams.



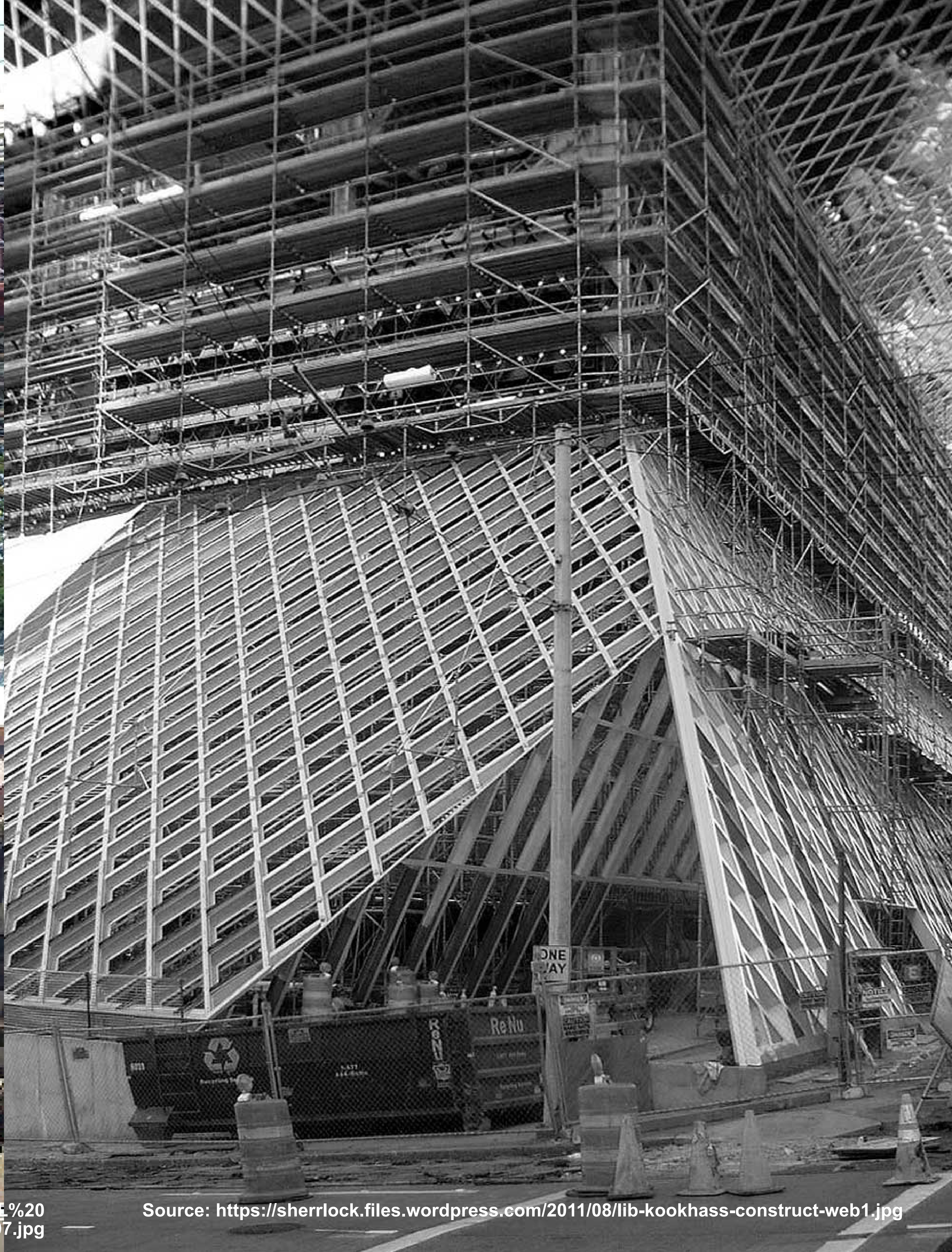
Typical (slope) mullion system


Vertical mullion system

Source: http://ad009cdnb.archdaily.net/wp-content/uploads/2009/01/1203497712_spl-living-room-prat.jpg

Seattle Library
Project FABRICATION

Source: http://photos1.blogger.com/x/blogger2/6627/4568/1600/506125/SCL%20 Laser%20Scanning%2007.jpg



Source: https://sherrlock.files.wordpress.com/2011/08/lib-kookhass-construct-web1.jpg

Seattle Library

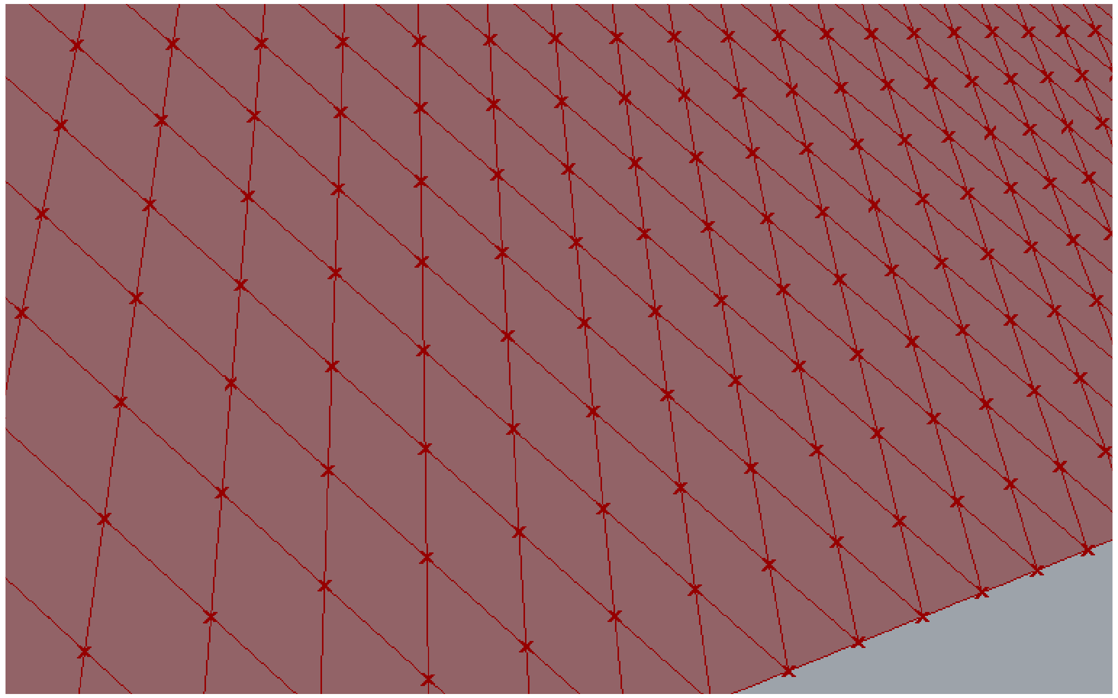
Project MATERIALS

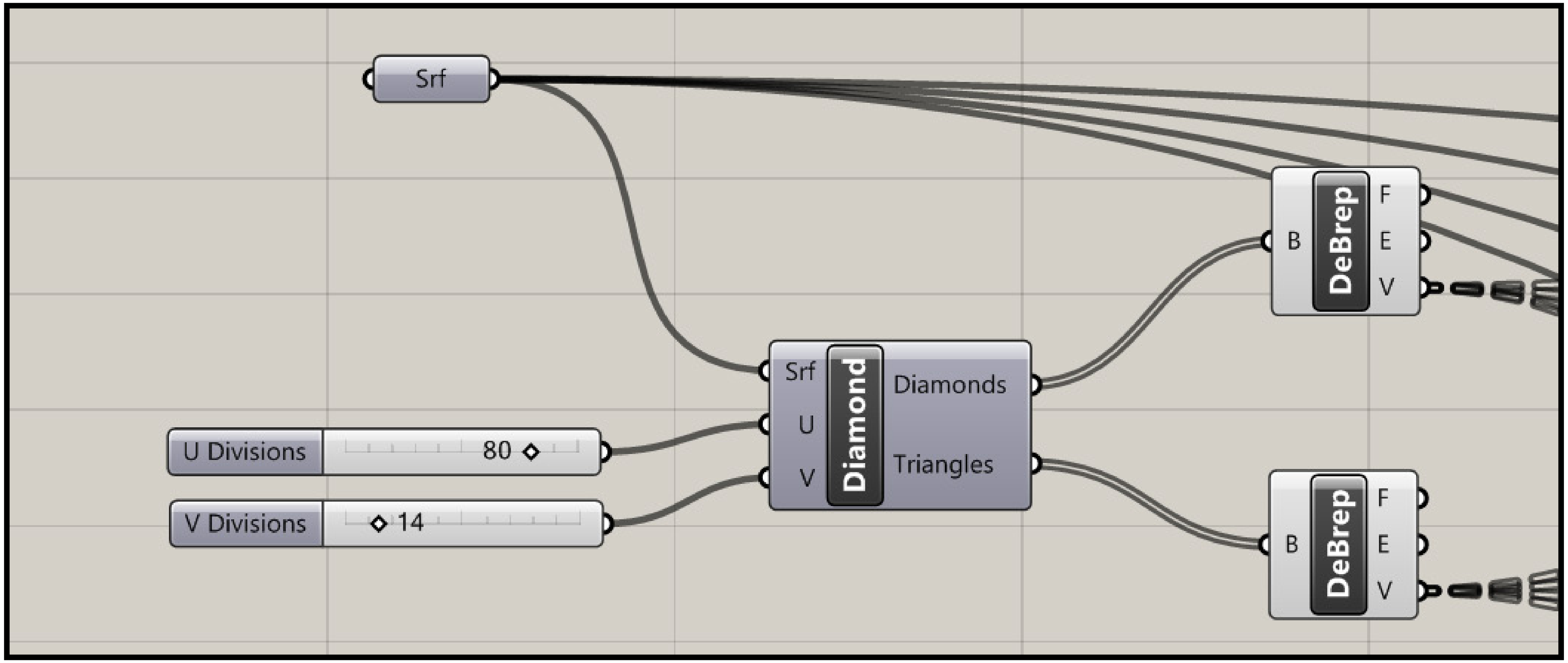
Seattle Public Library Quantity Survey		
Facade		
	Material	**Quantity**
Steel		4 644 tn
Glass (diamond)		9 994pcs

Source: http://ad009cdnb.archdaily.net/wp-content/uploads/2009/01/1685363506_spl-facade-detail-rualt.jpg

Seattle Library

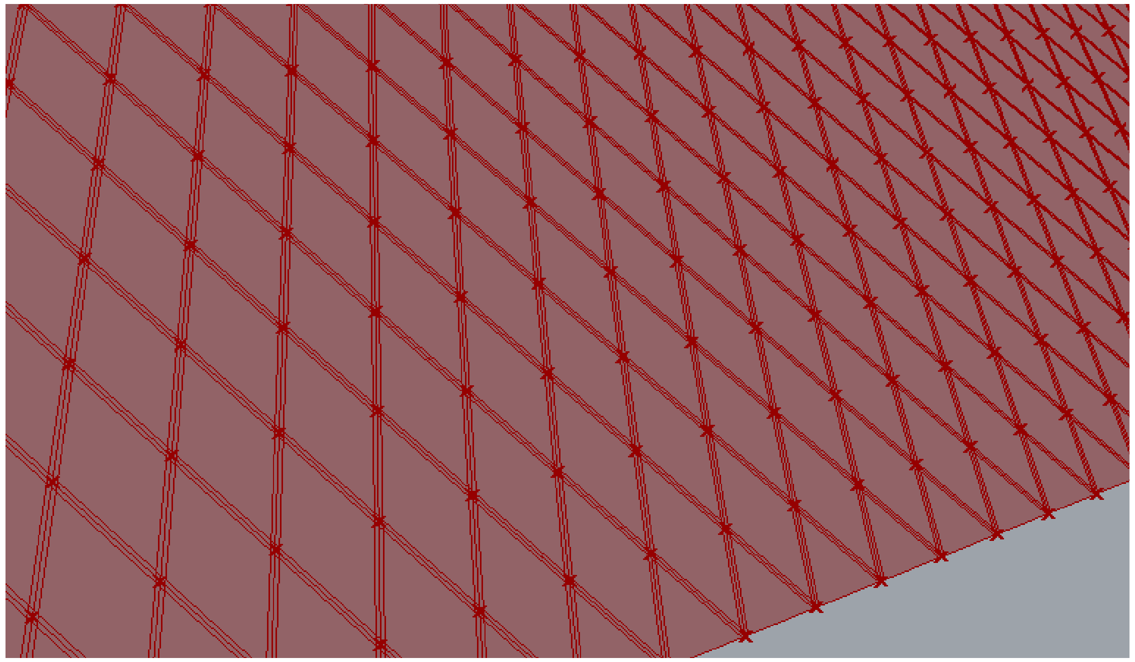
GRASSHOPPER
Modelling

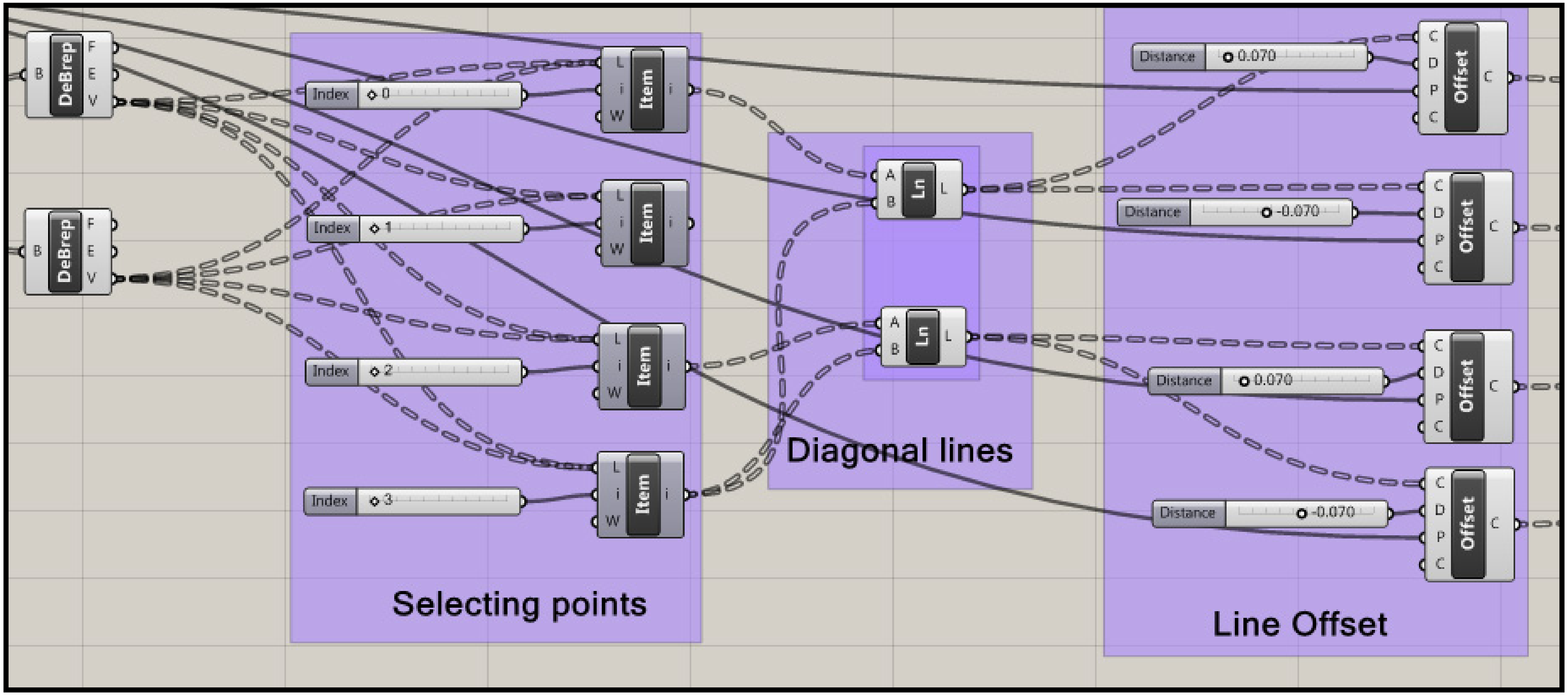




Seattle Library

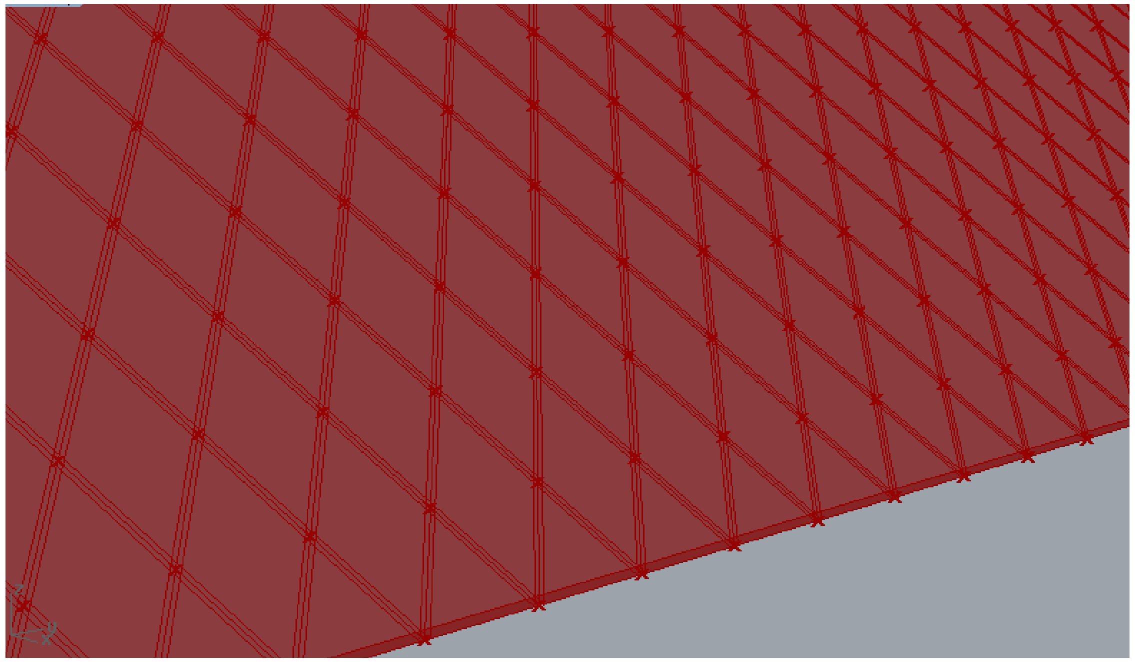
GRASSHOPPER
Modelling

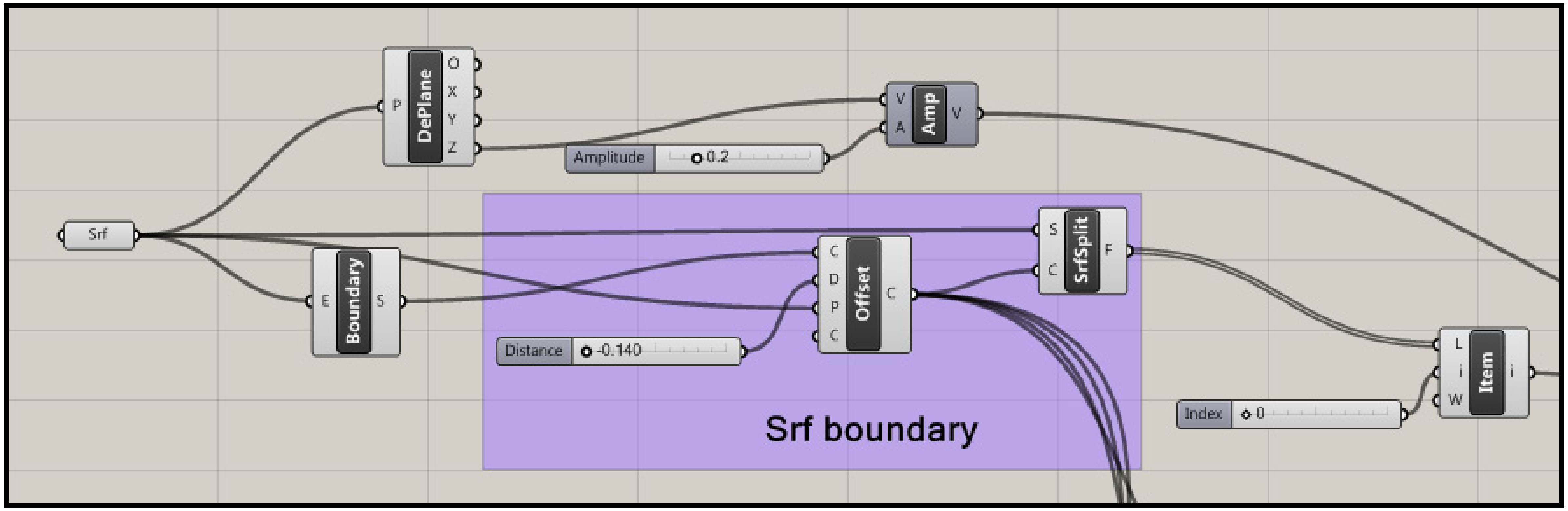




Seattle Library

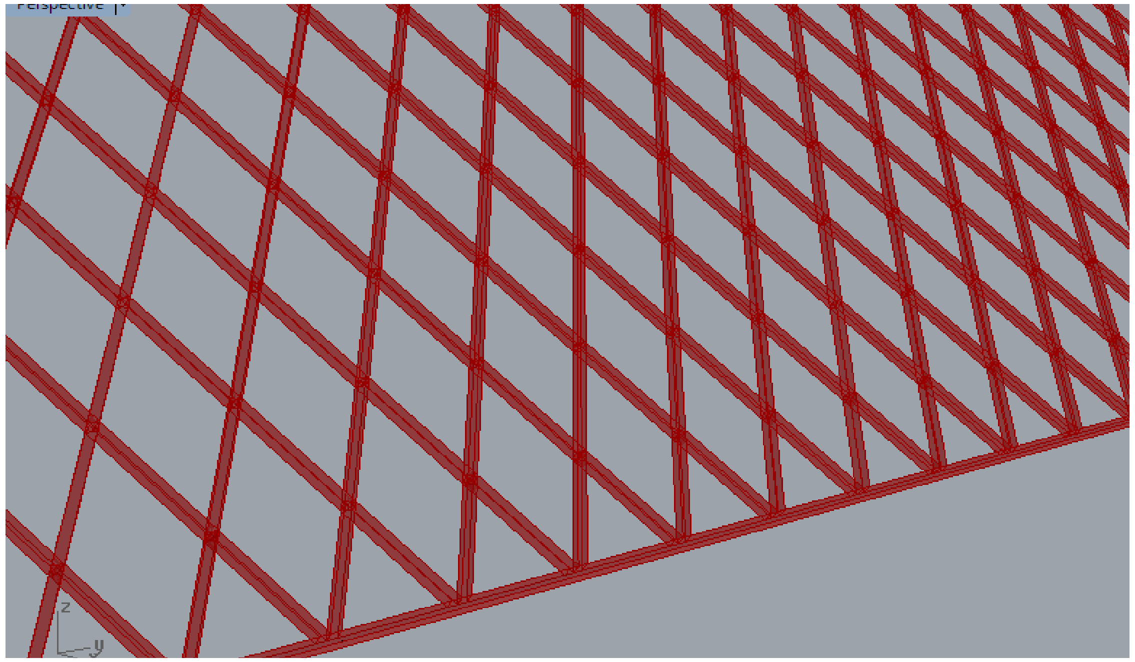
GRASSHOPPER
Modelling

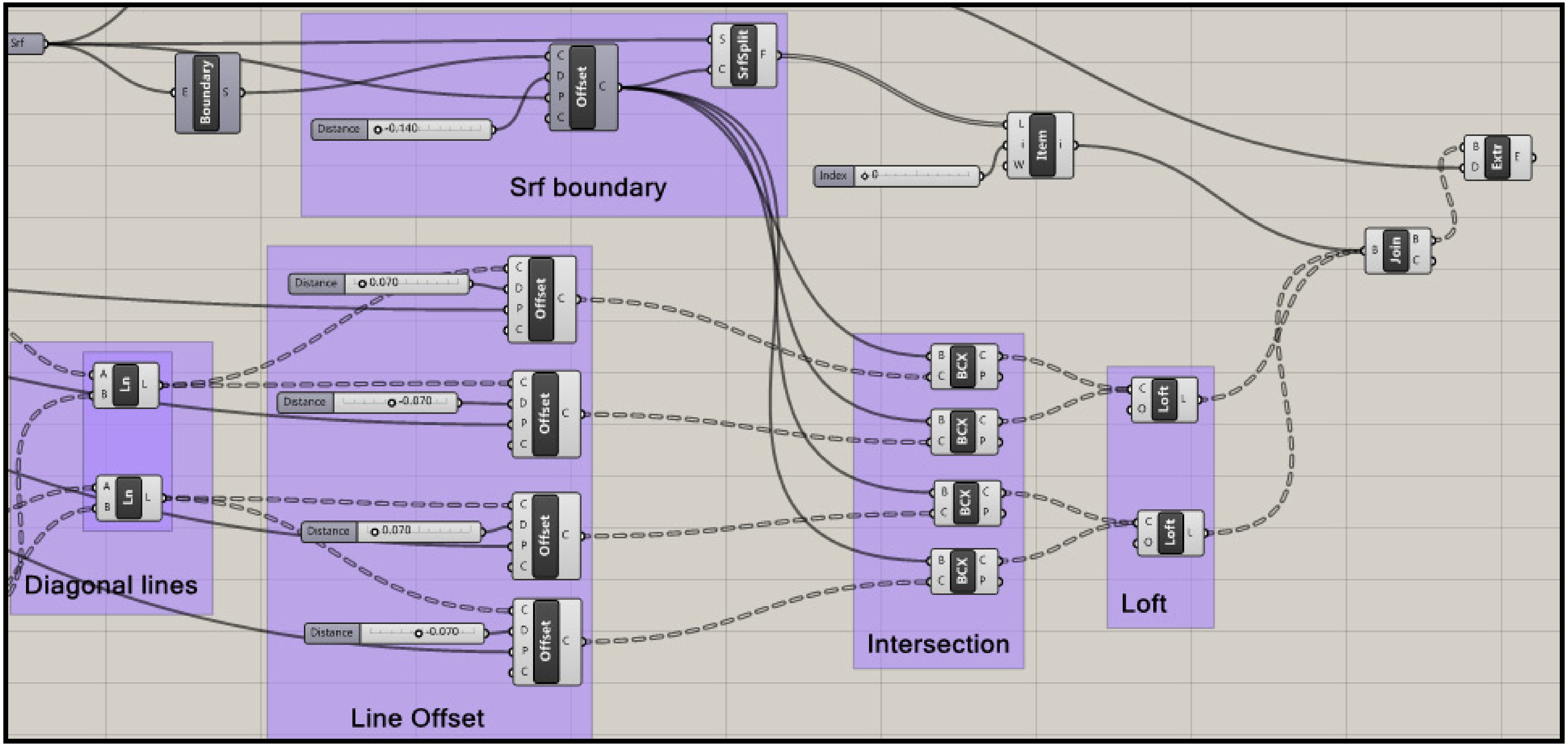




Seattle Library

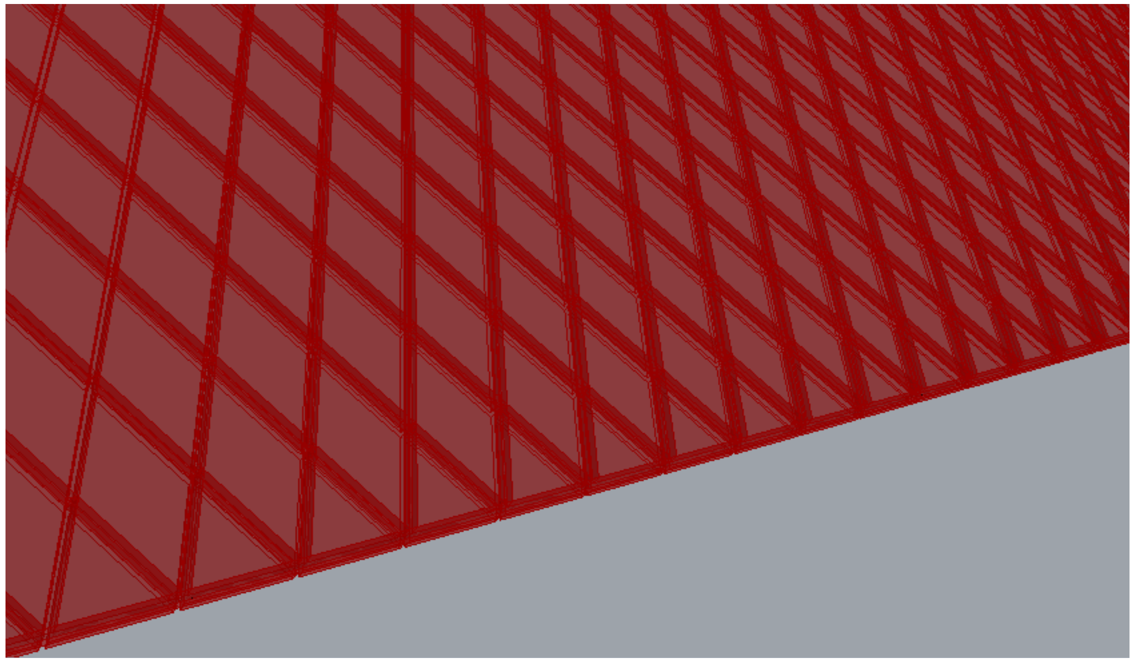
GRASSHOPPER
Modelling

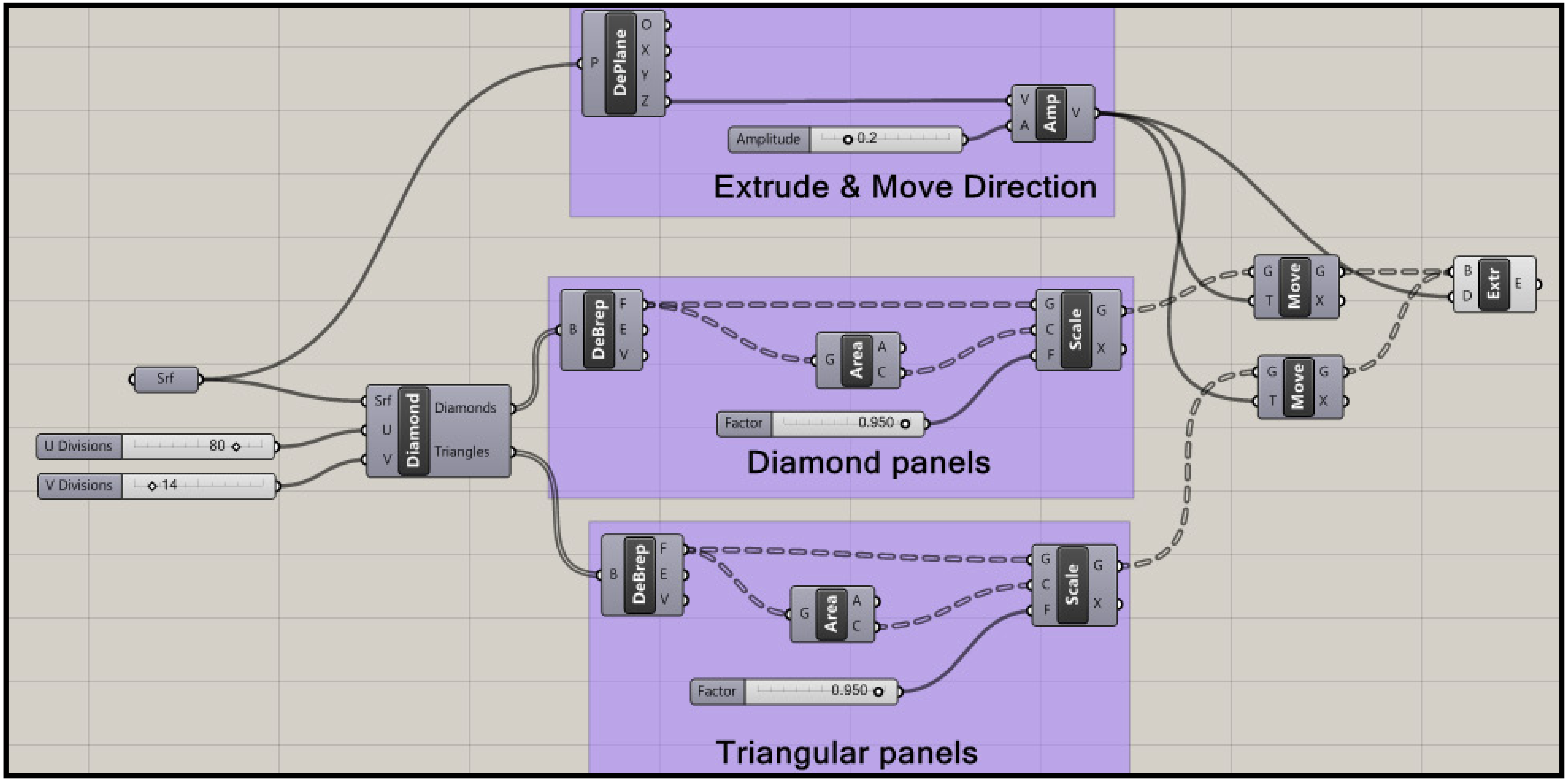




Seattle Library

GRASSHOPPER
Modelling

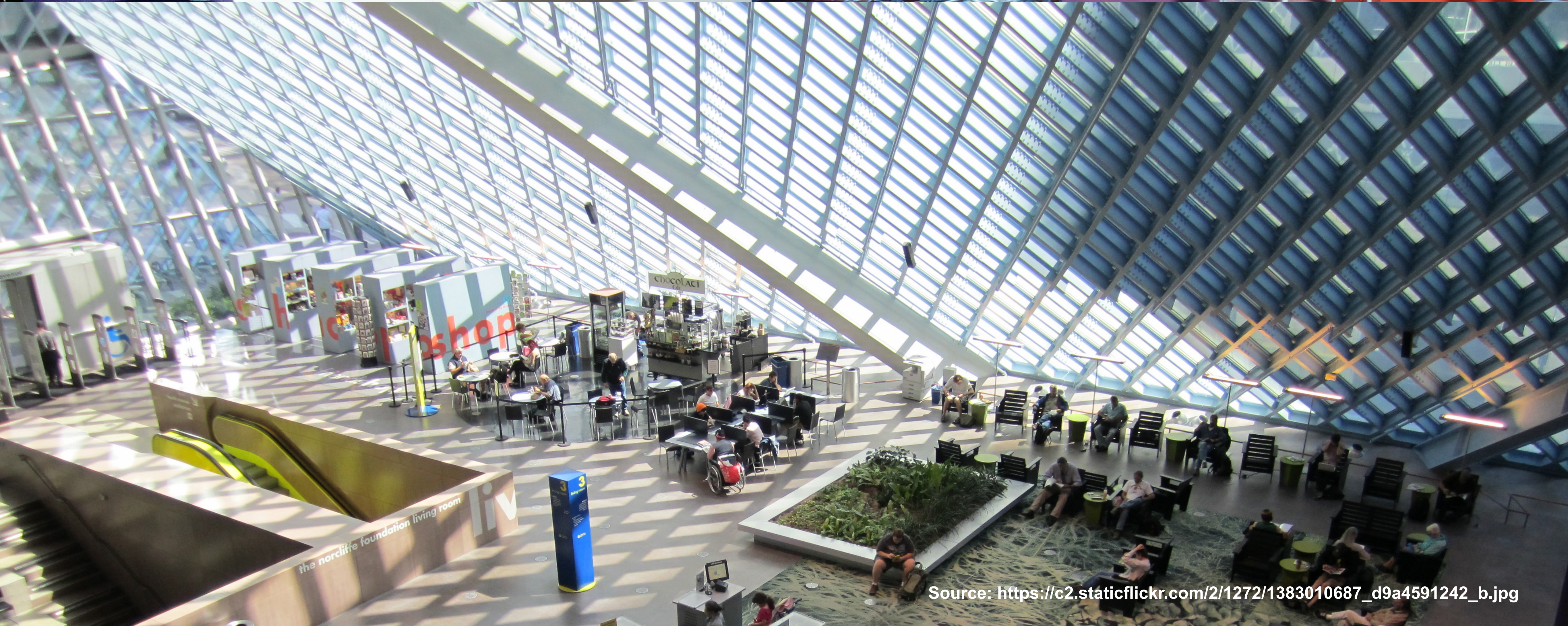




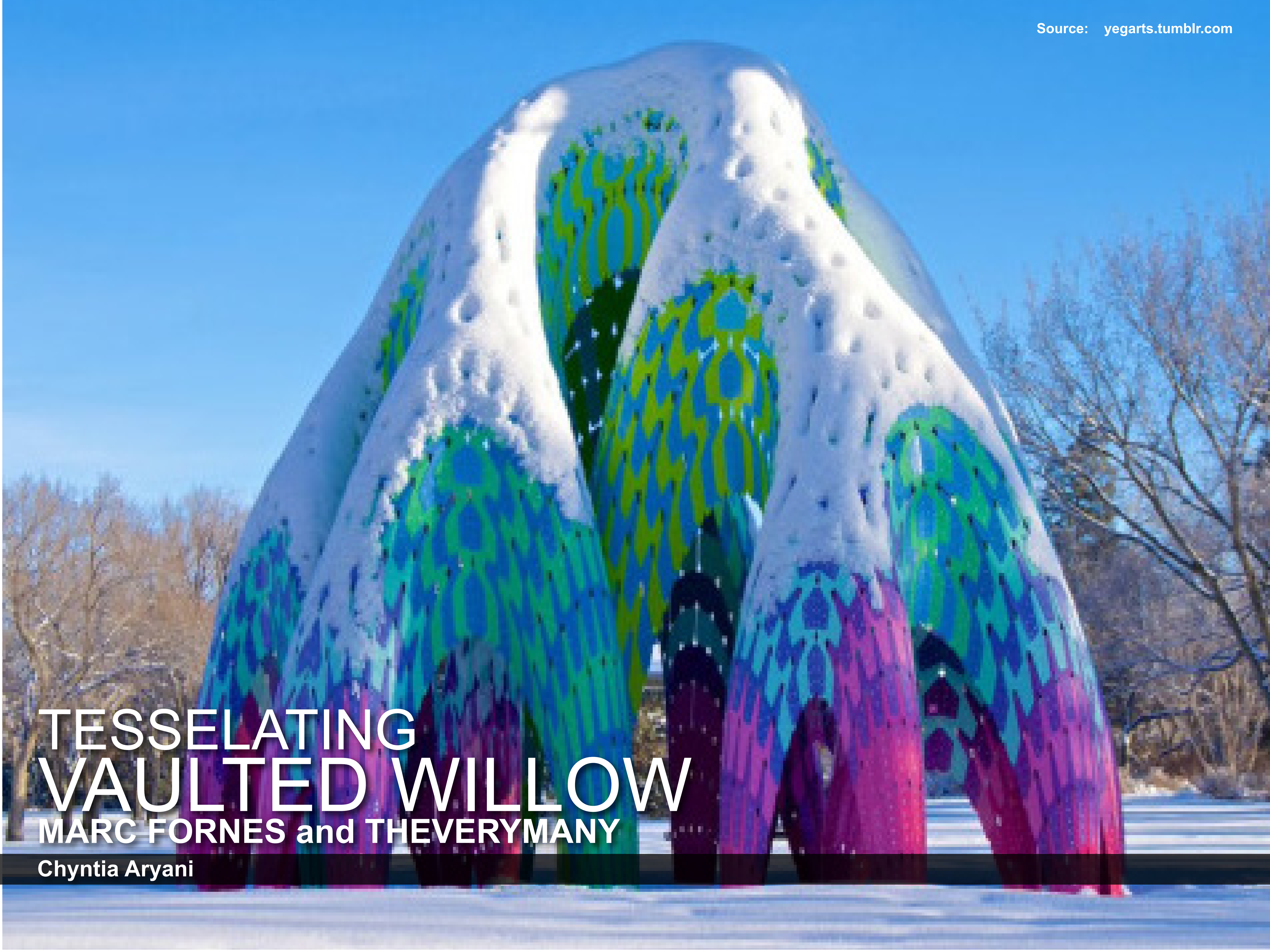
Seattle Library

Source: http://lmnarchitects.com/wp-content/uploads/2015/03/78c09f86-02bd-498e-a4cb-b24a64091621.jpg

Source: http://www.archinnovations.com/images/stories/Seattle_library/05.jpg

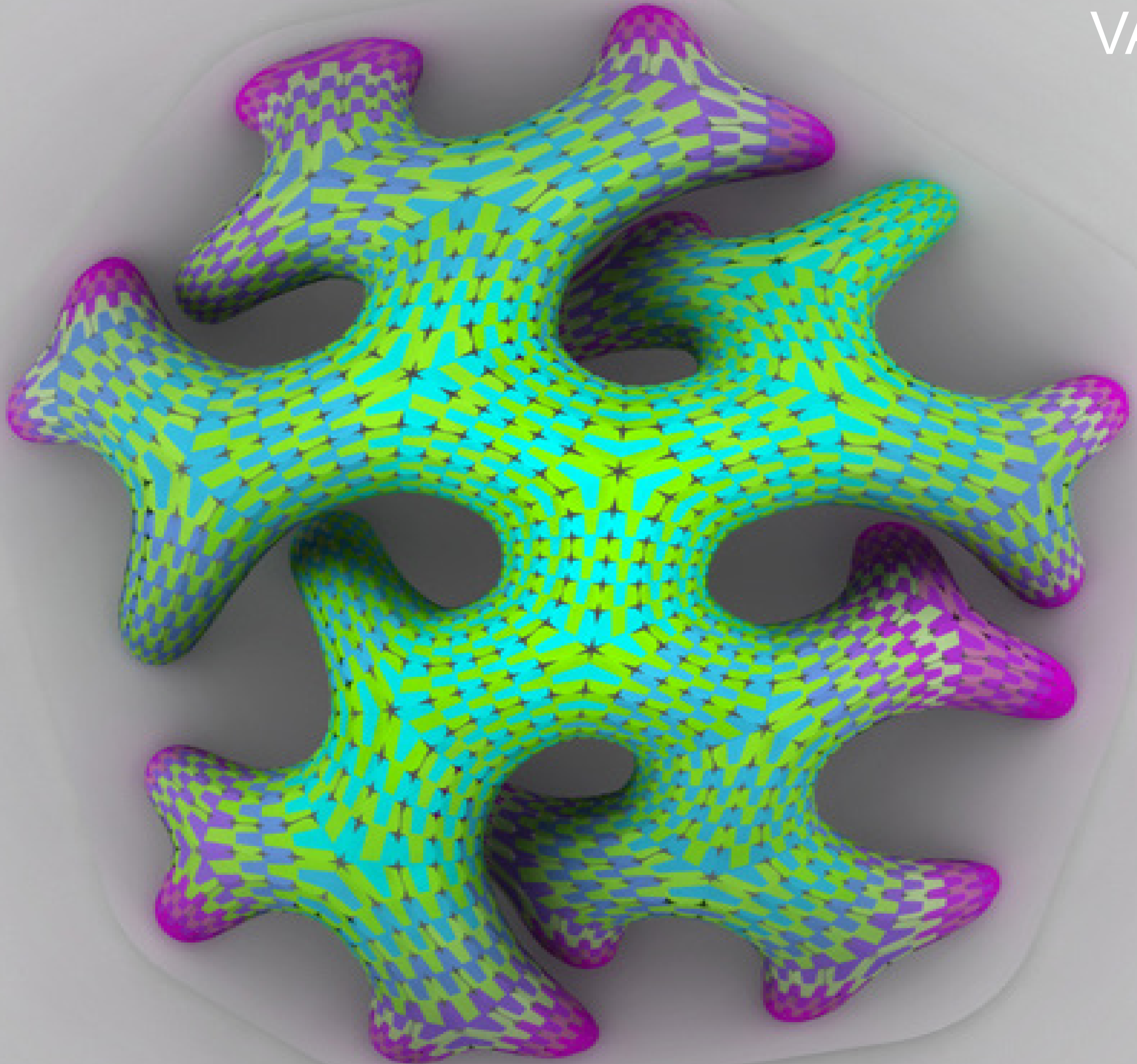


Source: https://c2.staticflickr.com/2/1272/1383010687_d9a4591242_b.jpg


Source: yegarts.tumblr.com
TESSELATING
VAULTED WILLOW
MARC FORNES and THEVERYMANY
Chyntia Aryani

VAULTED WILLOW

Project OUTLINE



Source: theverymany.com

Project Architect / Artist:
Marc Fornes and Theverymany

Location:
Borden Park, Edmonton, Canada

Investor:
The Edmonton Arts Council

Function:
Pavilion

Completed on:
June 18th, 2014

Dimensions:
XXXX

Construction Team:
Will Laufs, LaufsED

Materials Used:
Alumunium stripes, Connector,
epoxy concrete anchor

Budget:
$ 212.000

Major Fabrication Method Used:
Overlaping Tesselating

Fabricated By:
xxxxxx

Type Of Construction:
Lightweight, self supported shells

Modelling Software:
Rhino + Grasshopper+Phyton

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

VAULTED WILLOW

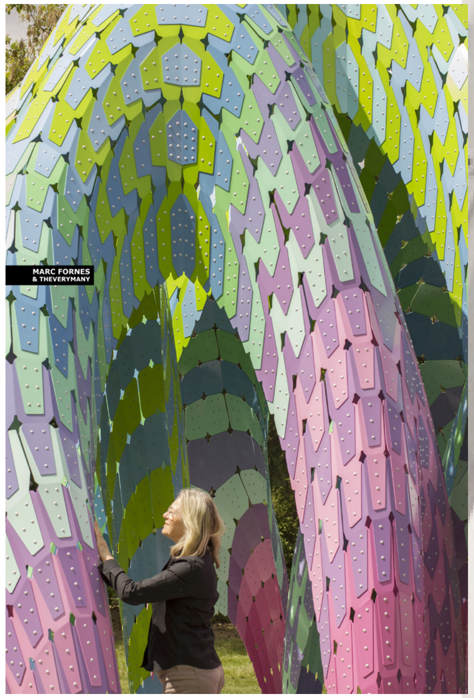
Project DESCRIPTION

VAULTED WILLOW, a sculptural pavilion designed by Marc Fornes and THEVERYMANY is an architectural folly which aims to resolve and explore the structure, skin and ornamentation into a single unified system. It has lightweight structure and self supported shells. It is developed of custom computational protocols of structural form-finding and descriptive geometry.

This project is comprised of 721 alumunium stripes, 14.043 connectors and 60 epoxy concrete anchors. This pavilion uses three different thickness of alumunium shells and it gets thicker nearer the bottom. The striated skin is an intricate assembly of structural structure. The skin are similar, unique, and digitally fabricated. These stripes are located at the edge of the surface increase tab overlap to help transfer additional loads through lamination and increase connectivity.

The pavilion is created of a reciprocal relationship that encompasses experiments in non-linear architectural typology (multiple entries, distributed feet with branching and spiral leg), structural differentiation (bifurcation of structural download forces, tighter radii of leg profiles for rigidity) and programmatic possibilities for a winding playground (hide and seek).

Source: **theverymany.com, www.designboom.com**



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

VAULTED WILLOW

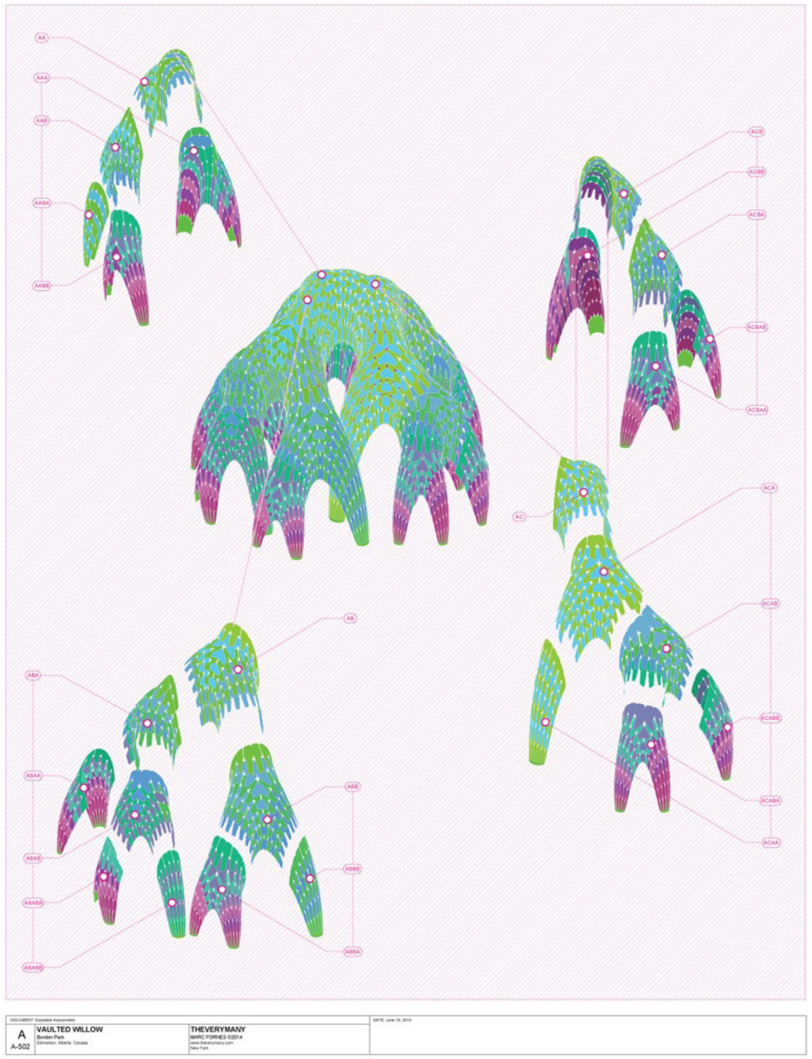
Project FABRICATION

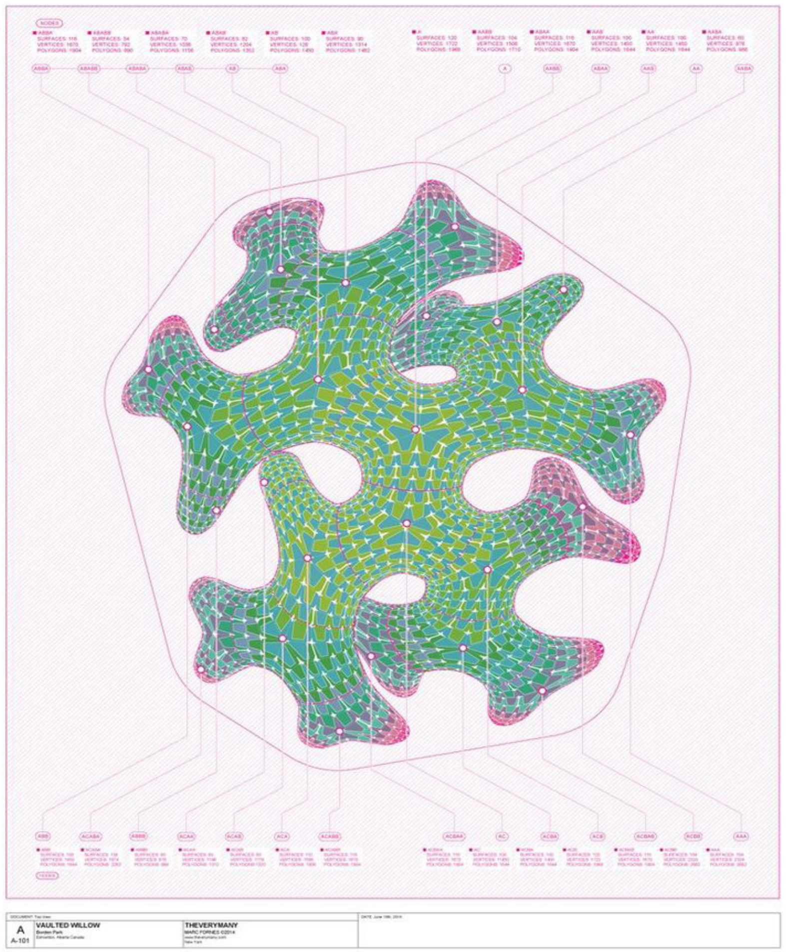
The studies elaborate on 2D geometry of catenary curves by exploiting a computionally derived dynamic spring network with behavioral attributes.
The springs come in various types (tensioner, straigtener) associated with multiple parameters (rest lenght, angle constraint.)

Running bonds split the stripes, shortening them to ease fabrication, assembly, and decrease material usage through more efficient nesting.

The extensive, computationally driven, descriptive geometry protocol developed for the project embeds axis of bending, angle measurements, part nomenclature, and color information for each stripe.

Source: theverymany.com, http://thenewstack.io/





VAULTED WILLOW

Project MATERIALS

Component	Material	Quantity
Stripes	Alumunium	721
Connector		14.043
Anchors	Epoxy concrete	60

This pavilion project uses aluminum of three different thicknesses. 24 base plates are anchored to a concrete pad of 240 cubic feet.

It took four days, and a crew of four to assemble the prefabricated parts.

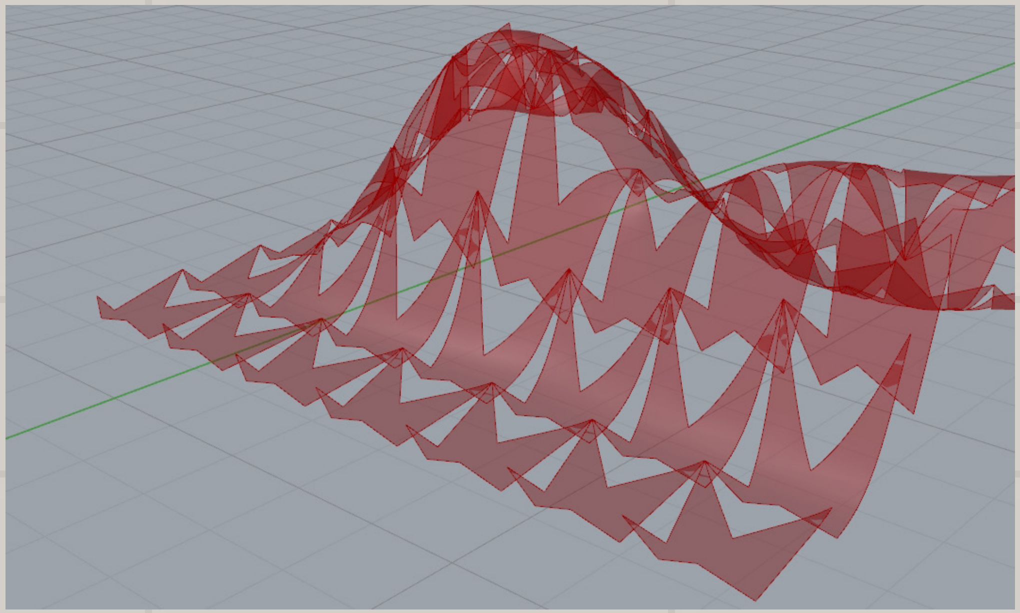
Source: theverymany.com, http://thenewstack.io/

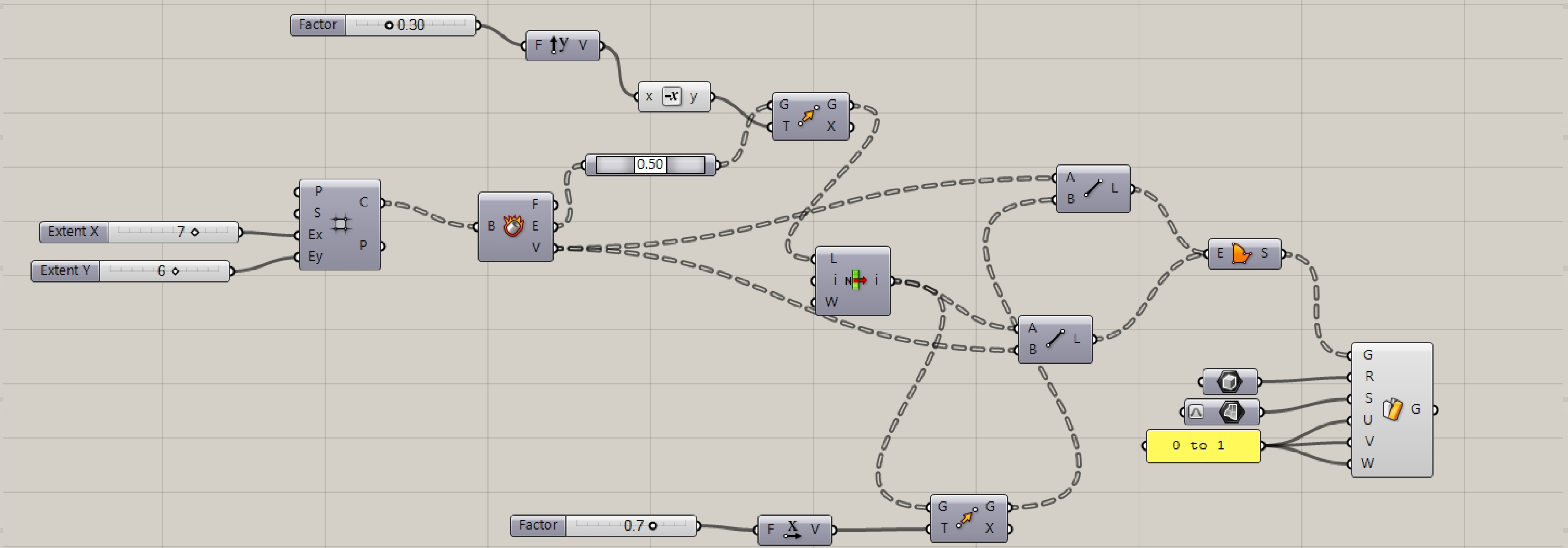
Source: http://www.youtube.com/

Source: http://www.youtube.com/

VAULTED WILLOW

GRASSHOPPER
Modelling





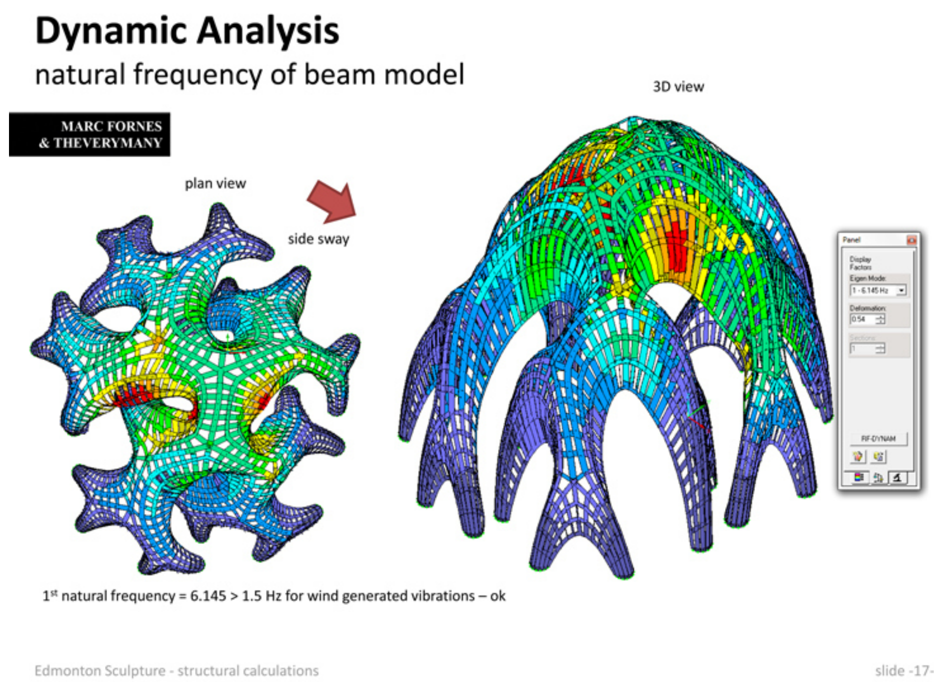
VAULTED WILLOW

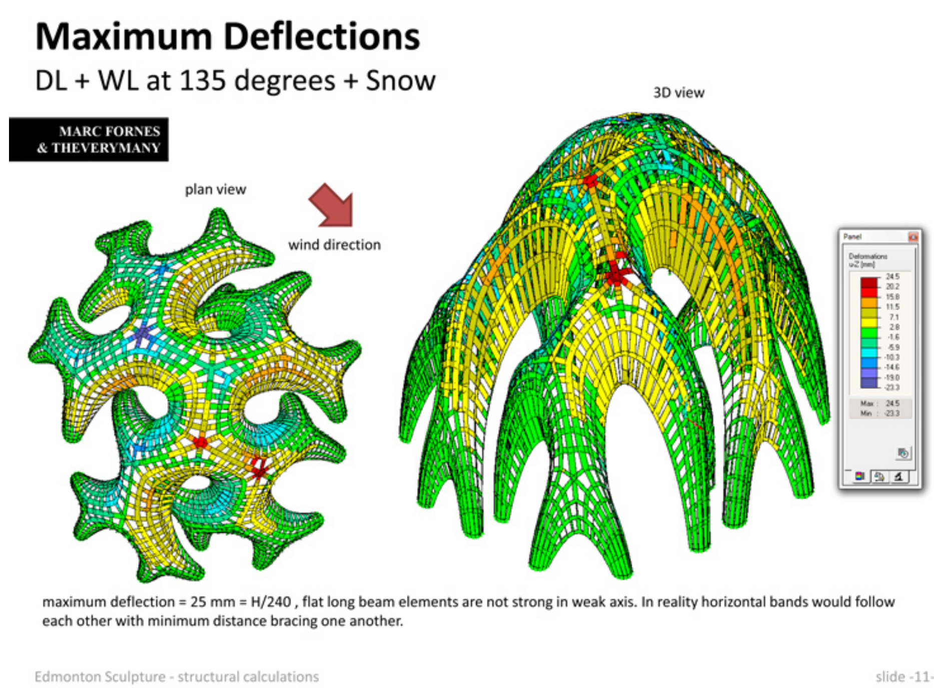
GRASSHOPPER
Structural Analysis

Vaulted Willow is the latest iteration of the studio's continuing research into self-supporting, lightweight monocoque shells, consisting of hundreds to thousands of assembled pieces. The pavilion's overall, curved catenary form is "inflated" along various planes to create double curvatures, which intrinsically creates stiffness without the need for a supporting structure, while optimizing anticipated forces and snow and wind loads. The structure is held together with a dynamic network of various types of connectors, determined by parameters like length, angle constraints and strength.

Various characteristics are computationally determined, like the density of the gaps between the shingles. The frequency and size of these openings increase with height to allow light to filter through, and also because less material is needed for structural strength near the top. Details like rivet density, the size of the overlapping tabs and color patterning are all driven by computational protocols, creating a resulting work that looks like a trippy, quasi-natural outgrowth of the park itself.

Source: **theverymany.com, http://thenewstack.io/**





VAULTED WILLOW

Project Suporting tools

grasshopper
GENERATIVE MODELING
FOR RHINO

Rhinoceros®
NURBS modeling for Windows

CNC MACHINE for cutting and bending

Source : http://i00.i.aliimg.com/photo


TESSELLATION
CAPITAL GATE
ABU DHABI
MOHAMMAD ASHHAB ZAMAN (4060699)
Source: http://www.google.de/imgres?imgurl=http%3A%2F%2Fwww.iisd.ca%2Firena%2Firenaa1%

Capital Gate

Project OUTLINE

Project Architect / Artist: RMJM (Robert Matthew Jo-hnson Marshall)

Location: Abu Dhabi (United Arab Emirates UAE)

Investor: Abu Dhabi National Exhibitions Company

Function: 5-star Hyatt Capital Gate hotel and additional office space.

Construction Year: 2011

Dimmensions: 160 m (520 ft) and 35 stories

Construction Team: Al Habtoor Engineering Enterpri-ses

Materials Used: Concrete,steel,glass,metals,

Budget: $231million

Major Fabrication Method Used: Regular tessellation

Secondary Fabrication Methods: Steel gridding

Fabricated By: Diagrid technology

Type Of Construction: Diagrid lattice arrangement of the façade which supports
Modelling Software: Rhino + Grasshopper

http://www.google.de/imgres?imgurl=http%3A%2F%2Fwww.abudhabi-city.

Capital Gate
Project DESCRIPTION

Capital Gate is a skyscraper in Abu Dhabi adjacent to the Abu Dhabi National Exhibition Centre designed with a striking lean. At 160 m (520 ft) and 35 stories, it is one of the tallest buildings in the city and inclines 18° to the west.[3] The owner and developer of Capital Gate is Abu Dhabi National Exhibitions Company.

The building has a diagrid especially designed to absorb and channel the forces created by wind and seismic loading, as well as the gradient of Capital Gate. Capital Gate is thought[by whom?] to be the Middle East's first building to use a diagrid; others around the world include London's 30 St Mary Axe (Gherkin), New York's Hearst Tower and Beijing's National Stadium.

The Capital Gate project was able to achieve its inclination through an engineering technique that allows floor plates to be stacked vertically up to the 12th storey, and staggered, one over another by between 300 mm to 1400 mm.

Capital Gate was designed by architectural firm RMJM and was due for completion in 2011. Upon completion, Capital Gate will house the 5-star Hyatt Capital Gate hotel and additional office space.

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

http://www.google.de/imgres?imgurl=http%3A%2F%2Fwww.businesstraveller.com%2Ffiles%2FNews-images%2FHyatt%2FHCG-Canopy-Close-Up_470x470.

Capital Gate

Project FABRICATION

The gravitational pressure caused by the 18° incline is countered by a technique called pre-cambered core, using a core of concrete reinforced with steel, with the core deliberately built slightly off-centre. It is also anchored to the ground by 490 piles which are drilled 20–30 metres underground.

The building has a diagrid especially designed to absorb and channel the forces created by wind and seismic loading, as well as the gradient of Capital Gate. Capital Gate is thought[by whom?] to be the Middle East's first building to use a diagrid; others around the world include London's 30 St Mary Axe (Gherkin), New York's Hearst Tower and Beijing's National Stadium.

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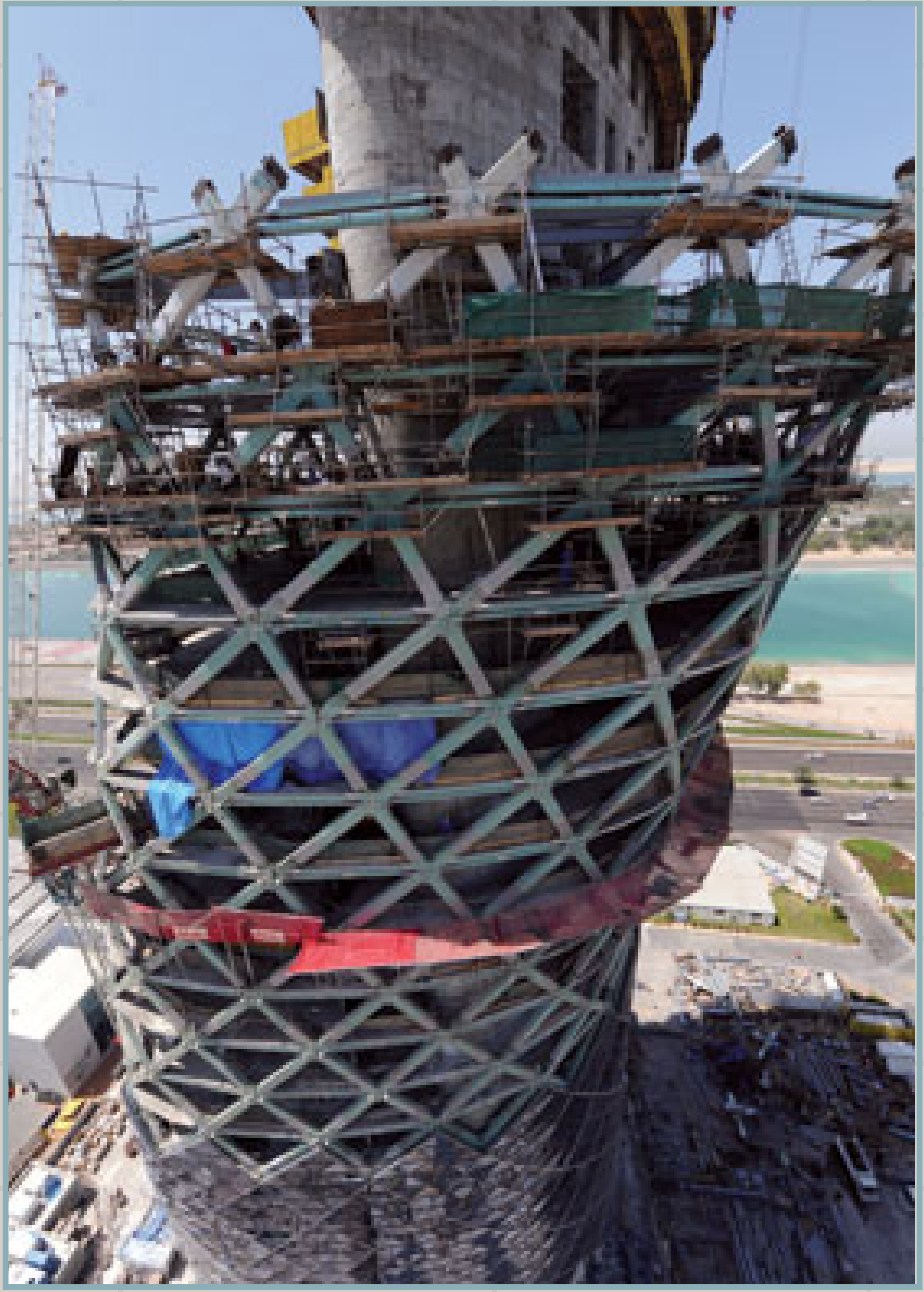


http://www.google.de/imgres?imgurl=http%3A%2F%2Fmedia-cdn.

Capital Gate

Project FABRICATION

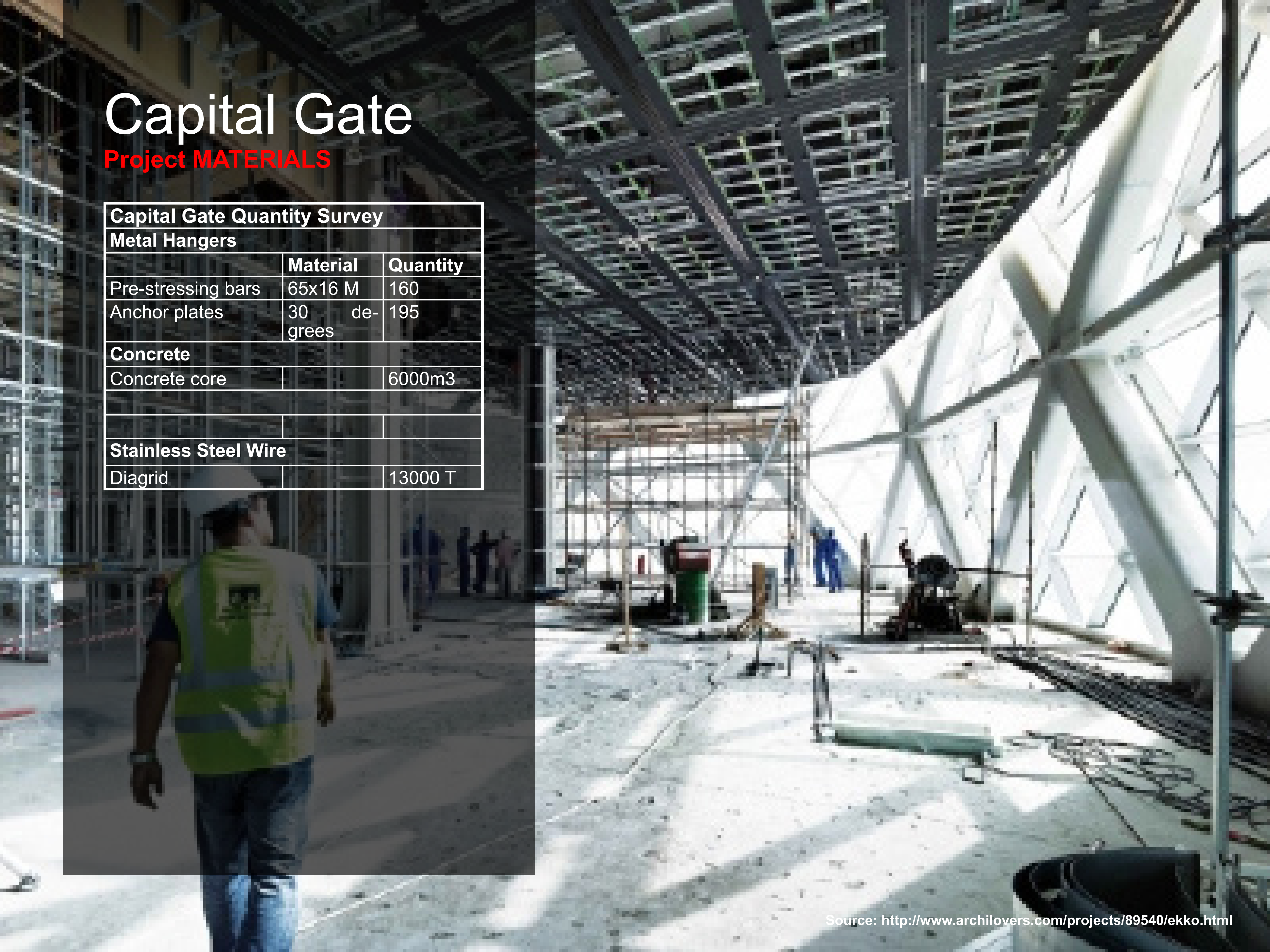
Source: http://www.google.de/imgres?imgurl=http%3A%2F%-

Source: http://www.google.de/imgres?imgurl=http%3A%-

Source: http://www.hlgroup.com/media/thumbnail/

Capital Gate

Project MATERIALS

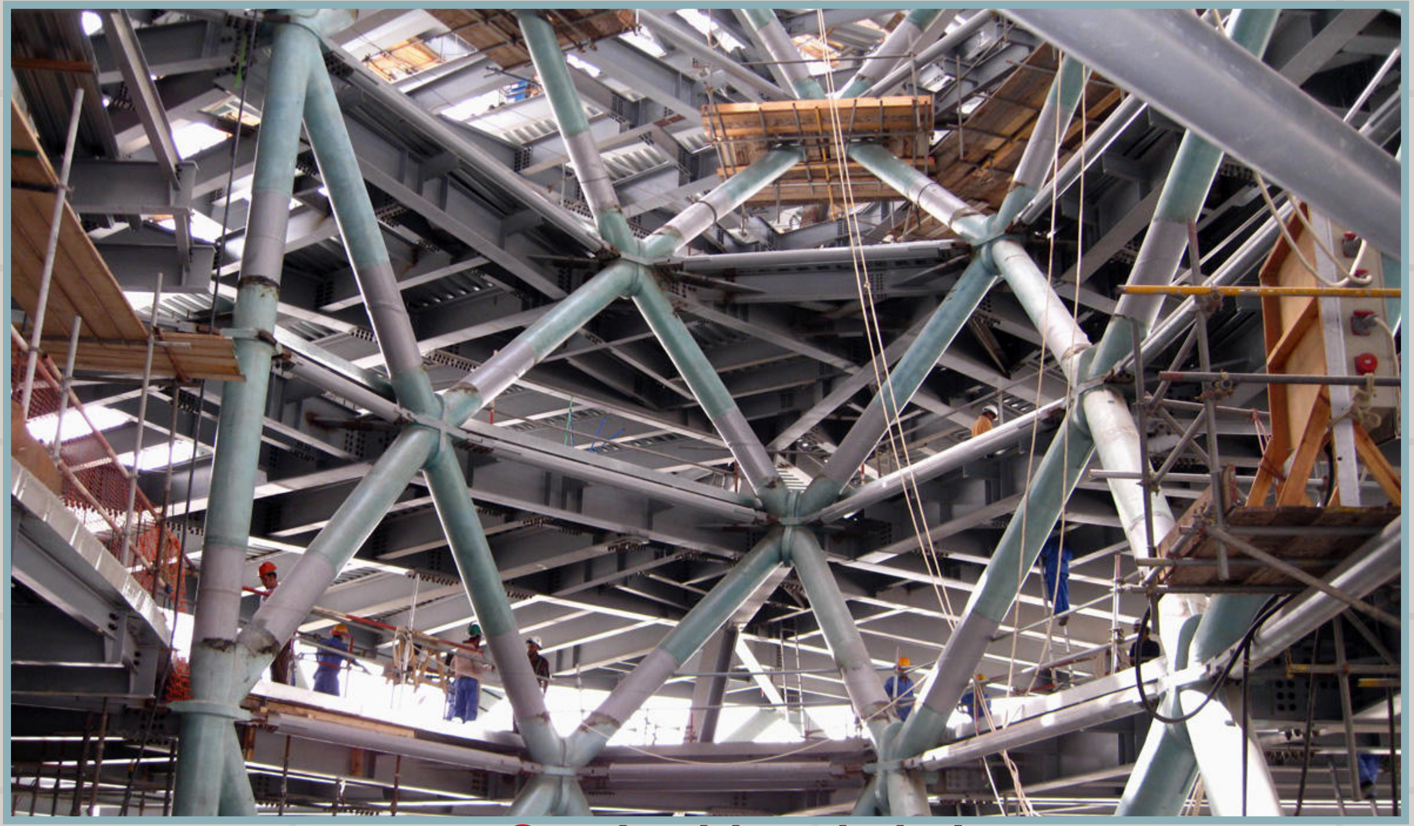


Capital Gate Quantity Survey		
Metal Hangers		
	Material	**Quantity**
Pre-stressing bars	65x16 M	160
Anchor plates	30 degrees	195
Concrete		
Concrete core		6000m3
Stainless Steel Wire		
Diagrid		13000 T

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

Capital Gate

Project MATERIALS



Steel grid and skeleton structure

Glass and steel

Concrete and steel skeleton

Capital Gate

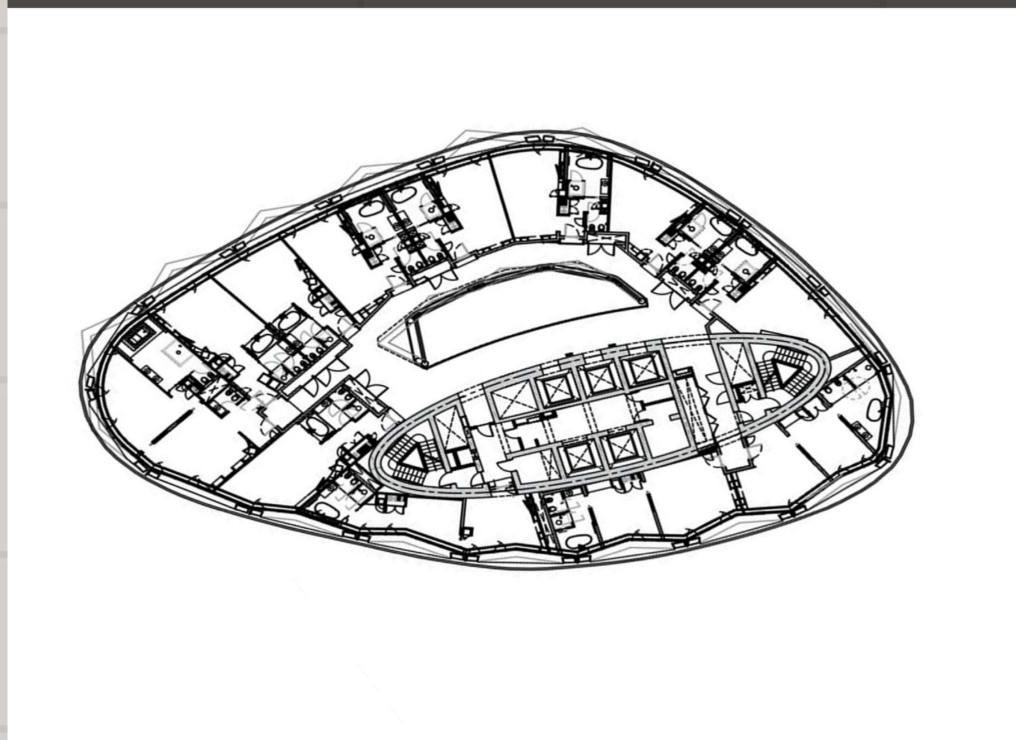
Project MACHINE / SOFTWARE

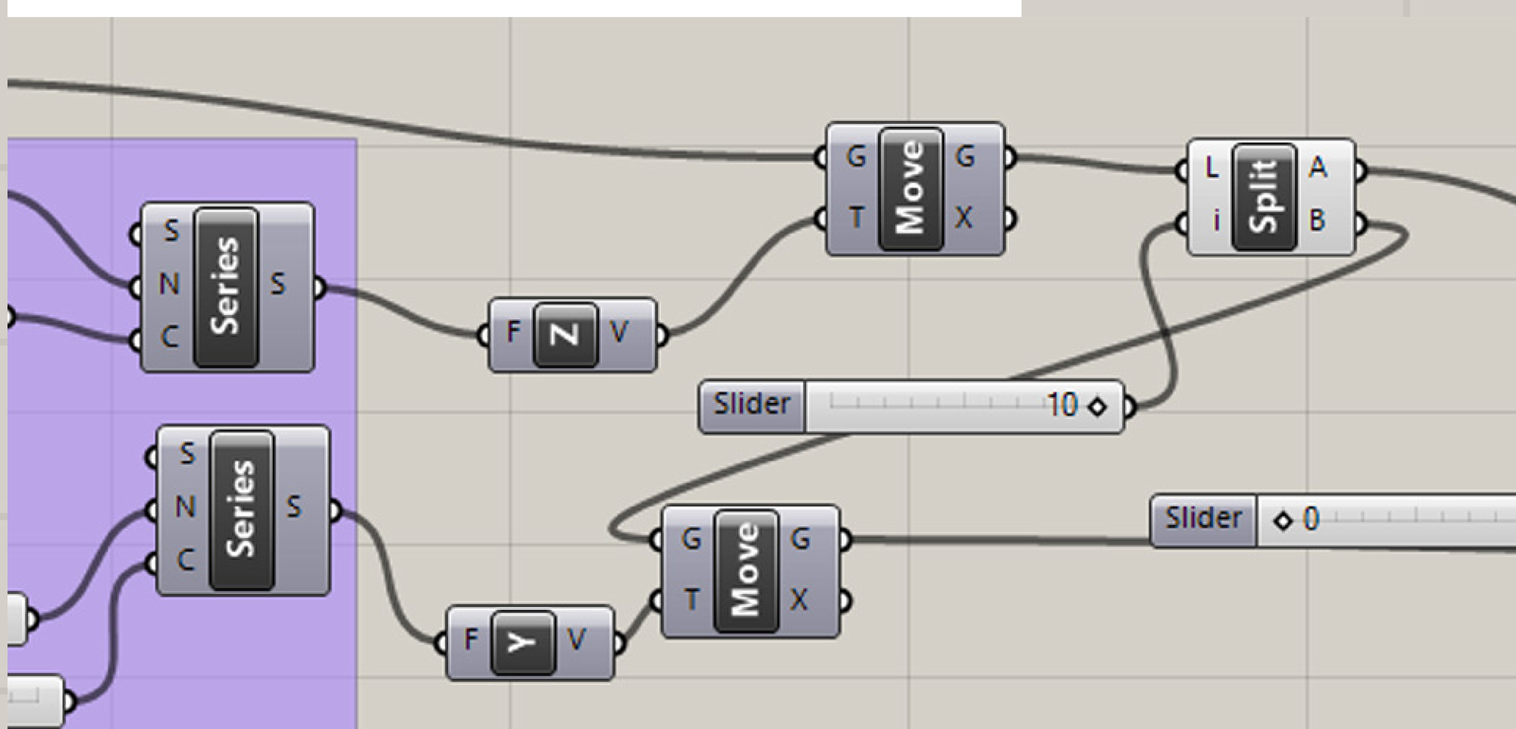
Software used: Rhino and Grasshopper

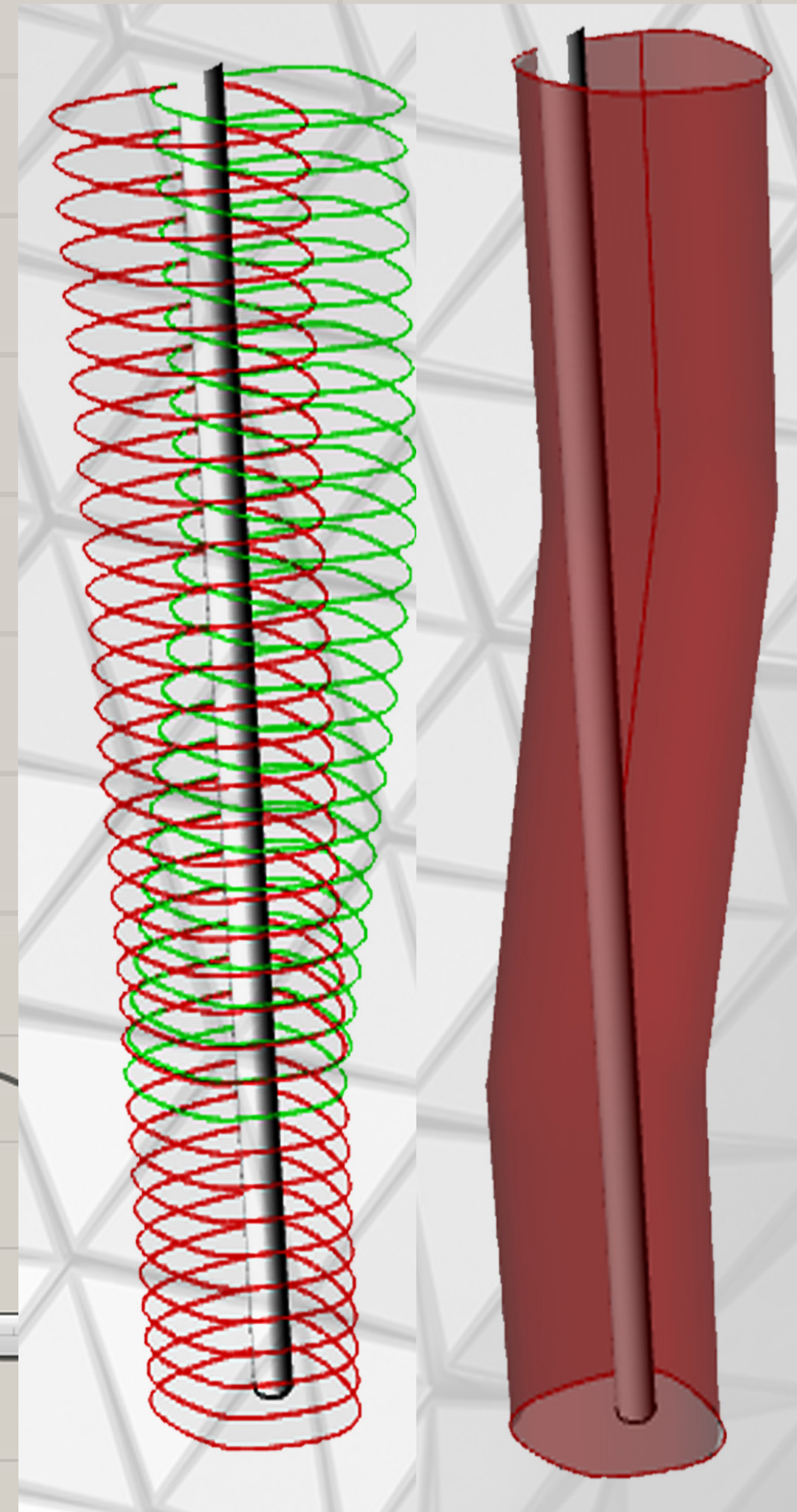
Source: xxxxxxxxxxxxxxxxxxx

Capital Gate

GRASSHOPPER
Modelling



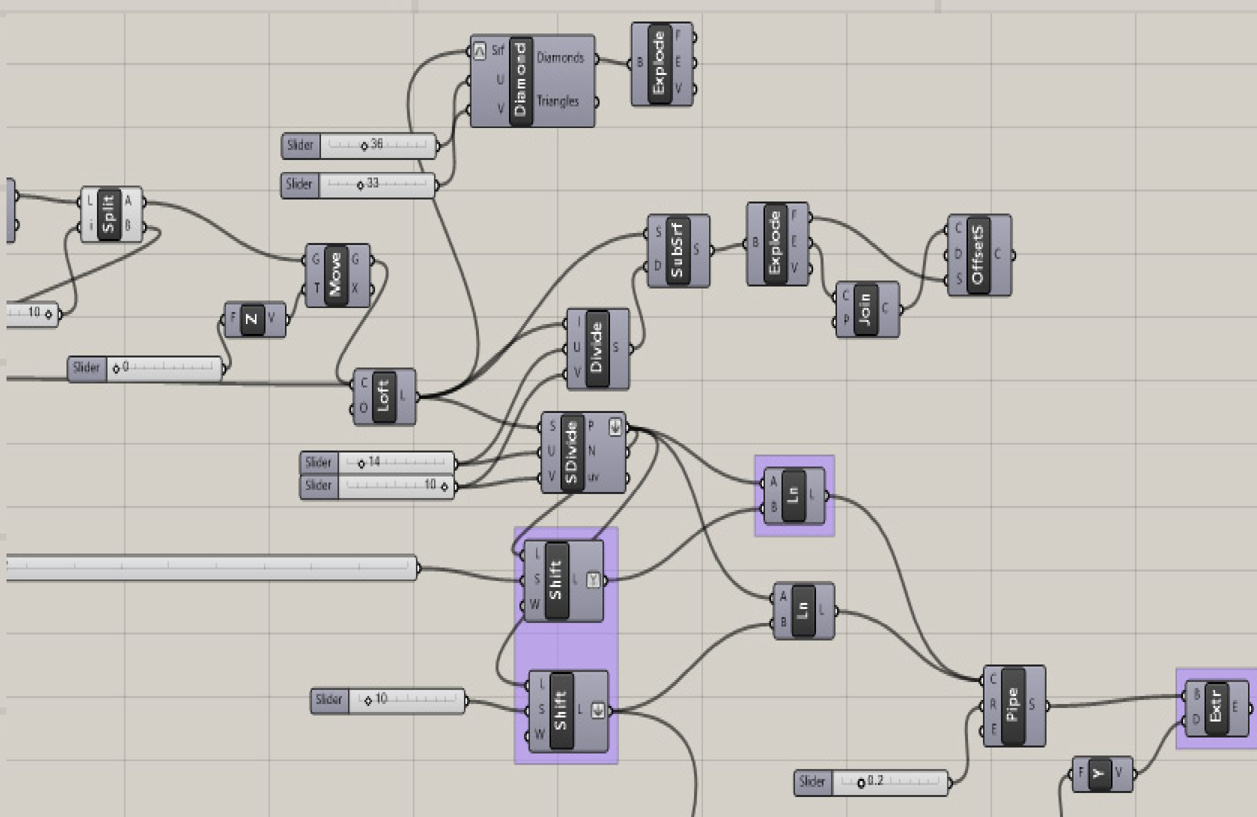


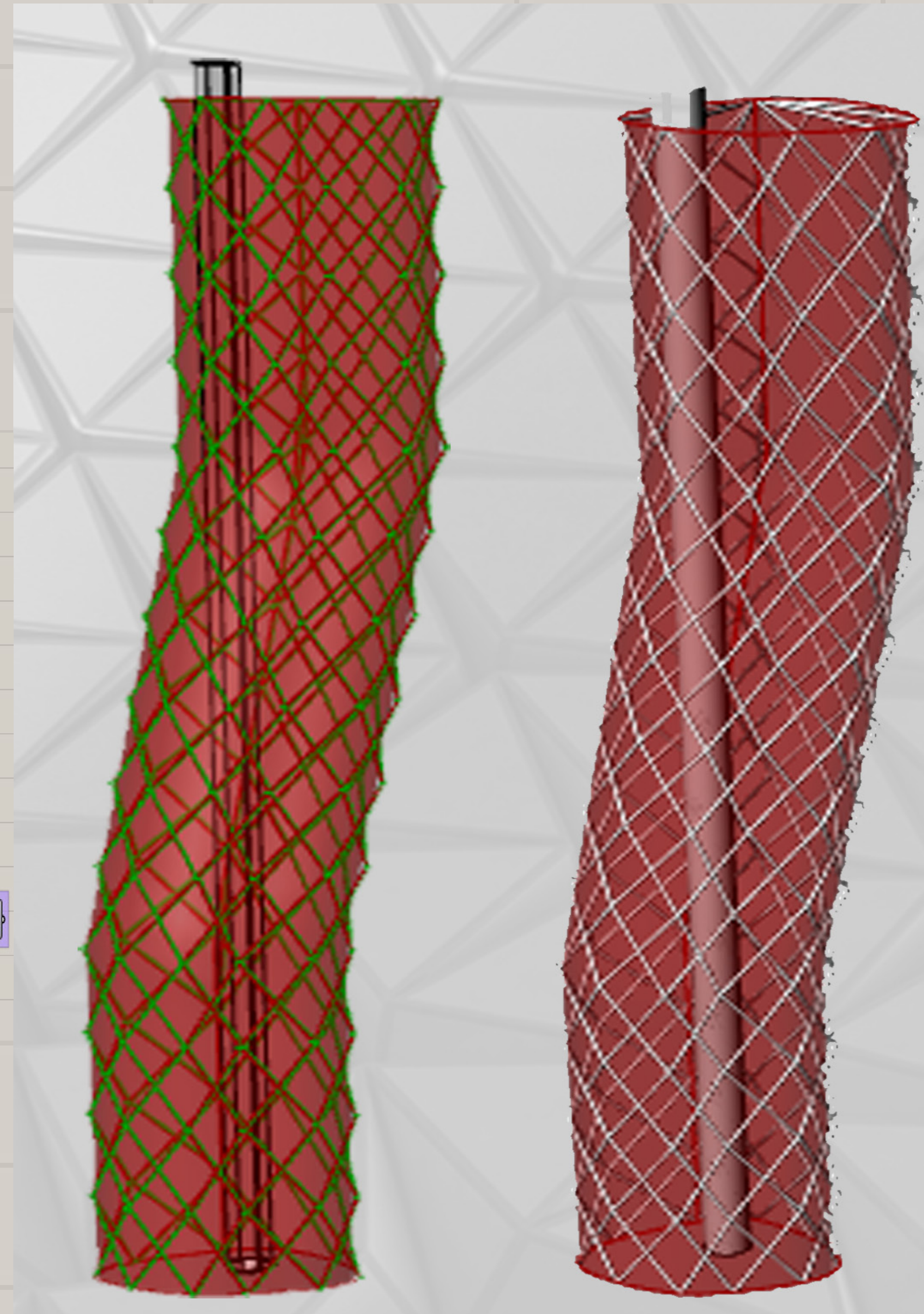


Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

Capital Gate

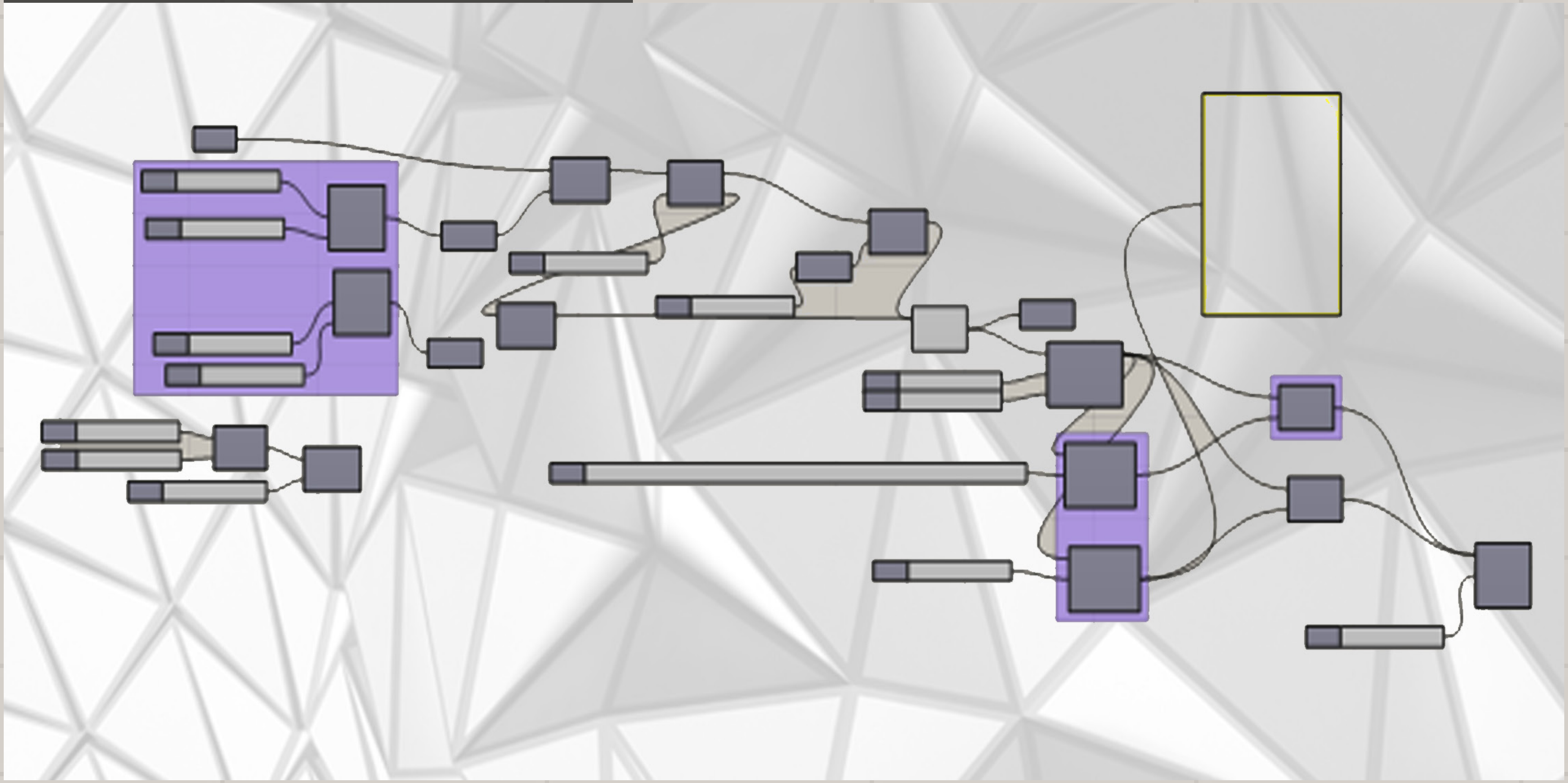
GRASSHOPPER Modelling





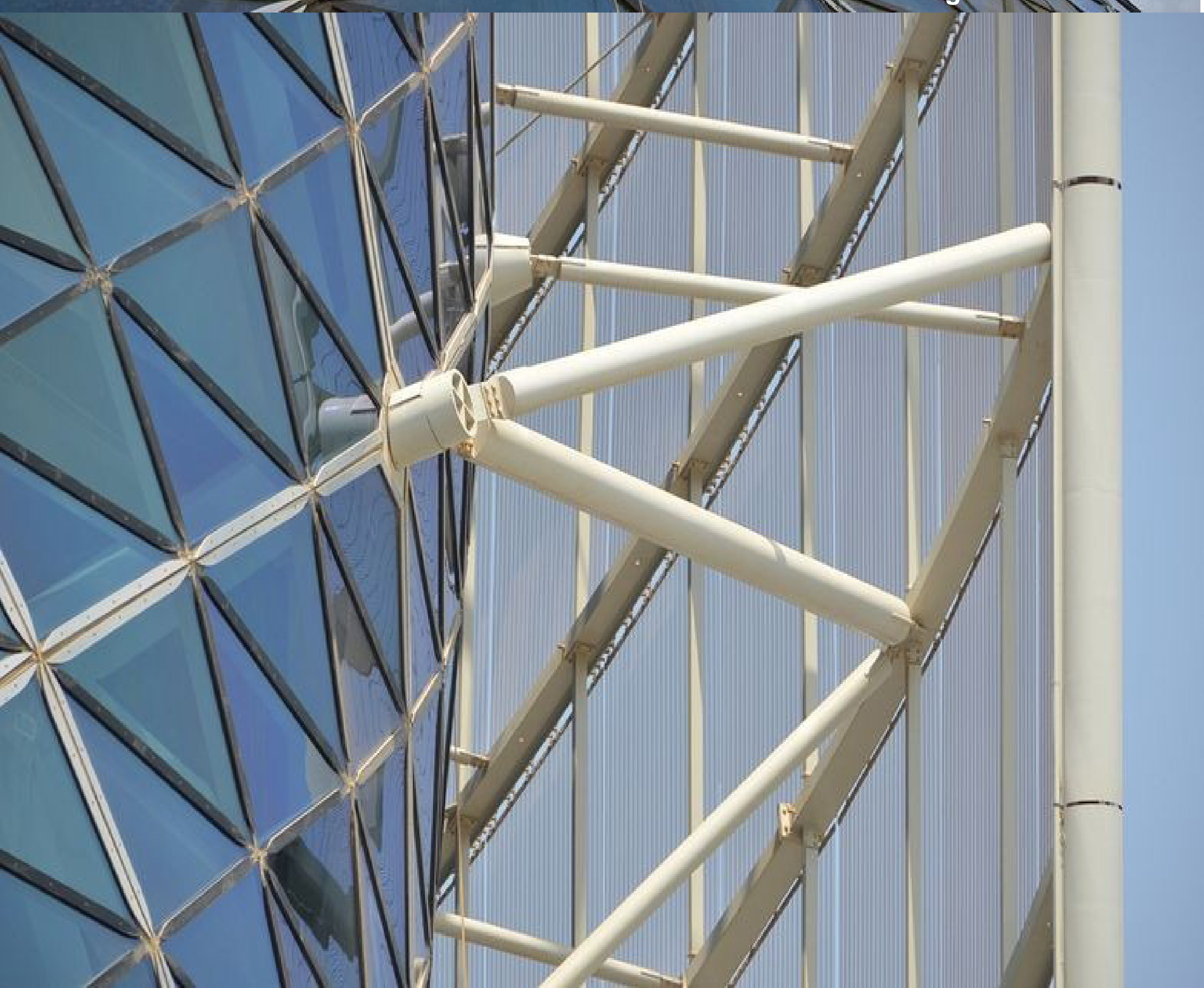
Capital Gate

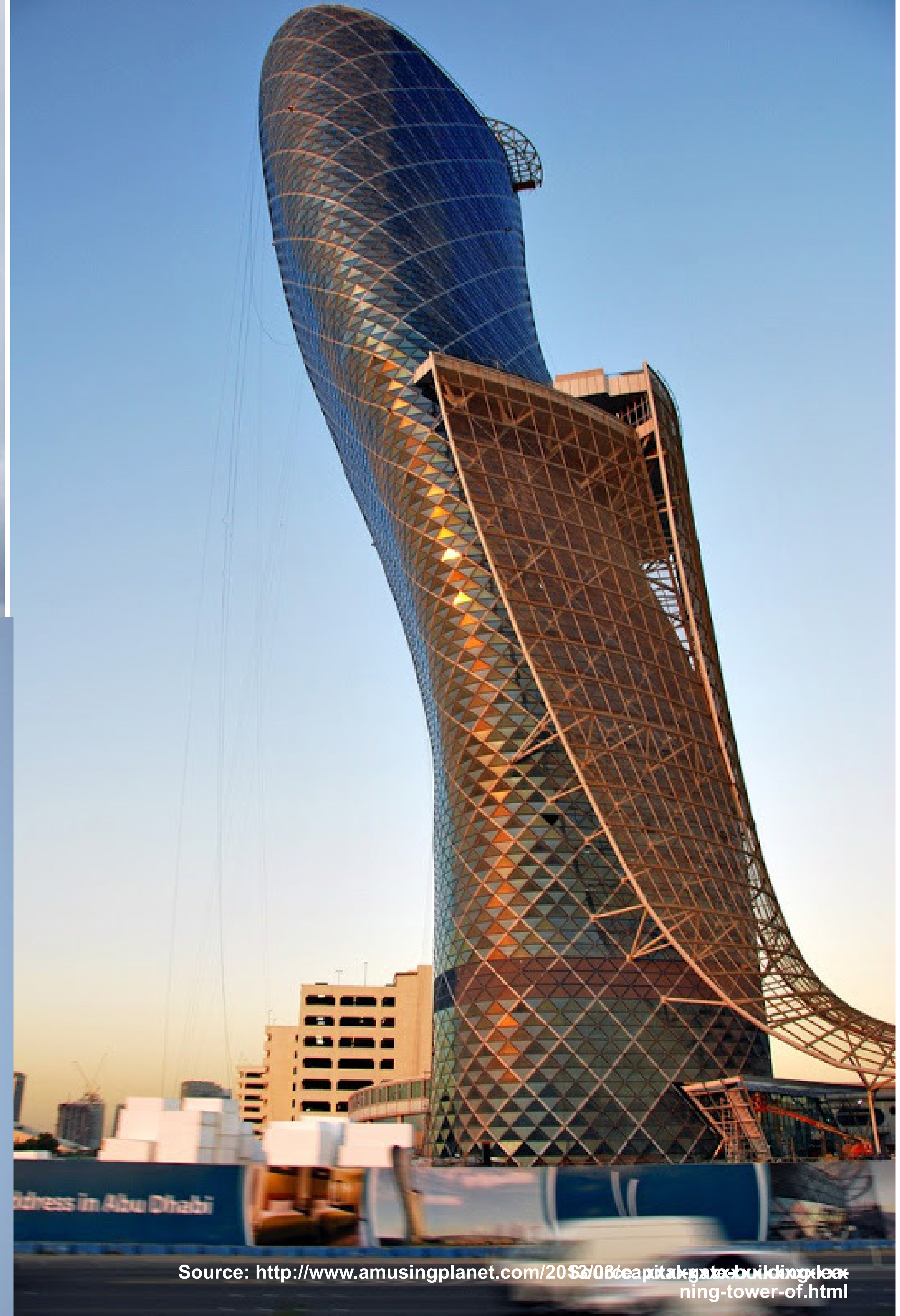
GRASSHOPPER Modelling



Capital Gate

Source: http://www.amusingplanet.com/2013/03/capital-gate-building-leaning-tower-of.html





Source: http://www.amusingplanet.com/2013/03/capital-gate-building-leaning-tower-of.html


Tessellation
International
Conference Center
Coop Himmelb(l)au
Guangpu Huo
http://www.archdaily.com/405787/dalian-international-conference-center-coop-himmelb-l-au/

International Conference Center

Project OUTLINE

Project Architect / Artist: Coop Himmb(l)au

Location: Dalian,China

Investor: Dalian Municipal People's Government, P.R. China

Function: Conference Center

Construction Year: 2011

Dimmensions: 59m High, 4.3hectare floor area

Construction Team: China Construction Eighth Engineering Division

Materials Used: Pressed steel , Aluminum, Concrete, glass

Budget: 40 million Euro

Major Fabrication Method Used: dem-regular tessellating

Fabricated By: Unilateral fixed twisted axis bending equipment , Crane , BIM

Type Of Construction: Space Steel Frame

Modelling Software: Rhino + Grasshopper

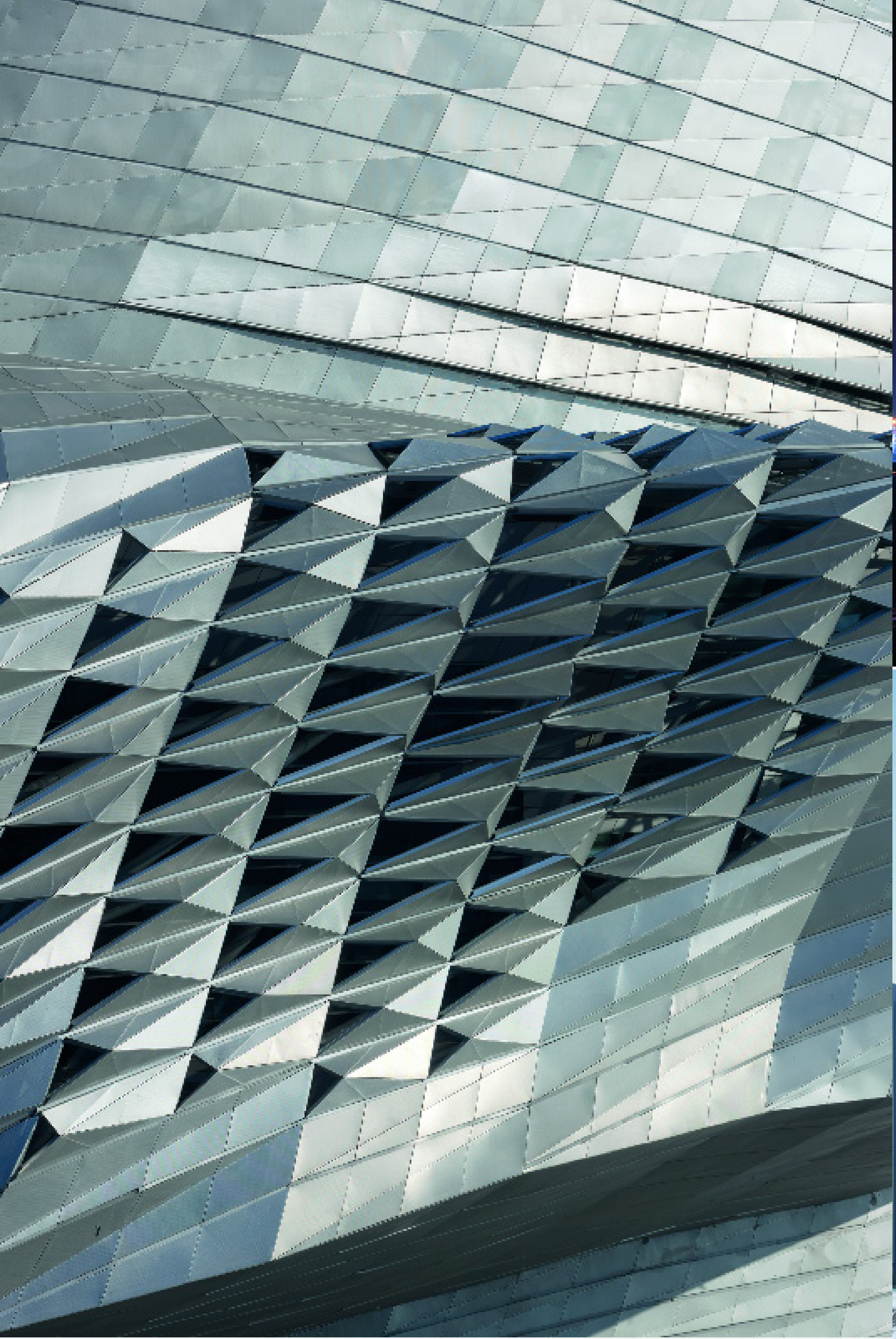
http://www.archdaily.com/405787/dalian-international-conference-center-coop-himmelb-l-au/

International Conference Center

Project DESCRIPTION

Dalian International Conference Center is designed by Coop Himmelb(l)au,located in Dalian China. The skin can be categorised into demi regular tessellating as it is formed by different types of triangles and quadrangles.It costed400 millions for the structure and 3 billions for the whole program.Program year is from 2008 to 2011.The structure and cover was built from April 2009 to August 2010.

http://www.archdaily.com/405787/dalian-international-conference-center-coop-himmelb-l-au/



http://www.archdaily.com/405787/dalian-international-conference-center-coop-himmelb-l-au/

International Conference Center

Project FABRICATION

International conference center was considerd as the hardest program to be built at that time.The fabrication process pruduced 21 key technologies, 5 construction method and 20 patents.They use unilateral fixed twisted axis bending equipment to pruduce the panels.BIM (Building Information Modeling) to locate every panel.

http://www.archdaily.com/105752/in-progress-dalian-international-conference-center-coop-himmel-

International Conference Center

Project FABRICATION

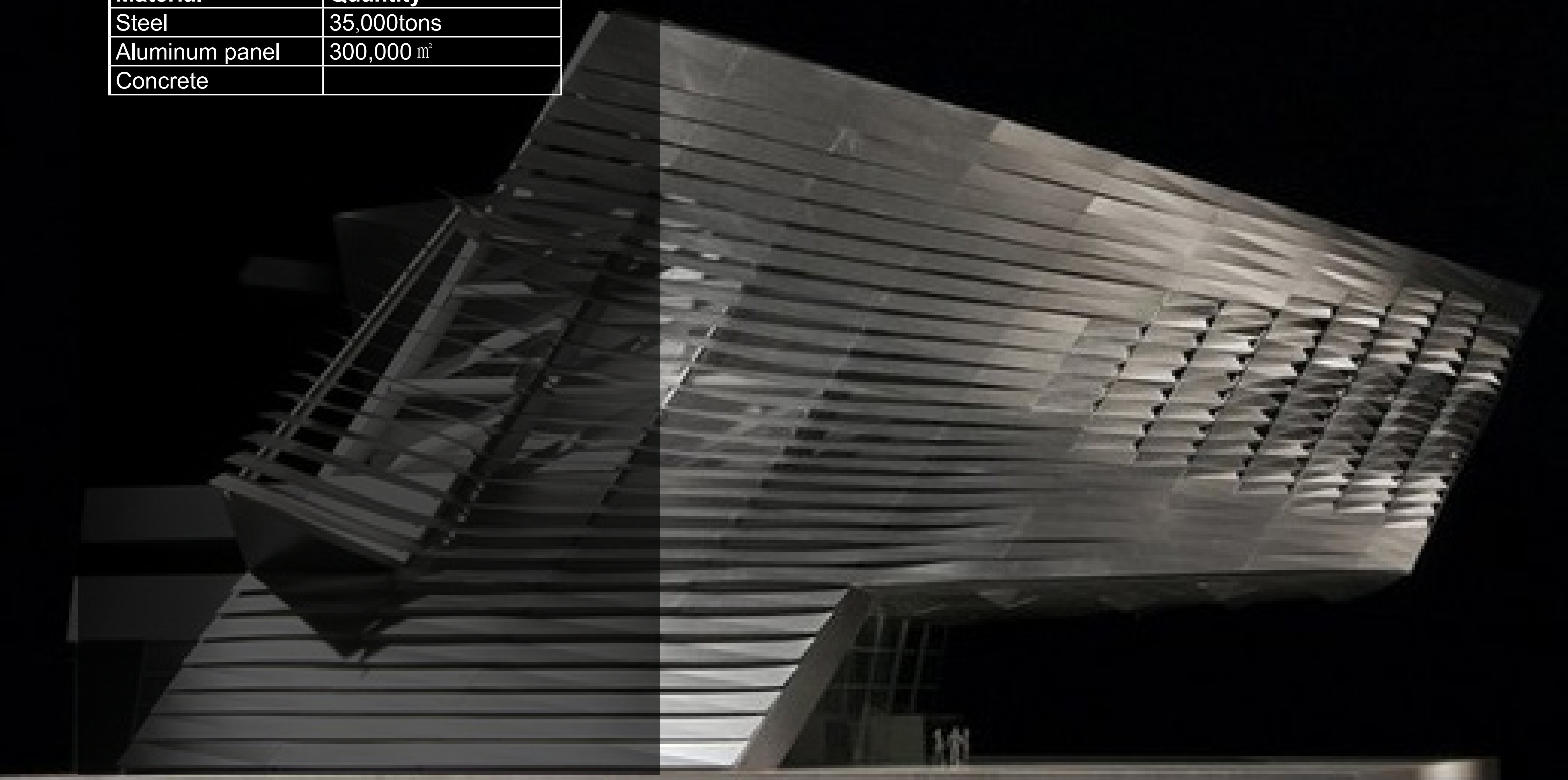
http://bbs.ncf-china.com/forum.php?mod=viewthread&tid=10874&page=1&authorid=2

http://bbs.ncf-china.com/forum.php?mod=viewthread&tid=10874&page=1&authorid=2

International Conference Center

Project MATERIALS

EKKO Pavilion Quantity Survey	
Material	**Quantity**
Steel	35,000tons
Aluminum panel	300,000 ㎡
Concrete	



http://www.archdaily.com/405787/dalian-international-conference-center-coop-himmelb-lau/

International Conference Center

Project MATERIALS

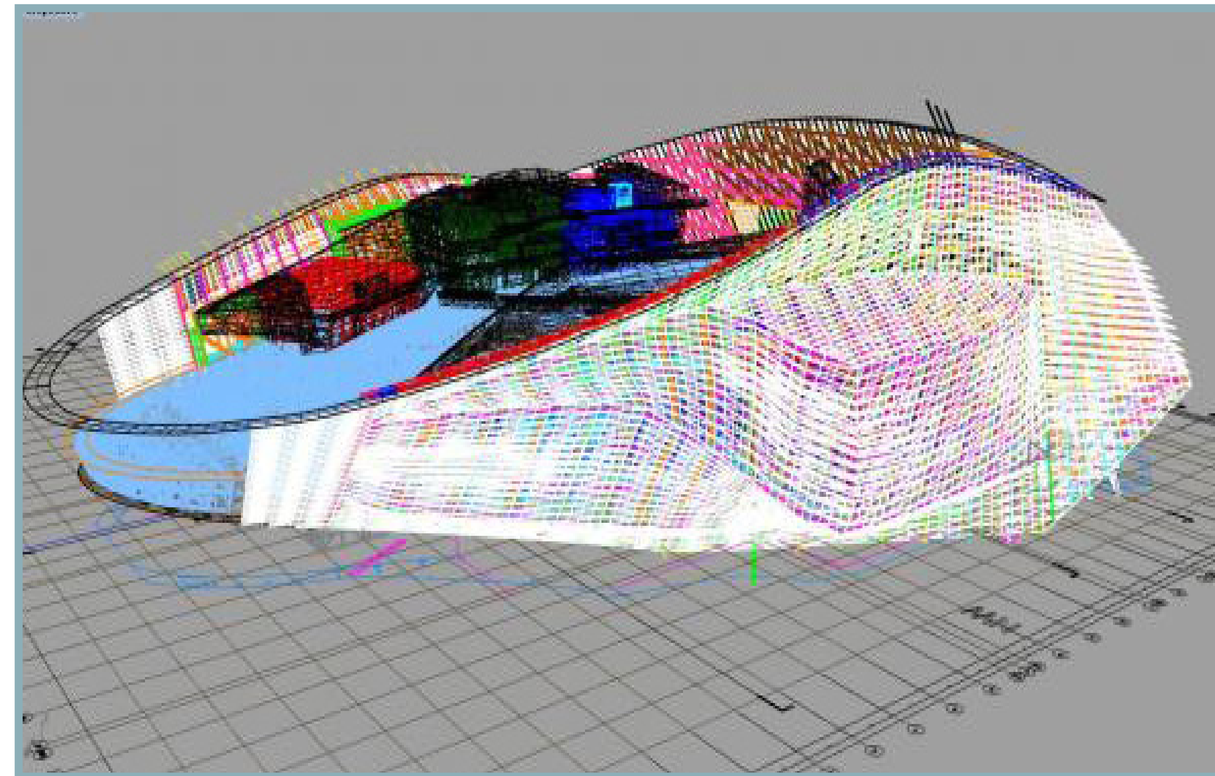
http://v.youku.com/v_show/id_XOTA2MTM5NzM2.html

http://file.zcwz.com/img/images/201207/20120717143655864.jpg

International Conference Center

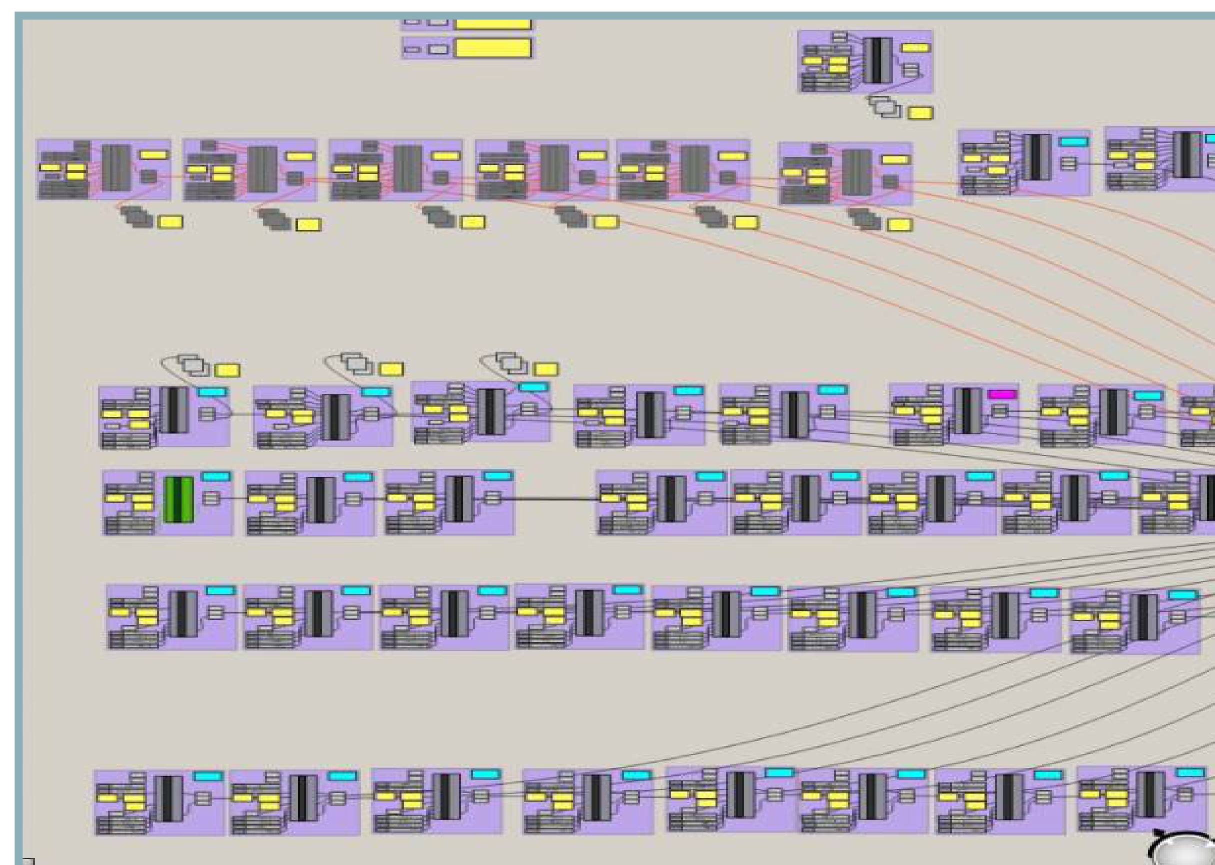
Project MACHINE / SOFTWARE

MACHINE: Unilateral fixed twisted axis bending equipment , Crane
SOFTWARE: Rhino + Grasshopper



http://bbs.ncf-china.com/forum.php?mod=viewthread&tid=10874&page=1&authorid=2

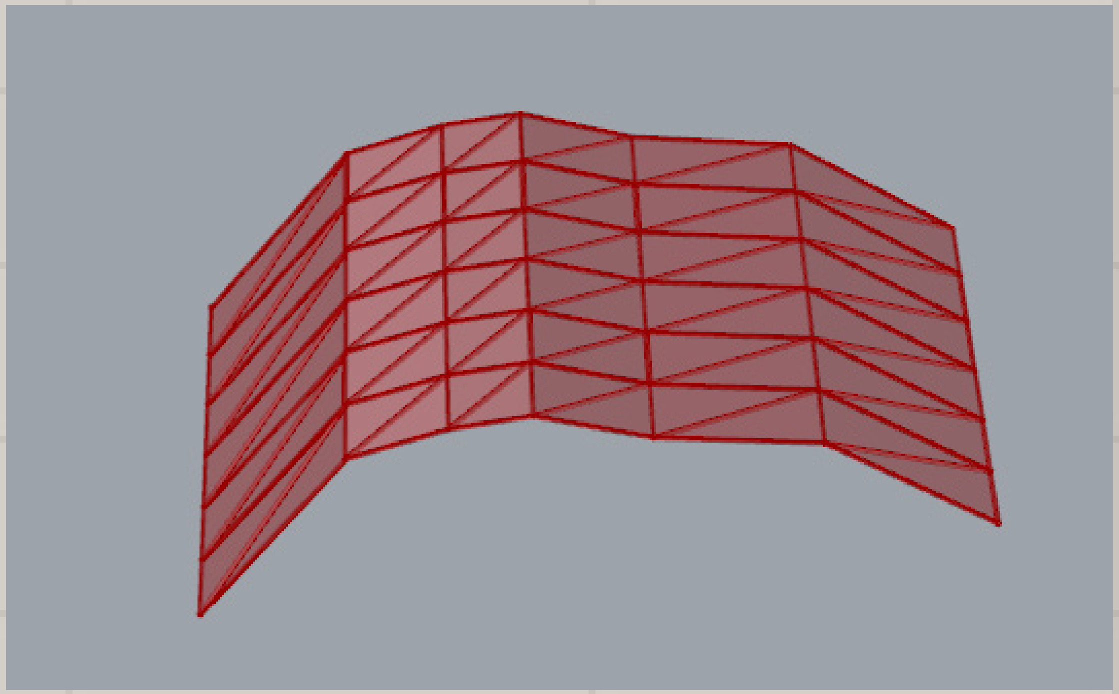
http://v.youku.com/v_show/id_XOTA2MTM5NzM2.html

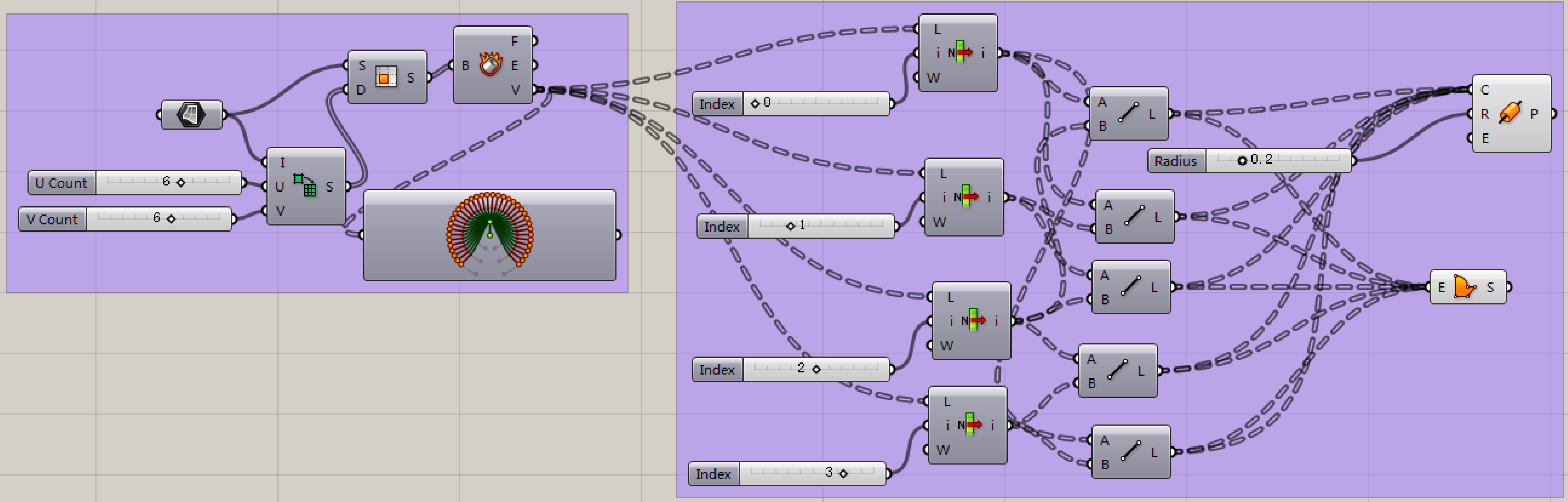


http://bbs.ncf-china.com/forum.php?mod=viewthread&tid=10874&page=1&authorid=2

International Conference Center

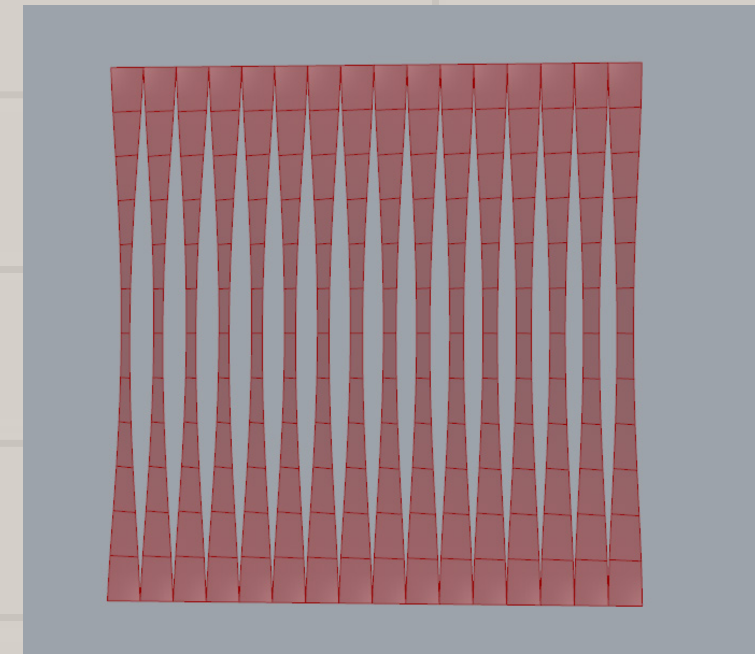
GRASSHOPPER
Modelling

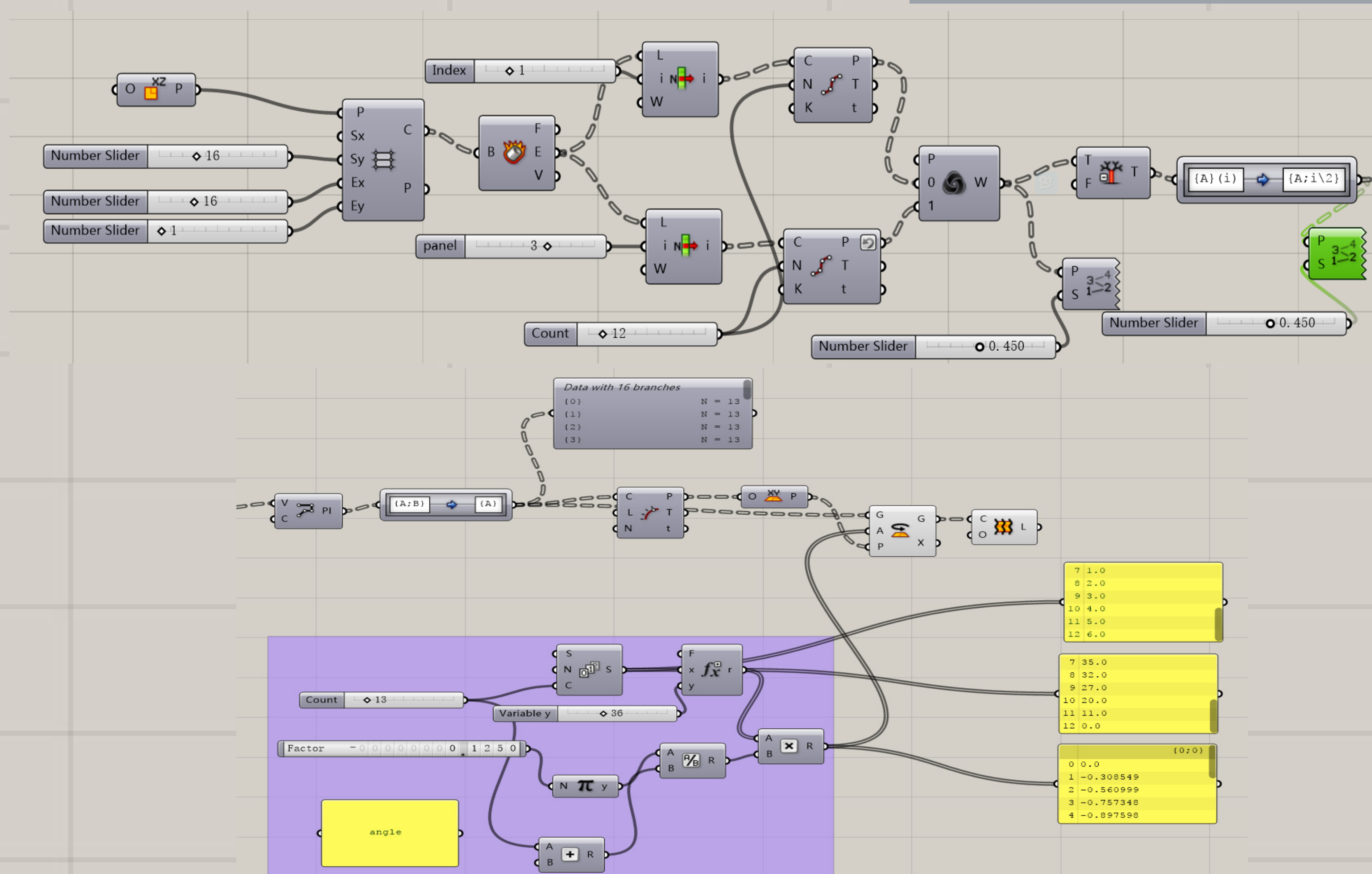




EKKO Pavilion

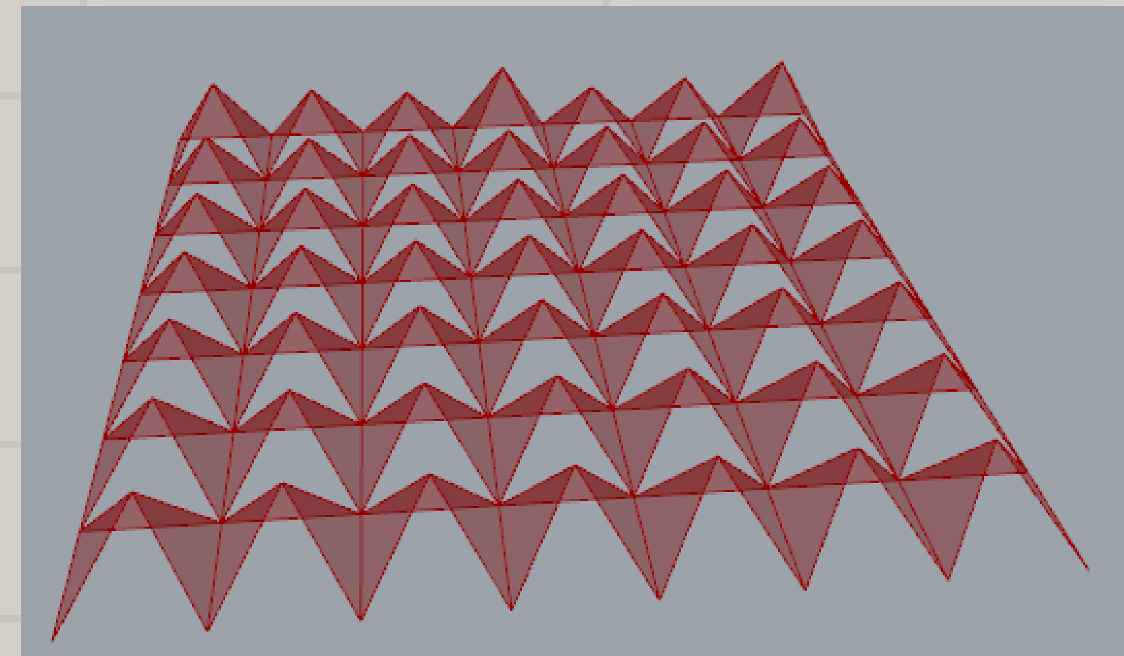
GRASSHOPPER
Modelling

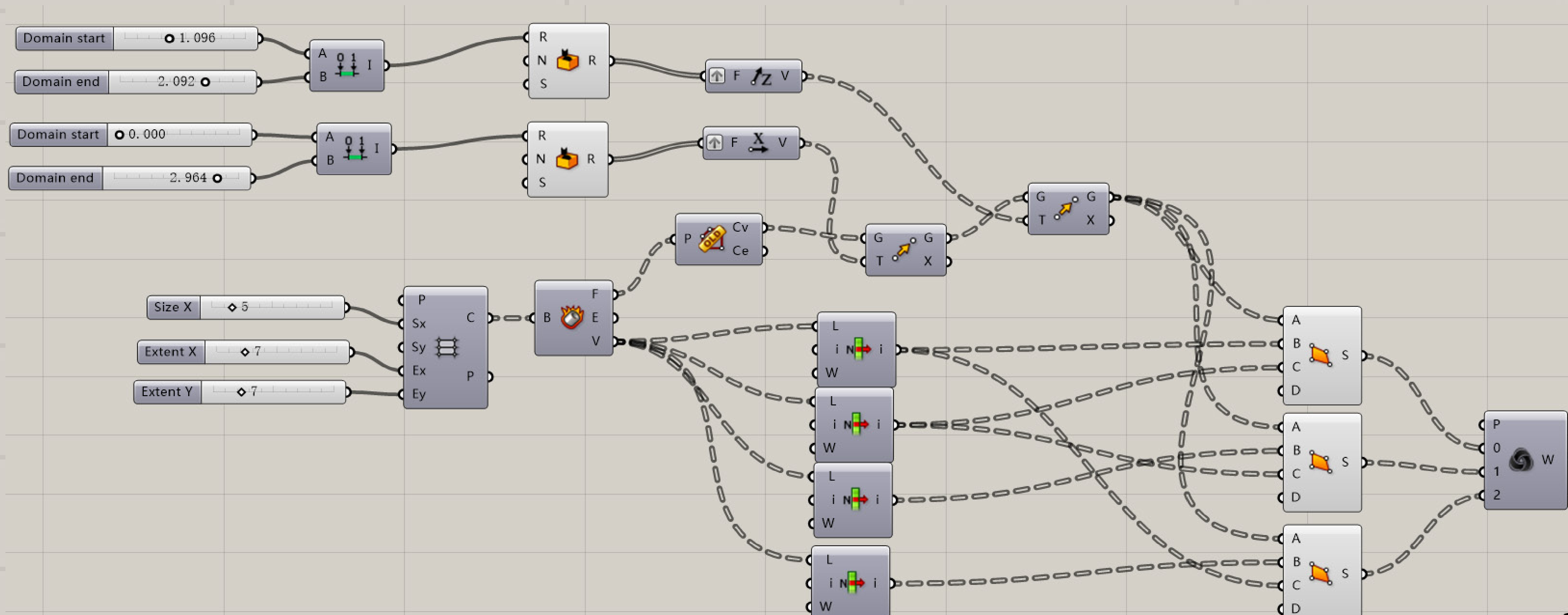


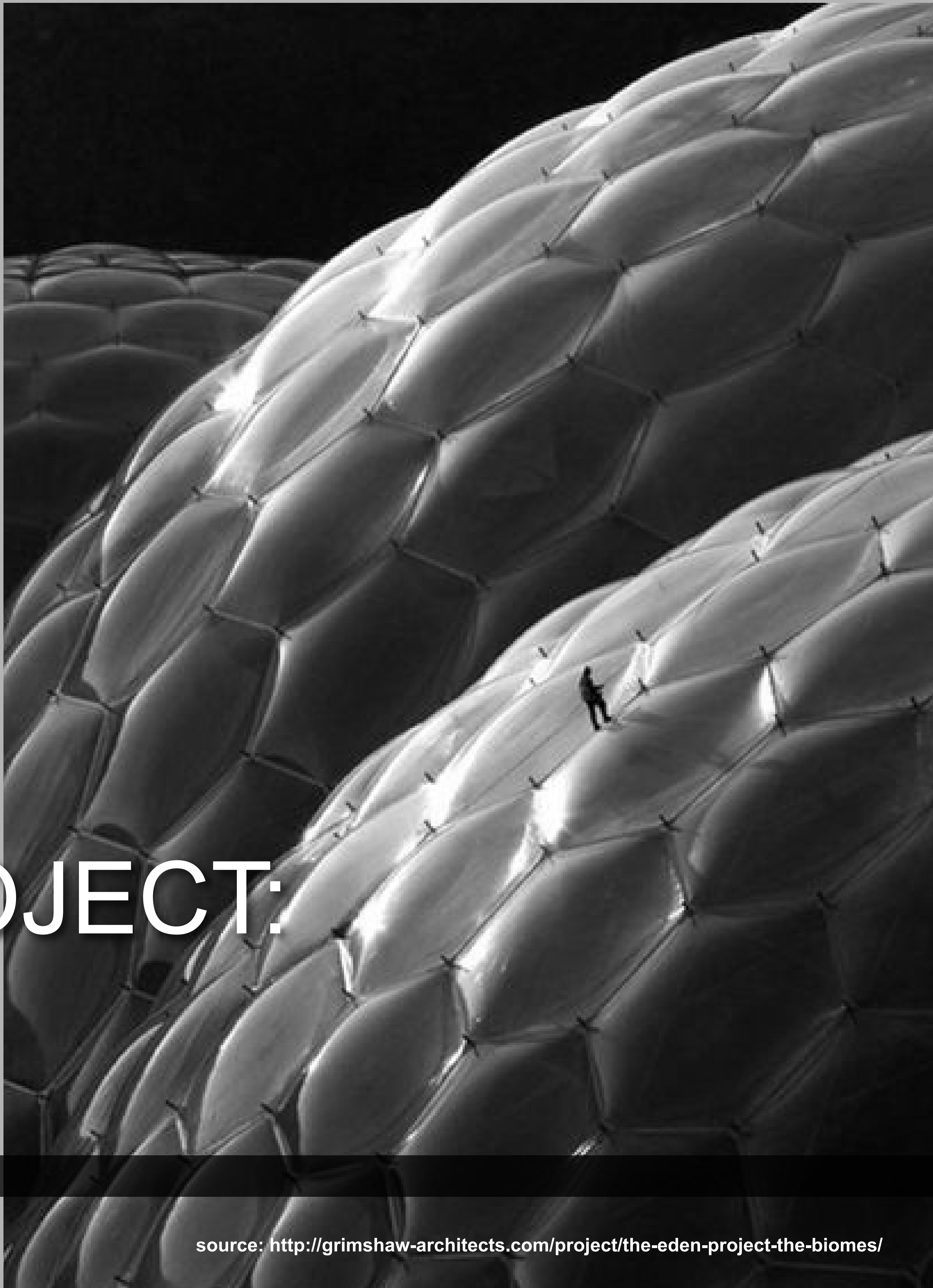


EKKO Pavilion

GRASSHOPPER
Modelling







TESSELLATING THE EDEN PROJECT: THE BIOMES

GRIMSHAW

Ivona Ivanova

source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/

The Eden Project

Project OUTLINE

Project Architect / Artist: Nicholas Grimshaw & Partners Ltd, London

Location: Cornwall, UK

Investor: Public funding, Private investors

Function: Ecosystem biomes: Tropical, Temperate, accommodating plants

Construction Year: 2001

Dimmensions: Dome diameters: 60 m, 48 m, 42 m, 26 m; 47 m; 31 m, 31m ;maximal structural spans of 124 m, maximum height:55m, maximal width: 65 m, overal length of clusters: 135 m

Construction Team: General Engineer: Anthony Hunt Associates, Cirencester
Bauphysik Ove Arup & Partners, London
Wind channel test: BMT Fluid Mechanics Limited London General Contractor McAlpine JV
Steel & Cladding: MERO GmbH & Co.KG, Würzburg
subcontractor : Foiltec GmbH, Bremen

Materials Used: ETFE(Ethylene Tetra Fluoro Ethylene) cushions, insulation foil, cable net reinforcement, Aluminium frame brackets, triple layer pneumatic cushion within a frame, Concrete fondation,

Budget: Brought economic benefits of 1.1 milion pounds to the local area
Major Fabrication Method Used: Radial Sectioning

source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/

THE EDEN PROJECT

Project DESCRIPTION

The Eden Project: The Biomes is a permanent structure in Cornwall, UK. It is housing plants, while simulating varying ecosystems. It comprises of two clusters of domes, enclosing vast internal space for the visitor center. The structure provides unique experience on paths and bridges around the plantages.

Each dome is comprised of a space frame on two layers. Hexagonal and pentagonal models build the structure. Dimensions between 5 to 11 m of the cushion ellements provide opportunity for different sizes of the domes and adjustment at connection points. Galvanised steel tubes form the frame of the cushions. The structure has been hold with semi rigid connections and concrede cast nodes of the elements connecting to the ground.

Initial steel truss model of the structure has been associated with the segments of corved tubes and the welding of the comprising elements.

Largest possible size of the ex-tri-hex modules have been used in order to maximize light transmission and minimize cost. Other consideration is about reducing the number of connections and the length of aluminium framing.

Connections are possible even on the uneven contour of the ground, which has been a guiding design principle.

source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/


source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/


source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/


source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/

THE EDEN PROJECT

Project FABRICATION

Eden Project uses steel framing technique of ETFE coushions.Insitu concrete has been used for the base.

ETFE Smooth surface provides self cleaning unaffected by ultra violet radiation, atmospheric pollution life expectancy of less than 40 years.

Sourc: http://www.domerama.com/general/what-is-the-eden-pro-

Sourc: http://www.domerama.com/general/what-is-the-eden-pro-

source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/

THE EDEN PROJECT

Project FABRICATION

Sourc: http://www.domerama.com/general/what-is-the-eden-pro-

Sourc: http://www.domerama.com/general/what
-is-the-eden-project/ tion/conservationists/
eden3.htm

Sourc: http://www.domerama.c

source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/

THE EDEN PROJECT

Project MATERIALS

Sourc: http://www.domerama.com/general/what-is-the-eden-pro-

Sourc: http://www.domerama.com/general/what-is-the-eden-pro-

Sourc: http://www.domerama.com/general/what-is-the-eden-pro-

source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/

THE EDEN PROJECT

Project MACHINE / SOFTWARE

3D modelling techniques have been implemented for the design of the domes.

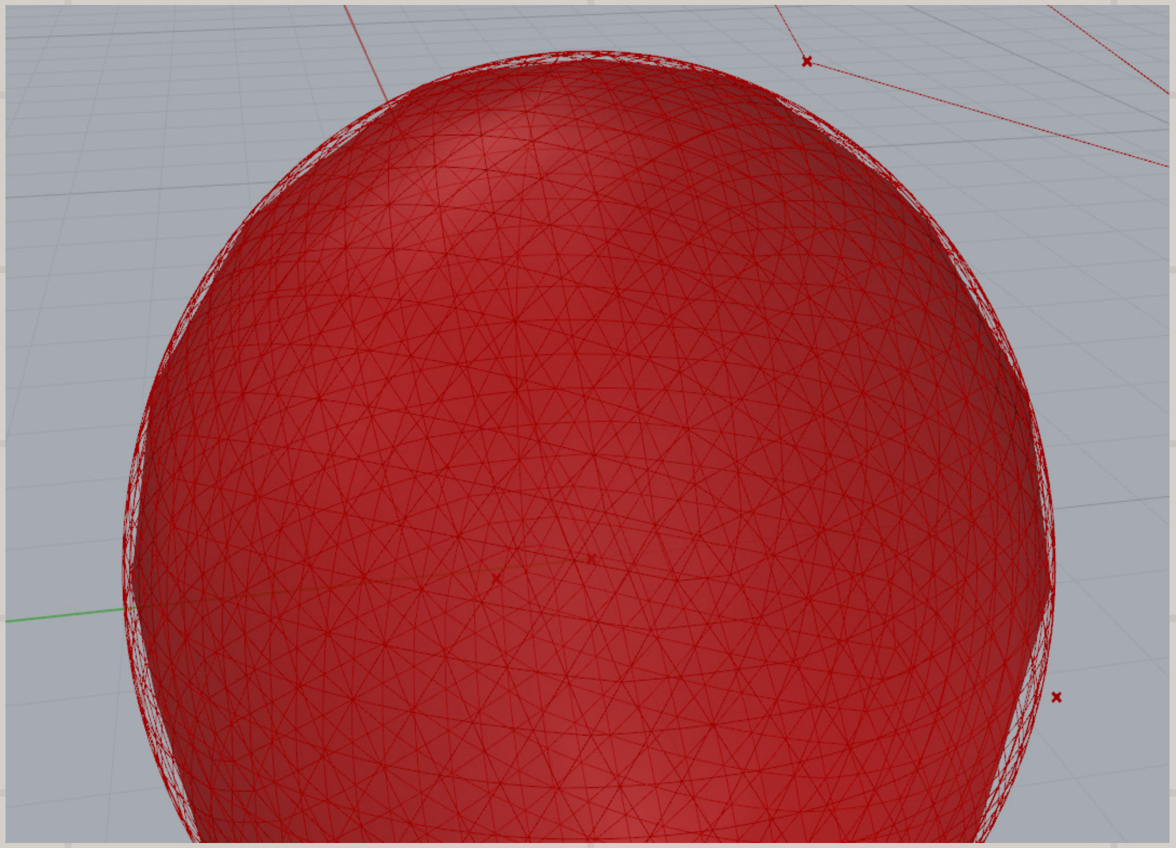
Solar gain modelling is another technique that has been used.

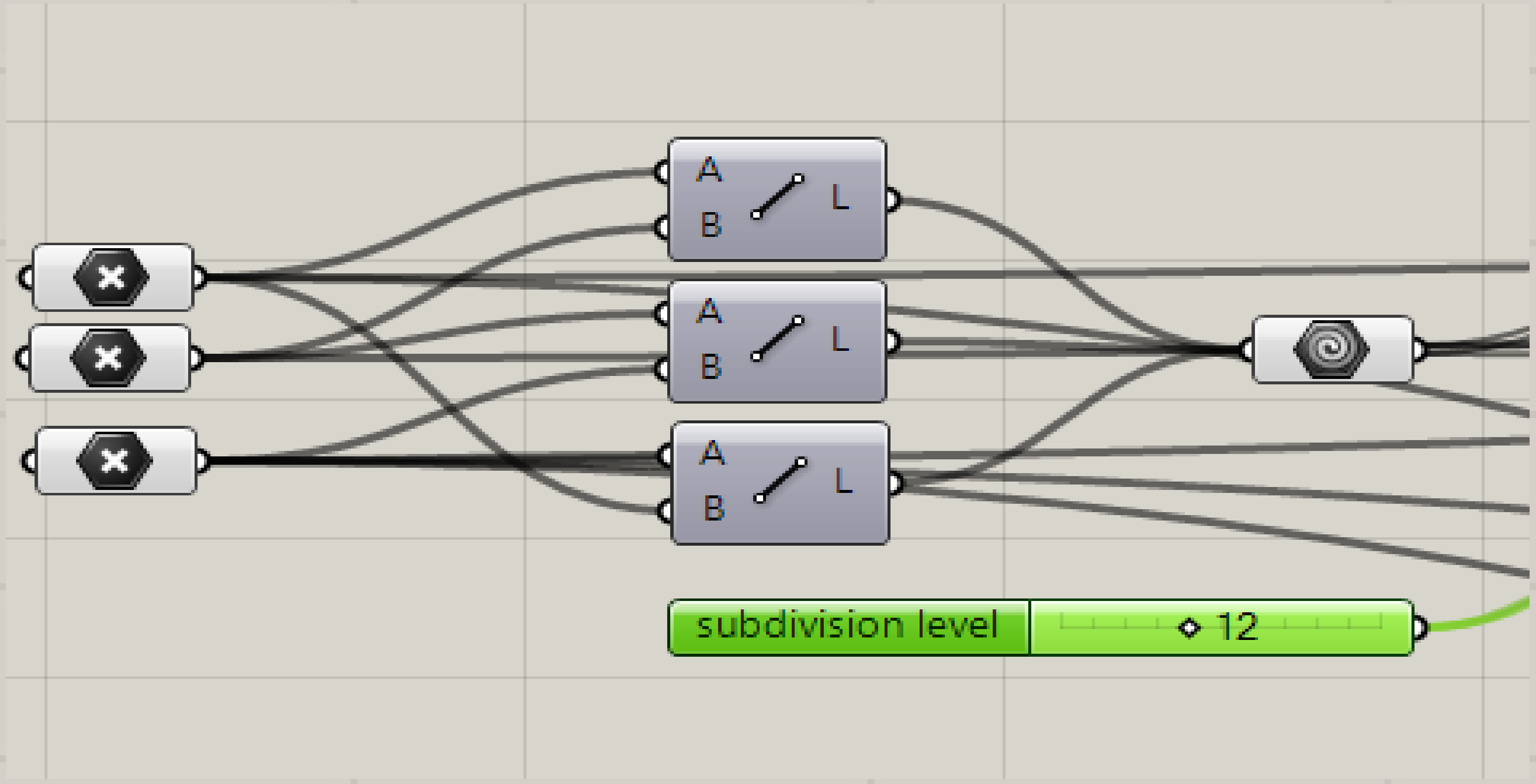
Analogies to natural forms have been taken into consideration during the design process.

source: http://grimshaw-architects.com/project/the-eden-project-the-biomes/

THE EDEN PROJECT

GRASSHOPPER
Modelling

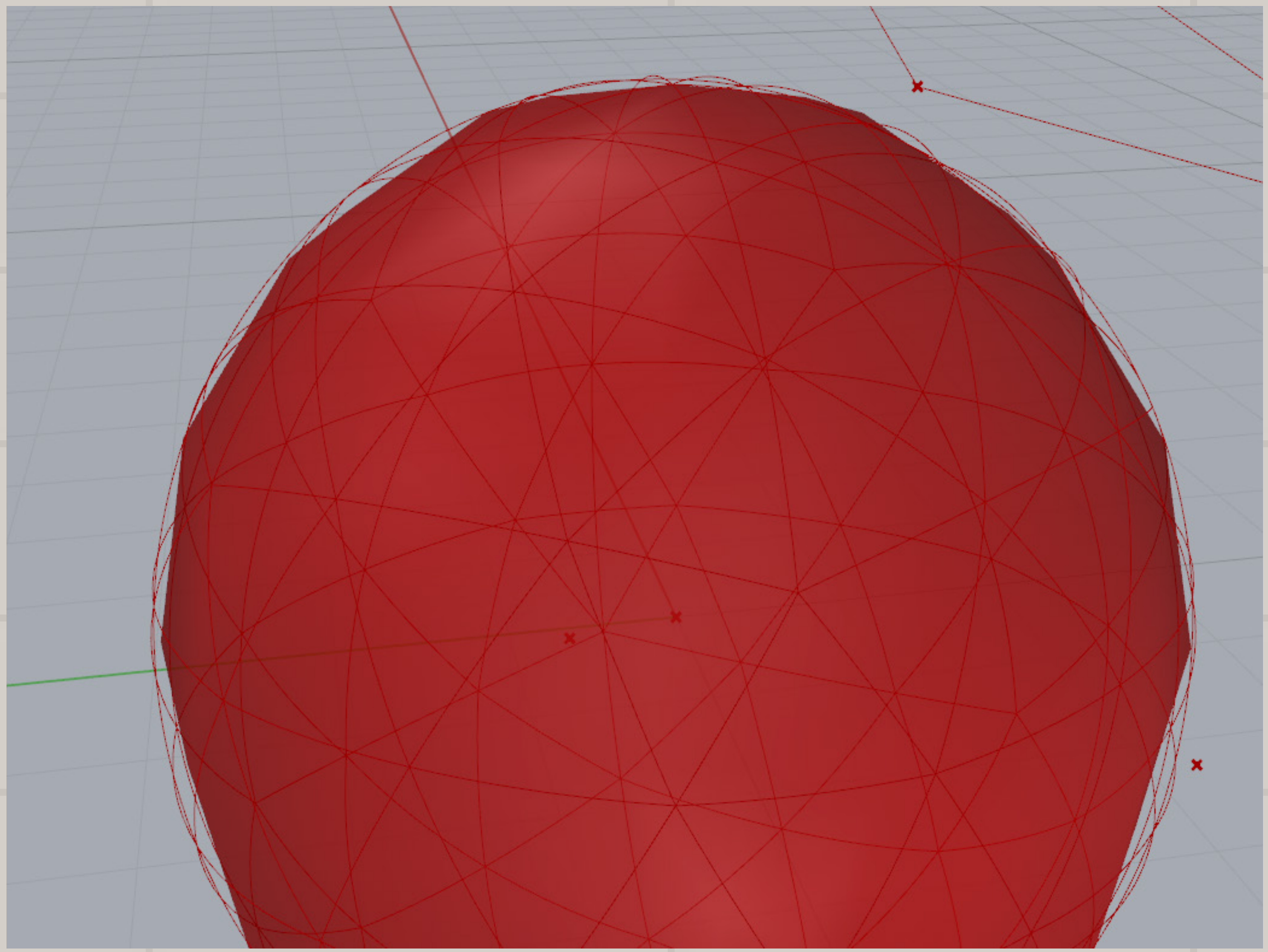


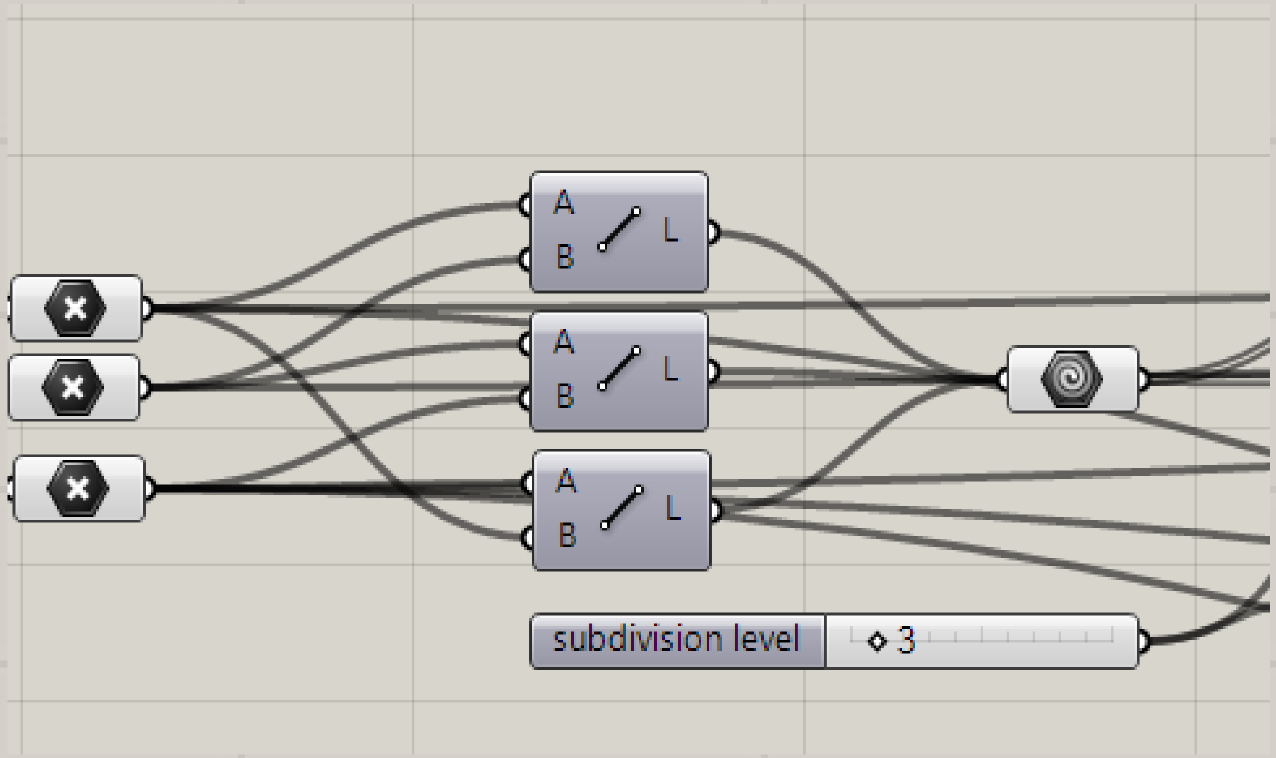


Source: http://architizer.com/blog/a-pavilion-that-makes-a-soundtrack-out-of-your-recorded-footsteps/

THE EDEN PROJECT

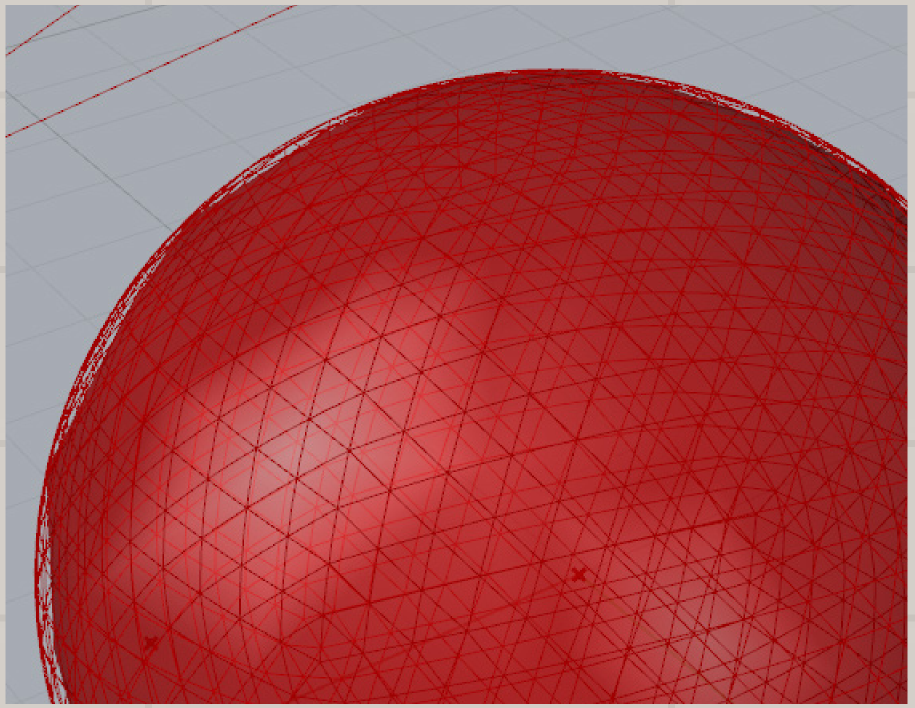
GRASSHOPPER
Modelling

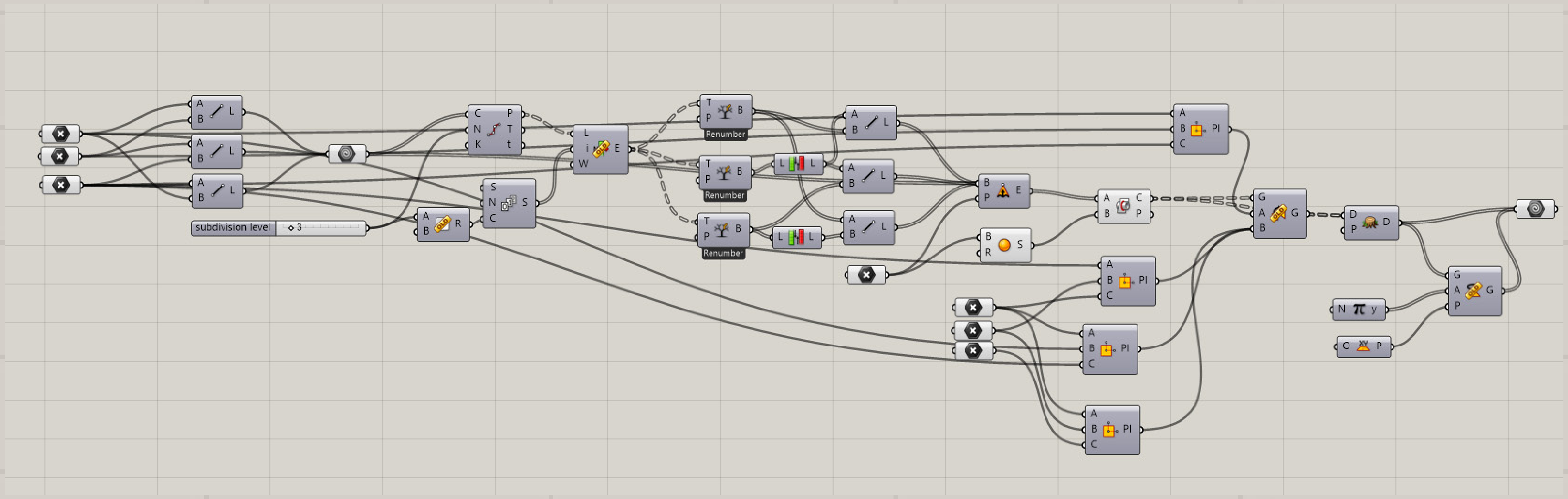




THE EDEN PROJECT

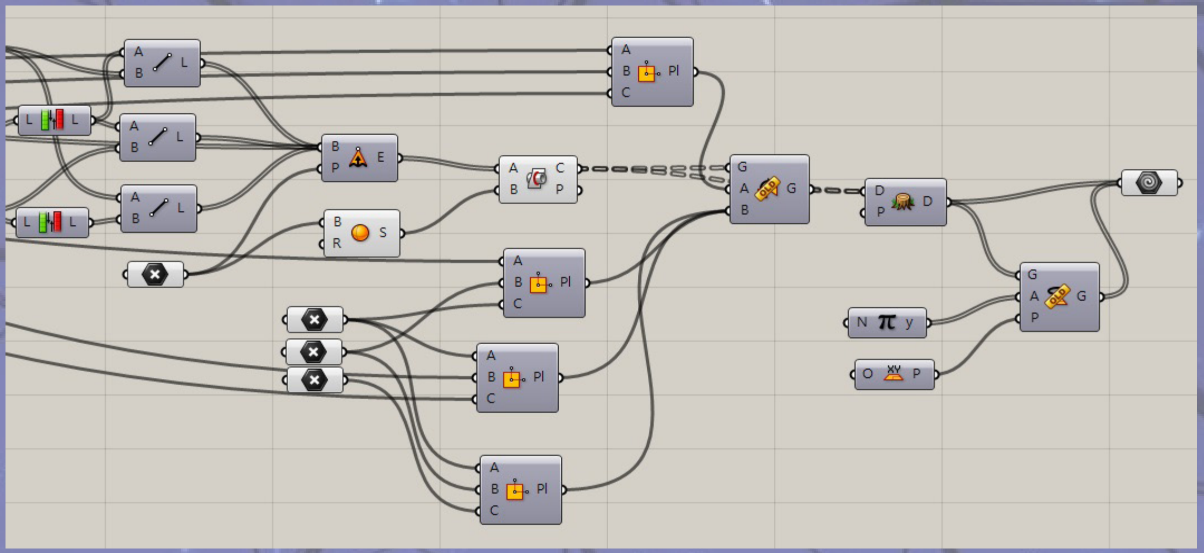
GRASSHOPPER
Modelling

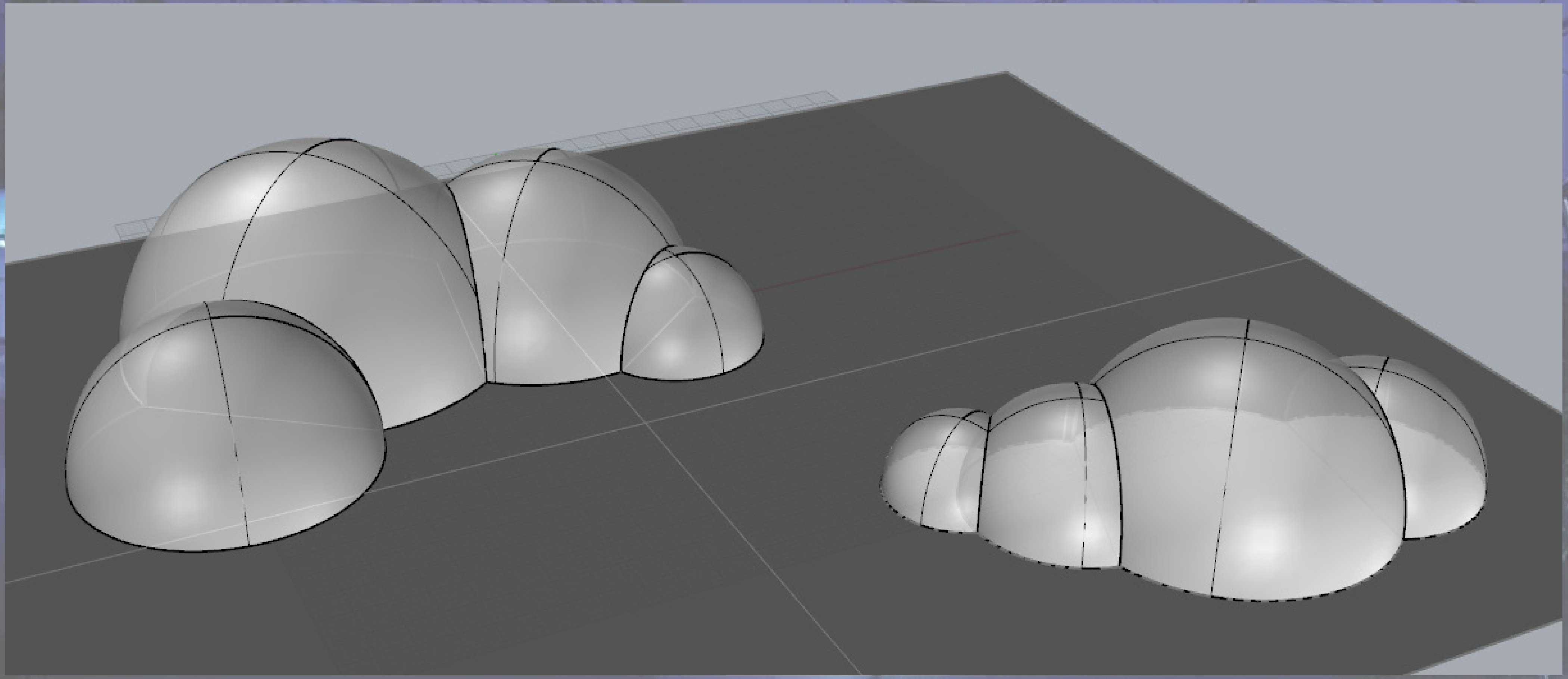




THE EDEN PROJECT

GRASSHOPPER
Structural Analysis





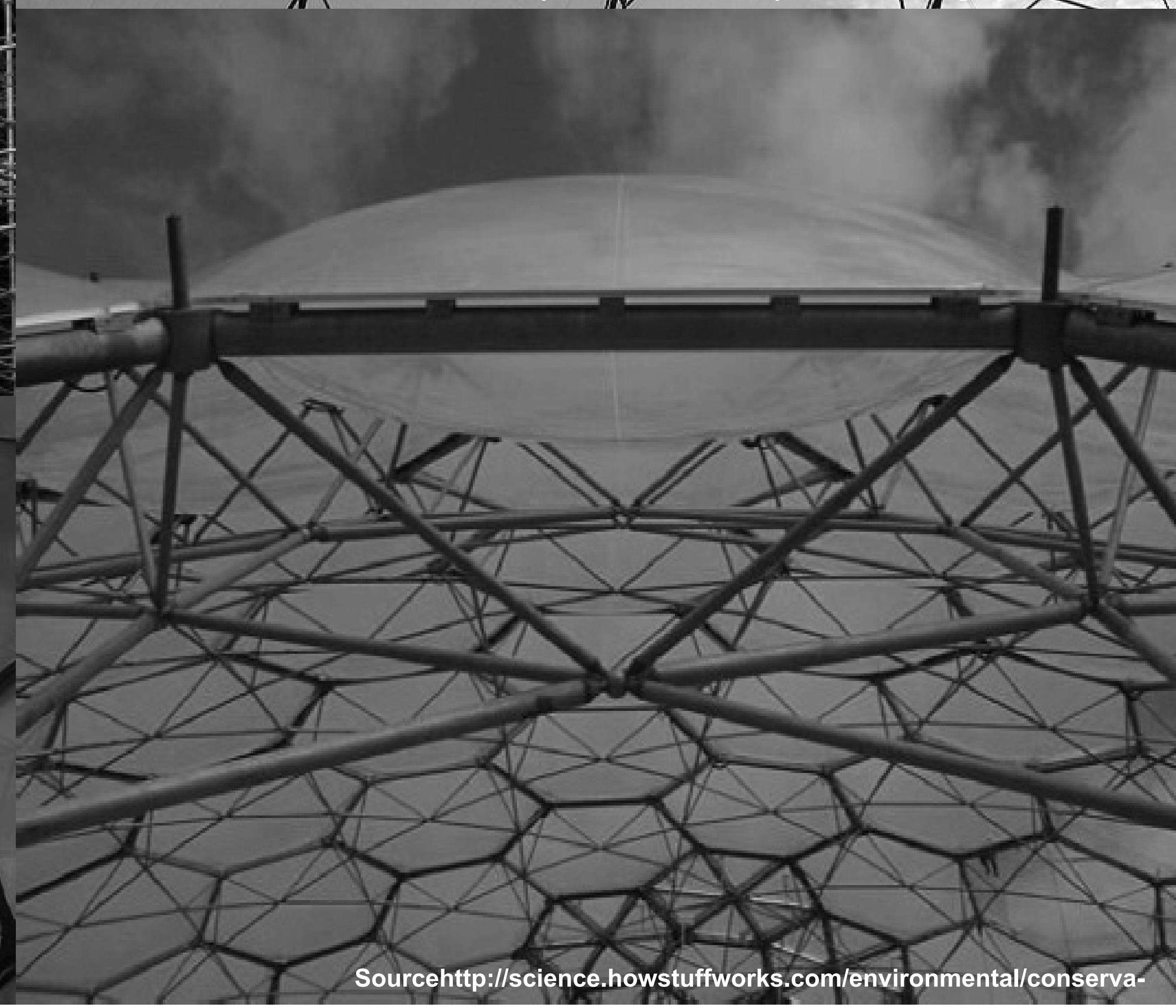
source: http://grimshaw-architects.com/project/the-eden-project/
Source: http://www.archilovers.com/projects/89540/

THE EDEN PROJECT

Source http://science.howstuffworks.com/environmental/conser-

Source: https://icecalibre.wordpress.com/category/architecture/

Source http://science.howstuffworks.com/environmental/conser-



Sourcehttp://science.howstuffworks.com/environmental/conserva-

TESSELLATION
BUTTERFLY EFFECT PAVILION
GENE KAO

Maja Udilovic

Source: http://www.geneatcg.com/

Butterly E. Pavilion

Project OUTLINE

Project Architect / Artist: Gene Kao

Location: Taipei, Taiwan

Investor: I-Lan Green Expo

Function: Pavilion

Construction Year: 2014

Dimmensions: volume aprox. 3x5x5

Construction Team: Architecture students

Materials Used: steel sheets, plywood sheets

Budget: 1000 Euro

Major Fabrication Method Used: Laser cutting

Fabricated By: Laser cutter

Type Of Construction: plywood joints

Modelling Software: Rhino + Grasshopper

Source: http://www.geneatcg.com/

Butterly E. Pavilion

Project DESCRIPTION

Project was built for E-Lan expo happening annualy in Taiwan. It is designed by Gene Kao and team of students.

Pavilion wants to test the limits of light bendable material such as plywood. It uses curves on surface to strengthen its structural system.

It works as a canopy and lightning installation.

Source: http://www.geneatcg.com/


Source: http://www.geneatcg.com/

Source: http://www.geneatcg.com/

Source: http://www.geneatcg.com/

Butterfly E. Pavilion

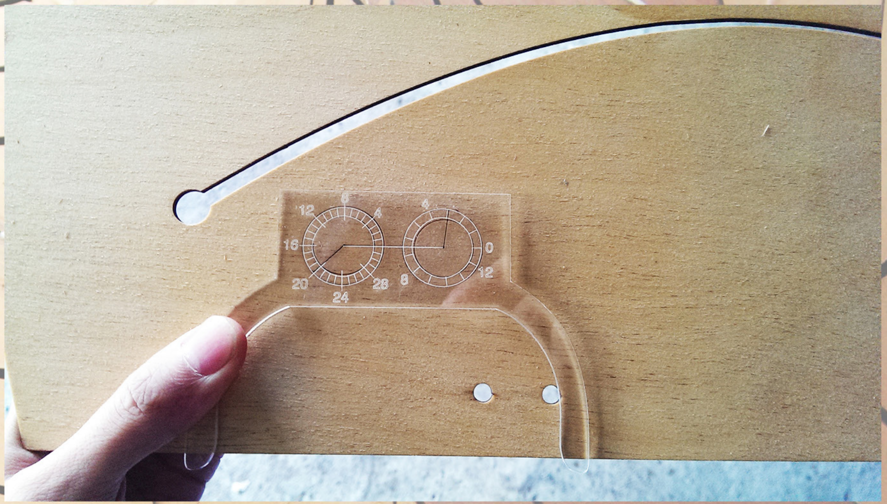
Project FABRICATION

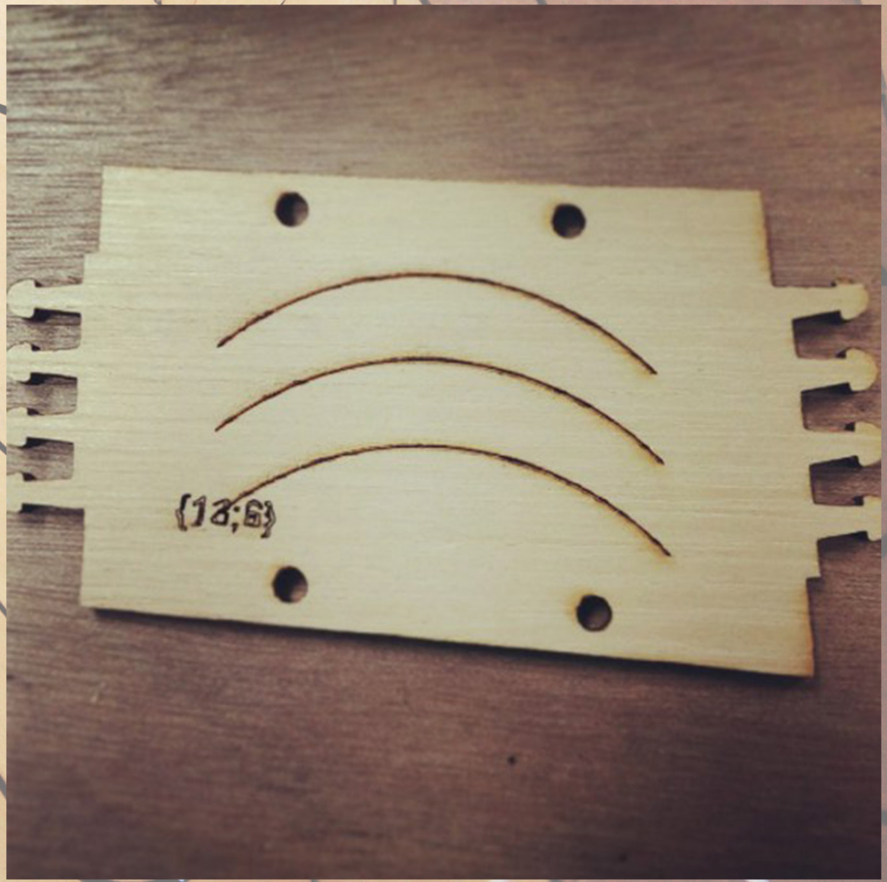
The elements are laser cuted out of plywood. Each element has a curved line which is cutted along its surface and which provides the flexing of the every single panel.

Each panel connects on both sides though zig-zag connection.

The panels are being tagged in Grasshopper so each has specified position.

There are 7 metal elements on which the whole pavilions sits- they provide support in staticaly fragile parts.

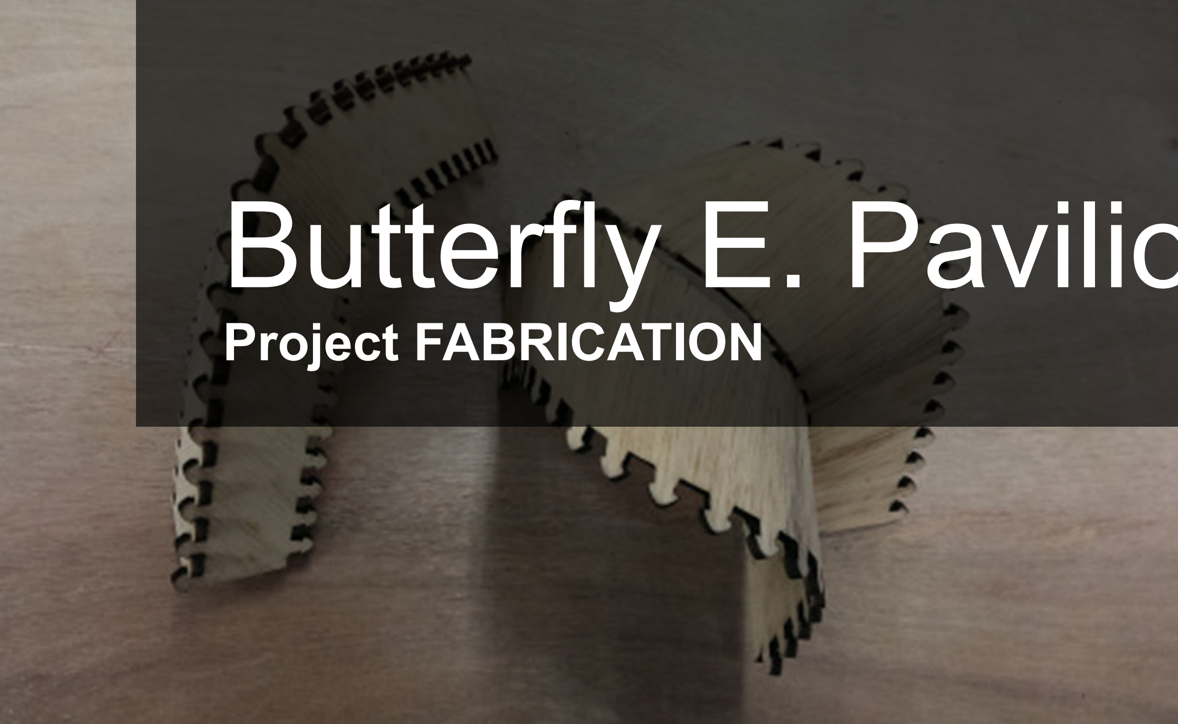


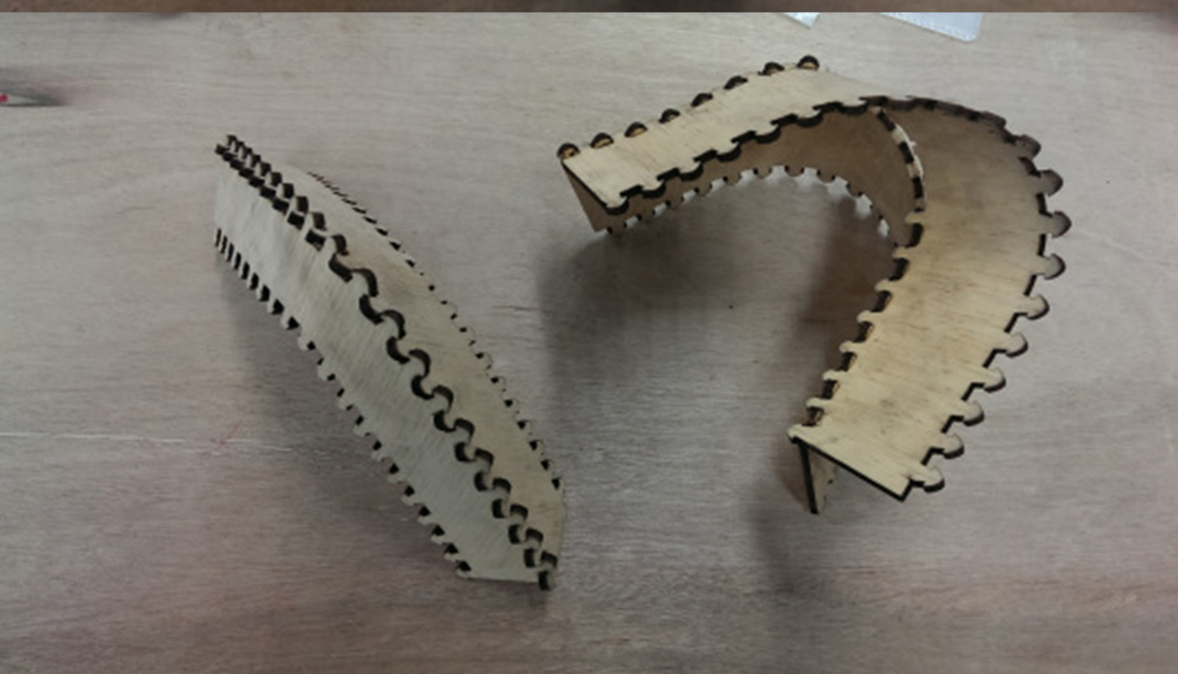


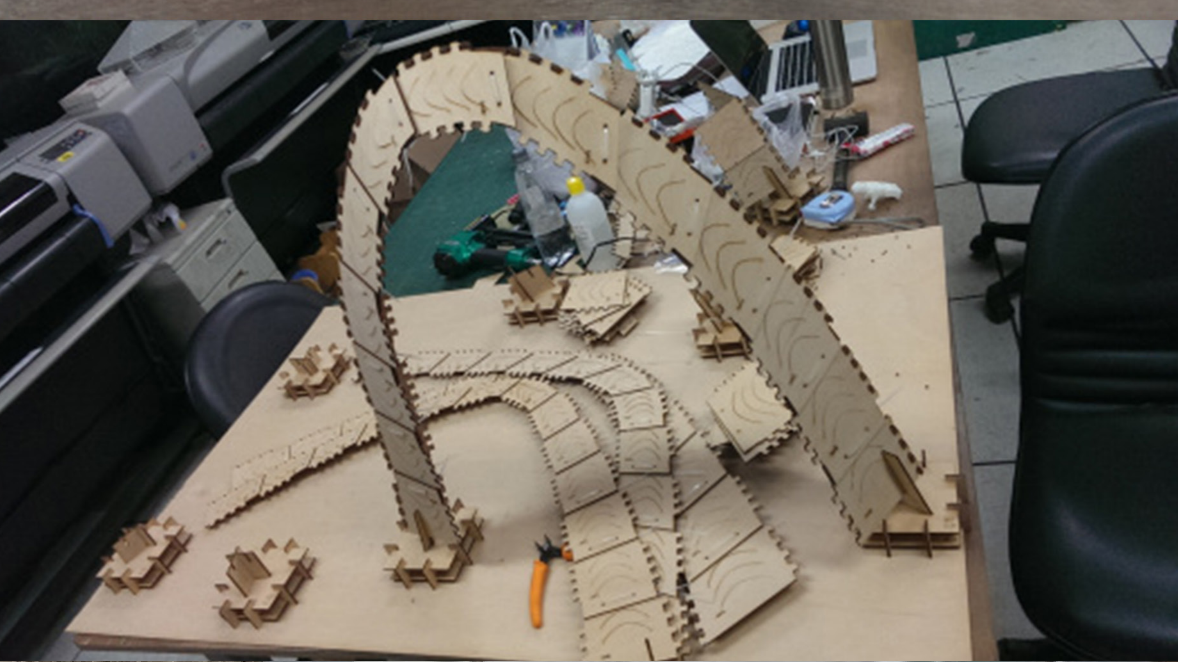
Source: http://www.geneatcg.com/

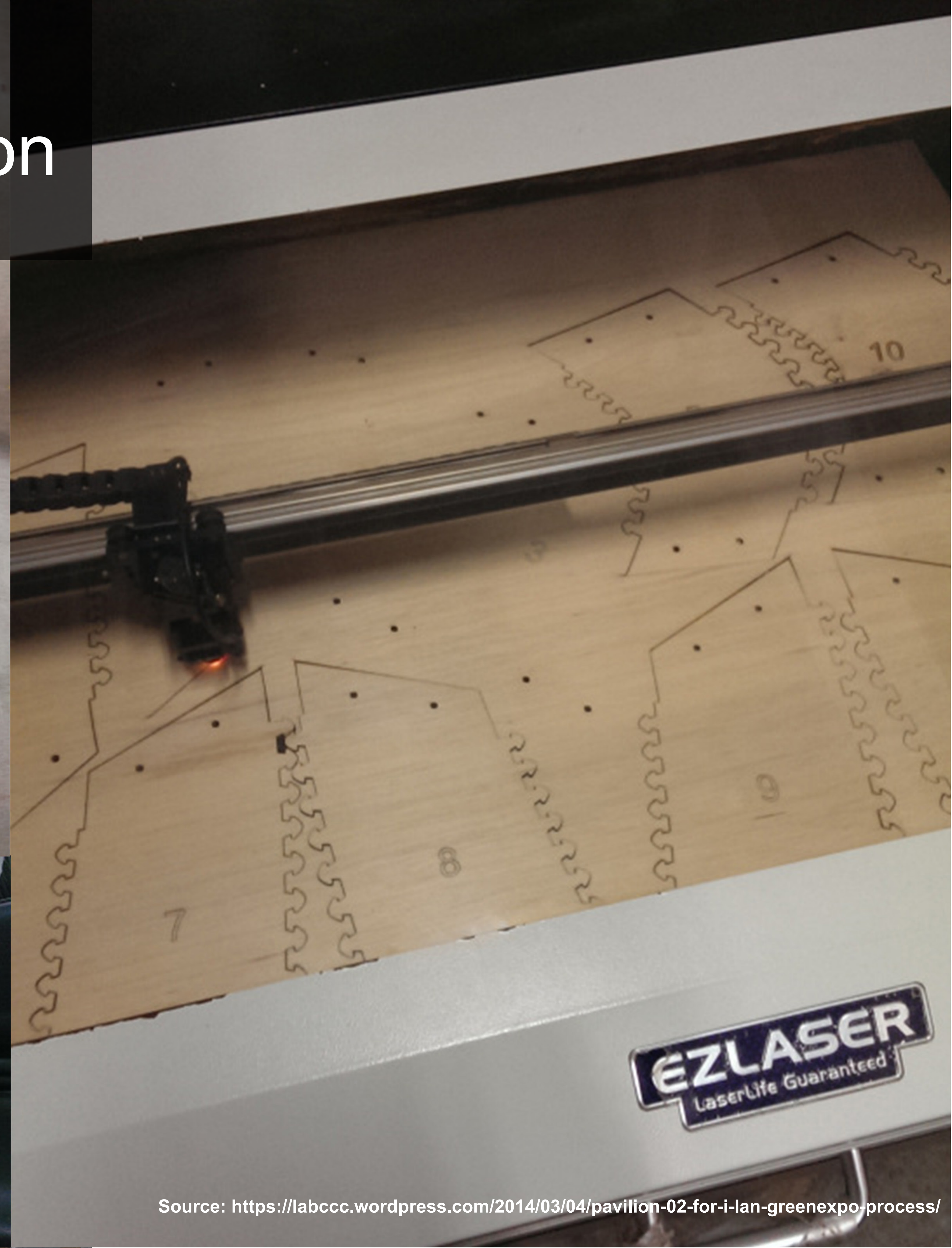
Butterfly E. Pavilion

Project FABRICATION









Source: https://labccc.wordpress.com/2014/03/04/pavilion-02-for-i-lan-greenexpo-process/

Butterfly E. Pavilion

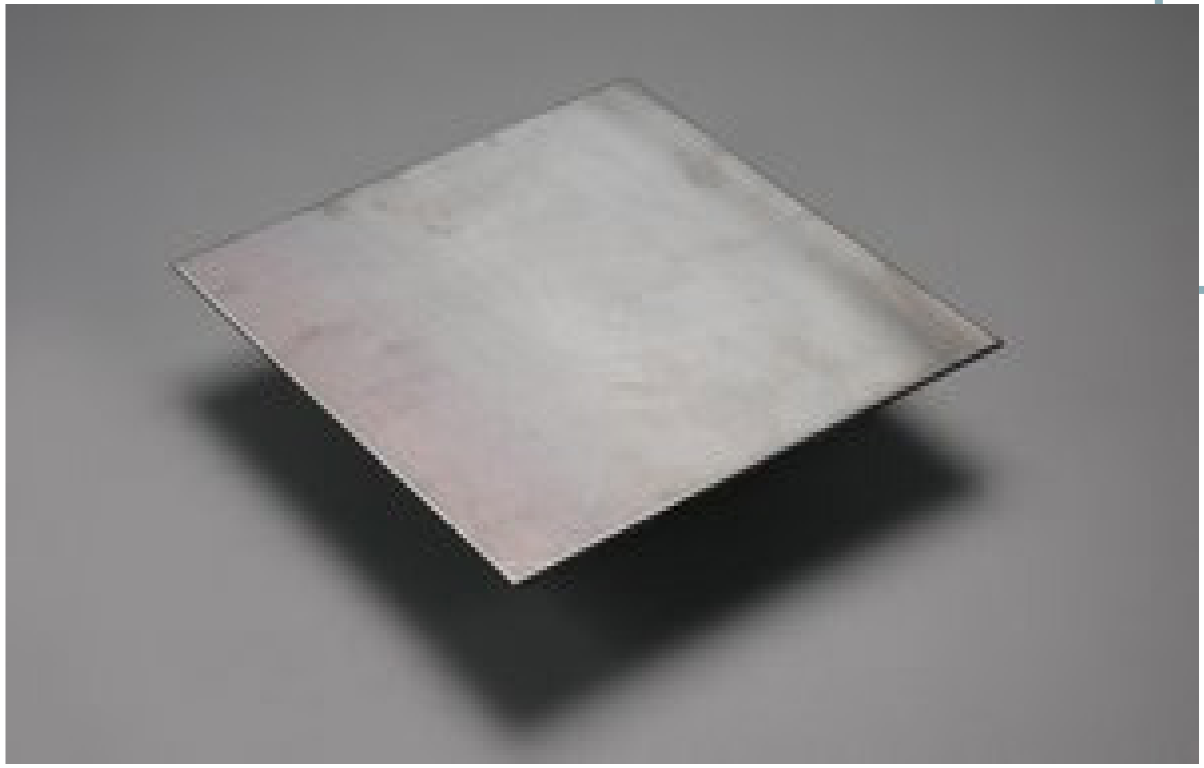
Project MATERIALS

Pavilion Quantity Survey		
Material		**Quantity**
Plywood sheets		20m2
Steel sheets		4m2

Source: https://labccc.wordpress.com/2014/03/04/pavilion-02-for-i-lan-greenexpo-process/

Butterly E. Pavilion

Project MATERIALS



source: http://www.discountsteel.com

http://www.sunriseaxiom.com/

Butterly E. Pavilion

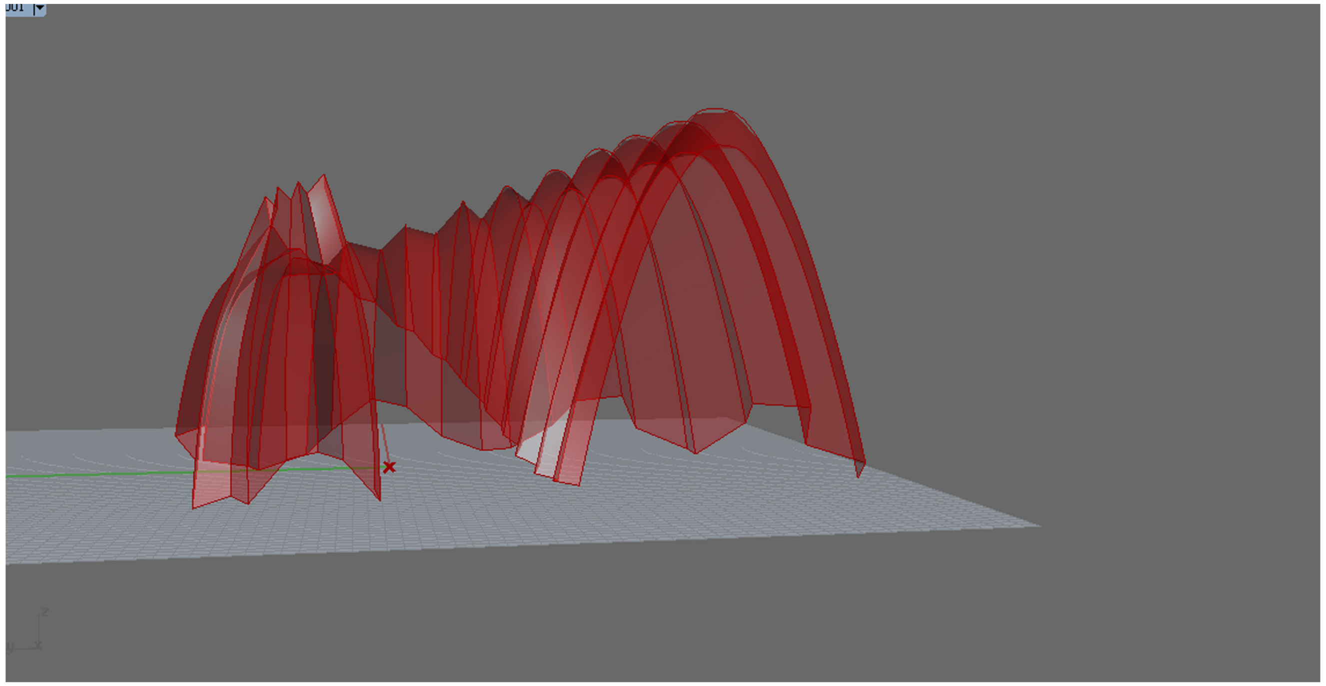
Project MACHINE / SOFTWARE

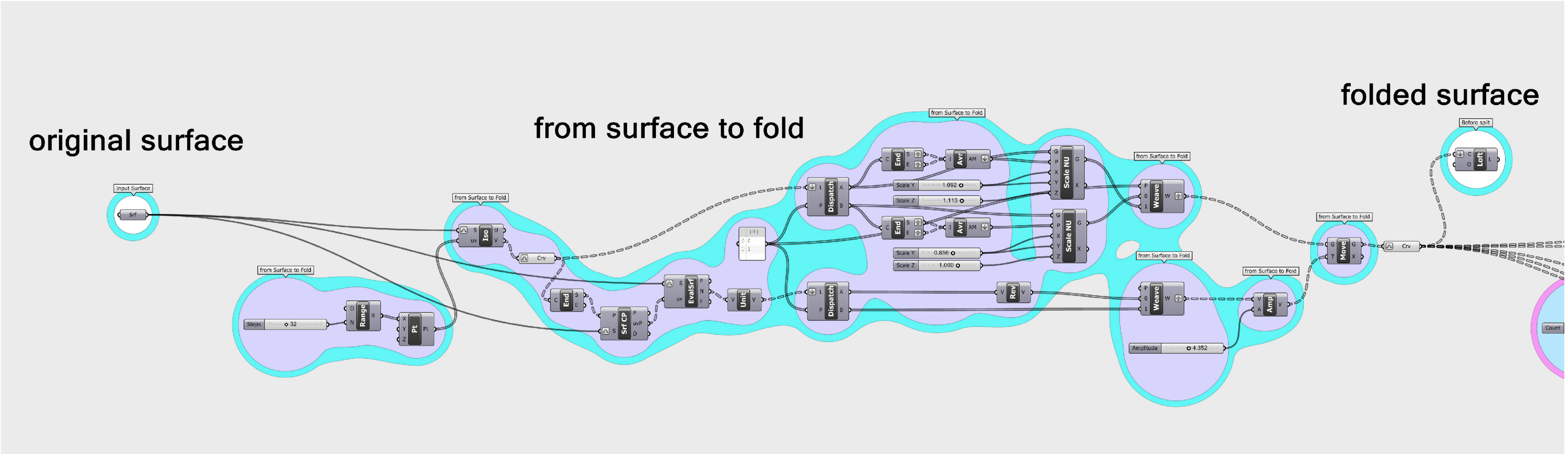
Laser Cutter- for cuttin sheets of plywood and steel.

Source: https://labccc.wordpress.com/2014/03/04/pavilion-02-for-i-lan-greenexpo-process/

Butterfly E. Pavilion

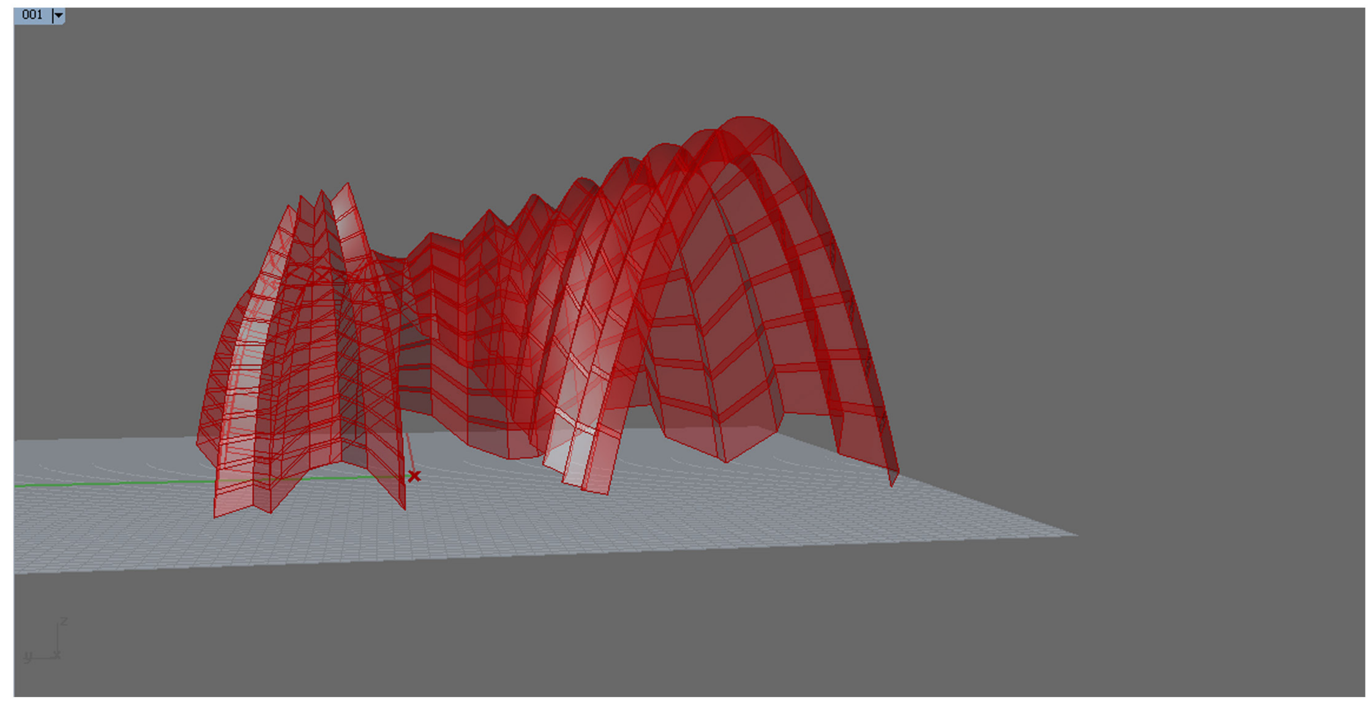
GRASSHOPPER
Modelling

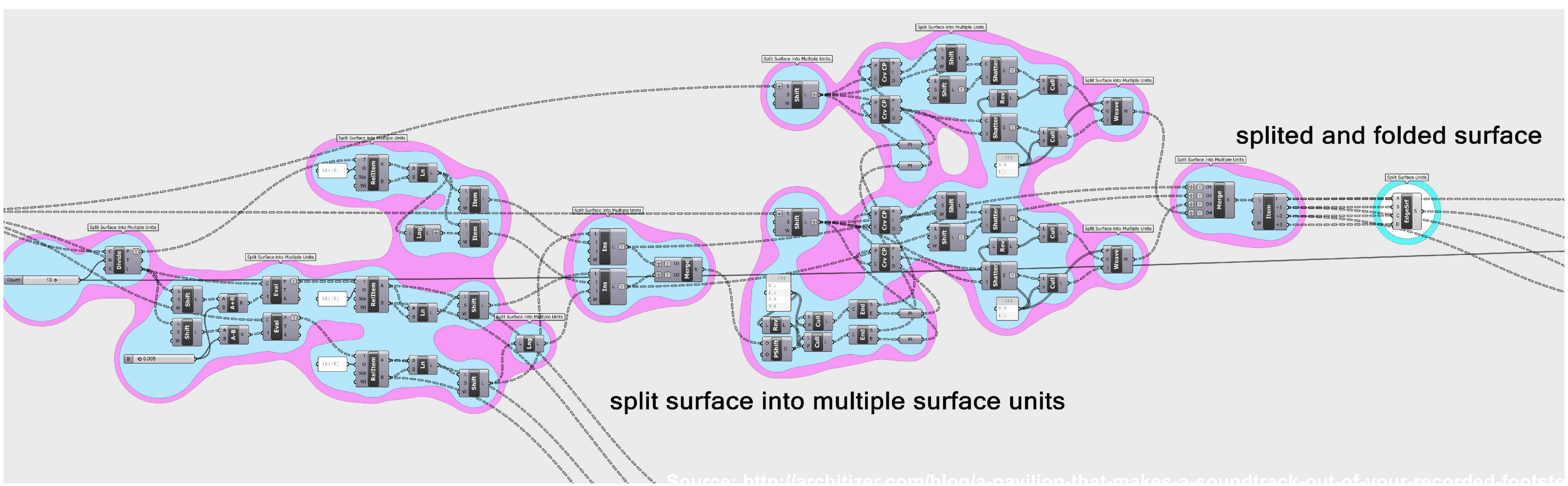




Butterfly E. Pavilion

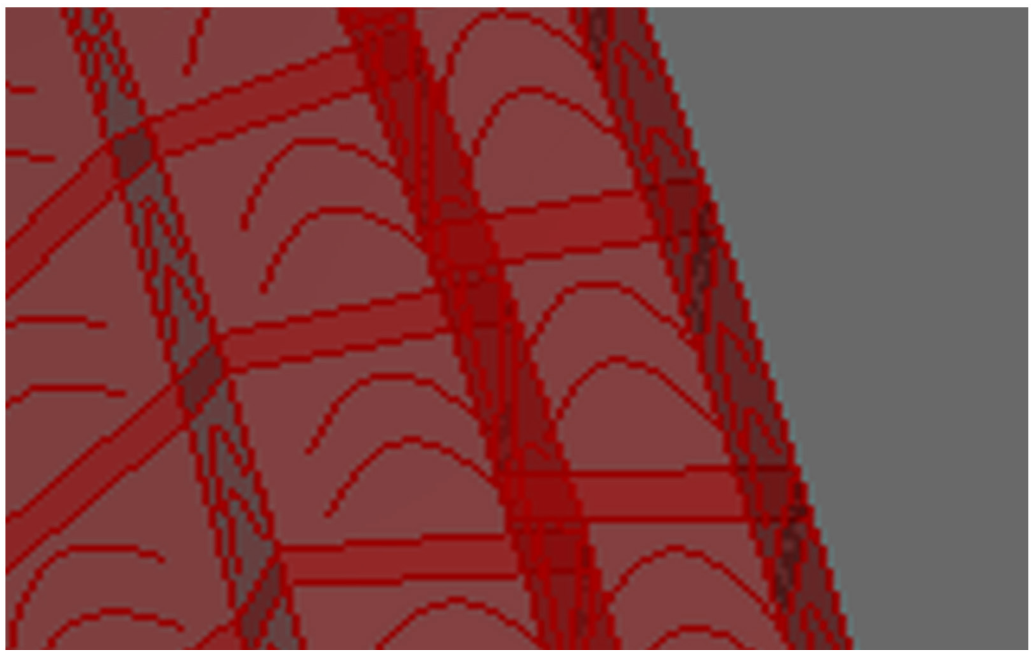
GRASSHOPPER
Modelling

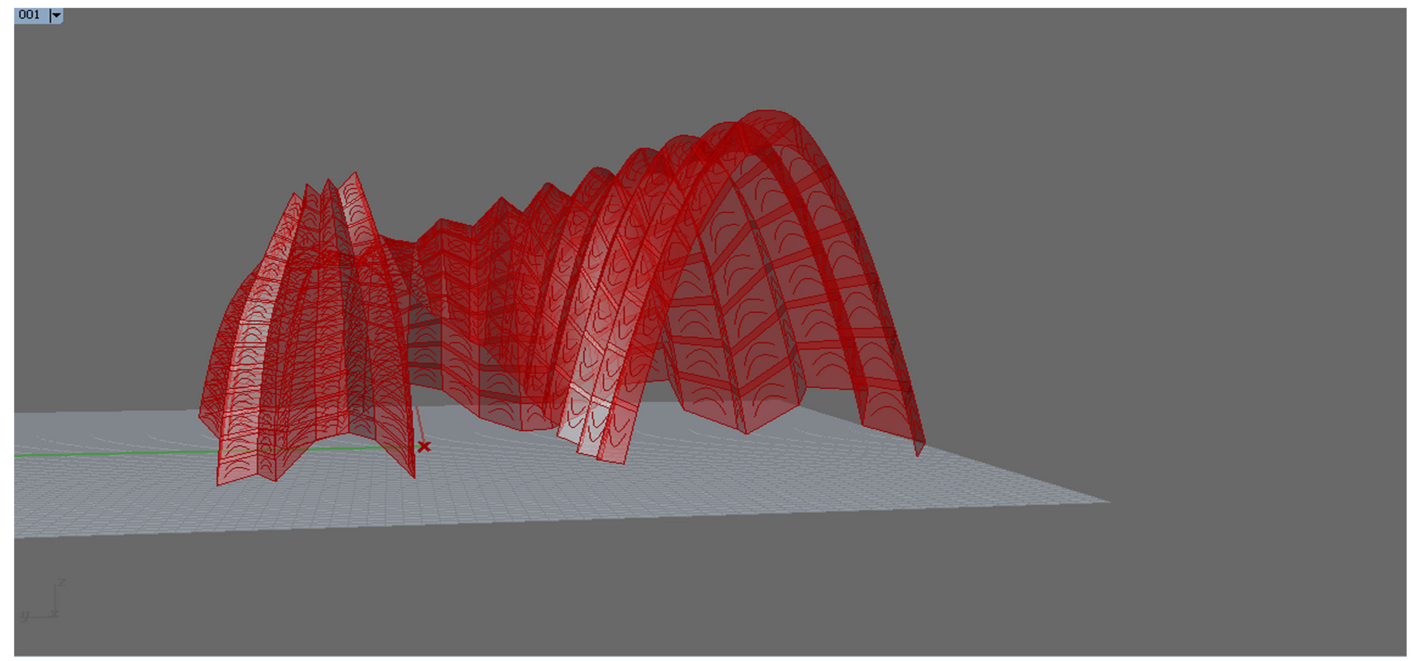


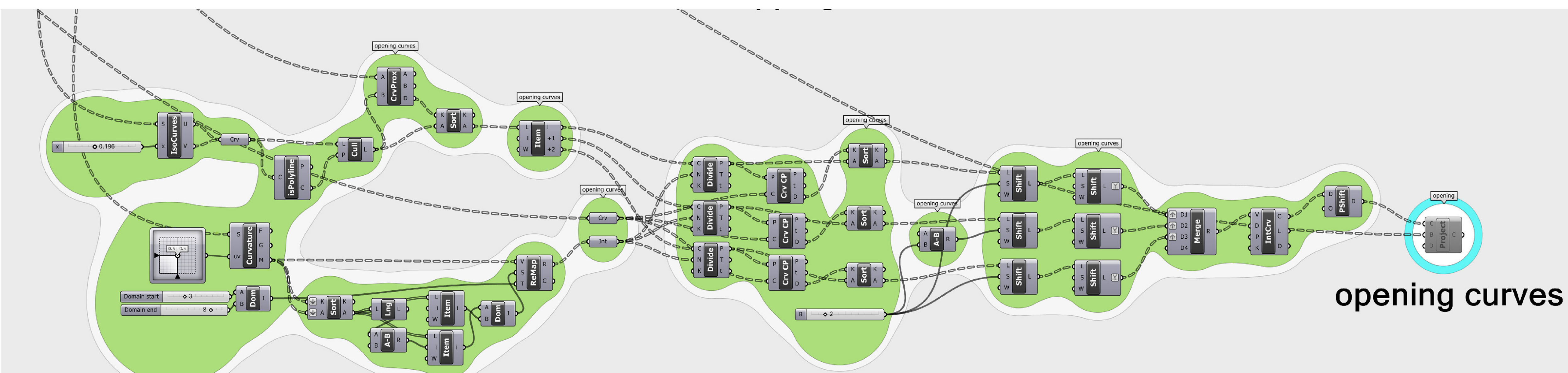


Butterfly E. Pavilion

GRASSHOPPER
Modelling



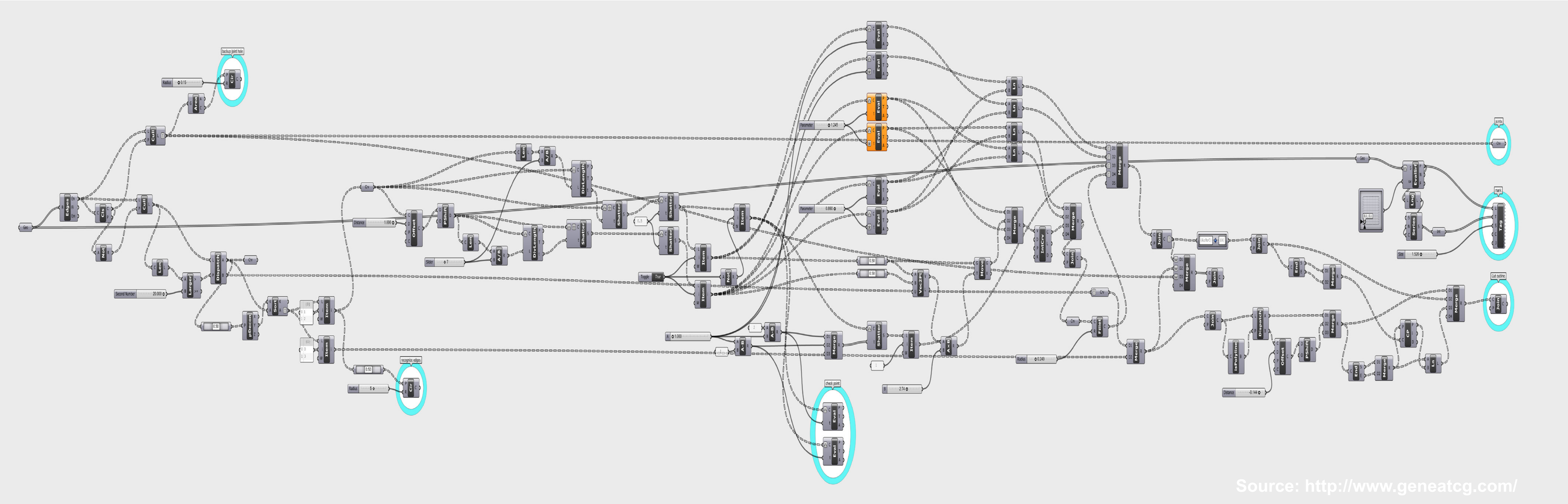




Making opening curves refer to curvature

Butterfly E. Pavilion

GRASSHOPPER
Fabrication Definition



Source: http://www.geneatcg.com/

Butterfly E. Pavilion

GRASSHOPPER

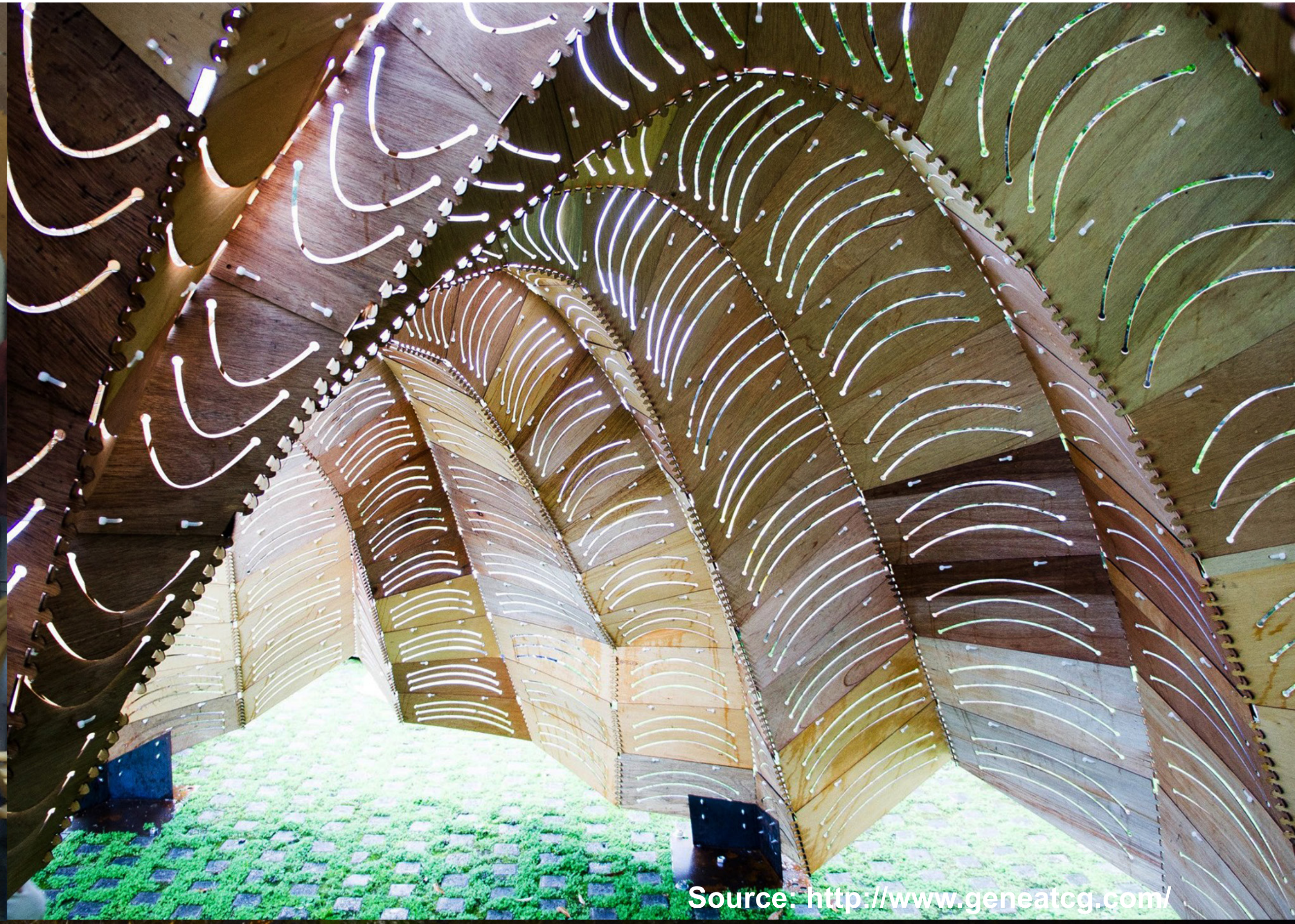
Fabrication Definition

Source: http://www.geneatcg.com/

–Geometry Size Selection Filter Python Code–

```
#### --Written by Gene Ting-Chun Kao-- ####

import rhinoscriptsyntax as rs

ids = rs.GetObjects("select surfaces",  rs.filter.polysurface)
area = rs.GetInteger("selected area limits", 10, 0)

rs.EnableRedraw(False)
print "Results: All", len(ids), "surfaces selected."

Count = 0
for i in ids:
    b = rs.SurfaceArea(i)
    if b:
        if b[0] <  area:
            rs.SelectObject(i)
            Count += 1

print "Results: Get", Count, "small objects."

rs.EnableRedraw(True)
```

Butterfly E. Pavilion




TESSELATING
Decay of a Dome at the Venice Biennale
Wang Shu, Lu Wenyu
Xinghua Liu
Source: http://www.designboom.com/architecture/amateur-architecture-studio-decay-of-a-dome/

Decay of a Dome

Project OUTLINE

Project Architect / Artist: Wang Shu, Vito Bertin, Lu Wen Yu
Location: Venice, Italy

Investor: The Venice Biennale

Function: Pavilion

Construction Year: 2010

Dimmensions: 4m High, 15m Circumference

Construction Team: XXXX

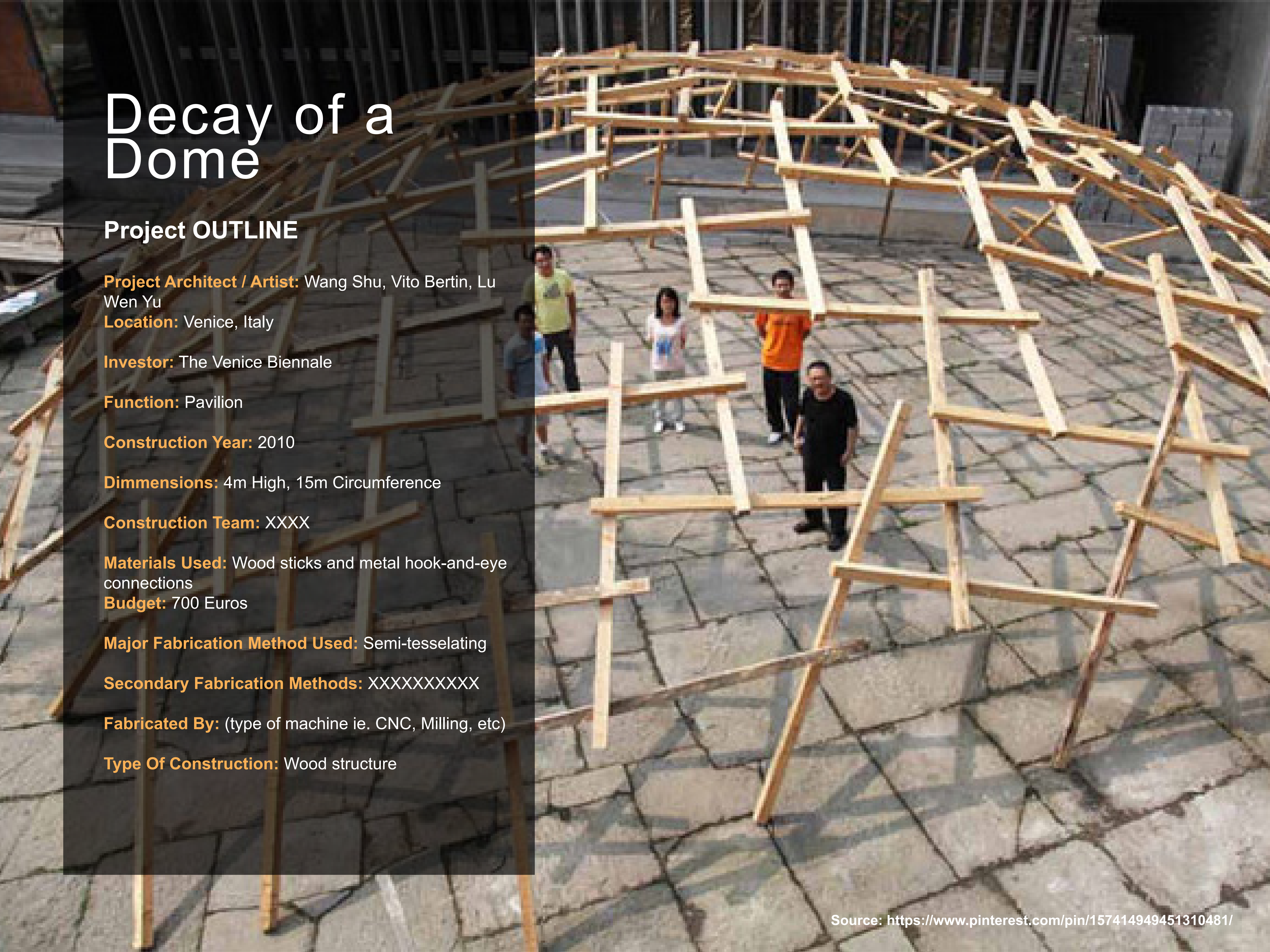
Materials Used: Wood sticks and metal hook-and-eye connections
Budget: 700 Euros

Major Fabrication Method Used: Semi-tesselating

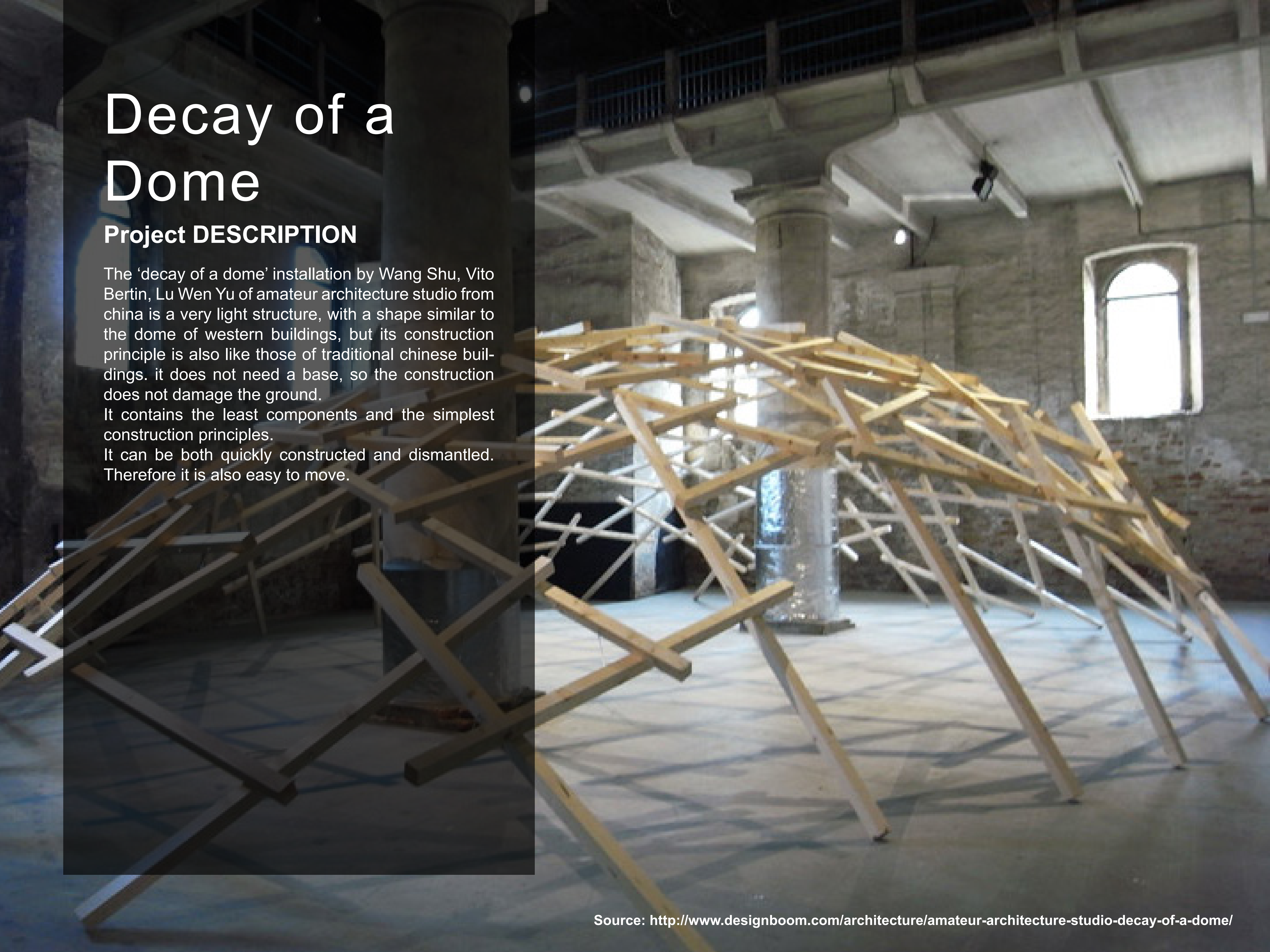
Secondary Fabrication Methods: XXXXXXXXXX

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

Type Of Construction: Wood structure



Source: https://www.pinterest.com/pin/157414949451310481/



Decay of a Dome

Project DESCRIPTION

The ‘decay of a dome’ installation by Wang Shu, Vito Bertin, Lu Wen Yu of amateur architecture studio from china is a very light structure, with a shape similar to the dome of western buildings, but its construction principle is also like those of traditional chinese buildings. it does not need a base, so the construction does not damage the ground.
It contains the least components and the simplest construction principles.
It can be both quickly constructed and dismantled. Therefore it is also easy to move.

Source: http://www.designboom.com/architecture/amateur-architecture-studio-decay-of-a-dome/

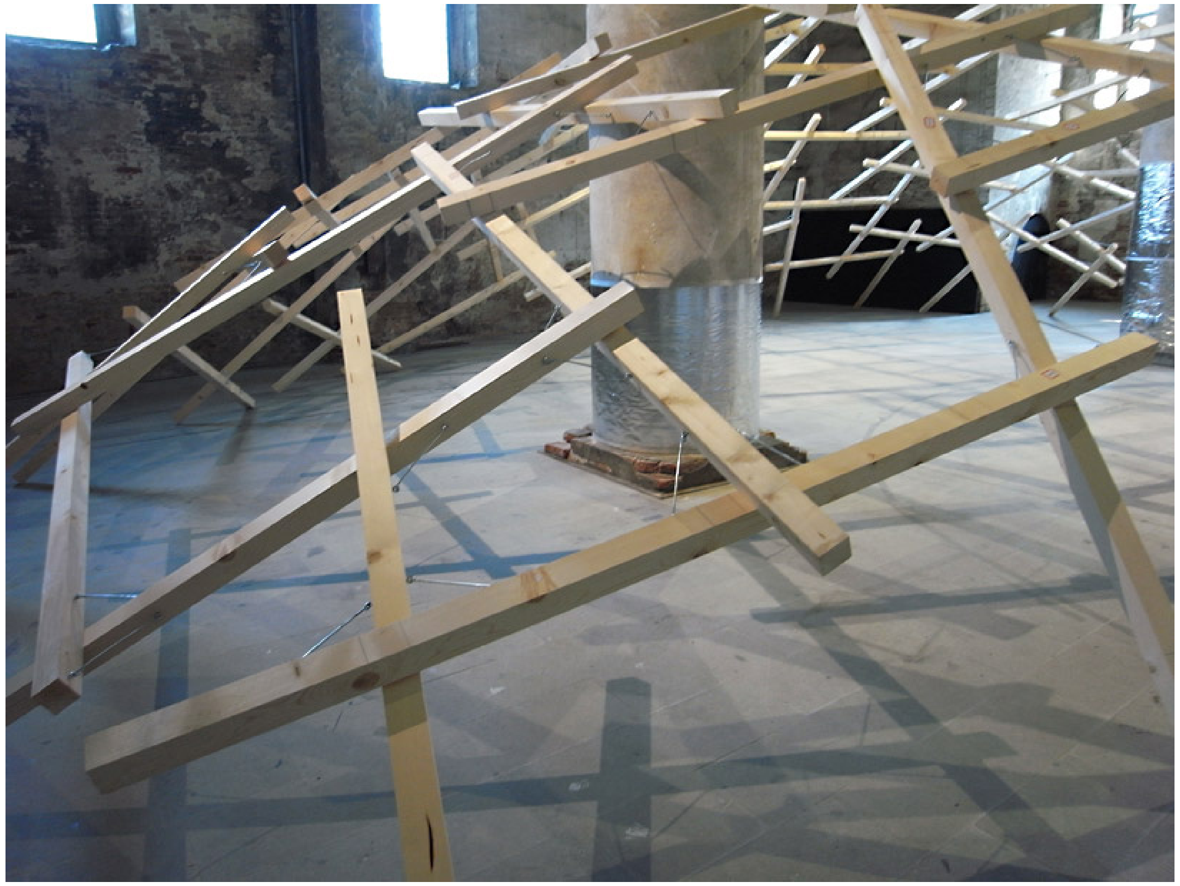
Source: http://www.designboom.com/architecture/amateur-architecture-studio-decay-of-a-dome/

Decay of a Dome

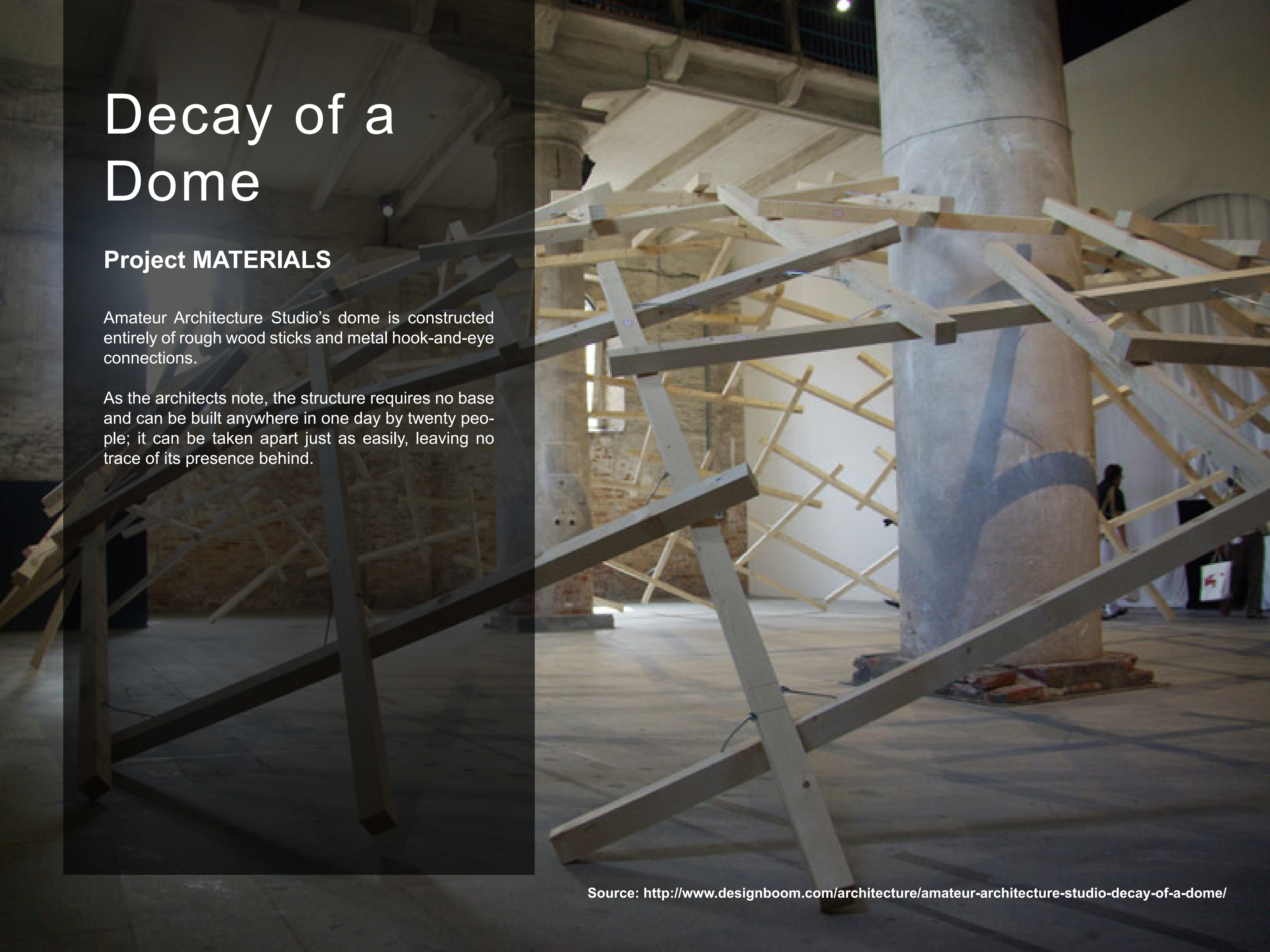
Project FABRICATION

This structure adopts a very clear and simple principle: one principle and sticks all the same size; It is small, everyday material but many people working together can build a huge space. Ten people working together could finish it in one day. Here, we had just three people and they finished it in three days, so it is a very exciting process.

It is made from only one element that, repeated, forms a domed shape almost of its own accord.



Source: http://www.designboom.com/architecture/amateur-architecture-studio-decay-of-a-dome/



Decay of a Dome

Project MATERIALS

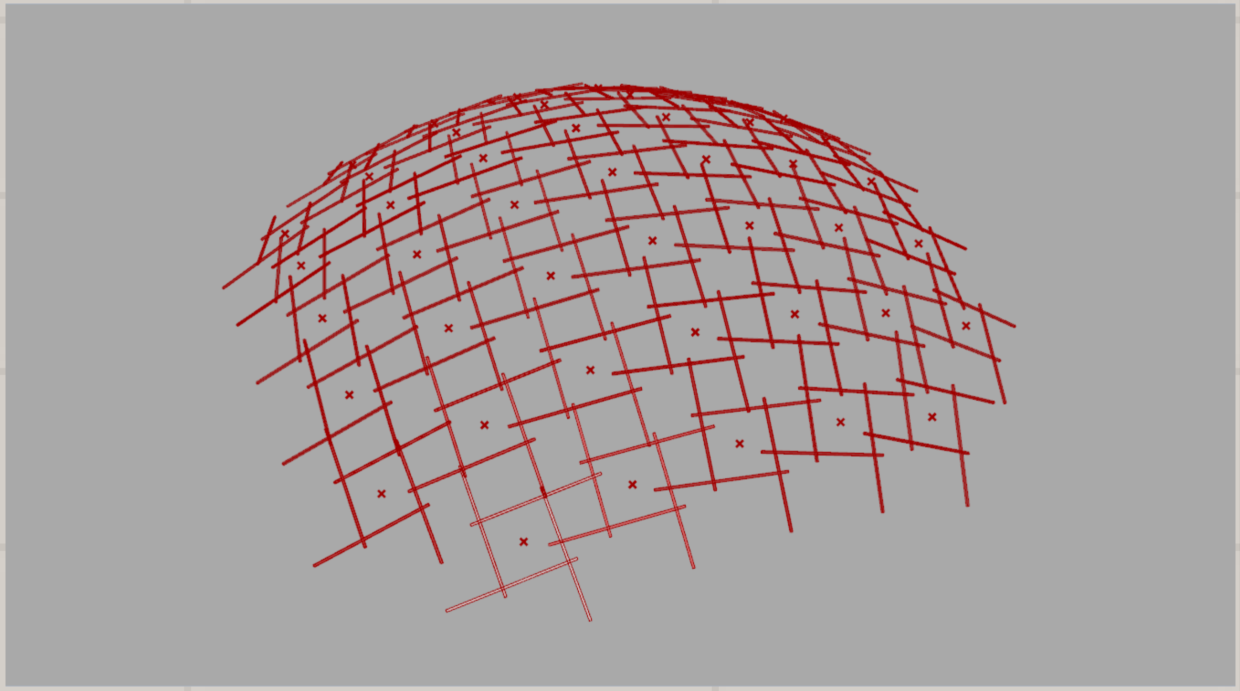
Amateur Architecture Studio’s dome is constructed entirely of rough wood sticks and metal hook-and-eye connections.

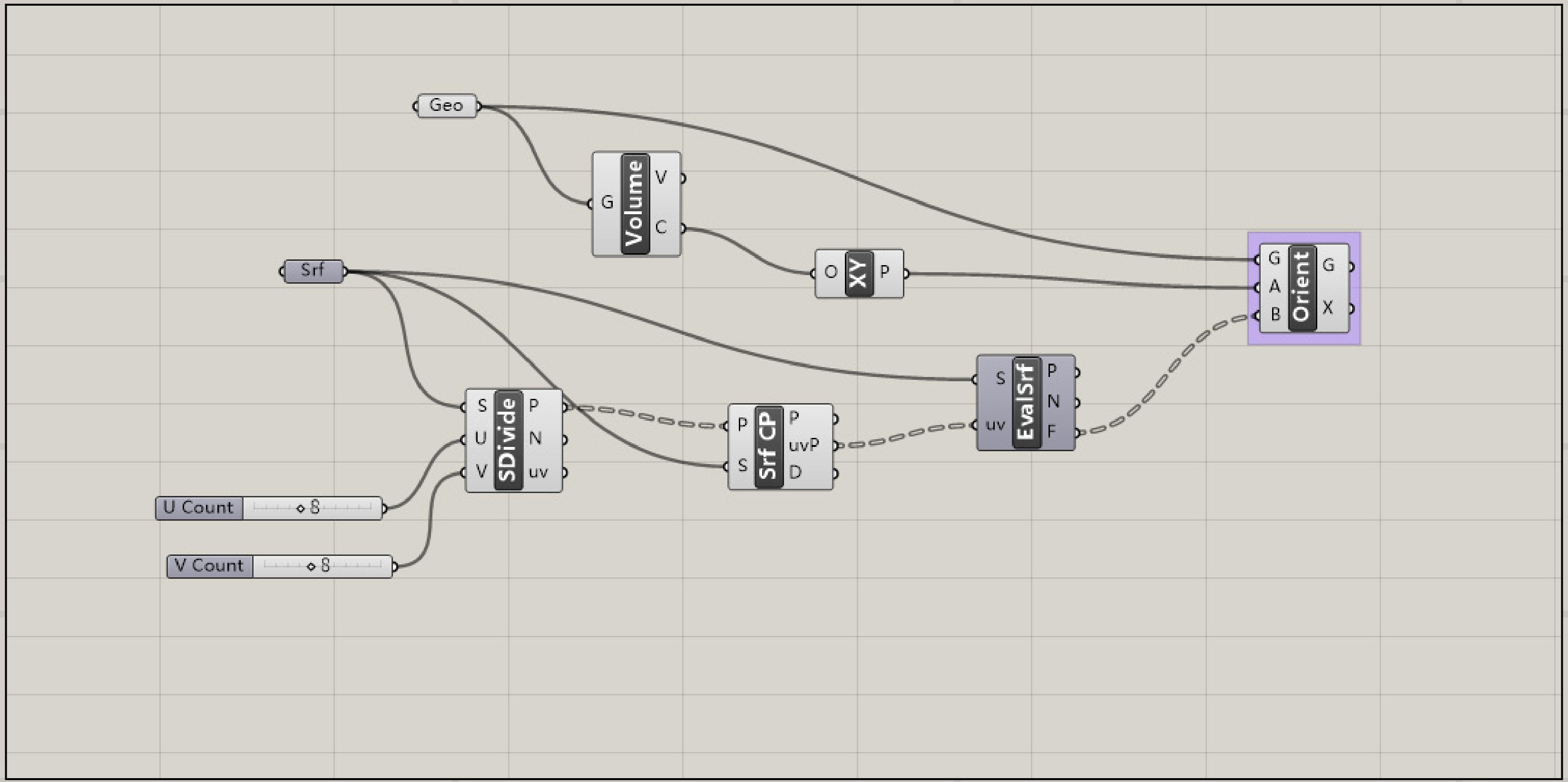
As the architects note, the structure requires no base and can be built anywhere in one day by twenty people; it can be taken apart just as easily, leaving no trace of its presence behind.

Source: http://www.designboom.com/architecture/amateur-architecture-studio-decay-of-a-dome/

Decay of a Dome

GRASSHOPPER
Modelling



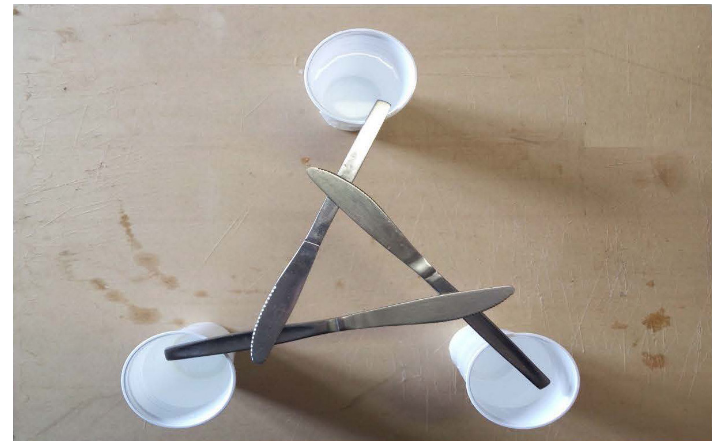


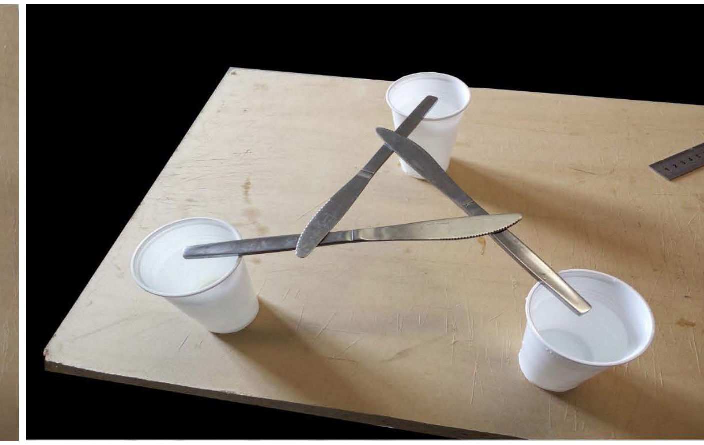
Decay of a Dome

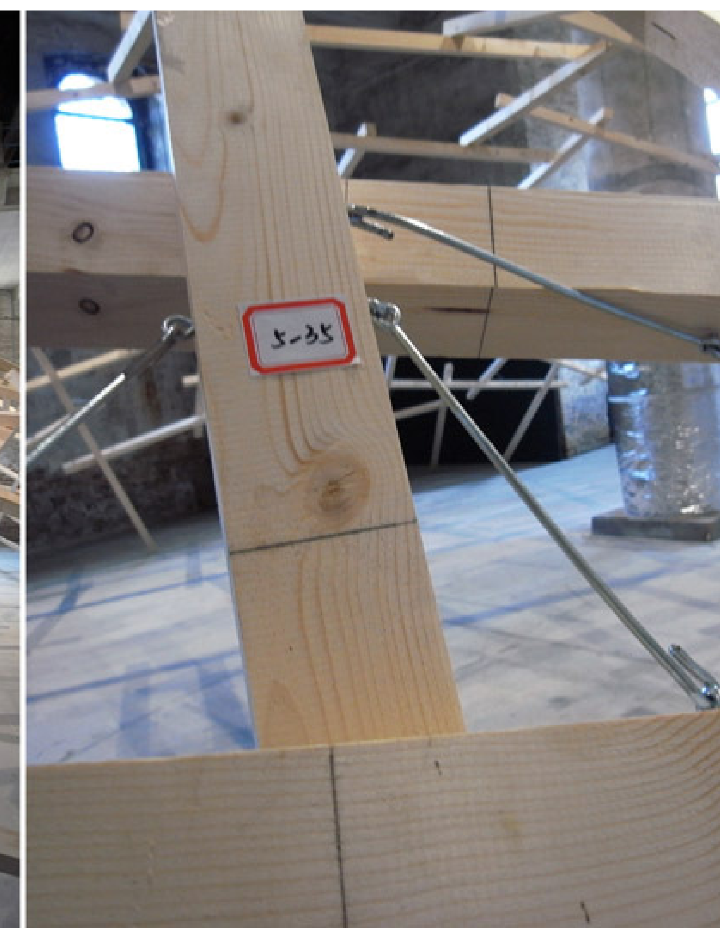
Structural Analysis

The basic structure logic is leverage theory. They are simply placed on each other and their rectangular shape and gravity do the rest.

They are architecural form but this structure is not Western. It is very similar to traditional Chinese architectural structures, made with simple wood sticks and a simple fixing system. This one is simpler than traditional Chinese architecture because the sticks are not fixed together. Wang Shu used window fasteners just for safety but they weren't necessary.



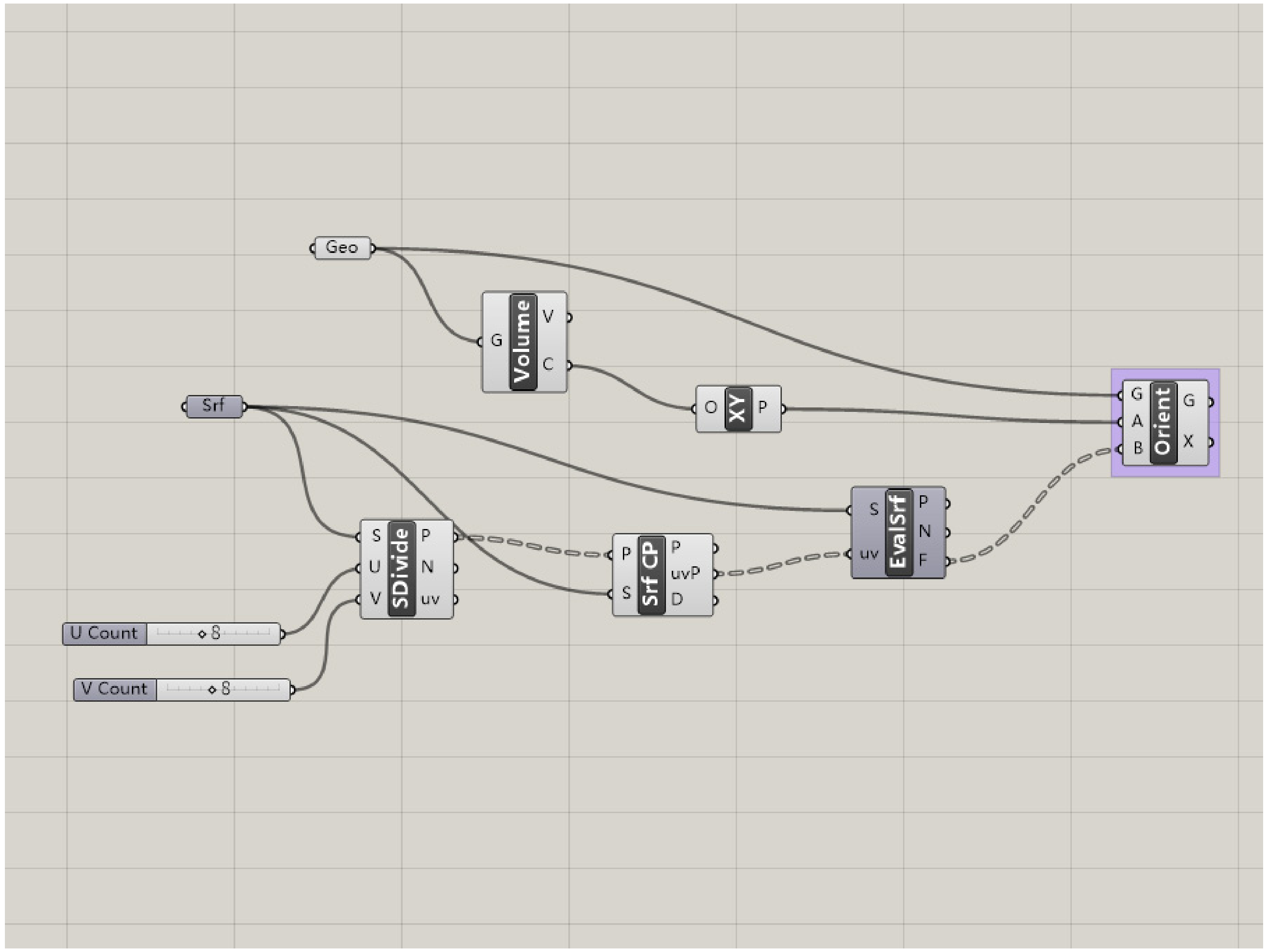




Source: http://www.designboom.com/architecture/amateur-architecture-studio-decay-of-a-dome/

Decay of a Dome

GRASSHOPPER
Fabrication Definition




Decay of a Dome
Source: http://www.boidus.co.uk/?p=2347


NEXT IMAGE ▶
TESSELATING
SYDNEY-PAVILION
Quan MA
Source: http://archinect.com/features/article/117185429/student-works-cellular-tessellation-pavilion

SYDNEY Pavilion

Project OUTLINE

Project Architect / Artist: Students of UTS

Location: Sydney

Investor: This is initiated by the Architure students

Function: Pavilion and lighting

Construction Year: 2014

Dimmensions: 3.2m High, 5.6m long

Construction Team: Counlsulting engeneers PL **Materials Used:** Aluminum panels, LED lights, glass **Budget:** 56.000 Euro

Major Fabrication Method Used: Cellular tesselating

Secondary Fabrication Methods: honeycomb

Fabricated By: Hand-made

Type Of Construction: Aluminum structure
Modelling Software: Rhino + Grasshopper

Source: http://archinect.com/features/article/117185429/student-works-cellular-tessellation-pavilion-

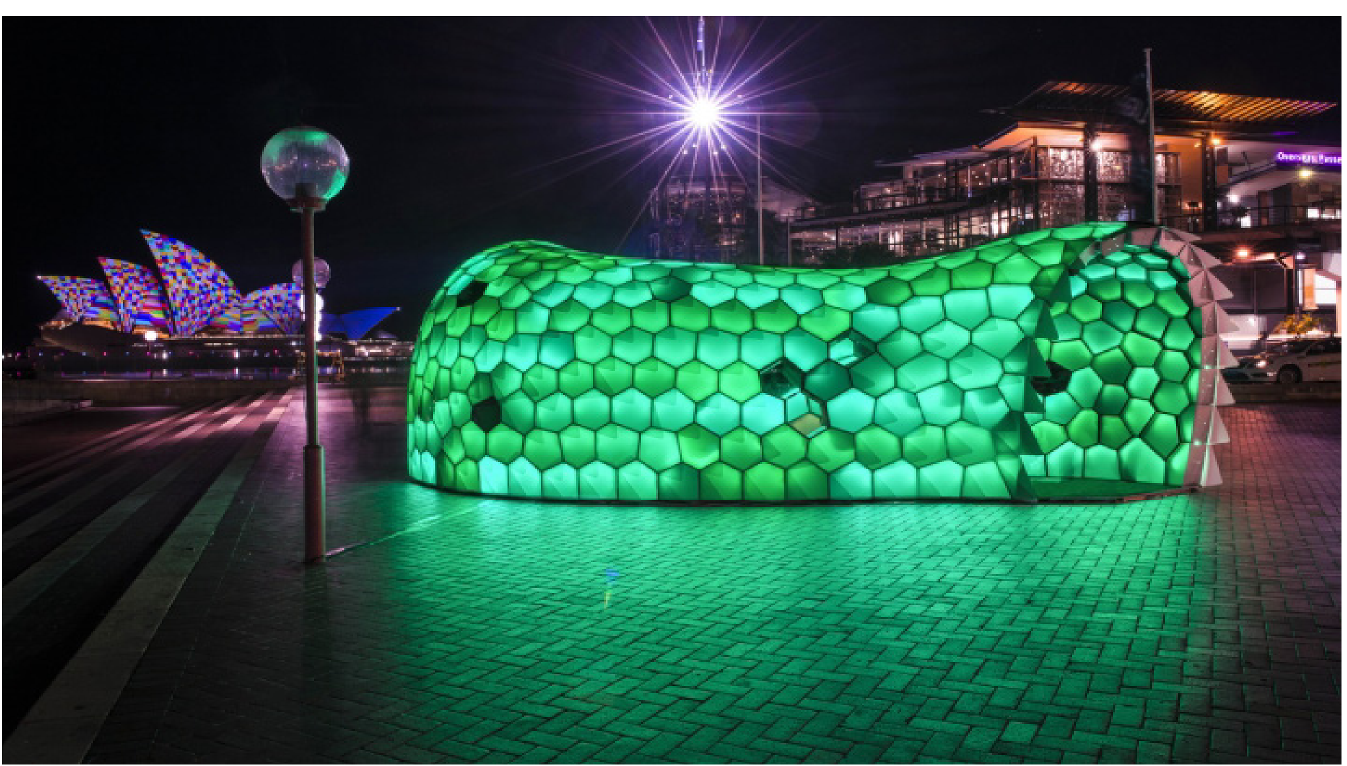
SYDNEY Pavilion

Project DESCRIPTION

Positioned in coordination with Sydney Harbor Bri-dge and the Utzonís Sydney Opera House, the Ce-llular Tessellation pavilion emits a colored light to fall on visiting pedestrians, traveling through its tunnel and 200 meters of LED lights. The basic structure is formed with digitally-fabricated aluminum panels, folded and aggregated, created by a project algori-thm that can work with nearly any surface. Coordi-nating with Abedian on the project were architecture student assistants from the University of Technology Sydney, University of South Wales, and University of Sydney..

Cellular Tessellation is a small yet generous pavilion put on display as part of the Sydney Vivid Light festi-val in 2014. The project is both spatial and aesthetic, bringing the quality of architectural inhabitation and visceral experience to an urban festival which is typi-cally limited to visual engagement.


PREVIOUS
NEXT IMAGE



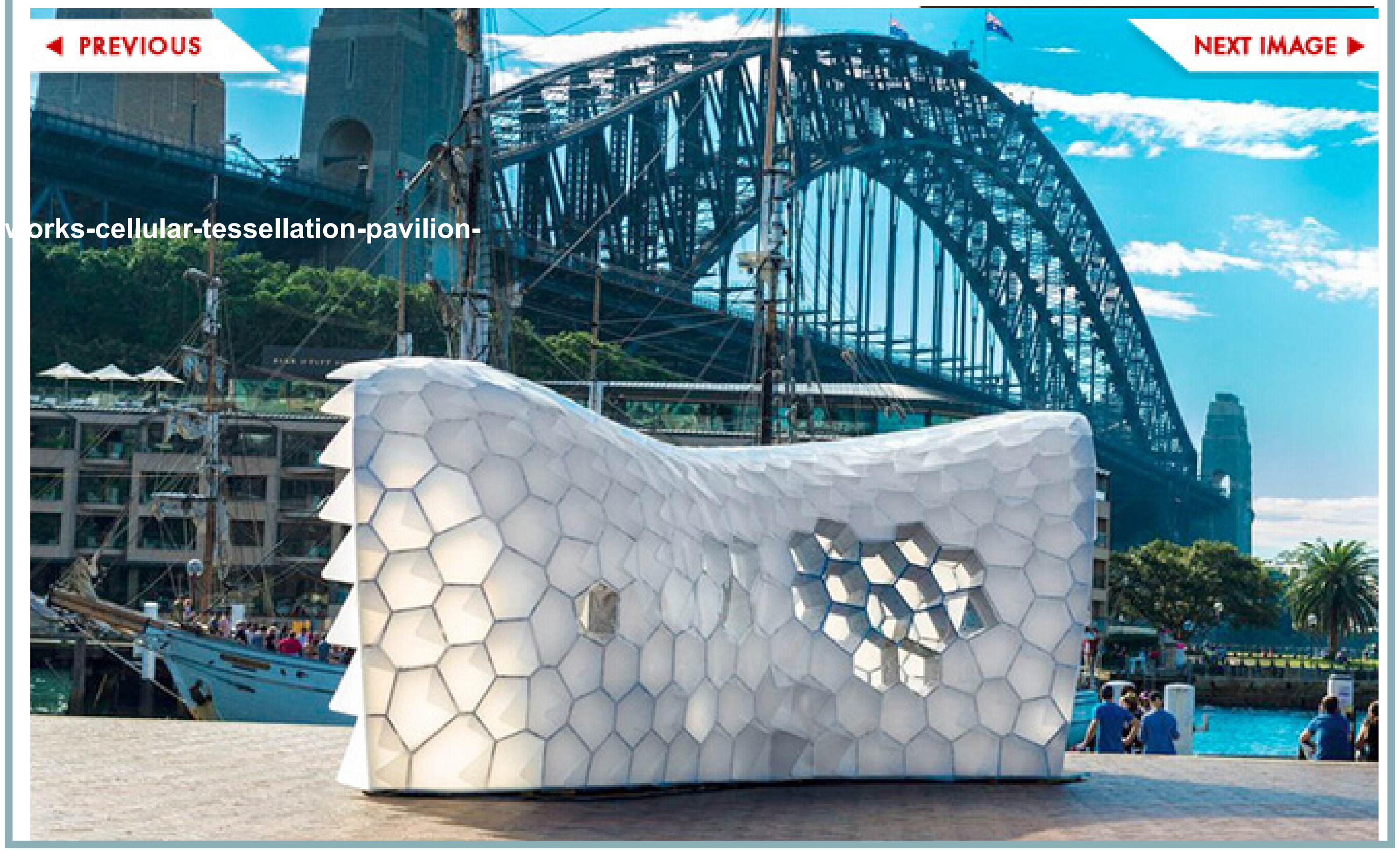
SYDNEY Pavilion

Project FABRICATION

The initial steps involve a sphere-packing routine which distributes equal size spheres over the base surface as tightly as possible without overlapping. The centre of these spheres, which are now evenly spaced across the surface in both U and V directions, can be then used to generate Voronoi cells that intersect the base surface at even increments. Before the cells are generated, the points are jittered in the X, Y, and Z directions by a small amount (+/- 60mm in this case) to generate more irregular forms, otherwise they will generate nearly perfect hexagonal cells.

This method proved proved ideal as it solved some very common issues with the generation and fabrication of Voronoi cells: controlling the range of final cell sizes, the even distribution of cells over doubly-curved surfaces, and the prevention of very small segments and faces.

Source: http://archinect.com/features/article/117185429/stude works-cellular-tessellation-pavilion-



Source: http://archinect.com/features/article/117185429/student-works-cellular-tessellation-pavilion-

Sydney Pavilion

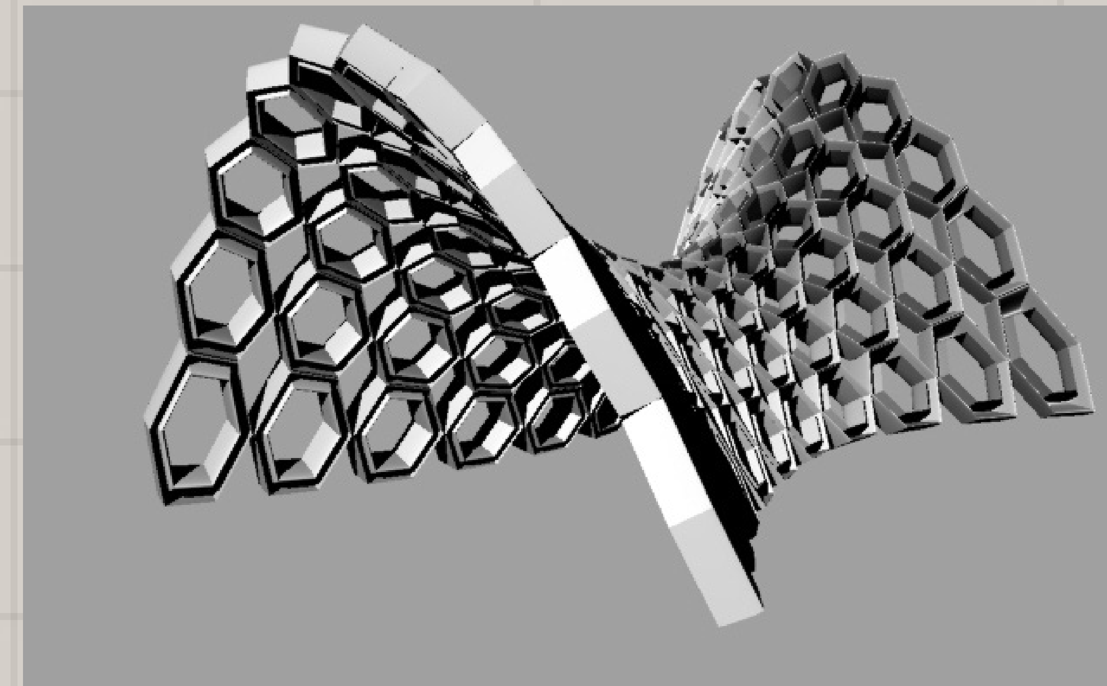
Project MATERIALS

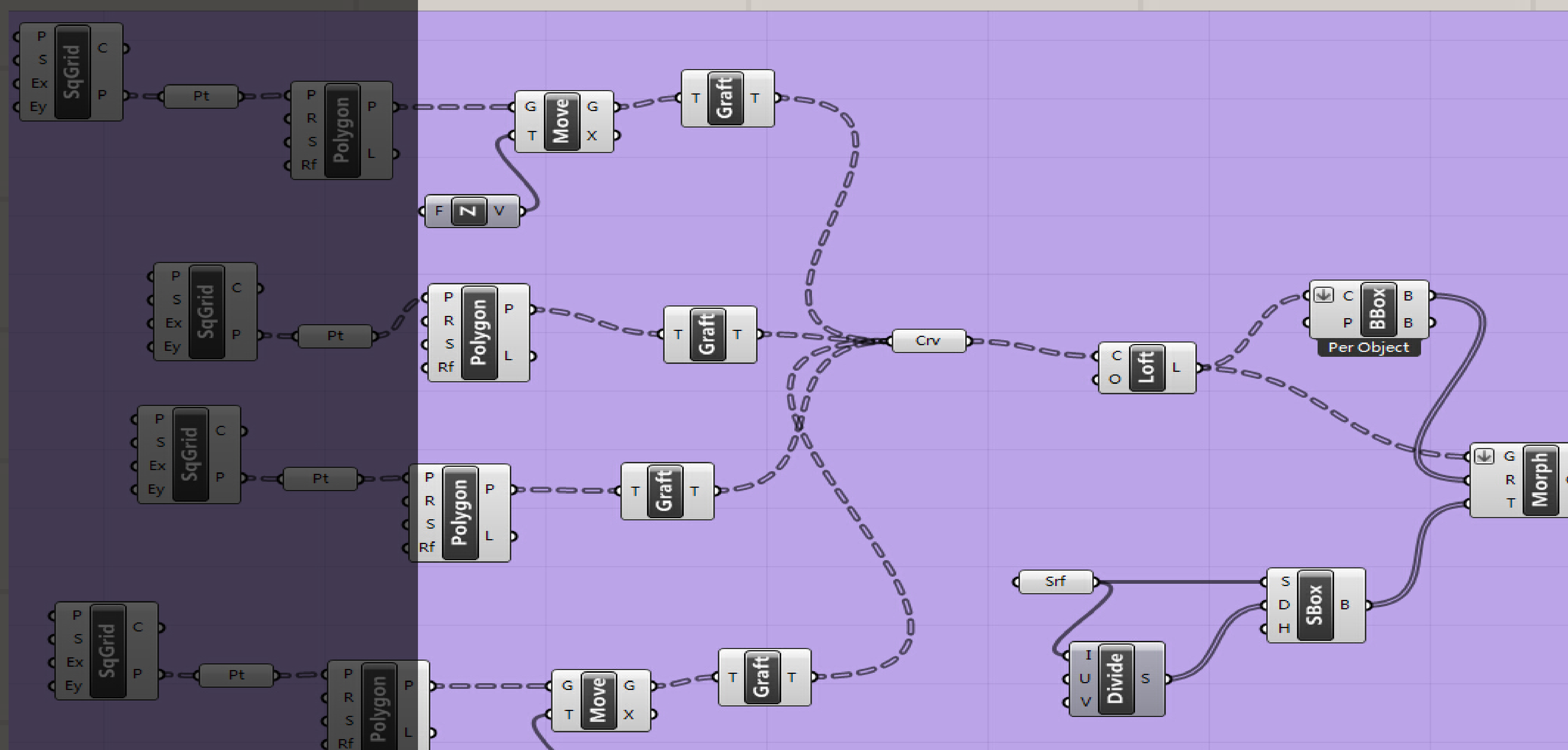
SydneyPavilion Quantity Survey		
Lumber		
	Material	**Quantity**
Surrounding “fence”	3.2x6;6, 3M	
Main structure	3, 6M	800
Aluminum panel		
Pathway		$64.2M^3$
Metal Hangers		
Nunber of panel	1071	
Glass		

Source: http://archinect.com/features/article/117185429/student-works-cellular-tessellation-pavilion-

Sydney Pavilion

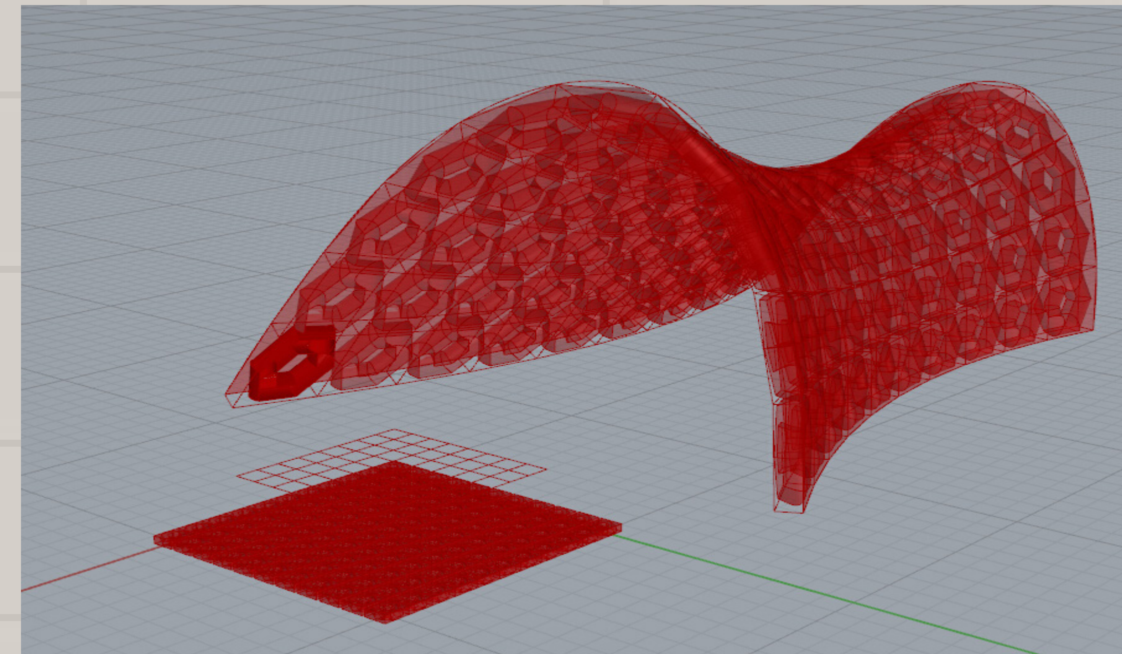
GRASSHOPPER
Modelling

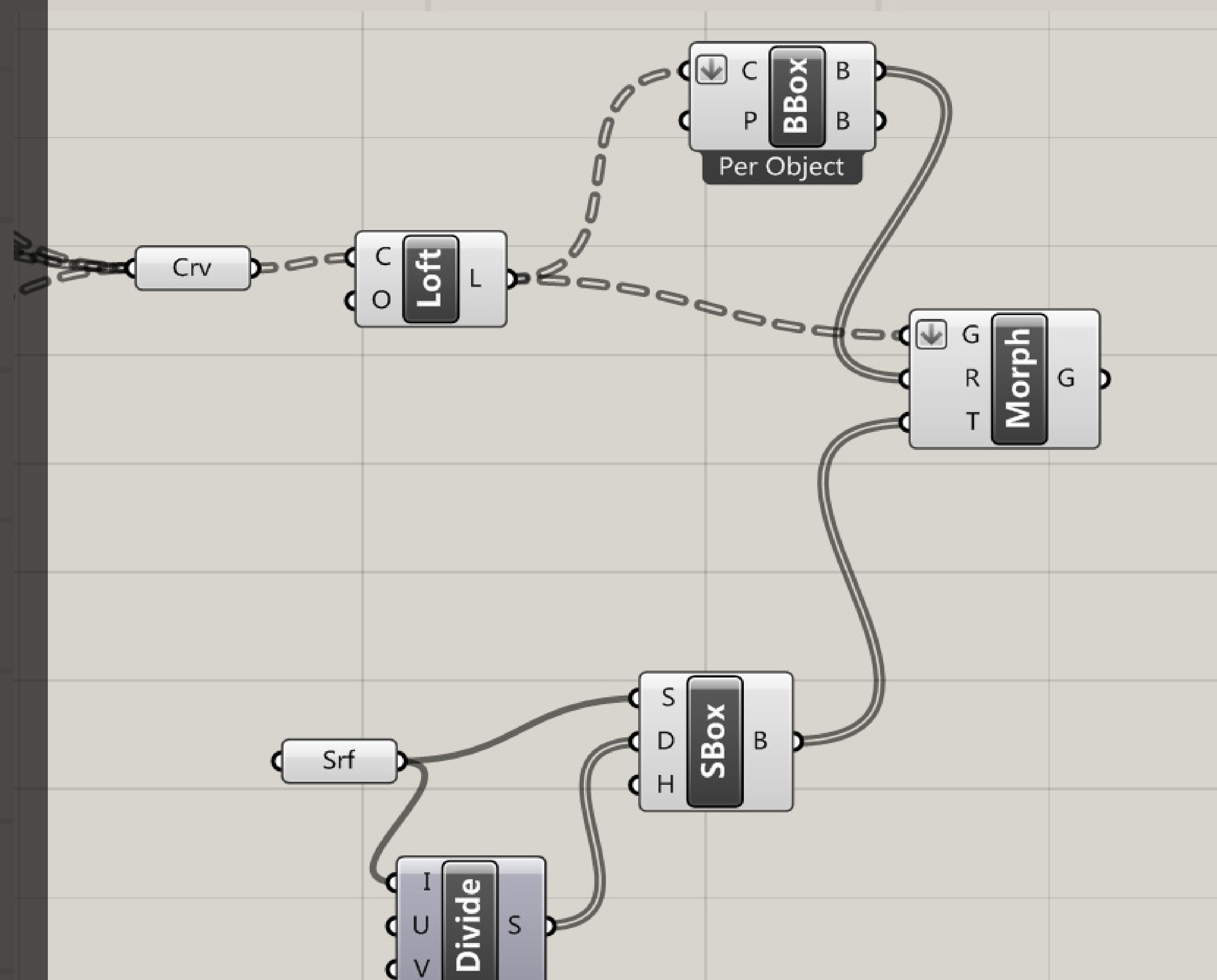




Sydney Pavilion

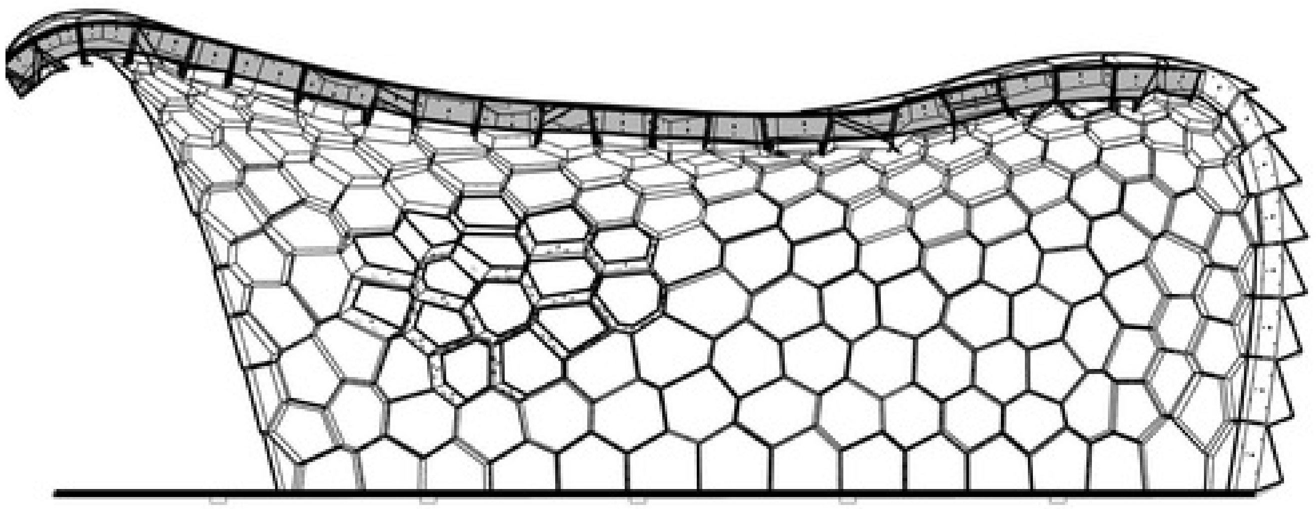
GRASSHOPPER
Modelling



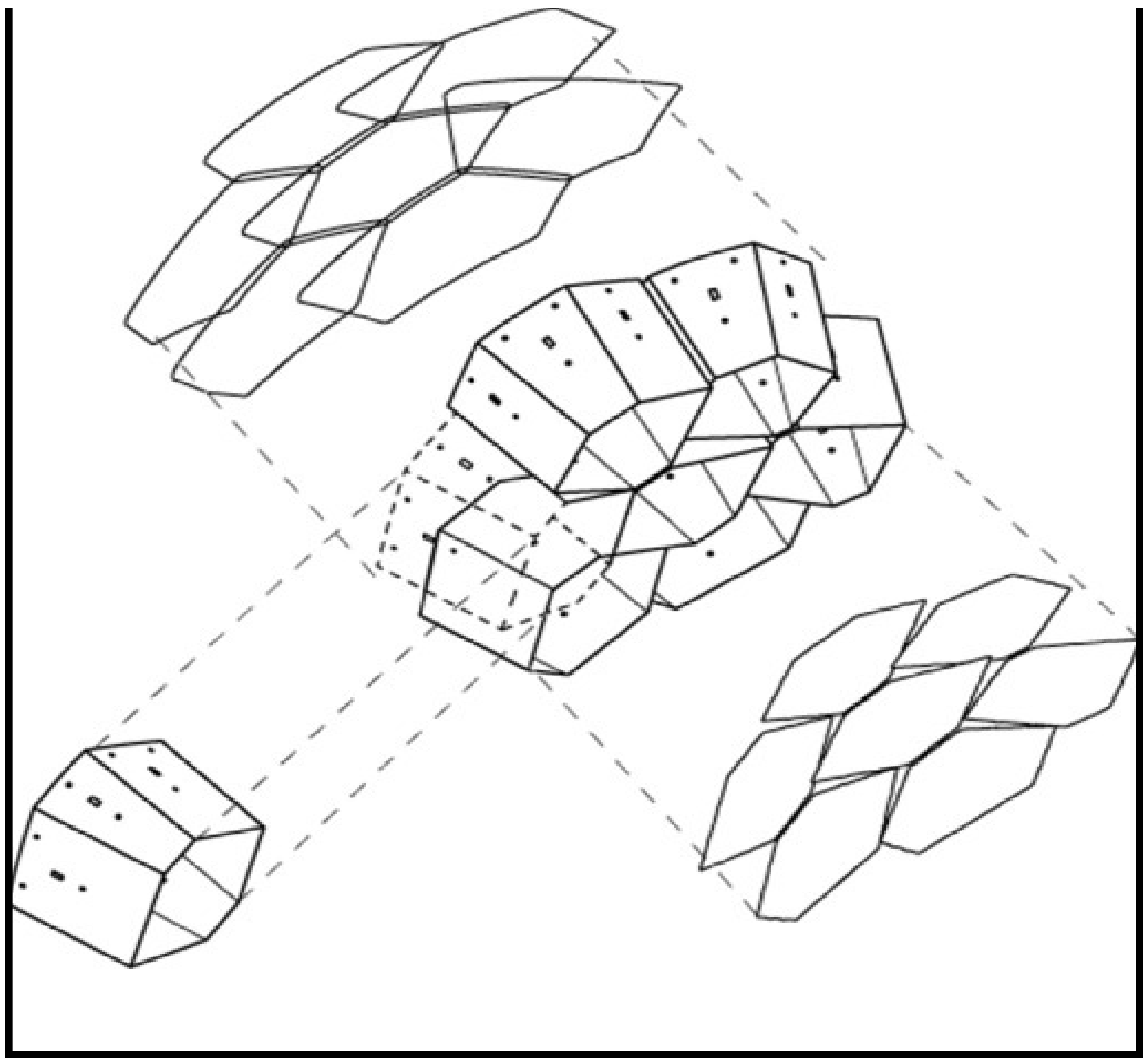


Sydney Pavilion

GRASSHOPPER
Structural Analysis



TION



Tessellation
Dragon Skin Pavilion
Laboratory for Explorative Architecture
Matthew Wong
Source: http://l-e-a-d.pro/w/wp-content/uploads/2011/07/iws17-1.jpg

PROJECT OVERVIEW

ProjectArchitects:
Laboratory for Explorative Architecture& Design Ltd. and EDGE Laboratory for Architectural and Urban Research

Location:
Hong Kong

Investor:
2011-12 Hong Kong & Shenzhen Bi-City Biennale of Urbanism\Architecture

Function:
Temporary pavilion

ConstructionYear:
2012

MaterialUsed:
Post-formable plywood

MaterialSpent:
163

MajorFabricationUsed:
Tessellatoion

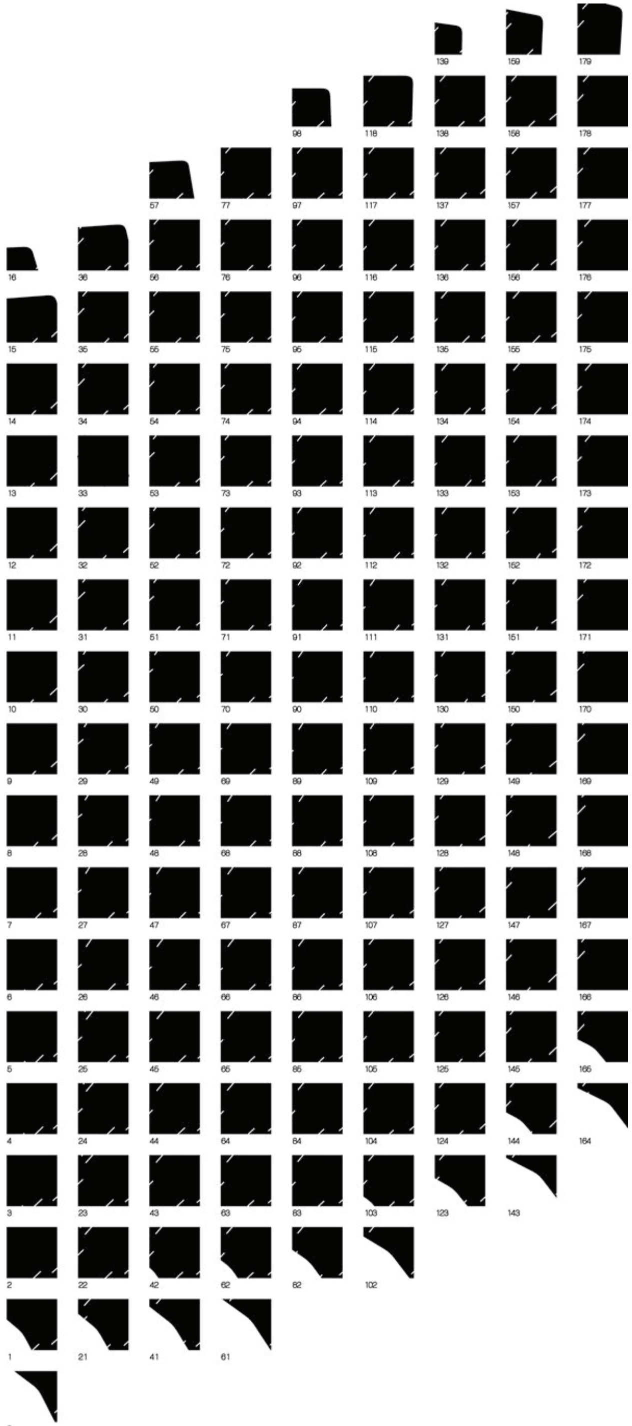
FabricationBy:
CNC milling

SoftwareUsed:
Rhino - Grasshopper

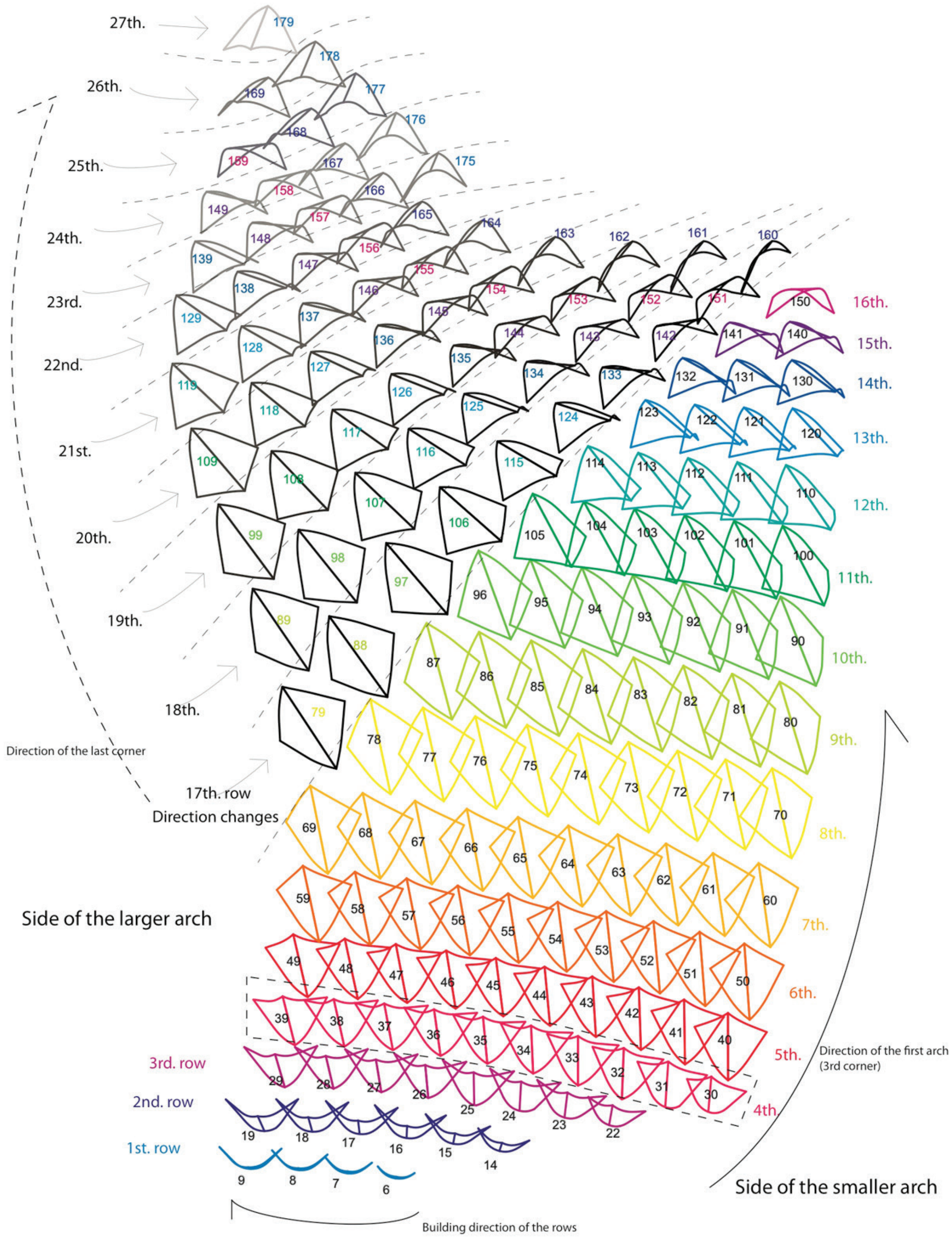
Internal View - http://www.archilovers.com/projects/71372/

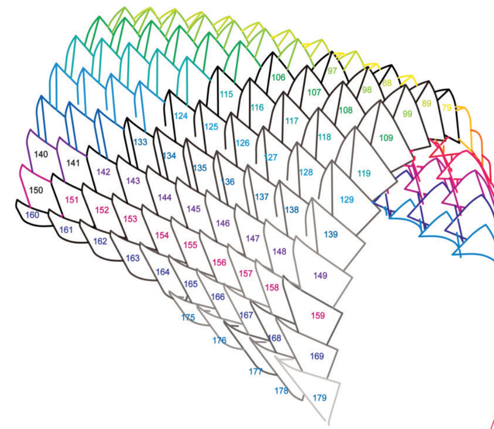
FABRICATION METHODS / process

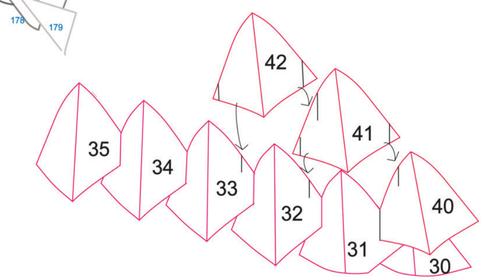
Using one single mould, all panels were bent into the same shape, and within six hours the numbered shells were slotted into place without using any plan drawings, glue or screws. The underlying equilibrium surface geometry removed all internal forces and deformations from the pavilion, which became a self-supporting, free-standing, lightweight skin with highly tactile tectonic properties and unique lighting effects.

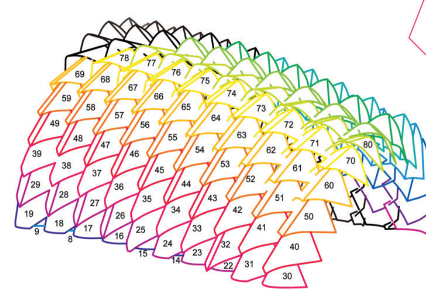


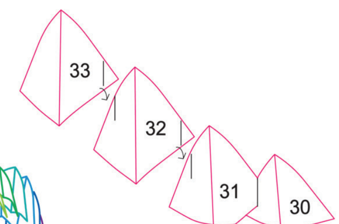
http://www.archilovers.com/projects/71372/dragon-skin-pavilion.html

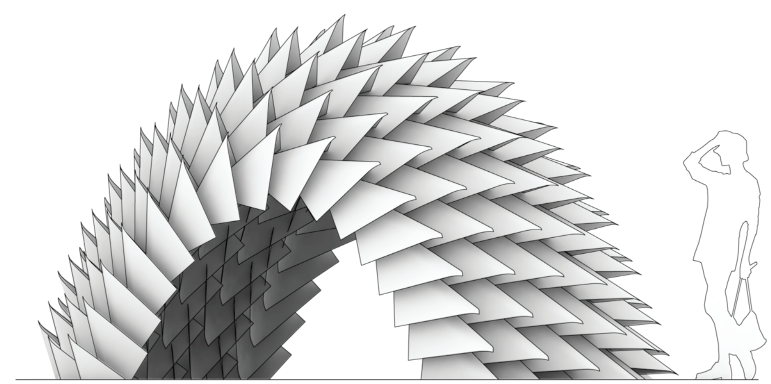

27th.
26th.
25th.
24th.
23rd.
22nd.
21st.
20th.
19th.
18th.
17th. row
Direction changes
Direction of the last corner
Side of the larger arch
16th.
15th.
14th.
13th.
12th.
11th.
10th.
9th.
8th.
7th.
6th.
5th.
4th.
3rd. row
2nd. row
1st. row
Direction of the first arch
(3rd corner)
Side of the smaller arch
Building direction of the rows









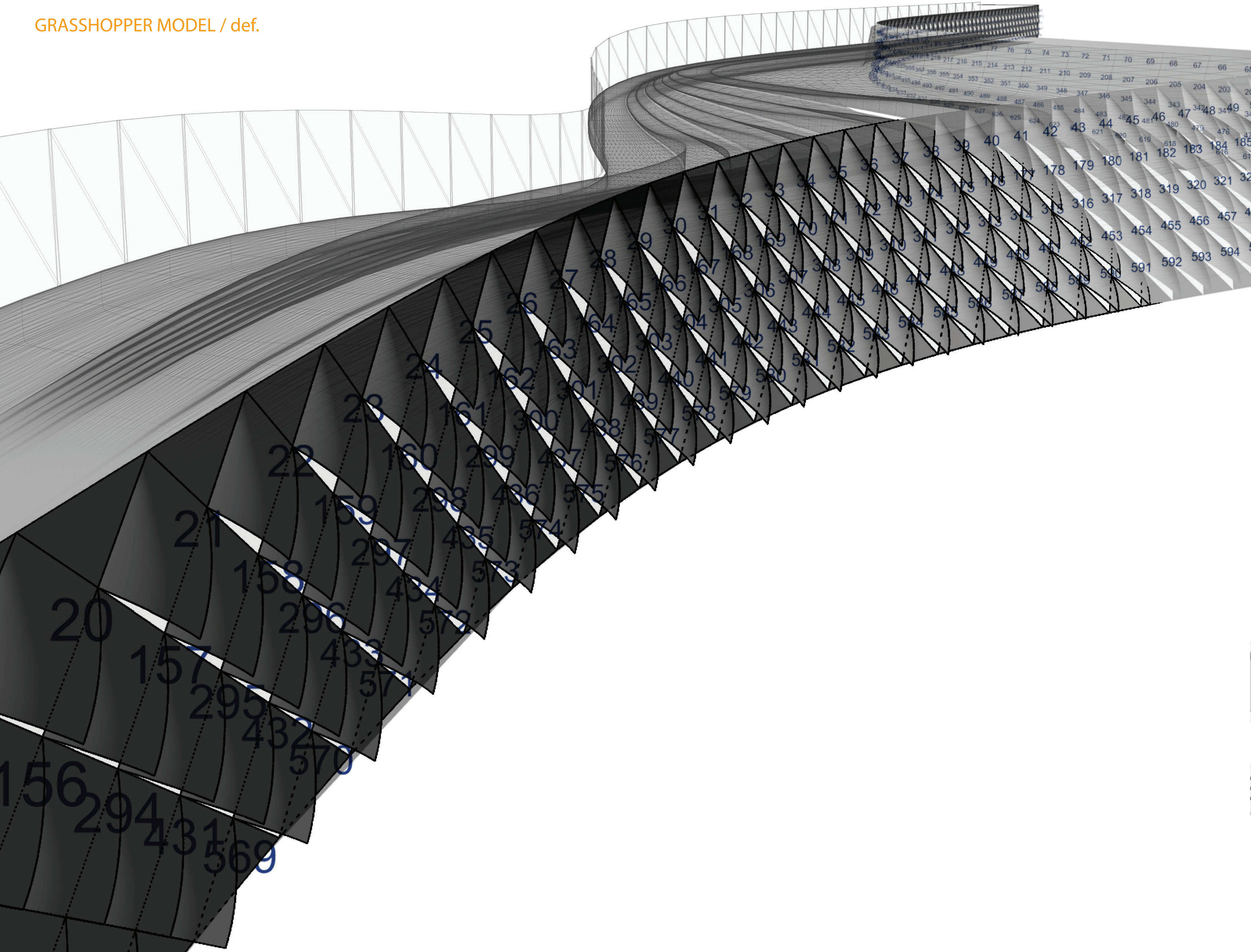


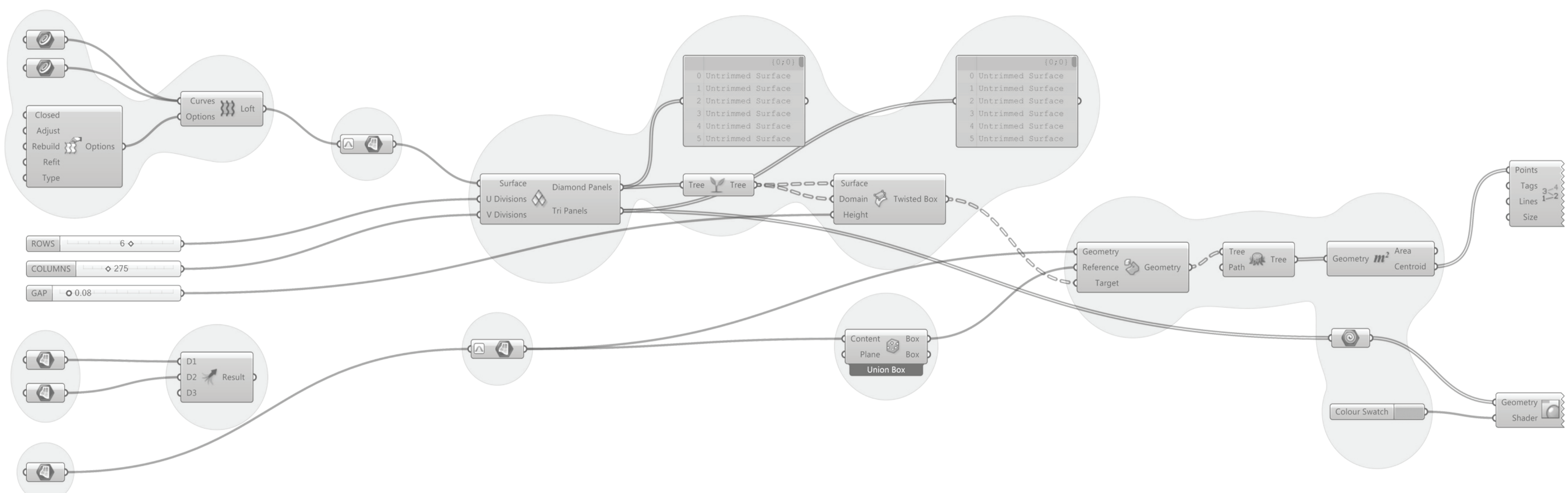
MATERIALS AND MACHINES

1. Parametric Modelling
2. Cutting Drawing
3. CNC Milling (2Axis)
4. Heating Up
5. Moulding Pressing
6. Assemble

https://vimeo.com/92013261

GRASSHOPPER MODEL / def.





http://dragonskinproject.com/

http://www.archdaily.com/215249/dragon-skin-pavilion-emmi-keskisarja-pekka-tynkkynen-lead

http://l-e-a-d.pro/w/wp-content/uploads/2011/07/iws17-1.jpg


Tessellation
Elytra Filament Pavilion
ICD/ITKE University of Stuttgart
Arian Sefiu
Source: http://icd.uni-stuttgart.de/?p=15826
KUKA

Elytra Filament Pavilion

ProjectArchitects:
Achim Menges with Moritz Dörstelmann and Jan Knippers

Location:
V&A Museum London

Investor:
Getty Lab
Kuka Roboter GmbH + Kuka Robotics UK Ltd
Hexion
Covestro AG
FBGS International NV
Arnold AG

Function:
Garden installation

ConstructionYear:
Opening on Wednesday, 18 May 2016

ConstructorsTeam:
Marshall Prado, Dylan Wood, Aikaterini Papadimitriou, Niccolo Dambrosio, Roberto Naboni, Daniel Reist, Nikolaos Xenos, Thu Nguyen, Pedro Giachini, Christian Arias, Andre Kauffman

MaterialUsed:
Tightly-woven carbon fibre cells

MajorFabricationUsed:
Tessellation

OtherFabricationUsed:
Coreless Filament Winding

FabricationBy:
Kuka Robot

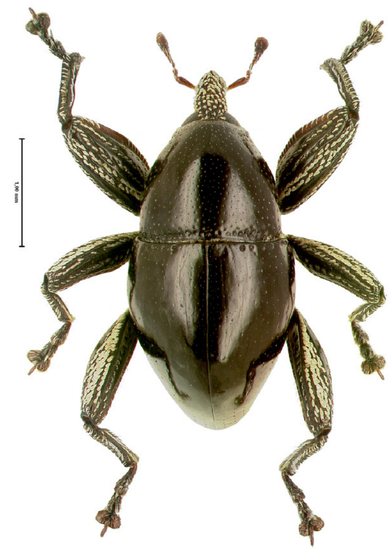
SoftwareUsed:
3dsMax / Rhino - Grasshopper

Elytra Filament Pavilion, render, V&A John Madejski Garden 2016.
Image © ICD/ITKE University of Stuttgart/

http://icd.uni-stuttgart.de/?p=15826

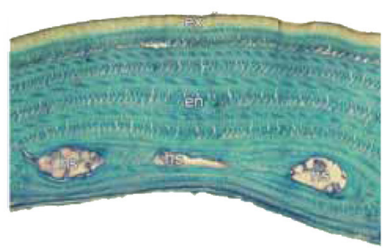
FABRICATION METHODS / process

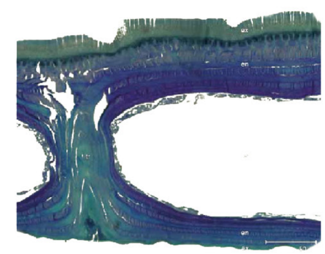
The installation – designed by architect Achim Menges – features an undulating canopy of tightly woven carbon fibre cells, drawing on the shells of insects called elytra. Visitors will also be able to watch the robots in action over the course of the summer as they continue to add new sections to the evolving 'Elytra Filament Pavilion'.



Trigonopterus nasutus | Ground Beetle

Cetonia aurata | Flying Beetle



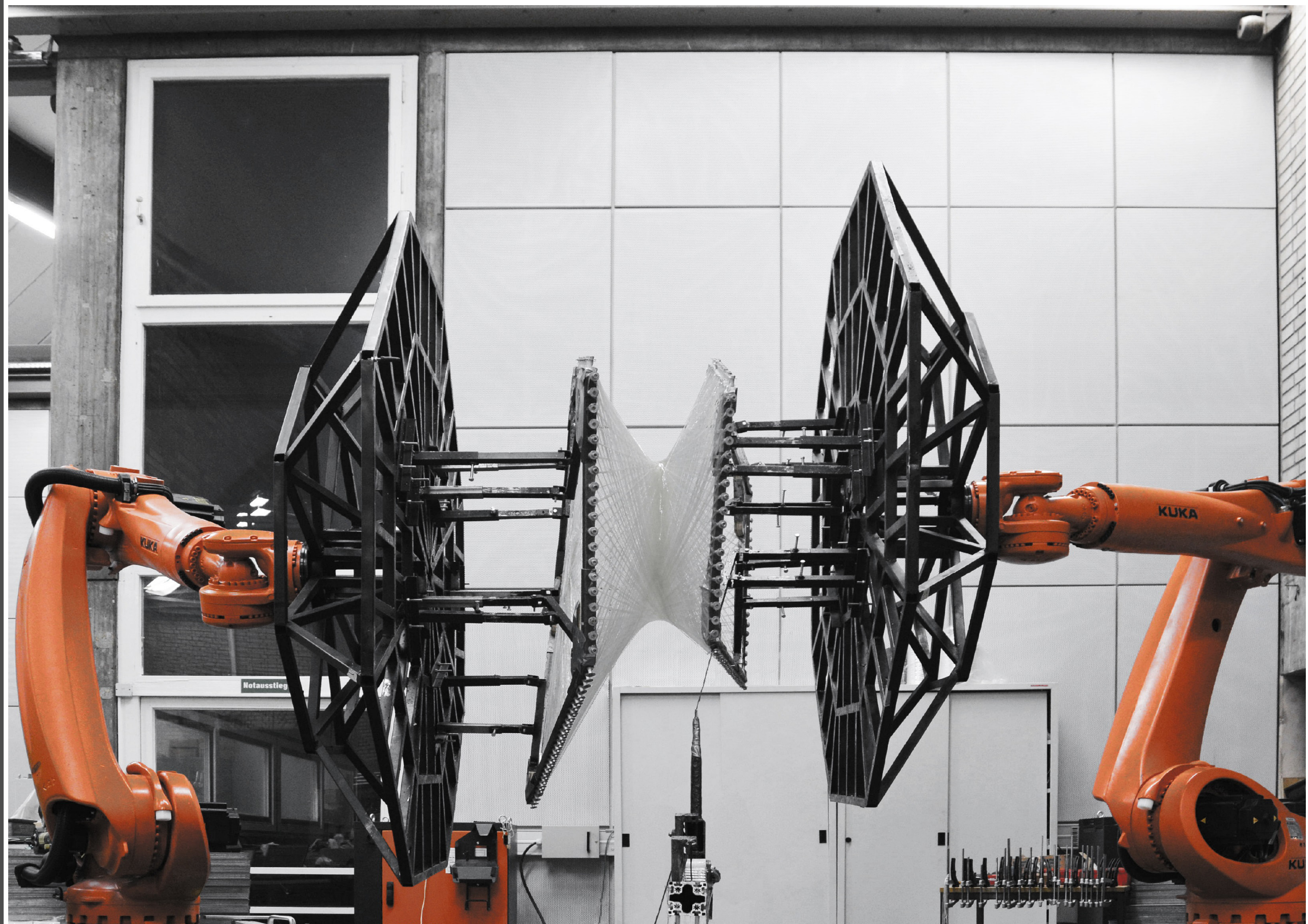


Comparison of internal elytron architecture in flying and flightless beetle – Courtesy of Dr.Thomas van de Kamp, Prof. Dr. Hartmut Greve

http://www.arch2o.com/elytra-filament-pavilion-achim-menges-john-madejski/

Kuka Robot KR QUANTEC ULTRA

The solution: a coreless winding process in which glass and carbon fibers soaked in resin are wound onto frames guided by two cooperating KUKA robots of type KR QUANTEC ULTRA. The thin frames merely constitute the edges of the workpieces – the workpiece geometry is created by the interaction of the fibers that are freely located in space. The fibers initially form segments with a linear structure. New fibers are laid on top of fibers that have already been wound, resulting in an alternating form and linking the segments together to create complex curved surfaces.
Based on a simulation of the frictional connection of the overall structure, the number of fibers in each individual component and their alignment are calculated and transferred as a sequence of winding instructions for the robots. The winding syntax, the motion planning of the robots, the mathematical coupling of external axes and robots, and the control of the robots themselves have been implemented in a specially developed, integrated, digital planning and production process. It was possible to adapt the frames located on the two KUKA industrial robots to the different component geometries, thereby enabling the production of all 36 modules with a single robot tool.
Result: A structure manufactured fully automatically that enables an innovative, resource-saving, high-performance load-bearing design and component composition for architecture.



Synchronized robots core-less filament winding – Courtesy of ICD/ITKE university of Stuttgart

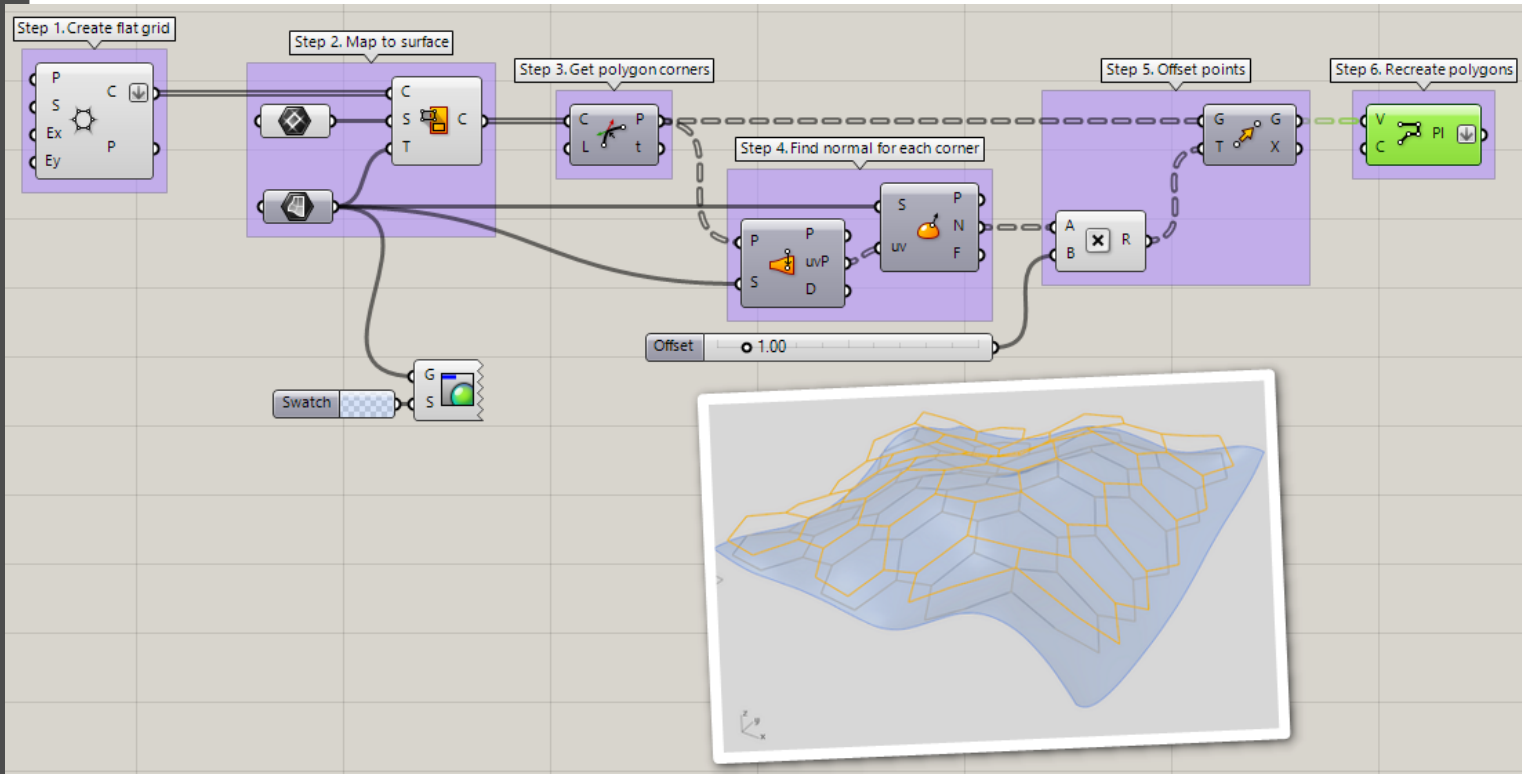
http://www.kuka-robotics.com/germany/en/pressevents/news/nn_20140908_robots_in_architecture.htm

Carbon Fibre

A carbon fiber is a long, thin strand of material about 0.0002-0.0004 in (0.005-0.010 mm) in diameter and composed mostly of carbon atoms. The carbon atoms are bonded together in microscopic crystals that are more or less aligned parallel to the long axis of the fiber. The crystal alignment makes the fiber incredibly strong for its size. Several thousand carbon fibers are twisted together to form a yarn, which may be used by itself or woven into a fabric. The yarn or fabric is combined with epoxy and wound or molded into shape to form various composite materials. Carbon fiber-reinforced composite materials are used to make aircraft and spacecraft parts, racing car bodies, golf club shafts, bicycle frames, fishing rods, automobile springs, sailboat masts, and many other components where light weight and high strength are needed. Thirty years ago, carbon fiber was a space-age material, too costly to be used in anything except aerospace. However today, carbon fiber is being used in wind turbines, automobiles, sporting goods, and many other applications.

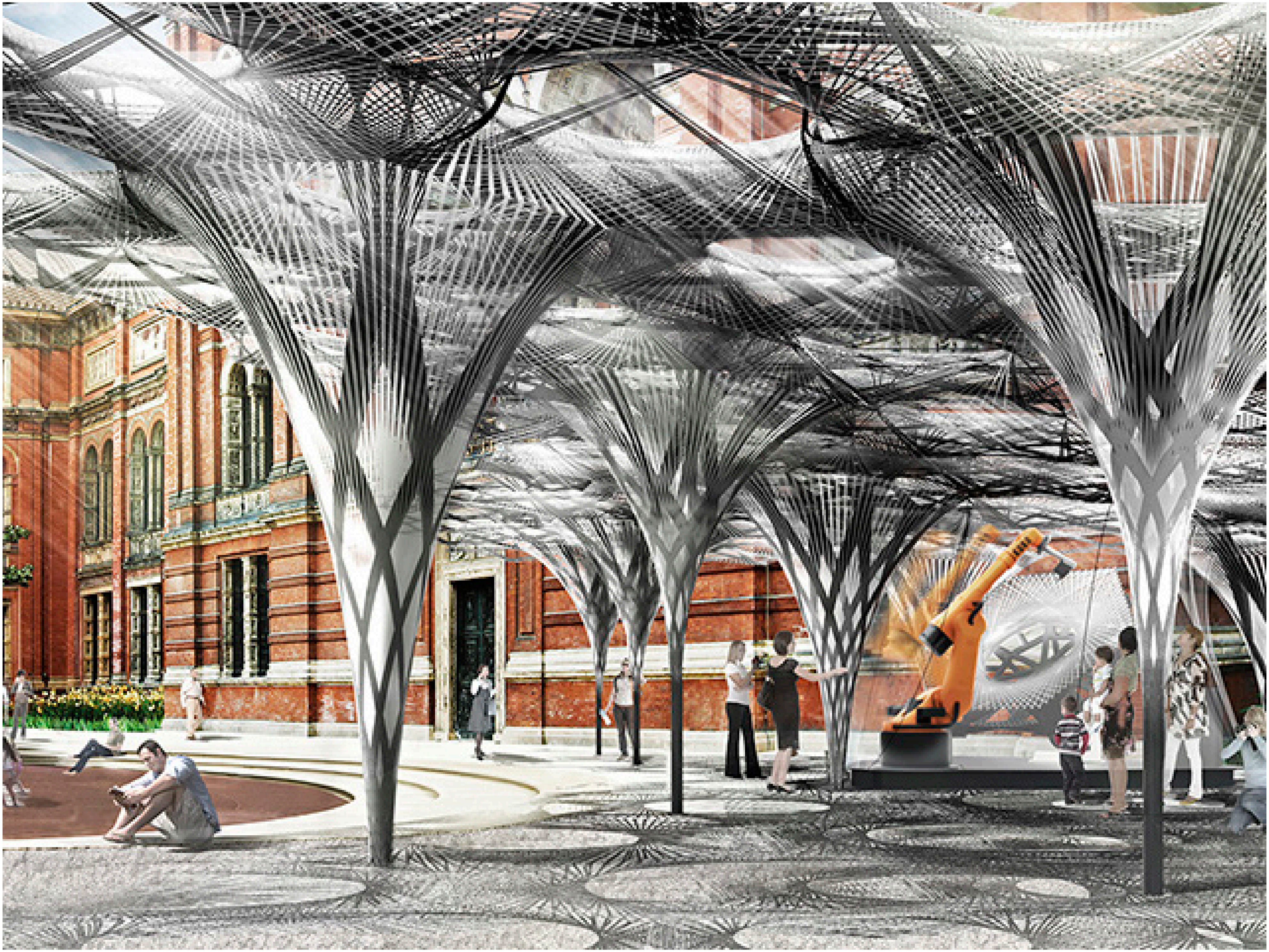
http://zoltek.com/carbonfiber/

GRASSHOPPER def.



http://www.grasshopper3d.com/forum/topics/reverse-engineering?commentId=2985220%3AComment%3A1483226

https://www.facebook.com/icd.stuttgart/?fref=nf



http://icd.uni-stuttgart.de/icd-imagedb/ICD_WEB_VA_ICD_ITKE_Canopy_640_480.jpg


Tessellation
Shell Star Pavilion
MATSYS
Orlen Ramzoti
Photography: Dennis Lo Designs

SHELL STAR

PROJECT OVERVIEW

ProjectArchitects:
MATSYS

Location:
Wan Chai, Hong Kong

Investor:
Detour 2012

Function:
Temporary Pavilion

ConstructionYear:
2012

Dimensions:
8 m x 8 m x 3 m

ConstructorsTeam:
Art Lab

MaterialUsed:
4mm Translucent Coroplast, Nylon Cable Ties, Steel Foundations, PVC and Steel Reinforcement Arches

Budget:
-

MajorFabricationUsed:
Tessellation

OtherFabricationUsed:
-

FabricationBy:
Laser cut Corrugated Polypropylene Sheet + Zipties

SoftwareUsed:
Grasshopper, Kangaroo

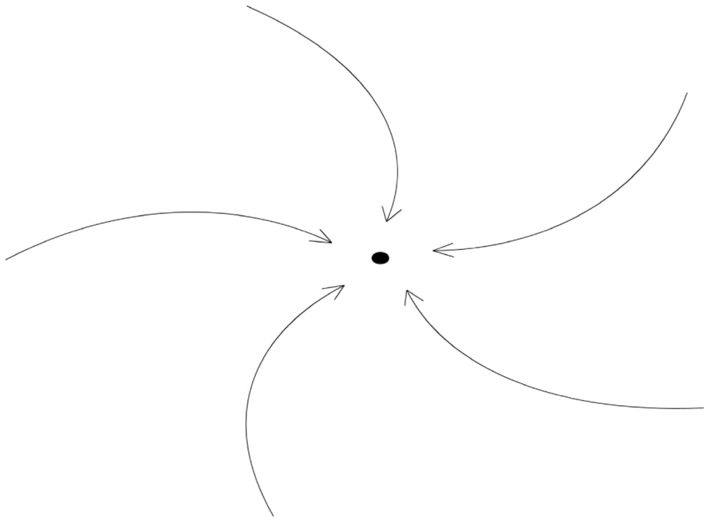
Photography: Dennis Lo Designs

Form-Finding

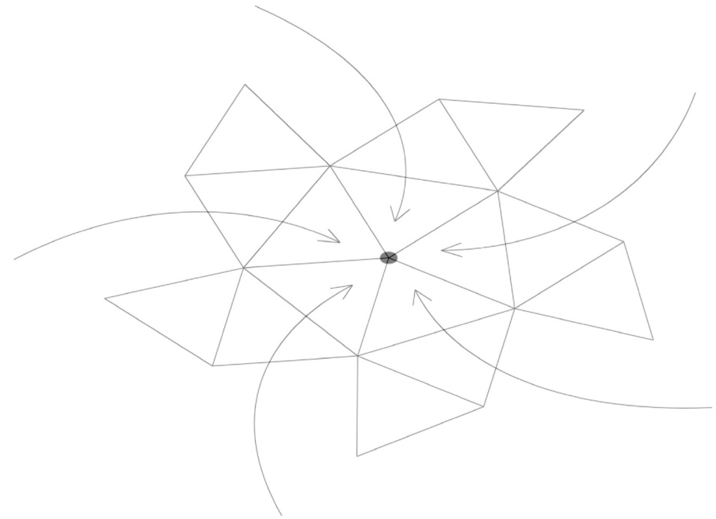
The form emerged out of a digital form-finding process based on the classic techniques developed by Antonio Guadi and Frei Otto, among others. Using Grasshopper and the physics engine Kangaroo, the form self-organizes into the catenary-like thrust surfaces that are aligned with the structural vectors and allow for minimal structural depths.

Surface Optimization

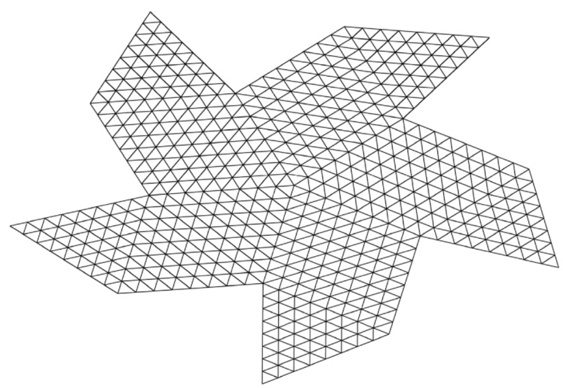
The structure is composed of nearly 1500 individual cells that are all slightly non-planar. In reality, the cells must bend slightly to take on the global curvature of the form. However, the cells cannot be too non-planar as this would make it difficult to cut them from flat sheet materials. Using a custom Python script, each cell is optimized so as to eliminate any interior seams and make them as planar as possible, greatly simplifying fabrication.



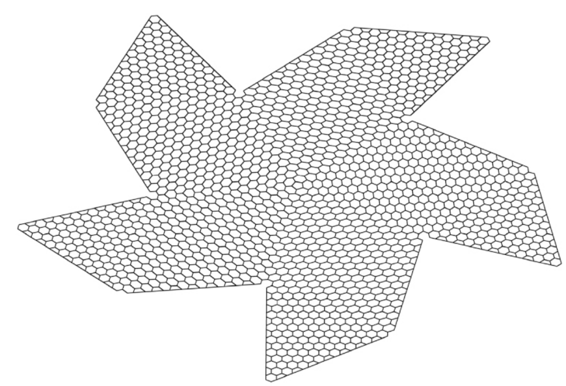
01: CONCEPT
Create a vortex that draws people in towards the center and sends them out in a new direction



02: BASE MESH
Create a simple, low-resolution mesh that responds to the vectors of movement.



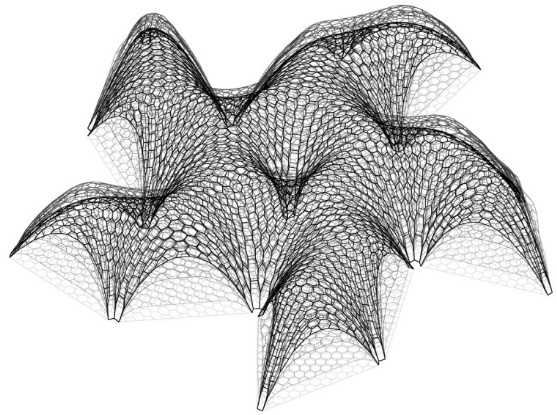
03: SUB-D MESH
Increase the mesh resolution by subdividing each face of the base mesh by a factor of two.



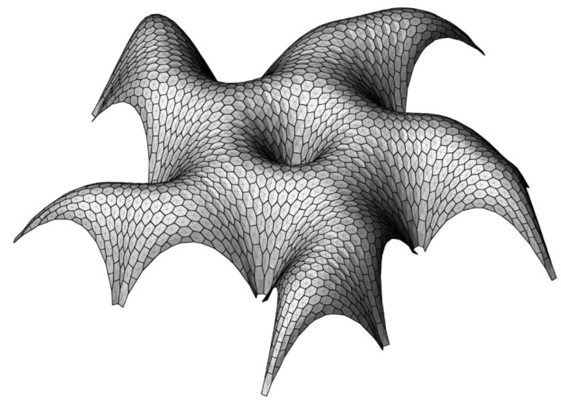
04: HEX CELL CURVES
Convert the trianglular mesh into mostly hexagonal closed curves

FABRICATION METHODS / process

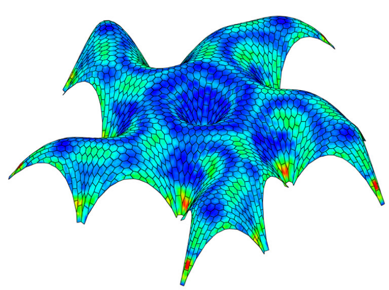
Structural Analasys
A new mesh was rebuilt from optimitized surfaces. The result was verified that it performs like a shell structure and to find the critical areas of stress. The initial geometry was changed as needed in regards to bending moments (left), deflection (center) and in-plane stress (right) and analysis were repeated until satisfied with the results.

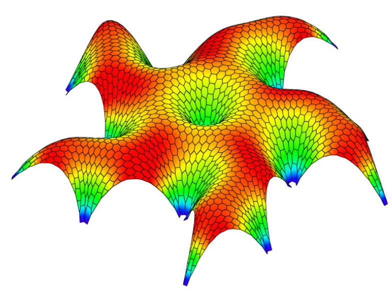


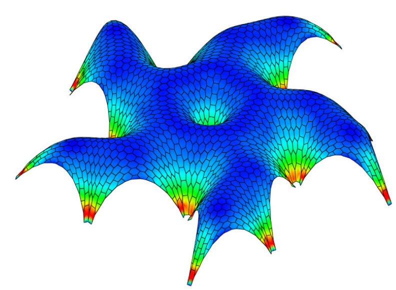
05: HANGING MESH SIMULATION
Apply mass to each mesh node and convert each mesh edge into a spring and simulate phyical interactions until system comes to rest.



06: OPTIMIZE PLANARITY OF CELLS
In order to reduce the number of seams when unfolded, find a point near the center of each cell whose angle summation with its vertices is 360 degrees.

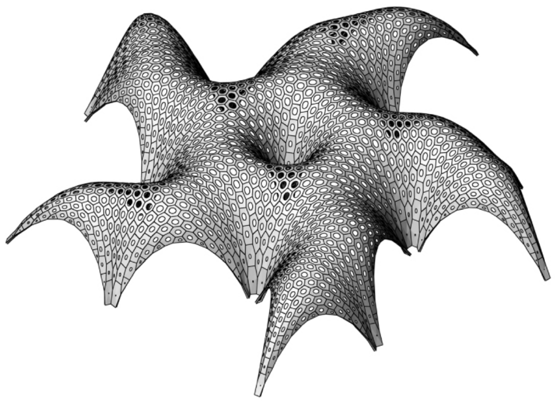




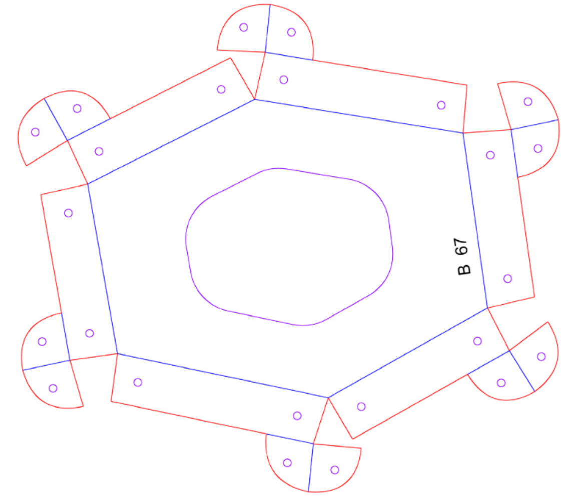


07: STRUCTURAL ANALYSIS

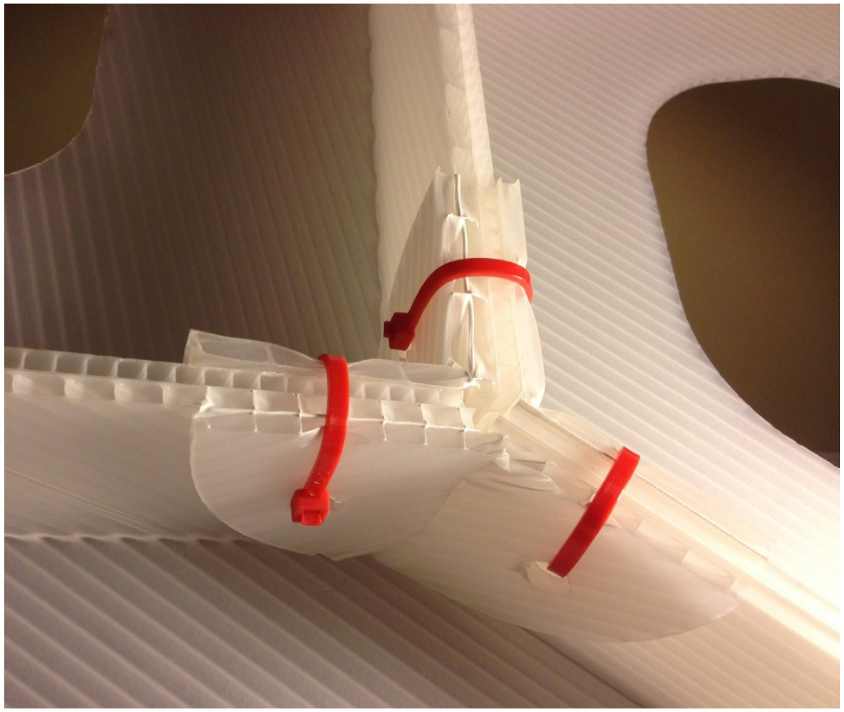
Fabrication Planning
Using more custom python scripts, each cell was unfolded flat and prepared for fabrication. The cell flanges and labels were automatically added and the cell orientation was analyzed and then rotated to align the flutes of the Coroplast material with the principal bending direction of the surface.



08: POPULATE CELLS WITH OPENING
In order to reduce wind load, add openings to each cell. Make the size of the opening propotional to the height of the cell so the lower cells remain solid.

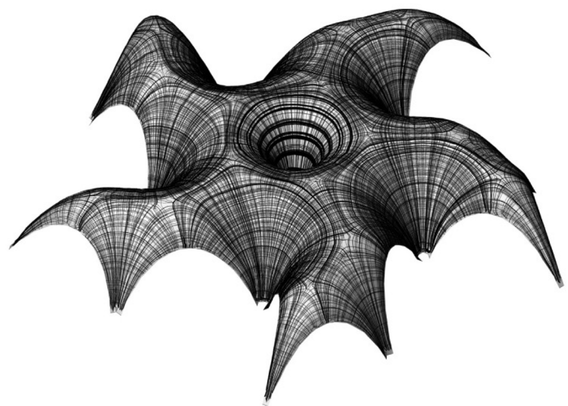


09: UNFOLD CELLS
Unfold each cell so that it is flat on the XY plane. Offset the cell to take into account material thickness. Add primary and secondary tabs, labels, and holes.

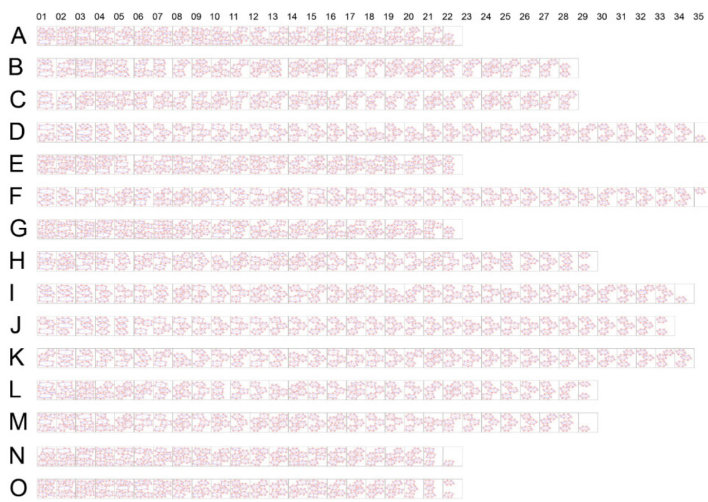


MATERIALS AND MACHINES

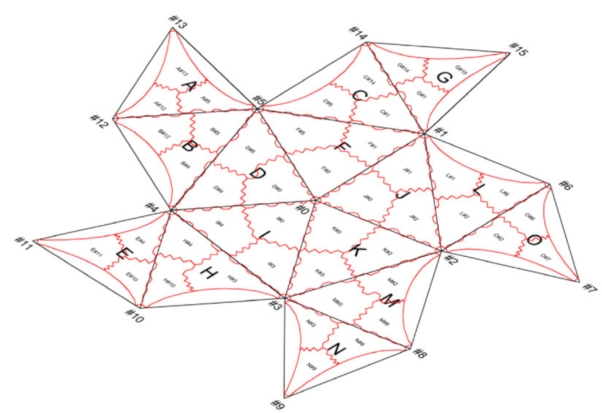
Preparing for transport
The cells were organized into groups and sub-groups of prefabricated panels that would be assembled off-site.



10: CELL ORIENTATION
Analyze the principle curvature of each cell and rotate the unfolded cell such that the direction of curvature runs parallel with the flutes in the material.



11: NEST CELLS
Nest all cells in groups according to the original base mesh (step 2).



12: ORGANIZE ASSEMBLY LOGISTICS
Organize cells into sub-groups and groups of prefabricated panels that will be assembled off-site.

Photography: Dennis Lo Designs

MATERIALS AND MACHINES

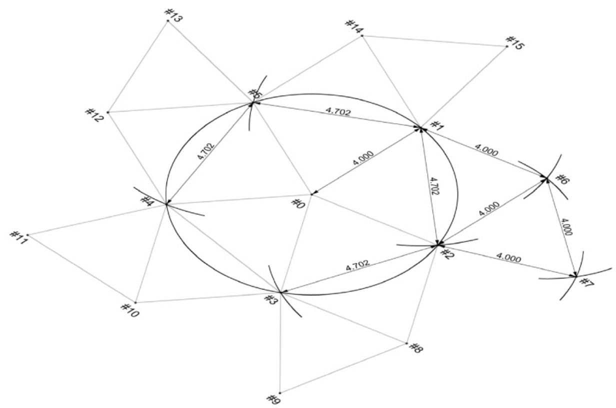
Assembling
The cells were organized into groups and sub-groups of prefabricated panels that would be assembled off-site.


Photography: Dennis Lo Designs

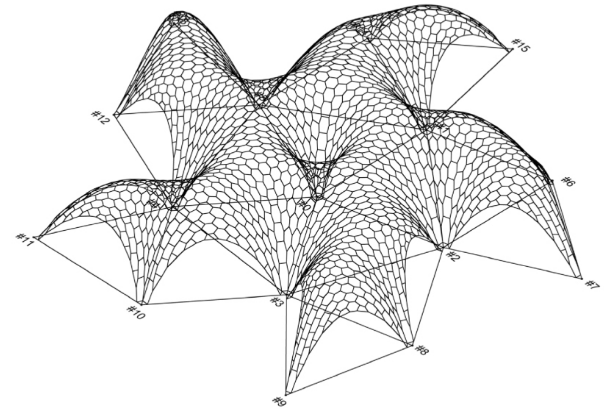

Photography: Dennis Lo Designs

MATERIALS AND MACHINES

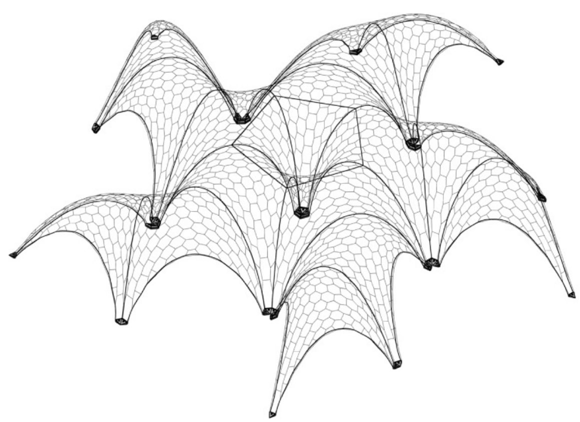
Adding edge reiforcement
A reinforcement structure was planned to maintain the plastic shelter above.



13. LOCATE ANCHOR POINTS
Using simple triangulation, set out the inital support points on the site ground. Drill anchor holes into site ground at all 16 support points.



14. ATTACH PRE-FABRICATED PANELS
Attached footings to the anchor bolts. Add each of the 15 pre-fabricated panels to the footings.



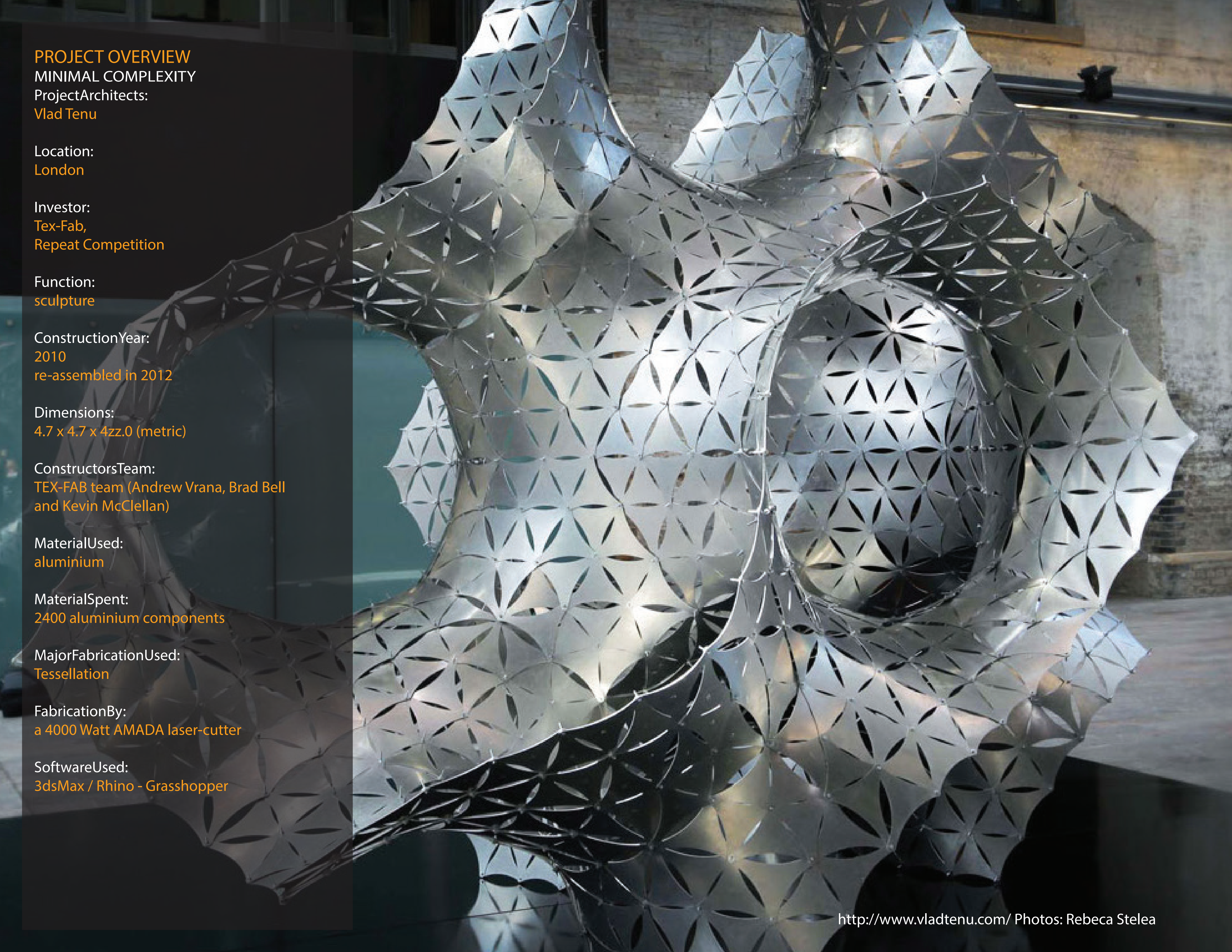
15: ADD EDGE REINFORCEMENT
Add reinforcing arches along edges of mesh.


Photography: Dennis Lo Designs

Photography: Dennis Lo Designs


Dennis Lo Designs


Tessellation
MINIMAL COMPLEXITY
Vlad Tenu
Elena Shepeleva
Source: http://www.vladtenu.com/ Photos: Rebeca Stelea



PROJECT OVERVIEW

MINIMAL COMPLEXITY

ProjectArchitects:
Vlad Tenu

Location:
London

Investor:
Tex-Fab,
Repeat Competition

Function:
sculpture

ConstructionYear:
2010
re-assembled in 2012

Dimensions:
4.7 x 4.7 x 4zz.0 (metric)

ConstructorsTeam:
TEX-FAB team (Andrew Vrana, Brad Bell and Kevin McClellan)

MaterialUsed:
aluminium

MaterialSpent:
2400 aluminium components

MajorFabricationUsed:
Tessellation

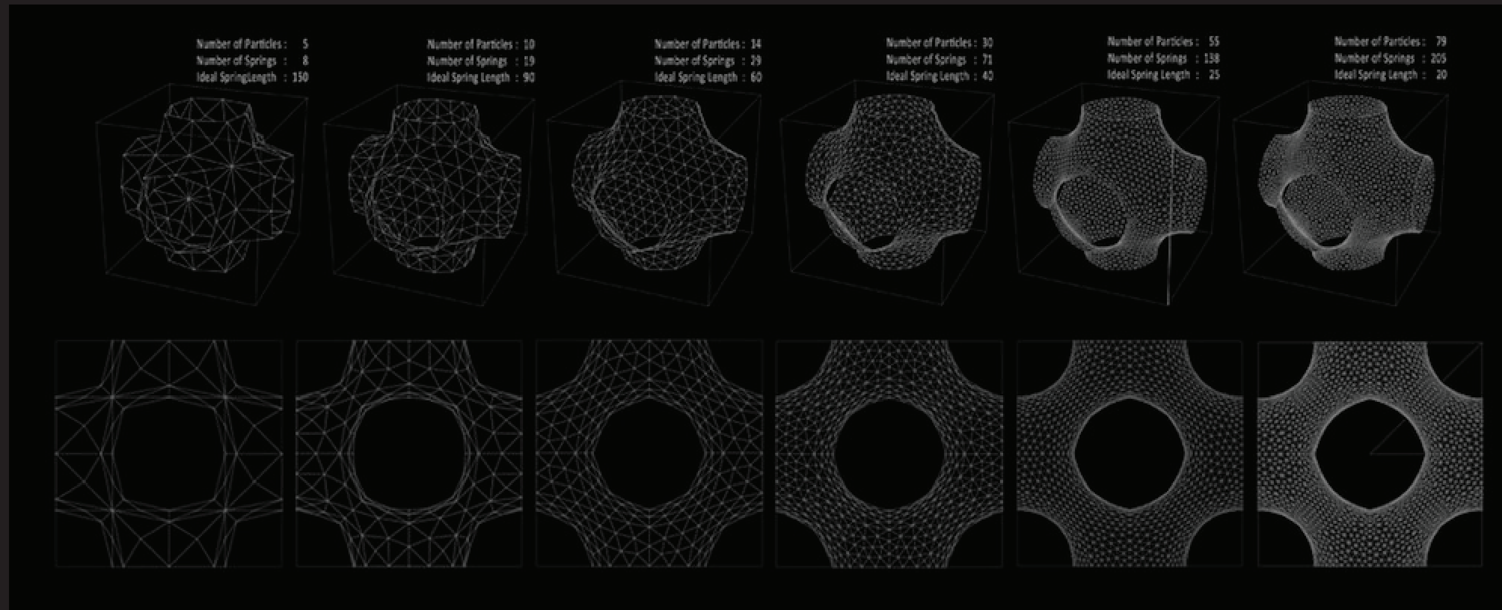
FabricationBy:
a 4000 Watt AMADA laser-cutter

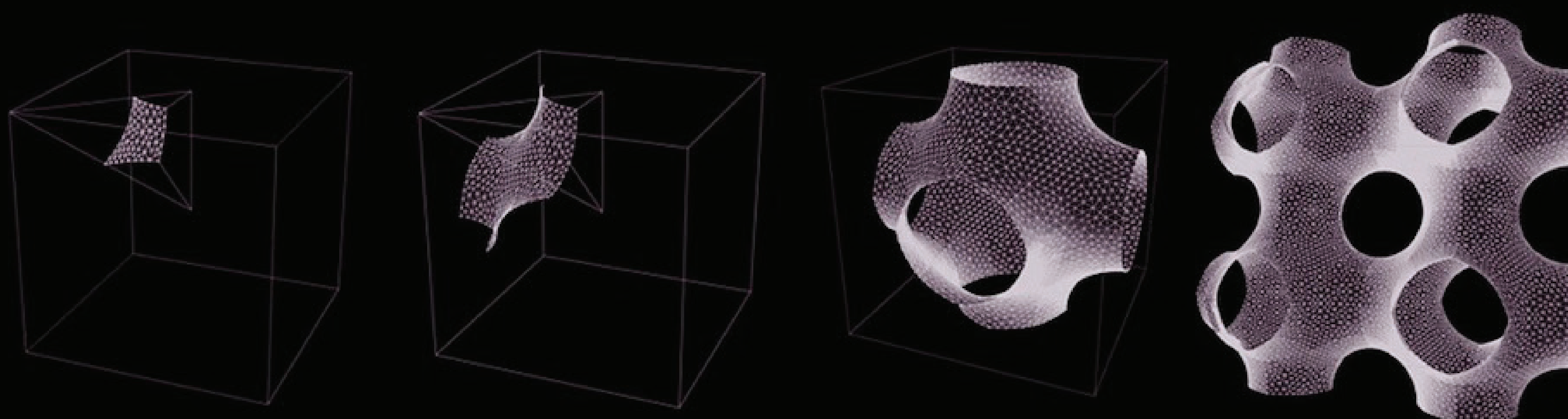
SoftwareUsed:
3dsMax / Rhino - Grasshopper

http://www.vladtenu.com/ Photos: Rebeca Stelea

FABRICATION METHODS / process

This project was developed around the design problem of minimal surface structures, in order to create an alternative algorithmic method for generating minimal surfaces as well as for building them from modular components. Using the principle of simulation of virtual soap films in order to generate minimal surface geometries, while optimizing them for a modular fabrication system.

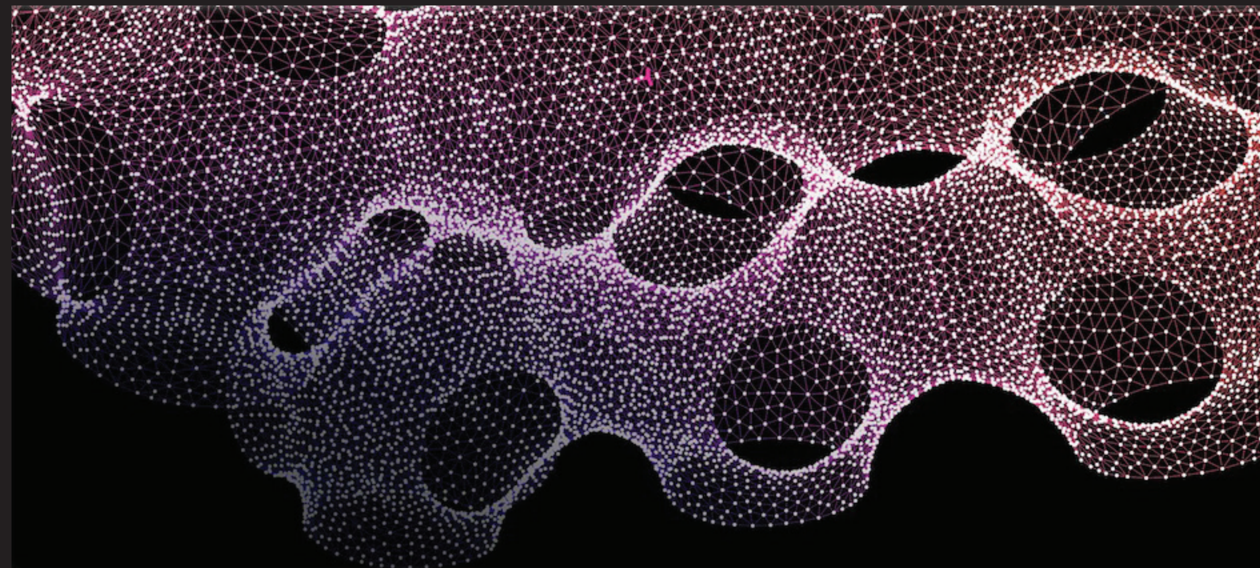


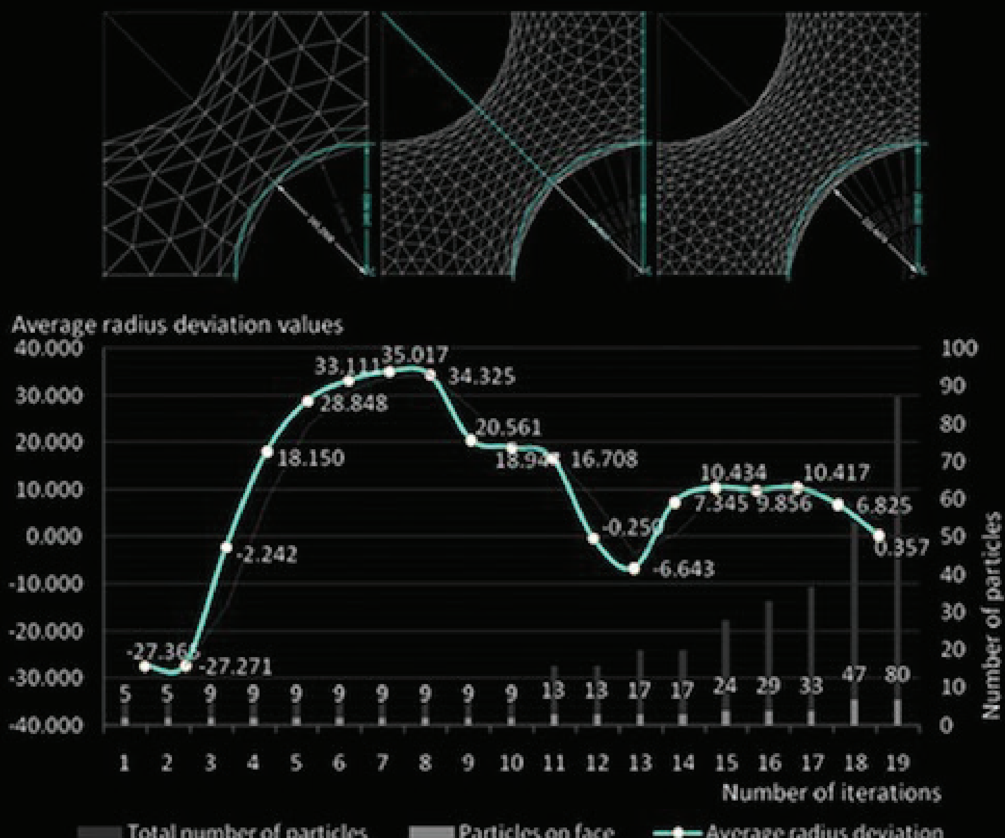


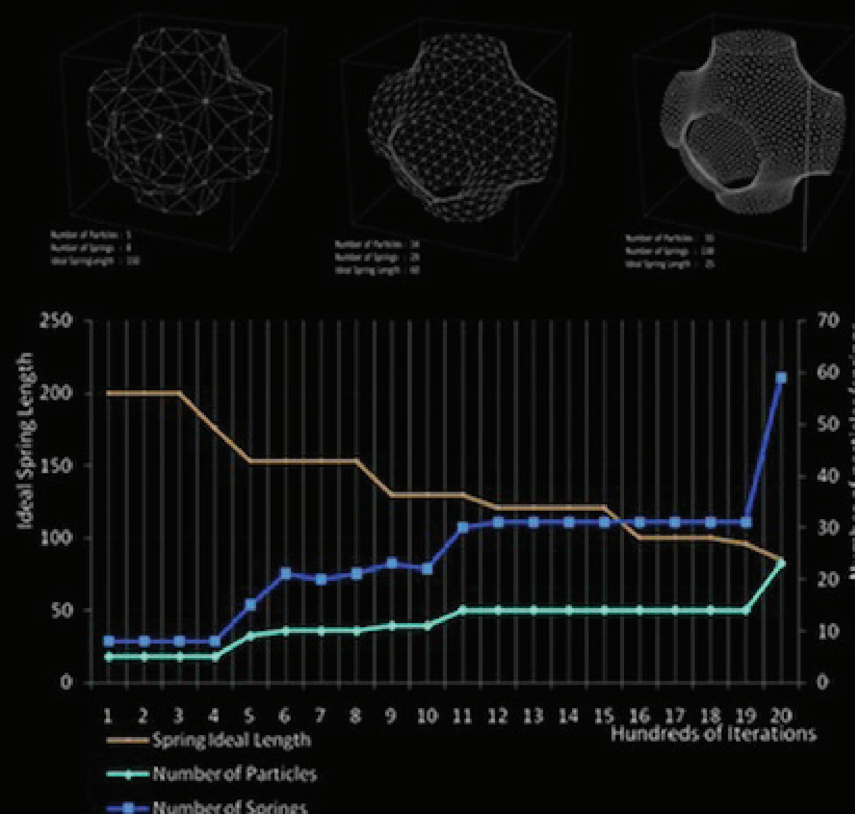
http://www.vladtenu.com/

FABRICATION METHODS / process

The algorithm is materialized through a concept derived from the principle of natural organisms, Each iteration is programmed to update the relationships between the components of the system, reapply the defined rules and minimize the energy, in our case the tensional energy in order to achieve a state of equilibrium.

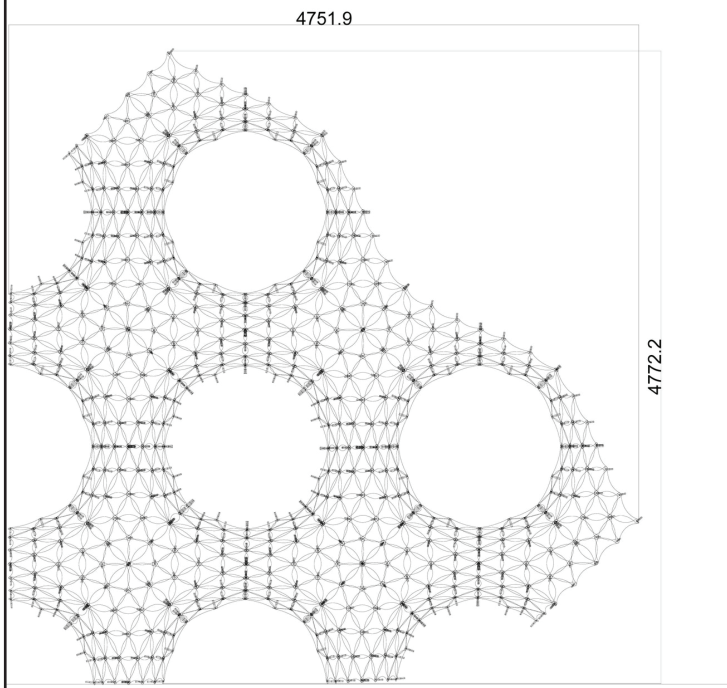




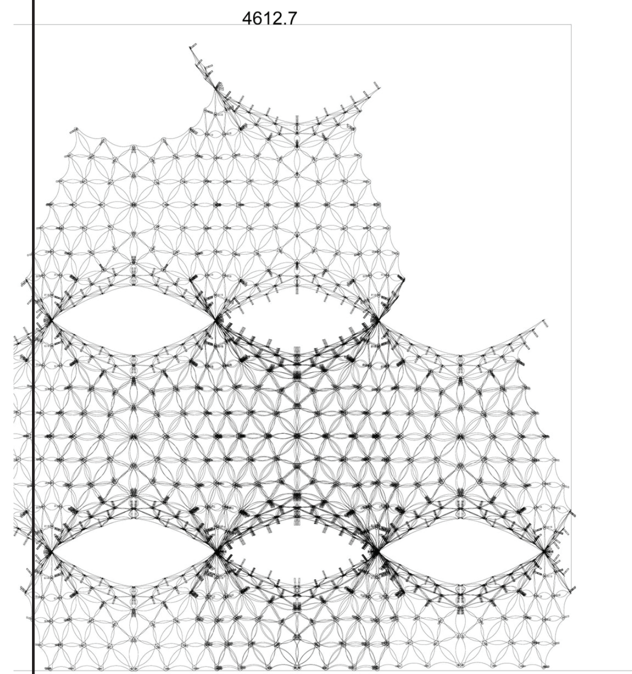


FABRICATION METHODS / process

Plans and Elevations

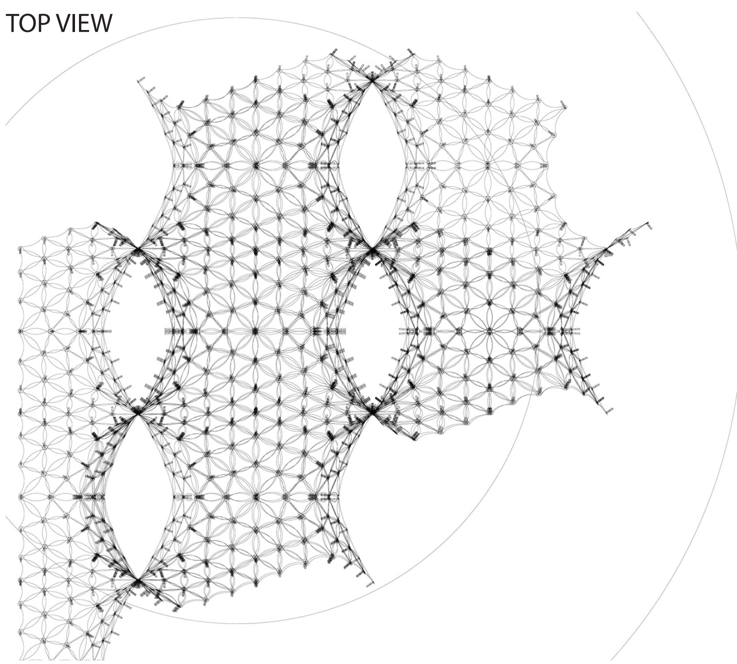


FRONT VIEW



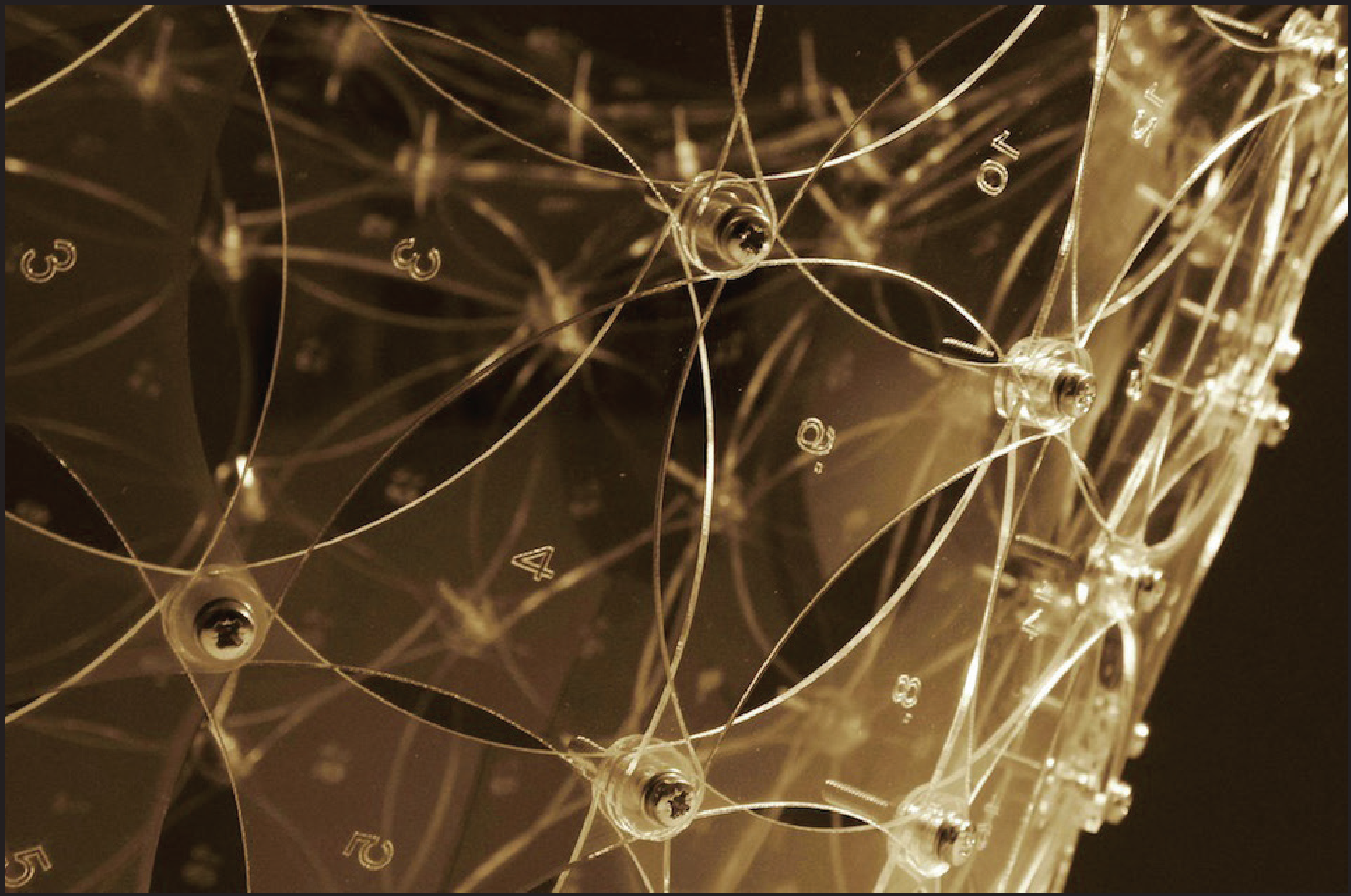
RIGHT VIEW

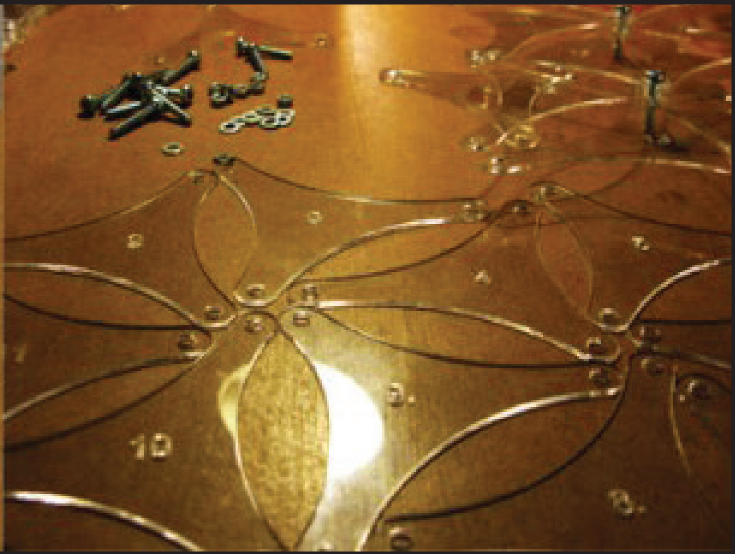
TOP VIEW



MATERIALS AND MACHINES

From the fabrication point of view, the project is focused on modularity and repetition while creating very complex differentiated minimal surface geometries.The prototype is following a series of different fabrication systems that have been tested.





MATERIALS AND MACHINES

The 14 gauge aluminium components were cut by CROW Corporation on a 4000 Watt AMADA laser-cutter. After being cut , all the components (around 2400 pieces) were passed through an automatic tumbler in order to make the assembly a safer process and to give the material a better finish quality. Several tests on tolerances and different types of fasteners were considering factors such as the overall weight of the final piece or the one of the separate sub-assemblies. The usage of ladders and special tools needed for the 1:1 scale model were all criteria that lead to a very specific order of the sequences of the whole assembly process. The team was lead by Thomas Behrman.



Tessellation

ArboSkin Pavilion

ITKE - Stuggart University

Nabil Rajjoub

Source: http://ge.archello.com/en/project/arboskin-durable-and-recyclablebioplastics-facade-mock

PROJECT OVERVIEW

ProjectArchitects:
Students and professors from Stuggart University's ITKE
Institute of Building structures and structural Layout

Location:
Stuggart University located in Stuggart, Germany

Investor:
ARBOLEND research project

Function:
Pavillion

ConstructionYear:
2013

ConstructorsTeam:
Students and professors from Stuggart Uni

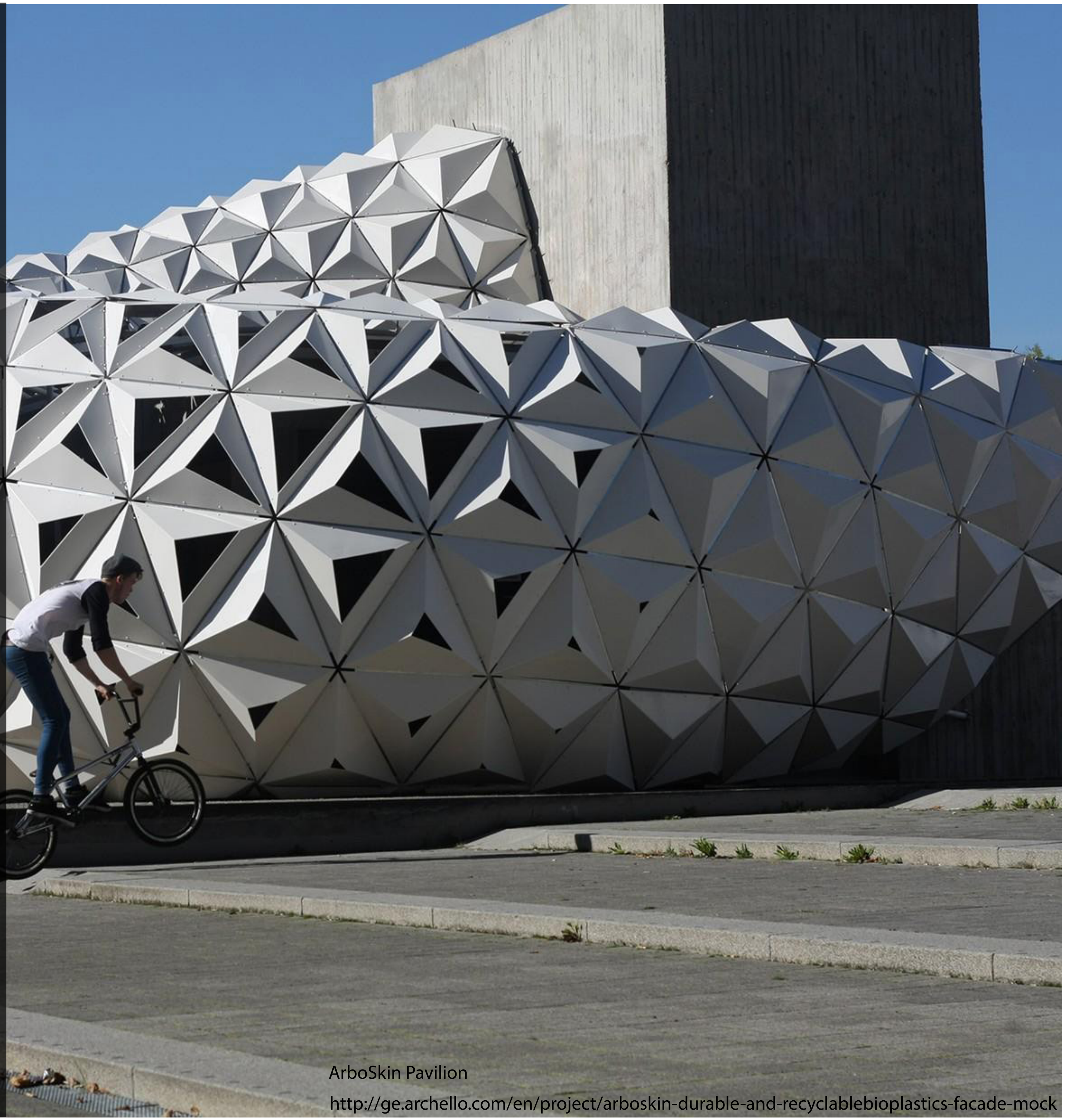
MaterialUsed:
biobased thermoplast (equipped with flame retardants) made from >90% renewable resources

MaterialSpent:
$1.75/lb

MajorFabricationUsed:
Tessellation

FabricationBy:
CNC, milling

SoftwareUsed:
Rhino - Grasshopper

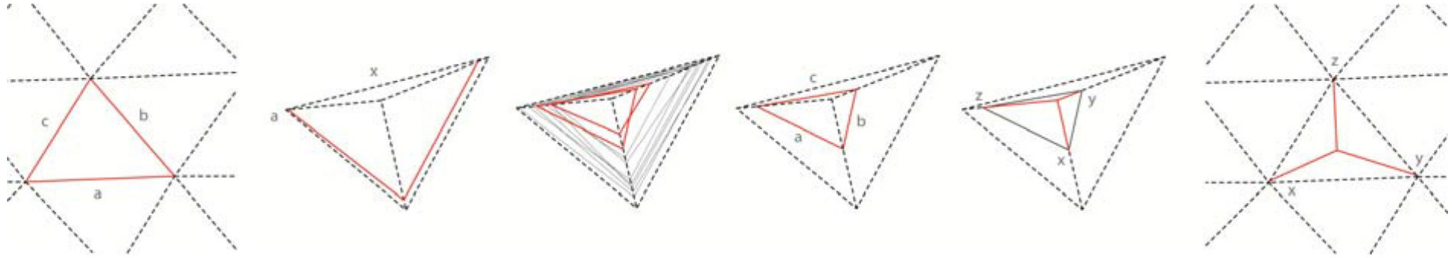


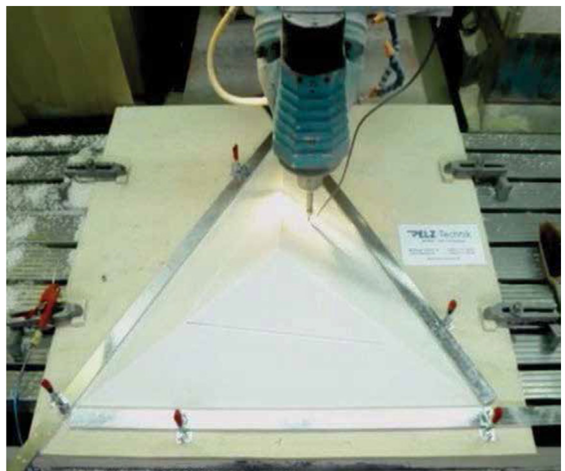
ArboSkin Pavilion

http://ge.archello.com/en/project/arboskin-durable-and-recyclablebioplastics-facade-mock

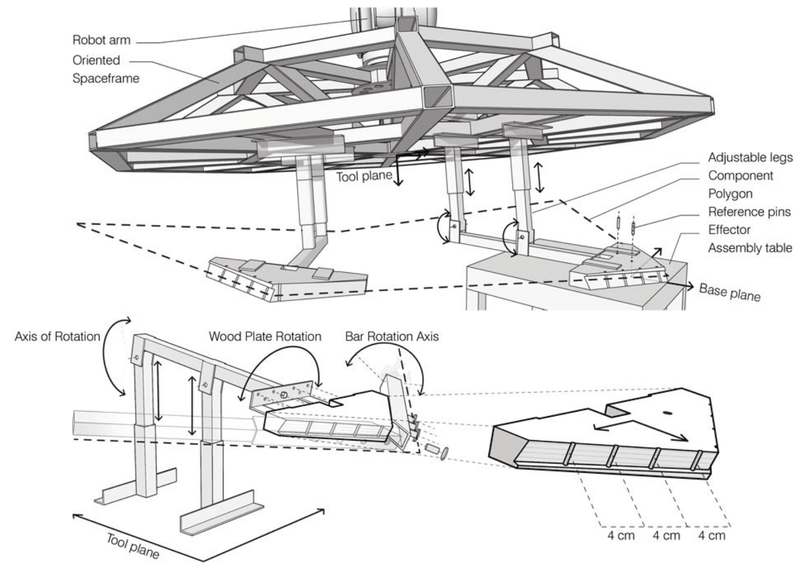
FABRICATION METHODS / process

The pavilion is constructed from 388 bioplastic pyramids
which are braced with rings and joists, creating a loadbearing,
waterproof façade. The modules together create
a complex, double-curved surface based on a network of
triangular shapes of different sizes. The double curved
skin is made of 3.5 mm thick bioplastic pyramids that are
mechanically assembled to create the free form surface.
The bioplastic sheets can be freely shaped and adapted to
fit any requirement for building exteriors





07



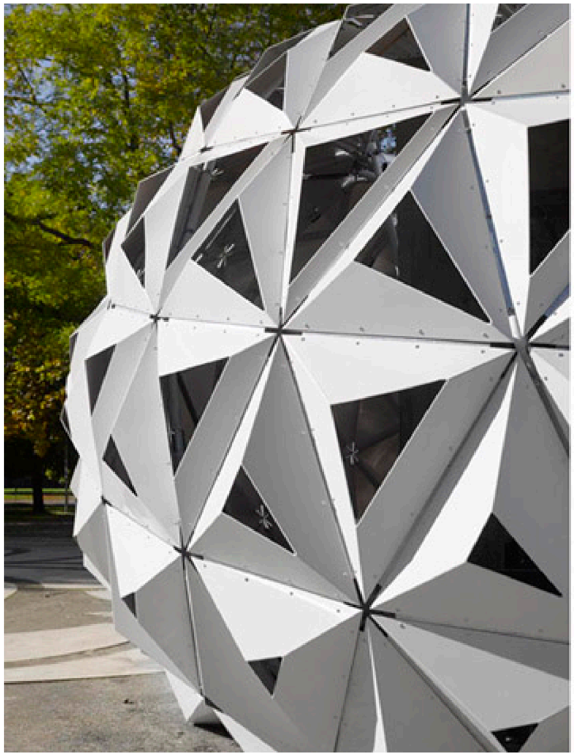
MATERIALS AND MACHINES

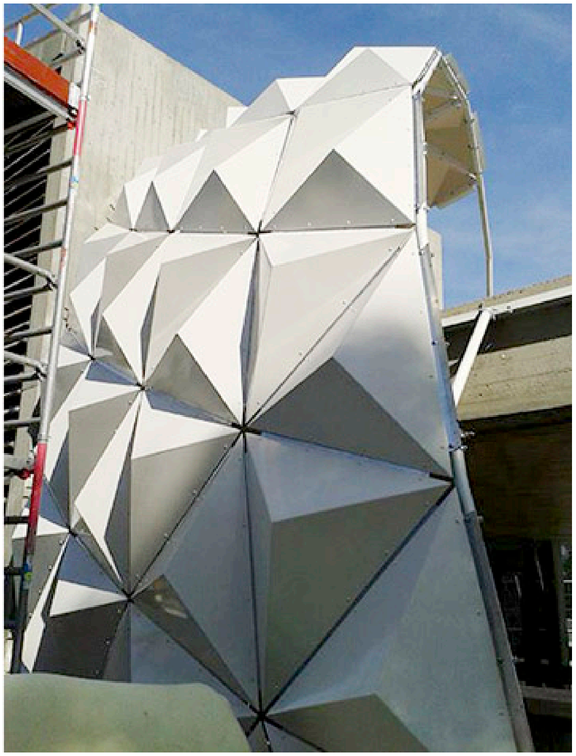
Extruded sheets made of the bioplastic materials developed by TECNARO throughout the project are thermoformed into identical pyramidal moulding components.

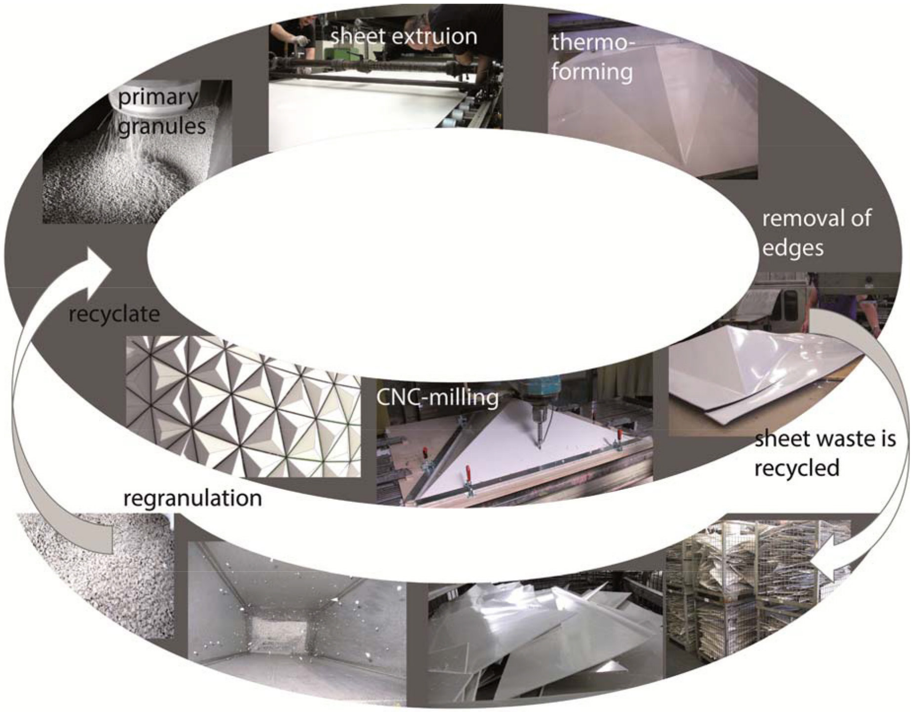
Thenecessary process of contour milling allows for multiple variations among the moulding components as identical thermoformed parts can be processed differently using various CNC milling paths. This allows for the cladding of freeform areas with a single moulded component.

The plastic waste that results from CNC millingprocess is regranulated and directly returned to the extruding process.

At the end of their useful life, the facadesheets can be composted or disposed of almost carbon-neutrally.







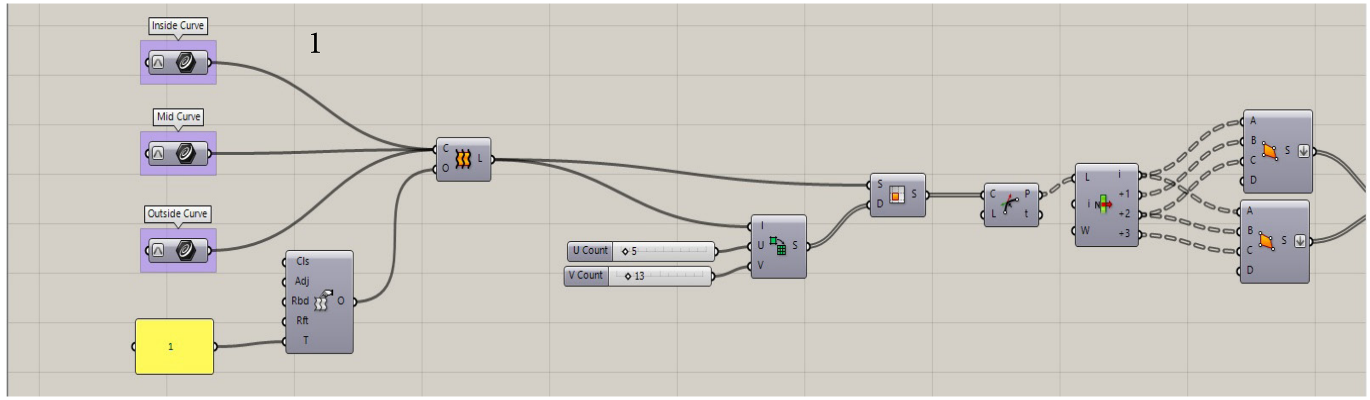
Arboblend meets other important criteria for construction materials. It is durable, and complies with flammability standards, all of which mean that it is considered quite suitable for a wide range of building purposes. It is hoped that this project could be the start of a new building resource. These sheets can be used both for cladding and for building exteriors. As a flame-retardant sheet material, Arboblend is also being considered for other applications in building interiors. This makes it ideally placed to address two current trends in the design world. The growing demand for sustainable materials, and ecologically sound buildings, and the development of double-curved geometrics and planar facade components in many modern buildings.

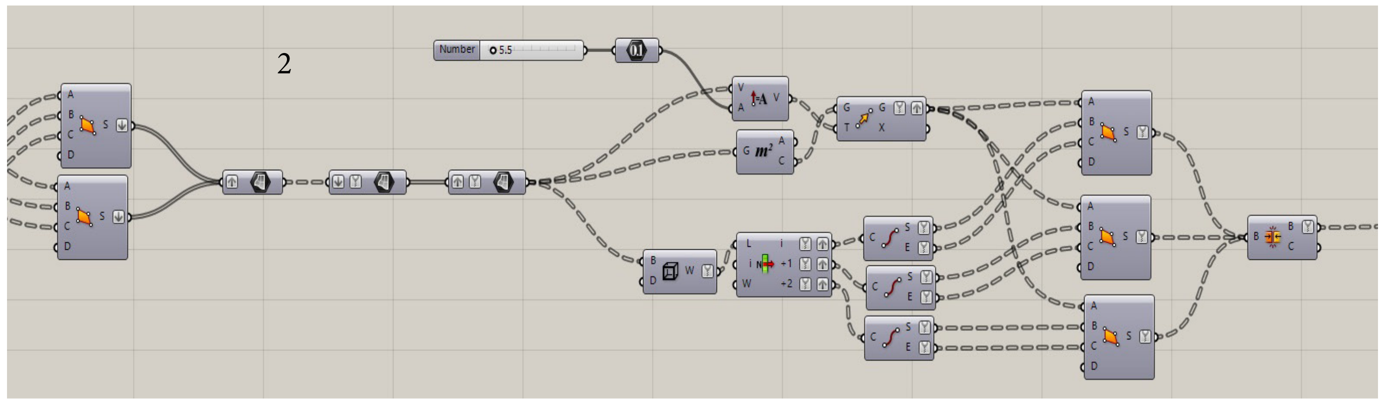
09

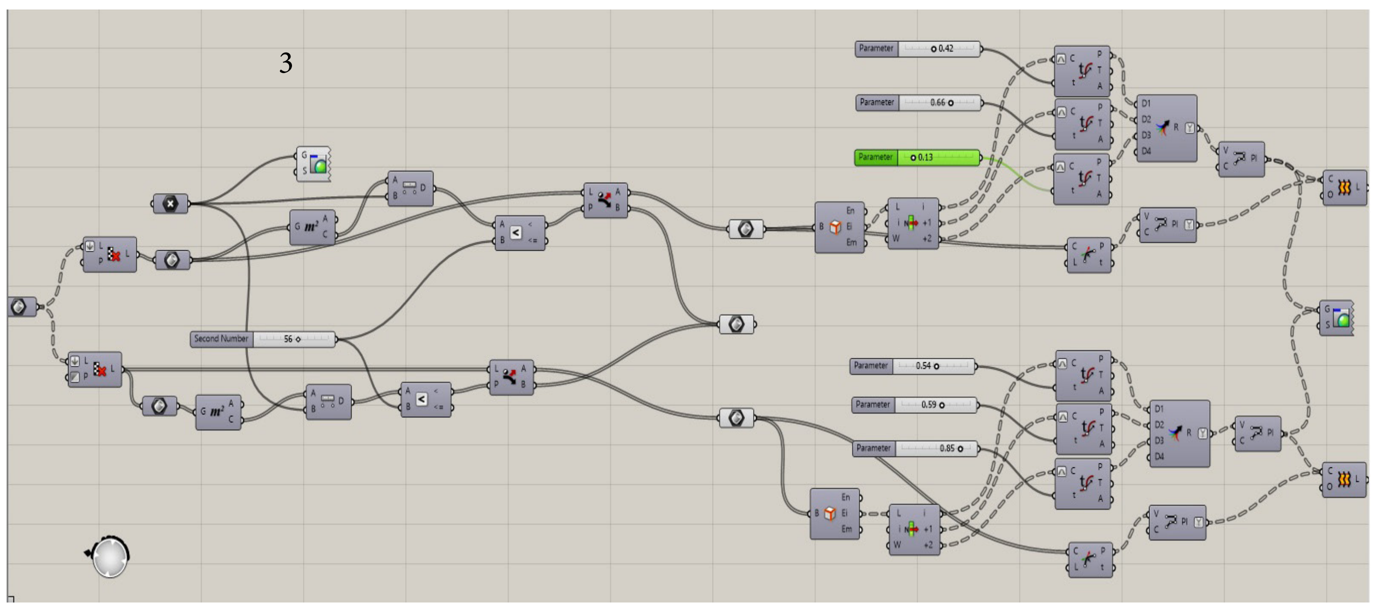
https://www.materialist.com/arboskin-pavilion-demonstrates-new-bioplastic-solutions-2/

GRASSHOPPER MODEL / def.

GRASSHOPPER DEFINITION



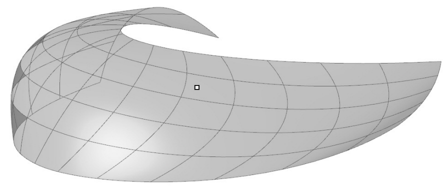




GRASSHOPPER MODEL / def.

BUILDING GEOMETRY

1



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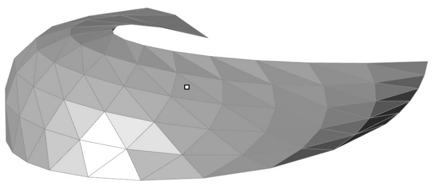

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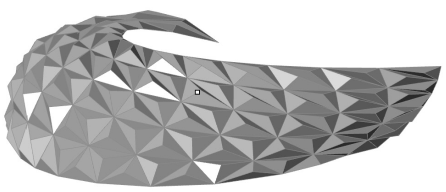

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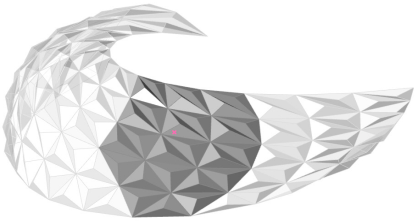

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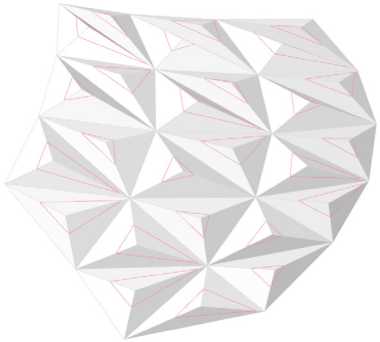

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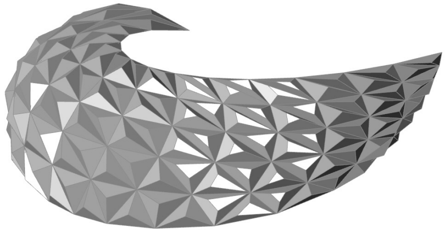
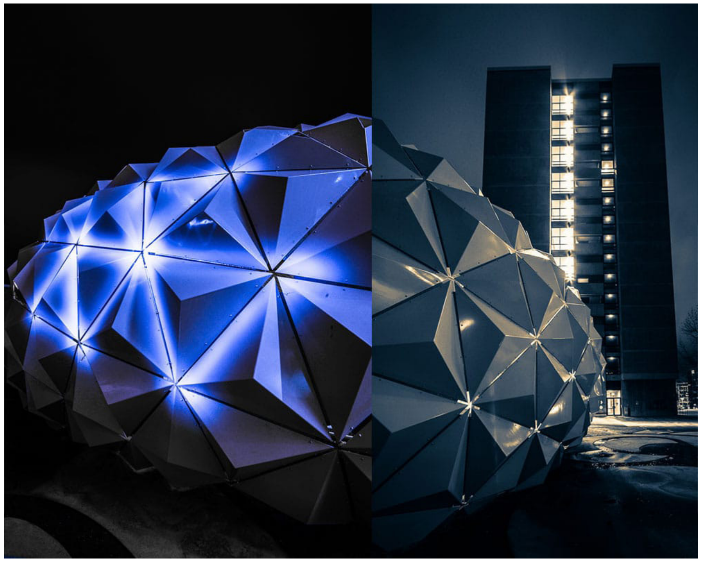
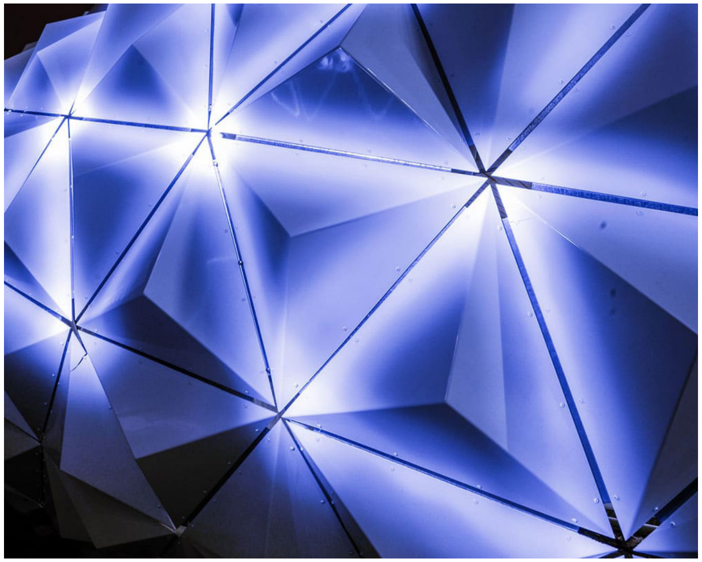


ArboSkin Pavilion

Design, functionality, sustainability, this structure has it all! The ArboSkin Pavilion in Stuttgart, Germany stood out to us as a building that went above and beyond to provide a beautiful, socially-responsible space.

While the ArboSkin pavilion certainly has a distinctive appearance, it is the sustainable materials from which it is made, rather than what it looks like that is causing interest in the building world.





Tessellation
Burning Man Pavilion
Toby Burgess and Arthur Mamou-Mani.
Blanca Tovar

Source: http://images.google.de/imgres?imgurl=https%3A%2F%2Fwewanttolearn.files.wordpress.

PROJECT OVERVIEW

ProjectArchitects:
Toby Burgess and Arthur Mamou-Mani.

Location:
Black Rock Desert of Nevada.

Investor:
Diploma Studio 10 at the University of Westminster

Function:
Small scale project (Temporary Pavilion)

ConstructionYear:
2013 Burning Man festival

Dimensions:
2.90 m

ConstructorsTeam:
Toby Burgess and Arthur Mamou-Mani a.k.a. Ratchet and Baby Cup (Project Directors) - Students - Ramboll Computational Design (RCD) – Stephen Melville, Harri Lewis, James Solly

MaterialUsed:
Timber pods - Metal joins

MaterialSpent:
Unkown

Budget:
Unknown

MajorFabricationUsed
Tesellation

FabricationBy:
CNC

SoftwareUsed:
Rhino - Grasshopper

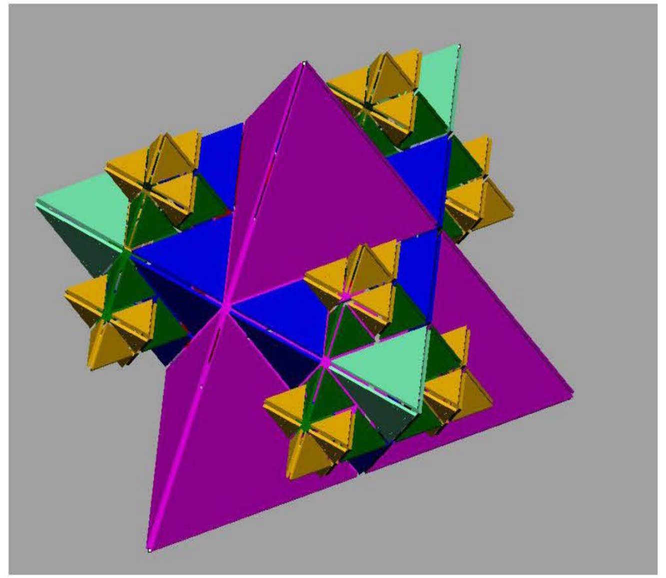
http://images.google.de/imgres?imgurl=https%3A%2F%2Fwewanttolearn.files.wordpress.

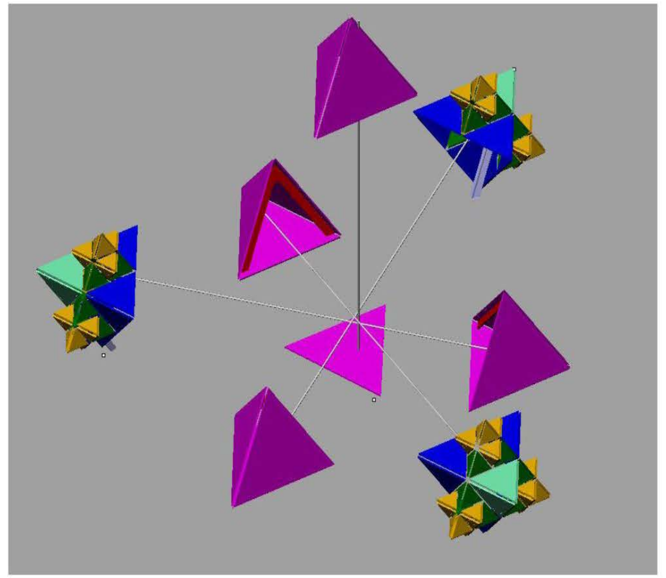
FABRICATION METHODS / process

The geometry of the installation is based on the work of Swedish mathematician Niels Fabian Helge von Koch and in particular his invention of the Koch Snowflake, one of the earliest fractal curves to be described. Is a three-dimensional environment that essentially starts with a regular tetrahedron and recursively generates new tetrahedrons on each of its faces resulting in a complex, yet simply and efficiently defined, end result.

The installation is consisted by 4 timber-made, fractal pods that symmetrically surround a space frame-like structure of a similar fractal nature and with climbing nets dressing the faces of the geometrical shape that is created.

The timber pods, during daylight, are the first structure that a visitor encounters and both initiate and welcome the exploration of its symmetric but complex structure. Visitors are also able to enter the pods and experience an even more intriguing spectacle of the formation of faces and joints that create a kaleidoscope-like effect.





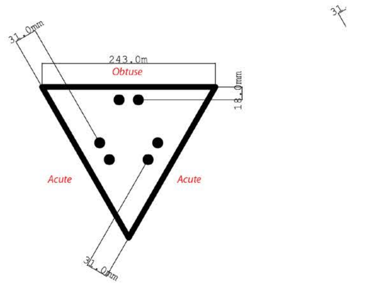
BEFORE STARTING, SORT ALL PIECES INTO THE FIVE CATEGORIES AS LISTED OVER THE NEXT THREE PAGES - THIS CAN BE DONE USING THE TRIANGLES EDGE LENGTHS - EACH OF THE FIVE TYPES ARE A DIFFERENT LENGTH

TO ORIENT THE FACES CORRECTLY USE THE BOLT HOLE OFFSET DISTANCE TO DETERMINE WHICH EDGES ARE TO BECOME ACUTE ANGLES [72°] AND WHICH ARE TO BECOME OBTUSE ANGLES [109°]

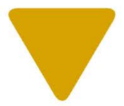
OBTUSE = 31MM
ACUTE = 18MM

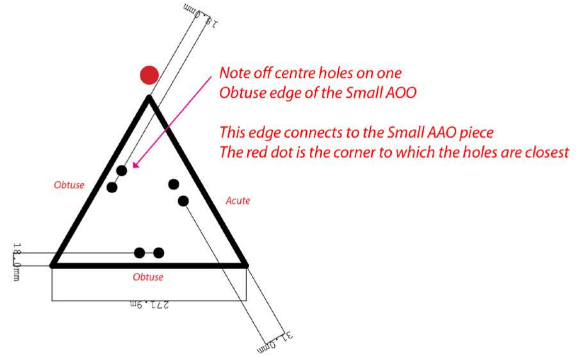
TRIANGLE DIMENSIONS - SMALL

ACUTE = 31MM
OBTUSE = 18MM



Small AAO x108□[Orange

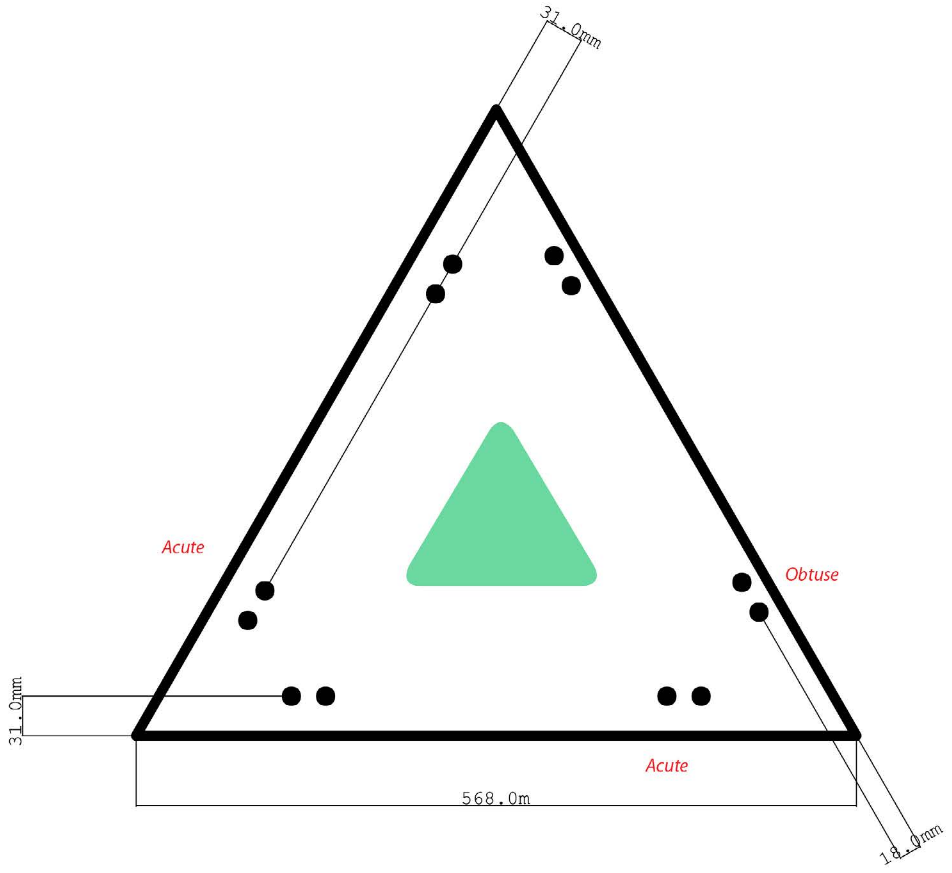


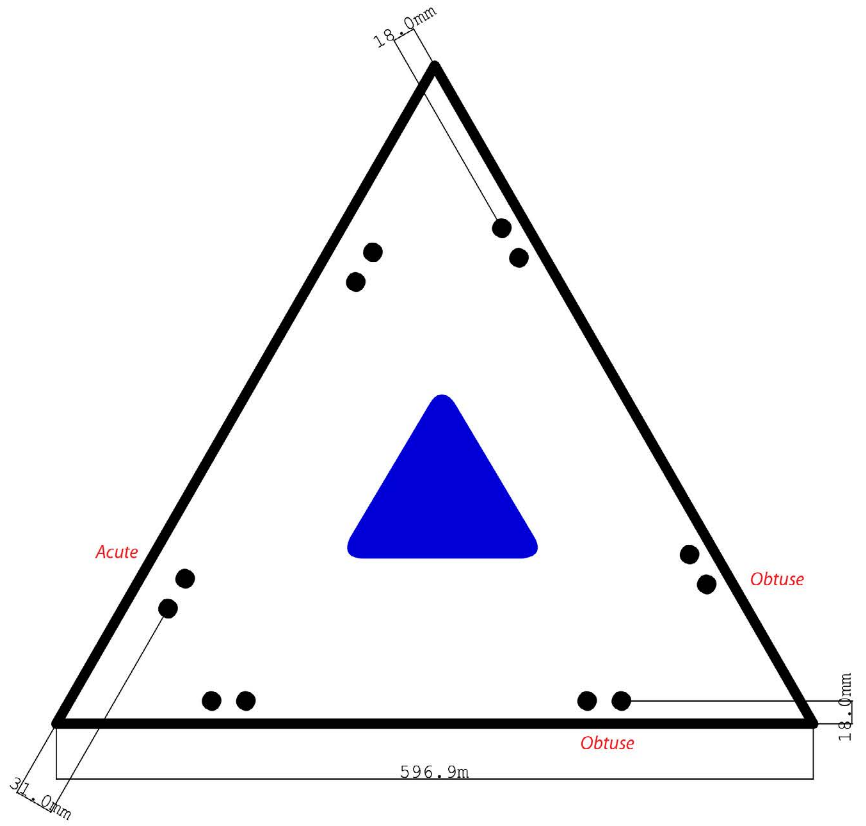


Small AOO x54□[Dark Green]

TRIANGLE DIMENSIONS - MEDIUM

ACUTE = 31MM
OBTUSE = 18MM



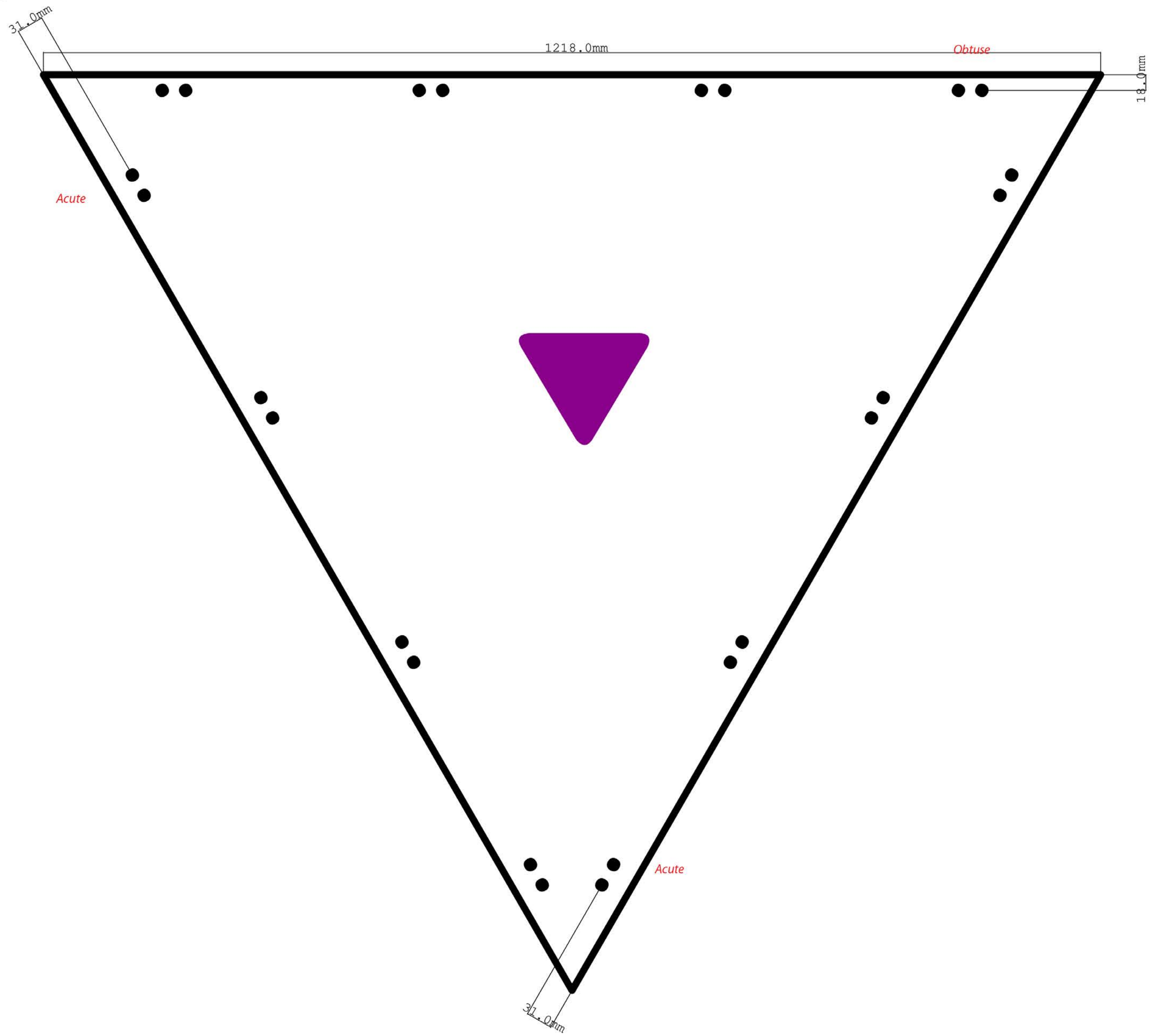


Medium AAO x9□[Turqoise]

TRIANGLE DIMENSIONS - LARGE

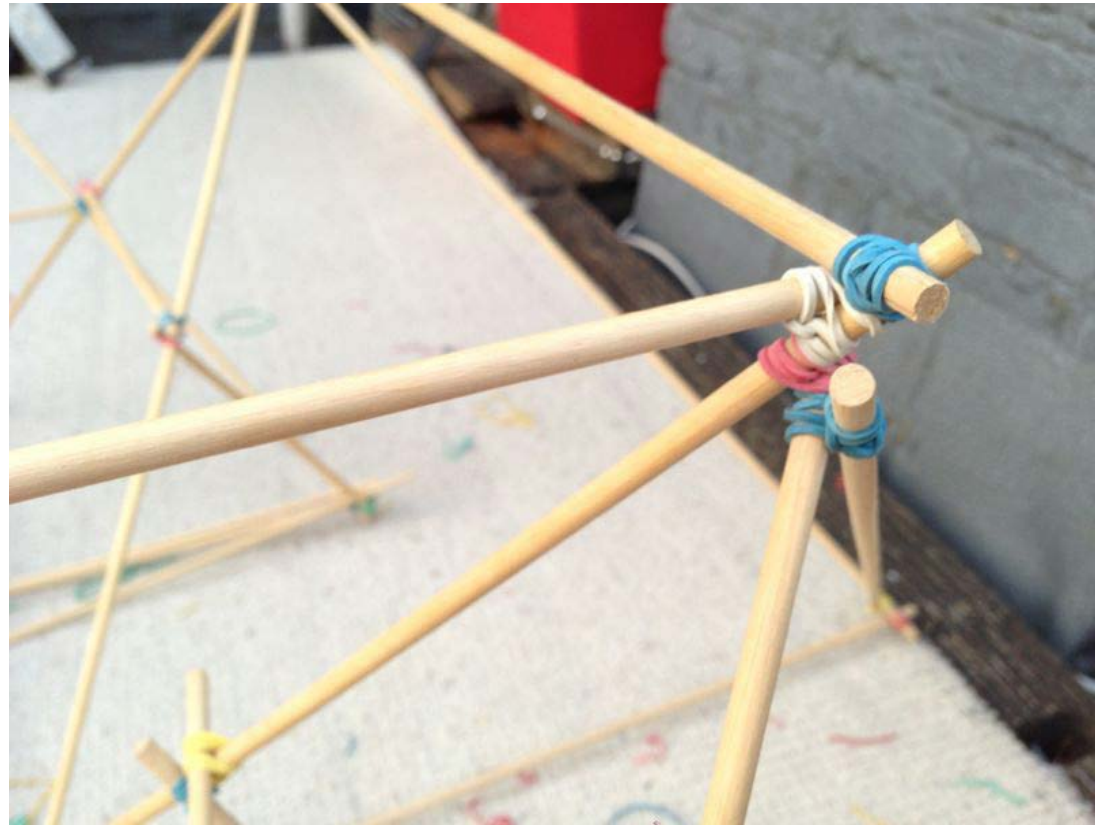
ACUTE = 31MM
OBTUSE = 18MM

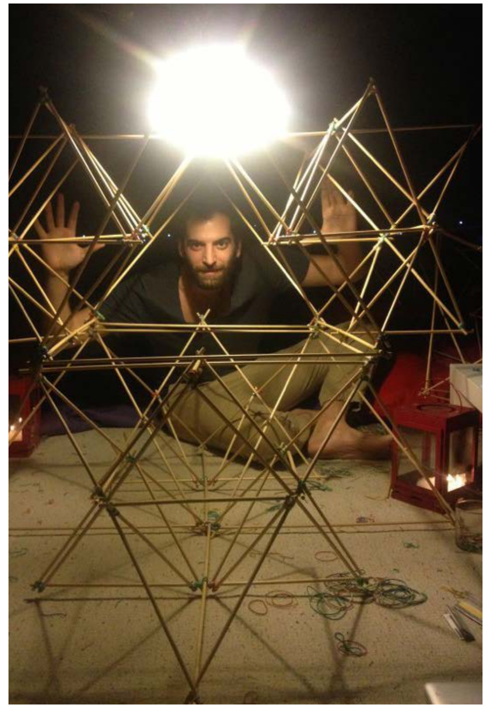
Large AAO x12□[Magenta

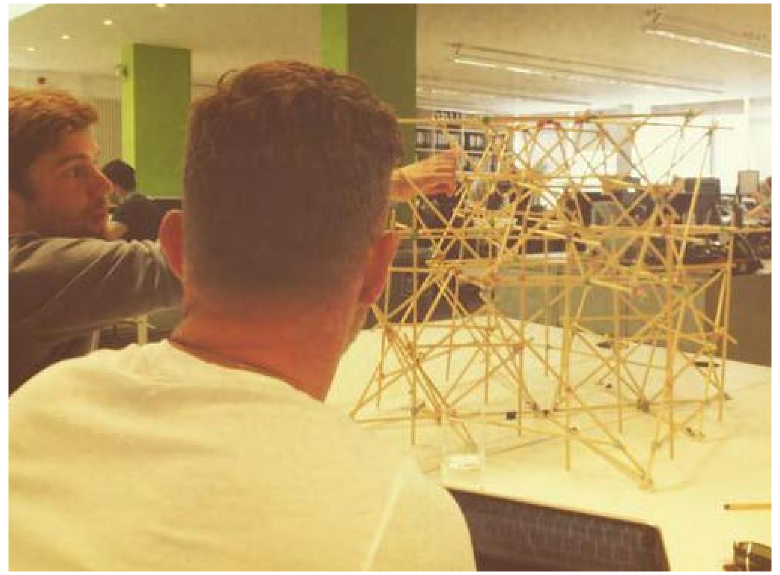


MATERIALS AND MACHINES

They start making Fractal Cult scaffolding test model with wood sticks and and tying them with ropes.



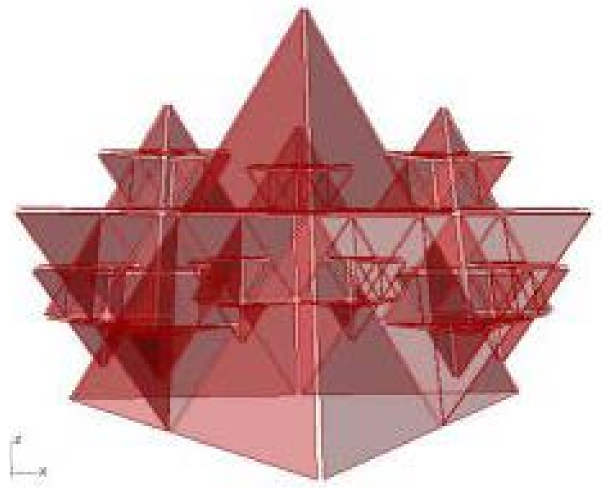


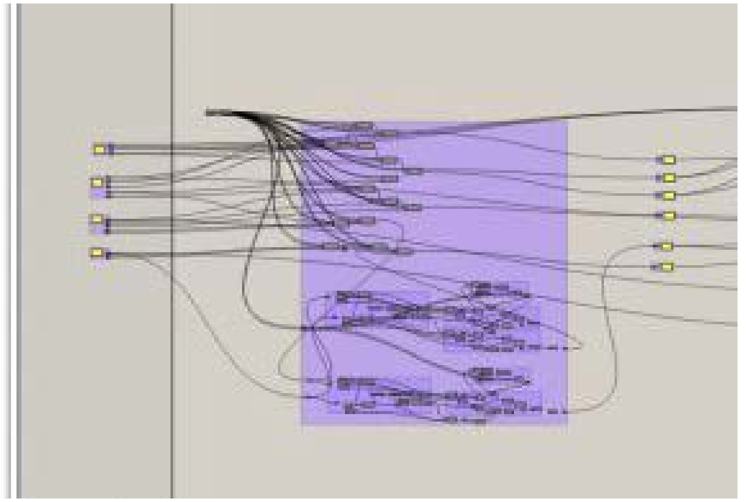


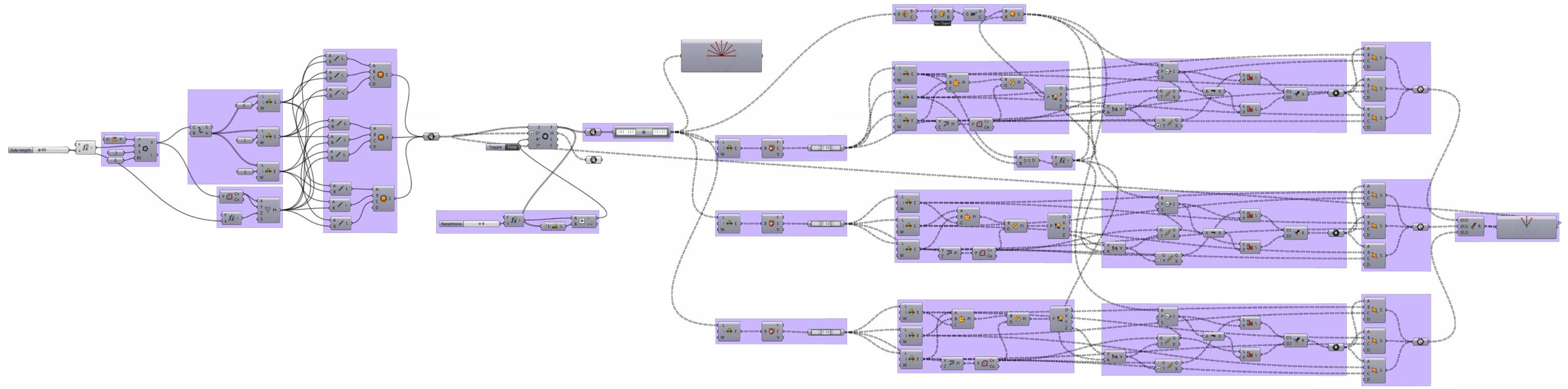
GRASSHOPPER MODEL / def.

The Fractal Cult was redrawn using rules defined by the hinge connection suggested by Ramboll. There are 5 different types of piece that make up each of the four fractal cults. Extracts from the rules as specified by Dan Dodds and Thanasis Korras:

The Acute angles on all triangles all have bolt holes with an offset of 32mm
The Obstuse angles all have bolt holes with an offset of 22mm

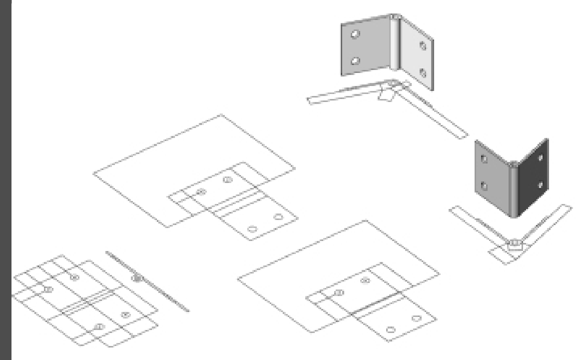


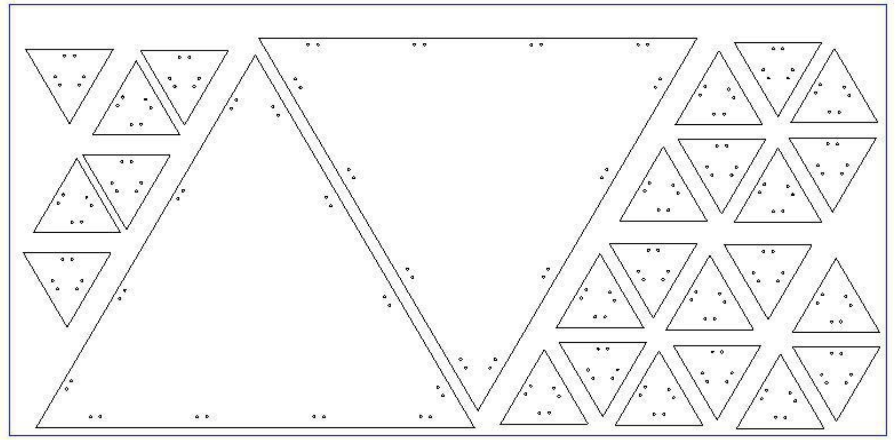


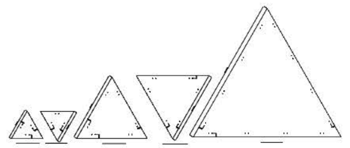


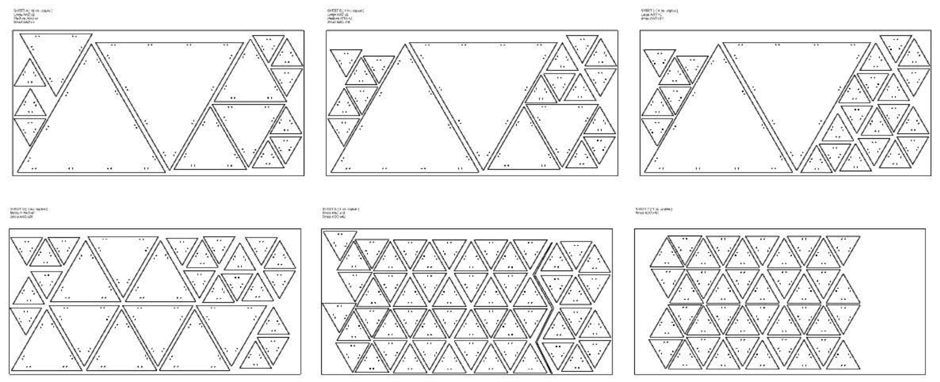
DEVELOPMENT - EXAMPLE

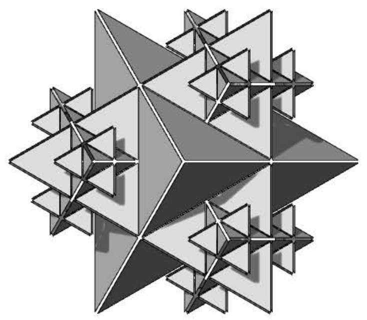
CNC Layout for Quote – Fractal Cult – Dan Dodds

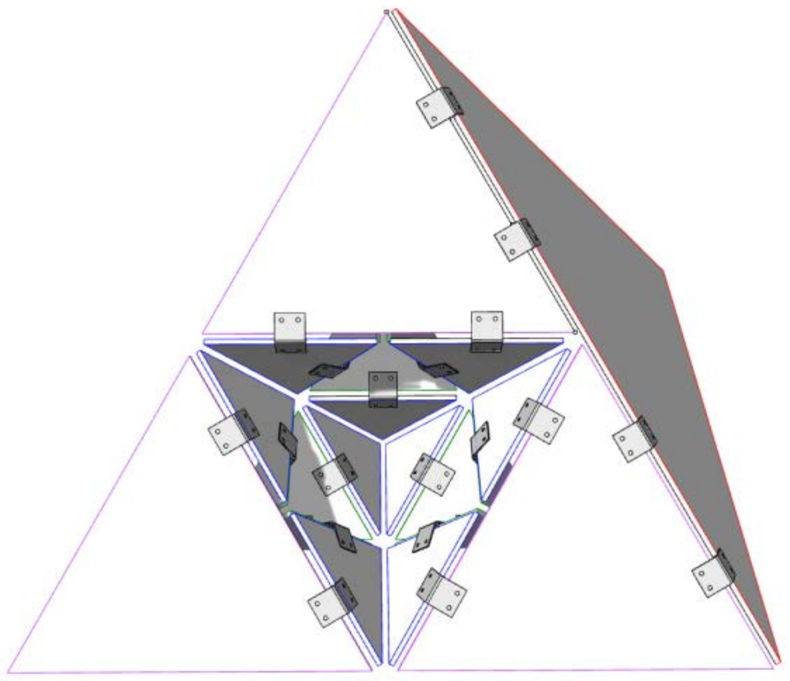


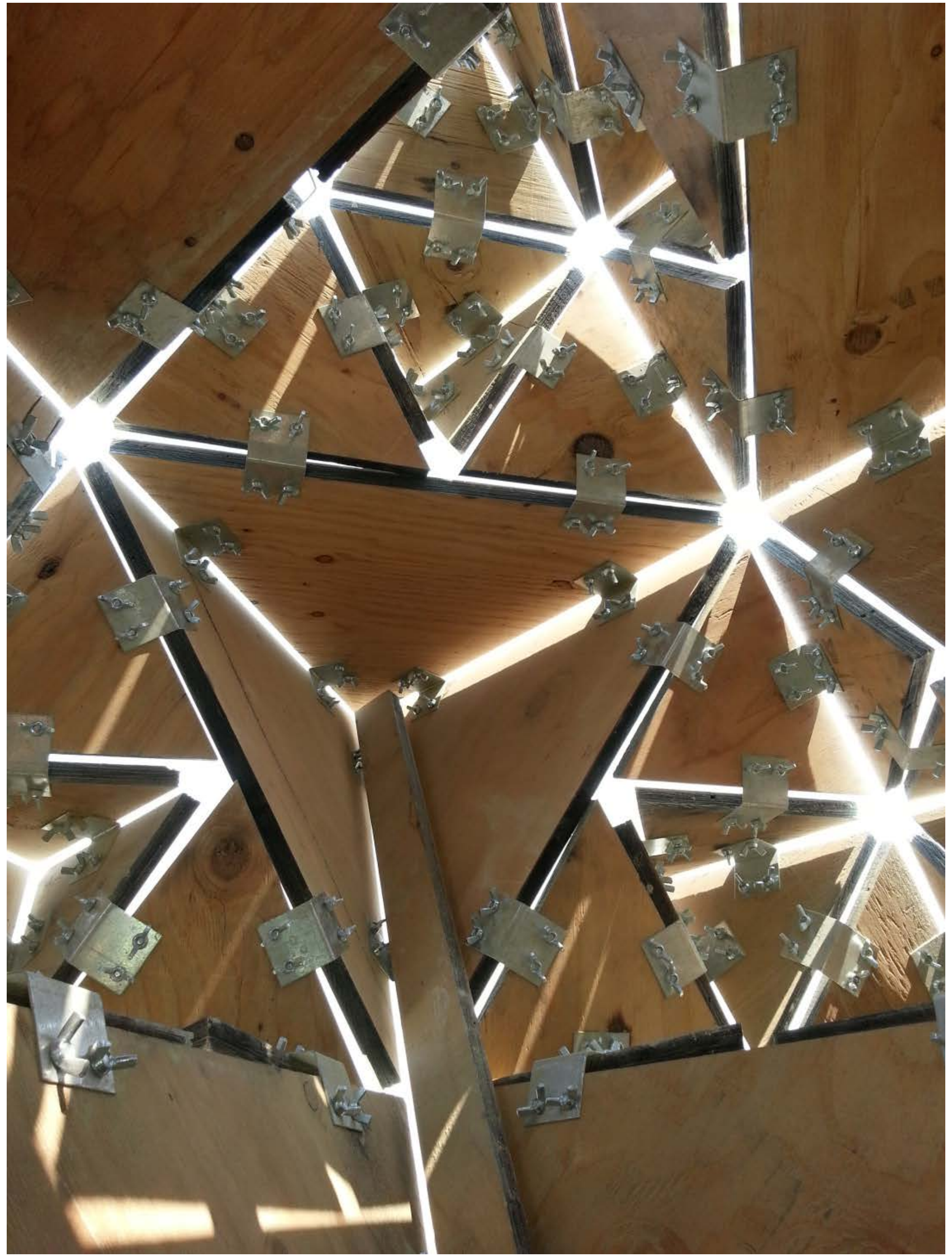













Tessellation
The Swarm Pavilion
Wieland Schmidt Architekten
JuanLee
Source: http://www.plas.me/project/the-swarm-a-parametric-pavilion/

THE SWARM

ProjectArchitects:
Wieland Schmidt Architekten

Location:
Bavarian chamber of Architects.

Investor:
3A Composites GMBH, Aluform, Metalbau Böhn, Erco, Terrafix, Thalerkies and Boals

Function:
Exhibition in the Bayrische Architektursummer - Technische Universität München.

ConstructionYear:
2012

Dimensions:
14 mt x 4.75 mt x 4.0 mt (metric)

ConstructorsTeam:
Sabrina Appel
Max Langwieder
Sascha Posanski

MaterialUsed:
Composite Alucobond

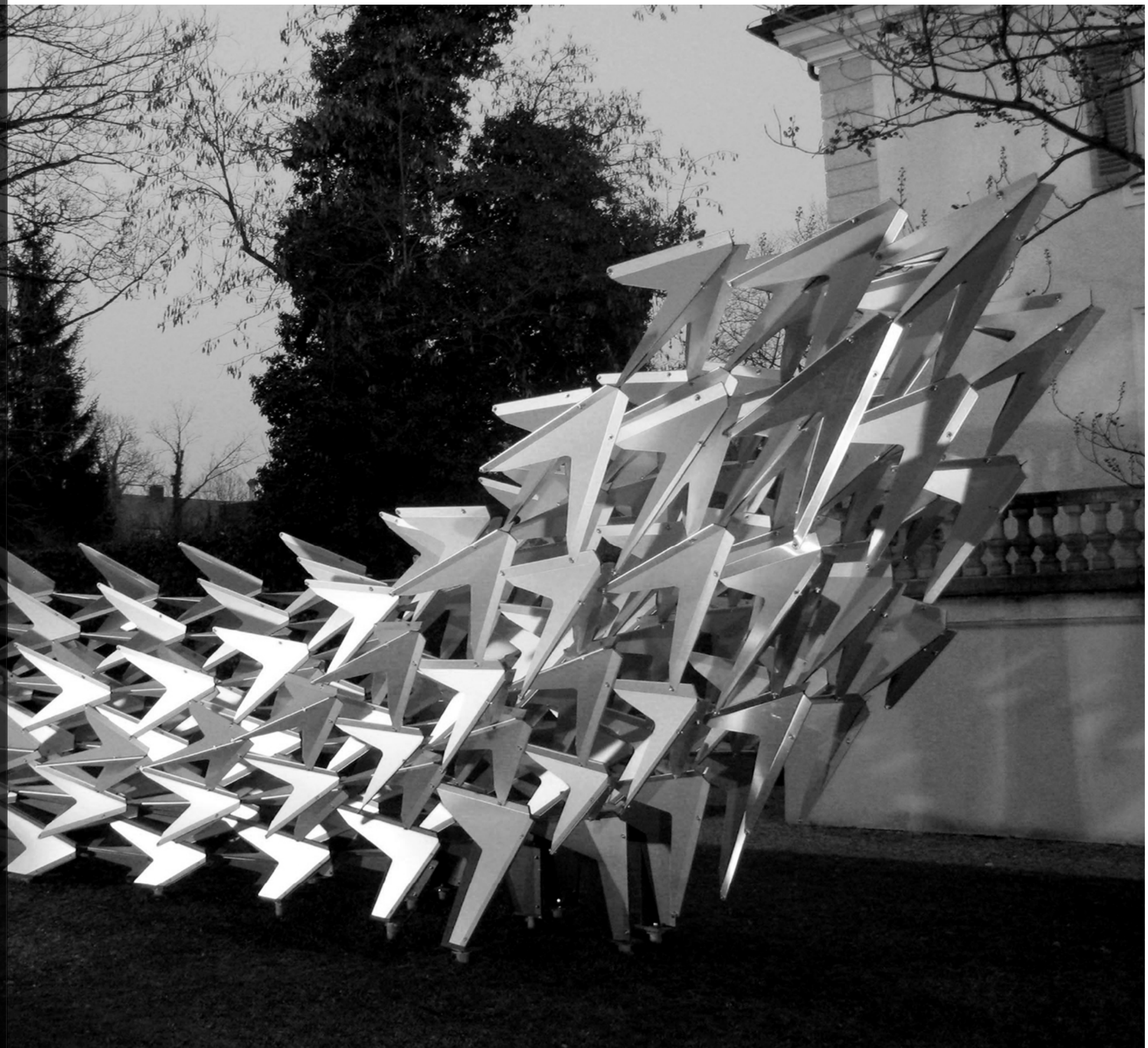
MaterialSpent:
77 Plaques of Alucobond 1.25 cm ^{3}/m
Total Material spent 94.71 cm ^{3}/m

Budget:
Unknown

MajorFabricationUsed:
Tessellation

OtherFabricationUsed:
None

FabricationBy:
Computer Numerical Control Machine

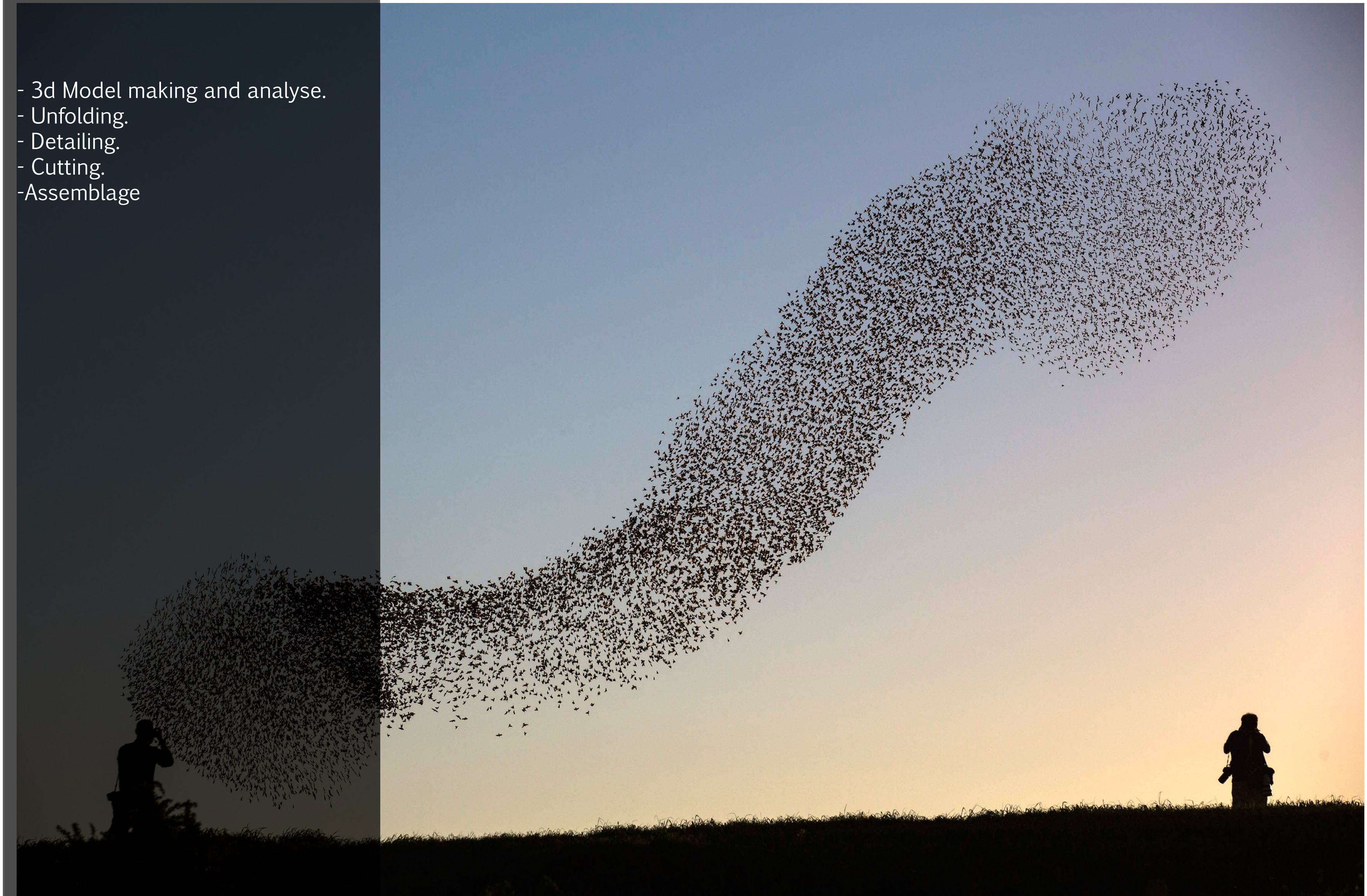


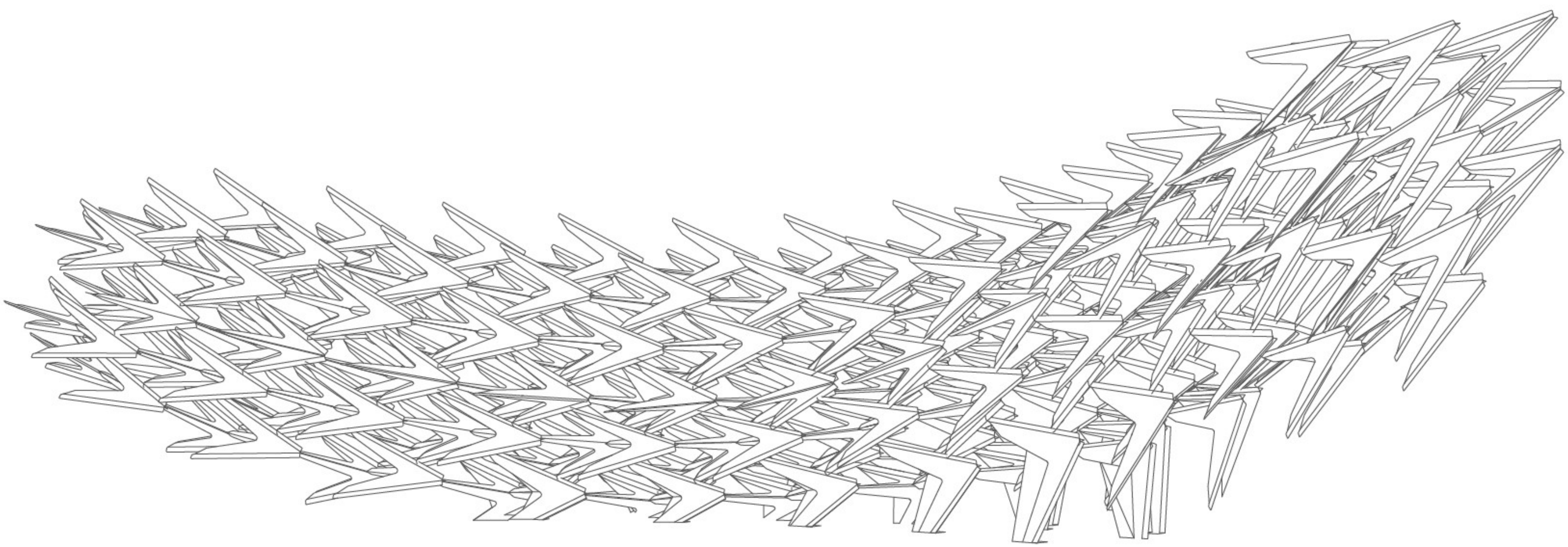
http://www.plas.me/project/the-swarm-a-parametric-pavilion/

FABRICATION METHODS / process

Flock of birds.

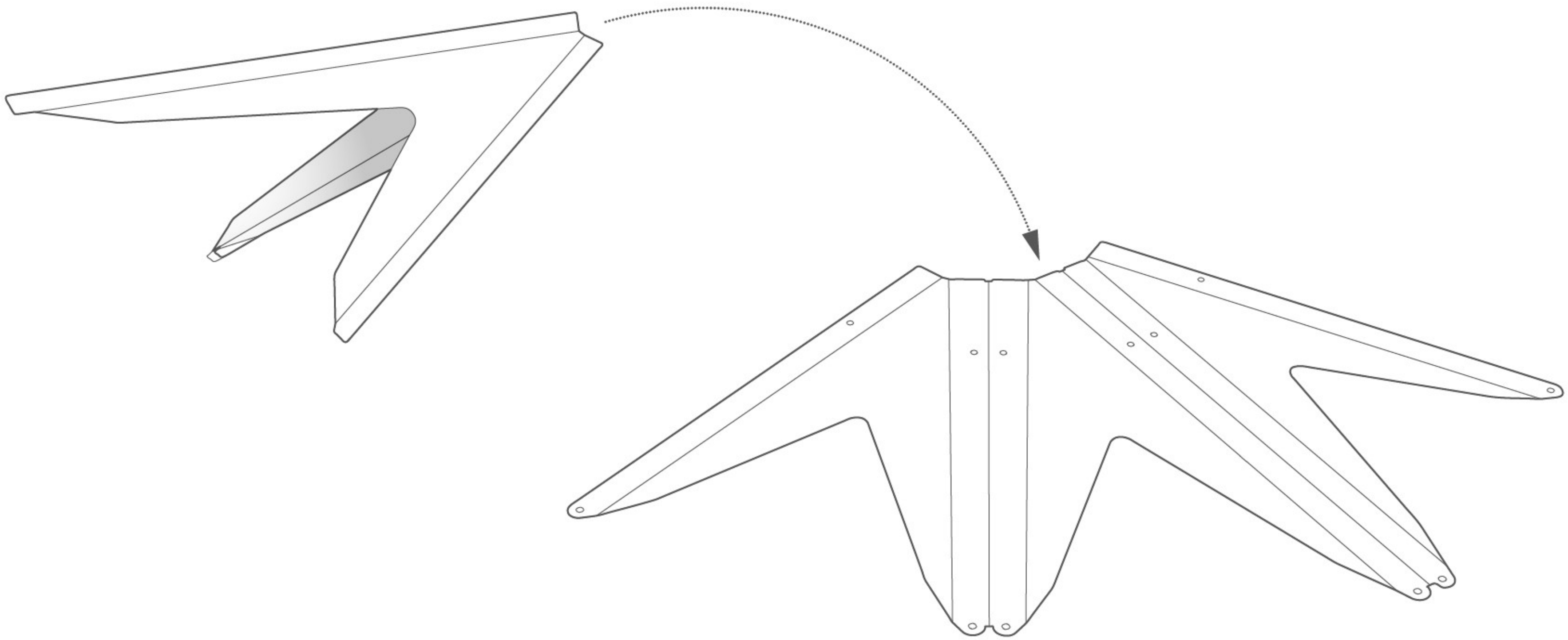
- 3d Model making and analyse.
- Unfolding.
- Detailing.
- Cutting.
-Assemblage





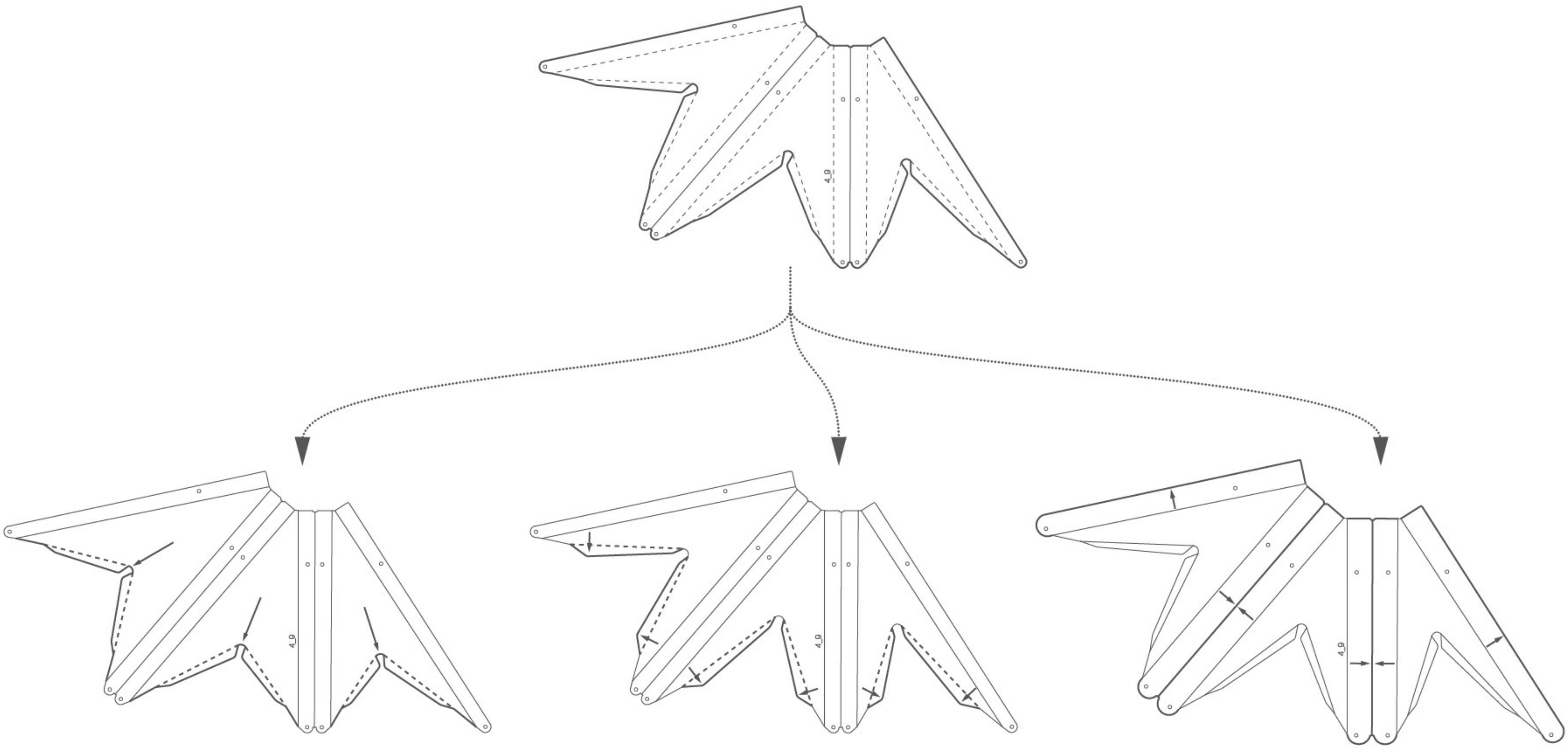
http://www.plas.me/project/the-swarm-a-parametric-pavilion/

Sistematic unfolding.



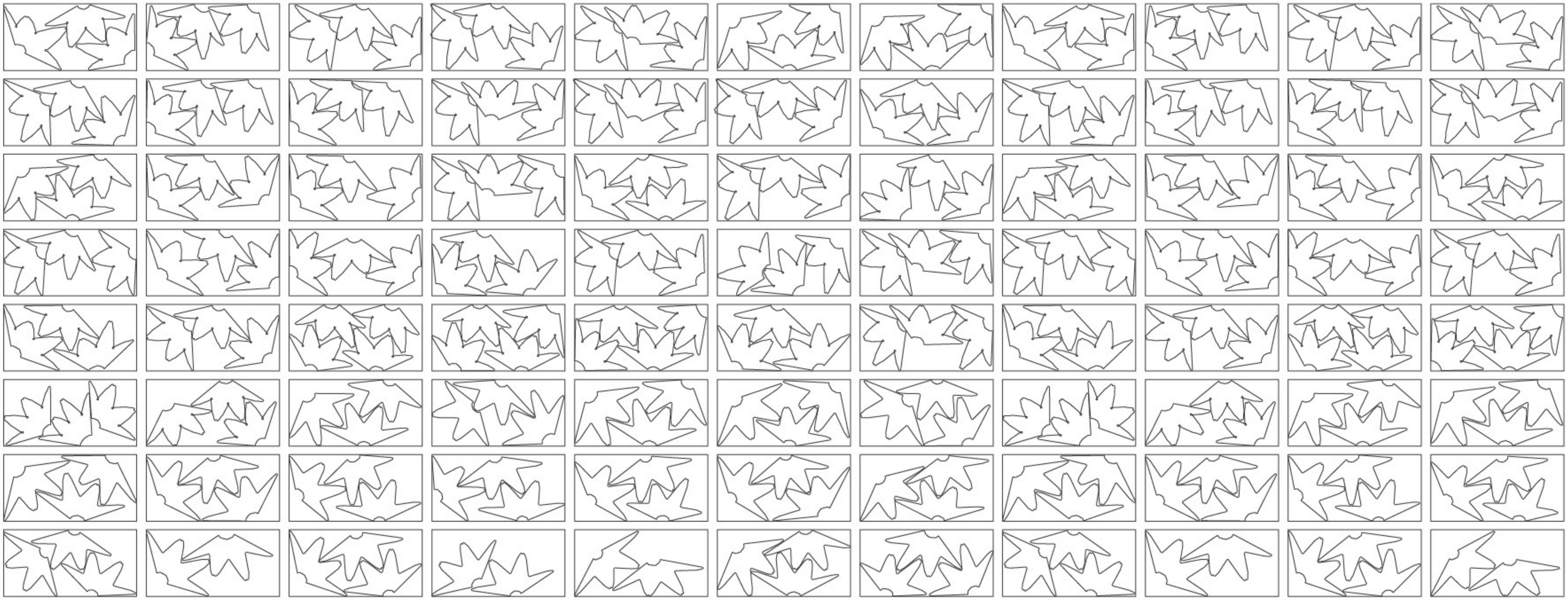
http://www.plas.me/project/the-swarm-a-parametric-pavilion/

Detailing



http://www.plas.me/project/the-swarm-a-parametric-pavilion/

Automatic Nesting production.



http://www.plas.me/project/the-swarm-a-parametric-pavilion/

http://www.grasshopper3d.com/profiles/blogs/the-swarm

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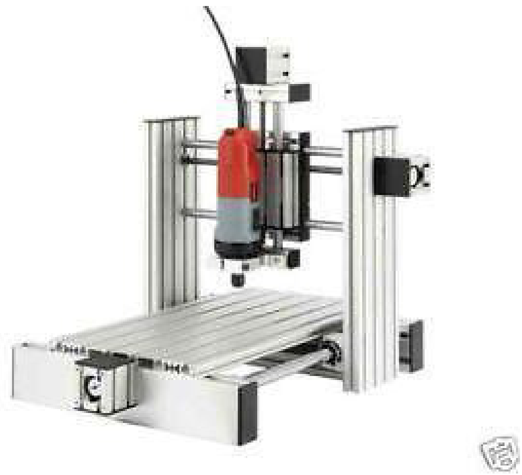
CNC MACHINE.

CNC is the short form for Computer Numerical control. The CNC machine comprises of the mini computer or the microcomputer that acts as the controller unit of the machine. While in the NC machine the program is fed into the punch cards, in CNC machines the program of instructions is fed directly into the computer via a small board similar to the traditional keyboard.

In CNC machine the program is stored in the memory of the computer. The programmer can easily write the codes and edit the programs as per the requirements. These programs can be used for different parts, and they don't have to be repeated again and again.

Compared to the NC machine, the CNC machine offers greater additional flexibility and computational capability. New systems can be incorporated into the CNC controller simply by reprogramming the unit. Because of its capacity and the flexibility the CNC machines are called as "soft-wired" NC.



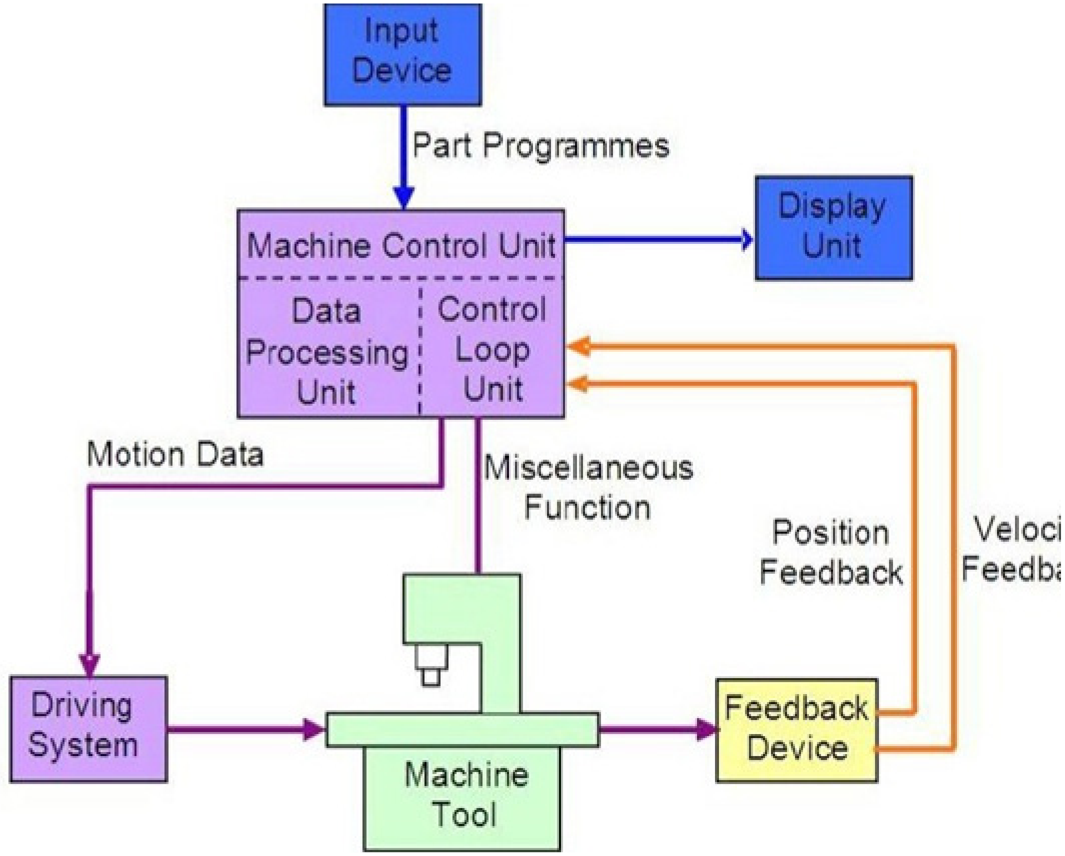
Small research about the materials and machines used in your project their properties and its advantages and disadvantages and their prices...
PICTURES ONLY + description and reference link below every pic

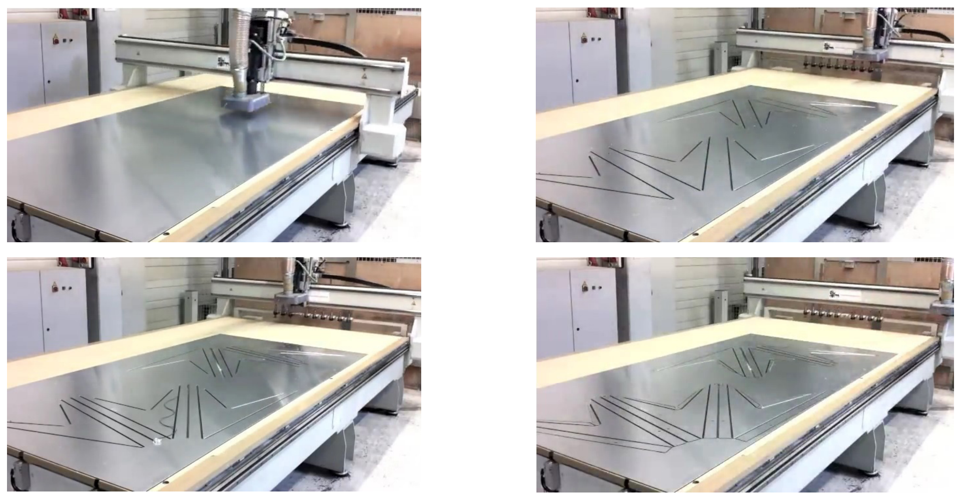
* Inform yourself about machines near Dessau... Where can we fabricate our project!!!

*you can multiply this slide as much as you need

How the CNC Machine Works?

The CNC machine comprises of the computer in which the program is fed for cutting of the metal of the job as per the requirements. All the cutting processes that are to be carried out and all the final dimensions are fed into the computer via the program. The computer thus knows what exactly is to be done and carries out all the cutting processes. CNC machine works like the Robot, which has to be fed with the program and it follows all your instructions.



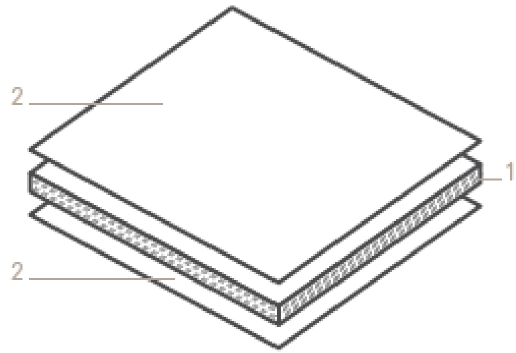


http://www.editsworld.com/cnc-machine/#.VyJuajB96Uk
http://www.grasshopper3d.com/profiles/blogs/the-swarm

Alucobond

Is a composite panel consisting of two aluminium cover sheets and a plastic core. The superb properties of this material boost one's inspiration and offer architecture a whole new range of solutions - whether your project is a residential or public building, a corporate headquarter, an office building, a trading or industrial complex - or if your organisation wants to create a new image-building Corporate Design - whether for petrol stations, car showrooms, banks or supermarkets.

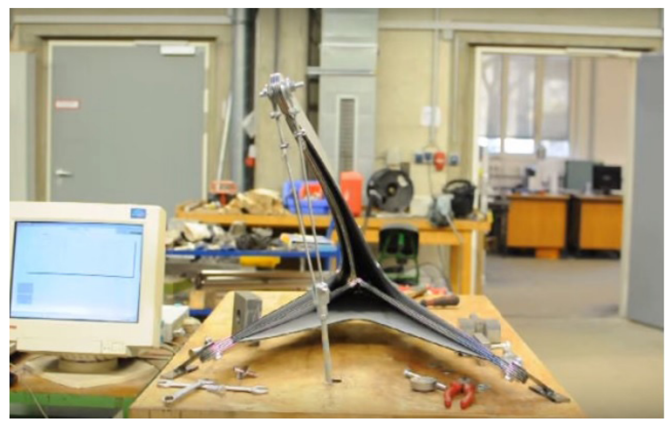
The composite structure of Alucobond results in an impressive strength-to-weight ratio, even when comparing large panel sizes. Despite its low weight, which makes Alucobond easy to transport and handle in the factory and on site, its rigidity and high strength make the panels keep their shape and remain flat, even when exposed to extreme temperature changes.



1 Plastic core

2 0,5mm aluminium

Characteristics	Advantages
Low weight, high rigidity, perfect flatness	Low cost for substructures and fasteners, Smooth handling on the site
Large variety of colours	Unlimited planning and design
Weatherproof	Supplied ready to install
Vibration-damping	No additional sound-damping needed
Can easily be folded and bent	Simple processing using conventional tools
Large panel sizes, fast installation, pre-fabricated panels	Short construction times, adherence to schedules, low cost

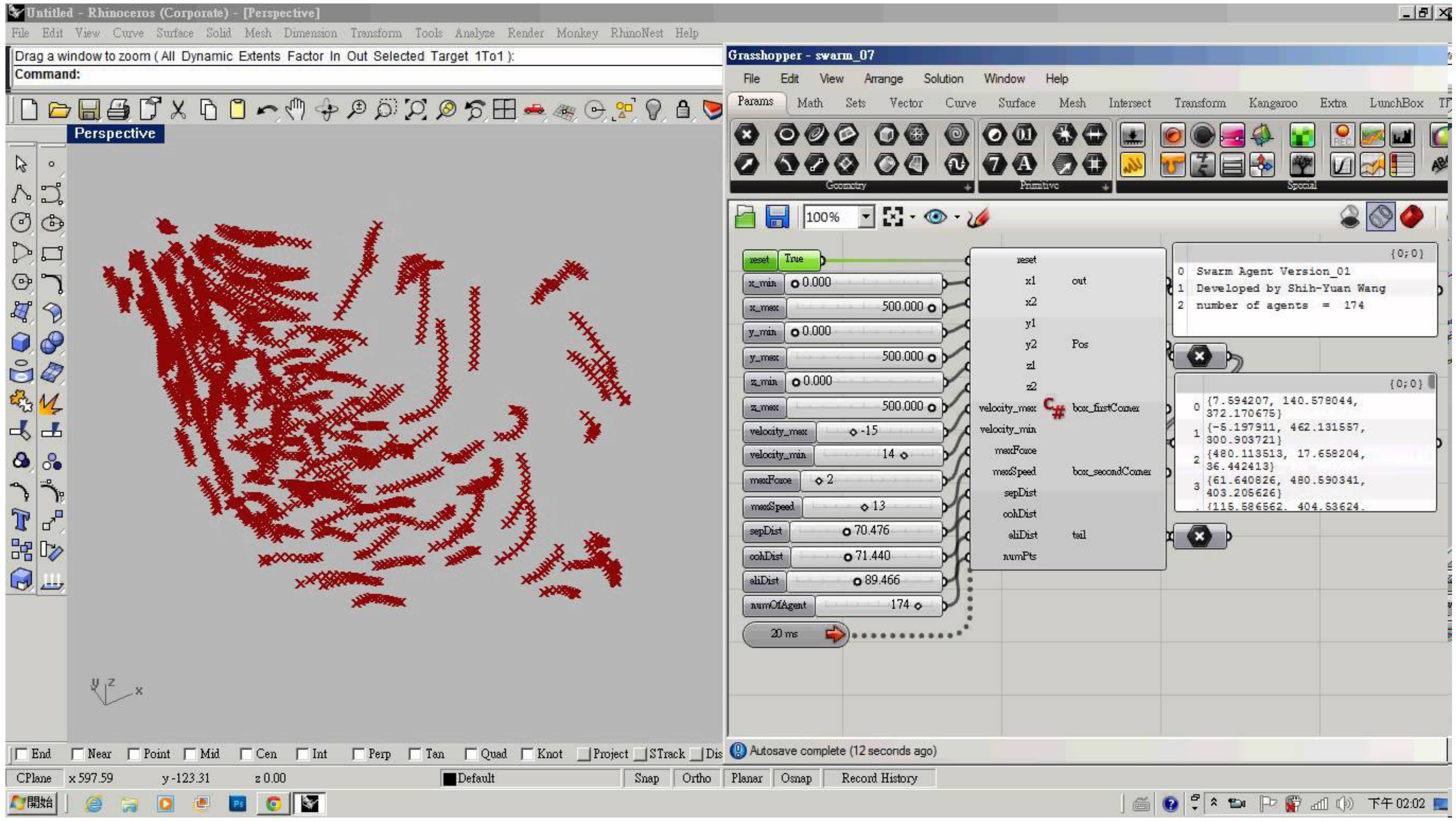


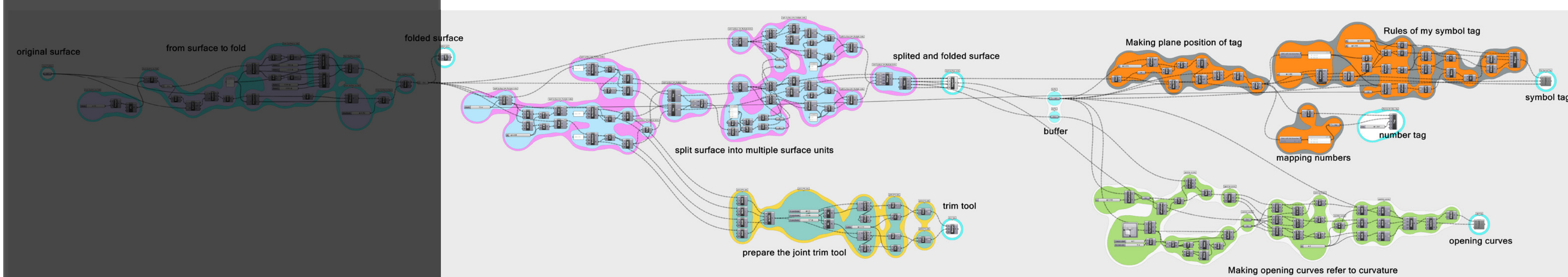
	ALUCOBOND®			Aluminium	
Rigidity (E J)	Section modulus	Thickness	Weight	Thickness	Weight
1250 kN cm²/m	1.25 cm³/m	3 mm	4.5 kg/m²	2.7 mm	7.3 kg/m²
2400 kN cm²/m	1.75 cm³/m	4 mm	5.5 kg/m²	3.3 mm	8.9 kg/m²

GRASSHOPPER MODEL / def.

The project was made in Grasshopper with the help of the scripting language C#; this means that the swarm that gave the general shape of the pavillion was coded by the designers themselves.

After having the final behaviour set, the team thought together a module which will then follow the digital produced swarm in grasshopper. To proceed, they end up designing three different modules and continued with the tesselation and numeration of each separate piece; this was crusial when working with the CNC machine (cutting phase).





https://www.youtube.com/watch?v=gfzNeavlYSg

THE SWARM PAVILION - Wieland Schmidt Architekten

http://www.hangar-7.com/en/art/exhibitions/the-swarm/

http://www.hangar-7.com/en/art/exhibitions/the-swarm/

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