FOLDING
Individual Research

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FOLDING

DEFINITION

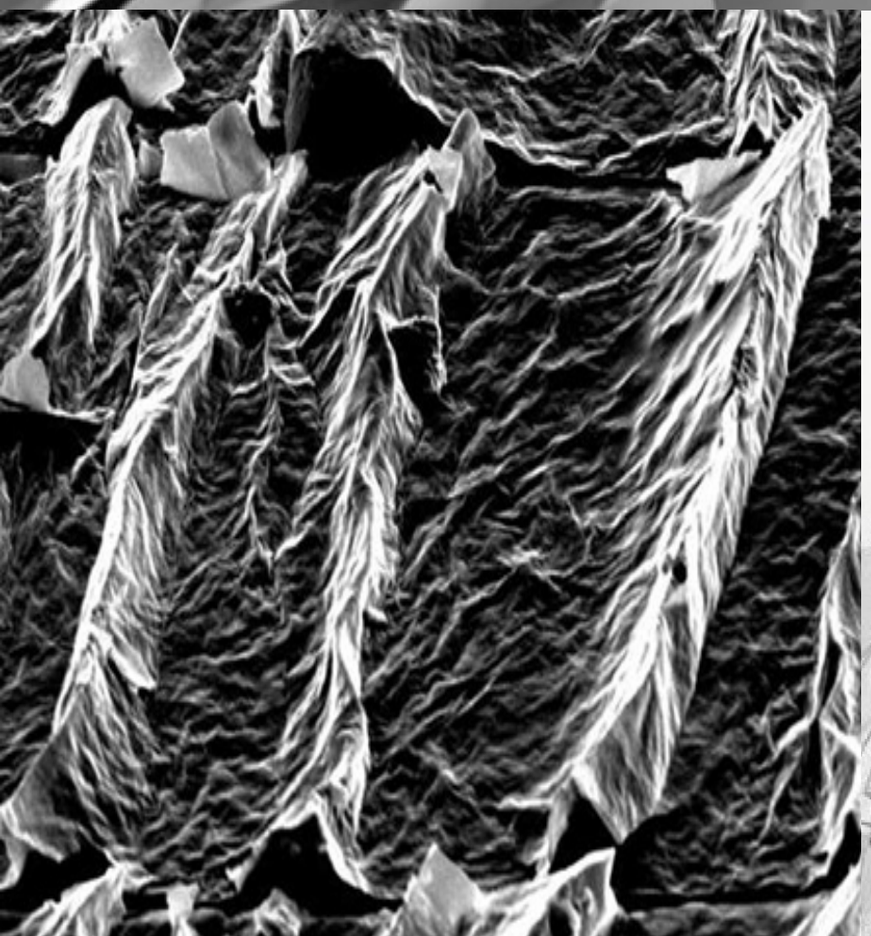
Folding turns a flat surface into a three-dimensional one. It is a powerful technique not only for making form but also for creating structure with geometry. When folds are introduced gain stiffness and rigidity, can span distance, and can often be self-supporting. Folding is materially economical, visually appealing, and effective at multiple scales. It is not surprising that architects have expanded its use in the digital age.

In architecture, folding is theoretical concept, formal tactic, and the most literally material operation. Naturally, this chapter focuses on the material operation, but it is helpful to speak about it in the context of its other association. In all cases, folding, or pleating, allows new space and territories to emerge without losing the native characteristics of what is being folded. It is already well understood that an architectural aspiration for the fold lies in its potential for manifesting cohesion and a contimuity of competing spatial, cultural, social, programmatic, and contextual conditions within a single language. Greg Lynn argued in 1993 that “if there is a single effect produced in the architecture of folding, it will be the ability to integrate unrelated elements within a new continuous mixture.”

FOLDING

EXAMPLES FROM NATURE

We can find lots of examples of folding or similar form from nature, like fold structure on geography, pleats on clothes, fold texture of plants, the skin wrinkles of animal and human, cell textures under microscopic world and so on.



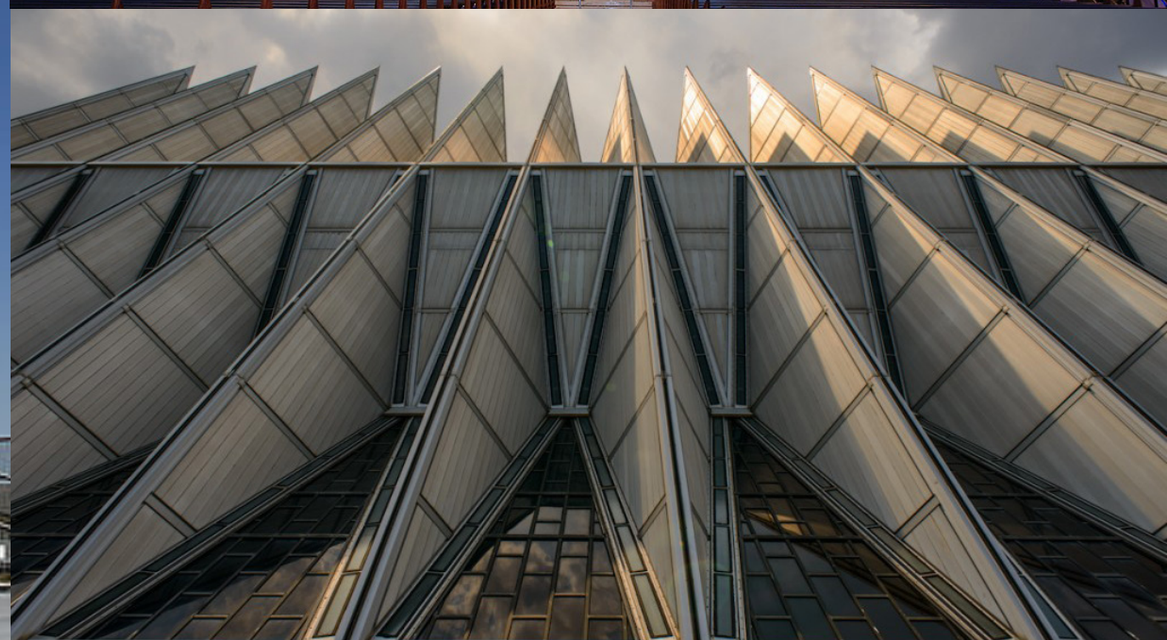
FOLDING

HISTORY & ORIGIN

Folding as a arts and a techniques has a long history which was origined of a traditional Japanese paper arts called Origami a thousand years ago. Also we can distinct paperfolding traditions arose in Europe, China, and Japan which have been well-documented by historians. These seem to have been mostly separate traditions, until the 20th century. But the Japanese Origami is the most representative one.

In Japan, the earliest unambiguous reference to a paper model is in a short poem by Ihara Saikaku in 1680 which mentions a traditional butterfly design used during Shinto weddings. Folding filled some ceremonial functions in Edo period Japanese culture.

This folding technique has also been used in building surface and structure before the computer aided design appears. For example, the United States Air Force Academy Cadet Chapel, which was completed by SOM in 1962.



FOLDING

EXAMPLE

Fragile Beasts sculpture made from paper by Łódź University of Technology students

Research Context

This sculpture was built as a part of a 3-day workshop on ‘Curved Folding’ at the Łódź University of Technology, Poland. The workshop explored the idea of curved folding as a design technique in Architecture, leading to some amazing outcomes that are pre-rationalized by their very nature. It continues the lineage of work on ‘Curved Folding’ and ‘Thin-Shell Structures’ started two years ago for ZHA’s Arum Pavilion at the Venice Biennale, and further pursued through academic workshops.

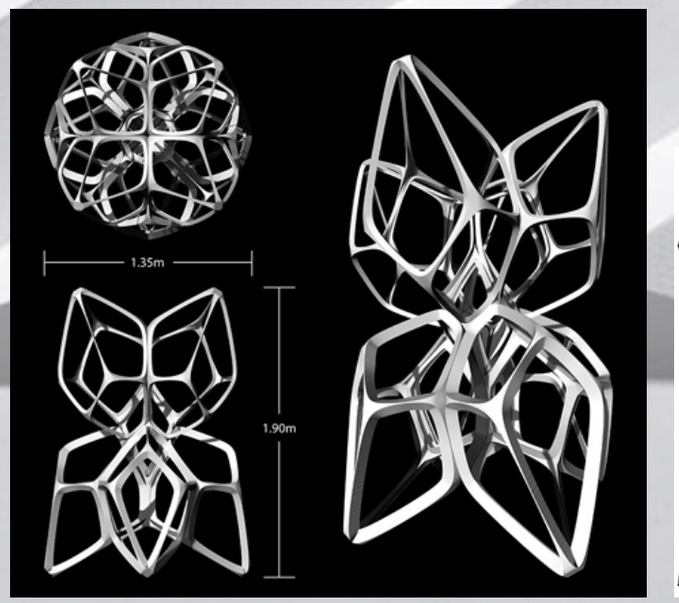
Fabricating

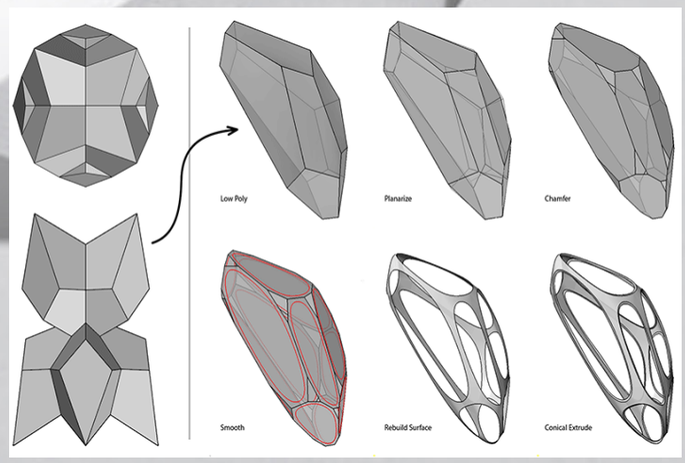
The sculpture was designed using digital modelling software to determine the slender polyhedra forms, which were then subjected to scripts that broke them down into shapes suitable for curved folding.Once the forms and net shapes of the irregular-sided polyhedra were determined, they were sent to a laser-cutting facility that transferred the design onto a series of flat cutout sheets in five hours.The 0.5 millimetre paper was then folded and glued into shape by the students, who had no previous experience of curved folding.

Highlights of the sculpture

Curved folding isn’t just the aesthetic, it’s also the structure: it can lend substantial stiffness to fairly flimsy material: 0.5mm thick card paper in this case.
Ease of assembly: The whole piece was put together with 17 students in their 4th year of undergraduate Architecture program (and novices at curved folding) in a matter of 5 hours (the laser cutting was outsourced and took an additional 5 hours).

Dimensions: 1.9m tall x 1.35m wide (6’4” x 4’6”), 0.5mm thick card paper.





Source: http://www.dezeen.com/2014/01/29/fragile-beasts-curved-folding-paper-sculpture/

FOLDING

EXAMPLE

Julio Barreno Gutiérrez creates a folded-steel shelter for a school playground

Research Context

Thin sheets of brightly painted steel have been folded to create this origami-inspired canopy, designed to shelter a school playground in an Andalusian village from the sun and rain (+ slideshow).

Featuring a pale turquoise roof and a hot-pink underside, the angular pavilion was created by Spanish architect Julio Barreno Gutiérrez for a school in Algodonales – a mountain village in the Cádiz region of Andalusia in southern Spain.

Concept/Fabricating

“The architectural tool was found in the fancy children’s world full of colour and fun,” said the architect.

“The structural quality and the inherent flexibility of origami, typical of the many craft activities developed in class by the children themselves, became the genetic property to formally develop the managed element,” he added.

The metal canopy straddles the two different levels to protect the ramp and staircase from the elements.

Sheets of one-centimetre-thick steel were bent to create the faceted shape and pointed legs. Both the bright colouring and folding technique are intended to be reminiscent of origami.

Source:http://www.dezeen.com/2015/06/14/julio-barreno-gutierrez-pavilion-canopy-folded-steel-awning-playground-school-algodonales-andalusia/

FOLDING
TYPOLOGY & CLASSIFICATION

Folding can generally be classified into 5 categories:

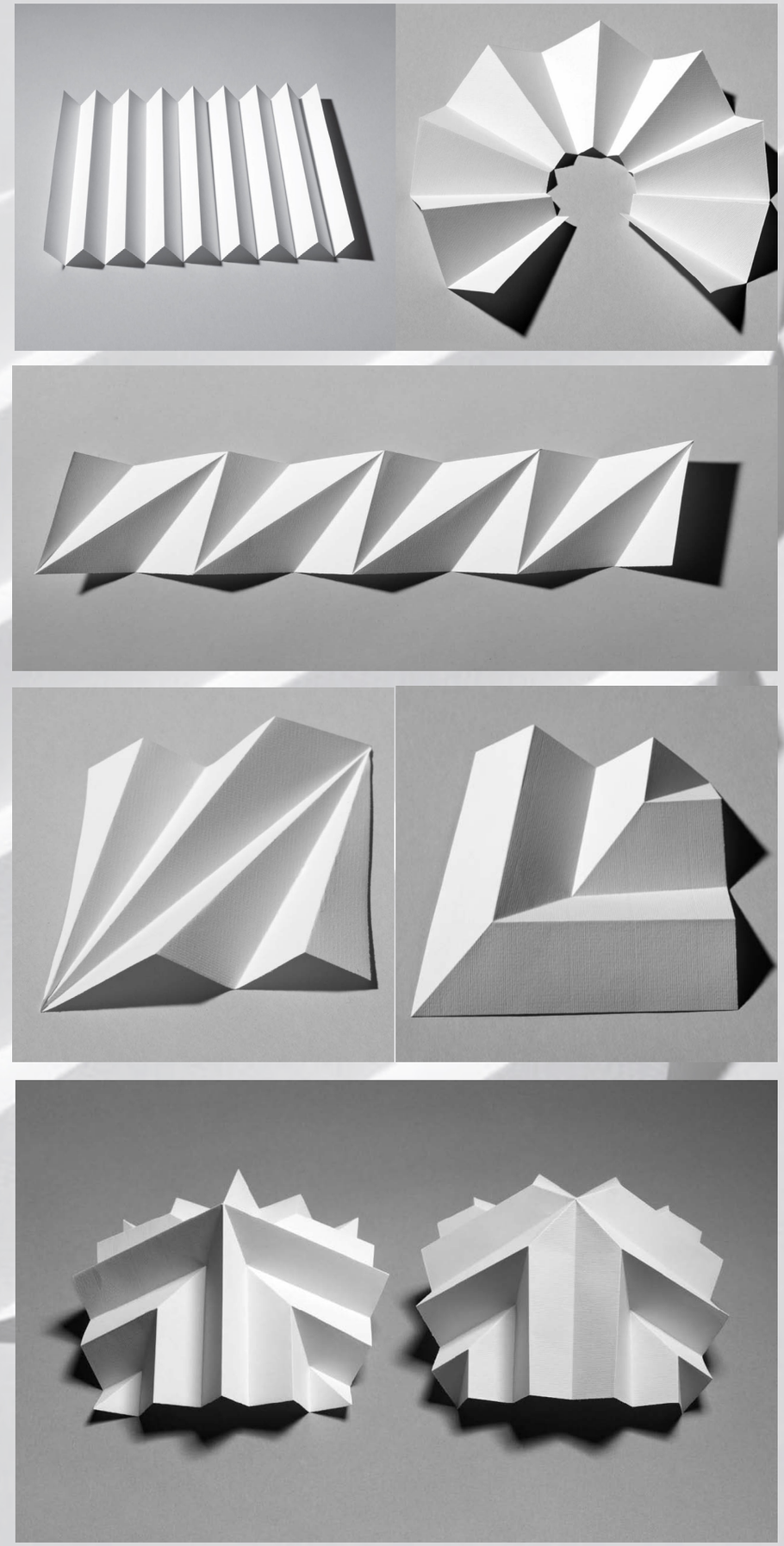
Dividing occurs when the geometry is sectioned according to the Y Cartessian axis.

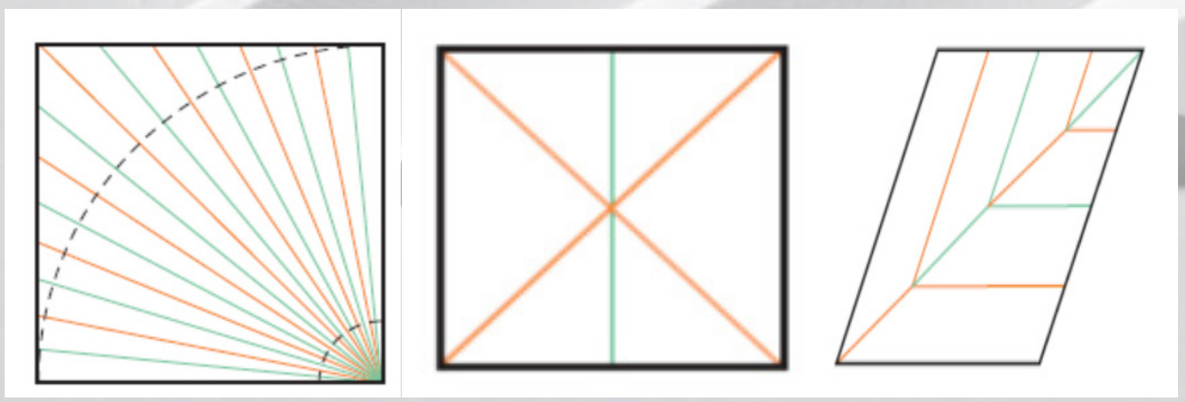
Symmetrical Repeats a motif is repeated exactly in one direction.A motif is repeated in a straight line without overlap. When applied to a square of paper (or other polygon), the squares are simply repeated side by side and the crease pattern repeated.

Stretch A square, when stretched in one specifi c direction, will create a rectangle.Depending on the original crease pattern, the pattern will transform differently if stretched vertically or horizontally, or it will transform in the same way in whichever direction it is stretched.

Skew A square skewed to one side will create opposite sides of equal length, but no angle of 90°. The transformations made to a form folded fi rst in square paper are more dramatic than if the square is stretched fi rst

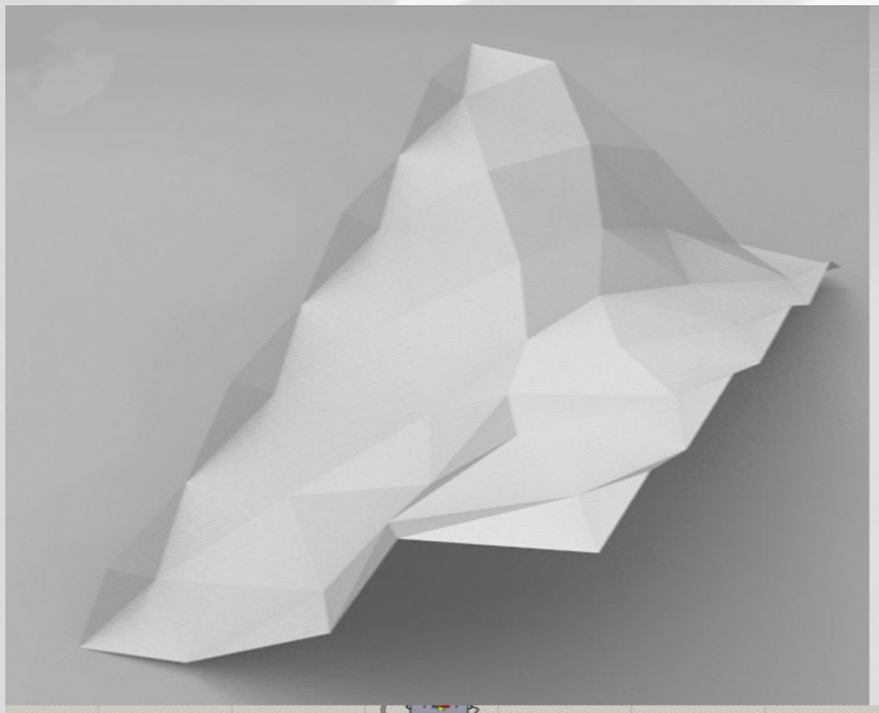
Polygons is a method which allows to follow the curvature and geometry of the object.

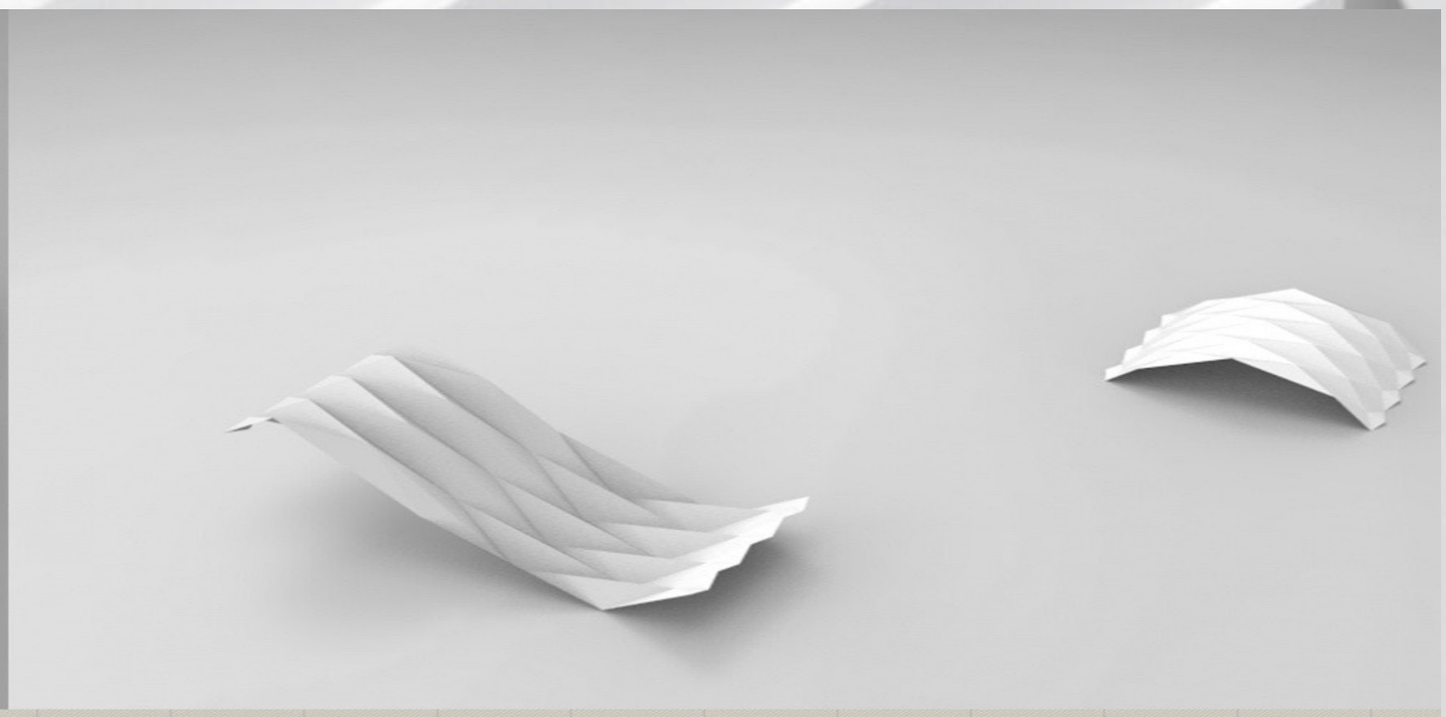


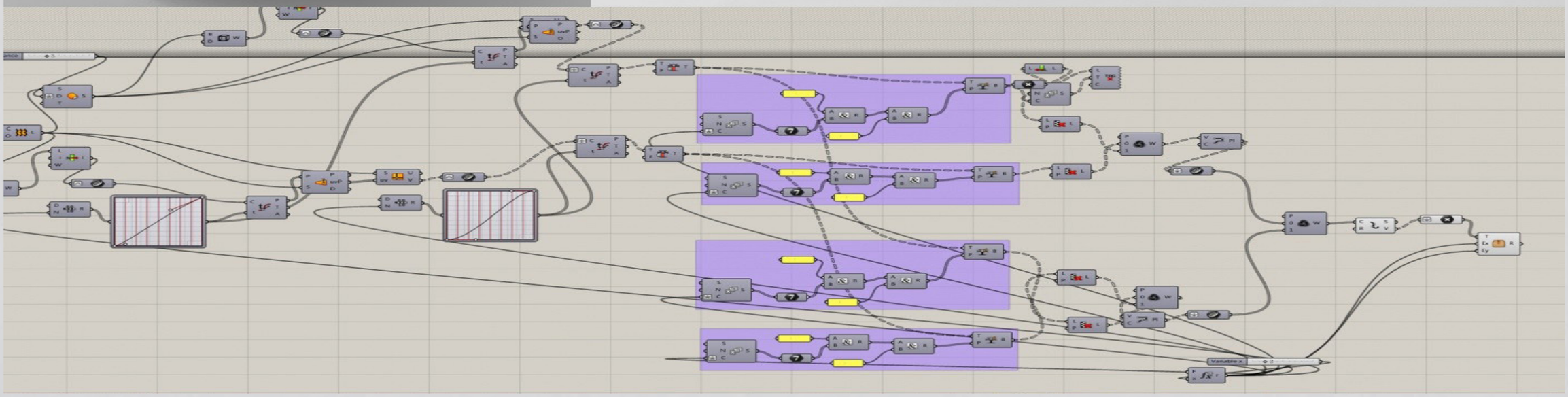


FOLDING
DIGITAL FABRICATION

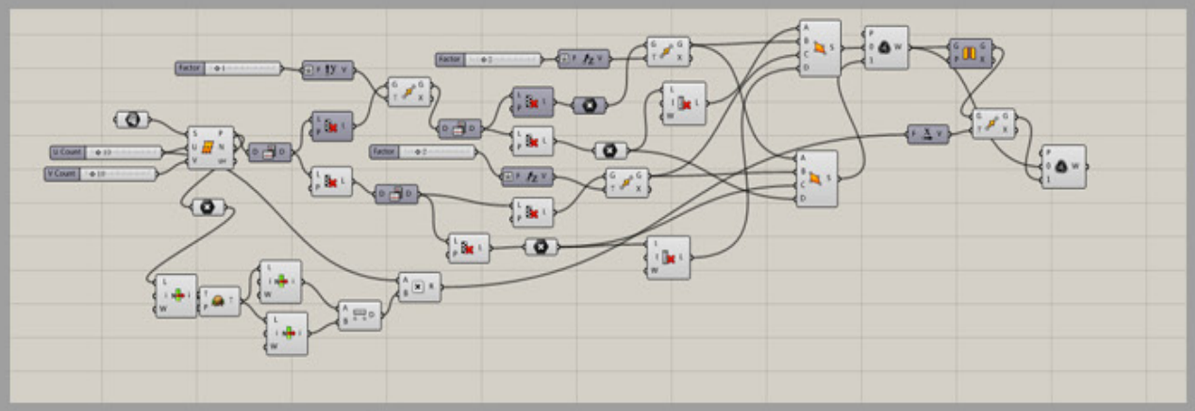
Folding can be accomplished in countless ways using Grasshopper. It’s convinent to change the data of two or three-dimensional surface to get different shapes.

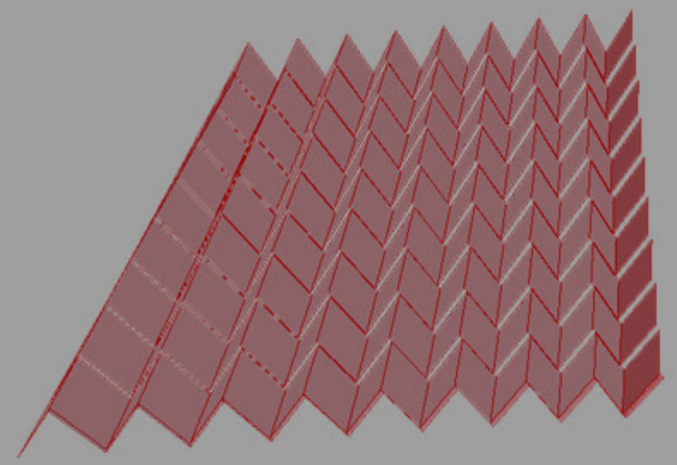


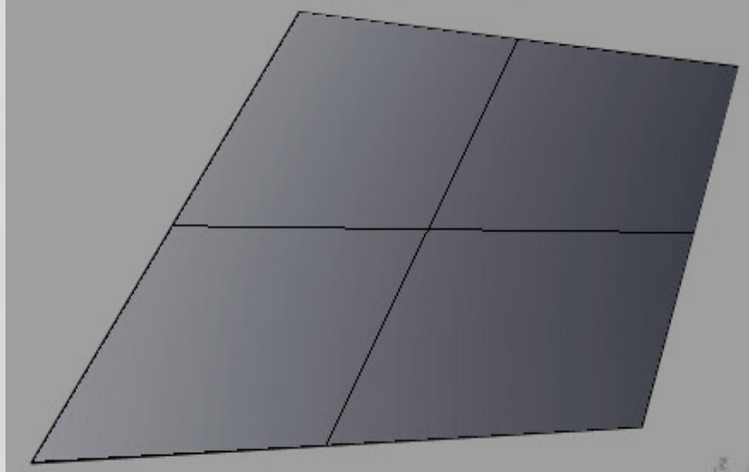


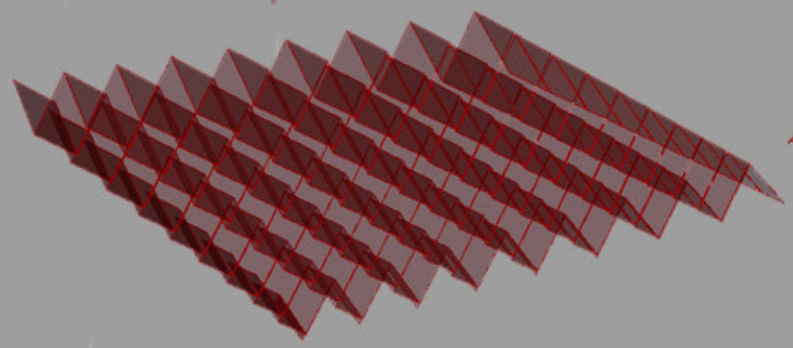


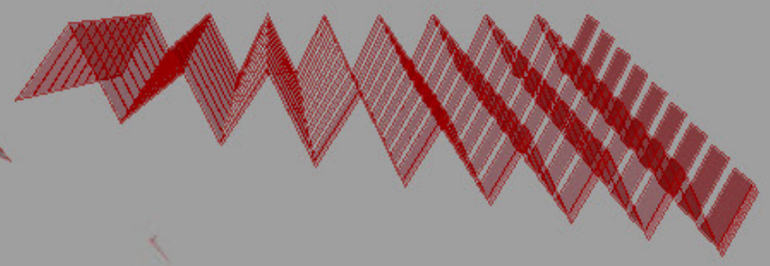
DIGITAL FABRICATION











STRIPS

FOLDING
DIGITIAL FABRICATION

Folding can use a series of line control to achieve the desired effect or outcome.There are several different types of it.

Simple Folding Parallel control lines

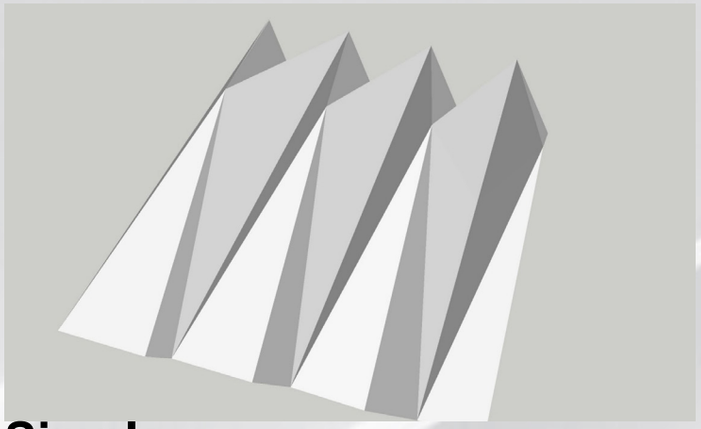
Curve Folding Parallel control curve

Parametric Curve Folding there are some parametric relationship between the control curve

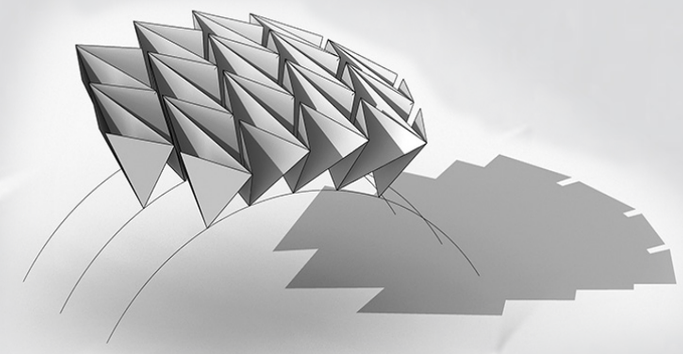
Parametric control and more detail in each face control it in the last phase and add more same details control in each face,and this control is not parametric.

Parametric control details in each face control it in the last phase and the details in each face is control by another parametric way.

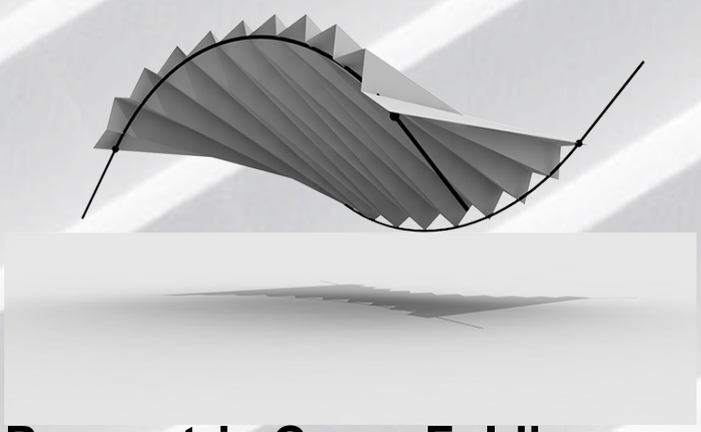
Parametric folding based on 3D objects create parametric folding in an easy way based on complex shapes with para 3D, plugin for 3ds max.



Simple

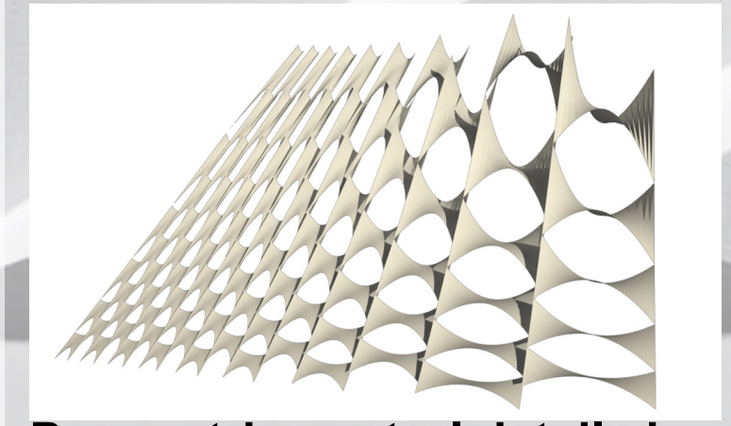


Curve Folding



Parametric Curve Folding

Parametric control details in each face



Parametric control details in each face

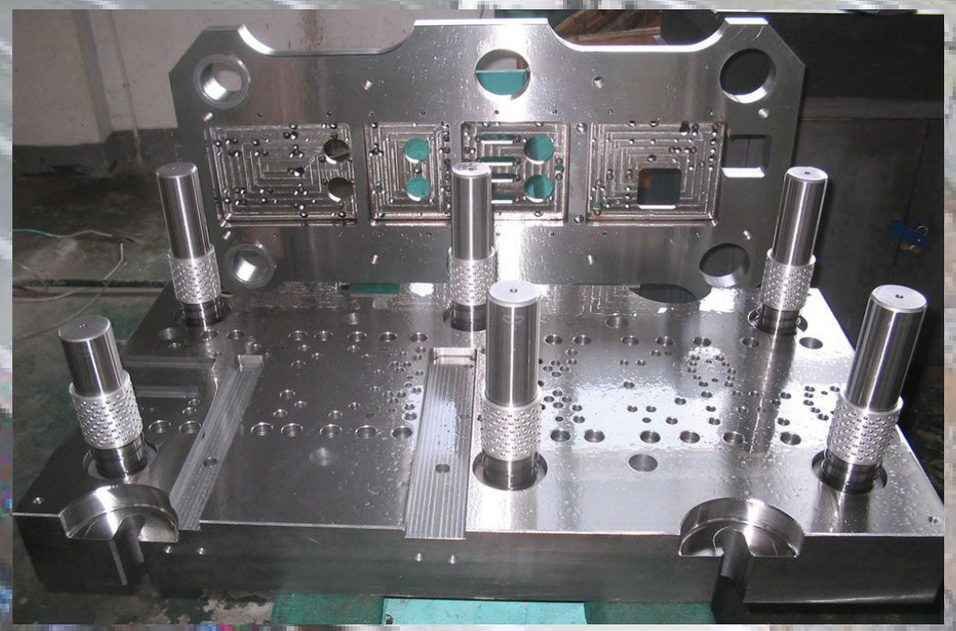
Parametric folding based on 3D objects

FOLDING
TOOLS AND MACHINES

Our project need to use CNC machine and Laser cutting.

CNC: Numerical control (NC) is the automation of machine tools that are operated by precisely programmed commands encoded on a storage medium, as opposed to controlled manually via hand wheels or levers, or mechanically automated via cams alone. Most NC today is computer (or computerized) numerical control (CNC),in which computers play an integral part of thecontrol.
We can go to berlin to use the CNC machine.The followings are some informations about the CNC machines in berlin.
CNC milling cutter MasterPRO 3220 AC Elsign
Work area 200 x 300 cm
Twin die extruder head with striation module, oscillating knife

Software: OptiScout, EnRoute

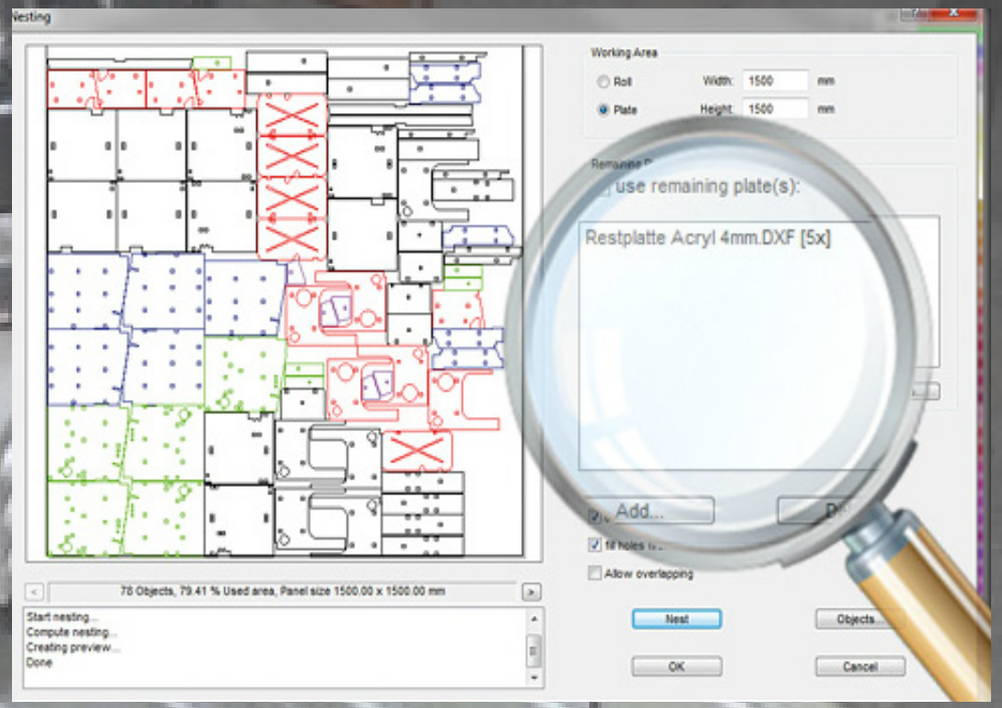


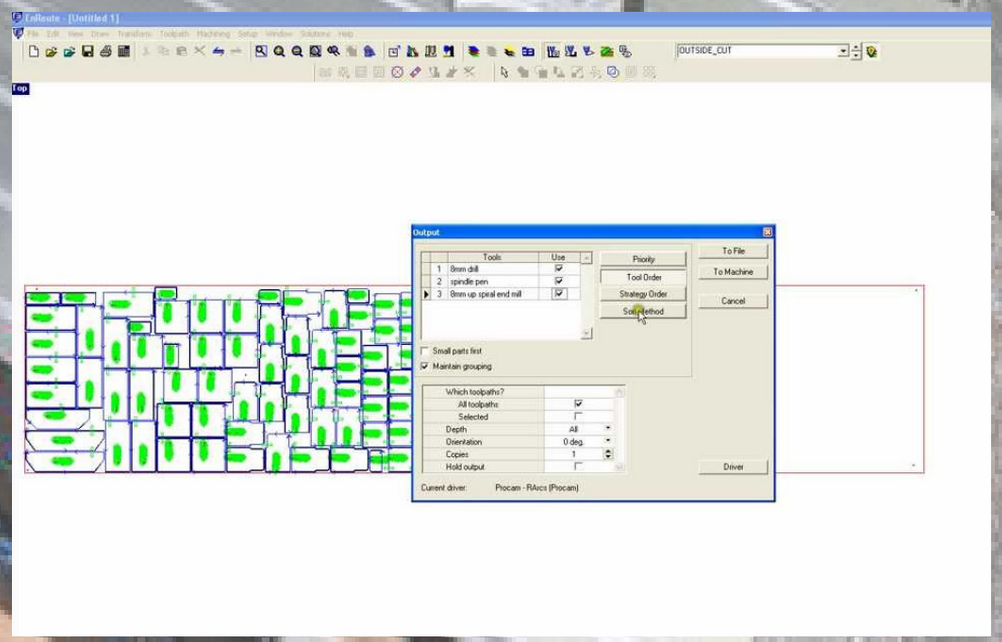
FOLDING

SOFTWARE AND LANGUAGES

OptiScout

Enroute



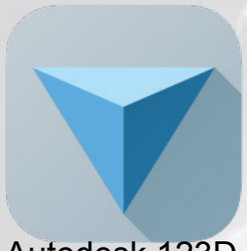


FOLDING
SOFTWARE USED

MODELLING SOFTWARE

Rhino3D

Grasshopper


AUTODESK®
123D® DESIGN
Autodesk 123D Design

FABRICATION SOFTWARE

OptiScout

Enroute

FOLDING
DIY Reykjavik Pavilion

Arnaldur Scram
Ruzhen Zhang

source:http://archinect.com/naldurinn/project/diy-pavilion

DIY Reykjavik Pavilion

Project OUTLINE

Location: Reykjavik, Iceland

Investor: New York design firm Shift

Function: Pavilion

Construction Year: 2010
Dimmensions: 3m High, 20m Diameter

Materials Used: Zinc coated steel, Aluminum, Concrete, Microphones

Budget: 5000 Euro

Major Fabrication Method Used: Radial Sectioning

Fabricated By: Laser-cut

Type Of Construction: Aluminium

Modelling Software: Rhino + Grasshopper

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

DIY Reykjavik Pavilion

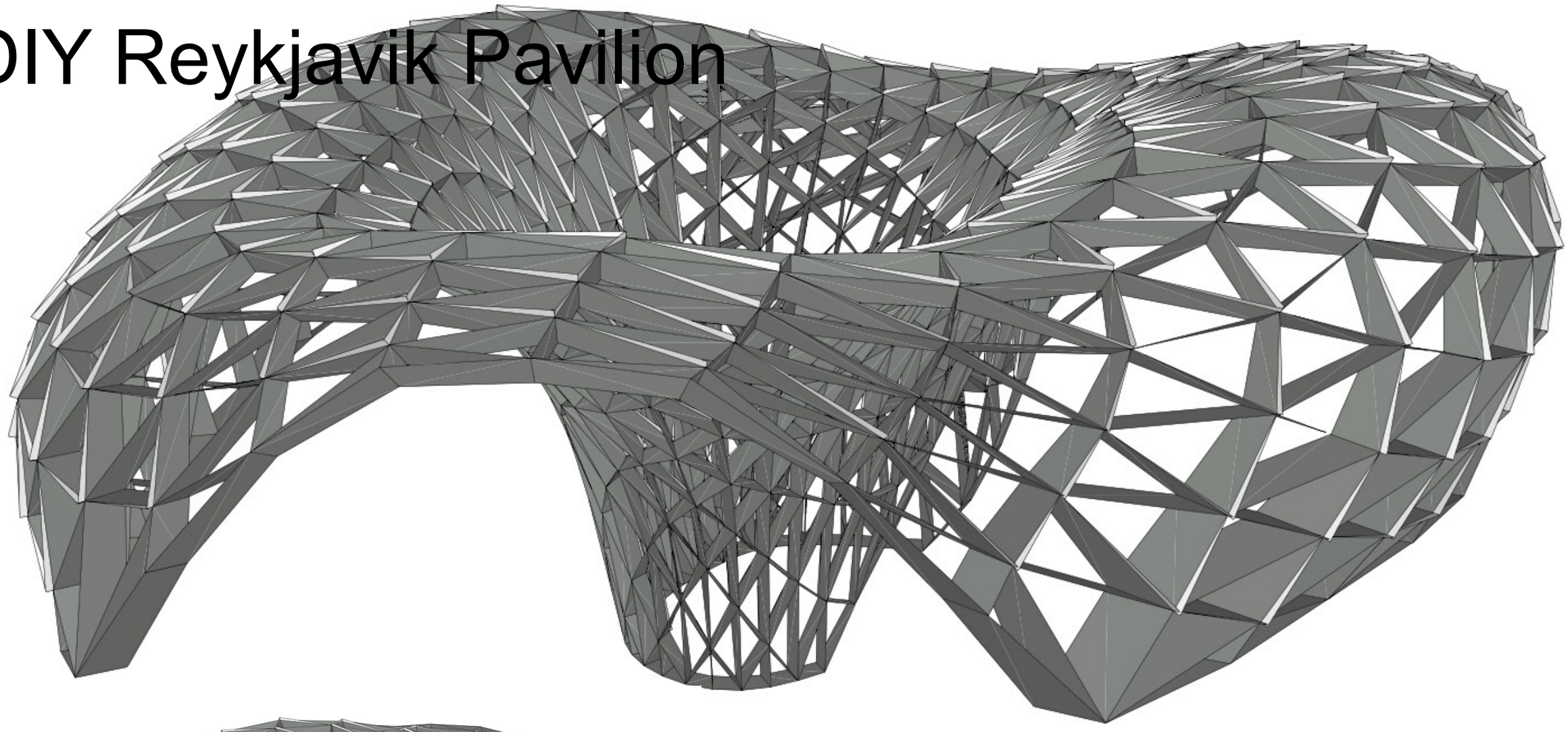
Project DESCRIPTION

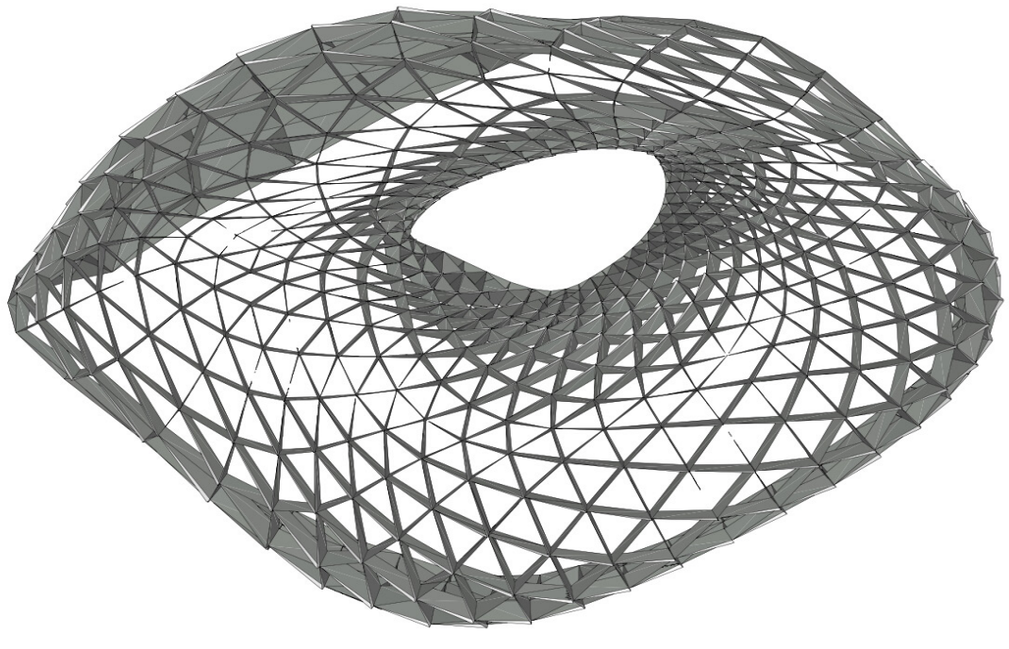
The pavilion is a temporary installation situated in front of the Nordic House in Reykjavik and coincides with the 2009 Reykjavik Design Days and 2009 Reykjavik Art Festival.

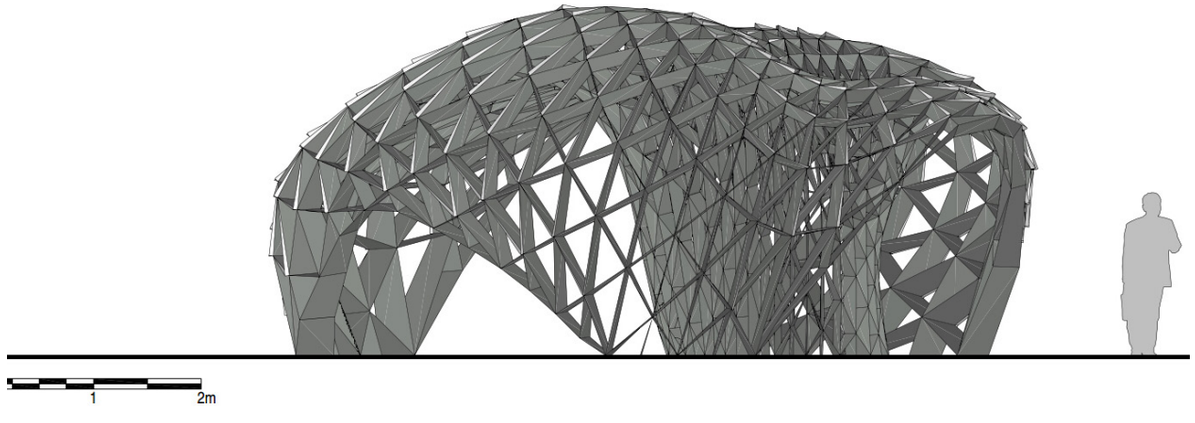
The structure consists of one thousand aluminum triangles – every single piece different in size, shape, fold, and configuration. It was designed and processed through a variety of 3D software, laser-cut, then folded and riveted by hand. Aluminum was deliberately chosen due to its unique structural challenges, its abundance and recyclability, but also for its potential to generate debate about the current and future use of the material.

source:http://www.archello.com/en/project/diy-reykjavik-pavilion

DIY Reykjavik Pavilion







DIY Reykjavik Pavilion

Project FABRICATION

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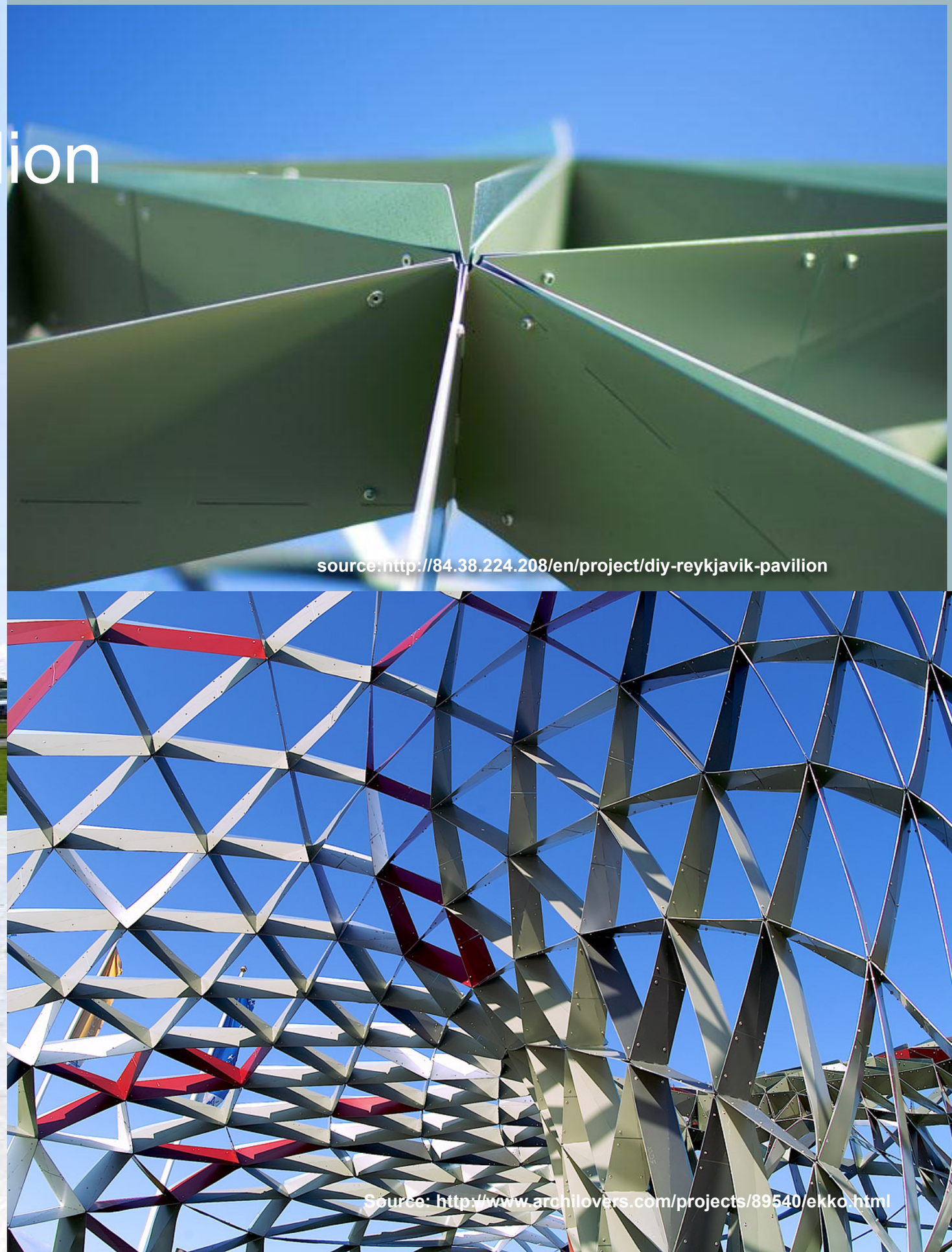
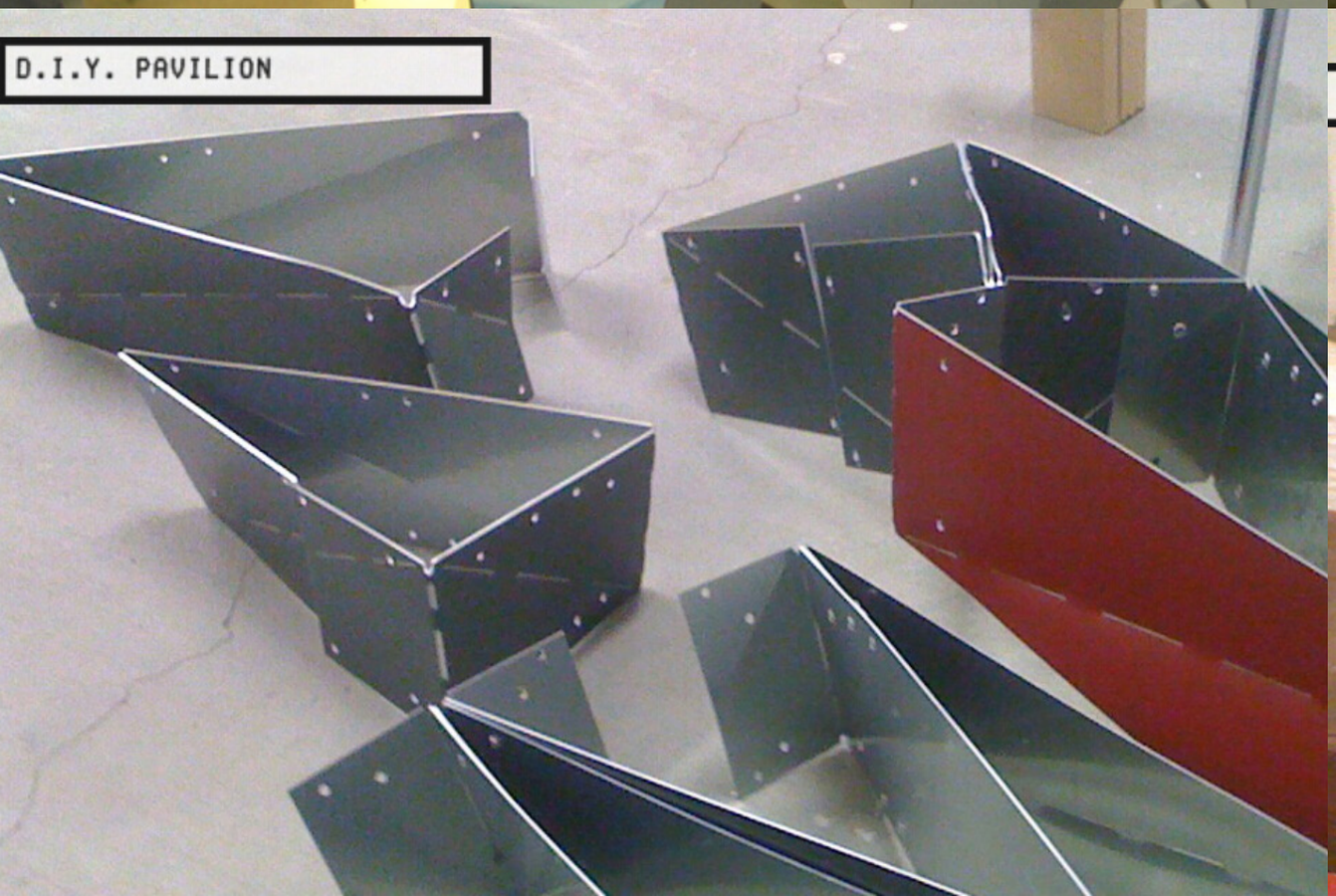


source:http://84.38.224.208/en/project/diy-reykjavik-pavilion

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

DIY Reykjavik Pavilion

Project FABRICATION



DIY Reykjavik Pavilion

Project MATERIALS

DIY Reykjavik Pavilion Quantity Survey		
Aluminium		
	Material	**Quantity**
Main structure		1000
Area		
Gross External		100
Metal Hangers		
“Fence” hangers		200
Connection		
revit		18000

http://www.trendhunter.com/trends/diy-reykjavik-pavilion

DIY Reykjavik Pavilion

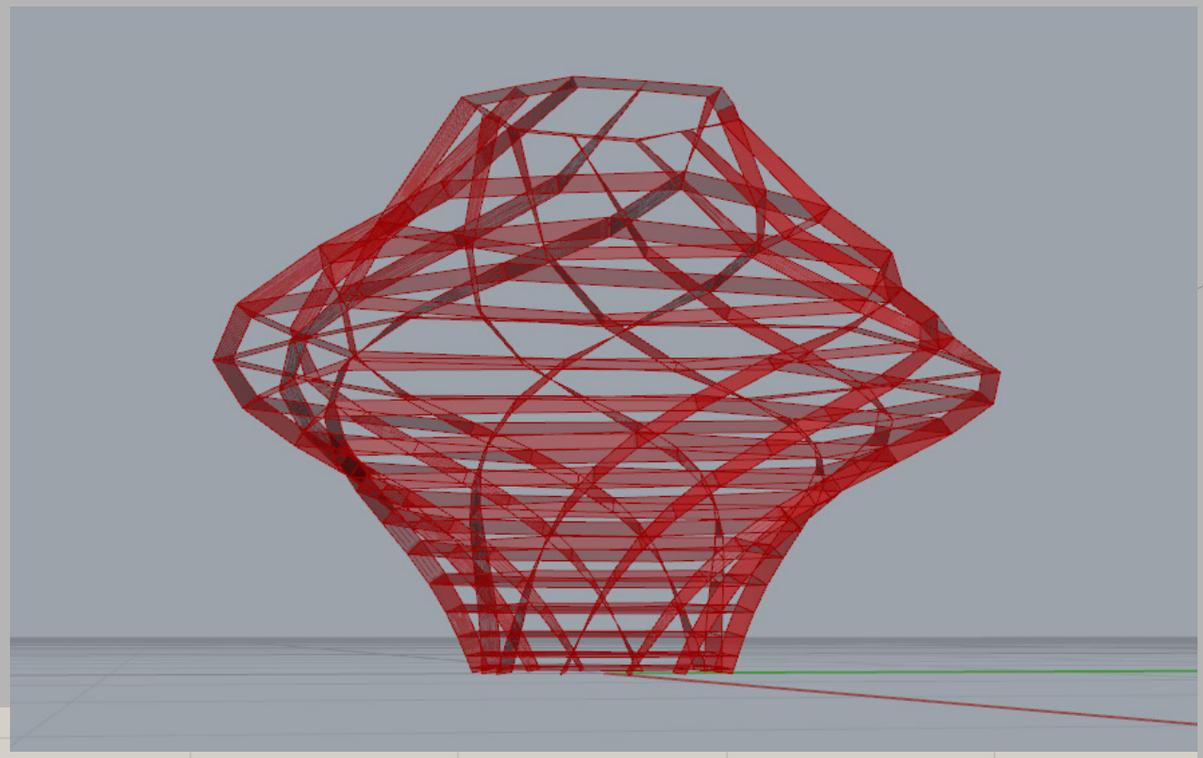
Project MATERIALS

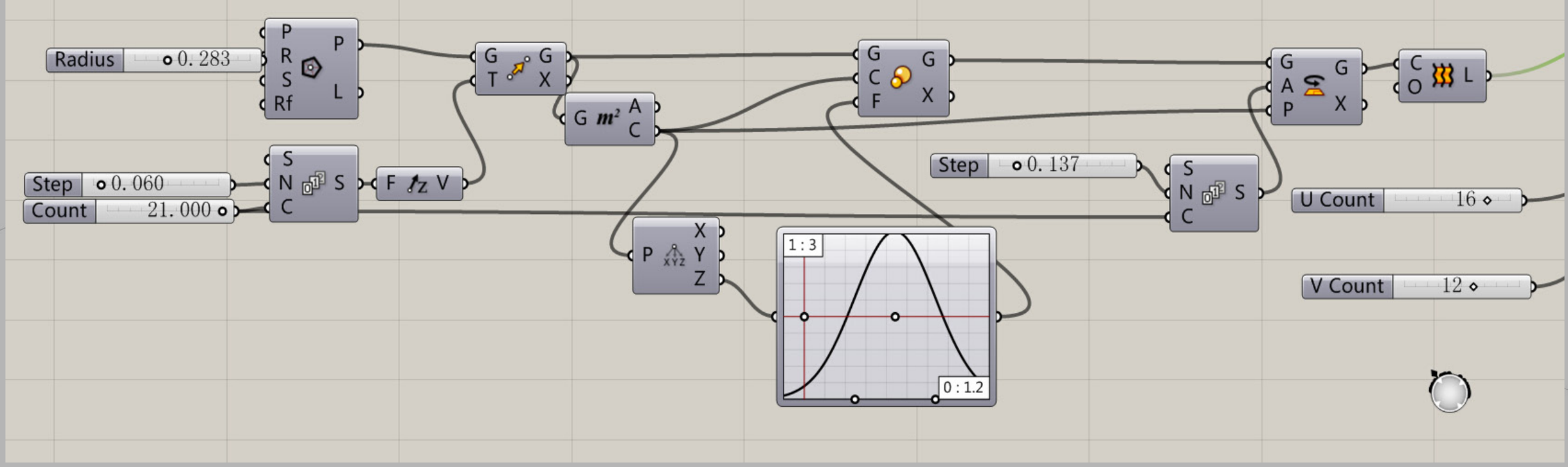
http://http://www.bustler.net/index.php/article/shift_builds_diy_reykjavik_pavilion_in_iceland

source:http://www.dailytonic.com/diy-reykjavik-pavilion-by-shift/

DIY Reykjavik Pavilion

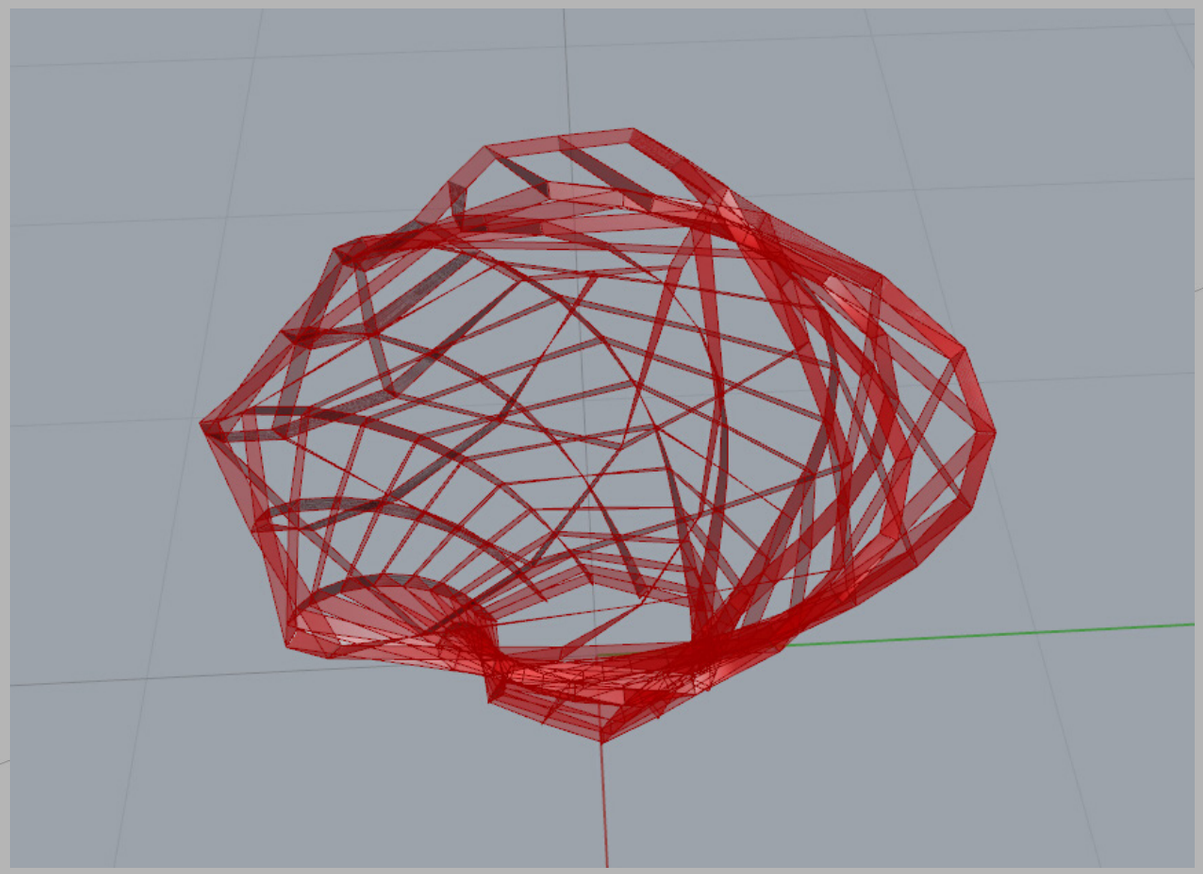
GRASSHOPPER
Modelling

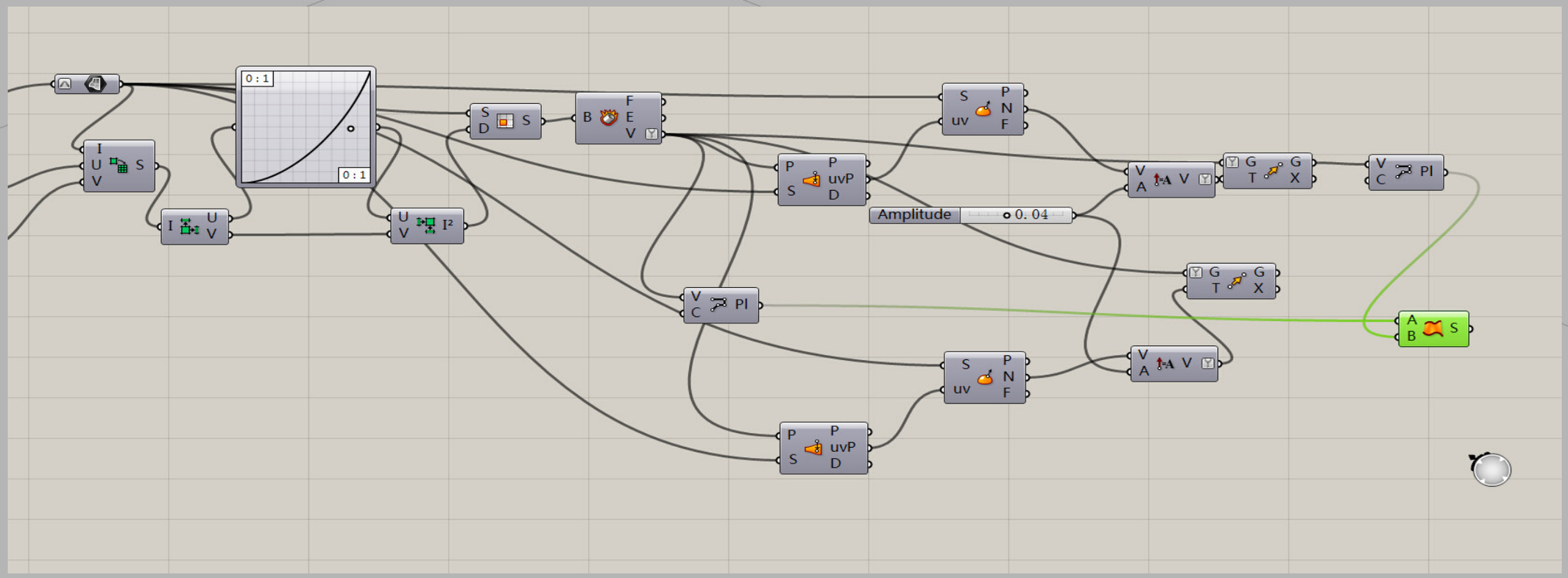




DIY Reykjavik Pavilion

GRASSHOPPER
Modelling





DIY Reykjavik Pavilion

source:http://www.archello.com/en/project/diy-reykjavik-pavilion/image-3

Source: http://www.bustler.net/index.php/article/shift_builds_diy_reykjavik_pavilion_in_iceland/

FOLDING
Accordion-Like ReCover Shelter

Mathew Malone

Xiaocha Jiang

Source: http://greenupgrader.com/3434/recover-disaster-shelter-by-mathew-malone/

Accordion-Like ReCover Shelter

Project OUTLINE

Project Architect / Artist: **Mathew Malone**
Location: the Gulf Coast

Function: Pavilion

Construction Year: 2008

Materials Used: polypropylene

Budget: very low

Major Fabrication Method Used: Folding

Fabricated By: CNC

Type Of Construction: folding construction

Modelling Software: Rhino + Grasshopper

Source: http://greenupgrader.com/3434/recover-disaster-shelter-by-mathew-malo-

Accordion-Like ReCover Shelter

Project DESCRIPTION

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

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

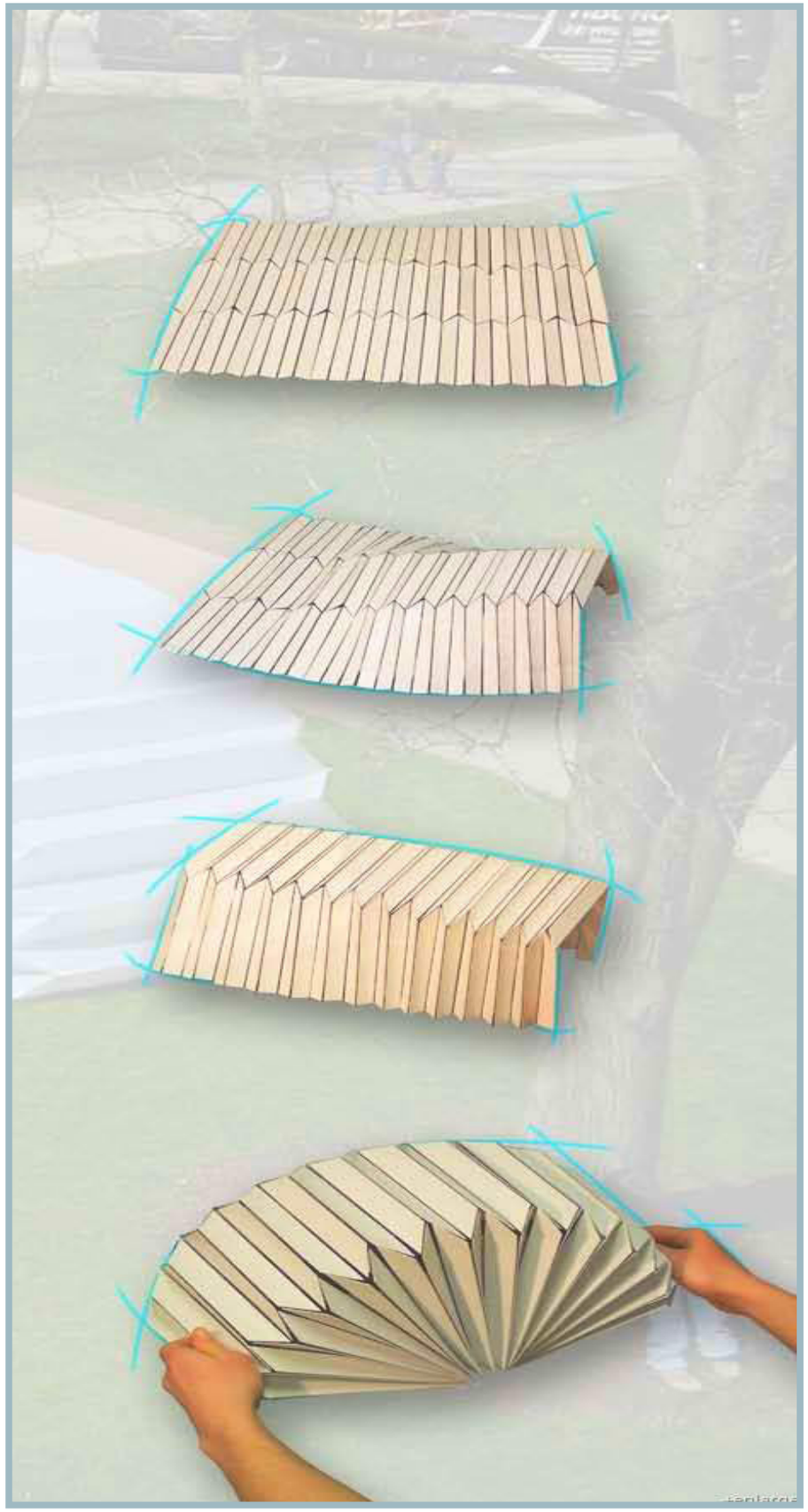
http://greenupgrader.com/3434/recover-disaster-shelter-by-mathew-malone/http://architizer.com/blo-

Accordion-Like ReCover Shelter

Project FABRICATION

The material is a food grade polypropylene (it is corrugated and something akin to some printed commercial signs) that can be folded into a flat sheet, stacked with hundreds of other for transport, set up by one person, and even zip tied together to make longer or more intricate structures. The material (which may be recycled after its intended use if damaged) is completely non-toxic in terms of leaching and gassing out. This is important for confined living spaces and water safety. In fact, the ridges of the structure allow for water runoff to be collected for use.

The reCover shelter can be secured in place to protect against wind movement and can be covered with local materials or vegetation to provide additional warmth and protection from the elements. The ability to add twists and turns to the structure means you can add walls and some privacy to an abode. Also, the material can be unfolded at the creases into a single sheet that lays flat. This could act as a floor for a overarching structure providing insulation from the earth.



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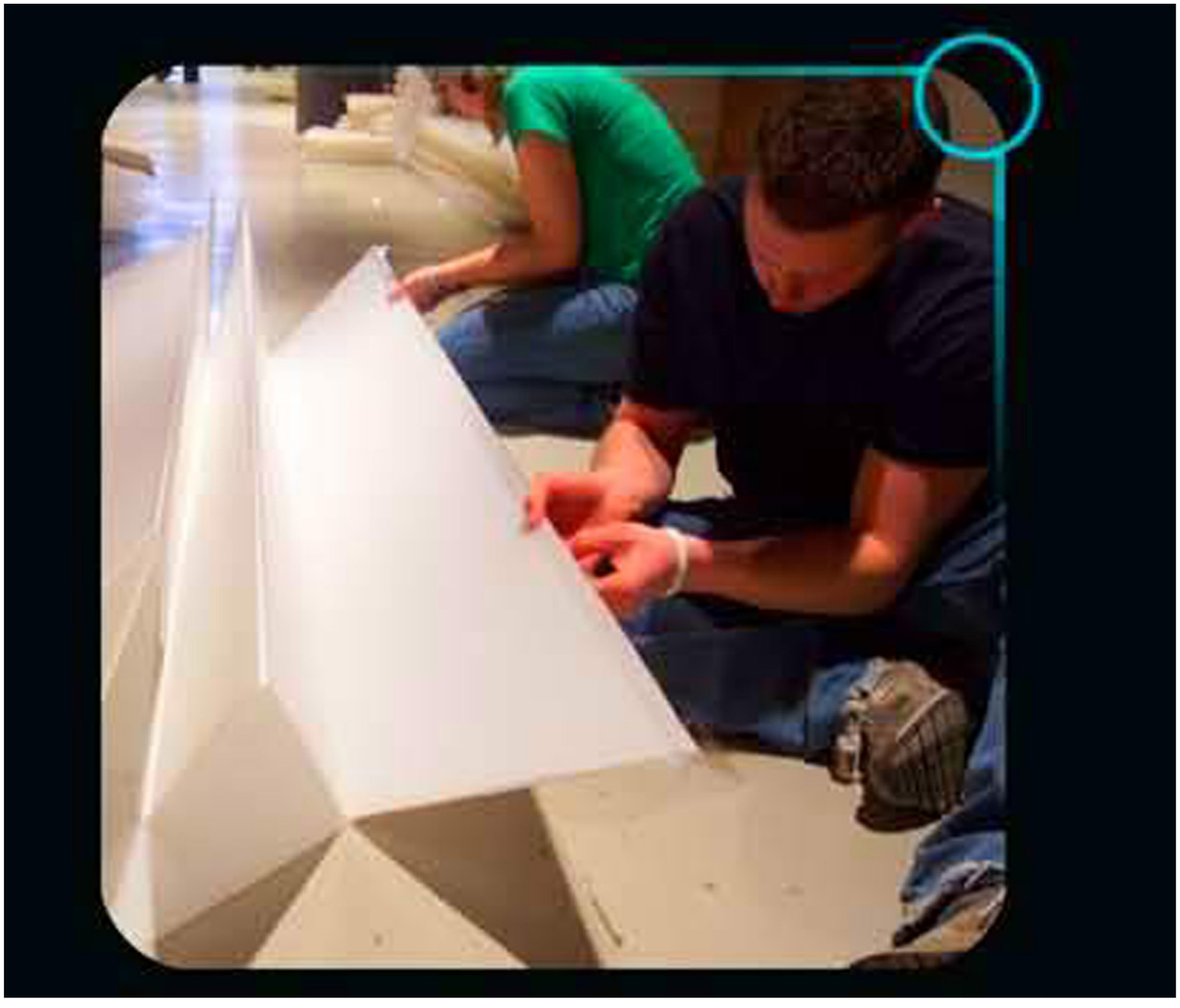
Accordion-Like ReCover Shelter

Project FABRICATION



Accordion-Like ReCover Shelter

Project MATERIALS

Accordion-Like ReCover Shelter **Quantity Survey**		
polypropylene		
	Material	**Quantity**
Surrounding “fence”	78x98, 3M	200
Main structure	78x98, 2.5M	800
Concrete		
Pathway		12M^3
Metal Hangers		
“Fence” hangers		200
Stainless Steel Wire		
Wire	3x60-80M	200M

Source: http://greenupgrader.com/3434/recover-disaster-shelter-by-mathew-malone/

Accordion-Like ReCover Shelter

Project MATERIALS

recover

benefits

1 The Recover shelter is 100% recyclable.

2 The ridges of the structure can be used to collect drinking water. It is made of a non-toxic polypropylene.

3 There is no harmful leaching or out gassing to contaminate the users or the environment.

4 The shelter can be covered in local materials for insulation. This also makes it a more permanent structure.

5 Many units can be transported on the same trailer at the same time.

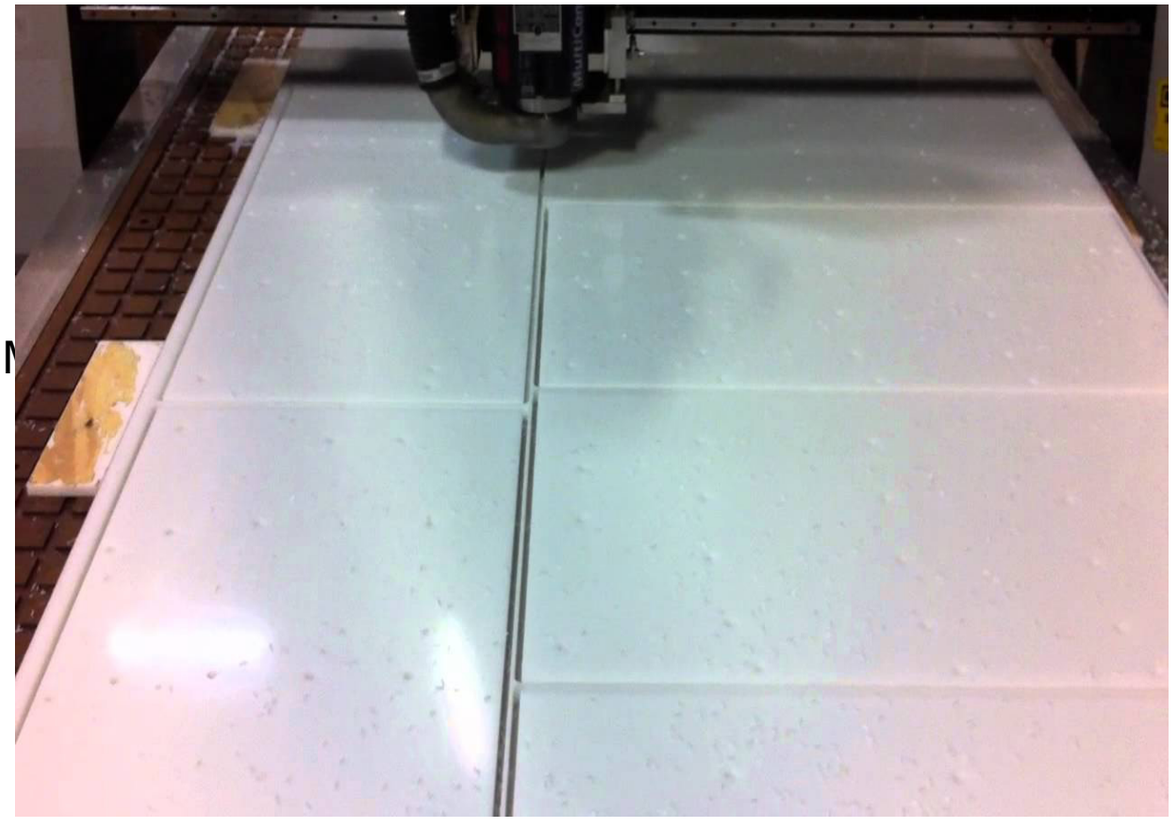
6 The shelter can easily be set up in minutes.

Accordion-Like ReCover Shelter

Project MACHINE / SOFTWARE

Description of machine (3D printer, CNC, etc.).
Software used.

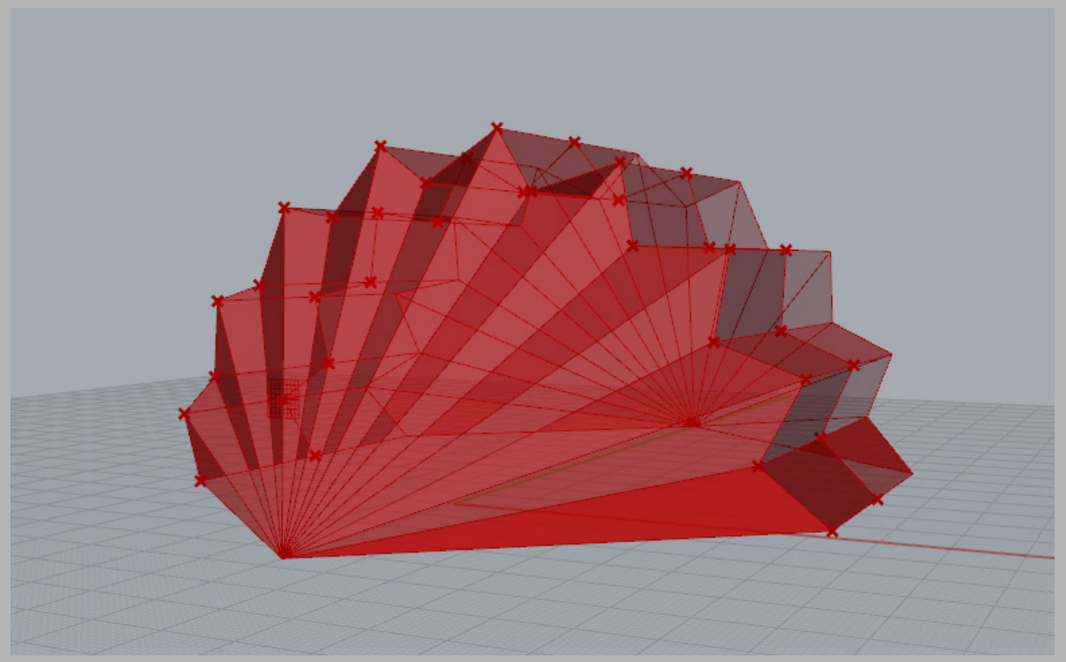
Please include photos.

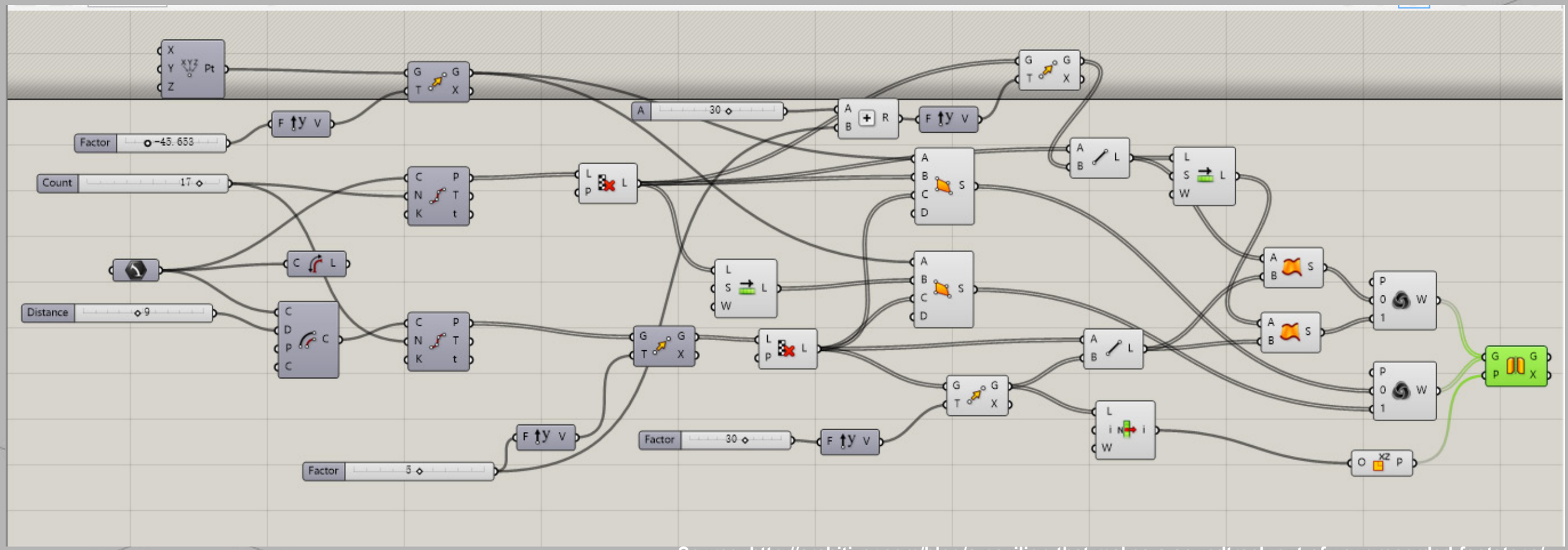


Machine / software photos. Please Source.

Accordion-Like ReCover

GRASSHOPPER
Modelling





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

FOLDING
LOS MANANTIALES
FELIX CANDELA
Ruda Adolpho Conti Gonçalves de Carvalho

Source: http://madebyalyse.blogspot.de/2013_03_01_archive.html

Los Manantiales

Project OUTLINE

Project Architect / Artist: Felix Candela

Location: Mexico City, Mexico

Investor: XXXXXXXX

Function: Restaurant

Construction Year: 1958

Dimmensions: 8.25m High, 42m Diameter

Construction Team: XXXX

Materials Used: Reinforced concrete, Glass, Aluminium.

Budget: XXXXXXX

Major Fabrication Method Used: Molded in Place

Secondary Fabrication Methods: XXXXXXXXXX

Fabricated By: XXXXXXXX

Type Of Construction: Concrete Shel

Modelling Software: XXXXXXXXXX

Source:http://www.archdaily.com/496202/ad-classics-los-manantiales-felix-candela/

Los Manantiales

Project DESCRIPTION

Candela did’nt want to crash the tradicion and the nature of the place, so he decided to propose a building, as an object that floats from its structure, resembling a flower lotus floating on the water. The result was a kind of flower-like float

Source: http://www.panamericanwrld.com/es/articulo/felix-candela-arquitecto-espanol-adoptado-mexico

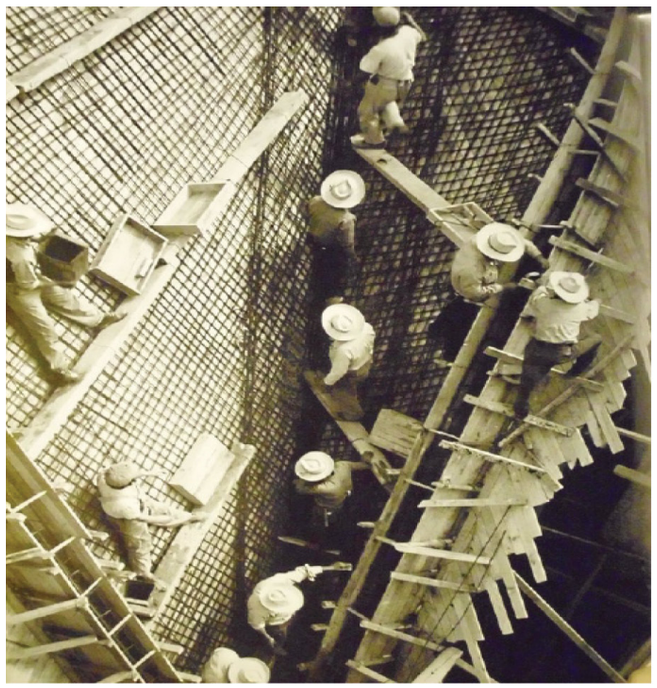
Los Manantiales

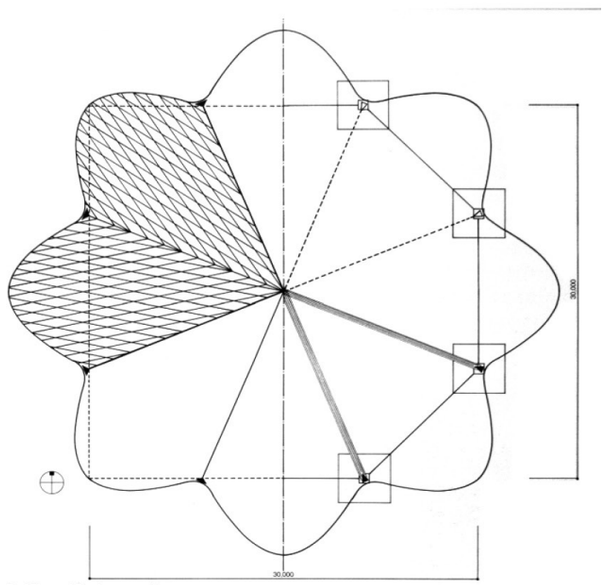
Project DESCRIPTION

Los Manantiales utilizes reinforced concrete as a concrete shell. That kind of structure was the first kind of folding structure maded.

The concrete shell serves as the own structure of the build. They are maded in place above wood shapes, and after was used glass as the windows and locks.

Source: http://www.archdaily.com/496202/ad-classics-los-manantiales-felix-candela/



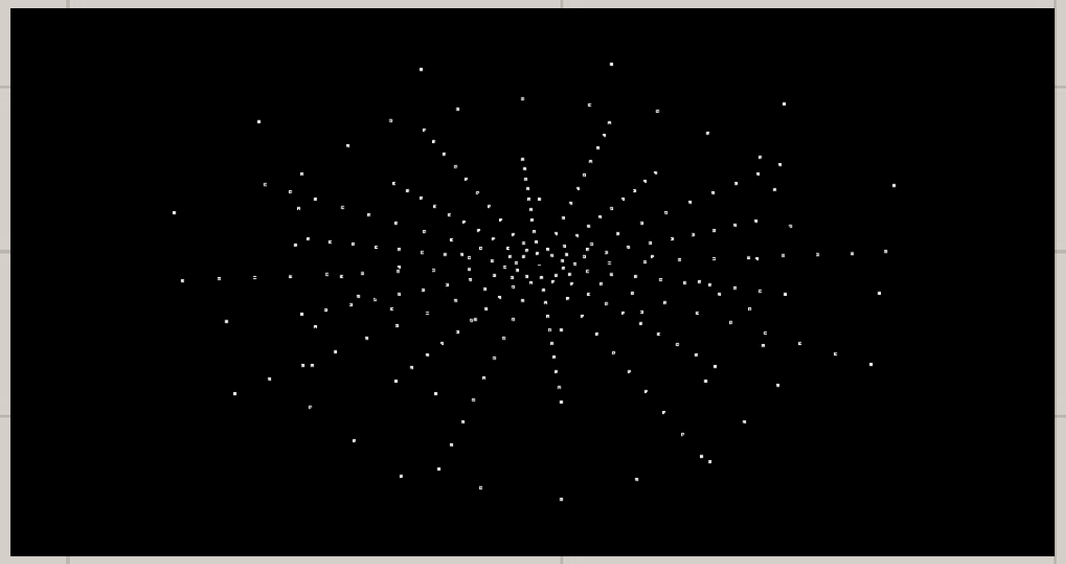


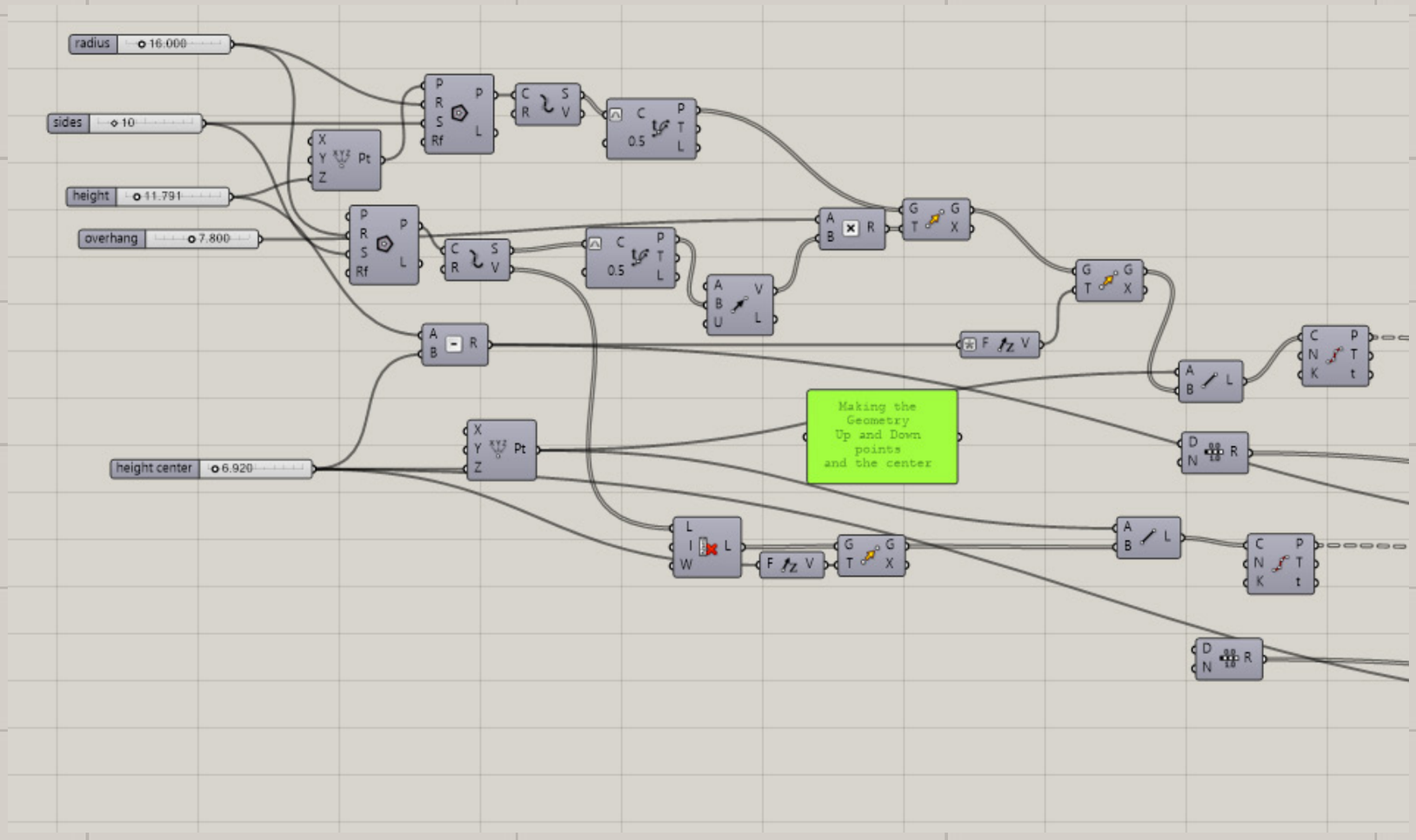
Roof Plan and Bar Arrangement

Source: http://www.archdaily.com/496202/ad-classics-los-manantiales-felix-candela/

Los Manantiales

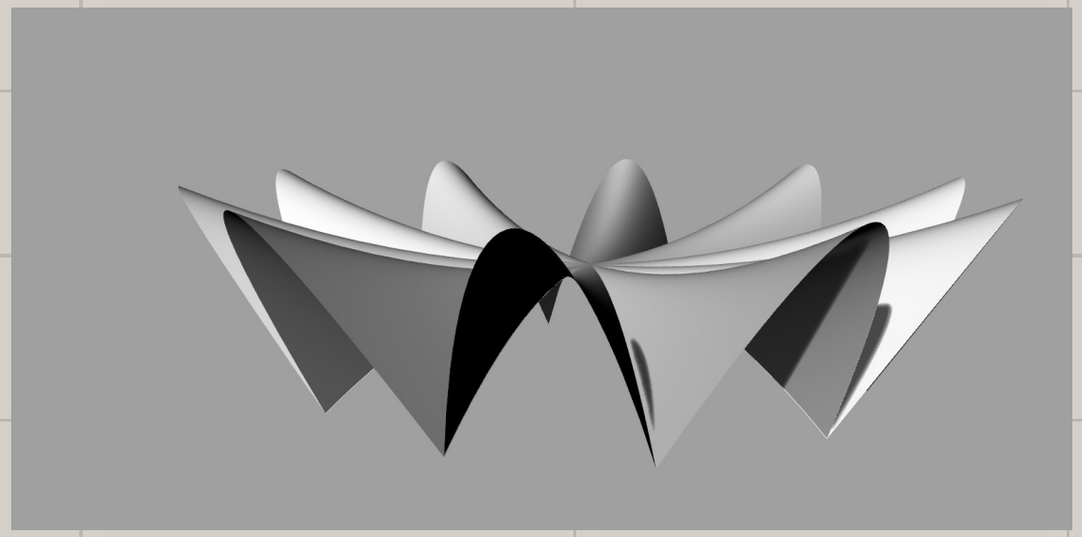
GRASSHOPPER
Modelling

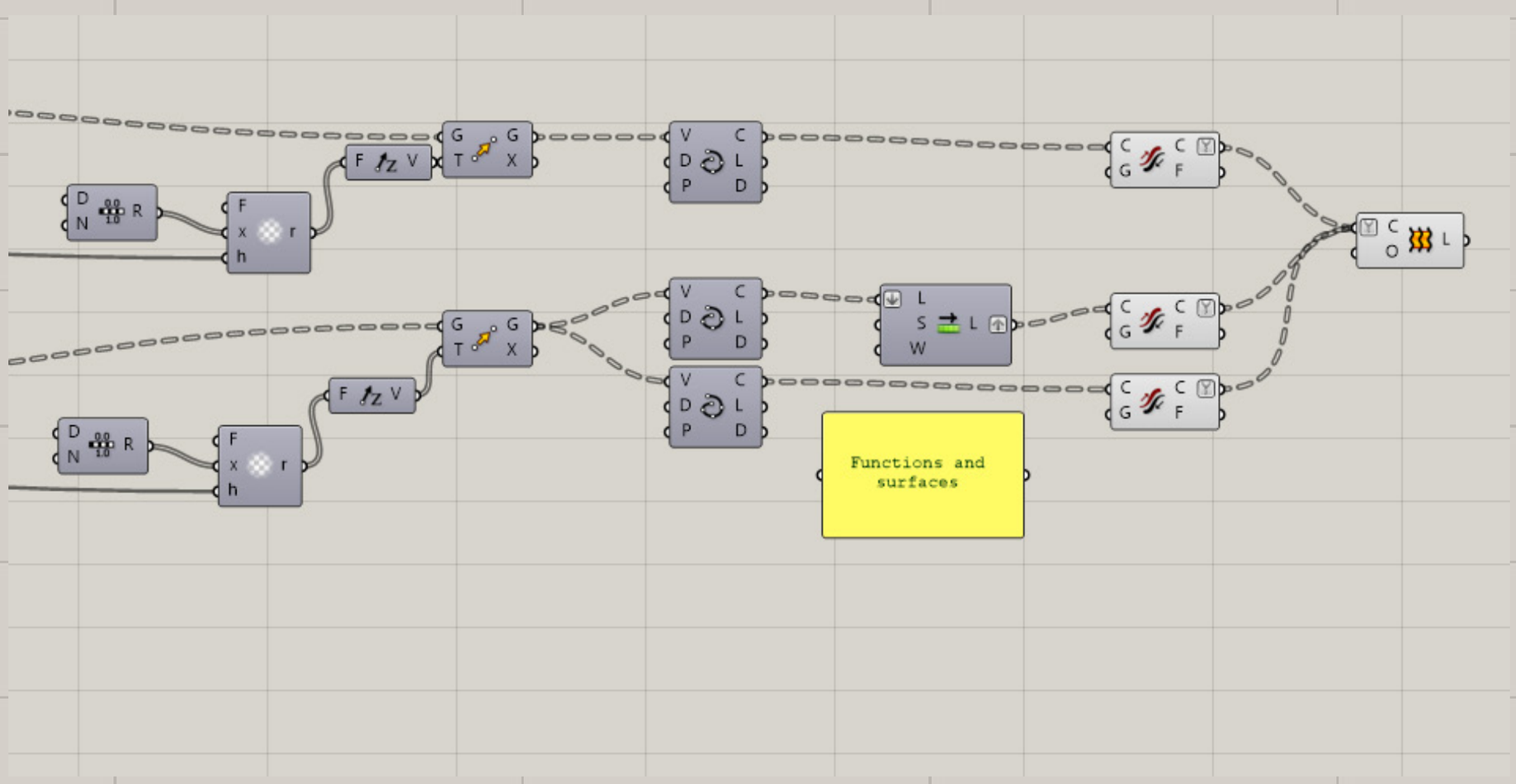




Los Manantiales

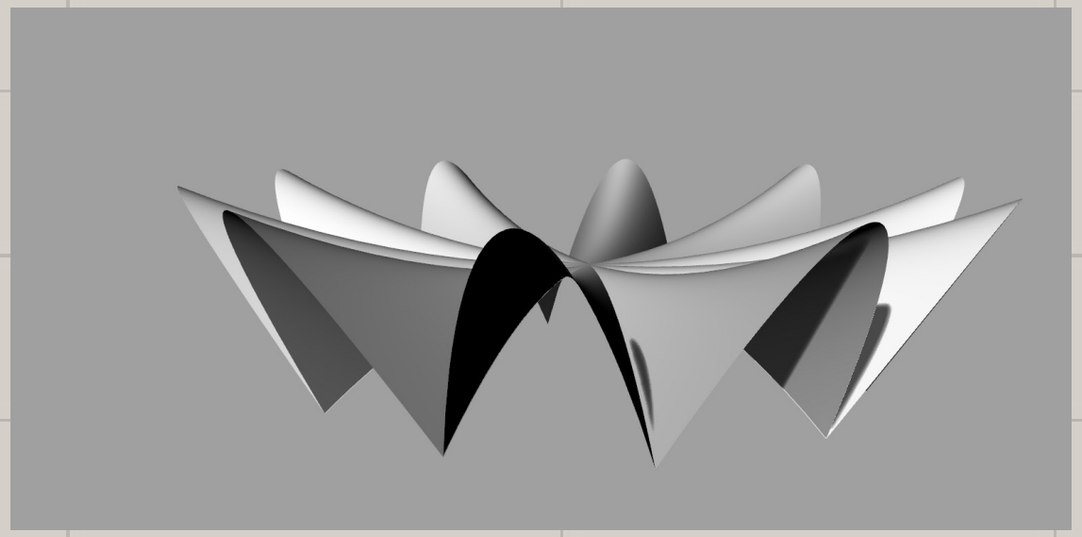
GRASSHOPPER
Modelling

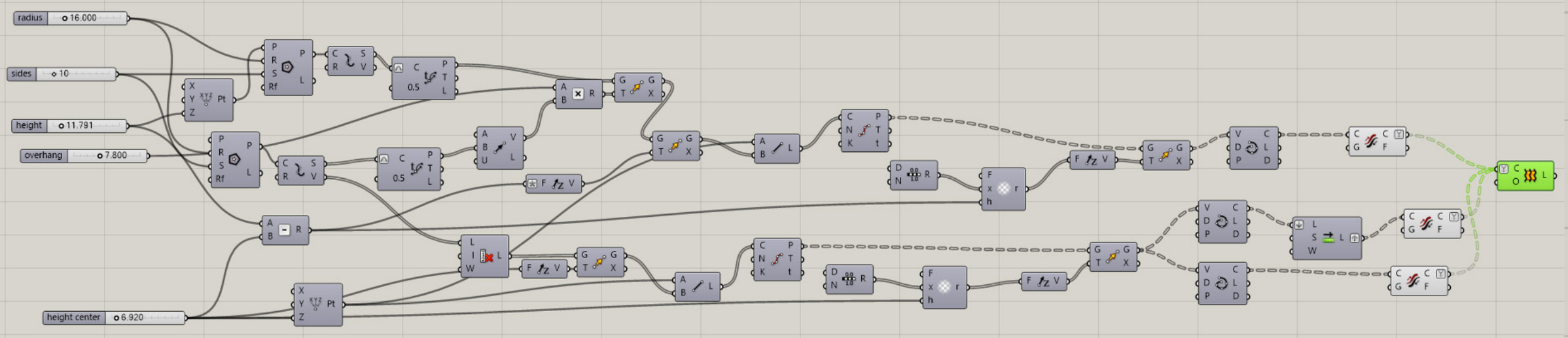




Los Manantiales

GRASSHOPPER
Modelling





FOLDING PLEATS.M

Hironaka Ogawa

Ke Chen 4061498

Source: http://www.archdaily.com/338149/pleats-m-hironaka-ogawa-associates

PLEATS.M

Project Overview

Project Architect / Artist: Hironaka Ogawa&Associates

Location: Saitama, Japan

Investor: Wedding Group Pleats.M

Function: Wedding Hall

Construction Year: 2013

Dimmensions: **9.6m high, 47m wide**

Construction Team: Construction and Installation Co., Ltd., Saitama

Materials Used: Wood, White Coatings, Steel, Alumi num, Concrete.

Budget:

Major Fabrication Method Used: Folding Pleats

Secondary Fabrication Methods:

Fabricated By: CNC Machine,Crane,Pneumatic drill, Piledriver

Type Of Construction: Reinforced Concrete structure

Modelling Software: Rhino + Grasshopper

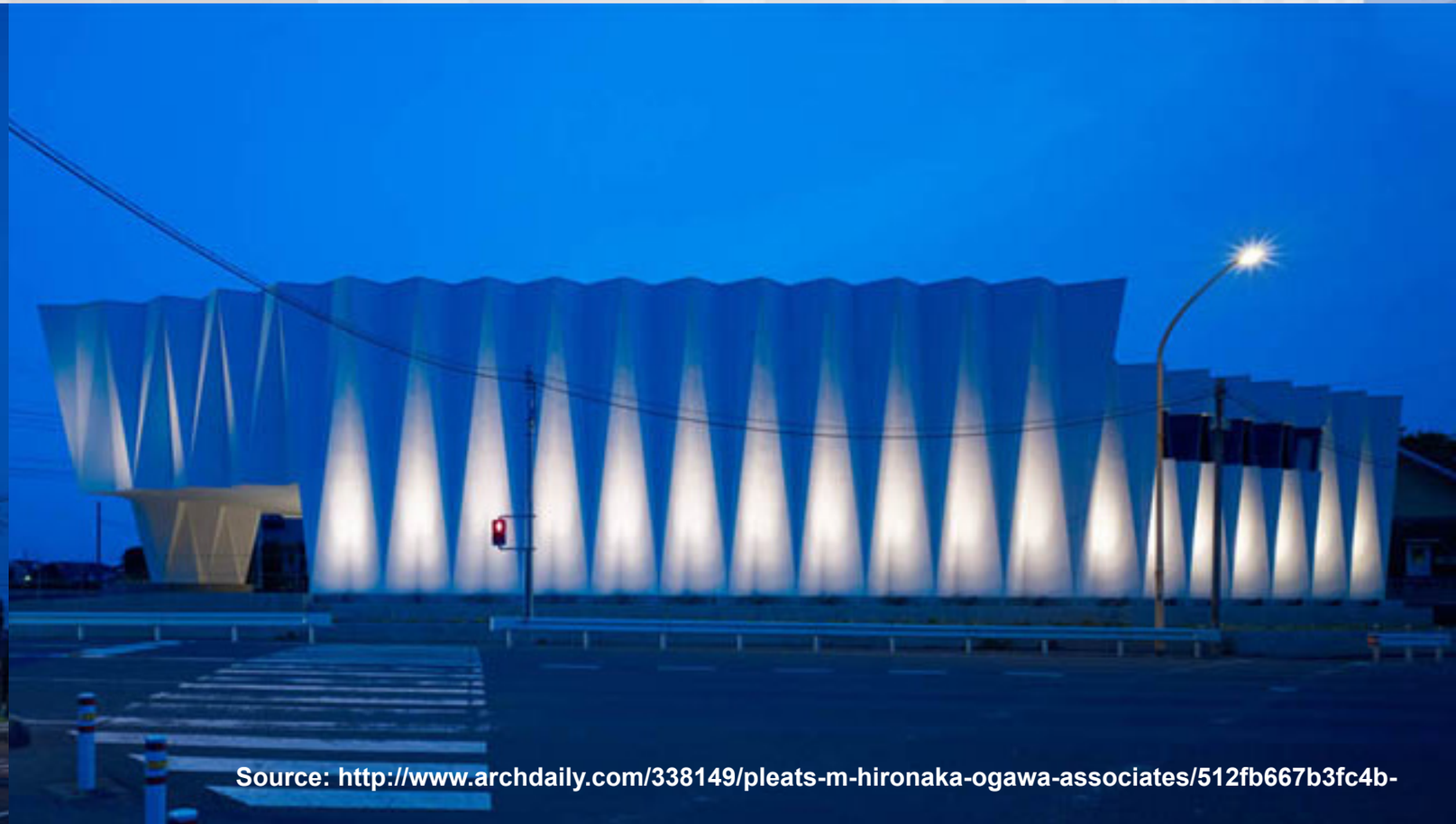
Source: http://www.archdaily.com/338149/pleats-m-hironaka-ogawa-associates/512fb590b3fc-

Pleats.M

Project Description

This is a project for a wedding facility located by a suburban road. The client desired to launch a fresh wedding brand and requested me to create a design that will be repeatable in their following developments.
Also, the client desired a new concept for their facility that reflected their unique site. Ordinary and traditional suburban wedding facilities would not use sites as narrow and irregularly shaped as this one.
In addition, the pleats make shadows that change slowly by the sun further creating various looks each season. The pleated wall has reversed pattern on its back counterpart. Therefore, even a single pleated wall shows different looks on its exterior and interior simultaneously.
Pleats on clothing bring a unique richness by folding a large fabric. It is a very simple rule to fold. However, diverse folds host many functions such as structure, decorations, and sound reflectors. The uniquely pleated walls serve as both decorations and building structures. Thereby the pleated walls create various spaces for wedding ceremonies.

Source: http://www.archdaily.com/338149/pleats-m-hironaka-ogawa-associates/512fb56fb3fc4b-

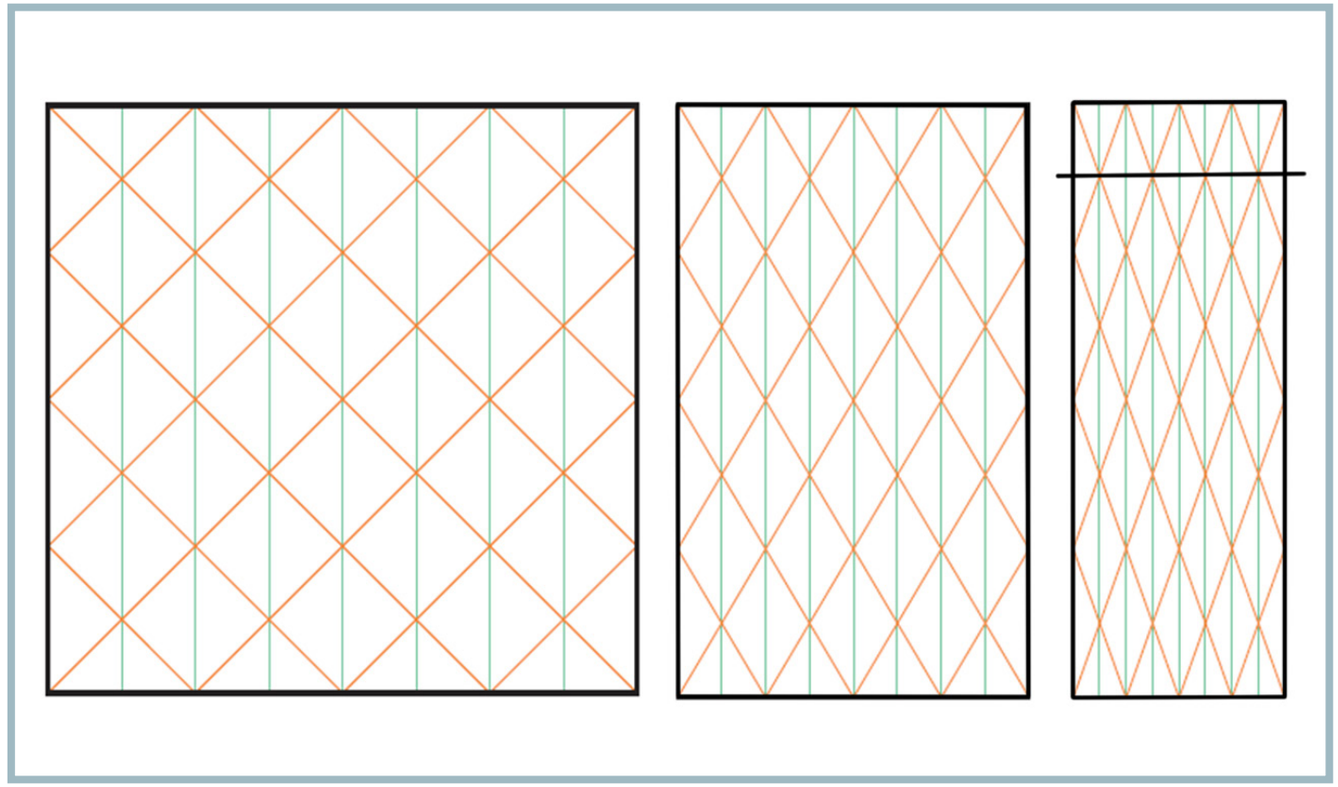


Source: http://www.archdaily.com/338149/pleats-m-hironaka-ogawa-associates/512fb667b3fc4b-

Pleats.M

Project Fabrication

The idea of Pleats.M cames from the pleats of womens pleated skirts and originated in origami.
The crease pattern here is the same as in but is stretched horizontally so that the angle between the strokes of each X is 60°, not 90° as before. The result is to make a span that curls so quickly back on itself that it hardly makes a span at all.



Source: http://www.archdaily.com/338149/pleats-m-hironaka-ogawa-associates/512fb5a2b3fc4b-

Pleats.M

Project Fabrication

Pleats.M

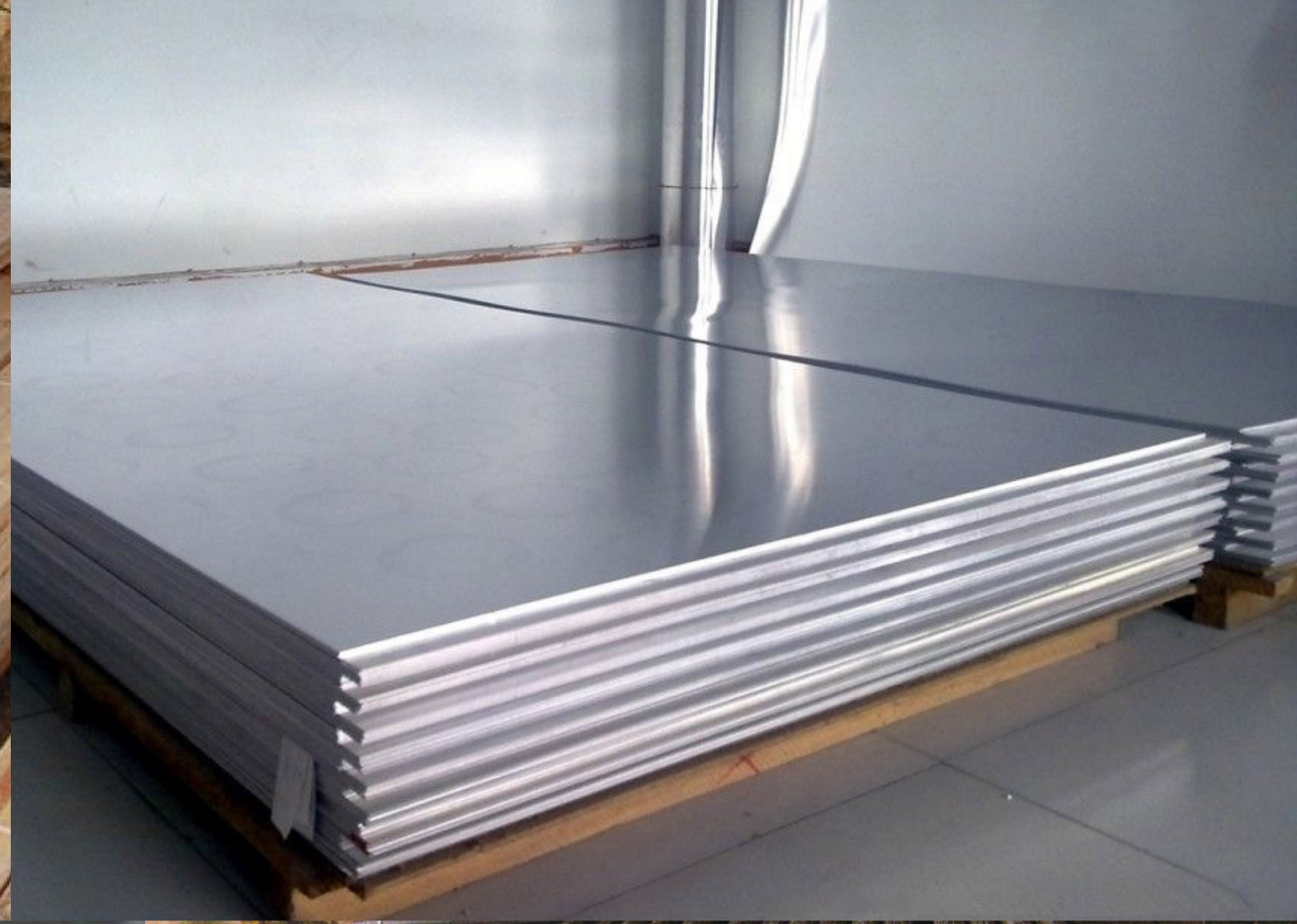
Project Material

Pleats.M		
Quantity Survey(mm)		
	Material	**Quantity**
Aluminum Plates	6sqm	352
Wood	5m	100
Concrete		
Concrete	4ton	
Metal Hangers		
Steel	10m	200

Source: http://www.archdaily.com/338149/pleats-m-hironaka-ogawa-associates/512fb5e4b3fc4ba0ee-

Pleats.M

Project Materials



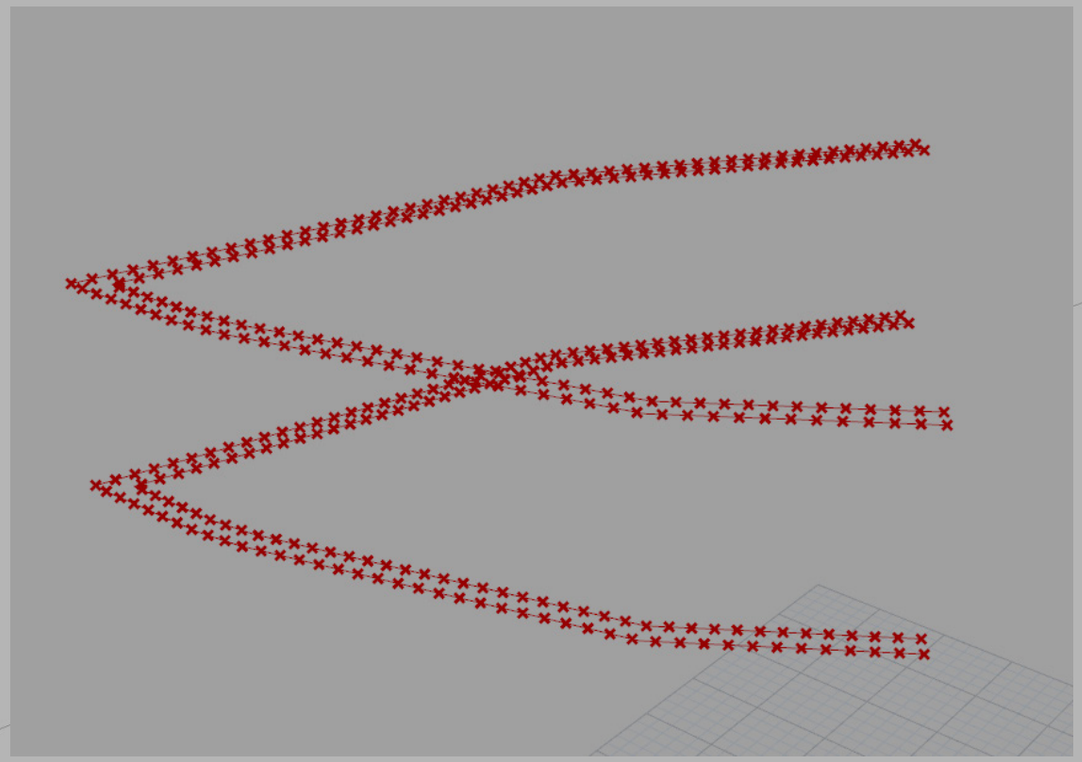
Pleats.M

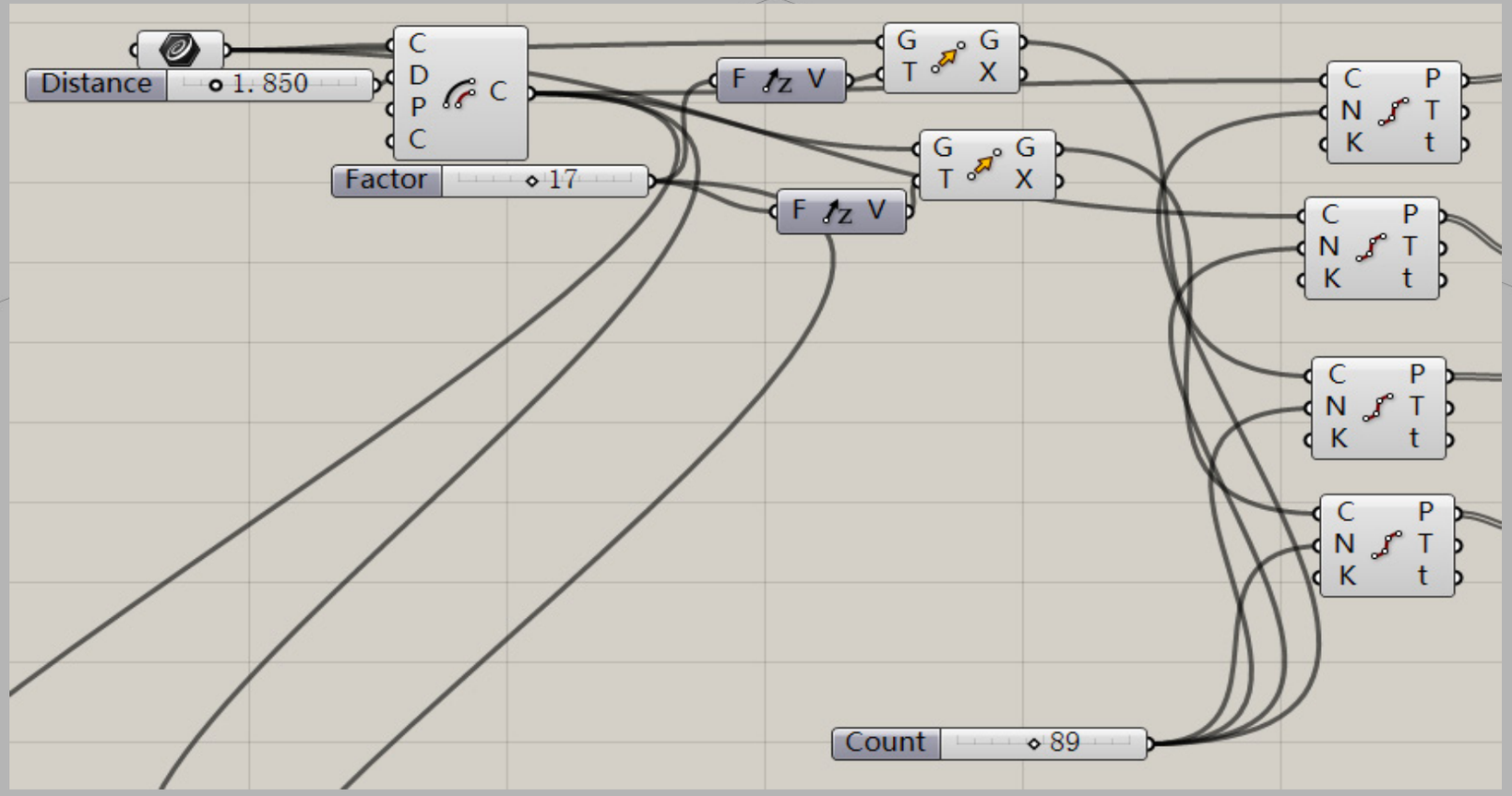
Project Machine / Software

Machine: CNC Machine,Crane,Pneumatic drill, Piledriver

Pleats.M

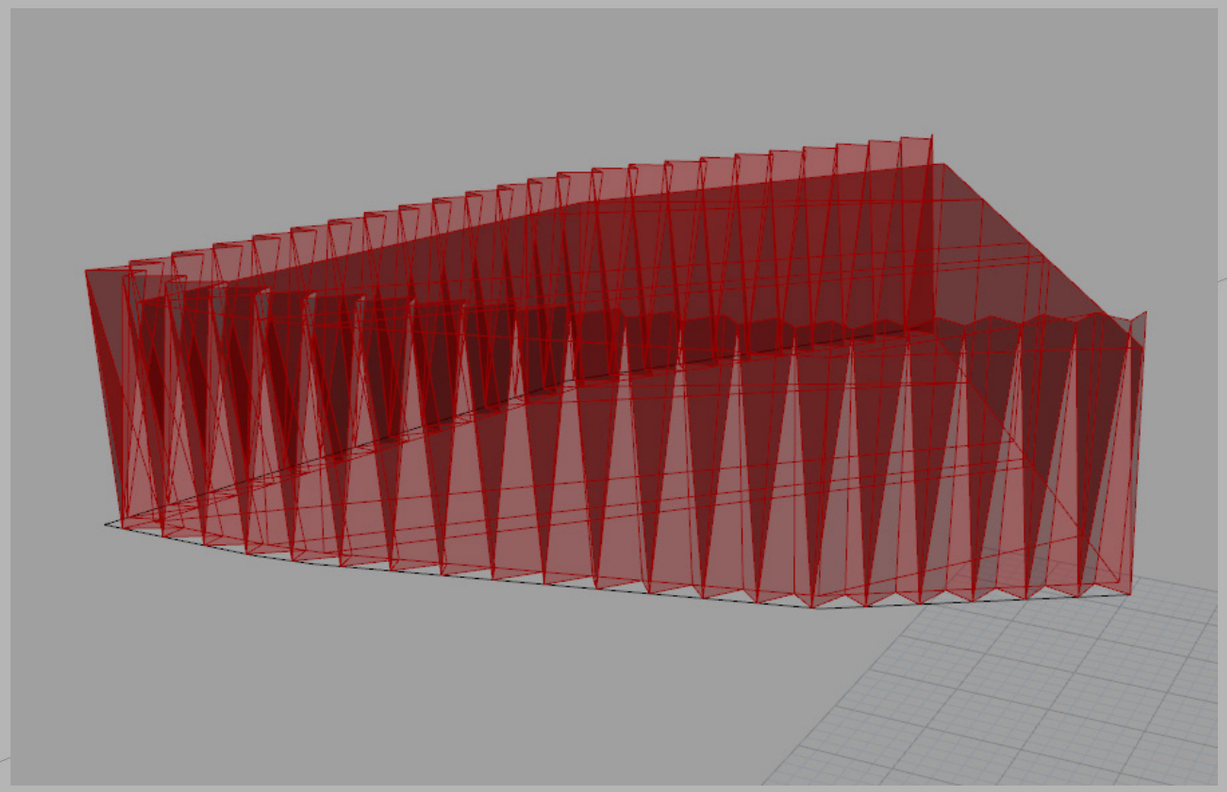
GRASSHOPPER
Modelling

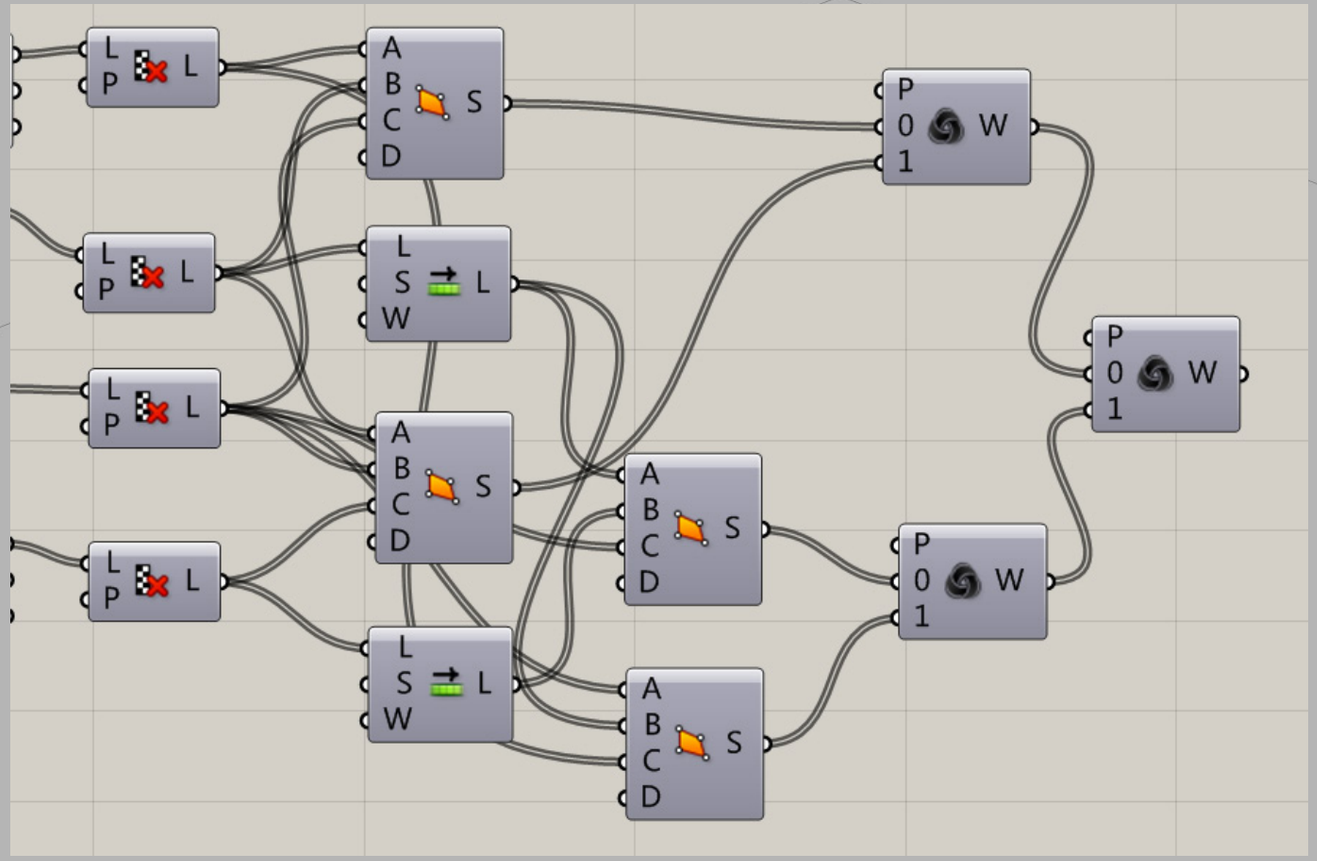




Pleats.M

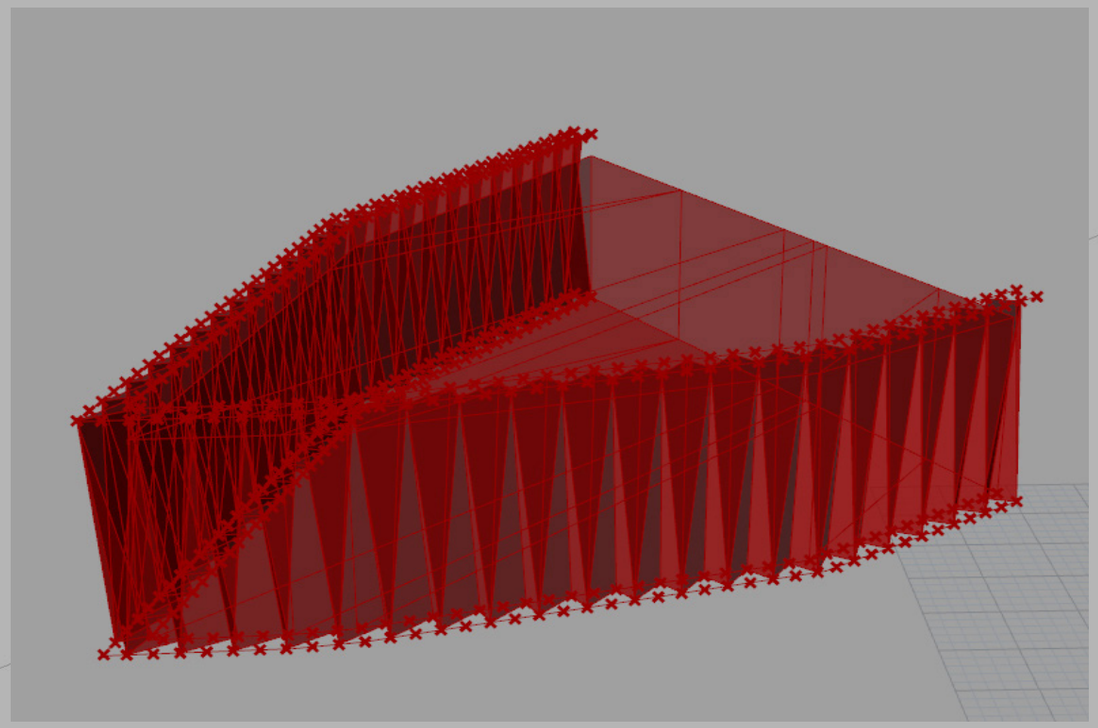
GRASSHOPPER
Modelling

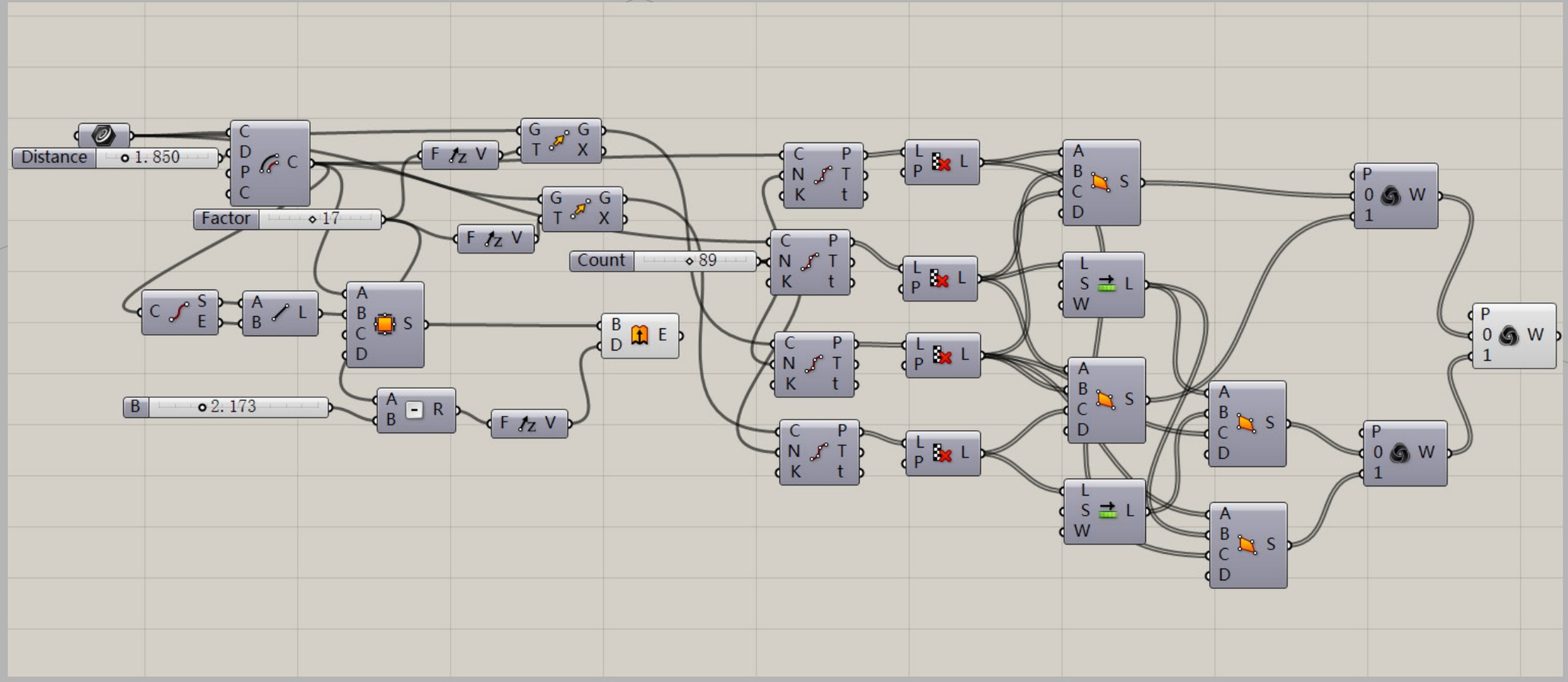




Pleats.M

GRASSHOPPER
Modelling

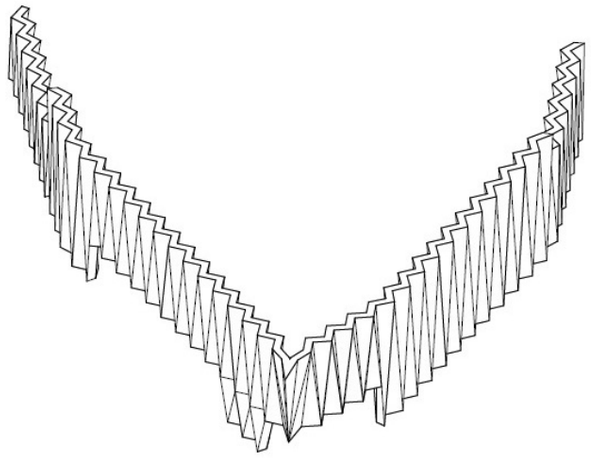


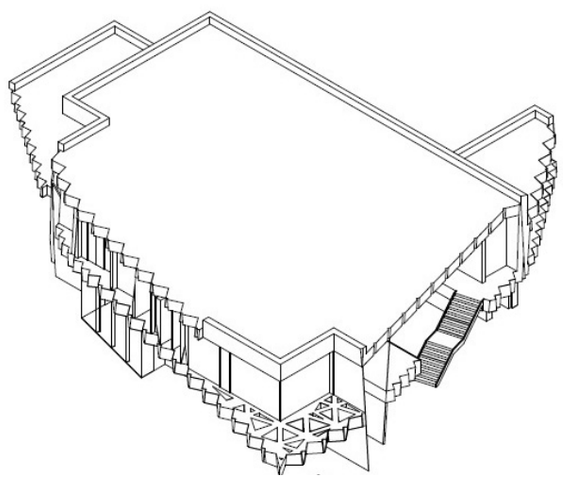


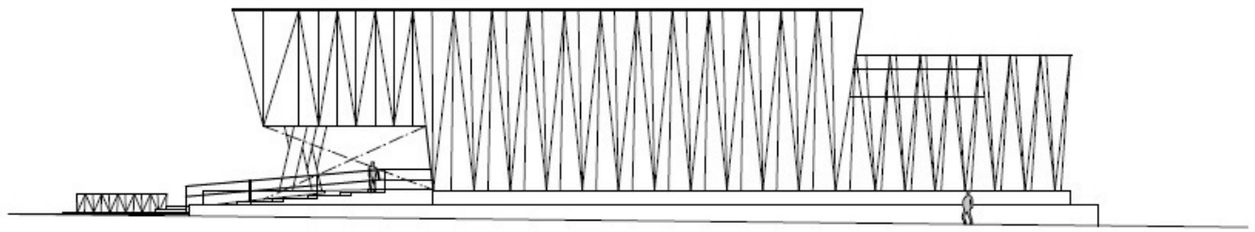
Pleats.M

Structural Analysis

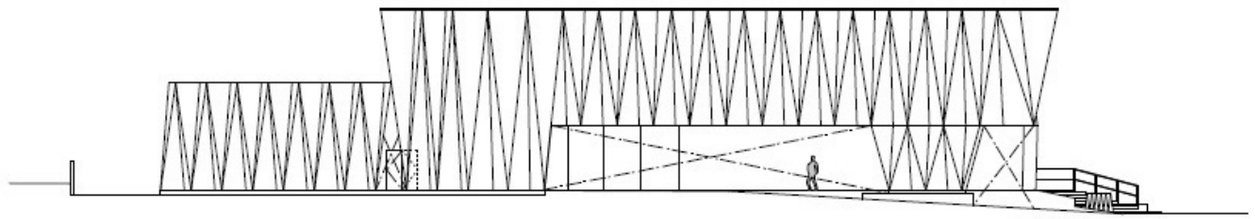
The main structural of this building is reinforced concrete steel frame structure and the pleats facade is steel support structure.



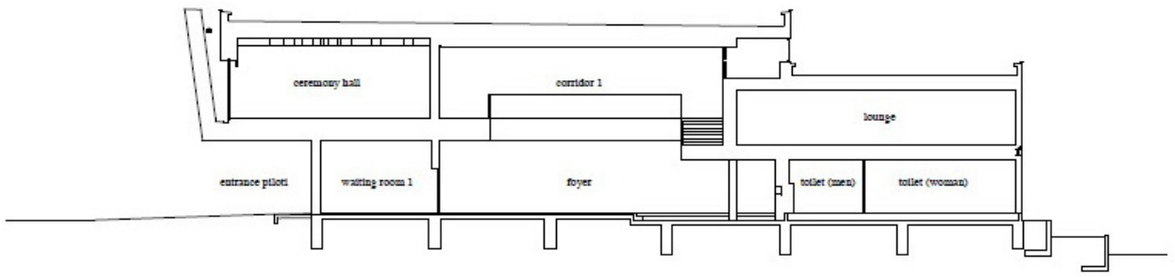


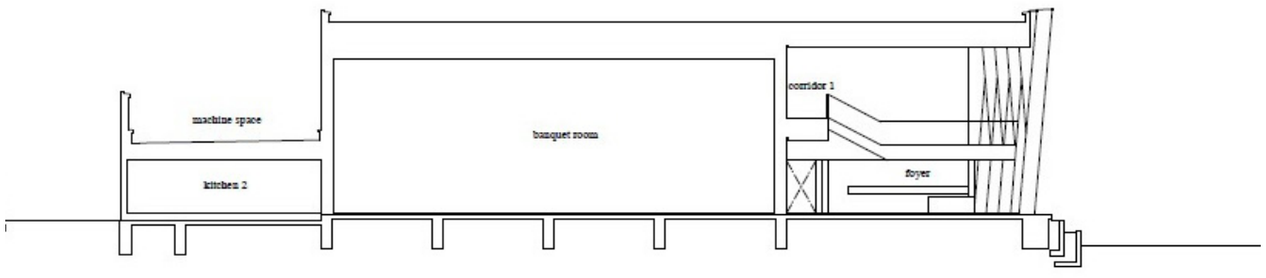


WEST



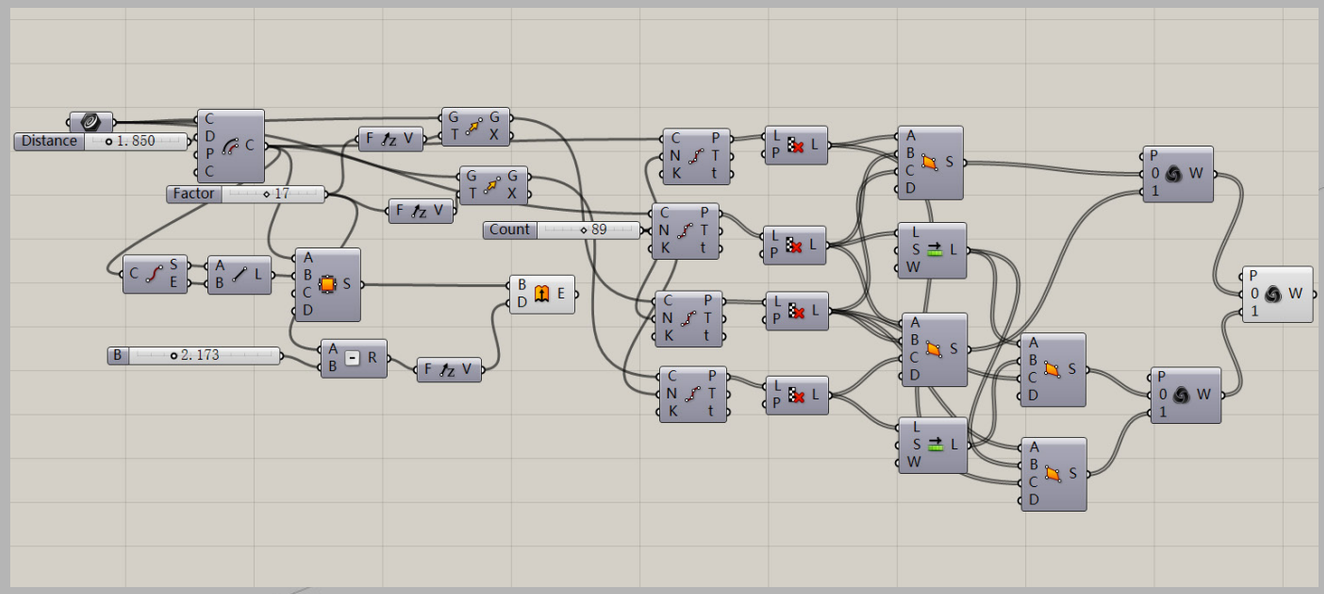
SOUTH

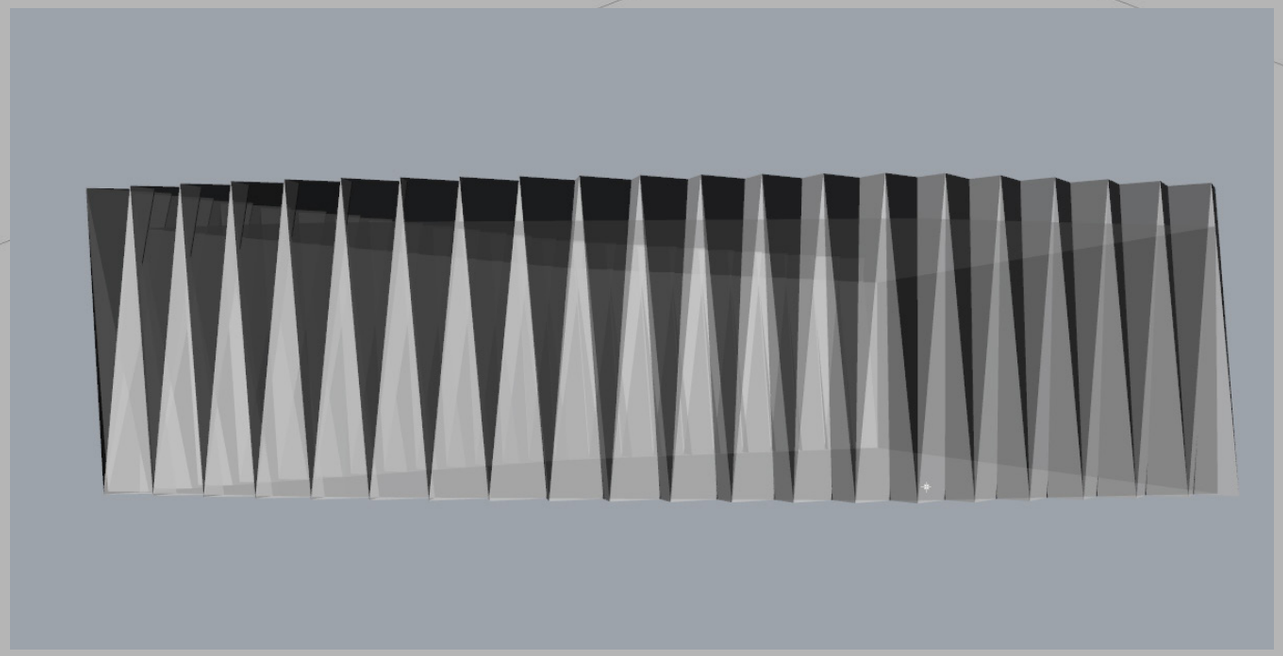


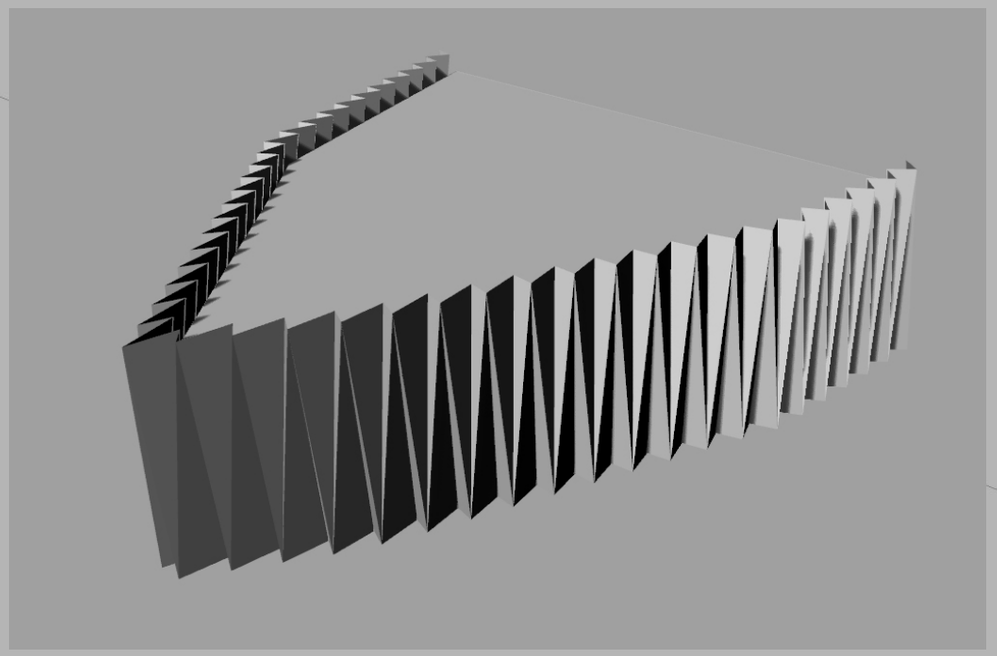


Pleats.M

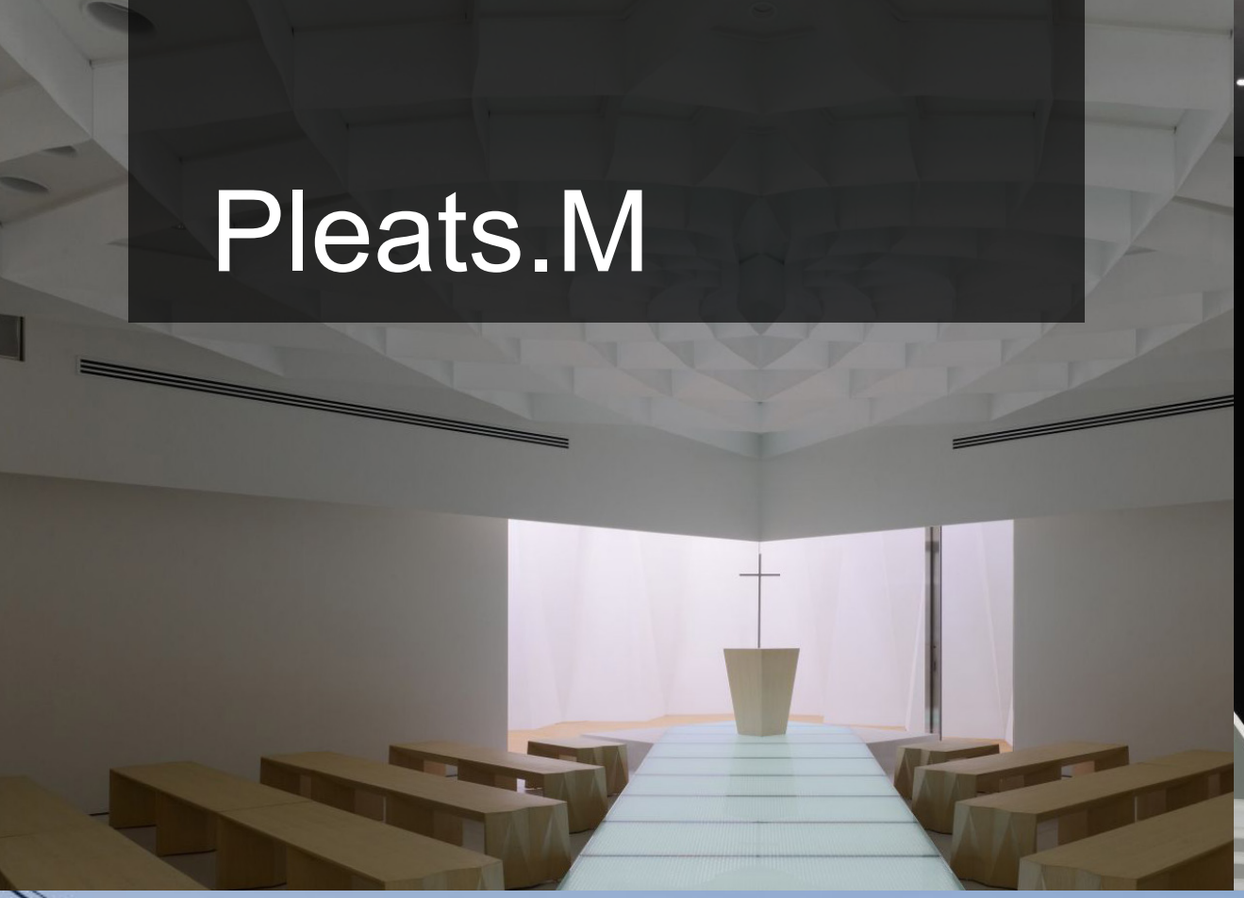
GRASSHOPPER
Fabrication Definition

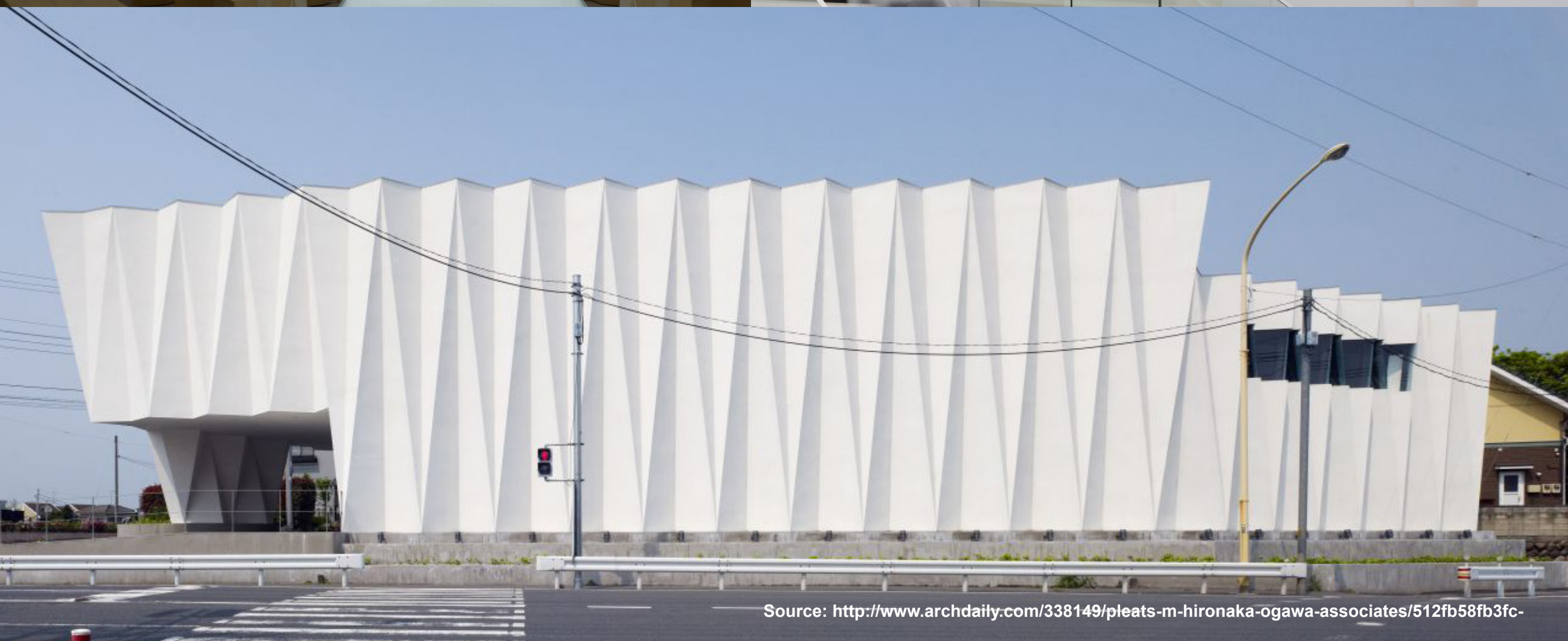






Pleats.M





Source: http://www.archdaily.com/338149/pleats-m-hironaka-ogawa-associates/512fb58fb3fc-

FOLDING
JNBY PAVILION

HHD_FUN Architects

Li,Dapeng

Source:http://www.archdaily.com/111922/jnby-hhd_fun-architects/

JNBY Pavilion

Project OUTLINE

Project Architect / Artist: HHD_FUN Architects

Location: Shanghai, China

Investor: JNBY COTTON USA

Function: Pavilion

Construction Year: 2010

Project area: 150 sqm

Construction Team: H & J International

Materials Used: steel, a taut elastic waterproof material with translucent properties

Budget: XXXX

Major Fabrication Method Used: Folding

Secondary Fabrication Methods: XXXXXXXXXX

Fabricated By: XXXXXXXXXX

Type Of Construction: Steel Structure

Modelling Software: Rhino + Grasshopper

Source:http://www.archdaily.com/111922/jnby-hhd_fun-architects/

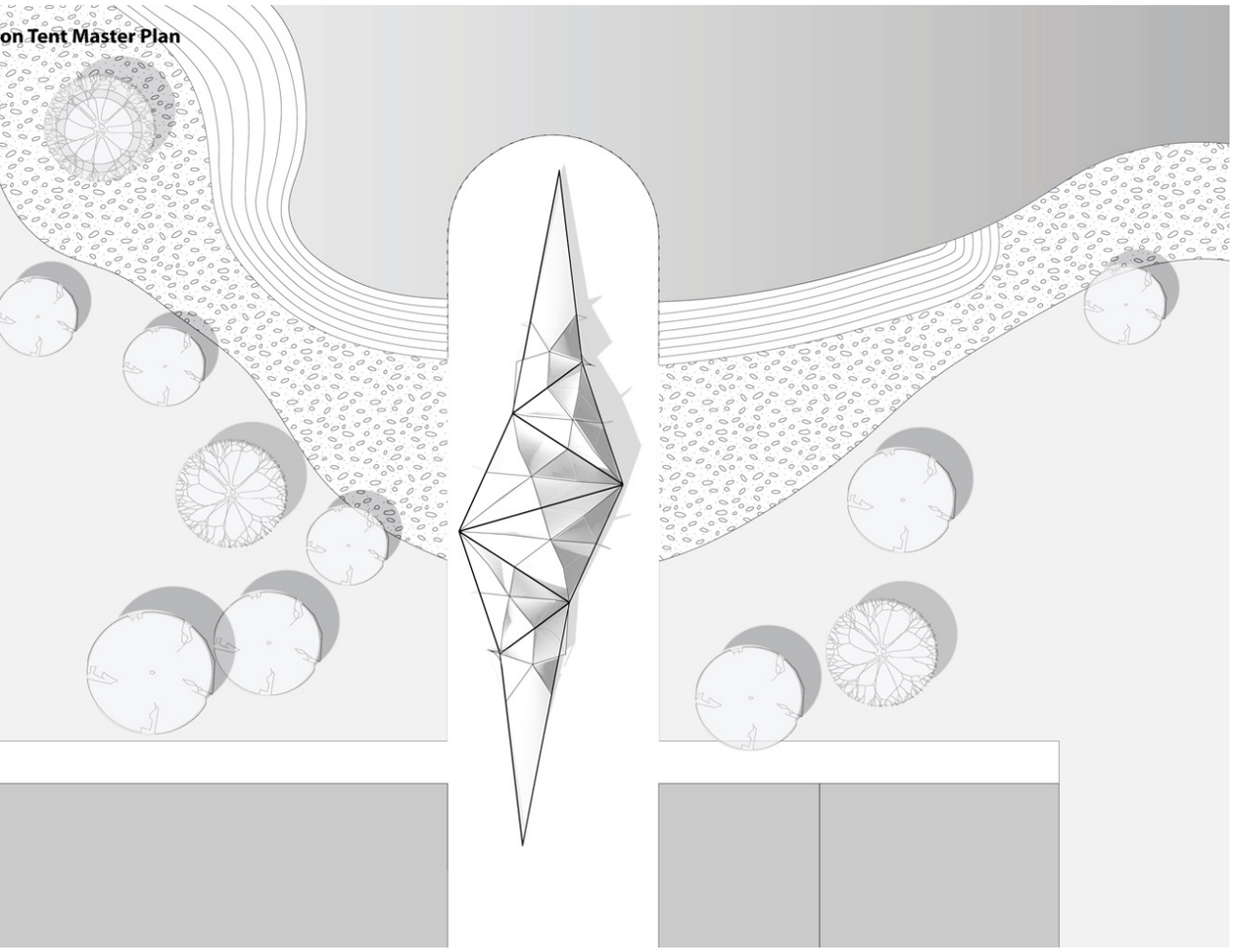
Project DESCRIPTION

HHD_FUN architects, Beijing, presented a transformable temporary structure for the JNBY and COTTON USA fashion show, held in Shanghai, with an ability to take on numerous different forms. The structure hosted a list of events throughout December, including live music and corporate entertainment.

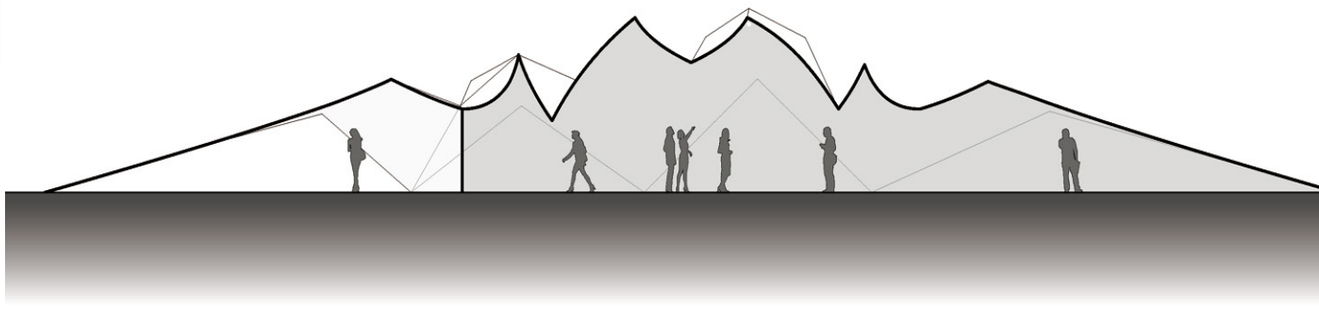
The design was developed alongside the notion of the international image of JNBY and COTTON USA,and so a practical and an environmentally friendly approach was taken.

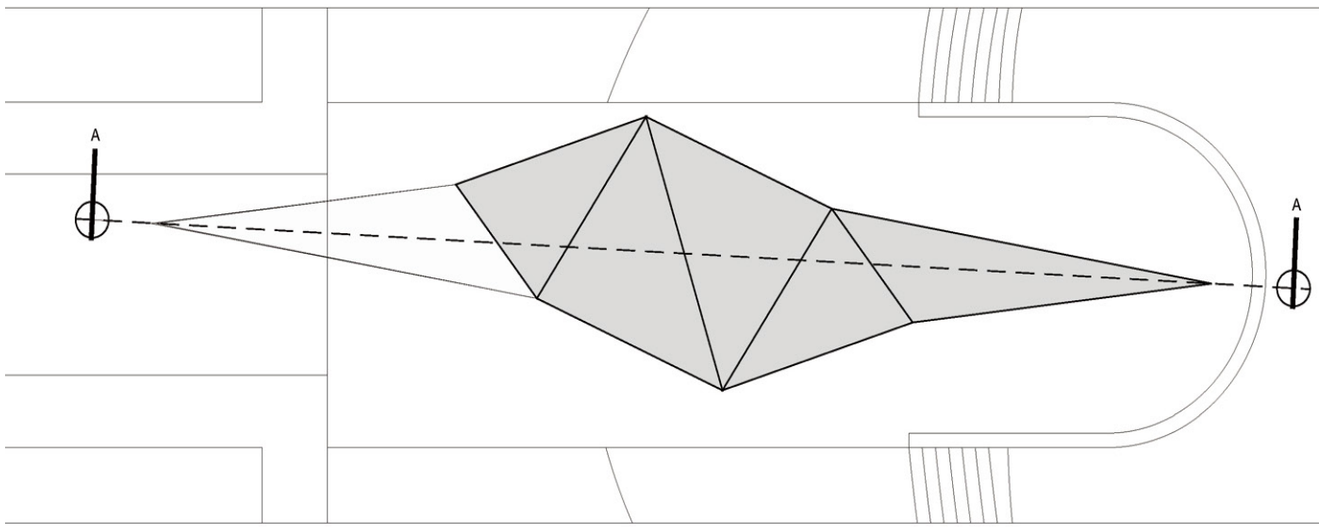
Source:http://www.archdaily.com/111922/jnby-hhd_fun-architects

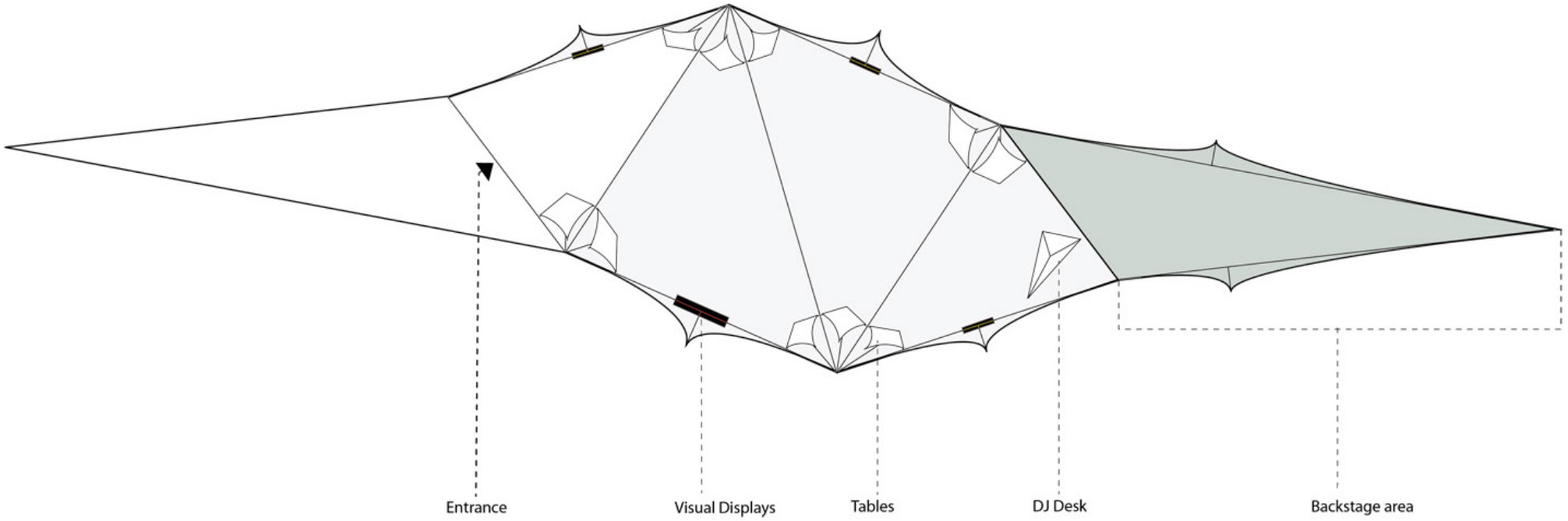
on Tent Master Plan



Section A - A







JNBY Pavilion

Project FABRICATION

Based on the formation of origami triangles, combined with the use of the latest parametric design tools and topological analysis, the unique structural design was formed.

The whole structure consists of 6 inter-locking components, sharing 3 varied designs. Each design was achieved from a process of continuous deformation and manipulation of one triangular surface, resulting in a shape which corresponds to the overall layout.The archways, acting as an entrance or an interlocking face, have corresponding dimensions to other archways and so increasing the number of possible overall forms. Once fully constructed, the form can span a total sheltered area of 150m2

Formation of the structure:

1.Formation of an isosceles triangle

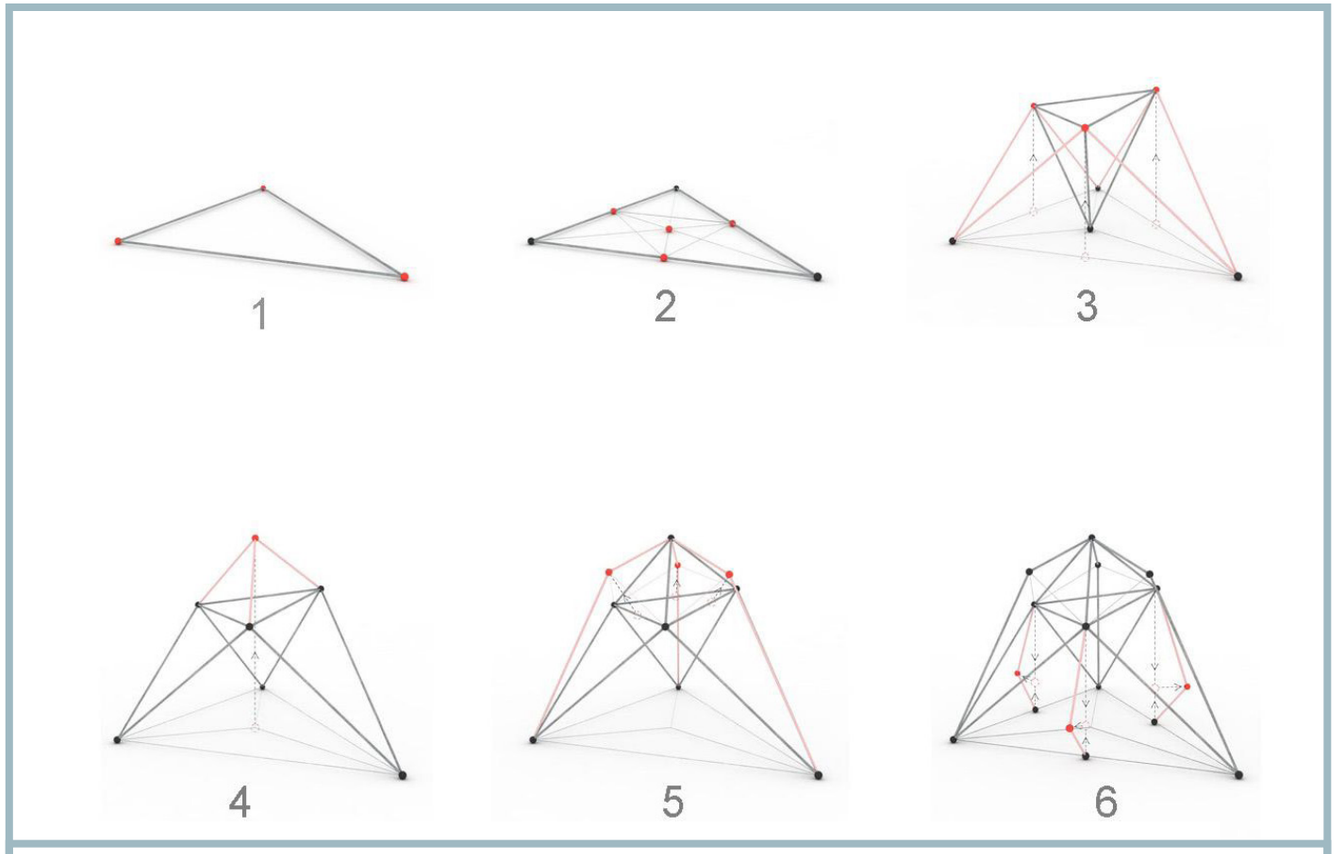
2.Original triangle divided by 4 triangles into 12 sections,identifying 7 control points.

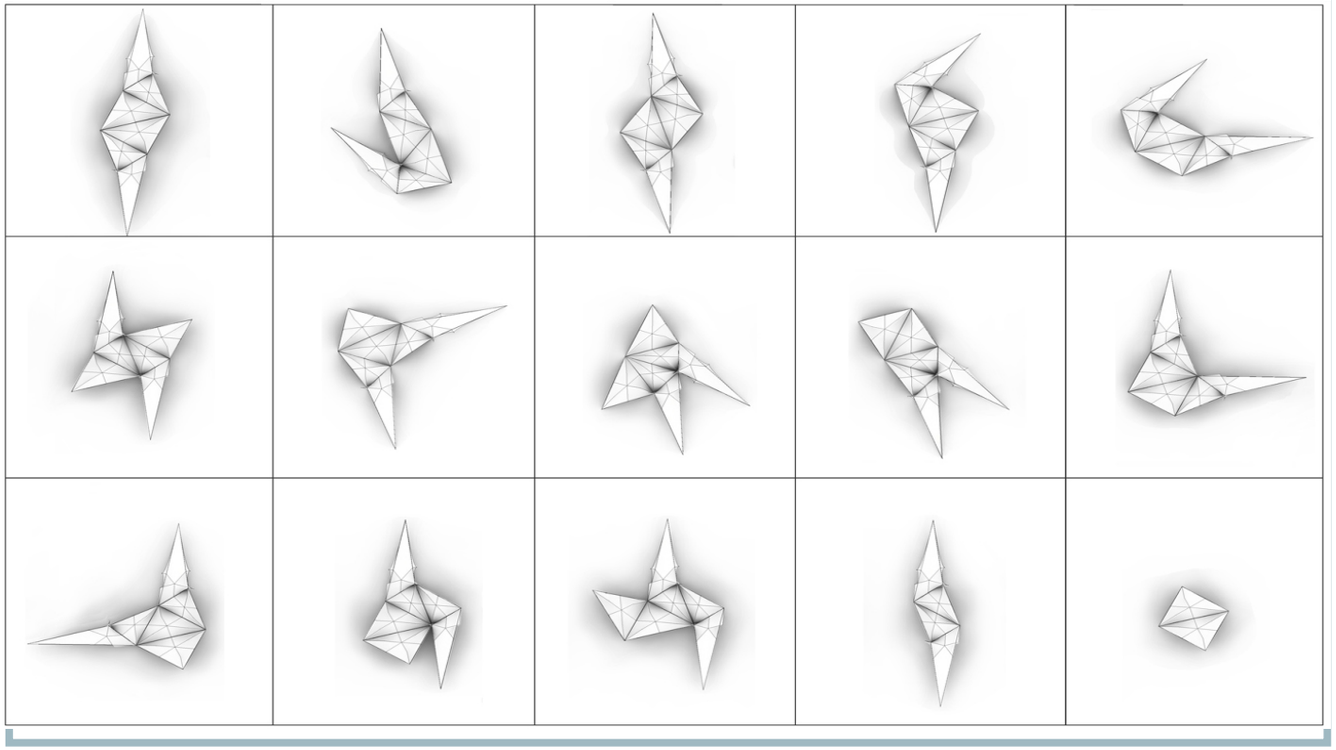
3.Mid-length control points of original triangle is raised,above the newly formed triangle.

4.Centre control points of original triangle is raised,above the newly formed triangle

5.Mid-length control point of the top triangle are created and pulled out wards.

6.In line with the original mid-length control points,a new control point is created and pulled out wards.

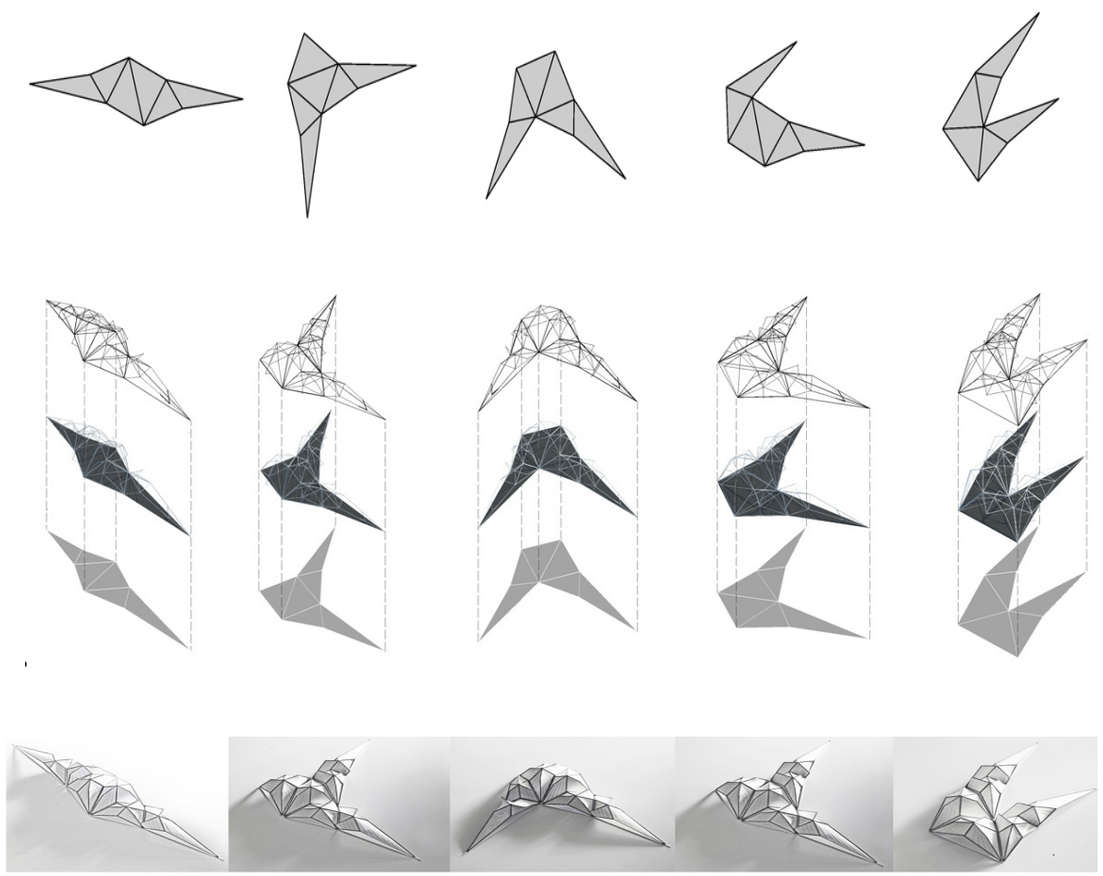


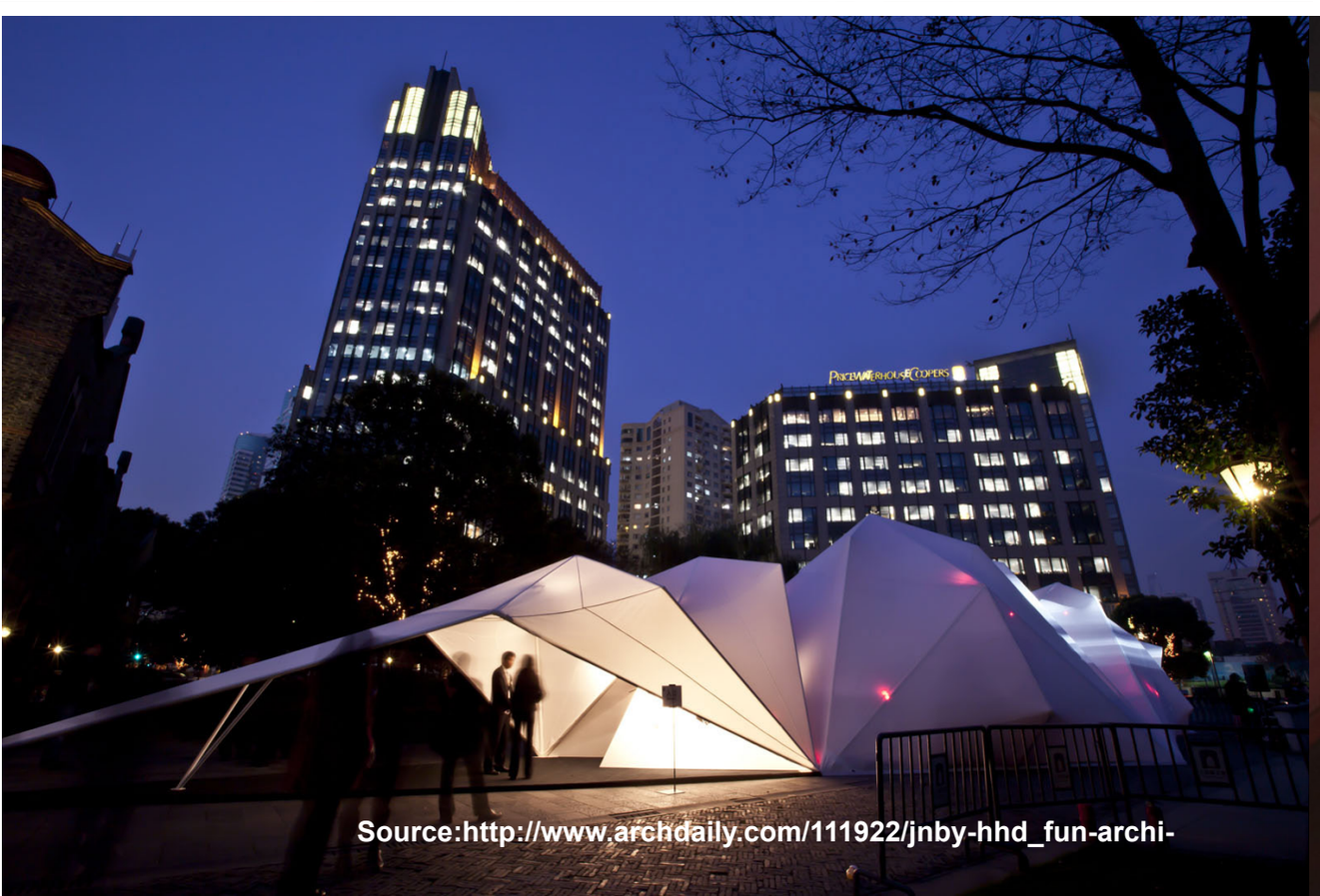


JNBY Pavilion

Project FABRICATION

Source:http://www.archdaily.com/111922/jnby-hhd_fun-archi-





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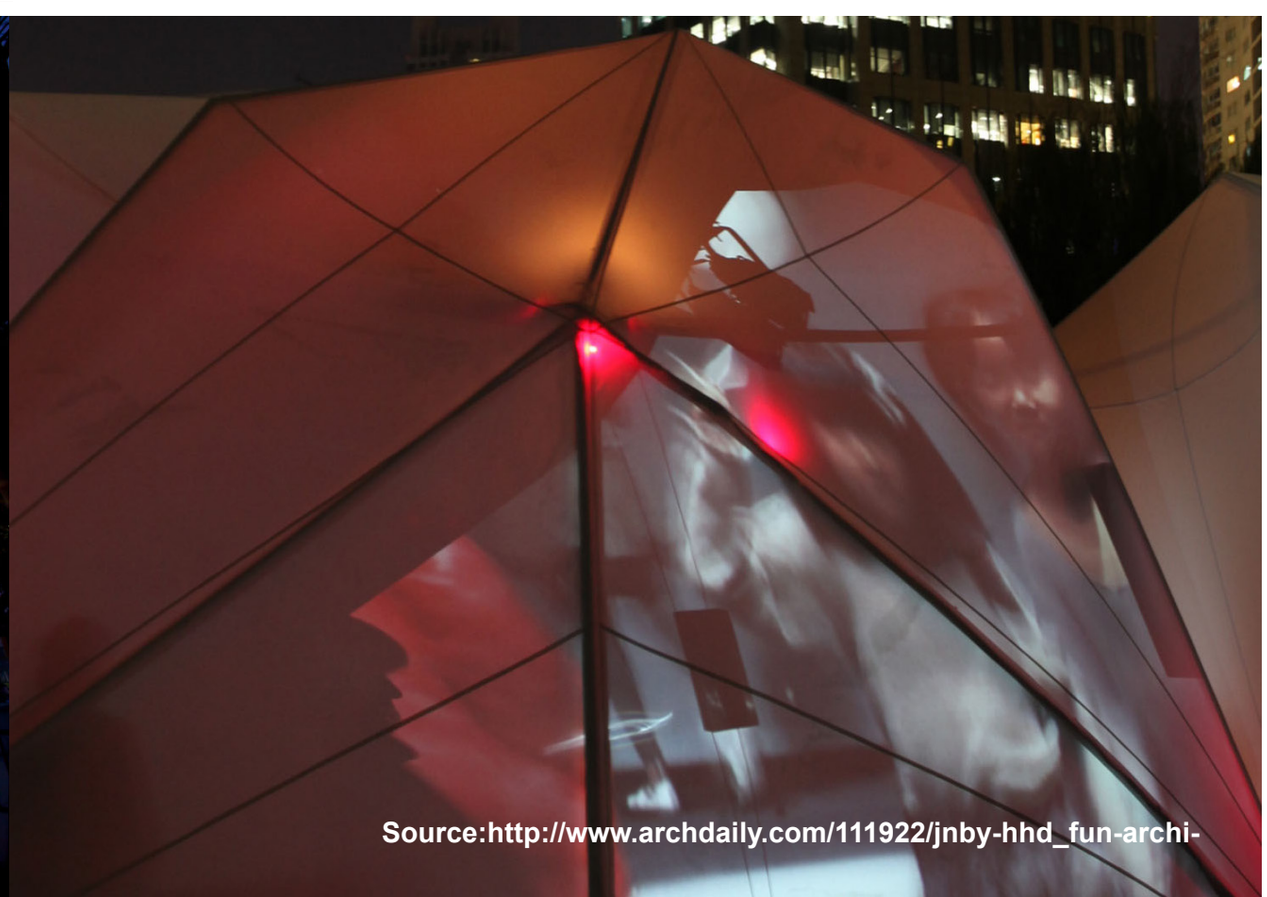


Source:http://www.archdaily.com/111922/jnby-hhd_fun-archi-

JNBY Pavilion

Project MATERIALS

Within the structure soft furnishings are laid out in a manner influencing the flow of movement through the tent. Interactive installations and laser demonstrations were installed at particular areas of the tent to create the required upbeat atmosphere.

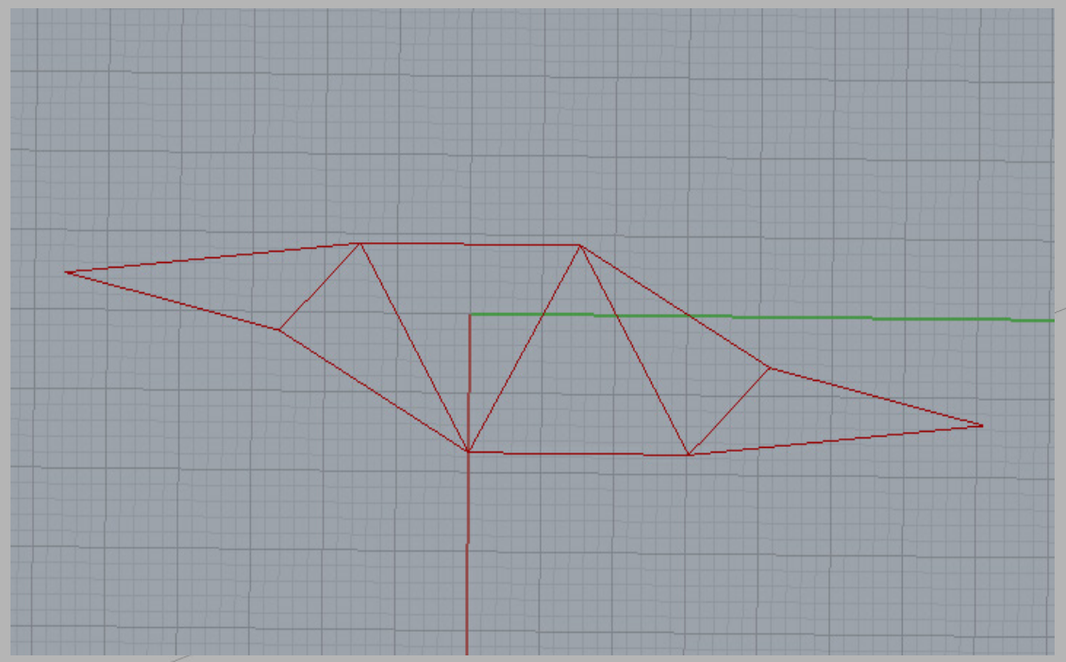
The tent itself is created from a steel structure with a taut elastic waterproof material with translucent properties. The material, provided by COTTON USA was made from low-carbon footprint products, creating a biologically friendly installation with a major advantage of being able to be easily re-installed and re-used
in the future, with a new form.

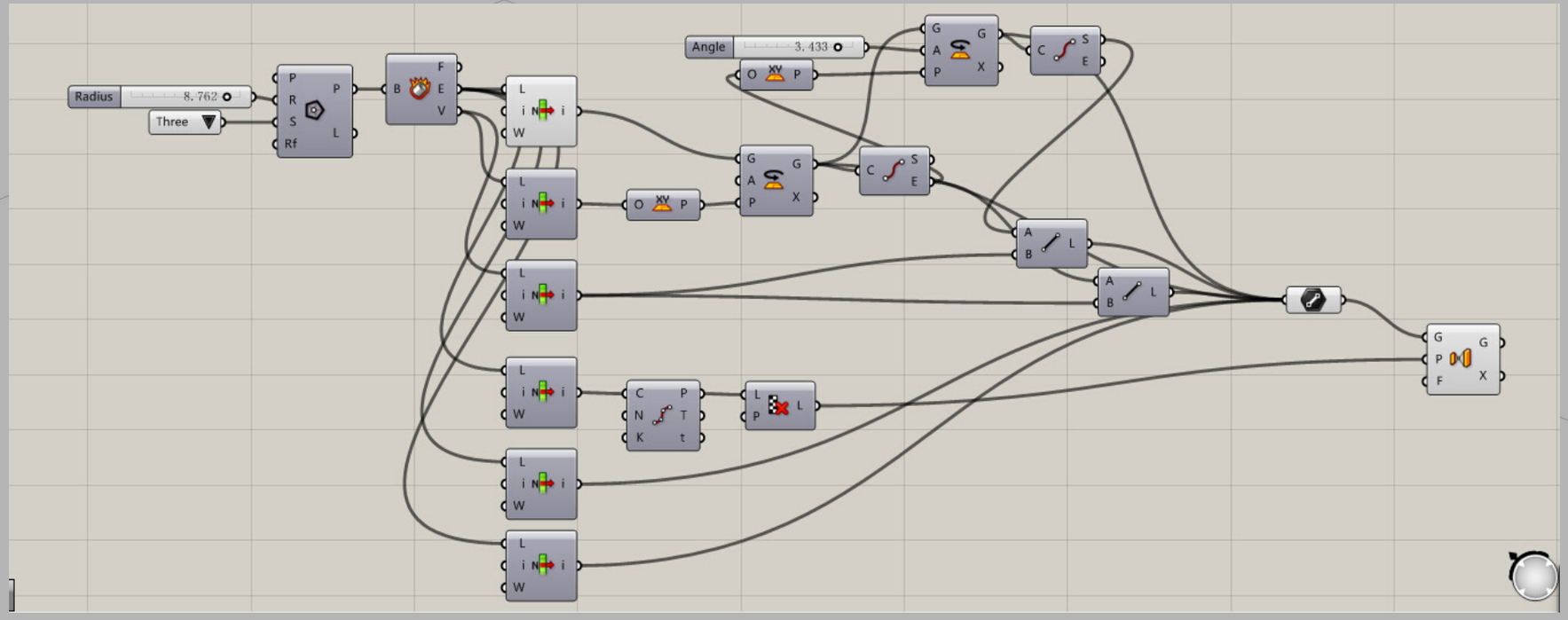
Source:http://www.archdaily.com/111922/jnby-hhd_fun-architects

JNBY Pavilion

GRASSHOPPER

Modelling

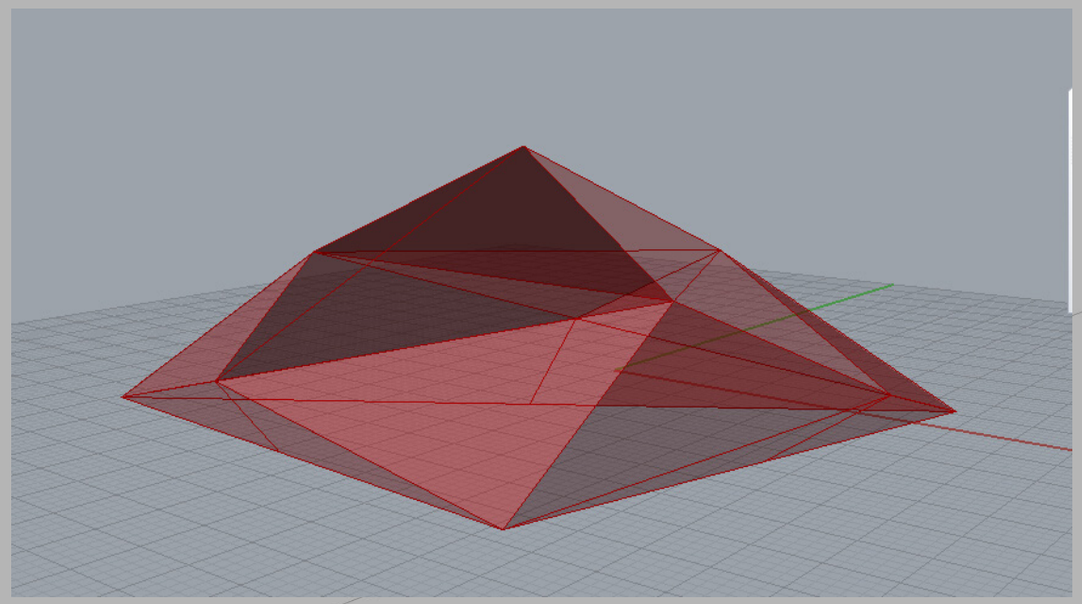


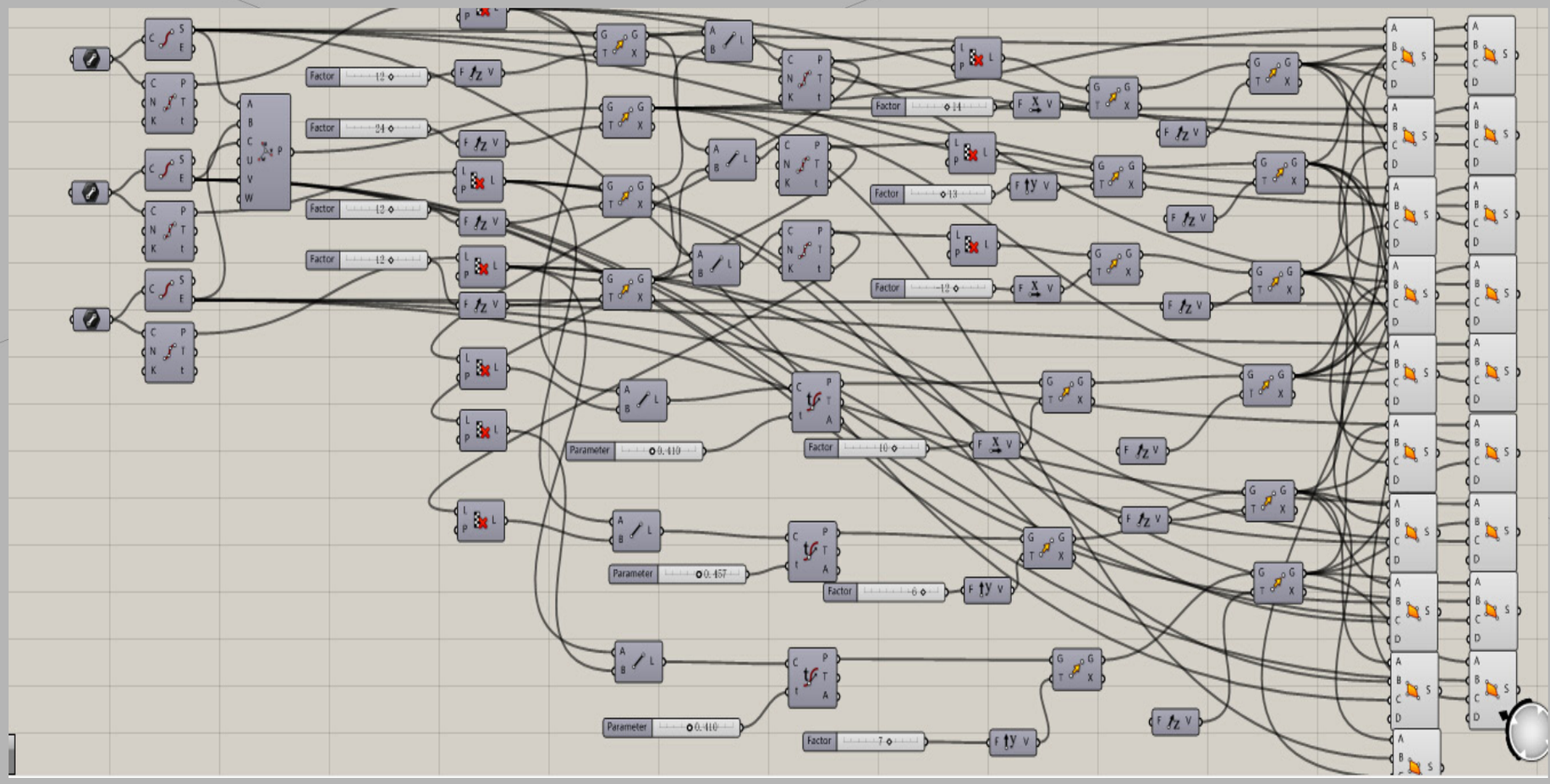


JNBY Pavilion

GRASSHOPPER

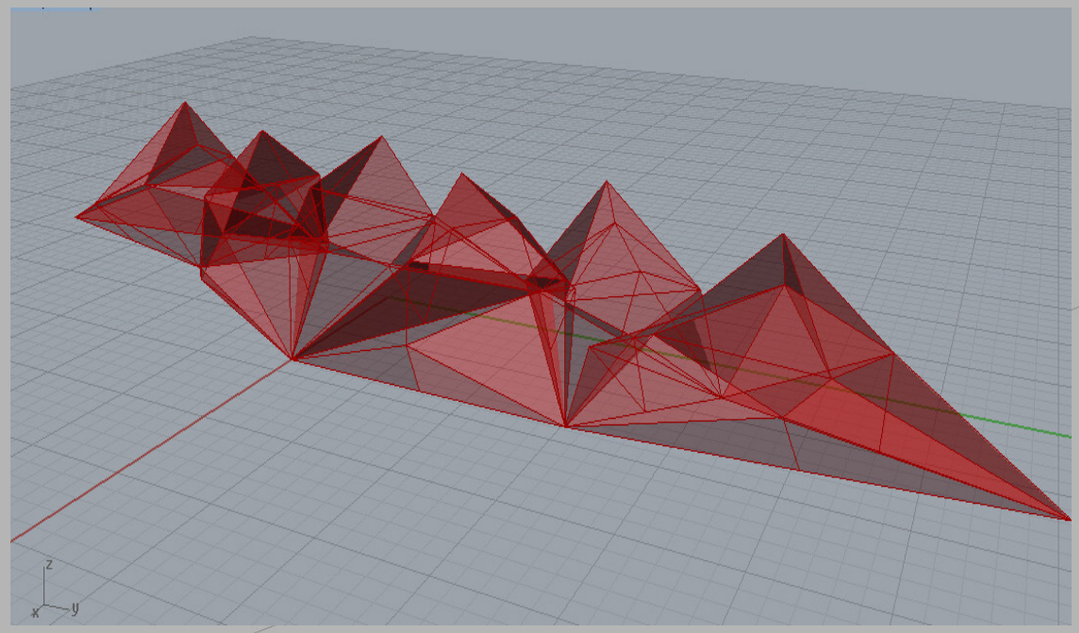
Modelling

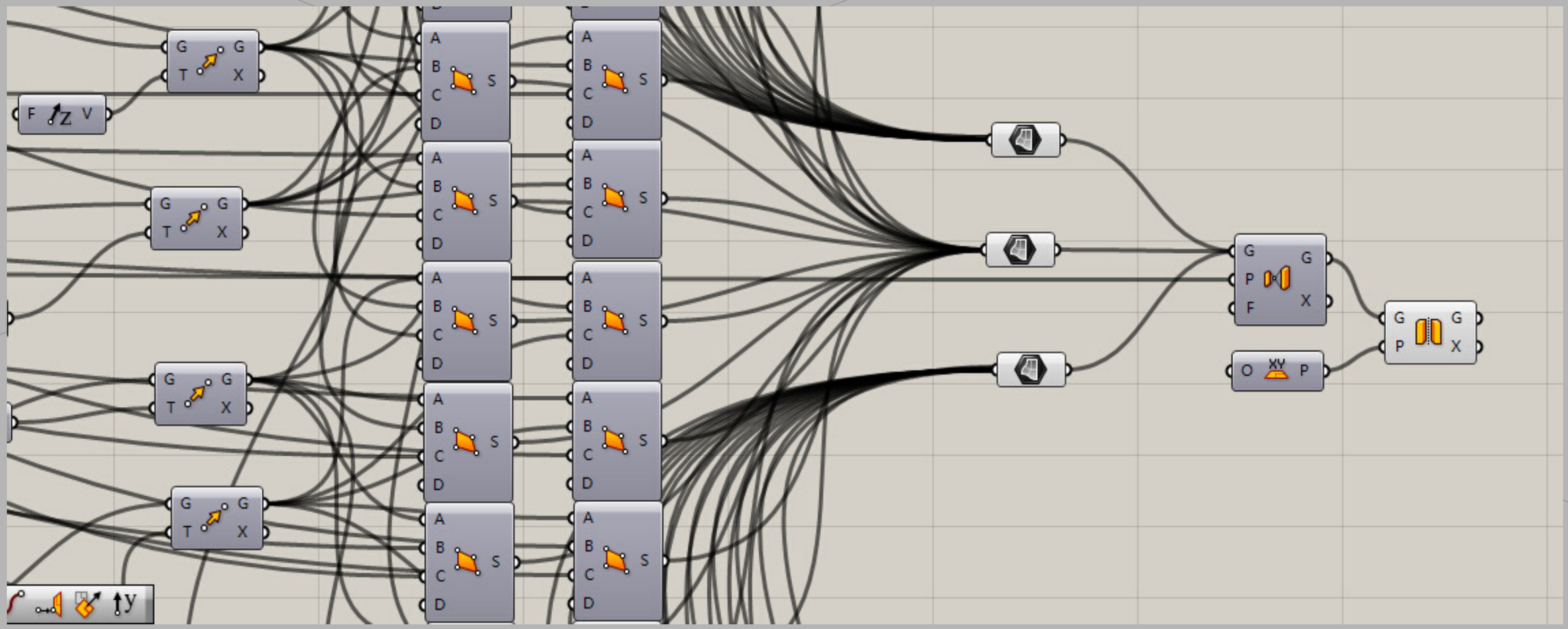




JNBY Pavilion

GRASSHOPPER
Modelling

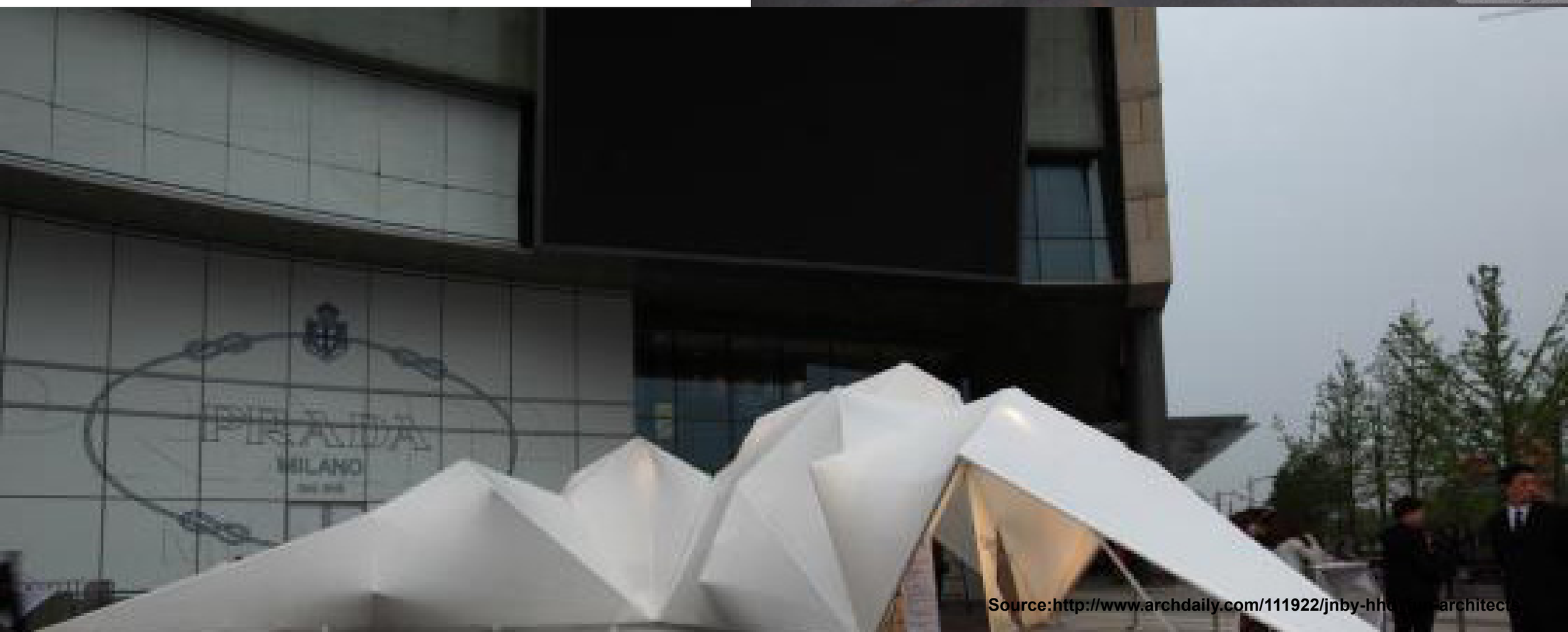




JNBY Pavilion

Source:http://www.archdaily.com/111922/jnby-hhd_fun-architectsteps

Source:http://www.archdaily.com/111922/jnby-hhd_fun-architects



Source:http://www.archdaily.com/111922/jnby-hhd_fun-architect

FOLDING RESPONSIVE FACADE _ AL BAHR TOWER

AEDAS ARCHITECTS

Tanmay Chakrabarty _ 4061189

Source: http://img3.adsttc.com/media/images/557f/94ce/432e/78ef/0b00/09b6/large_jpg/adic-responsive-facade-abu-dhabi-uae-research.jpg?1434424522

Responsive Facade –
Al Bahr Tower
Project OUTLINE

Project Architect : AEDAS Architects

Location: Abu Dhabi, United Arab Emirates

Investor: Abu Dhabi Investment Council and Al Hilal Bank
Function: 02 Commercial Office Towers

Construction Year: 2009 - 2012

Dimmensions: 02 Towers (29 storied each, 145m tall) and consisted of 2,098 automated Umbrella like folded panels.

Construction Team: Arup and Al-Futtaim Carillion

Materials Used: Stainless steel Frame, Coated Fibre Glass, Aluminium frame, Automated Technology for the Responsiveness to Sun angle.

Budget: XXXXX

Major Fabrication Method Used: Generative Folding, Louvre system, Origami, Triangulation, Wall Screen

Secondary Fabrication Methods: Regular Tessellation

Fabricated By: CNC, Milling, Hand Cladded

Type Of Construction: Steel Frame

Modelling Software: Rhino + Grasshopper

Source: https://acdn.architizer.com/thumbnails-PRODUCTION/25/ff/25fffb5180b5bc9e461dd4e4ade0d8f2.jpg

RESPONSIVE FACADE

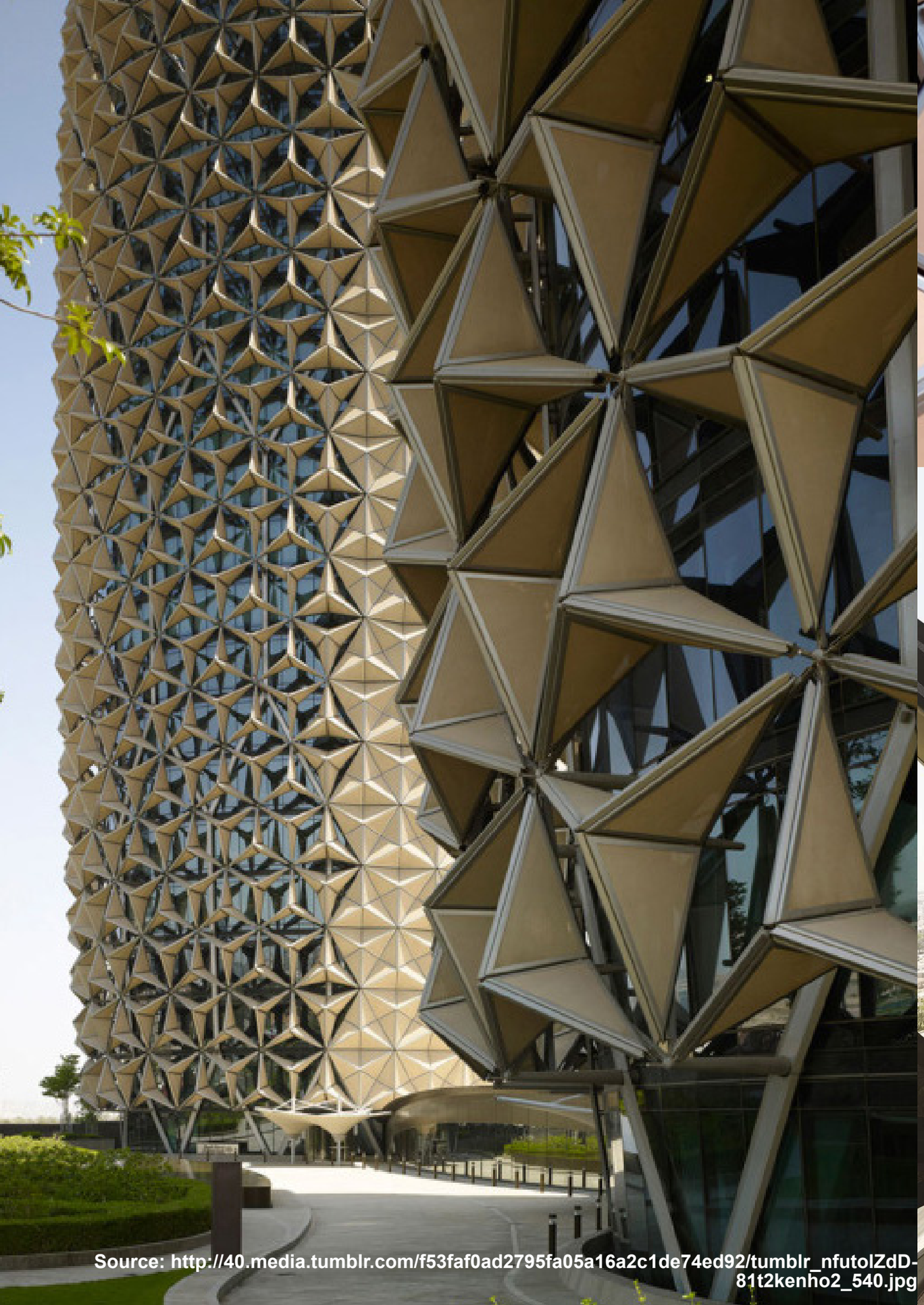
Project DESCRIPTION

The Al Bahr Towers' mashrabiya facade is not only eye-catching, but it's very effective in protecting the towers from the relentless solar gain that is problematic for many modern buildings in hot climates. The distinguishing feature of the iconic towers is their protective skin of 2,098 umbrella-like glass elements that automatically open and close depending on the intensity of sunlight. Inspired by the 'mashrabiya', geometrically-designed wooden lattice screens that have been used to fill windows of traditional Arabic architecture since the 14th century, the 'intelligent' façade of the Al Bahr Towers is dynamically controlled by a building management system. The adjustable shades help reduce interior heat gains caused by sunlight by around 50 percent. The gigantic latticework almost entirely wraps both towers except for the area of the facades facing north.

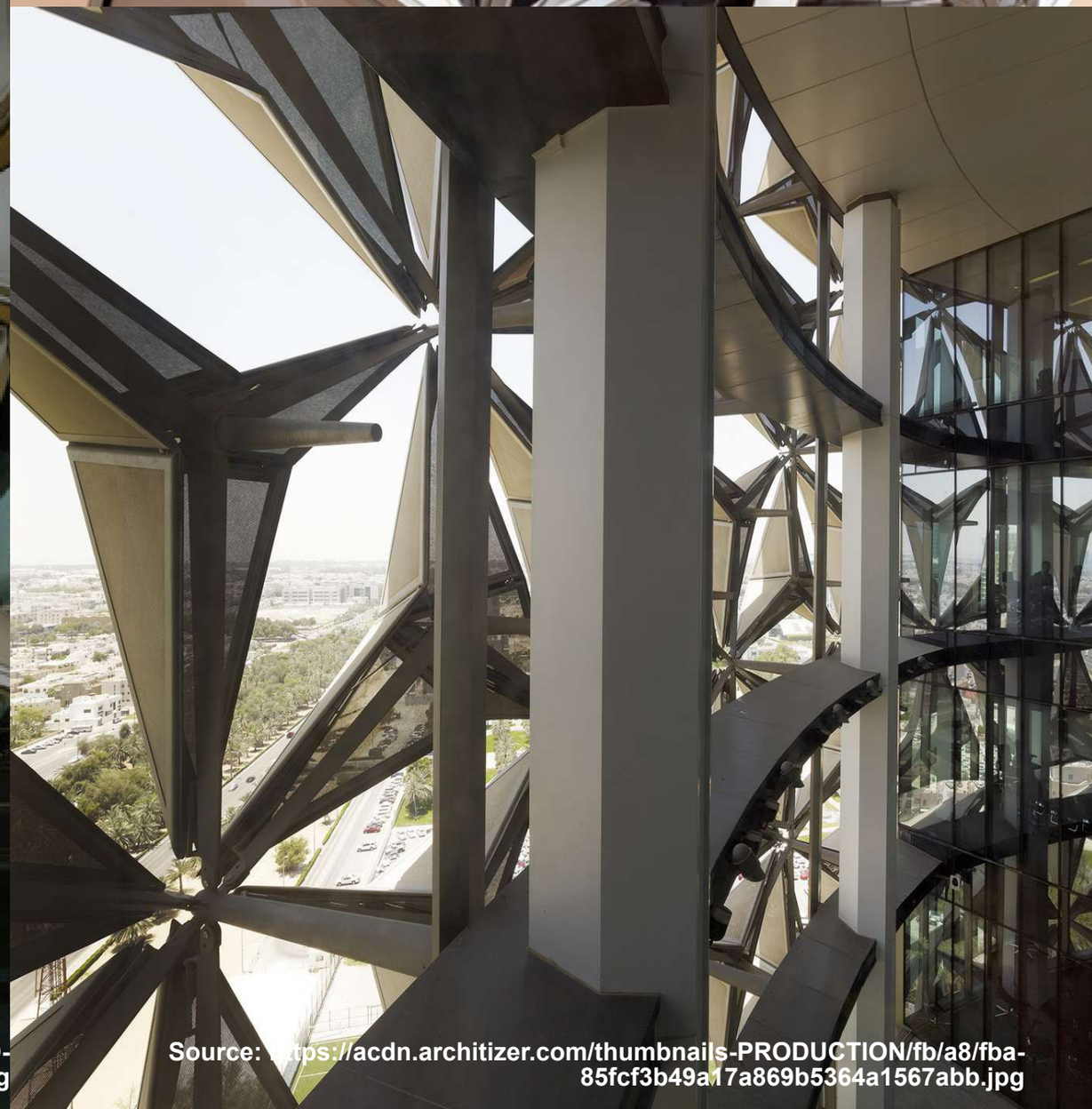
The riddle Aedas faced was how to keep the building cool without using massive amounts of air conditioning. Such a sustainable approach to architecture is important to Abu Dhabi, as the city has pledged to develop an economy that can thrive once its oil reserves are exhausted. The solution is a software-driven design that creates an intricate modern version of the mashrabiya, the geometric screens that are found on buildings all over the Middle East.

For ADIC and Abu Dhabi, the Al Bahr Towers are a shining example of how to use the latest in modern technology while rooting a building in its cultural context. Traditional Arabian architecture long helped locals survive under the most extreme weather conditions. As Abu Dhabi strives towards environmental sustainability and cultural integrity, the Al Bahar Towers stand tall as an example of how the new and old can coexist.

Source: http://www.dali-ag.org/dali-award/shortlist-dali-award-2014/details/news/detail/News/al-bahar-towers.html, https://c1.staticflickr.com/9/8088/8452507121_6f2cdf7160_b.jpg



Source: http://40.media.tumblr.com/f53faf0ad2795fa05a16a2c1de74ed92/tumblr_nfutolZdD-81t2kenho2_540.jpg

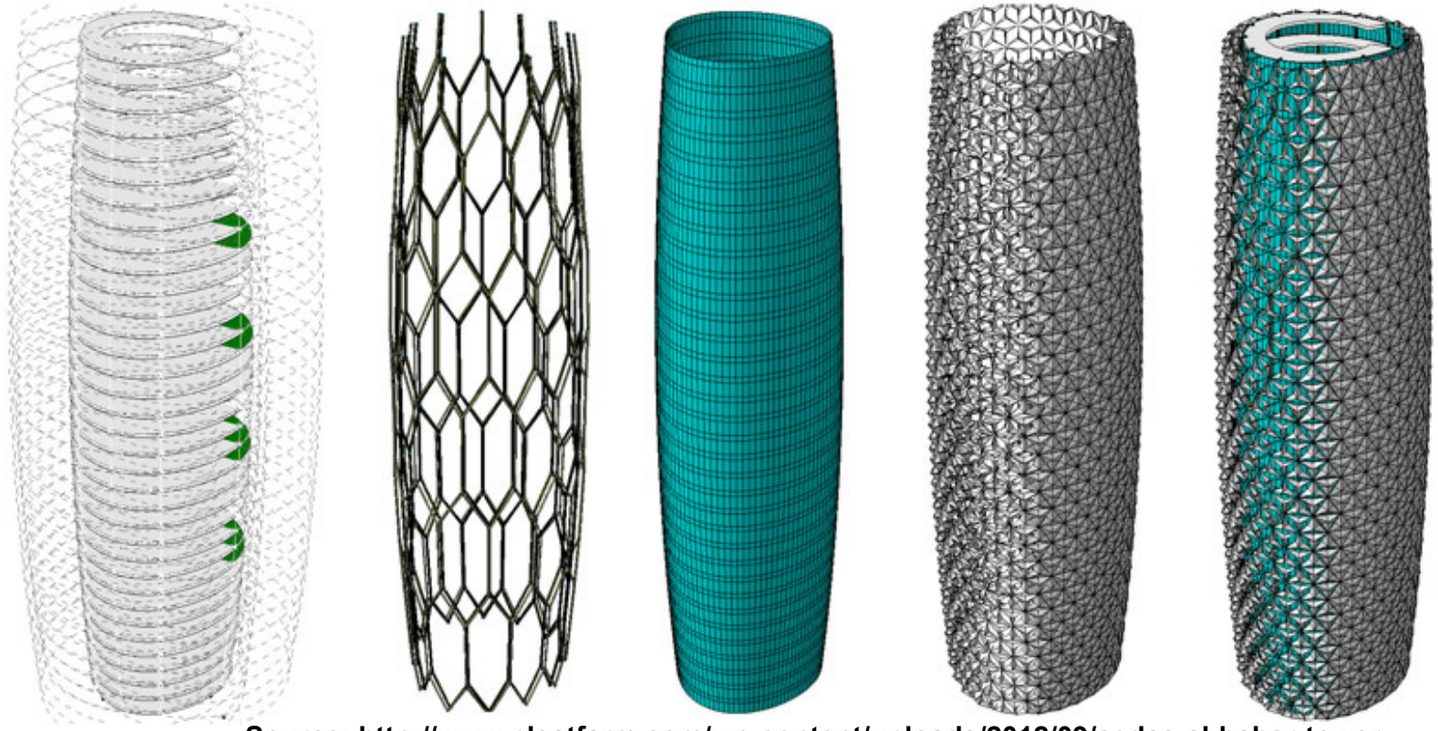


Source: https://acdn.architizer.com/thumbnails-PRODUCTION/fb/a8/fba-85fcf3b49a17a869b5364a1567abb.jpg

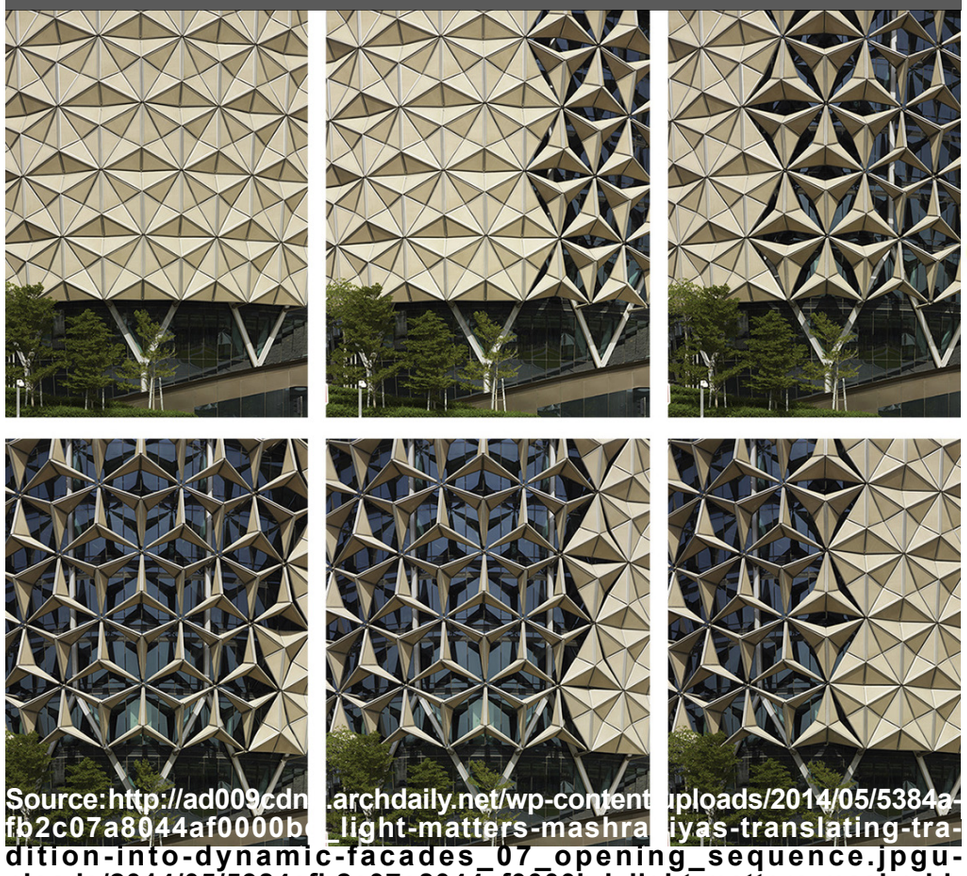
AL BAHR TOWER
Adaptive Skin

Project FABRICATION

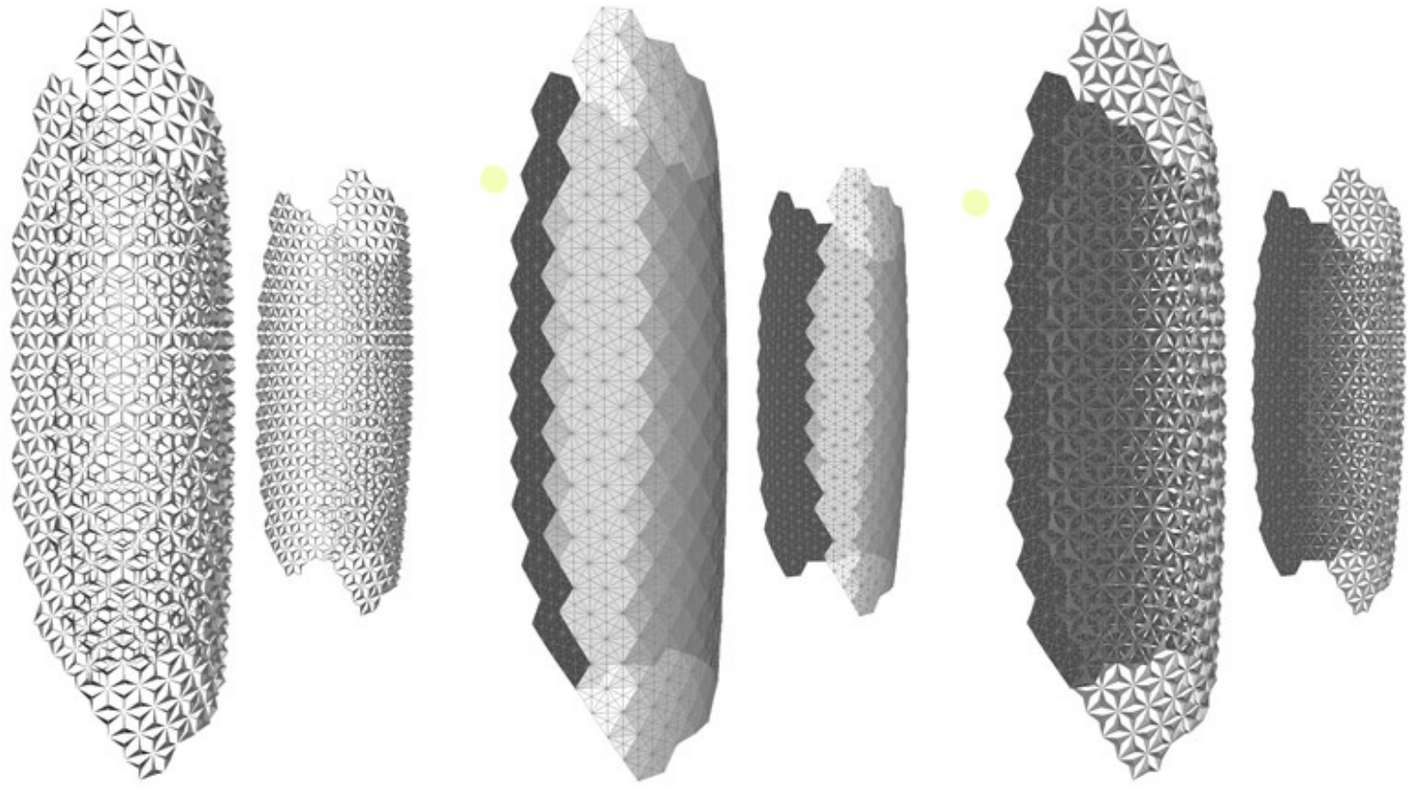
The key highlight of the 29-storey Al Bahr twin Towers in Abu Dhabi is the solar-responsive shading device that are parametrically designed based on the geometric mosaics of the ‘mashrabiya’ – traditional wood lattice screens prevalent Arabic architecture. The architectural office of Aedas at the helm of the project conceived a system of triangulated panels arranged within a series of hexagons that folds up to create a solar barrier for the towers as they response to direct sun exposure, thereby reducing glare and heat gain.



Source: http://www.pleatfarm.com/wp-content/uploads/2012/09/aedas-al-bahar-tower-structural-system.jpg



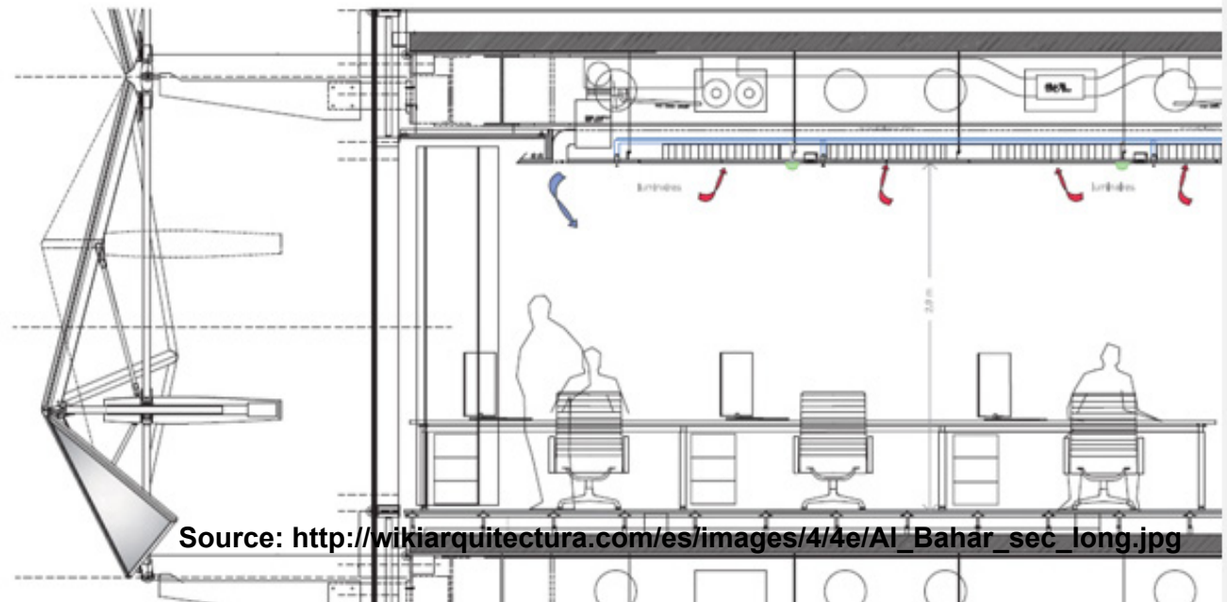
Source:http://ad009cdn.archdaily.net/wp-content/uploads/2014/05/5384afb2c07a8044af0000bd_light-matters-mashrabiyas-translating-tradition-into-dynamic-facades_07_opening_sequence.jpguploads/2014/05/5384afb2c07a8044af0000bd_light-matters-mashrabiyas-translating-tradition-into-dynamic-facades_07_opening_sequence.jpg



Source: http://www.pleatfarm.com/wp-content/uploads/2012/09/aedas-al-bahar-tower-geometric-panel-system.jpg

AL BAHR TOWER
Adaptive Skin
Project FABRICATION

Source: http://www.pleatfarm.com/wp-content/uploads/2012/09/aedas-al-bahar-tower-main.jpg



Source: http://wikiarquitectura.com/es/images/4/4e/Al_Bahar_sec_long.jpg

Source: http://www.pleatfarm.com/wp-content/uploads/2012/09/aedas-al-bahar-tower-04-1024x768.jpg

Source: http://assets.inhabitat.com/wp-content/blogs.dir/1/files/2014/01/Al-Bahar-Towers-lead2-537x355.jpg

AL BAHR TOWER
Adaptive Skin

Project FABRICATION

- 2,098 fibre glass panels coated with photo voltaic cell on each building.
- 1000 movable panels on each building.
- Each individual panel section length is 2m.
- Total surface area of the facade covered is approx. 60,000 sqm.

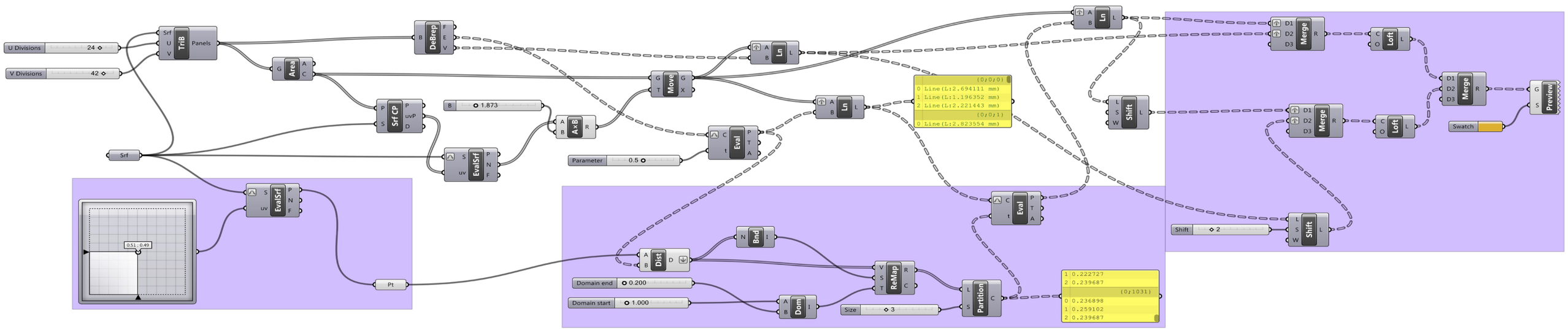
Source: https://digger666.files.wordpress.com/2013/02/al-bahar-towers-6-mashrabiyas-open-close-to-sun-position-aedas.jpg

Source: http://www.macegroup.com/sites/default/files/projects/albahr.jpg

AL BAHR TOWER
Adaptive Skin

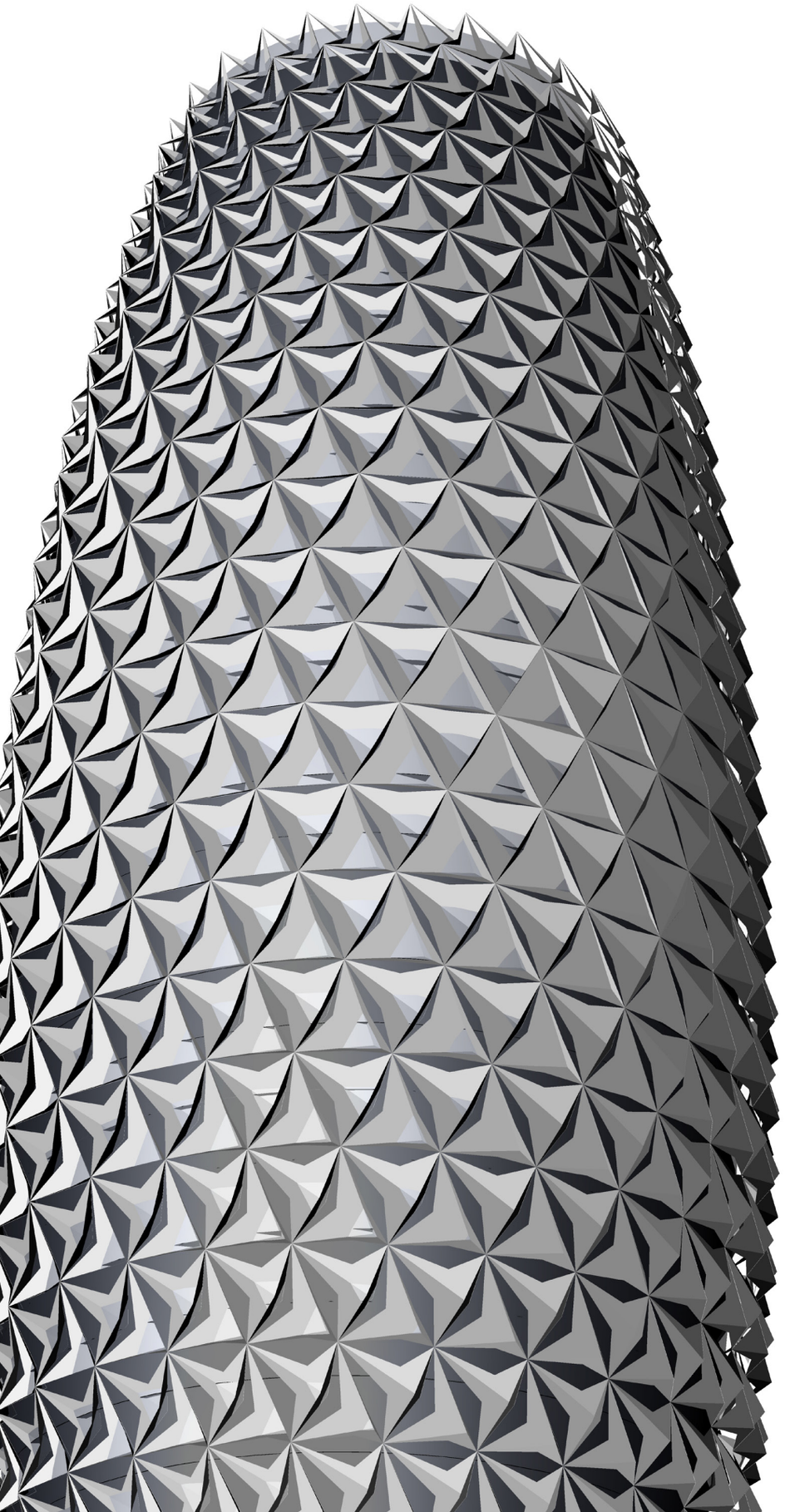
GRASSHOPPER

Modelling of the skin



AL BAHR TOWER
Adaptive Skin

GRASSHOPPER
Modelling of the skin



FOLDING
Corogami Folding Hut
David Penner

Li,Yang'jie

Source: http://www.pleatfarm.com/2010/03/15/corogami-hut-david-penner-architecture/

Corogami Folding Hut

Project OUTLINE

Architect: David Penner

Structural Engineer: Wolfrom Engineering

Location: Winnipeg, Manitoba

Category: Small Projects

Function: Warming Hut

Owner/Client: David Penner

Project Completion: March 15, 2010

Material:silicon lamination, and pinning with brass paper fasteners

Fabricated By: Handing

Structure: The pleating

Weight:two hundred pounds

Construction Budget: $900

Schedule: 10 days

Co-Conspiritors: 13

Modelling Software: Rhino + Grasshopper

Source: http://www.pleatfarm.com/2010/03/15/corogami-hut-david-penner-architec-

Corogami Folding Hut

Project DESCRIPTION

As an ‘uninvited’ entry in The Warming Hut: An Art + Architecture Exposition on Ice, the Corogami Hut (so named for the Coroplast material + origami form) journeyed through the streets of Crescentwood and down the back of the Assiniboine under the cover of night. The rogue structure made it’s temporary home at the Hugo Dock site of the river trail. After a month of hosting skaters, sunlight, lovers, and midnight revelers, the hut lifted it’s frozen feet, folded flat and walked away – days later, the site disappeared as well.

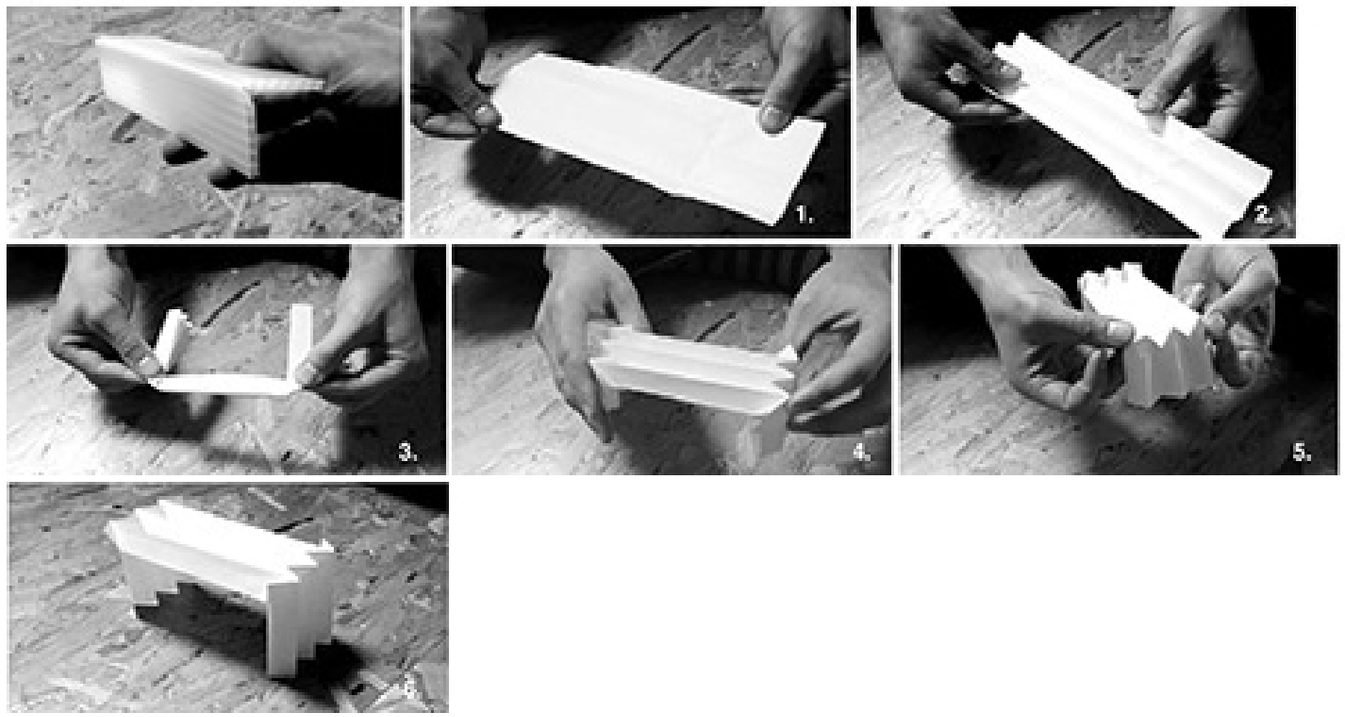
Source: http://www.mbarchitects.org/2010_prairie_design_award_winners_details.php?id=10

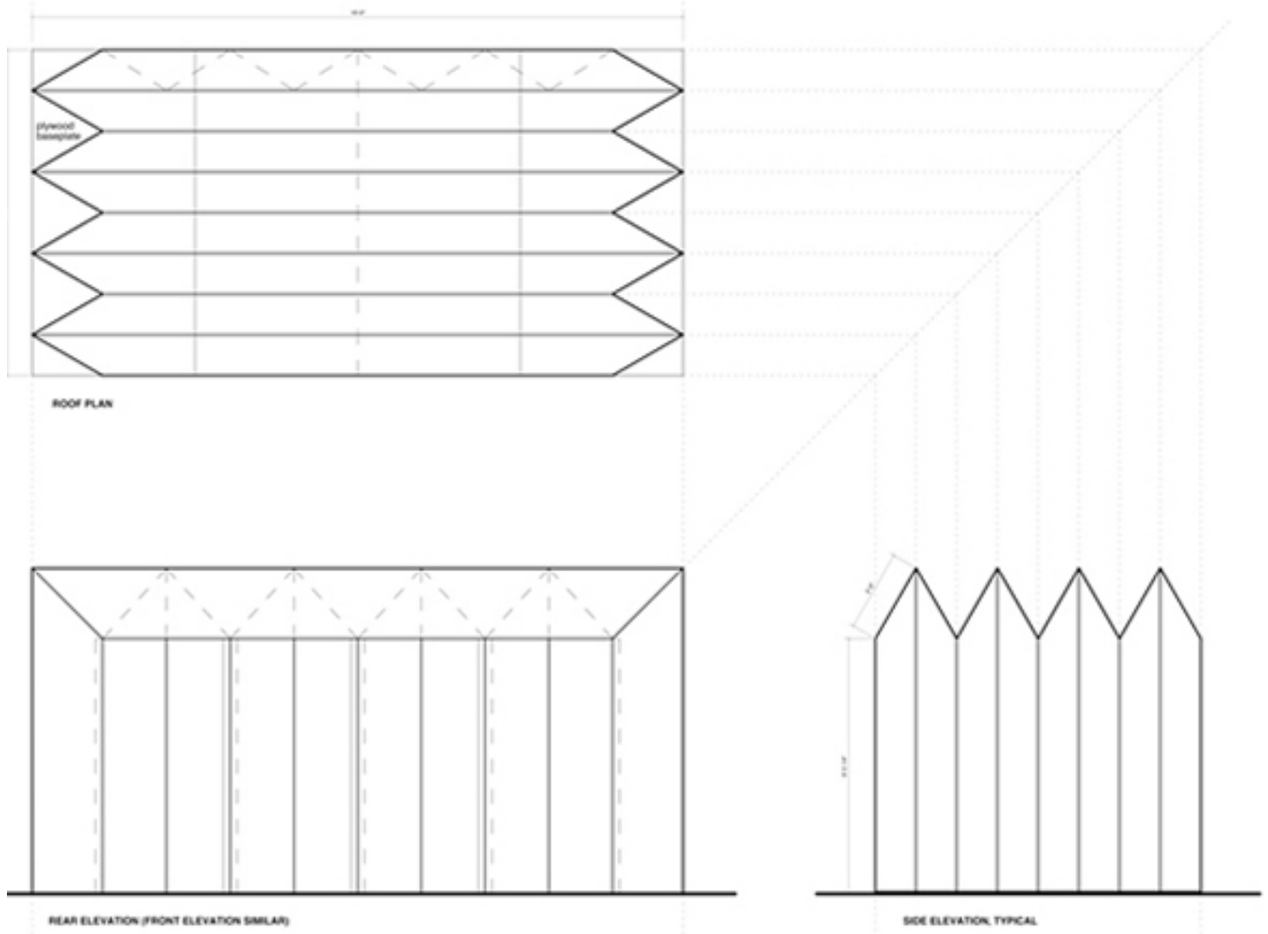
Corogami Folding Hut

Corogami Folding Hut

Project FABRICATION

Conceived of the lightness of translucent twin-wall polypropylene panels and the structural simplicity of the fold, the Corogami Hut is born out of pleating, silicon lamination, and pinning with brass paper fasteners. Complete fabrication and assembly is achieved in a large living room. The modern arch, spanning sixteen feet and providing an eight foot deep shelter, collapses into four inches thickness for mobility. The entire structure weighs two hundred pounds; it's plywood feet are pinned and adhered with water to the ice floor upon arrival on site.



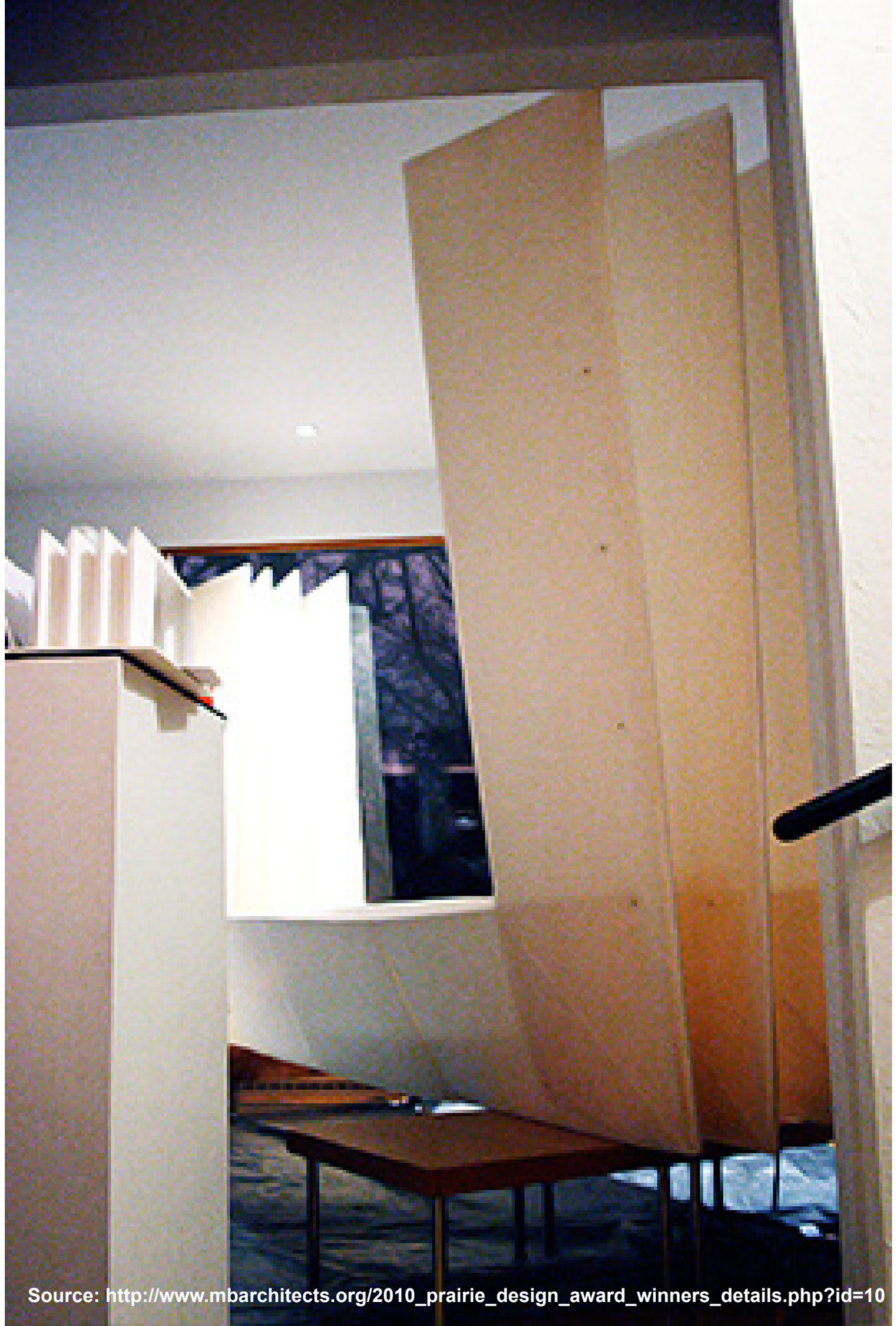


Source: http://www.mbarchitects.org/2010_prairie_design_award_winners_details.php?id=10

Corogami Folding Hut

Project MATERIALS

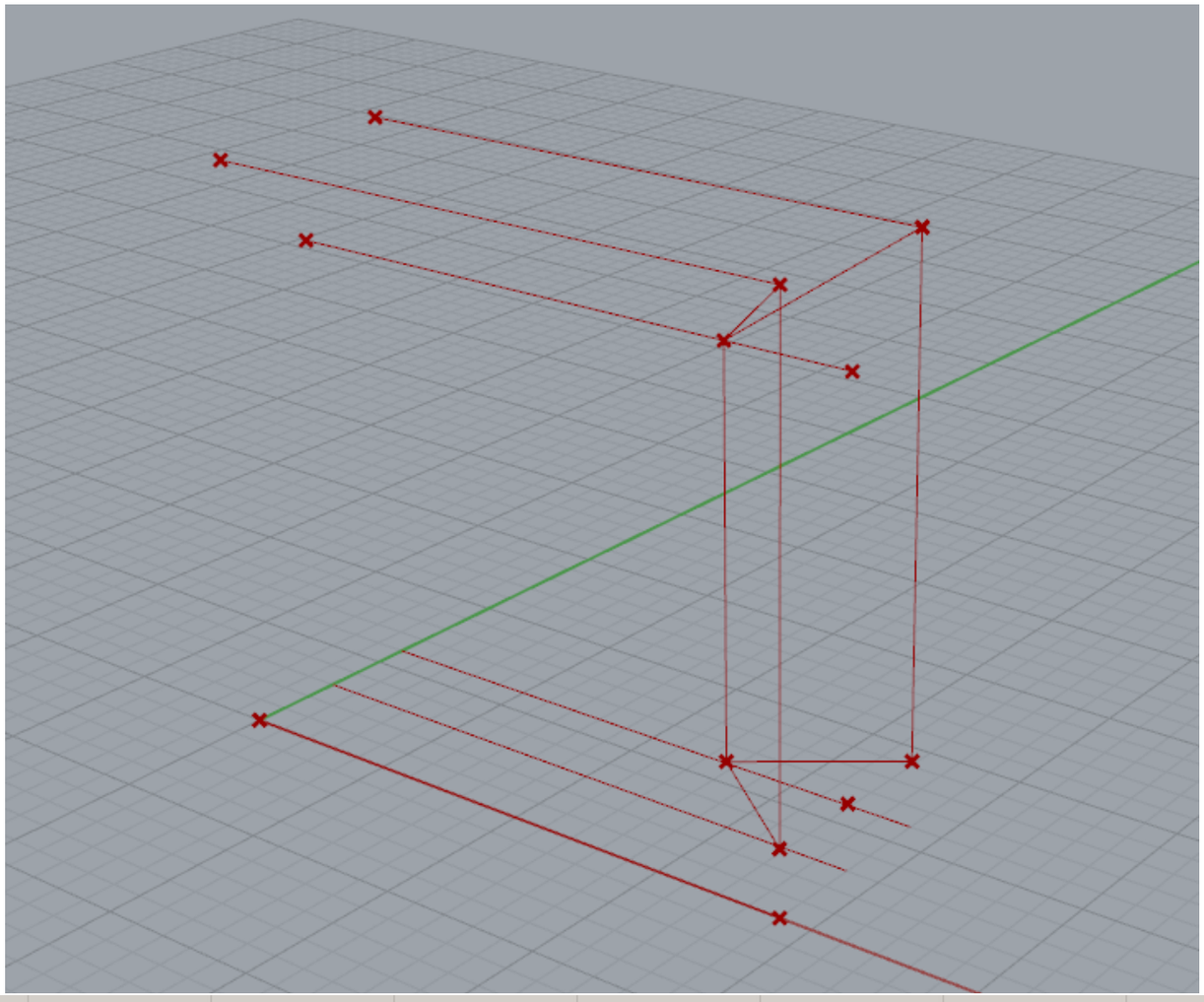
Material:silicon lamination, and pinning with brass paper fasteners

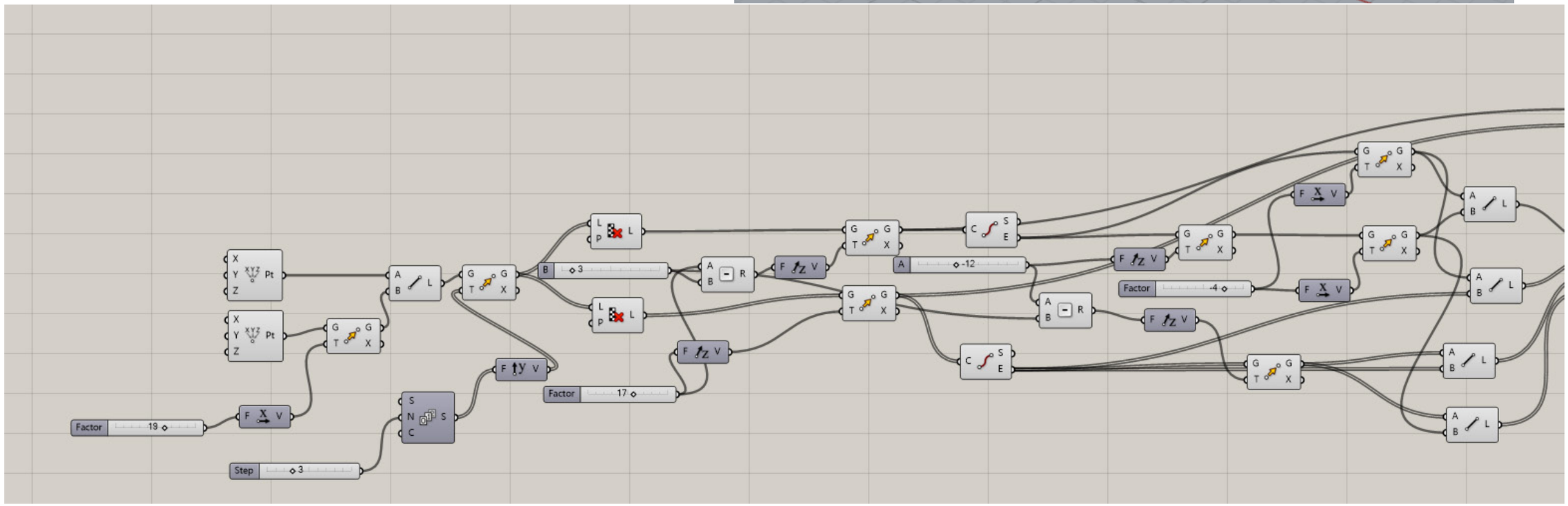


Source: http://www.mbarchitects.org/2010_prairie_design_award_winners_details.php?id=10

Corogami Folding Hut

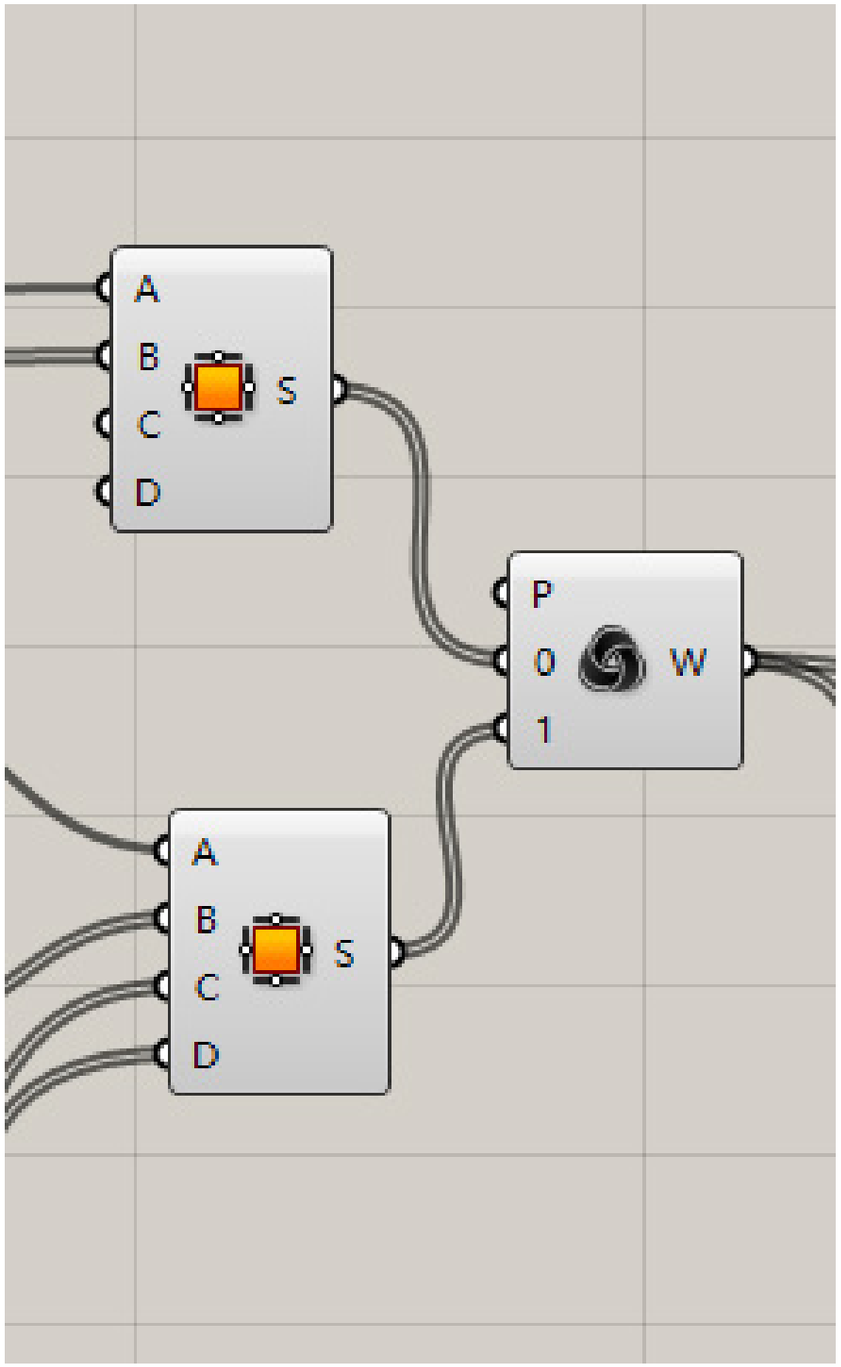
GRASSHOPPER
Modelling

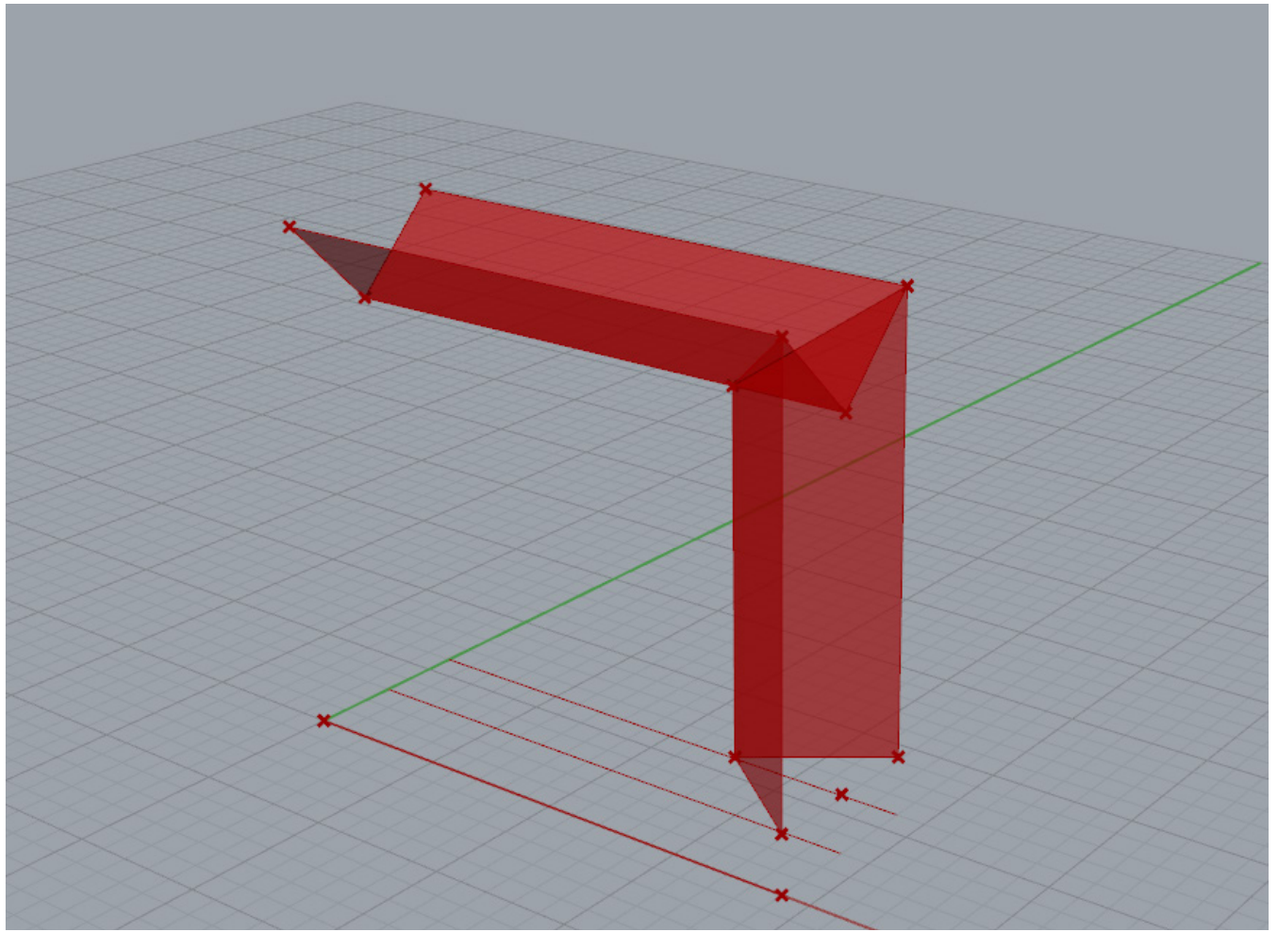




Corogami Folding Hut

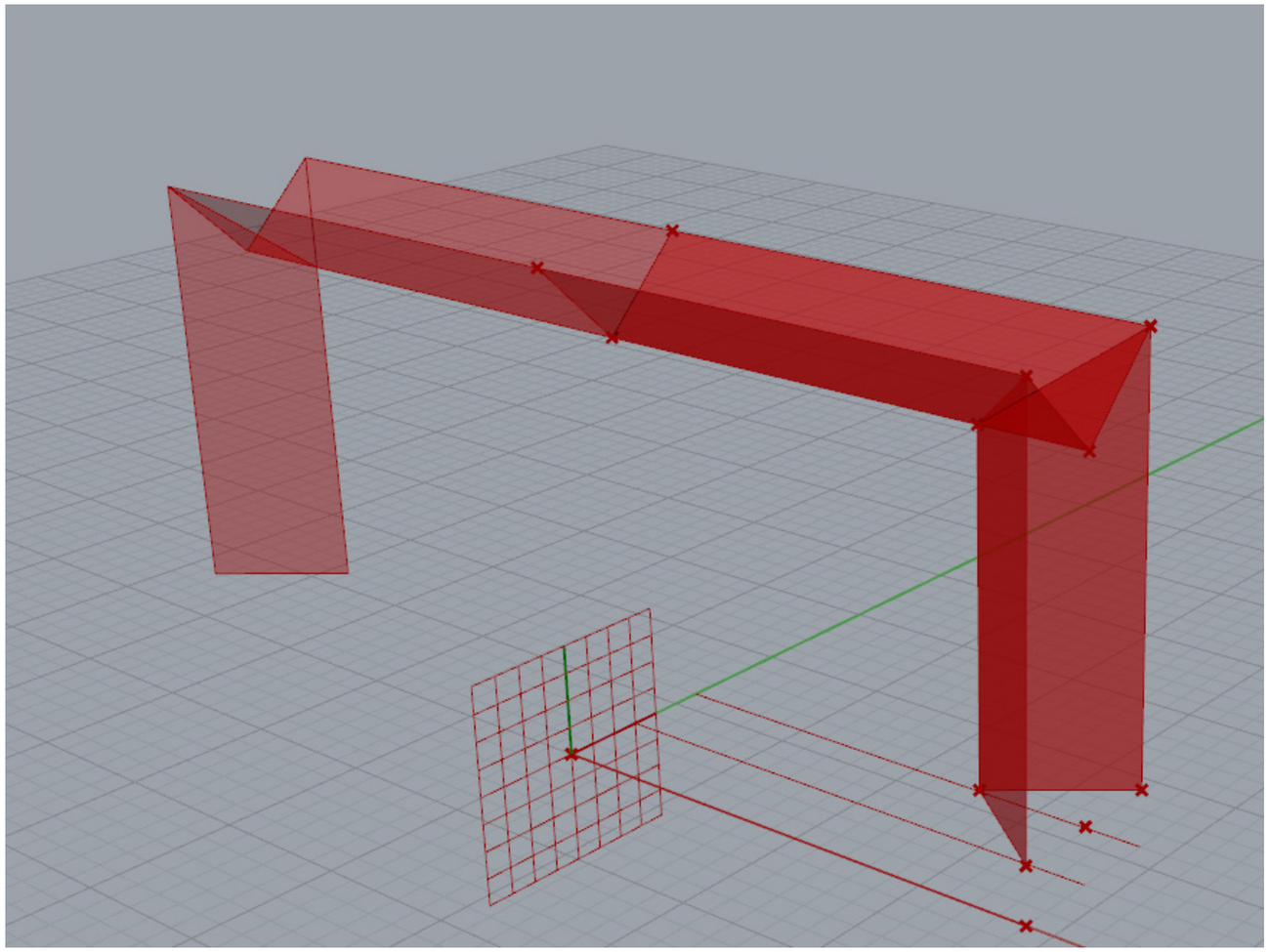
GRASSHOPPER
Modelling

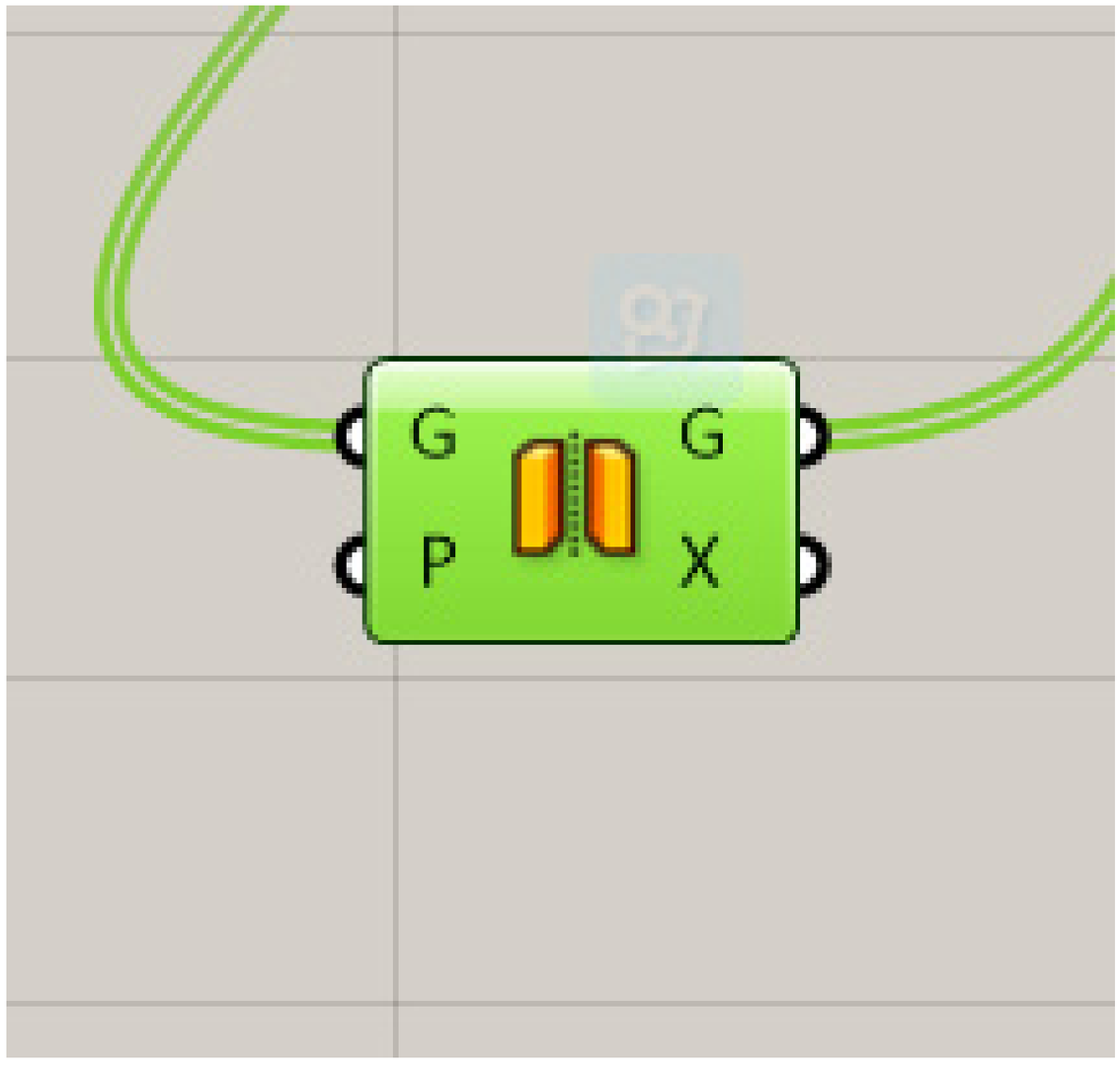




Corogami Folding Hut

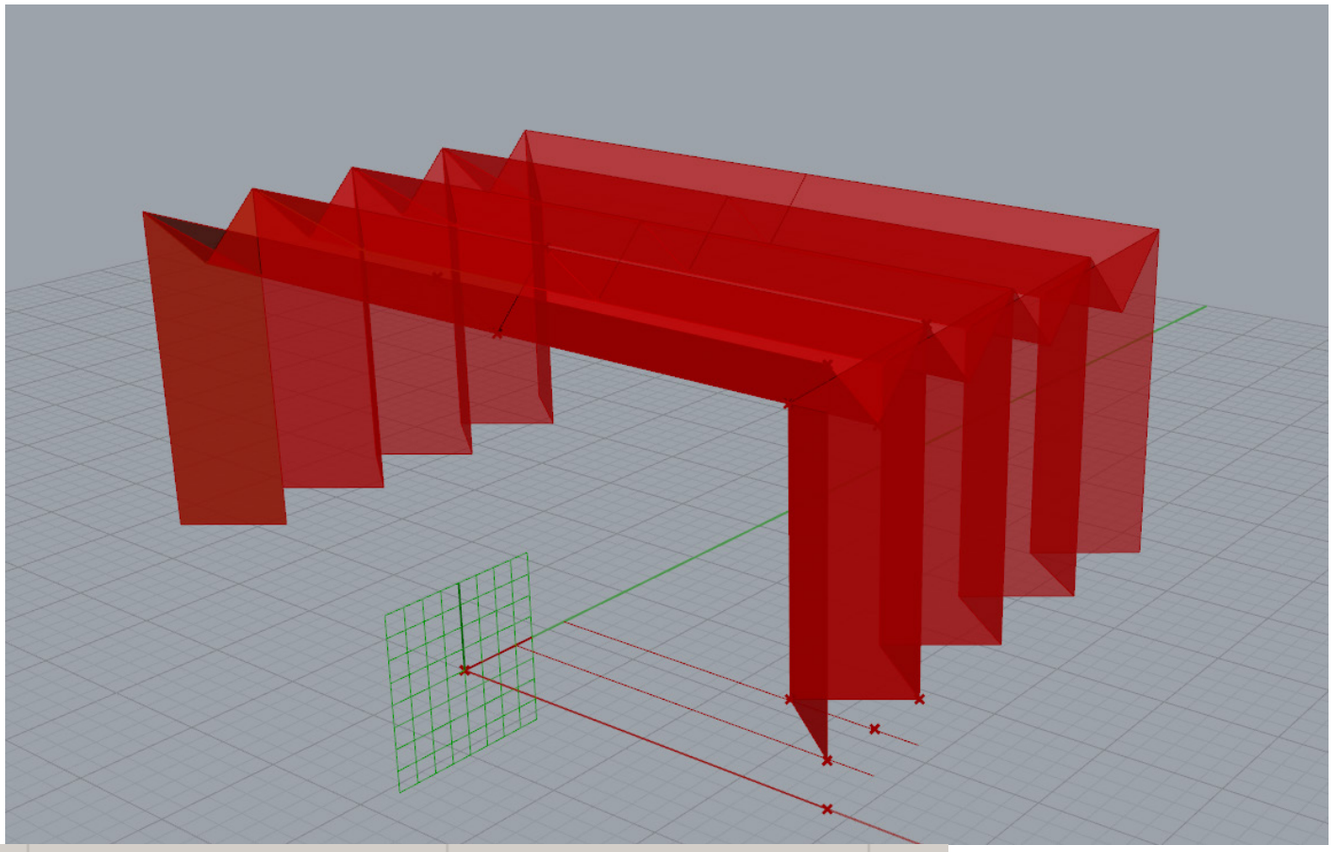
GRASSHOPPER
Modelling

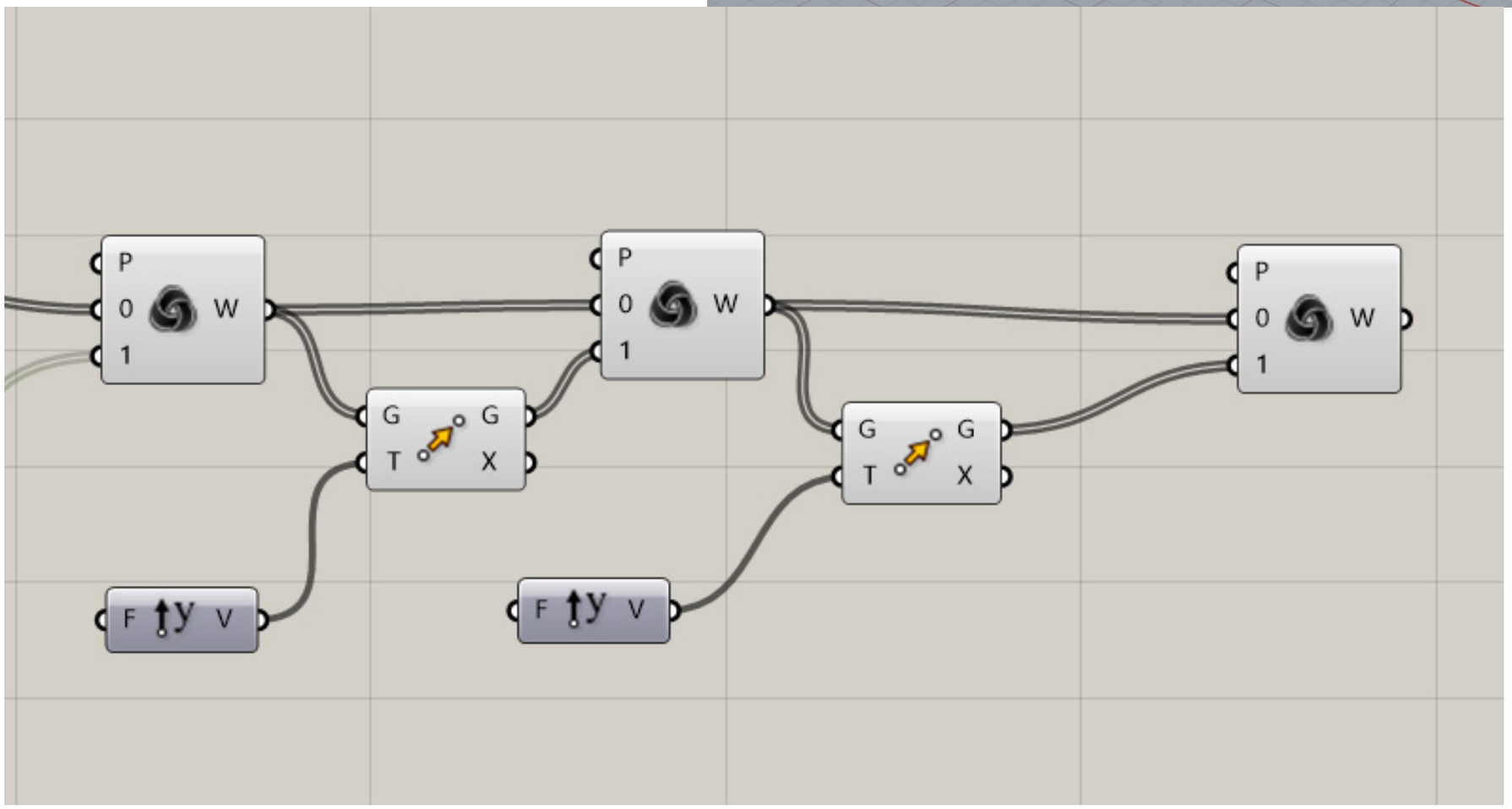




Corogami Folding Hut

GRASSHOPPER
Modelling





FOLDING
Cardboard Banquet
University of Cambridge
RAMY MAHER

Source: http://www.pleatfarm.com/2009/11/09/cardboard-banquet-cambridge-university/

Cardboard Banquet

Project OUTLINE

Project Architect / Artist: Cambridge University Students

Location: Cambridge, UK

Investor: Cambridge University

Function: Pavilion

Construction Year: 2009

Dimmensions: 4m High, 6m Width, 20m Length

Construction Team: Cambridge University Students

Materials Used: Cardboard and ropes to tie them together

Budget: Unspecified

Fabrication Method Used: Folding

Fabricated By: Physically

Type Of Construction: Cardboard folding

Modelling Software: None

Source: http://www.pleatfarm.com/2009/11/09/cardboard-banquet-cambridge-uni-

Cardboard Banquet

Project DESCRIPTION

After being given a lecture on folding and origami, students were asked to design and build a pavilion out of cardboard.

The design took 2 weeks, and the construction took 3 days. It was built entirely out of cardboard as a part of an architectural studio.

First year and third year students participated in the workshop, and they started building out of folding techniques.

Third year students were asked to design houses from folding techniques while first year students were asked to design furniture.

The pavilion was designed and fabricated without using one computer progam- only depending on the workshop the students had studied.

Source: http://www.pleatfarm.com/2009/11/09/cardboard-banquet-cambridge-university/

Cardboard Banquet

Project FABRICATION

The project was constructed by the students on the spot. Both construction and design combined took 3 days.

http://www.iconeye.com/component/k2/item/4142-cambridge-university%E2%80%99s-%E2%80%9Ccardboard-banquet%E2%80%9D

Cardboard Banquet

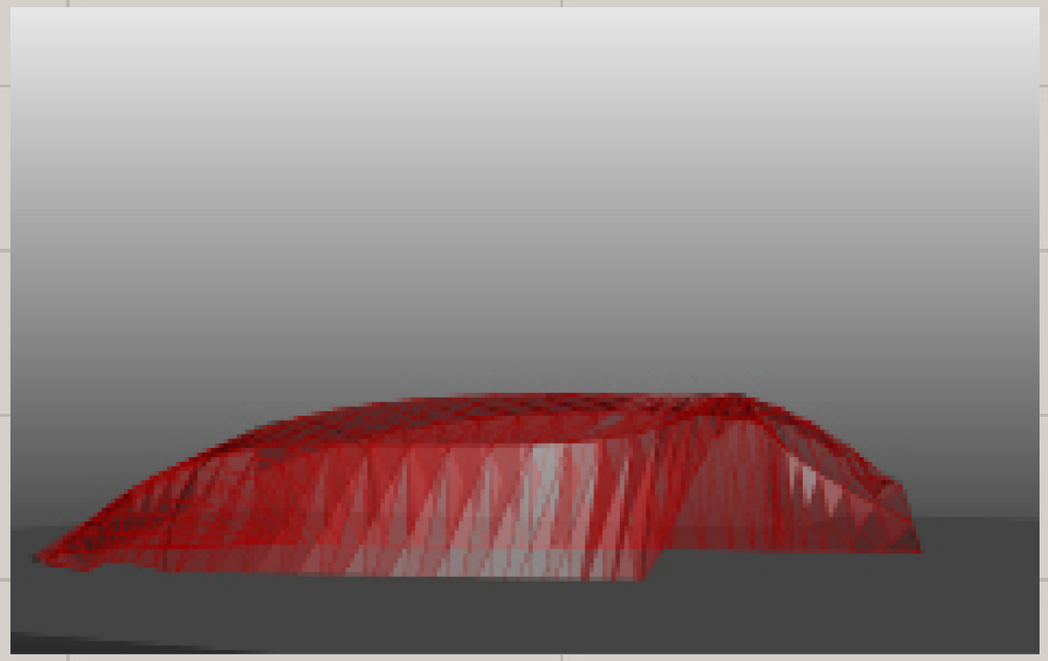
Project MATERIALS

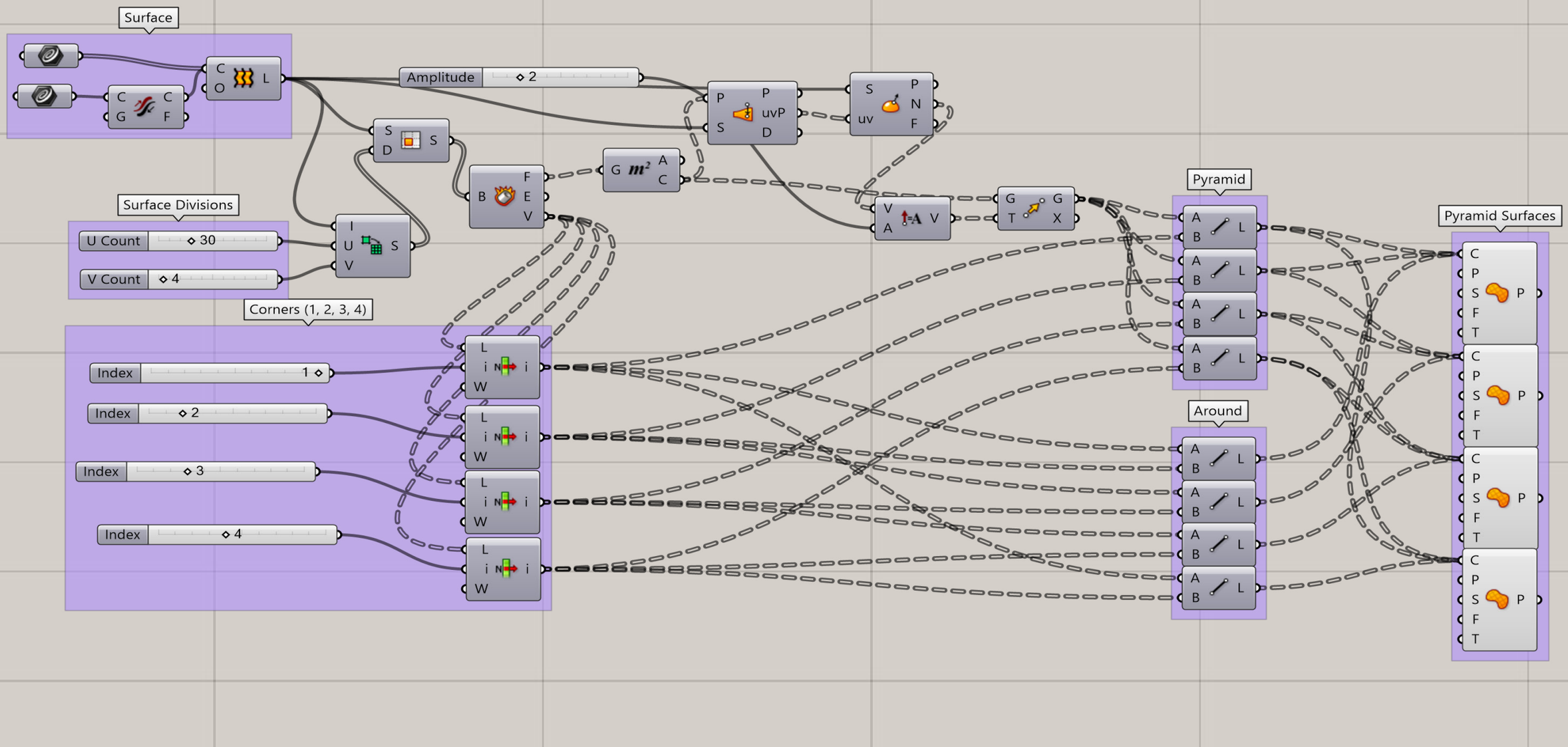
Quantity Survey		
	Material	**Quantity**
Crdboard Sheets	100x80x0.8cm	220
Ropes	40m	1

Cardboard Banquet

GRASSHOPPER

Modelling





*IMPORTANT
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FOLDING
ARCHED PAVILION

YHE studio
Yiying Wang

Folding Pavilion

Project OUTLINE

Project Architect / Artist: YEH studio

Location: University's Gallery

Investor: YHE studio

Function: Pavilion

Construction Year: 2015

Dimmensions: 2.5m High, 5m Wide

Materials Used: translucent double walled polycarbonate sheets

Budget: 250 Euro

Major Fabrication Method Used: Paper Folding

Fabricated By: (Gum,Hinge)

Type Of Construction: polycarbonate sheets Frame

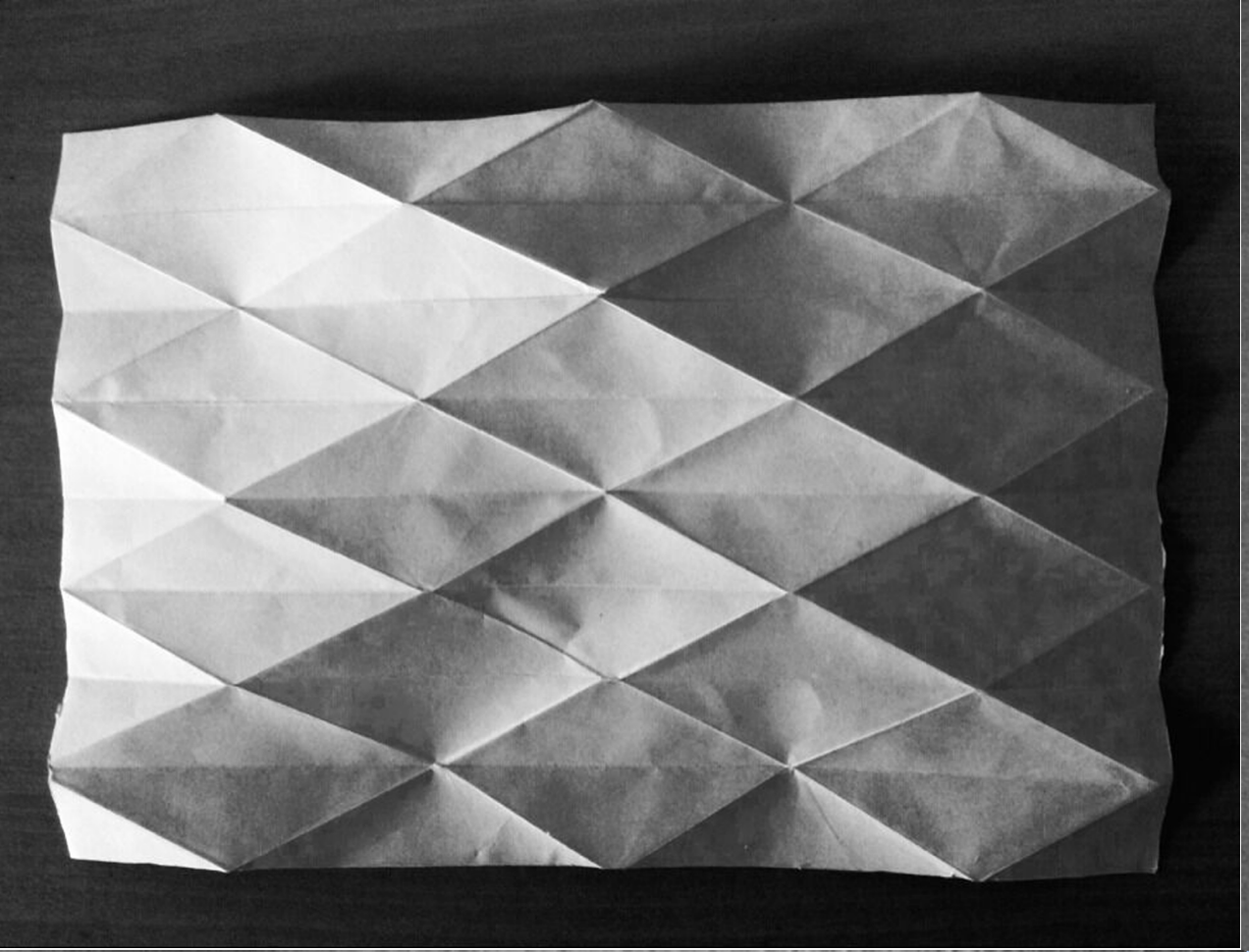
Modelling Software: Rhino + Grasshopper

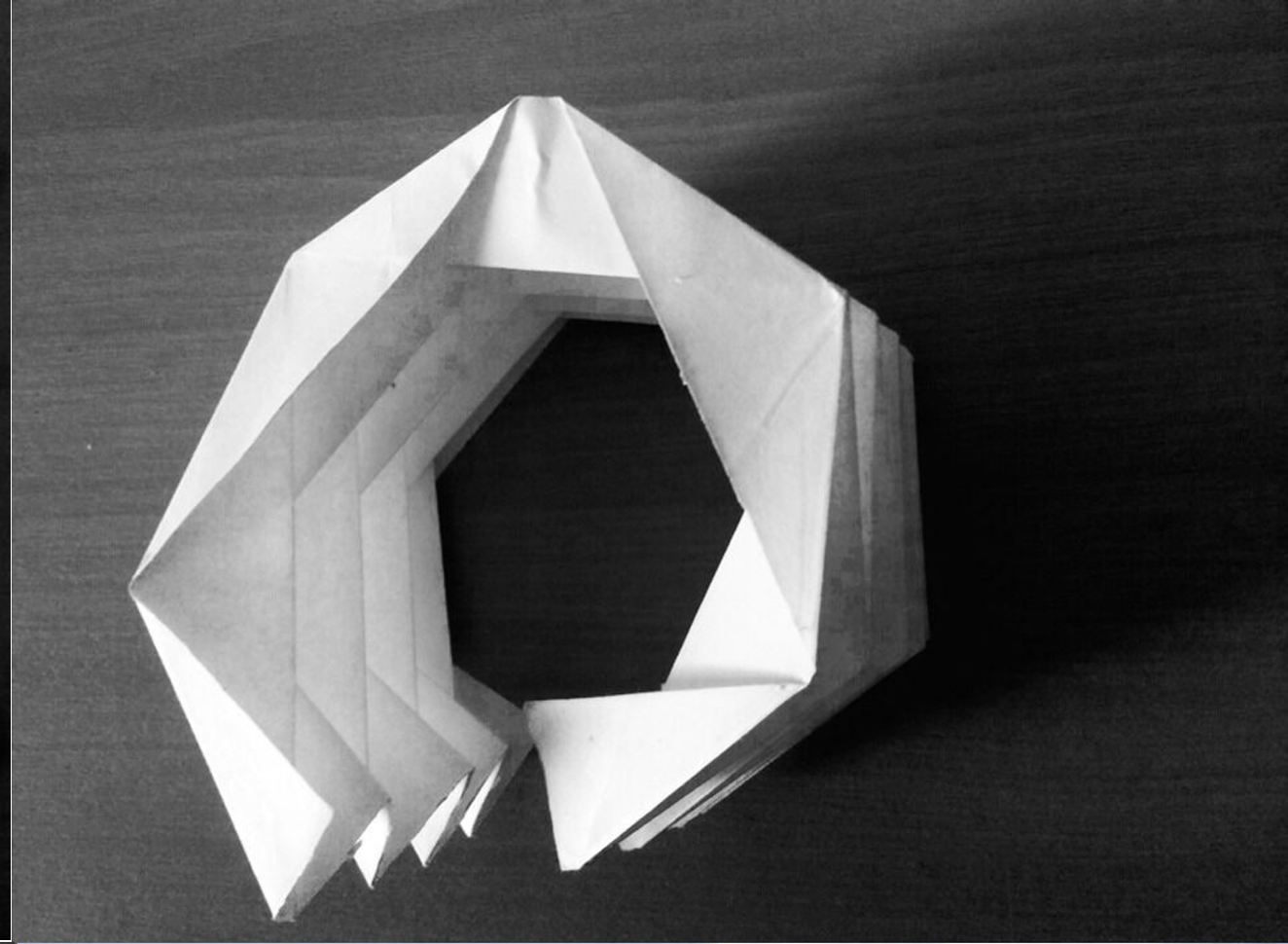
Folding Pavilion

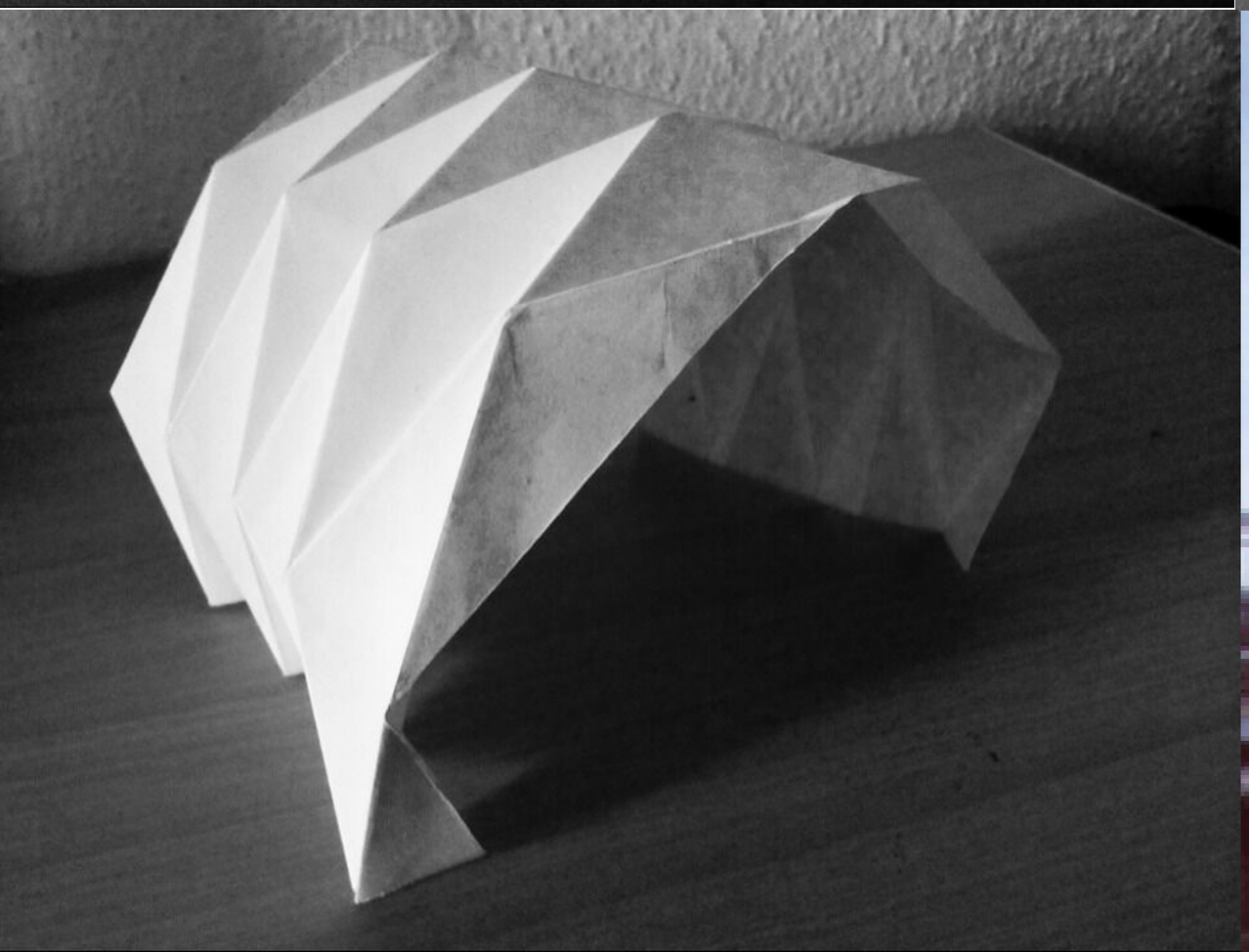
Project DESCRIPTION

The folding plate truss structure grew out of our early experiments with paper folding and a love of the longspan structural systems documented in Heino Engel's beautiful 1967 book "Structure Systems".

We were asked to participate in a exhibition at Chapman University's Gallery curated by Kati Rubinyi. The folding structure is literally a scaled up paper sheet structure constructed in translucent double walled polycarbonate sheeting. The sculptural arch folds flat and into form just like its small ideator.





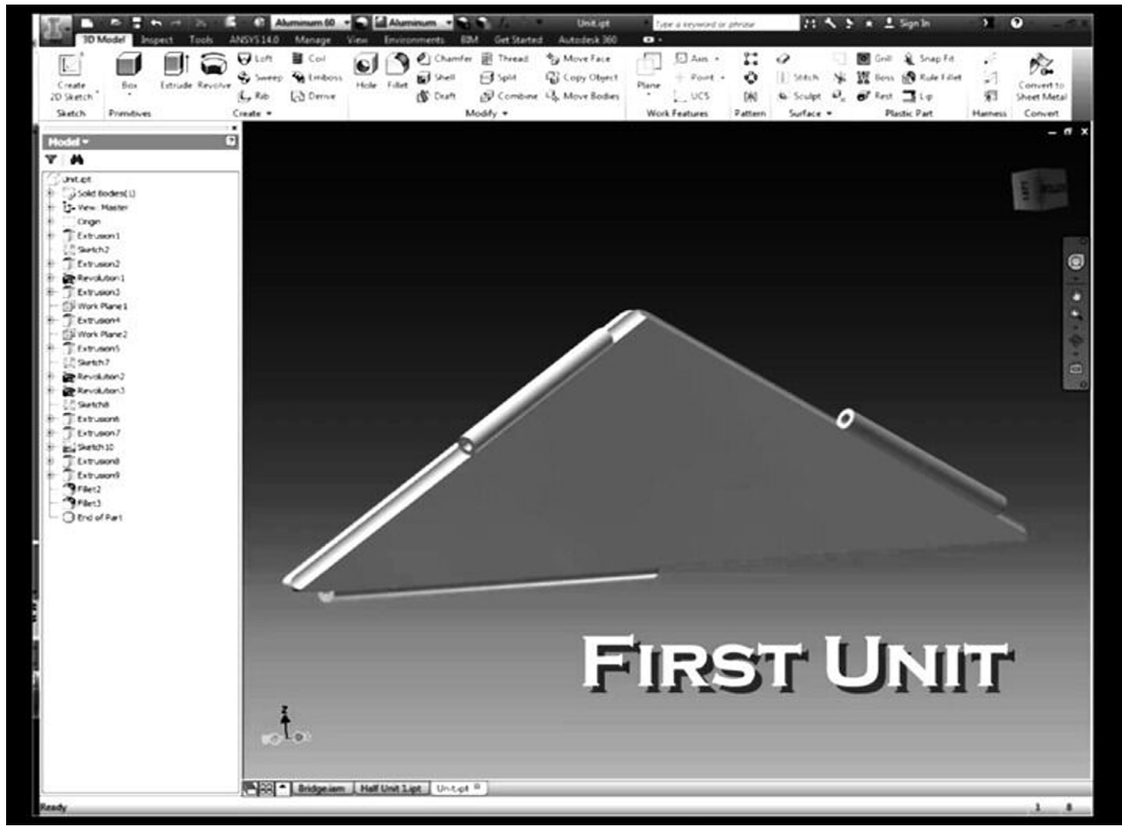


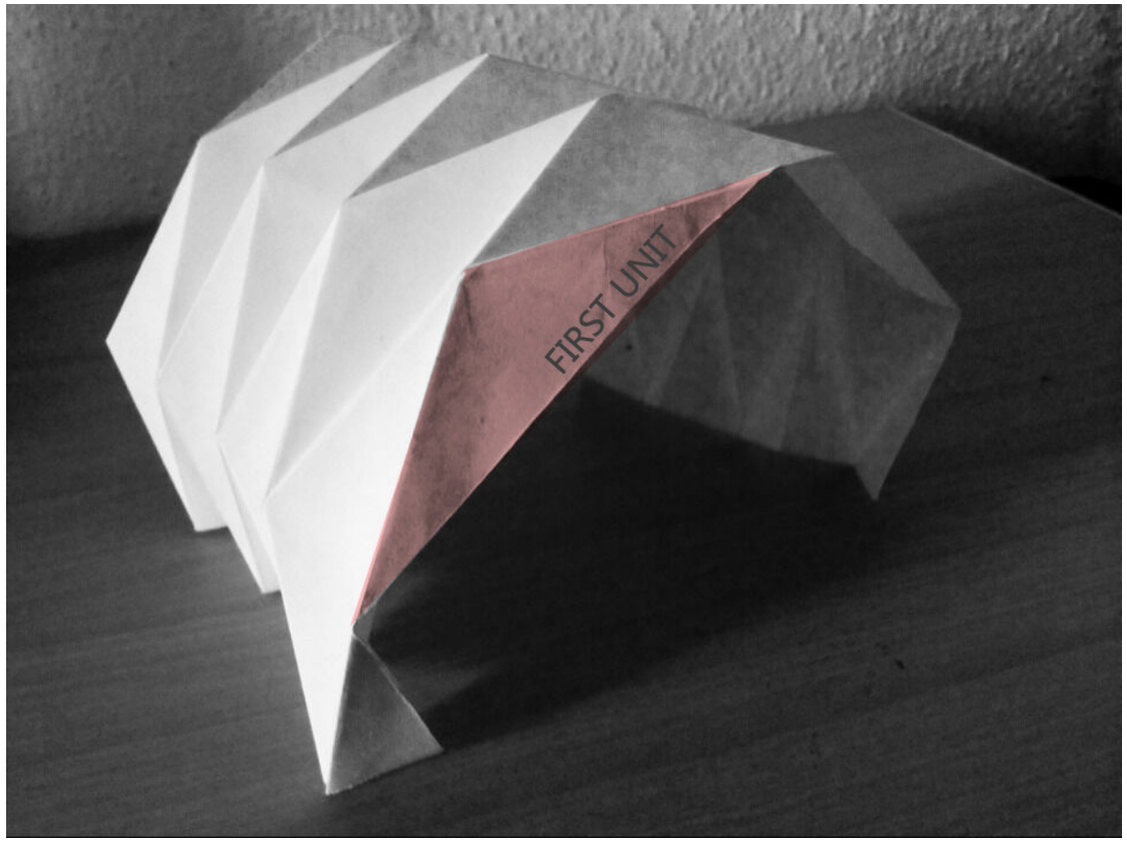
Folding Pavilion

Project FABRICATION

To made the whole structure we need two kinds of units.The following is the first unit.

In the paper model we can see that the unit1 is in the top of the structure.So we thought the material of unit1 is light weight material(hard paper...)



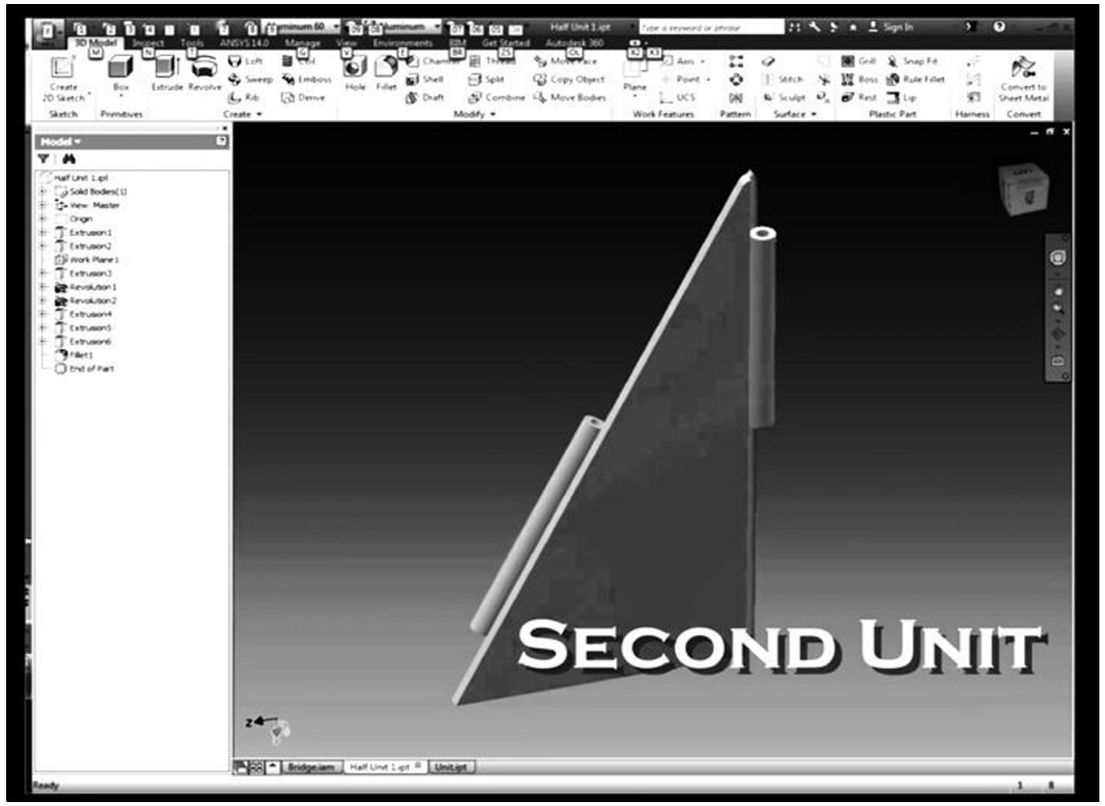


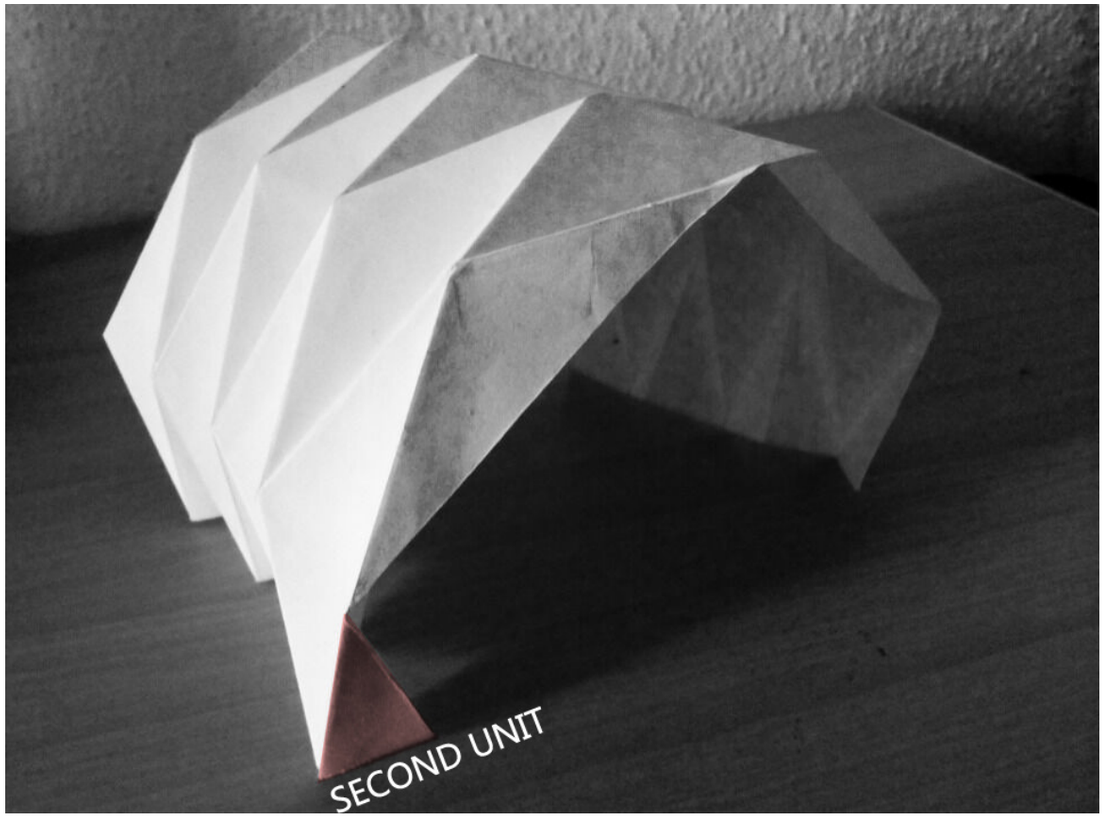
Folding Pavilion

Project FABRICATION

In the paper model we can see that unit2 support

the whole model.So we thought the material of those part should be steel or something strong enough.



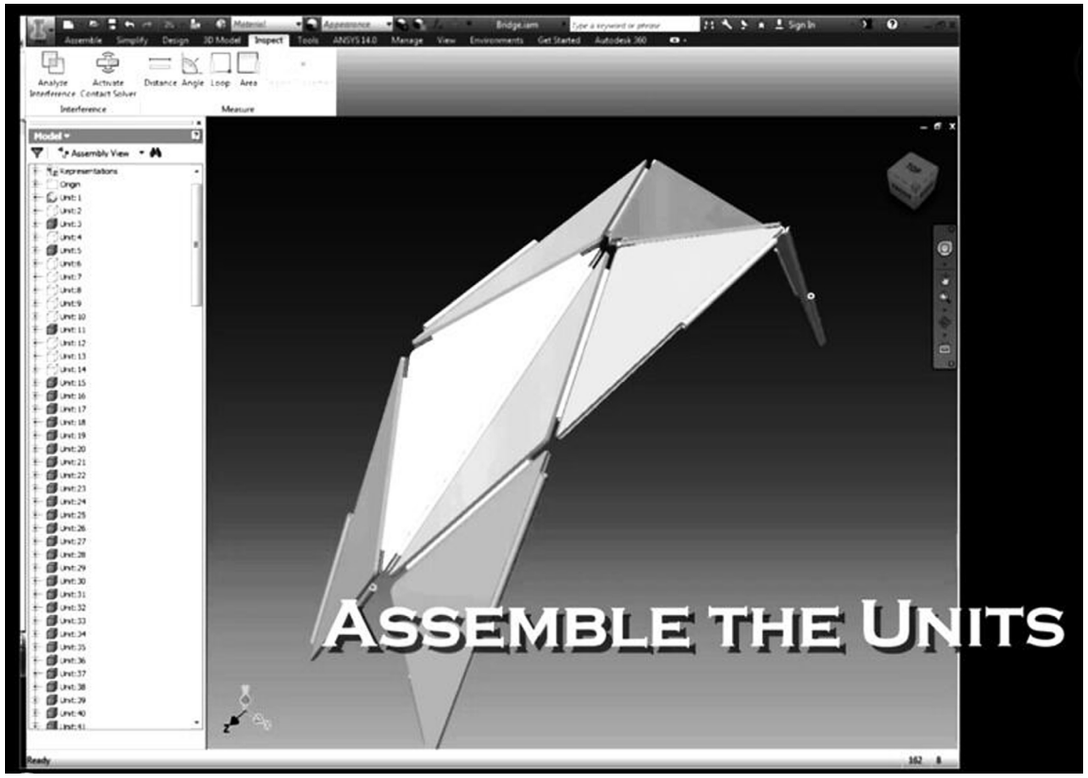


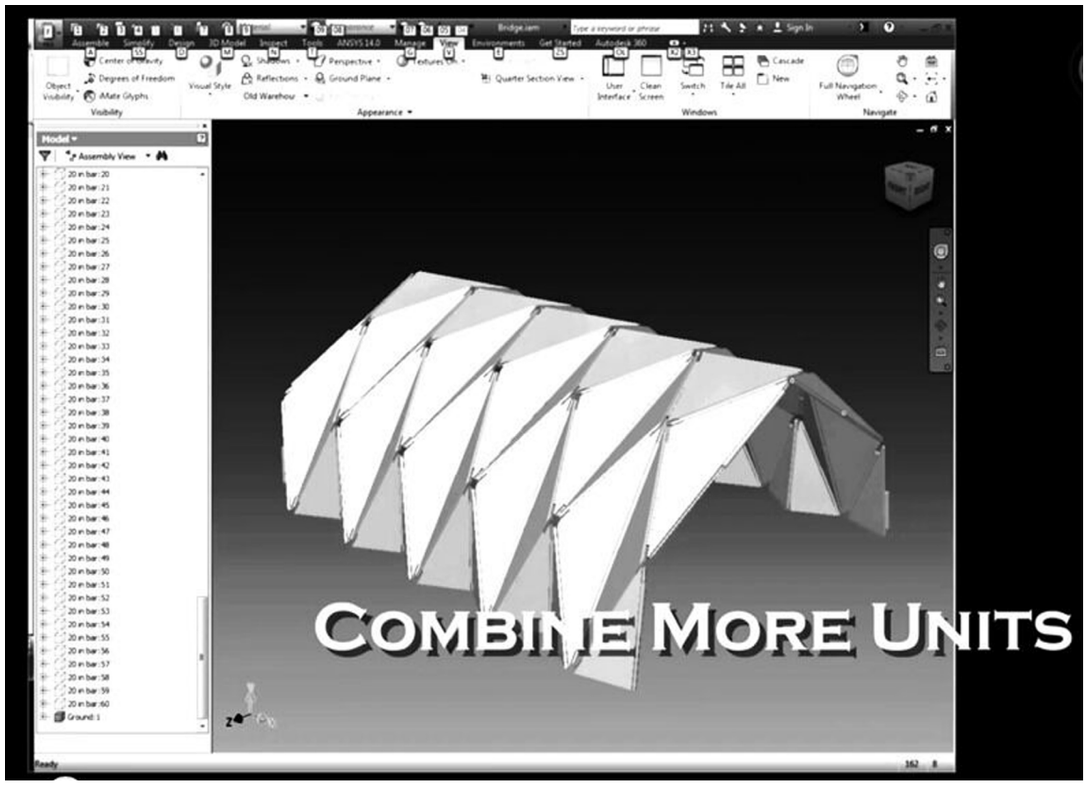
Folding Pavilion

Project FABRICATION

About how to connect each units we have two plan
Plan1:We made all the units in hard paper and then we just use glue or tape to connect each units
Plan2:We afraid plan1 is not strong enough,so we get the second plan.We made every units as the picture shows us and we connect each unit with the connection fittings(as the following picture)

Last step is to combined more units





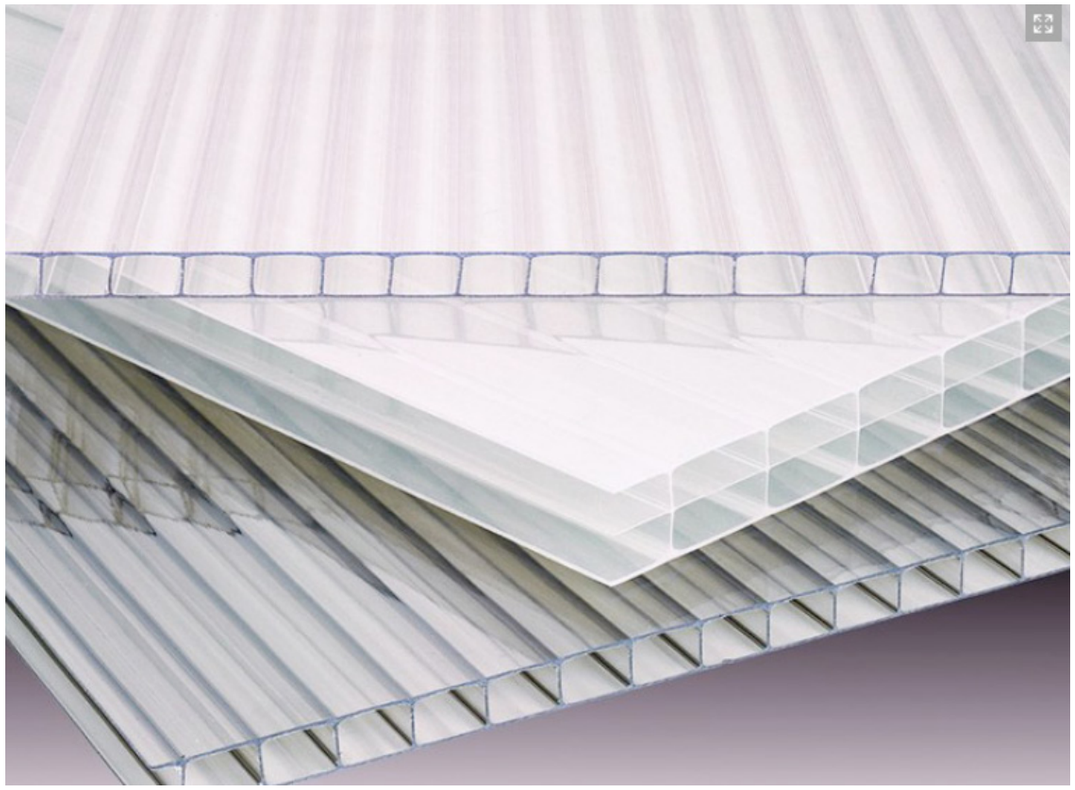
Folding Pavilion

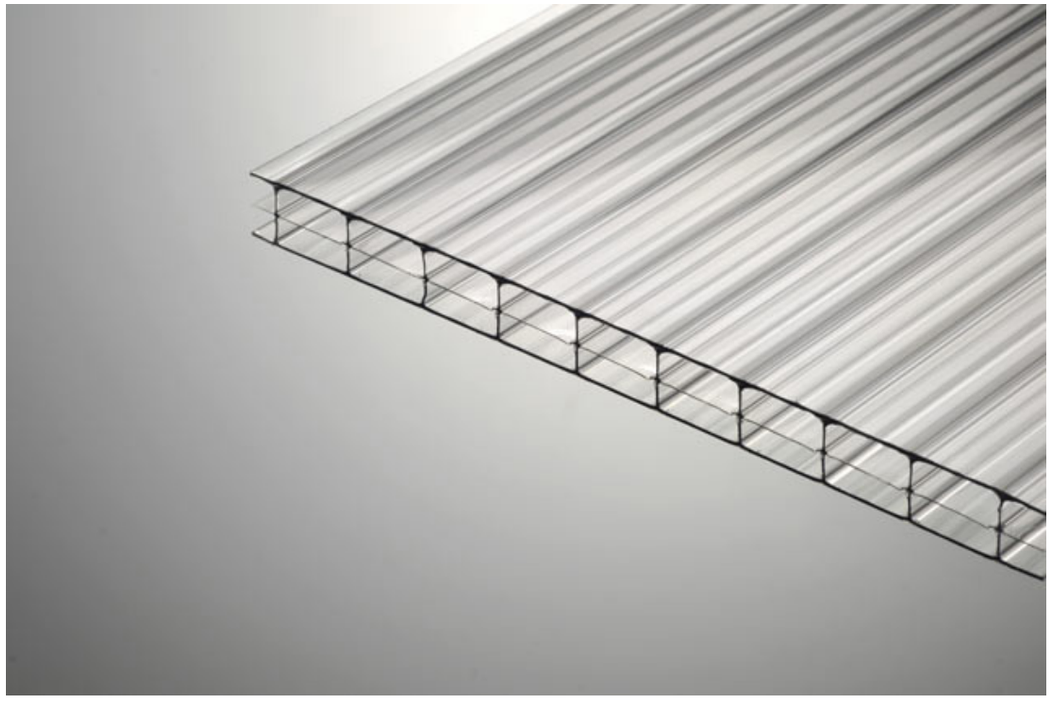
Project MATERIALS

Folding Pavilion Quantity Survey		
polycarbonate sheets		
	Material	**Total area**
Unit 1	50×0.527m	26.35sq.m
Unit 2	25×0.263m	6.575sq.m
Steel		
Hinge		

Folding Pavilion

Project MATERIALS

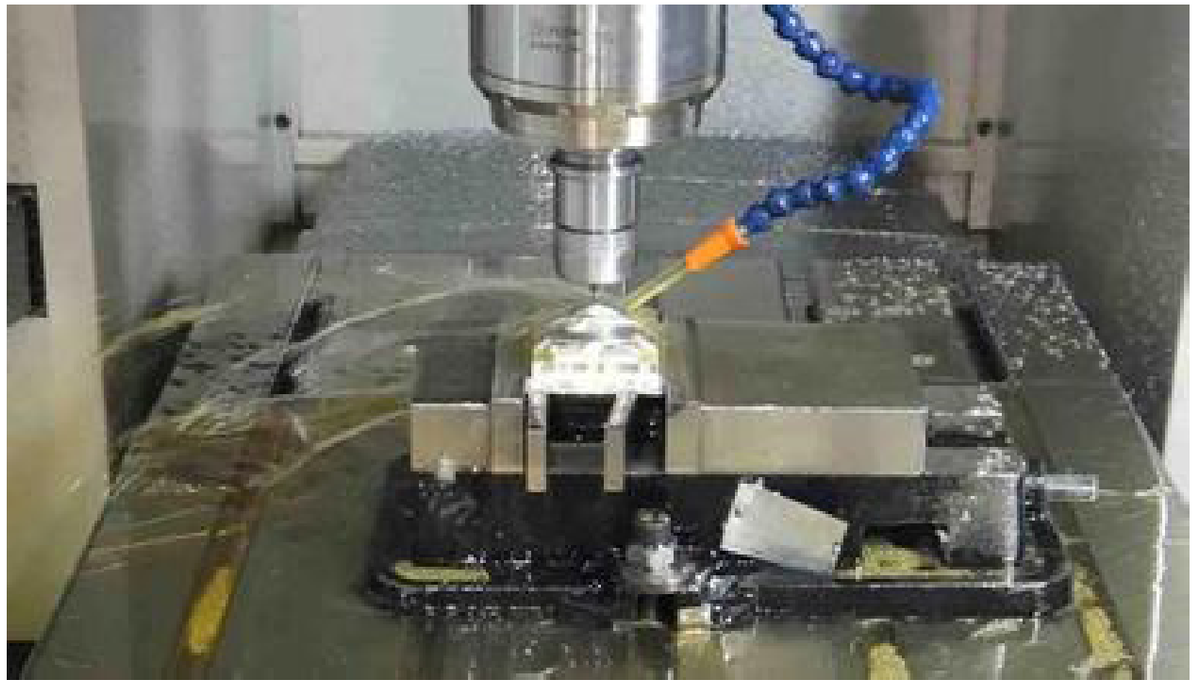




Folding Pavilion

Project MACHINE / SOFTWARE

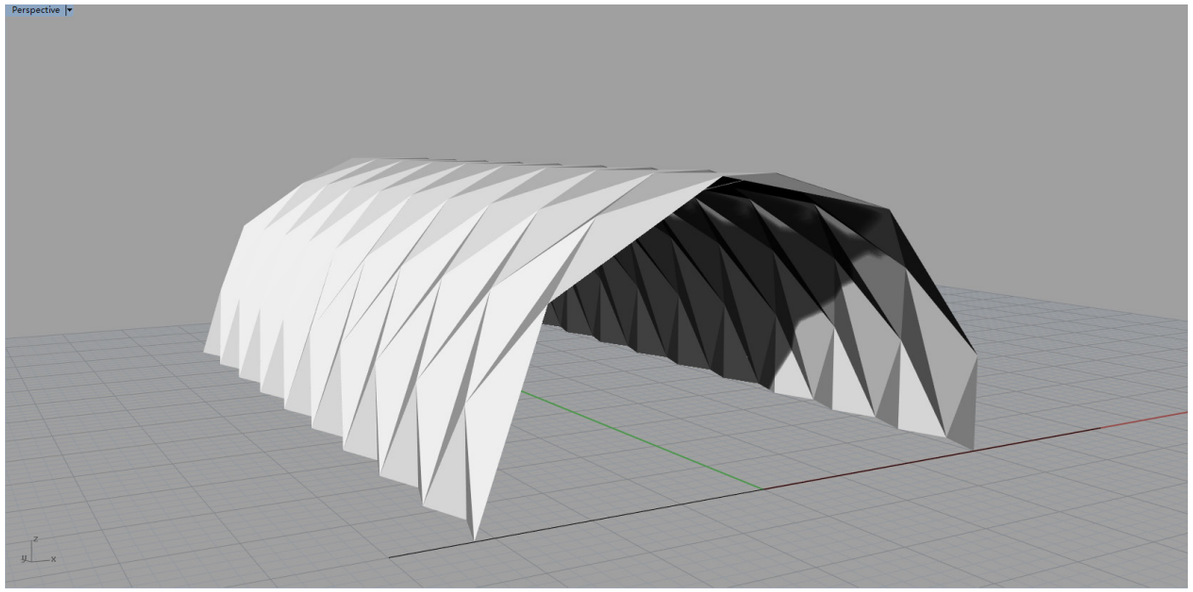
CNC:Numerical control (NC) is the automation of machine tools that are operated by precisely programmed commands encoded on a storage medium, as opposed to controlled manually via hand wheels or levers, or mechanically automated via cams alone. Most NC today is computer (or computerized) numerical control (CNC),[1] in which computers play an integral part of the control.

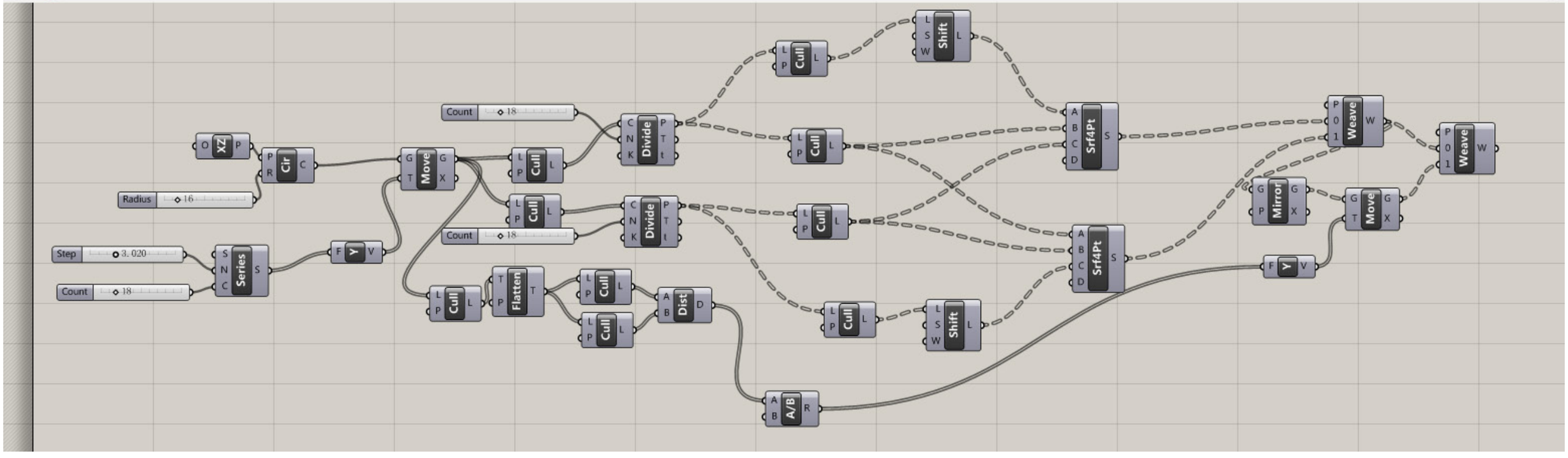


Folding Pavilion

GRASSHOPPER

Modelling

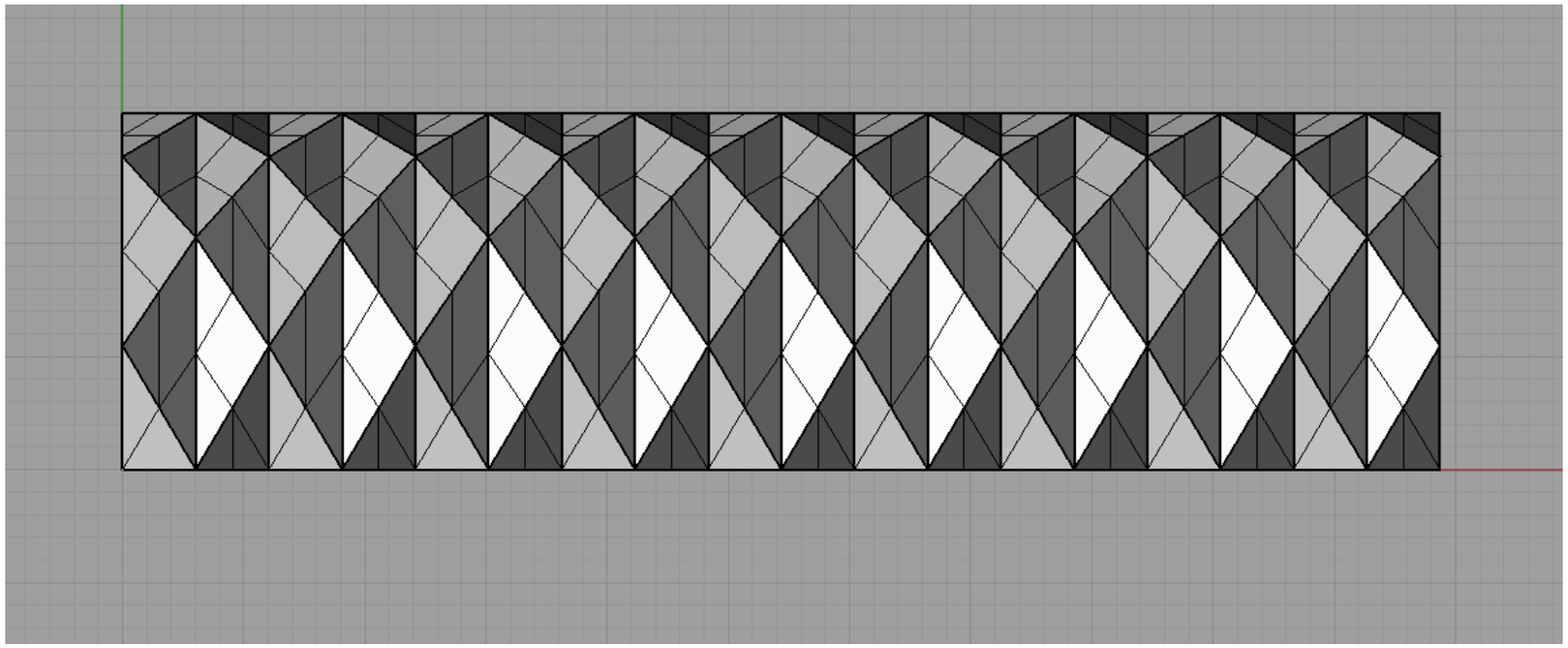


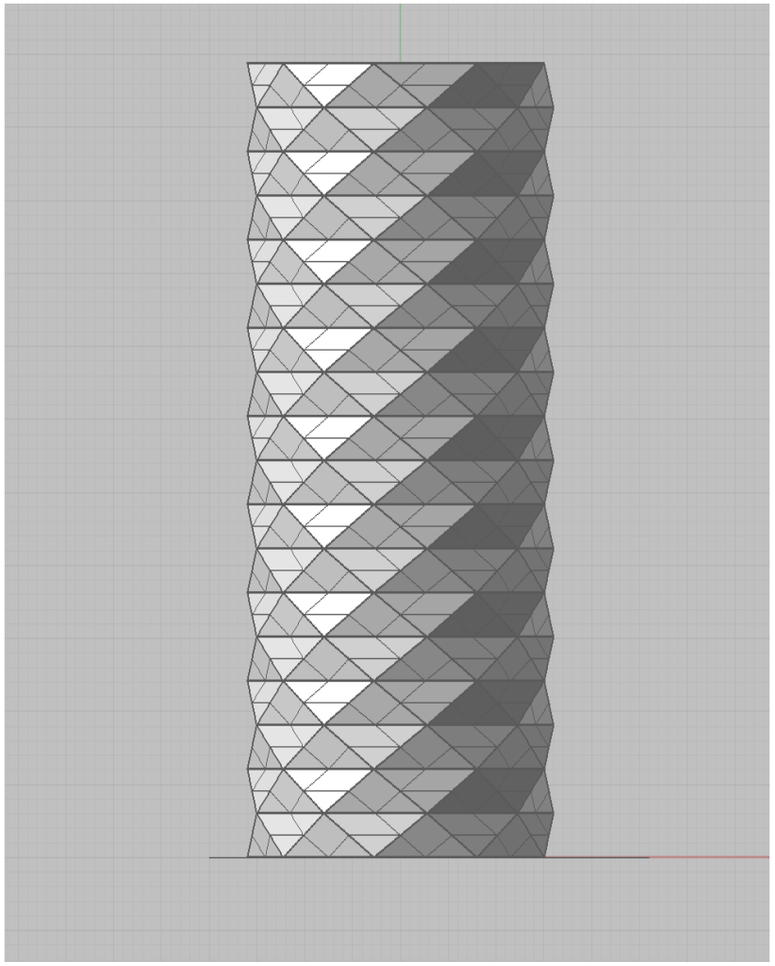


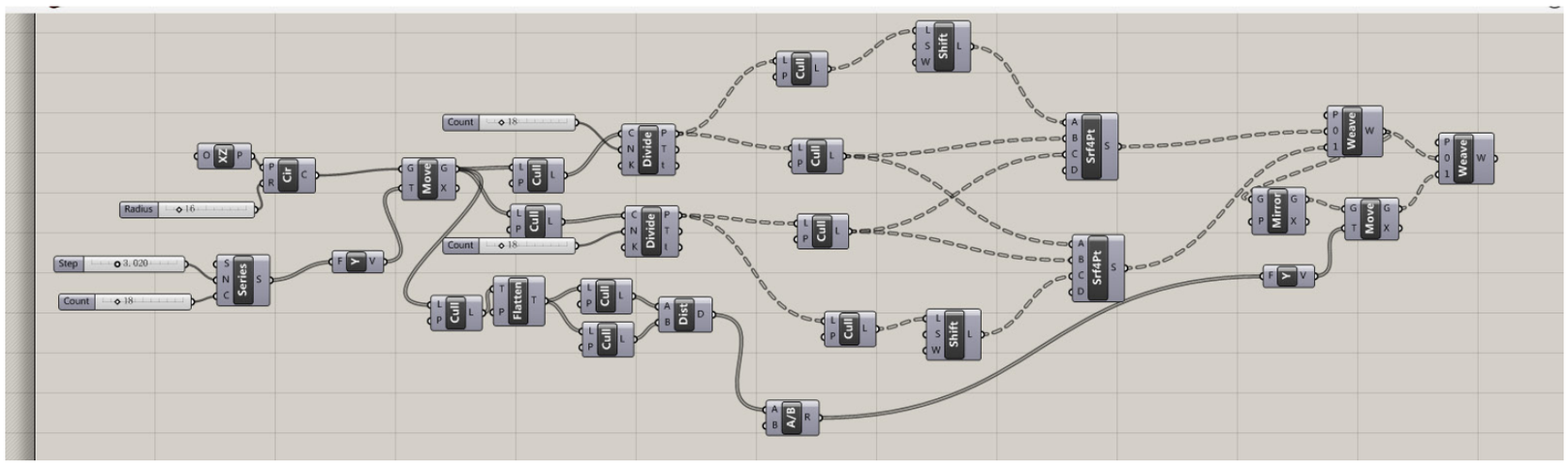
Folding Pavilion

GRASSHOPPER

Fabrication Definition







Folding Pavilion

FOLDING

FOLDED METAL KIOSKS

MAKE ARCHITECTS

Adhy Wibawa Wangsaatmadja - 4061272

http://www.archdaily.com/474940/kiosk-make-architects/52f5ab16e8e44efa5e000139

Make Kiosk

Project OUTLINE

Project Architect / Artist: Sean Affleck, Make lead project architects

Location: London, UK

Investor: Canary Wharf Group plc

Function: Retail - Kiosks

Construction Year: 2014

Dimmensions: 1.95m deep x 3m wide (6.4 x 9.8 ft) interior

Construction Team: Entech Environmental Technology Ltd

Materials Used: Hollow-section steel, Steel pin, Aluminium cladding, Plywood-stressed

Budget: Each kiosk will cost between £40,000 - £50,000

Major Fabrication Method Used: Radial Folding

Secondary Fabrication Methods: Rectangular Framing

Fabricated By: CNC laser cutting

Type Of Construction: Steel Frame

Modelling Software: Rhino + Grasshopper

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Make Kiosk

Project DESCRIPTION

The simple folding geometric shape of this unique prefabricated retail kiosk designed by Make Architects is based on the concept of origami. Expressed as a compact, sculptural rectangular box when closed, the structure is transformed when open, with folds and hinges in the aluminium panels allowing them to expand and contract like a fan when the kiosk opens and closes.

Make's design for a new street kiosk aims to provide the best possible trading environment for street vendors while at the same time upgrading the streetscape. The concept for the kiosk is a compact, rectangular box that transforms when it opens and its function is revealed. The kiosk's opening faces were developed using the concept of origami; folds and hinges in the material allow the panels to expand and contract, like a concertina or a fan. The result is a simple folding geometric form that appears sculptural when closed and dynamic when open. The opening mechanism is designed as a simple counterweight system with few moving parts, ensuring easy, fail safe operation.

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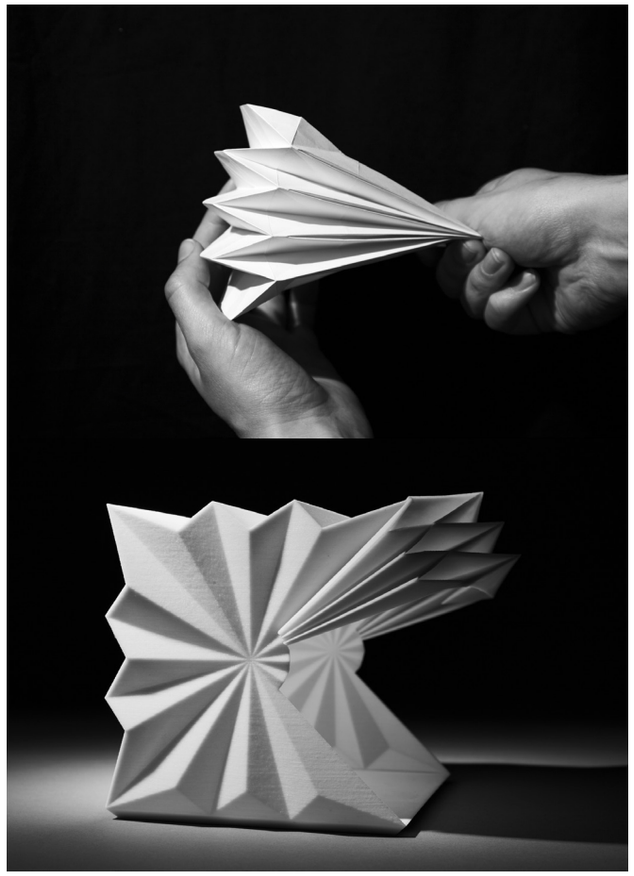
http://www.archdaily.com/474940/kiosk-make-architects/52f5ae-

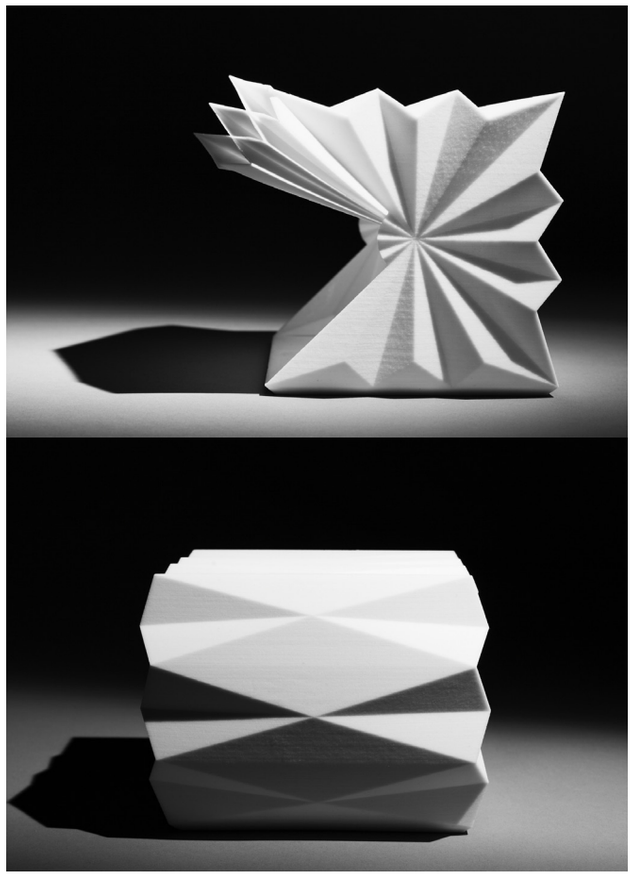
Make Kiosk

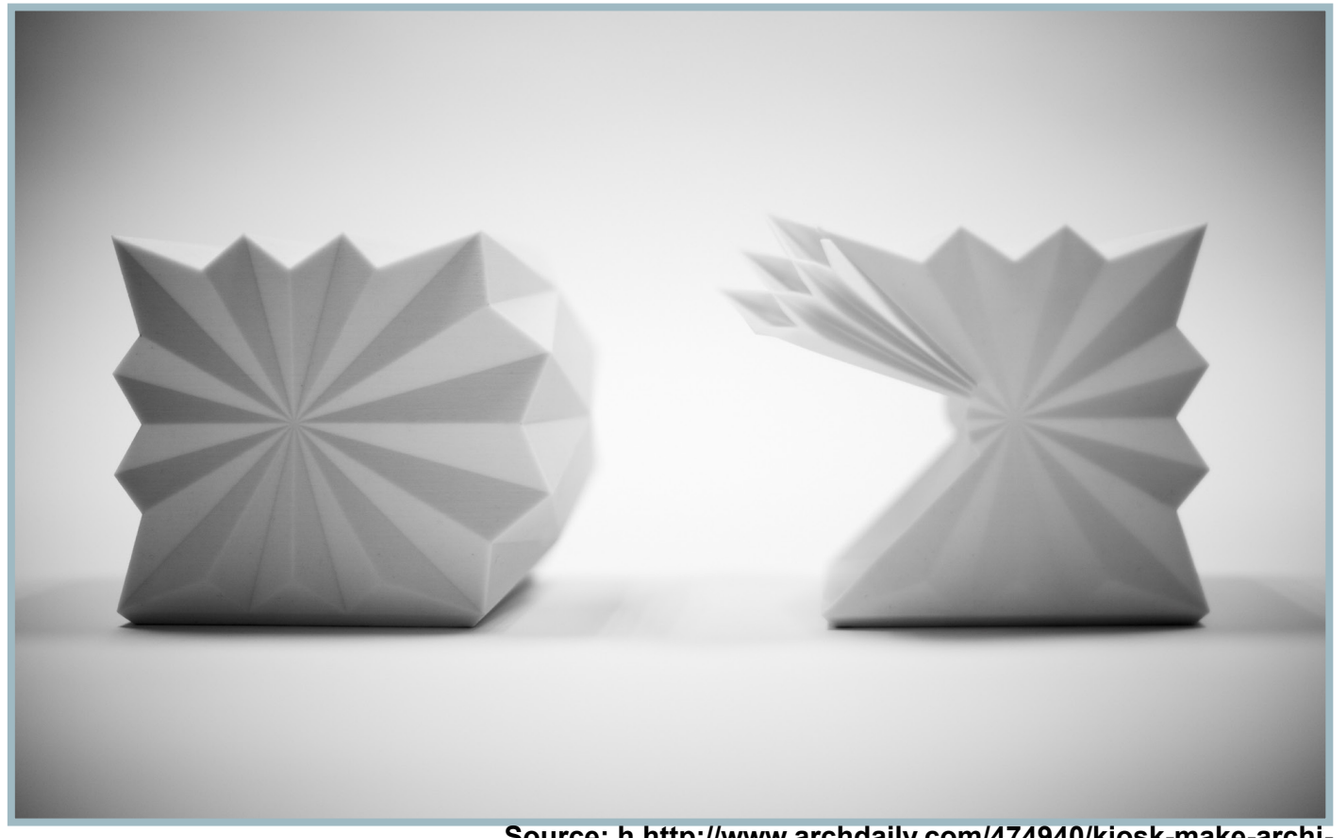
Project FABRICATION

Origami concept became the basis and beginning of the design idea. The fabrication process is done in several stages. The first is to create and compile a rectangular frame of steel material. This is done to balance the static frame on the rear and dynamic cover aluminum clading on the front. The system folds on the front kiosk operated by winch.

In this project, Make collaborated with metal fabrication specialist Entech Environmental Technology Ltd to manufacture and test the pavilions off-site and then transported and installed them pre-assembled.







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Make Kiosk

Project FABRICATION

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Make Kiosk

Project MATERIALS

Rectangular hollow-section steel
Steel pin
Plywood-stressed
Skin covered - waterproof membrane
Powder-coated
Aluminium cladding panels

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Make Kiosk

Project MATERIALS

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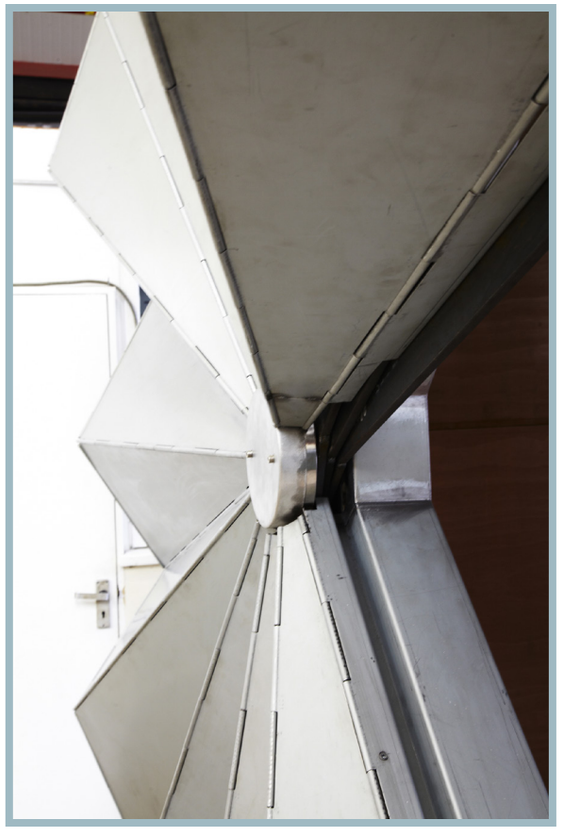

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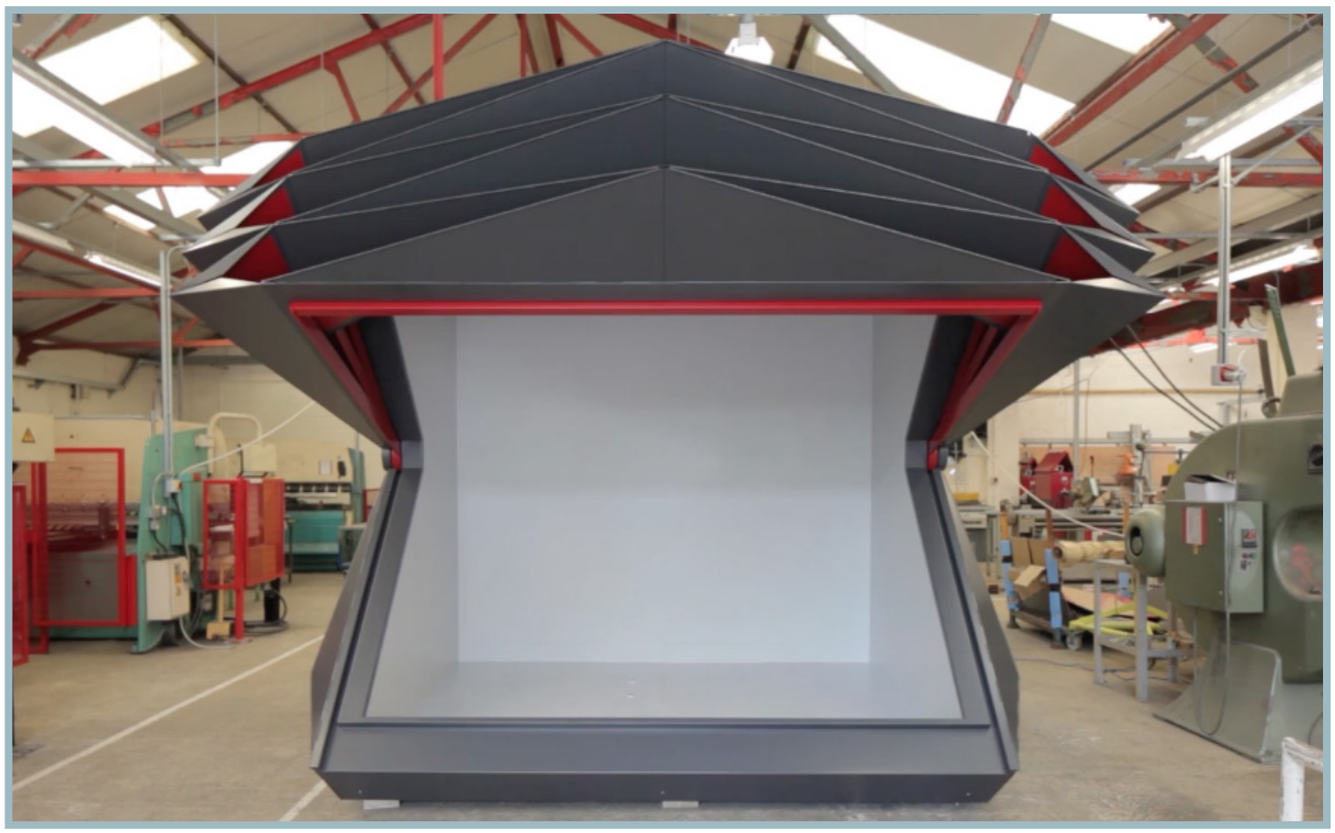
Make Kiosk

Project MACHINE / SOFTWARE

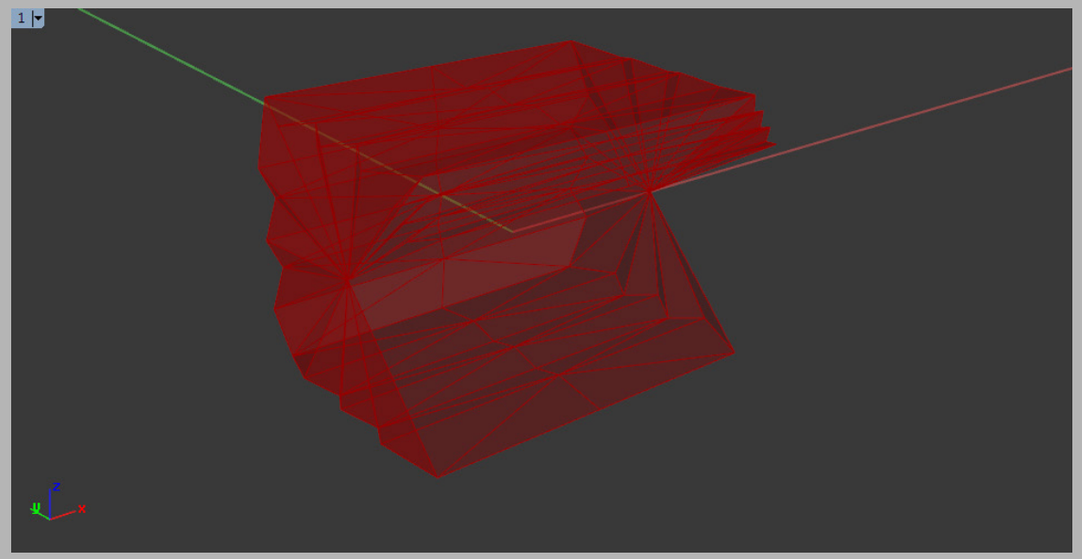
Laser cutting is a technology that uses a laser to cut materials, and is typically used for industrial manufacturing applications, but is also starting to be used by schools, small businesses, and hobbyists. Laser cutting works by directing the output of a high-power laser most commonly through optics. The laser optics and CNC (computer numerical control) are used to direct the material or the laser beam generated. A typical commercial laser for cutting materials would involve a motion control system to follow a CNC or G-code of the pattern to be cut onto the material.

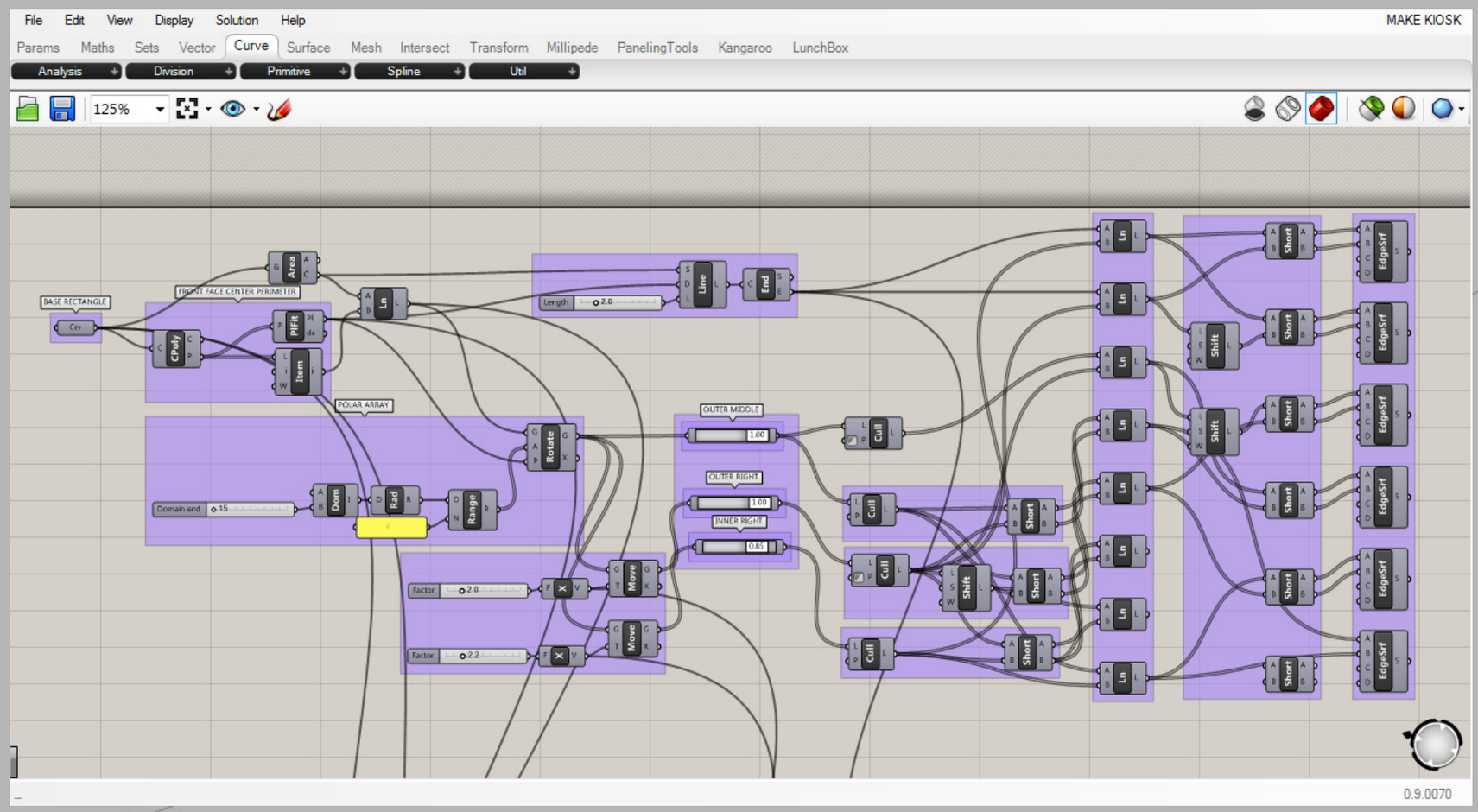


Make Kiosk

GRASSHOPPER

Modelling

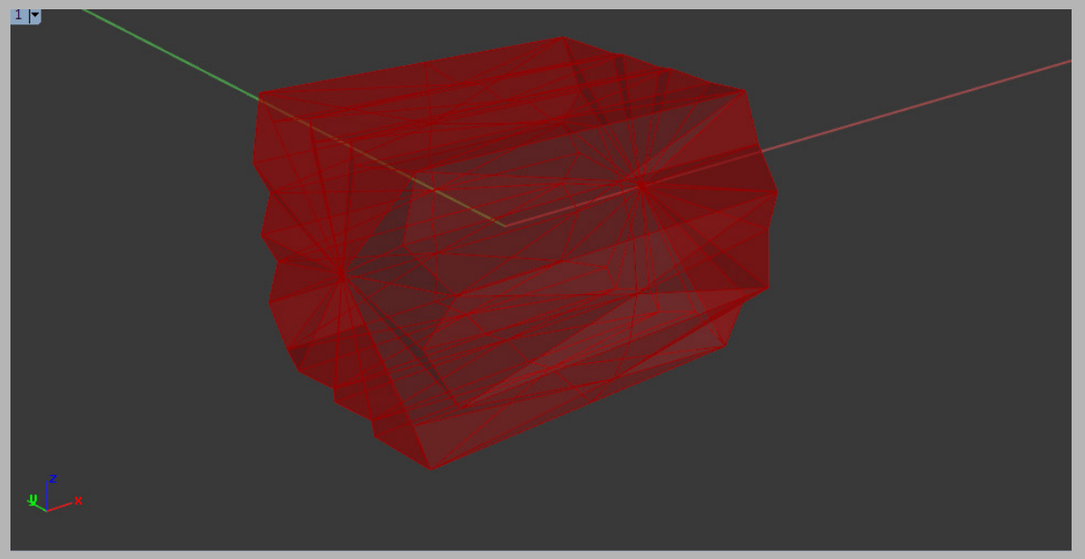


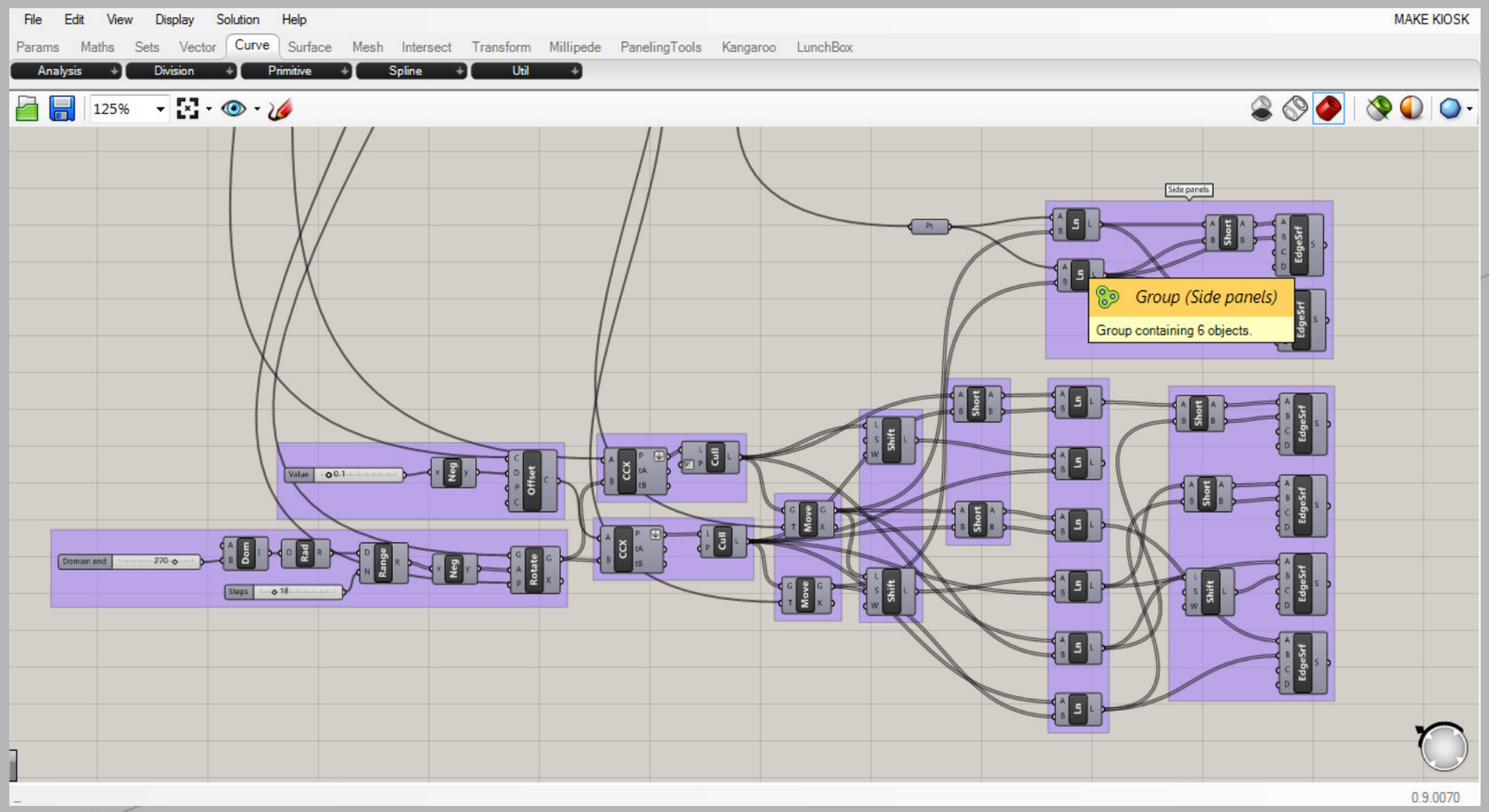


Make Kiosk

GRASSHOPPER

Modelling

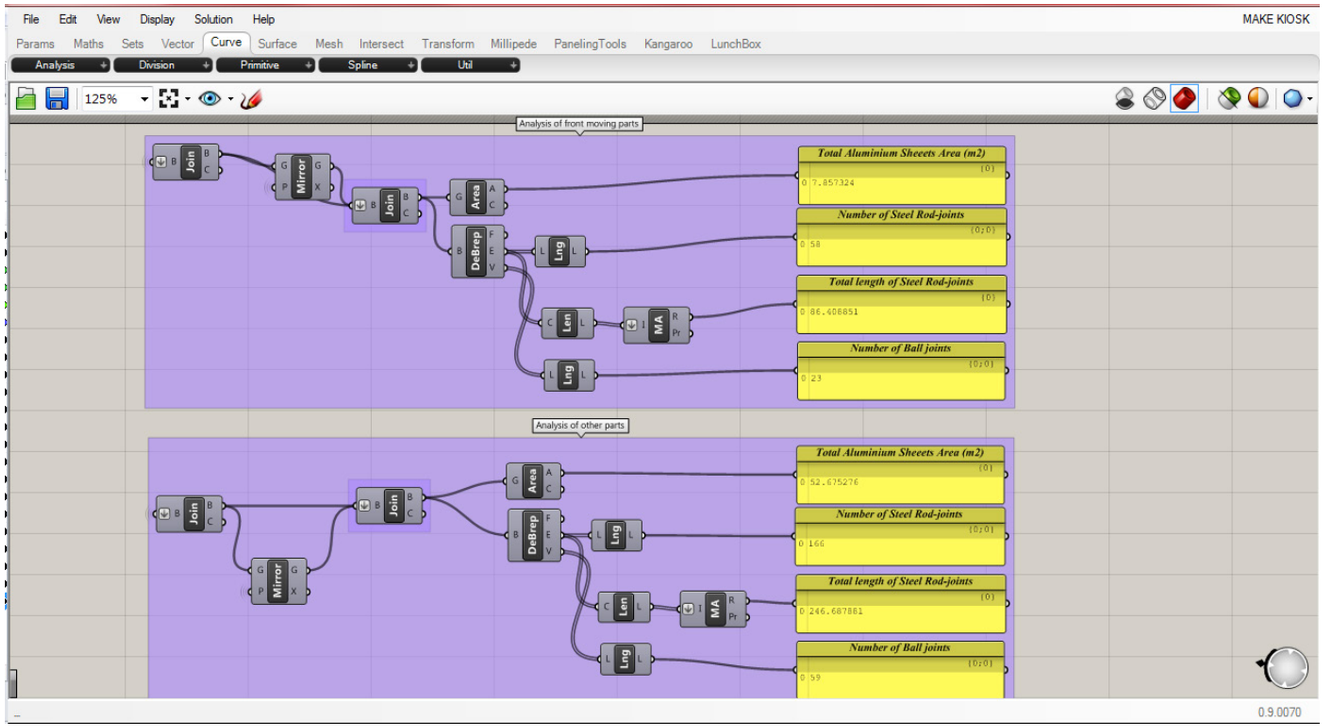


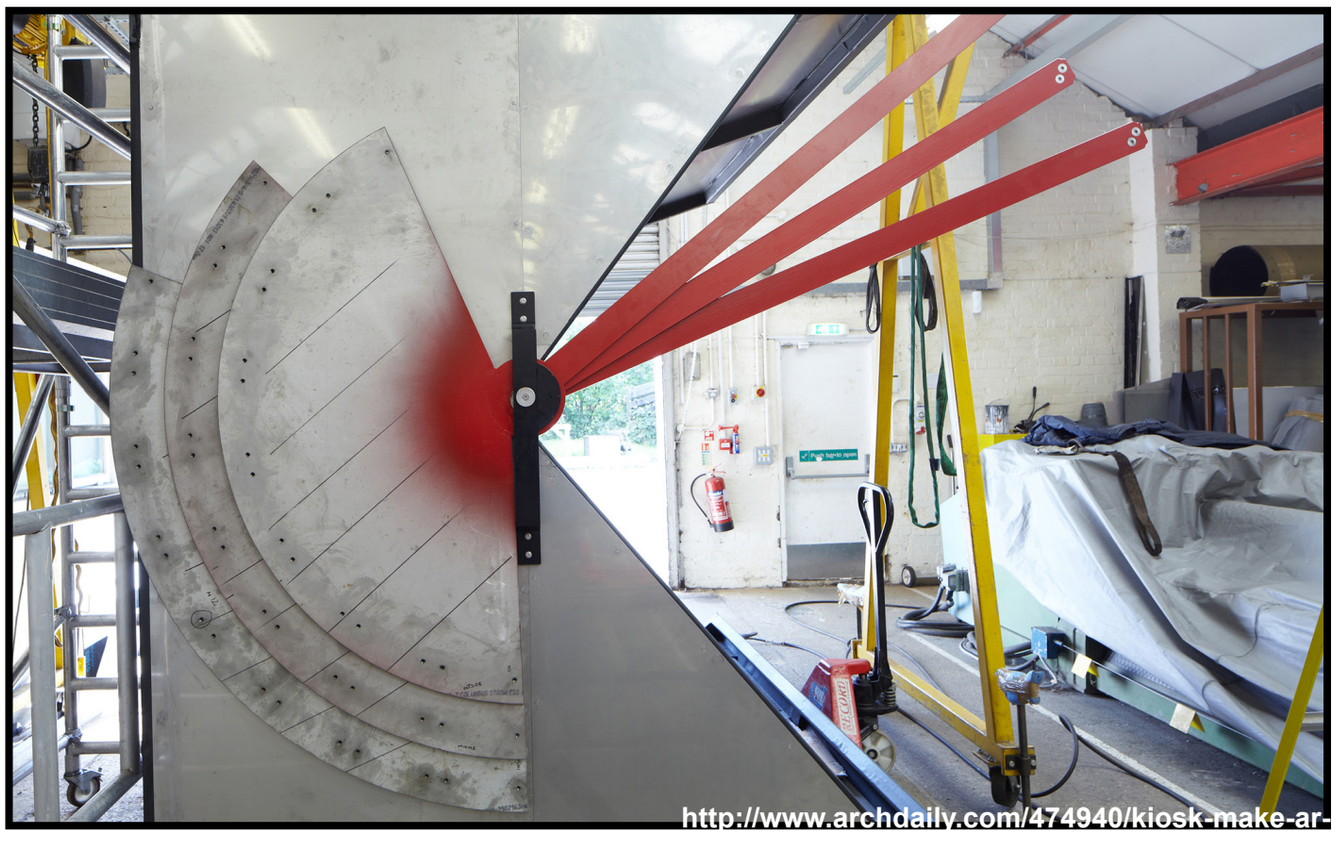


Make Kiosk

GRASSHOPPER
Structural Analysis

Structural analysis is first done by calculating the area of the inside. then followed by calculating an area of the outer skin part. This is done by menuntukan how many folds that are formed of combining two kinds of different geometries. Square shape as the basic form on the right and left kiosk transformed by adding a circular line that is placed in the middle. Then determine the amount of radius based on the number of folds to be created. With this process we can find out the number of area and materials needed in the fabrication process.



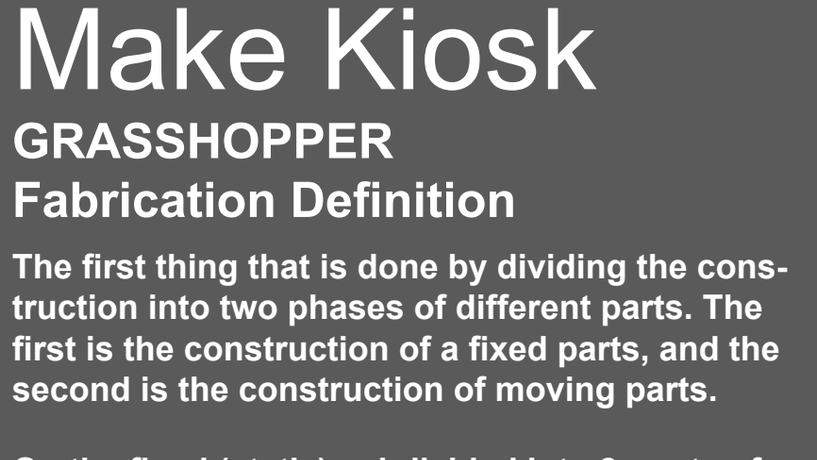


Make Kiosk

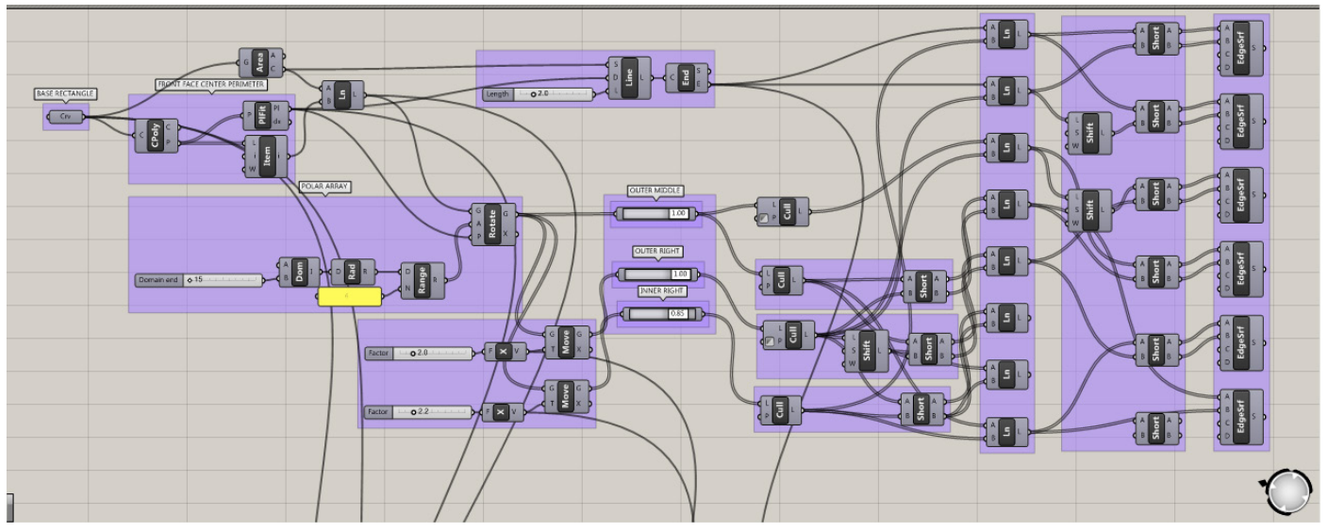
GRASSHOPPER
Fabrication Definition

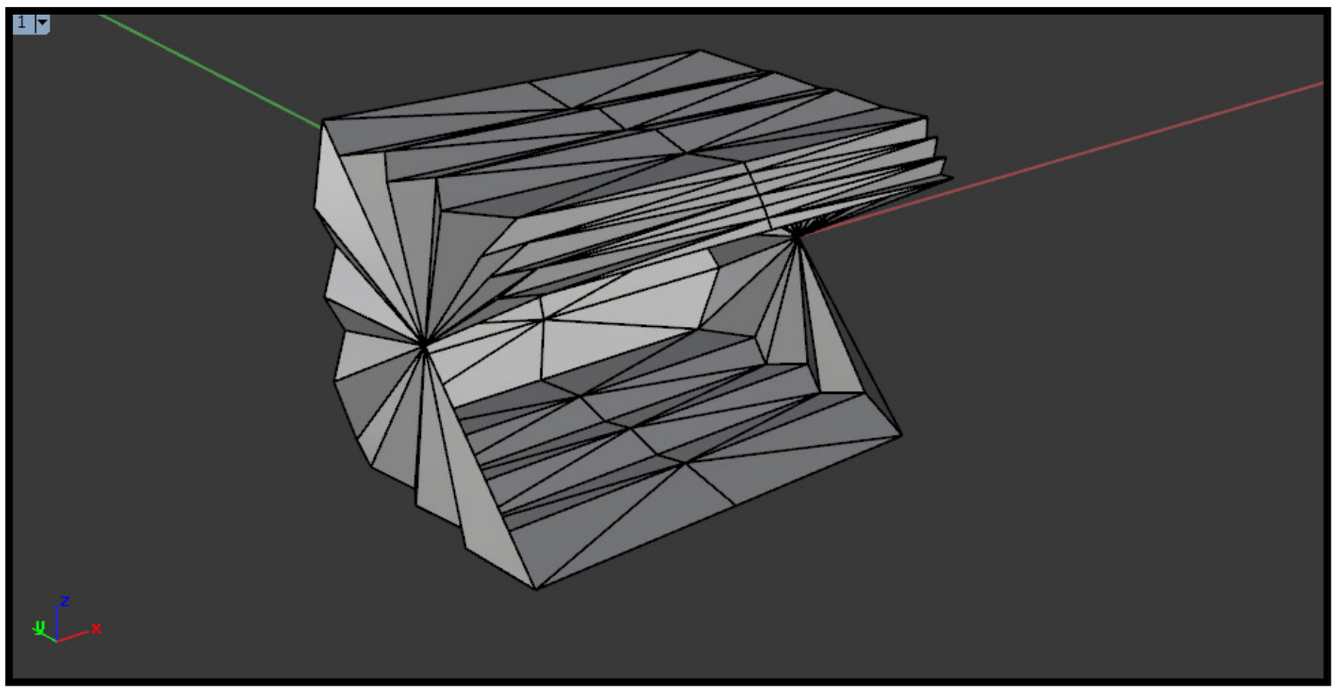
The first thing that is done by dividing the construction into two phases of different parts. The first is the construction of a fixed parts, and the second is the construction of moving parts.

On the fixed (static) subdivided into 2, parts of the main structure and the outer skin on the rear body. In the moving parts (dynamic) on the front, the parameters needed to determine the opening system that will affect the number of folds that will be created when the entire front side open. The calculation is done by using the basic formula area of a circle to get the exact number of angles. And then enter that number into square shape with a circular axis in the middle section.



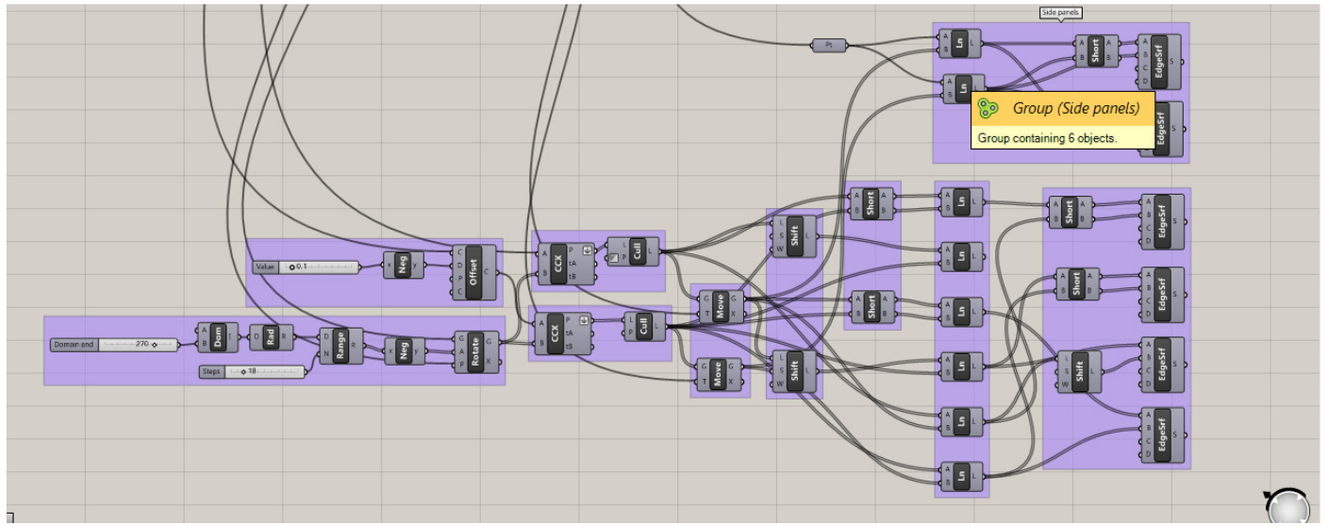
https://vimeo.com/85824380wharf-kiosk/Project-

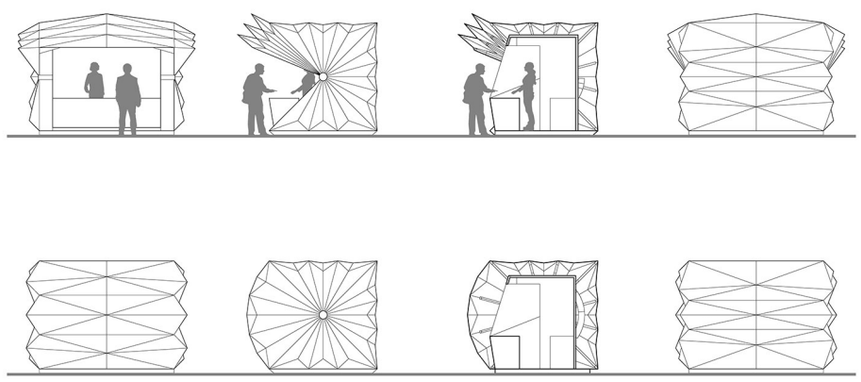




Make Kiosk

GRASSHOPPER
Fabrication Definition





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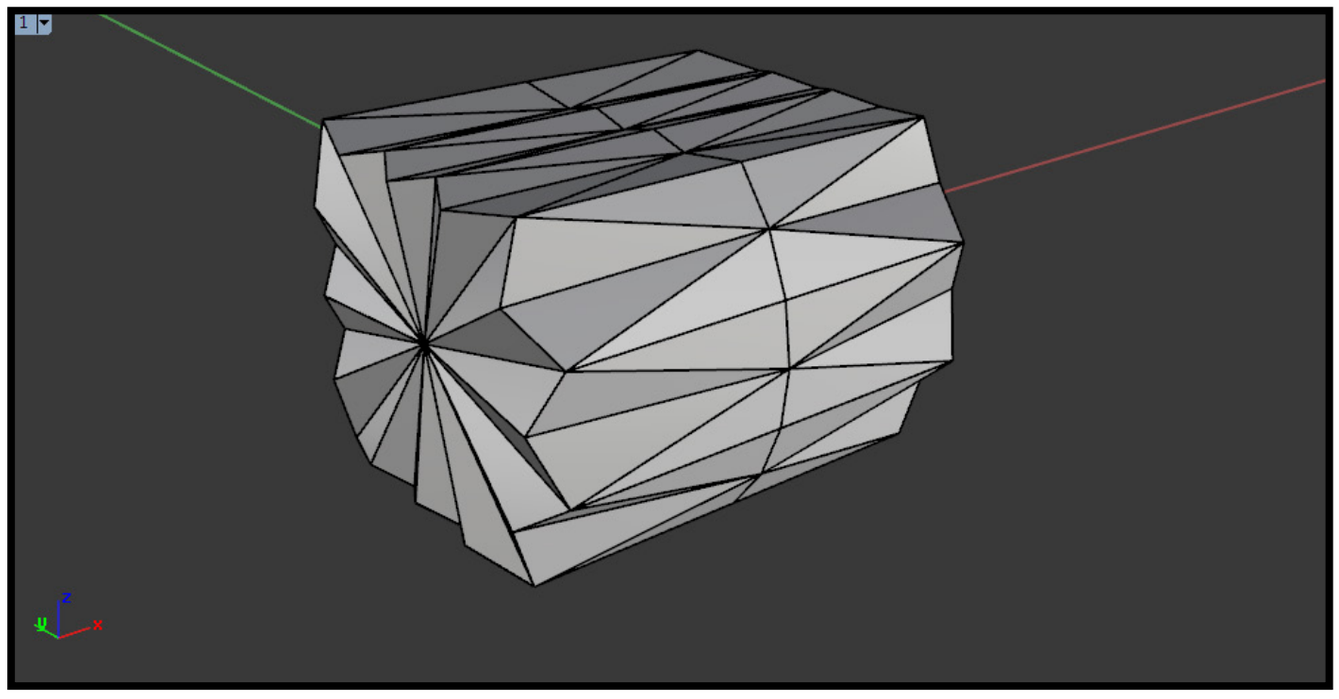

Make Kiosk

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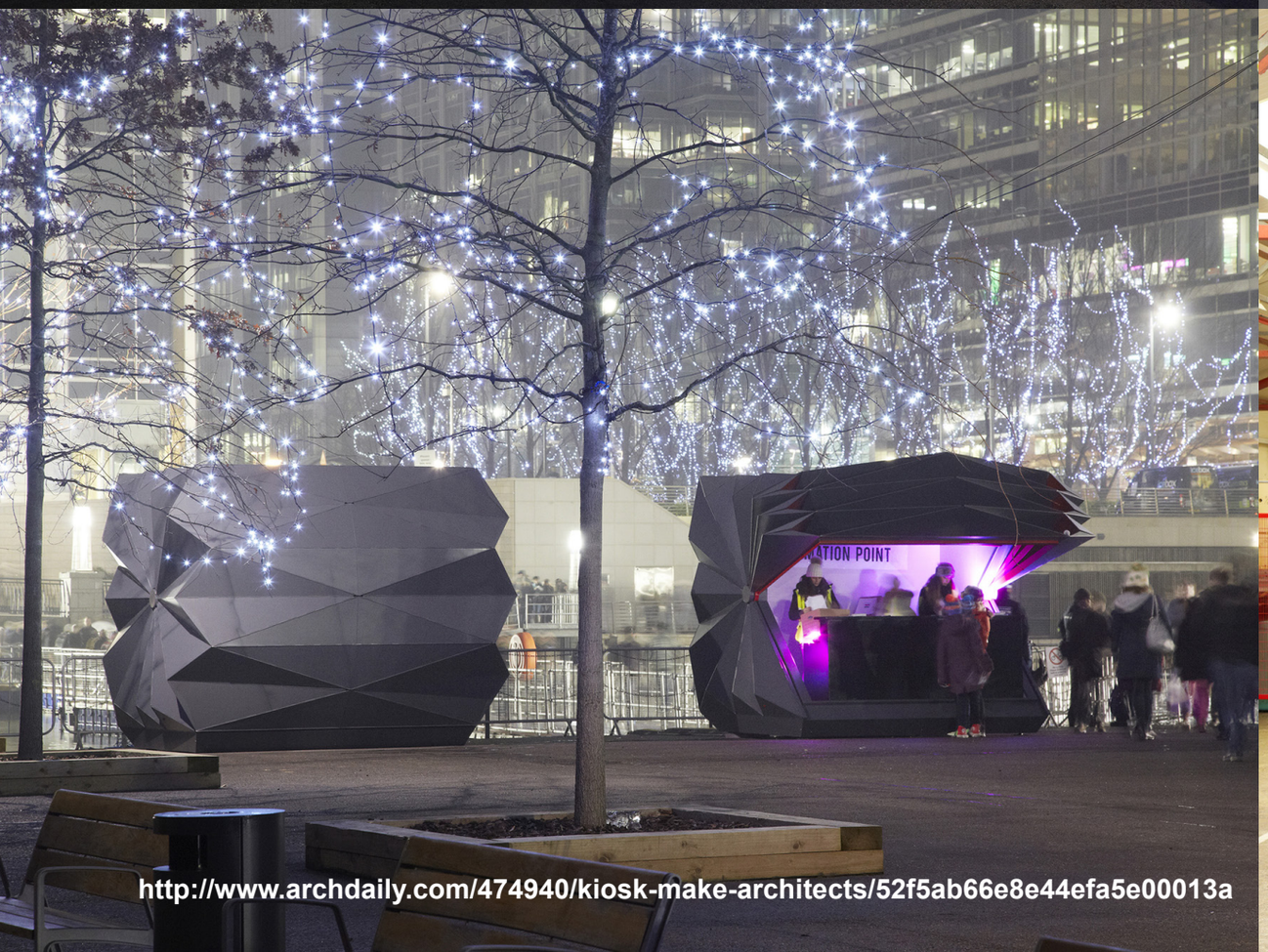

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