FILLING SPACE: GEOMETRY & CNC HOTWIRE CUTTING

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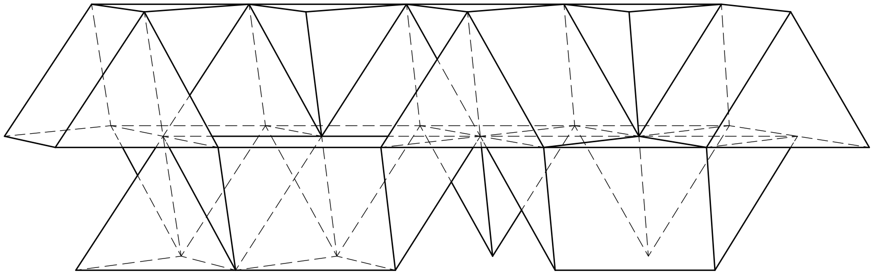
BY Jialin Lin

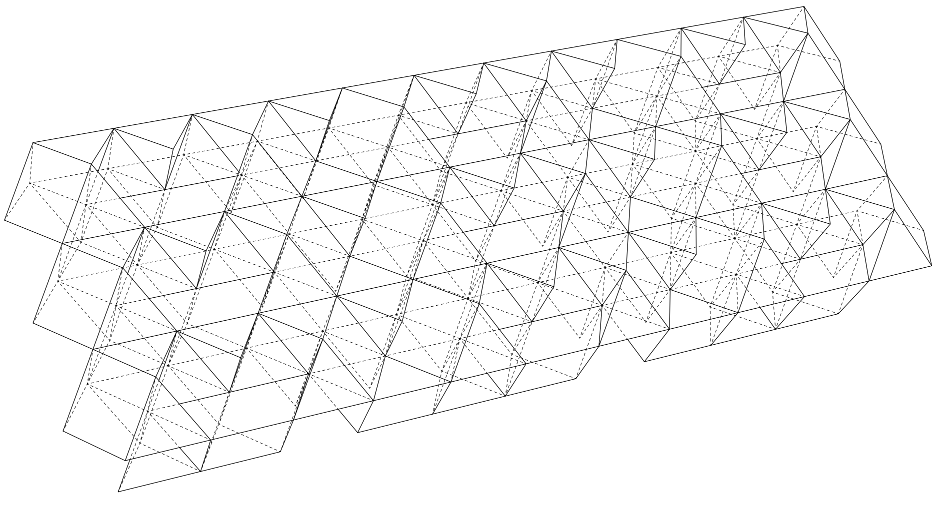
THE RESEARCH MODULE
WINTER TERM 2016/17

DIGITAL DESIGN UNIT
PROF. OLIVER TESSMANN

ANDREA ROSSI

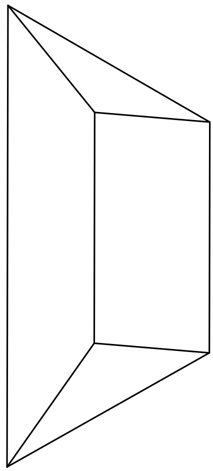


Unit



Structure

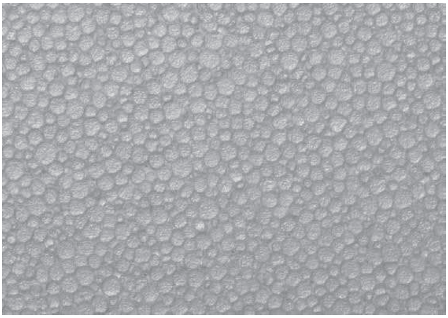
Abstract



Single geometry

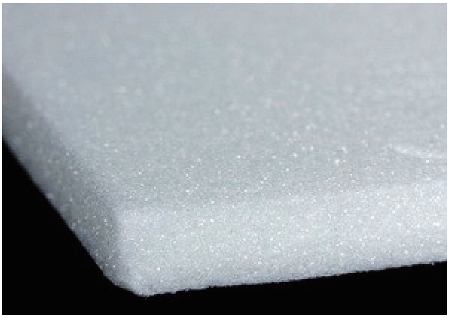
My topic is researching CNC hotwire cutting and come up with one space-filling geometry to build up a shelf for exhibition. Above is my final geometry. This geometry comes from the process when I cut the more complicated geometry. Since the machine has its limits and there are more errors in the complexer form, I just pull a simple basic form from my initial geometry. This basic form provides more possibilities and flexibilities than the previors one. And it can be cut more precise with CNC hotwire cutter. For Aggregation rules I did not number the surfaces to show the connections, because the connections do not all happen in the whole surface. The Aggregation will be showed in lines with different colours. The geometry are the same, but different colours mean different possitioning of the geometry.

Foams suitable for hot-wire cutting:

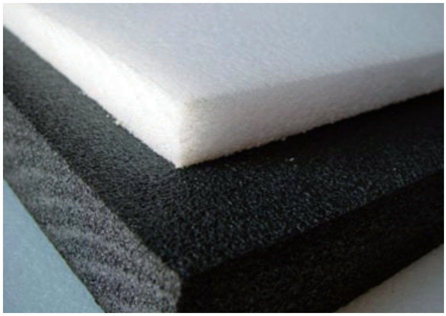


Expanded polystyrene

Extruded polystyrene

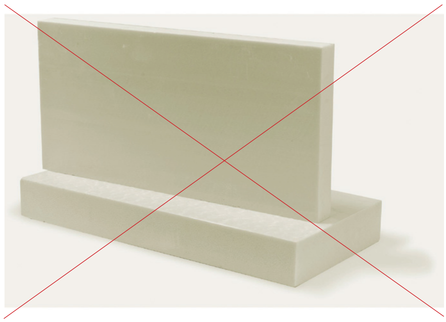


Polymethacrylimide low density rigid foam (very expensive)



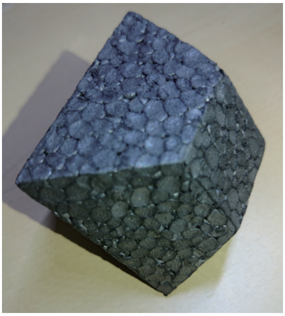
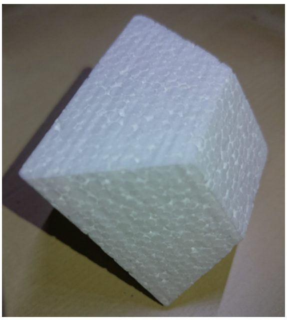
Polyethylene foams

PU convoluted foam



Polystyrene rigid foam foam

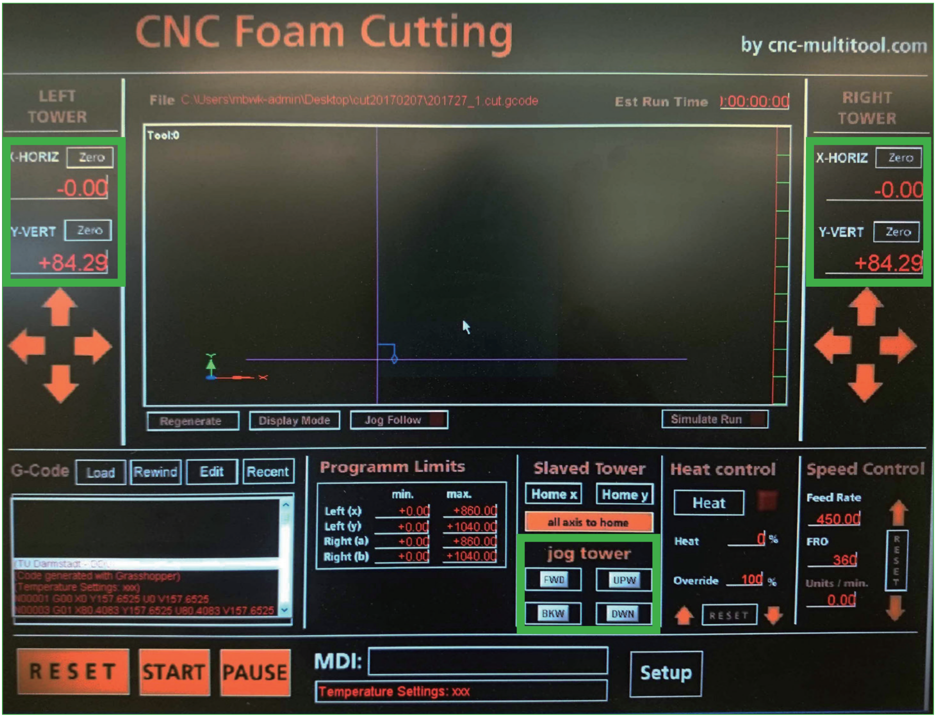
Suitable temperature and speed (Midterm results)

Type	Temperature	Speed
	48	360
	51	360
	53	360

* The speed and temperature should be ajusted also according to the size of the aimed figure and the degree of the angle. Because when it‘s big enough, the error could be neglected and it could speed up. The size of the tested figure above is 25*32*55 mm. The difference between different sizes will be showed on the following pages.

CNC Hotwire Maschine

How to use CNC Hotwire Maschine



1. Open the programm and make sure you choose the foam cutting one.

2. Turn on the maschine. Move all tower back to the start point and then point the number of all the towers back to 0.00. (See the green blocks)

3. Upload your cutting route file and check it on the screen to see if the cutting route is right.

4. Put the foam on the start point in the maschine. Turn the hitting controll on and set the temperture right (the two on the left). Wait for the temperture to be stable and point : Start!

* When you finish cutting, turn the hitting controll off before you touch the foam.

Space-filling Geometry samples

The bisymmetric hendecahedra

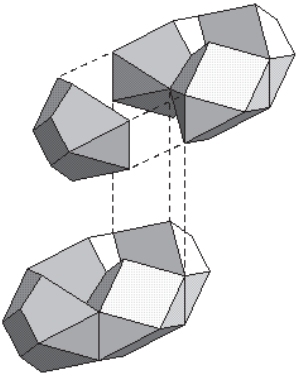


Fig. 2 The hendecahedra form inter-locking hexagonal "boat" shapes.

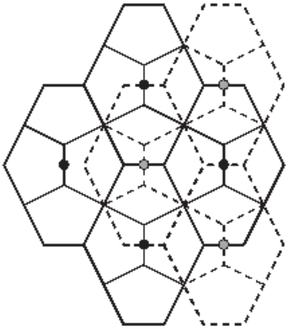


Fig. 3 One layer (dashed) over another, showing the centre of each translation unit.

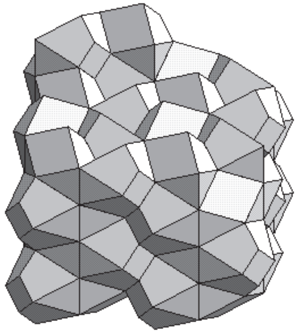
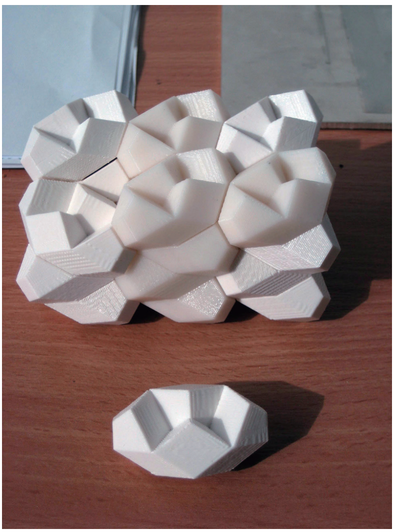
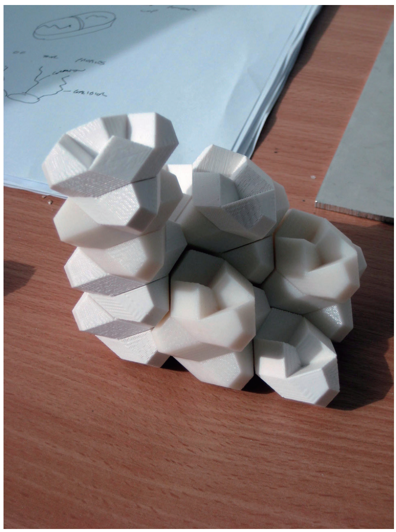


Fig. 4 A general stack.

(http://www.steelpillow.com/polyhedra/five_sf/five.htm)

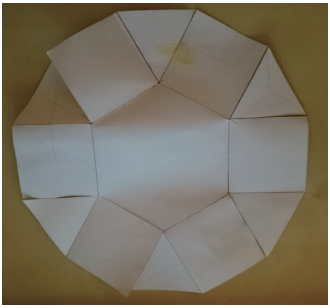


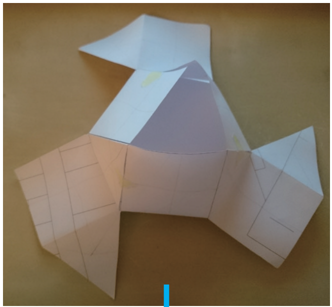


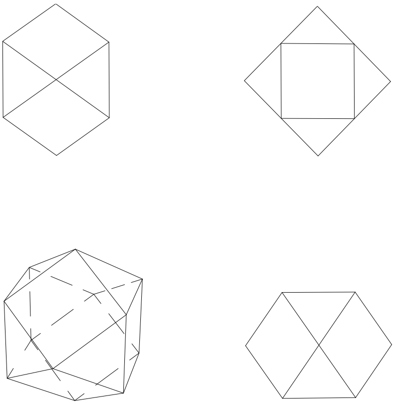
(Google image)

Space-filling Geometry G1

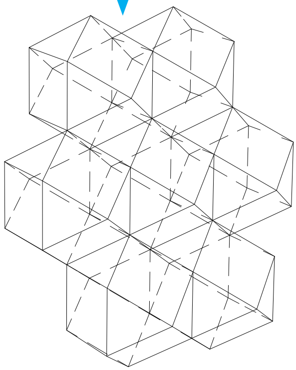
regular Dodecagon: Triangle + Square + Hexagon





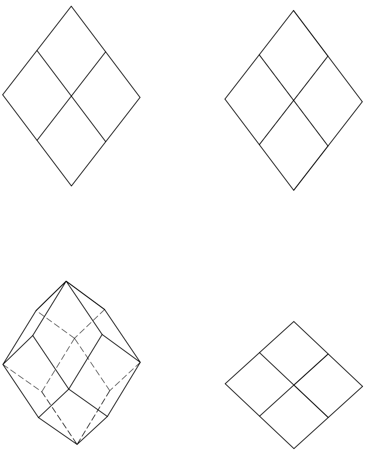


Views

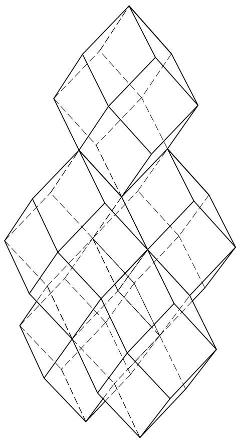


Aggregation

Space-filling Geometry G2

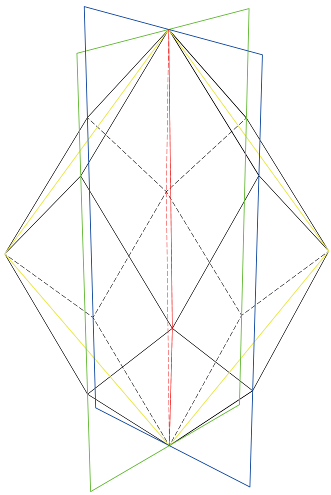


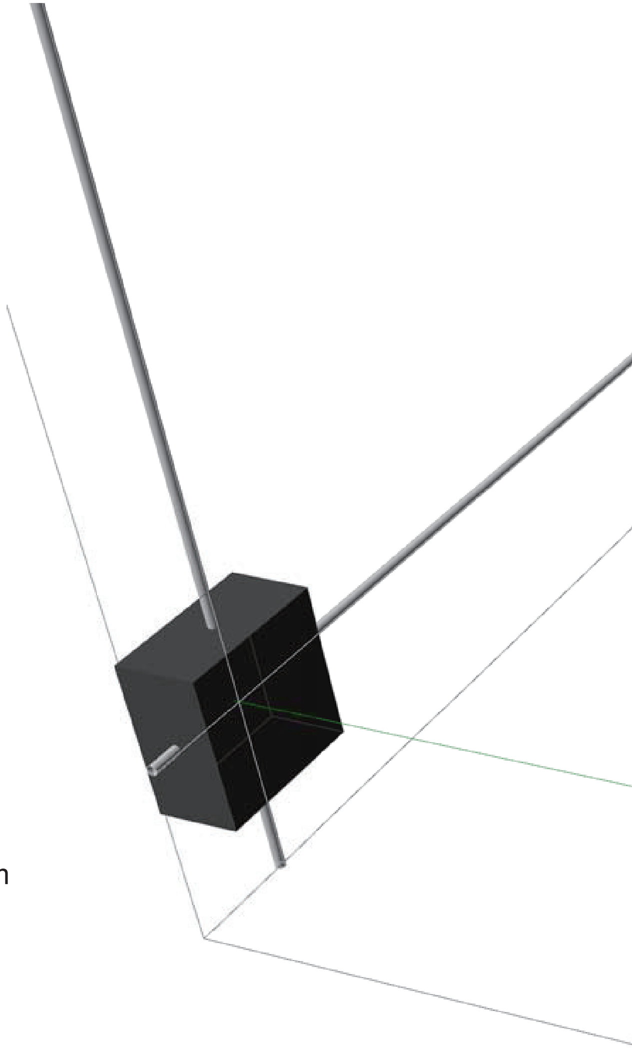
Views



Aggregation

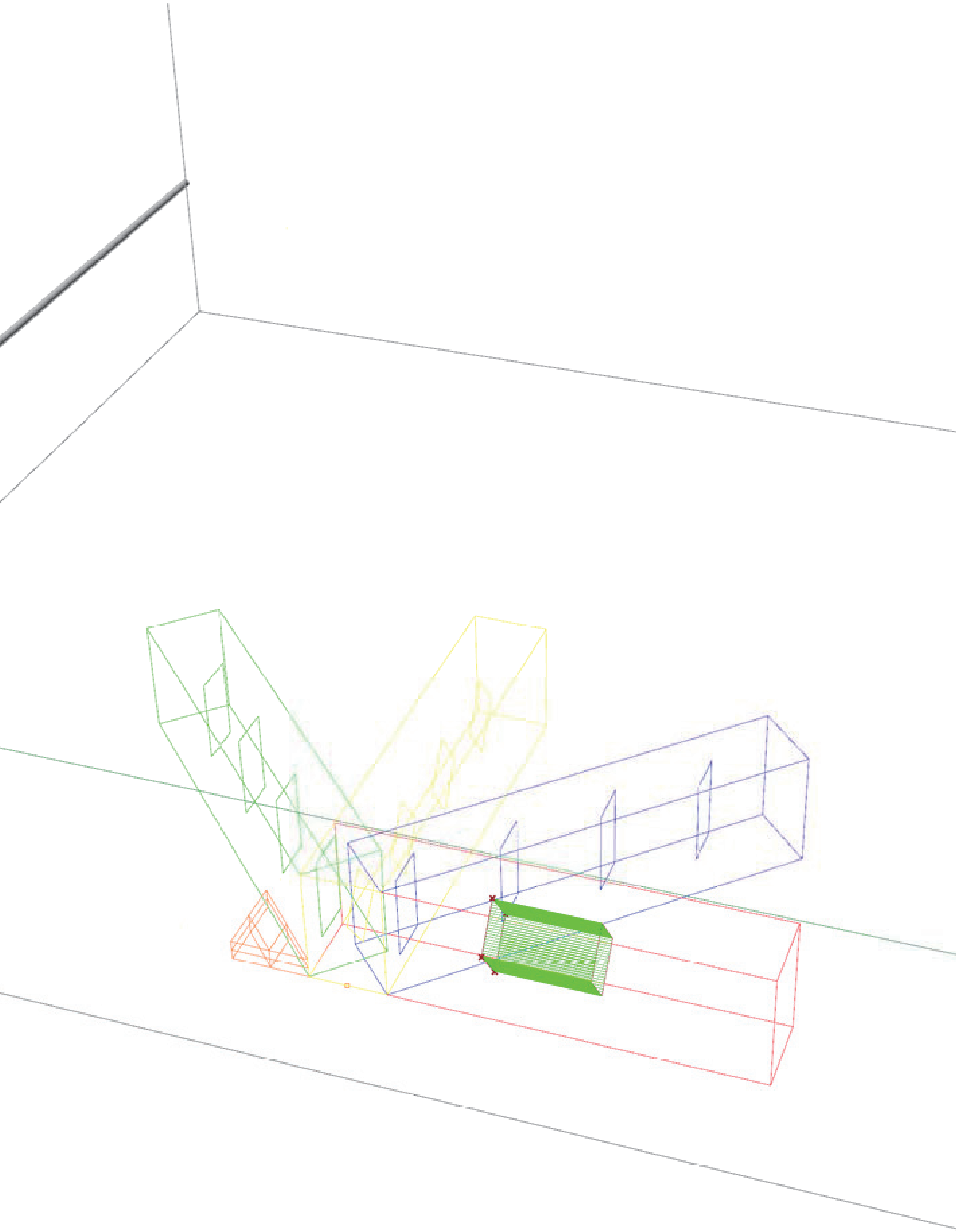
Cutting Test with G2



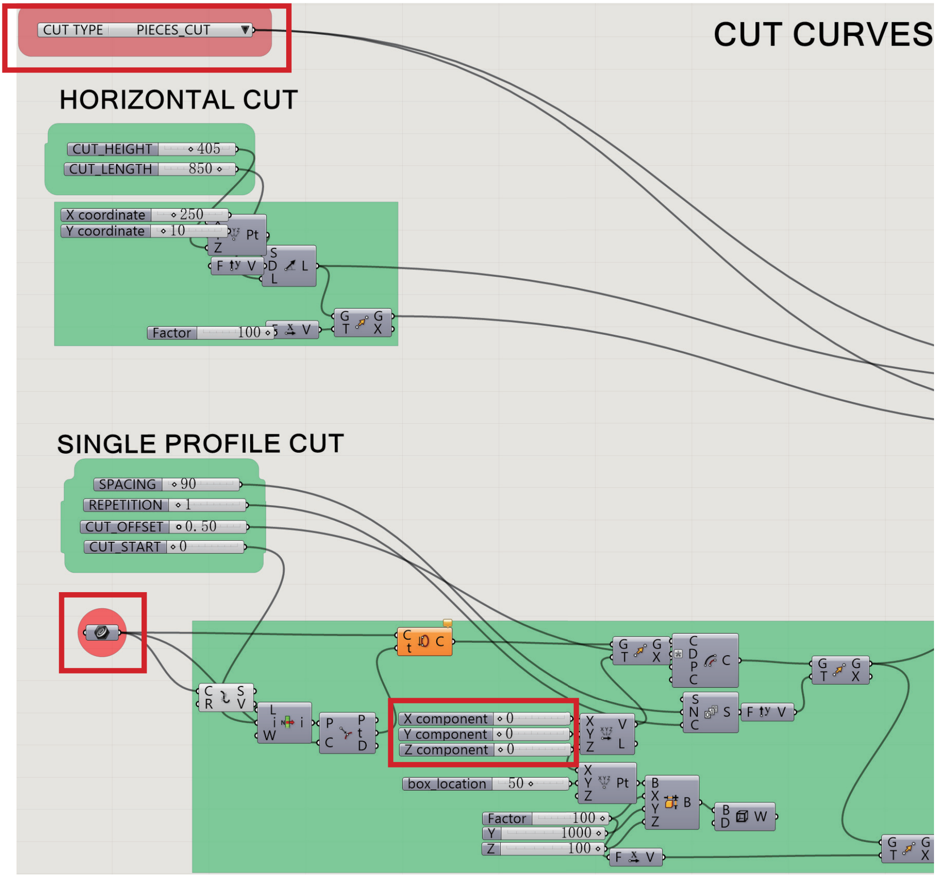


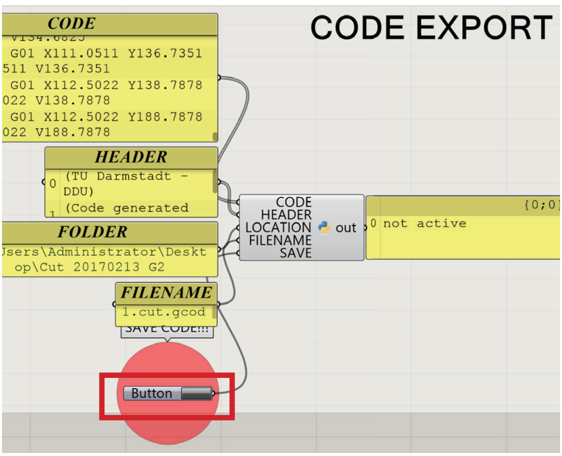
- 1. Cut
- 2. Cut
- 3. Cut
- 4. Cut

* The size of the cutting foam must be measured and the scene canbe simulated in Rhino before you put them in GH.The volume should be turned 45° between each cut. (a single tool with 45° angle and the width of the cutting foam could be helpful to set the cutting position) The cutting lines should not go through the same surface twice. Make sure that the central axis will not move.



Cutting Test with G2

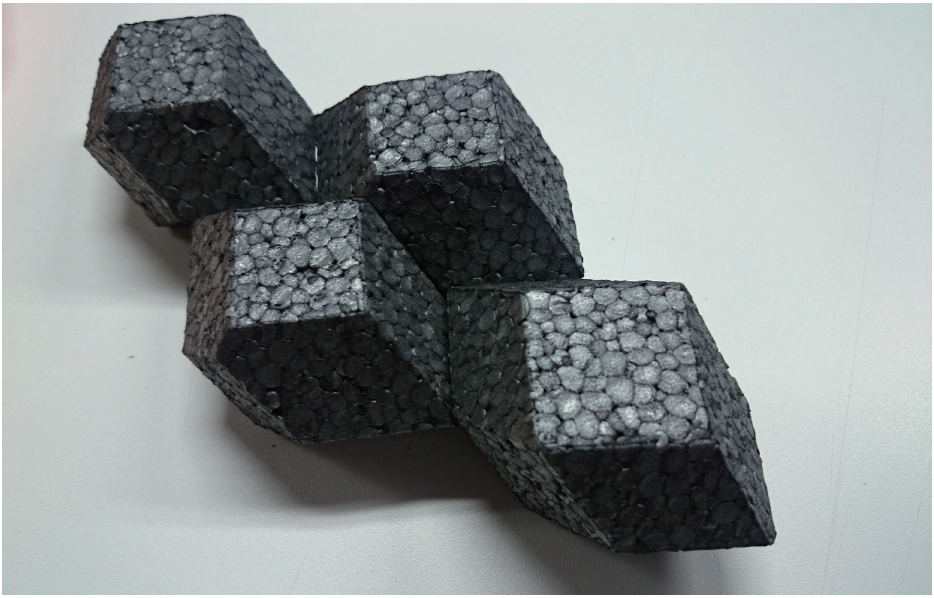




1. Cut type: Pieces cut
2. Set curves
3. Save route

Cut #01 30*42.5 mm

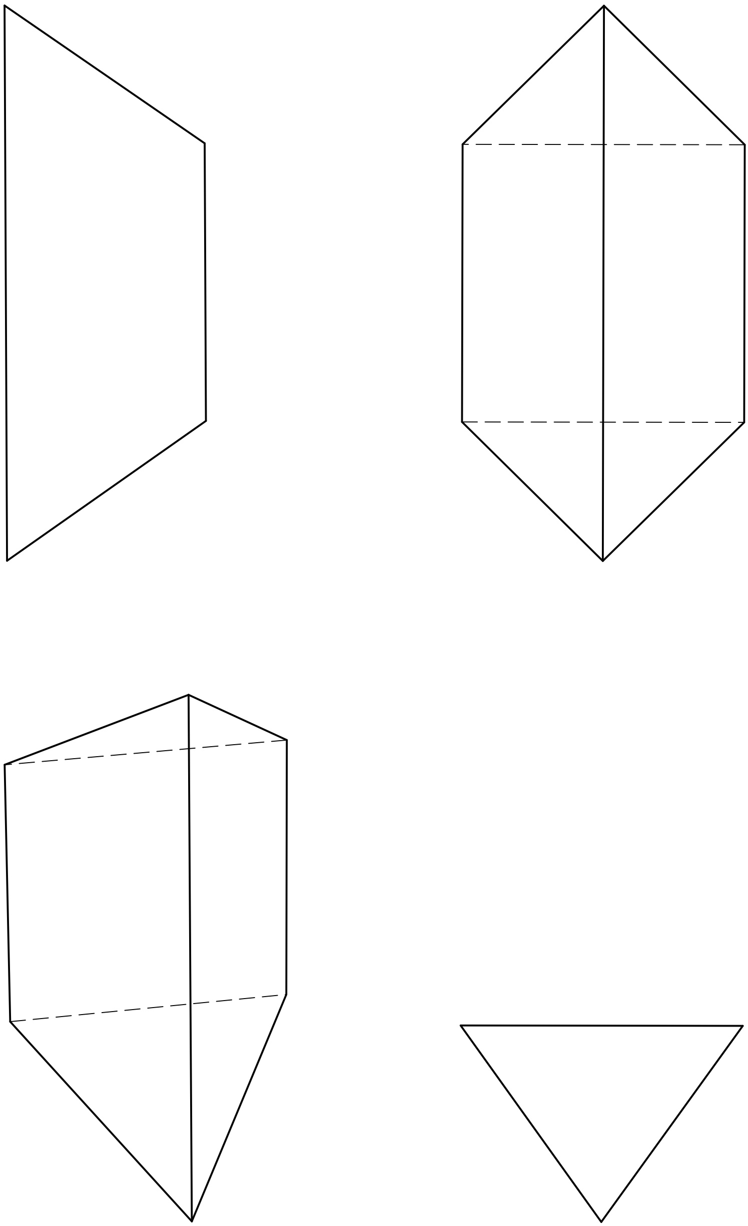
Cut #02 60*85 mm



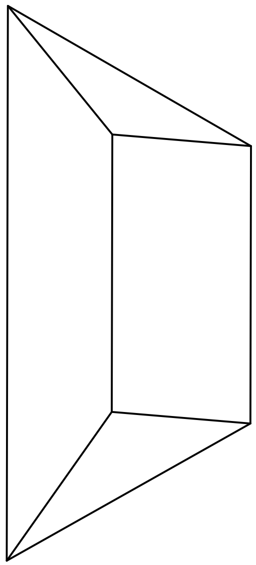
* The test of cutting G2 in different size shows the importance of the size in CNC hotwire cutting. The bigger the figure is, the more presice you can get. When it‘s really small, then 1mm is almost part of your figure, and this error will make your form change.

Space-filling Geometry G3

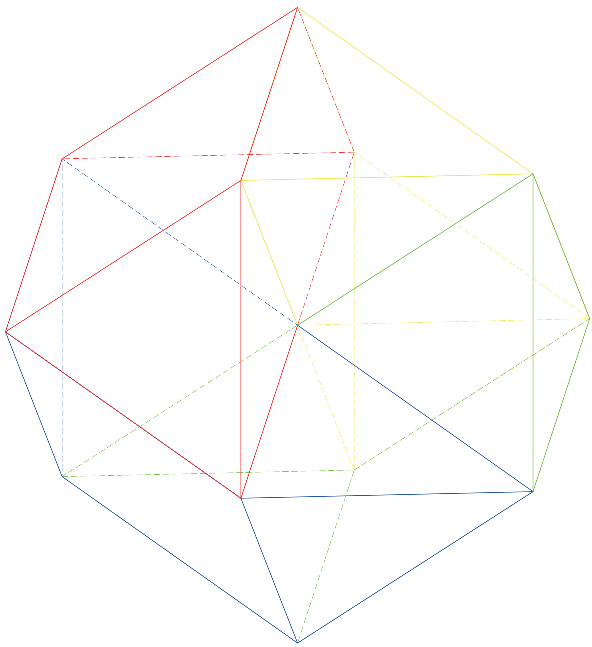
Views



Axonometry

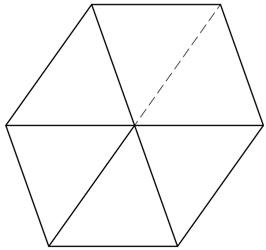


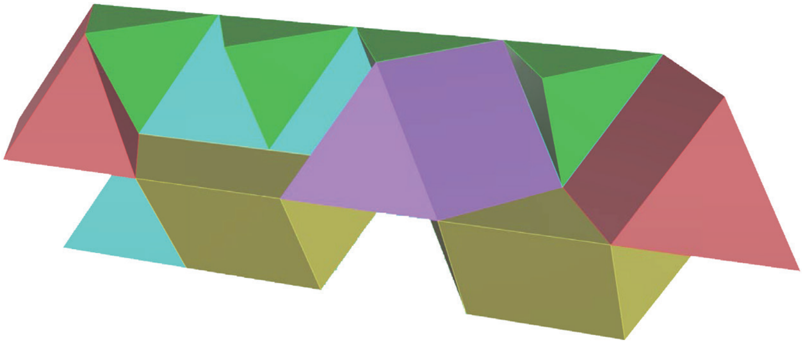
Aggregation #01

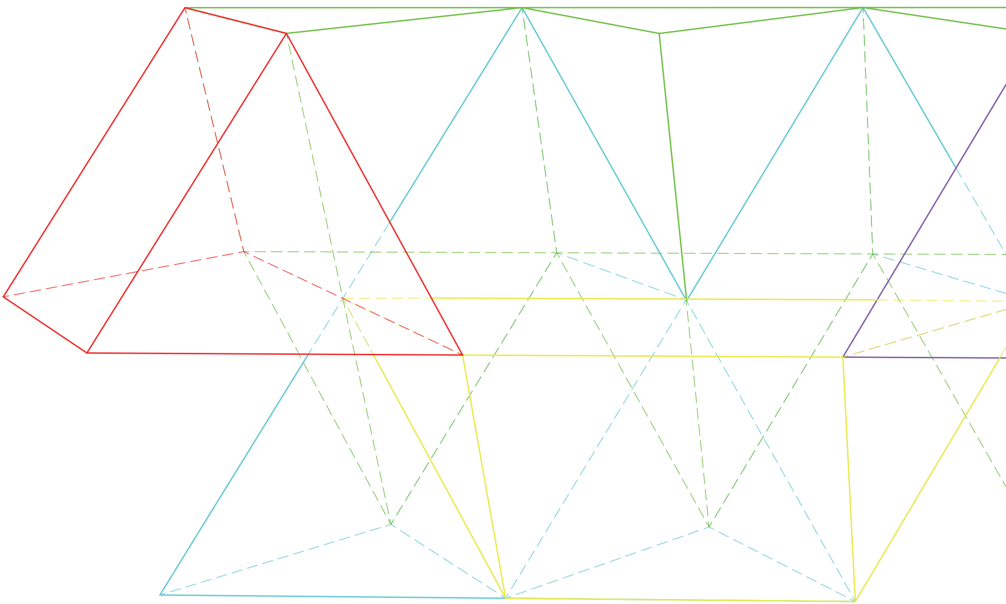


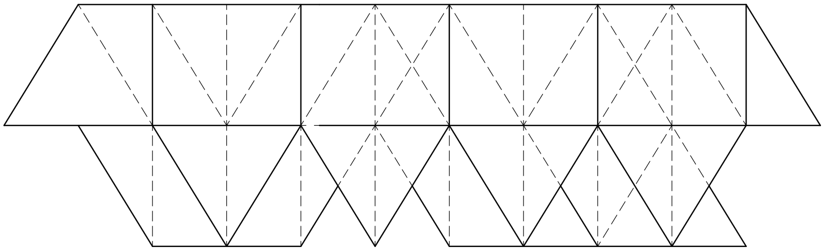
Space-filling Geometry G3

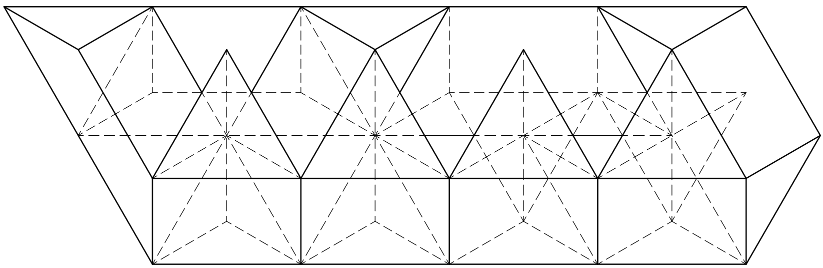
Aggregation #02

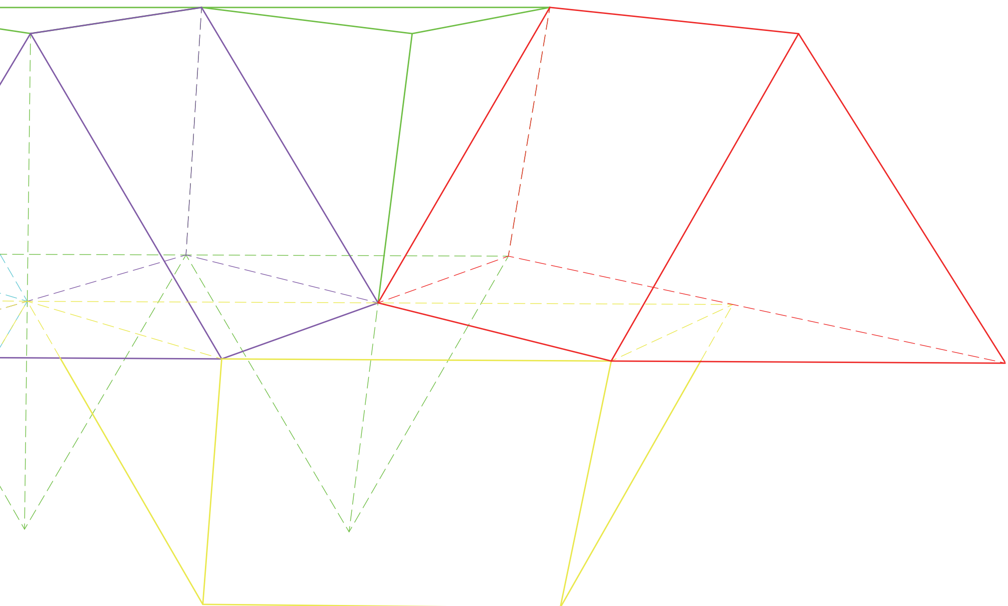












Space-filling Geometry G3

Aggregation #02 Construction of the shelf