ANDREA NUCCETELLI

MATERIALS

SECOND YEAR TECHNICAL STUDIES

AA SCHOOL OF ARCHITECTURE

CATEGORY EIGHT:

Most easily deconstructed

-You must construct a piece of facade min 30x30cm for a temporary touring exhibition. The pieces need to be easy to assemble, demountable and easily transportable. Think of the key issues and what is the most suitable material and form.

RESEARCH

What are temporary structures?

Temporary structures, also known as portable/demountable/transportable buildings, are strcutures designed and erected with the aim of filling a temporary need, as opposed to being permanently located in place. These structures have life-spans ranging from hours, to days, to years but are nevertheless eventually moved. These types of buildings are made in several types of forms and materials.
Temporary structures are used for several different purposes and in a wide range of locations. Due to their portability, they can be transported and located roughly anywhere. Their uses vary from camping to temporary housing, from school extensions to one-time event structures.

A more modern approach to temporary structures are modular structures sectional prefabricated buildings, or houses, that consist of multiple sections called modules. These modules are constructed in a remote facility, then delivered to their intended site of use. They are then placed in different ways allowing a wide variety of configurations and styles in the building layout.
The advantage of modular structures is that they are reusable in addition to being easy to put up and take down. They can be moved easily all over, can be set up in a very short period of time to provide immediate shelter or function.

RESEARCH

What materials are used?

1. STRUCTURAL FABRICS

- Structural fabrics are a popular choice of material for temporary structures.
- Structural fabrics are forms of constructed fabric which can be used with the purpose of building. They are a sub-category of tensile structures.
- They have structural, flame-retardant and weather resistant properties.
- Made up of fabric as opposed to films or meshes.
- The fabric is coated with synthetic materials in order to increase its resitance and durability.
- Types of structural fabrics that are mostly used: woven fiberglass, and polyesters.

-POLYESTERS: are least expensive, relatively stronger yet flexible and more durable. They can either be laminated (vinyl films woven into polyester meshes), or coated with vinyl.

- FIBERGLASS: coated or woven with silicone is widely used. Glass fibers are made into 'threads' or filaments which are then woven. Silicone coating increases its resistance to temperature (very high melting point), and fiberglass is very elastic, carrying a high tensile strength.

-Structural fabrics are used in temporary structures for installations such as *inflatable structures* or roofing.

RESEARCH

What materials are used?

2. TIMBER

- Timber is a type of wood that is harvested and manifactured into planks and boards.
- It is very widely used for structural purposes, and can be classified and purchased as both hardwood and softwood.
- Timber is a popular choice of material when it comes to structure, due to its advantages in handling and durability.
- The properiest of timber are very variable, depending on the type of wood, the quality and how it was treated. However, timber is genrally a strong and robust type of wood, and can last for a while.
- The main advantage of timber - and thus the reason why it is used in temporary structures - is its ease of construction: timber is produced into planks and boards, which means that it can be purchased already pre-cut and simply transported and mounted into site.
- This type of wood has also a high level of insulation, meaning it retains a greater amount of heat.

RESEARCH

What materials are used?

3. THERMOPLASTIC POLYMERS

- A thermoplastic is a polymer that has the property of moulding and changing shape when heated, and returning to solid state once cooled down.
- Thermoplastics are quite resistant and a wise option when a resistant and transparent material is needed.
-The brittleness of the plastic can be lowered by adding plasticizers, by copolumerizing it or by adding non-reactive side chains to monomers before polymerization.

-ACRYLIC: also known as perspex/plexiglass is used as a substitute of glass, due to its resistance and studiness. It is made up of PMMA particles that are suspended in water.

- POLYPROPELENE: is used in a very wide range of object, from small scale food containers to piping systems. It is relatively strong, yet it is sensitive to UVA radiations which in the long run can decay it. It is relatively efficent in terms of insulation, yet it is slightly permeable to certain liquids.

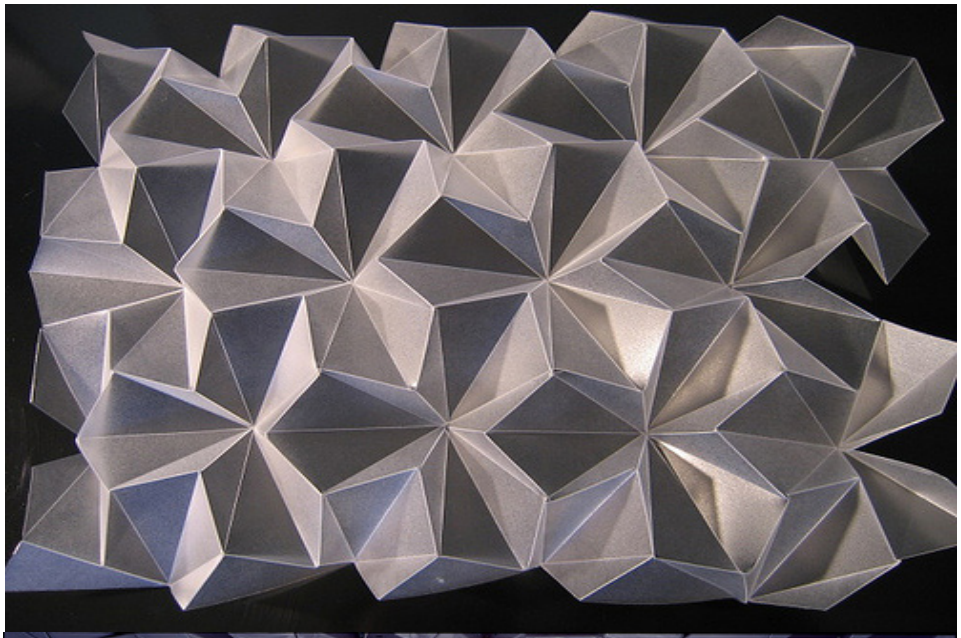
- POLYBENZIMIDAZOLE: Polybenzimidazole is considered to be the highest performance thermoplastic. It has the highest heat resistance and mechanical property of any plastic. It has high levels of load bearing, stability and resistance at extreme temperatures. PBI is used in a very wide range of things such as chamber seals, water transportation devices, electrical insulating parts and so on.

DEVELOPMENT

Possible methods to create a facade

TESSELLATING:

- A technique which involves a series of detached pieces, which are joined together, fitting perfectly (thus without leaving gaps), to form a surface or a plane.
- Tessellation can be any shape, so long as the pieces fit together coherently.
- Usually a technique used with materials such as ceramic (tiles), siding and bricks.
- Tessellation is used when referring to digitally defined mesh patterns, or tiled patterns on a facade of a building.
- Used in the past, and in Islamic culture, to create screen surfaces which were used to filter light into a space.
- Could be a possible option for a demountable and transportable facade.



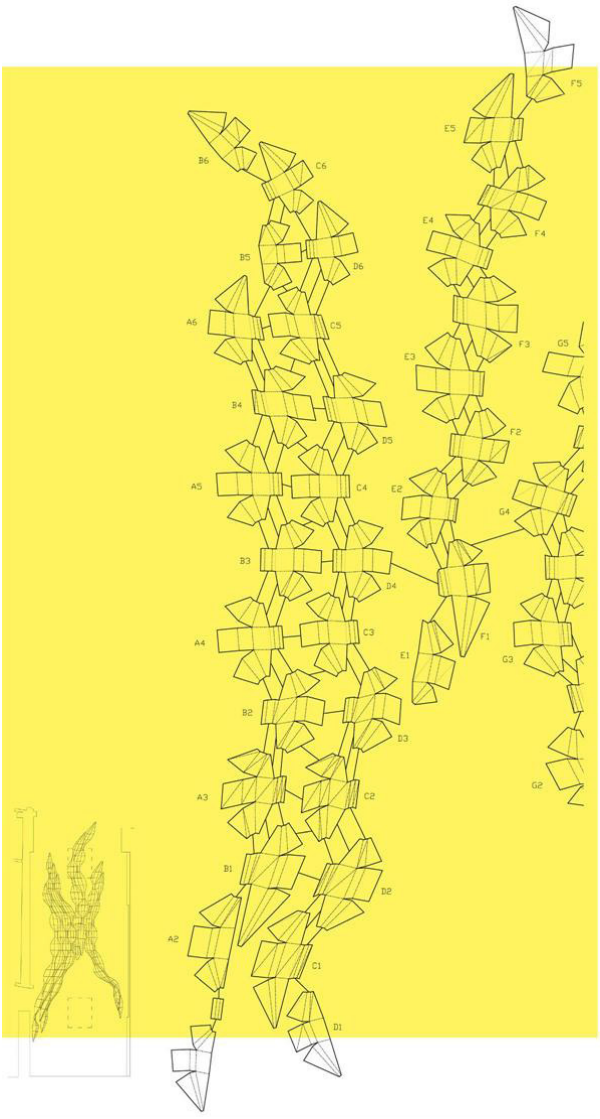
DEVELOPMENT

Possible methods to create a facade

FOLDING:
- The technique of turning a flat surface into a three-dimensional object.
- Creates fluidity and multifunctionality within a continuous surface.
- It is used to make forms and objects, but also to create structures with a specific geometry.
- When materials are folded:

1. **they gain stiffness and rigidity**
2. **they can span long distances**
3. **they can (usually) be self standing**

- Materials that are usually a choice for this technique are metal sheets, thick paper/card, and fabric. This is due to the fact that the materials need to be capable of folding and bending without snapping.



CONCEPT

Developing ideas for the facade

MODULAR-ORIGAMI FACADE:

1. The facade will be made of 30x30cm components.
2. Each component, however, will be made up of smaller, folding fragments.
3. Therefore, each component can be folded from a flat 30x30 surface into a 3D form, and back to a flat surface.
4. The 30x30 components will be detached from one another - this means that they are carried separately, and folded flat.
5. Once on site, the components are opened up, and folded into 3D forms, and, through tessellation, joined together to form a uniform surface.

Therefore:
- The facade is demountable ---> can detach each component from one another, and fold them into small fragments.

- The facade is transportable ---> once all the 30x30 components are detached and folded, they can be carried easily to different locations

- The facade is easily assembled ---> the pieces simply need to be opened up and joined together.

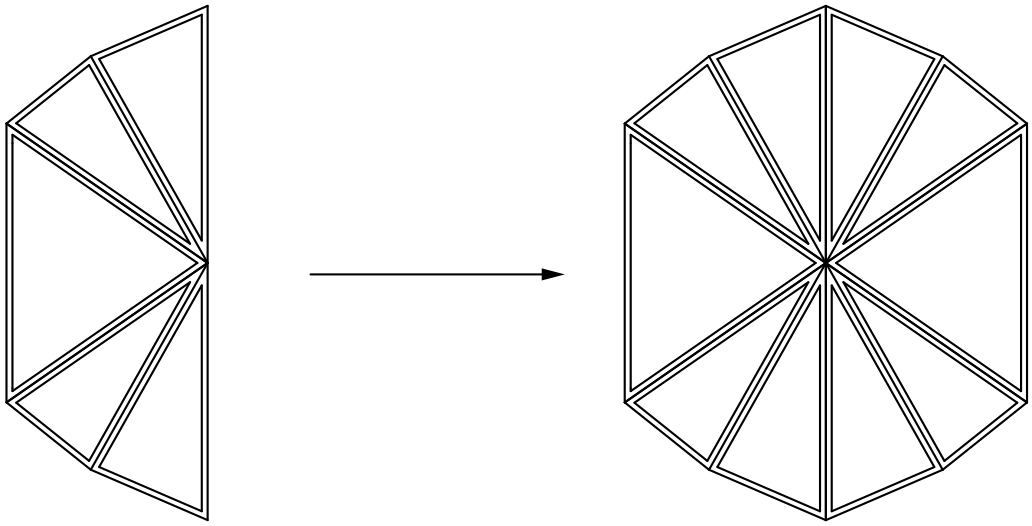
INITIAL IDEA

Tasselation and folding

- Looking into tasselation - a facade made of several smaller components which fit perfectly together.
- Origami folding in order to facilitate demounting and transporting the pieces.
- Main focus of the way the structure is developed lies in the 'temporary' and 'demountable' aspects that are required for a touring facade.
- The smaller components are lightweight and can be assembled and disassembled according to whatever need or form the facade needs to be.

STAGE 1

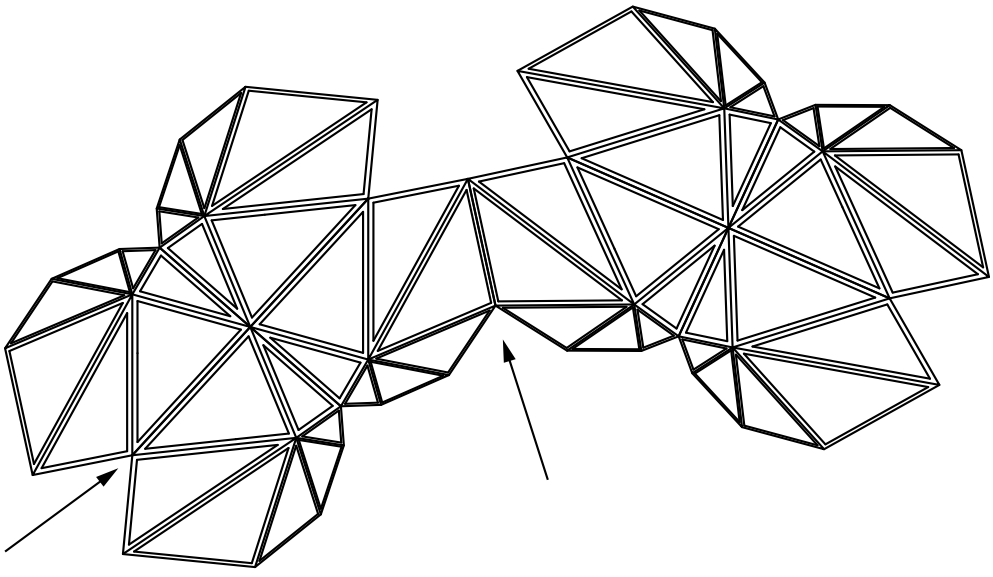
STAGE 2



The piece is folded into a small component, and it is detached from the other parts.

The piece is easily unfolded into a flat, segmented tile

STAGE 3



The flat pieces are then folded into 3D forms.
The shell-shaped components are then joined on matching sides (by hinges) in order to form precise compositions, and in order to create a facade which can be set up and folded into small segments easily.

WORK

Creating the final facade

1. Changing the concept: turning the facade into a screening surface, which is placed on an already exhisting facade.

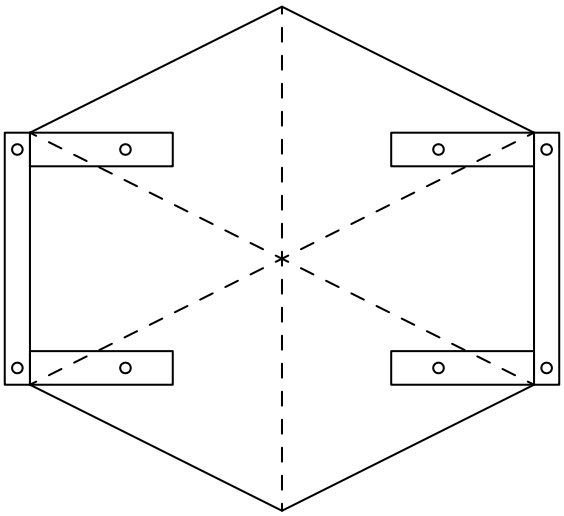
2. Giving it more rigour and structure (i.e. a set geometry, and rods to hold the fragments together and on the existing facades).

FINAL COMPONENTS

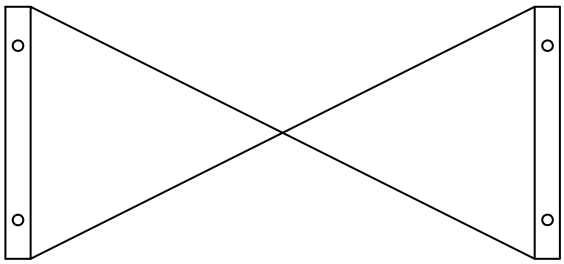
The building blocks of the facade

- The facade is made up of two different types of components: hexagonal and triangular.
- The hexagonal components are foldable, whereas the triangular shaped ones are static.
- The pieces are hooked on 'hooks' by the sides.
- The hexagonal components can be folded in, so to protrude out. This is done by pushin in the sides of the shape, and hooking them on the inner hooks.
- The hexagonal components can be folded in different lay-outs to manipulate the amount of air or light coming in.
- When the hexagonal pieces are folded, gaps are created on the surface of the facade, allowing air and light to come in.

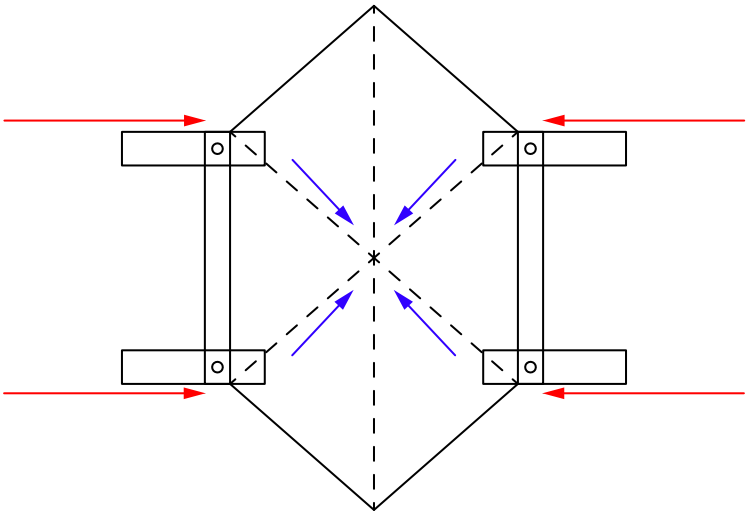
COMPONENT 1



COMPONENT 2



folding in the material

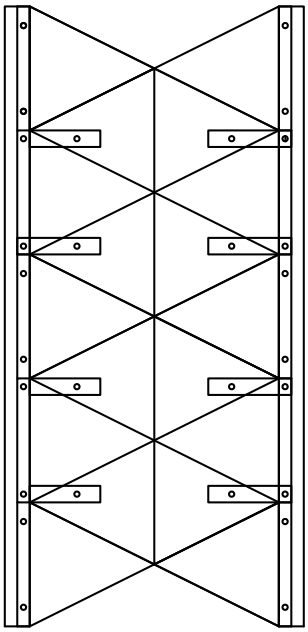


FOLDING SCREEN FACADE

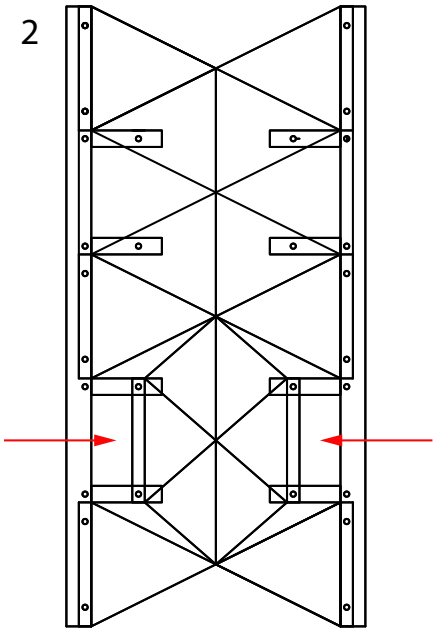
The functioning of the panels

- The final piece of facade is a 'shading screen-facade'. Provided shading and (limited) protection.
- It is made up of two types of geometrical components: triangles and hexagons, which interlock to form a surface.
- The pieces are not attached to the supporting structure - they are placed on haning on 'hooks'.
- The the hexagonal componets (30x30cm) can be folded, in the style of origami: the vertical sides can be brought in, sliding them on the small horizontal beams and attaching them on the inside hooks.
- Different arrangements of folding provide different openings (i.e. different amounts of light and air coming through).
- The pieces can all be taken apart (including the structure), and transported to any location.

1



2



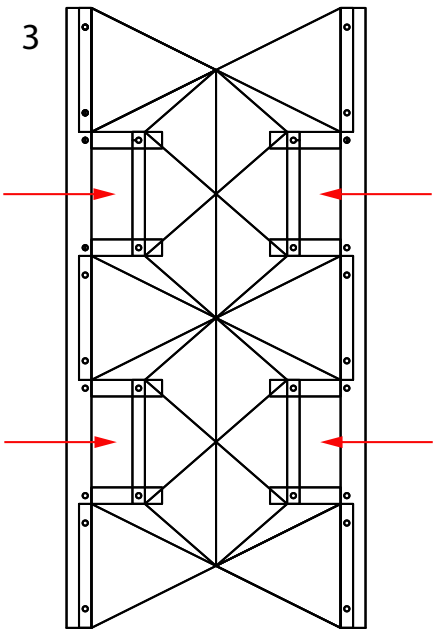
1. The facade screen is applied on an already existing window or facade.

2. The pieces can be kept flat - thus providing both greater screening and insulation/protection.

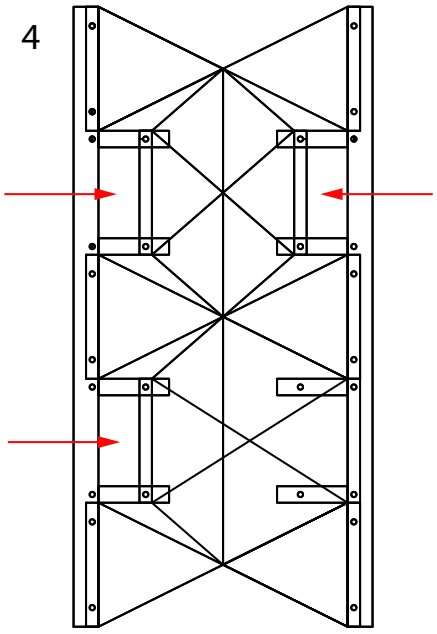
3. According to desires, the hexagonal pieces can be folded in completely (image 2 and 3), half-way (image 5) or a combination of the two.

4. the triangular shaped components remain in place once the hexagonal parts are folded, in order to maintain a minimum level of screening and protection

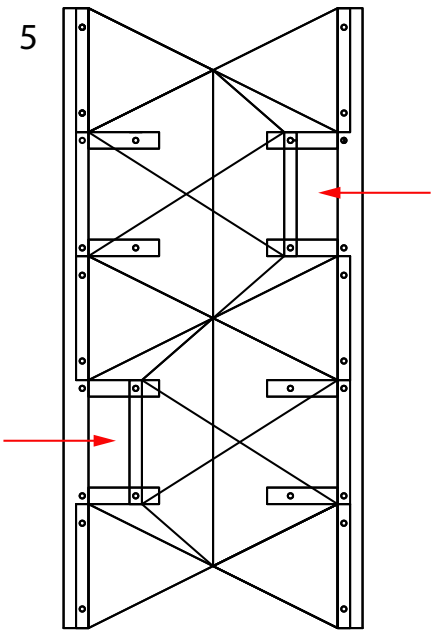
3



4



5



FINAL MODEL