Group C1

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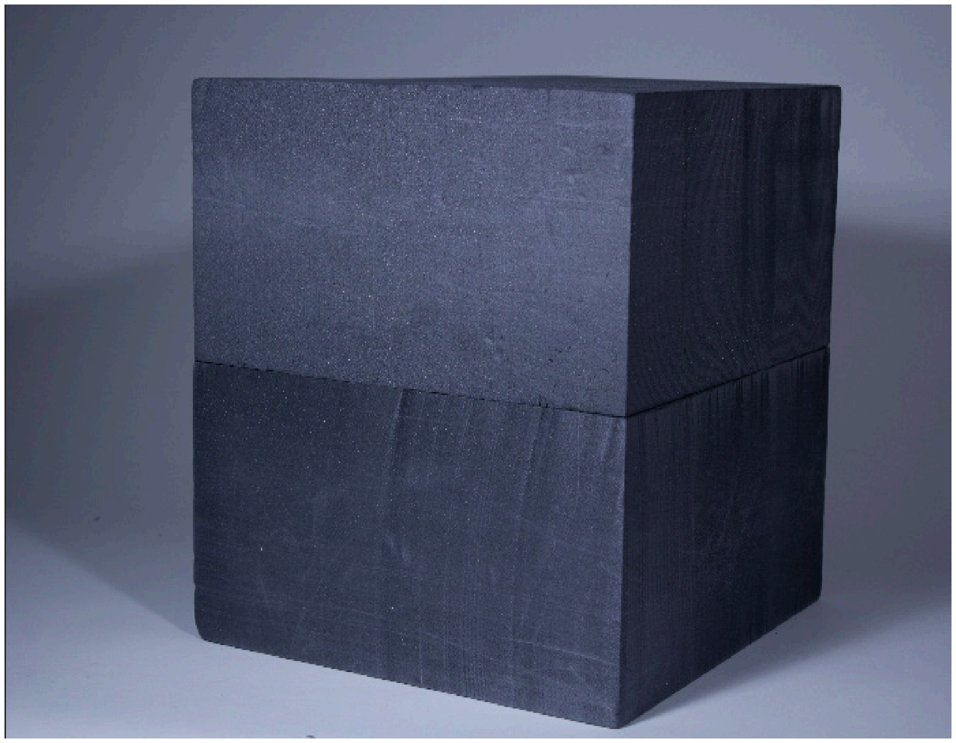
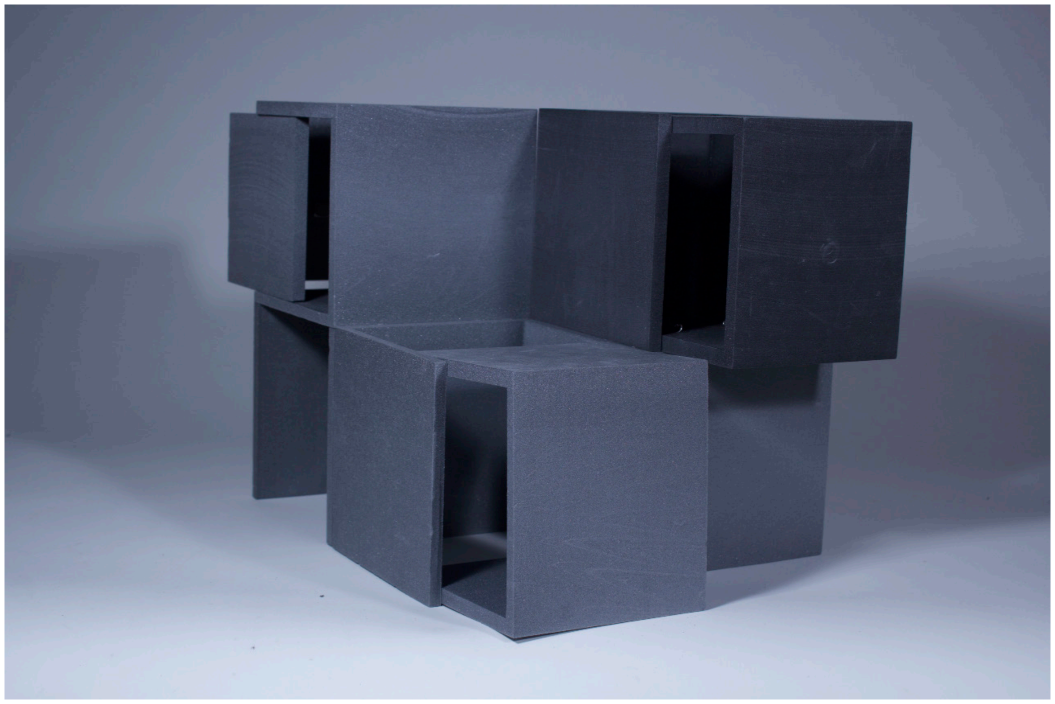
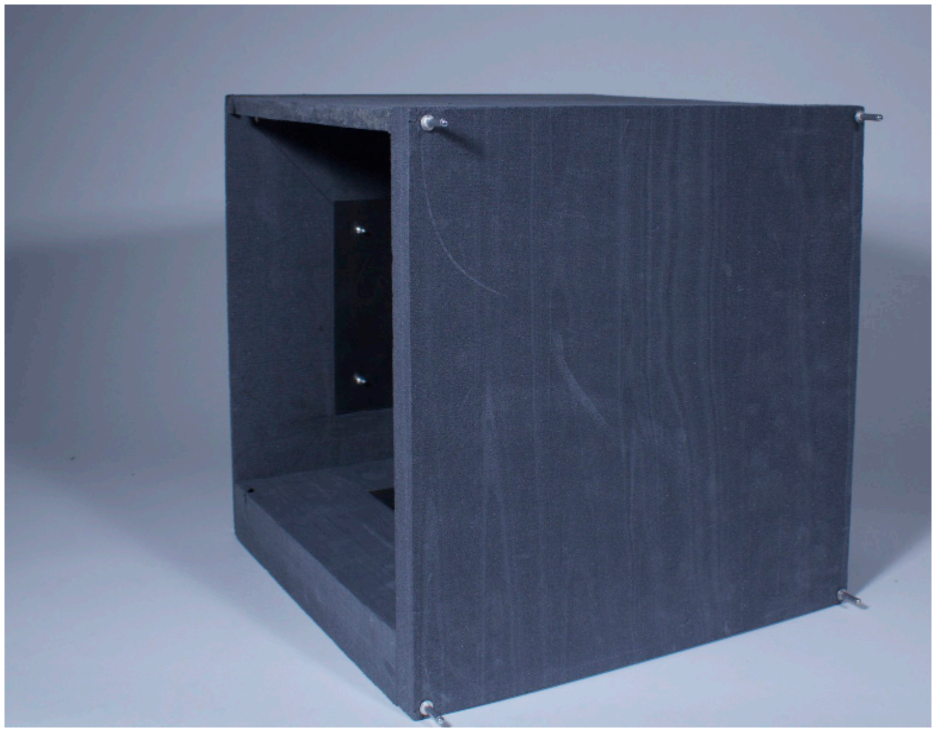
PRESENTATION
HAS
FRAGILE



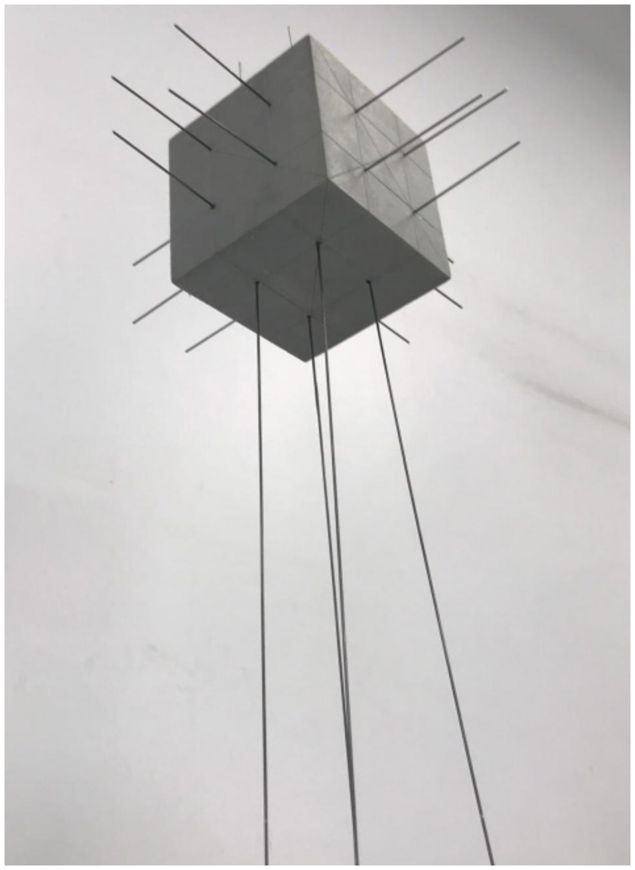
Base Cube - EPS foam



1st Corruption -Better



2nd Corruption -Hotter



3rd Corruption - Stability-er

Base Cube

Material

Properties of EPS

Home / What is EPS? / Properties of EPS

EPS has been a material of choice for over half a century because of its technical versatility, performance and cost effectiveness. It is widely used in many everyday applications where its light weight, strength, durability, thermal insulation and shock absorption characteristics provide economic, high performance products.

Light Weight

EPS is an extremely lightweight material which is not surprising considering it is comprised of ~98% air. This characteristic makes it ideal for use in packaging as it does not significantly add to the weight of the total product thereby reducing transportation costs. Energy consumption for transport fuel is also reduced and vehicle emissions minimised - all contributing to lower global warming.

Durability

The exceptional durability of EPS makes it an effective and reliable protective packaging for a wide range of goods. The cellular structure of EPS makes it dimensionally stable and therefore does not deteriorate with age. EPS is also odourless and non-toxic.

Moisture Resistance

EPS is a closed cell material and does not readily absorb water. There is no loss of strength in damp conditions, making EPS ideal for cool-chain products. The material is moisture resistant, so the highest hygiene requirements are met. The ability of EPS to resist moisture also lends itself for use in fishing floats and marina buoys. Even when subjected to prolonged saturation in water, EPS will still maintain its shape, size, structure and physical appearance with only a slight reduction to its thermal performance.

Thermal Efficiency

The superior thermal efficiency of EPS makes it ideal for packaging any product that is sensitive to temperature change. Products enclosed in EPS containers can be maintained for long periods at temperature above or below ambient conditions and can be protected from sudden temperature changes that can occur in the transport through different climatic zones. Examples include fresh produce and seafood as well as pharmaceutical and medical products.

Shock Absorption

EPS exhibits excellent shock absorbing characteristics making it the first choice for packaging of a wide range of products including appliances, electronic products, computers and chemicals.

Versatility

EPS can be manufactured to almost any shape or size, or it can be easily cut and shaped when required to suit any application. EPS is also produced in a wide range of densities providing a varying range of physical properties. These are matched to the various applications where the material is used to optimise its performance. In addition, EPS is also compatible with a wide variety of materials.

Ease of Use

For building and construction applications, EPS is considered to be one of the easiest materials to install on site. It is normally supplied in sheet form however can also be moulded into shapes or in large blocks.

Documentation of concept: As the brief for the base cube was only to make it 300x300x300mm, we did not go for an extravagant design. We decided to keep the design simple as we did not know what corruptions we will get next, we thought it would be better so start with a simple easy in order to advance more smoothly in the further corruptions. We decided to make the cube completely out of foam.

When coming to choosing the material, we considered several options. Such as wood, paper, acrylic, metal and eps foam. After researching about the properties of the different materials, we evaluated them and made a final decision to make our cube out of foam due to several reasons.

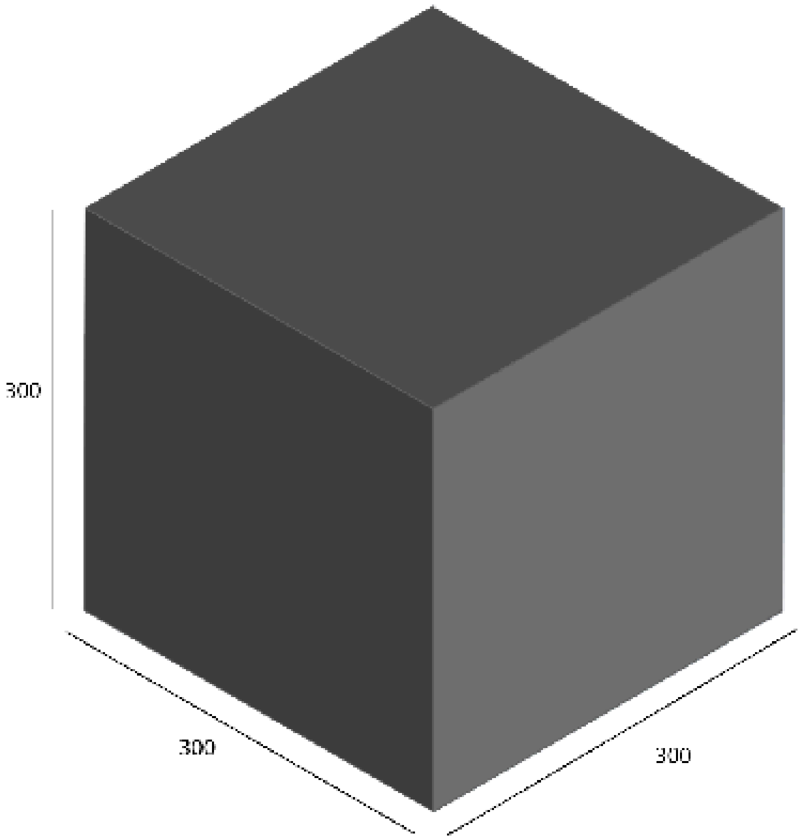
1: Lightweight

2: Easy to assemble (with copydex or special glue)

3: Easy to cut

4:Moisture resistant (less likely to be damaged)

5: Shock absorbant (less likely to be damaged)



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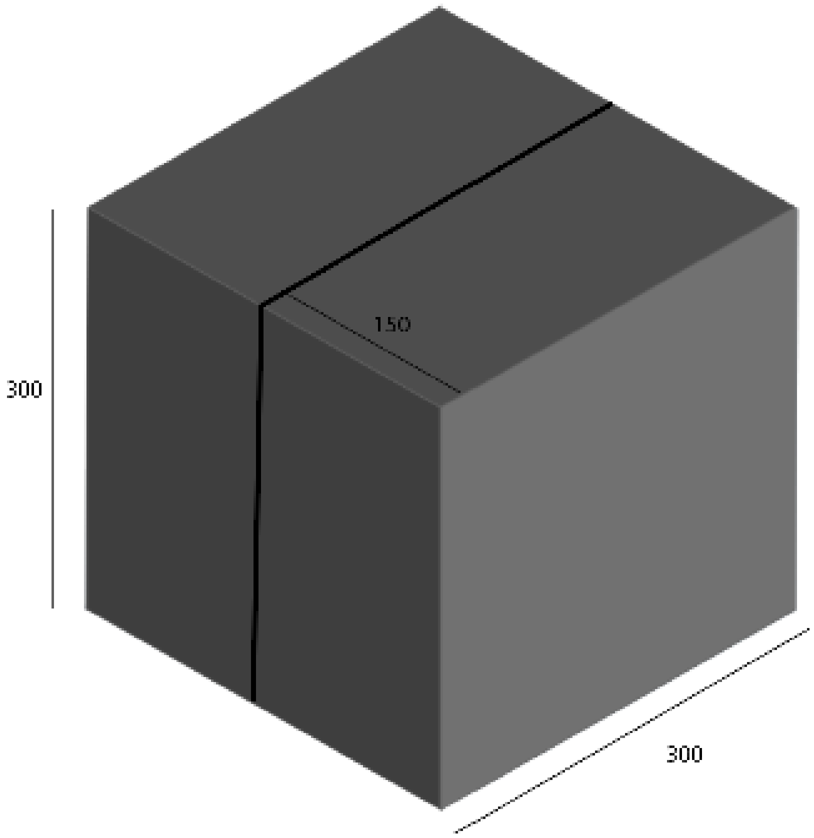
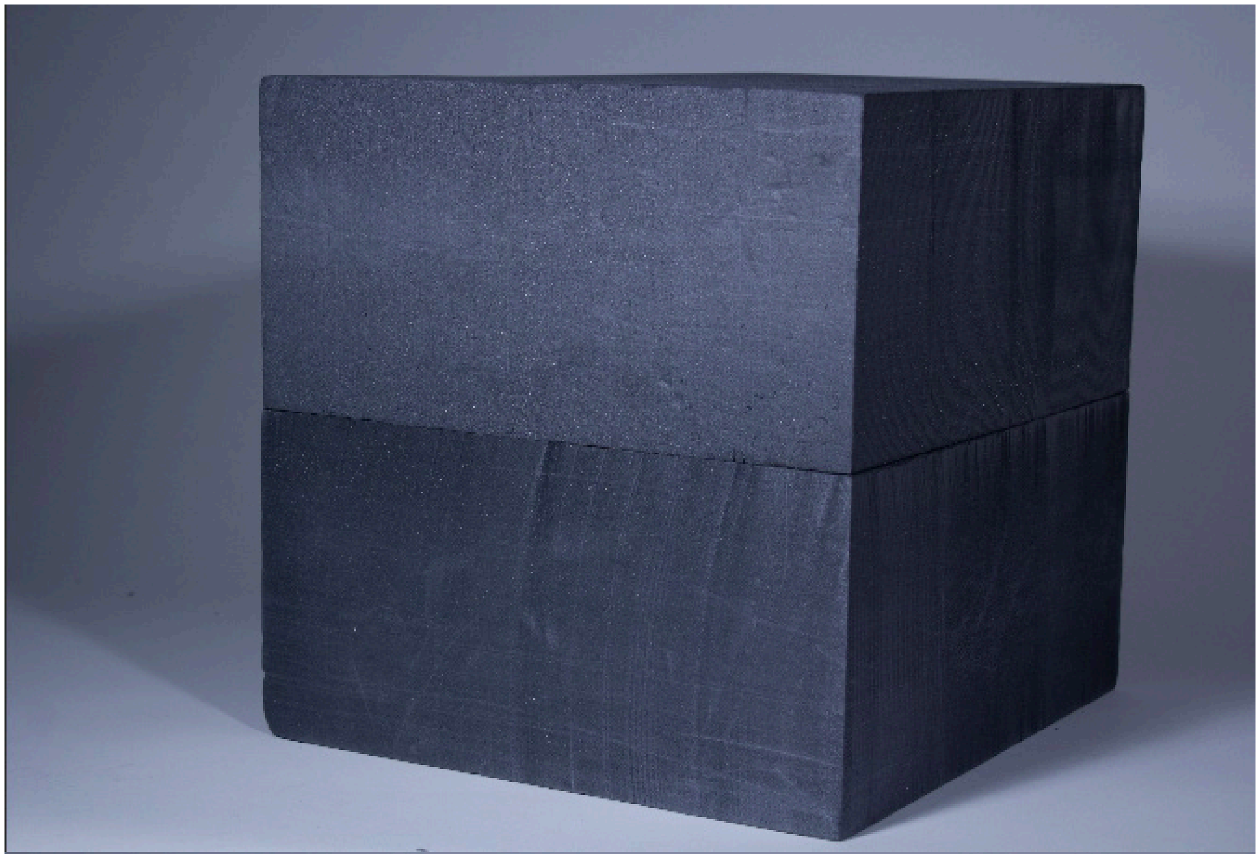


2

Documentation of progress: We bought a large piece of foam which measured 165x600x1250mm and we decided to cut it into 300x300x300mm with a bandsaw and hotwire (image 1). However there was an issue with the size of cutting for both the bandsaw and the hotwire, which was that they were not big enough for us to cut the original size of foam down to 300x300x300mm directly. Therefore we decided to make 2 parts of the cube separately and assemble them together. Each piece measured 150x300x300 (image 2).



Evaluation

The making of the cube was much harder than we expected.
Firstly, we had to make the cube by cutting two separate pieces and joining them, which caused slight inaccuracy as the making of two different pieces was not consistent. Secondly, we did not know that the hot wire machine was the factor of inaccuracy, as we didn't expect the hot wire to melt the foam so fast that a minimal thickness of foam is taken away everytime we cut it, which was unpredicted.
Thirdly, eps foam is mostly air inside, which is not very rigid. Therefore the exposed 4 edges can bend very easily, causing the structure to no longer stay as a 300x300x300mm cube.

What we learnt from this base cube was how the bandsaw and hot wire machine worked, how the property of foam reacts to it, especially to high temperature. We can use this opportunity to reflect on our making of the cube so that the craftsmanship will improve next time.

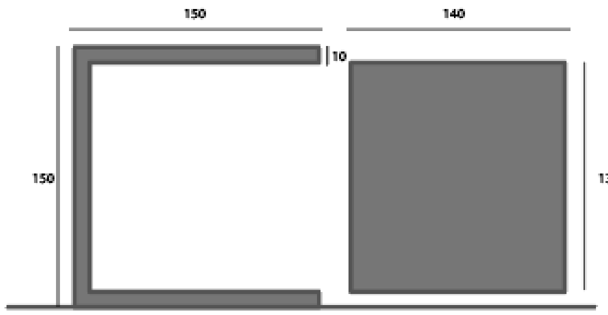
1st Corruption

Materials - *Better*

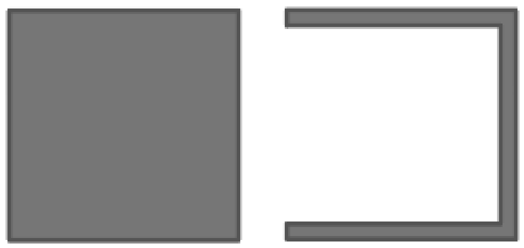
Aspects of better:

Time
Amount of material used
Functionality
Craftsmanship

How it can be applied to our cube:
1.Reduce the time spent on making the cube
2.Reduce material wasted
3.Give function, so it can be used and not thrown away
4.Make it look good, so people will want to use the cube

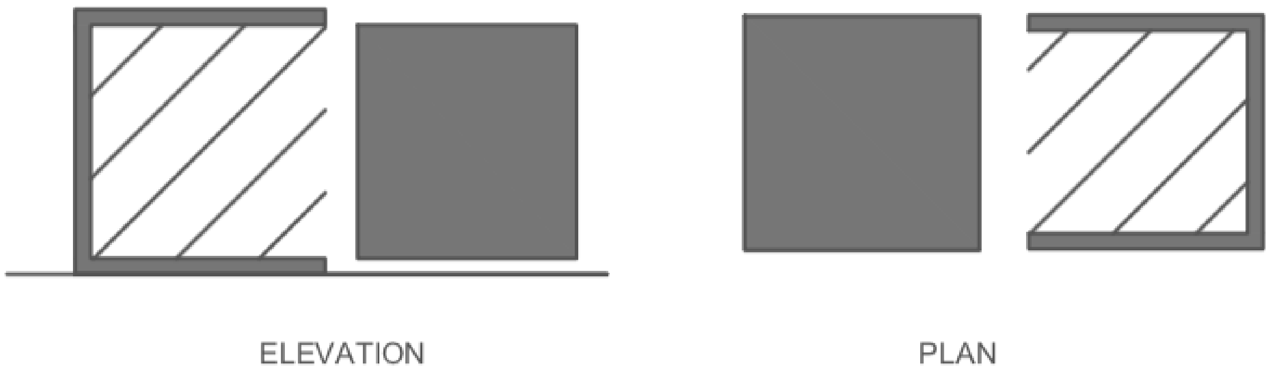


ELEVATION



PLAN

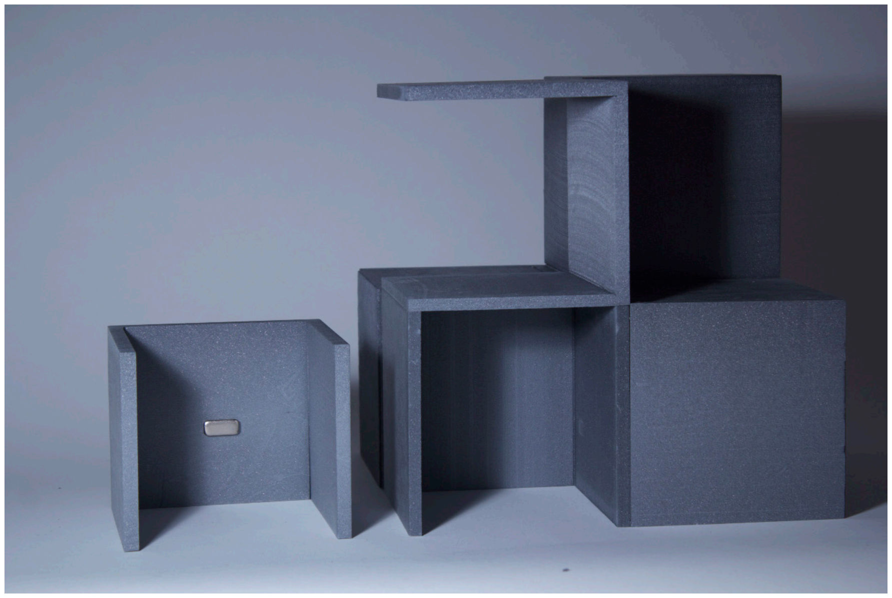
Design concept:
We wanted to change our design so that it can be applicable to all the aspects of better we thought of, however looking fairly similar to our base cube. The design we’ve come up of is to make 8 small cubes to fill up the 300x300x300mm volume space. The small cubes are hollow are consist of 2 components to form the cube. The 2 components are in ‘C’ structure, with one smaller to slide into the larger one.

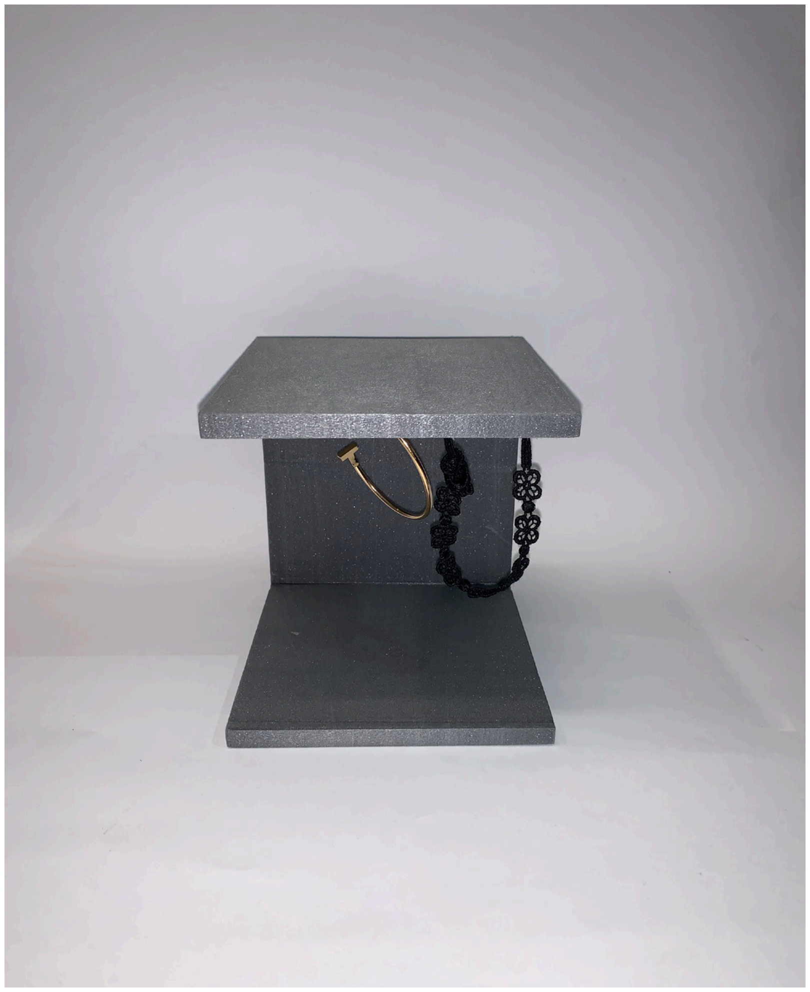


Efficiency and material waste

As all for us worked on the base cube together when only one or two people were using the bandsaw and hotwire to cut the foam at a time, the total exhausted time could be reduced to splitting the workload into 4 as this design requires the making of 6 cubes. In the end the time we each used was much less than the base cube of 2 hours, compared to this time which was 30 minutes.

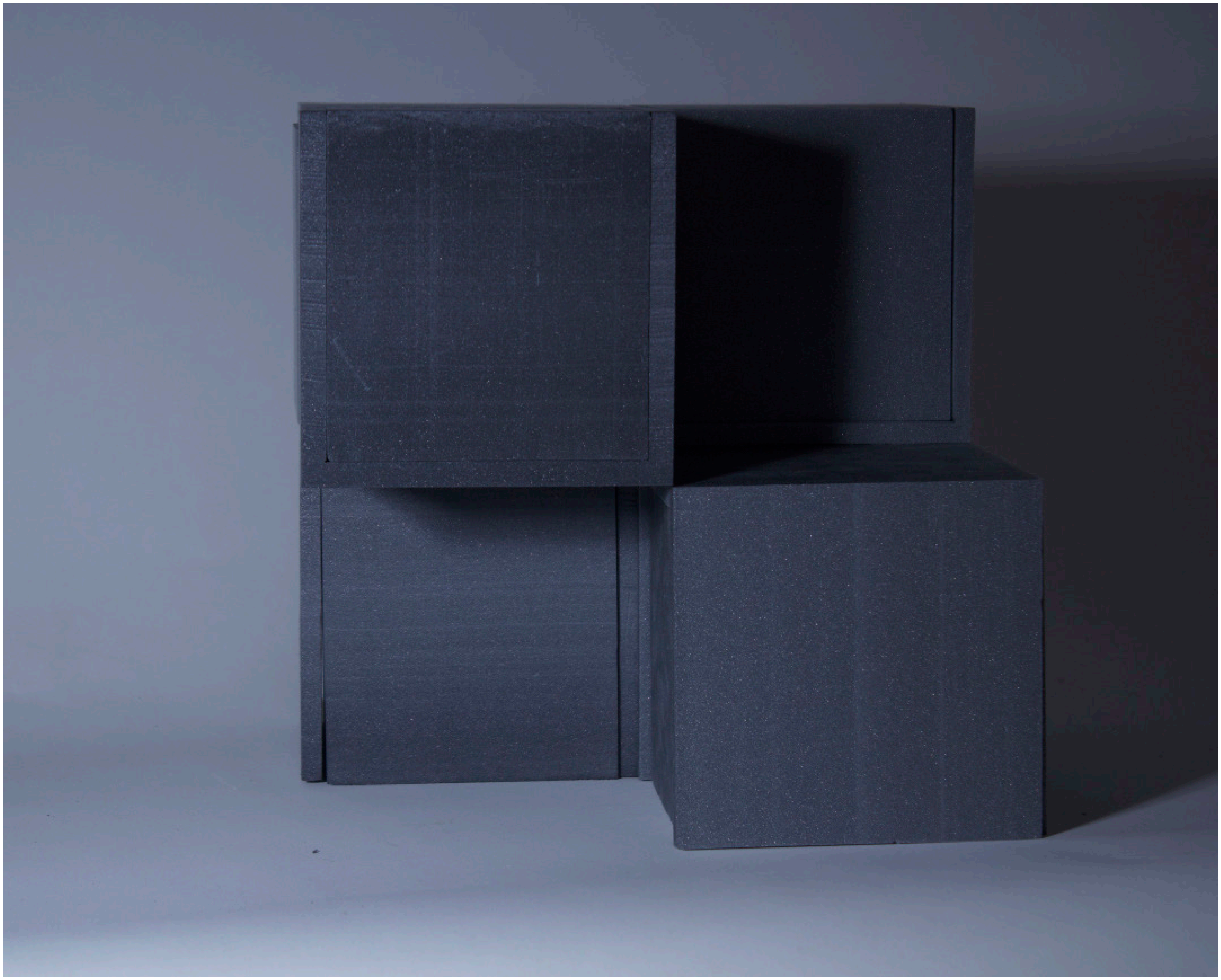
In terms of the material wasted, the volume of the base cube is 27000cm^3 and for this, the volume we used was only 7068cm^3, which created a differences of 19932cm^3 of foam, a total reduce of 74%. As for the excess foam, we will use it for the other corruptions.Therefore no foam was wasted.





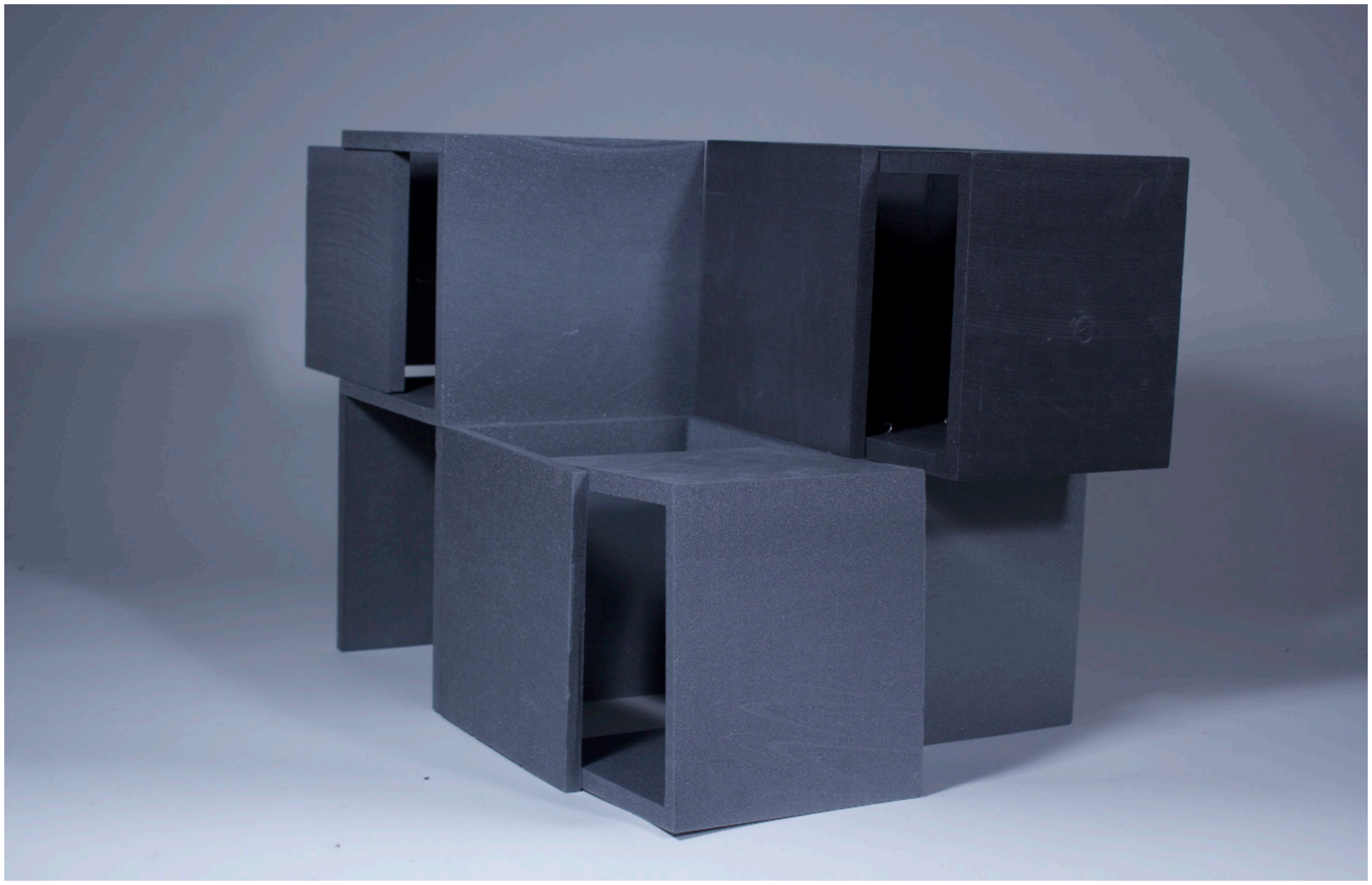
Functionality

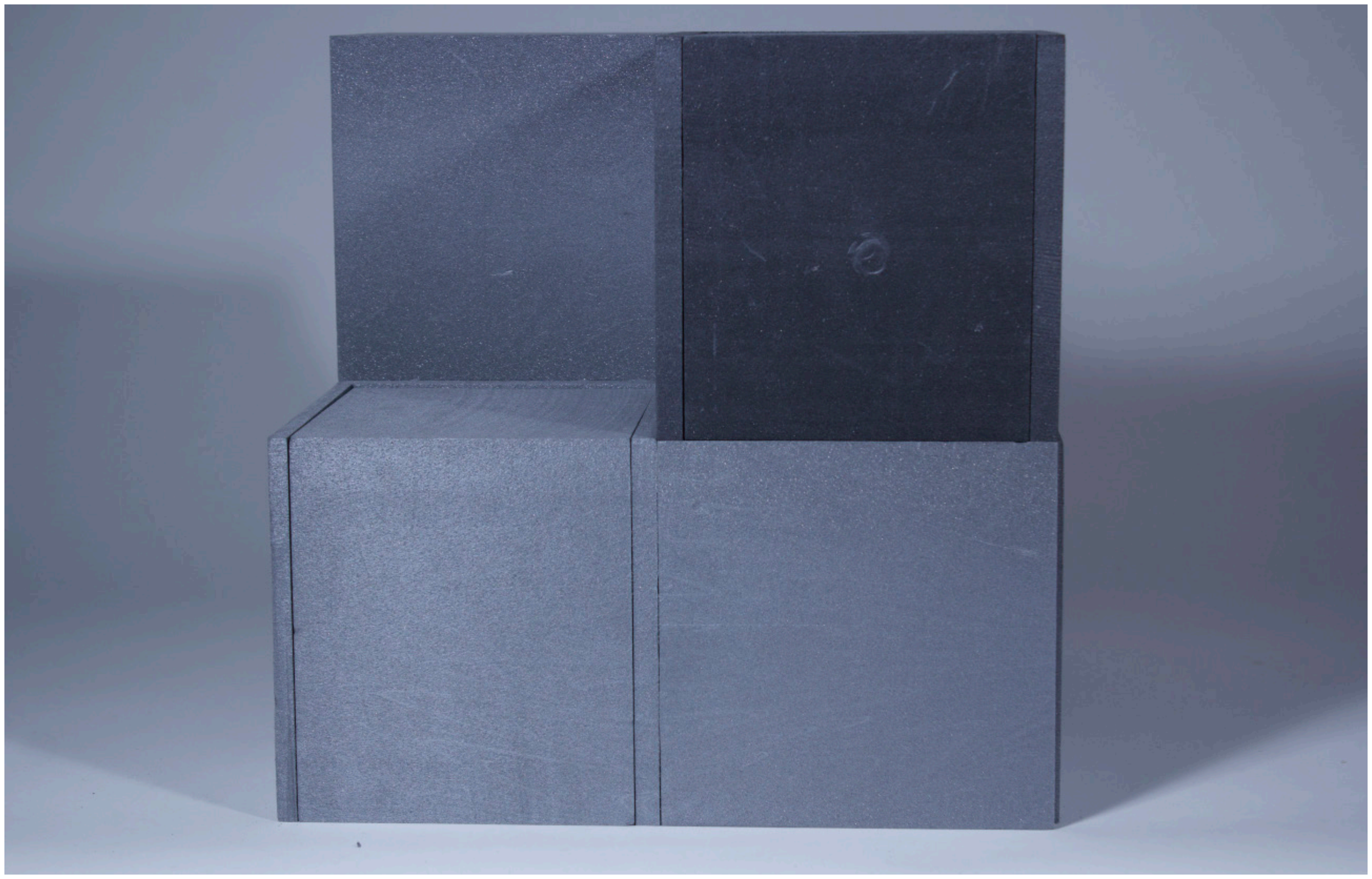
As we investigated and explored the materiality of eps foam more, we learnt that as it is mostly air, foam is actually penetrable. Therefore to make this cube useful, we decided to make it a secret storage box. Firstly, there are steel hoops that are just attached by having the straight end penetrated into the foam. The function of these hoops is to hang accessories like bracelets. Secondly, there are magents stuck on the sides of the 'C' foam pieces to have the storage space opened with a magnet, to maintain the consistency of having nothing in the facade like the base cube. Thirdly, we left 2 gaps empty (not putting small cubes) for the platform to act as somewhere to put objects.



Craftsmanship

From what we learnt making the base cube, we refined the faces of the foam by making it smoother. To do this, when we needed to cut the foam into 150x150x150mm small cubes. We didn't cut the larger piece of foam directly into 150x150x150mm with the hot wire machine. Instead, we cut the sides little by little in order to maximise the opportunity to cut the smoothest face. For more delicate areas, we sanded the rough parts of the foam off.





Evaluation

There are 4 things we think we did BETTER for this corruption. Firstly, the reduced the time of making by three quaters. Secondly, the material we used for this cube was substantially less than the base cube and we recycled the excess foam by using it for other purposes. Thirdly, there is a function to this cube so that the cube will not be wasted at the end of the term, it could be used in our daily lives. Lastly, we explored the property of foam well enough to improve our craftmanship so that the cube is pleasing enough to be used.

In this corruption, we learnt how to manipulate the property of foam and use it to the best extent. Which is that the hot wire allows the cutting of foam to be very smooth and accurate, therefore we opportunitised the making of the cube to make it as nice as possible.

What we think we could have done better is that maybe the compartment sizes could vary in order to put different objects, rather than having them all the size, minizing the variation of things we can put inside.

2nd Corruption

Environment - *Hotter*

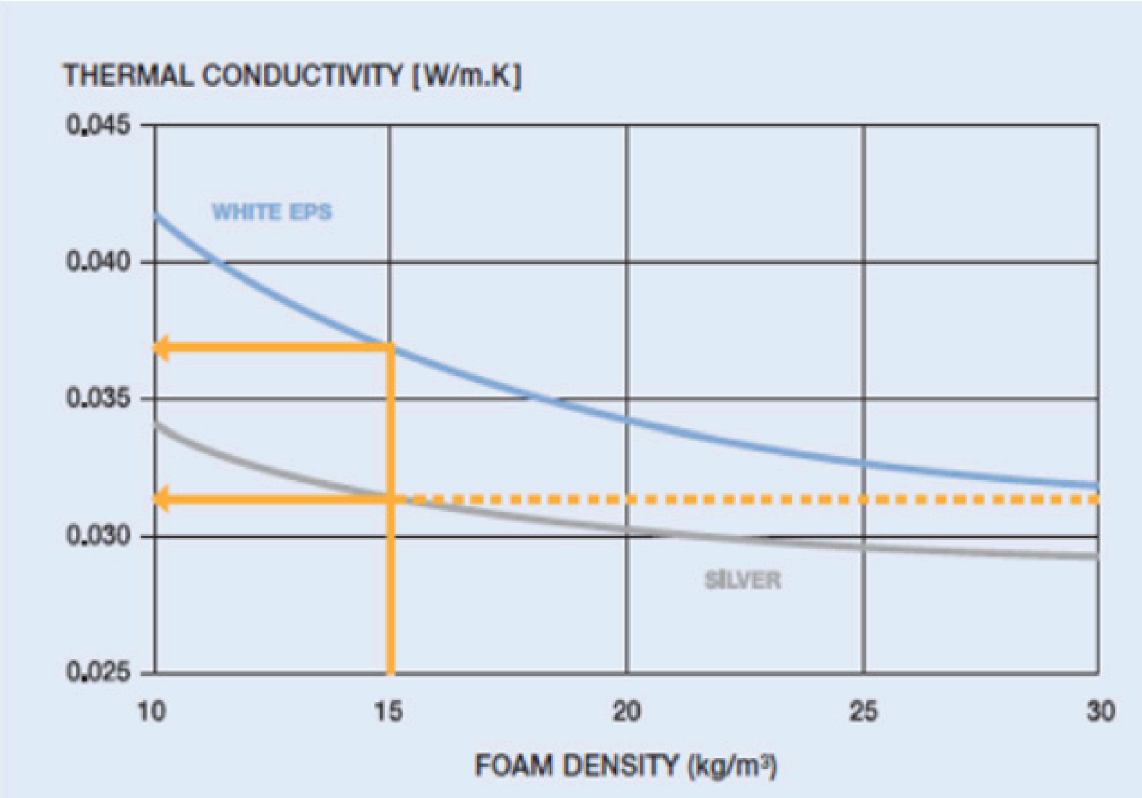


Figure 1 : The thermal conductivity of Silver compared to white EPS as a function of the foam density.

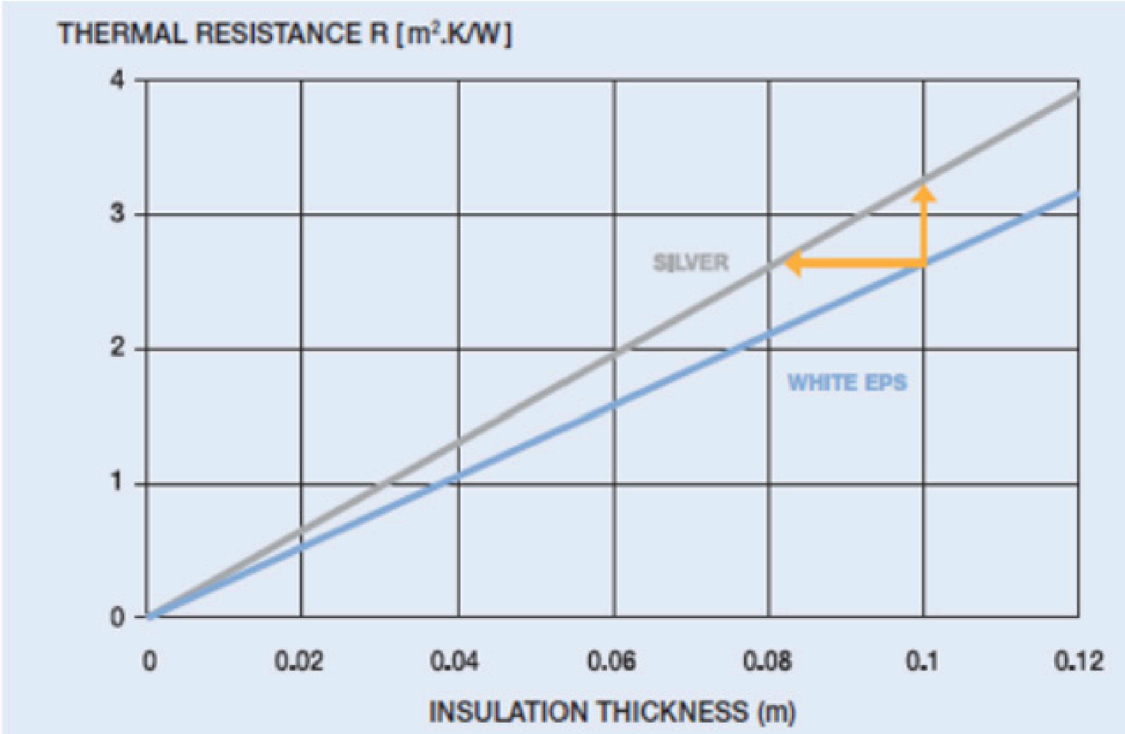
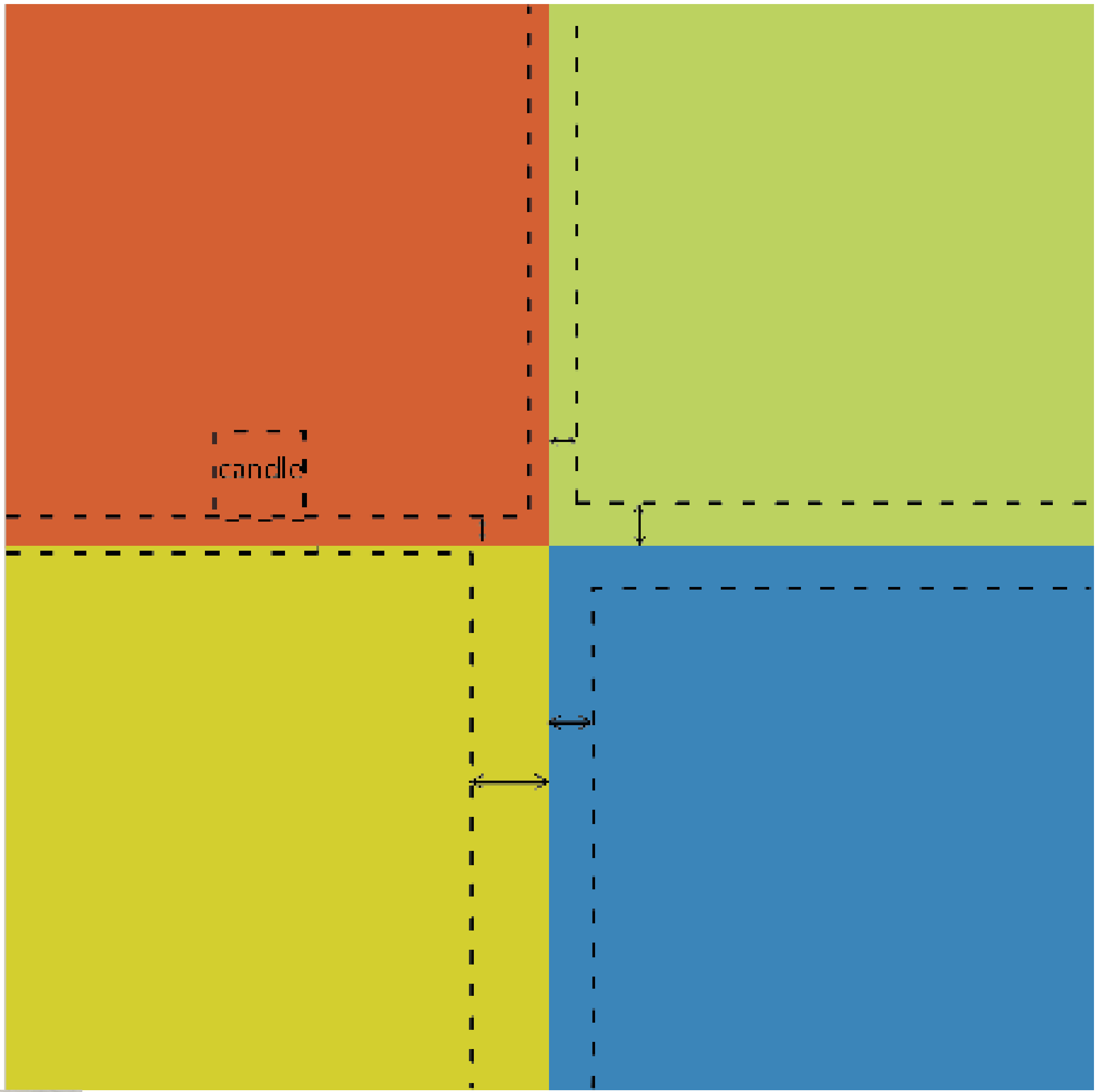
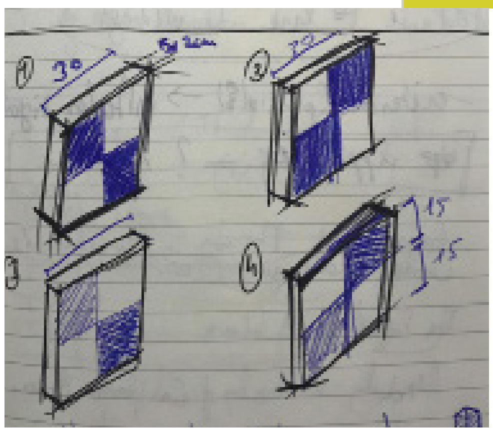


Figure 2 : Thermal resistance (R = Thickness / Thermal conductivity) of Silver and white EPS at a density of 15 kg/m³ as a function of foam board thickness.

This is what we found about the properties of foam and how it acts as an insulator, We found out that eps silver (the one we use) has a much higher thermal resistance than white eps foam. Therefore it means that the eps silver foam can keep in heat much better than the white one does.

The design concept:
We researched on the thermal materiality of eps foam and noticed that it is an insulator. In order to create patterns from the thermal camera, we have to design the cube in a way such that the foam can react to the heat and show different colours. As foam is an insulator, we decided to incoporate steel, which is a conductor, which higher thermal conductivity to work with the foam to generate different colours.

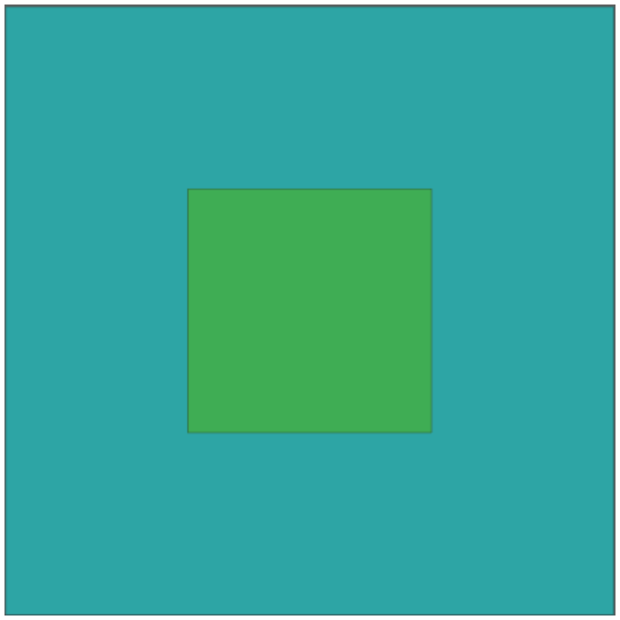




Design 1:
Our first design is to have 8 small cubes inside a larger foam cube, relating to the concept in corruption 1. To make it applicable to this corruption, the thickness of the sides of the small inner cubes will be varied in order to alter the thermoconductivity of each of the different thickness of foam. The candle will be placed in one of the top corners, the steel plates will help in conducting the heat to the foam.
The thickness of the sides will affect the temperature of neighbouring cubes, so if the face is thick, the neighbouring cube might be colder than thinner hotter.

1

2



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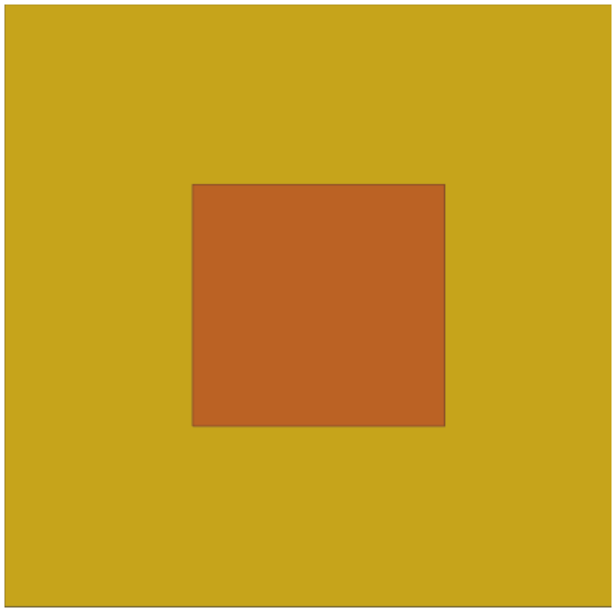
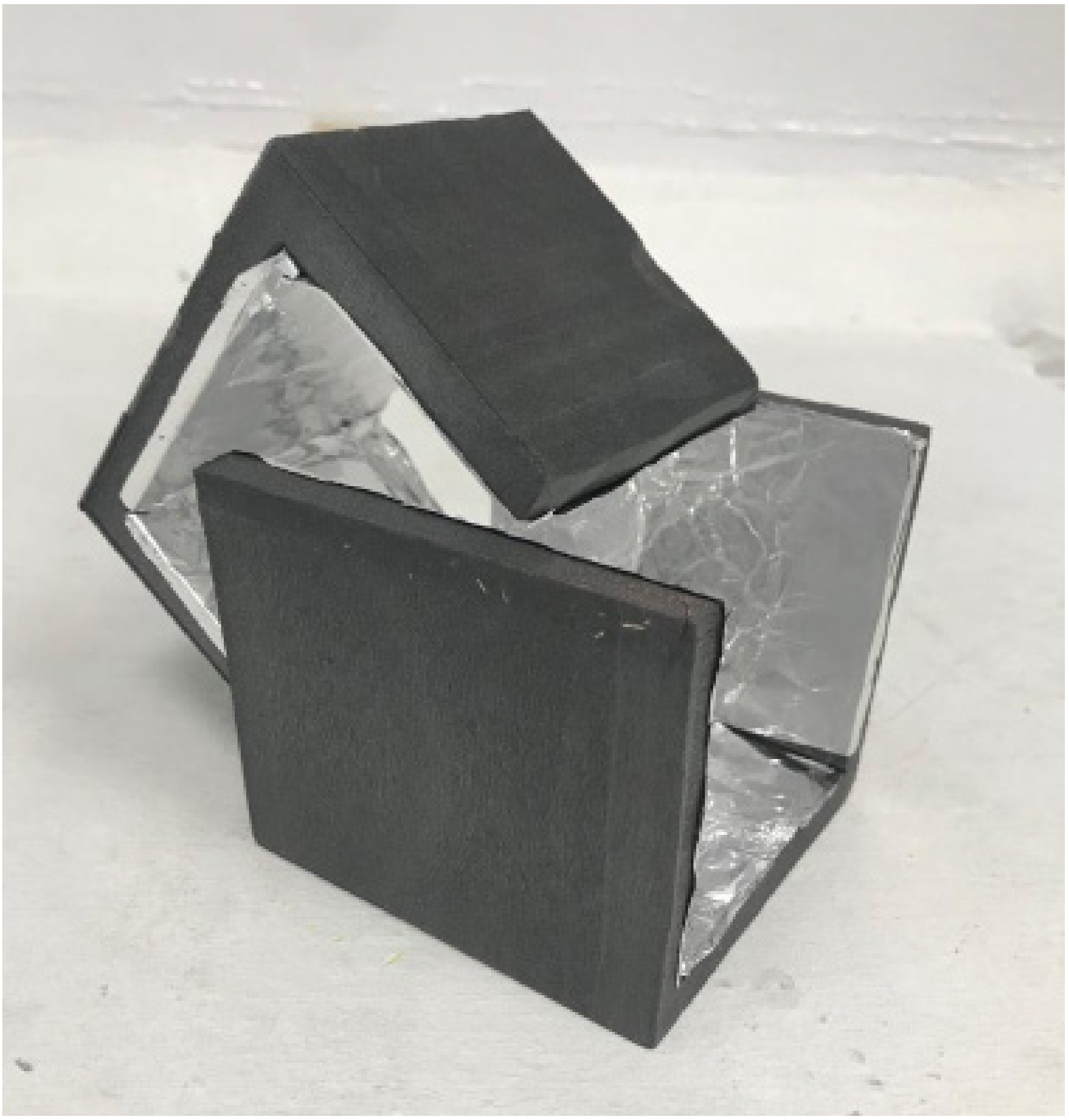


Design 2:

Our second design is to have the cube hollow, the cube will be made up of 4 foam pieces of different thicknesses and steel plates of equal thickness will be placed in the middle of the foam sheets.

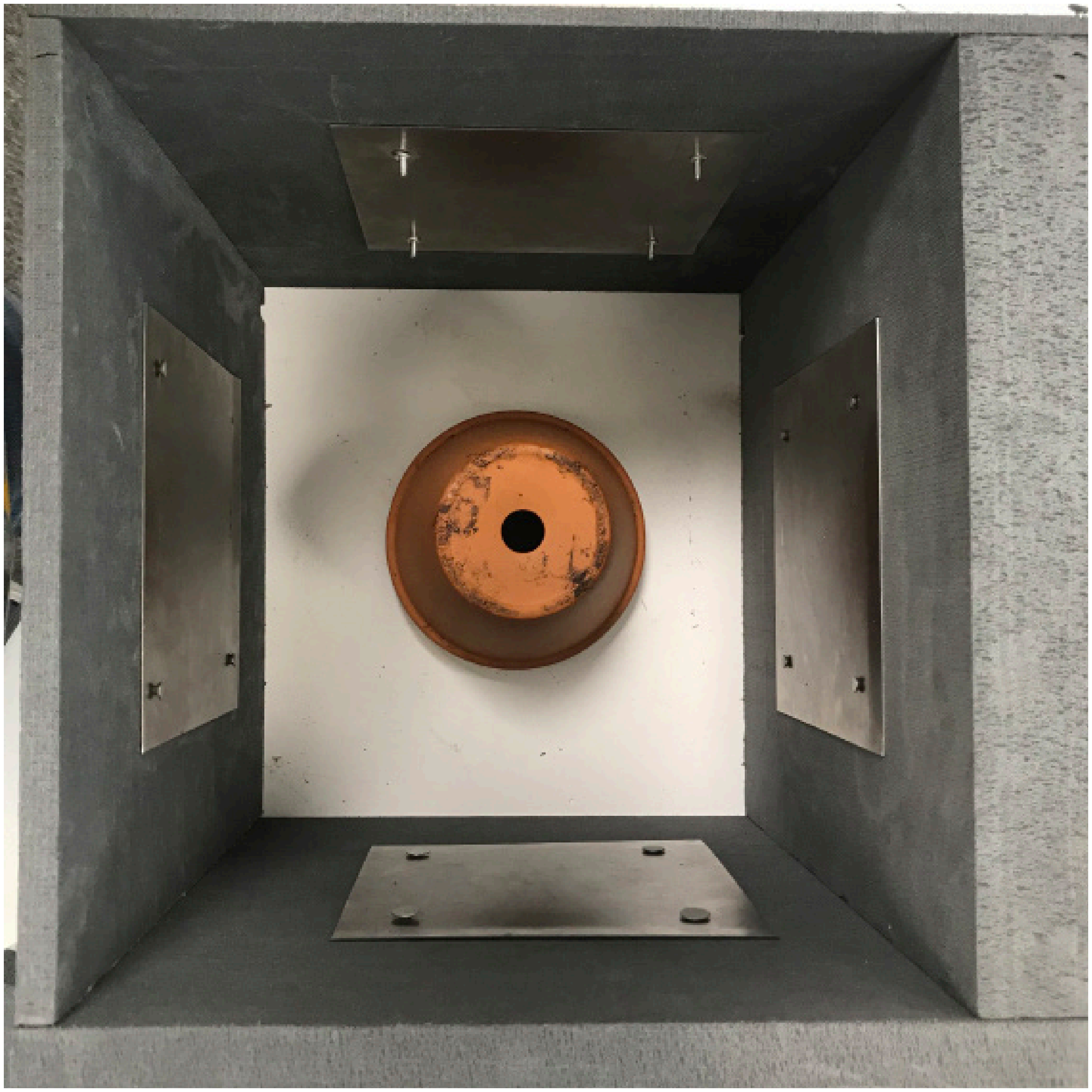
Therefore the pattern we want to see will be something like the images above.

1. Thickest foam -40mm
2. 20mm
3. 10mm
4. 5mm

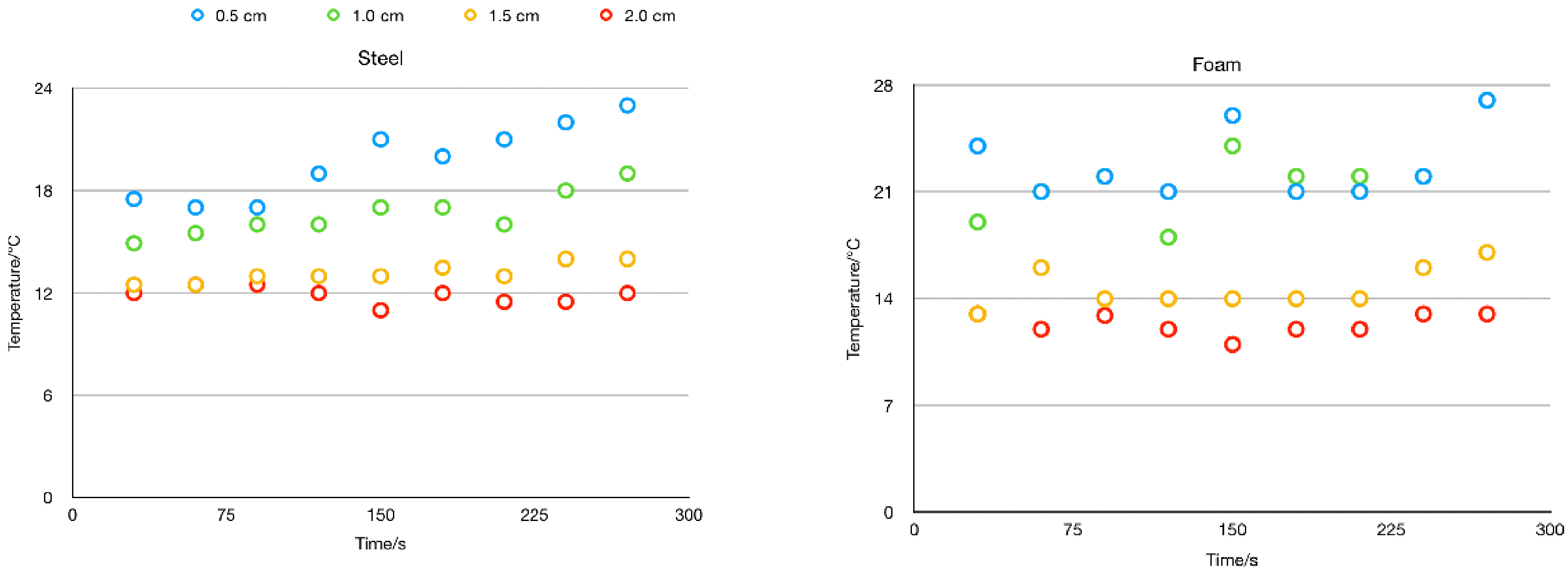


Test:
We carried out tests to see the relationship between the thickness of foam and it’s thermalconductivity. We made small cubes of different thicknesses: 5mm, 10mm and 20mm and placed alumninium foil around it in order to prevent the thin foam from melting.
We put candles in and timed for around 30s, a general idea we understood is that the thinner the foam is, the faster it heats up as it is less of a good insulator. We couldn’t conduct the experiment for any longer because one of the cubes caught on fire.

Test evaluation:
We learnt from this experiment how the thicknesses of foam will help in generating different patterns in the real cube.
If we want a darker colour, the foam should be thicker to increase insulation and vice versa.



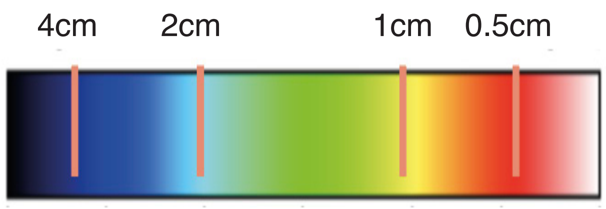
Final design:
For our final design, we chose the second cube as it will be easier to construct and the pattern will be much clearer.
The thicknesses will be 40mm,20mm,10mm and 5mm
We used metal nails to join the foam to eachother and the steel plates to the foam pieces, not copydex glue to avoid having another material contributing and possibly affecting our results.



Results:
We did an expeirment with the final cube and tested how the different foam pieces and steel plates will react to the candles.
Graph 1 shows the relationship between foam and heat
Graph 2 shows the relationship between steel and heat (with the foam in between)

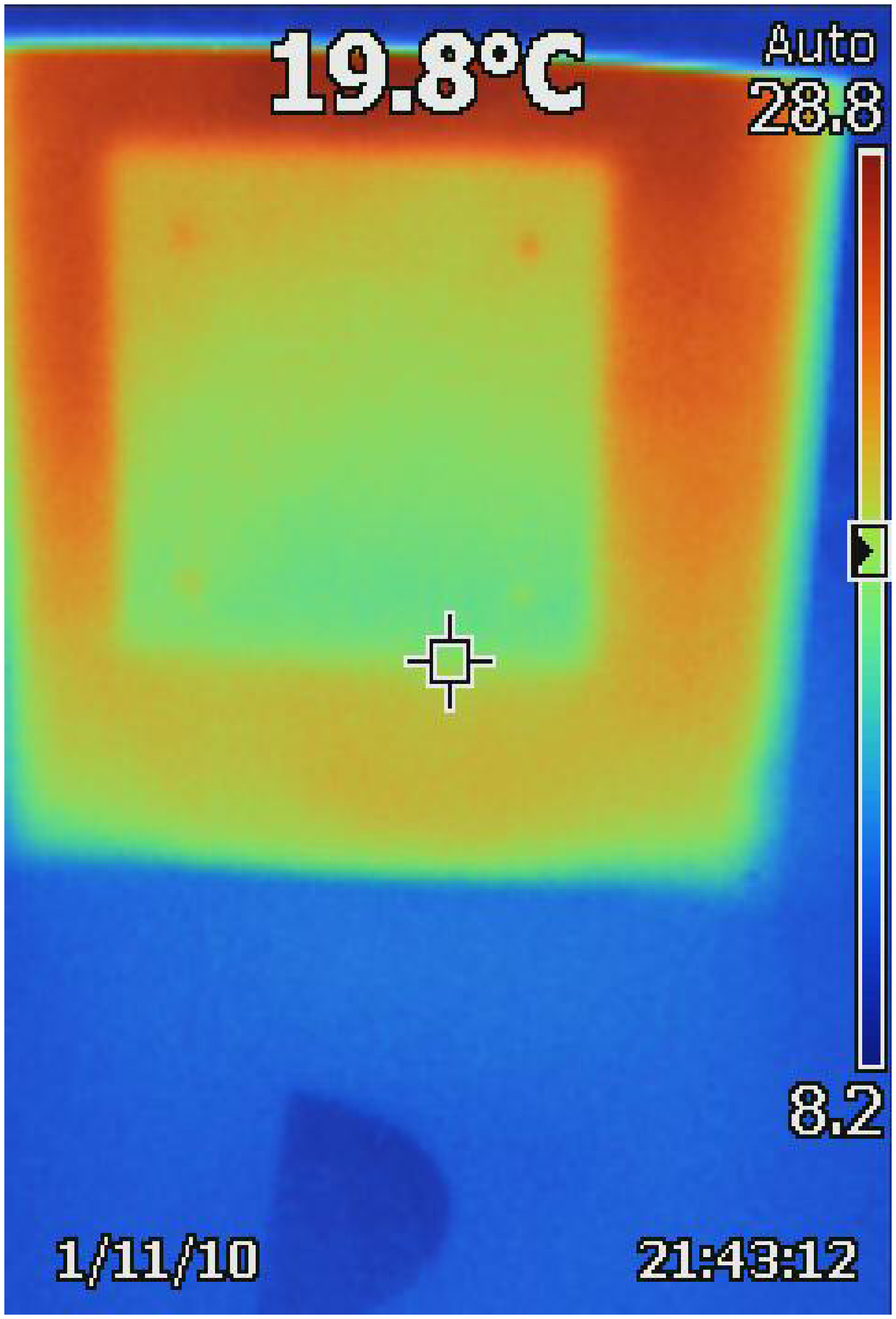
The results show that the thinnest foam heats up quickest and the thickest was barely warm. In terms of the colours and pattern generated by the thermal camera, there is an approximate spectrum view of what colours the different thicknesses of foam can create.

The results were actually slightly different from our hypothesis, we thought that the steel plates will heat up more than the foam, which is why in our concept pattern, the colour of the middle square is always slightly closer to the red side of the spectrum. However in the result from the thermal camera, it shows that the foam heats up more than the steel plates.



Approximation of where each thickness sits on the thermal colour chart

Evaluation:
What we think we did well was understanding the properties of our materials, eps foam and steel. We were really lucky because they have opposite properties so we can manipulate this do create a pattern.
In terms of the craftsmanship, we think the joining of parts can be done better and maybe have the nails hidden rathern than protruding, to look more clean.
However, we think that the results are well generated and reflects our understanding of materiality and how we manipulated the properties.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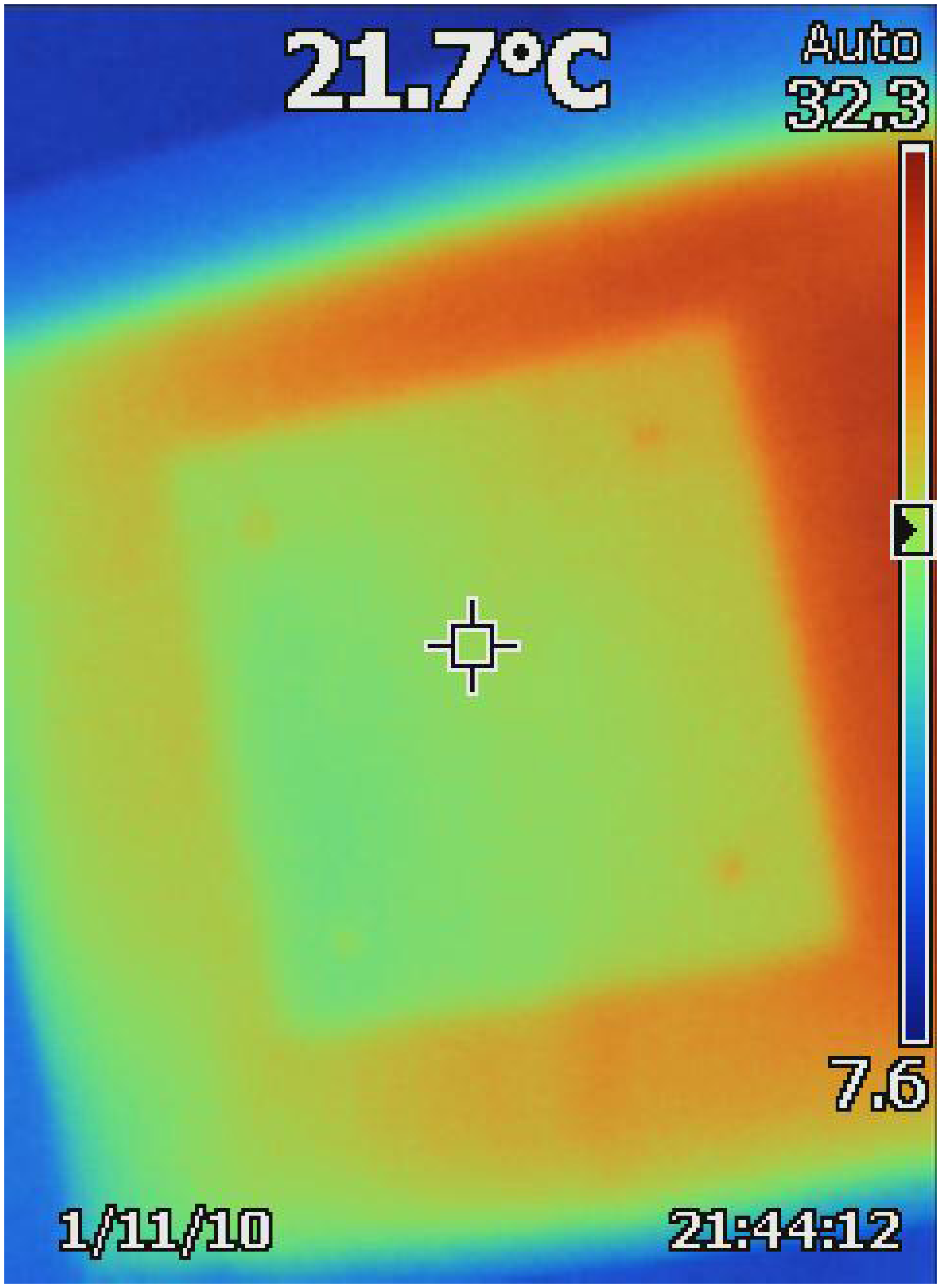
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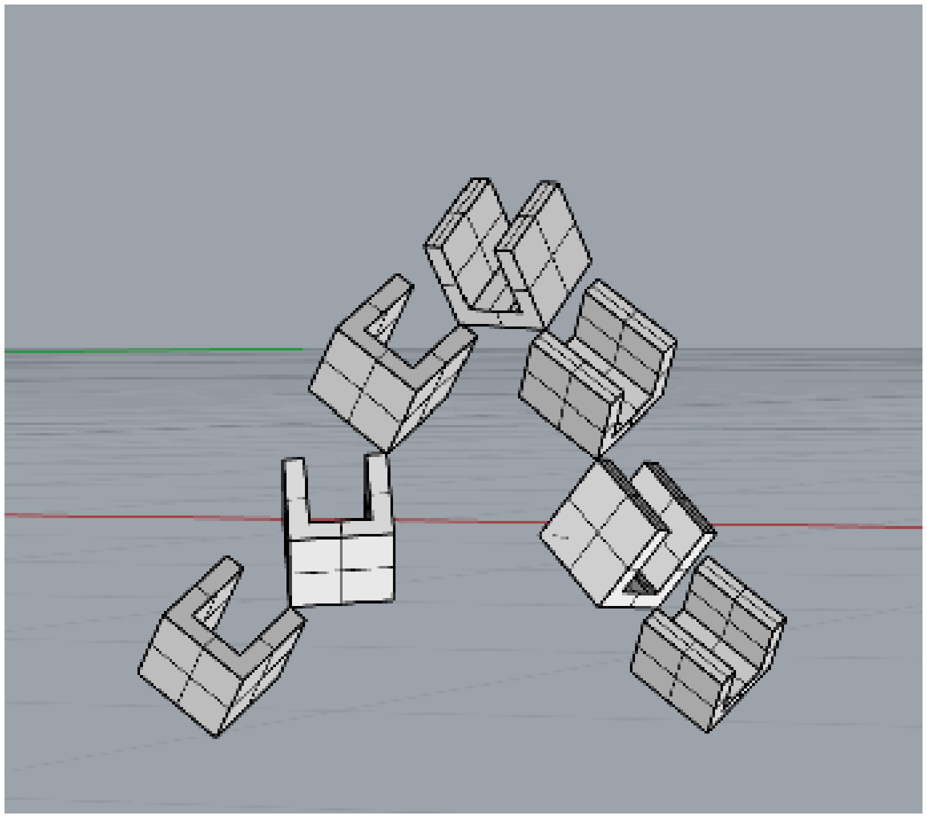
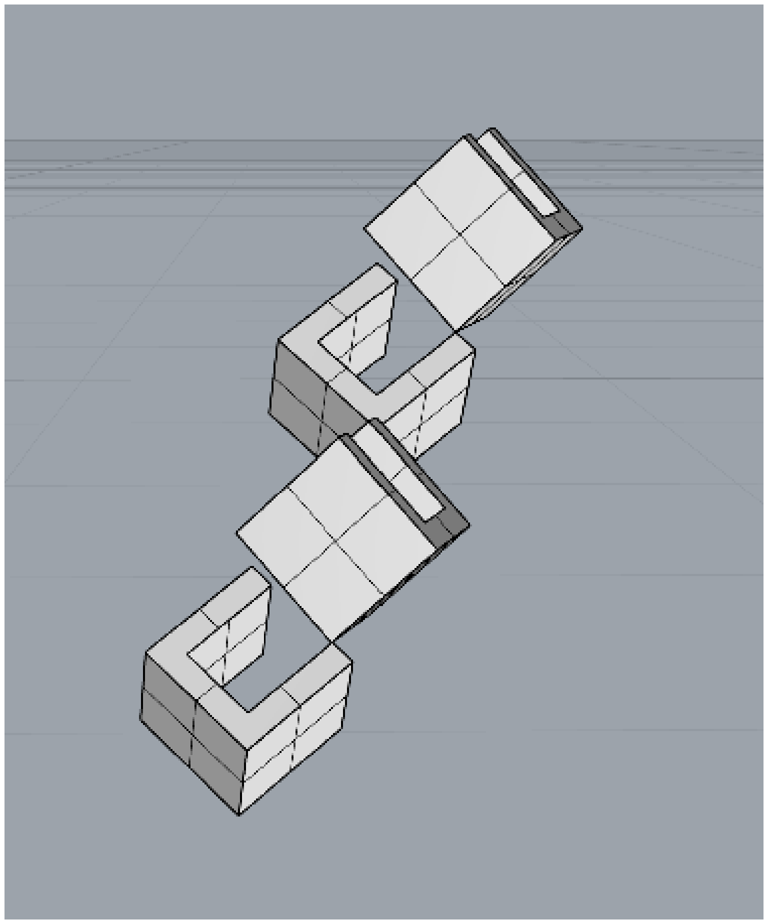
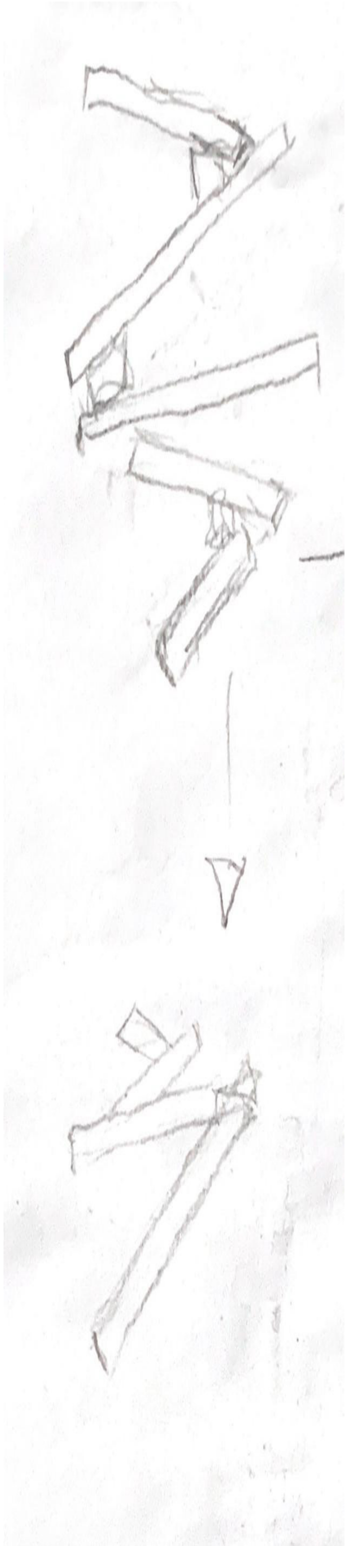
3rd Corruption

Structure - *Stabilty-er*
Playful-er
Happy New Year

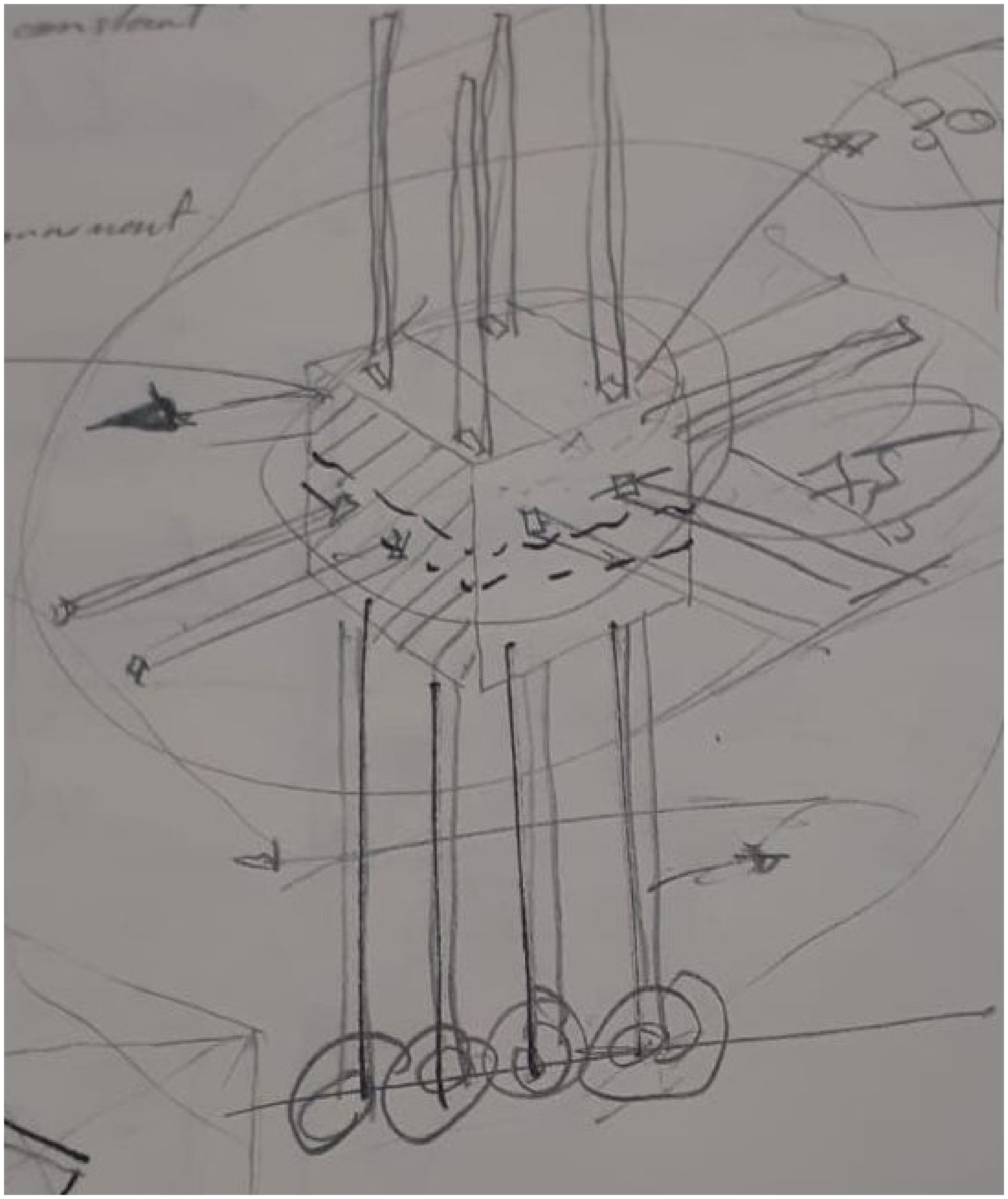




Design concept 1:
After the presentation of the last corruption, we came up with an idea each (one member absent).
1st idea was to use the idea of tensegrity and to challenge the limits of stability. there will be small cubes inside the 300x300x300 volume of space, stanidng and stacked on each other's edges. To have this structure stable, the free edges of the cubes will be connected and pulled by thin steel string to a frame. Therefore the general idea is to use the tension of strings to stabilise the inner structure.

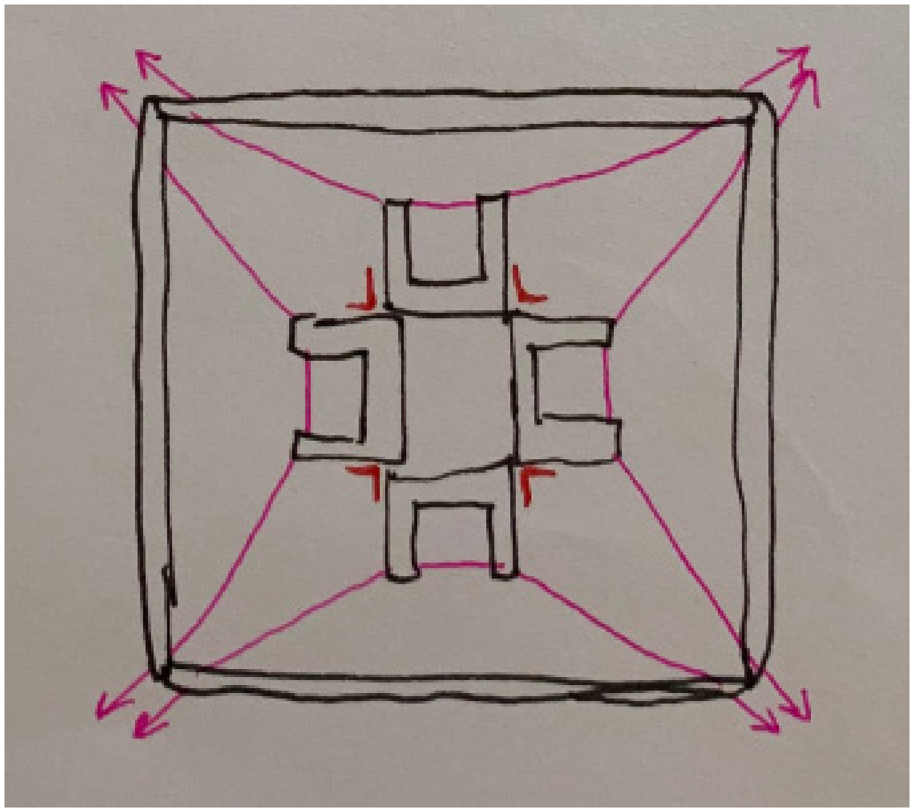


Design concept 2:
The idea was to make about 5 thick foam sticks that vary in size and connect them with steel hinges. The smaller one would be on the bottom while the biggest at the top; the smallest one would have some weight added inside of it to support the weight on the ones on top.

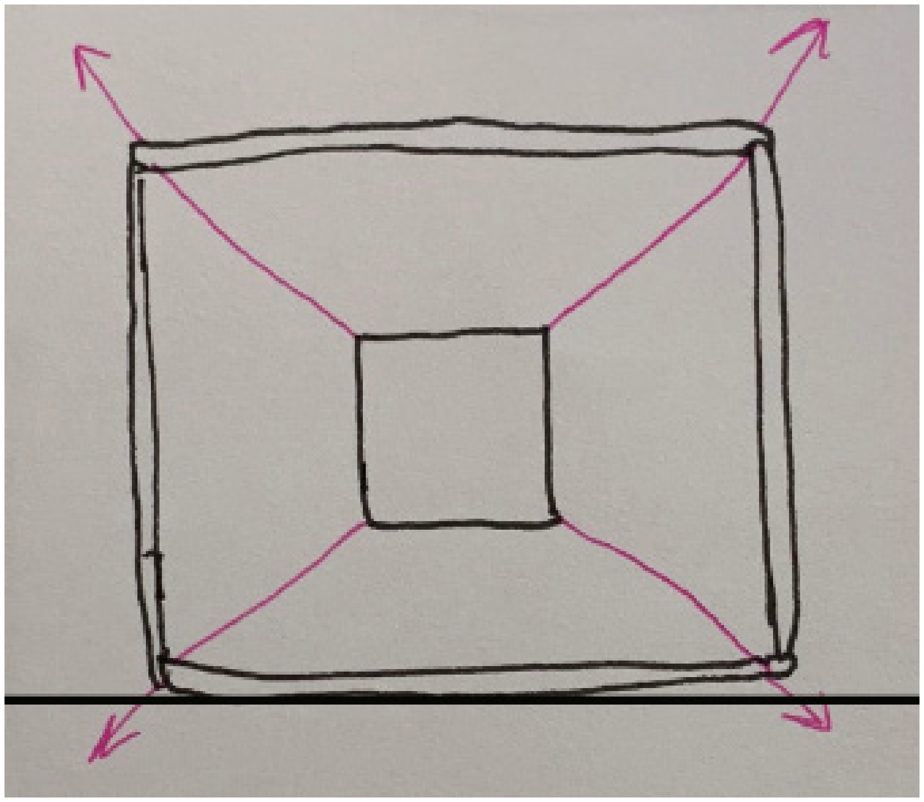


Design concept 3:
Challenging the property of steel and how the design of structure can show stability and the opposite.

pink: steel wire
red: hinge



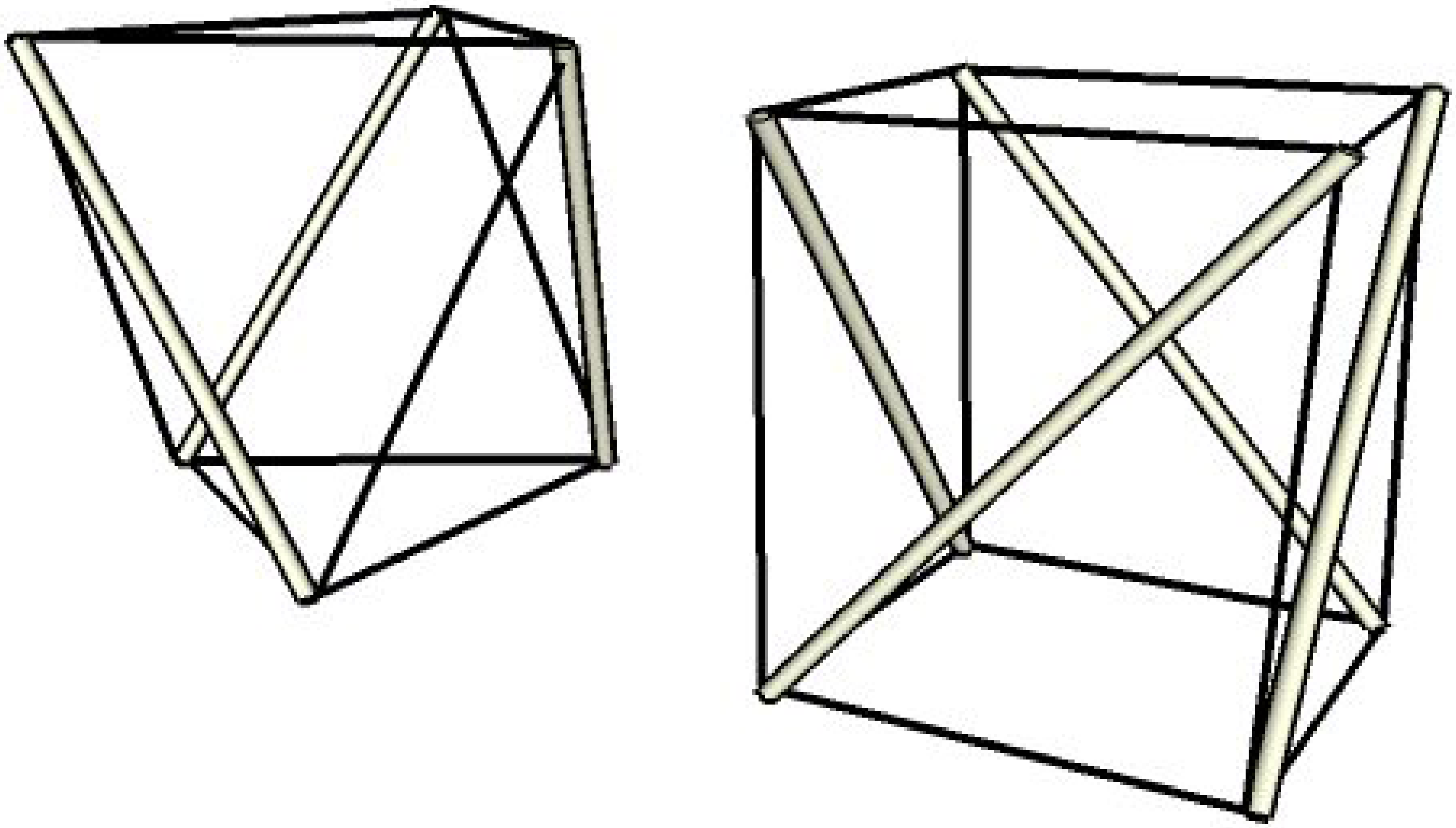
PLAN



ELEVATION

Final design:
The final design is to merge the three ideas together. There will be 4 ‘C’ foam structures, relaiting to the previous concepts, in the middle of the 300x300x300 volume space. Forming a structure showed in the diagram above. The four foam pieces will be put together with 4 removable metal hinges joining them next to each other (shown in red). Then there will be thin steel wire going through each cube and through the holes of the rods of the steel frame. The idea is when the hinge is removed, at least the 2 of the ‘C’ structures will detatch, therefore is unstable. Then the strings can be pulled so that the ‘C’ structures is pulled towards the frame, which will then be stabilised. The extra thin wire that has been pulled out will be secured with magnets on the steel rods of the frame.

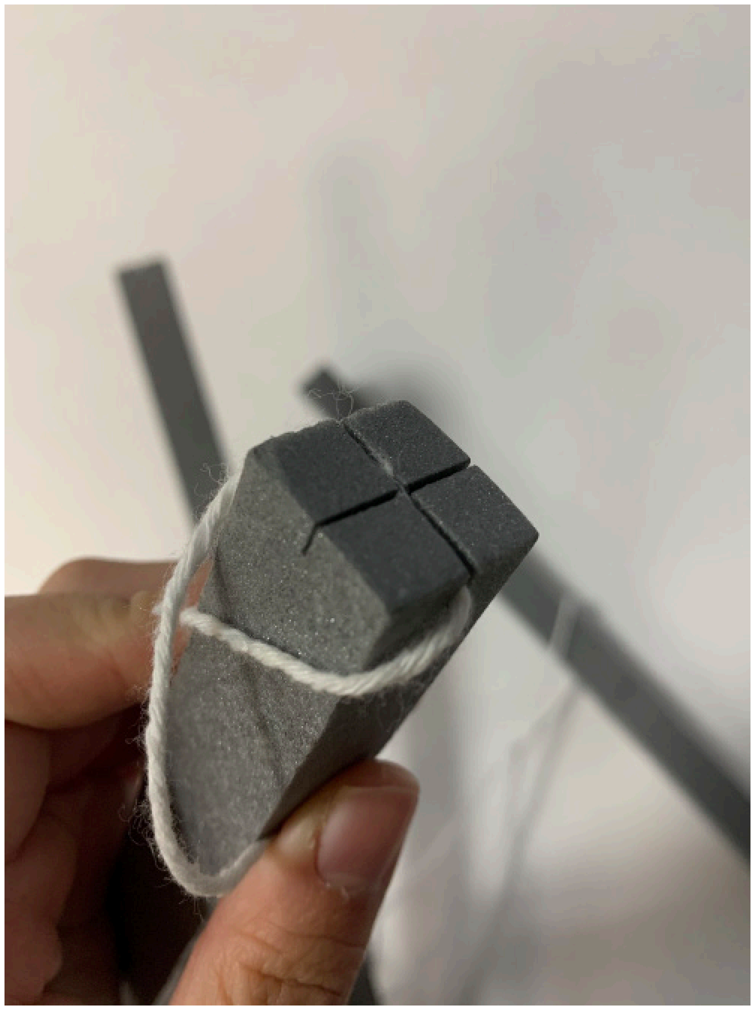
Evaluation:
Our design was unsucessful due to several reasons.
1.The hinge was too heavy for the strings to hold up therefore the inner structure will just drop down once let go.
2.The steel wire is not flexible enough to be pulled easily without getting stuck somewhere in the holes.

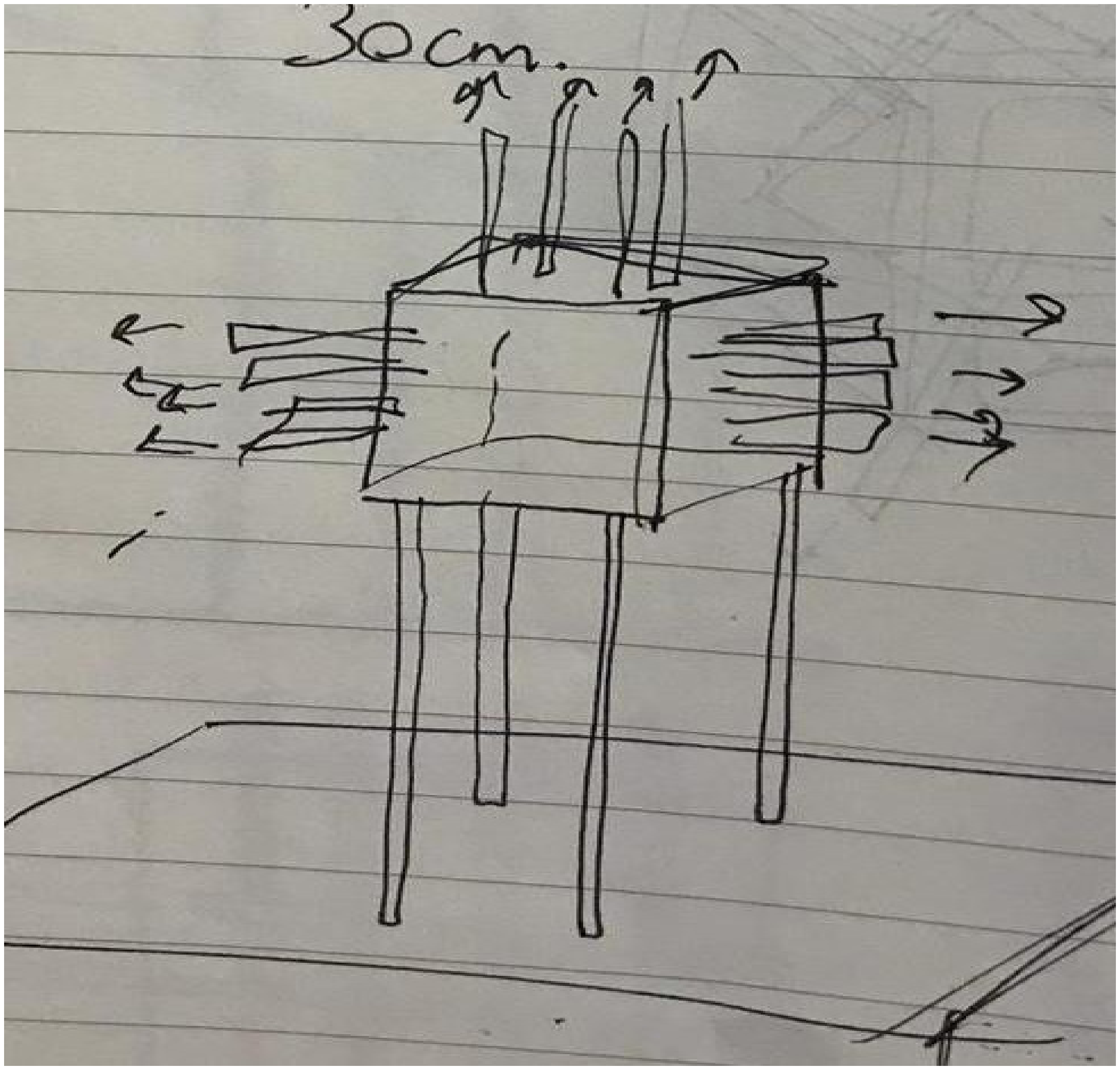


Design concept 2:
Knowing that the first concept was unsuccessful, we quickly came up with another idea, which is to only use the idea of tensegrity. We decided to make 4 pieces fo foam rods and put them diagonally on the faces of the 300x300x300mm volume space sides, then they will be stabilised and will be able to stand with the tensions of strings.

Evaluation:
Our first attempt of making the tensegrity was not very successful.
The hot wire machine was not big enough to directly cut the foam rod into the 420mm length. Therefore it had to be cut into two and joined together. The way we join it together is using copydex glue to join the 2 flat egdes of the rod. This caused the foam rod to collapse very quickly due to the rod itsel being unstable, after being pulled by the tension of strings.

What we can do better to improve this is perhaps to change the way we join the 2 foam pieces to form the rod. We can try using the boy girl structure to make the foam rod more secure. We also could merge the 2 different ideas that we carried out together.





Final design:
Our final idea is to challenge the stability of steel, the operation works around the density of foam. The process of going from a stable to unstable cube can be done as a game form. (Inital concept 3)
The arrow signs represent the direction you can pull the steel rods. The rods that come out from the sides are not continuous long rods, they are short rods that can be removed from each side. There will be the long steel rods that act as a balance, holding the foam cube in the air.

The structure is stable when all the rods are put in, it starts to lose stability when the horizontal rods are being pulled out one by one.

Our first cube was a 300x300x300mm foam cube and we decided to reuse/ recycle the interior foam. To make the 150cmx150cmx150mm 4th cube.

The process of showing stability and the opposite is in a game form.

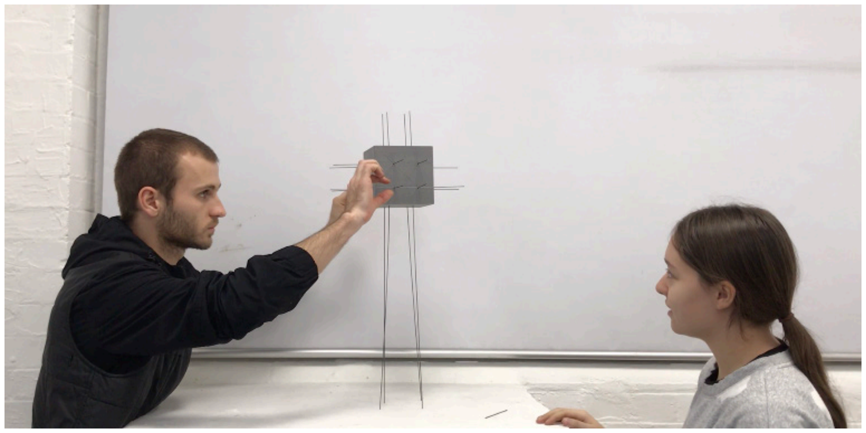
Rules:
This is a game for 2 or more players
Players take turn to pull out the horizontal steel rods until the structure completely loses stability and collapses. (Jenga -like game)

This game is to challenge the properties of steel and how it reacts to the tension and compression created by the weight of the foam, which is 87g.

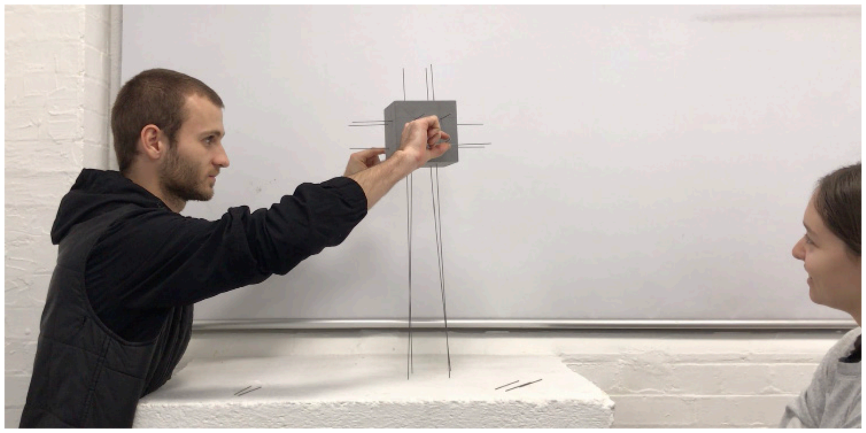
We did an experiment on different weights of foam and the results are shown below.

The “balloon frame” structure is held by the foam cube and the cube is held by the steel structure. Without the density and the weight of the foam the 1.57mm steel rods can’t stand and without the steel rods the cube can’t stand.

Weight (g)	200	150	100	90	80	85	86	87	88
Stretching (cm)	x	x	x	8	5	x	x	0.5	2
Results	collapse	collapse	collapse	collapse	Stable	Stable	Stable	Stable	Almost collapse



1



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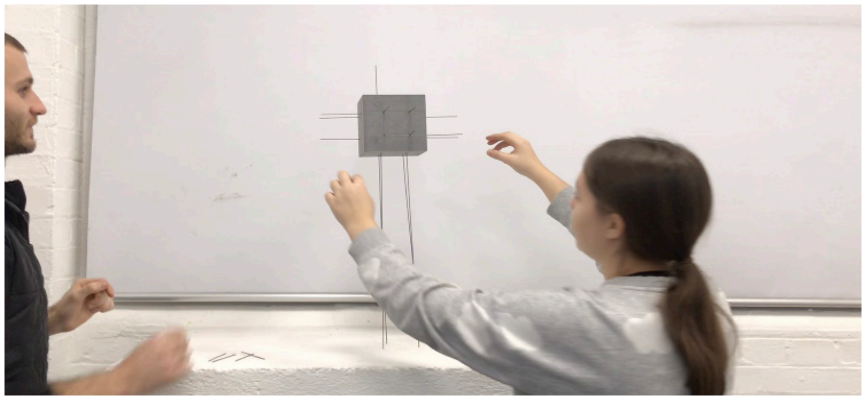

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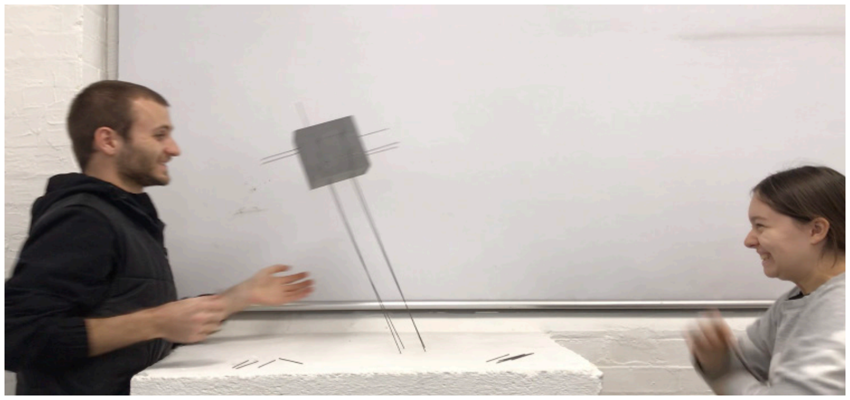
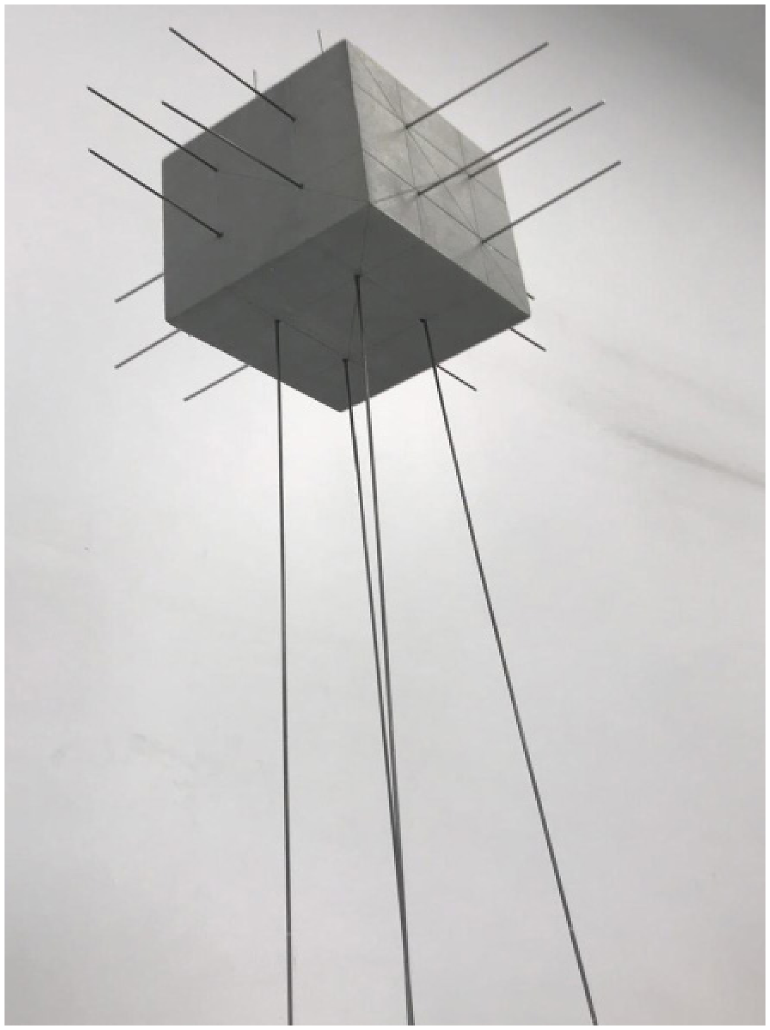


4

Screenshots of video of gameplay

1:1



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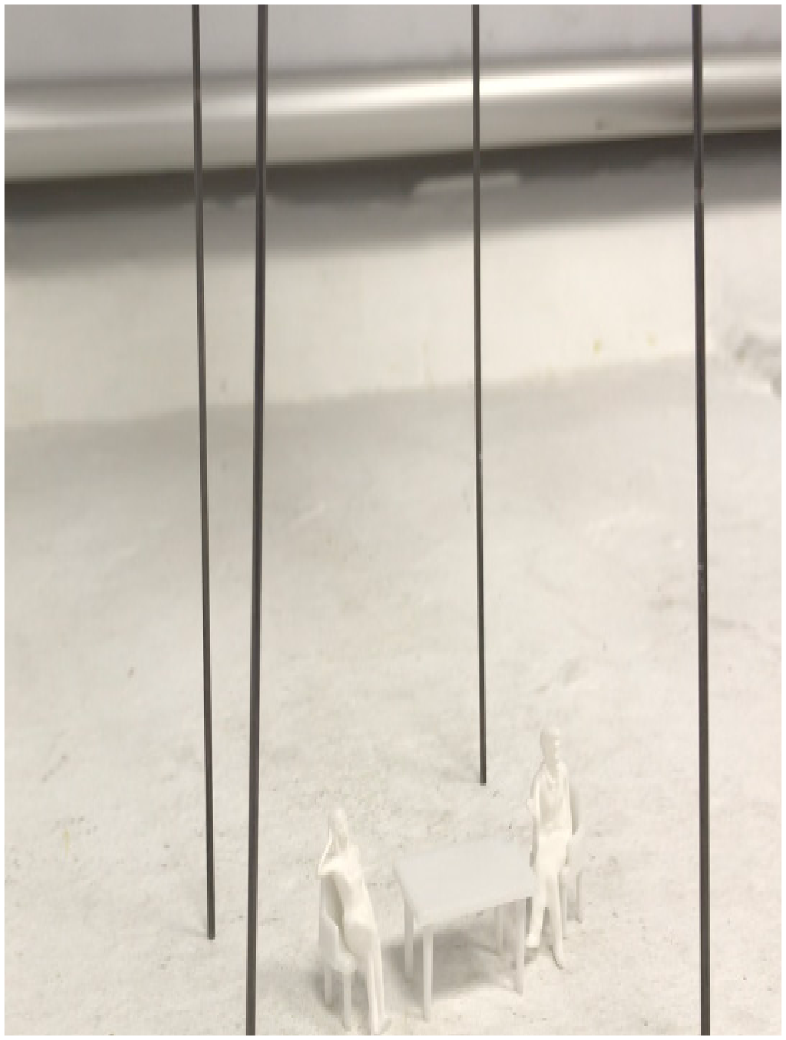

Evaluation:

We had several iterations for this corruption as our ideas were not developed enough.

Having done and attempted different designs, we in total looked at many different types of forms to show stability.

1. Using hinges and strings
2. Tensegrity
3. Tension and compression of steel

This corruption was a really good opportunity to learn about the different forms of stability even if some of our designs failed.

We chose the final design due to several reasons.

1. It is interactive
2. The transition from stable to unstable is very obvious
3. The concept and intention are clear