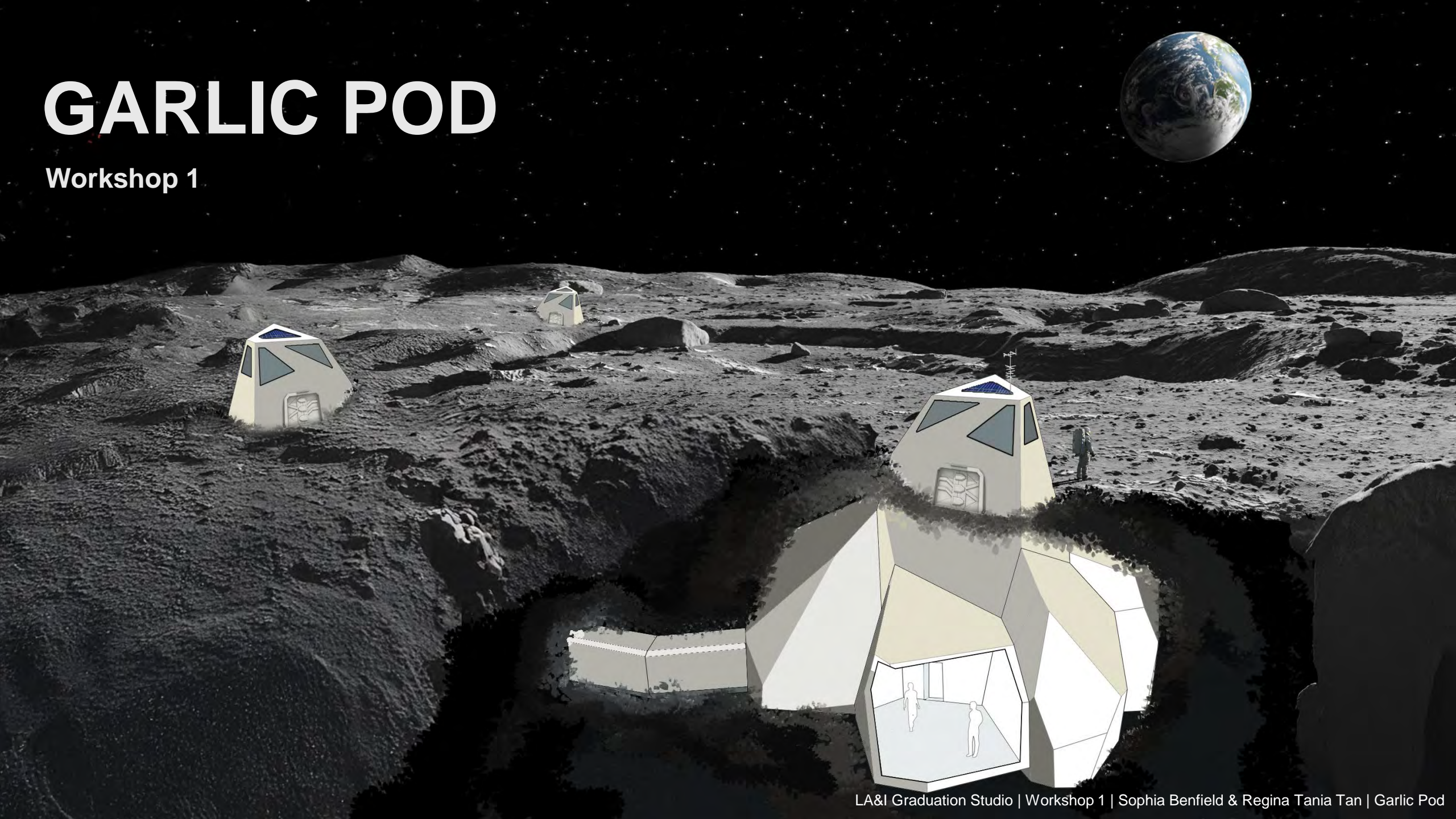


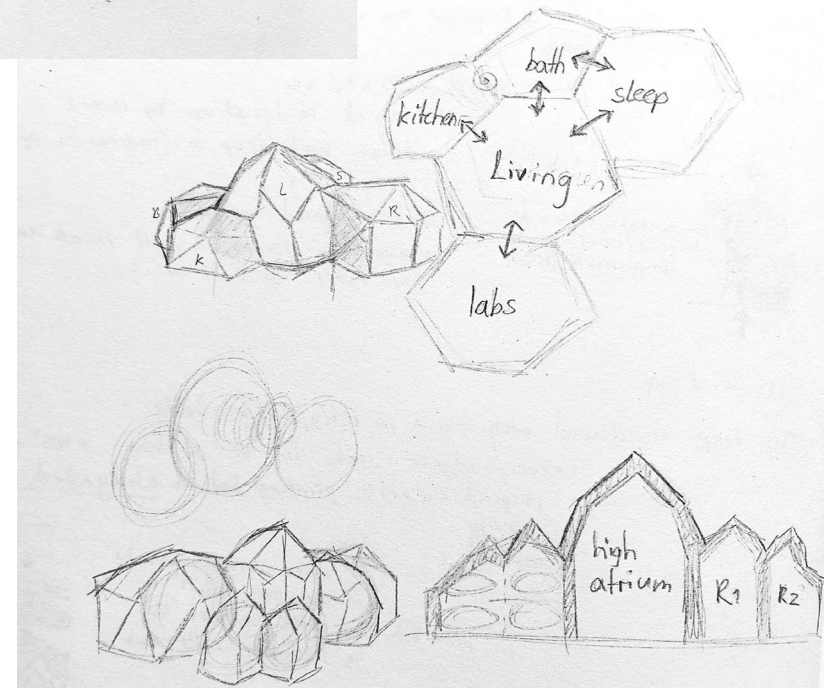
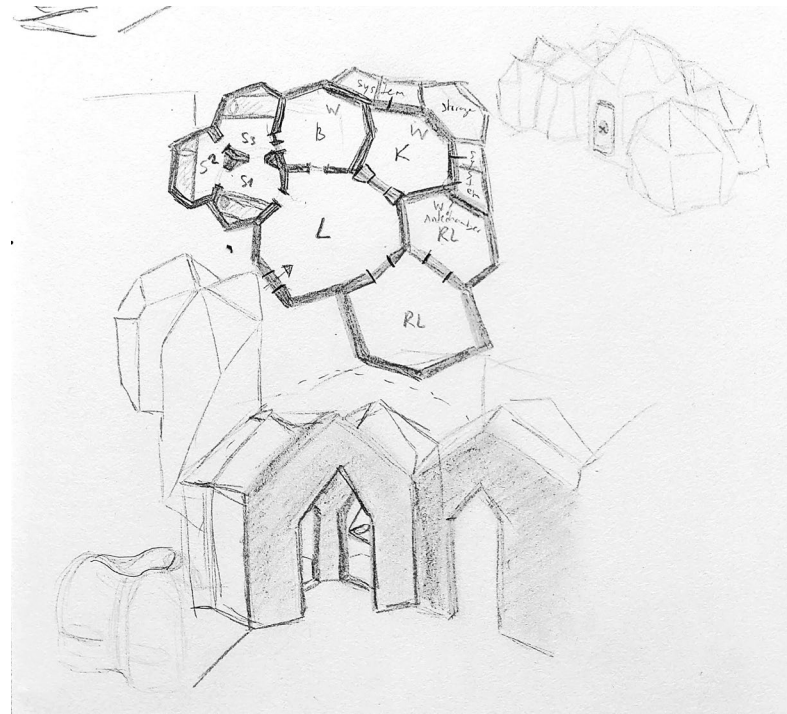
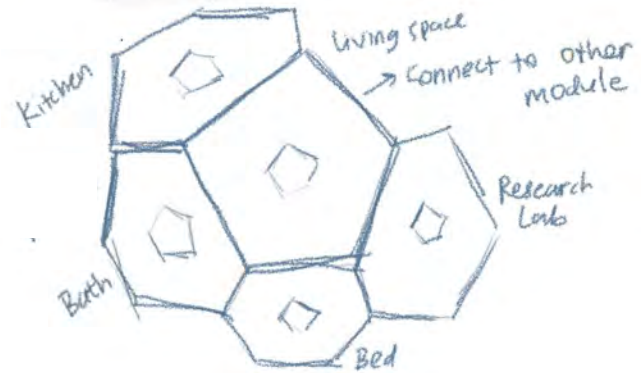
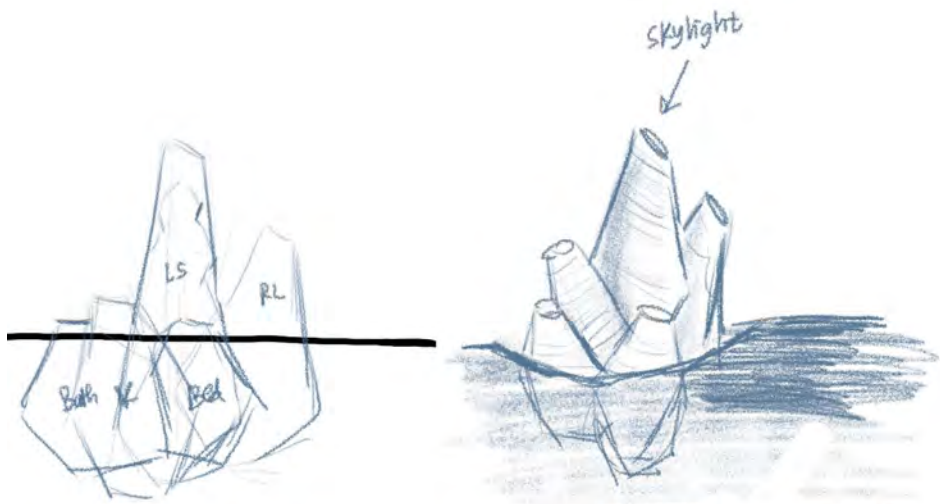
GARLIC POD

Workshop 1



The background of the slide features several detailed sketches of garlic. On the left, a large sketch shows a garlic bulb with its papery skin partially peeled away, revealing the individual cloves and their fibrous texture. Below it, a smaller sketch shows a single clove. On the right, a large sketch shows a cross-section of a garlic bulb, highlighting the internal structure of the cloves and the central stem. The sketches are rendered in a light, naturalistic style with soft shading to show depth and texture.

Initial Sketches



Vertical Strategy

Horizontal Strategy

A photograph of garlic bulbs and a cross-section. On the left, a whole garlic bulb is shown with its stem and roots. In the center, a single garlic clove is visible. On the right, a garlic bulb is cut in half, revealing the internal structure of the cloves. The word "Inspiration" is overlaid in the center in a large, bold, black font.

Inspiration



Atrium

Protective barrier

Rooms

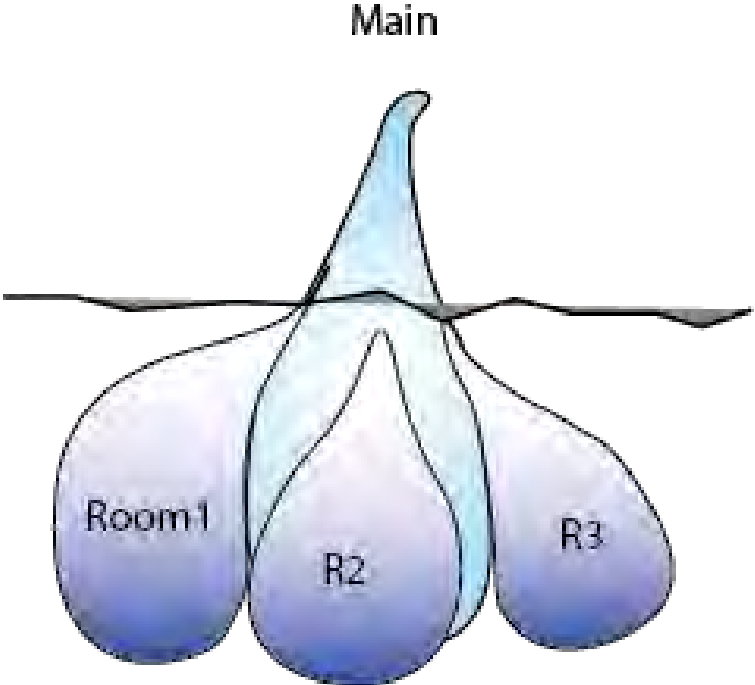
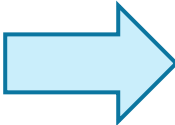
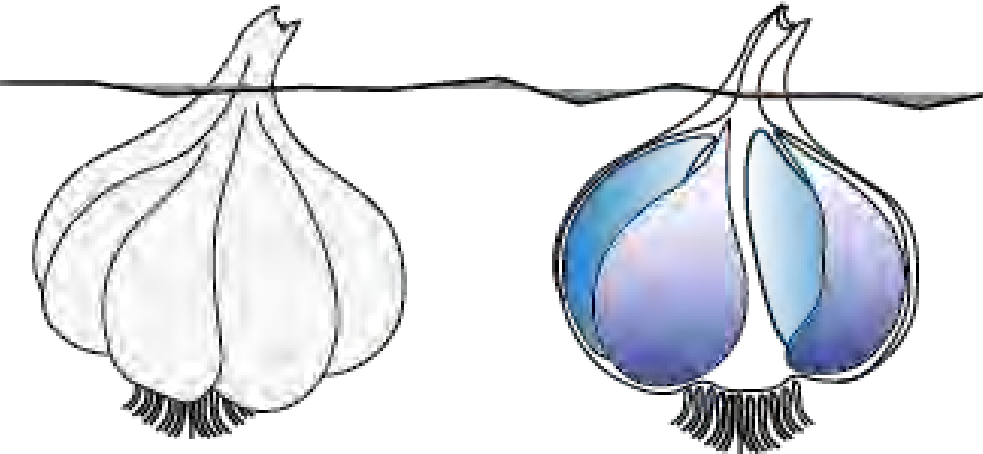
Rooms

Foundation

Connection

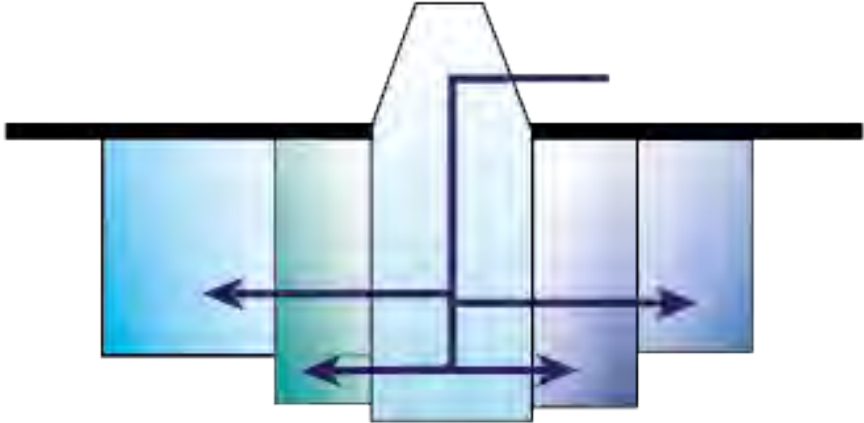
"Voronoi"

Synthesis garlic concept | Concept diagrams

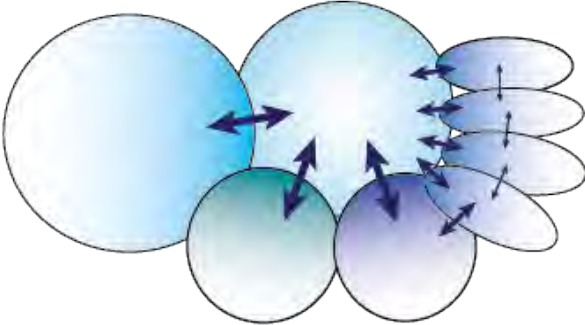
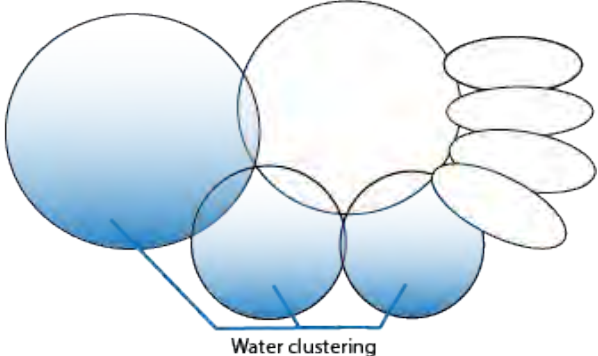
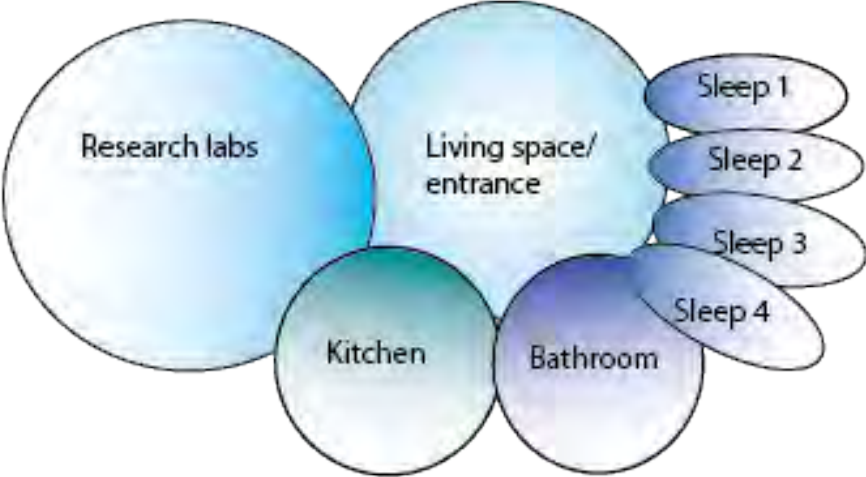


Synthesis garlic concept | Concept diagrams

Section



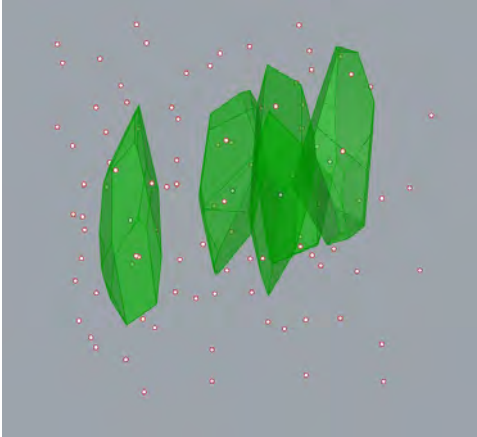
Topview



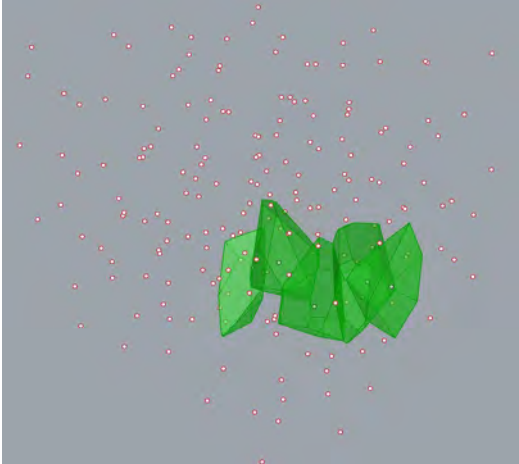
The background of the slide features several garlic bulbs. On the left, a bulb is partially peeled, showing its individual cloves. In the center, a whole bulb is visible. On the right, a bulb is cut in half, revealing the internal structure of the cloves. The text 'Form-Finding Process' is overlaid in the center in a large, bold, black font.

Form-Finding Process

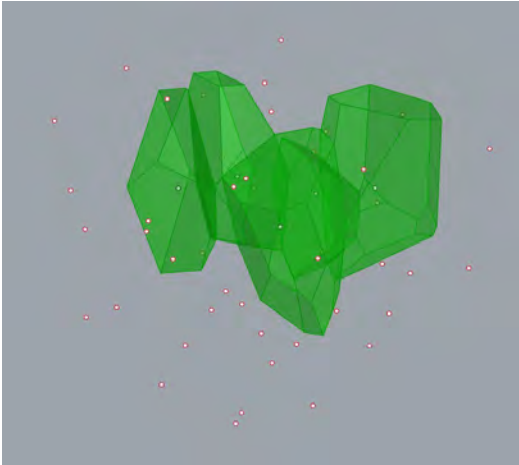
Code-generated Iterations | Strategy



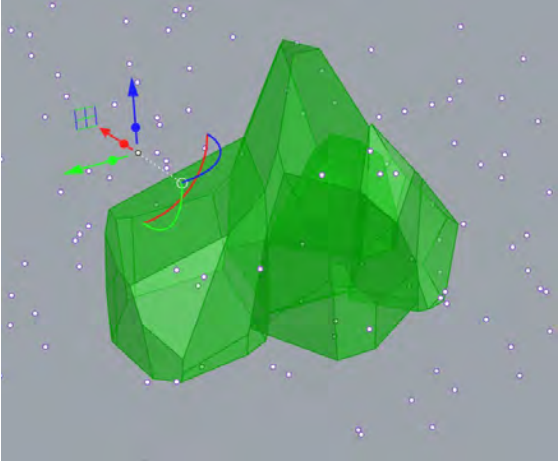
Initial Shape
100 points



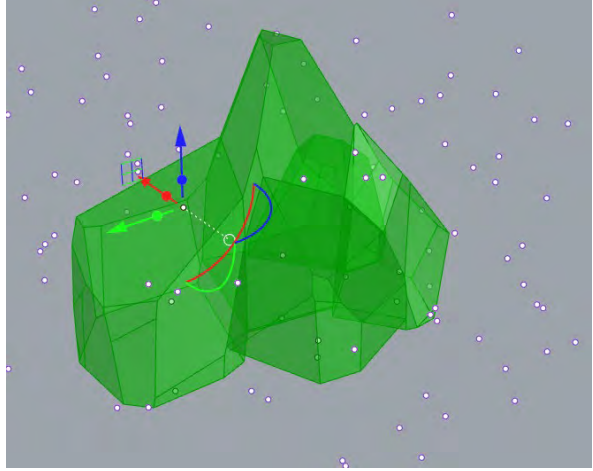
Increase Point Cloud
200 points
More variative iterations



Decrease Point Cloud
50 points
Better control



Most effective controlling shapes:
Manually moving points



Controlling flat bottom surface:
Copy main point under volume

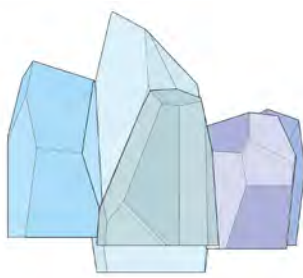
Form-finding process | Iterations



Starting shape: vertical cluster



Iteration 1: flat bottom and central atrium



Iteration 2: different levels



Iteration 3: levels spiral upward



Iteration 4: enlarge atrium



Iteration 5: bring together



Iteration 6: change proportions



Iteration 7: 2-sided cluster

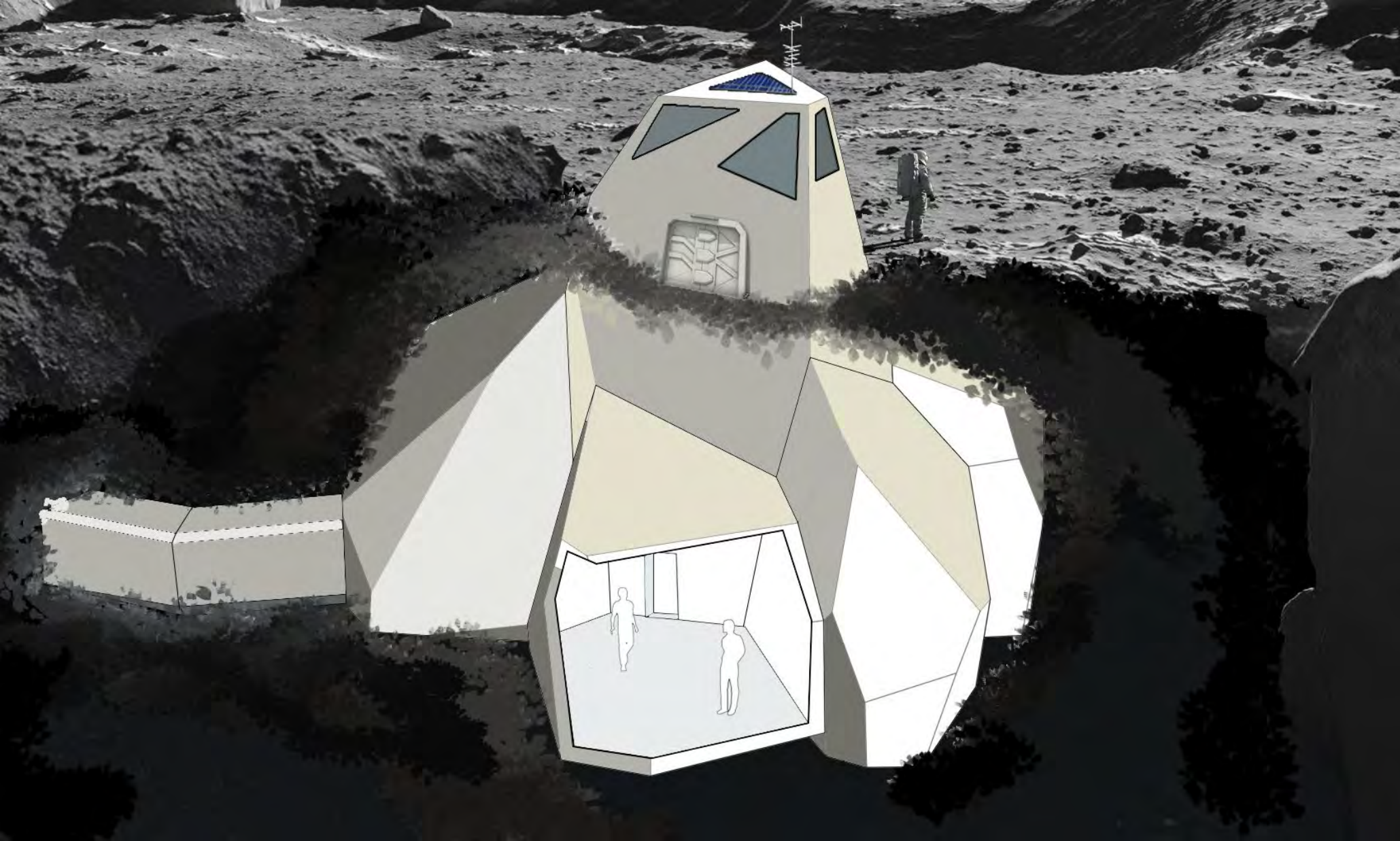


Iteration 8: change proportions



Iteration 9: get close to garlic shape

Form-finding process | Final Design



A photograph of garlic bulbs. One bulb on the left is partially peeled, showing the individual cloves. Another bulb is in the background, and a large cross-section of a bulb is on the right, revealing the internal structure of the cloves. The text is overlaid on the image.

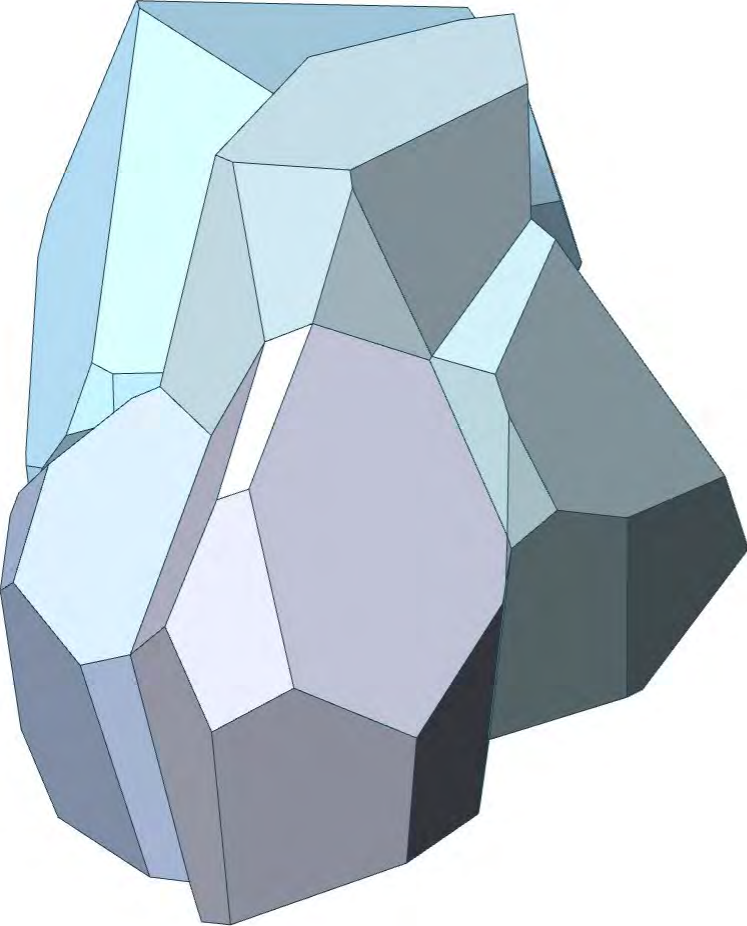
D2RP&A

Building Fragment

Wall Fragment

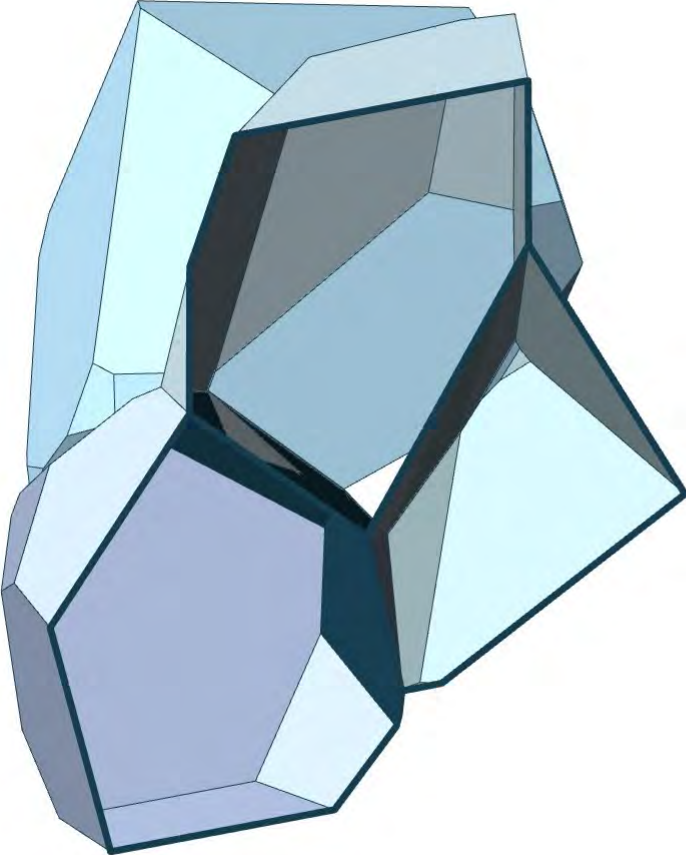
Fragment Components

Choosing Representative Fragment



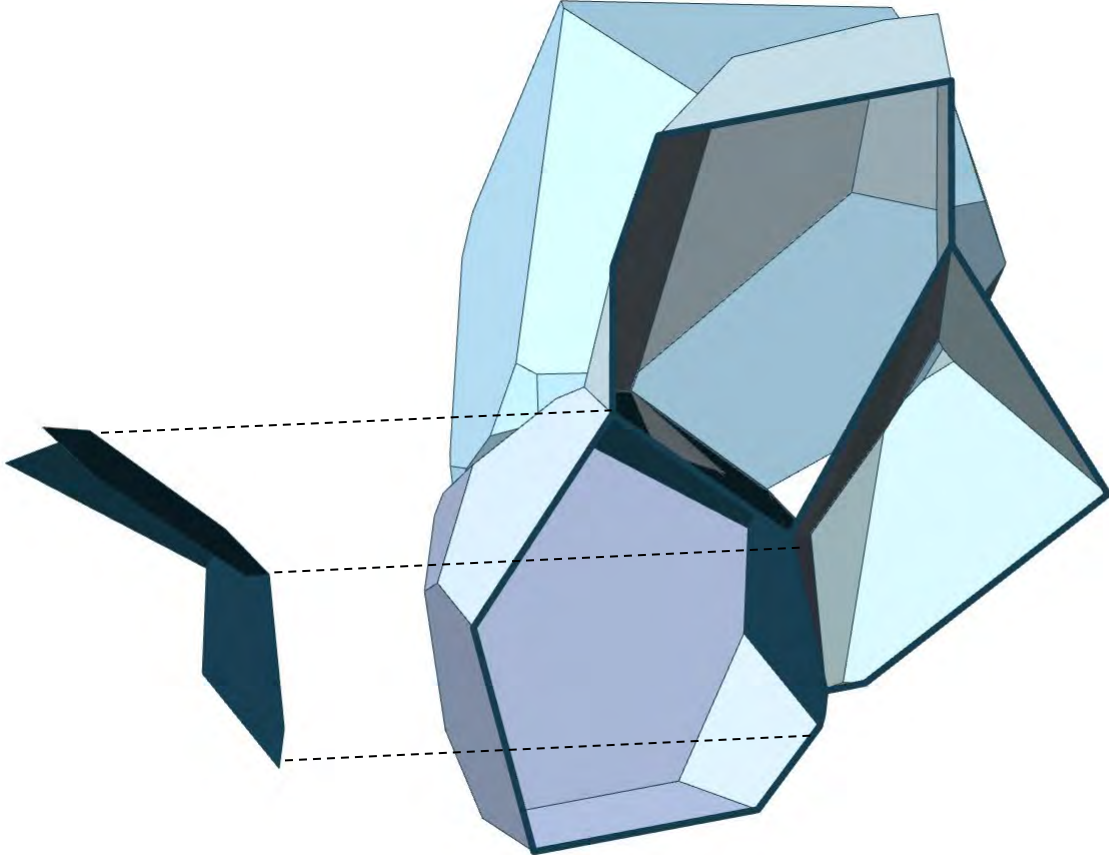
D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Choosing Representative Fragment



D2RP&A
Building Fragment
Wall Fragment
Fragment Components

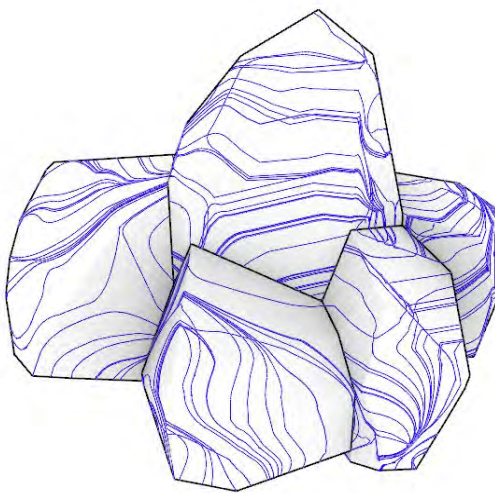
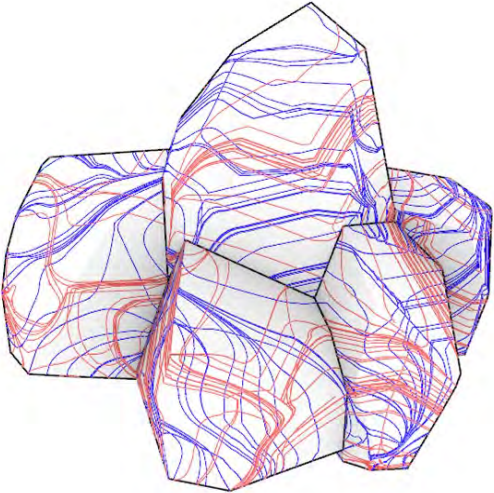
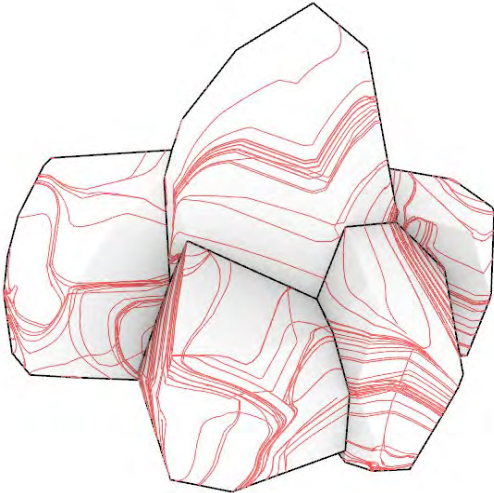
Choosing Representative Fragment



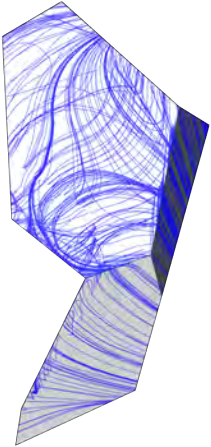
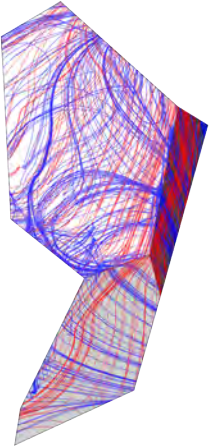
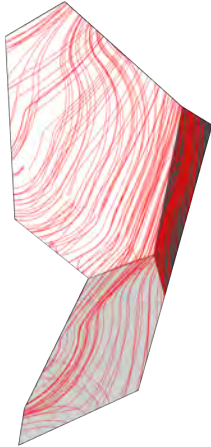
D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Stress Diagram

Building



Fragment



Compression

Overall

Tension

D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Fragment Extraction Process



Extracted wall fragment



Adjust angle to ensure proper support in turning point



Add wall thickness



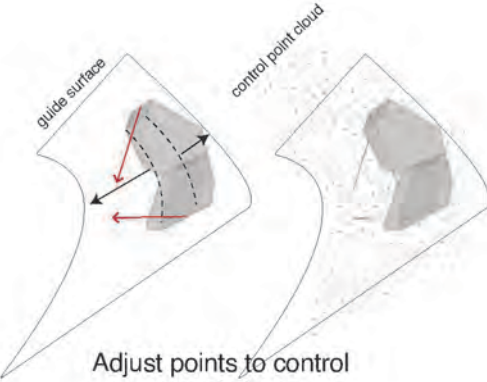
Adjusted wall



Choose wall fragment for robotic production



Refine wall fragment shape, ensure the fragment width change is not extreme



Adjust points to control voronoi shape



Wall fragment after iterations of voronoi structure

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
Increased 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*

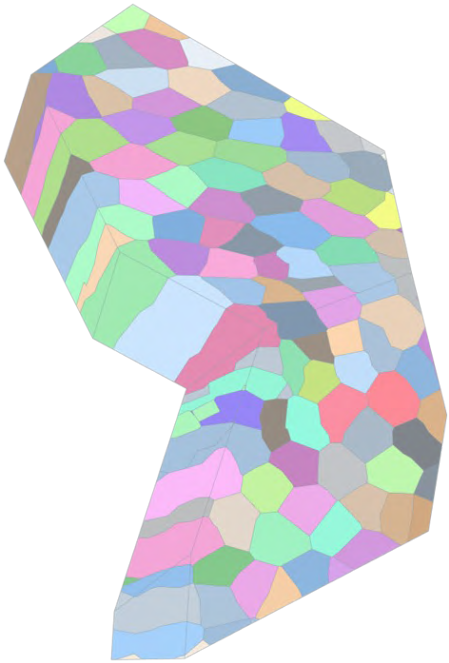
Manually adjust points from the generated seed

*Point count 130
Reference top angle 0,
bottom angle 90*

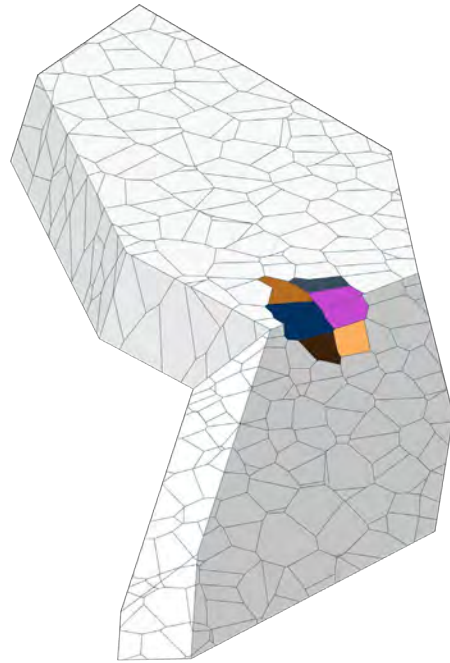
Goal achieved:

- (1) Laterally stretched and vertically compressed components
- (2) Generally even distribution and shape of voronoi geometry

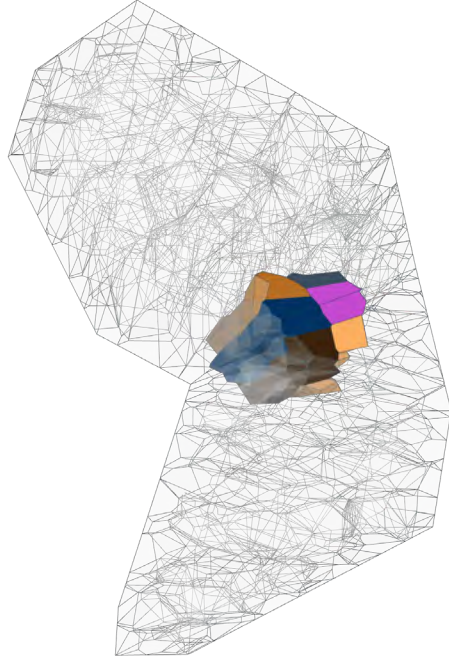
Breakdown fragment into components



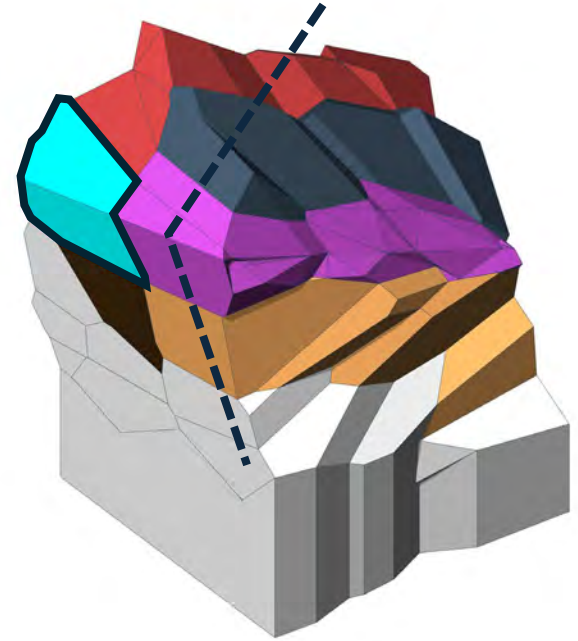
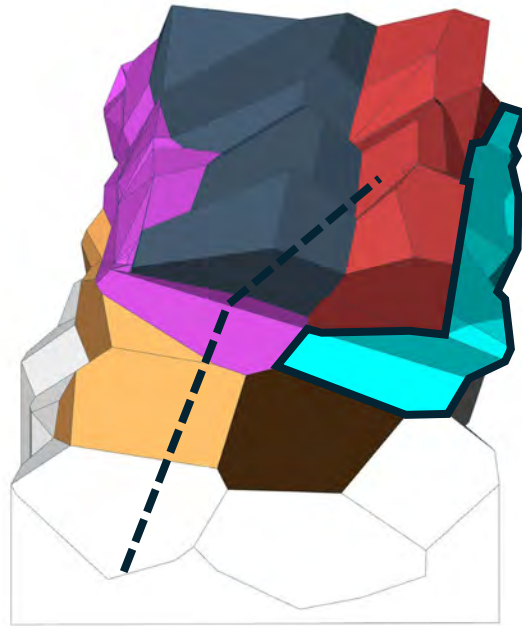
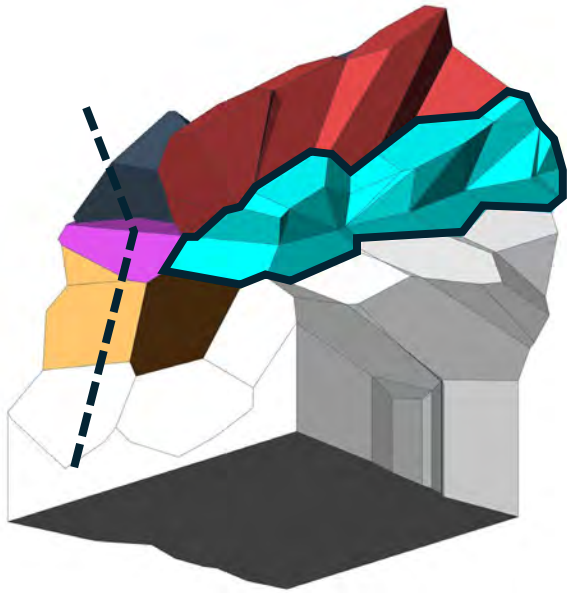
Chosen fragment



Representative component in turning point to test stability

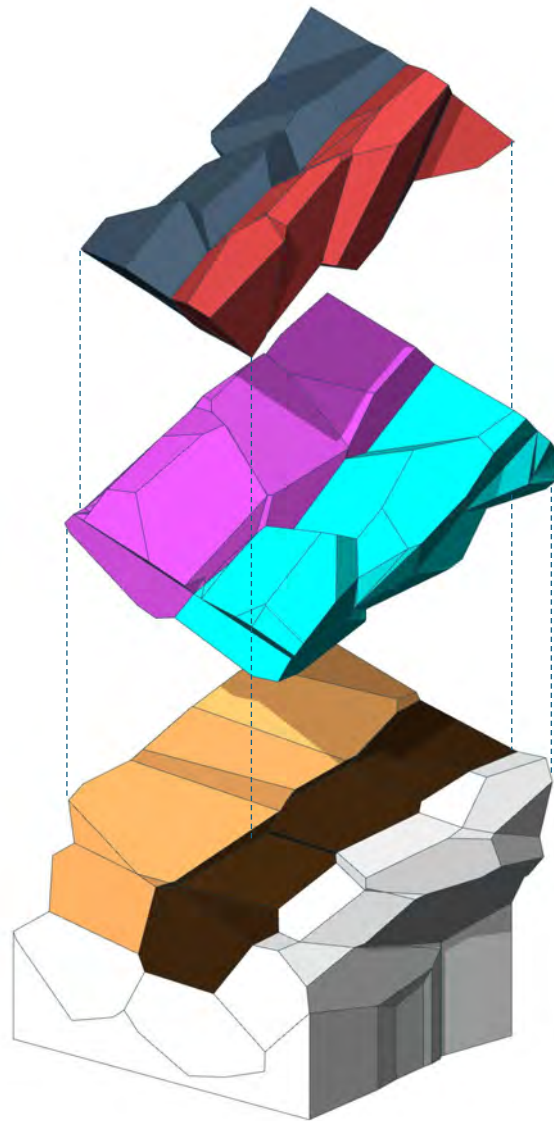
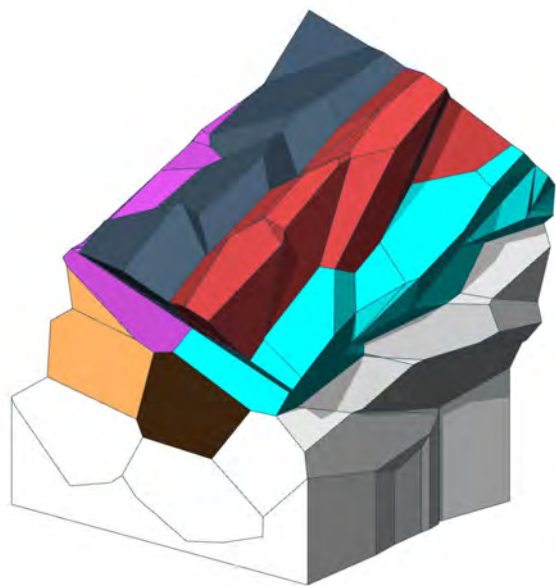


Chosen component to develop for production



Chosen component for simulation
on the folding area, considering higher complexity for testing

Fragment of 6 Components

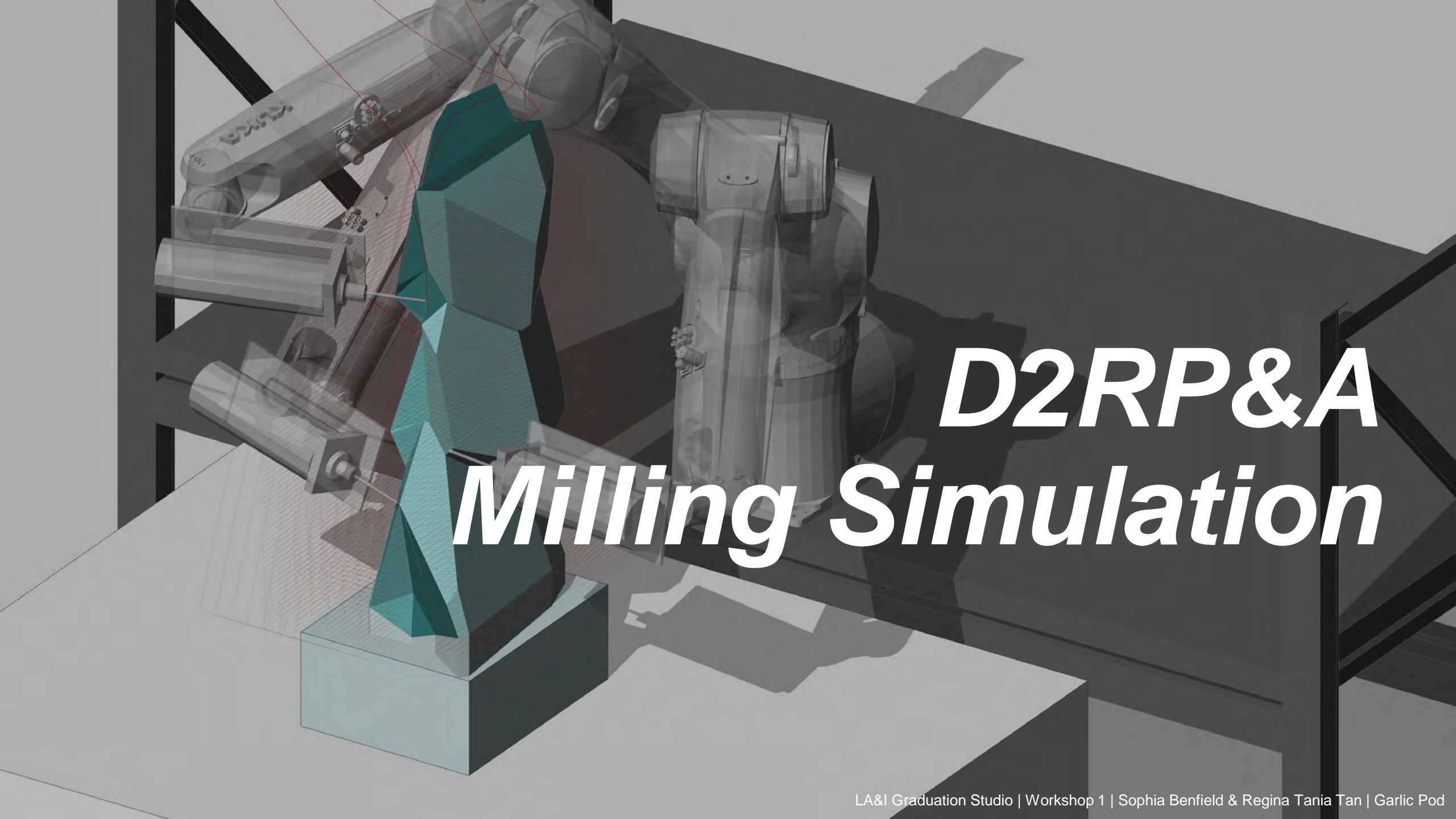


Connection

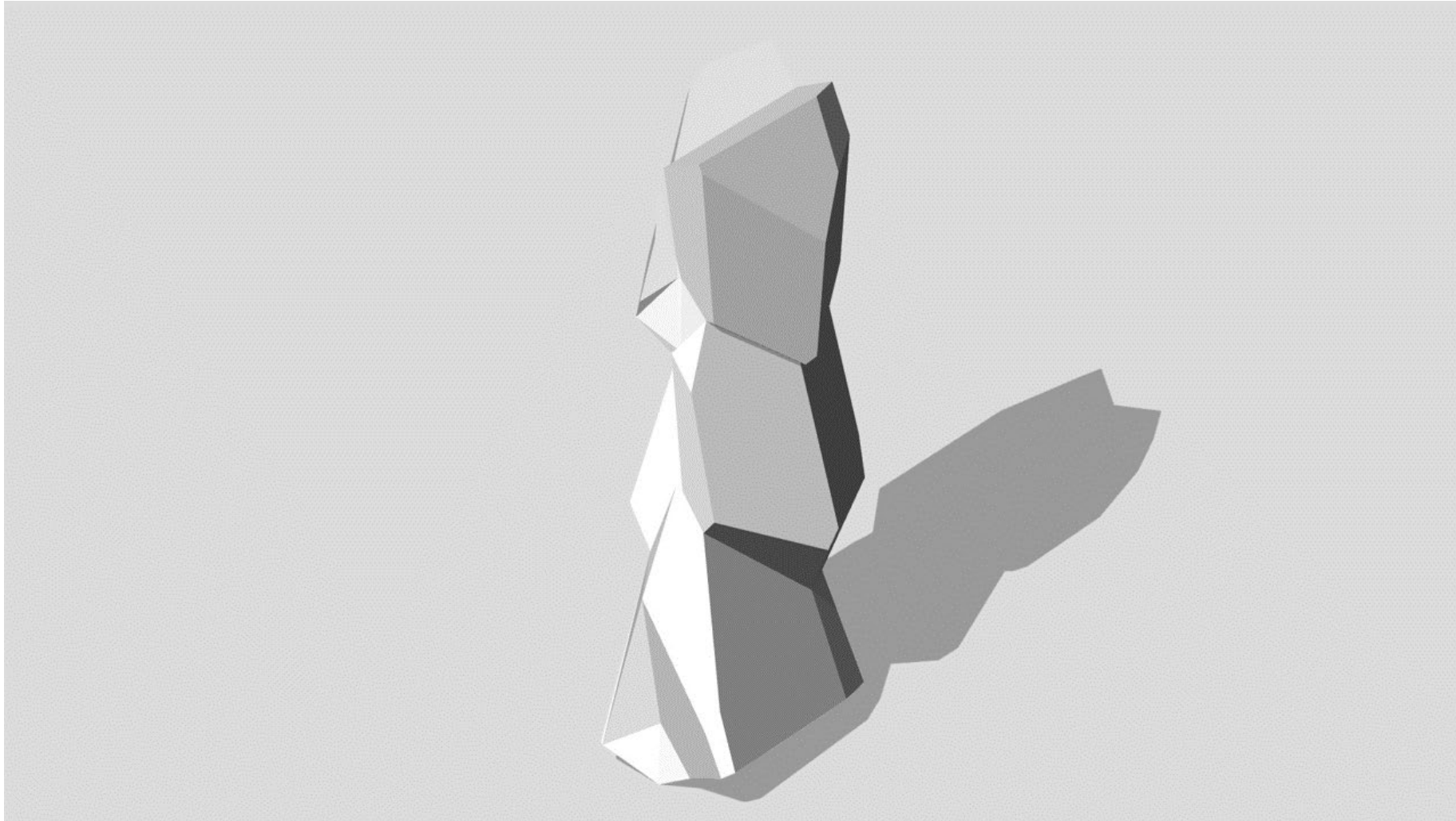


Milling Holes

D2RP&A
Building Fragment
Wall Fragment
Fragment Components



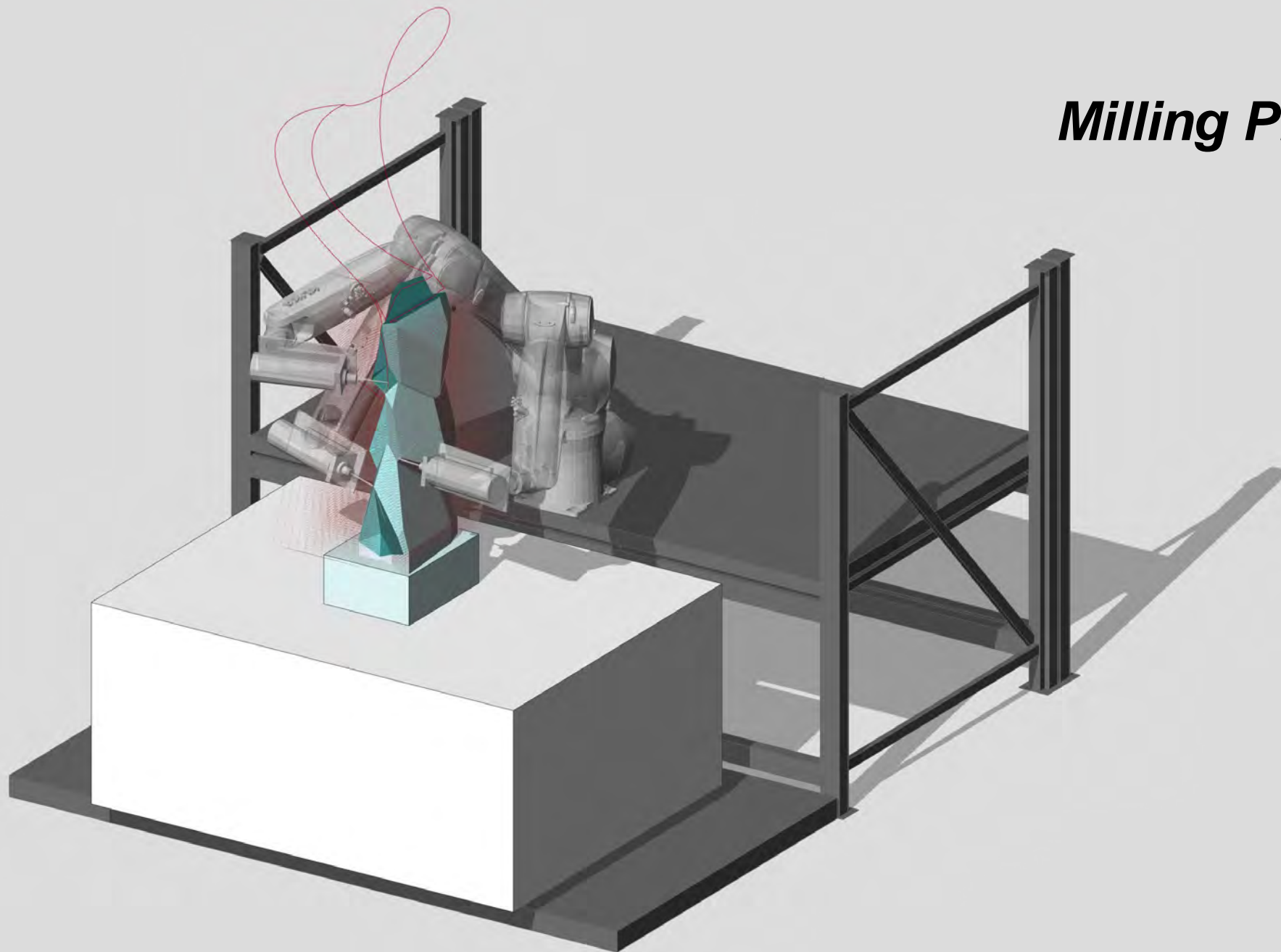
D2RP&A Milling Simulation



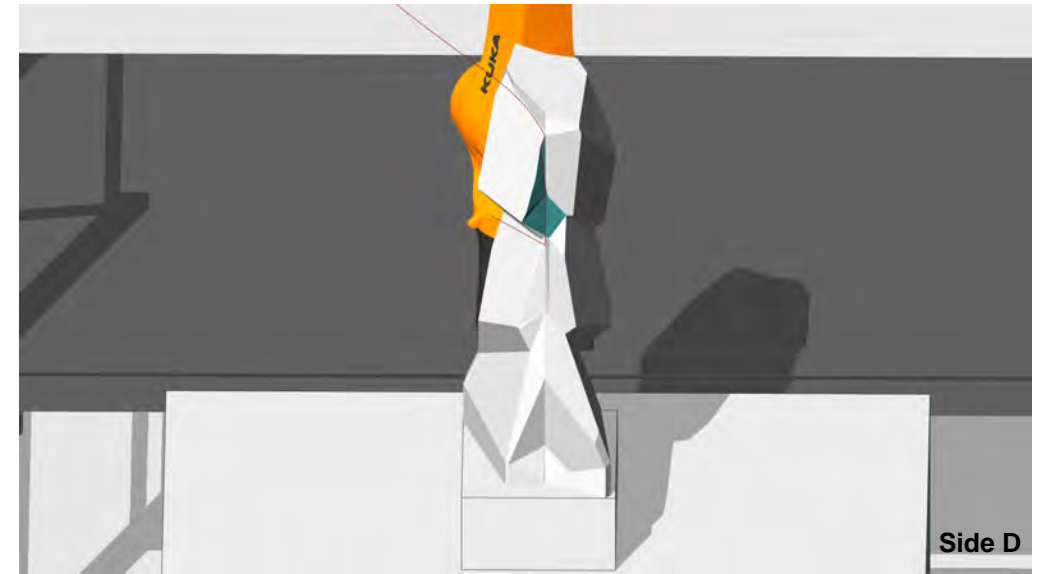
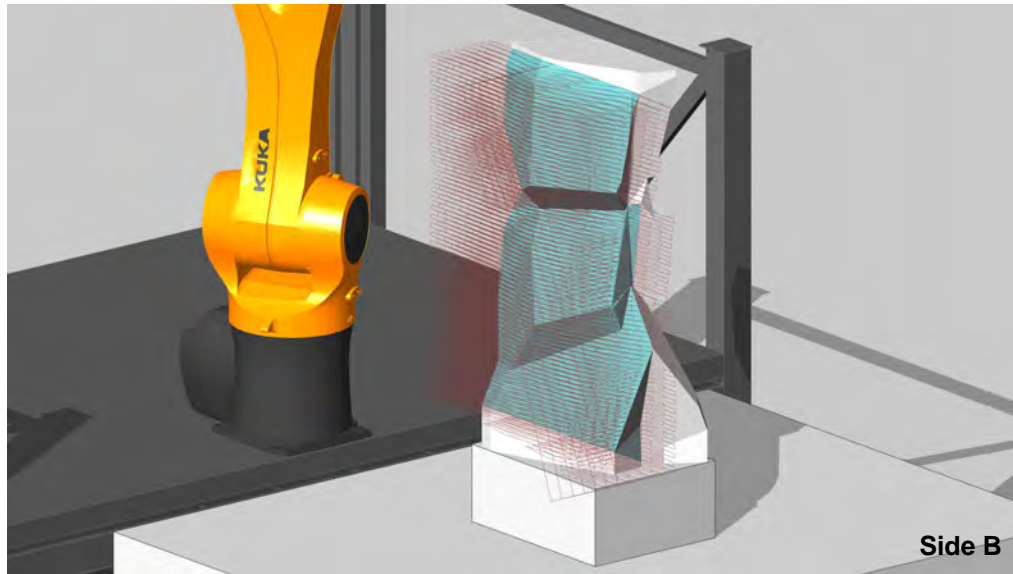
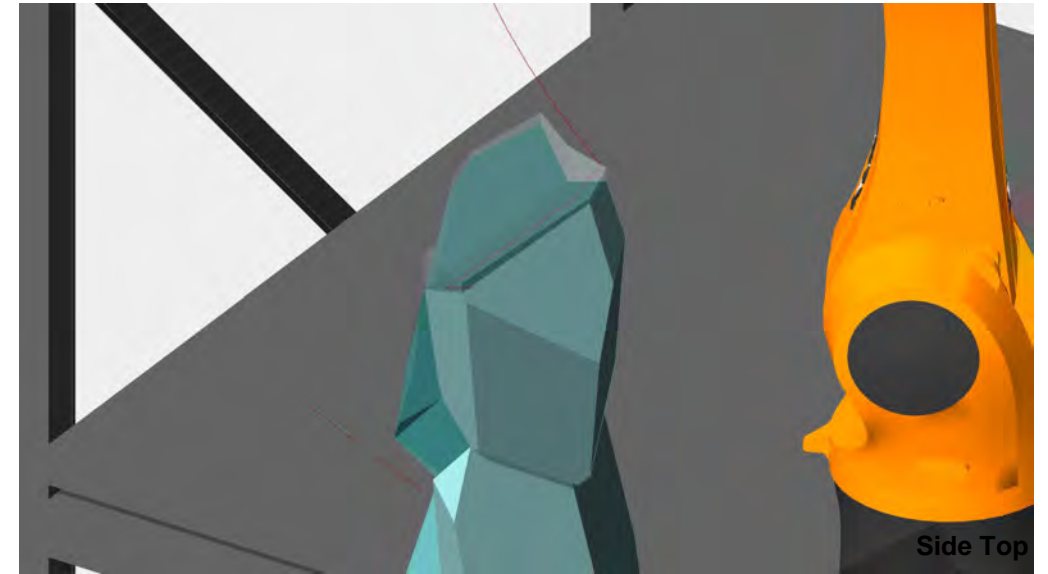
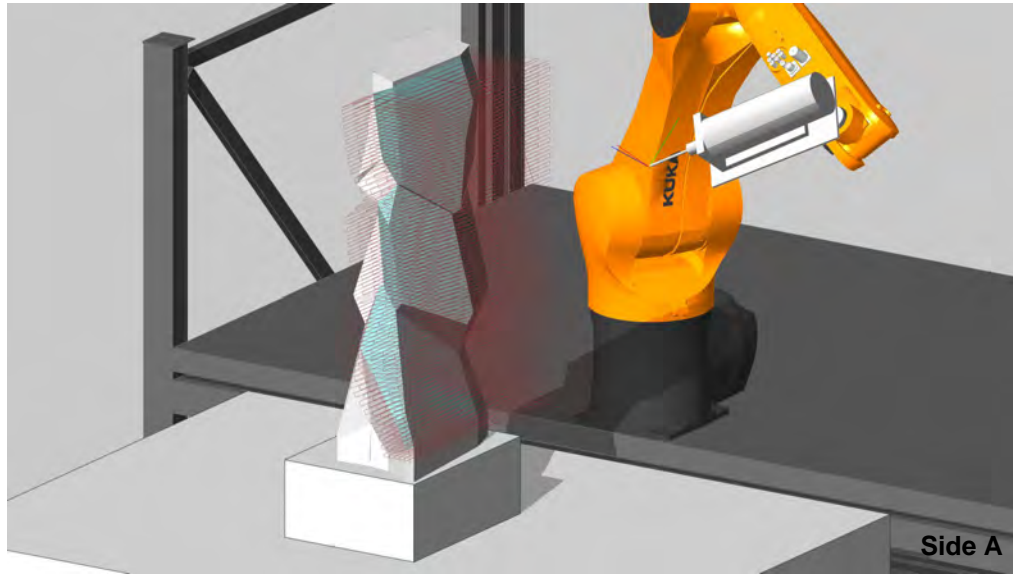
D2RP&A
Building Fragment
Wall Fragment
Fragment Components

Surface Selection

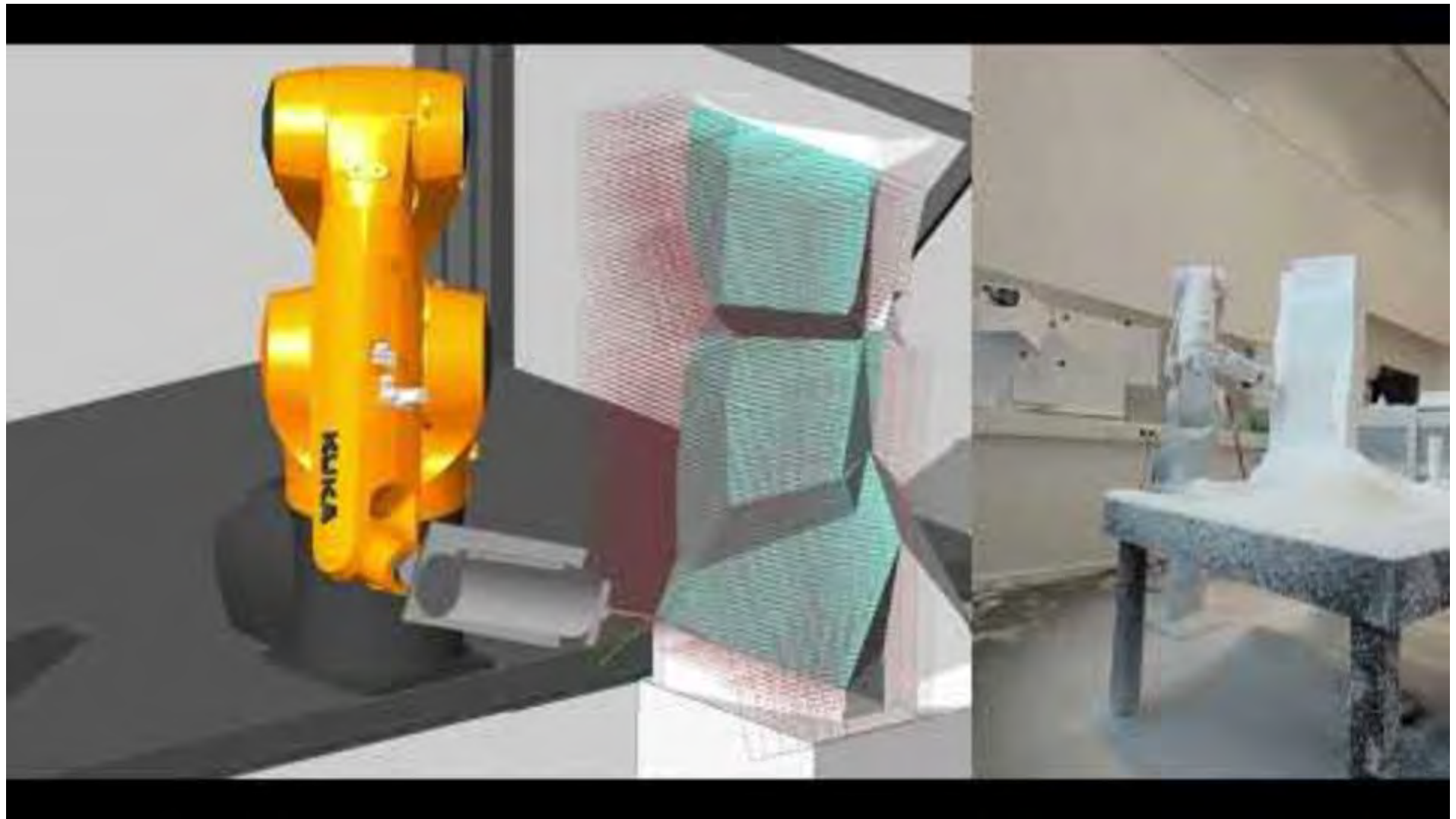
Milling Process



D2RP&A
Building Fragment
Wall Fragment
Fragment Components



D2RP&A
Building Fragment
Wall Fragment
Fragment Components



Side A

D2RP&A
Building Fragment
Wall Fragment
Fragment Components