

ARUP AGU

GENERATIVE GEOMETRIES
AND STRUCTURES

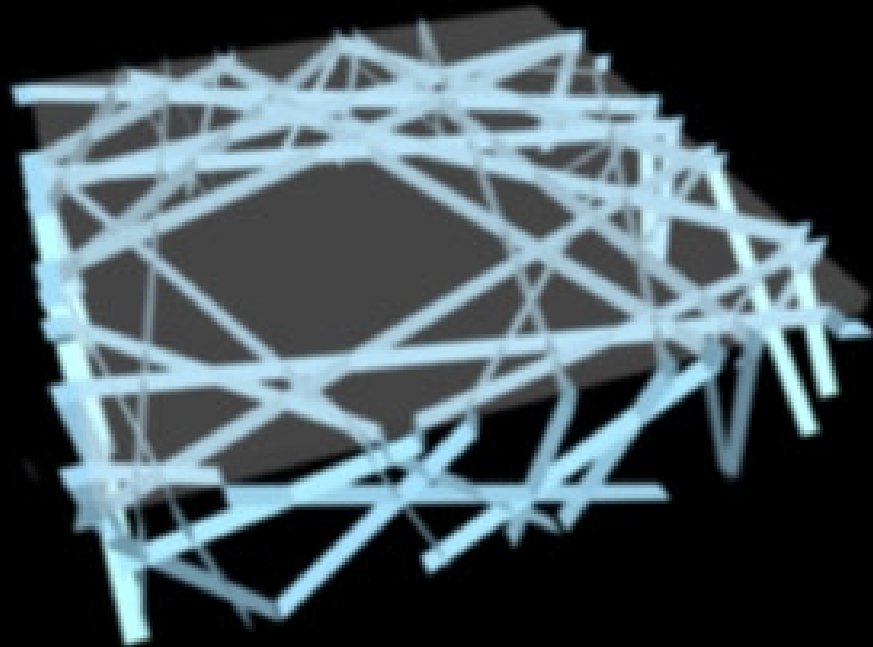
FLORIAN GAUSS

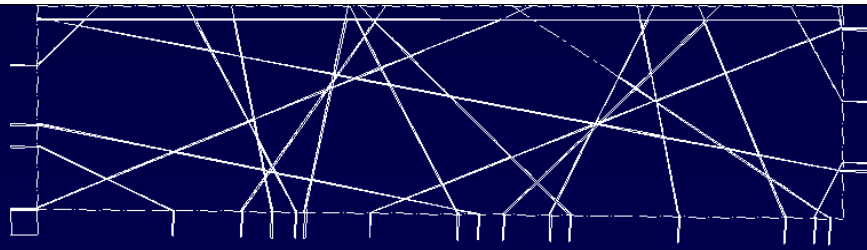
SERPENTINE PAVILION 2002, LONDON



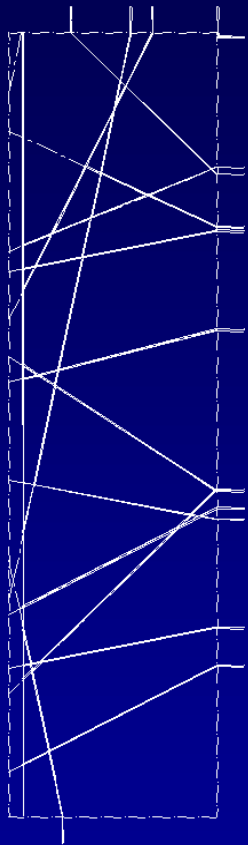
ARUP AGU



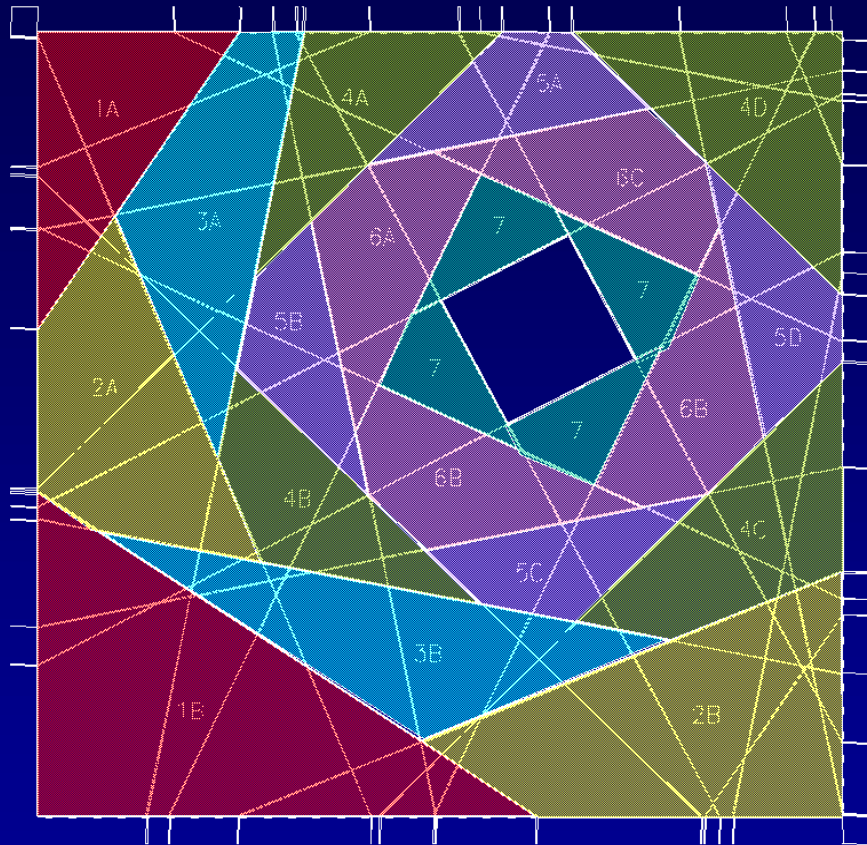




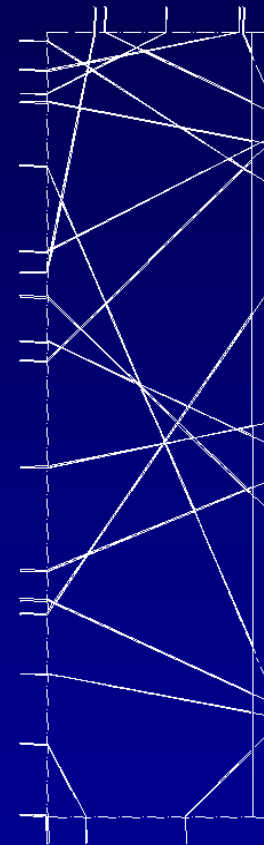
Wall A



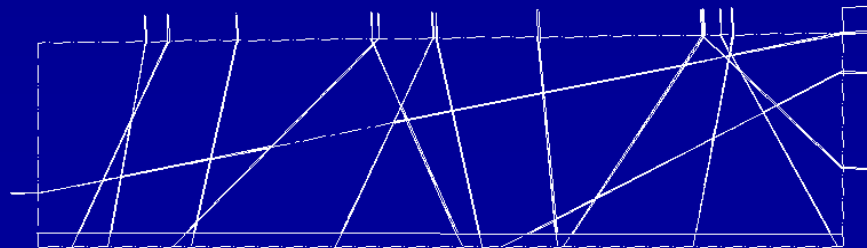
Wall B

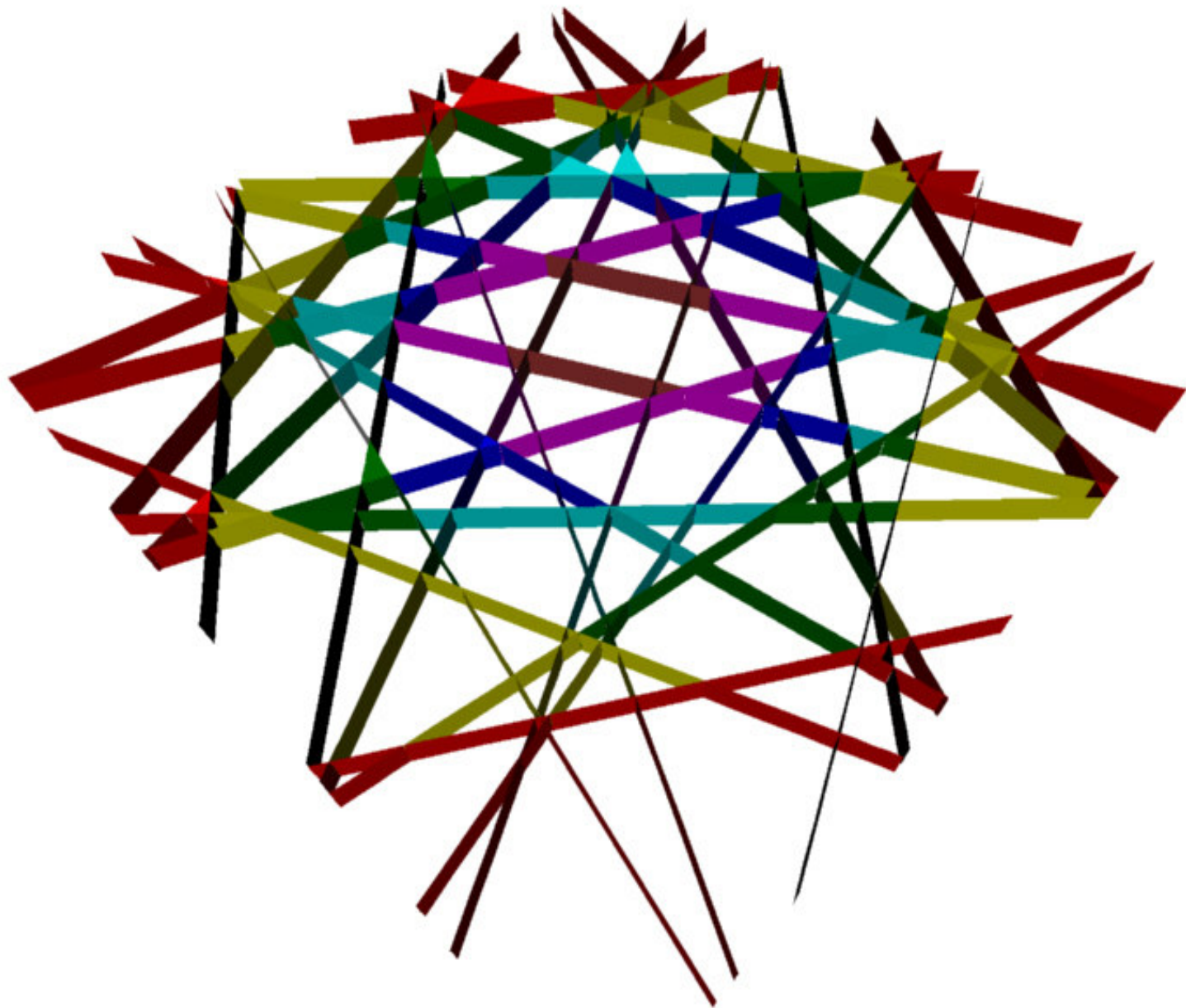


Roof Plan



Wall D



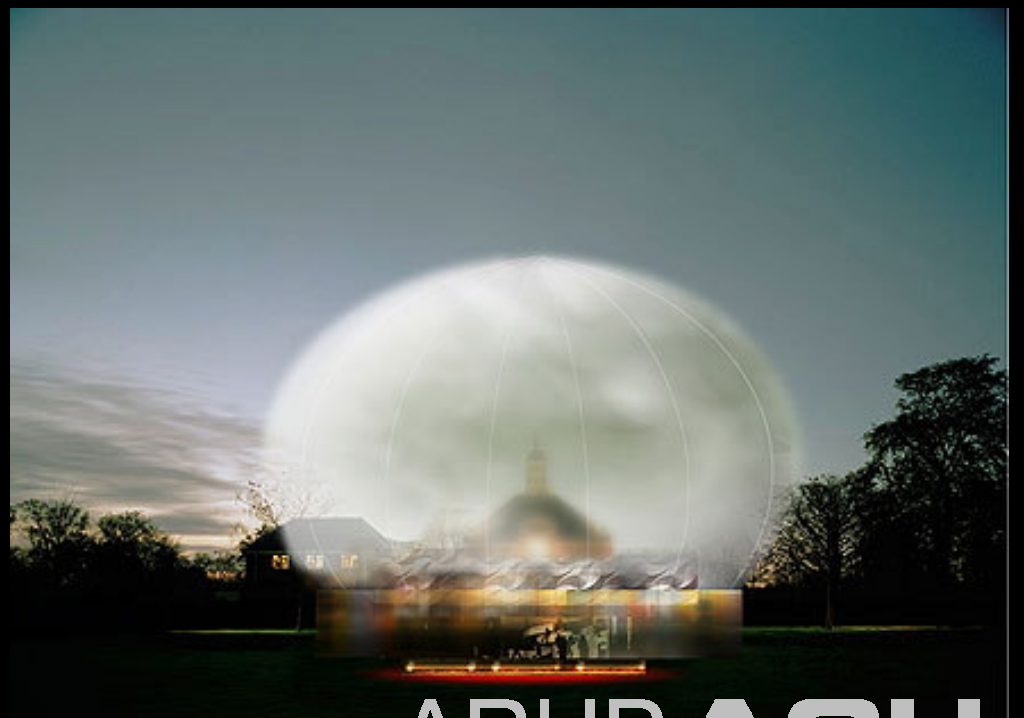




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V&A SPIRAL, LONDON

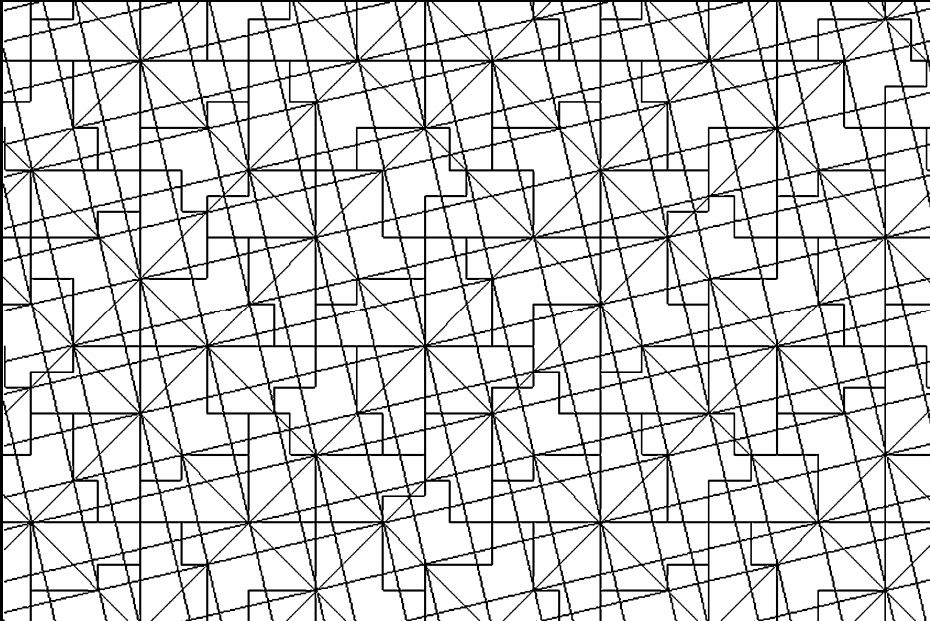
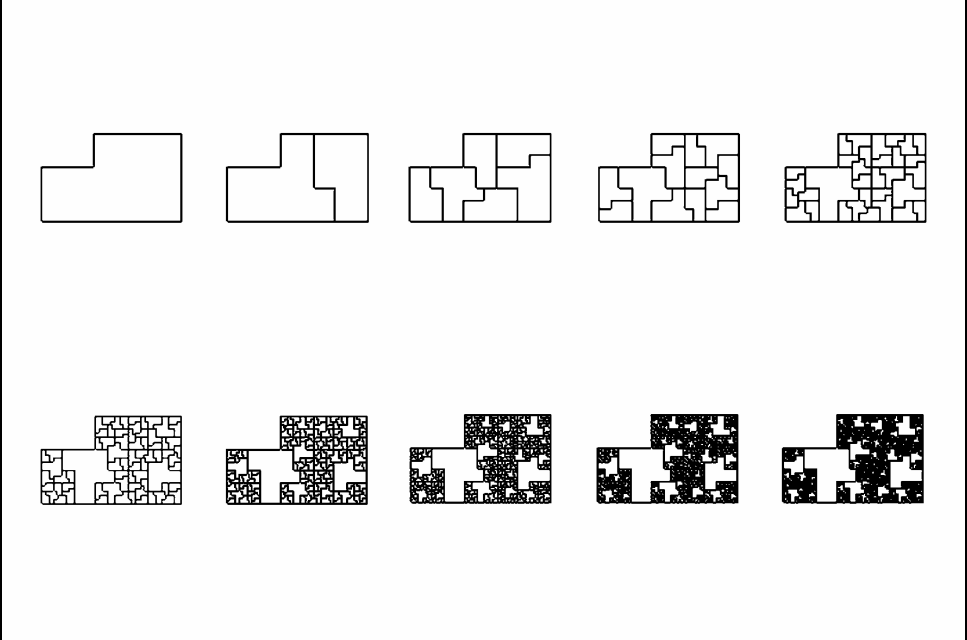
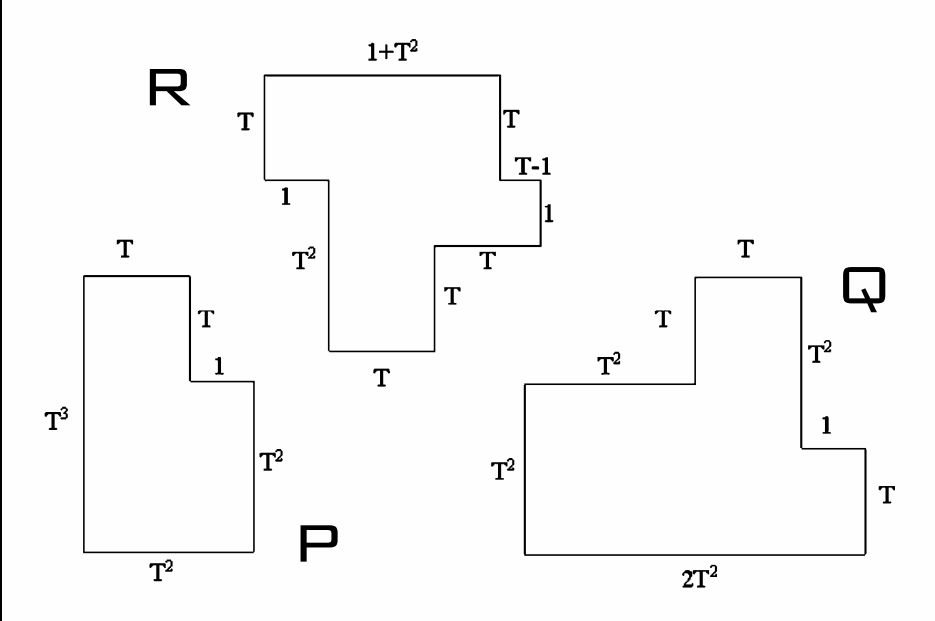


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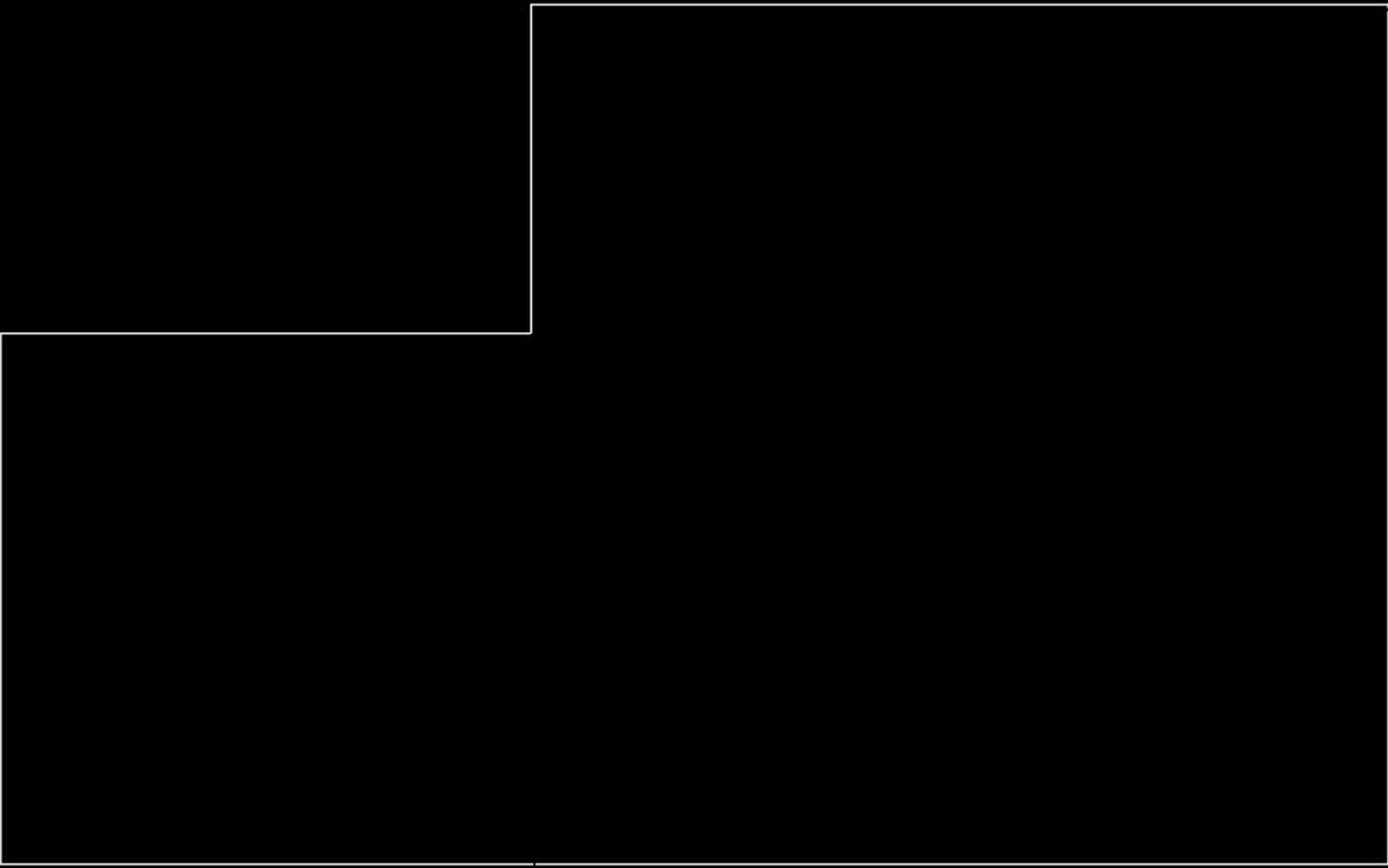


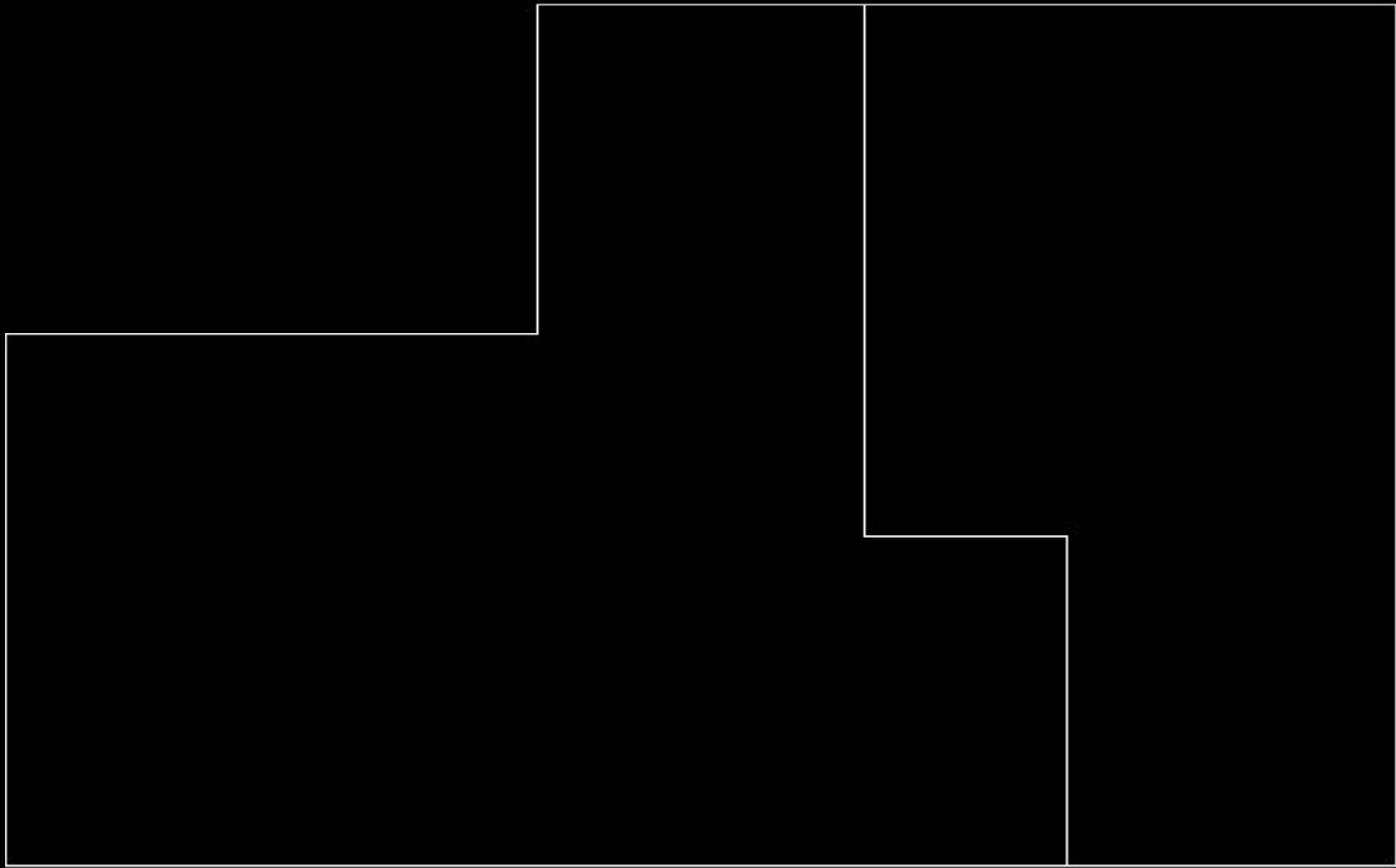
ARUP AGU

2 - D AMMAN TILING

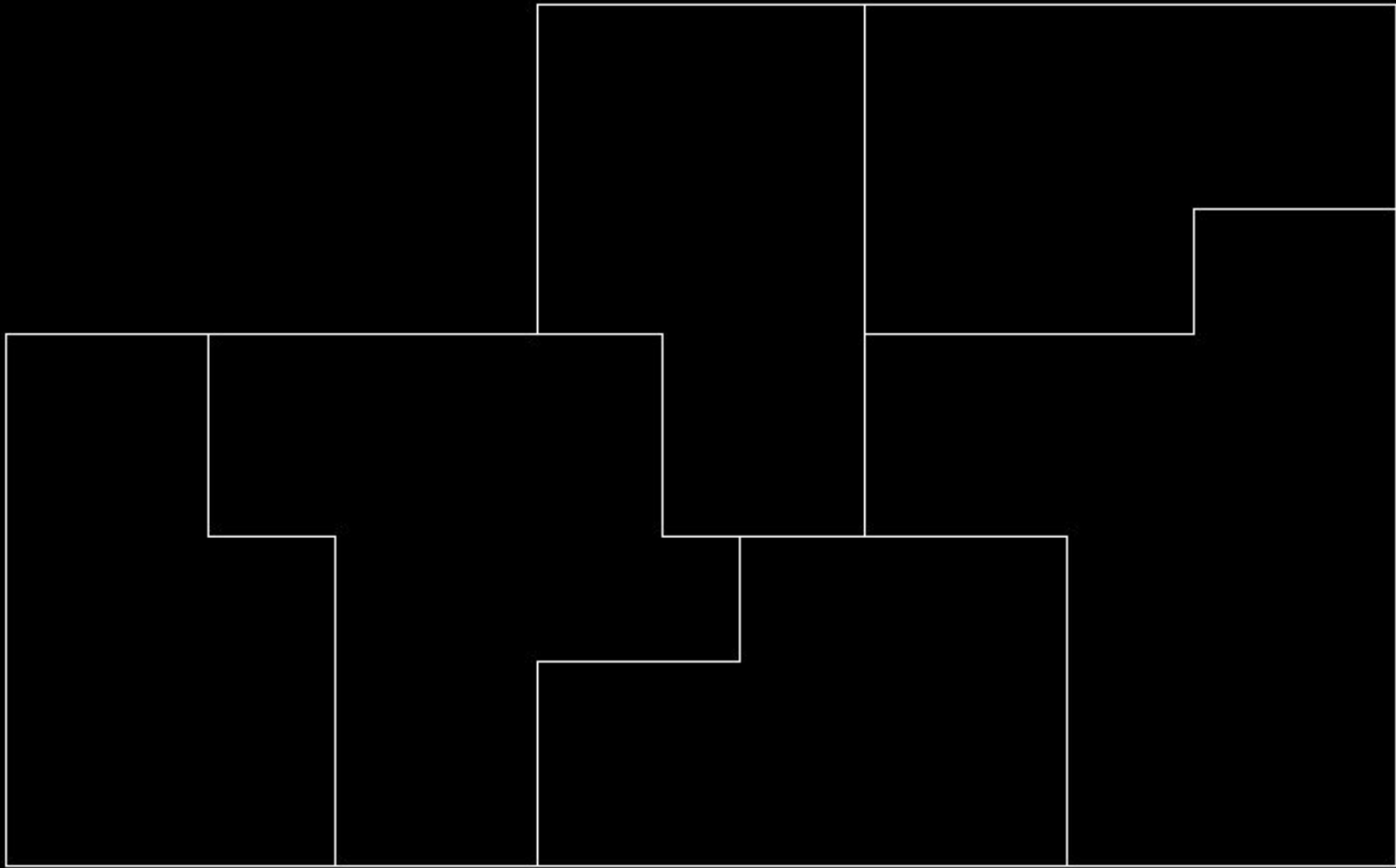


2 - D AMMAN TILING

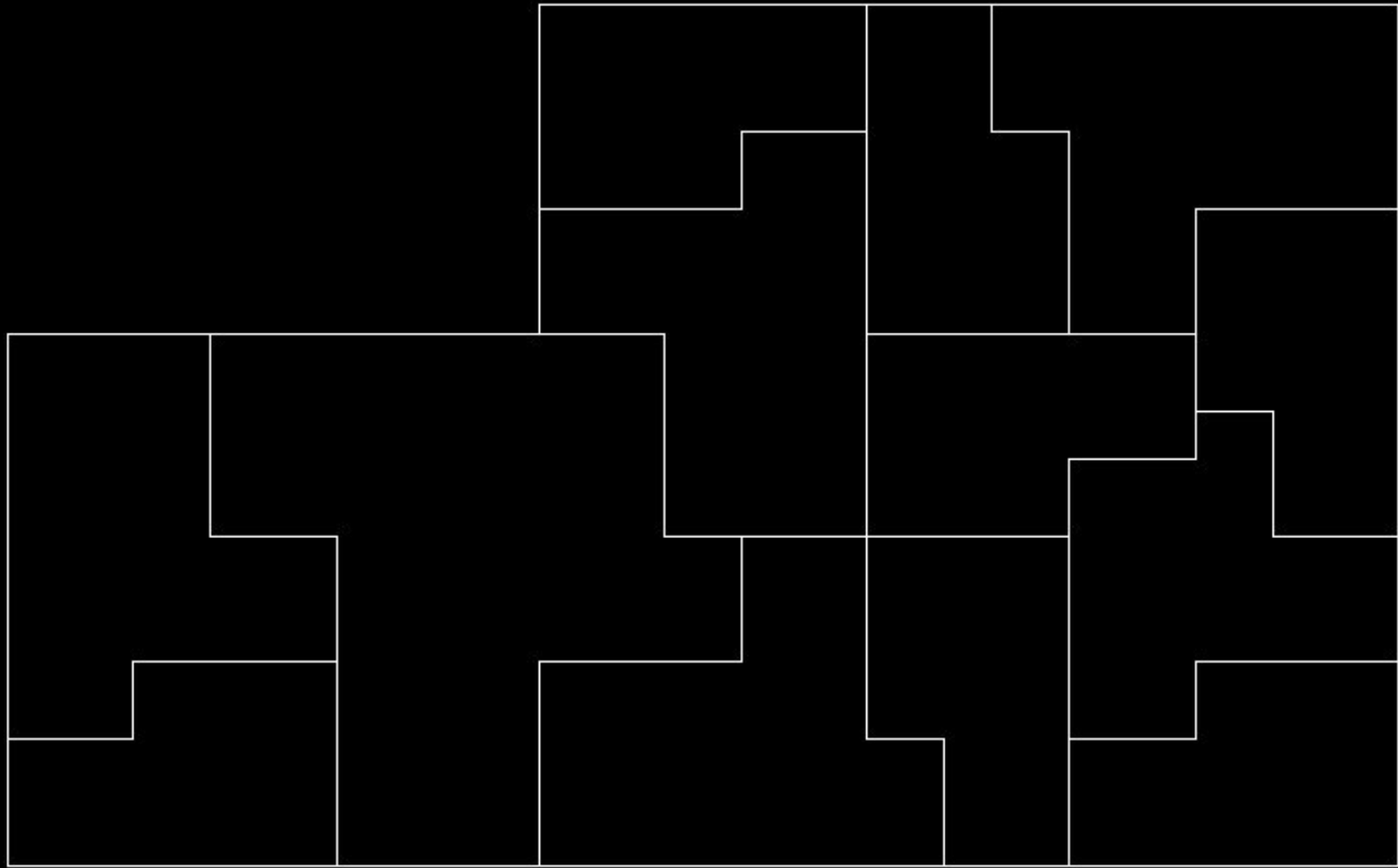


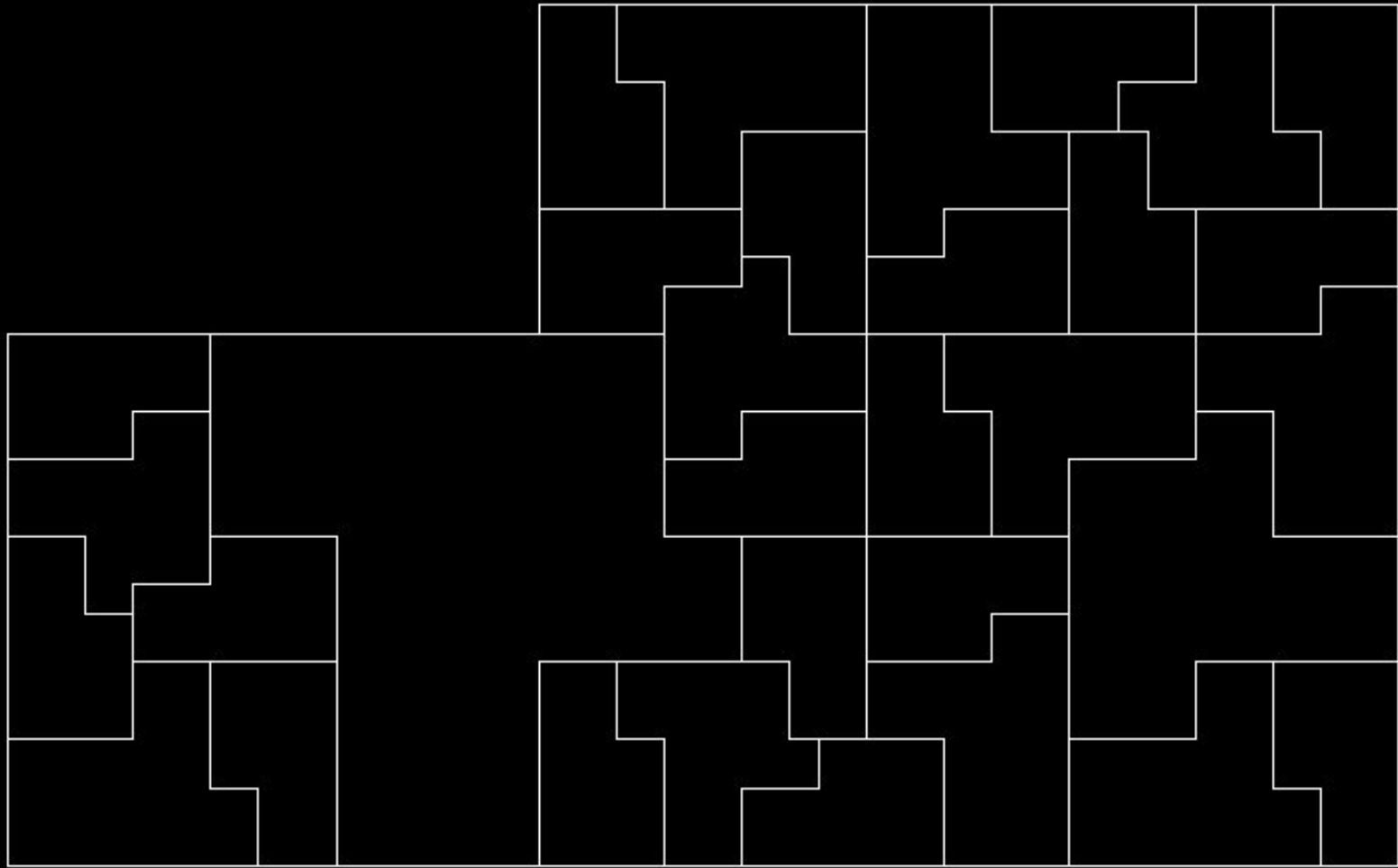


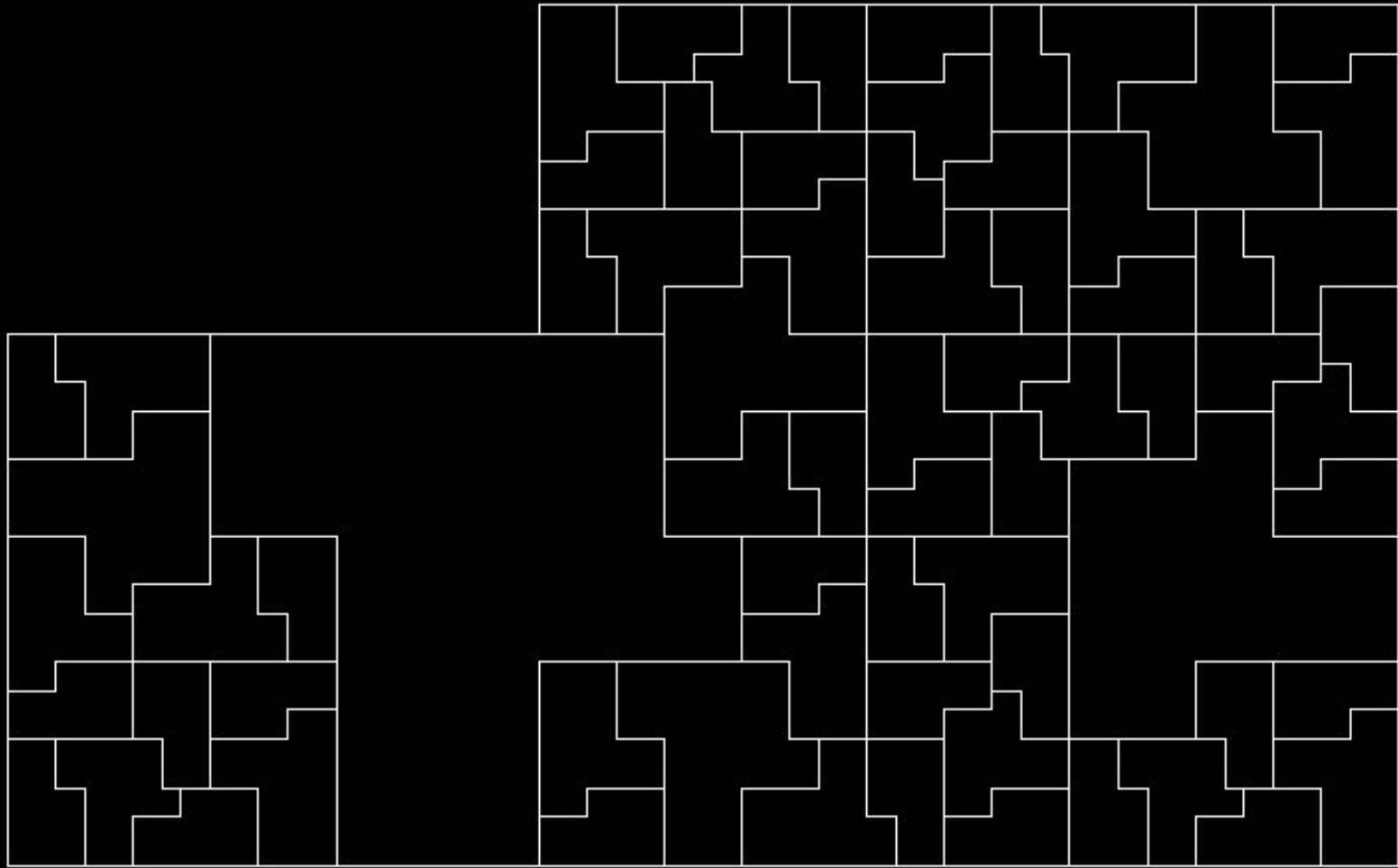
ARUP **AGU**

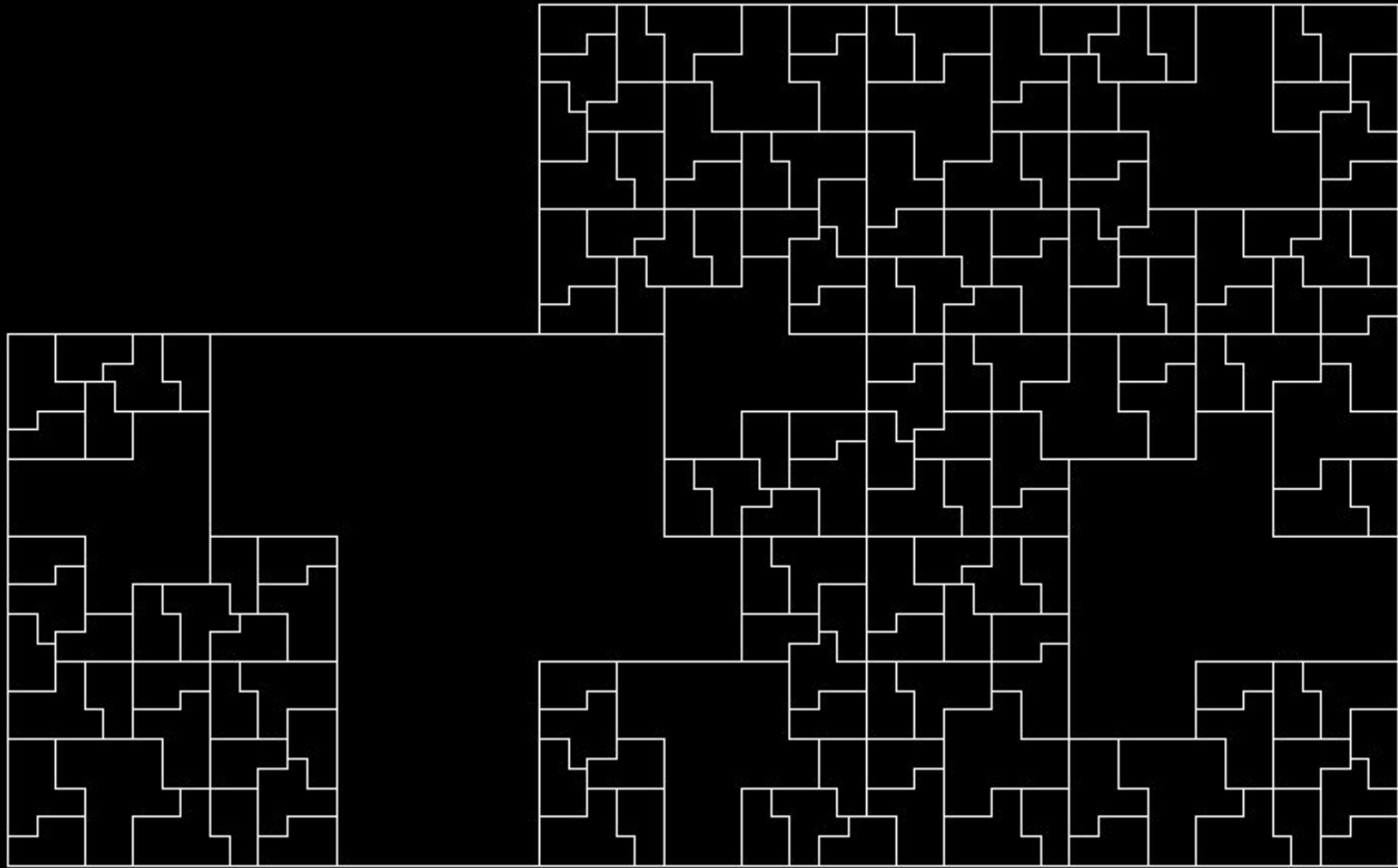


ARUP **AGU**

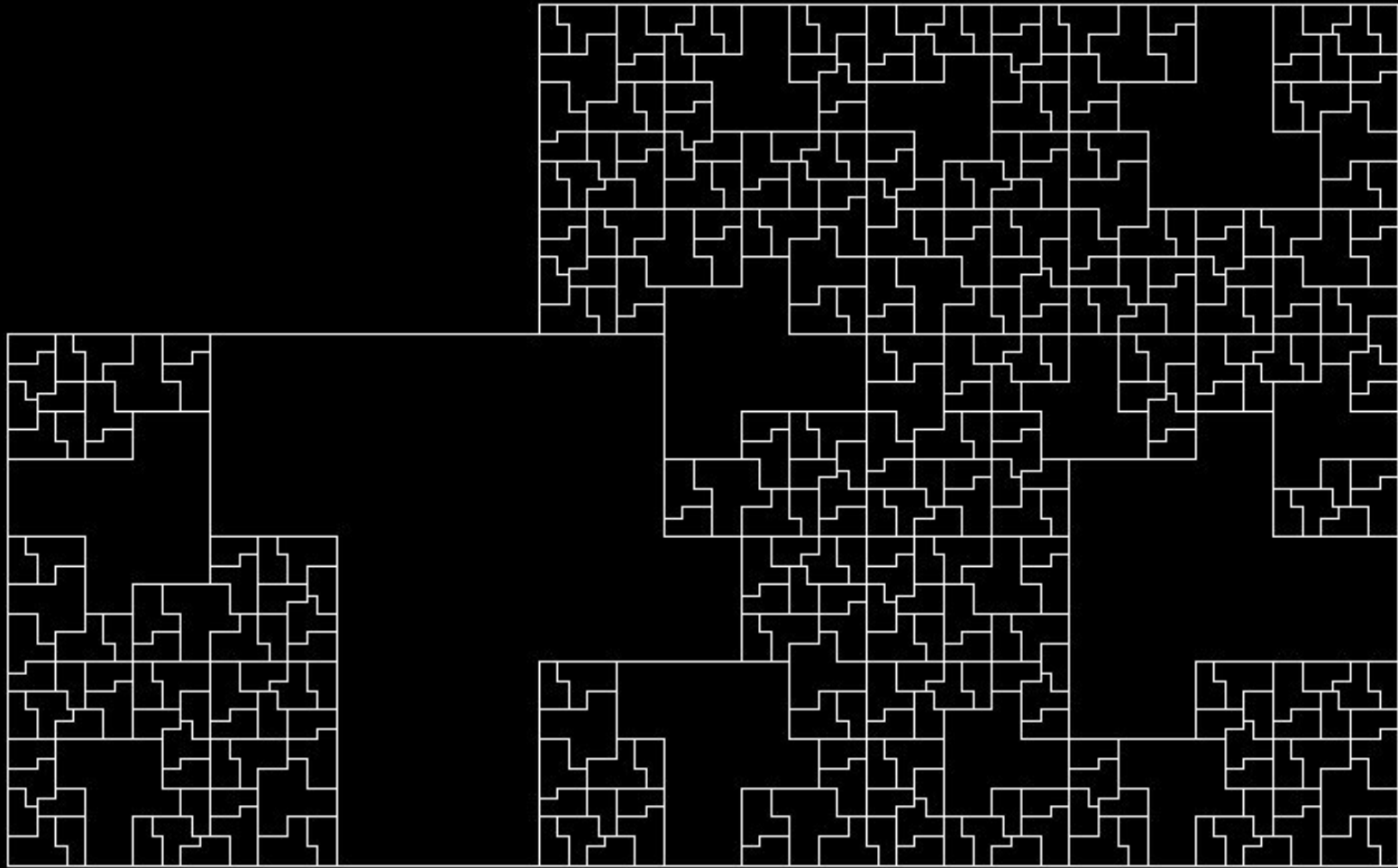




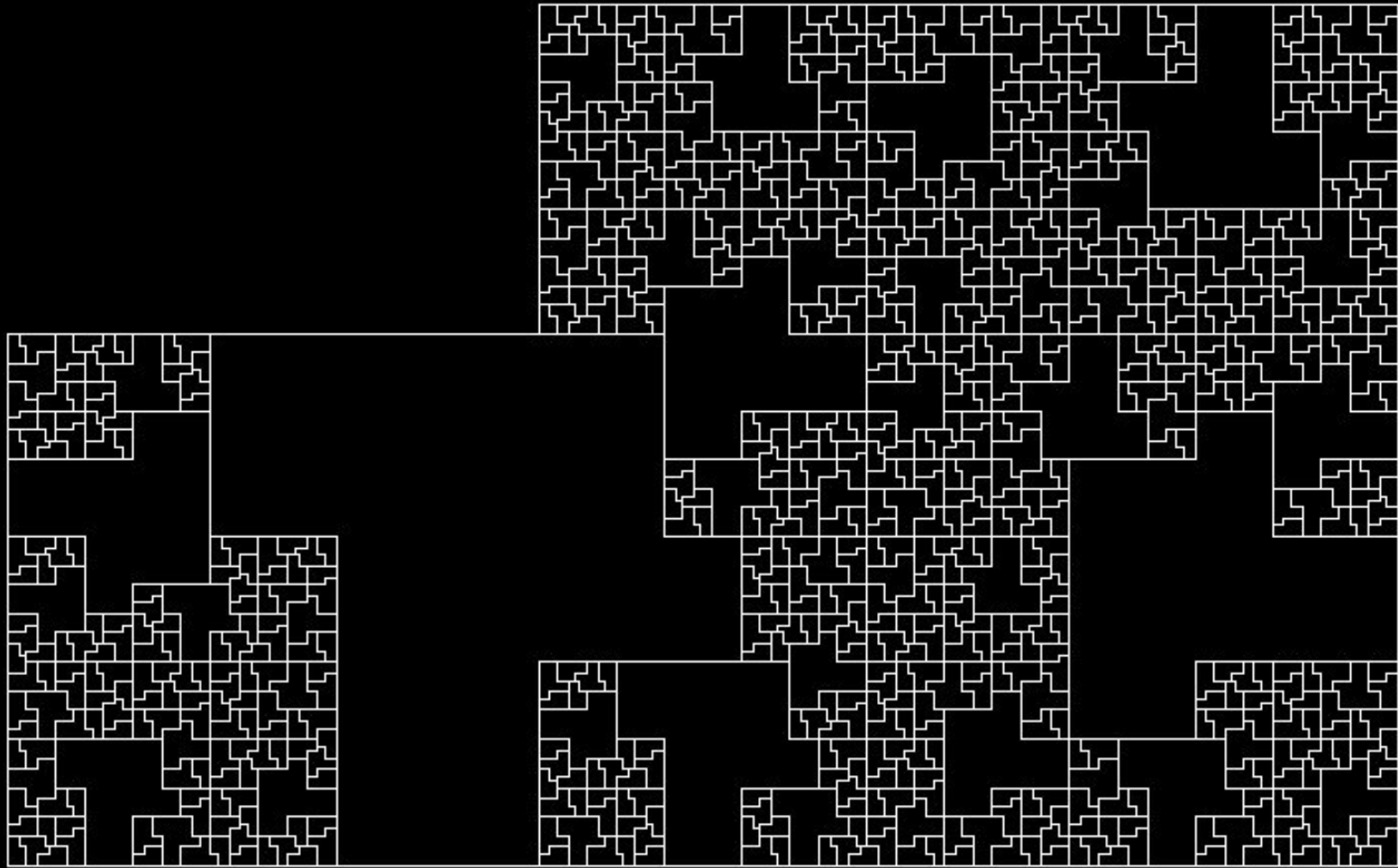




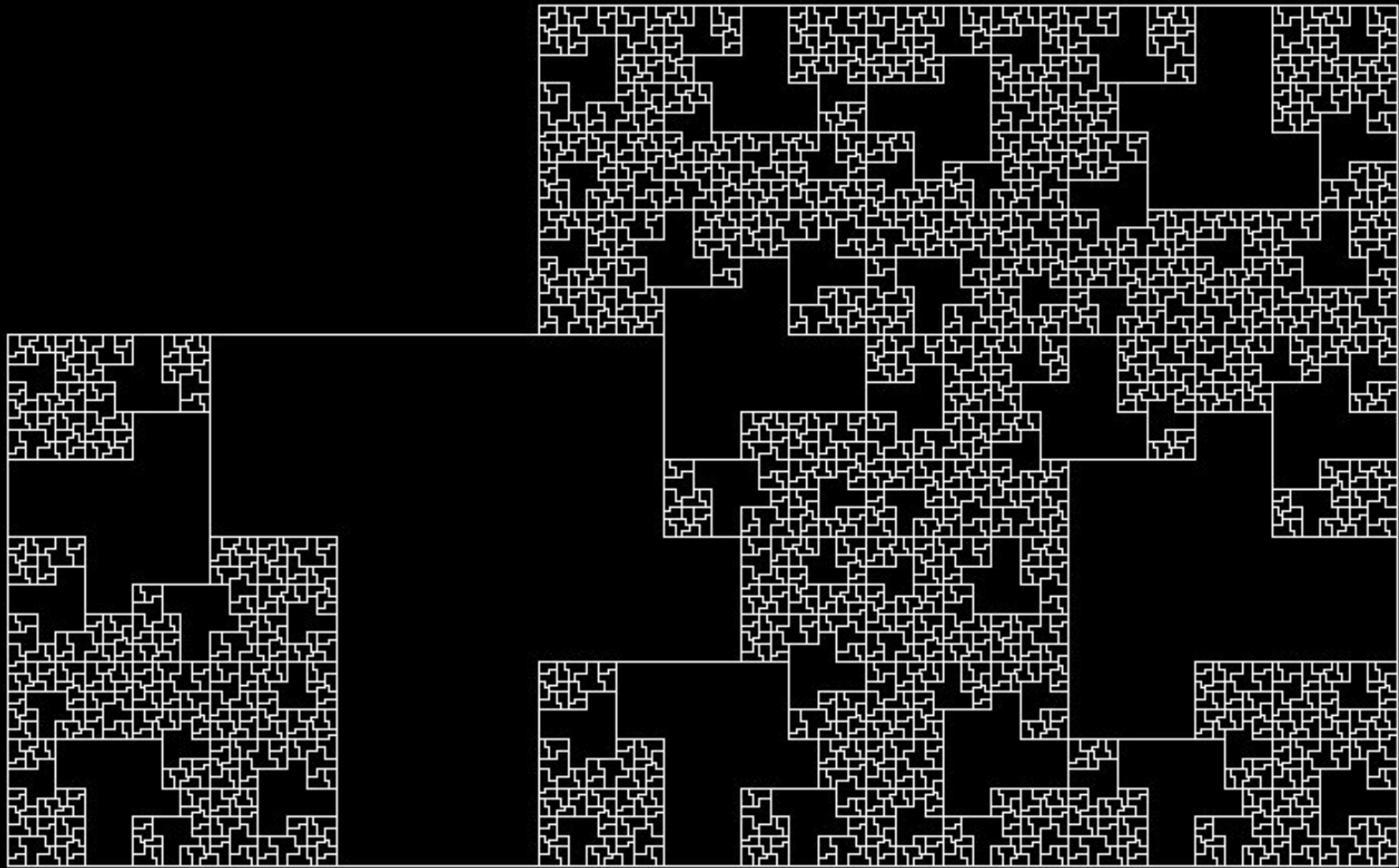
ARUP AGU



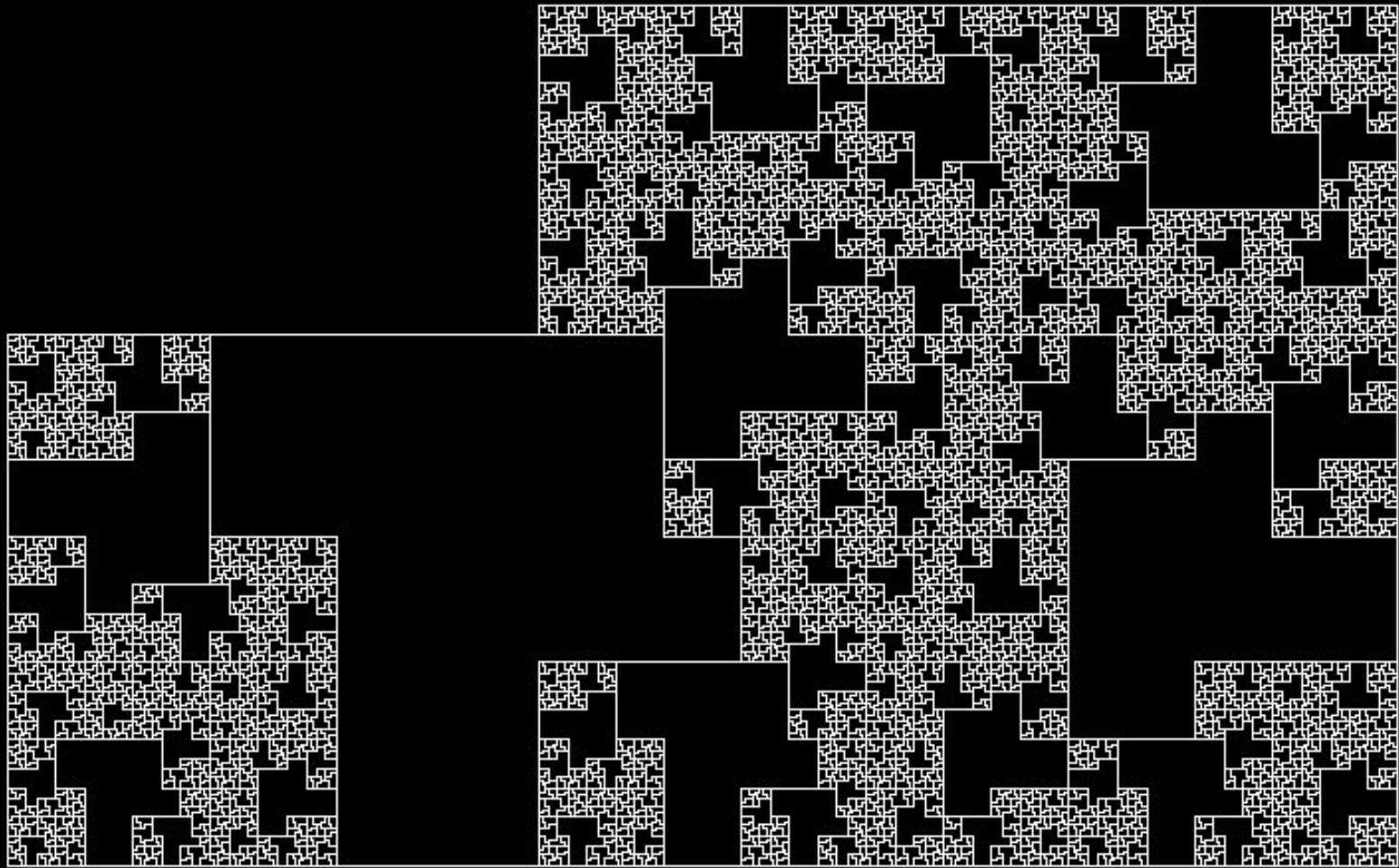
ARUP AGU



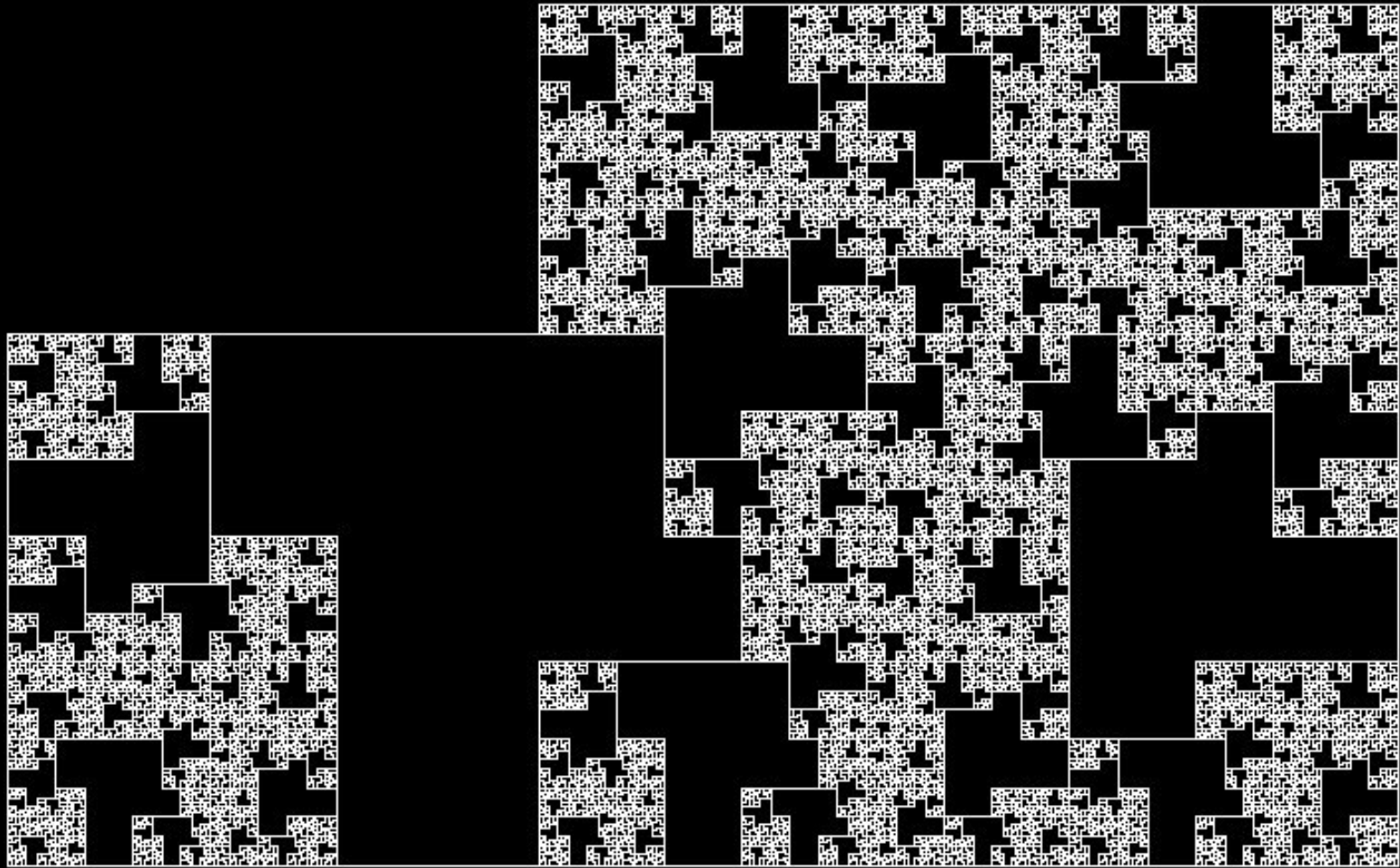
ARUP AGU



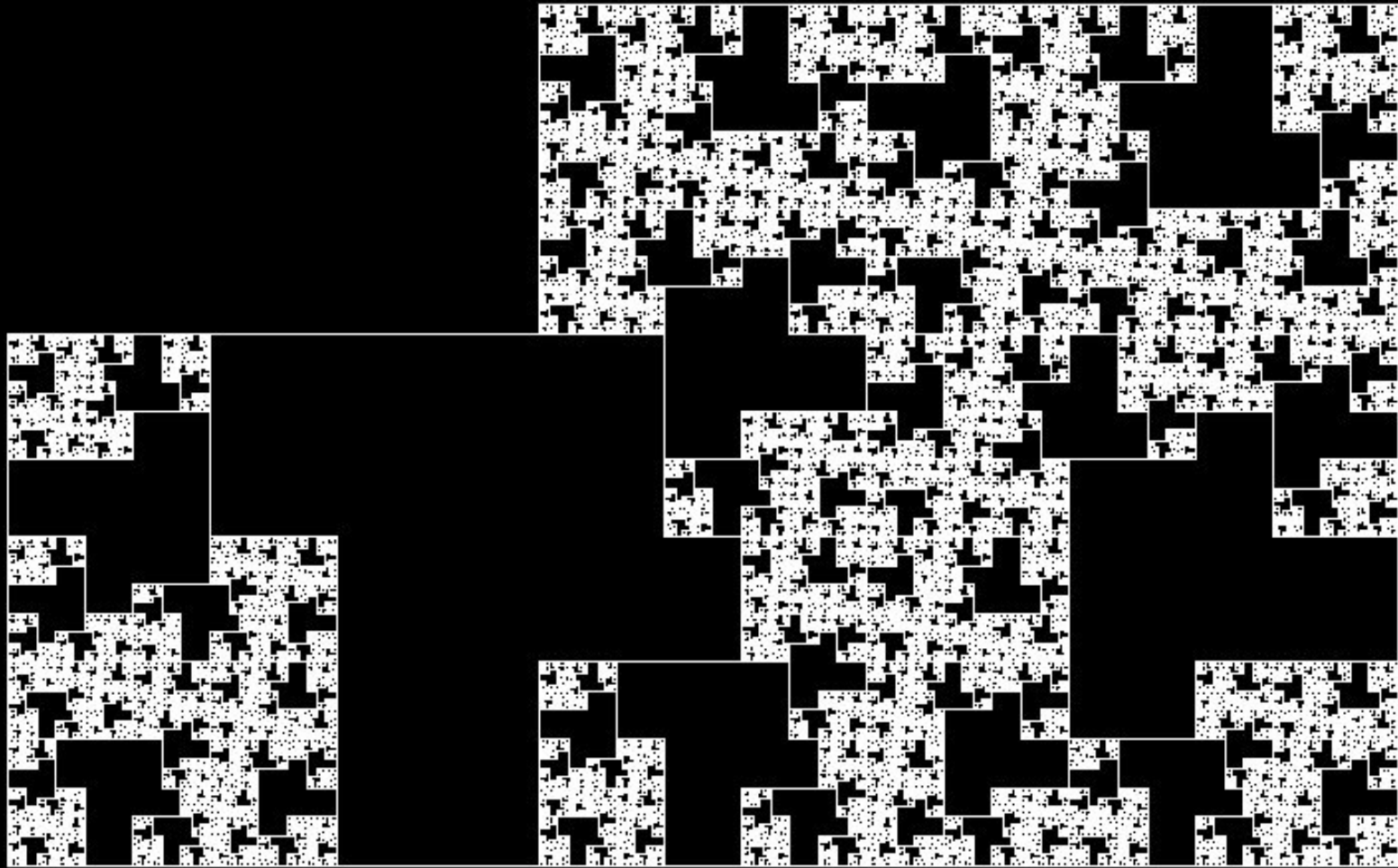
ARUP AGU



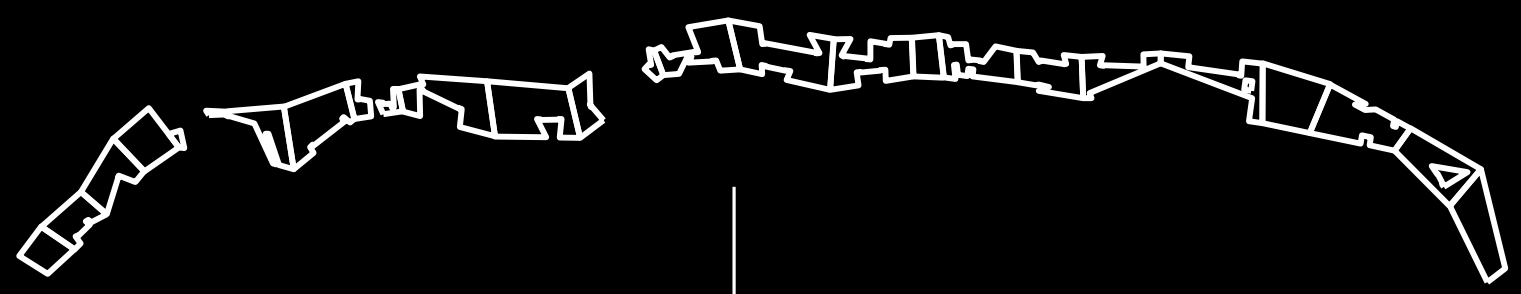
ARUP AGU



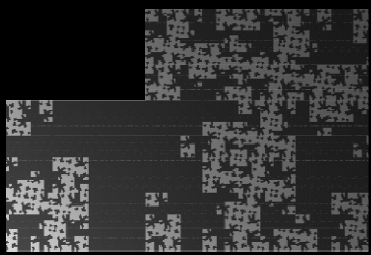
ARUP AGU



ARUP AGU



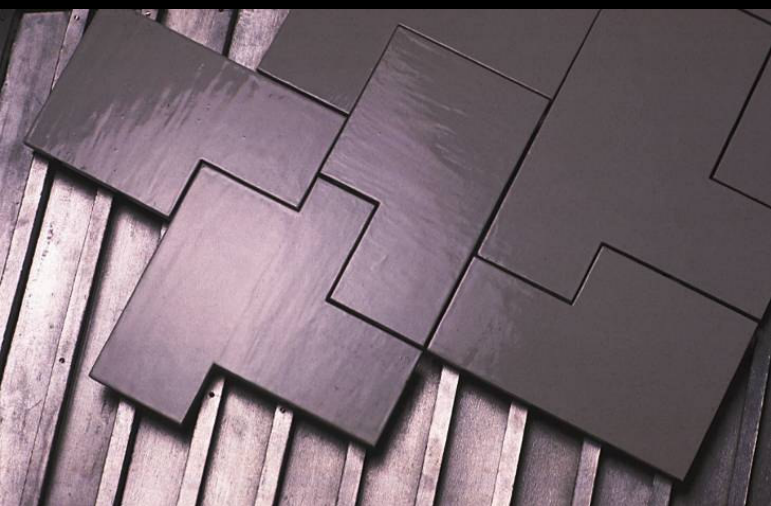
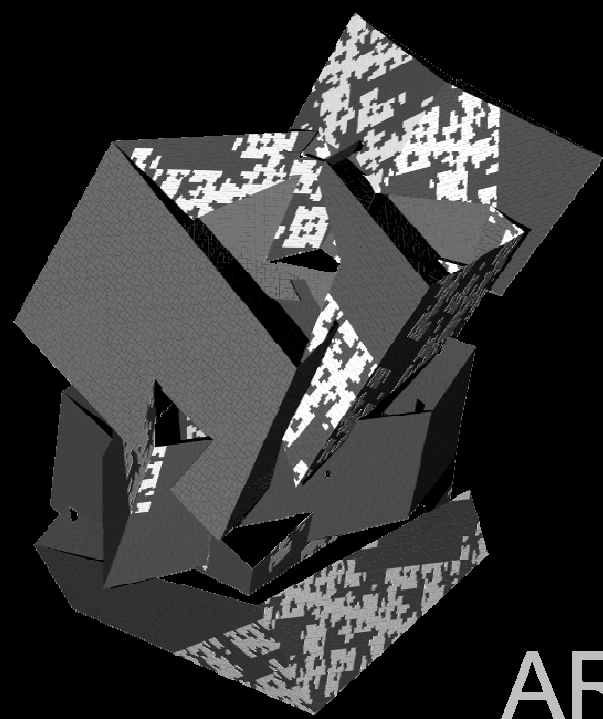
1.Unfolded spiral



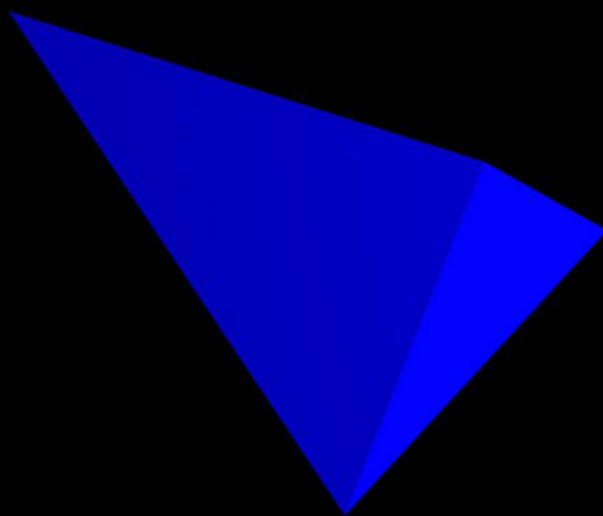
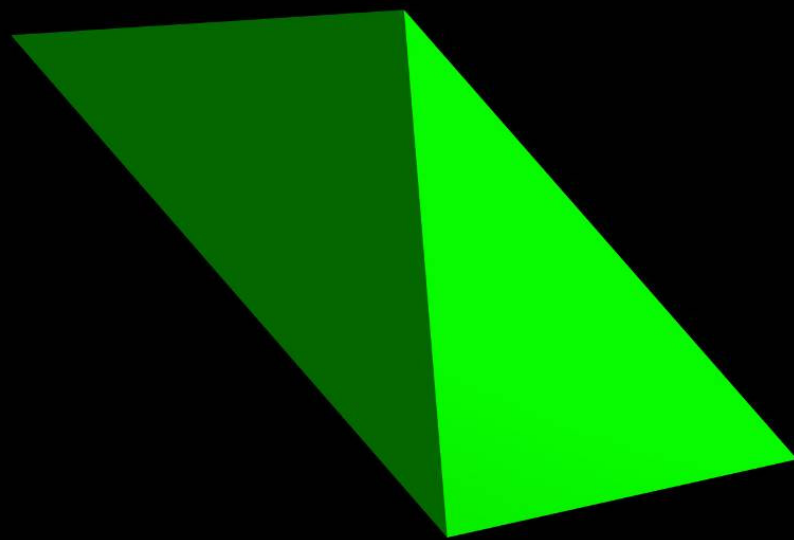
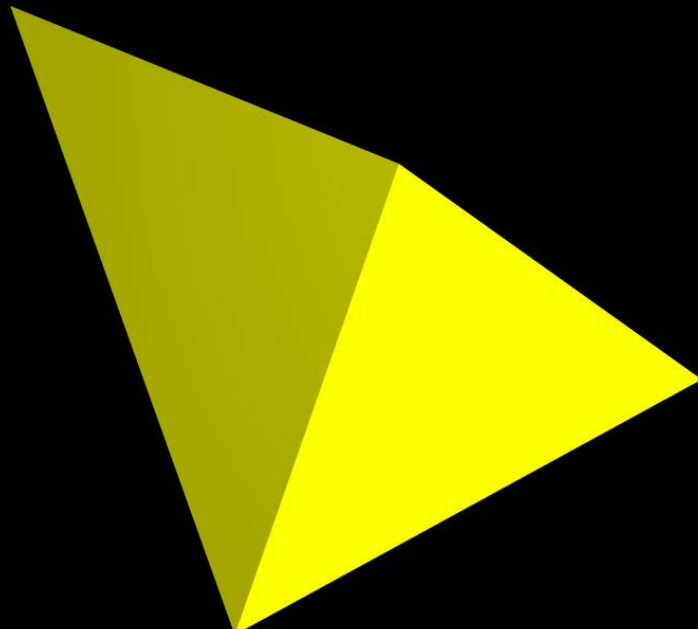
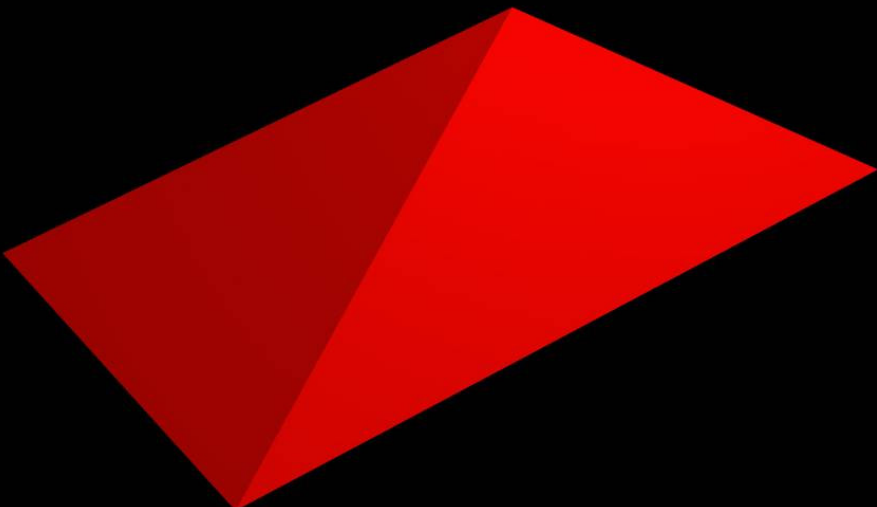
2.Apply pattern

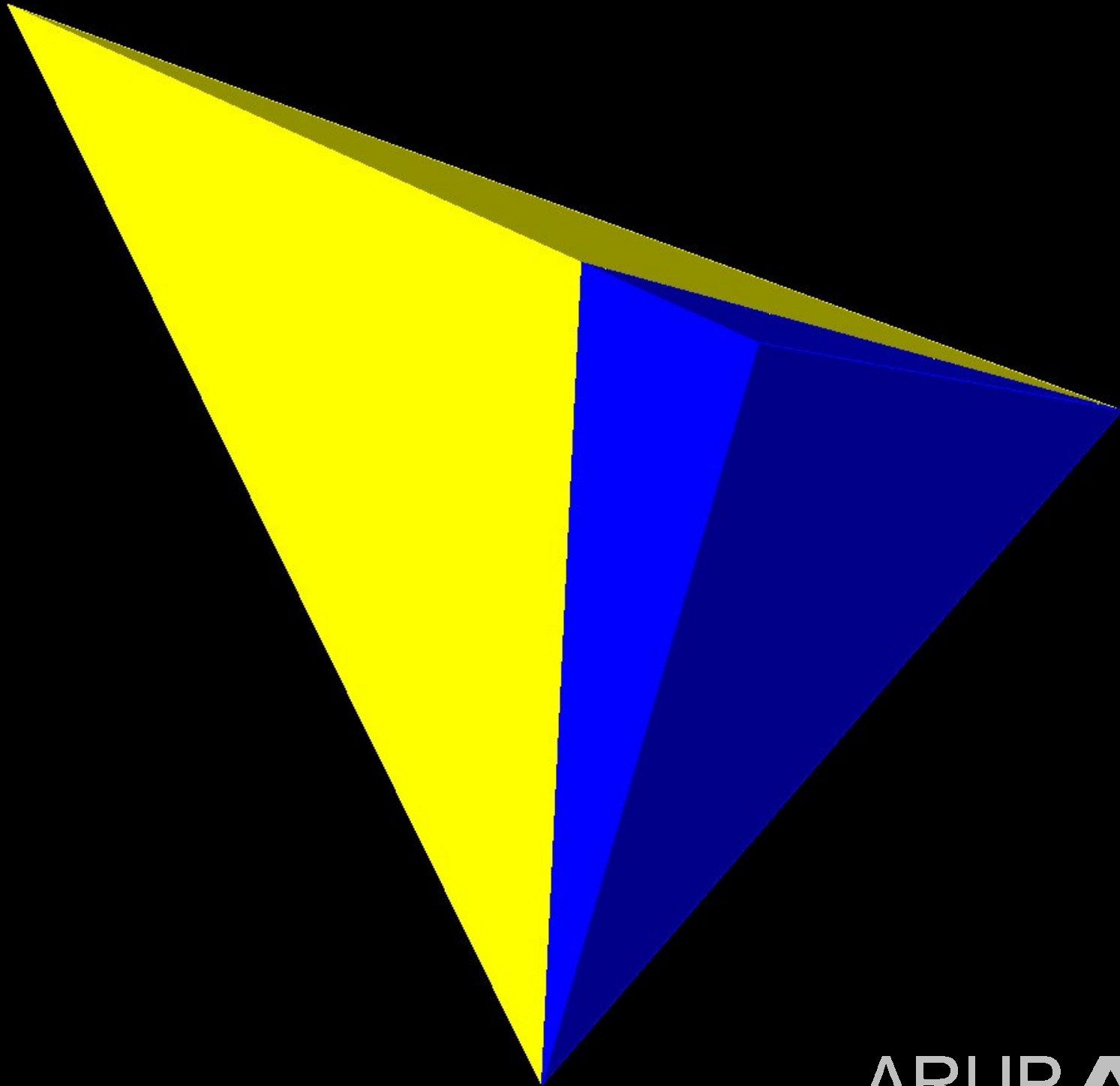


3.Fold

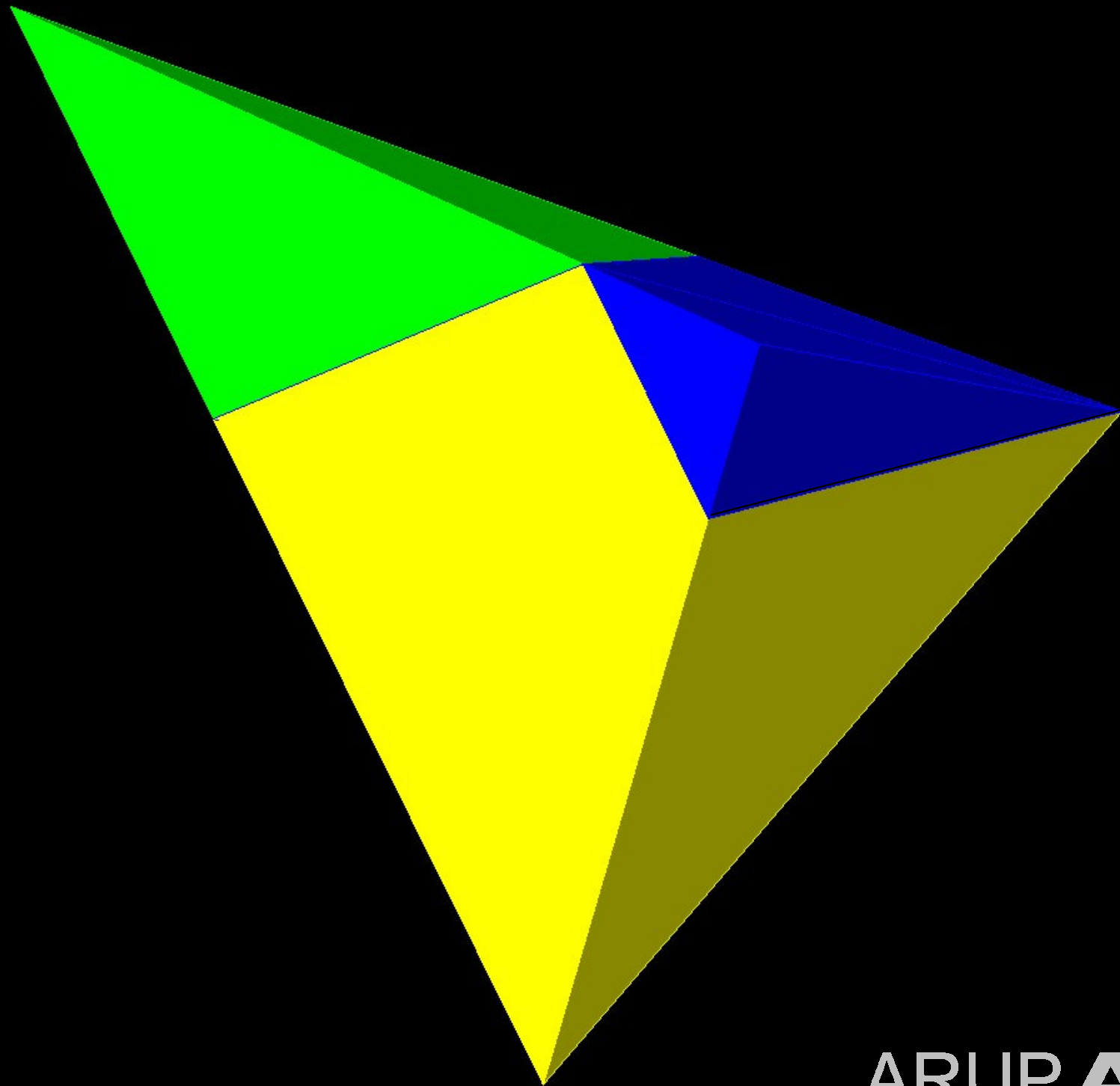


3 - D DANZER PACKING

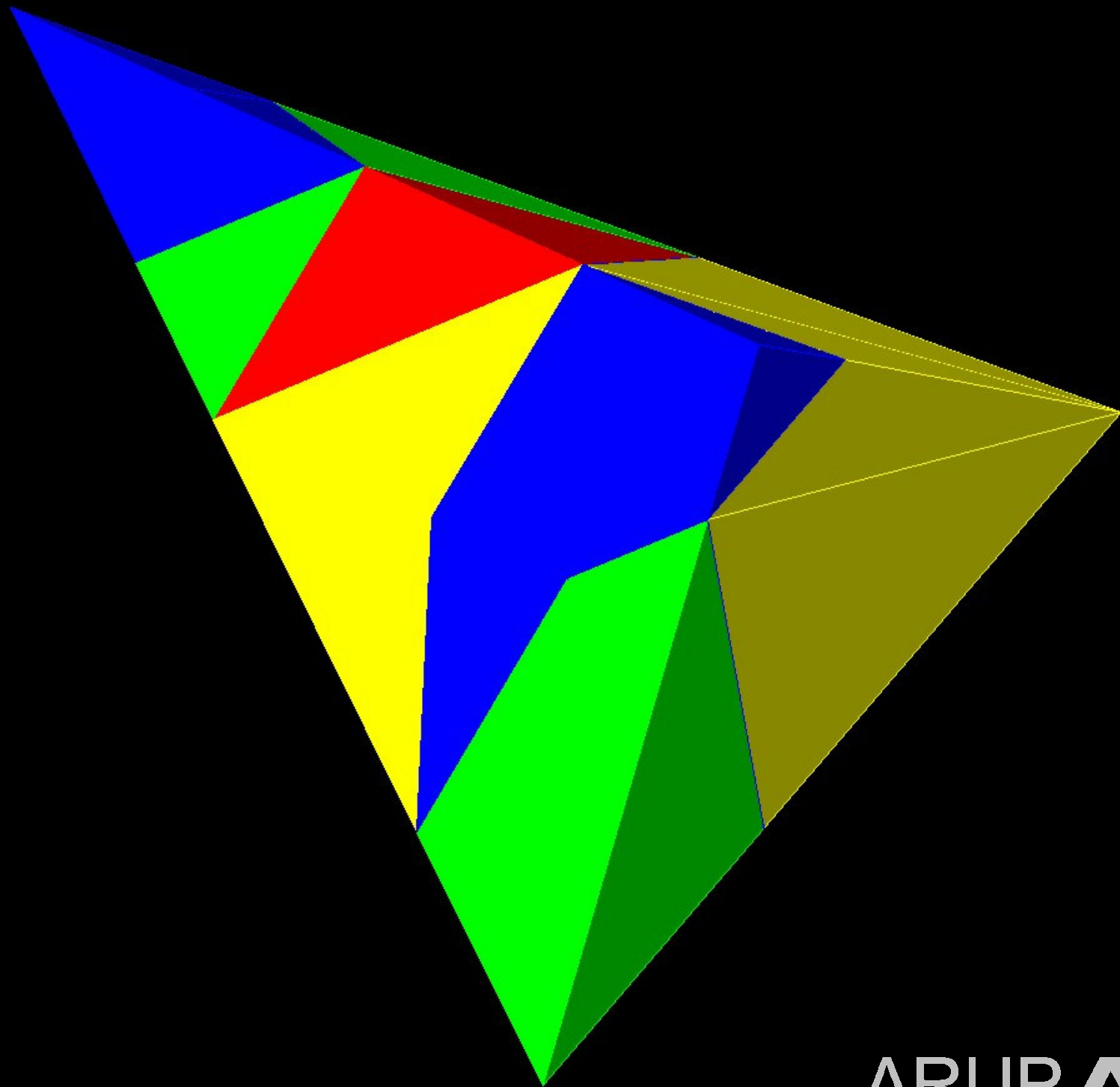




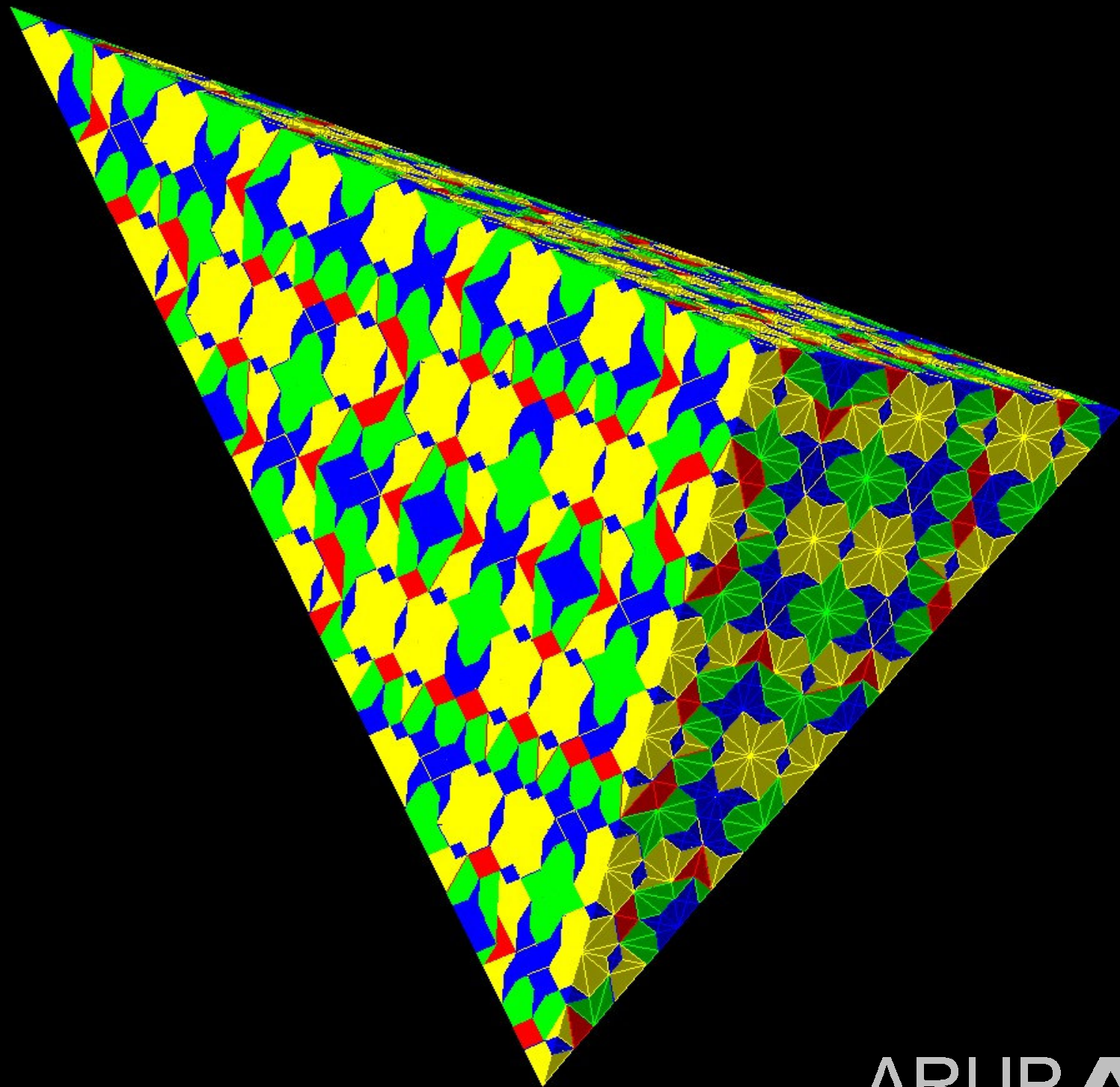
ARUP **AGU**



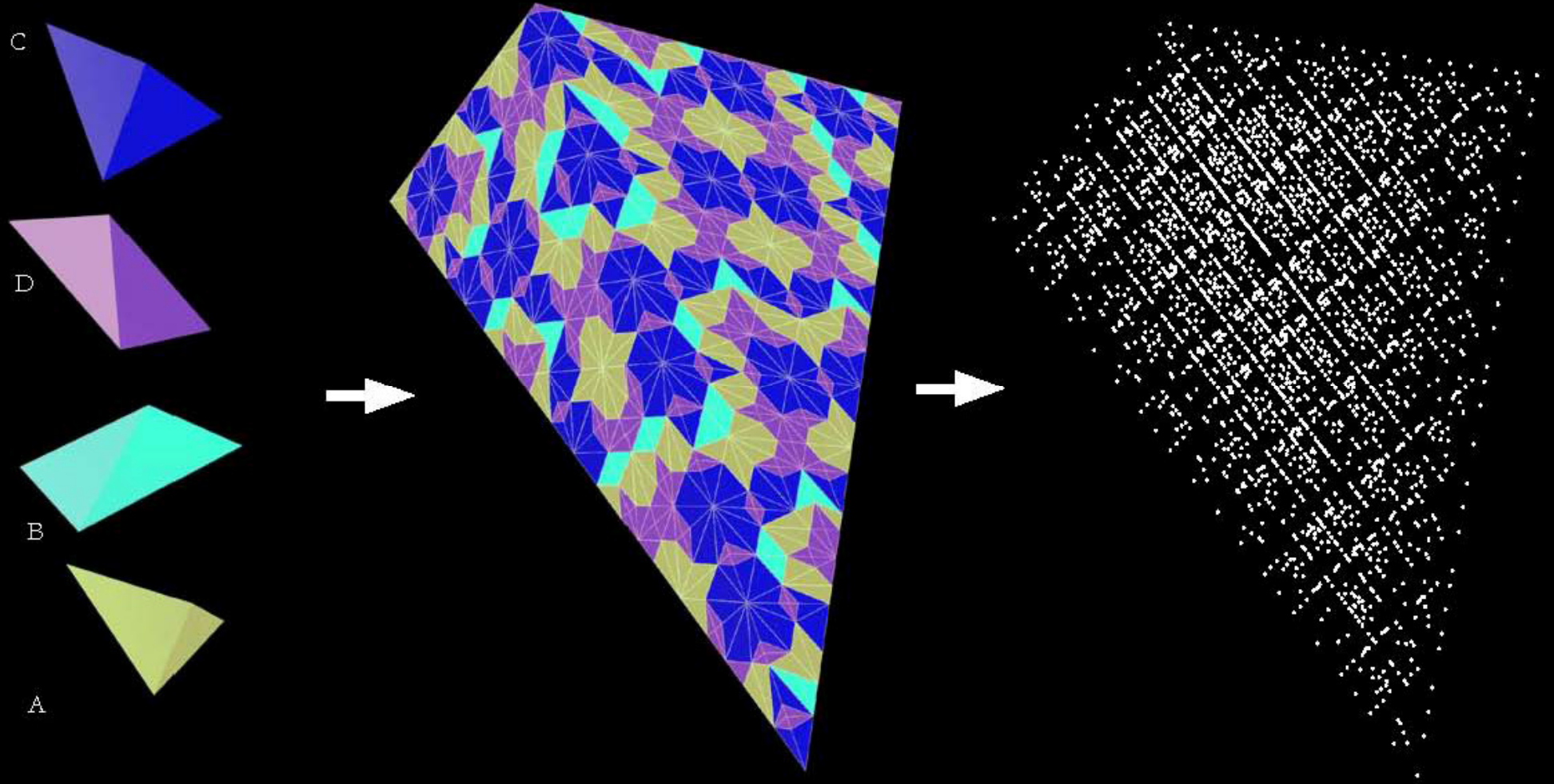
ARUP AGU



ARUP AGU



ARUP AGU

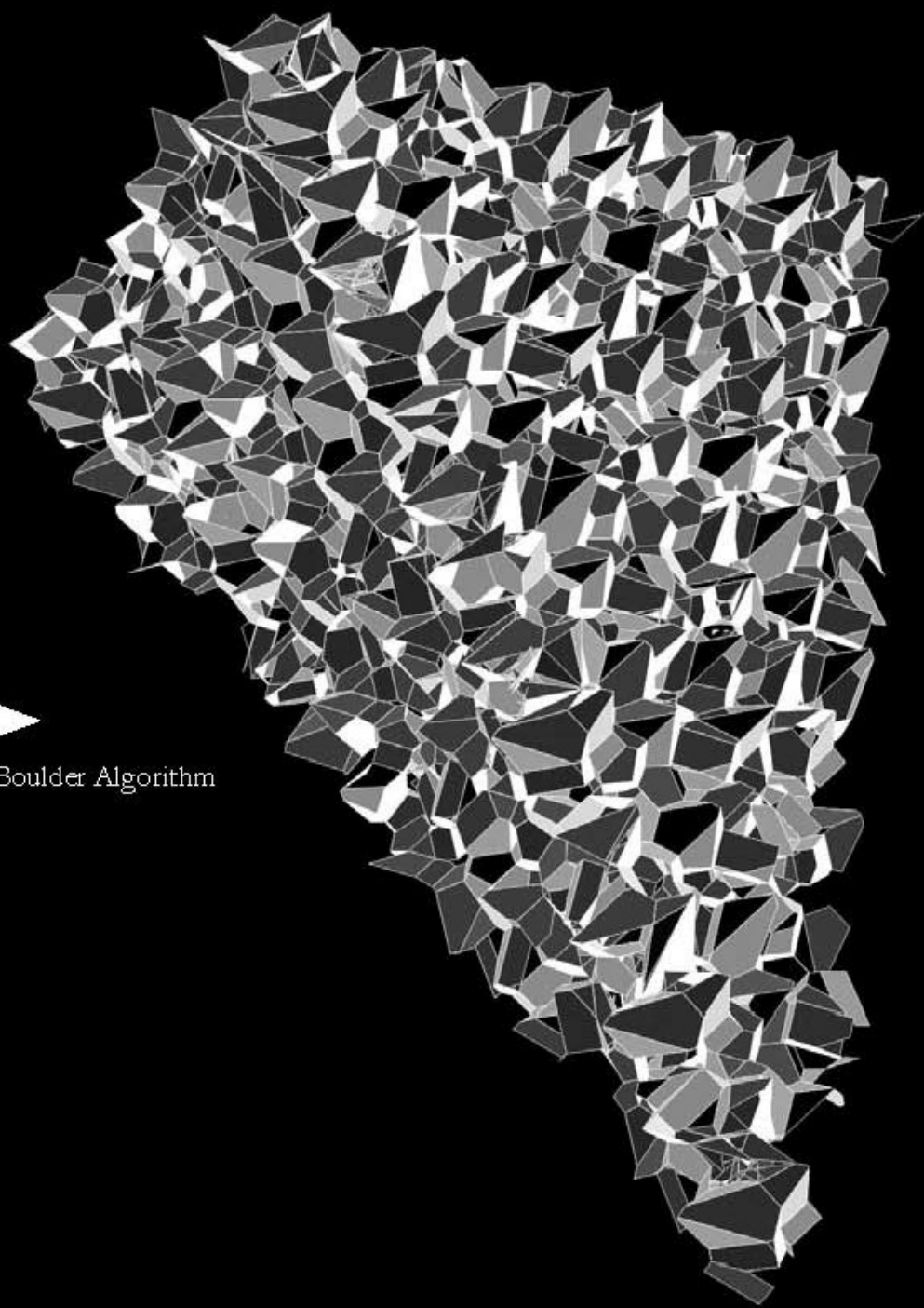


Danzer "K" Tile: 7 Generations:
11382 triangles (tetrahedrals)

Conversion to 3066 points



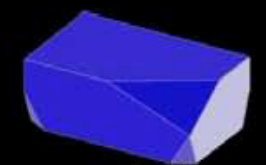
Run Boulder Algorithm



A boulder mess made of only 4 different modular boulders.



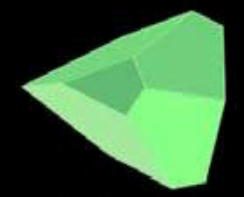
1. Balls



2. Erasers

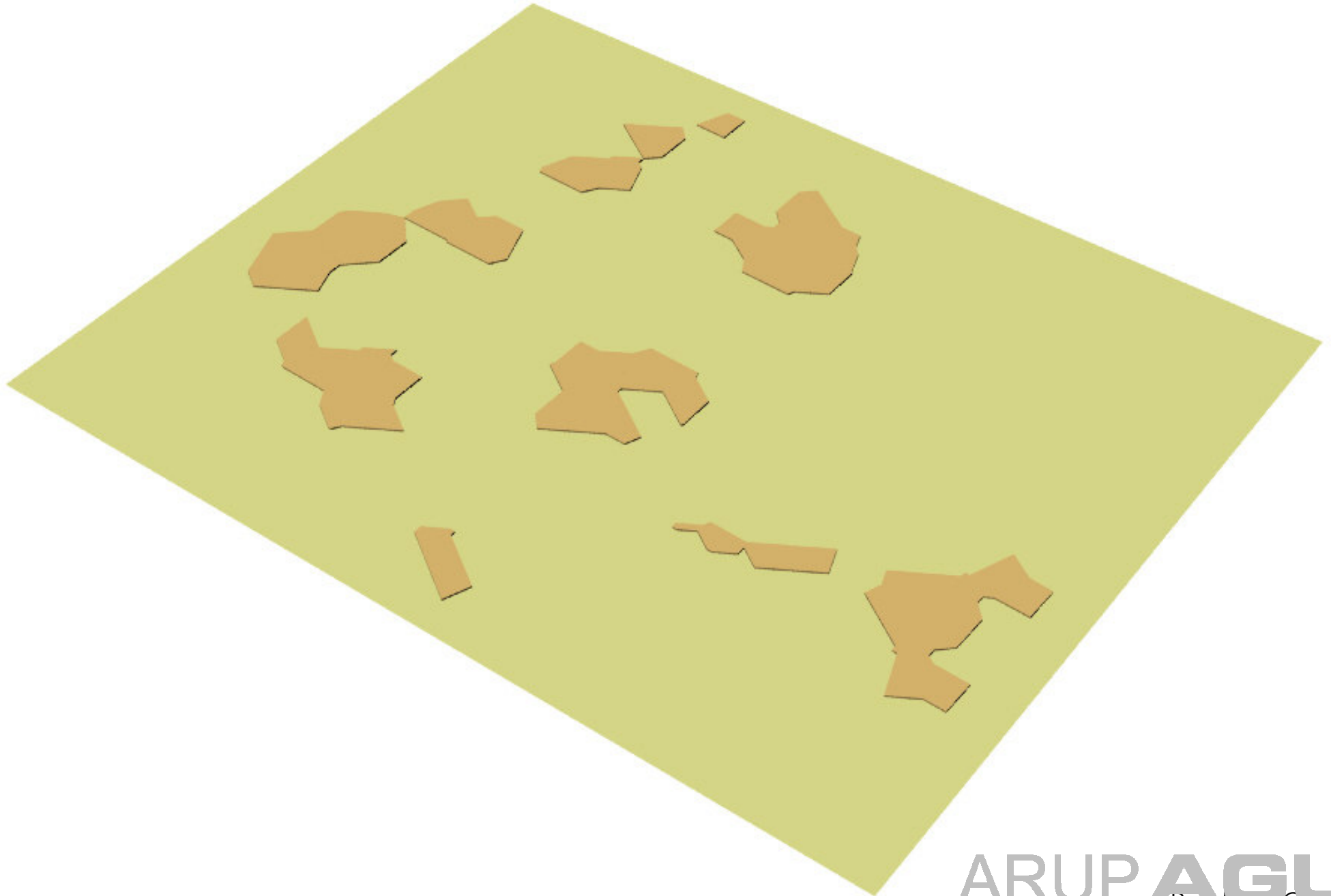


3. Plugs

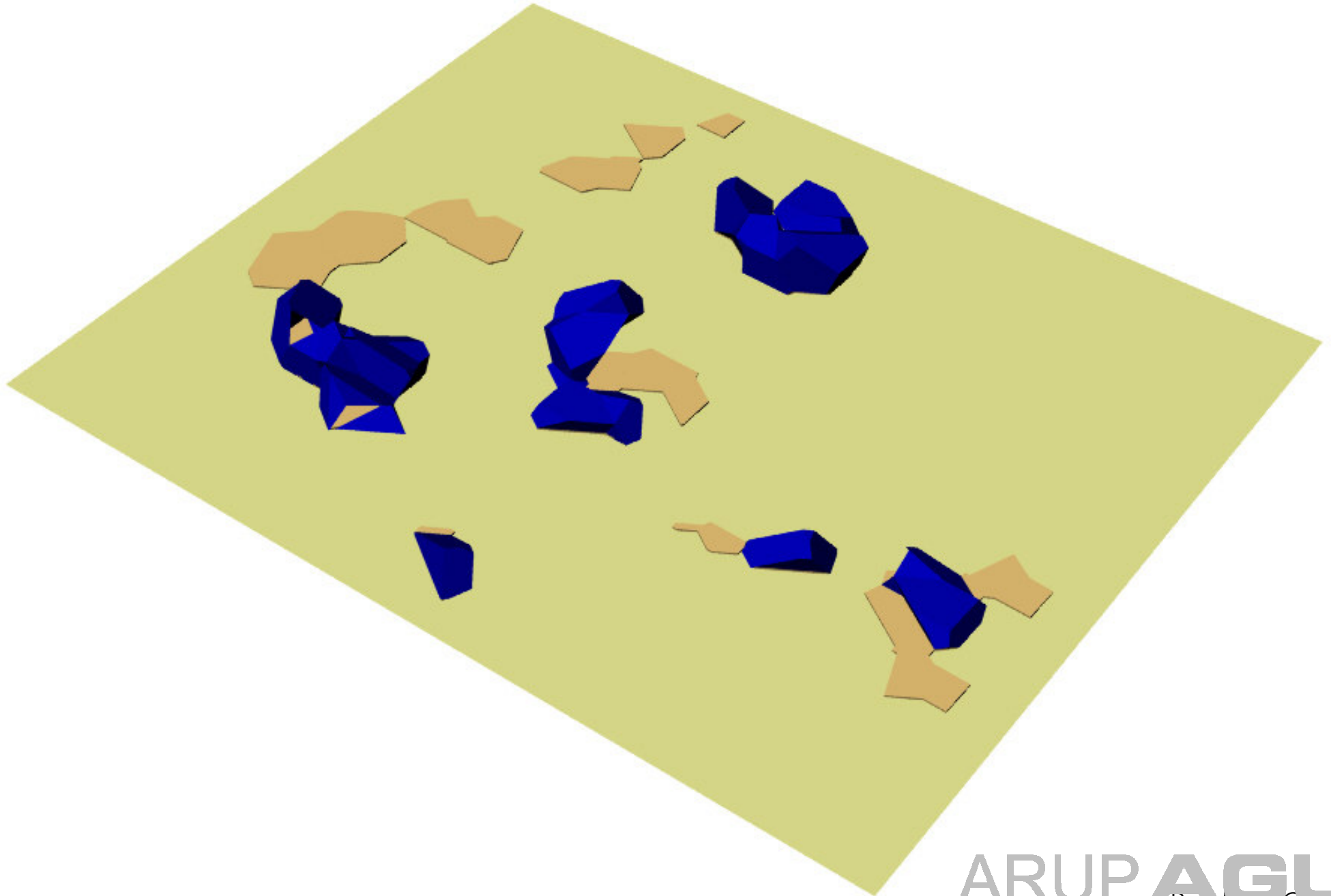


4. Monsters

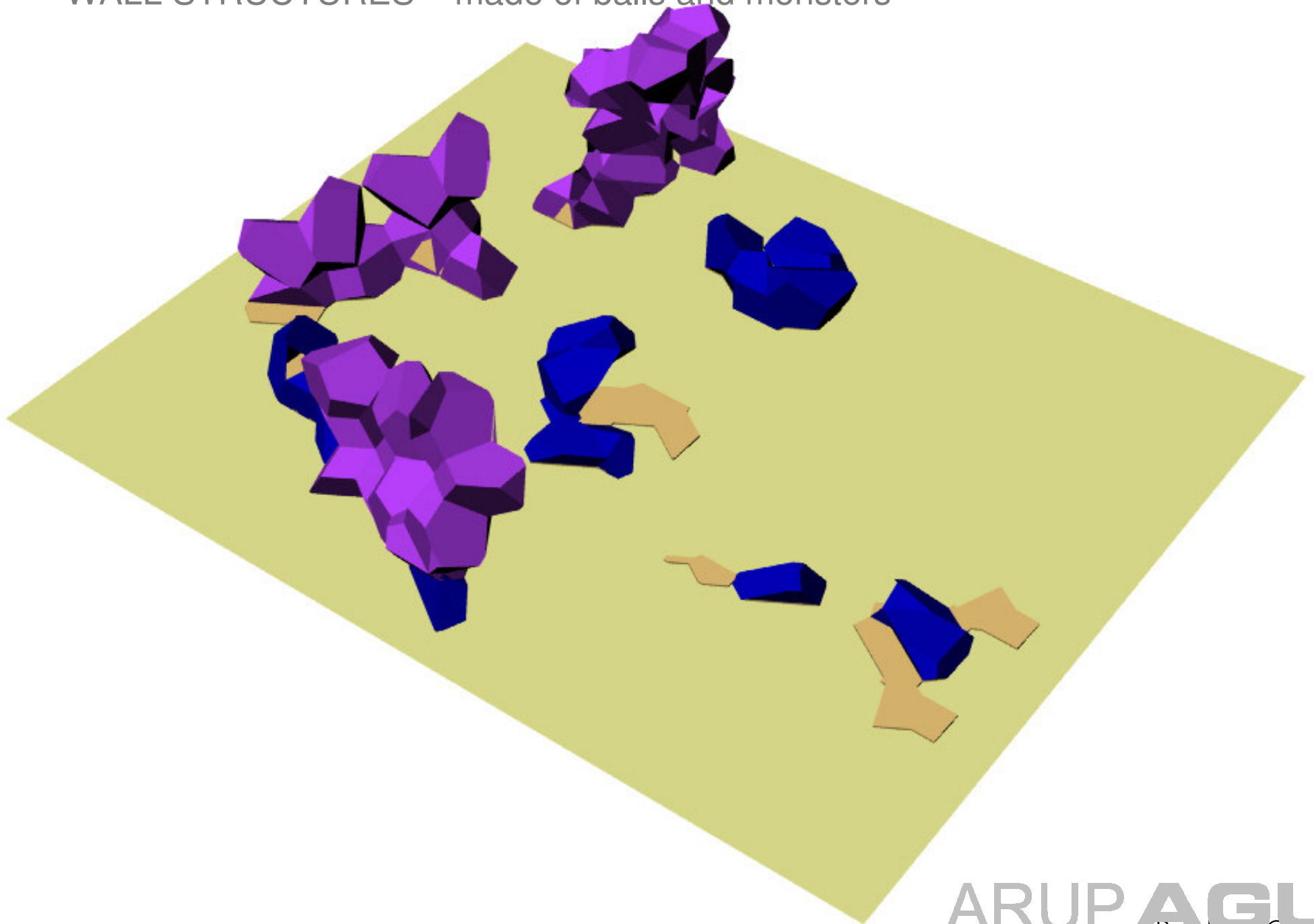
FOOTPRINT – marine ply ground anchored



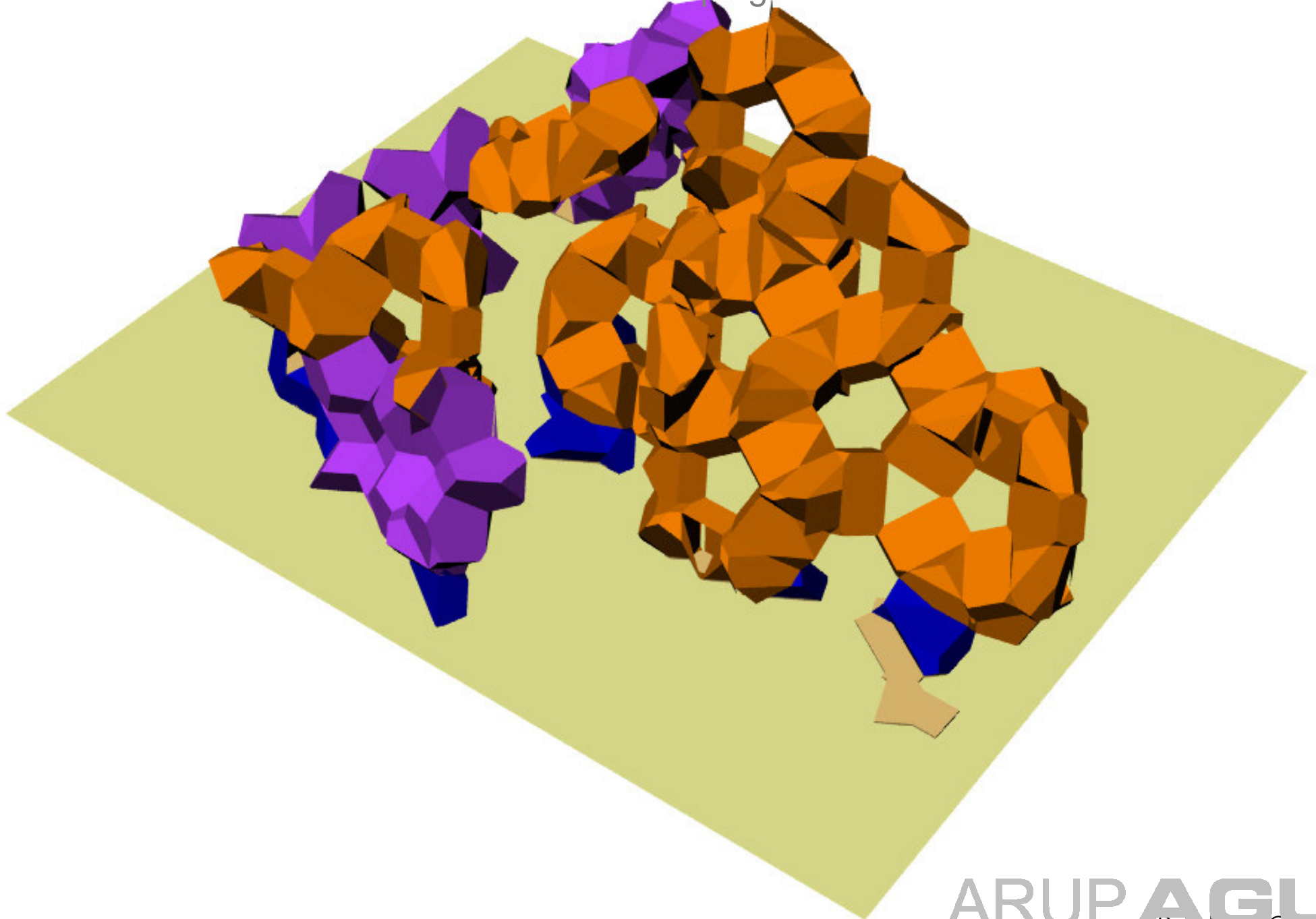
BASE BLOCKS – made of balls and monsters



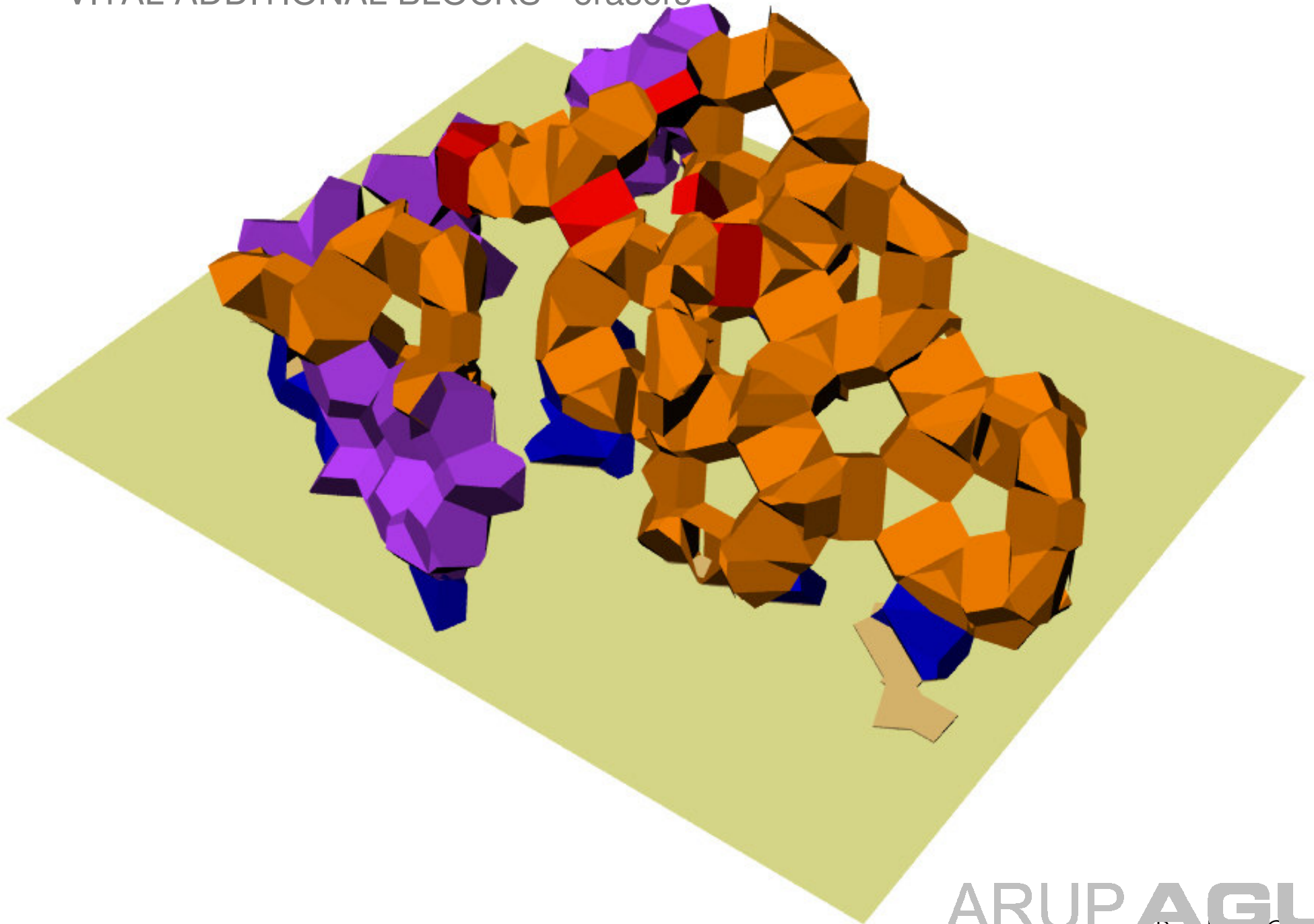
WALL STRUCTURES – made of balls and monsters



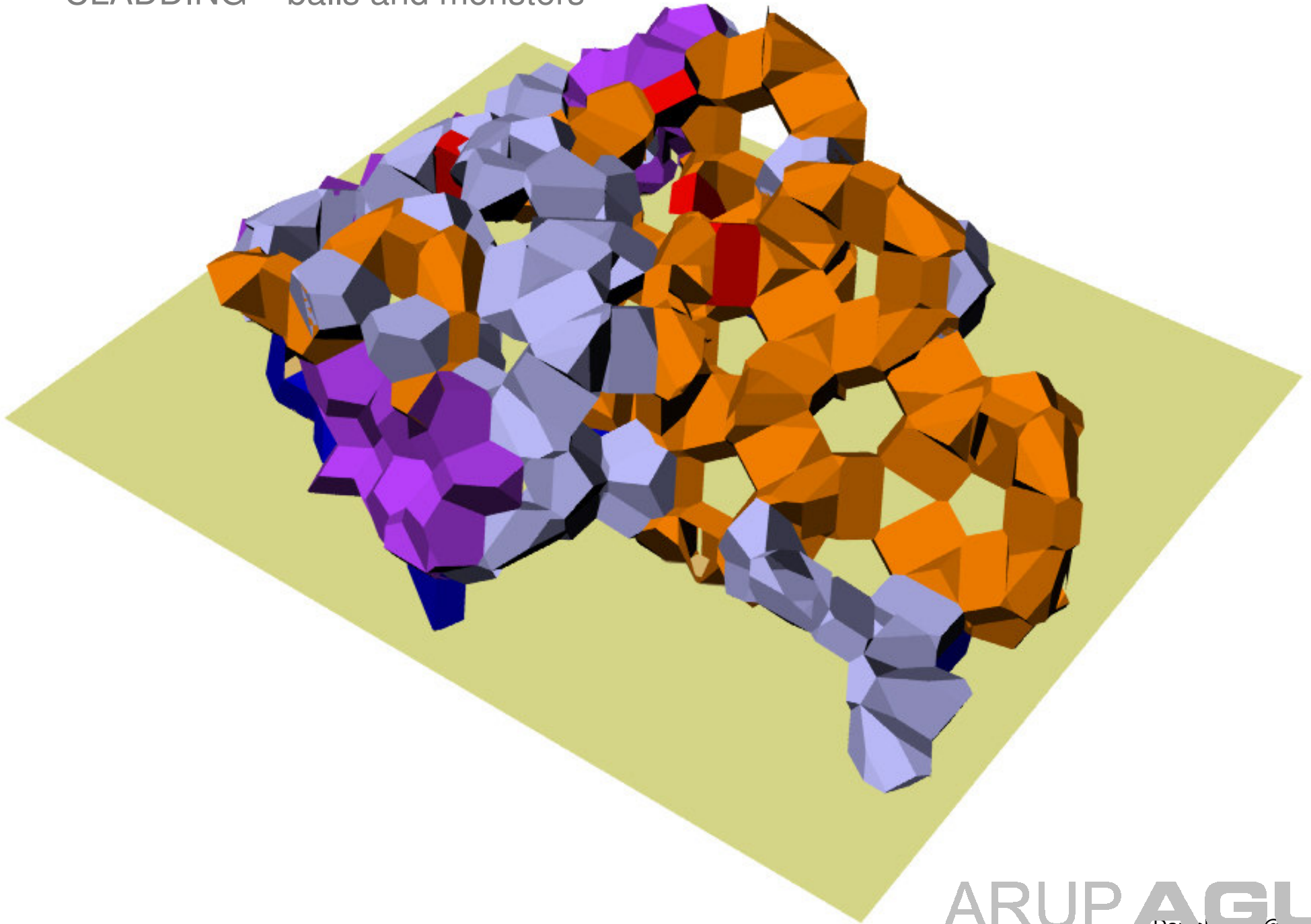
MAIN ARCHITNG RINGS –erasers and plugs

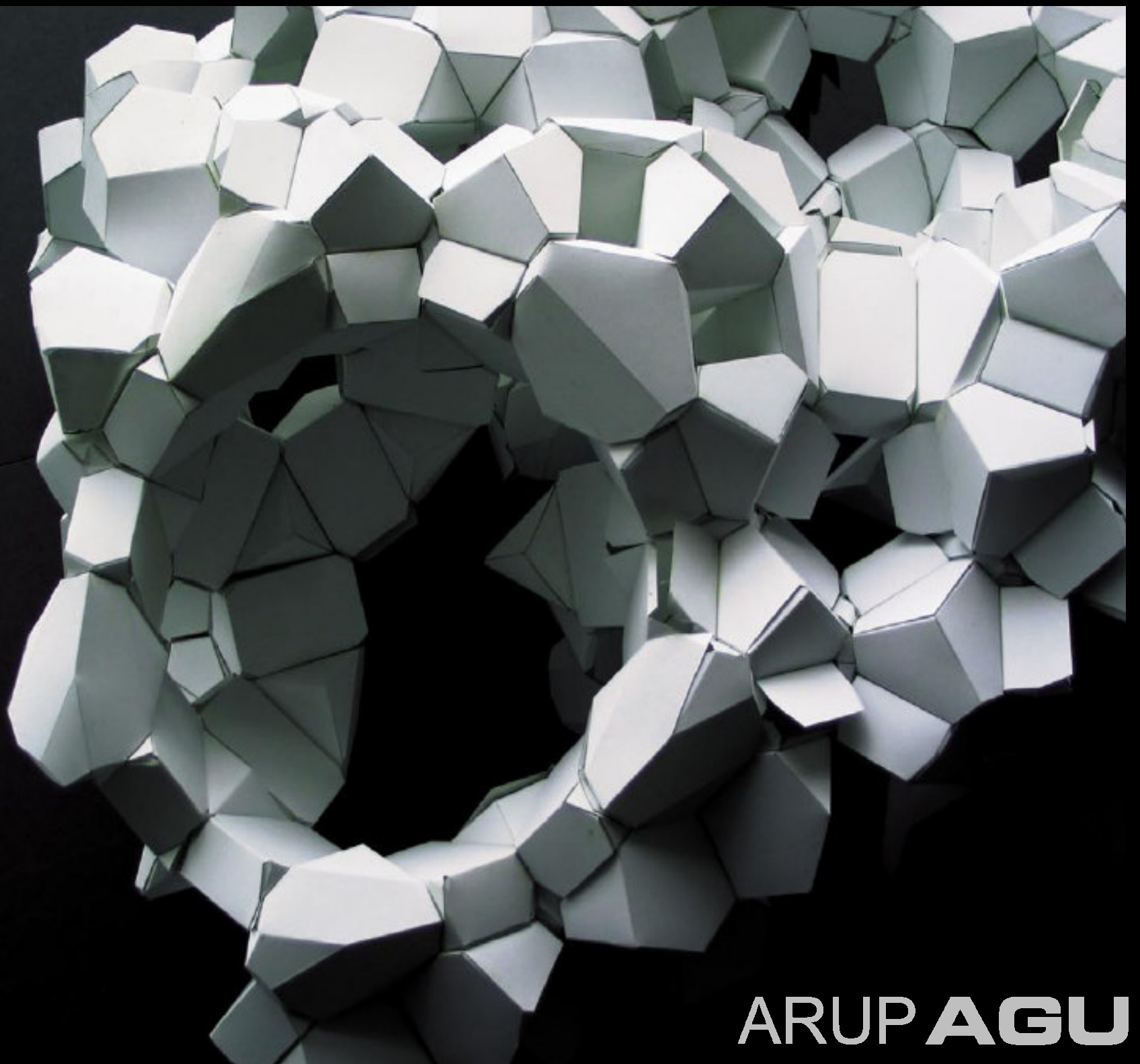


VITAL ADDITIONAL BLOCKS - erasers



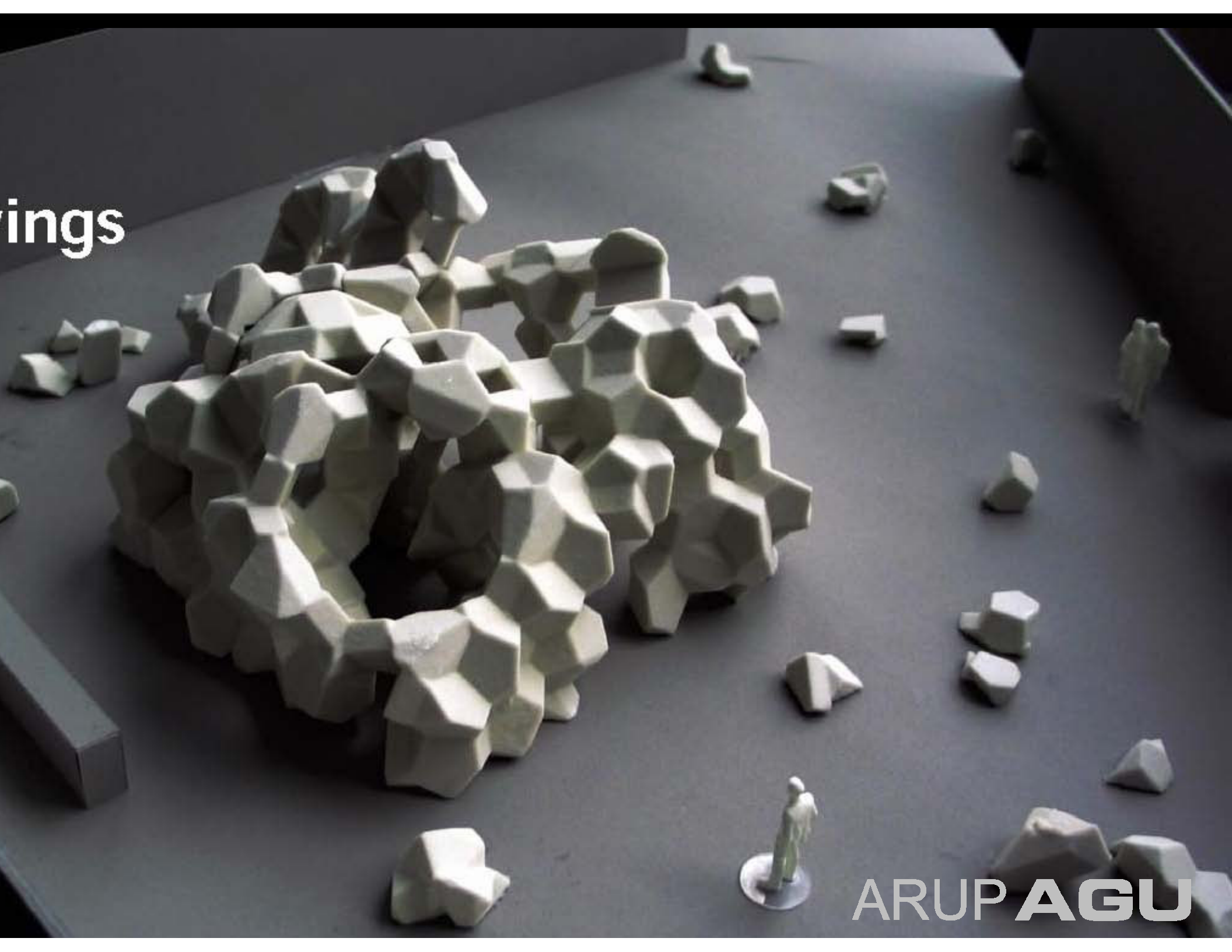
CLADDING – balls and monsters





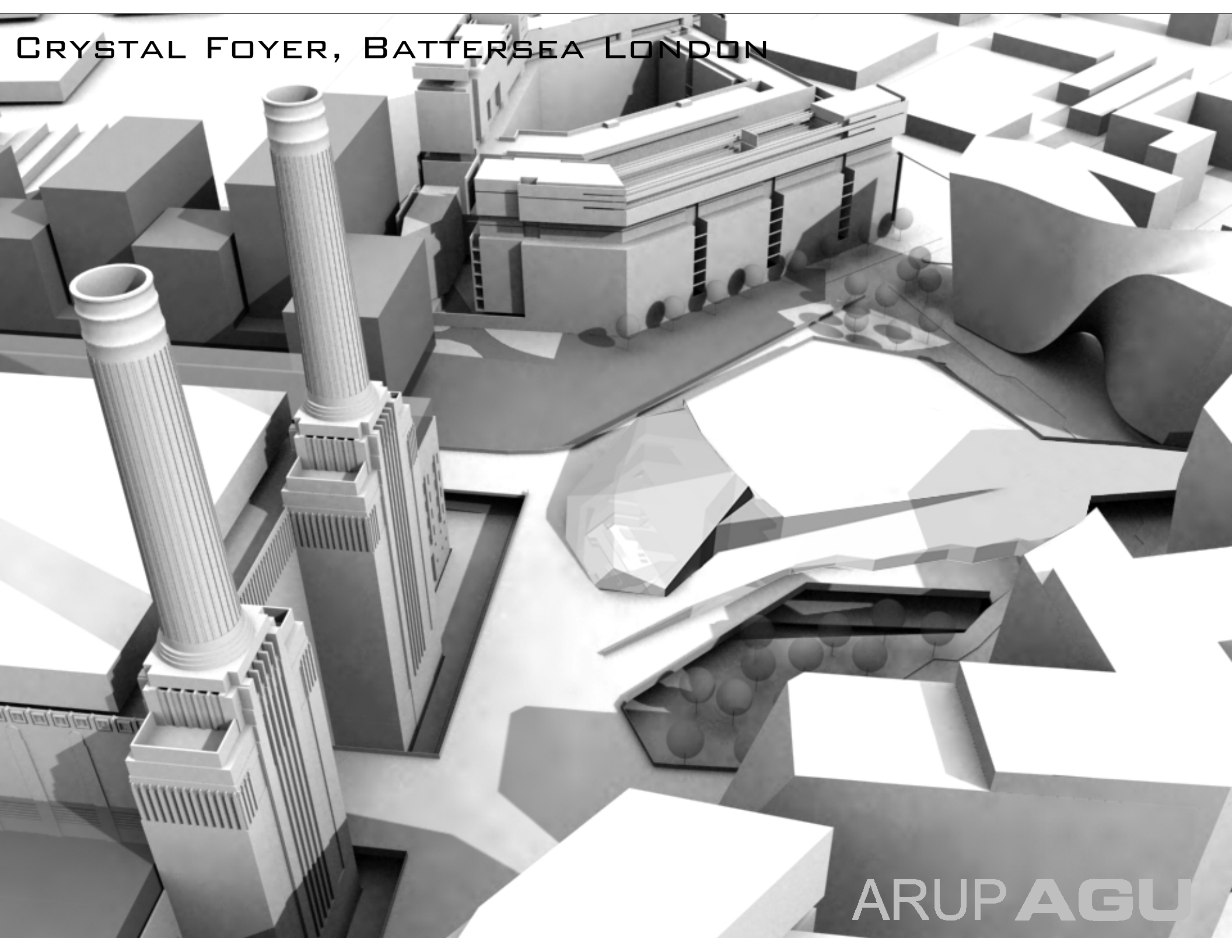
ARUP AGU

ings

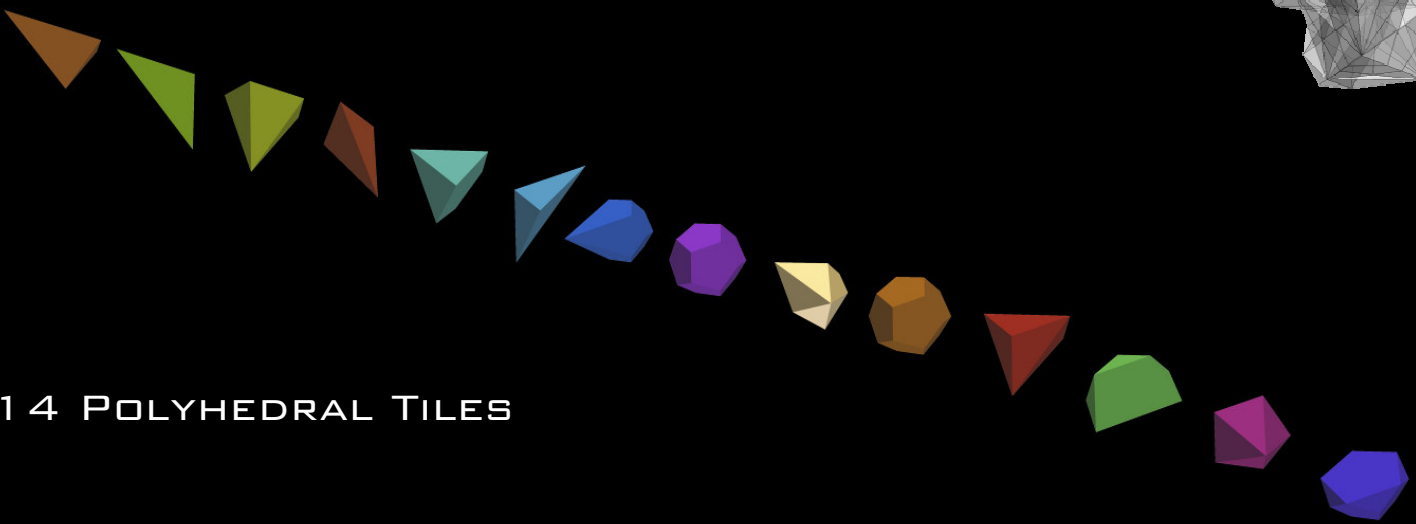
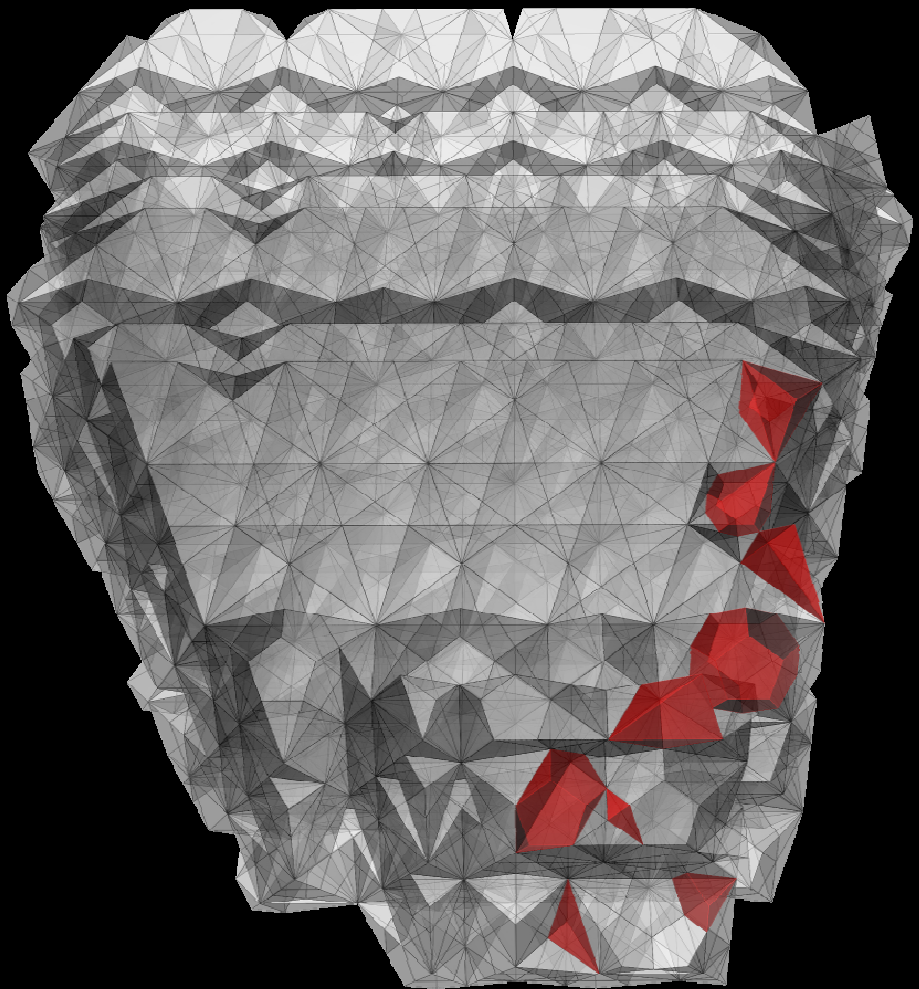
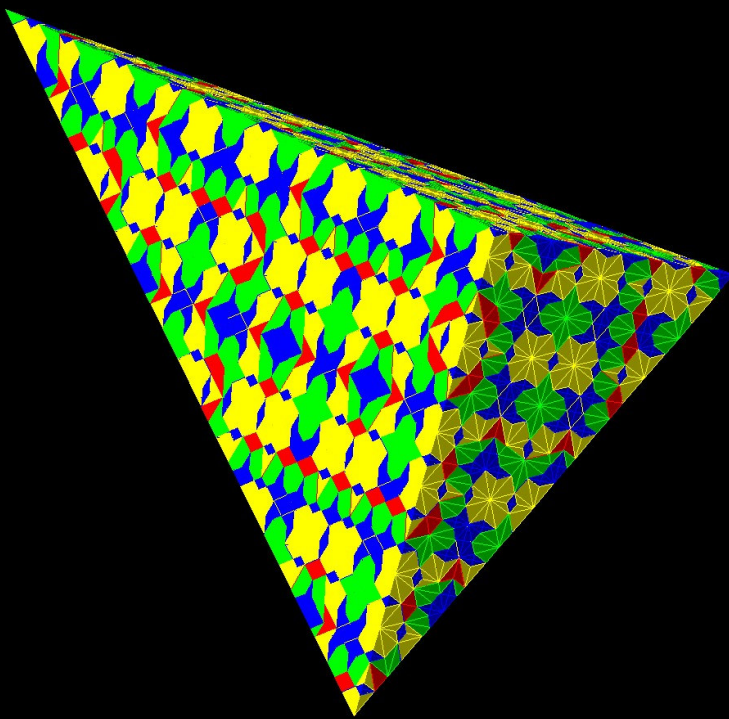


ARUP AGU

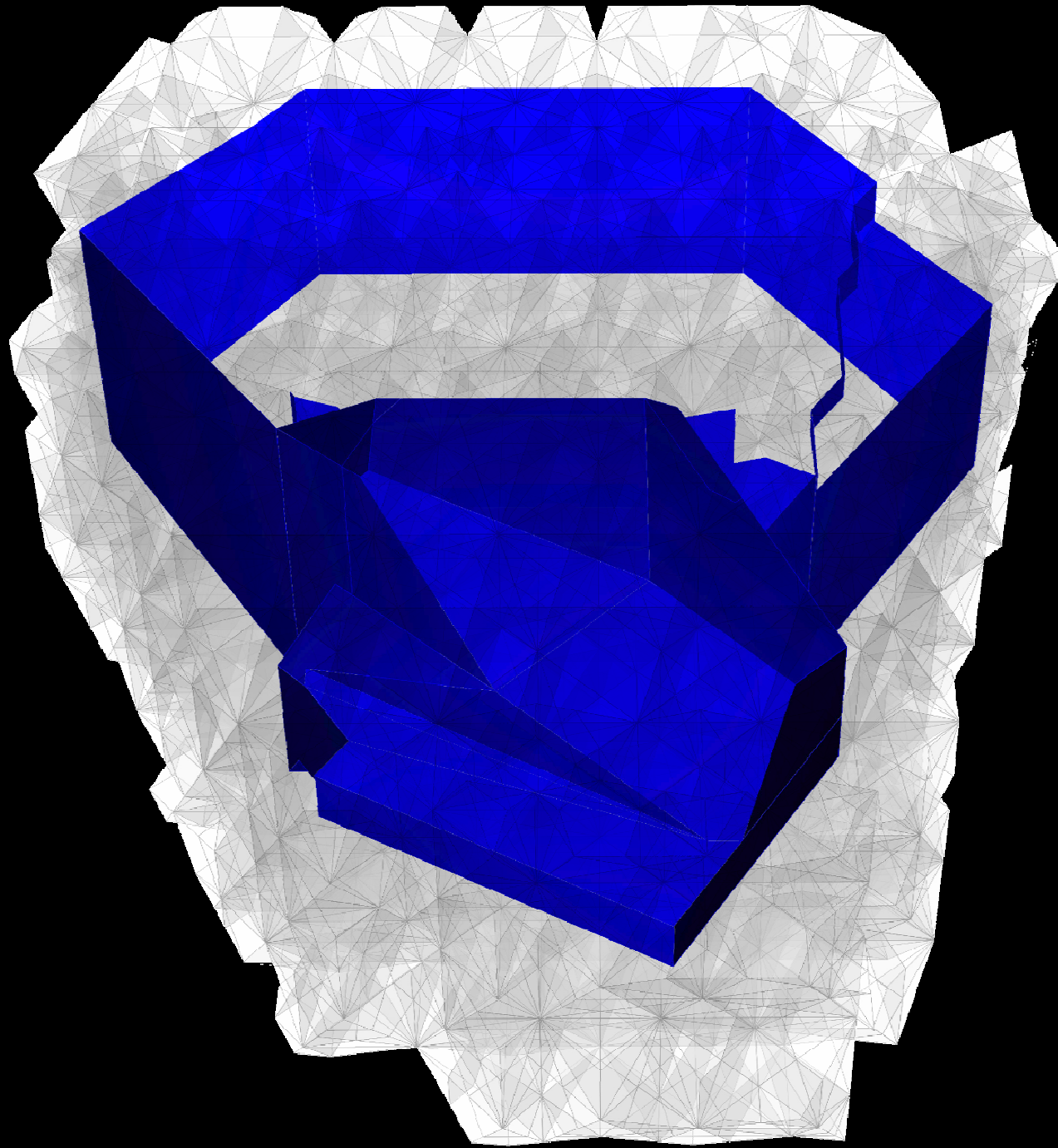
CRYSTAL FOYER, BATTERSEA LONDON



3 - D QUASI CRYSTAL PACKING

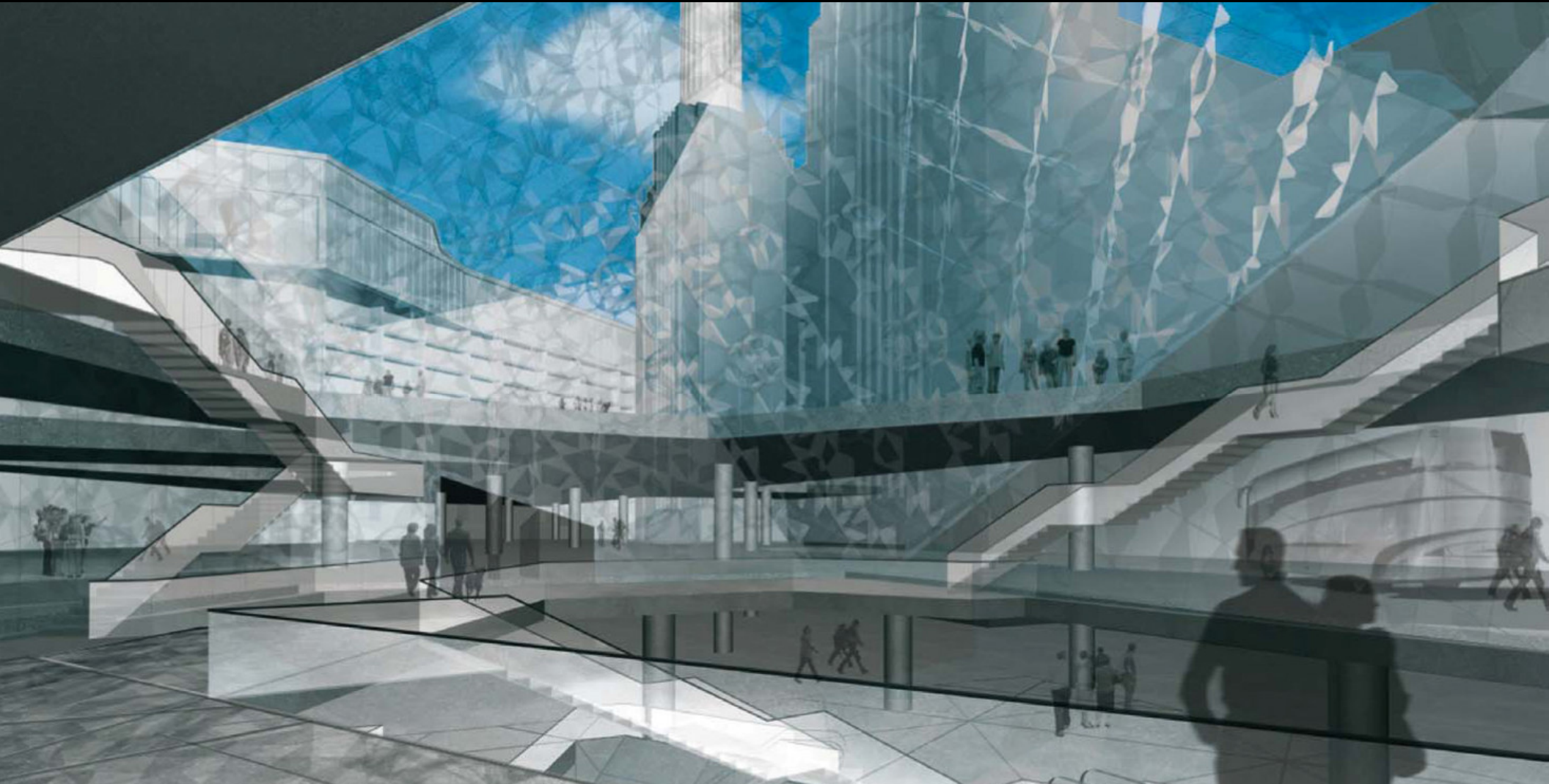


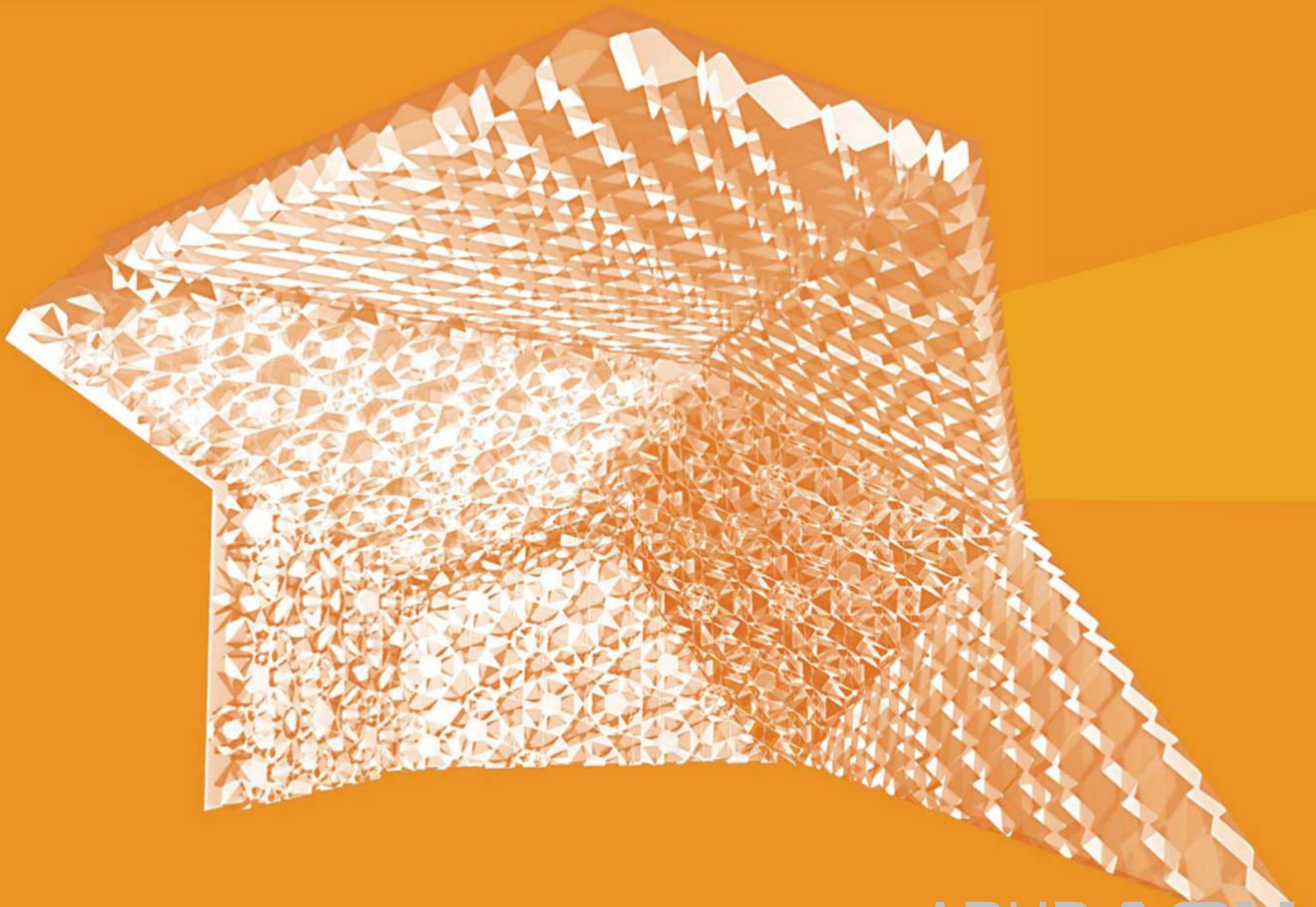
14 POLYHEDRAL TILES



ARUP AGU

CRYSTAL FOYER

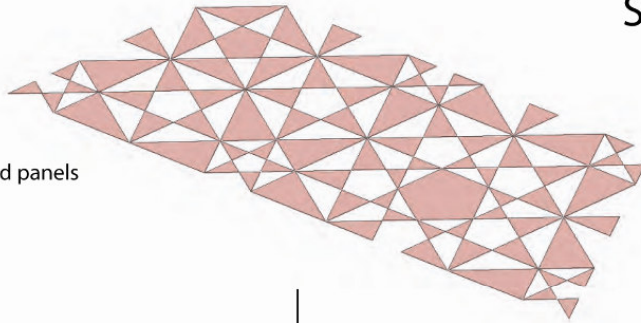




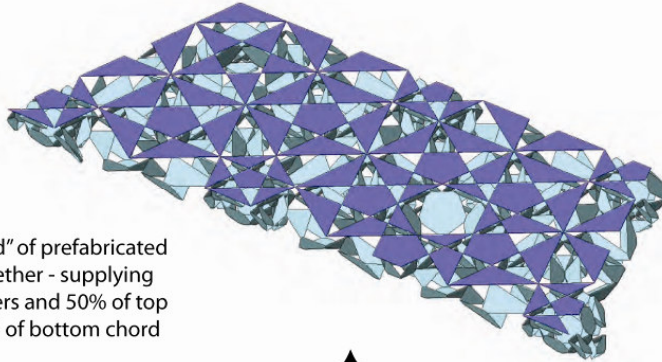
ARUP AGU

Structure

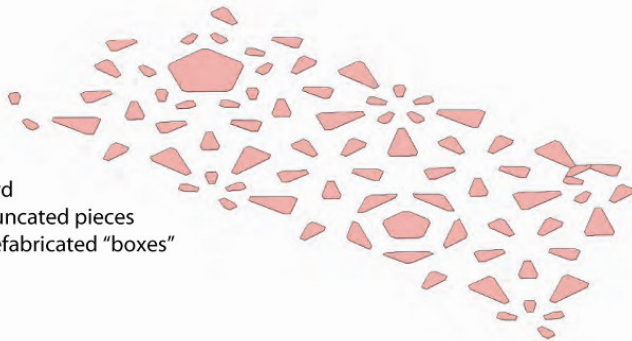
top chord of
double glazed panels



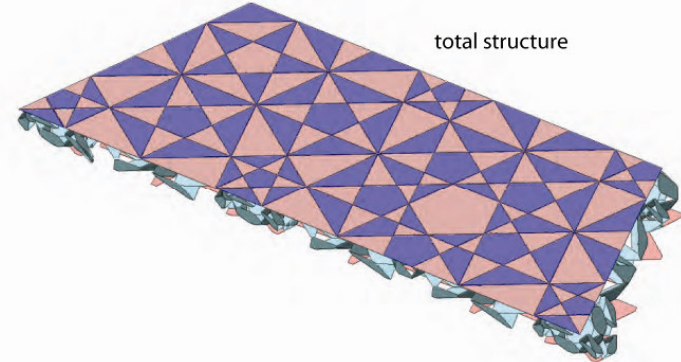
"chequer-board" of prefabricated
"boxes" fit together - supplying
all web members and 50% of top
chord and 50% of bottom chord

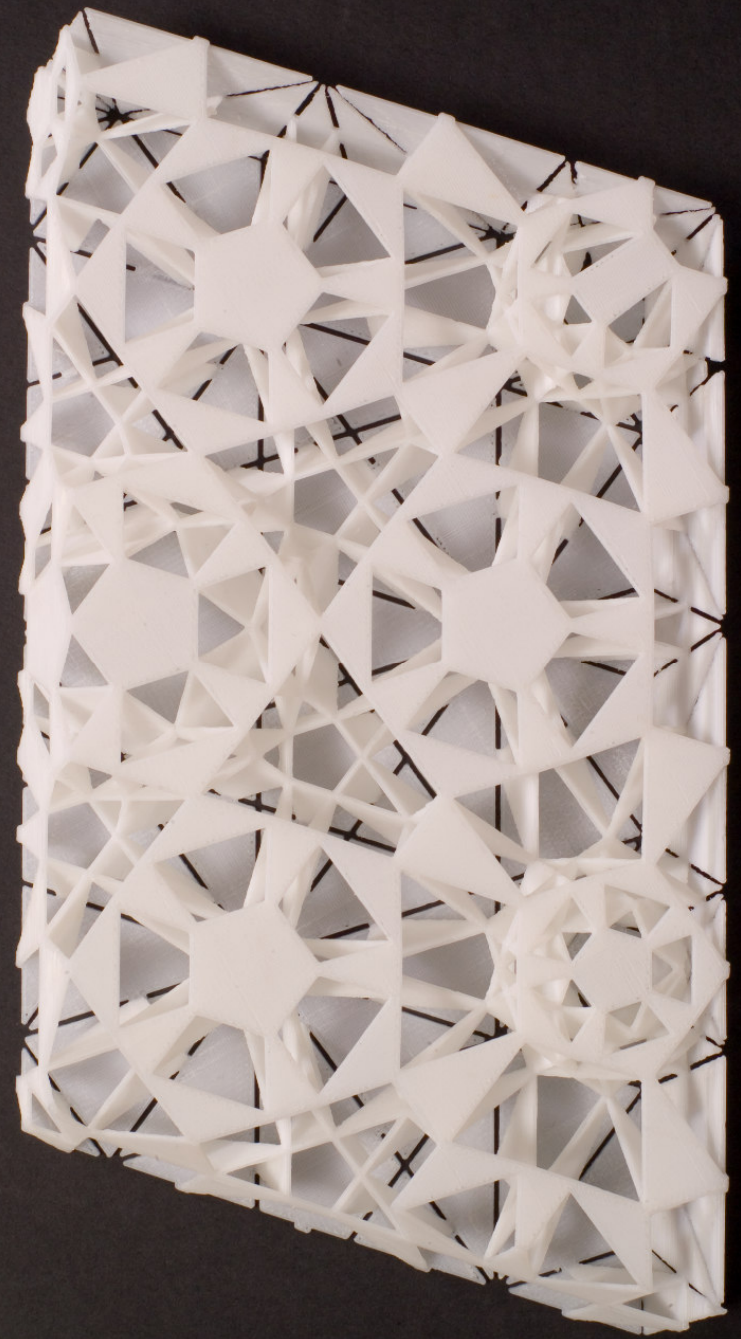


bottom chord
structural truncated pieces
between prefabricated "boxes"

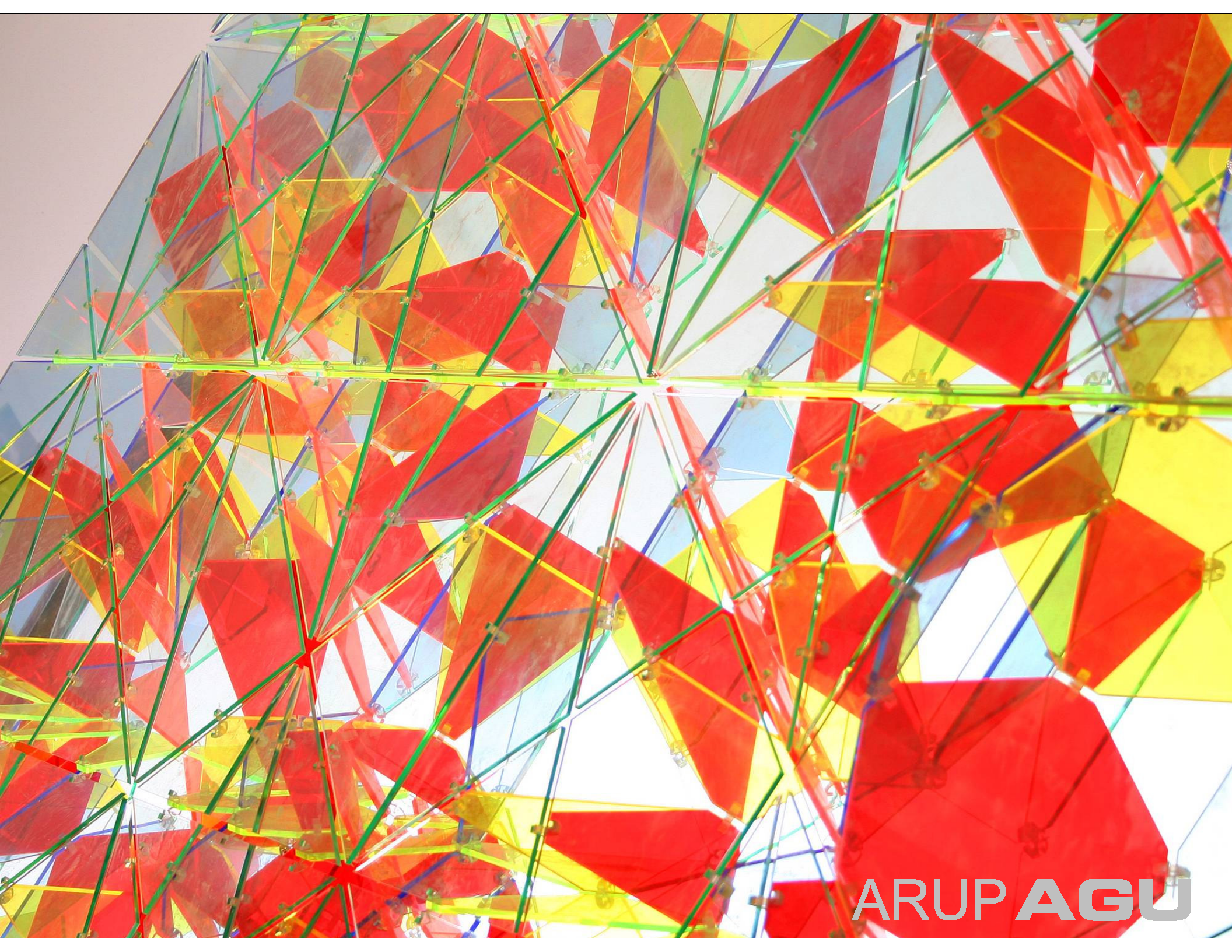


total structure





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FRACTAL GEOMETRY

GRAND EGYPTIAN MUSEUM/CAIRO EGYPT

HENEGEN PENG WITH AGU

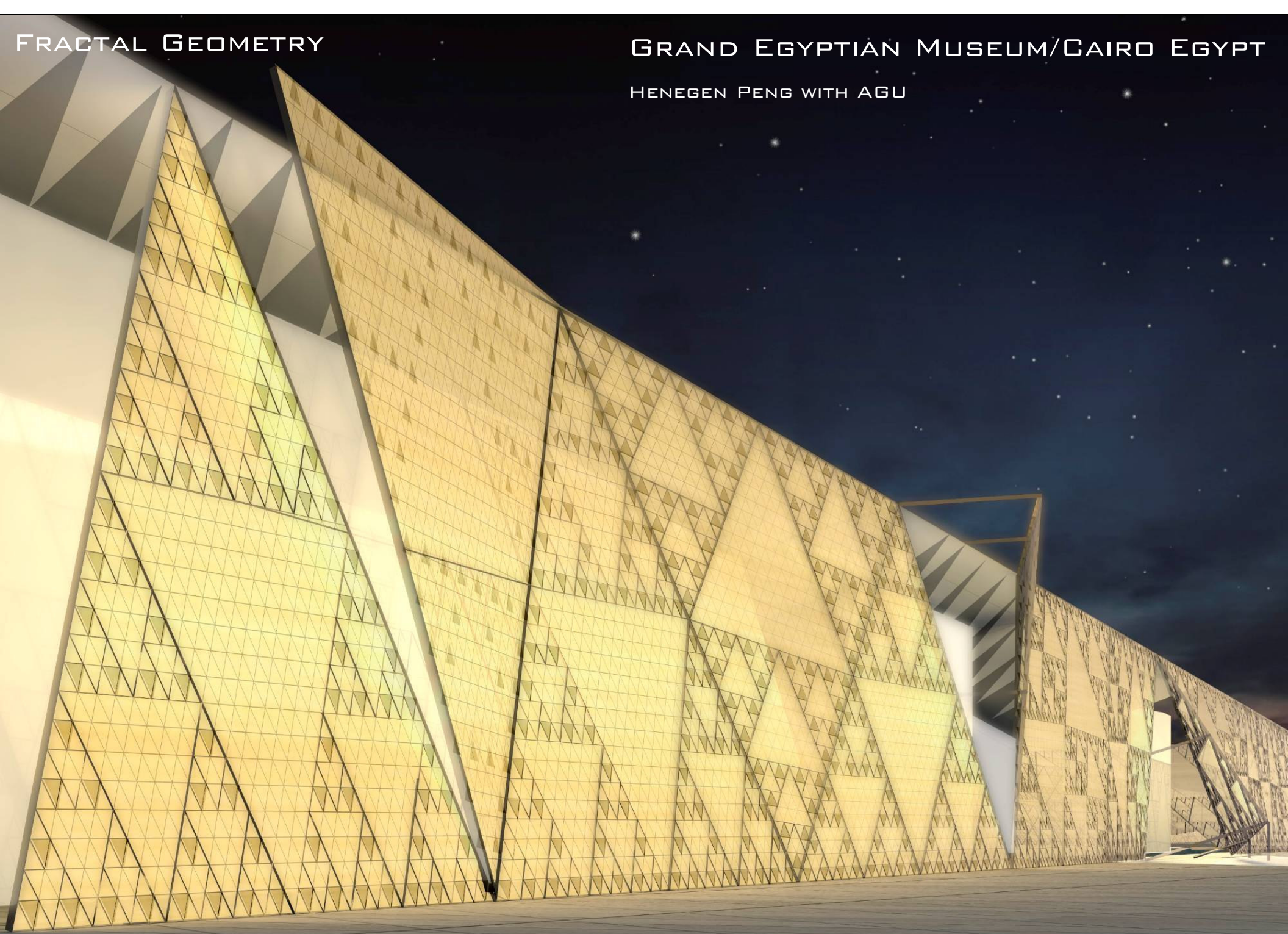
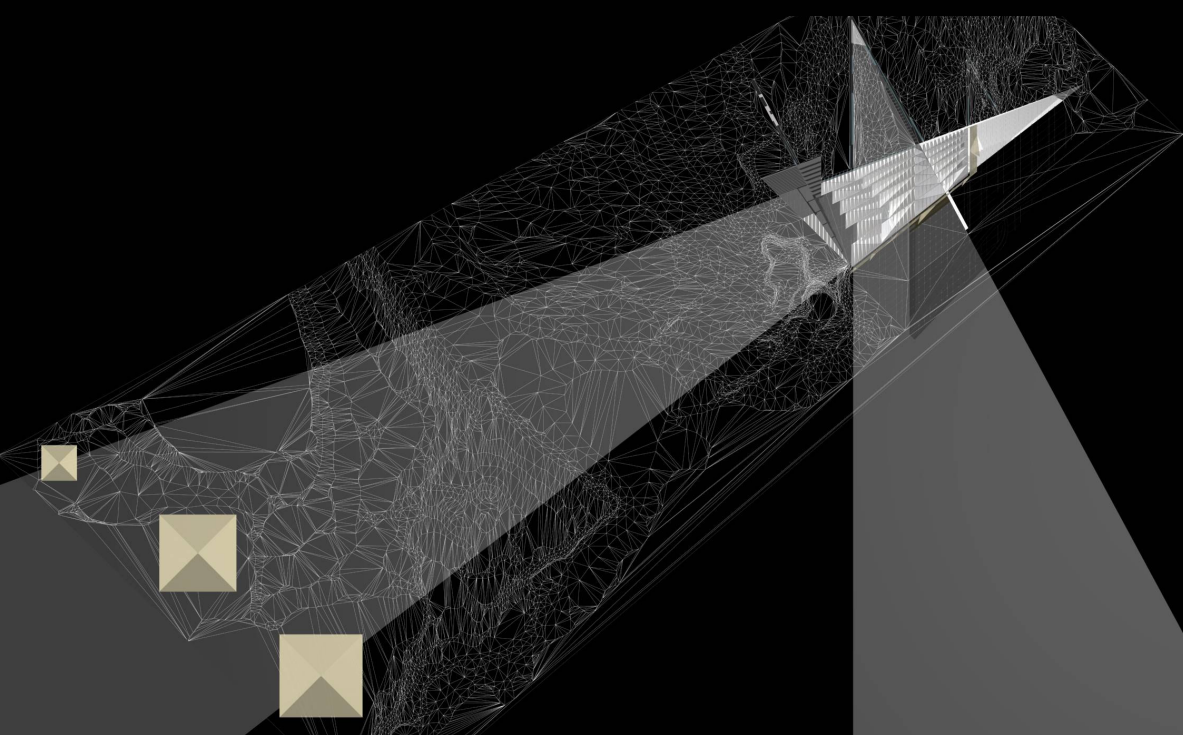
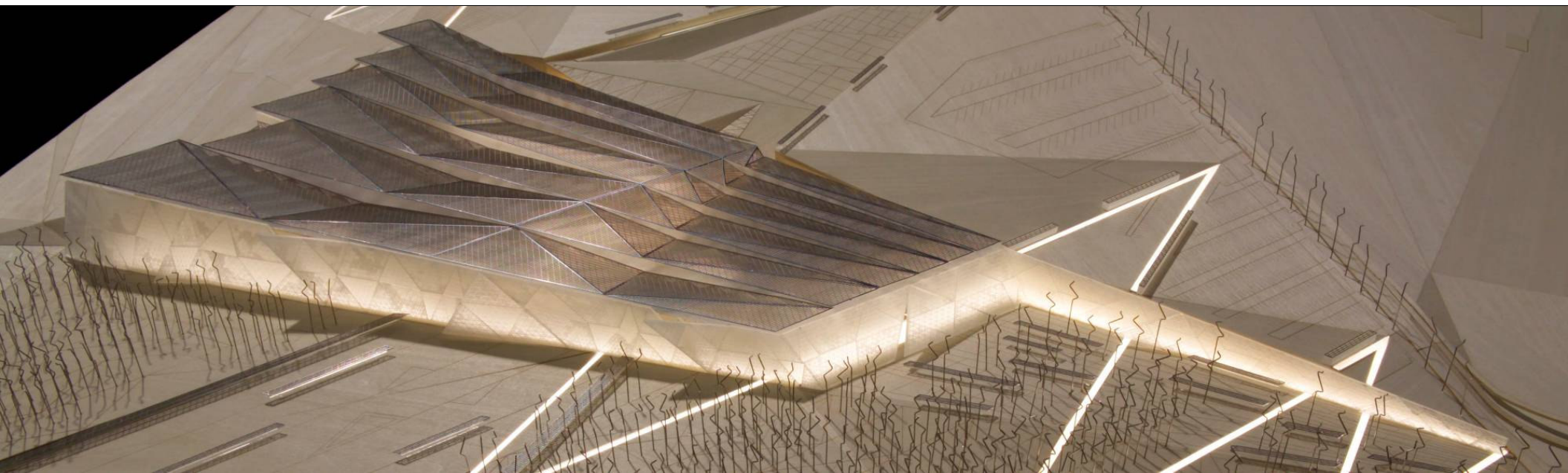
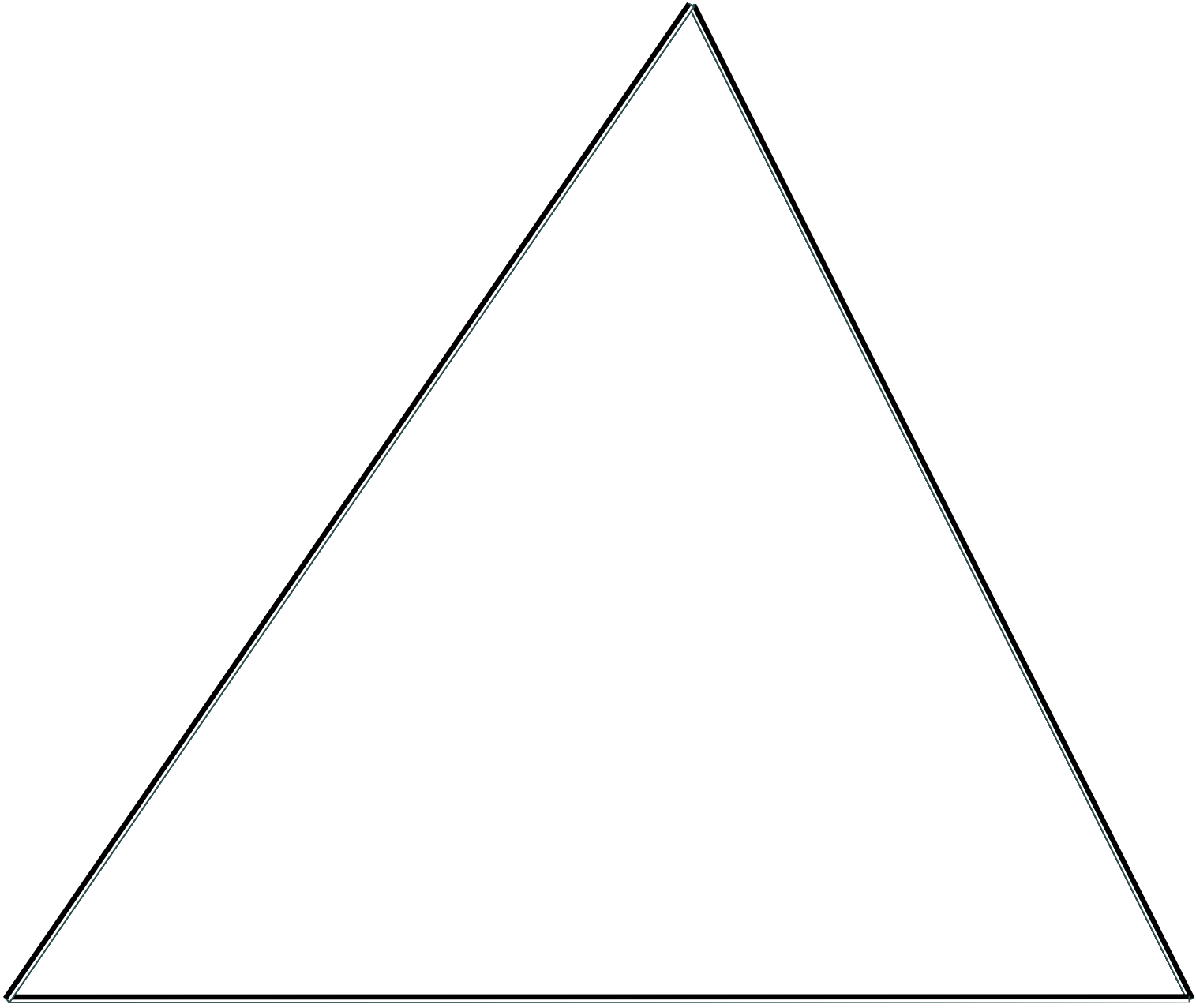


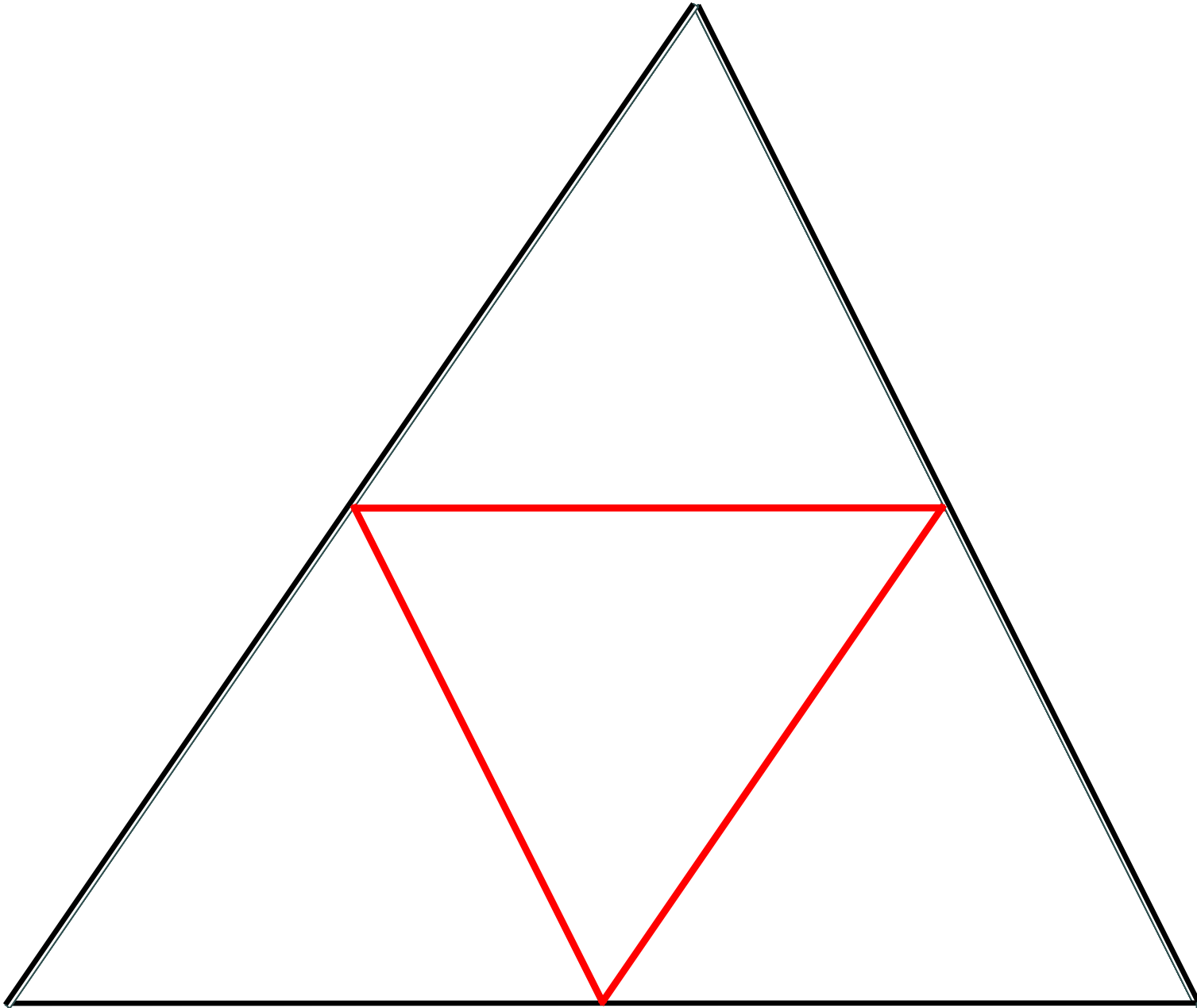
IMAGE BY HENEGEN PENG ARCHITECTS



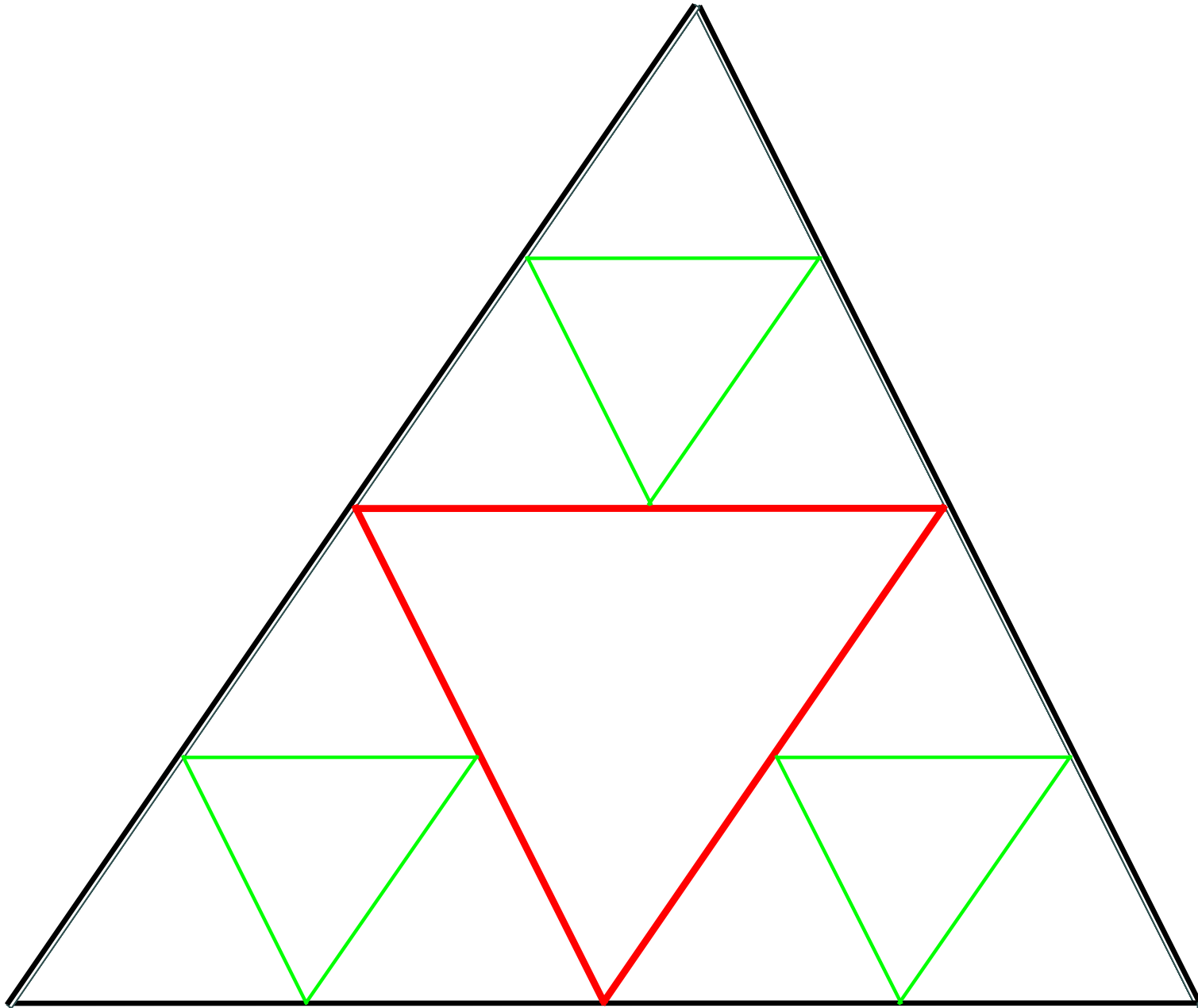
ARUP AGU



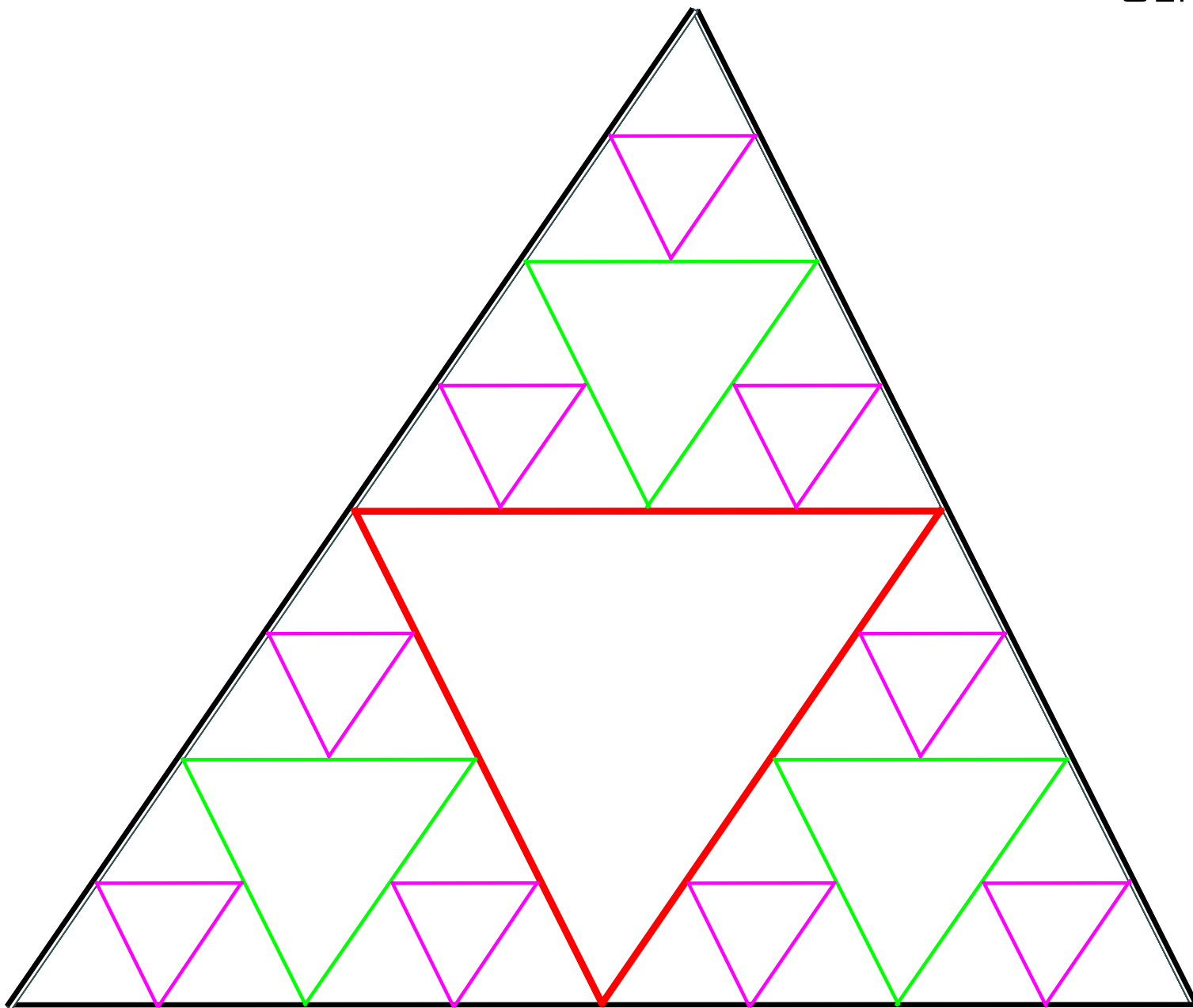
SIERPINSKI
GENERATION 2



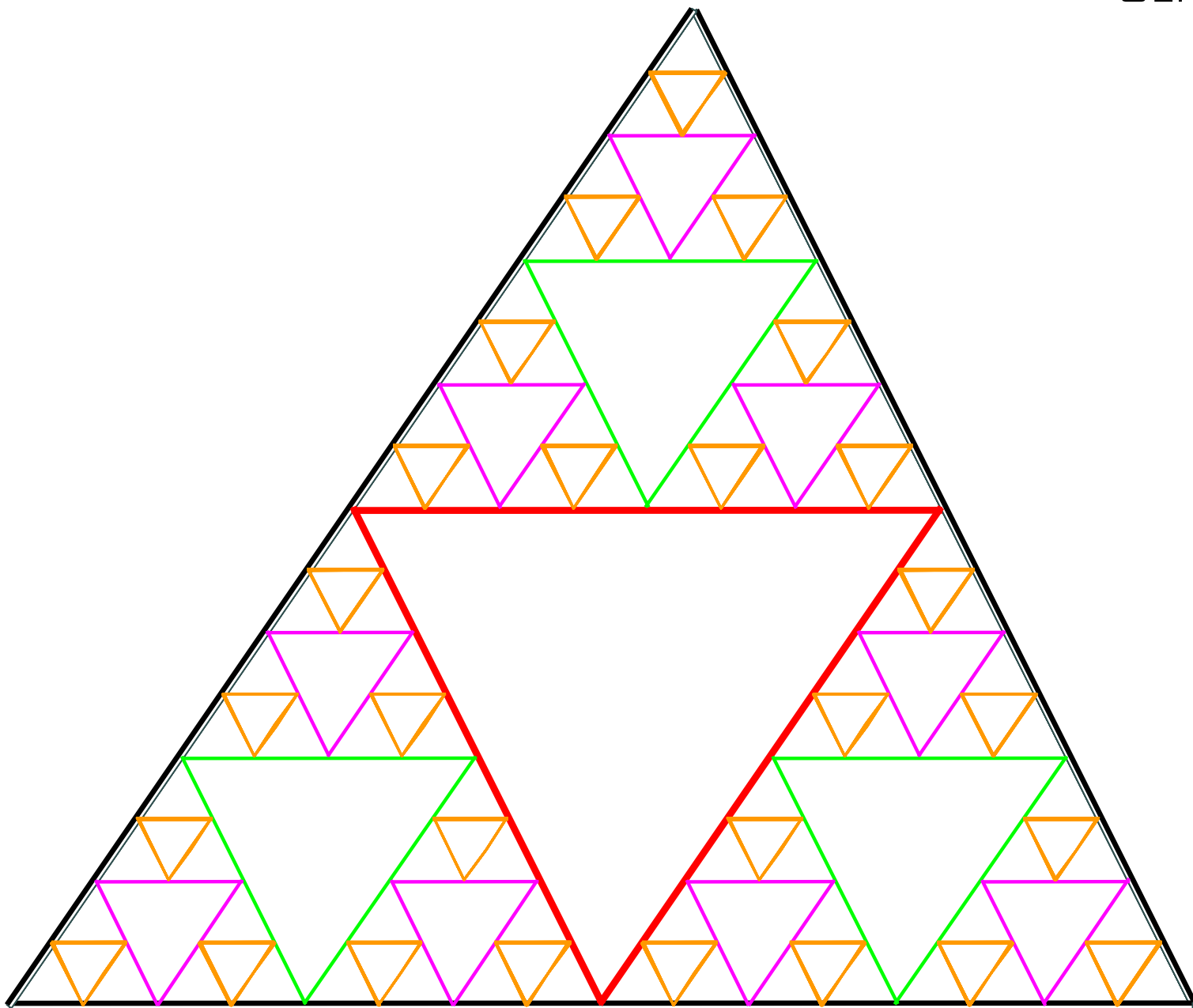
SIERPINSKI
GENERATION 3



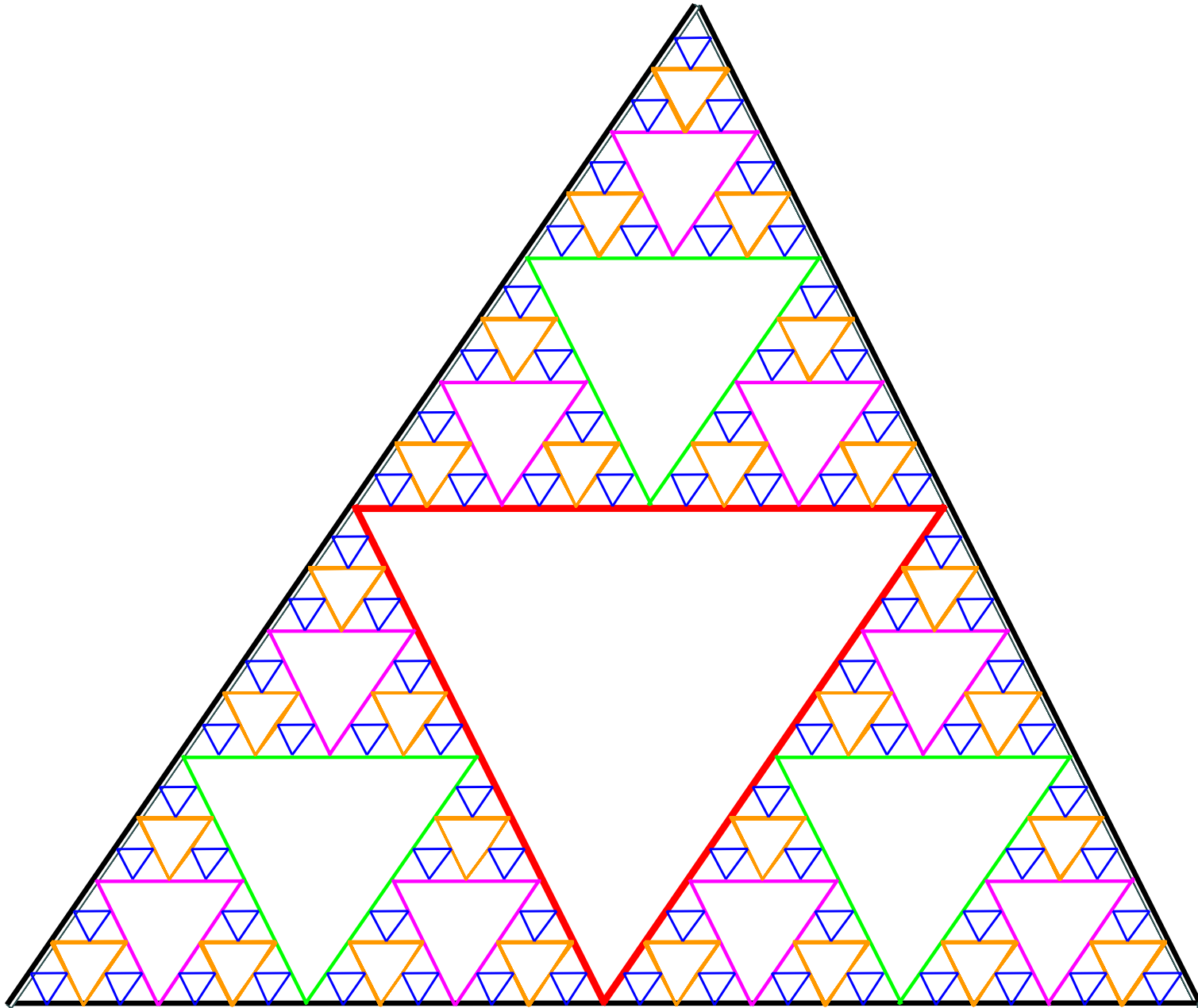
SIERPINSKI
GENERATION 4

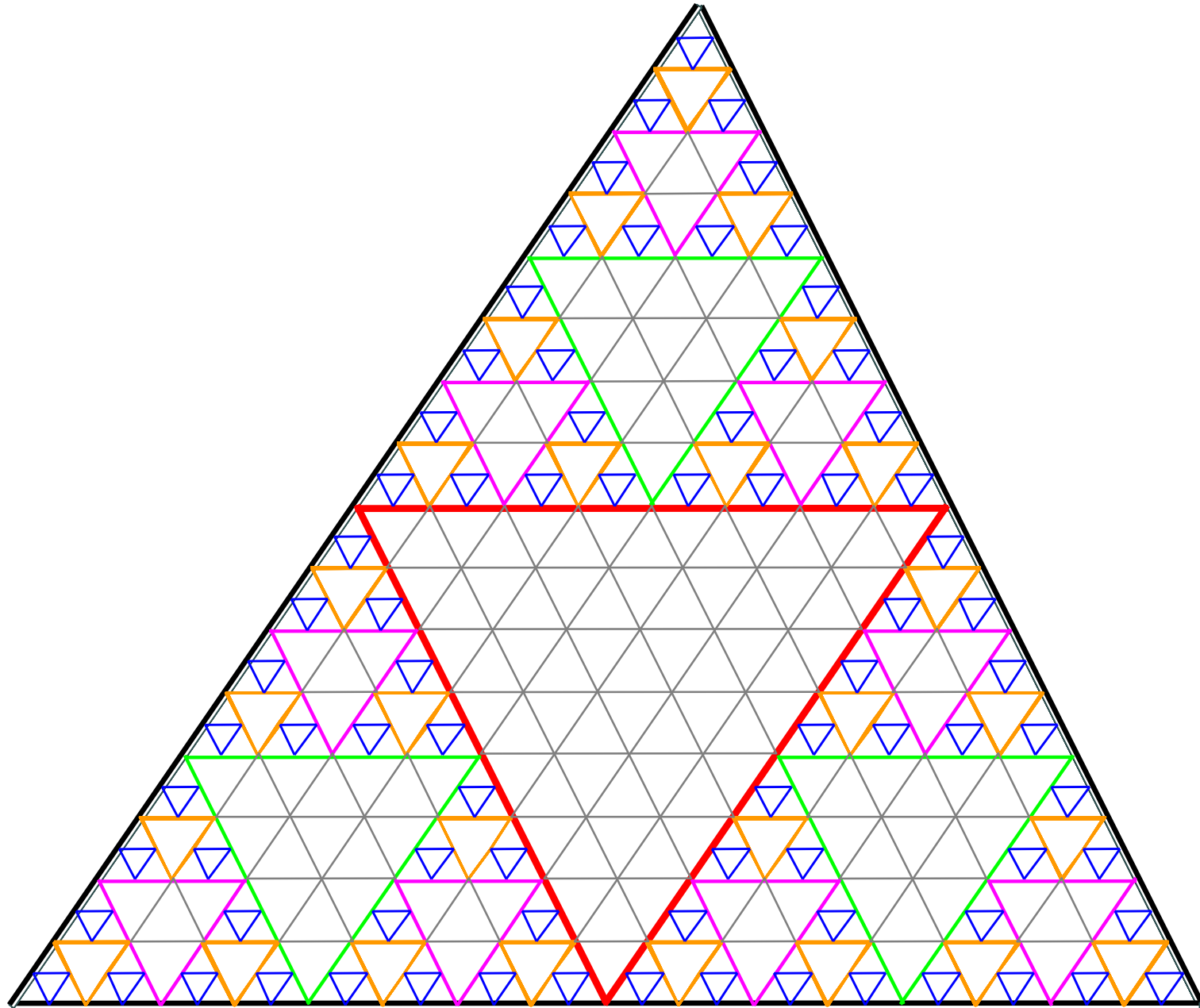


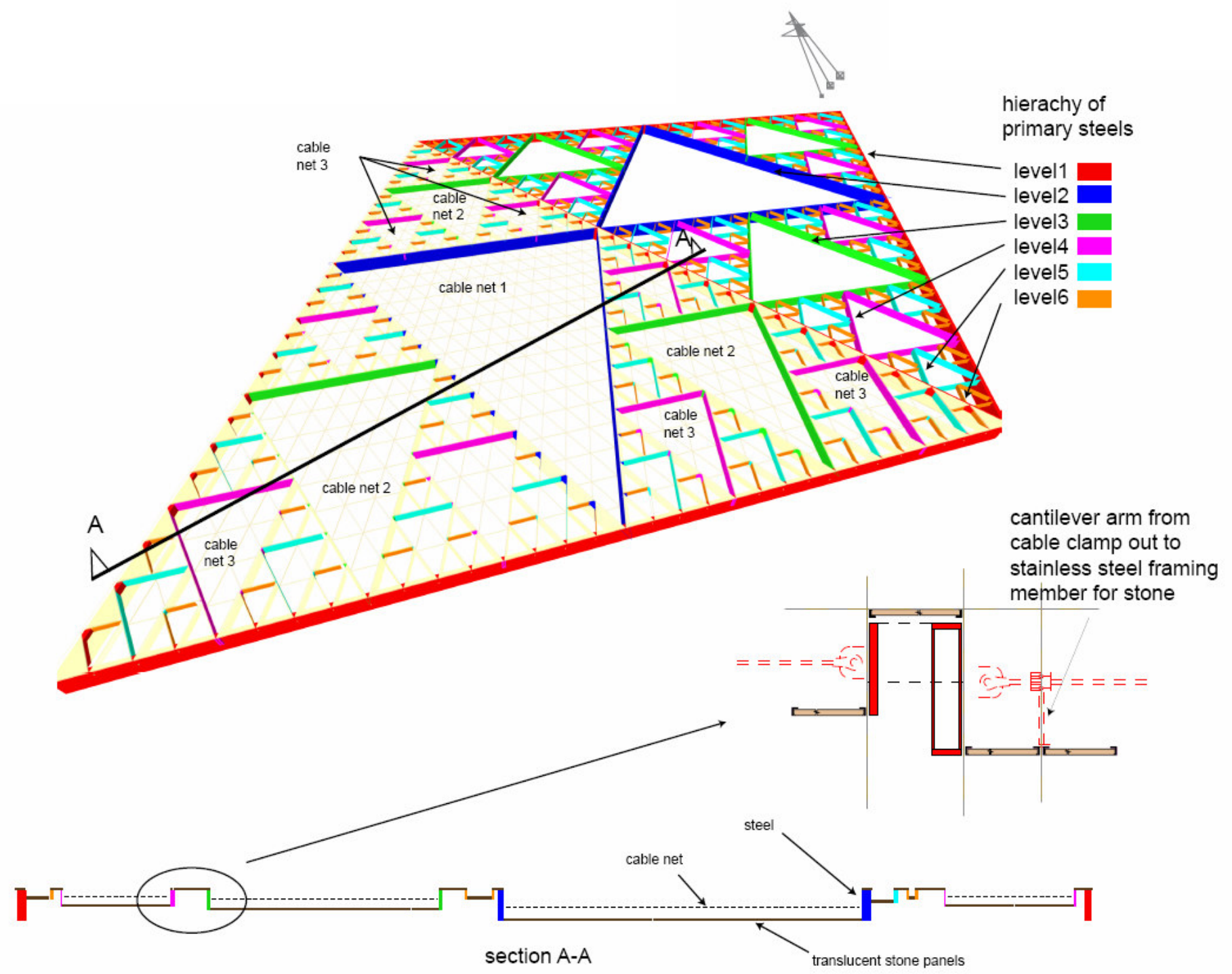
SIERPINSKI
GENERATION 5

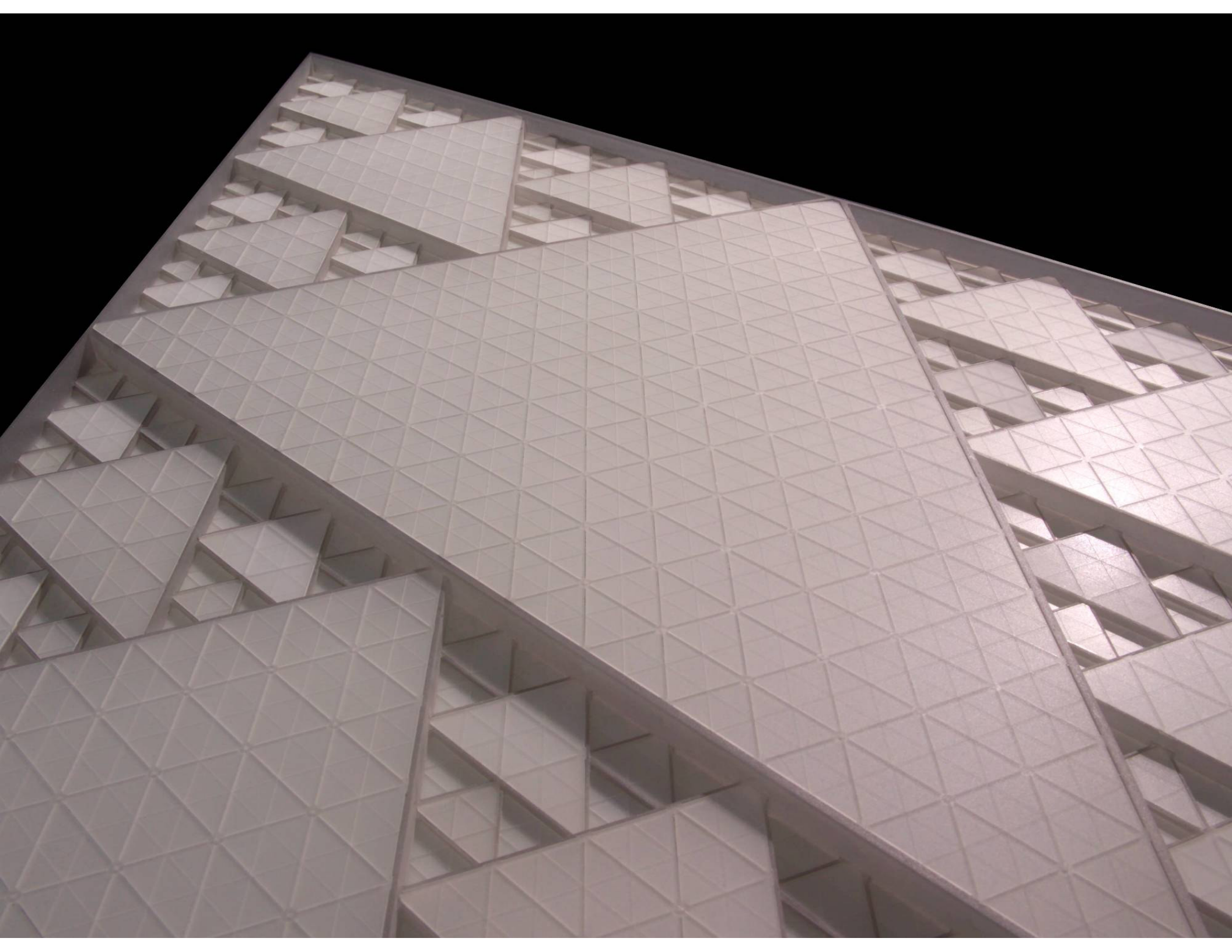


SIERPINSKI
GENERATION 6









Click a
377 cu
Comm
Comm



Sierpinski Generations:

Gap between Panels [mm]:

Profiles		d [mm]	w [mm]	t flange [mm]	t web [mm]
Sierpinski 1	<input type="checkbox"/> Solid	<input type="text" value="800"/>	<input type="text" value="200"/>	<input type="text" value="40"/>	<input type="text" value="20"/>
Sierpinski 2	<input type="checkbox"/> Solid	<input type="text" value="800"/>	<input type="text" value="150"/>	<input type="text" value="25"/>	<input type="text" value="15"/>
Sierpinski 3	<input type="checkbox"/> Solid	<input type="text" value="500"/>	<input type="text" value="200"/>	<input type="text" value="25"/>	<input type="text" value="10"/>
Sierpinski 4	<input checked="" type="checkbox"/> Solid	<input type="text" value="400"/>	<input type="text" value="50"/>	<input type="text"/>	<input type="text"/>
Sierpinski 5	<input checked="" type="checkbox"/> Solid	<input type="text" value="300"/>	<input type="text" value="35"/>	<input type="text"/>	<input type="text"/>
Sierpinski 6	<input checked="" type="checkbox"/> Solid	<input type="text" value="150"/>	<input type="text" value="25"/>	<input type="text"/>	<input type="text"/>

Cable Net 1:

Cable Net 2:

Cable Net 3:

Offsets of Cableplanes relative to interior face of steel:

Offset cablenet 1 [mm]: U - Direction (Horizontal)

Offset cablenet 2 [mm]: W - Direction (Parallel Side2)

Offset cablenet 3 [mm]: V - Direction (Parallel Side3)

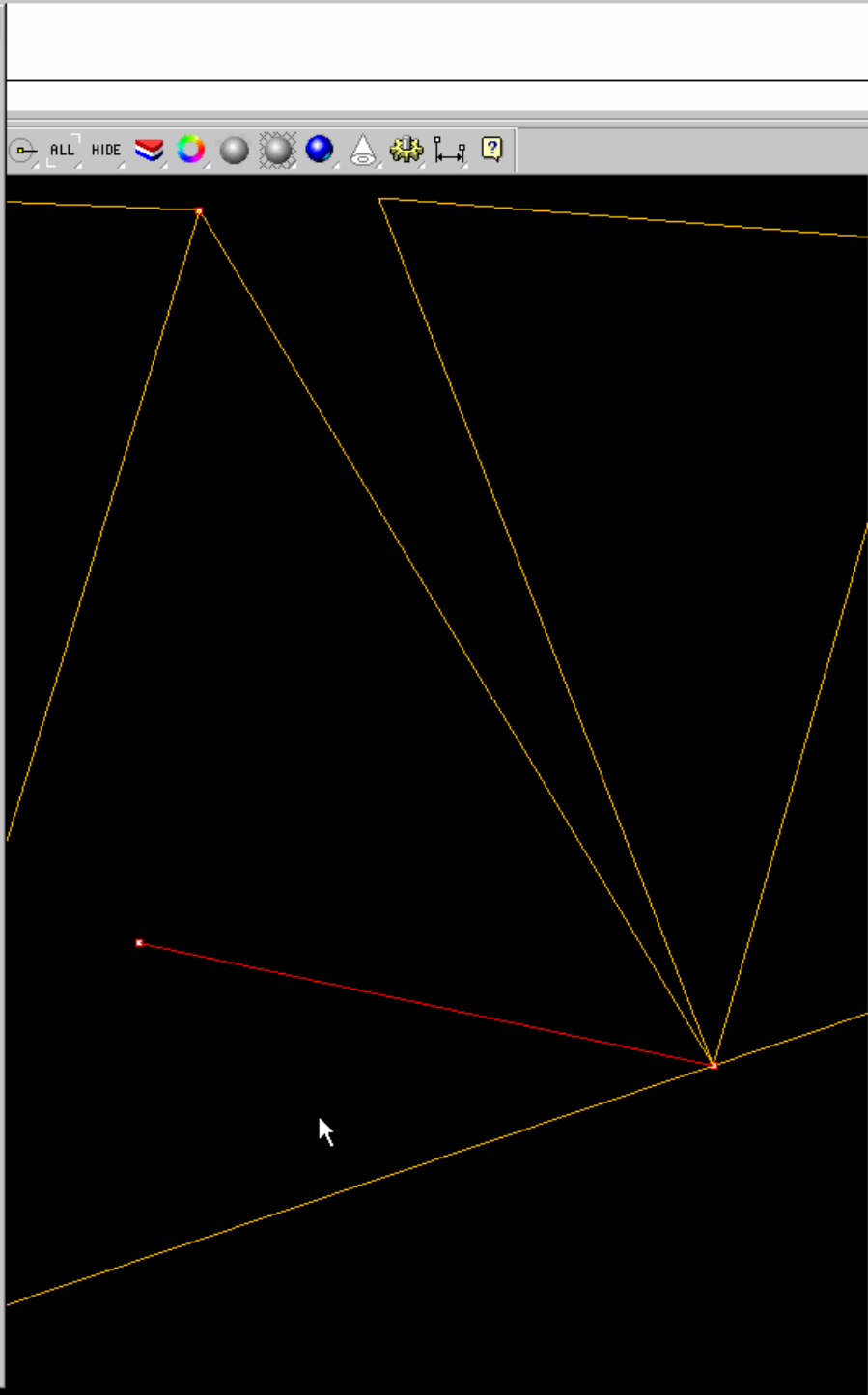
Half Density Cable Nets

Loads

		Prestress [kN]
Cladding [kN/m2]	<input type="text" value="1.0"/>	Cablenet 1 <input type="text" value="60"/>
Wind [kN/m2]	<input type="text" value="1.0"/>	Cablenet 2 <input type="text" value="50"/>
		Cablenet 3 <input type="text" value="40"/>

Draw points Draw members Draw Cladding

Inverse panel Planar offset Create GWA file



ALL HIDE [color icons]

Layers - All Layers

Name	Light	Color
working	<input type="checkbox"/>	
offset principle	<input type="checkbox"/>	
outline	<input type="checkbox"/>	
srf	<input type="checkbox"/>	
input	<input type="checkbox"/>	
Sierpinski1	<input type="checkbox"/>	
Sierpinski2	<input type="checkbox"/>	
Sierpinski3	<input type="checkbox"/>	
Sierpinski4	<input type="checkbox"/>	
Sierpinski5	<input type="checkbox"/>	
Sierpinski6	<input type="checkbox"/>	
Sierpinski7	<input type="checkbox"/>	
Sierpinski8	<input type="checkbox"/>	
Sierpinski9	<input type="checkbox"/>	
Sierpinski10	<input checked="" type="checkbox"/>	
Sierpinski11	<input type="checkbox"/>	
Sierpinski12	<input type="checkbox"/>	
Sierpinski13	<input type="checkbox"/>	
Sierpinski14	<input type="checkbox"/>	

Properties

Object:

Object type:

Name:

Layer:

Color:

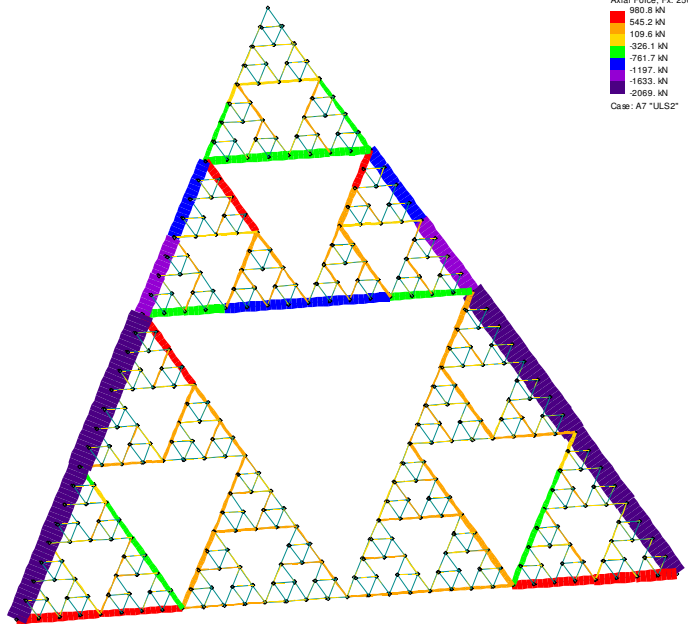
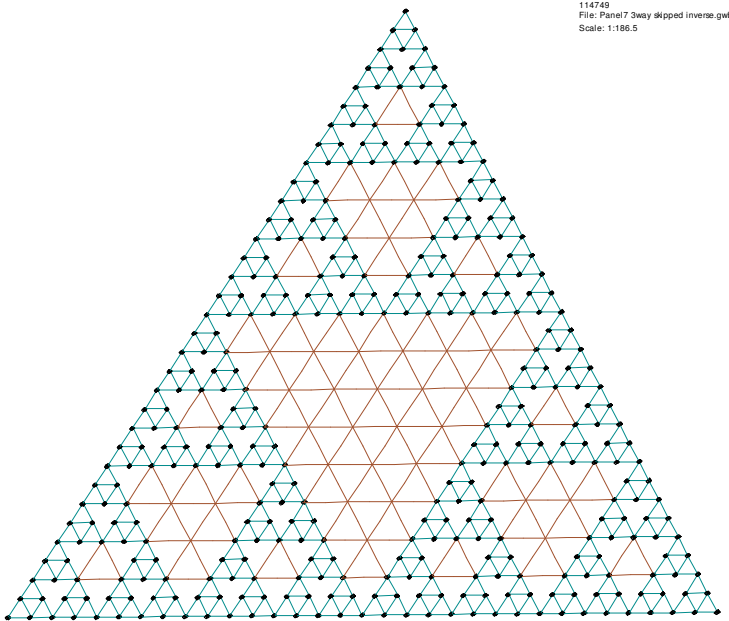
Isocurve density:

Show surface isocurve

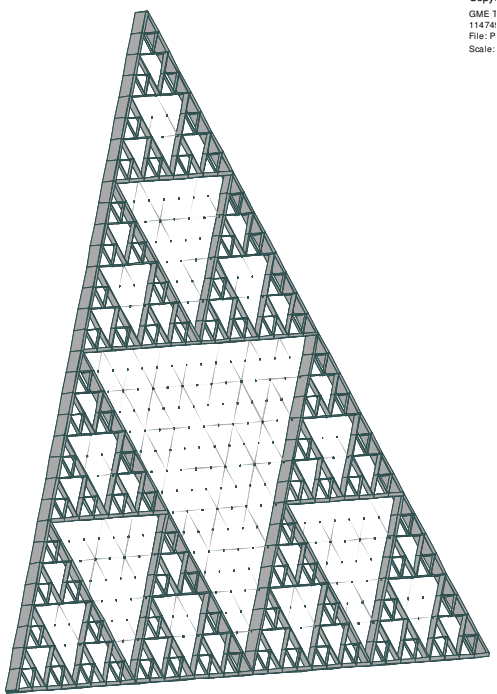
AUTOMATED STRUCTURAL MODEL

GSA version 8.1
 Copyright © Oasys 1997-2005
 GME Translucent Stone wall
 114749
 File: Panel7.3way skipped inverse.gwb
 Scale: 1:186.5

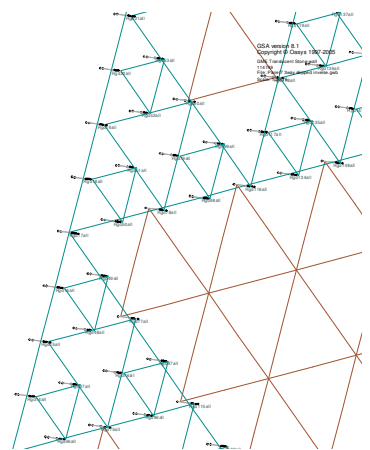
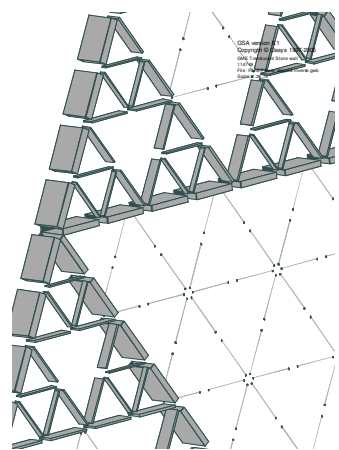
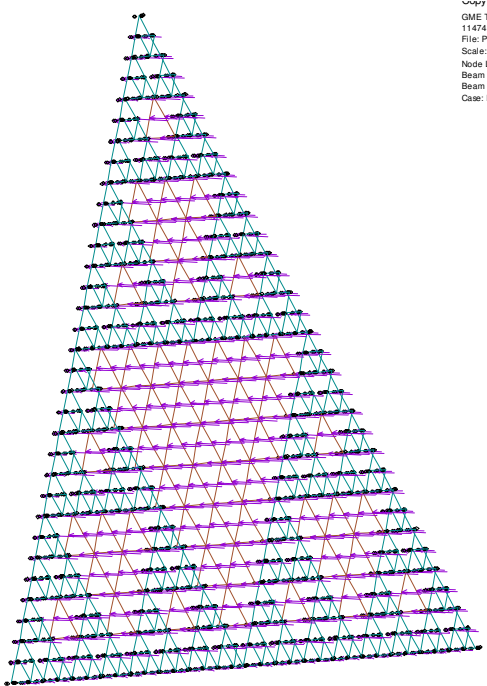
Element Id: "Frame"
 Scale: 1:193.4
 Axial Force, Fx: 2500. Wpic.cm
 990.8 kN
 545.2 kN
 109.6 kN
 -325.1 kN
 -761.7 kN
 -1197. kN
 -1633. kN
 -2059. kN
 Case: A7 'ULS2'



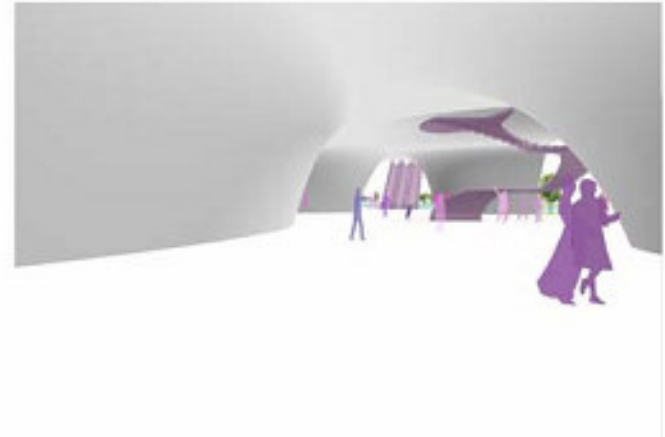
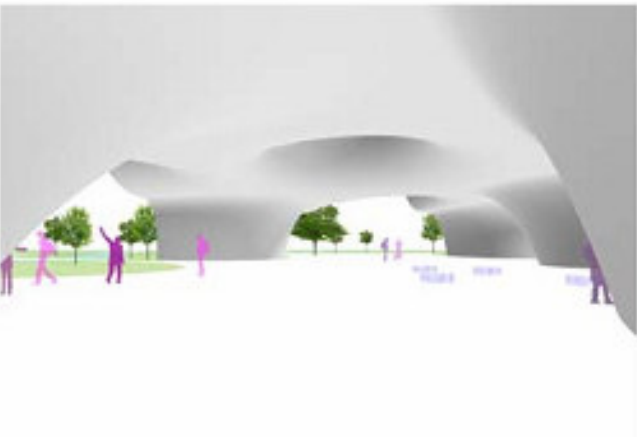
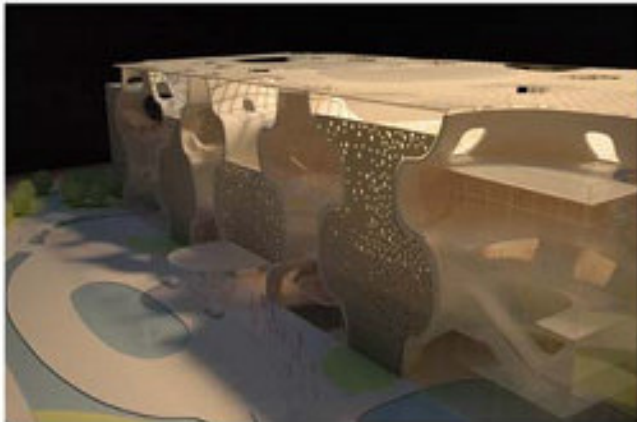
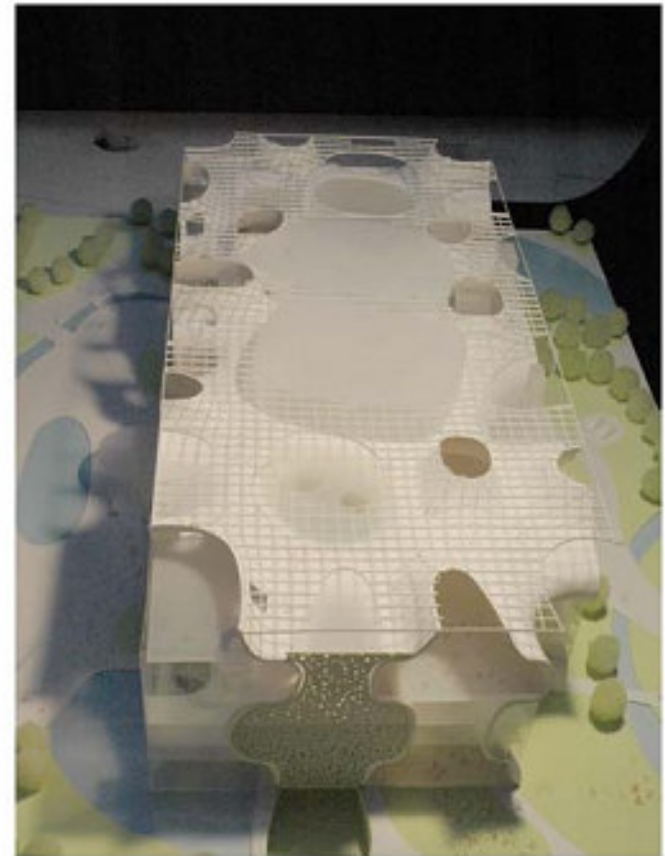
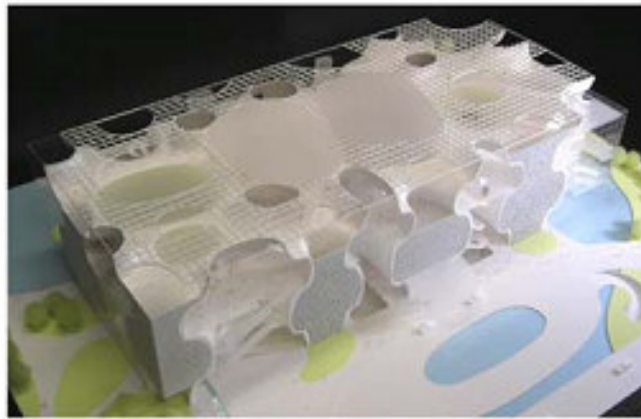
GSA
 Copy:
 GME 1
 114749
 File: P
 Scale:



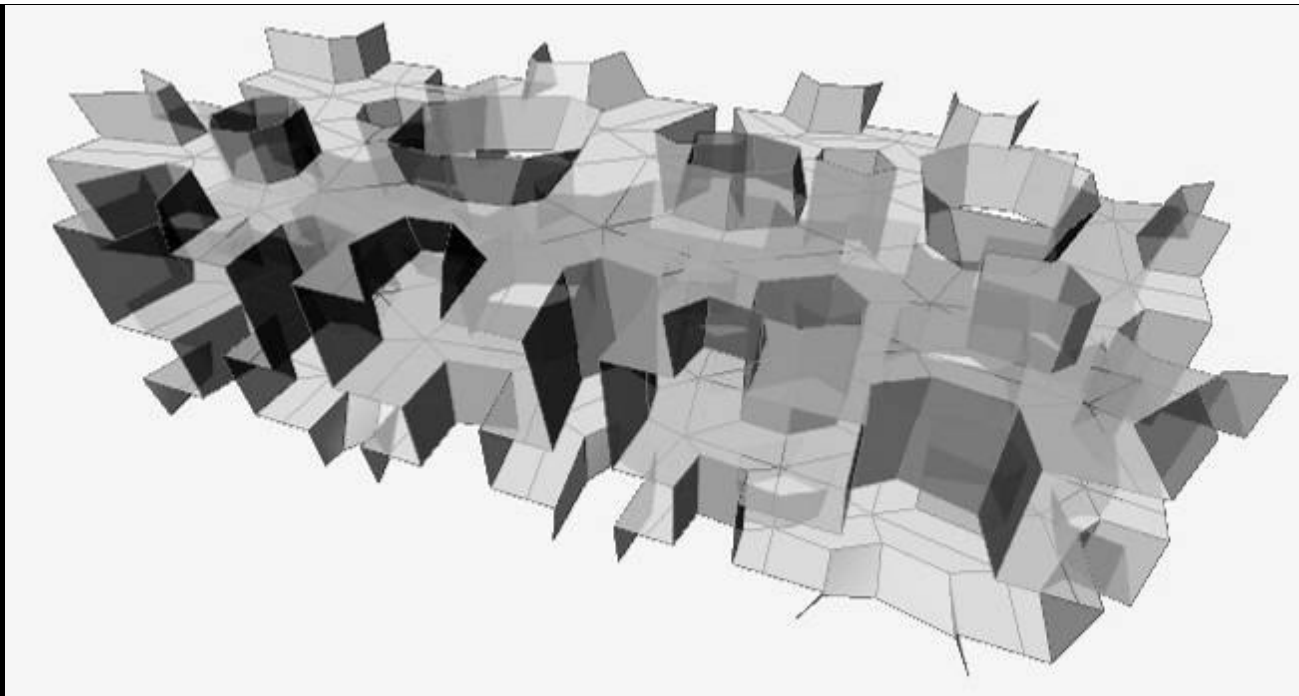
GSA
 GME 1
 114749
 File: P
 Scale:
 Node I
 Beam I
 Case: L



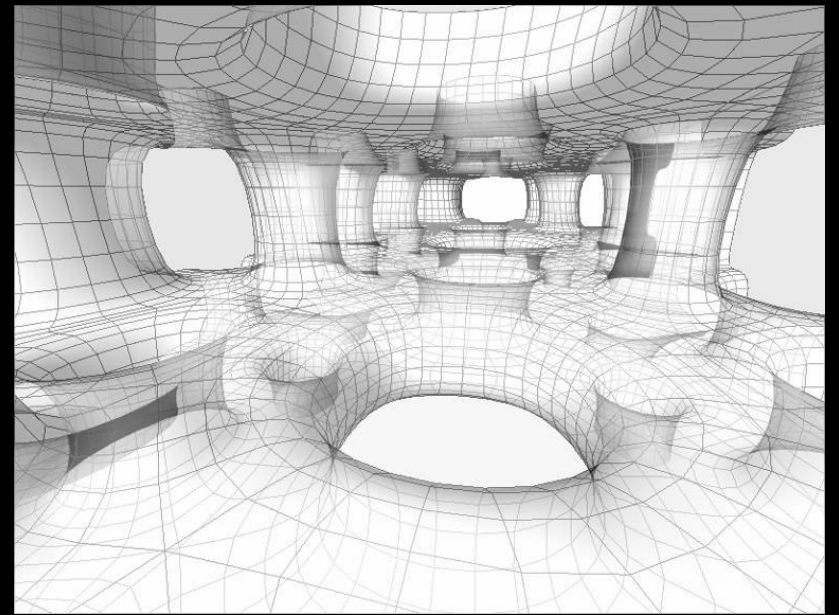
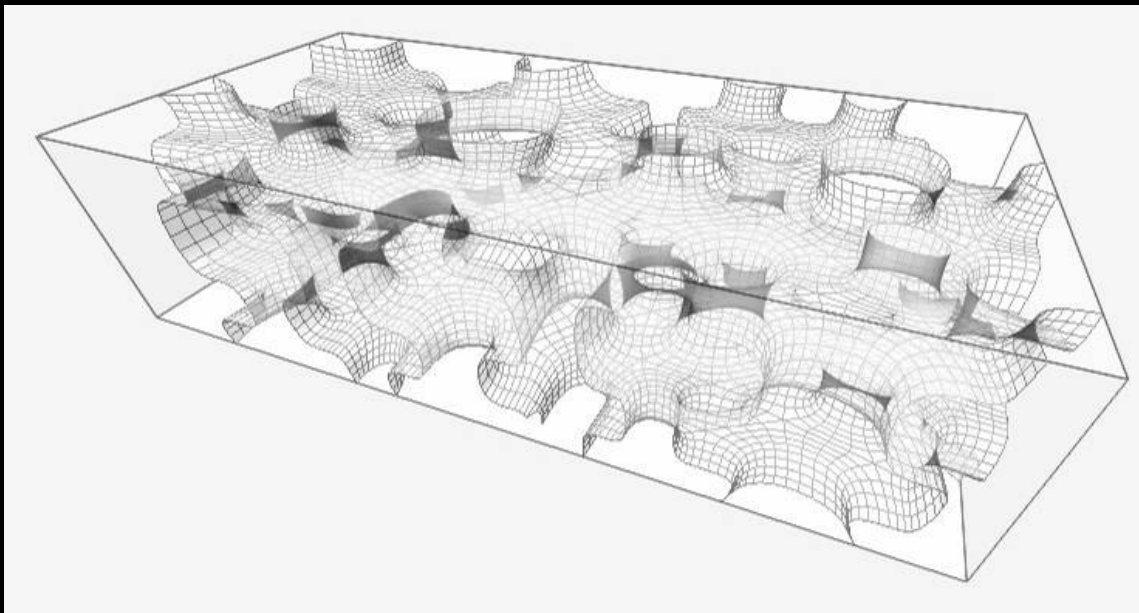
TAICHUNG OPERA HOUSE



CRUDE
MESH

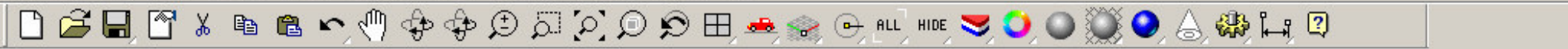


CATMULL CLARK ALGORITHM

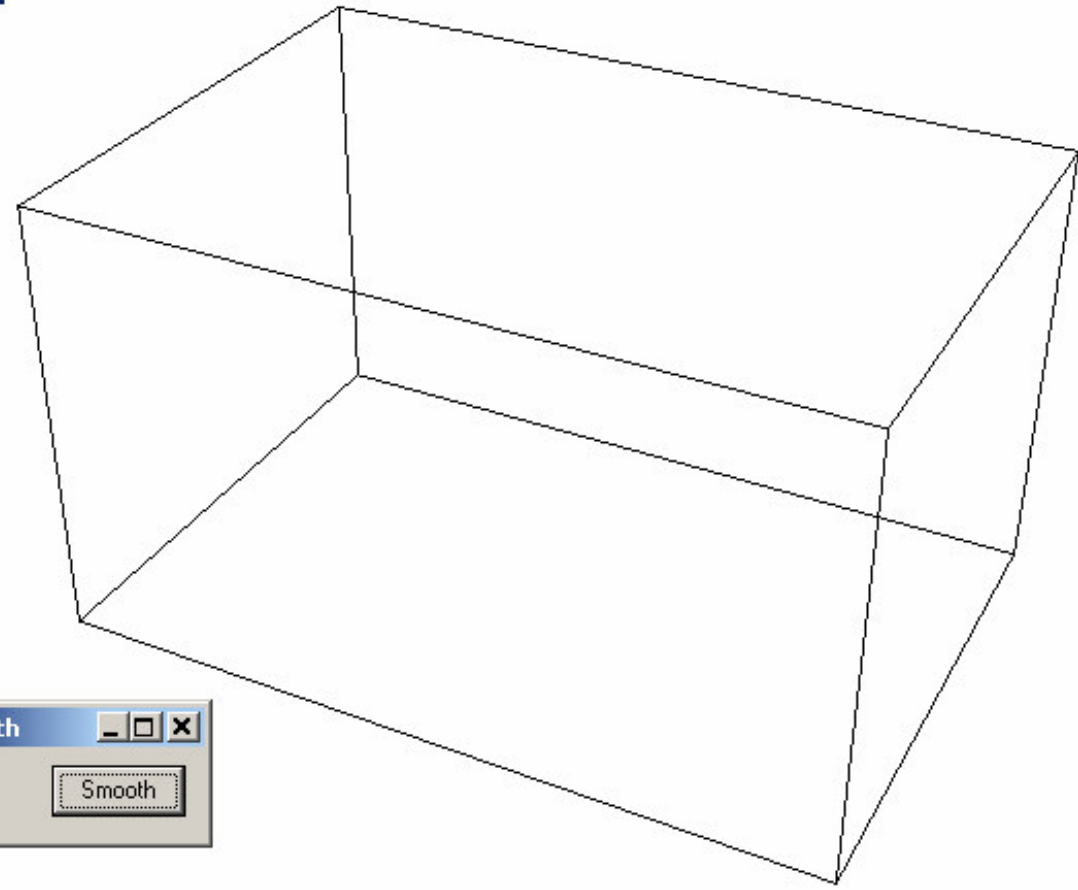


SMOOTH MESH

ARUP AGU



Perspective

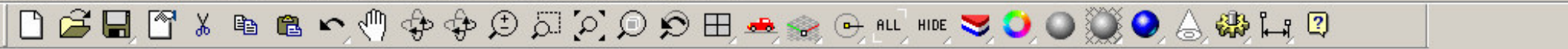


Layers - All Layers

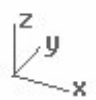
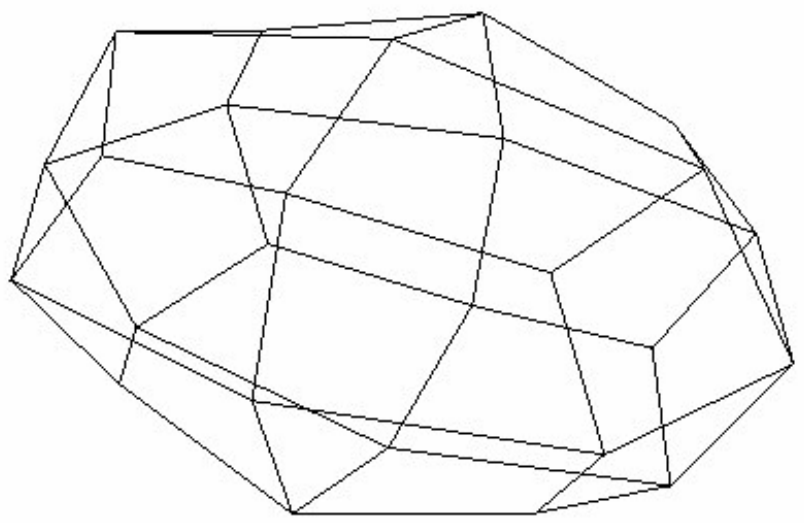
Name	Lock	Light	Color	Style
Default	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	White	None
Layer 01	<input type="checkbox"/>	<input type="checkbox"/>	Red	None
Layer 02	<input type="checkbox"/>	<input type="checkbox"/>	Purple	None
Layer 03	<input type="checkbox"/>	<input type="checkbox"/>	Blue	None
Layer 04	<input type="checkbox"/>	<input type="checkbox"/>	Green	None
Layer 05	<input type="checkbox"/>	<input type="checkbox"/>	Yellow	None

Command: _Zoom
 Drag a window to zoom (All Dynamic Extents Factor In Out Selected Target): _Extents
 Command: _ScreenCaptureToFile

Command:



Perspective



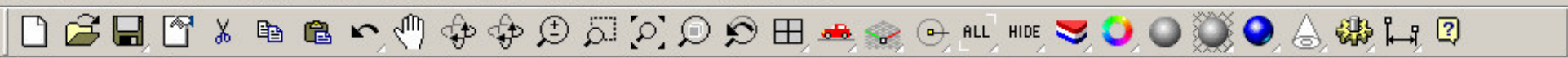
Layers - All Layers

Name	Lock	Light	Color	Alpha
Default	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Black	100%
Layer 01	<input type="checkbox"/>	<input type="checkbox"/>	Red	100%
Layer 02	<input type="checkbox"/>	<input type="checkbox"/>	Purple	100%
Layer 03	<input type="checkbox"/>	<input type="checkbox"/>	Blue	100%
Layer 04	<input type="checkbox"/>	<input type="checkbox"/>	Green	100%
Layer 05	<input type="checkbox"/>	<input type="checkbox"/>	White	100%

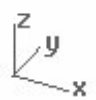
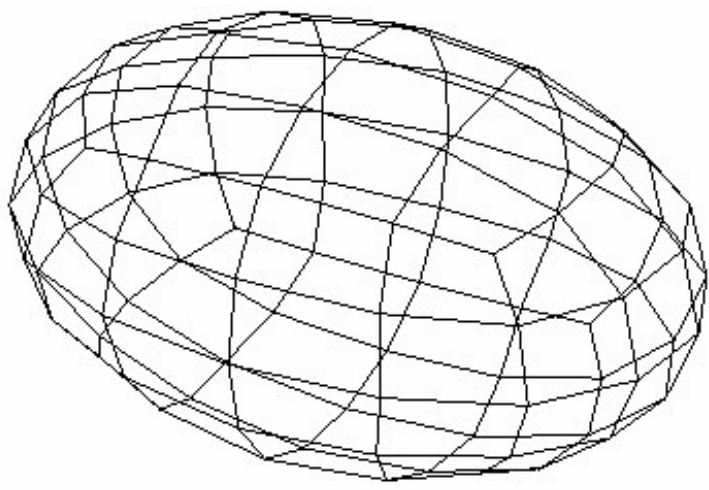
Drag a window to zoom (All Dynamic Extents Factor In Out Selected Target): _Extents
 Command: _ScreenCaptureToFile
 Pick a mesh:
Pick a mesh:

End Near Point Mid Cen Int Perp Tan Quad Knot Project Disable

CPlane x -13.611 y 11.356 z 0 Default Snap Ortho Planar Osnap



Perspective



Layers - All Layers

Name	Lock	Light	Color	Alpha
Default	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	White	100%
Layer 01	<input type="checkbox"/>	<input type="checkbox"/>	Red	100%
Layer 02	<input type="checkbox"/>	<input type="checkbox"/>	Purple	100%
Layer 03	<input type="checkbox"/>	<input type="checkbox"/>	Blue	100%
Layer 04	<input type="checkbox"/>	<input type="checkbox"/>	Green	100%
Layer 05	<input type="checkbox"/>	<input type="checkbox"/>	Yellow	100%

Command: _ScreenCaptureToFile

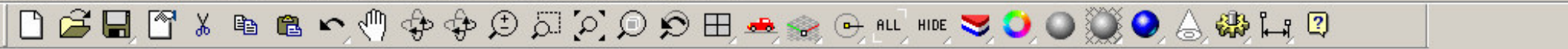
Pick a mesh:

Pick a mesh:

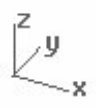
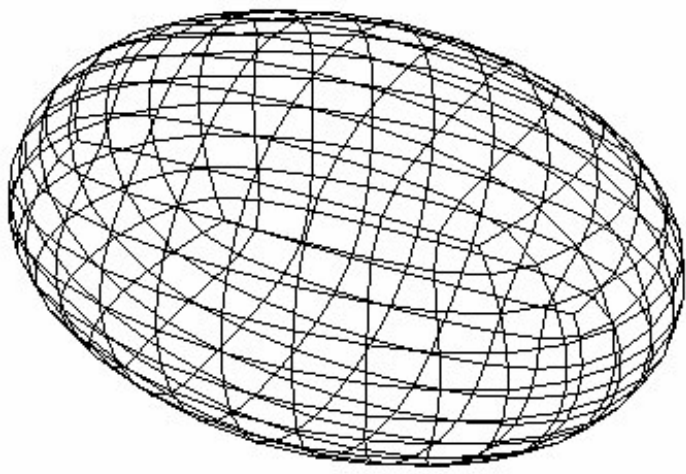
Pick a mesh:

End Near Point Mid Cen Int Perp Tan Quad Knot Project Disable

CPlane x 13.388 y -5.596 z 0 Default Snap Ortho Planar Osnap Select Object



Perspective



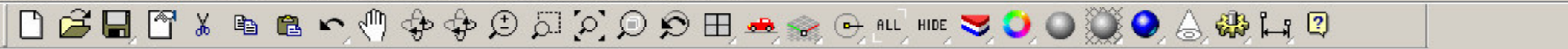
Layers - All Layers

Name	Lock	Light	Color	Visible
Default	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Layer 01	<input type="checkbox"/>	<input type="checkbox"/>	Red	<input type="checkbox"/>
Layer 02	<input type="checkbox"/>	<input type="checkbox"/>	Purple	<input type="checkbox"/>
Layer 03	<input type="checkbox"/>	<input type="checkbox"/>	Blue	<input type="checkbox"/>
Layer 04	<input type="checkbox"/>	<input type="checkbox"/>	Green	<input type="checkbox"/>
Layer 05	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>

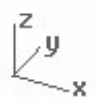
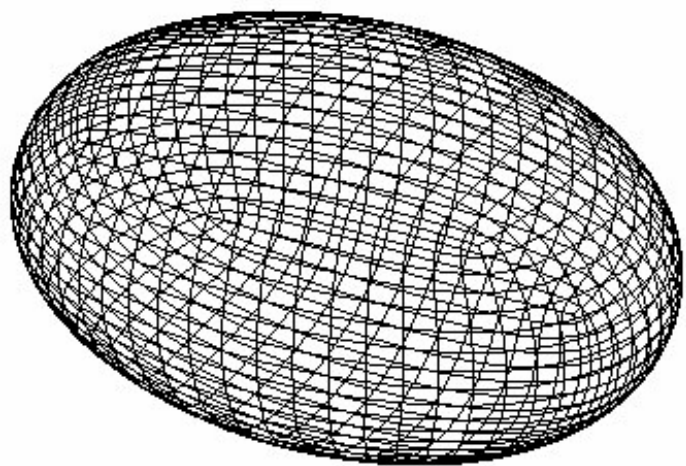
Pick a mesh:
Pick a mesh:
Pick a mesh:
Pick a mesh:

End Near Point Mid Cen Int Perp Tan Quad Knot Project Disable

CPlane x 8.008 y -3.910 z 0 Default **Snap** Ortho Planar **Osnap** Select Object



Perspective



Layers - All Layers

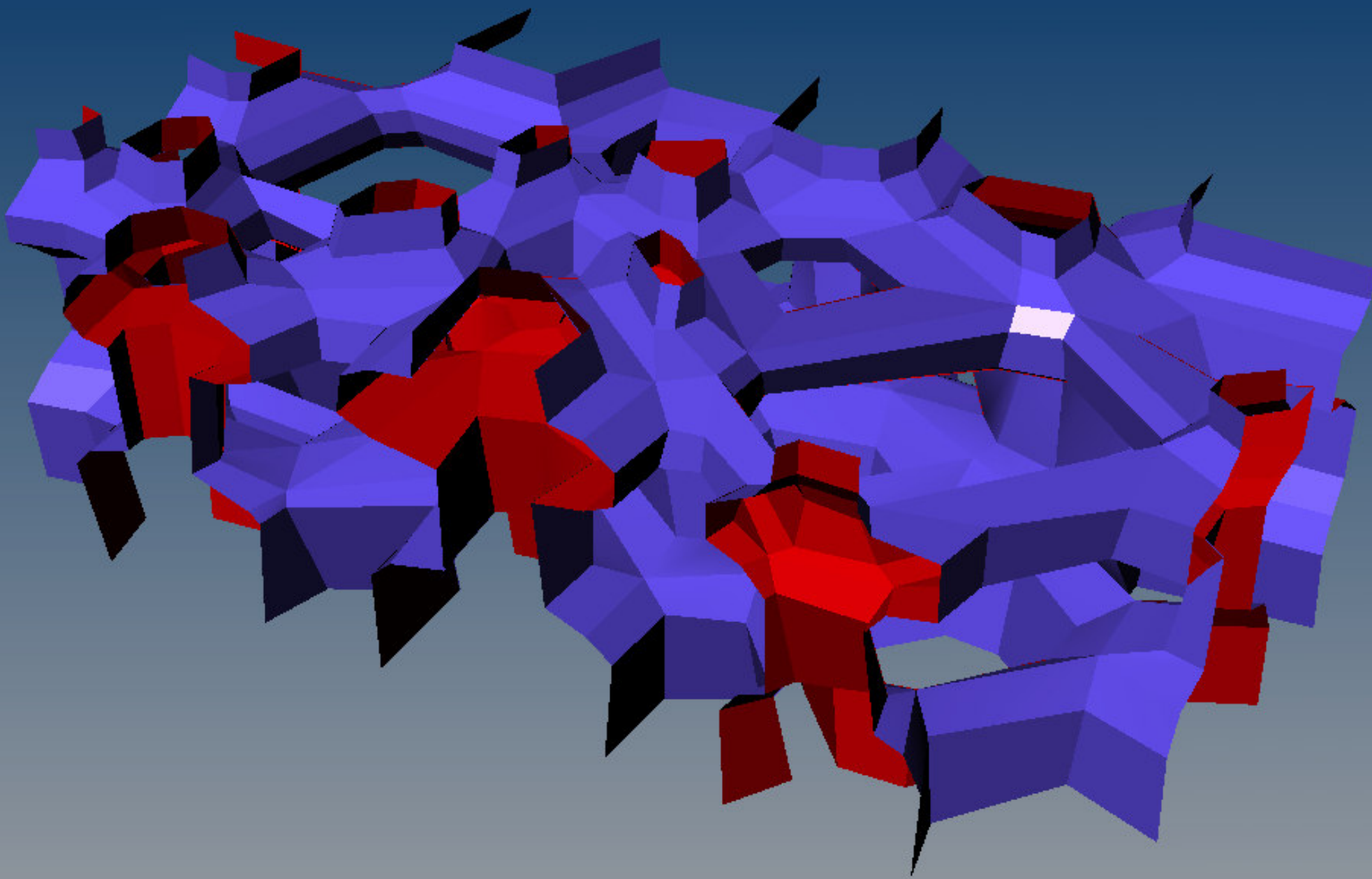
Name	Lock	Light	Color	Visible
Default	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Layer 01	<input type="checkbox"/>	<input type="checkbox"/>	Red	<input type="checkbox"/>
Layer 02	<input type="checkbox"/>	<input type="checkbox"/>	Purple	<input type="checkbox"/>
Layer 03	<input type="checkbox"/>	<input type="checkbox"/>	Blue	<input type="checkbox"/>
Layer 04	<input type="checkbox"/>	<input type="checkbox"/>	Green	<input type="checkbox"/>
Layer 05	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>

Pick a mesh:
Pick a mesh:
Pick a mesh:
Pick a mesh:

End Near Point Mid Cen Int Perp Tan Quad Knot Project Disable

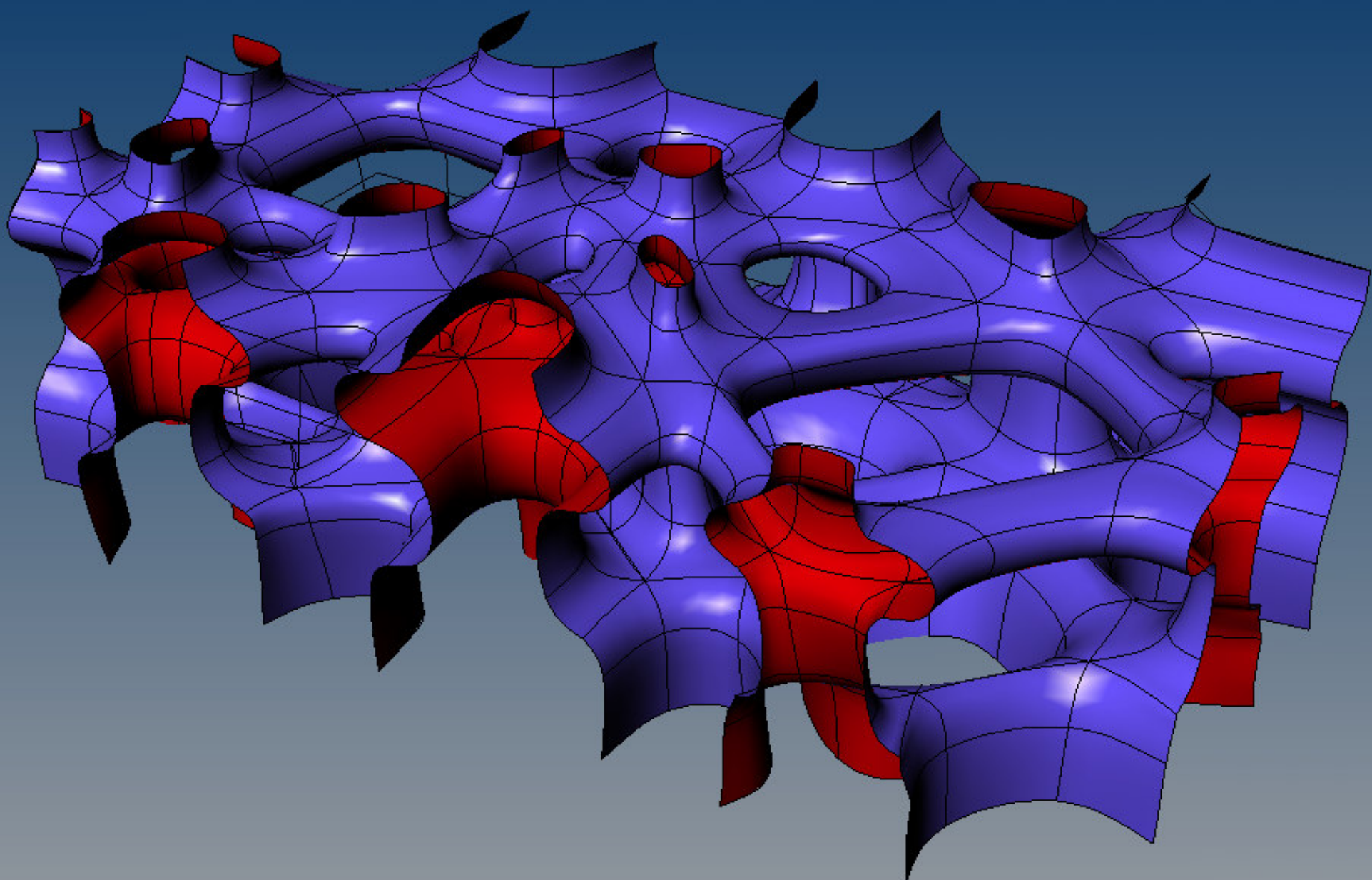
CPlane x 12.052 y -1.717 z 0 Default **Snap** Ortho Planar **Osnap** Select Object

CRUDE MESH



ARUP AGU

SMOOTH MESH



ARUP AGU

EXTENDED GEOMETRIC MODEL

Command: Create Teddy File

Surface Description

- Polygonal Grid + Coons Patch
- Splines + Coons Patch
- Splines + Nurbs

Average Spline segment [mm]

Input Model Dimensions

- [m] [mm]

Catenoid Dimensions [mm]

General Thickness

Selfe weight factor non solid sections

Wall / Slab Dimensions [mm]

Floor

Roof

Infill Walls

Facade

Loads [kN/m2]

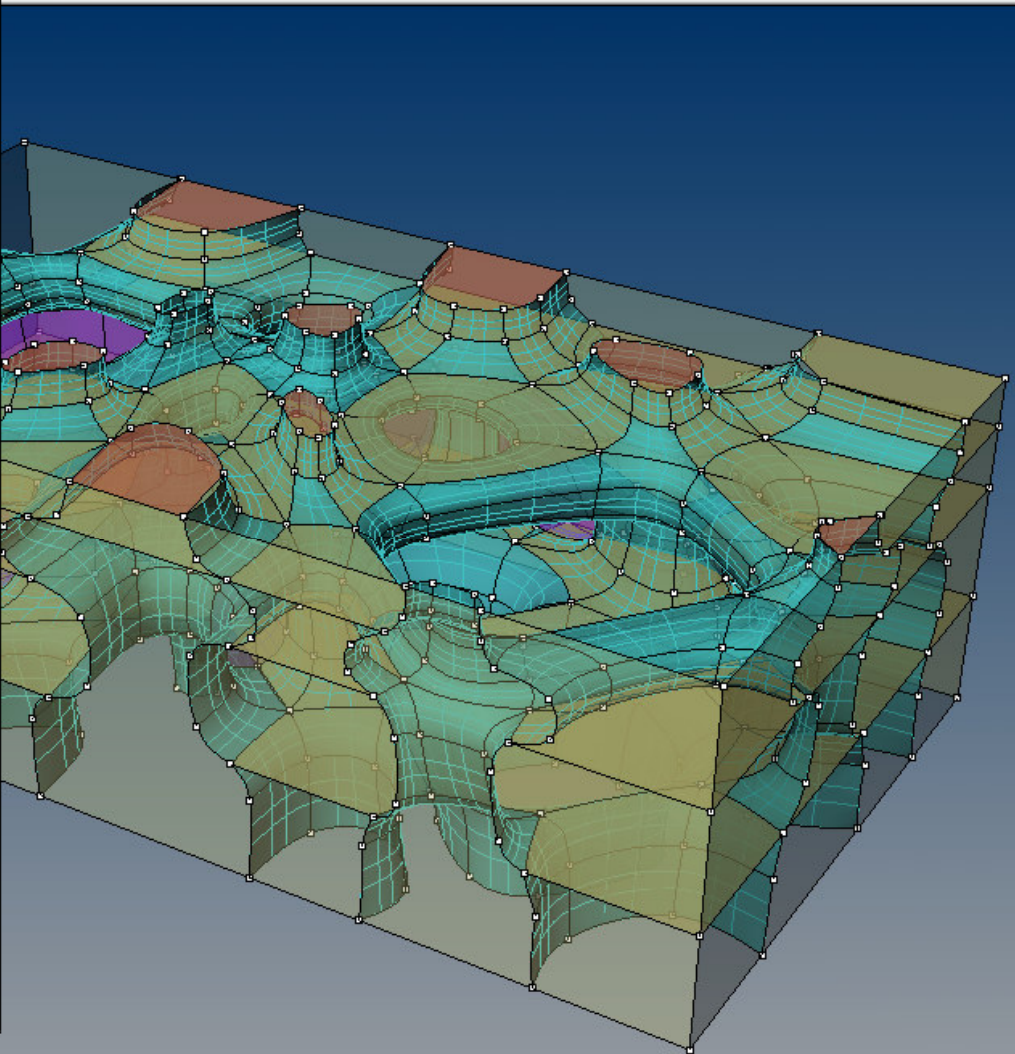
Floor finishes

Roof built up

Live Load

Add Object Layers

Create Teddy



Layers - All Layers

- 20061208 crude mesh
- 20061208 edge surfa...
- 20061208 projection ...
- 20061208 floor lines ...
- 20061208 wall lines ...
- 20061208 facade lines
- Layer 01
 - Mesh
 - Catenoid Surfaces
 - Other Surfaces
 - Curves
 - Points
 - Non Planar
 - Catenoid_Solid

Properties

Object

Object type

Name

Layer

Color

Isocurve density

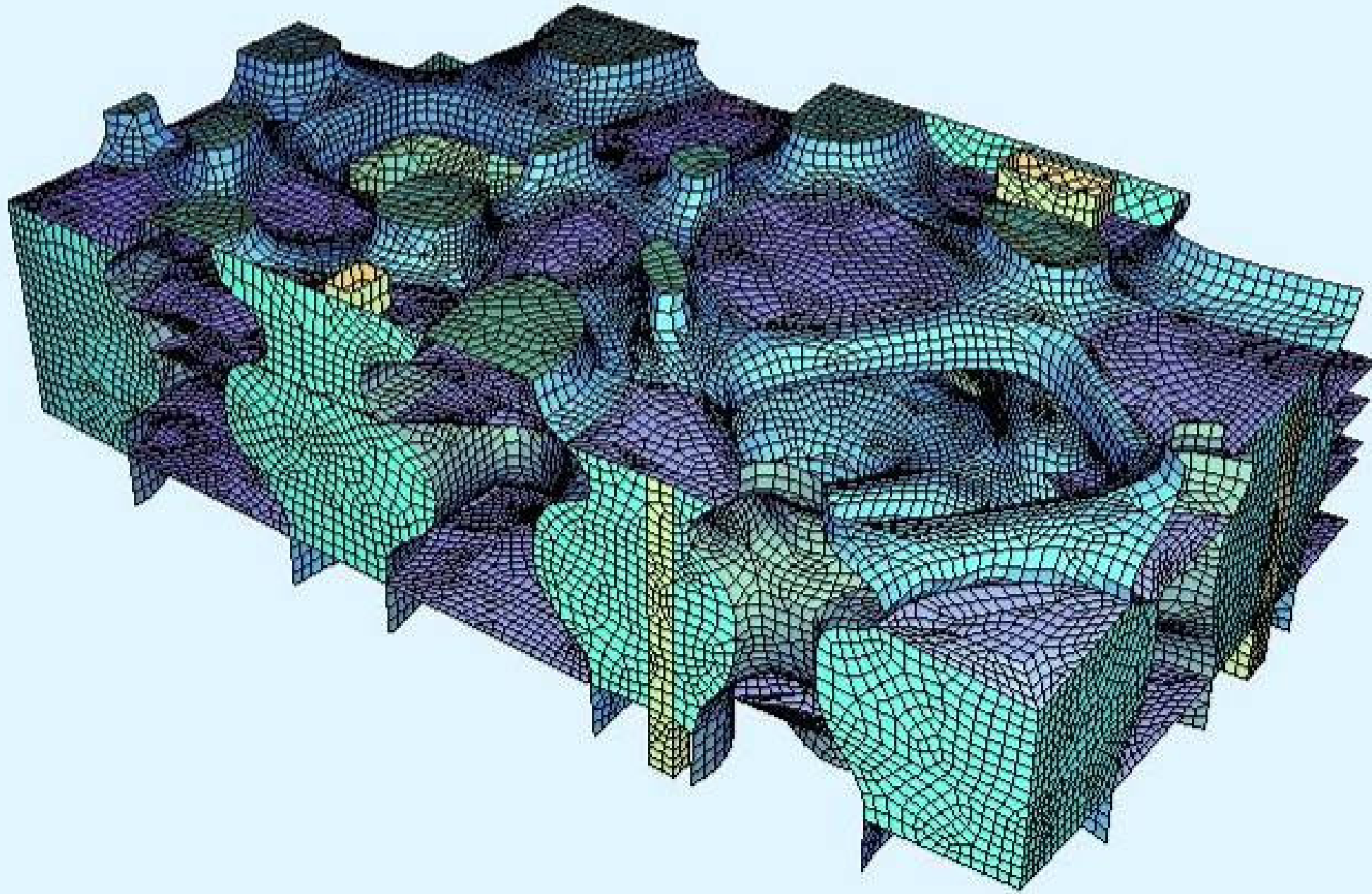
Show surface isocurve

Match

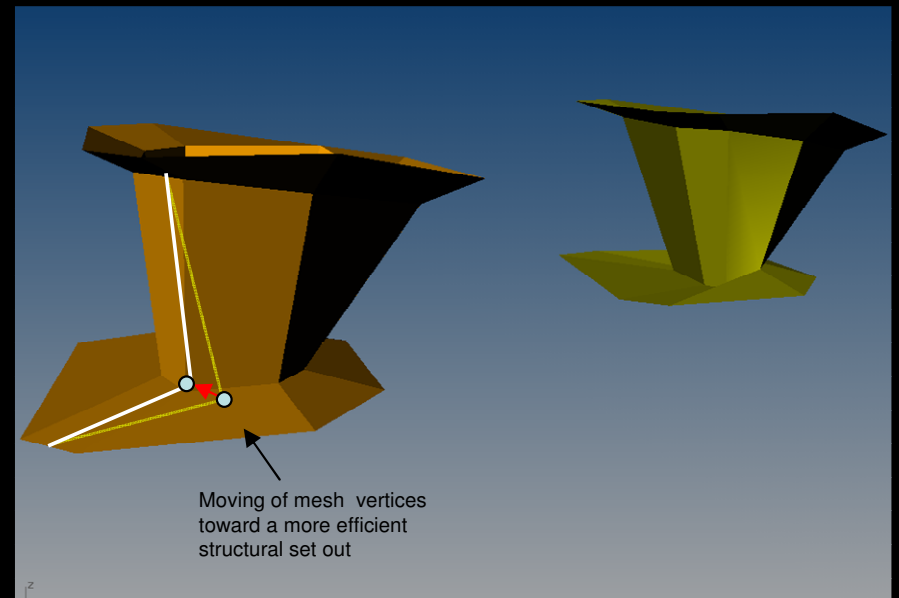
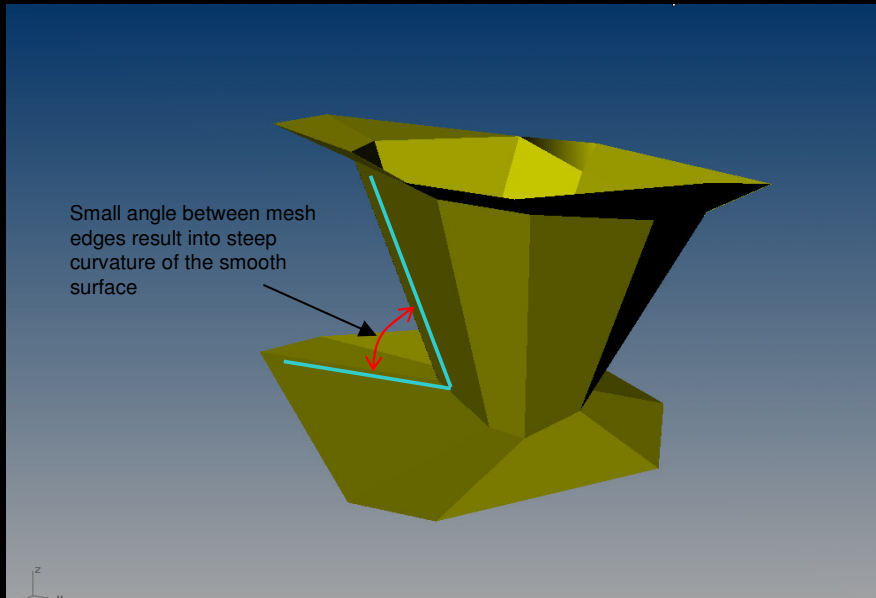
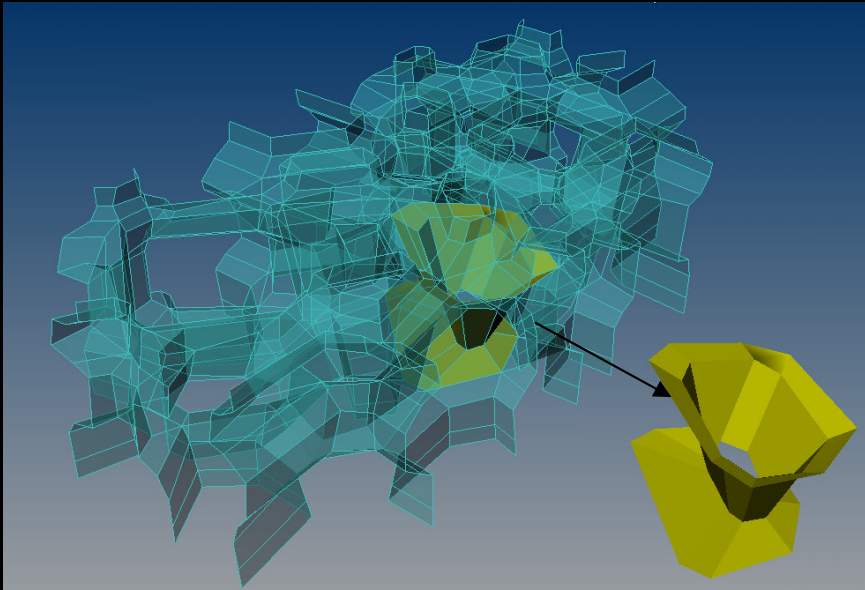
Details...

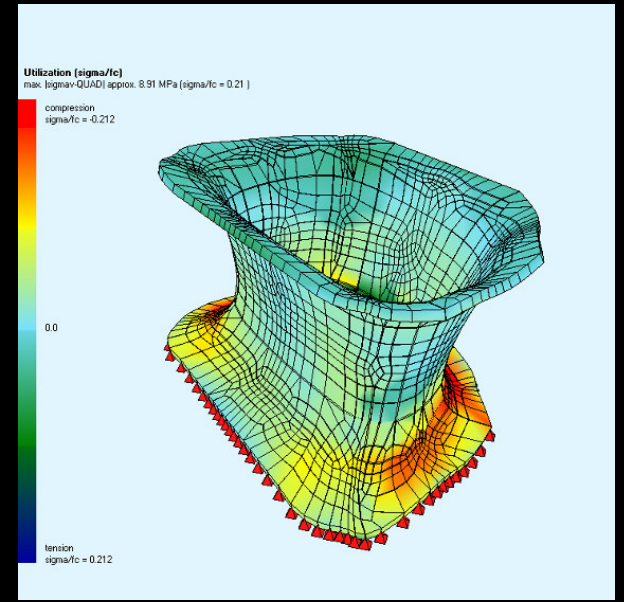
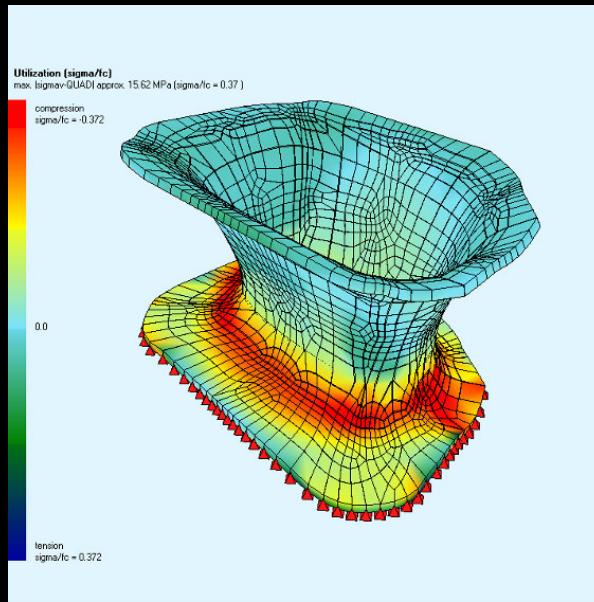
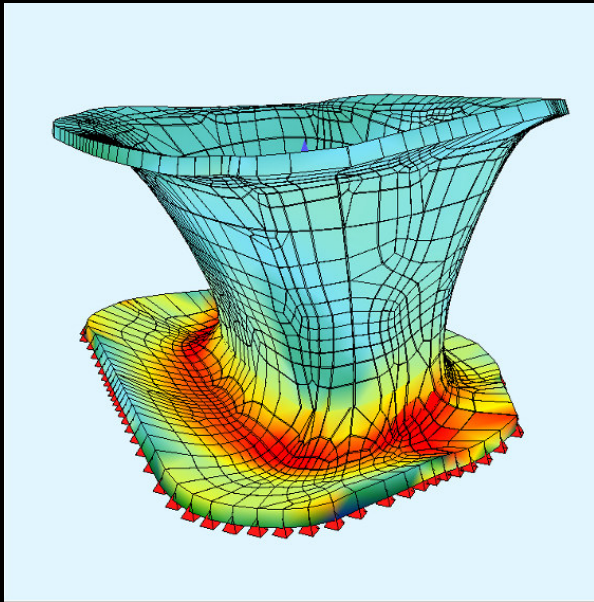
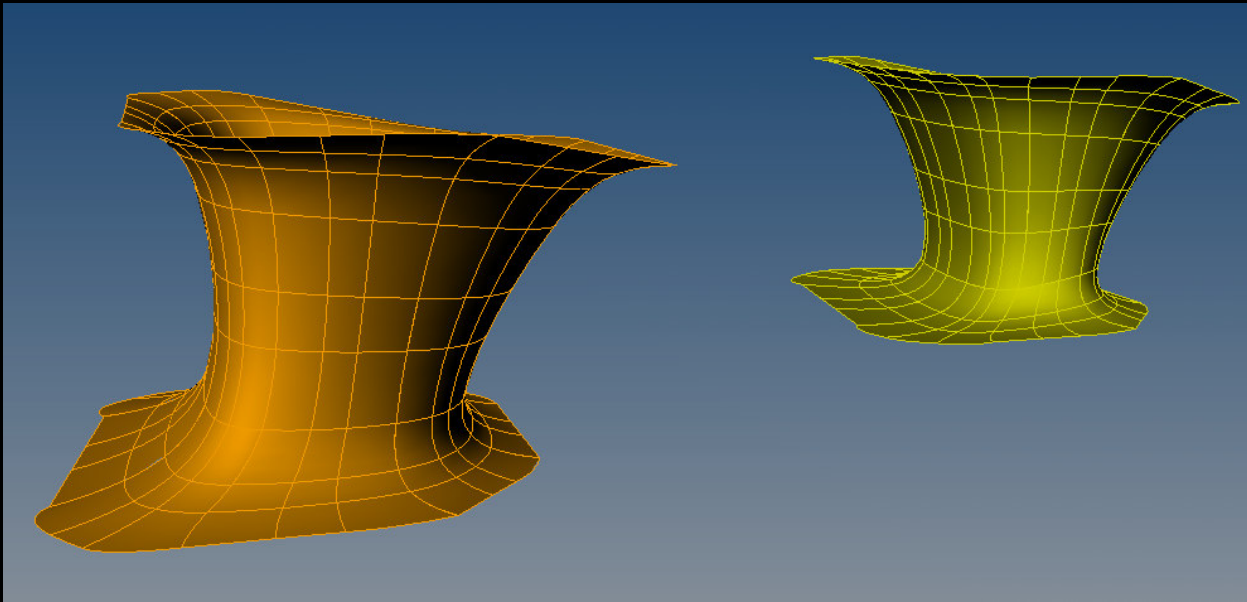
End Near Point Mid Cen Int Perp Tan Quad Knot Project Disable

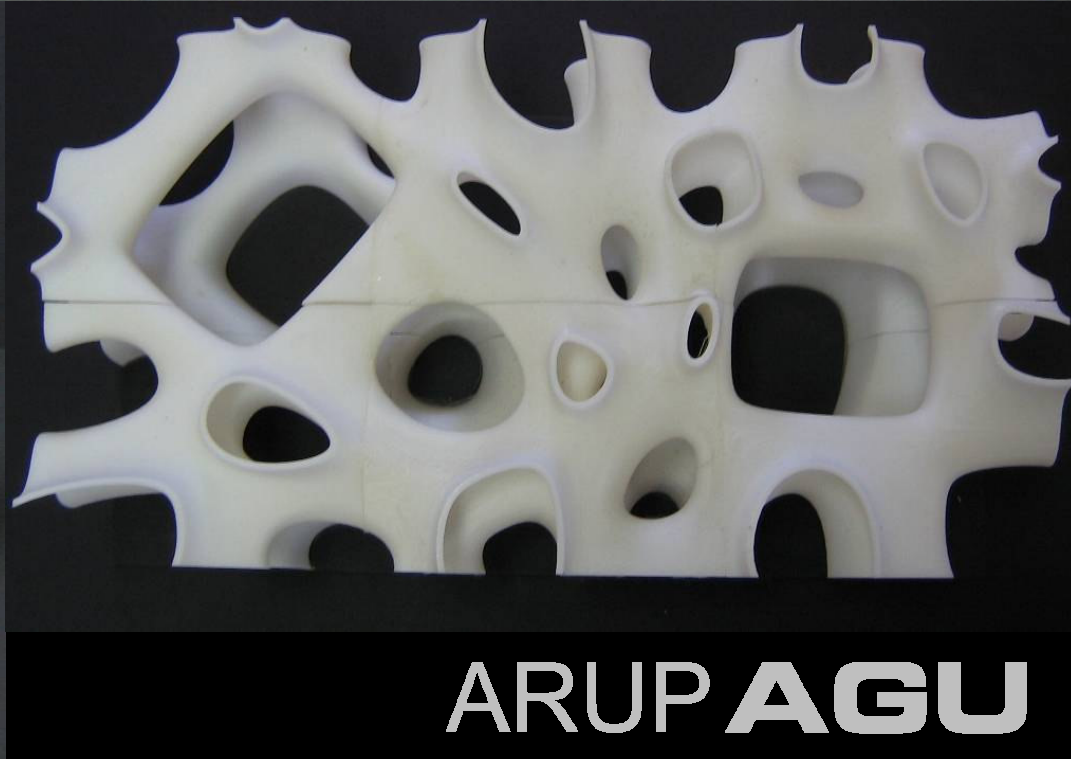
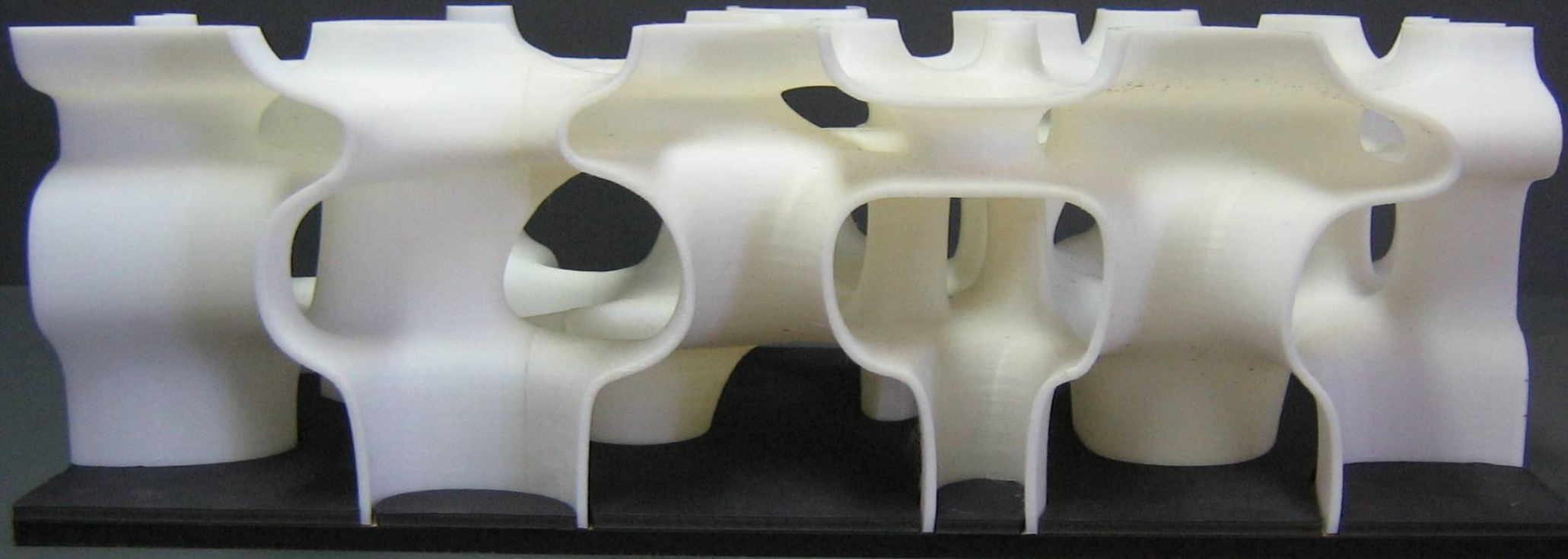
EXECUTED INPUT FILE



ARUP AGU







ARUP AGU