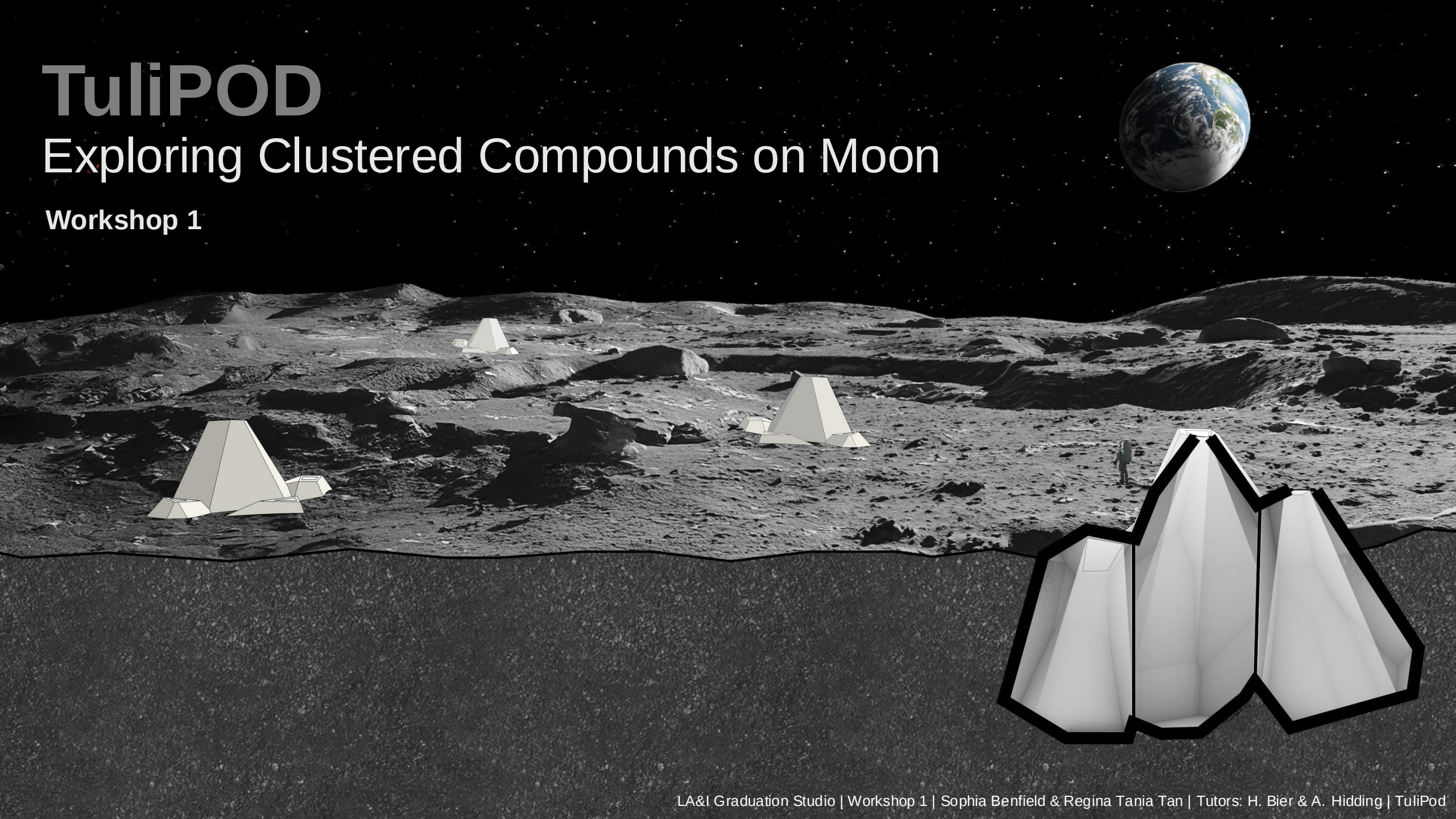
TuliPOD

Exploring Clustered Compounds on Moon

Workshop 1

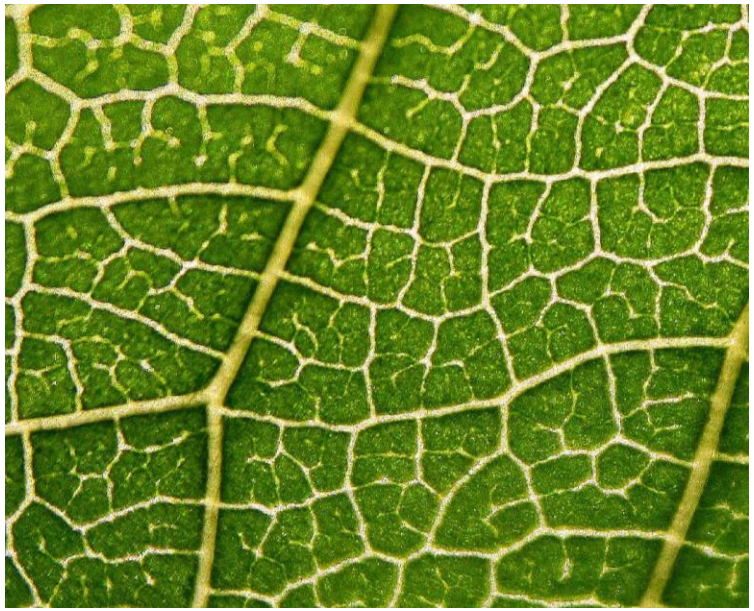


Vertical Strategy

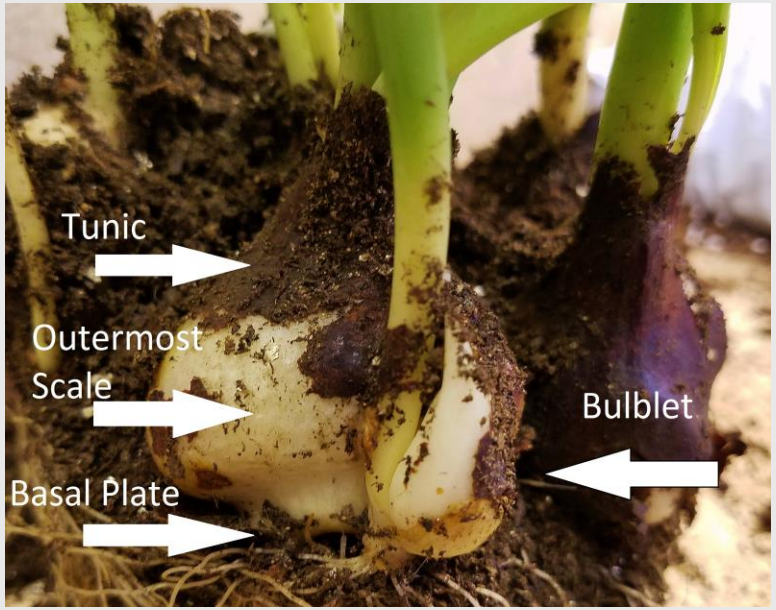
Horizontal Strategy

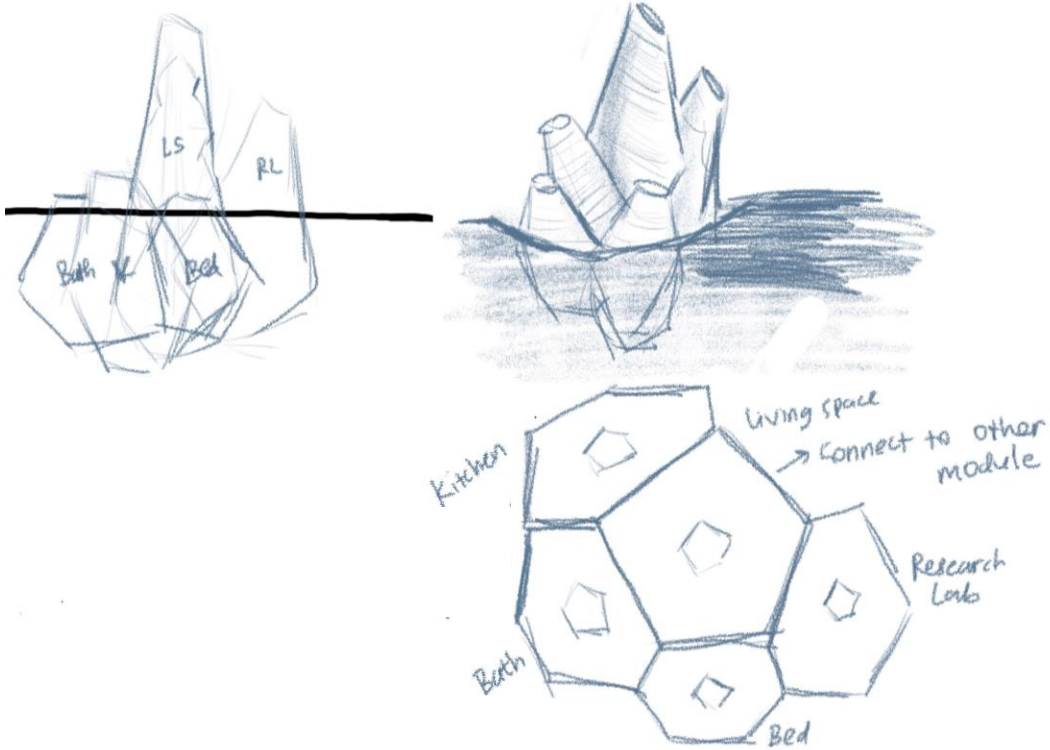
Inspiration

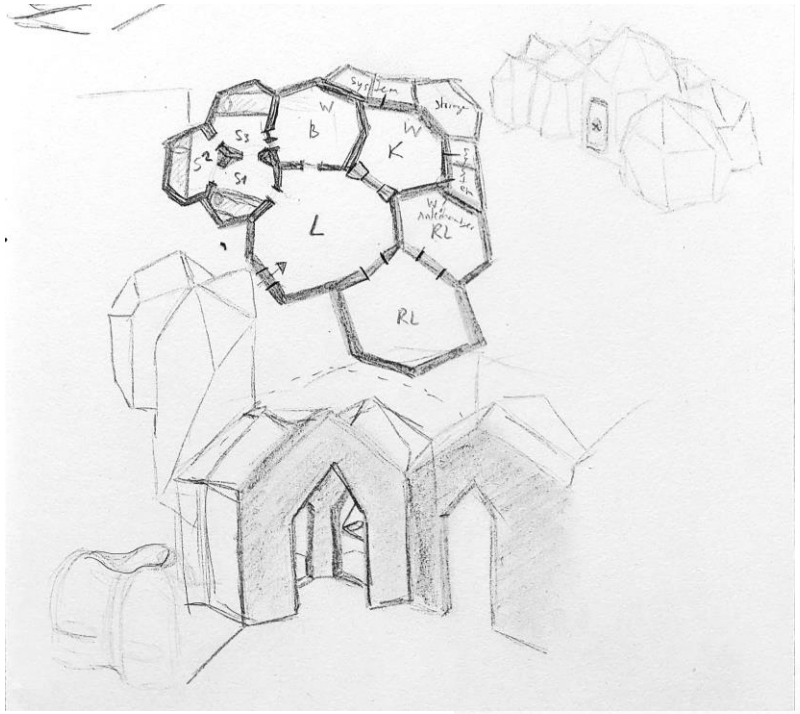
Voronoi geometry in nature

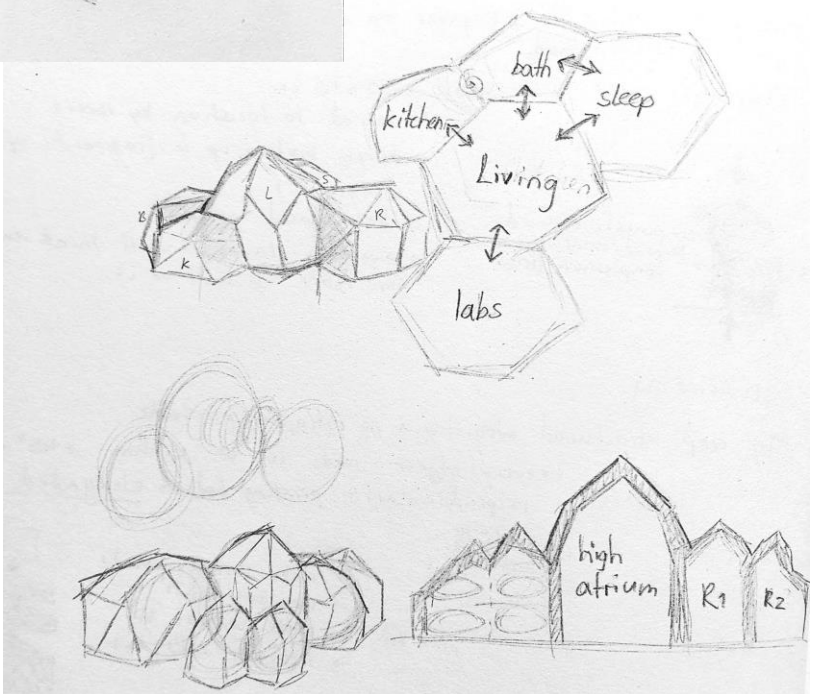


Underground formation in nature: Tulip bulbs

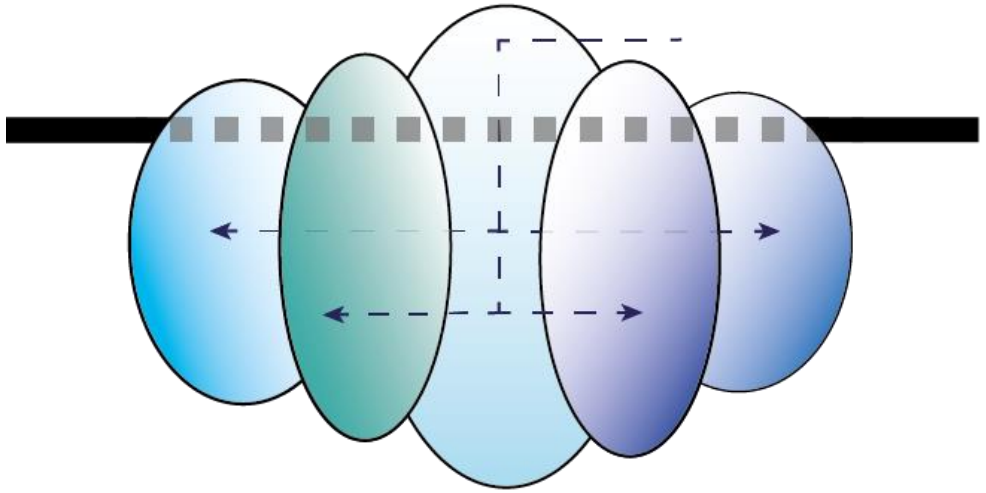



LS
RL
Bath
Bed
Skylight
Kitchen
Living space
Connect to other module
Research Lab
Bath
Bed


L
RL
RL

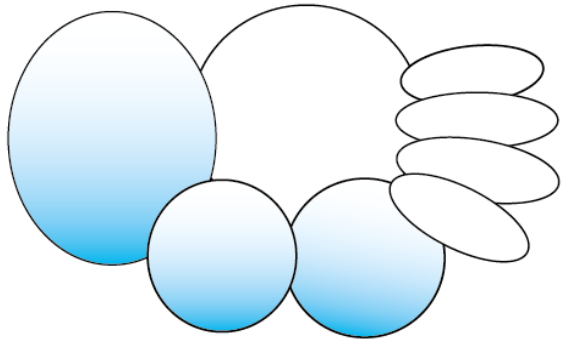

bath
sleep
kitchen
Living
labs
high atrium
R1
R2

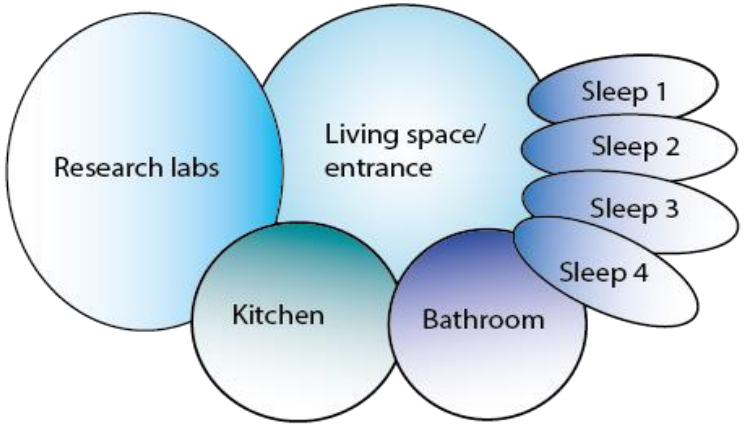
Synthesis tulip bulblets concept | **Concept diagrams**



Section

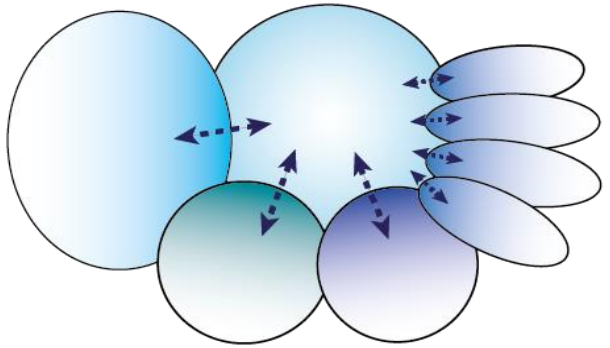
Water clustering



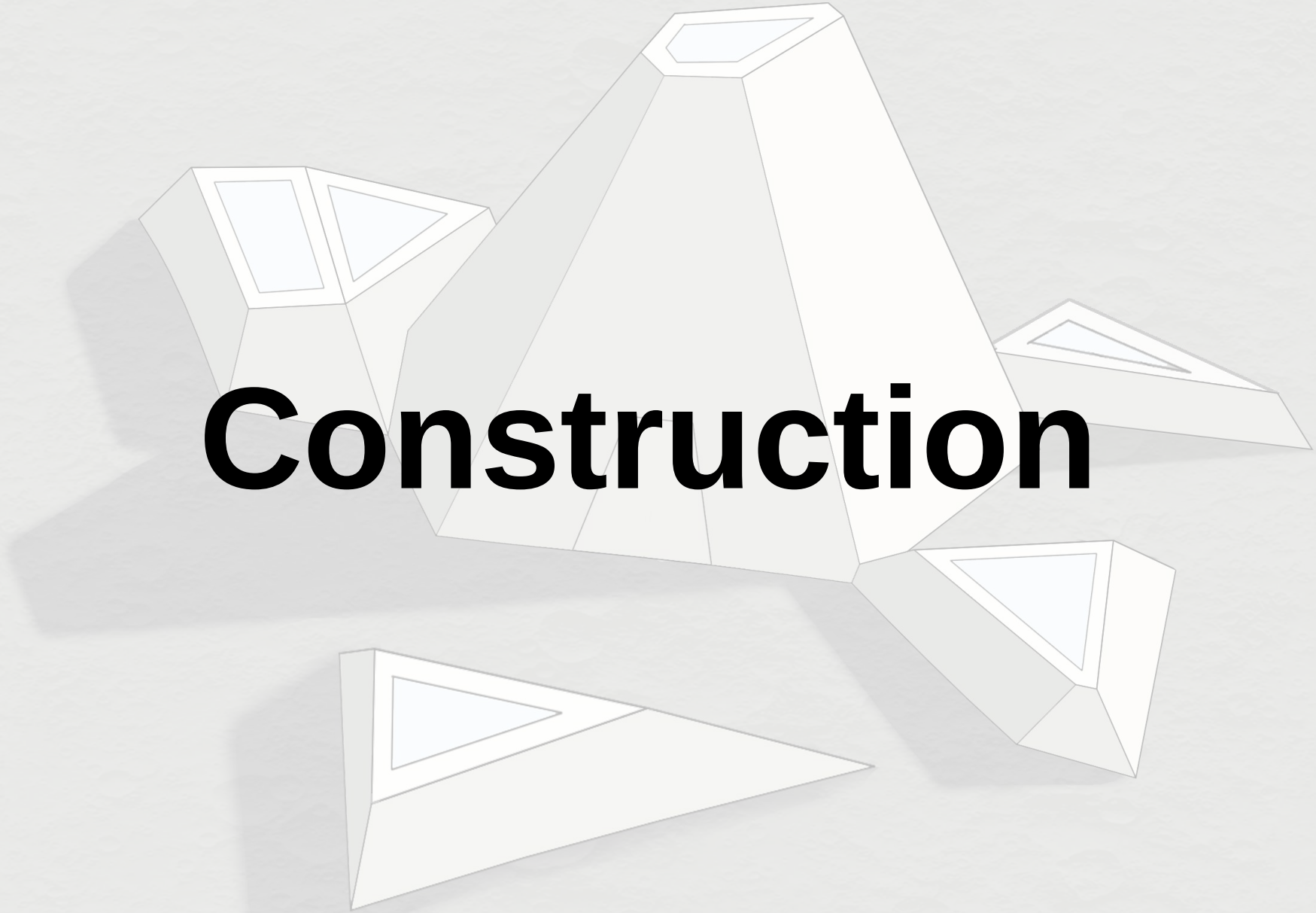


Plan

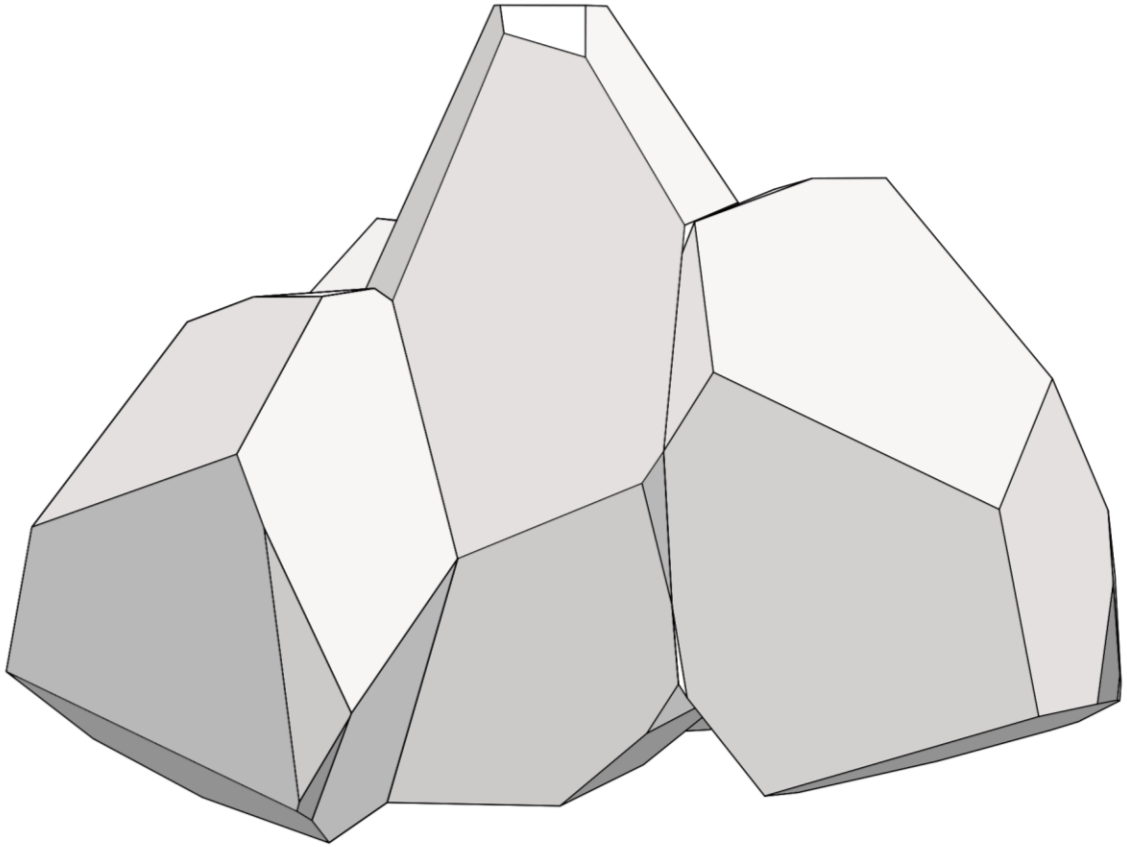
Connecting rooms



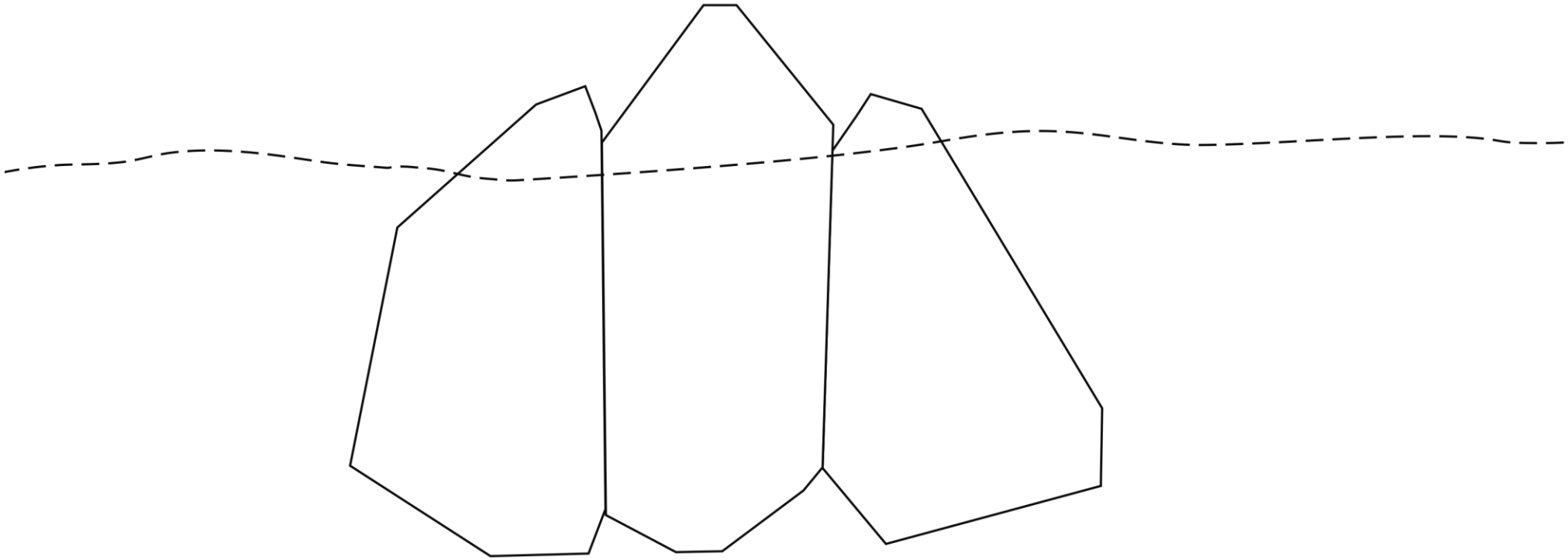
Construction



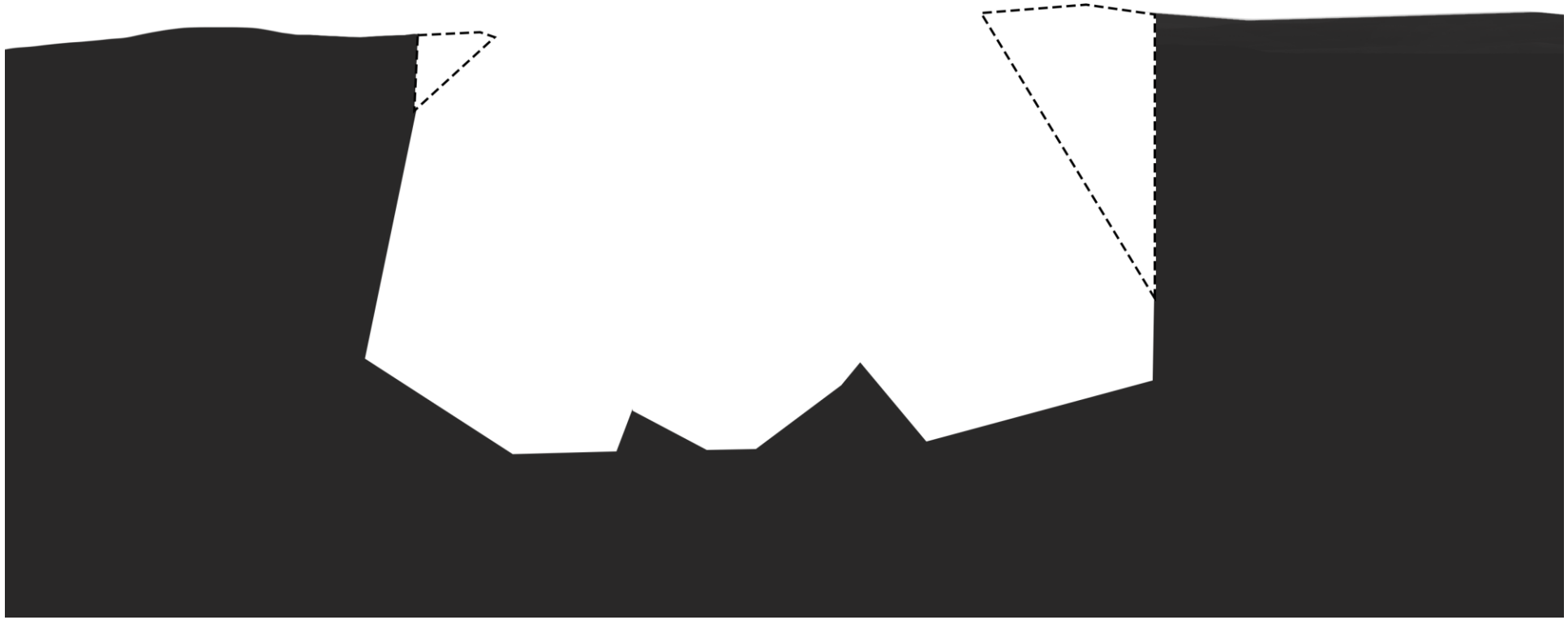
Construction Process | Volume



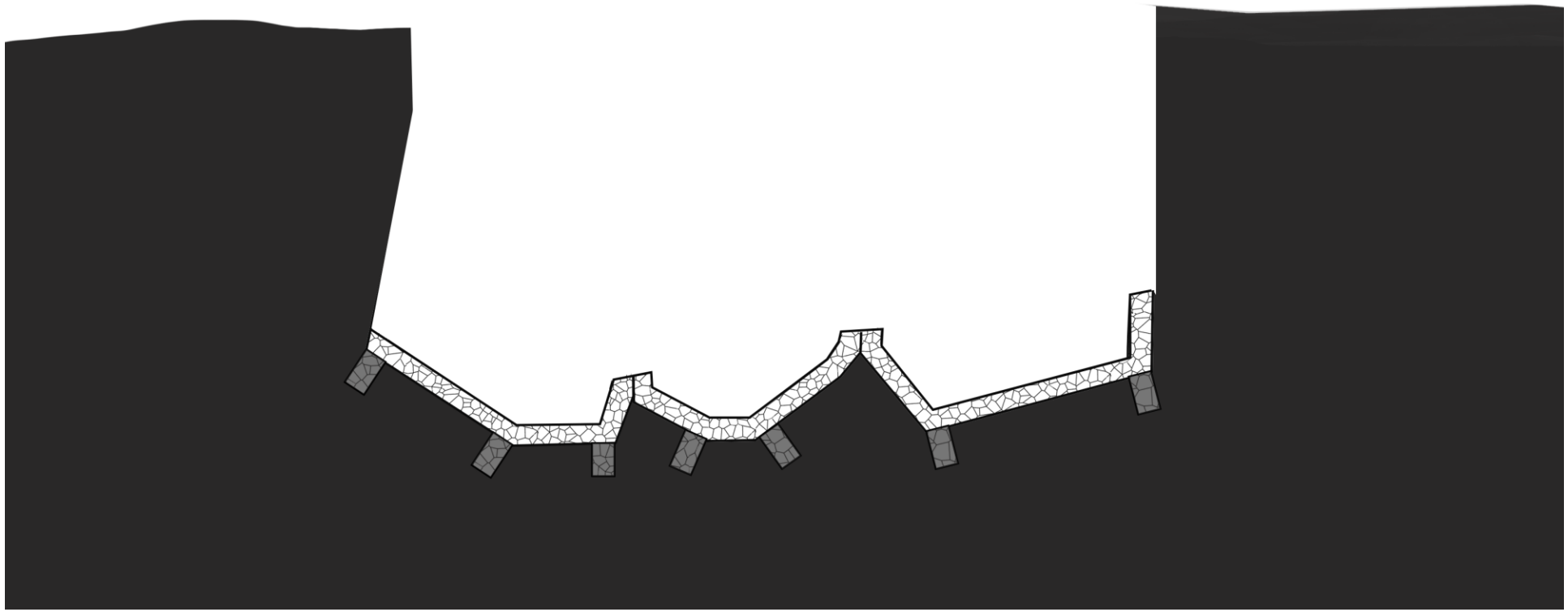
Construction Process | Going underground



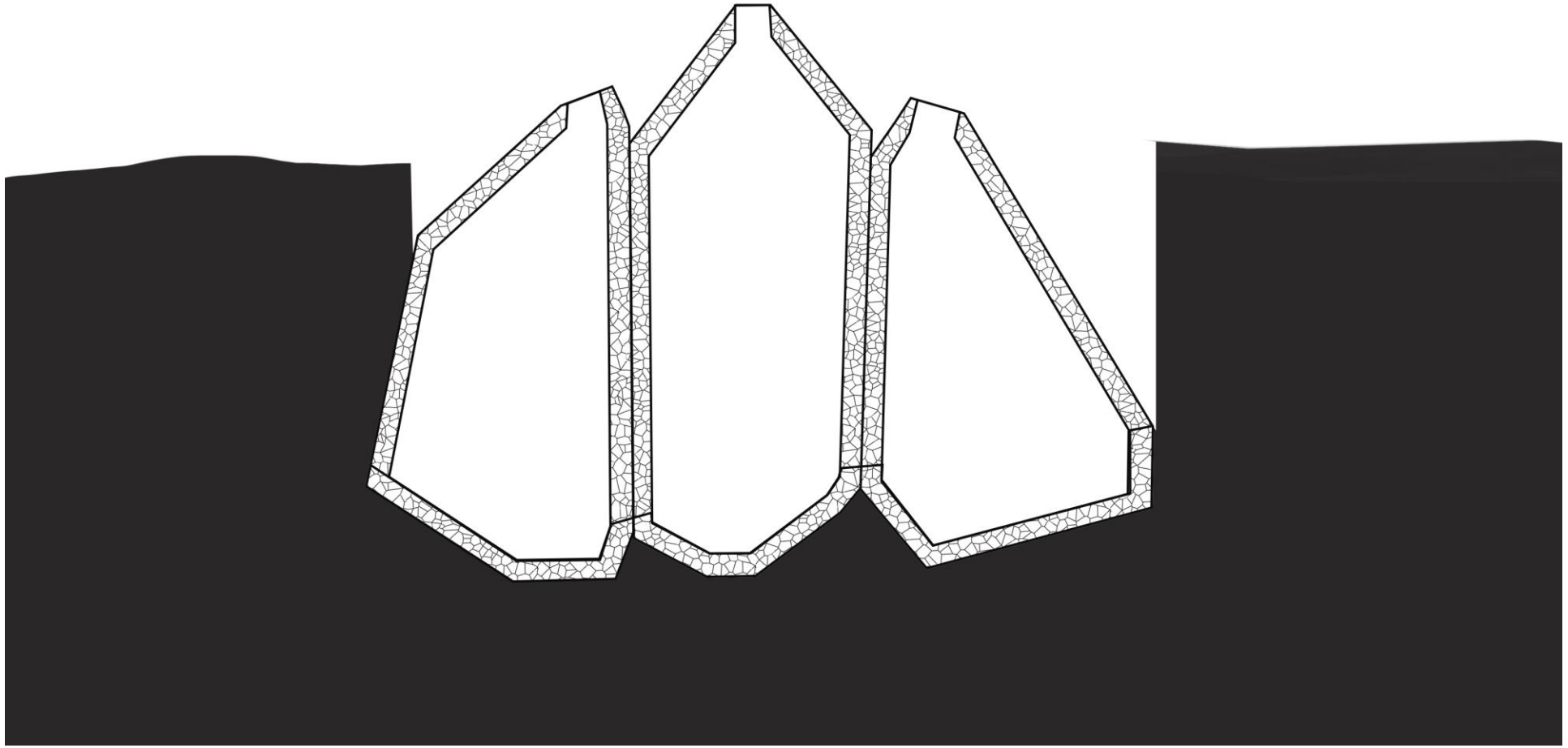
Construction Process | Excavation



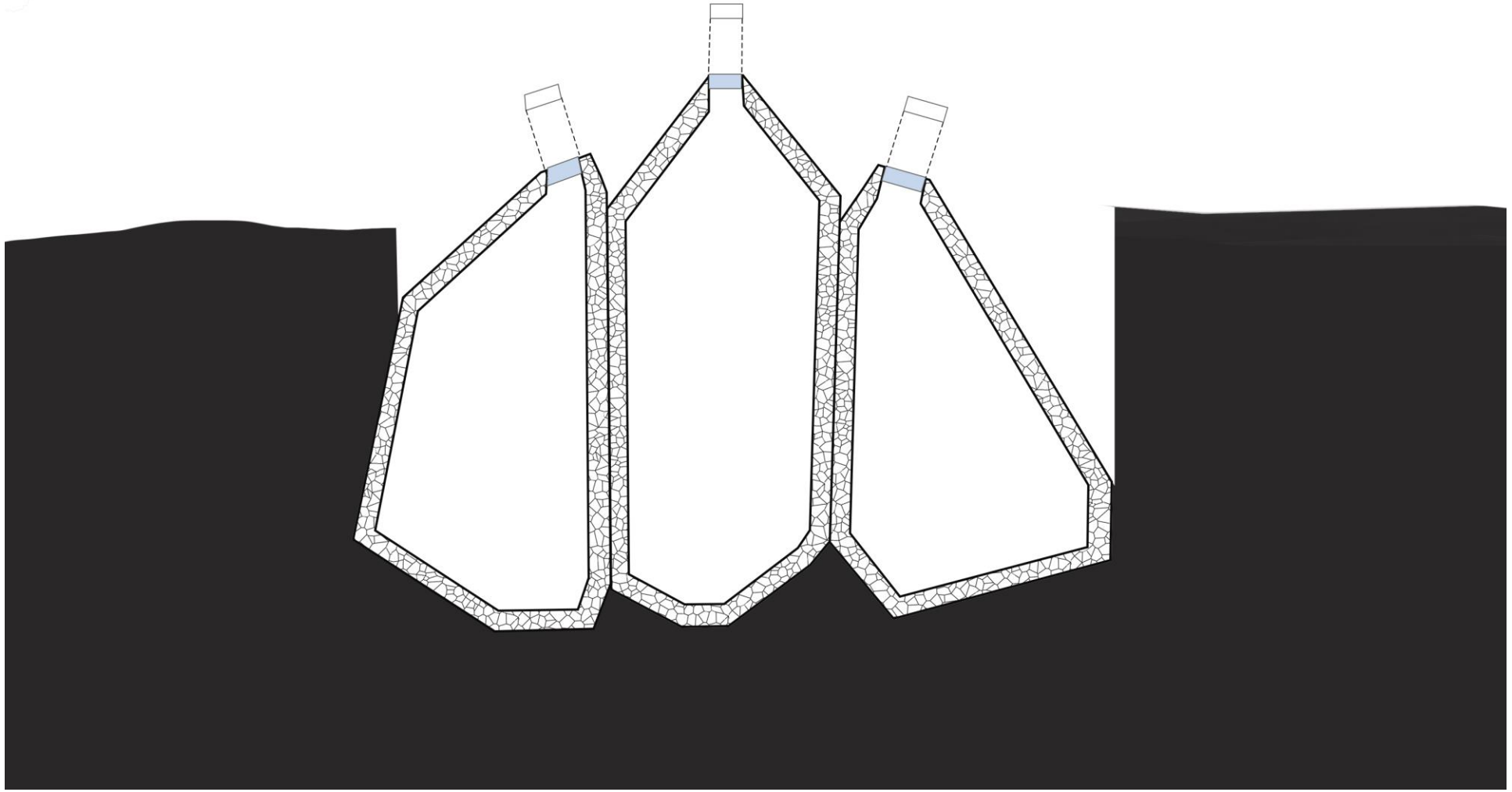
Construction Process | Base components



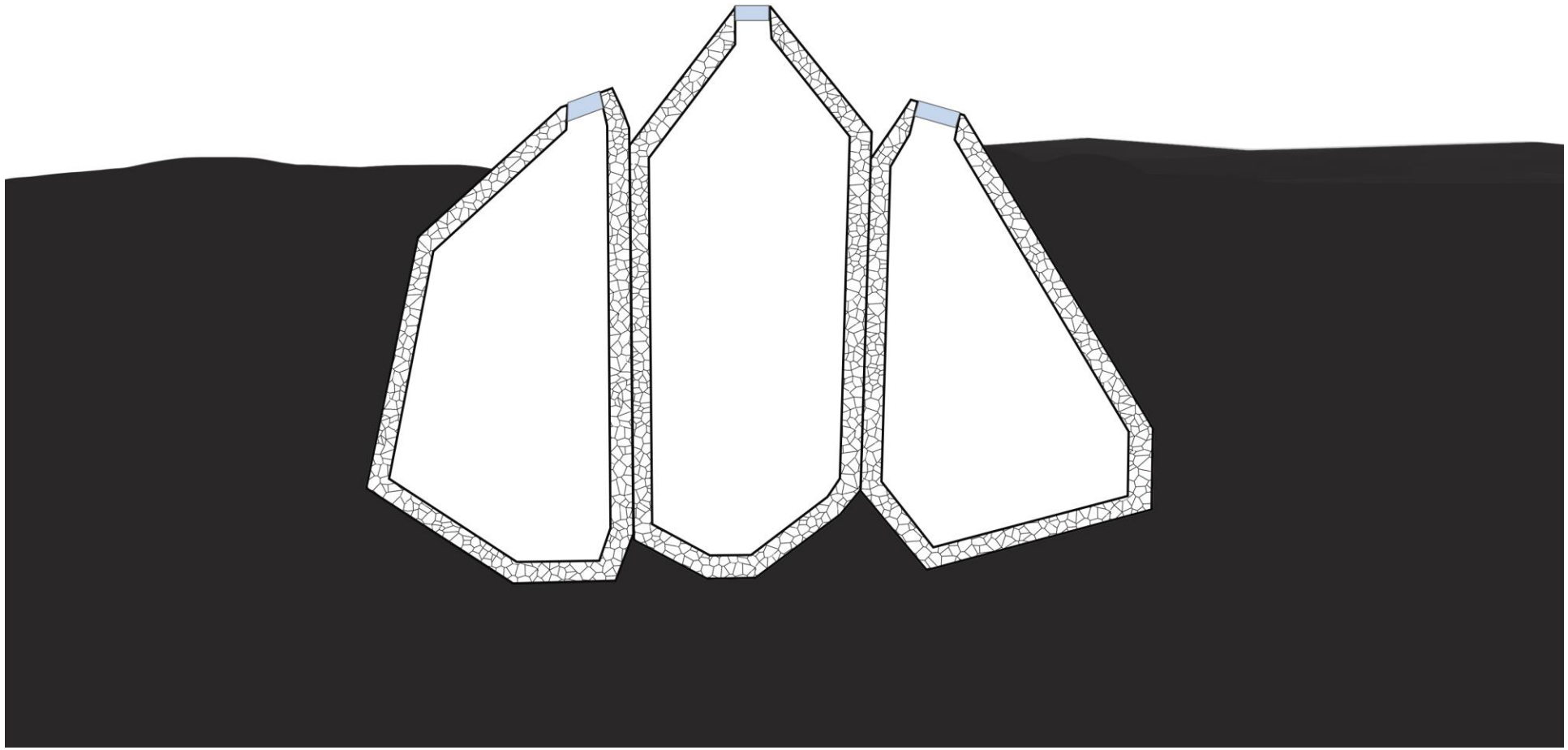
Construction Process | Further construction



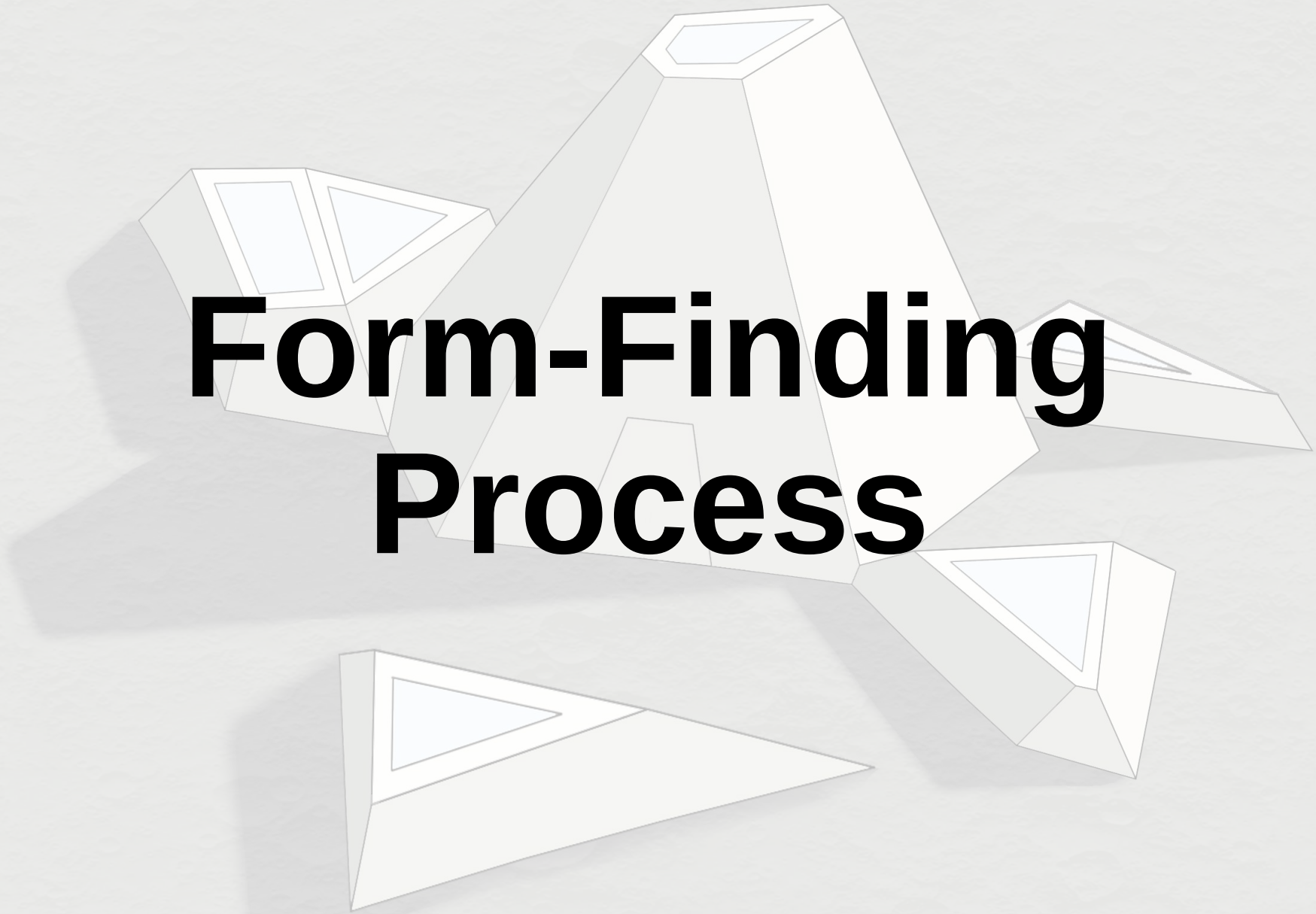
Construction Process | Skylights



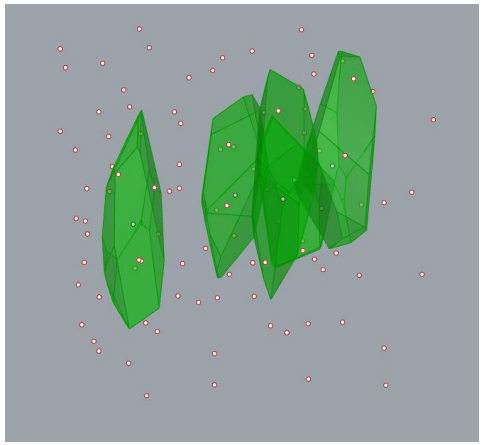
Construction Process | Closing Up



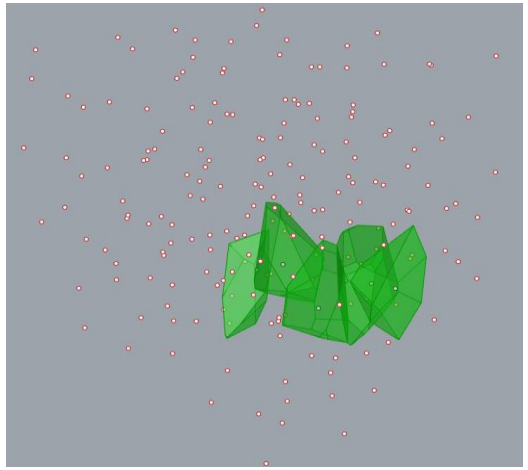
Form-Finding Process



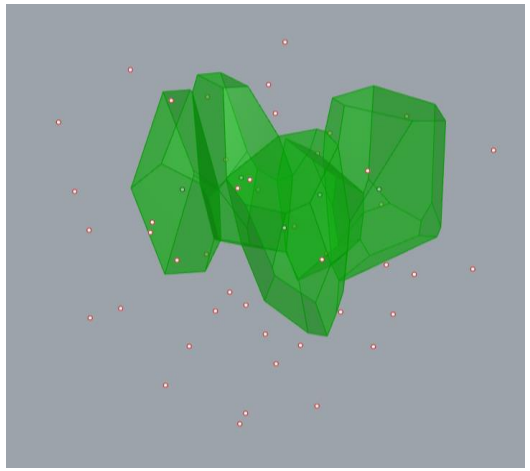
Code-generated Iterations | **Strategy**



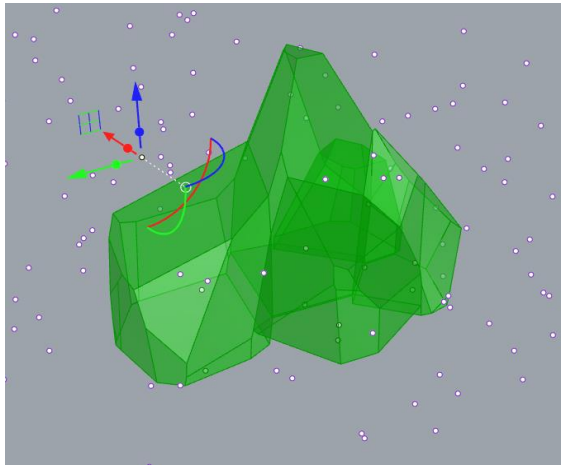
Initial Shape
100 points



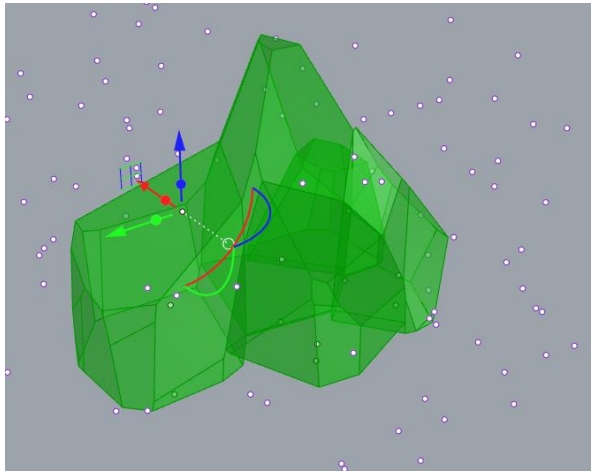
Increase Point Cloud
200 points
More variative iterations



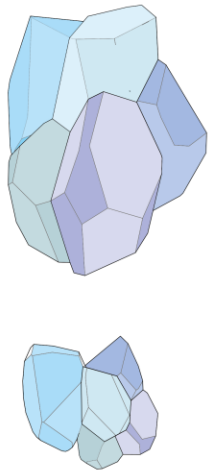
Decrease Point Cloud
50 points
Better control



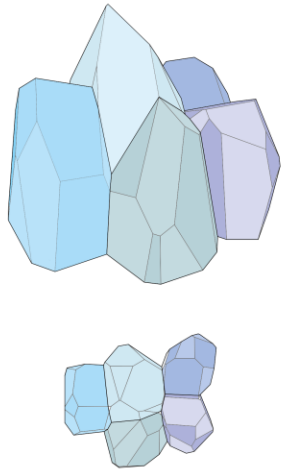
Most effective controlling shapes:
Manually moving points



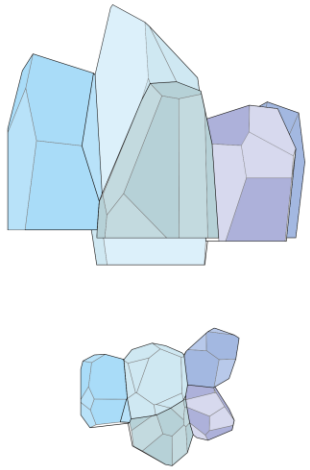
Form-finding process | **Iterations**



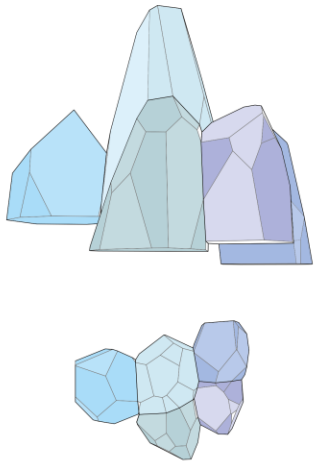
Starting shape: vertical cluster



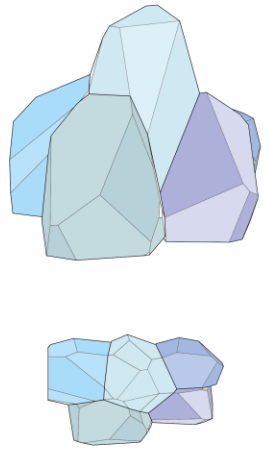
Iteration 1: flat bottom and central atrium



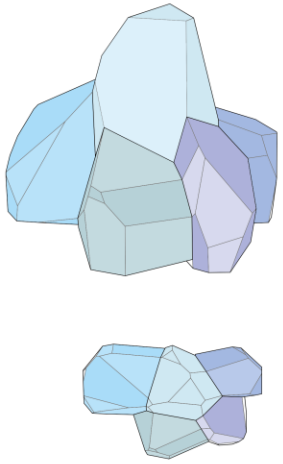
Iteration 2: different levels



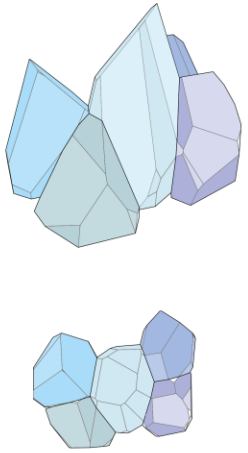
Iteration 3: enlarge atrium



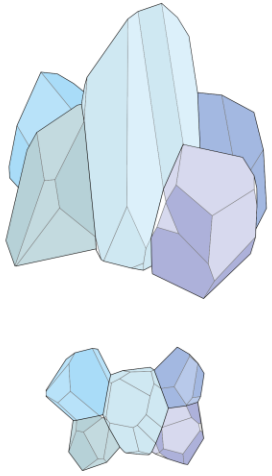
Iteration 4: bring together



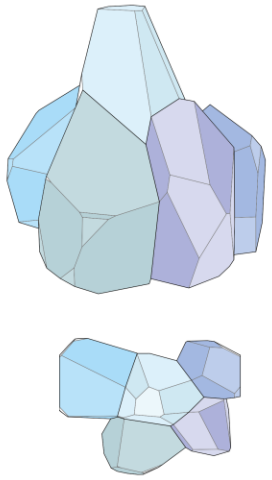
Iteration 5: change proportions



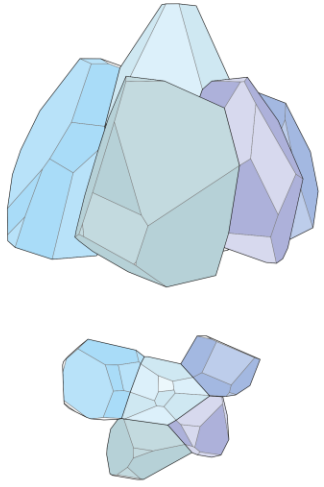
Iteration 6: 2-sided cluster



Iteration 7: change proportions

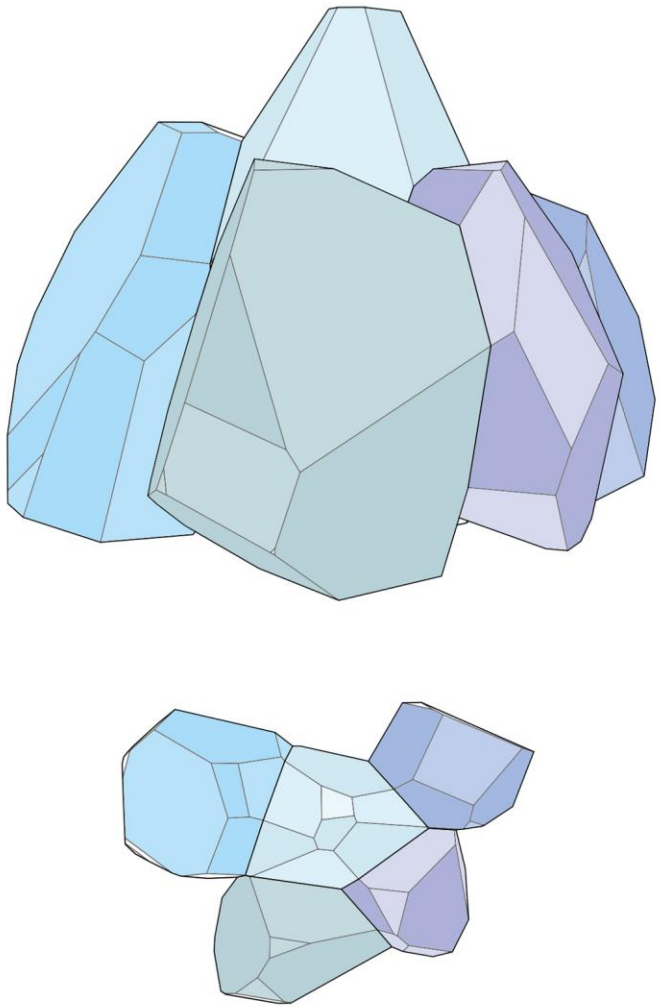


Iteration 8: no flat bottom



Iteration 9: multiple skylights

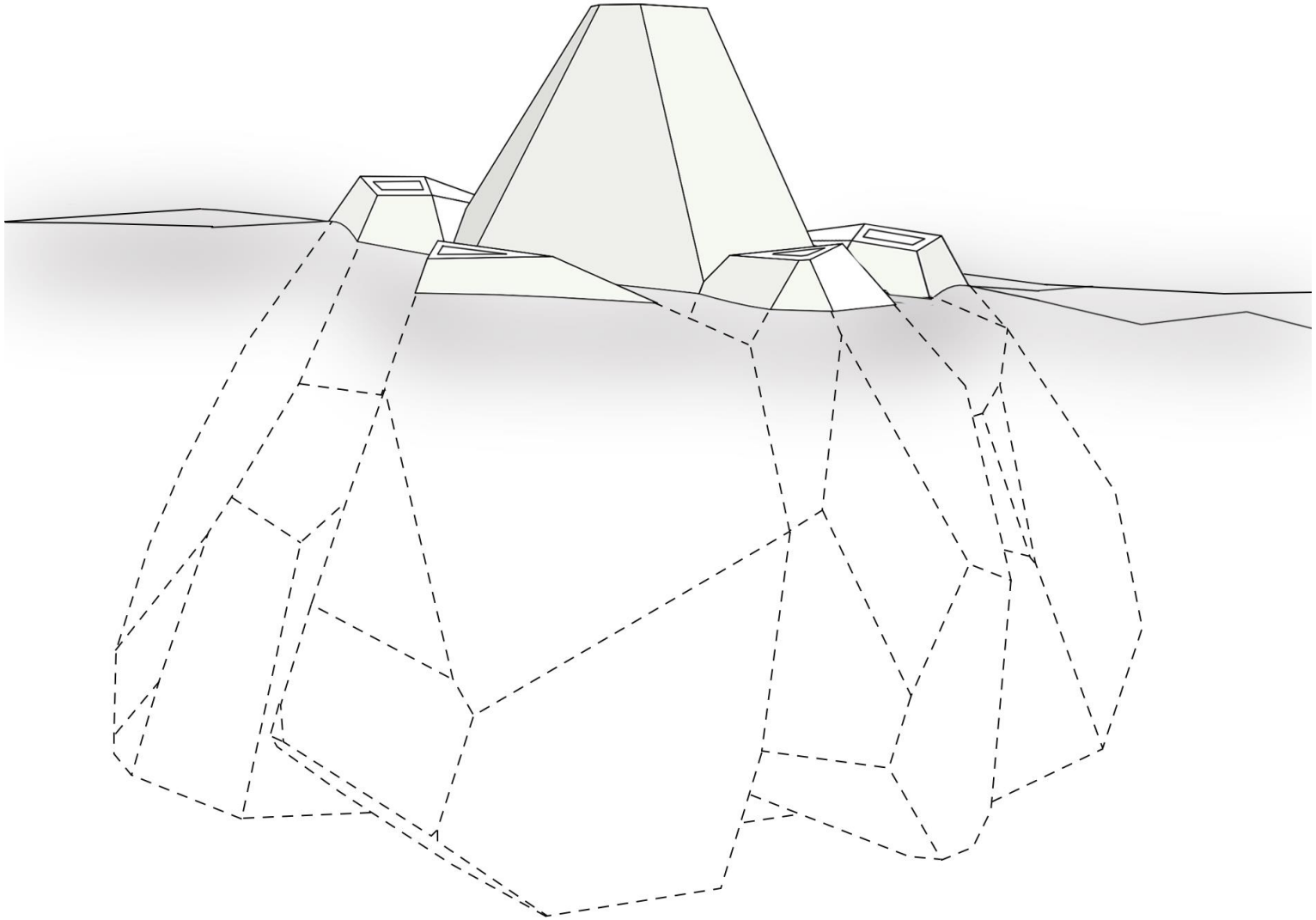
Form-finding process | **Iterations**



Iteration 9: multiple skylights

- Usable room proportions
- Central atrium sticks out enough to be an entrance
- All volumes reach the surface to facilitate multiple skylights
- All side volumes sufficiently adjoin the main atrium

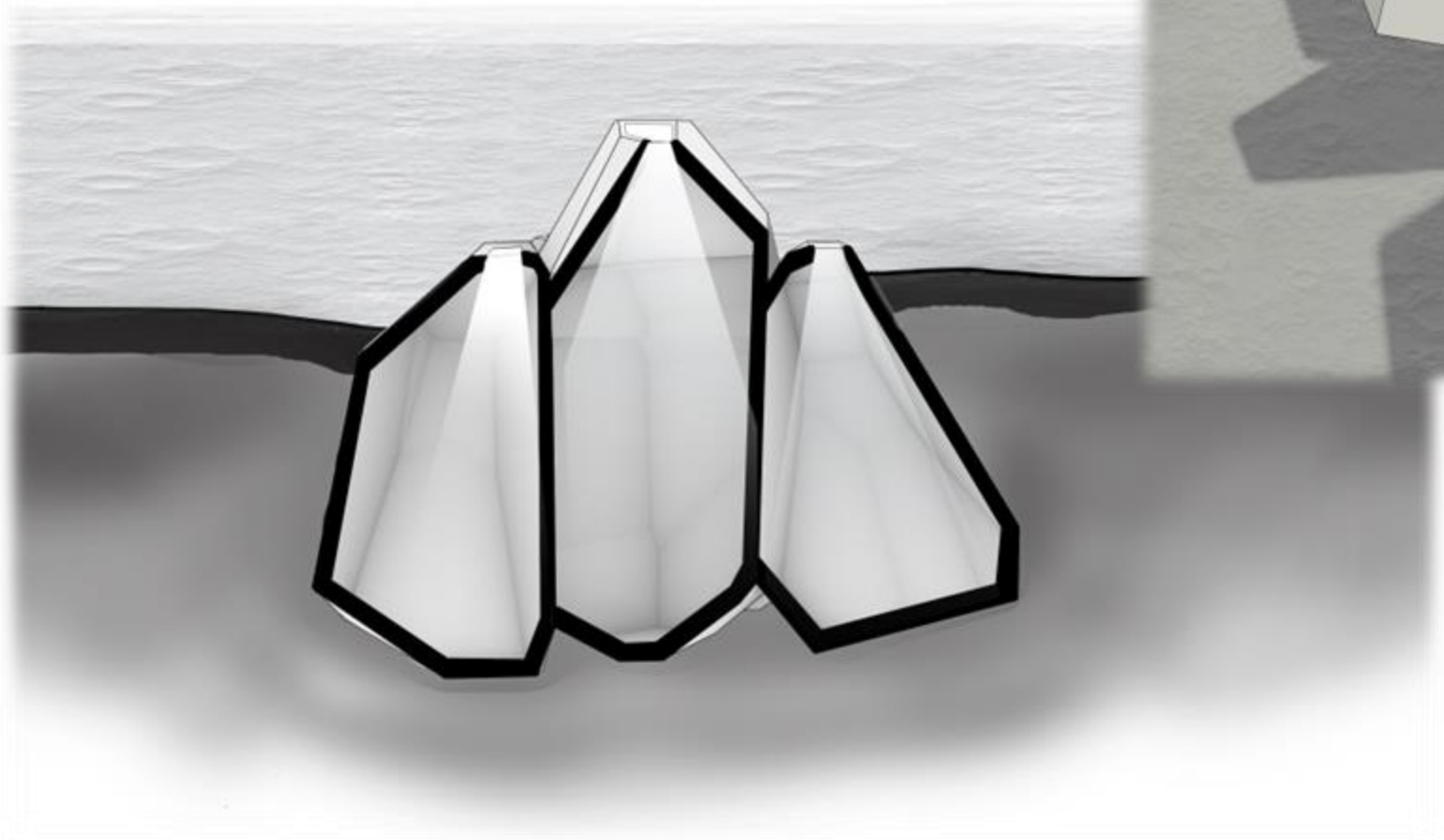
Form-finding process | **Final Design**

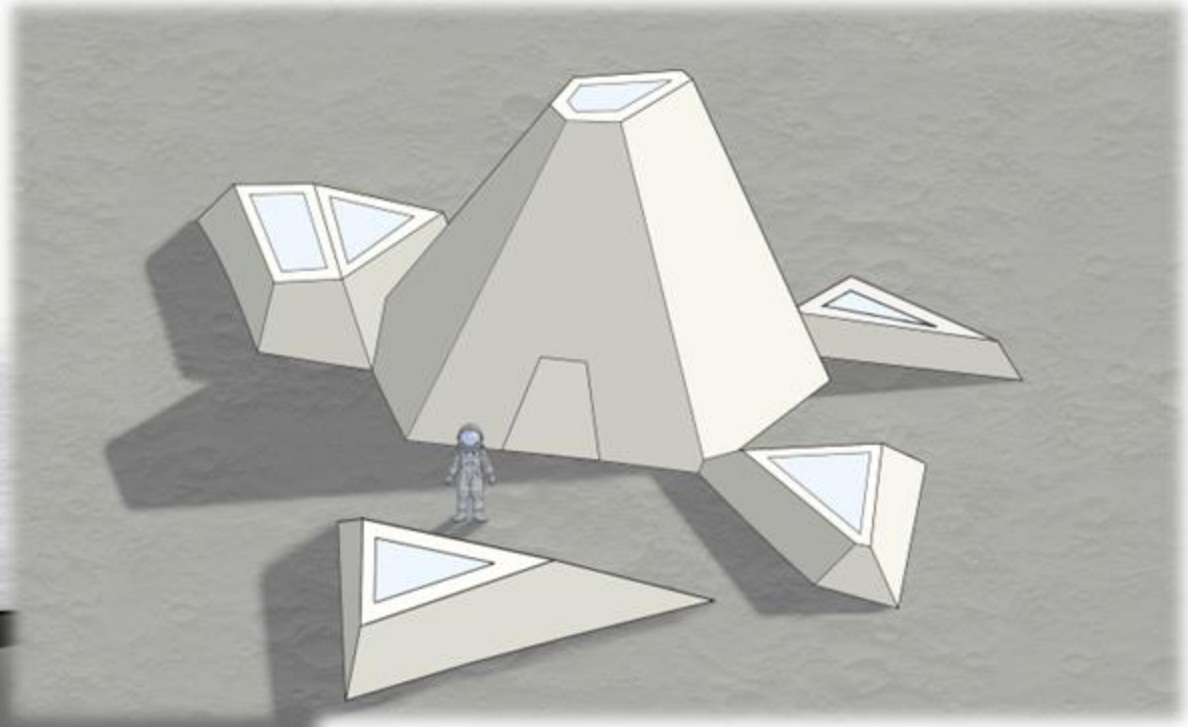


Back view - closed pod underground

Form-finding process | **Skylights**

Front view - section





Skylights surface view

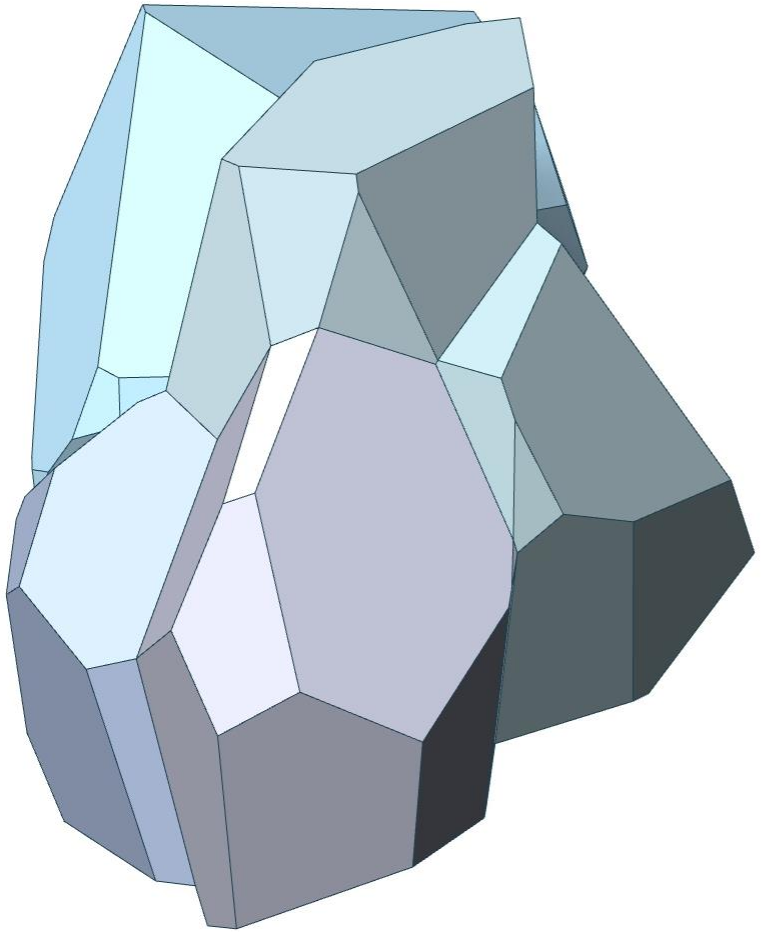
D2RP&A

Building Fragment

Wall Fragment

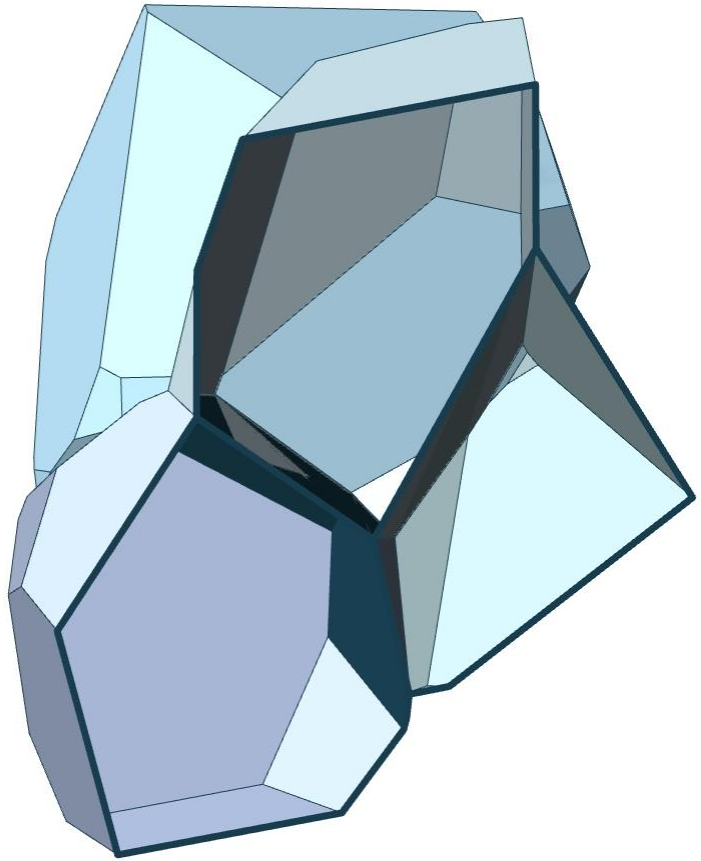
Fragment Components

Choosing Representative Fragment



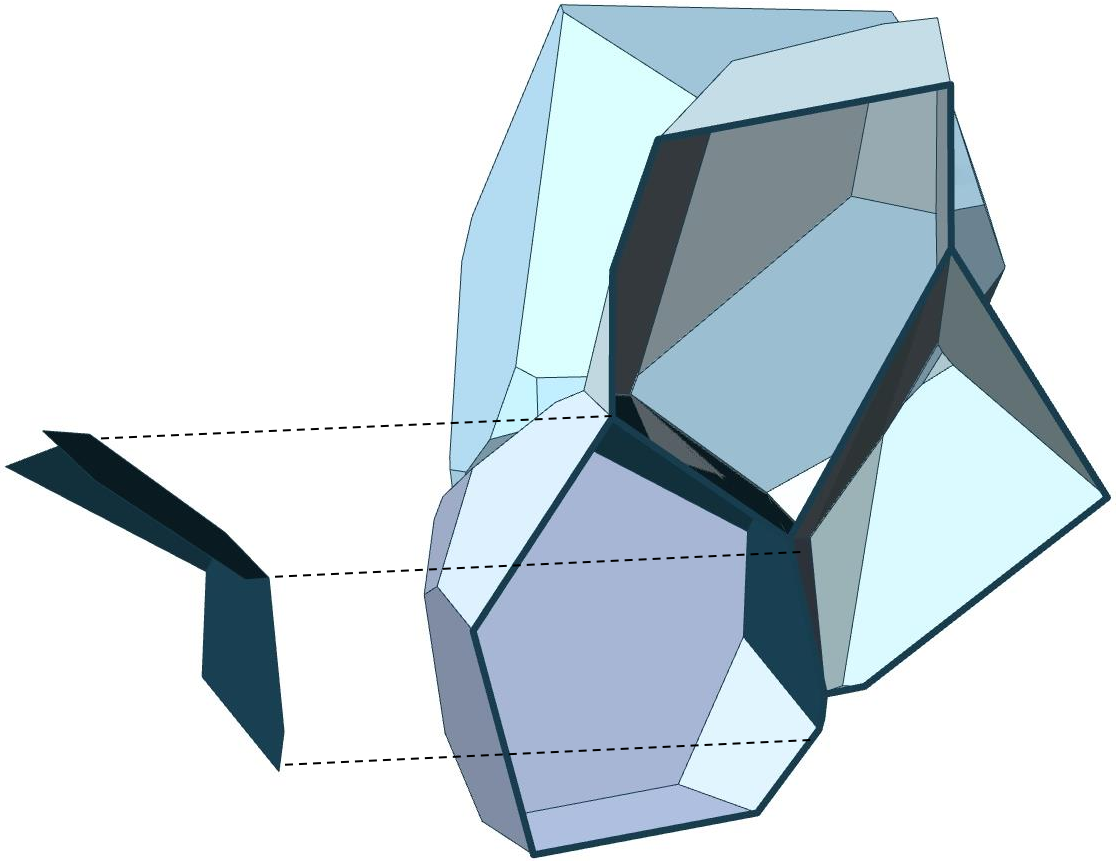
D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Choosing Representative Fragment



D2RP&A
Building Fragment
Wall Fragment
Fragment Components

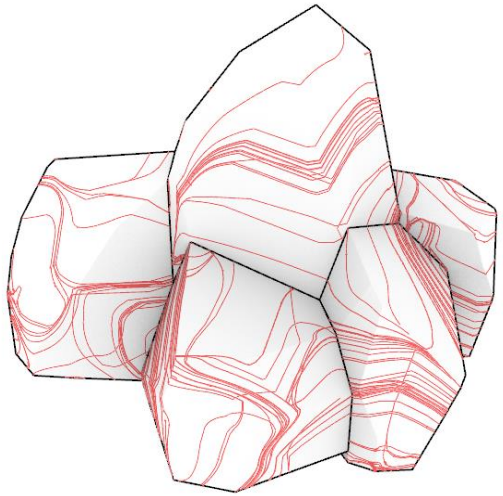
Choosing Representative Fragment

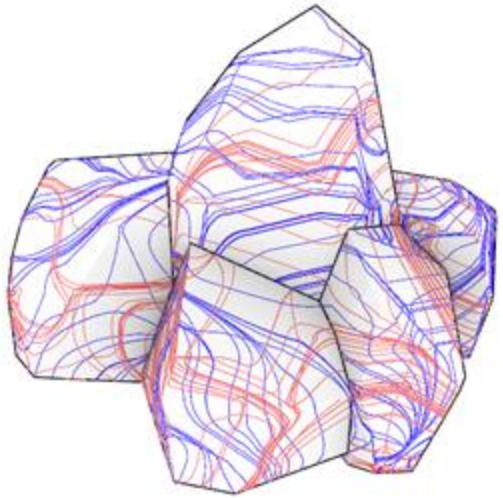


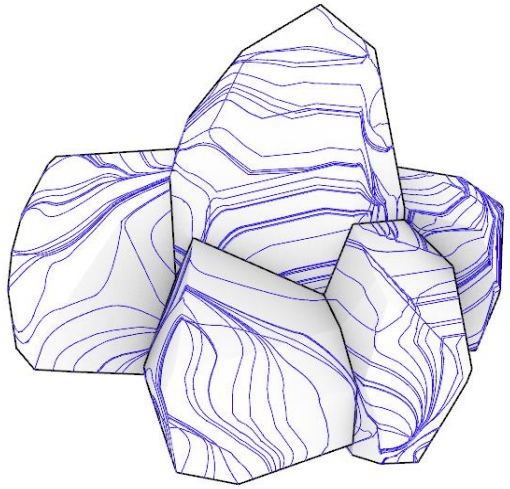
D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Stress Diagram

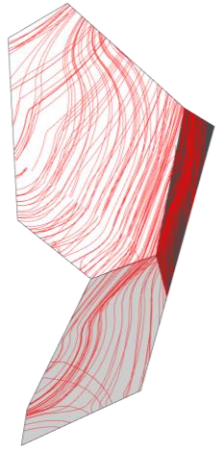
Building

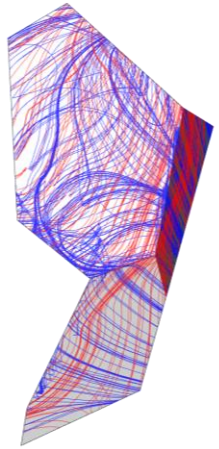


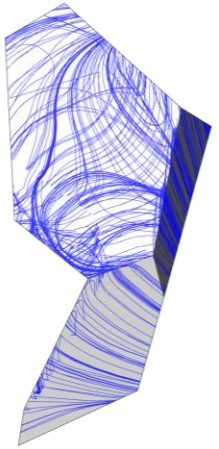




Fragment



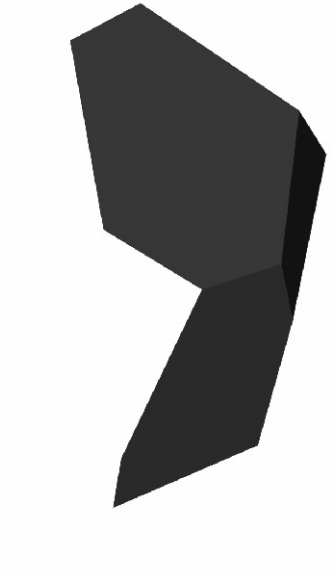




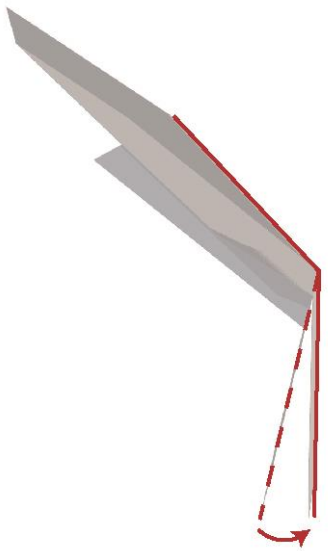
Compression **Overall** **Tension**

D2RP&A
Building Fragment
Wall Fragment
Fragment Components

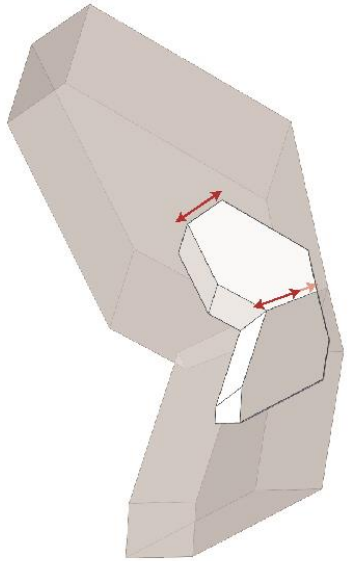
Fragment Extraction Process



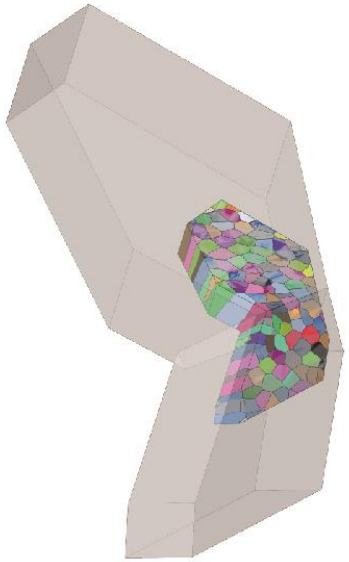
Choose representative wall for robotic production



Adjust angle, ensure proper support in turning point



Extract wall fragment for voronoi iteration



Wall fragment with voronoi iteration

D2RP&A

Building Fragment

Wall Fragment

Fragment Components

Fragment Iteration

Variations of voronoi stretch angle

Conclusion: different based on seed. Should be adjusted for walls with extreme angles. Either top or bottom angle should be kept at 0 for the voronoi geometry to properly merge in the turning point.


Seed 7, plane 0


Seed 7, plane 45


Seed 7, plane 90


Seed 9, plane 90


Seed 9, plane 0


Seed 9, plane 45

Variations of surface normal vector

Conclusion: centrally located normal lines produce more even voronoi geometry on the turning point.


Seed 5, plane 45


Seed 5, plane 0


Seed 10, plane 0


Seed 10, plane 45


Seed 9, plane 45
Shift normal plane


Seed 9, plane 45
Shift normal plane

Variations of point count

Conclusion: Point cloud should be adjusted in proportion to the wall fragment size to keep the component at around 200mm vertical thickness.


Seed 7, plane 45
Shift normal plane


Seed 7, plane 45
Increase point count (115)

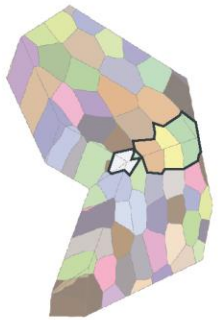

Seed 7, plane 0
Increased point count (125)


Seed 7, plane 0
Increased point count (170)


Seed 7, plane 45
Increased point count (170)

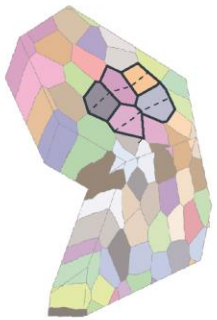

Seed 7, plane 90
Increased point count (170)

Fragment Iteration



Seed 1

Component sizes too different



Seed 7

Regenerate seed

Components too big

Seed 10

Increase control point count

Good proportion for most components
Components in turning point too tapered
may be problematic in milling
Components too vertical
need shorter components for compressive strength

Seed 10*

Manually adjust points from the generated seed

Point count 130
Reference top angle 0,
bottom angle 90

Goal achieved:

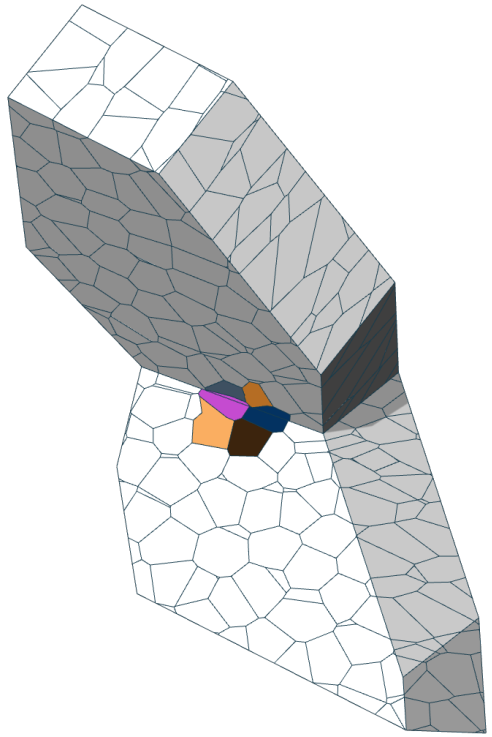
(1) Laterally stretched and vertically compressed components

(2) Generally even distribution and shape of voronoi geometry

D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Breakdown fragment into components

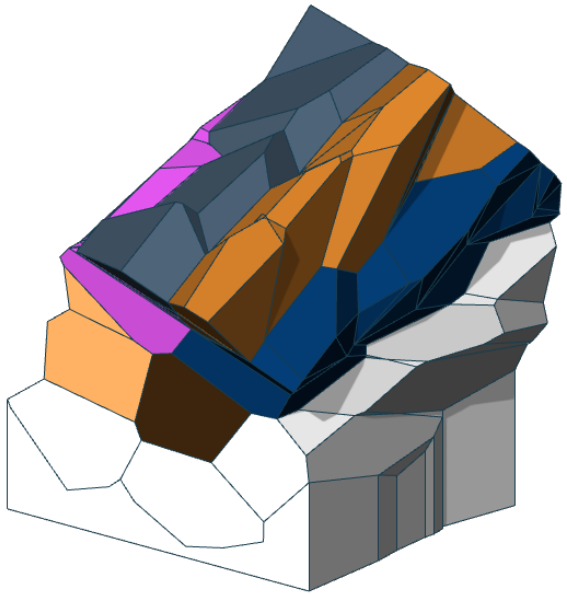
Chosen fragment composition



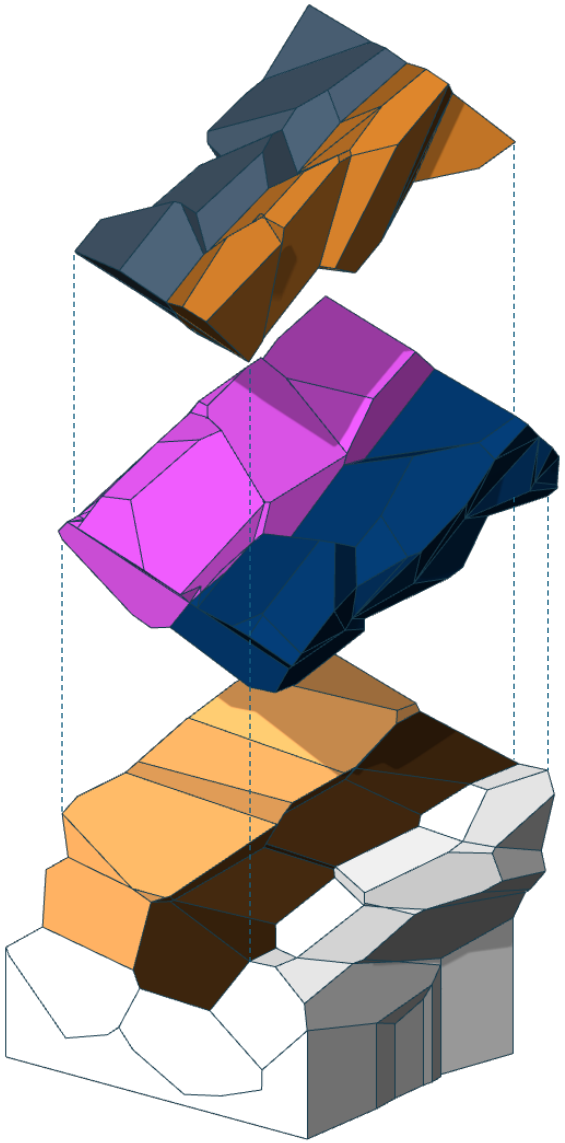
Chosen component to develop for production, to test stability

D2RP&A
Building Fragment
Wall Fragment
Fragment Components

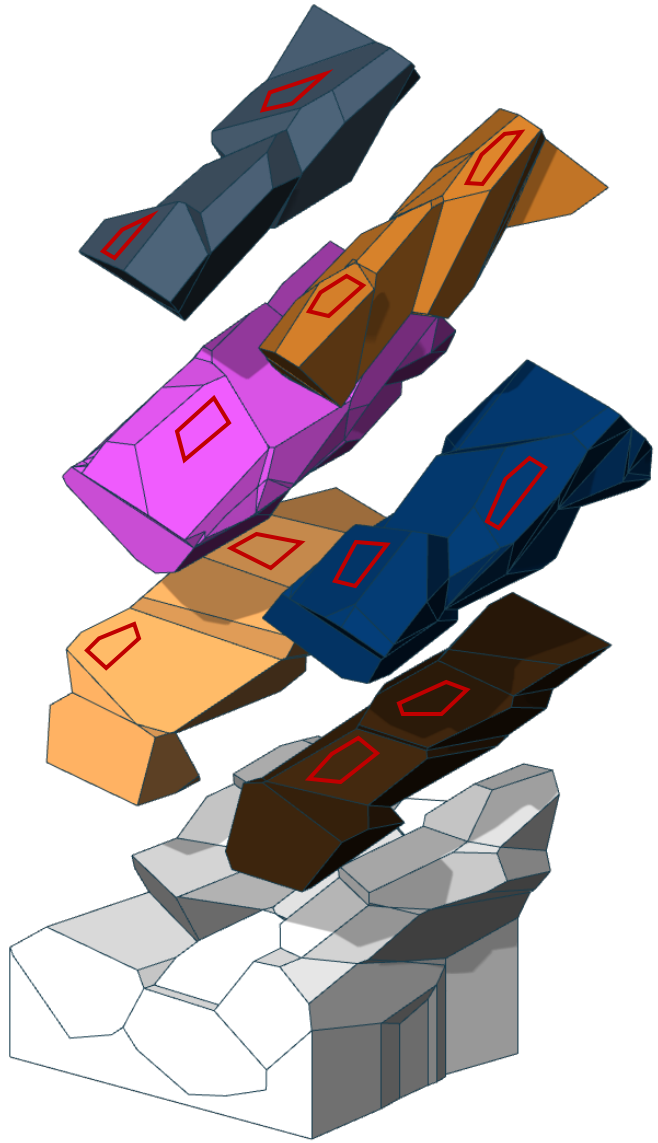
Fragment of 6 Components



Chosen Component



Connection



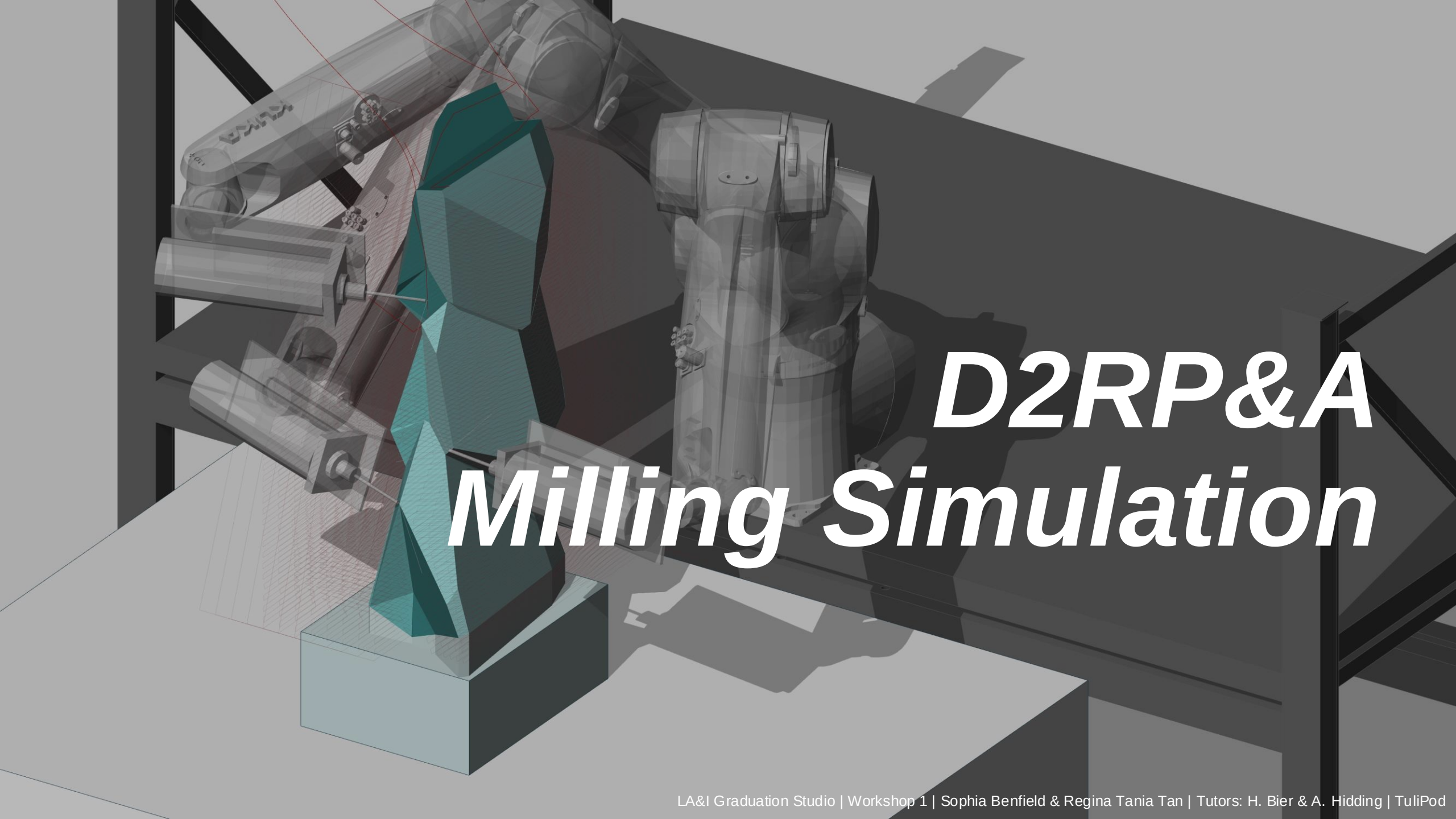
Milling Holes

D2RP&A

Building Fragment

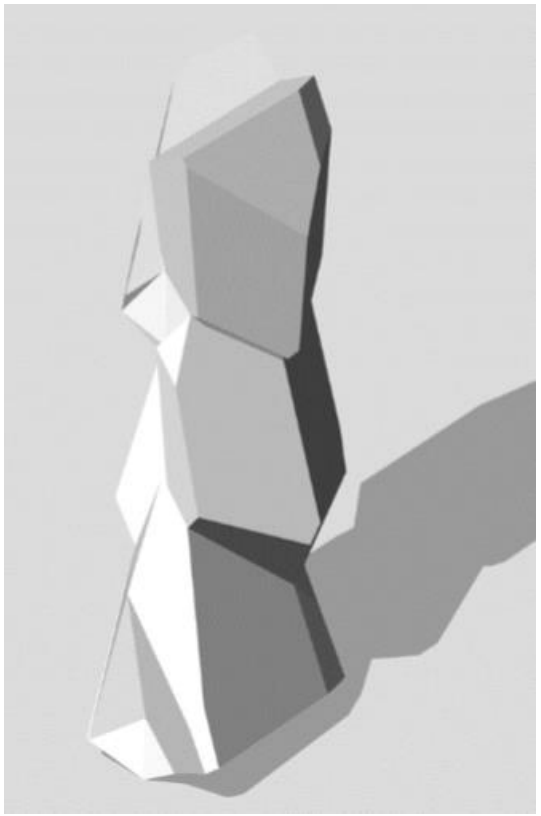
Wall Fragment

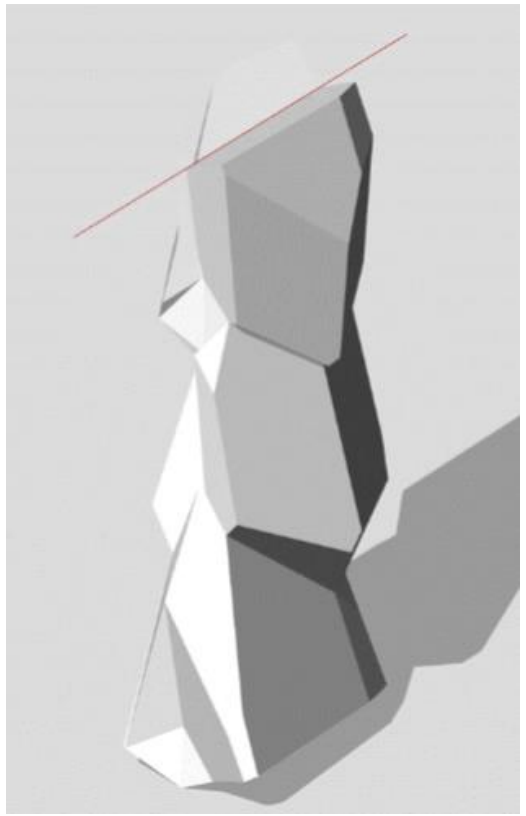
Fragment Components

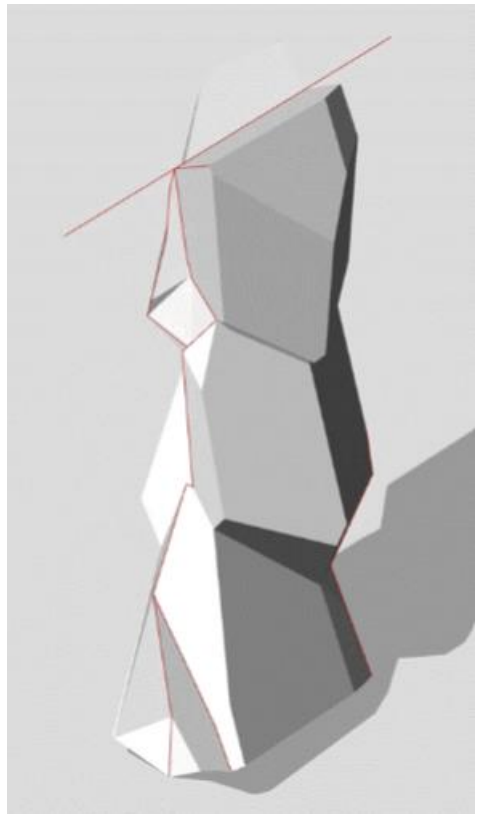


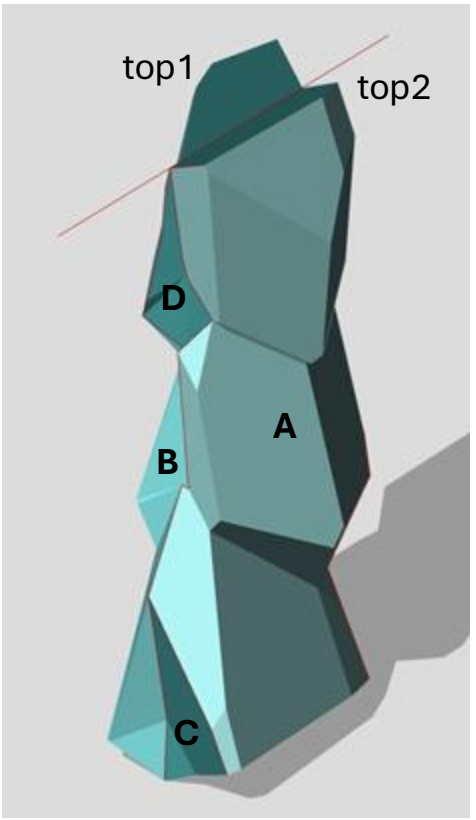
D2RP&A
Milling Simulation

LA&I Graduation Studio | Workshop 1 | Sophia Benfield & Regina Tania Tan | Tutors: H. Bier & A. Hidding | TuliPod





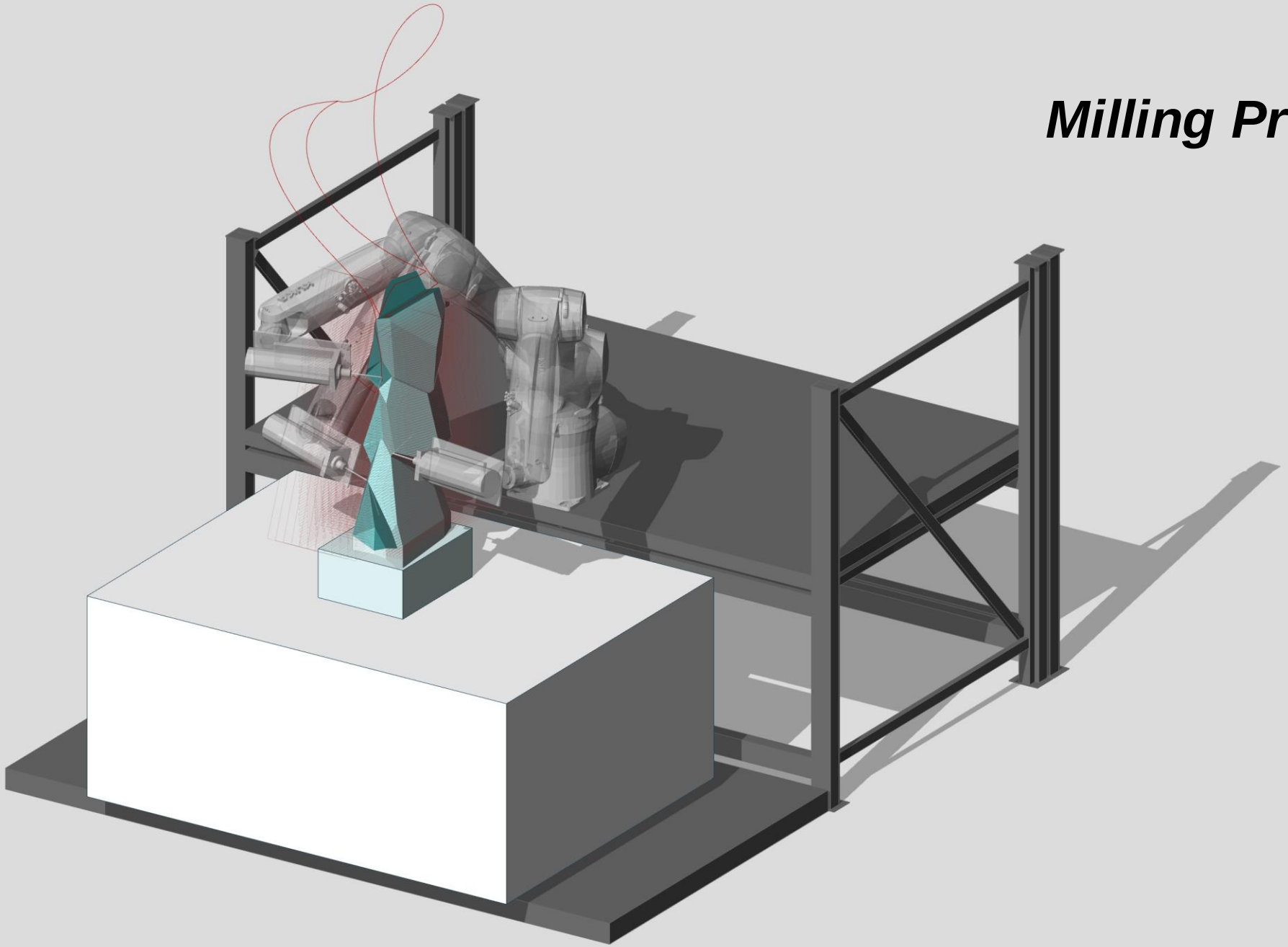




Surface Selection

D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Milling Process



D2RP&A
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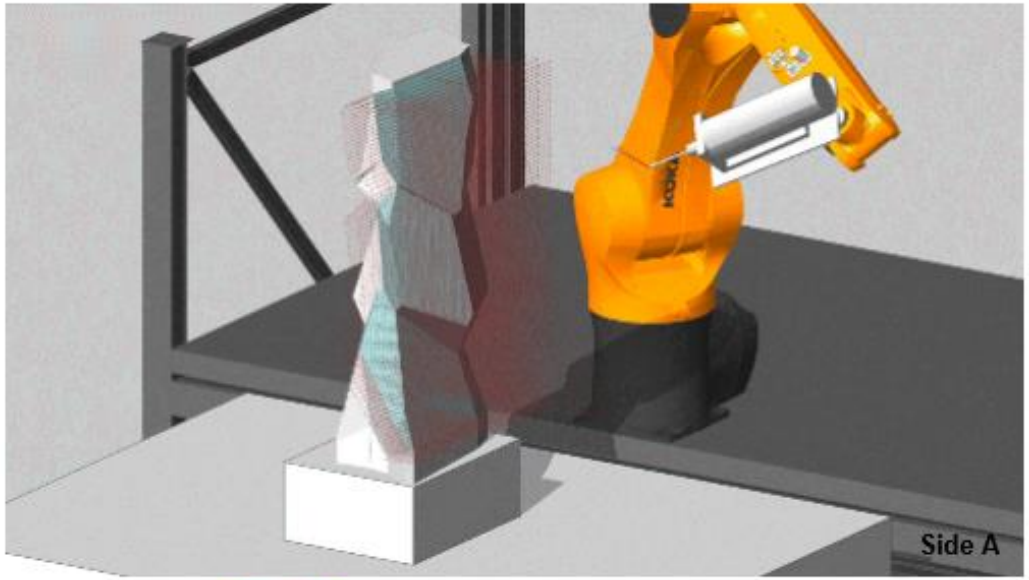
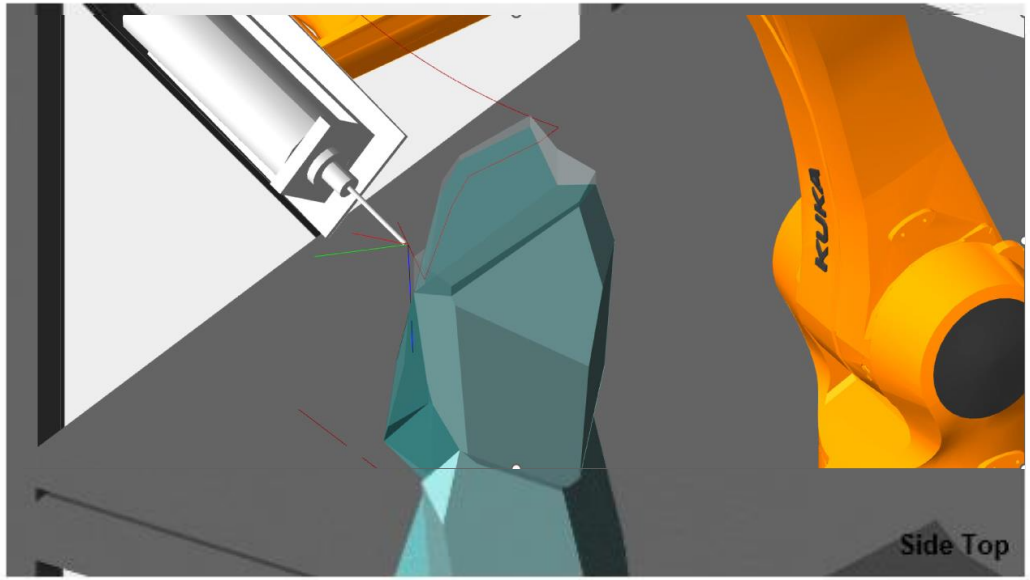
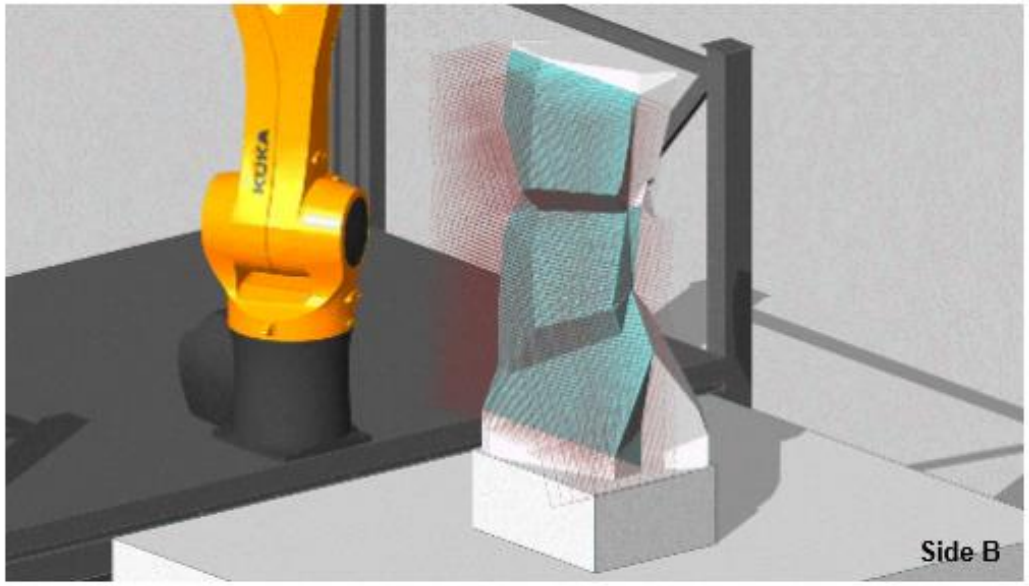
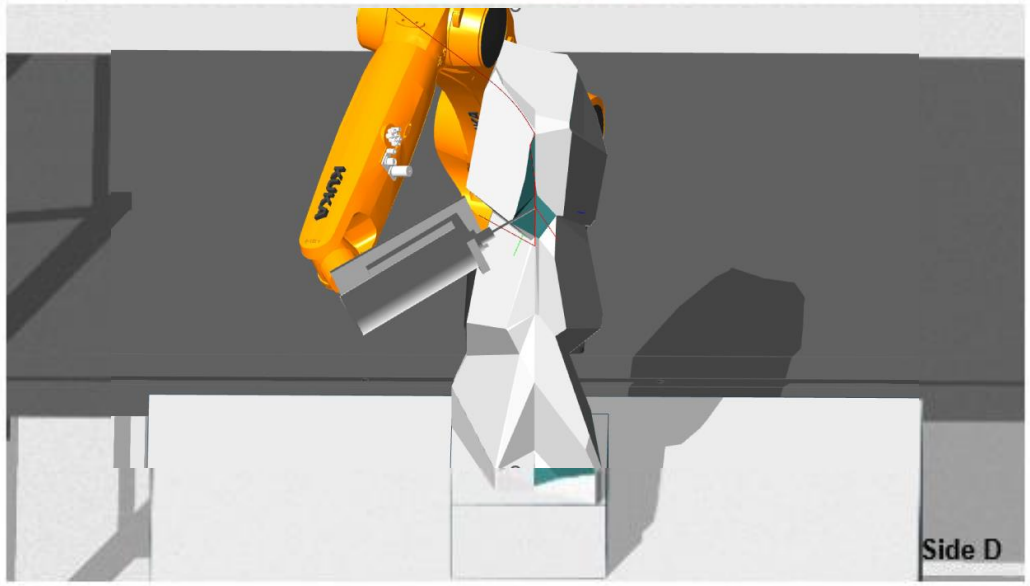
Fragment Components







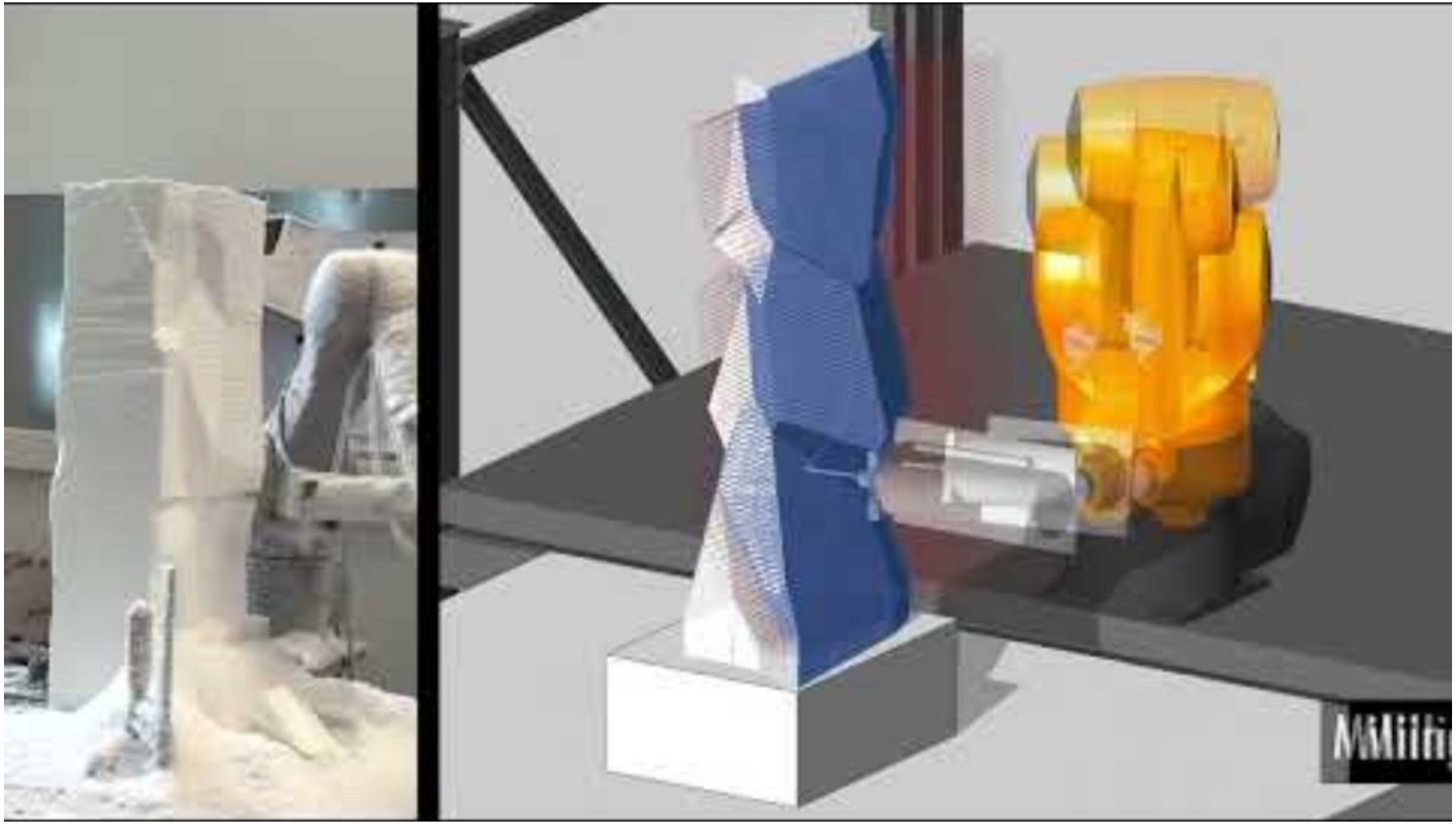


D2RP&A

Building Fragment

Wall Fragment

Fragment Components



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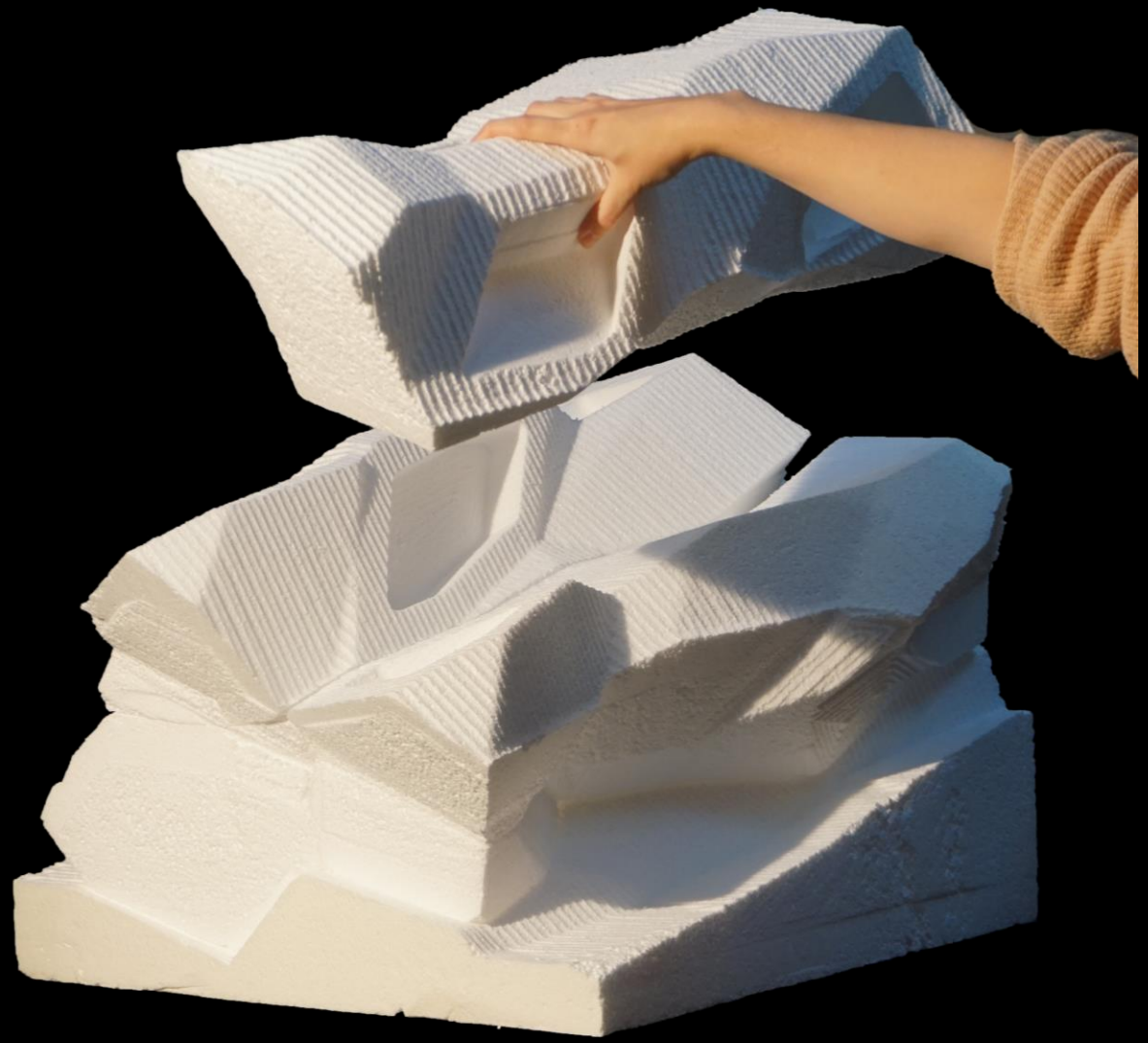
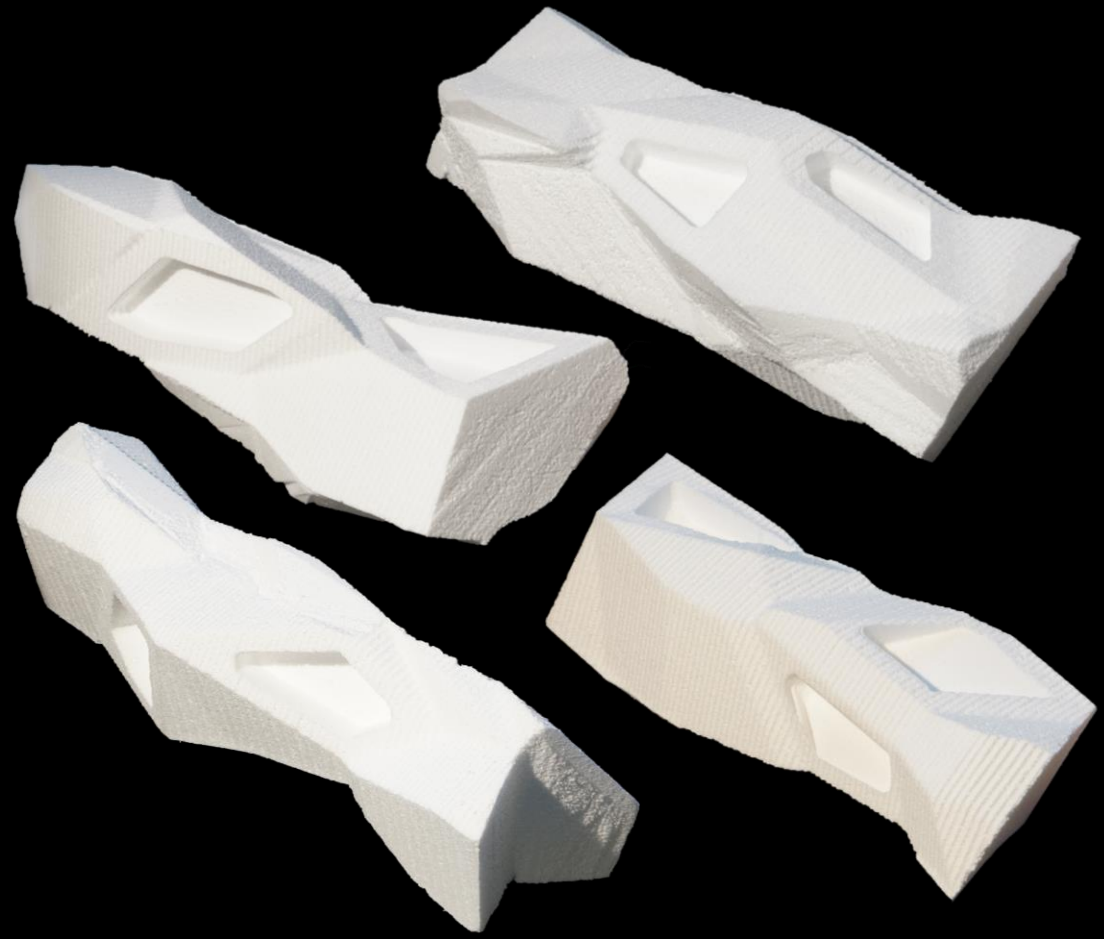
D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Photo of fragments

D2RP&A
Building Fragment
Wall Fragment
Fragment Components





D2RP&A
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