Modular Triangulation
AA Technical Studies Materials

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Intermediate 15
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Most Easily Deconstructed Façade

You must construct a piece of a façade min 30cm x 30cm 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.

The workshop should investigate a material by looking at the boundaries of its behaviour, formation or composition. This is an experimental workshop and the students are expected to explore beyond the "already known". Remember that the process is as important as the finished object. The unit may only be one panel of a facade (so it does not have to be the "window" element necessarily). You will present the final object and your research in a session at the end of the course. Marking criteria will include how it performs against the other pieces in its category but marks will also be given for ingenuity, lateral thinking, creativity and innovation.

At the end of term session 5 we will test all the systems. You may need to bring drawings of joints etc. if you cannot model them. Points will also be added for innovative processes but points will be deducted for not thinking about the element as a true façade (for example if it does not provide insulation) and don't forget that this is an important visual part of your building.

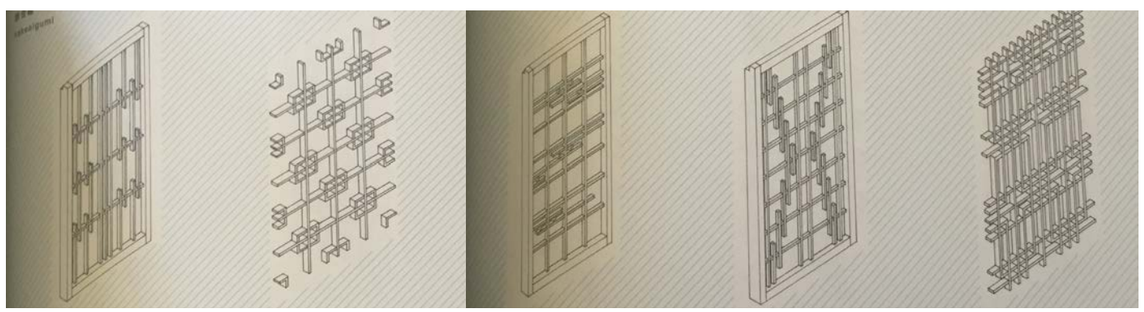
- Easy to assemble (efficiency/speed)
- Easy to demount
- Easily transportable (light, managable size)
- Protection against weather (wind, sun, rain)
- Water-tight
- Thermal performance/thermal bridging avoids condensation
- Structurally stable
- Provides adequate lighting
- Acoustics (dependent on function)
- Suitable for programmatic function (touring exhibition)

Proposal

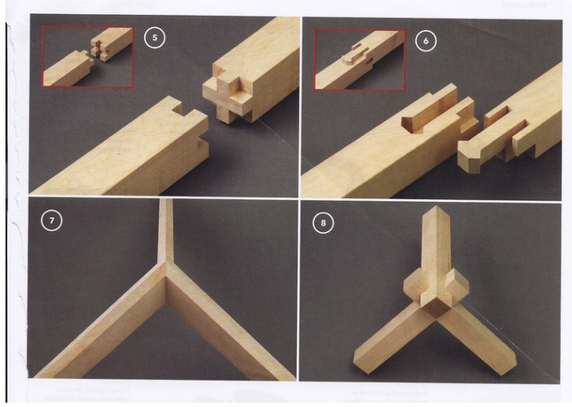
For the design, I took inspiration from traditional Japanese wood joinery techniques and Kengo Kuma's Tsumiki lego designs. The Japanese have always been skilled craftsmen using wood in their traditional architecture and their wooden structures are known to be the world's longest surviving wooden structures. Their joinery techniques are also known for their precision and strength. I am also taking inspiration from Shoji and Koshido wood joinery patterns.

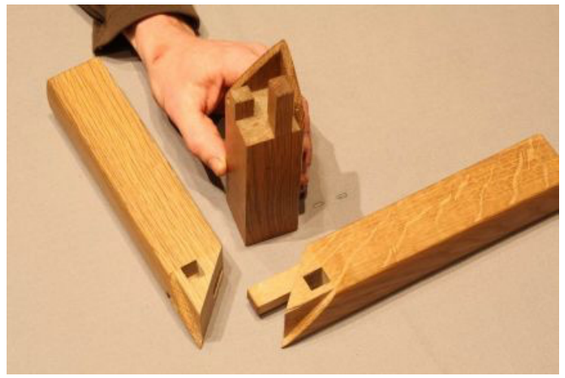
Using these techniques as inspiration, the idea is to create a modular façade system that is easy to assemble and demount using these joinery systems. In addition, the individual pieces can be light and transported seperately and then easily re-created on site. The type of joinery incluences the effectiveness of the façade to provide shelter from the weather yet still provide adequate lighting and ventilation etc.

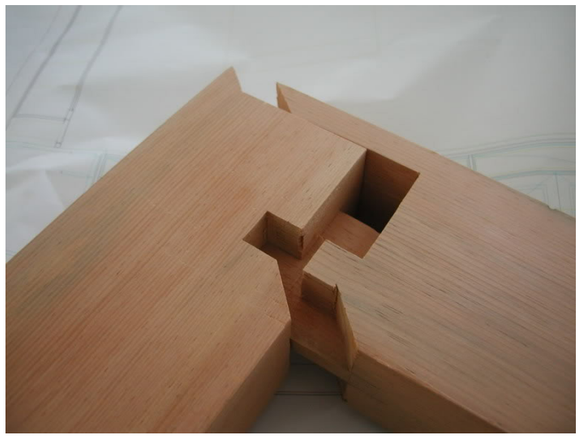
The materials to be used for the façade can either be timber, 3D printing (plastic) or a combination of both. Timber is the original traditional material used for these functions and can provide interesting lighting effects when perforated. Also, the grain direction of the wood can be used. Also, there have been many interesting cases of people 3D printing the joints for timber connections.



References/Inspiration



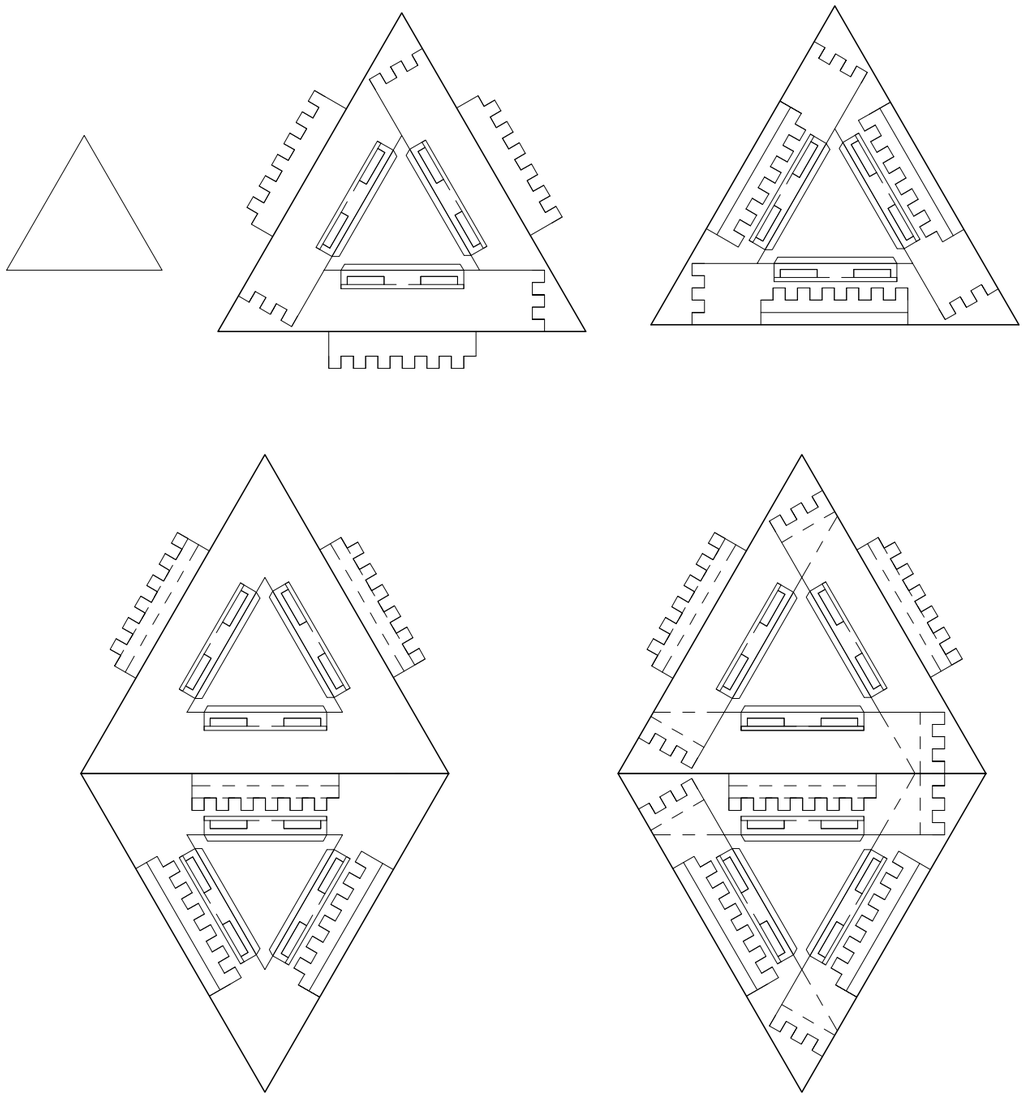




Design

These are my early plan drawings of my design. I decided to create two different types of triangular modules so that when combined in a certain way it would form a larger rectangular façade component. I wanted to try out different ways of creating the triangular module, so I designed the equilateral triangular module to be made of three seperate pieces that would slot together and the obtuse triangular module as a single fixed frame. All the joints are of the ssame time, just in different sizes and shapes according to the angle and its function. There is an empty space between each frame that allows a triangular window to be placed or it can be filled with a piece of wood to create a solid component. In this early design, I have drawn a component that will attach to the triangular frame and contain a clip to hold the window in place. These clips and the window can also be removed.

The façade can be disassembled into individual components and pieces and easily carried around.



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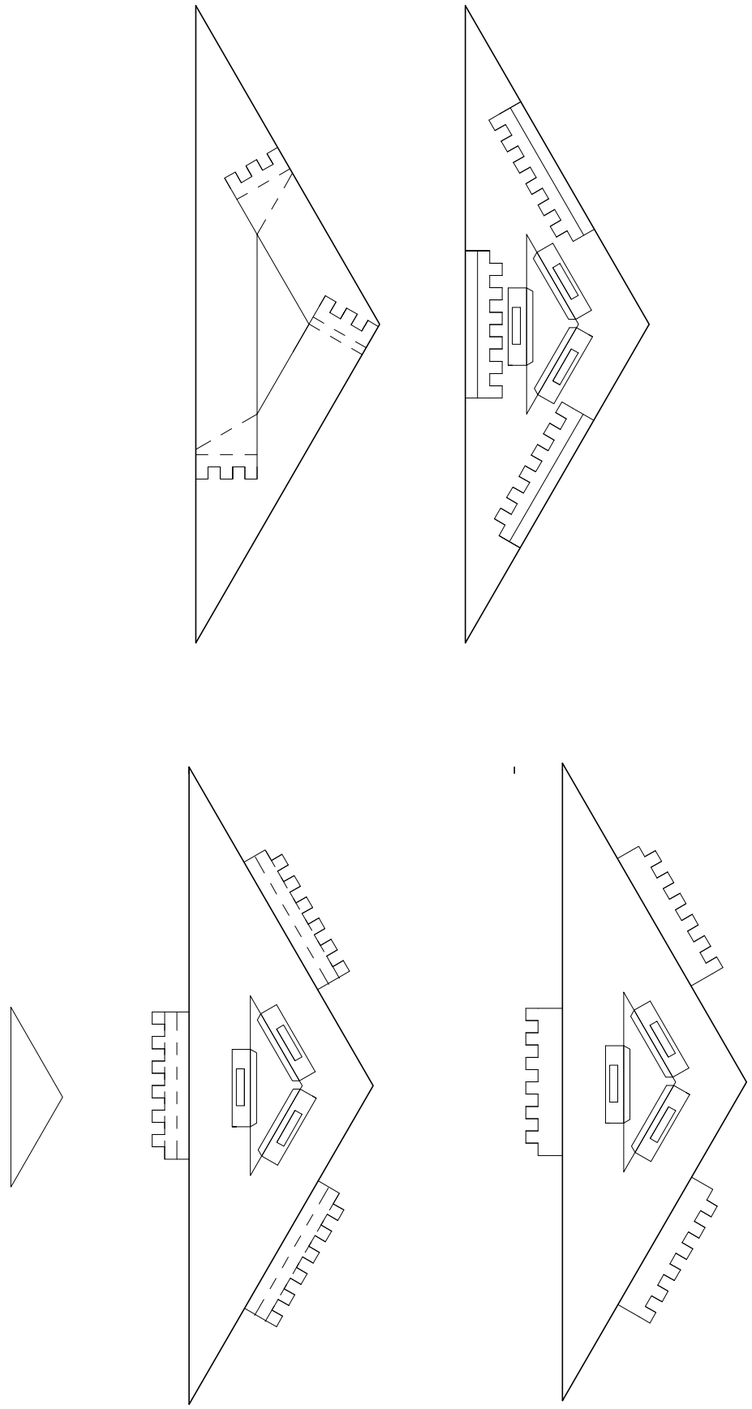

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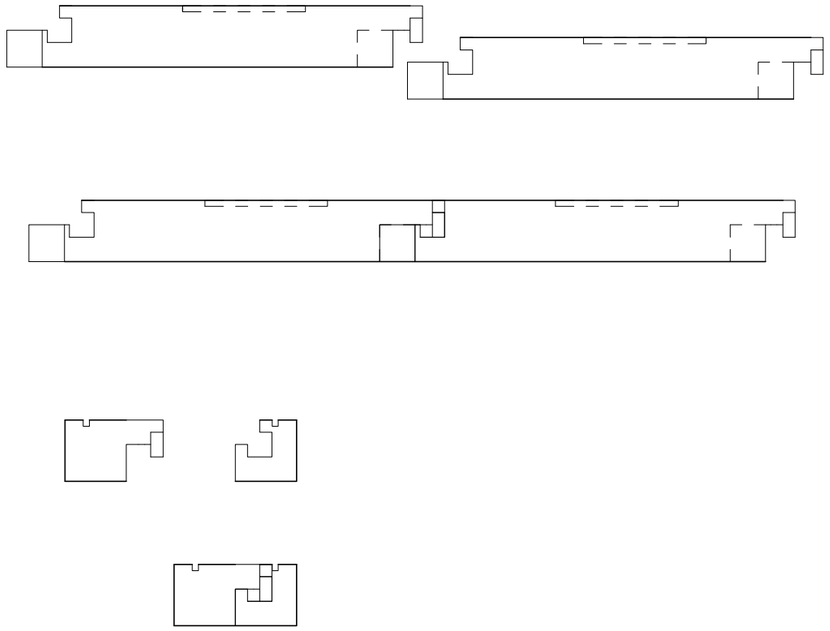
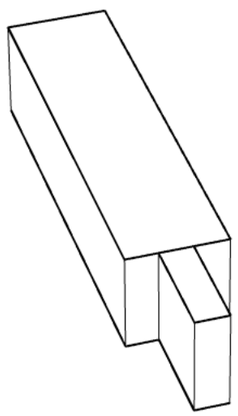
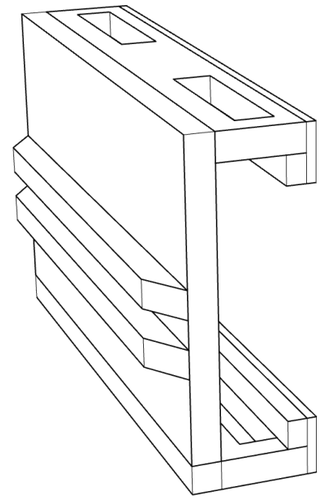
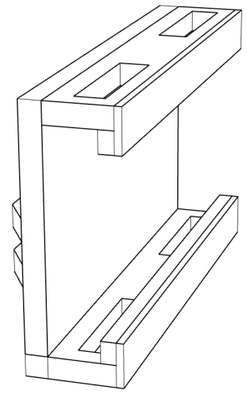


These are some sections of the joints that I made when thinking of the design. The early design of the joint is much more complex compared to the final one. Inspired by the Japanese joint technique, there are three different components that make up the joint. The first component, at the top, consists of a component that sort of acts like a puzzle piece on plan view. The second component, acts like a puzzle piece on the elevation view. Except this component is less intricate in design. This part of the joint is designed in a way so that when the two pieces are slotted together, up and down and all sideways movement are prevented. Because the joint is quite complex it is impossible to slot the two pieces together unless one piece is taken out. Therefore, after connecting the two pieces, a third component has to be slotted in.

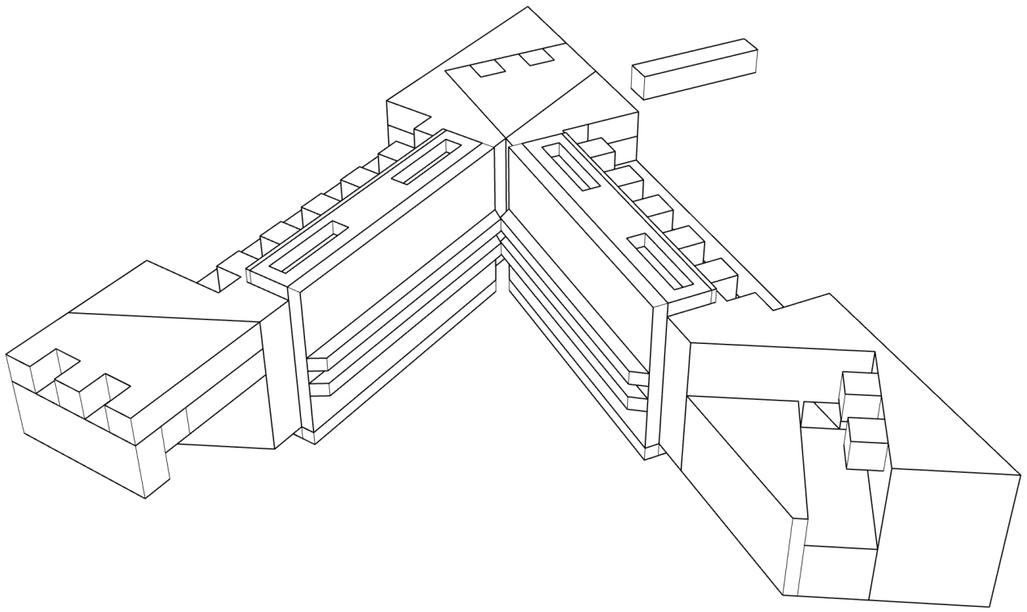
This is the third component for the joint. I created a small extrusion so that it would be easier to pull and push the slot in.



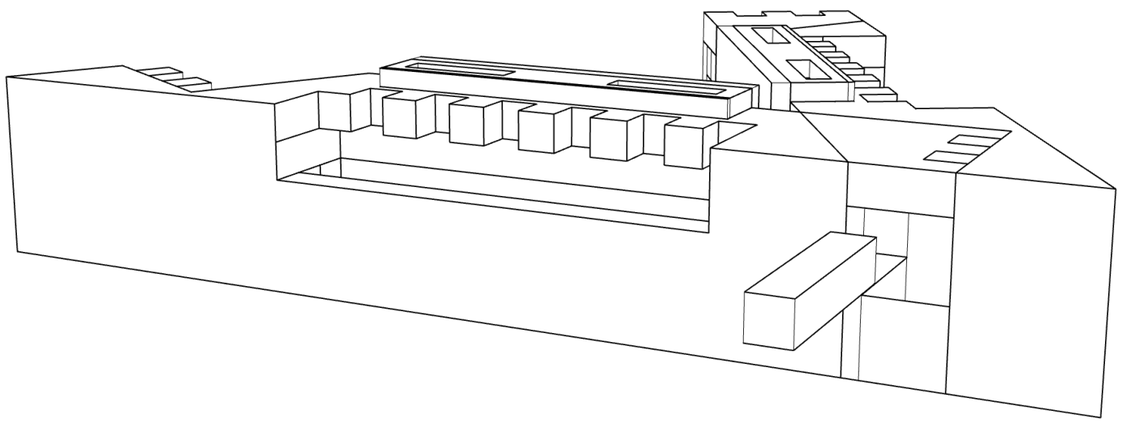




These are the drawings showing the clipping pieces for the window attachments.



Diagrams showing two components attached in the equilateral triangle module.



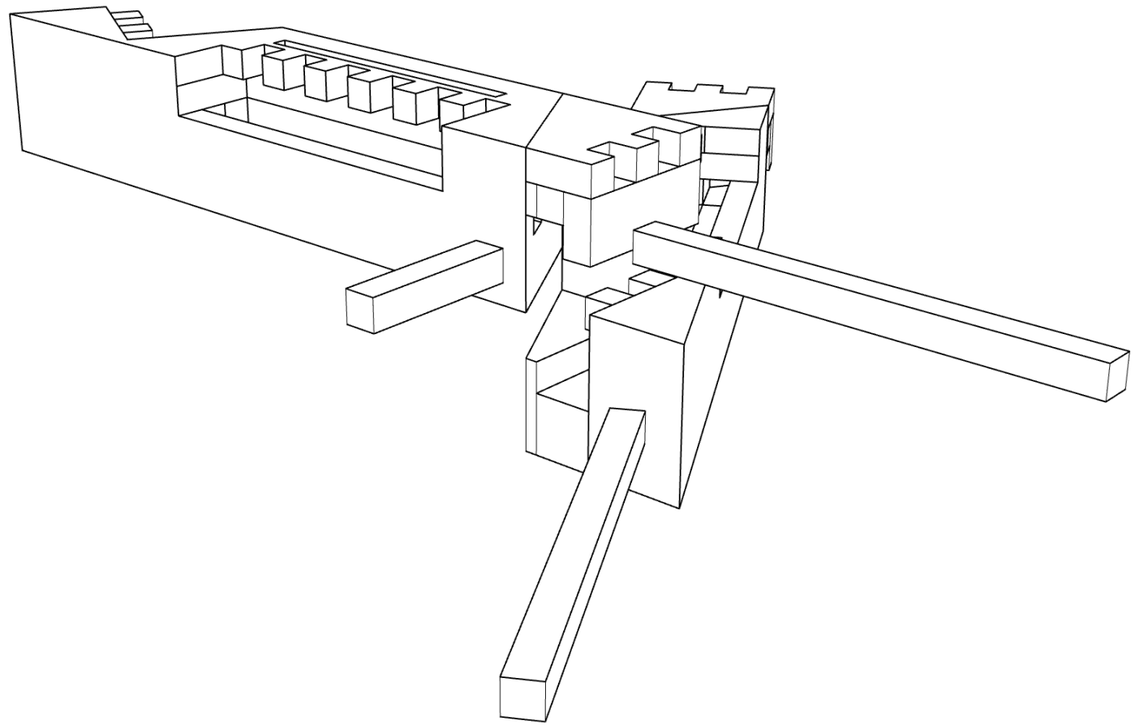
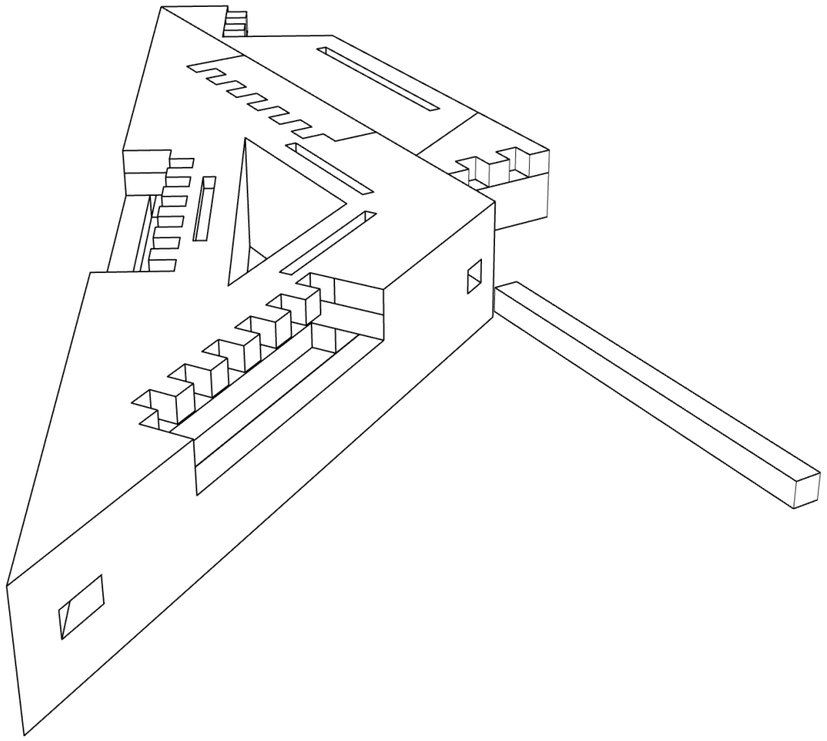
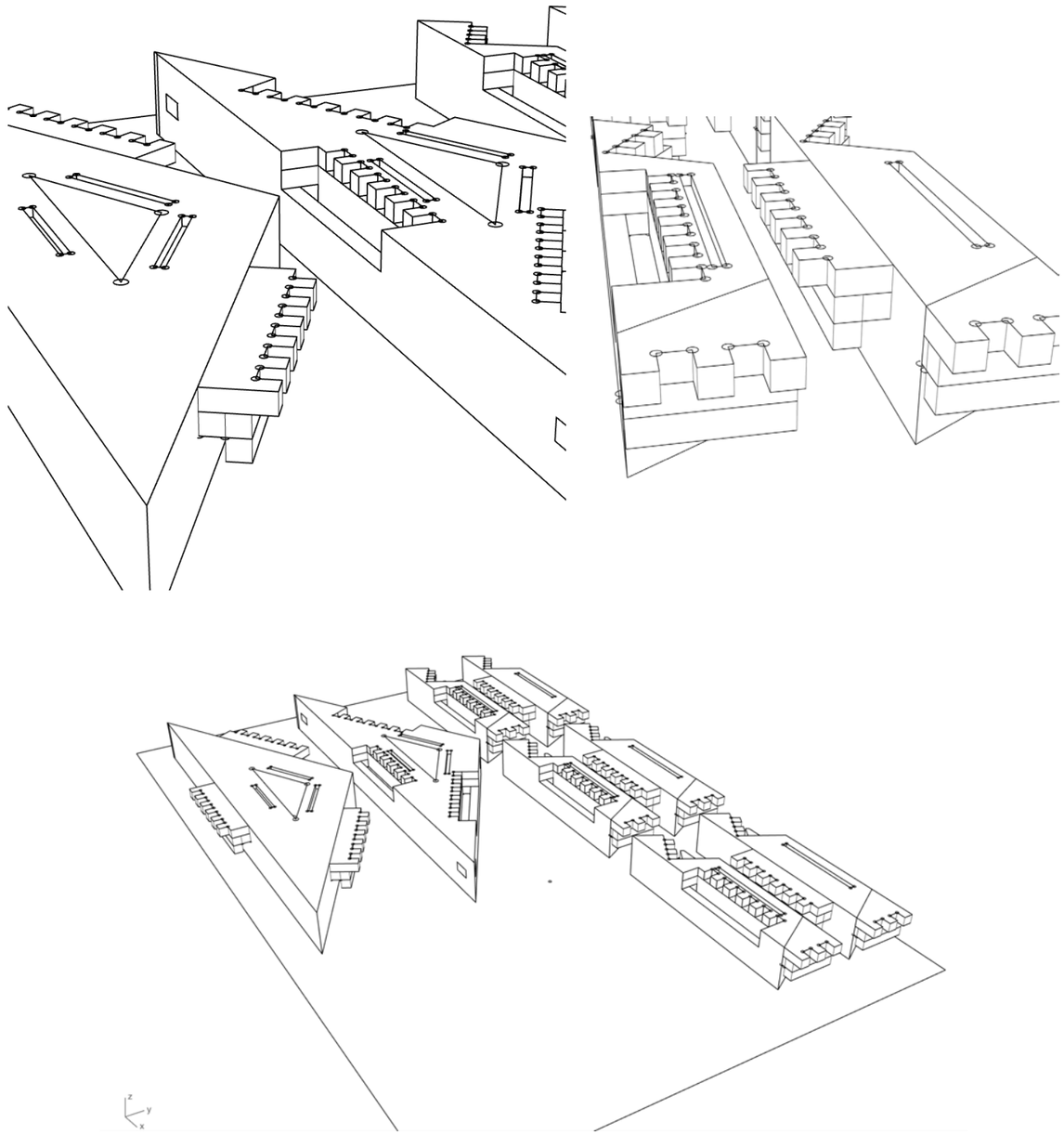
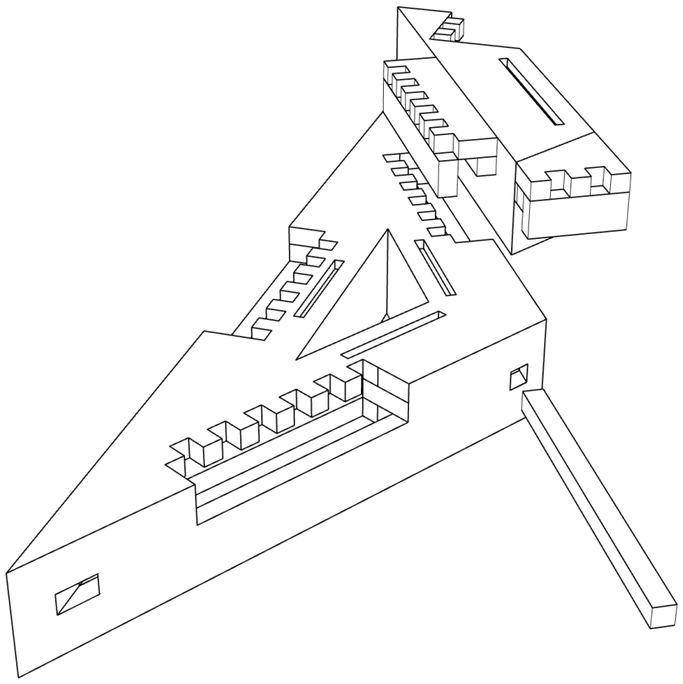


Diagram showing the joint system for the equilateral triangular modules. I had to create holes in the model so that the extra third components could easily slot in and be removed.

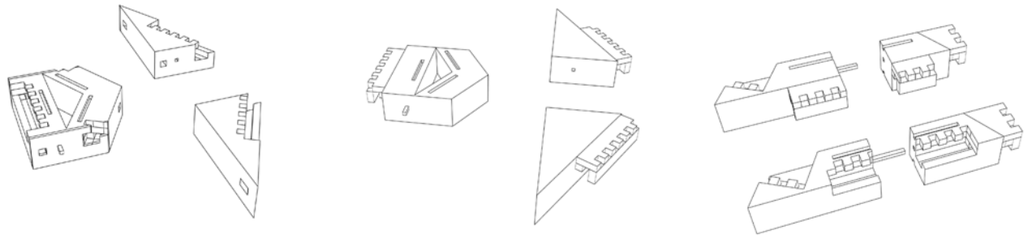


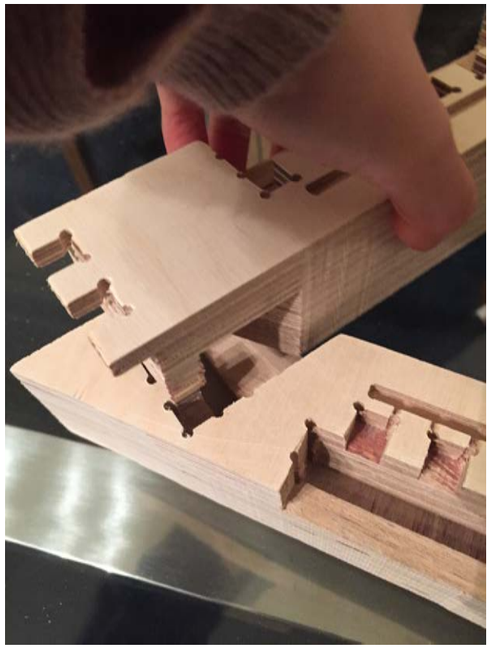


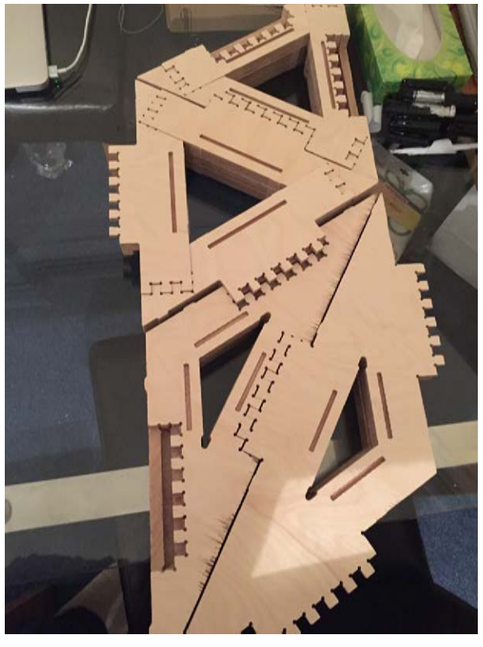
Diagrams showing how the joint system works for the obtuse triangular modules.

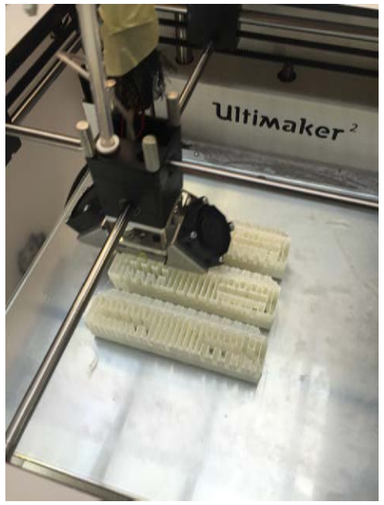


Manufactoring



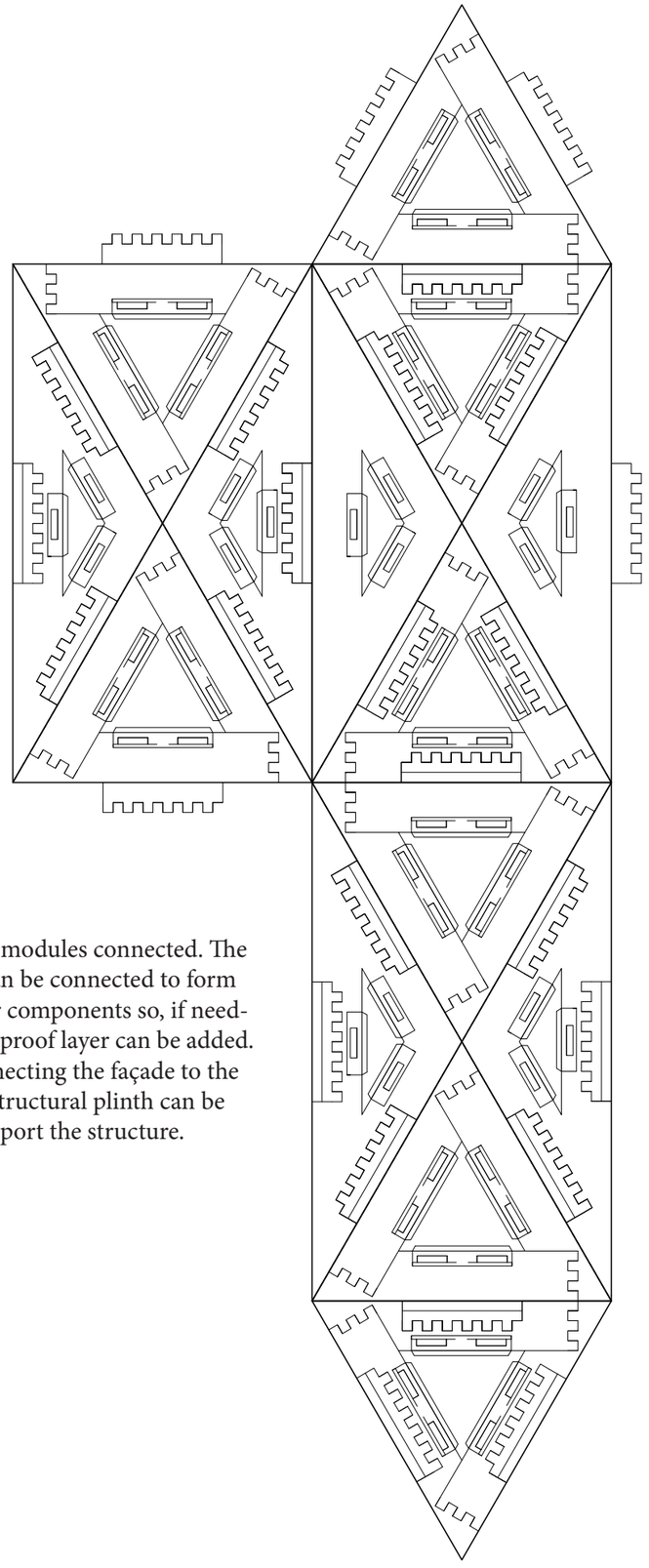




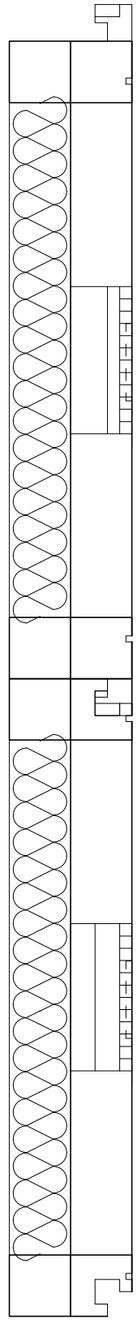


Initially, I wanted to CNC Plywood to create the different triangular modules. However the complexity of the joints meant that I have to CNC on 3 different sides, which made everything very difficult. Therefore, I thought of changing material and 3D printing. However, the pieces were too large it would not be practical to 3D print. In the end, I simplified the joints so I only had to CNC on two sides. There are no longer extra slotting components and you simply need to fit the joints together. For the windows, I tried 3D printing the clips. However, those did not fit and work so I simplified the design again to create ledges for the windws to slot in. I also had to try different sizes of windows until I found the perfect size.

Final Façade



Plan of the modules connected. The triangles can be connected to form rectangular components so, if needed, a water proof layer can be added. When connecting the façade to the ground, a structural plinth can be used to support the structure.



Section of the façade with two modules connected. Behind the triangular modules, there are wooden supports which allow an area for adding insulation behind the frame. The extra layers prevent thermal bridging through the gaps and areas between the joints.