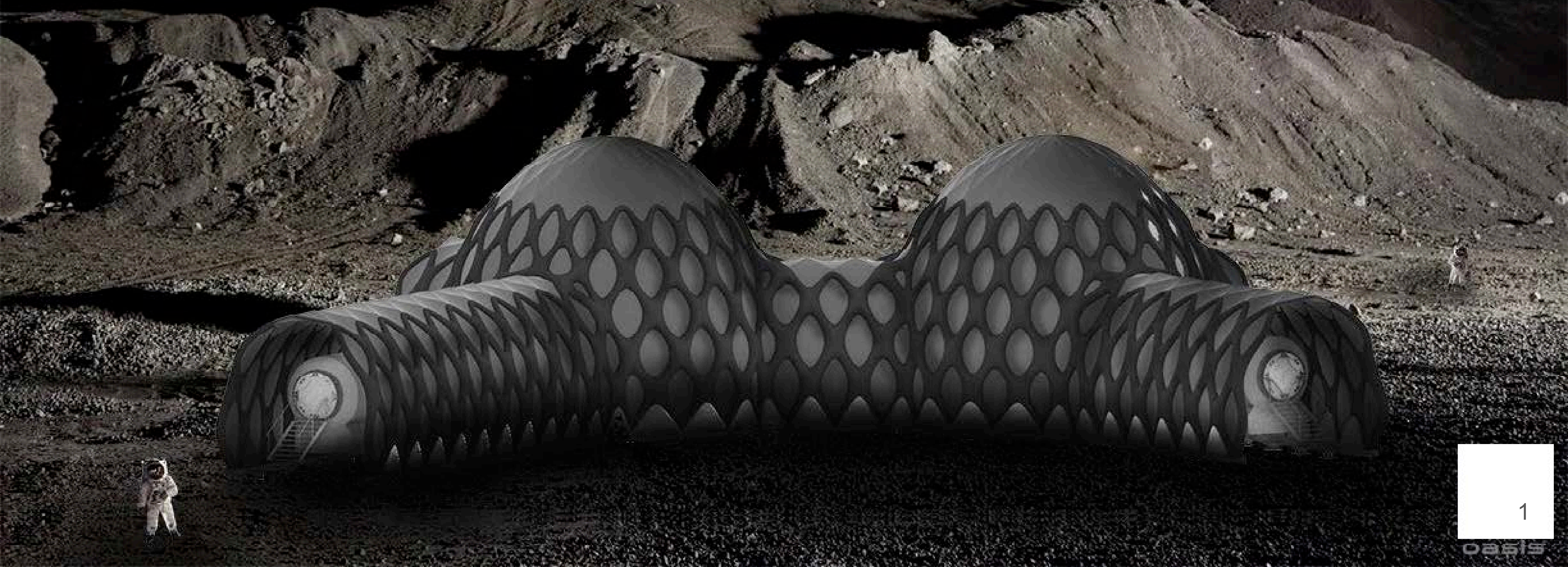
NASA + Pratt

X-HAB

OASIS HABITAT



NASA

Pratt

oasis

PI-FAB

CONSORTIUM
RESEARCH & ROBOTICS
HOSTED BY PRATT INSTITUTE

Project Goal

The goal of **Habitat: Oasis** is to create an in depth functioning **lunar habitat** that would serve **NASA's Artemis Project** and create a **resupply point on the moon that would allow for future space exploration**. This habitat would allow spacecraft to travel directly from the moon towards other planets within our solar system in a more efficient manner when compared to launching from Earth. We believe that our project is unique in its **focus on mitigating internal physical and mental distress** that our inhabitants would face with **extended stay on the lunar surface**.

The project from this semester focused on the efficient method-based **design of structure through 3D printing** and development of a **lunar landing pad**. Our study additionally focused on **how a research team could comfortably live** on this lunar surface we integrated a **GreenHouse/Zen Garden** with the addition of providing lunar views and a **comfortable program layout within the structure**. These additional focuses work in tandem with our priorities of safety and function through the **research and development** we generated earlier this semester and the ones prior.

oasis

TABLE OF CONTENTS

PRECEDENT PROJECTS

- CRATER HABITAT
- SCHROTER VALLEY RESEARCH HUB

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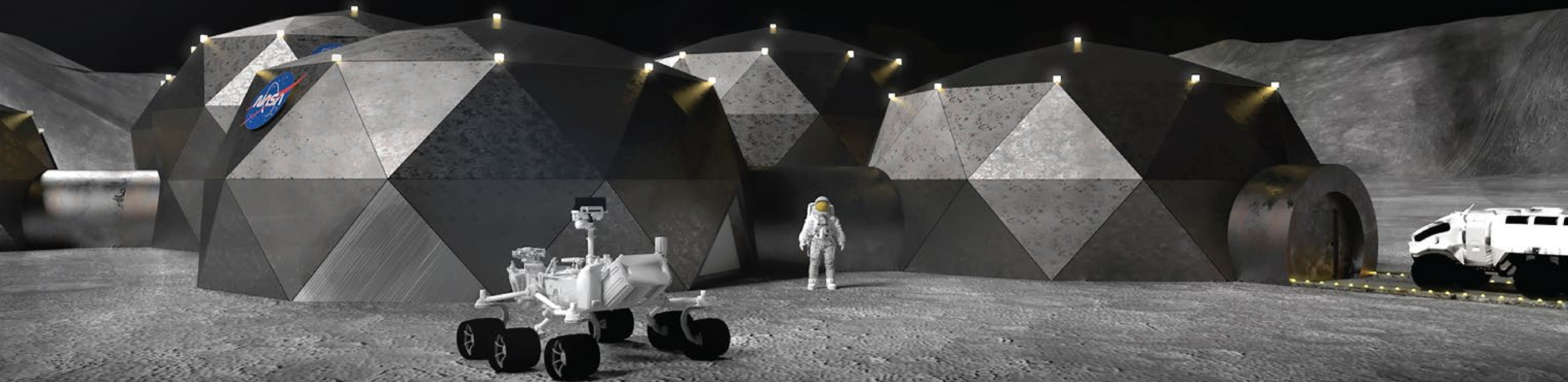
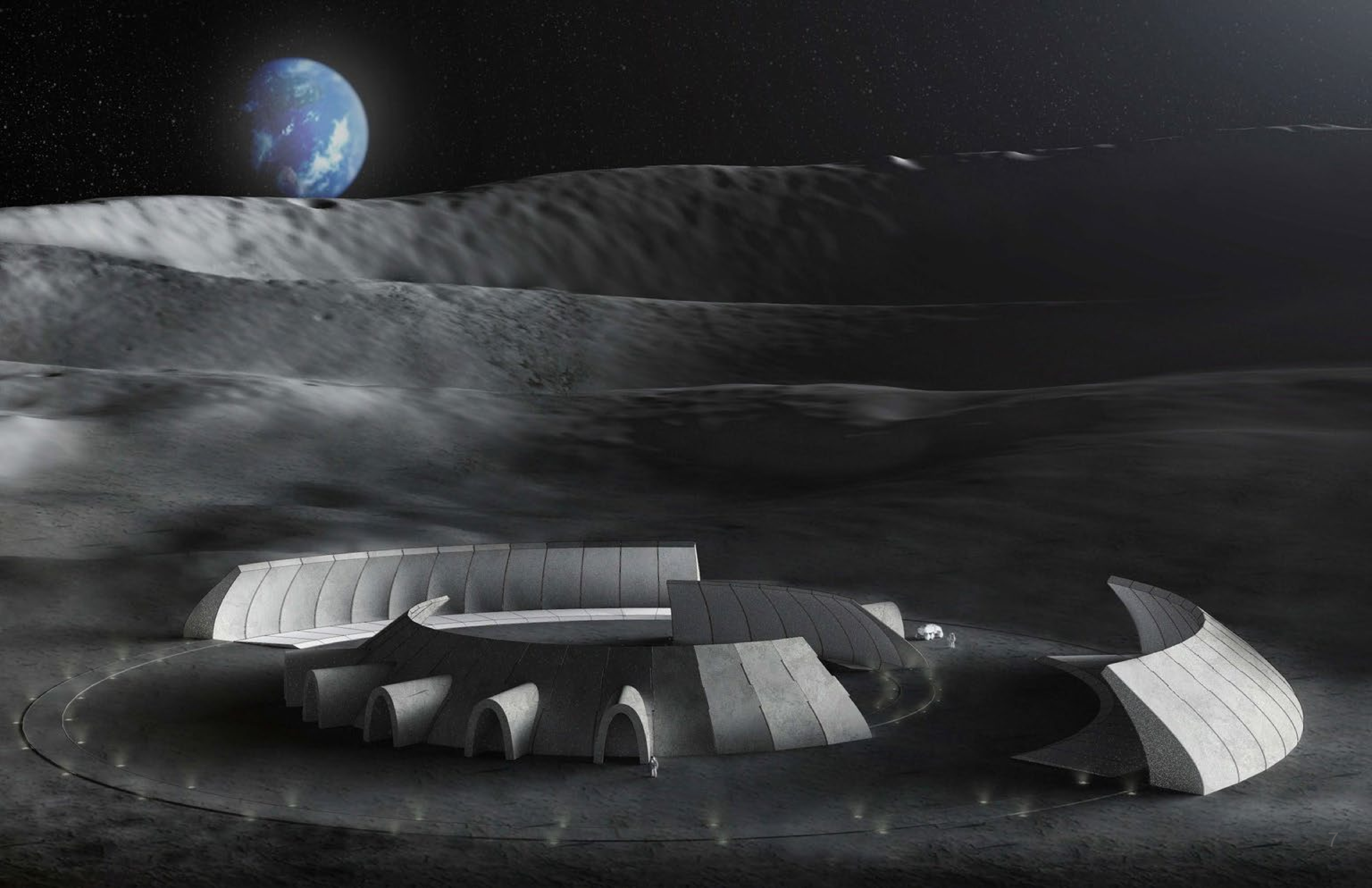
X-HAB: MOON TO MARS

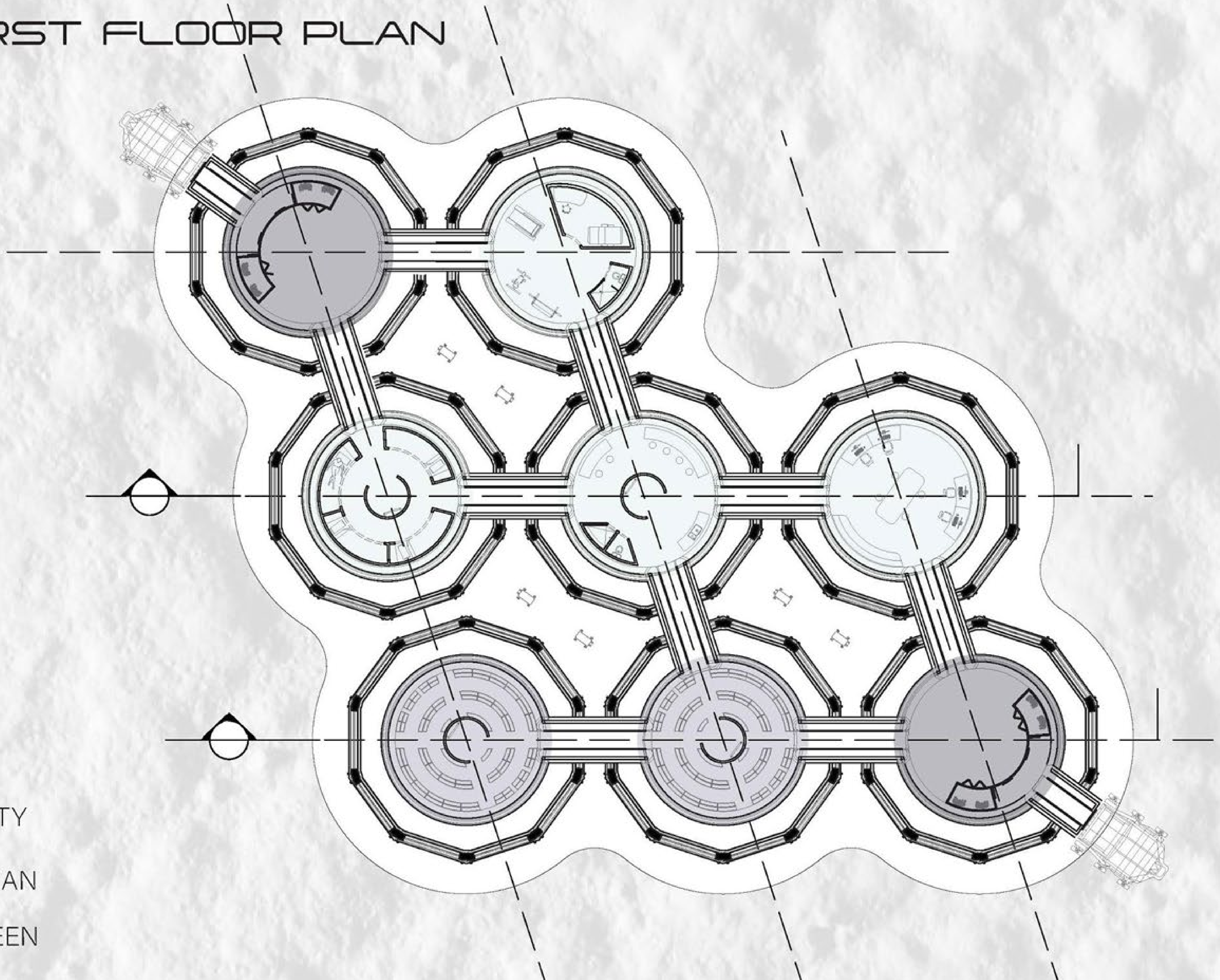
CRATER HABITAT



GROUP MEMBERS: - BENNY DENG, - MICHELLE SHIN, - CHAO QUN ZHANG, - KESHAN GOBERDHAN, - SUNG UK CHOI,
- SEUNG HYUN LIM. - GOSSELLE ASTUDILLO



FIRST FLOOR PLAN

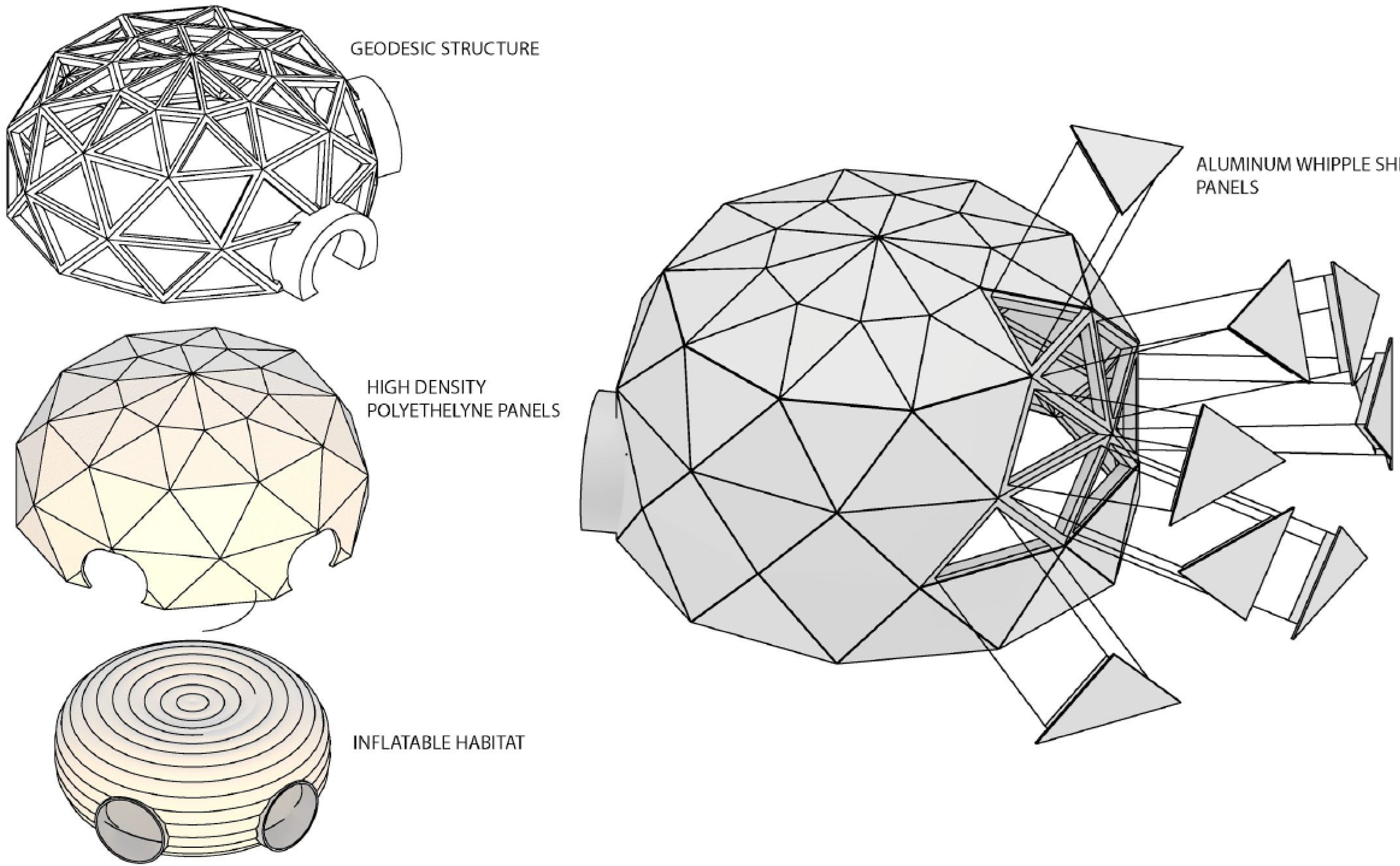


DIRTY

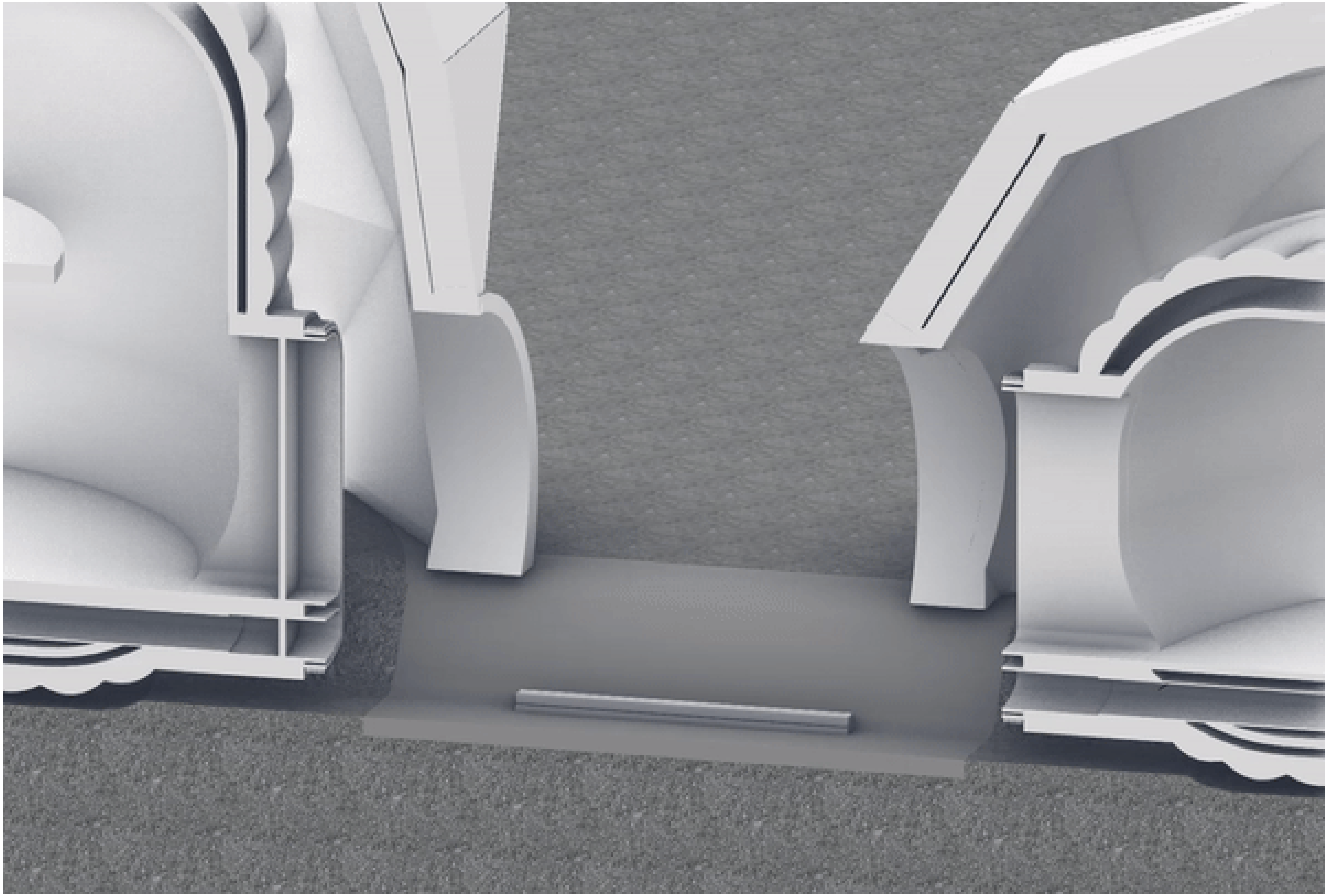
CLEAN

GREEN

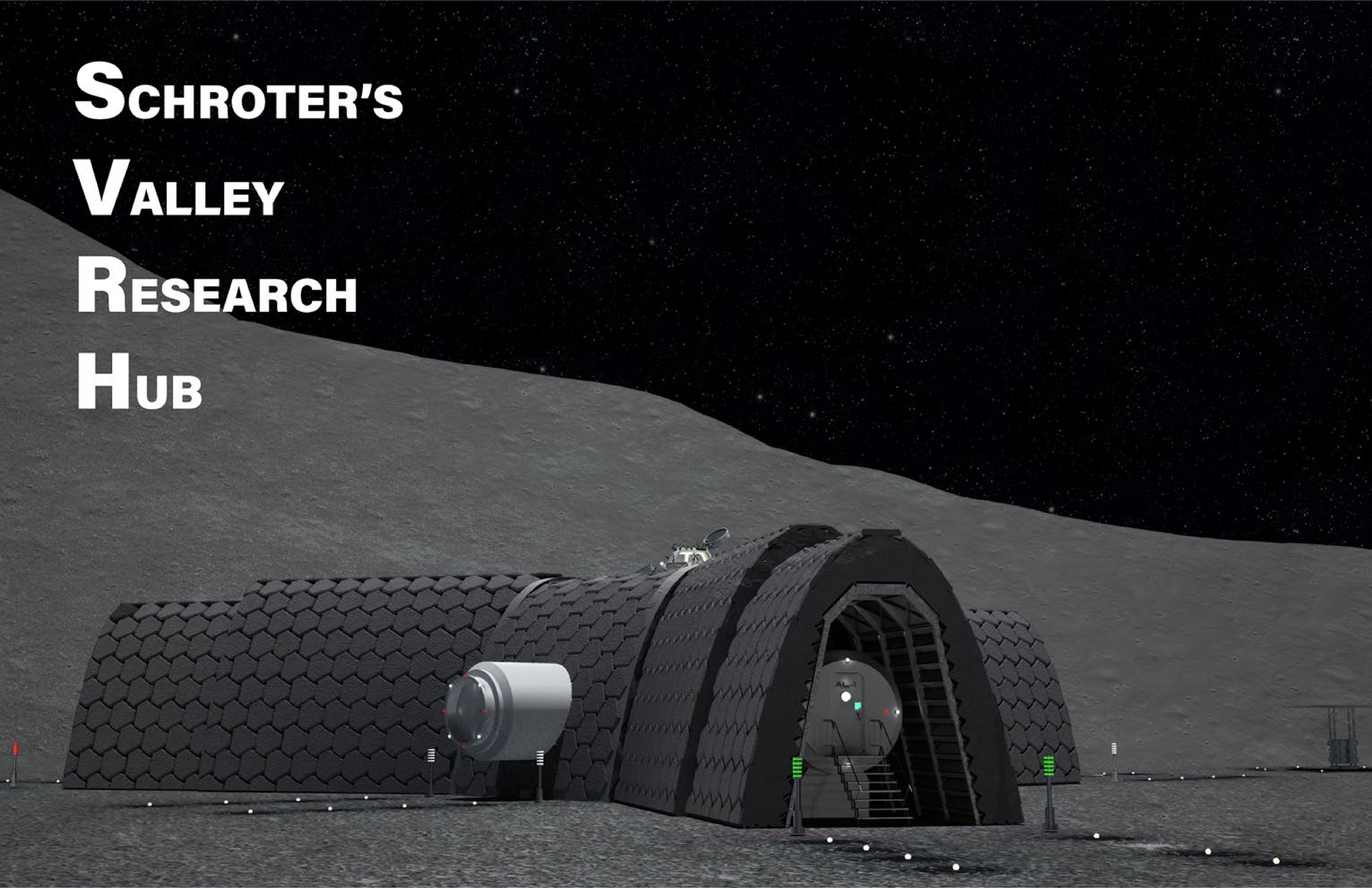
COMPONENTS


GEODESIC STRUCTURE
HIGH DENSITY
POLYETHELYNE PANELS
INFLATABLE HABITAT
ALUMINUM WHIPPLE SHIELD
PANELS

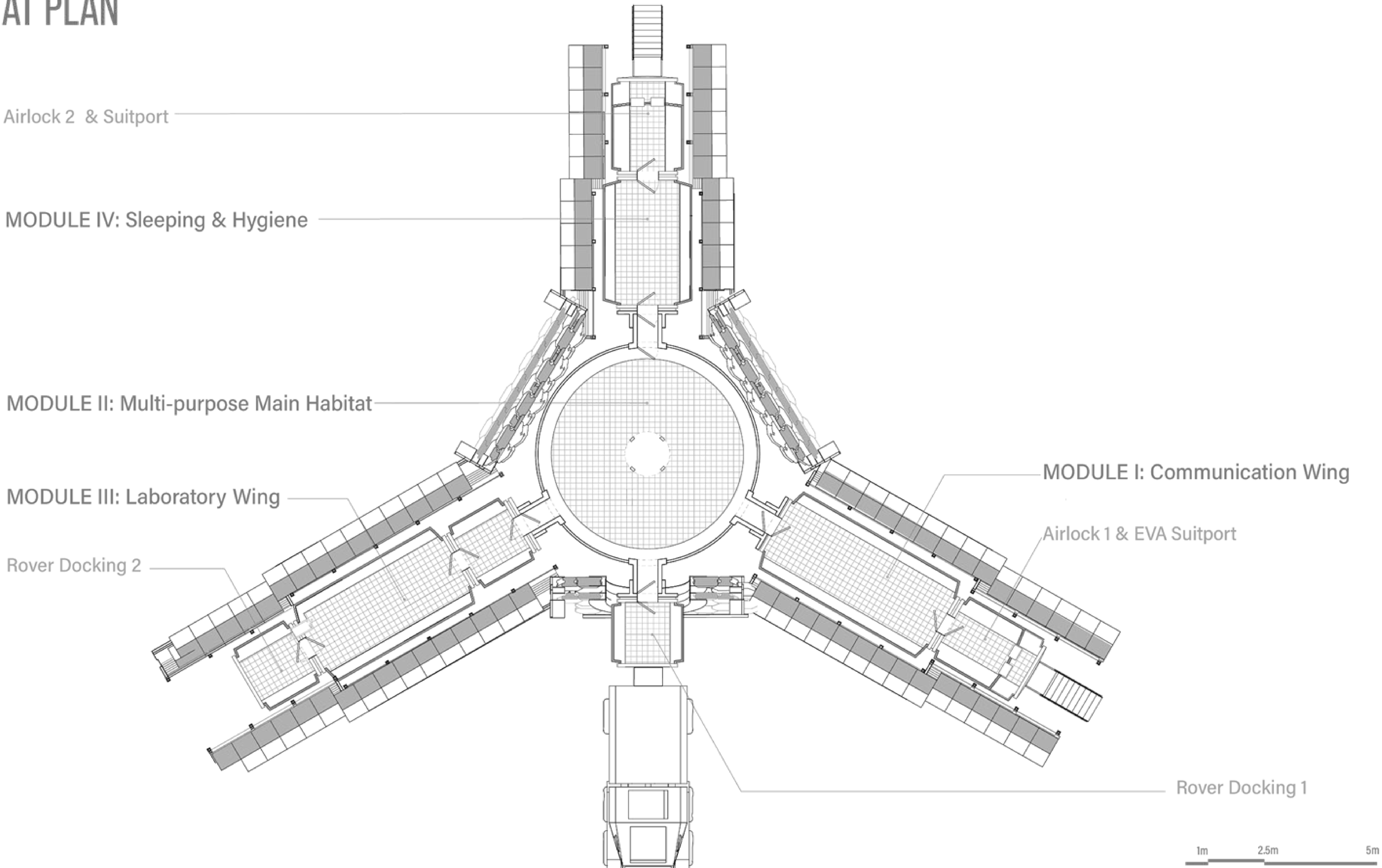
EXPANDABLE AIRLOCK



Schroter's Valley Research Hub



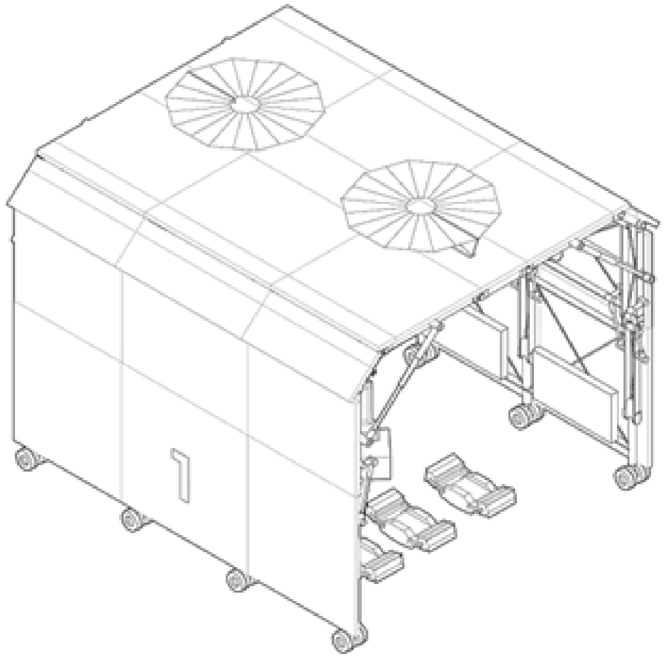
HABITAT PLAN



GANTRY SYSTEM

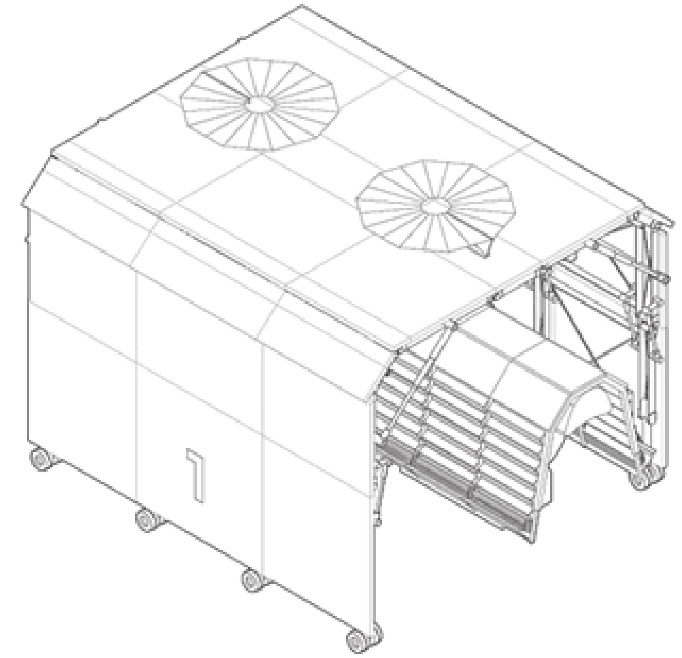
i. PROTECTION

Upon arrival, Gantry (MPCS) will autonomously deploy and protect construction process.



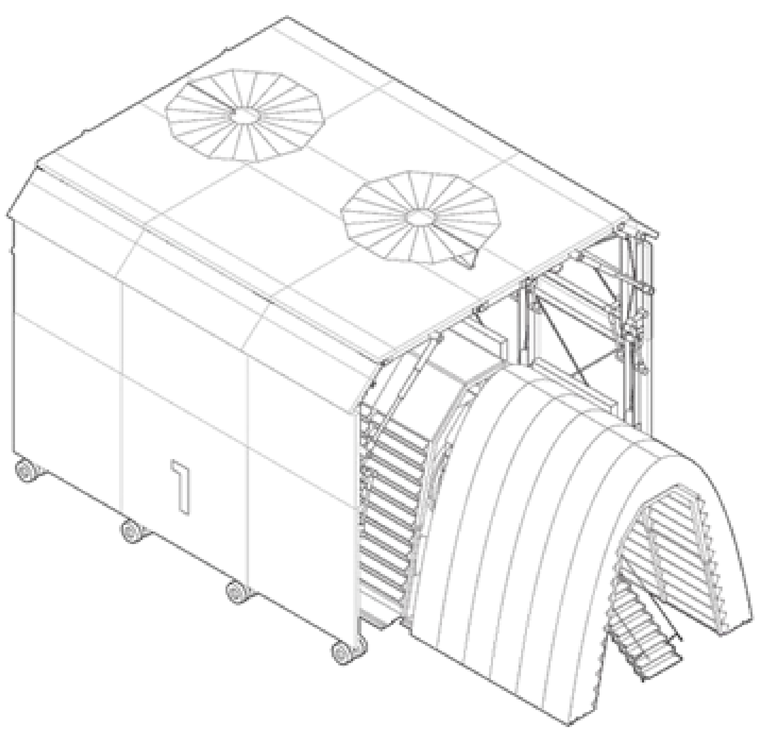
ii. DELIVERY

The MPCS will also autonomously deliver modules from landing to construction sites.



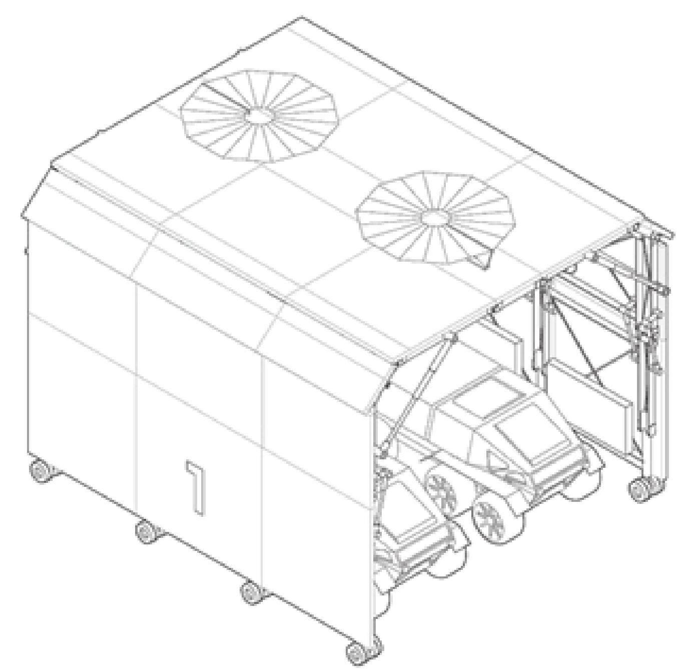
iii. CONSTRUCTION

Will provide a protected environment to assemble regolith blocks.



iv. CONTINUED USE

Will be on standby, and provide unpressurized protection for LRVs.

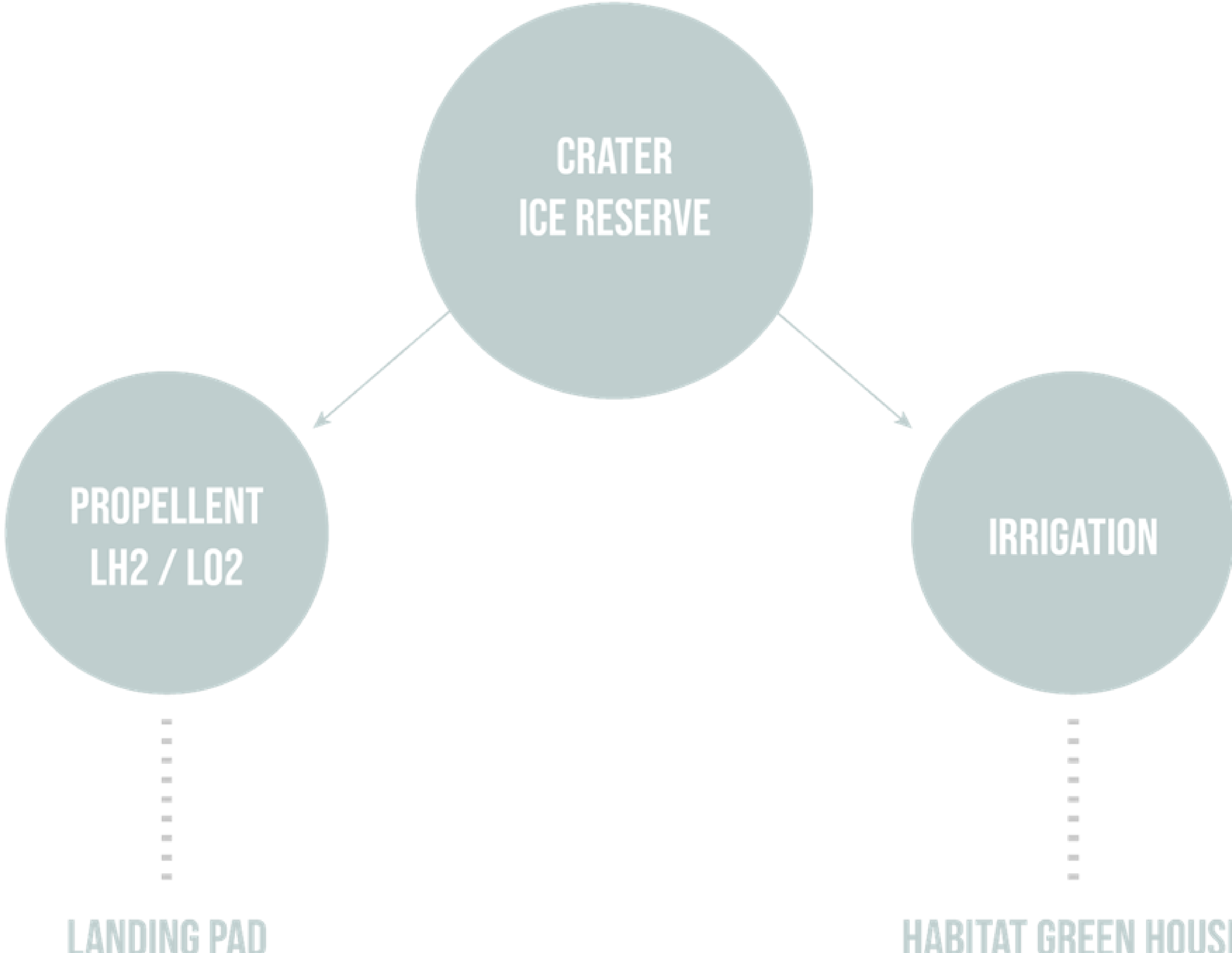


** Mobile Protected Construction System (MPCS)*

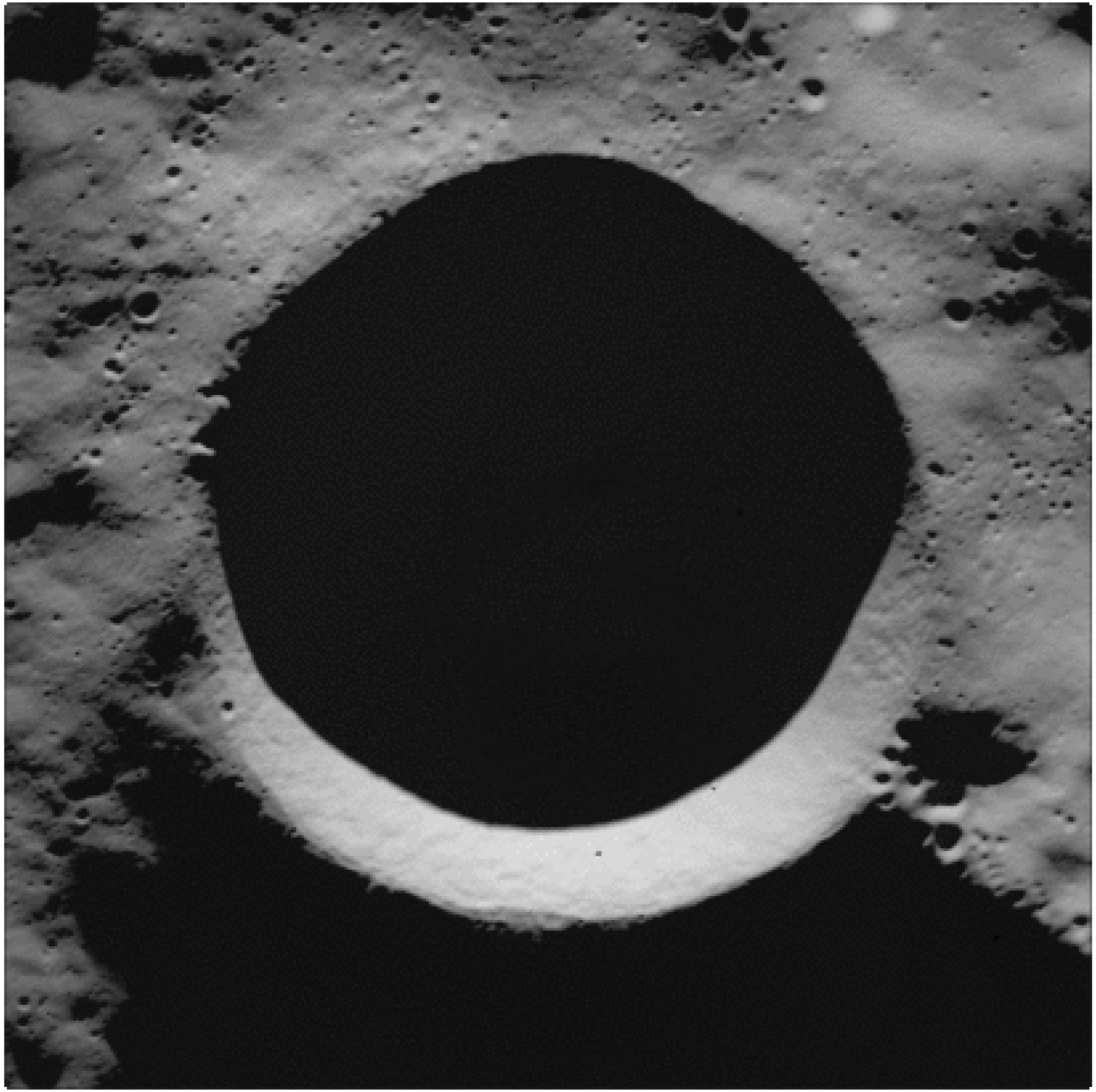
SITE ANALYSIS

- SITE RESOURCE
- SITE CONDITION

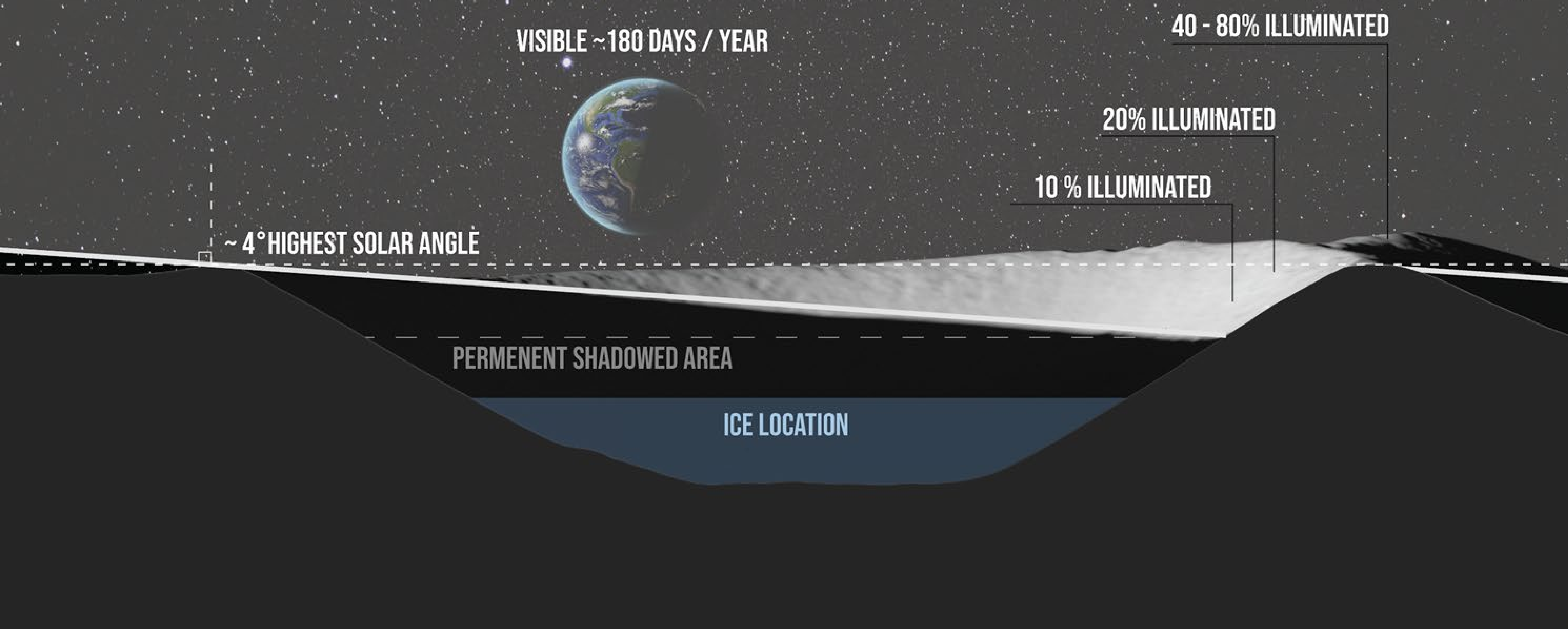
SITE STRATEGIES: SOUTH POLE



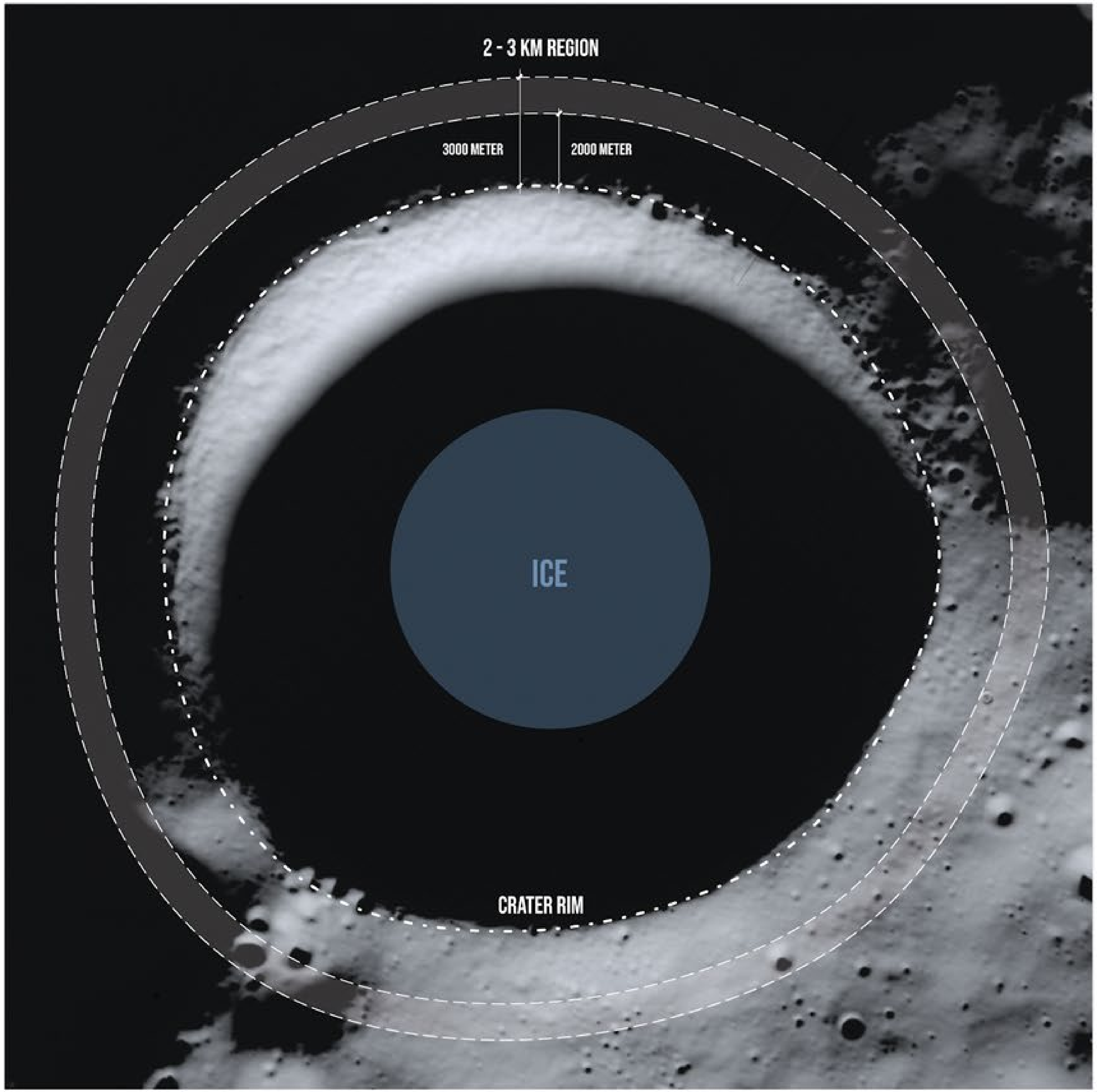
SUN STUDY



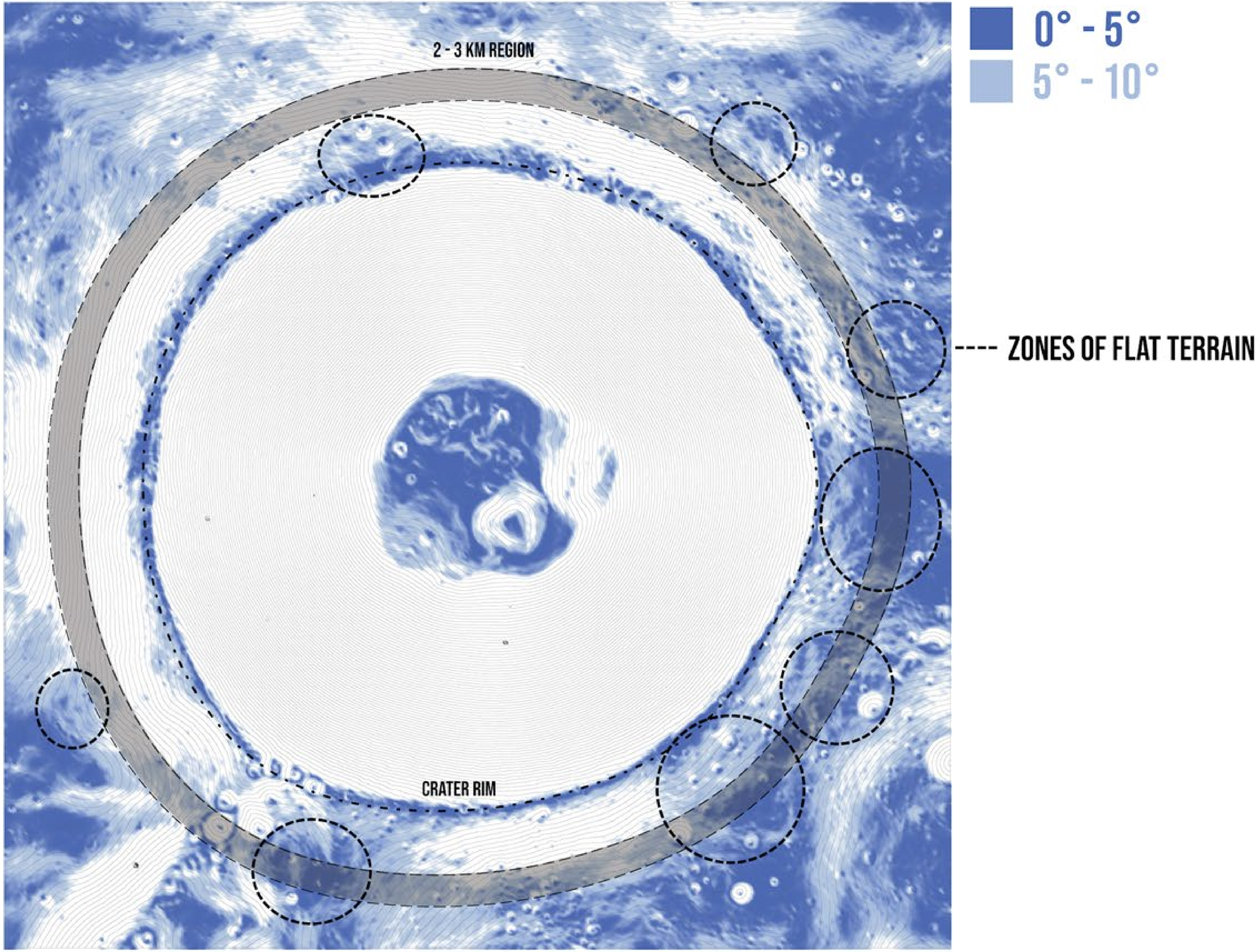
SITE CONDITION

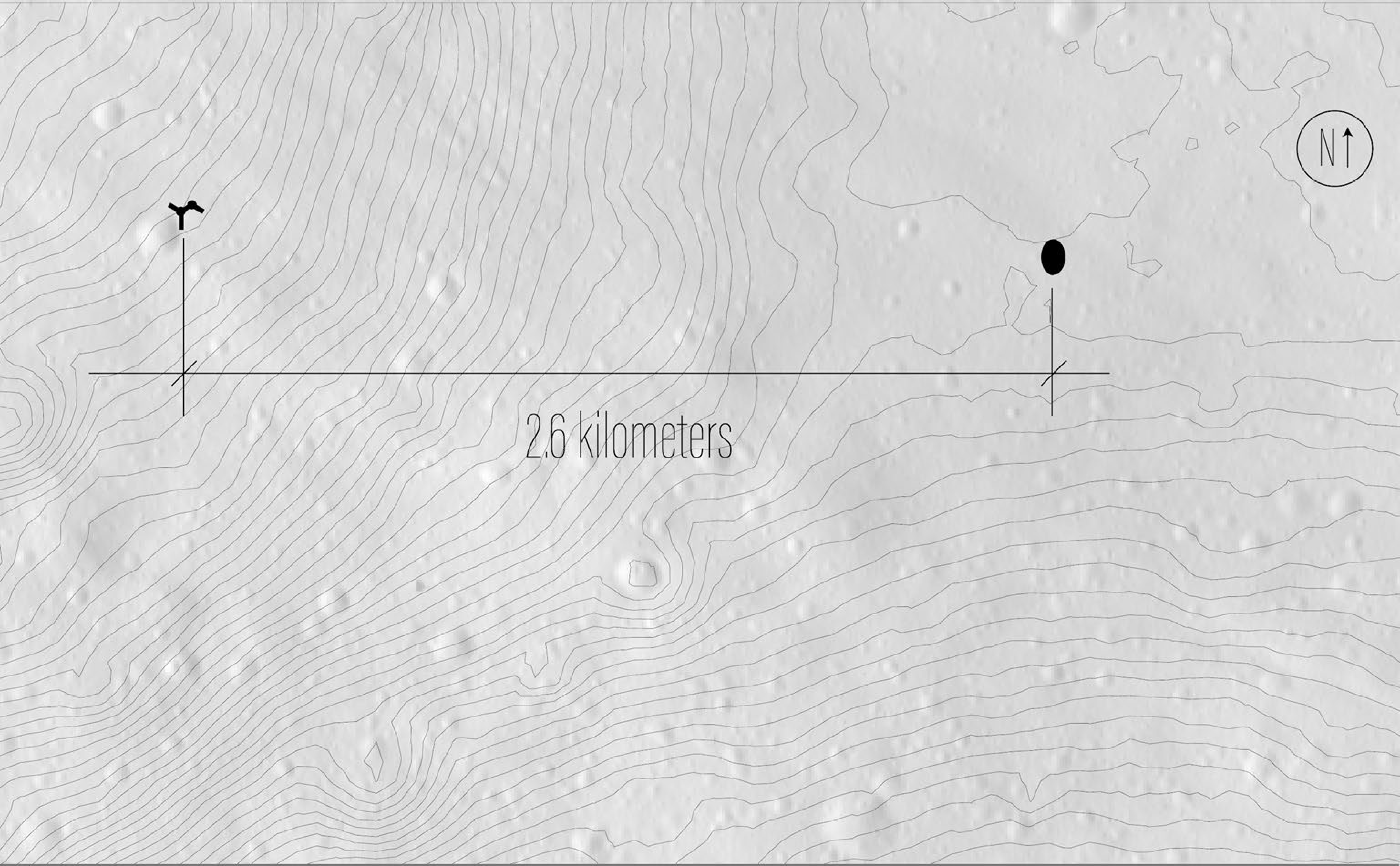


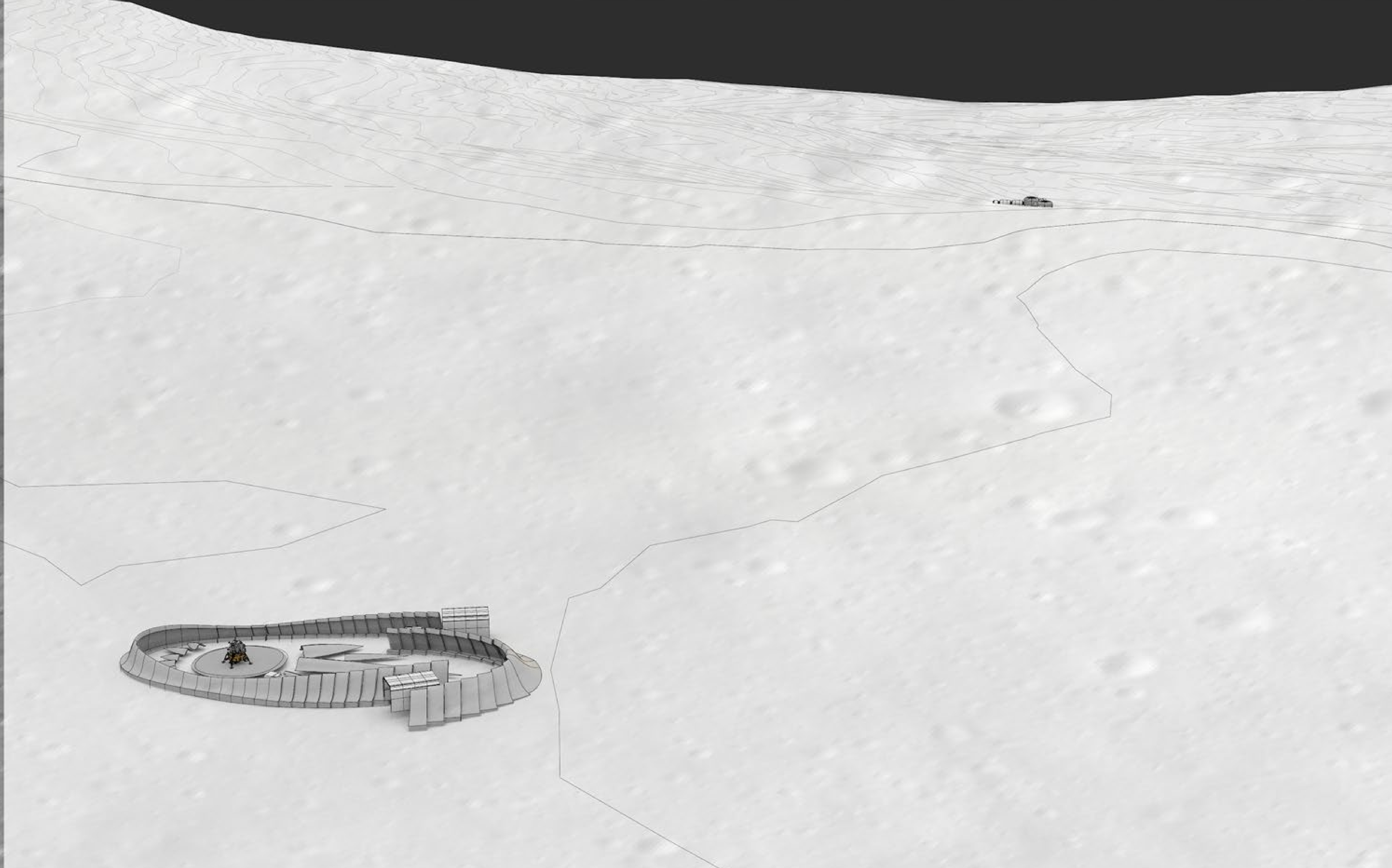
CRATER RIM OFFSET REGION



FLAT REGION




N
2.6 kilometers

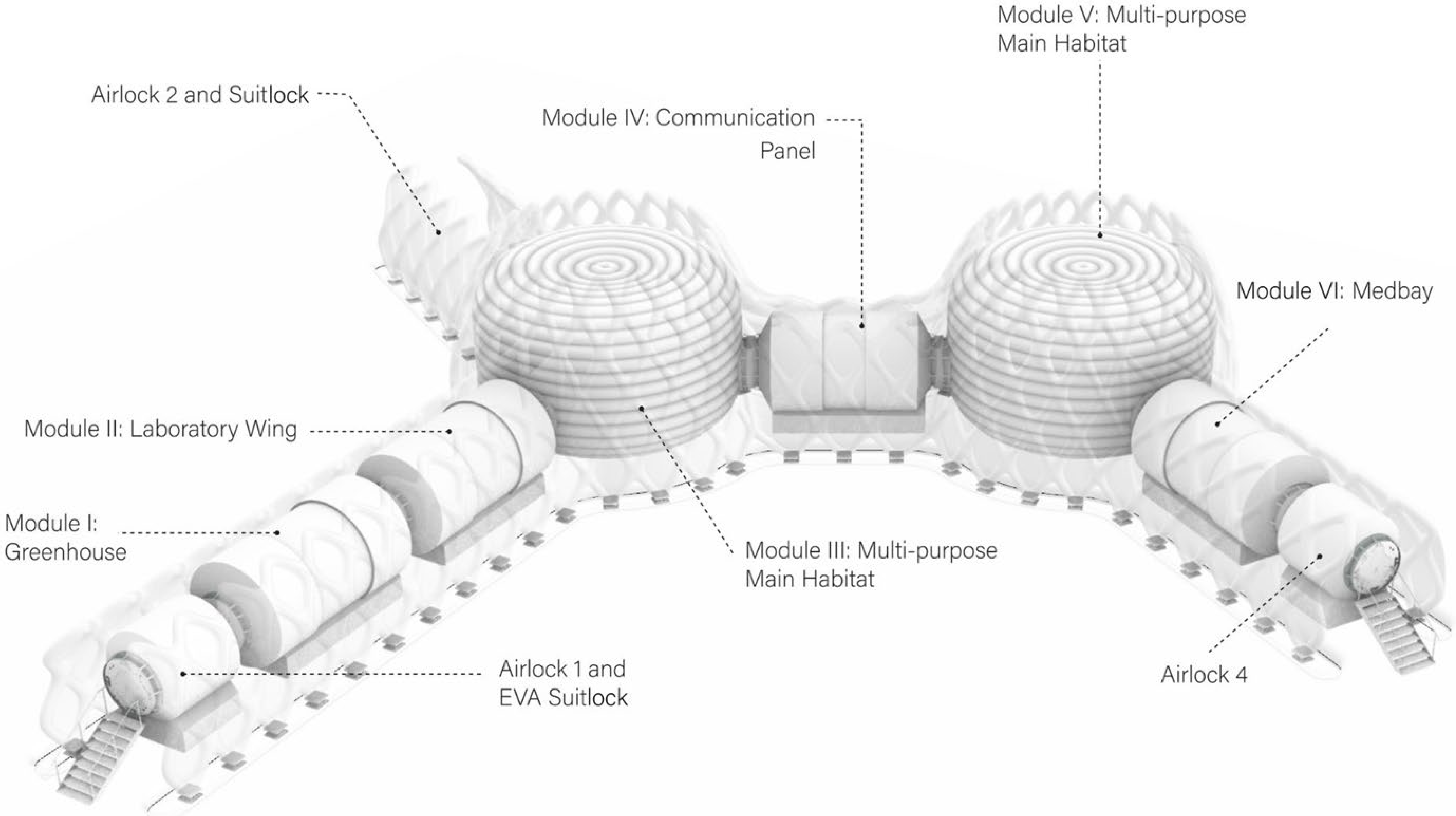


HABITAT DESIGN

- AXONOMETRIC X-RAY
- FLOOR PLANS
- SECTIONS
- RENDERS

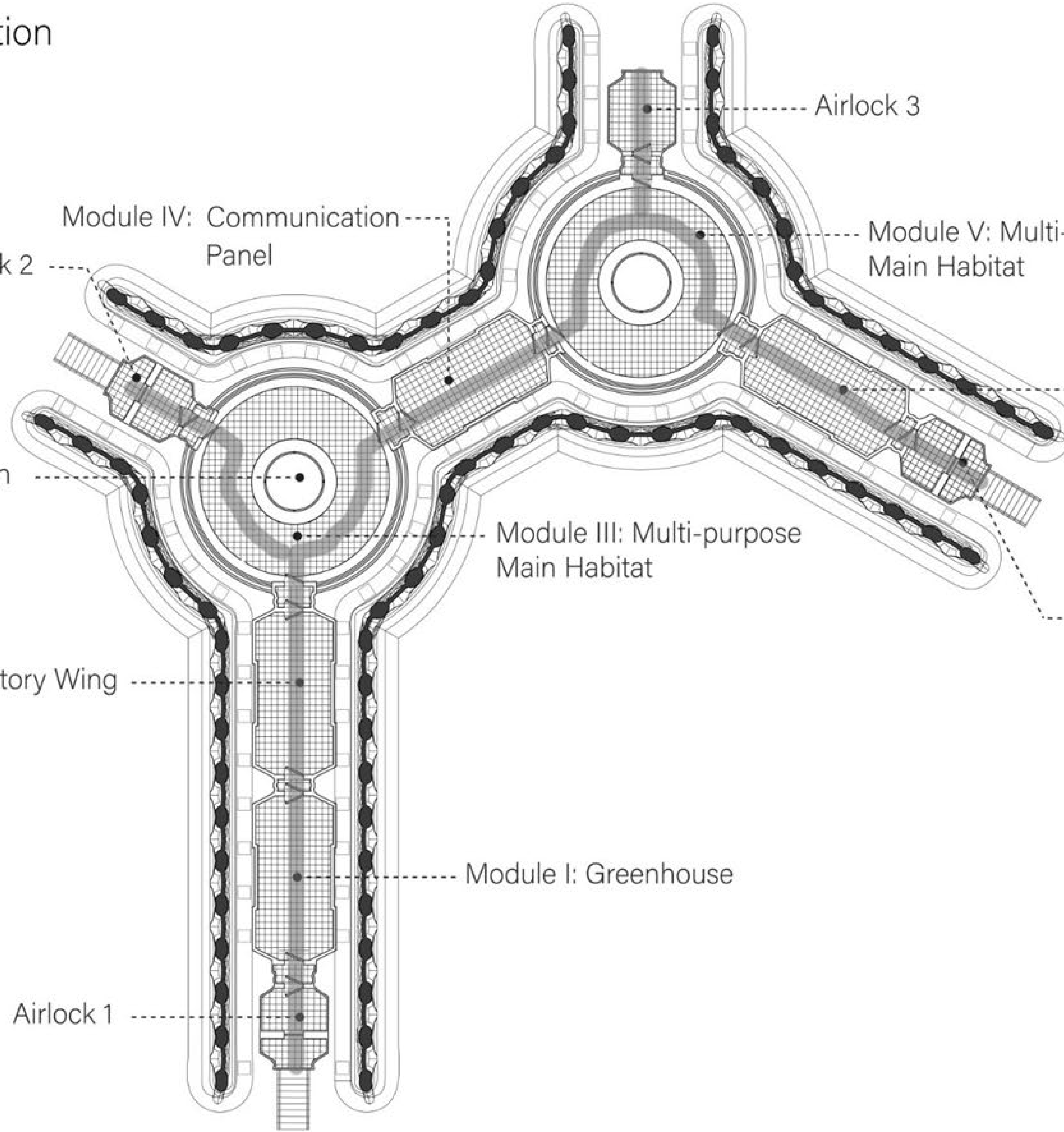
OASIS HABITAT

SHACKLETON CRATER, SOUTH POLE

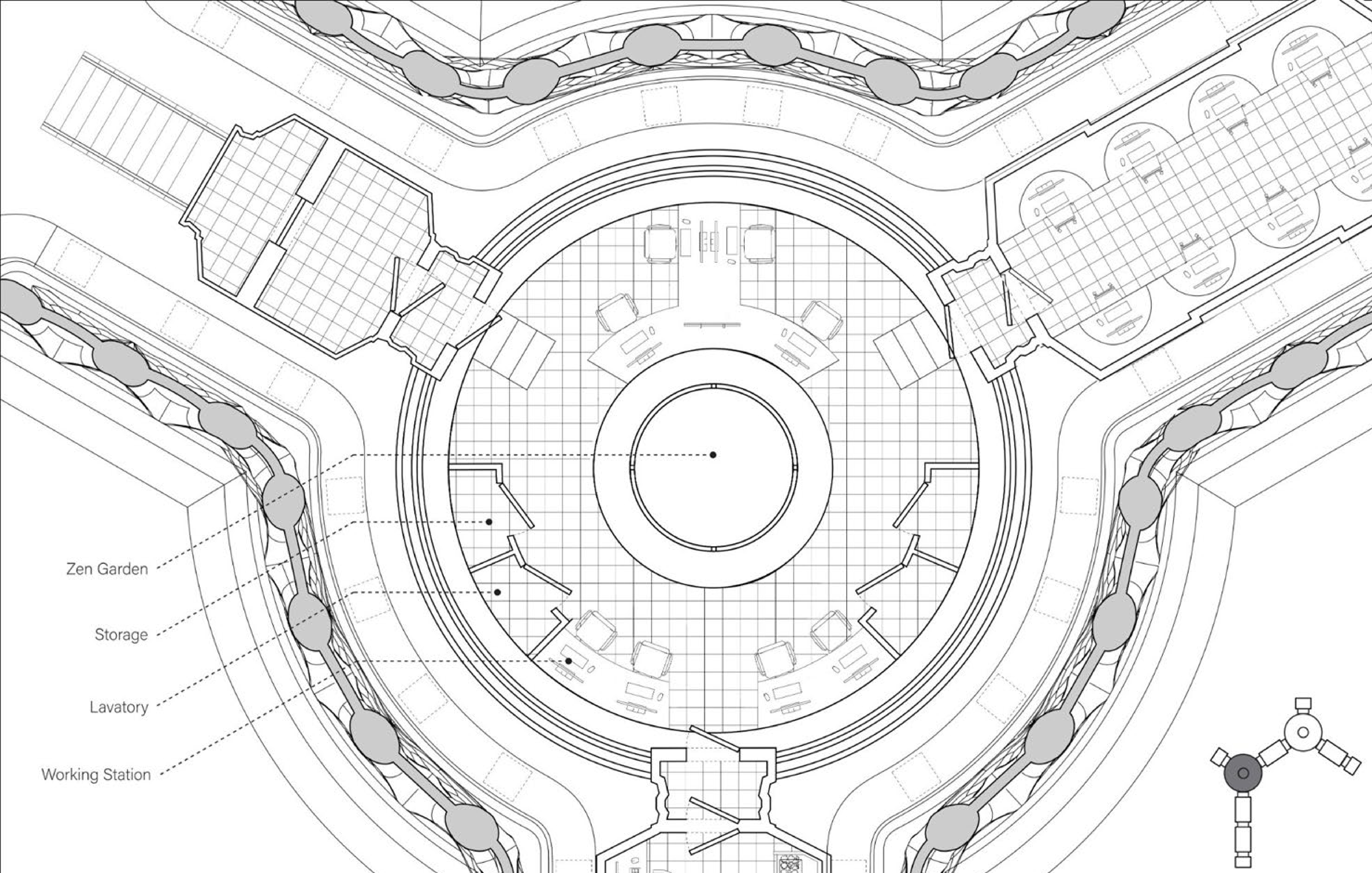


X-RAY AXONOMETRIC VIEW

Habitat: Program/ Circulation



1/4" = 1'-0"



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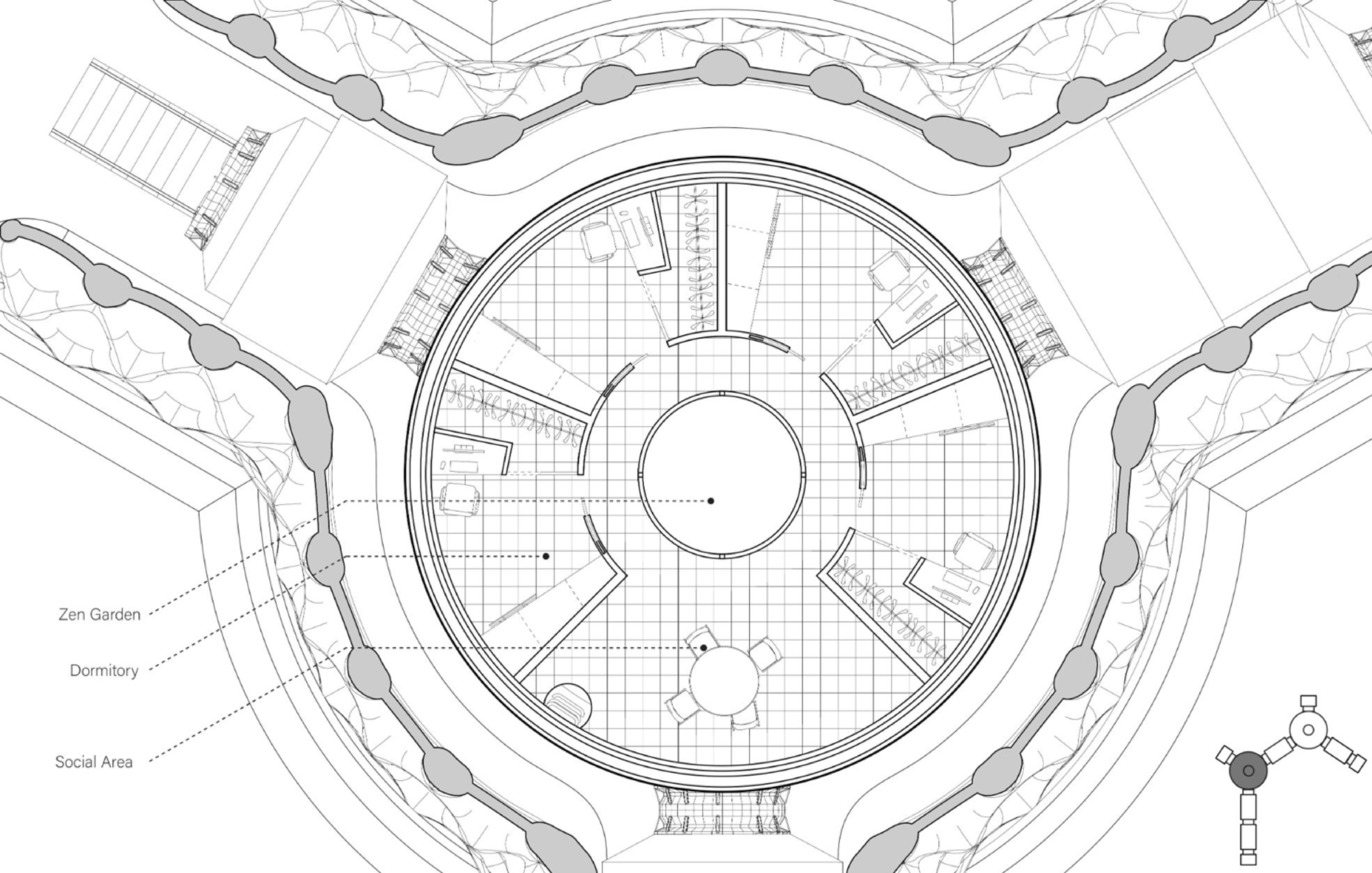
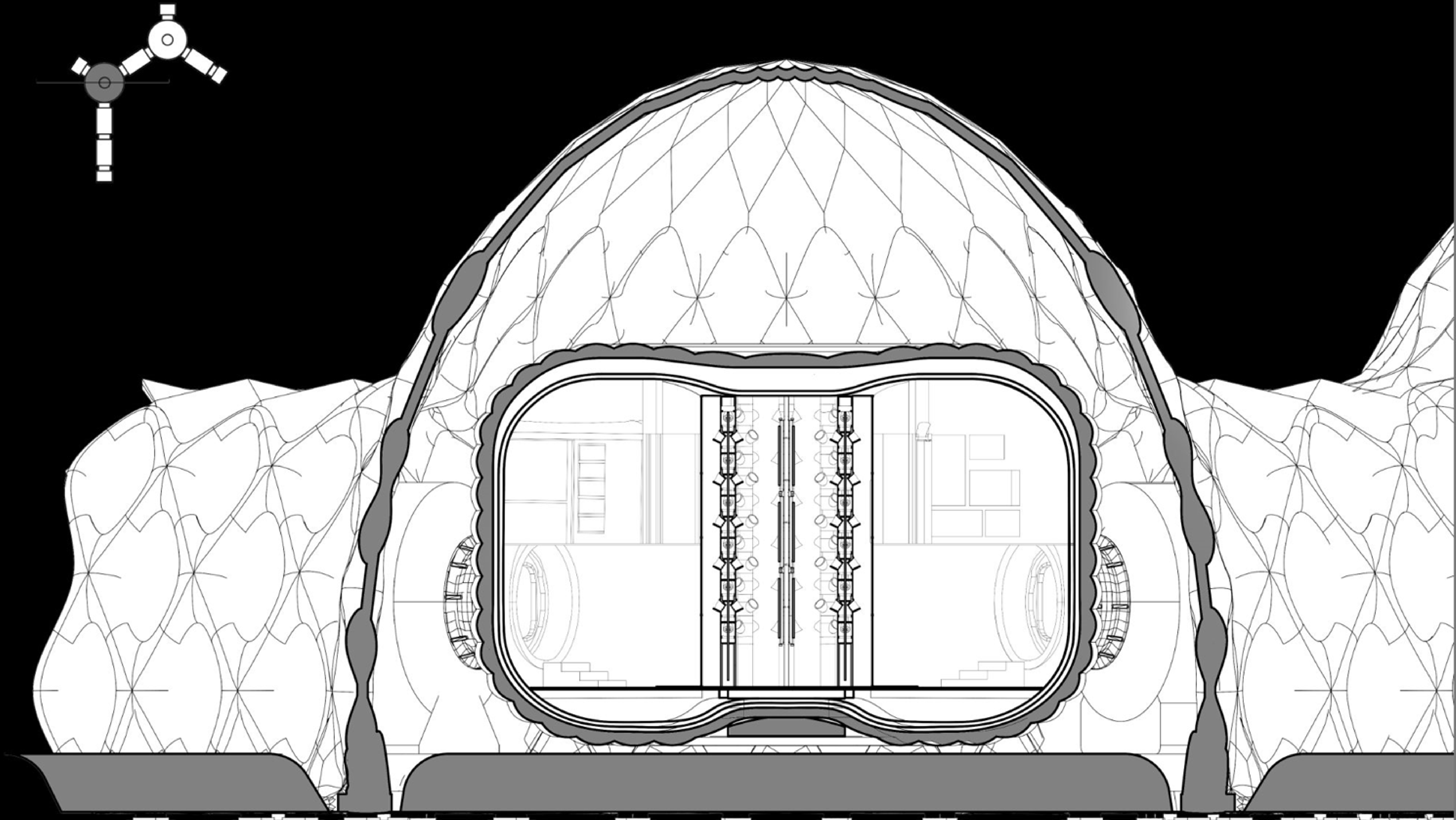
MODULE III: MULTI-PURPOSE MAIN HABITAT FLOOR



MODULE III: MULTI-PURPOSE MAIN



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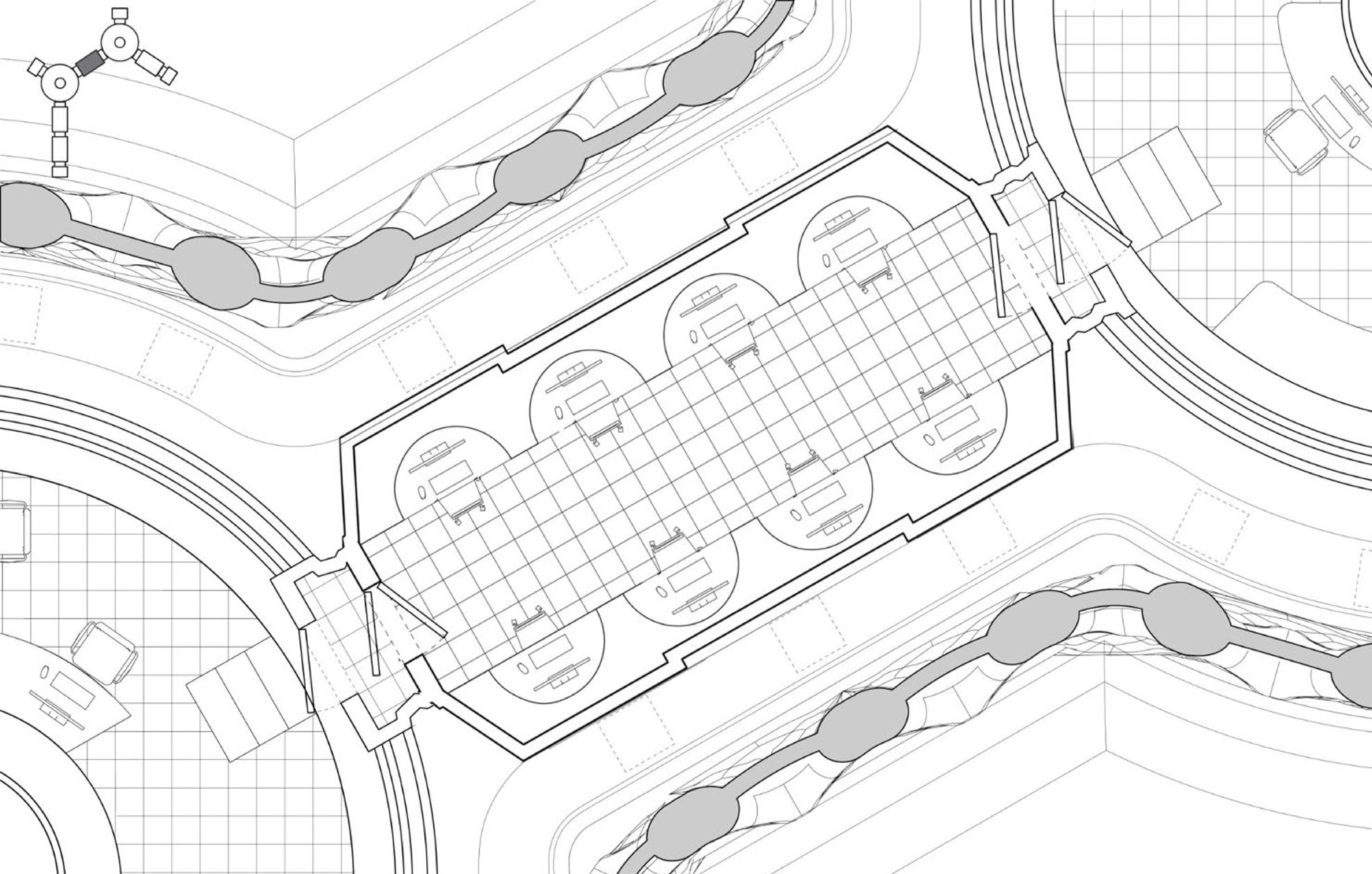
MODULE III: MULTI-PURPOSE MAIN


oasis



MODULE IV: COMMUNICATION PANEL

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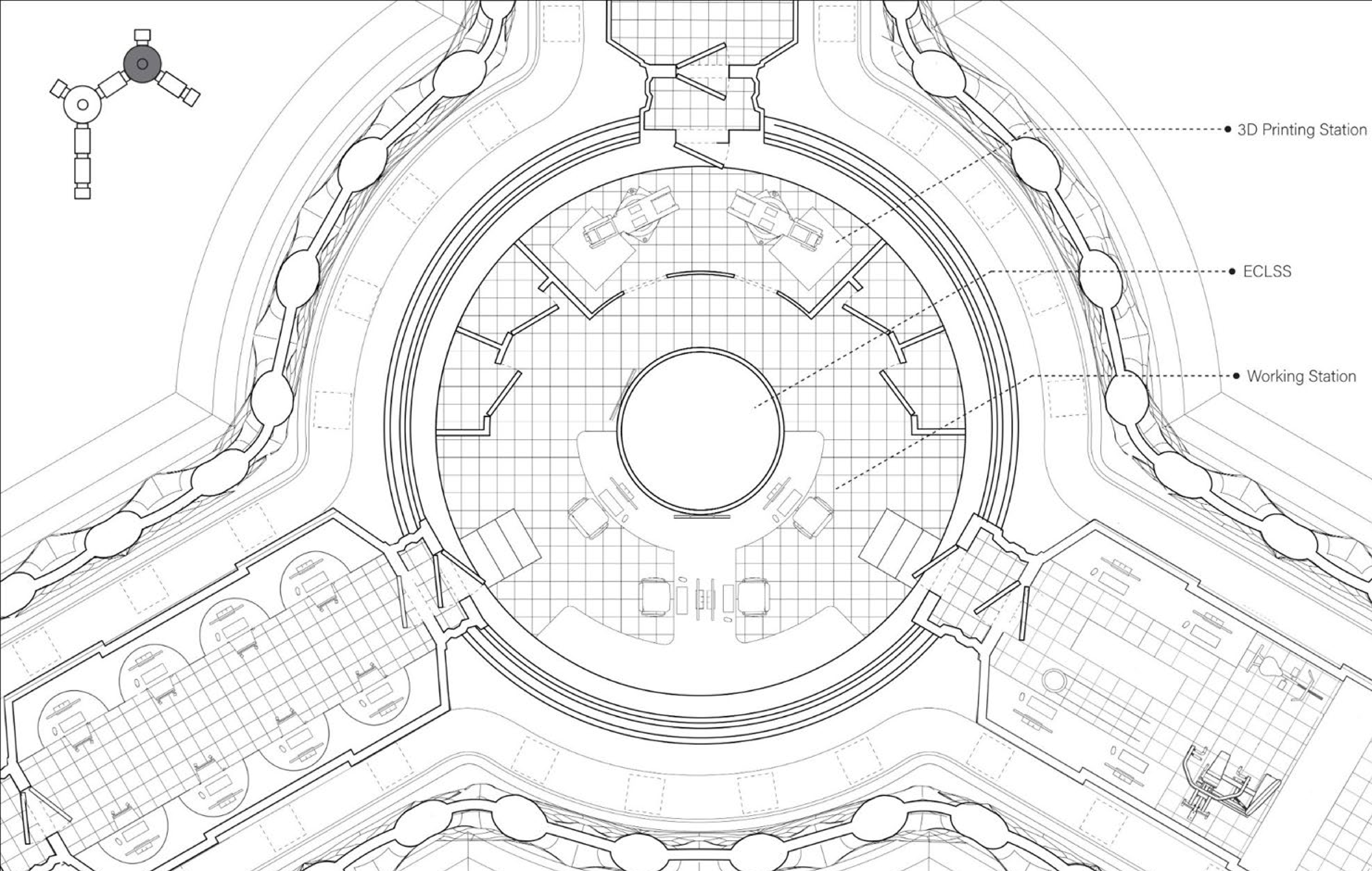
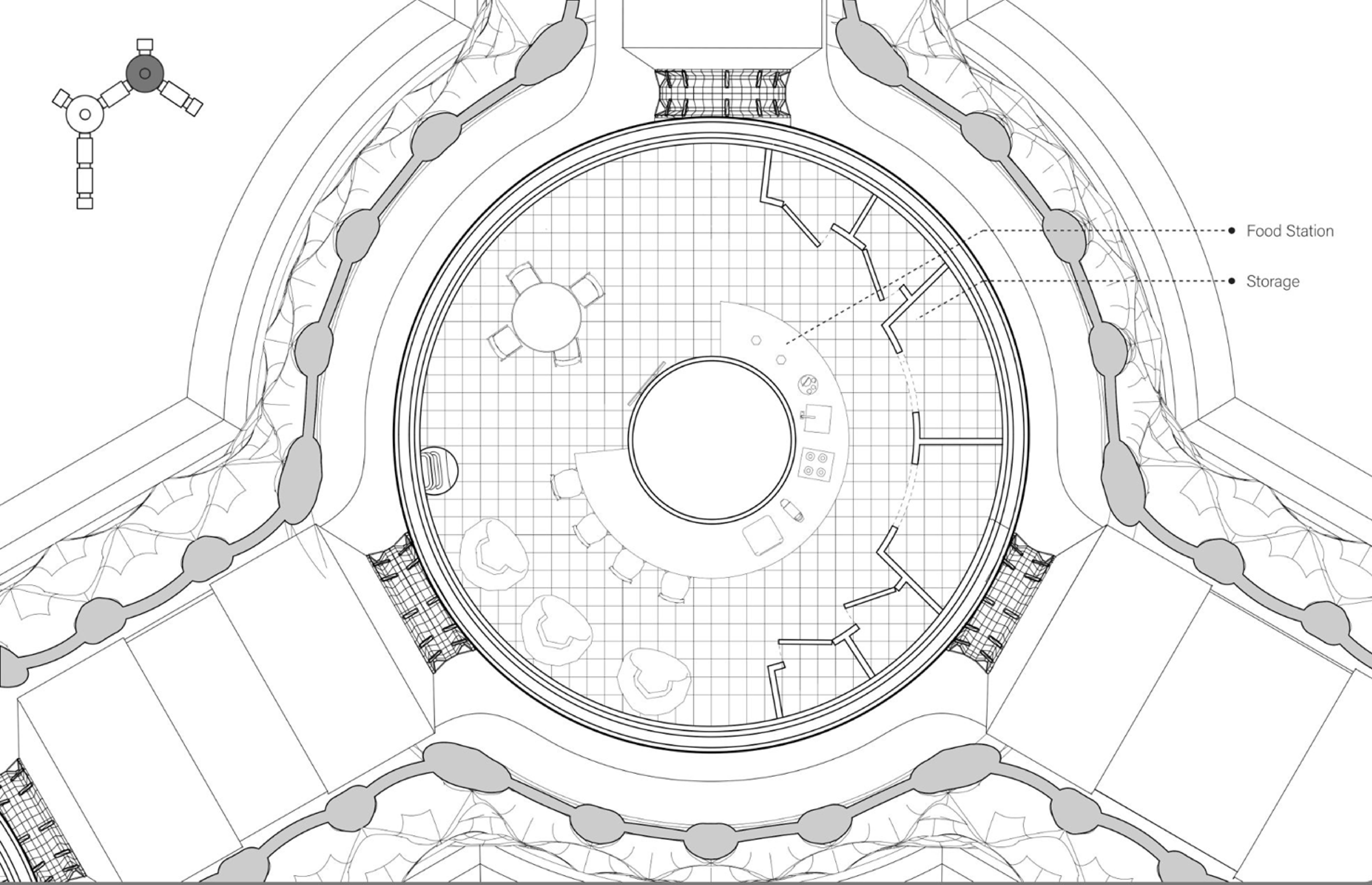
20E
40E
20E
40E
-00:15:30

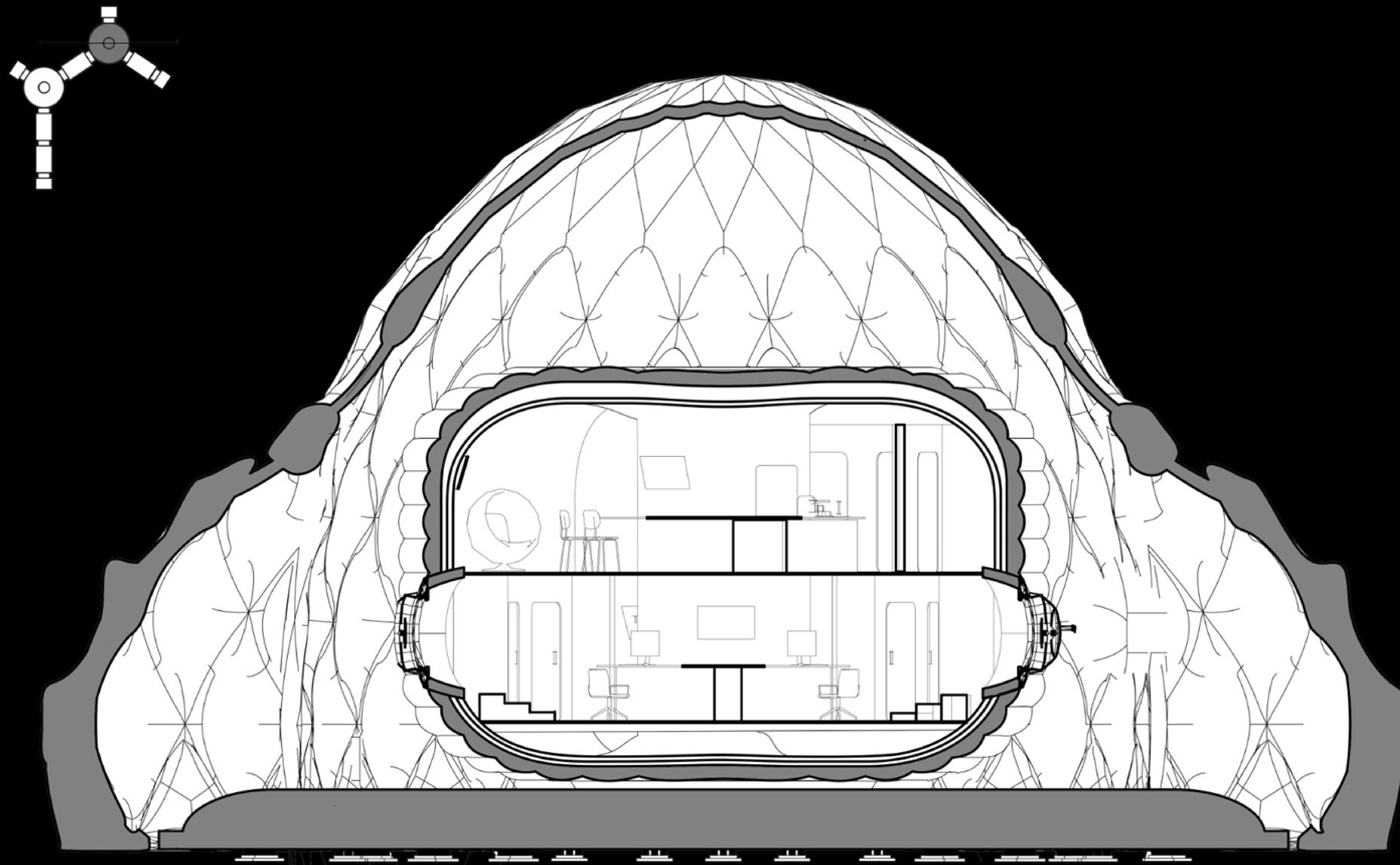


NASA + Pratt X-HAB

MODULE V: MULTI-PURPOSE MAIN HABITAT

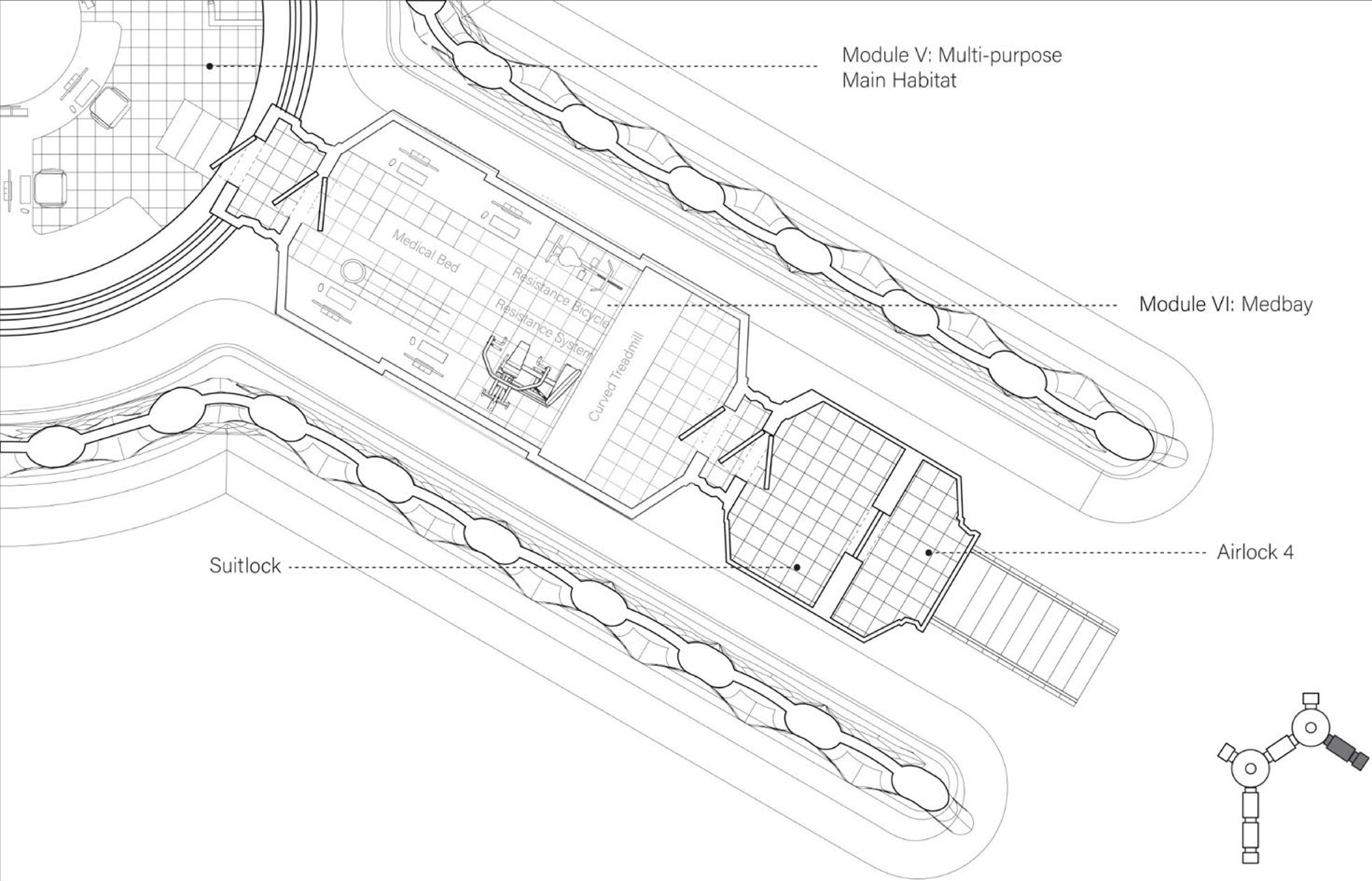


MODULE V: MULTI-PURPOSE MAIN



MODULE V: MULTI-PURPOSE MAIN


OASIS
OASIS



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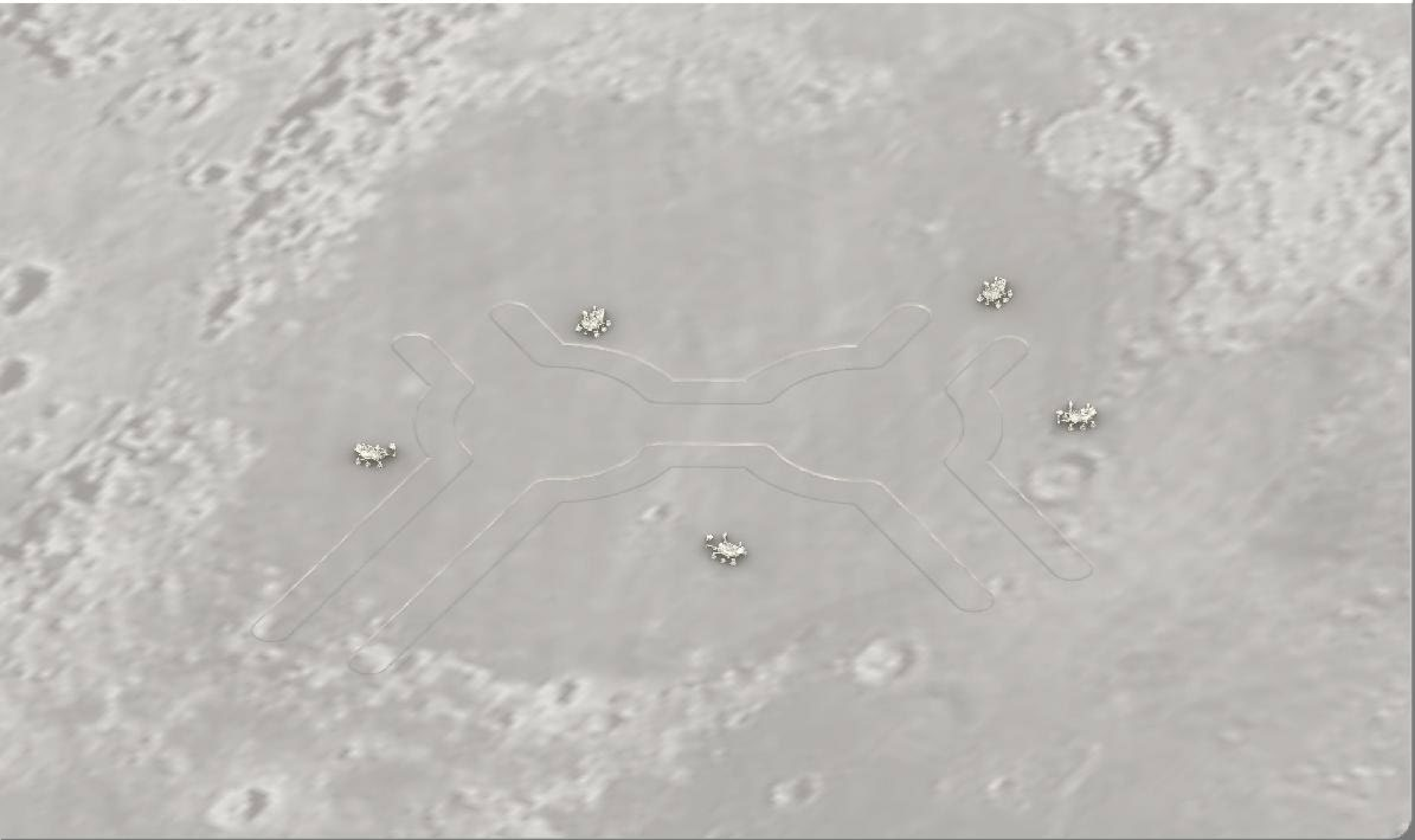
MODULE VI: MEDBAY


oasis
oasis

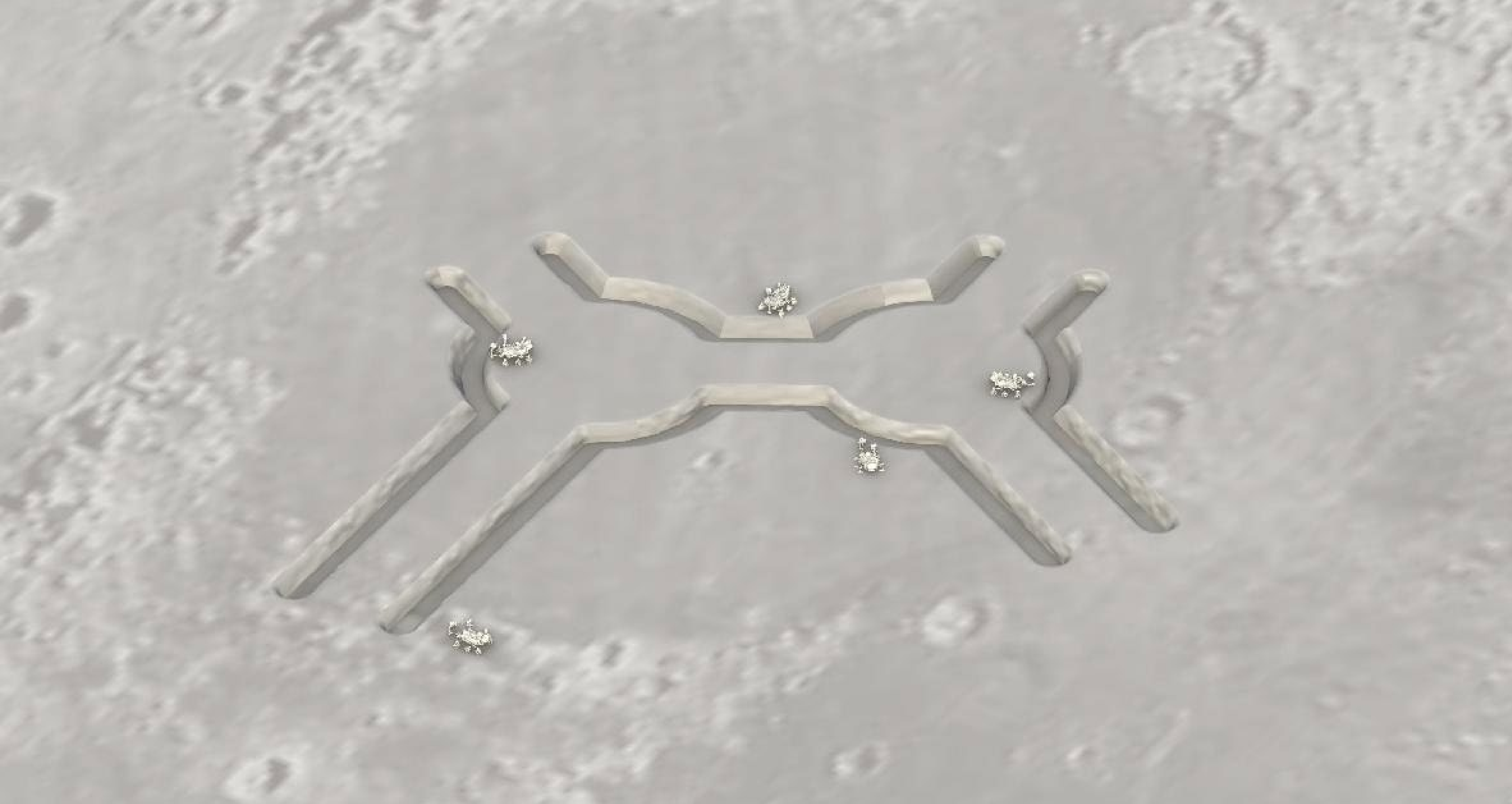
ASSEMBLY SEQUENCE

- HABITAT DEPLOYMENT

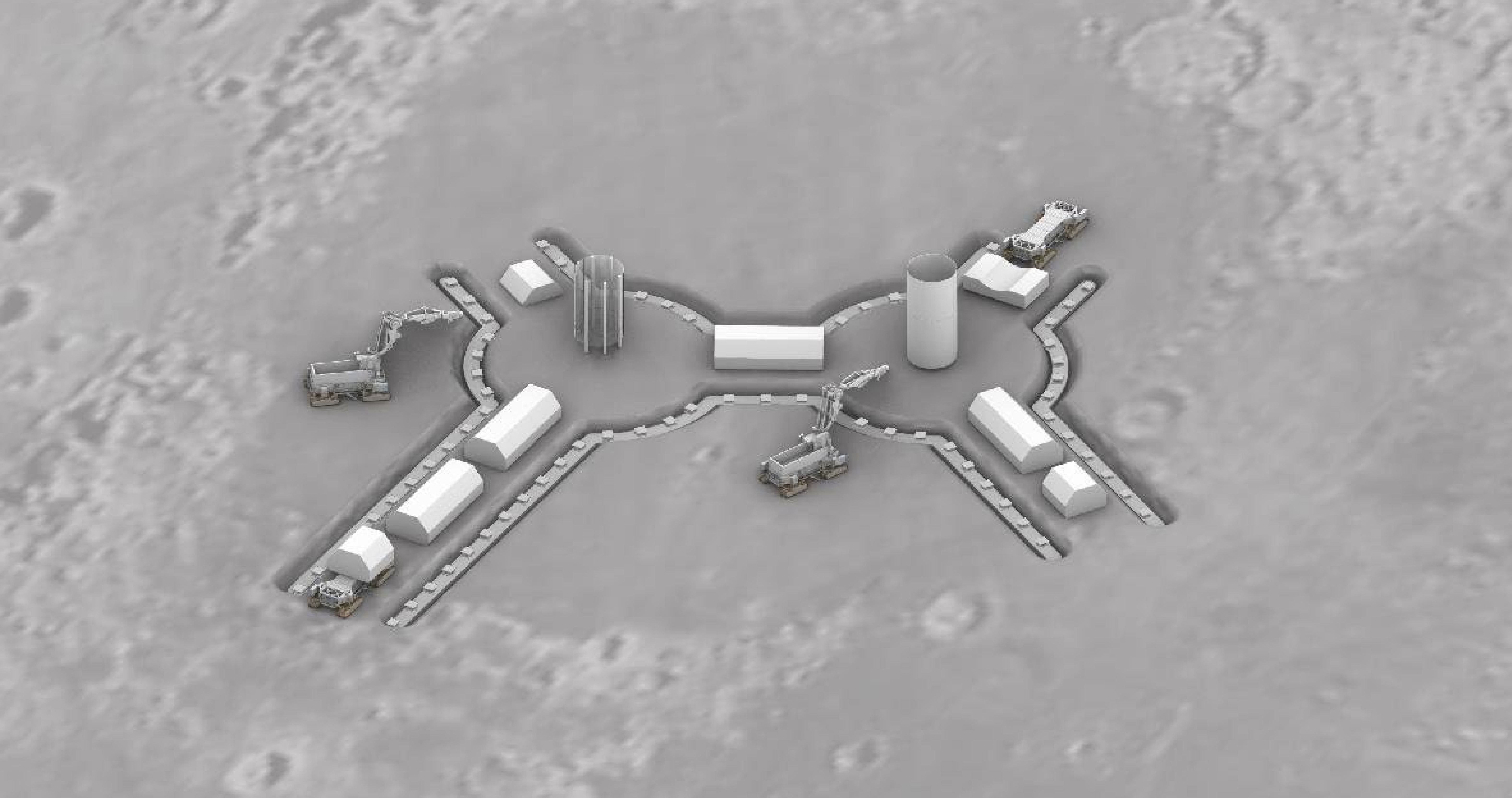
HABITAT: DEPLOYMENT

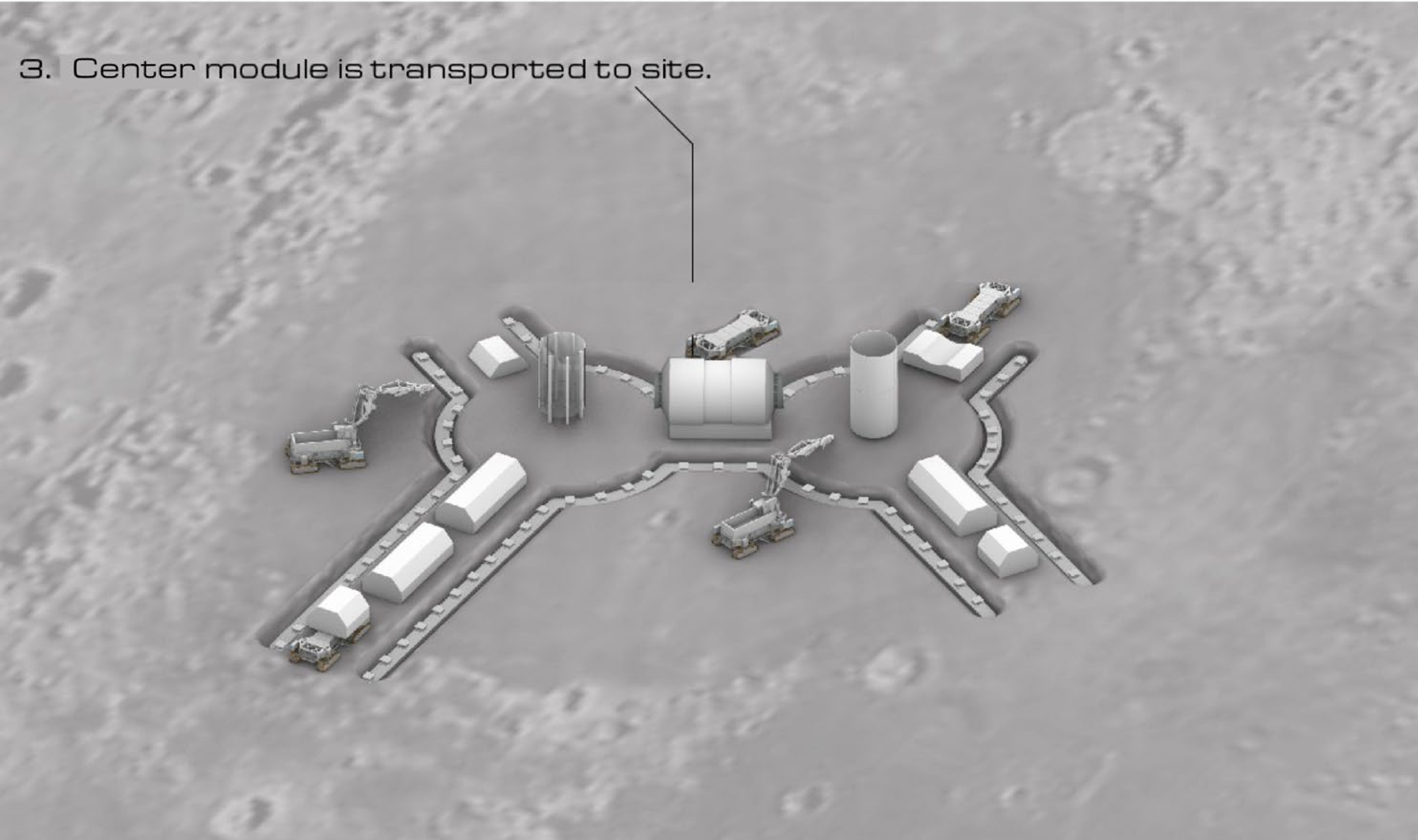


1. Excavators deployed for site excavation

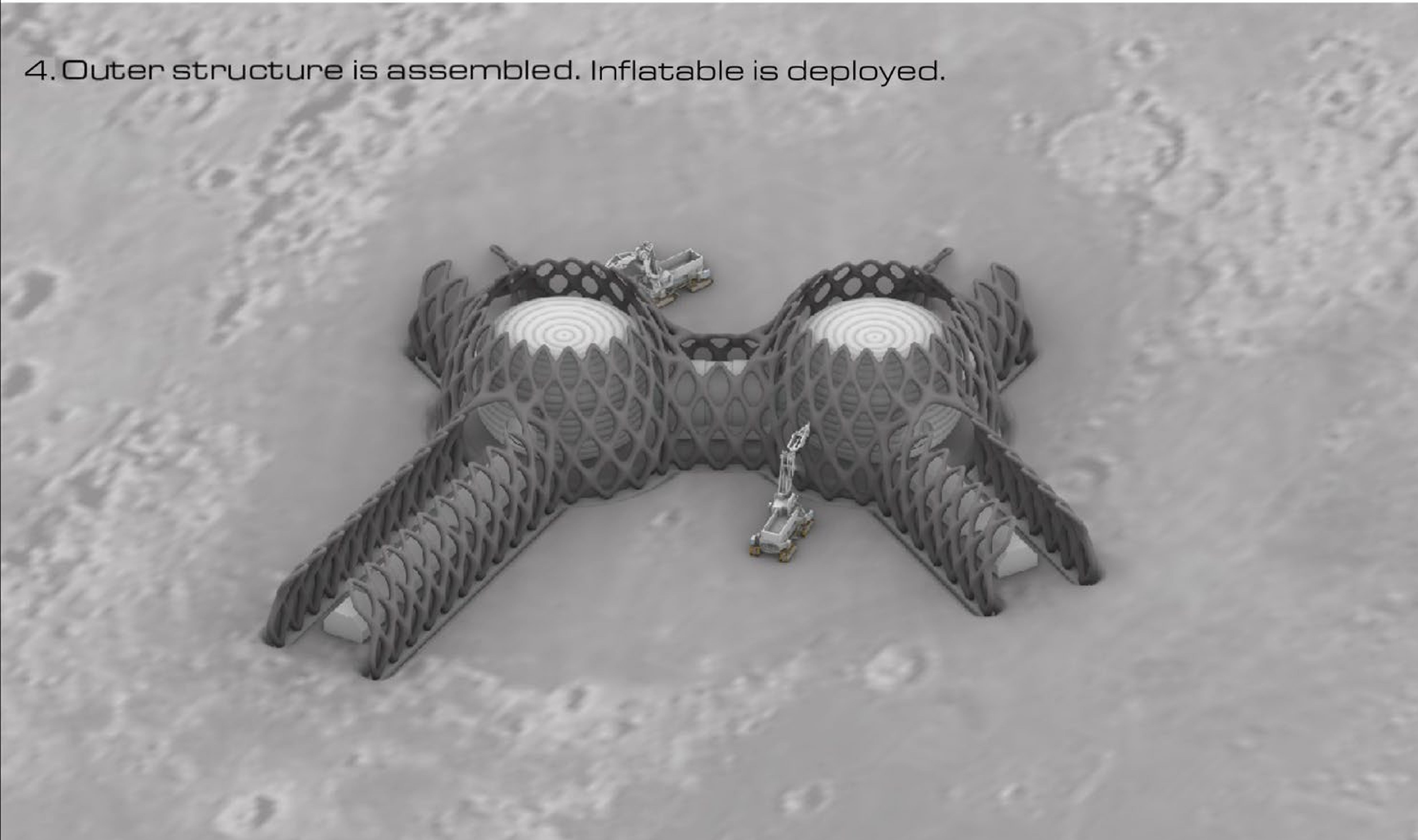


2. Base isolators and hab frames transported to site.

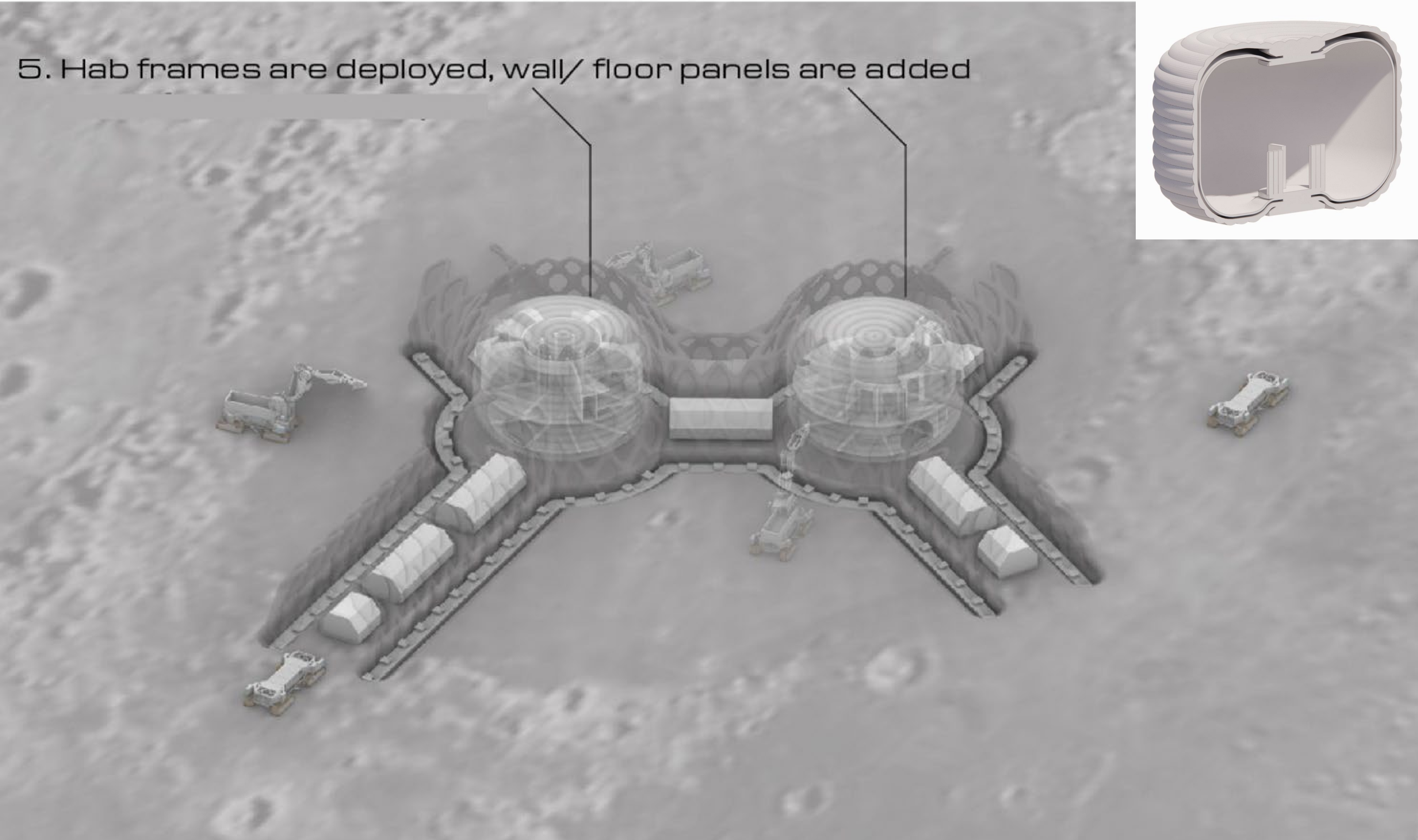



3. Center module is transported to site.

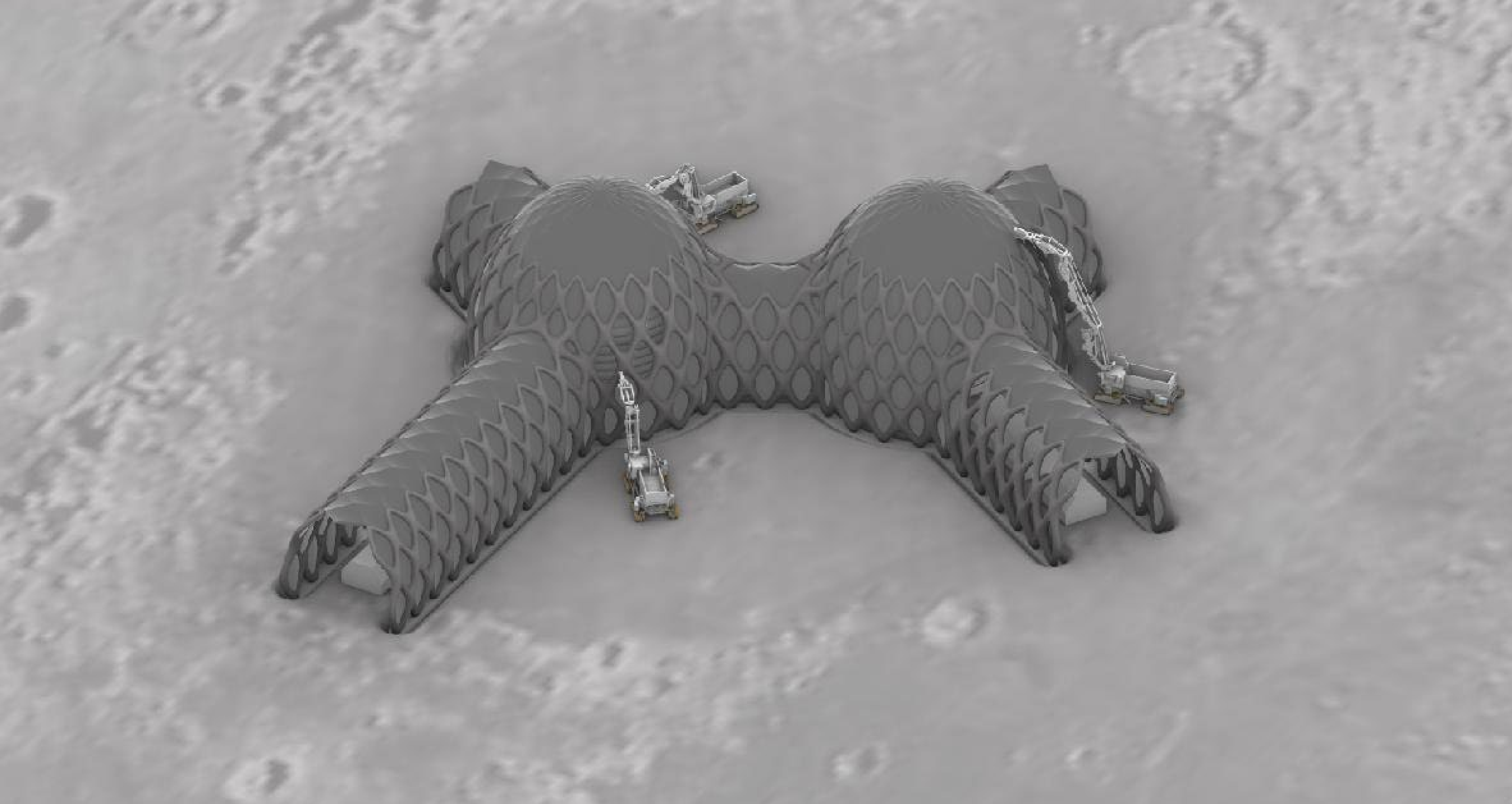
4. Outer structure is assembled. Inflatable is deployed.



HABITAT: DEPLOYMENT

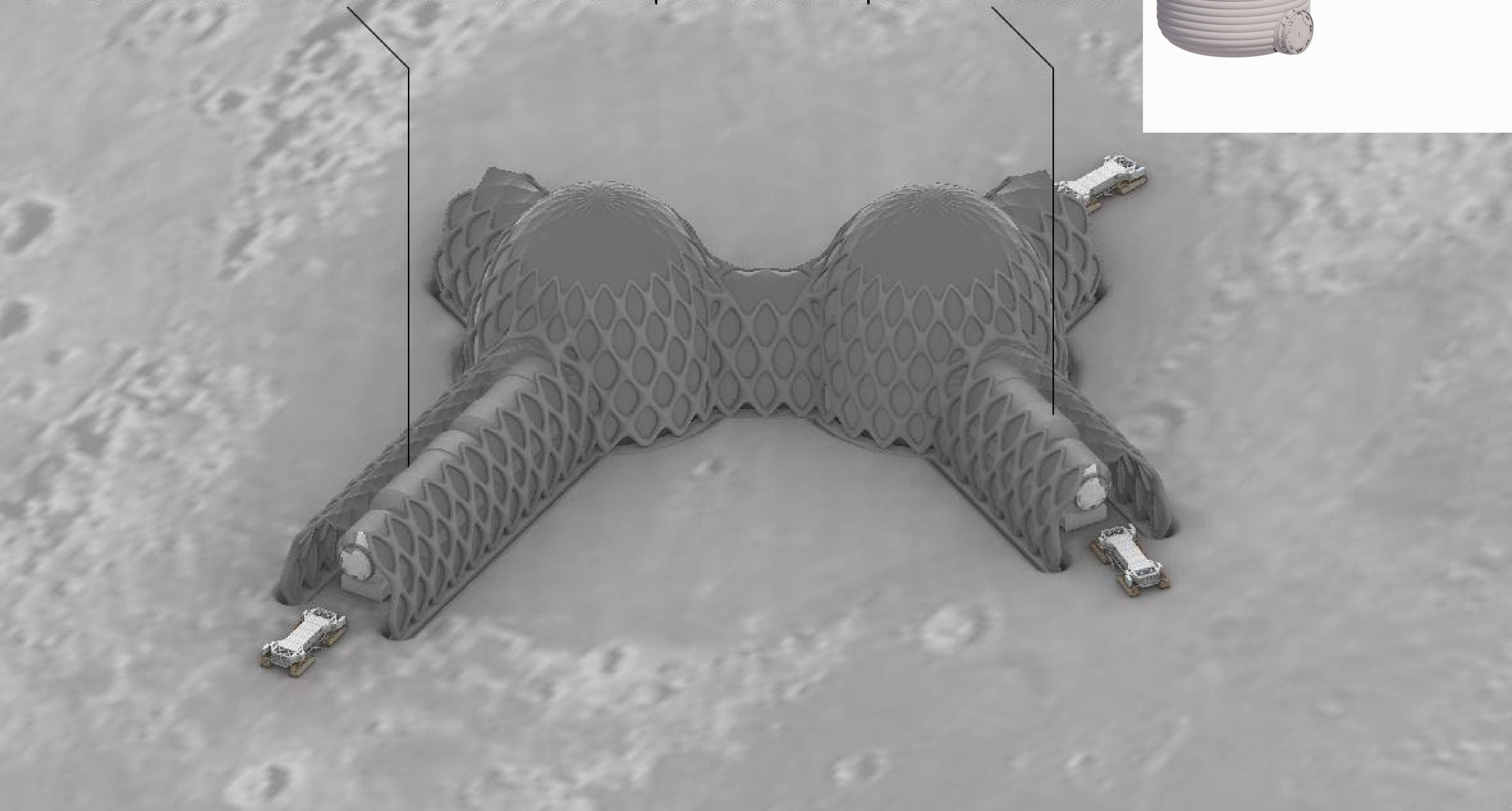


6. Paneling system is applied to outer structure.



HABITAT: DEPLOYMENT

7. Remainder of modules are transported and placed on site.



TIMELINE

TIMELINE TIMELINE

1	TASKS	START	END	2024	2025	2035	2045	2050	2060
2	EQUIPMENT DELIVERY	2024	2024						
3	RASSOR	2024	2024						
4	3D Printer	2024	2024						
5	Crane	2024	2024						
6	ROBOTIC BAY	2024	2060						
7	Polyethylene and Regolith Collecting	2024	2060						
8	Energy Grid	2024	2024						
9	HABITAT CONSTRUCTION AID	2024	2060						
10	Excavating and Collecting with RASSOR	2024	2025						
11	3D Printing Base	2024	2035						
12	3D Print Regolith Frame	2025	2060						
13	Inflatable Delivery	2035	2060						
14	Airlock Delivery + Installation	2035	2060						
15	Panel Delivery + Installation	2025	2035						
16	Crane Lifting Capstone	2060	2060						
17	LANDING PAD	2024	2060						
18	FAST Landing Pad	2024	2024						
19	Excavating	2024	2026						
20	Phase 1 Barrier Printing	2025	2045						
21	Phase 2 Barrier Printing	2045	2060						
22	Phase 3 Robotic Bay Printing	2050	2060						

GREEN HOUSE

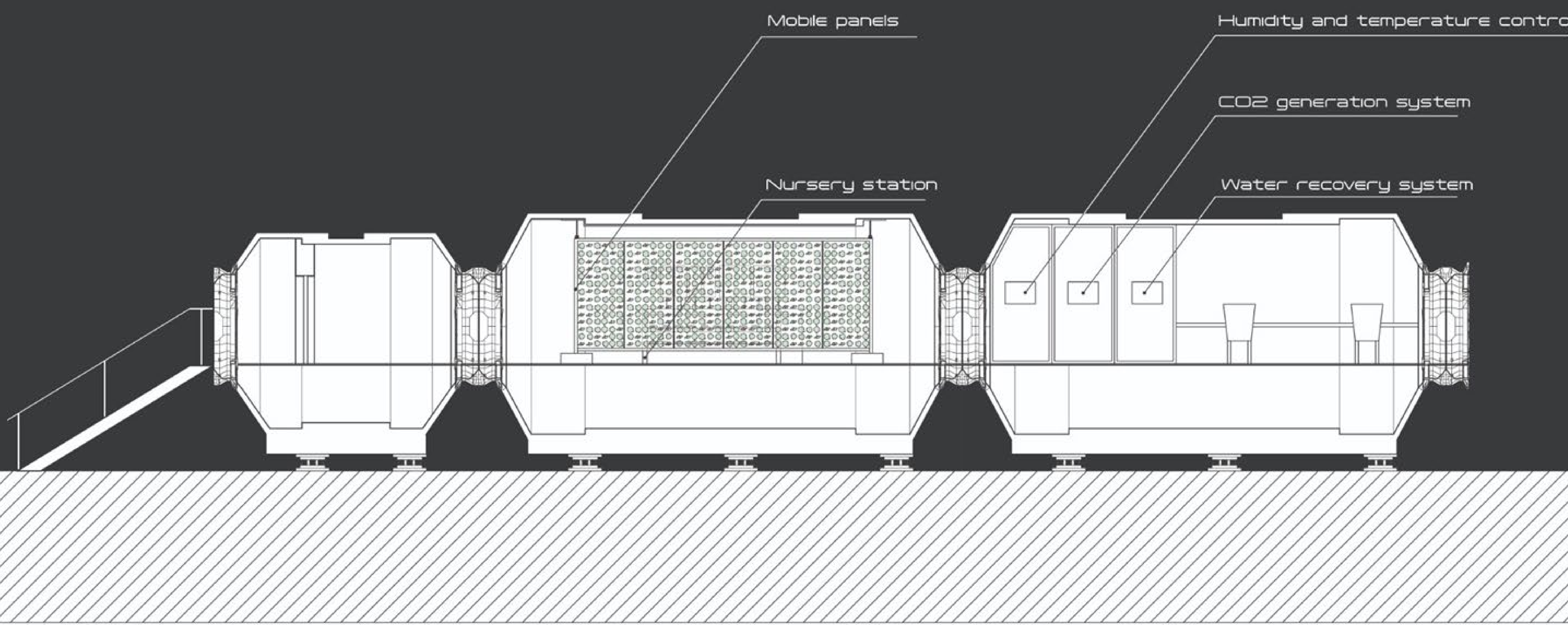
- LABORATORY WING
- ZEN GARDEN
- ROBOTS

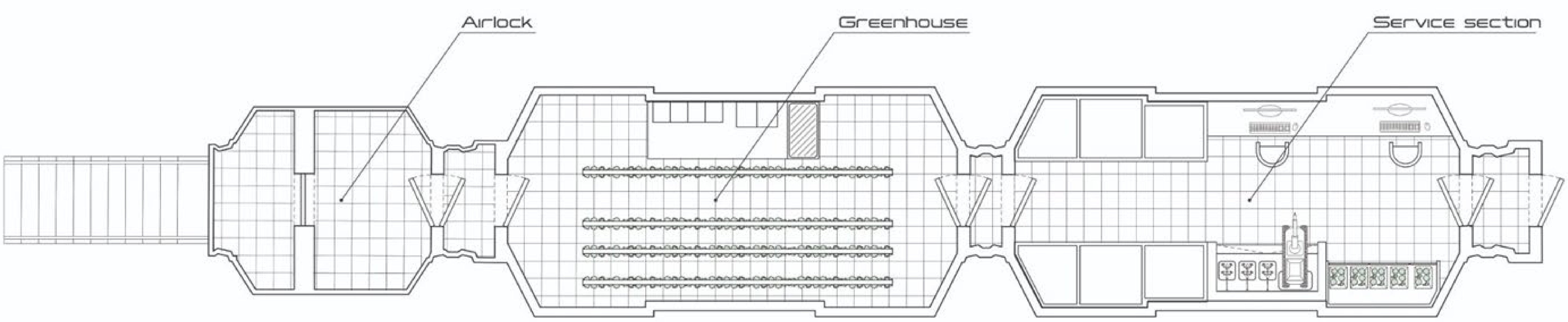
STATED AIMS

- Microgravity and organism's cells
- How to maintain food quantity and quality
- More effective agricultural growth
- Becoming self sufficient
- Reduce the weight of supplies lifted off of earth
- Increase health benefits, relief stress and boost morale

SELECTED VEGETABLES

- Lettuce // 30-50 days // 0.25 in /week
- Radish // 30-40 days // 1in/week
- Cucumber // 55-70 days // 1 in/week
- Sweet pepper // 60-90 days // 2 in week





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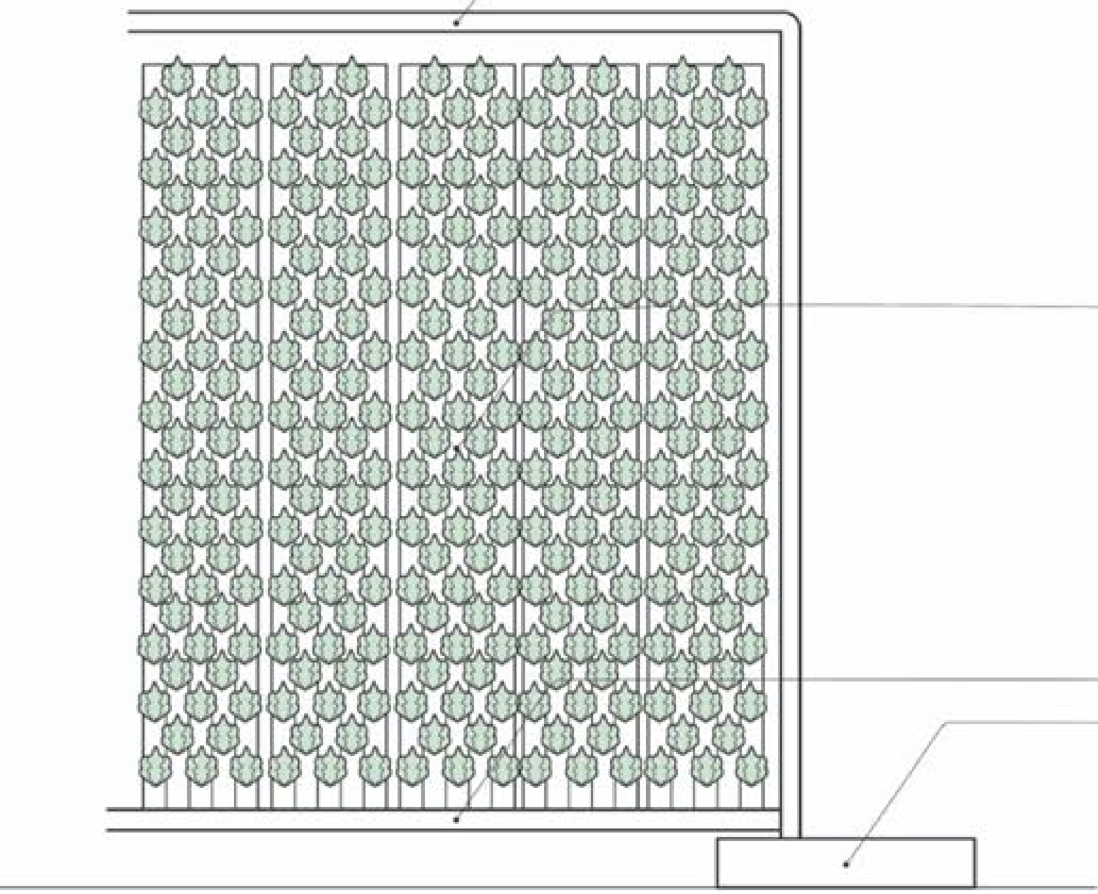
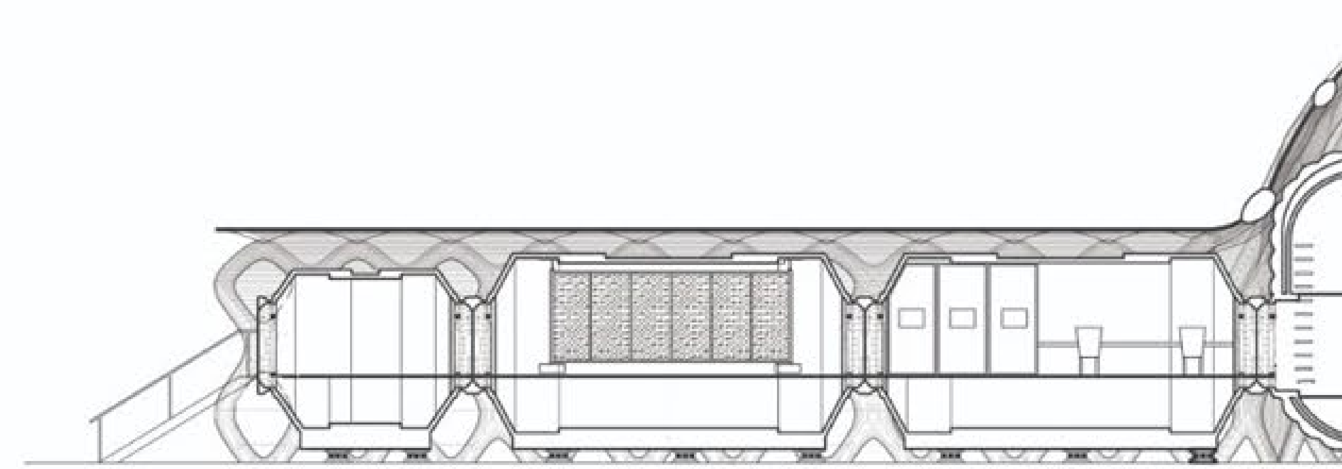
LABORATORY: PLAN // SECTION





Hydroponics system

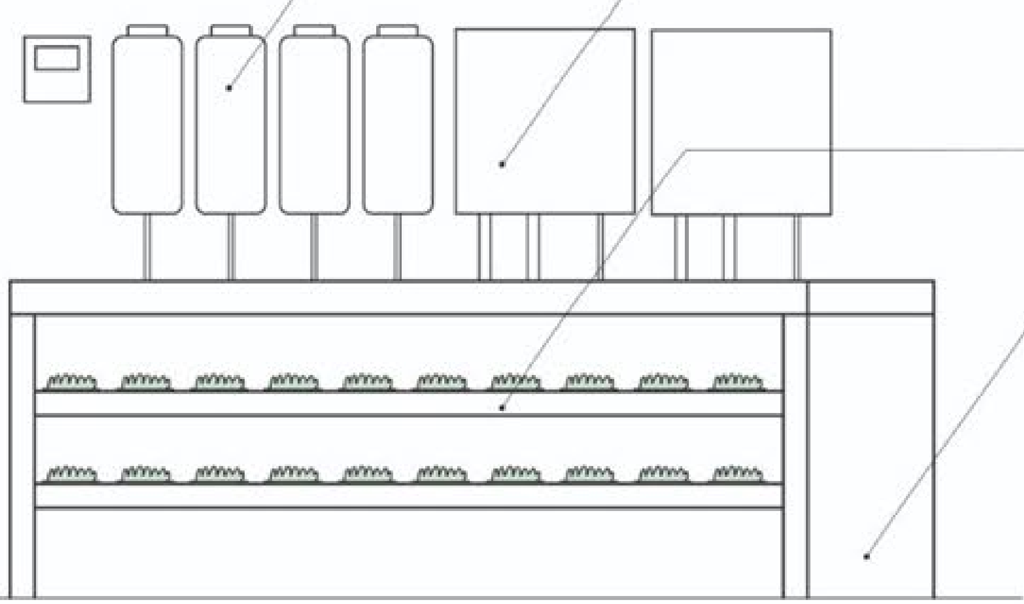
Overhead pipes drip water and nutrients to plants below

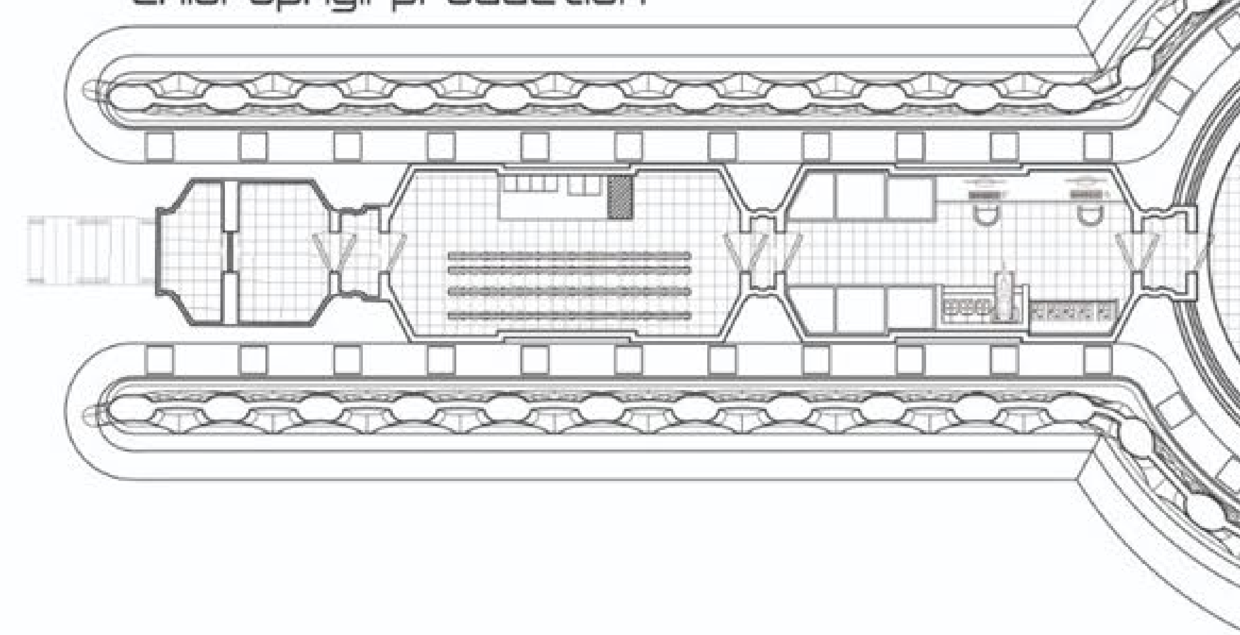
Uses 5 gallons of water a day

Led Array

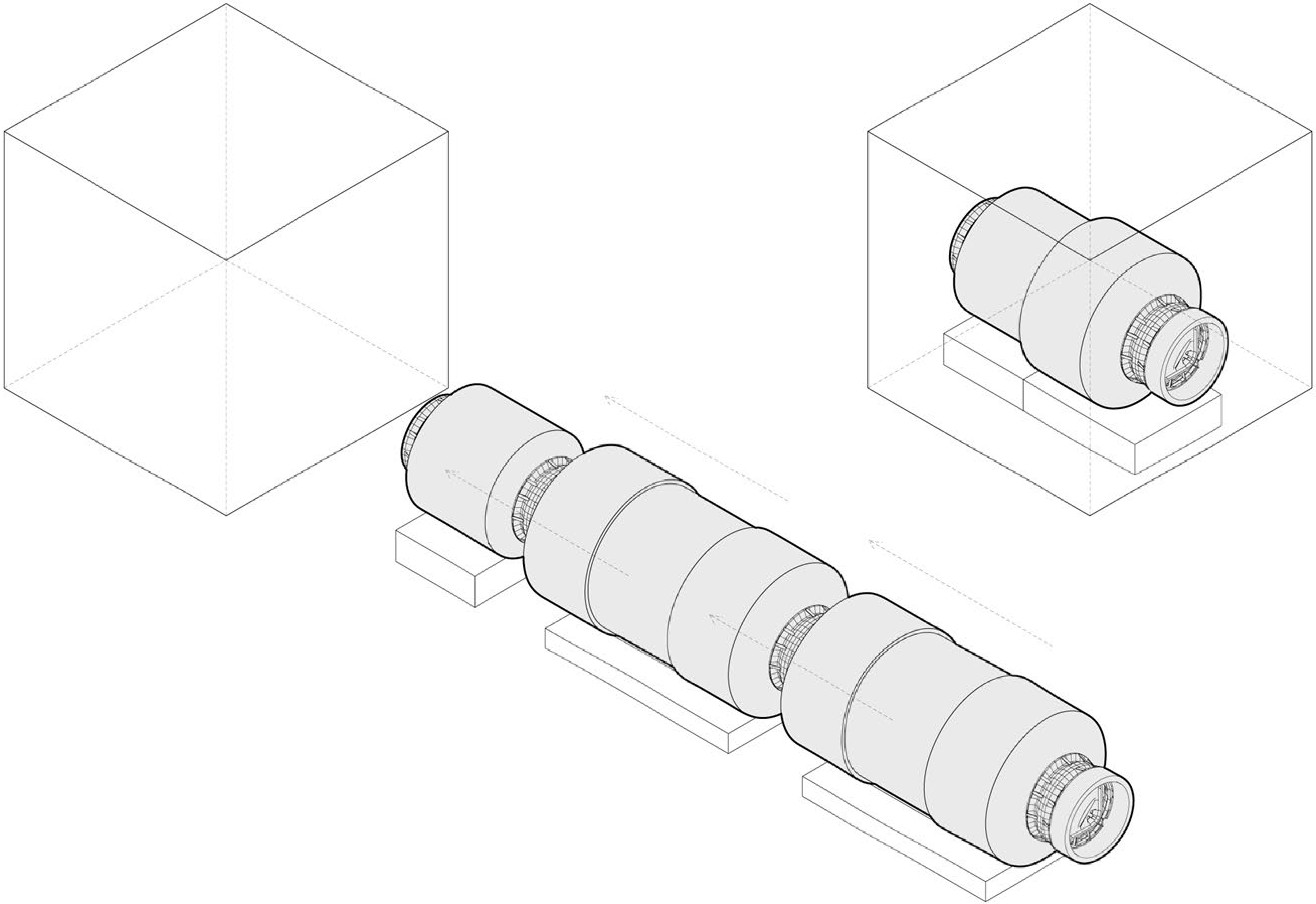
Red lights: essential for stem and leaf growth

Blue Lights: develop thick stem and promote chlorophyll production

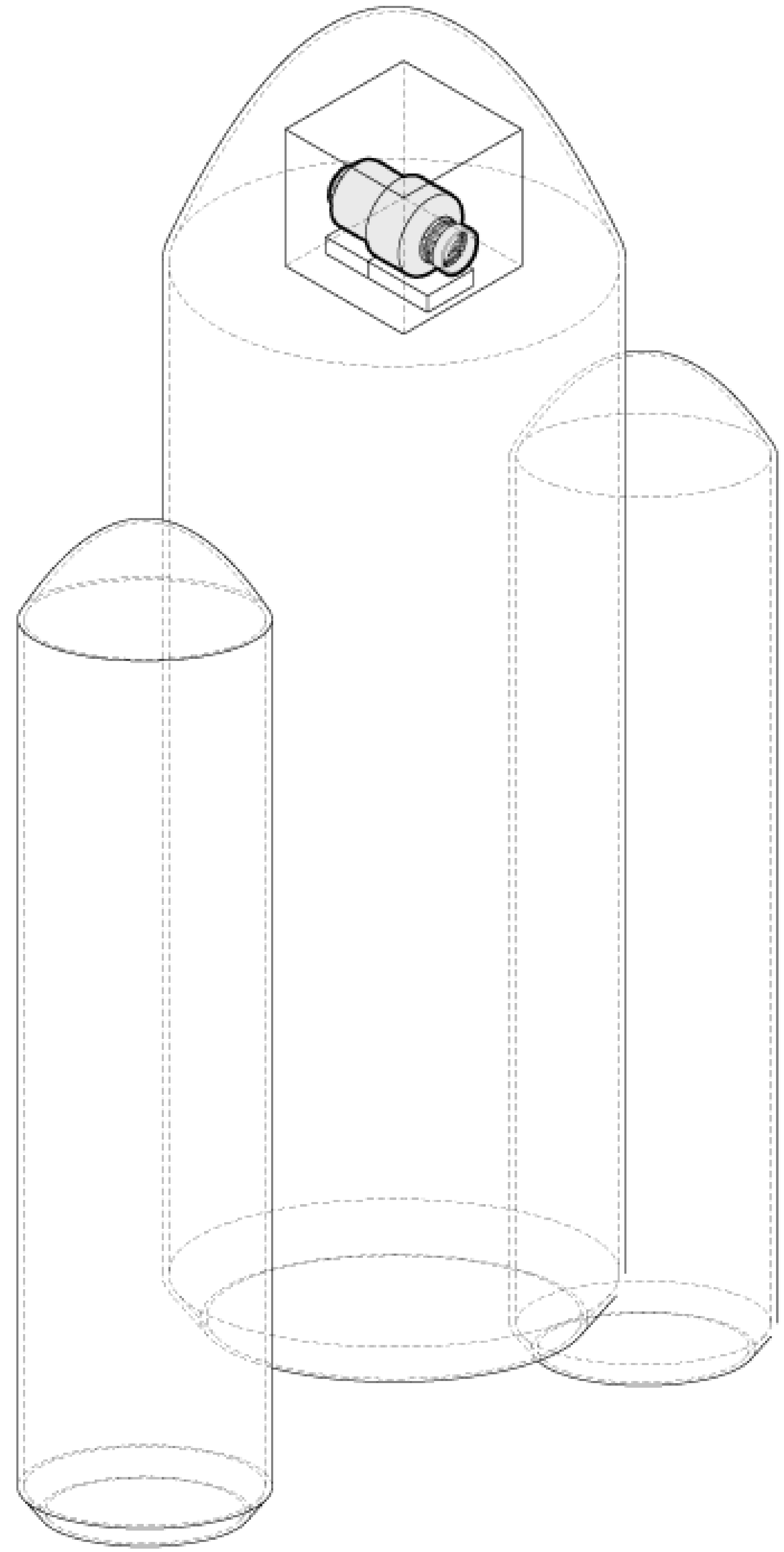




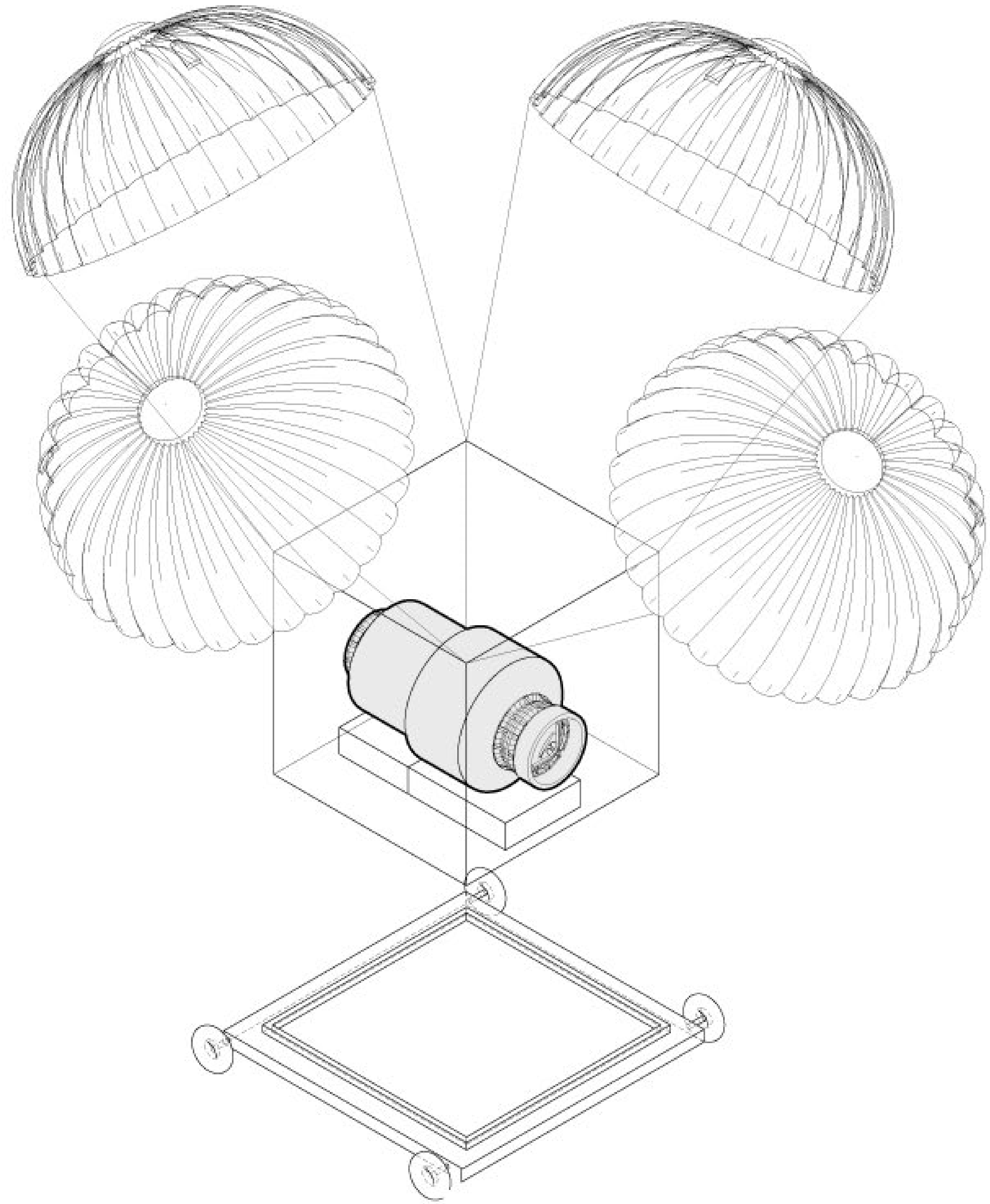
LABORATORY: DETAILS



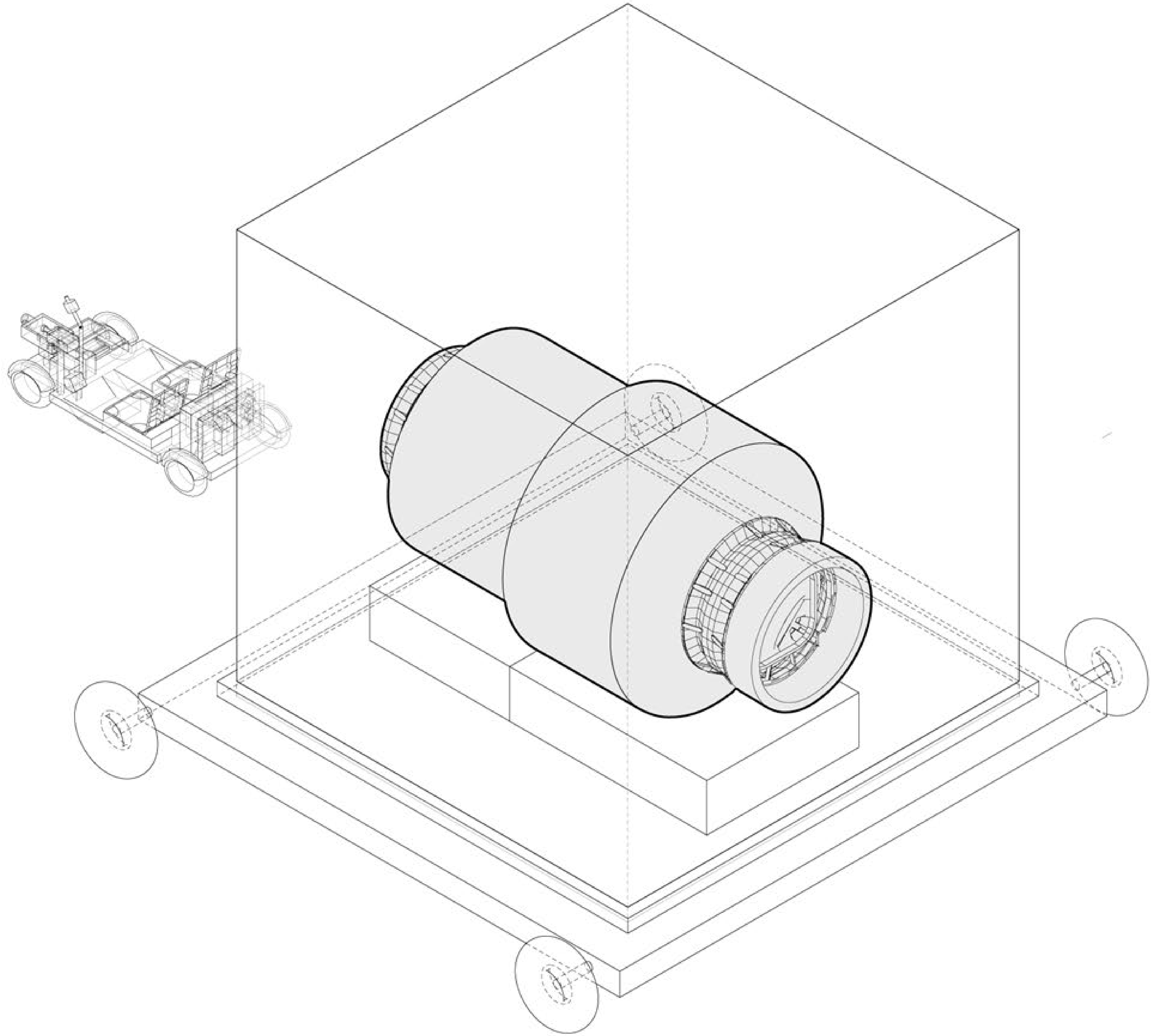
Installation in a 20x20x20ft cube



Launched in low earth orbit

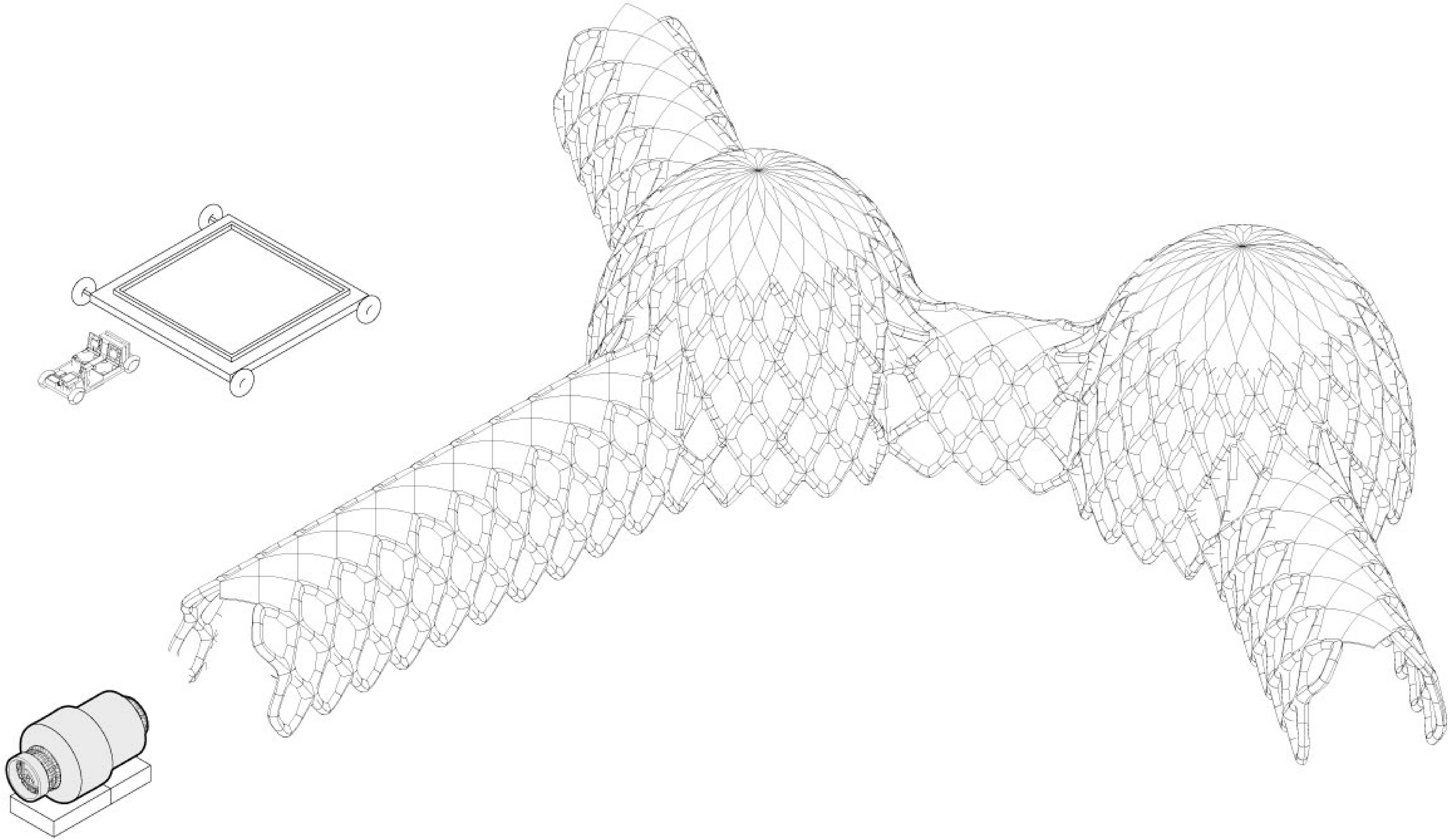


Docking stage

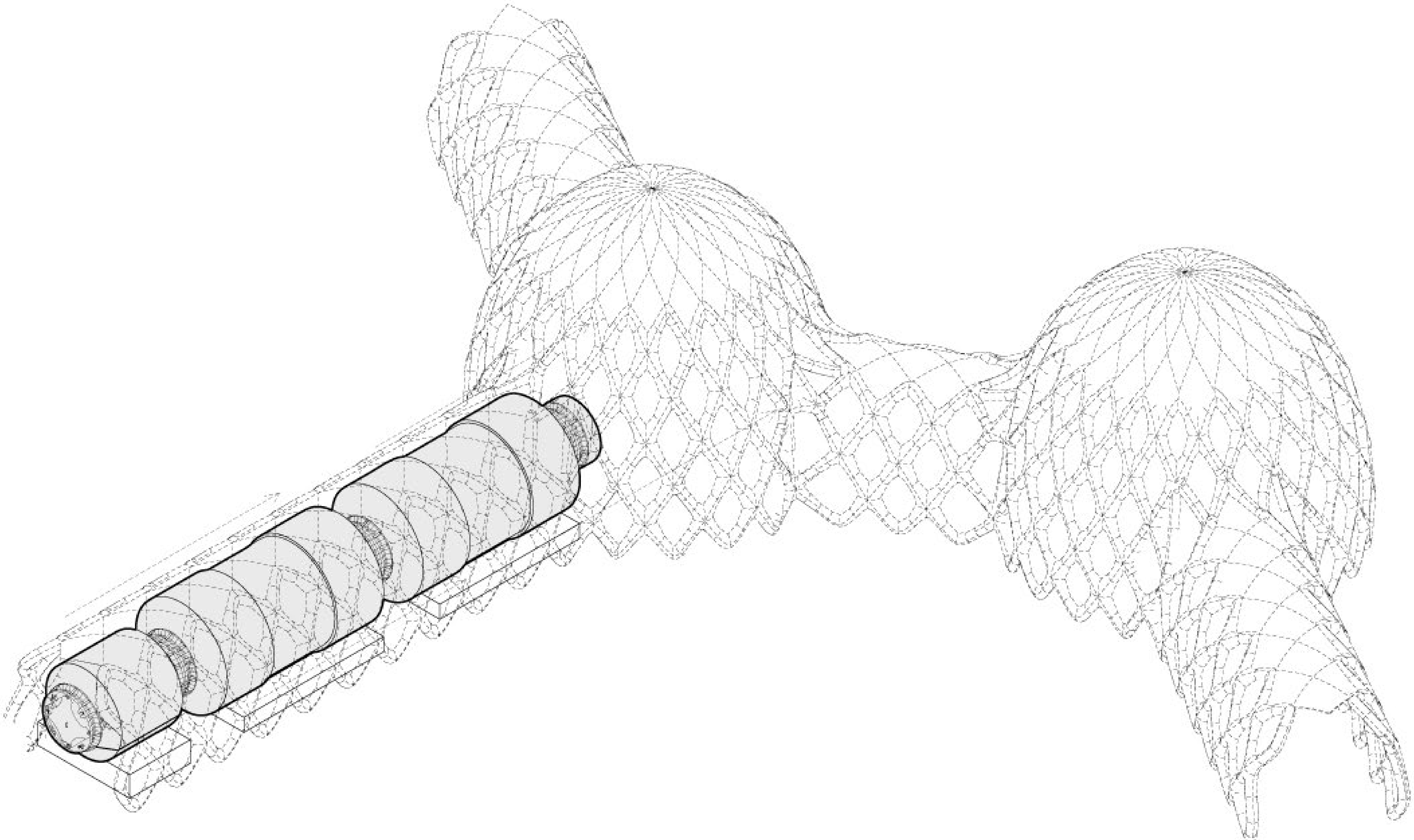


Transfer vehicle with docs

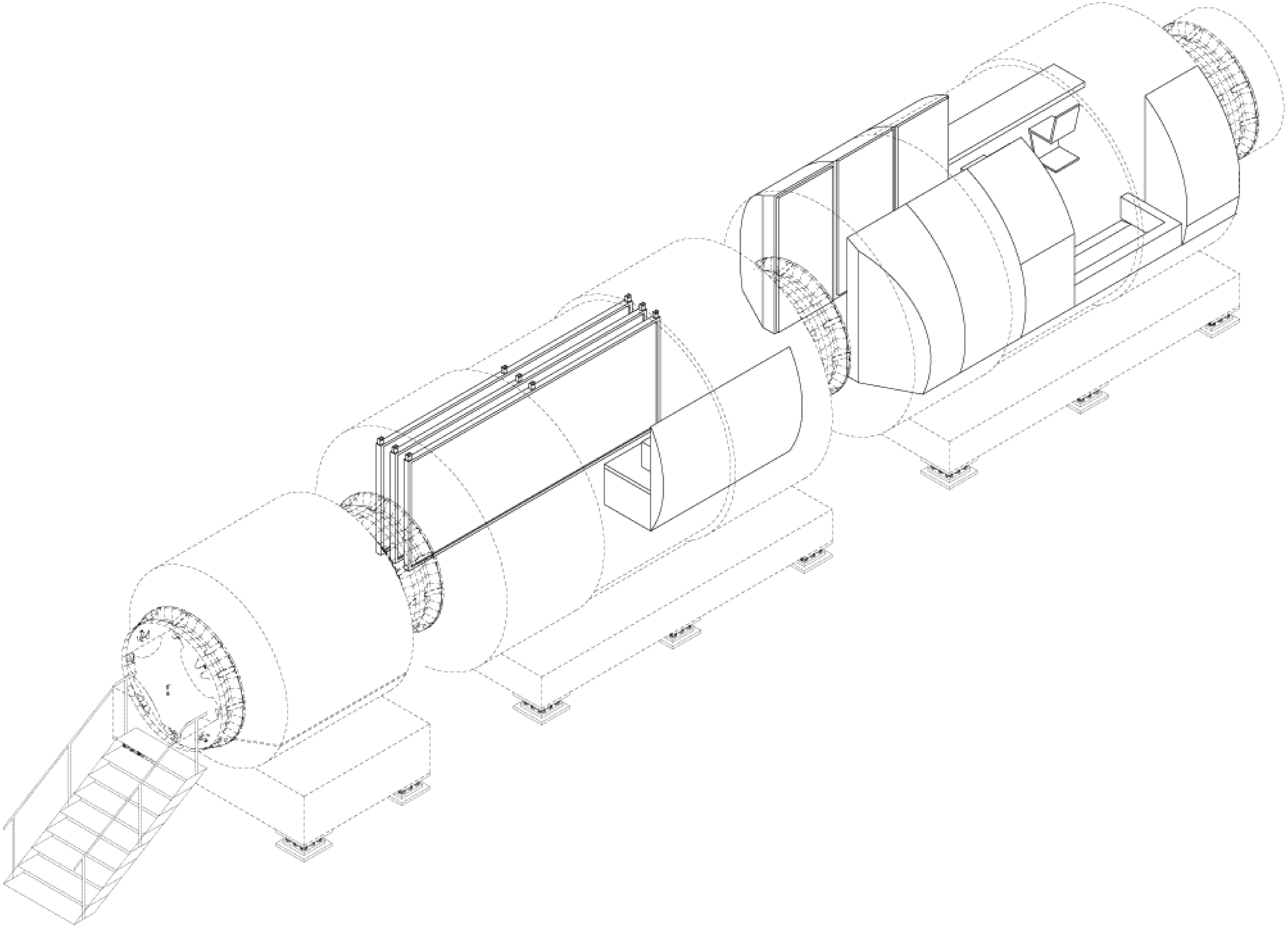
Transferred to desired location



Cube protection is removed



Outwards telescopic deployment



Remaining equipment installed

ZEN GARDEN: CONCEPT/OBJECTIVES

Prioritize Psychological Well-Being

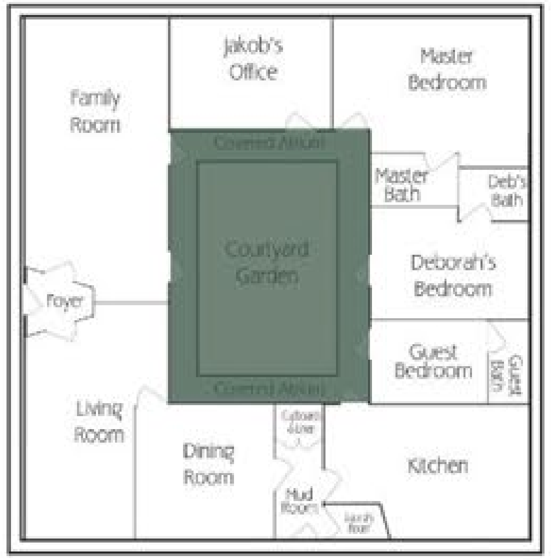
The desolate and lifeless environment will be detrimental to the psychological health of the astronauts on the habitat. We aim to mitigate this through integrating green space in Habitat: Oasis.

Studying human interaction with plants has shown :

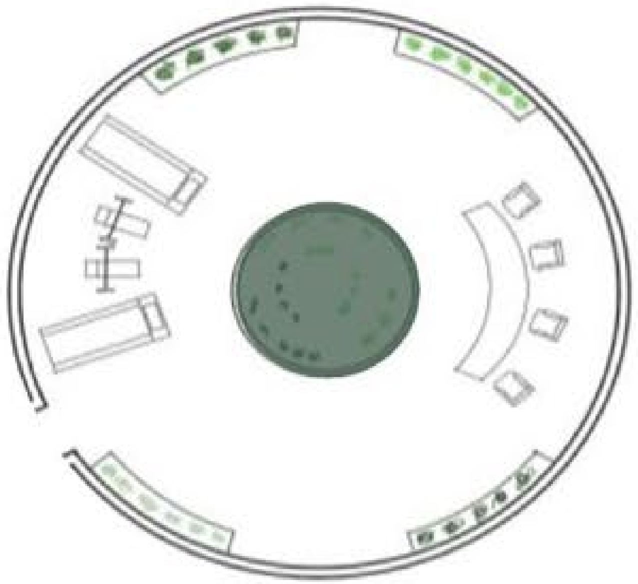
-individuals could reduce psychological and psychological stress
(Journal of Physiological Anthropology)

- stress levels decrease significantly more with gardening as compared to other cortisol-lowering activites like reading
(Journal of Health Psychology)

- being in the presence of plants helps improve memory and attention span by 20 percent and increases concentration.
(University of Michigan)

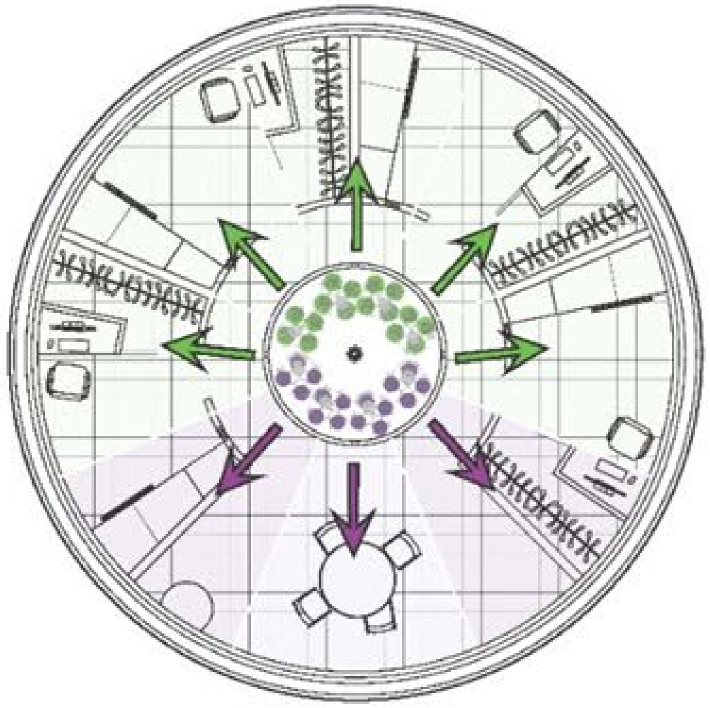


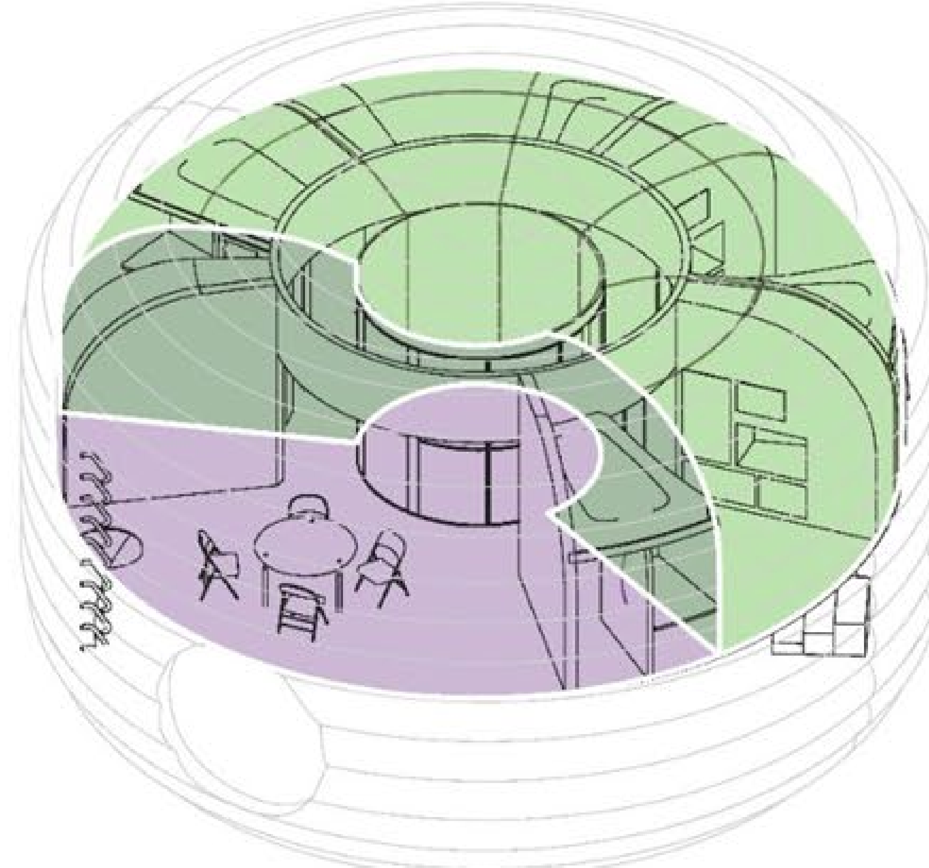
TYPICAL COURTYARD ON EARTH HOUSE



COURTYARD INTEGRATION ON LUNAR HABITAT

2nd Floor





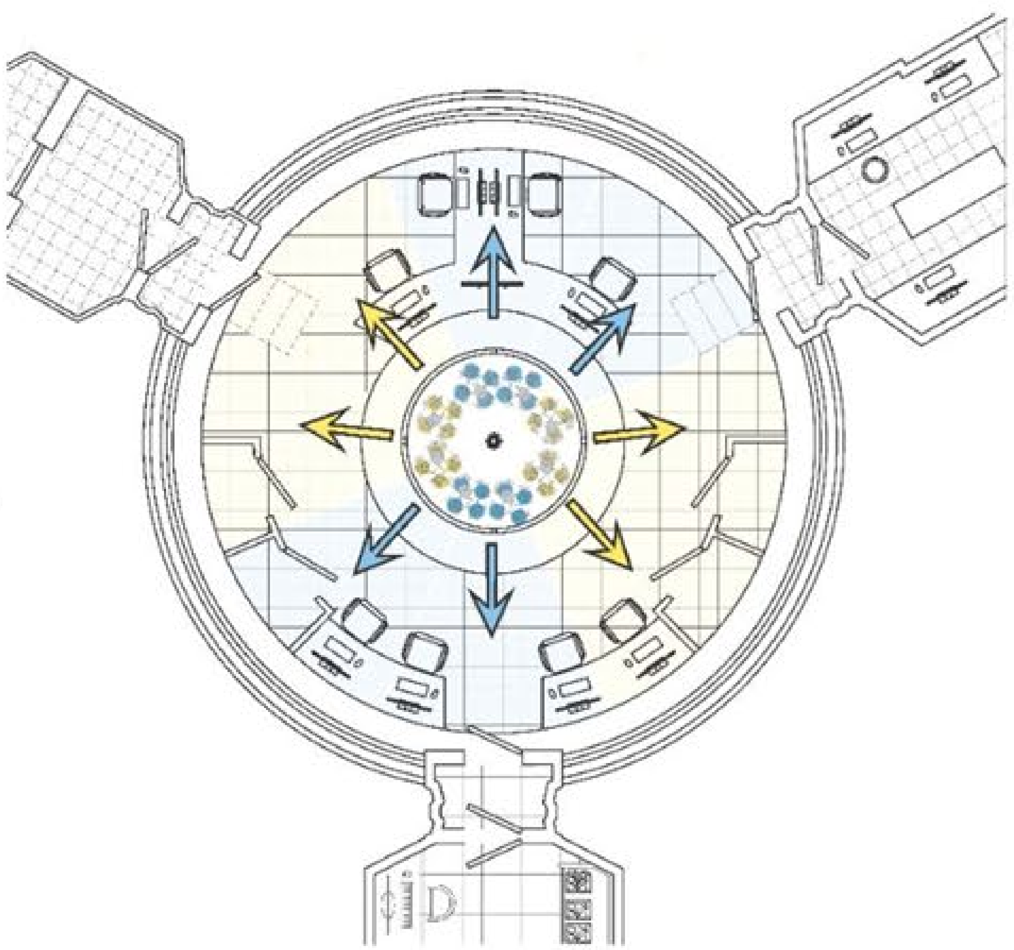
Pilea

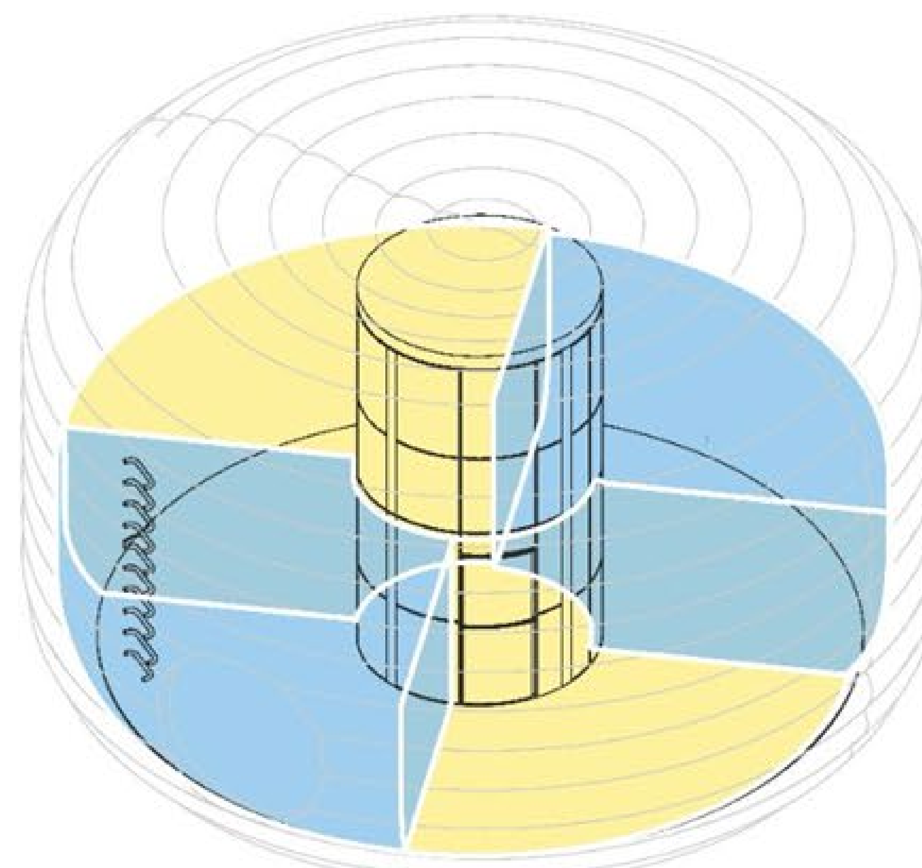
Green: Healing, Freshness

Monarda

Purple: Communication, Socialization

1st Floor



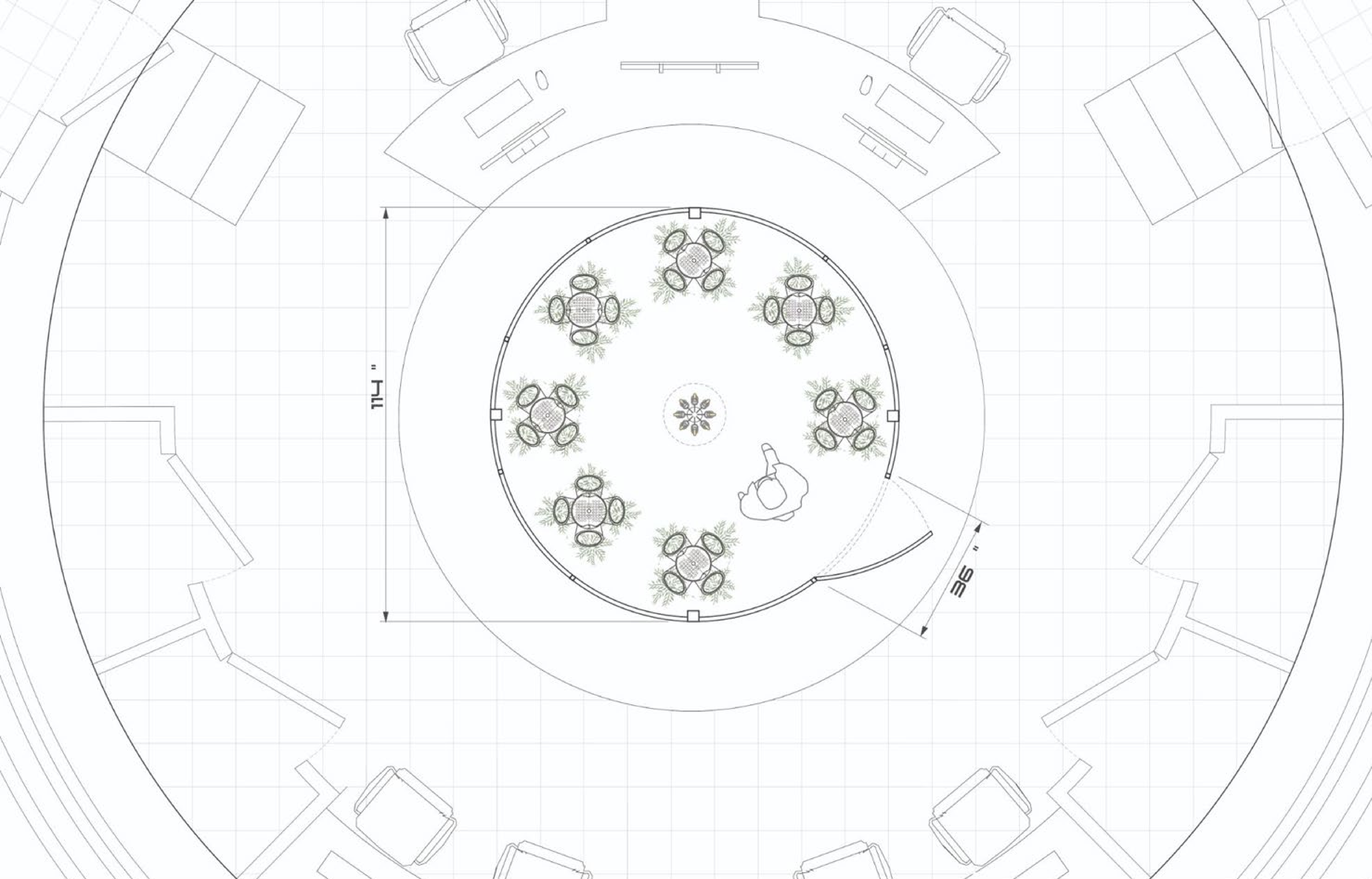


Violas

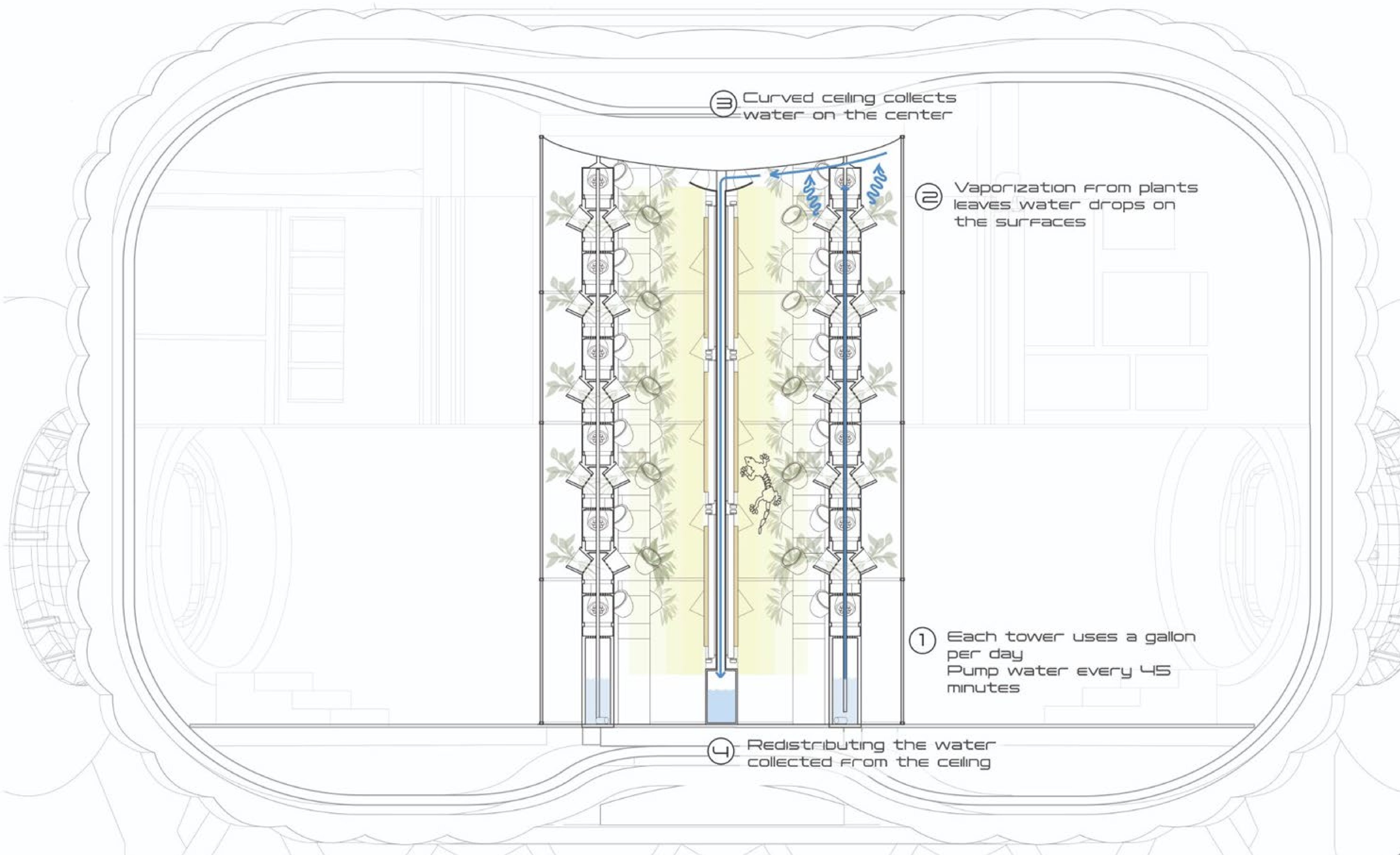
Blue: Logical thinking, Productivity

Marigolds

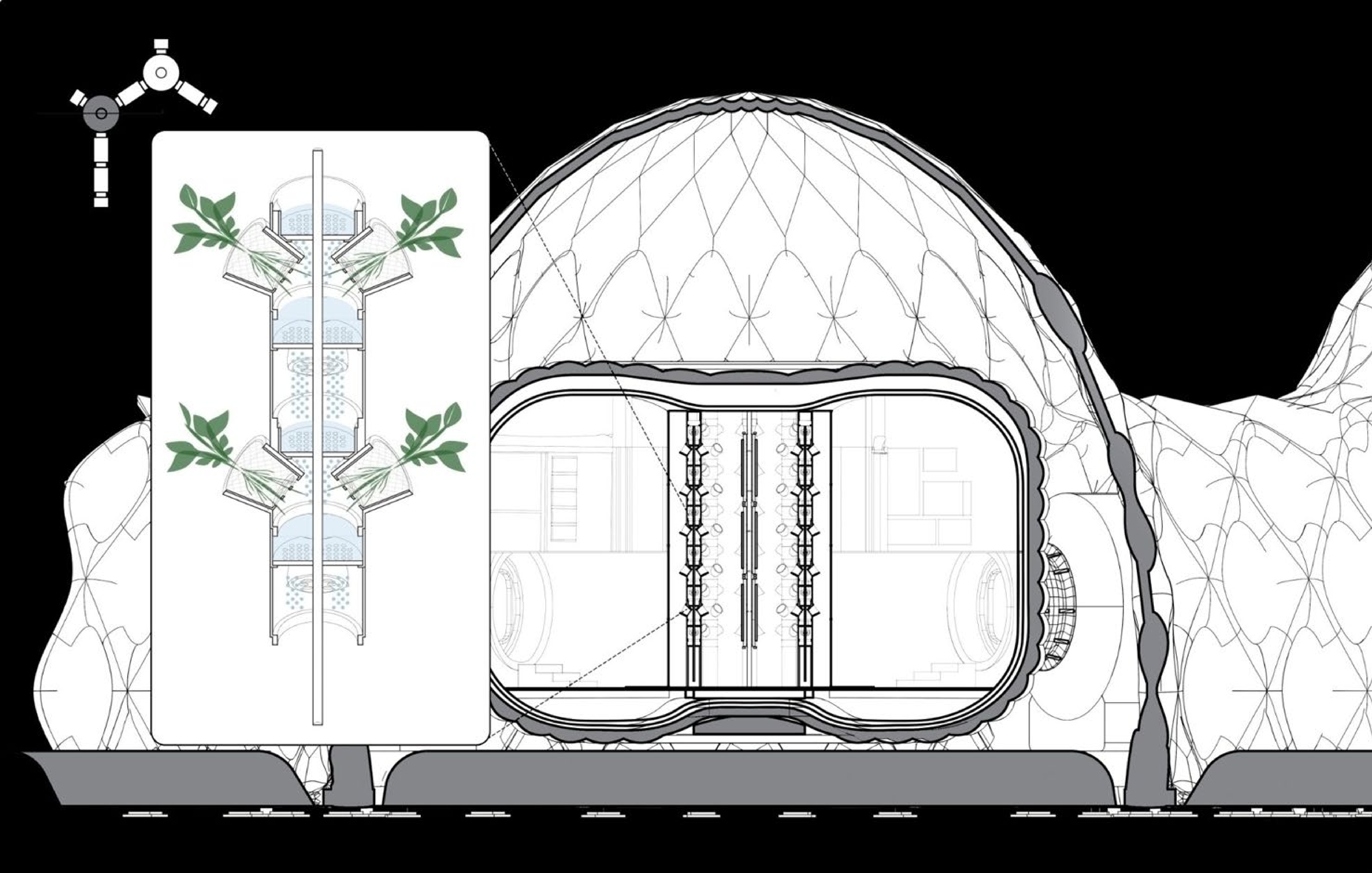
Yellow: Creativity, Joy



ZEN GARDEN: PLAN

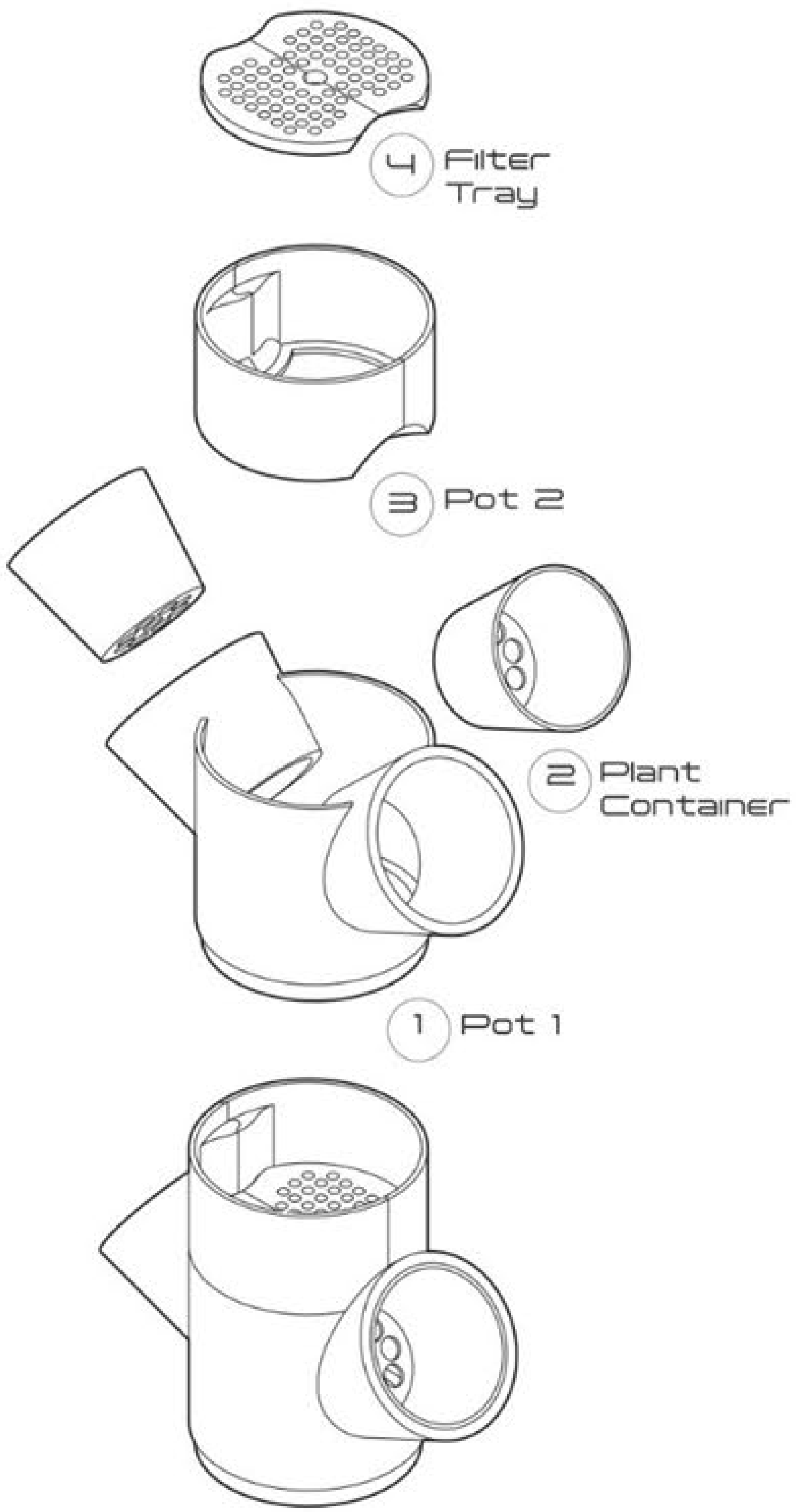


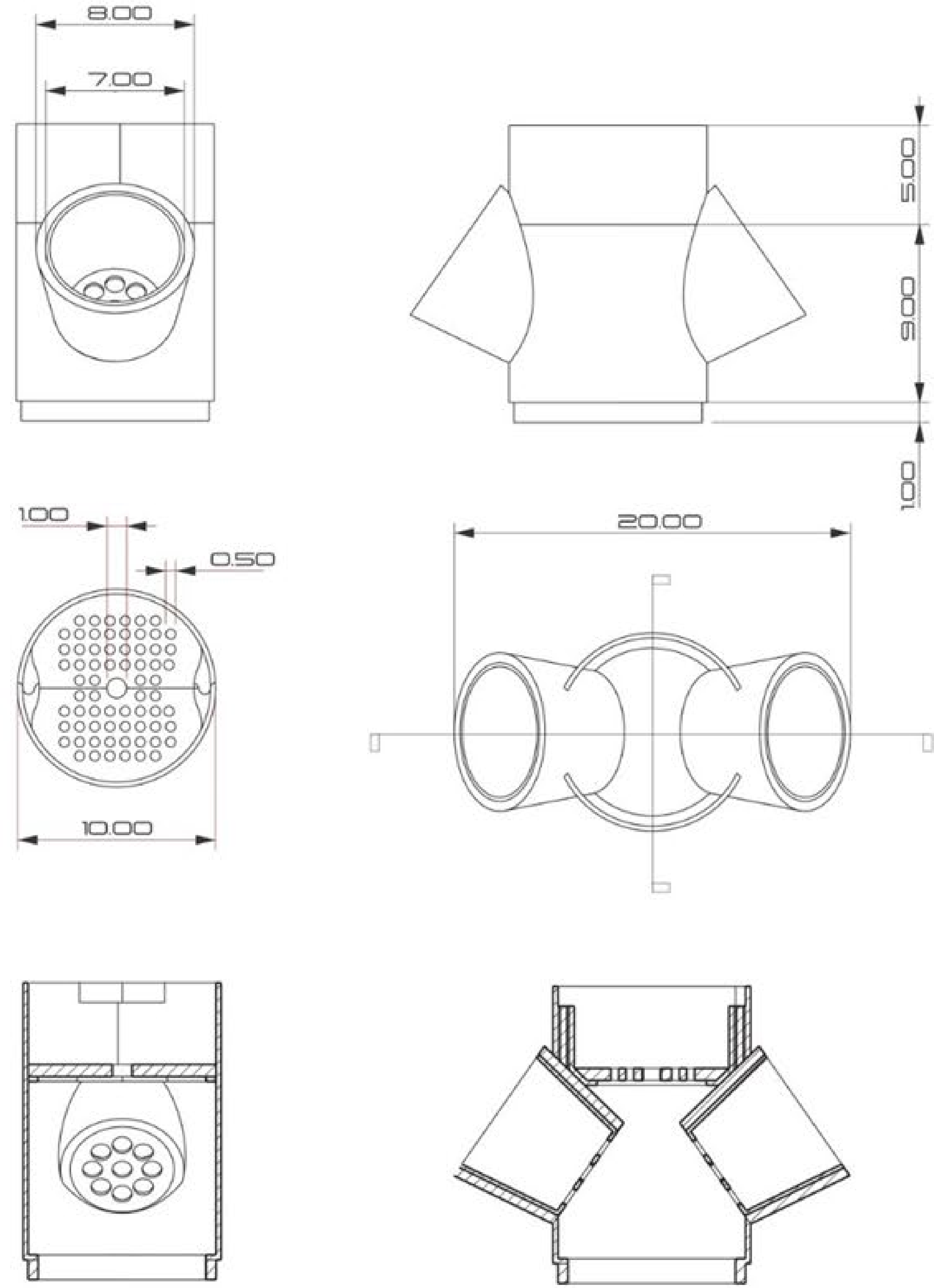
ZEN GARDEN: SYSTEM FLOW



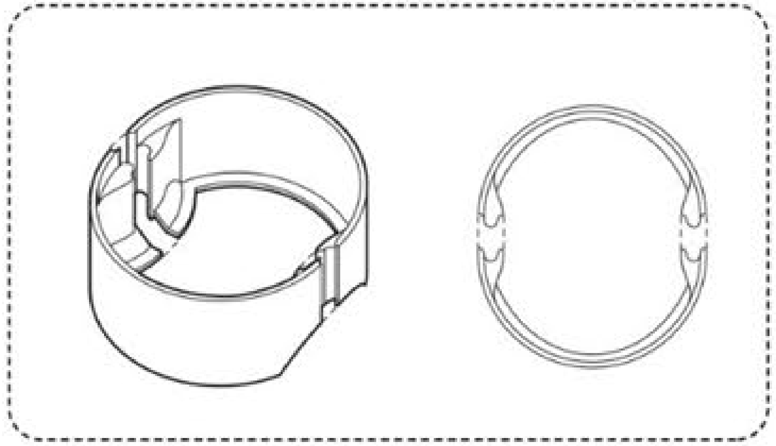
ZEN GARDEN: 3D-PRINTED POT

ZEN GARDEN: DETAILS

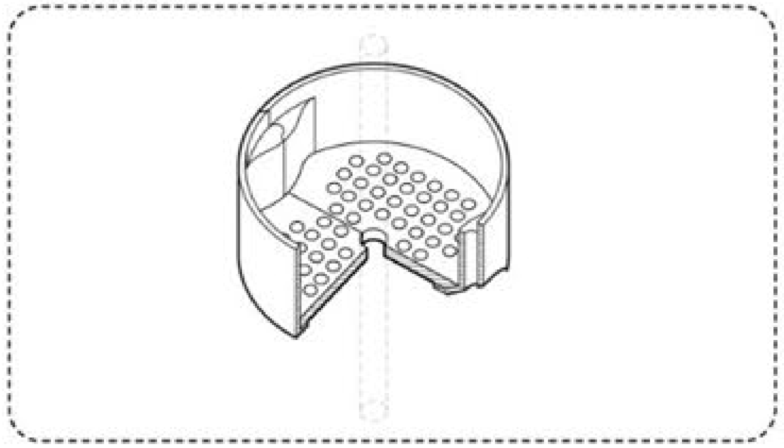




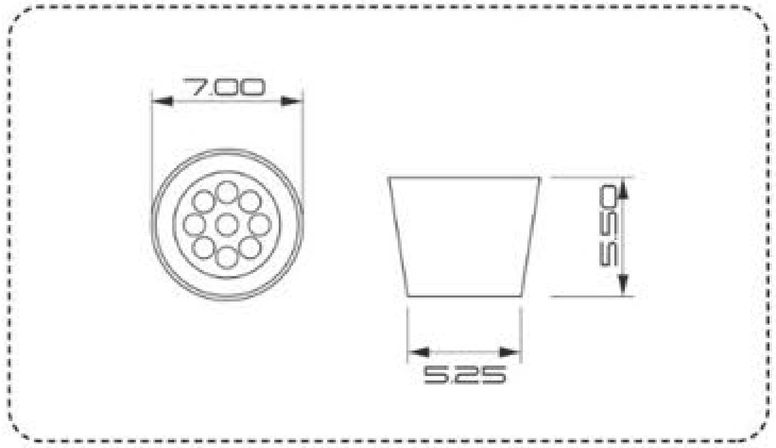
Detail 1



Detail 2

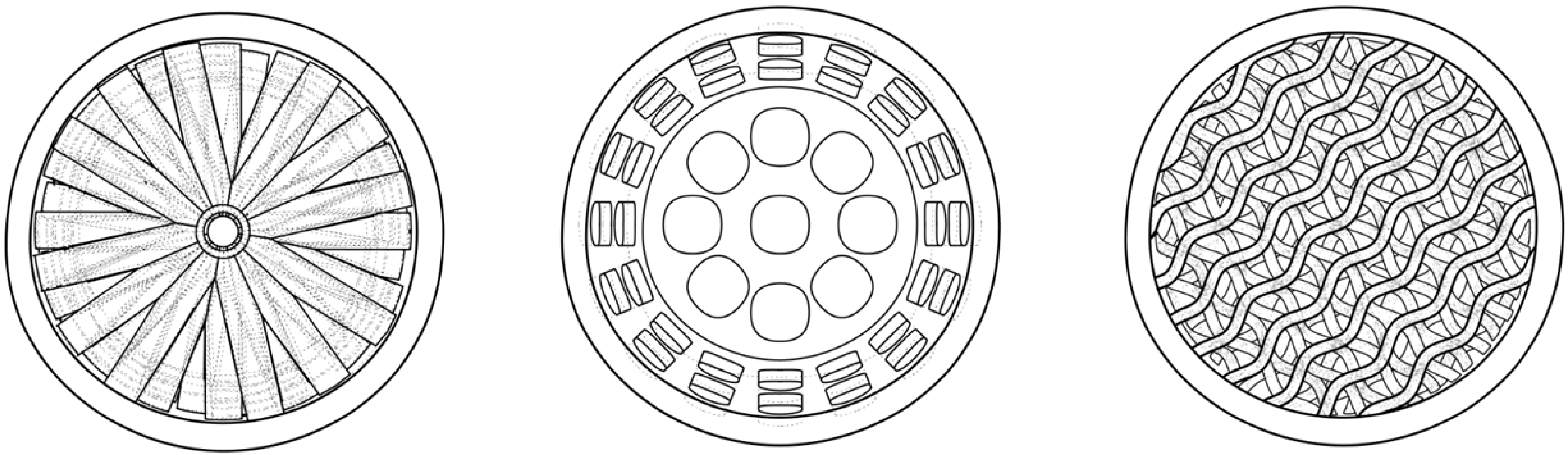


Plant Container Dimensions

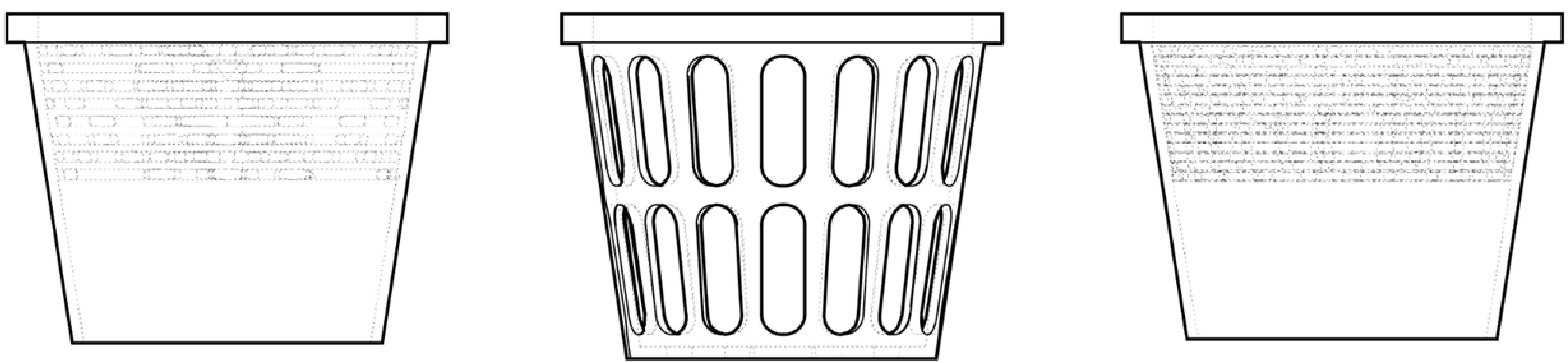


NASA + Pratt X-HAB

PLANTER CUPS + MATERIAL



RADIAL GROWTH | HYDROPONIC | OMNI-DIRECTIONAL



PLANTER CUPS + MATERIAL

HUMAN WASTE
↓
INTRODUCE GENTICALLY ENG. ECOLI
↓
ISOLATE PHB PLASTICS
↓

REGOLITH
↓
GATHER NUTRIENT RICH MINERALS
↓
BREAKDOWN INTO FINE AGGREGATE
↓

HUMAN WASTE IS USED AS A BINGING AGENT
REGOLITH IS THE AGGREGATE FOR THE FILAMENT

University of Calgary team human waste print.

PHB x TPU Plastic planter cup test print.

Pratt // ROSE (Robotic Organic Symbiotic Enviroment)

Phoebe DeGroot & Ofer Shouval

1st meeting: Stated aims

2nd meeting: Robot selection

3rd meeting: Final thoughts

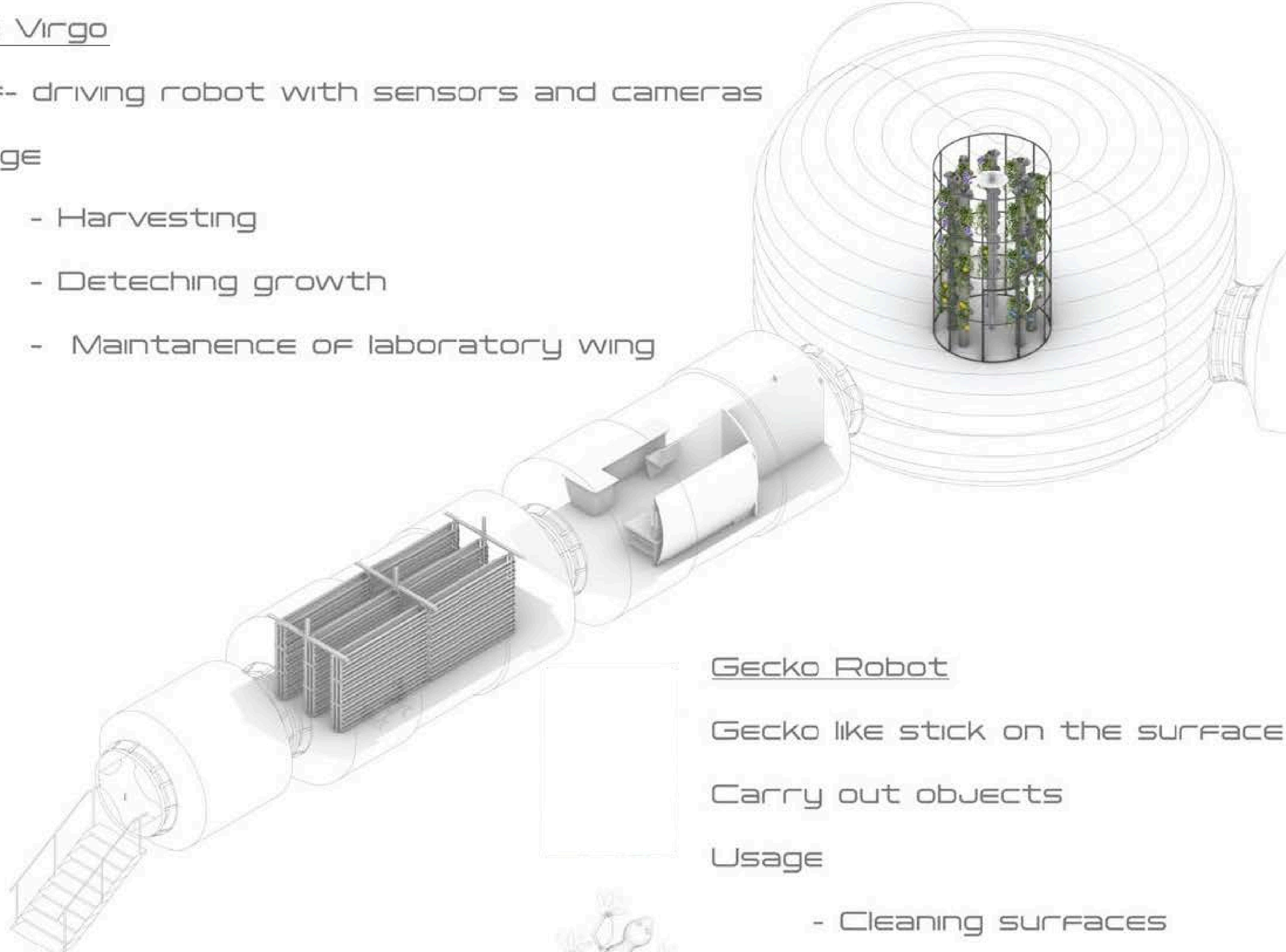
Final result: To create a robotic hub

The Virgo

Self- driving robot with sensors and cameras

Usage

- Harvesting
- Deteching growth
- Maintanence of laboratory wing



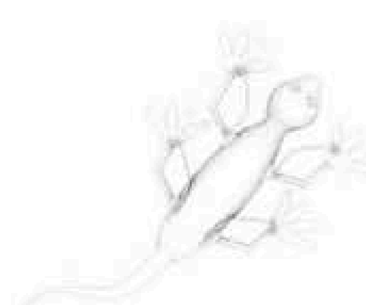
Gecko Robot

Gecko like stick on the surface

Carry out objects

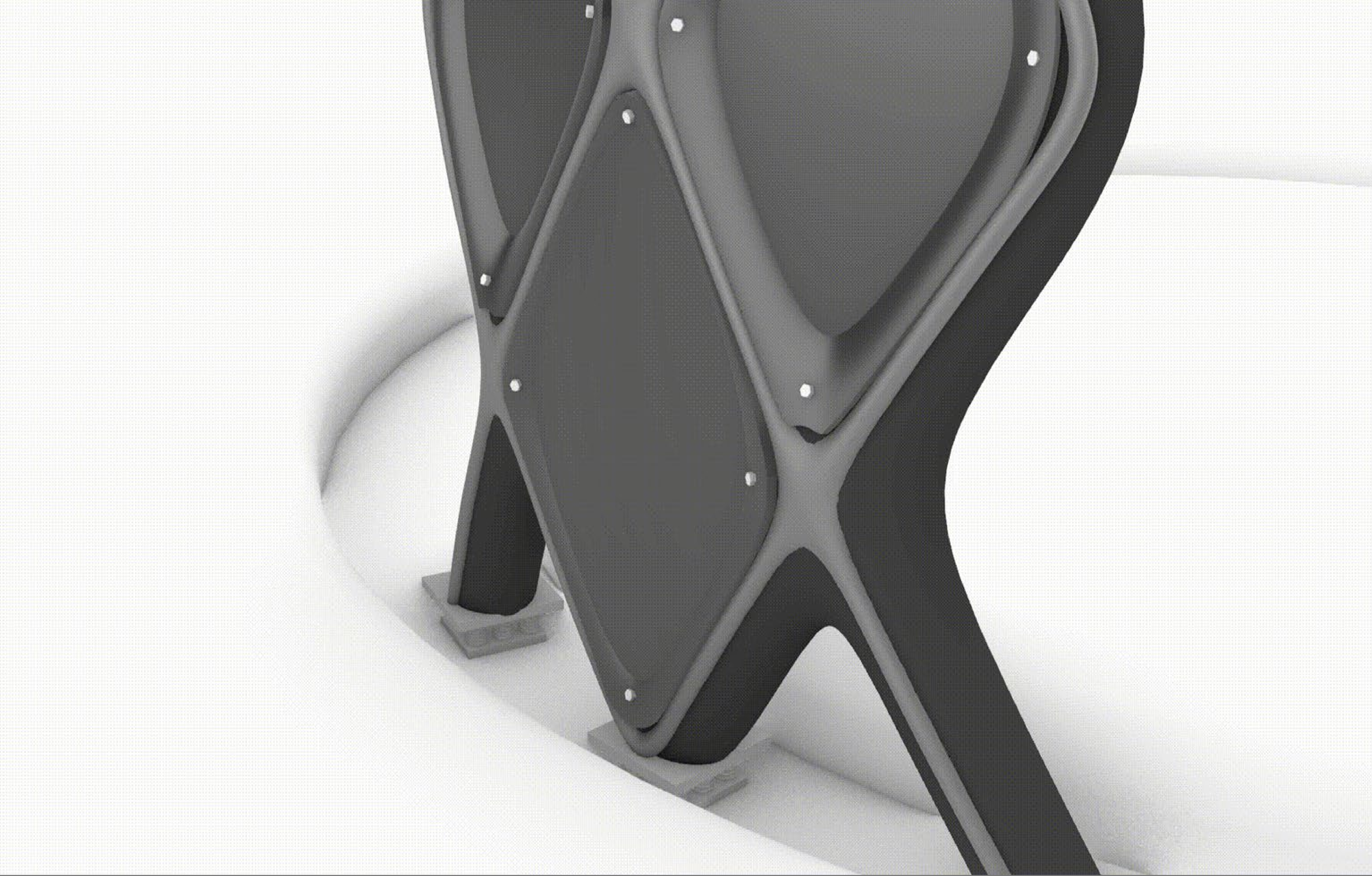
Usage

- Cleaning surfaces
- Handling plants

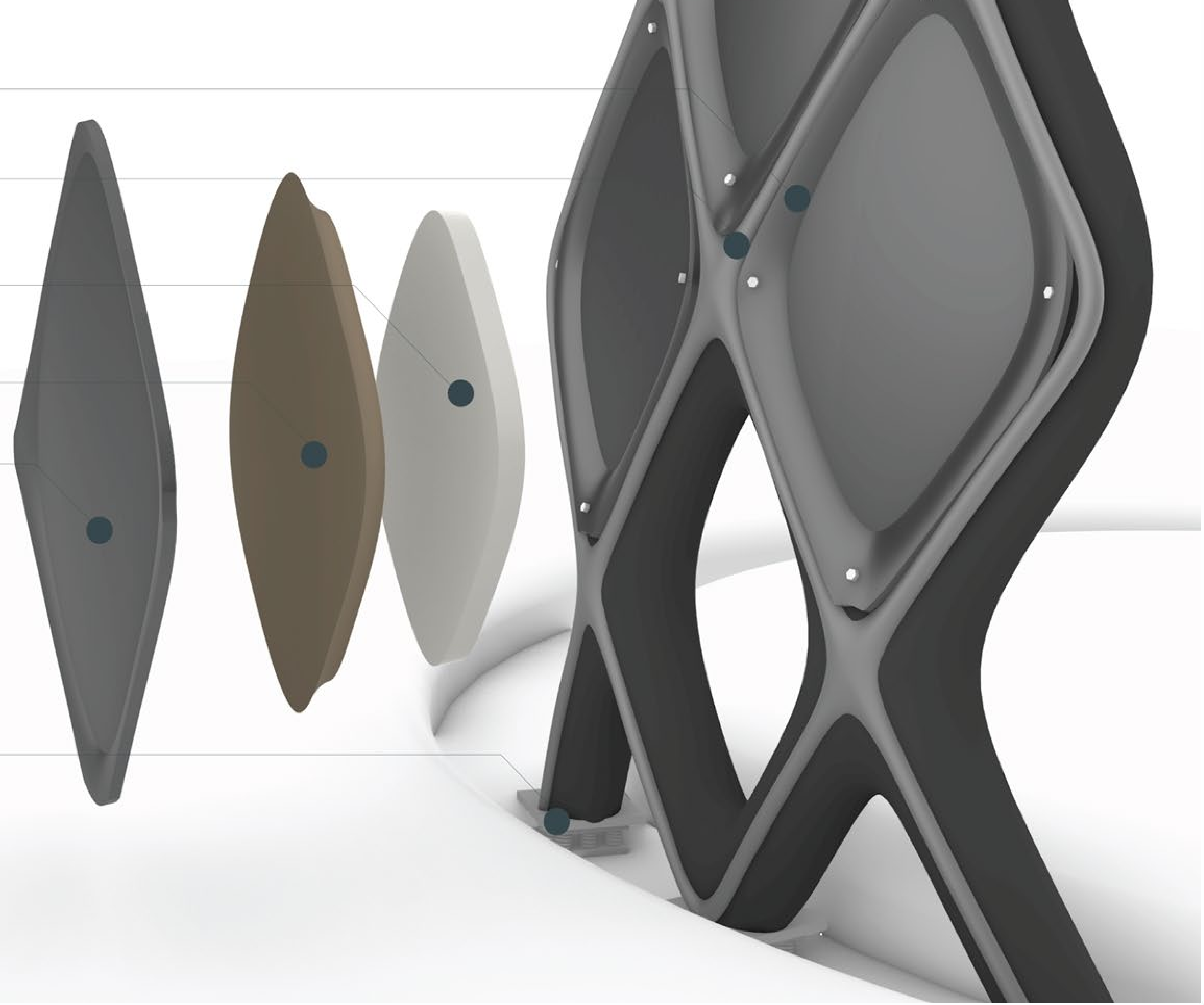


STRUCTURE

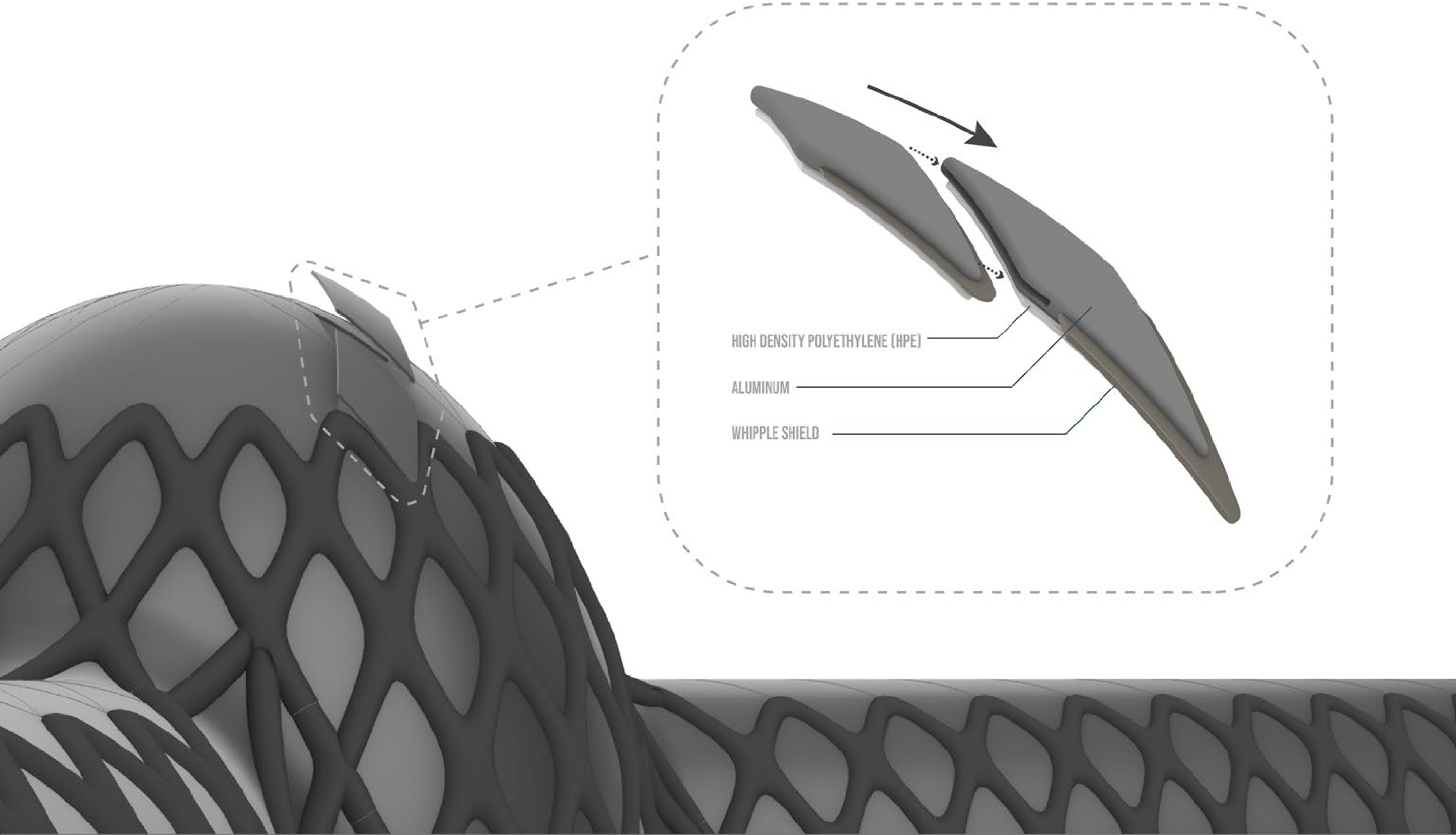
- HABITAT STRUCTURE
- HABITAT CONSTRUCTION
- MODEL LAYOUT
- MODEL CONSTRUCTION



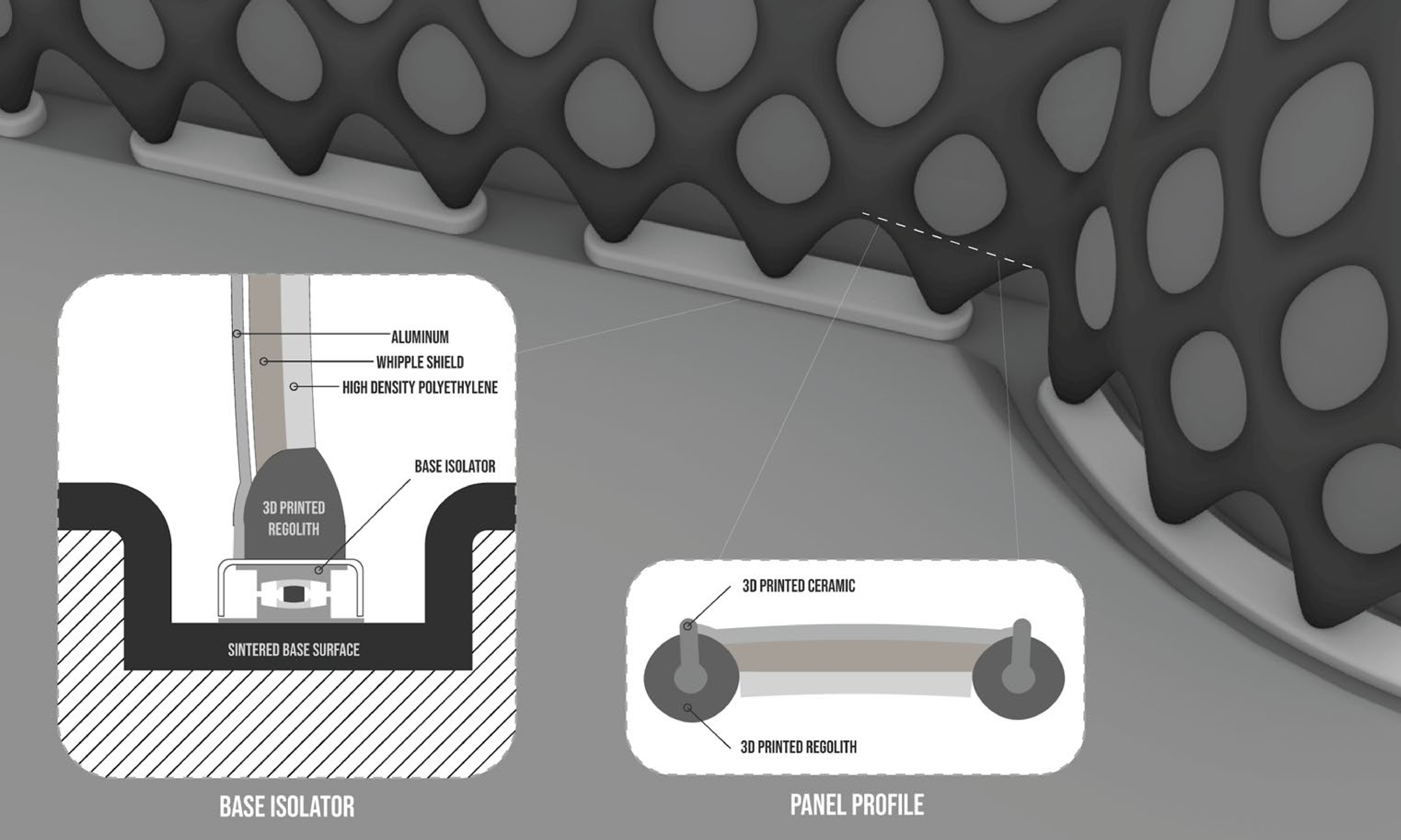
PANELING SYSTEM



CAPPING PANELS



DETAIL SECTIONS



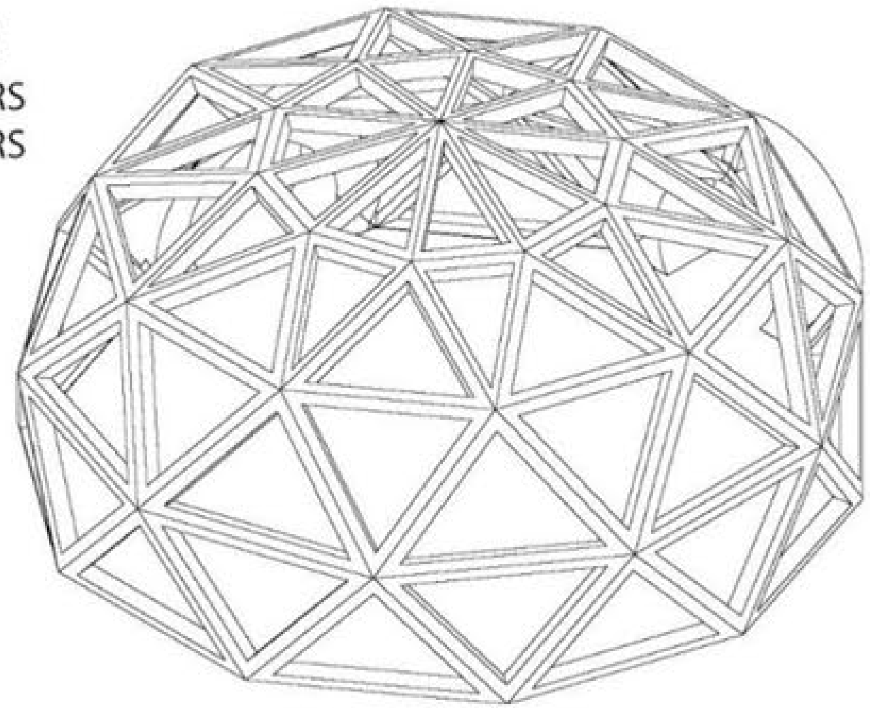
BASE ISOLATOR

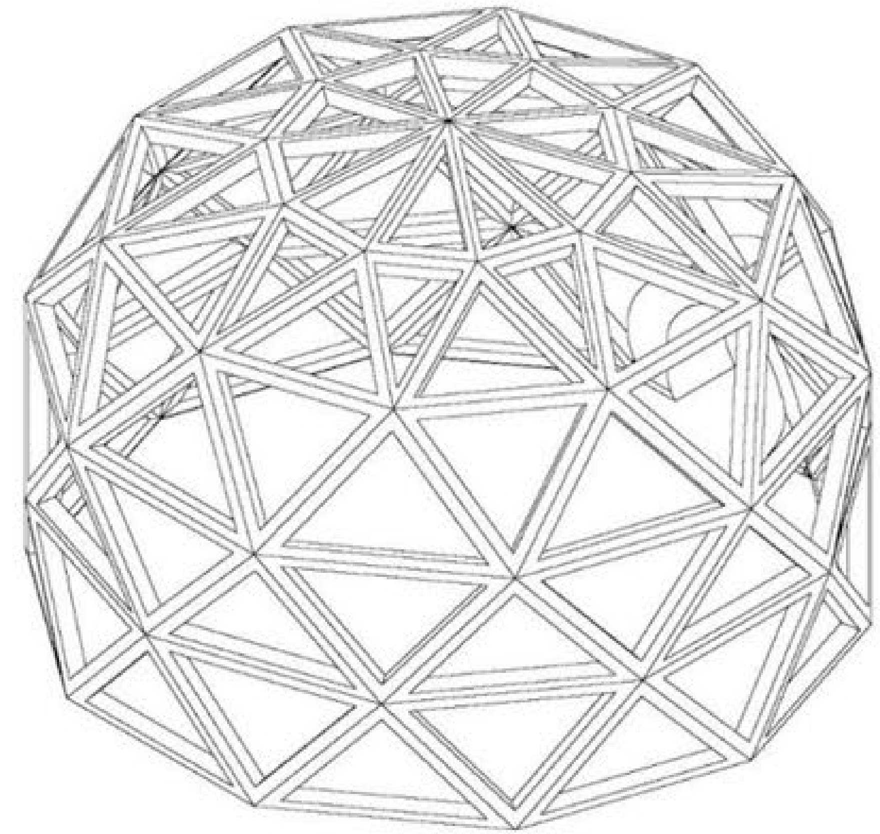
PANEL PROFILE

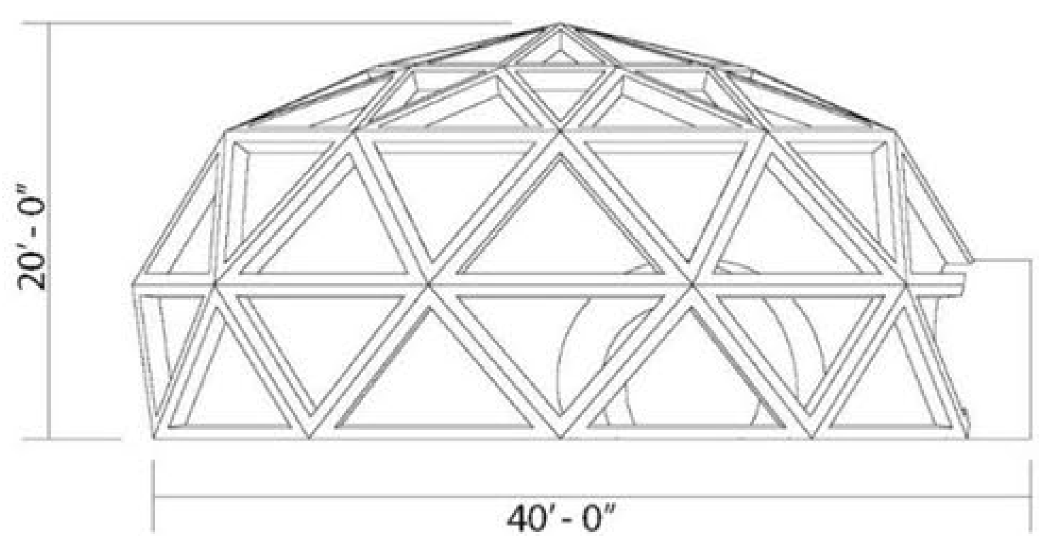
3D PRINTED REGOLITH

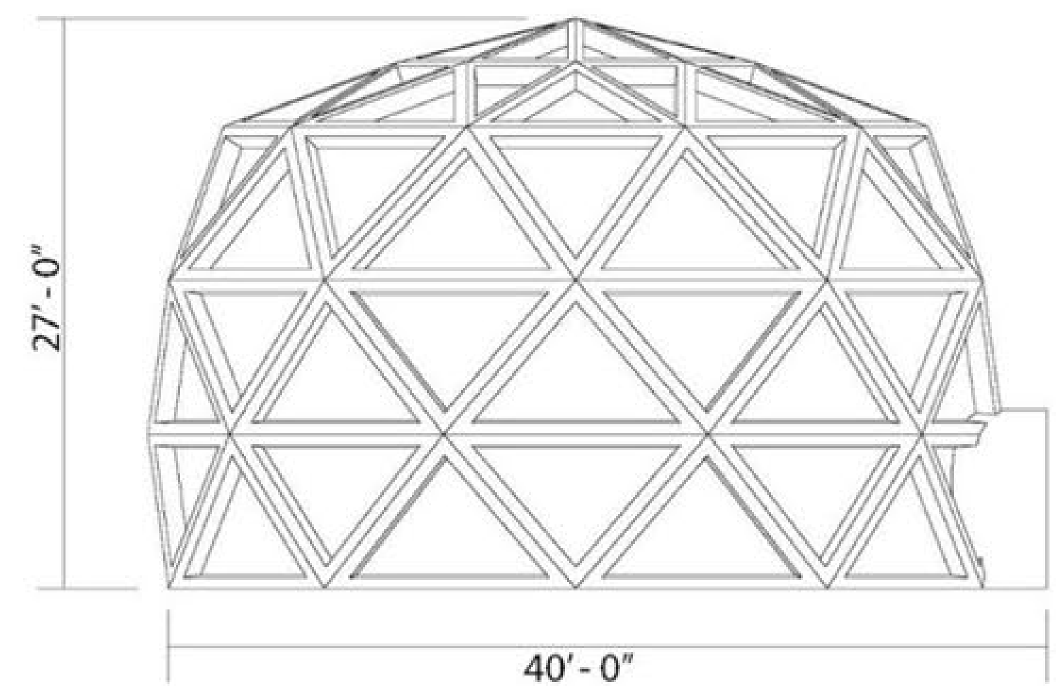
SOLID DOMES
1 STORY - 233 CUBIC METERS
2 STORY - 283 CUBIC METERS

GEODESIC DOMES
1 STORY - 32 CUBIC METERS
2 STORY - 37 CUBIC METERS

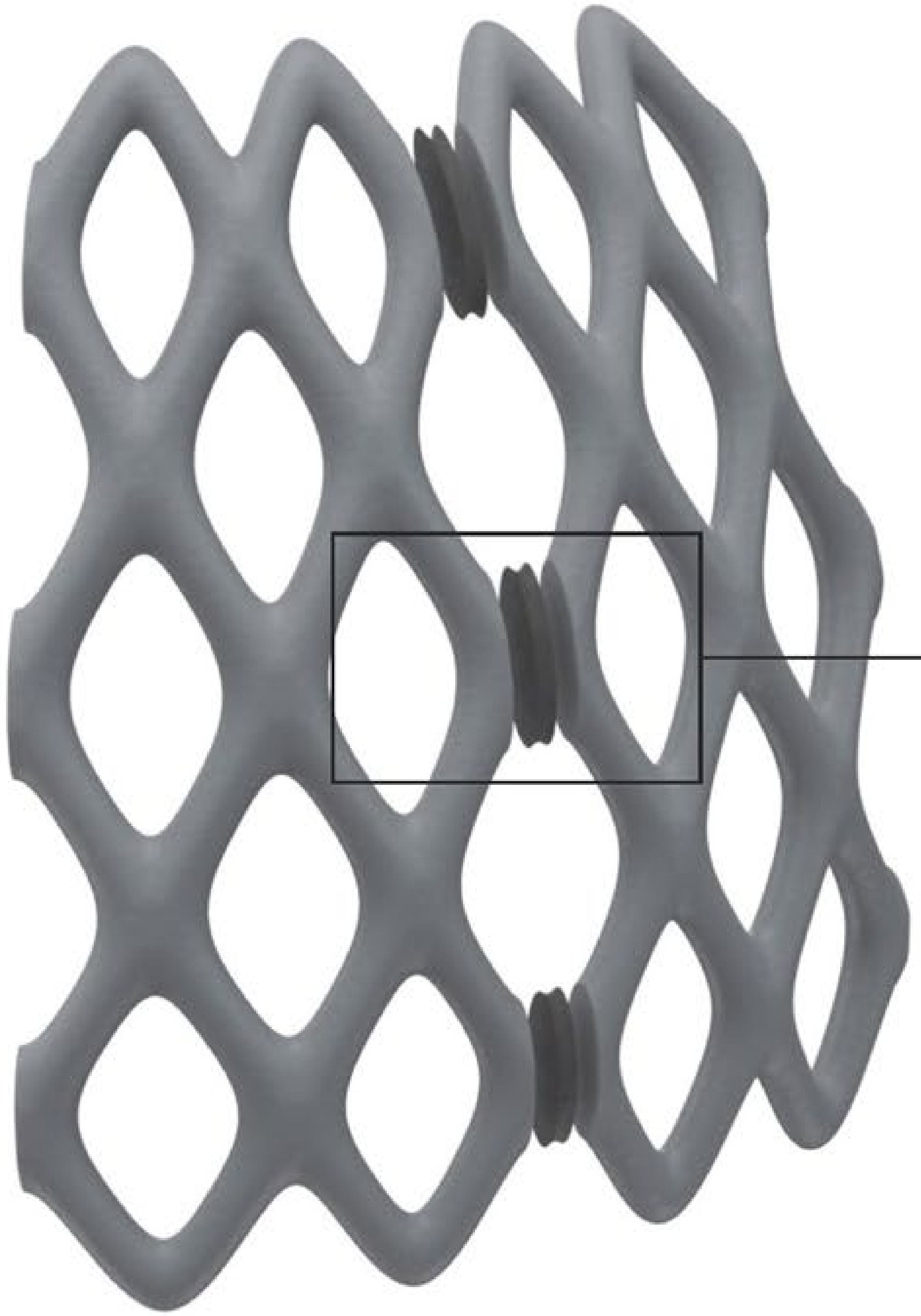


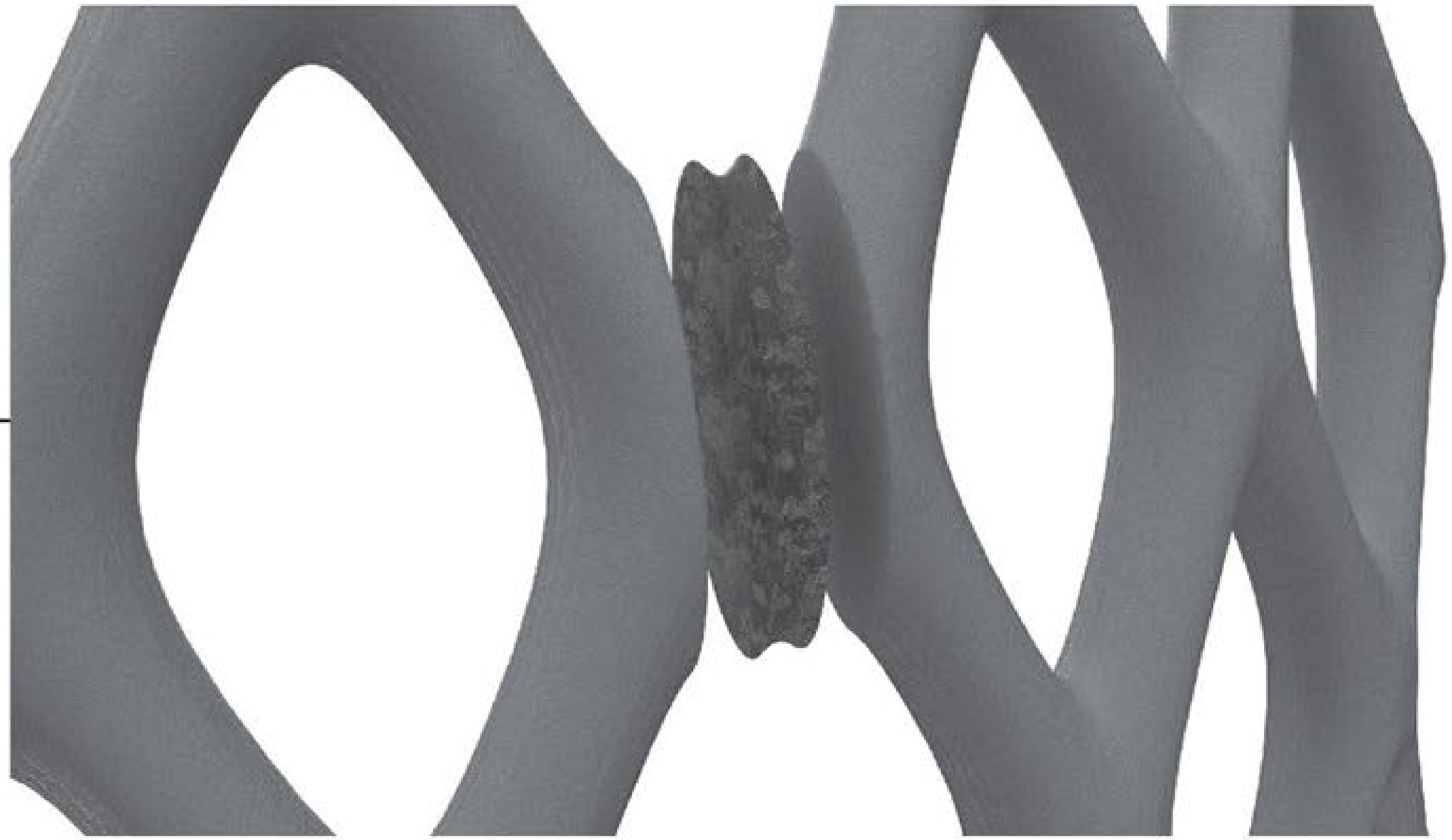






MATERIALITY



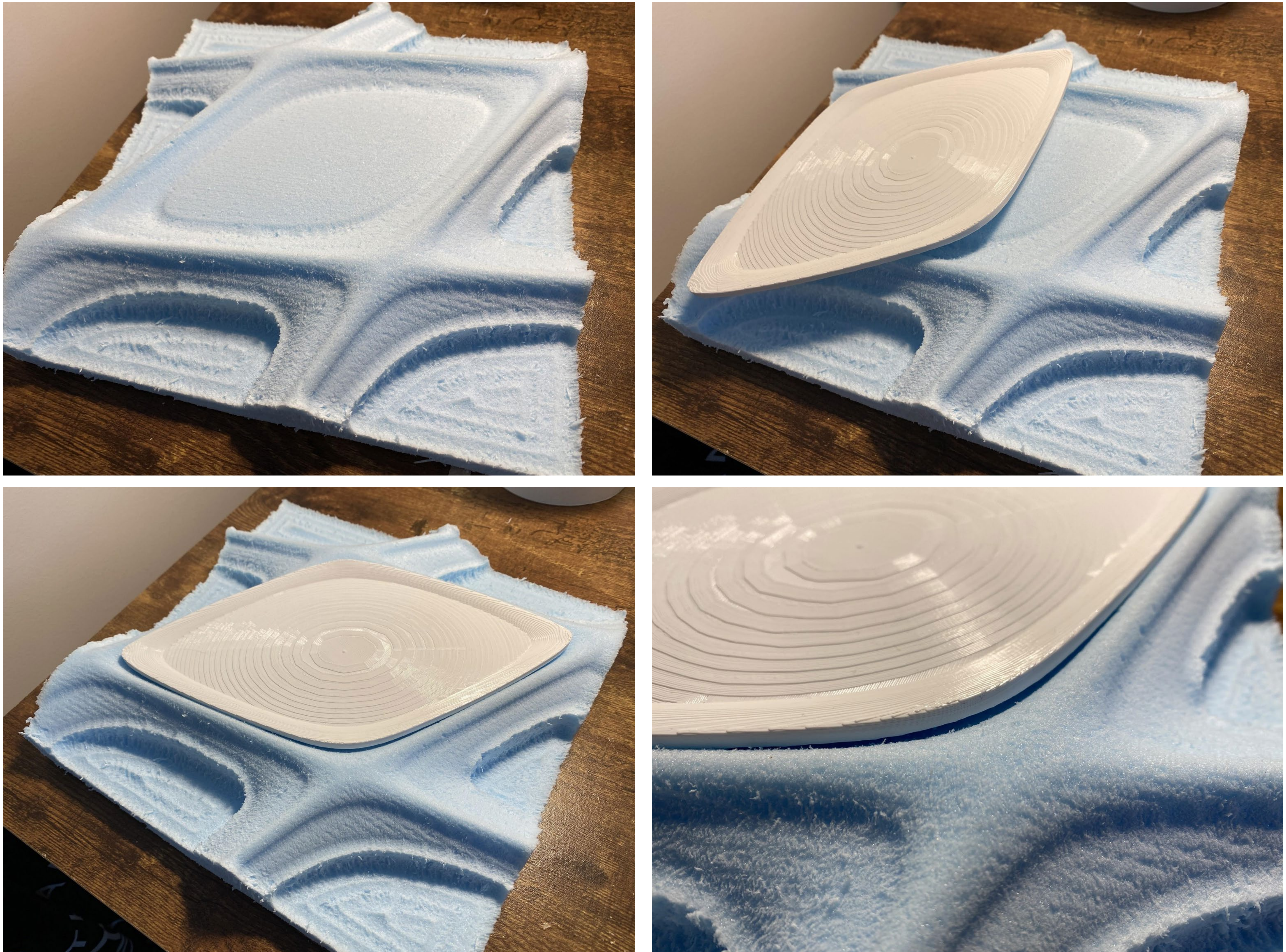


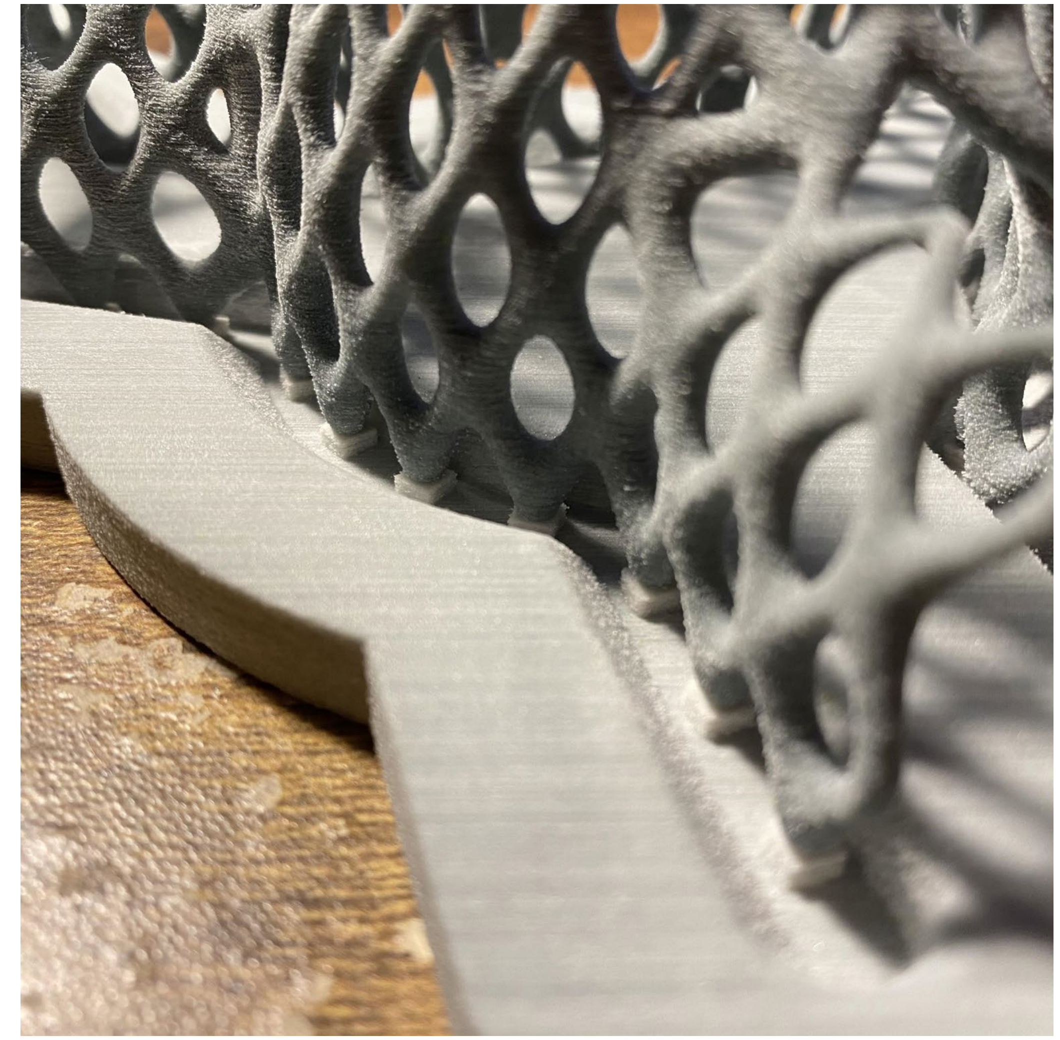
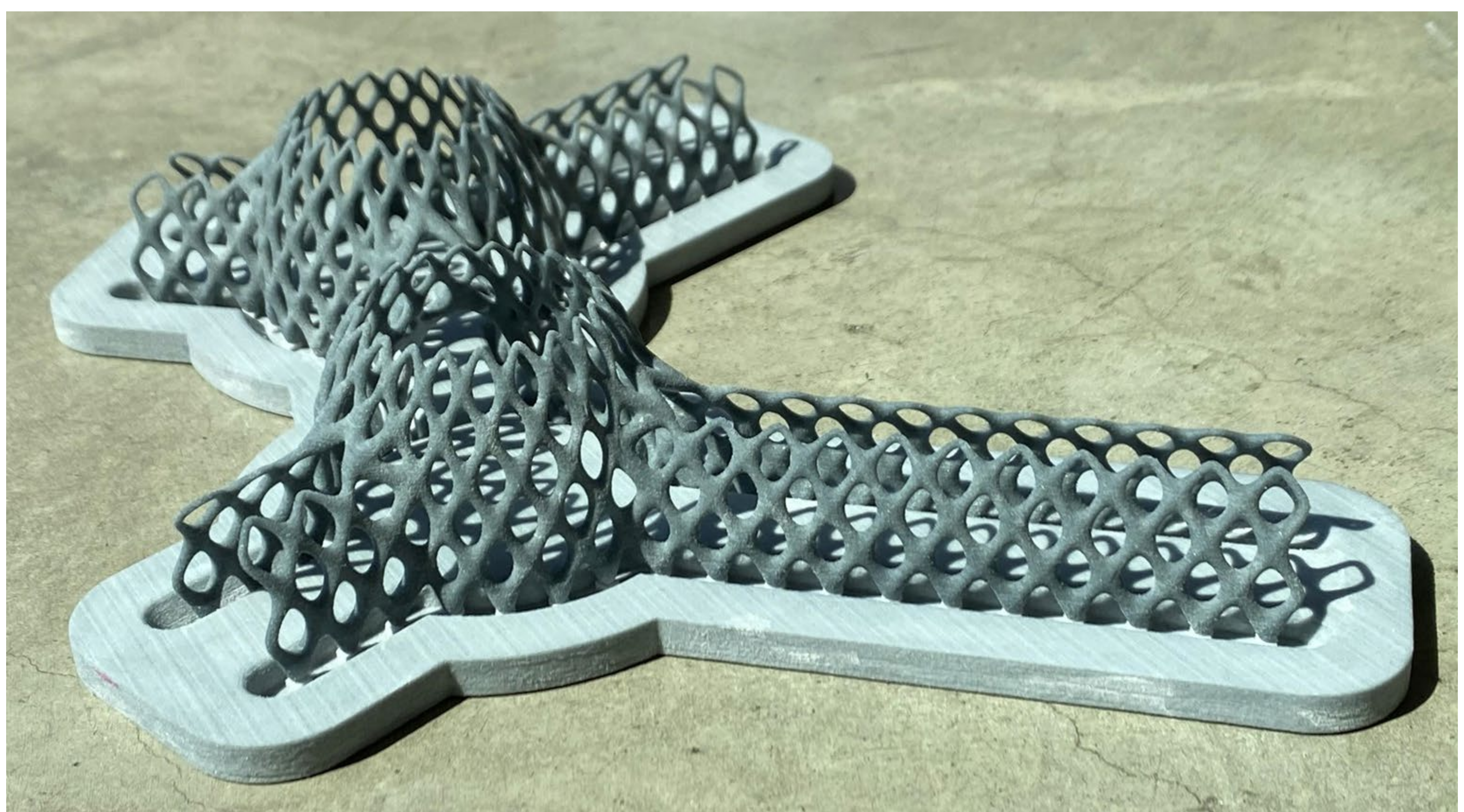
SINTERED LUNAR REGOLITH MIXED WITH SILICA ADDITIVES

-SILICA IS AMONG THE MOST ABUNDANT RESOURCES FOUND ON THE MOON
-MITIGATES HEAT EXTREMELY WELL
-THIS REDUCES THE THERMAL EXPANSION AND CONTRACTION OF THE STRUCTURE AS WELL AS PROVIDE INSULATION FOR THE INFLATABLE

FELT REUSABLE SURFACE INSULATION

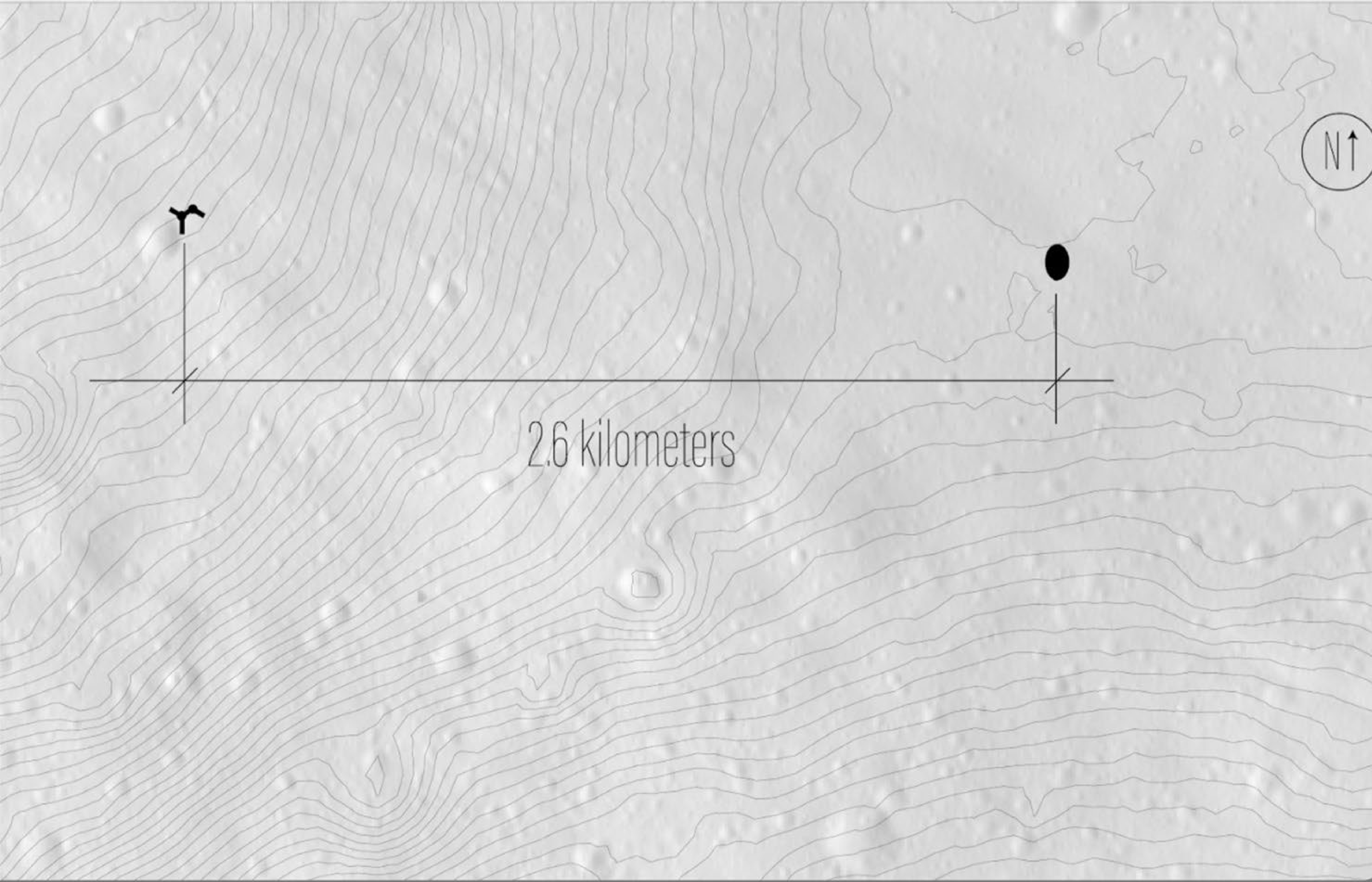
-CAN HANDLE THE TEMPURATURE FLUCTUATION ON THE MOON
-IT IS A RELATIVELY CHEAP AND LIGHT MATERIAL THAT CAN BE BROUGHT FROM EARTH
-IT WILL SERVE AS THE EXPANSION JOINT FOR THE STRUC-TURETO REDUCE CRACKING FROM SEISMIC ACTIVITY



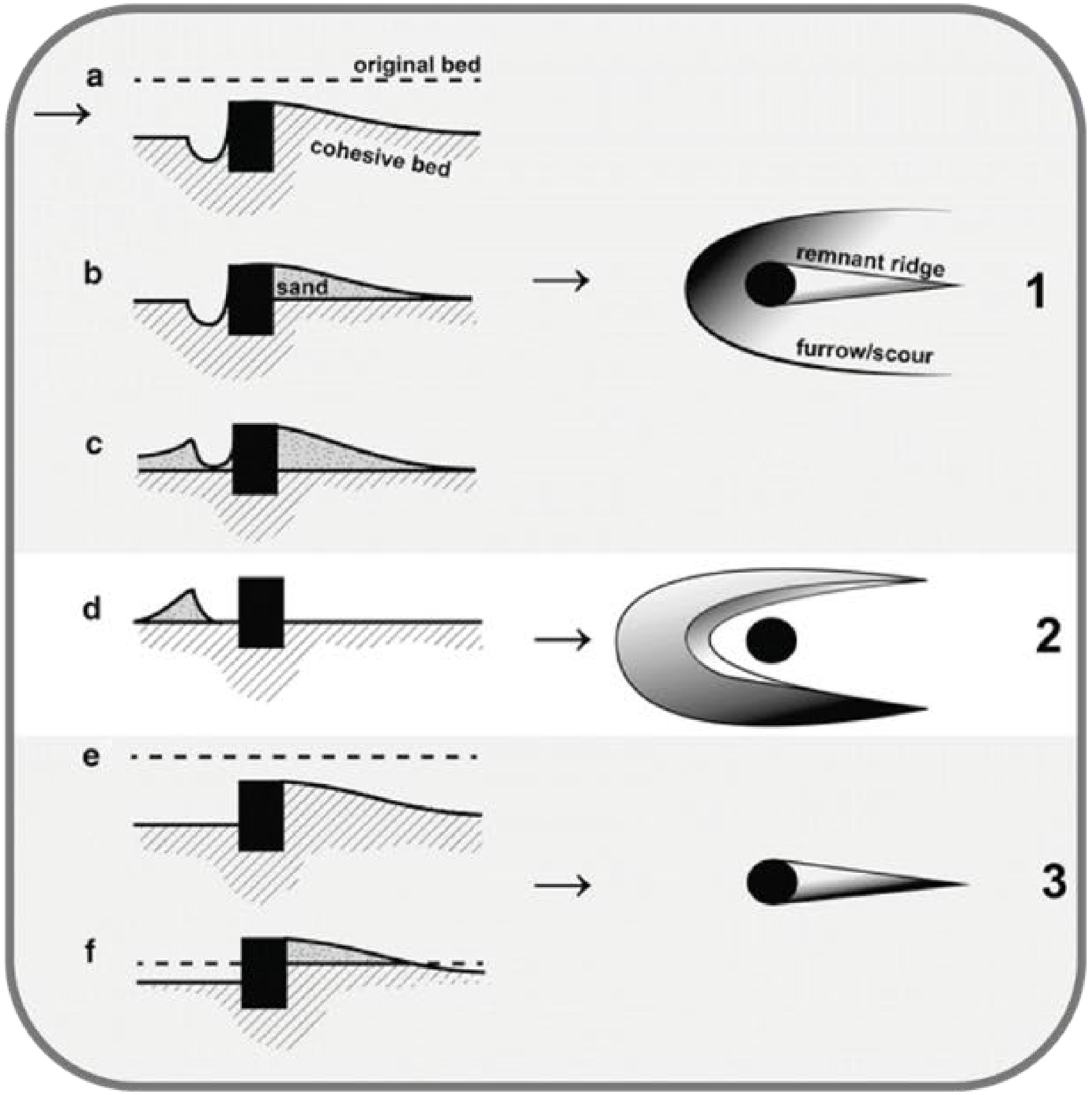




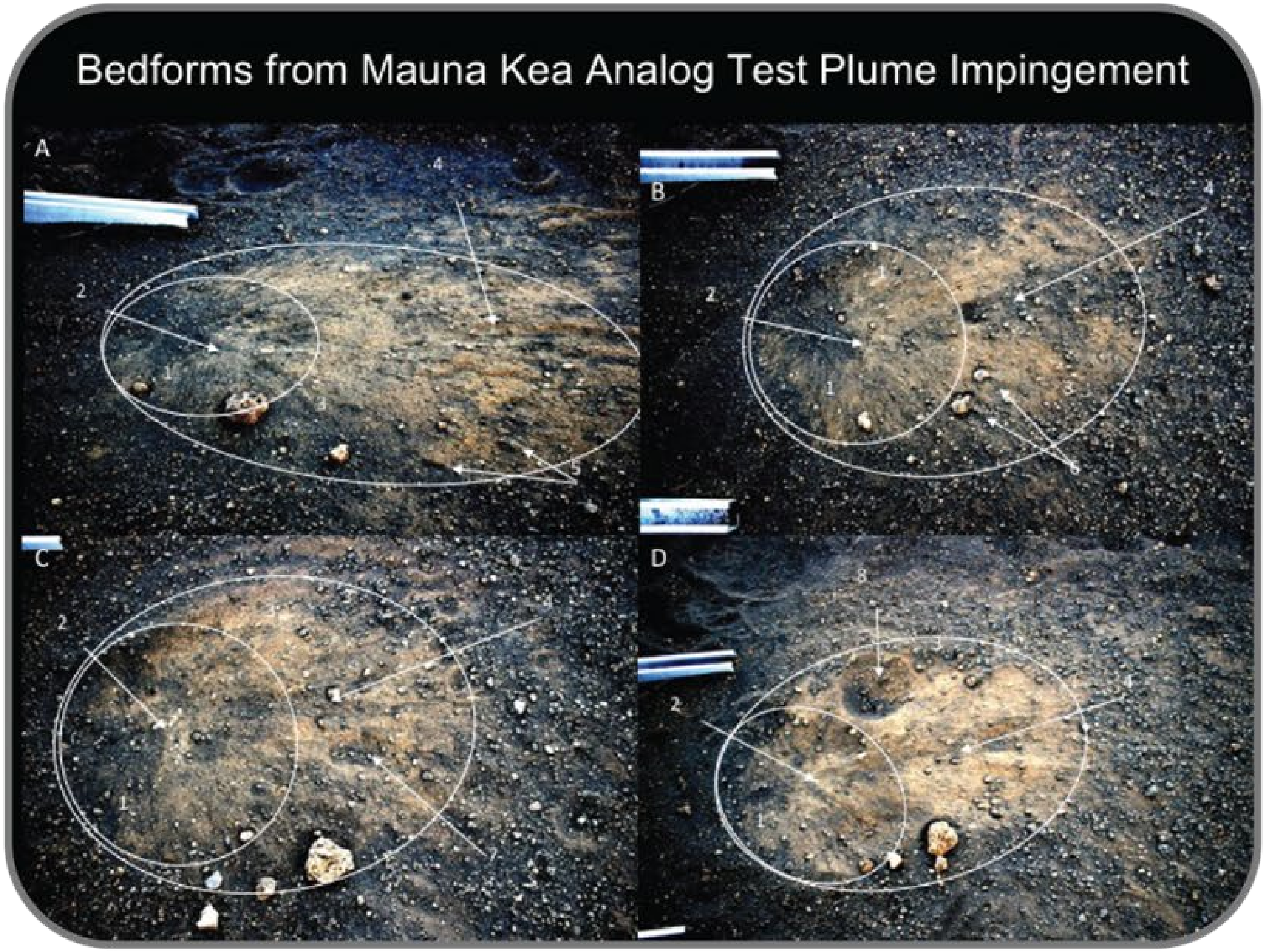

LANDING PAD

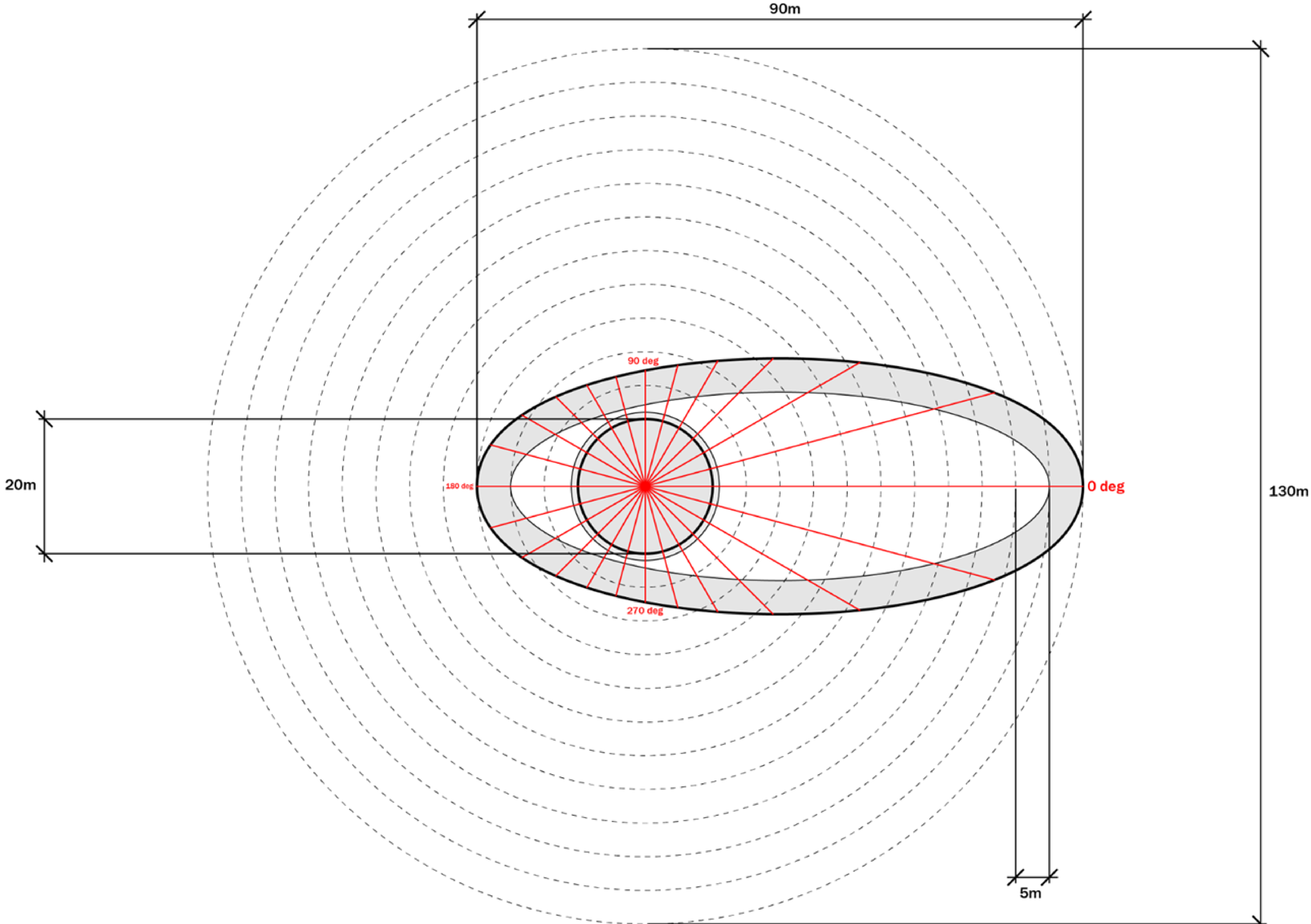
- SECTION CUTS
- ITERATION THROUGH MODELING
- SHEET METAL GROUND INSERTS
- “MUSGUM” TYPOLOGY
- MODEL CONSTRUCTION

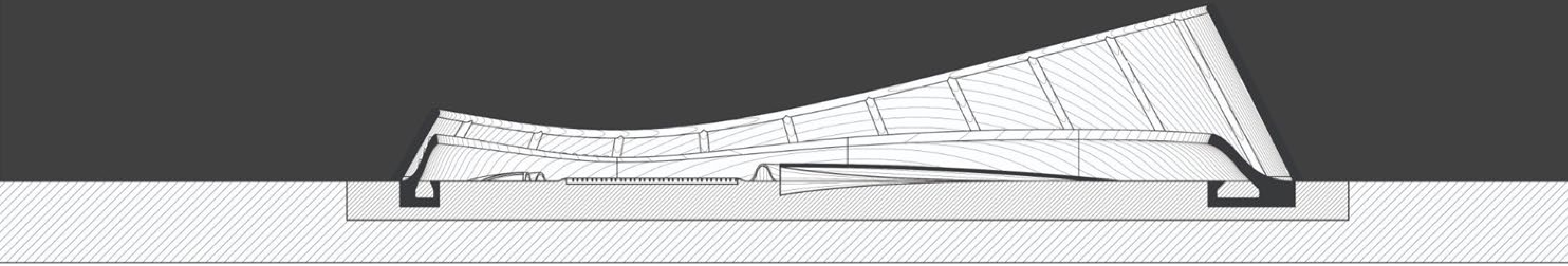

N
2.6 kilometers

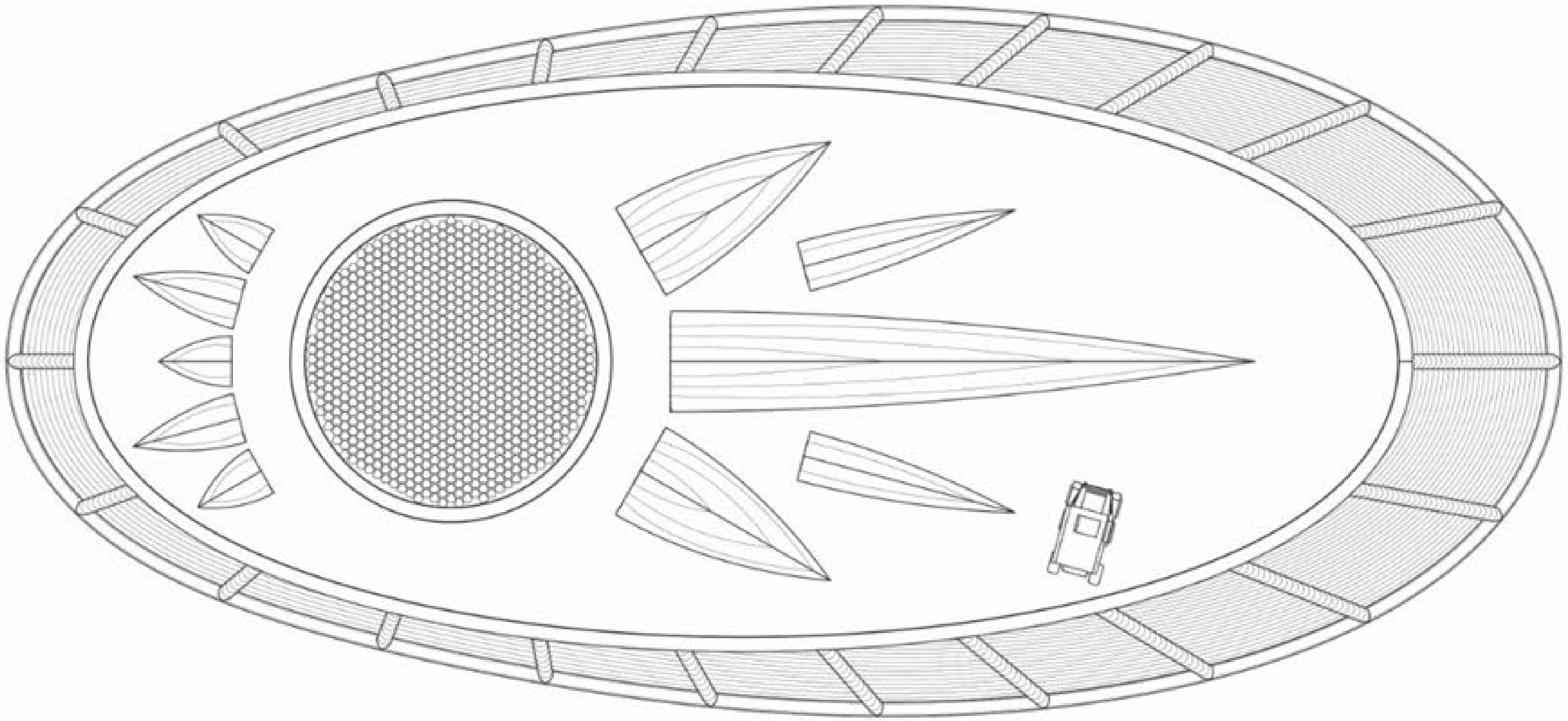
PRECEDENT


a
original bed
cohesive bed
b
sand
remnant ridge
furrow/scour
1
c
d
2
e
3
f

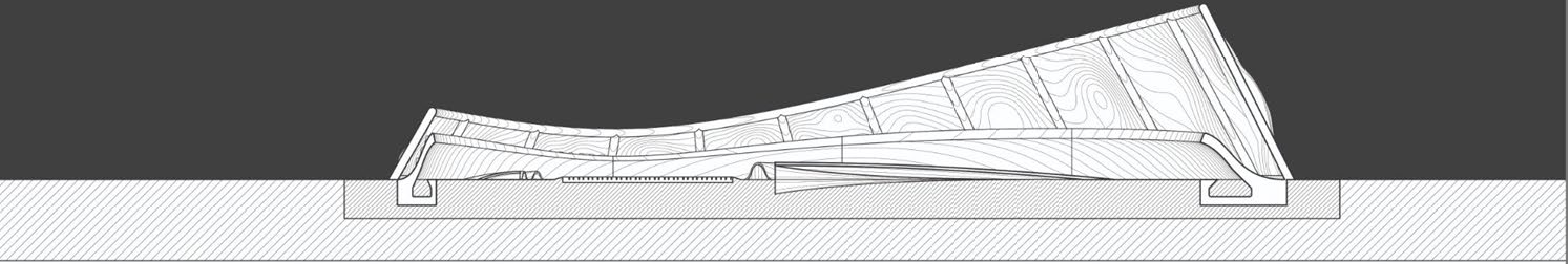

Bedforms from Mauna Kea Analog Test Plume Impingement
A
B
C
D

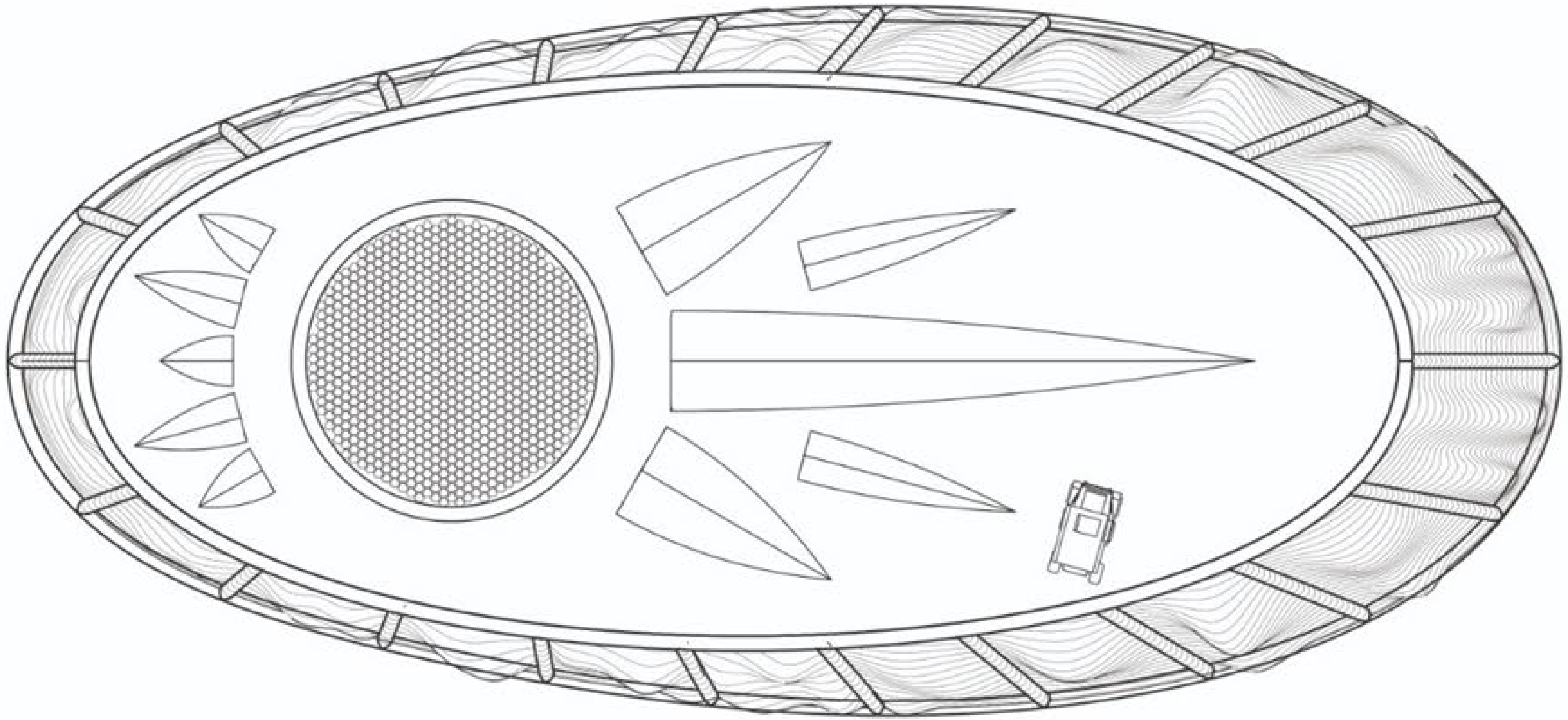

90m
130m
20m
5m
90 deg
180 deg
0 deg
270 deg



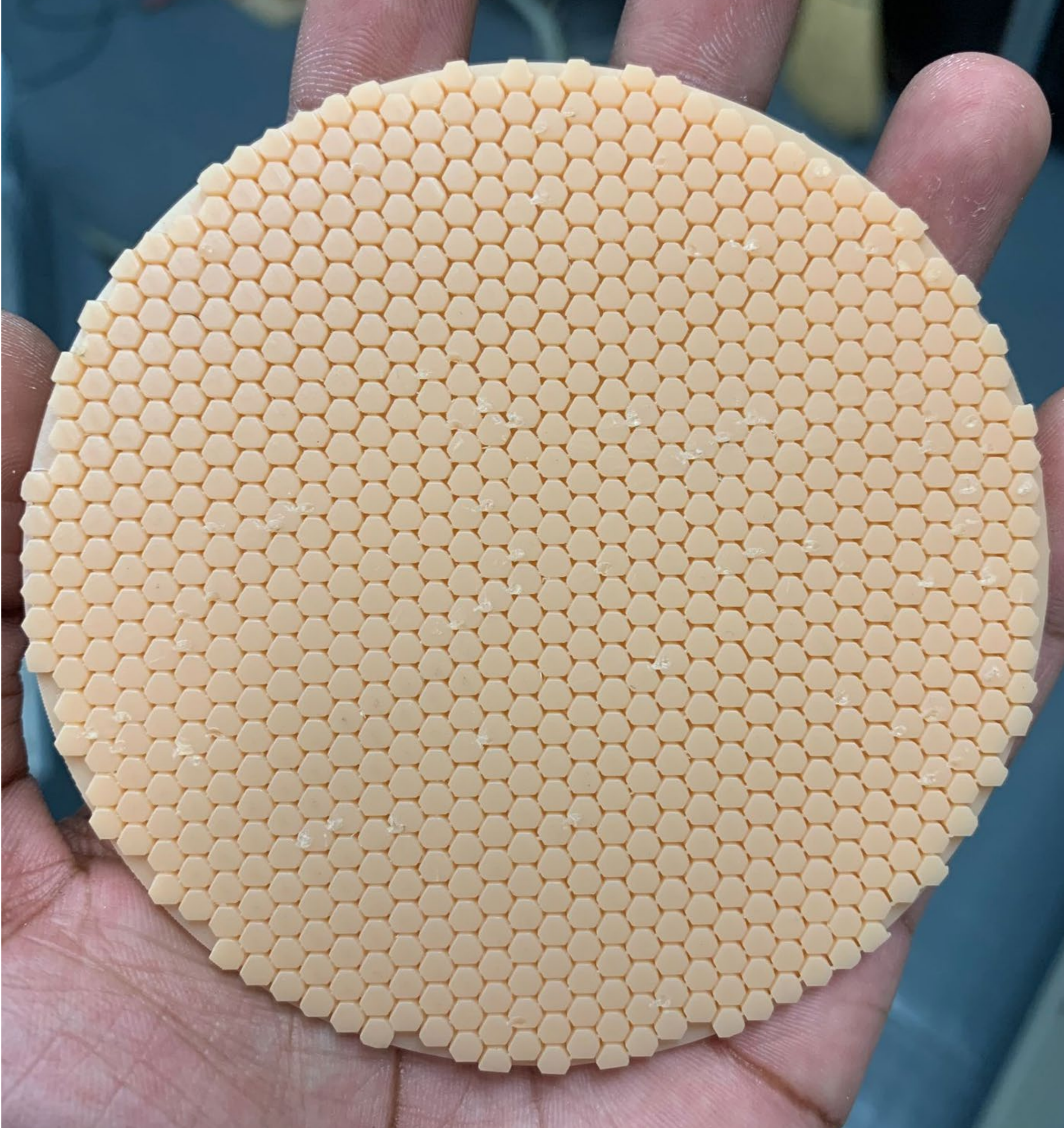


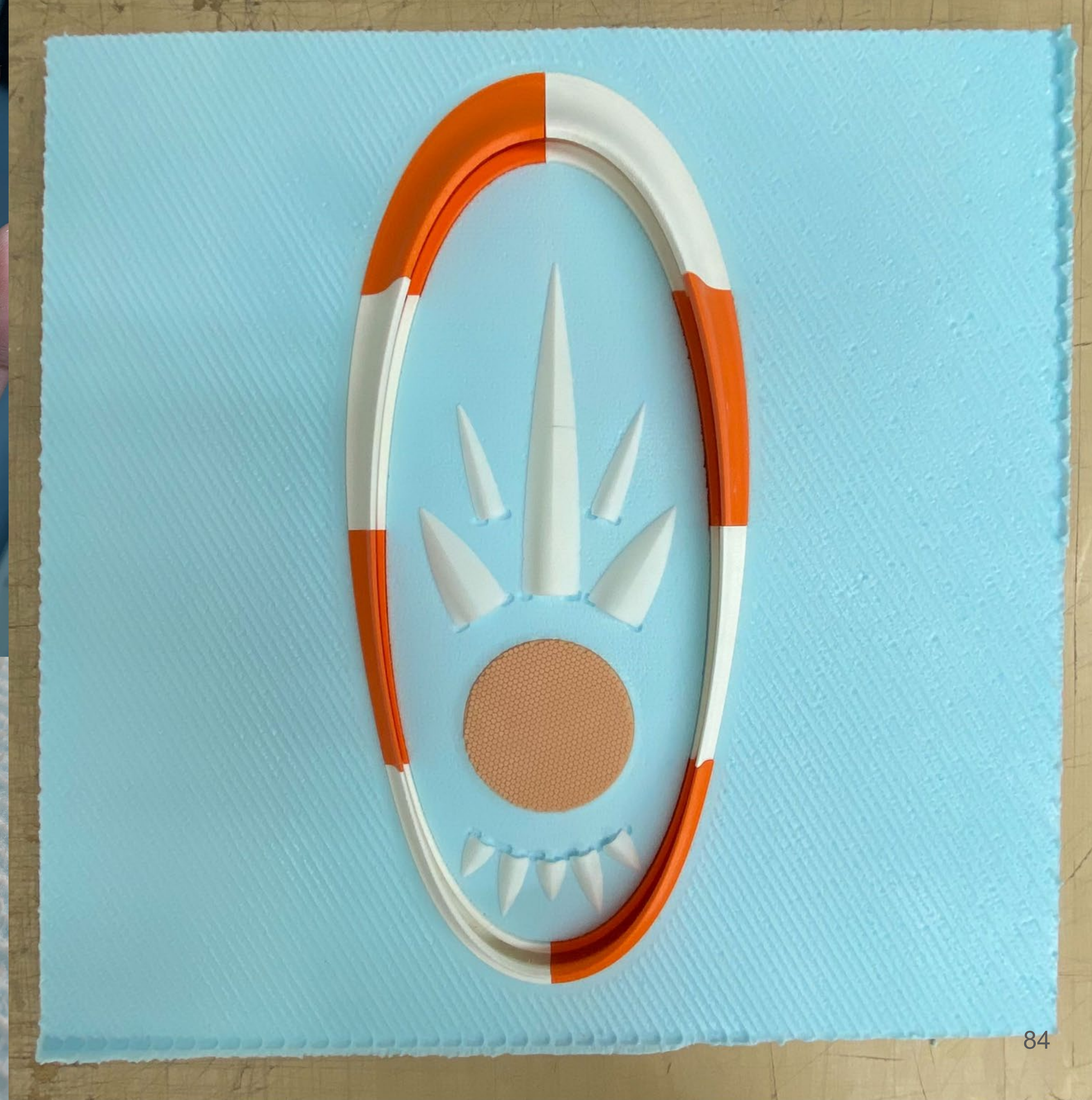
LANDING PAD: PLAN // SECTION

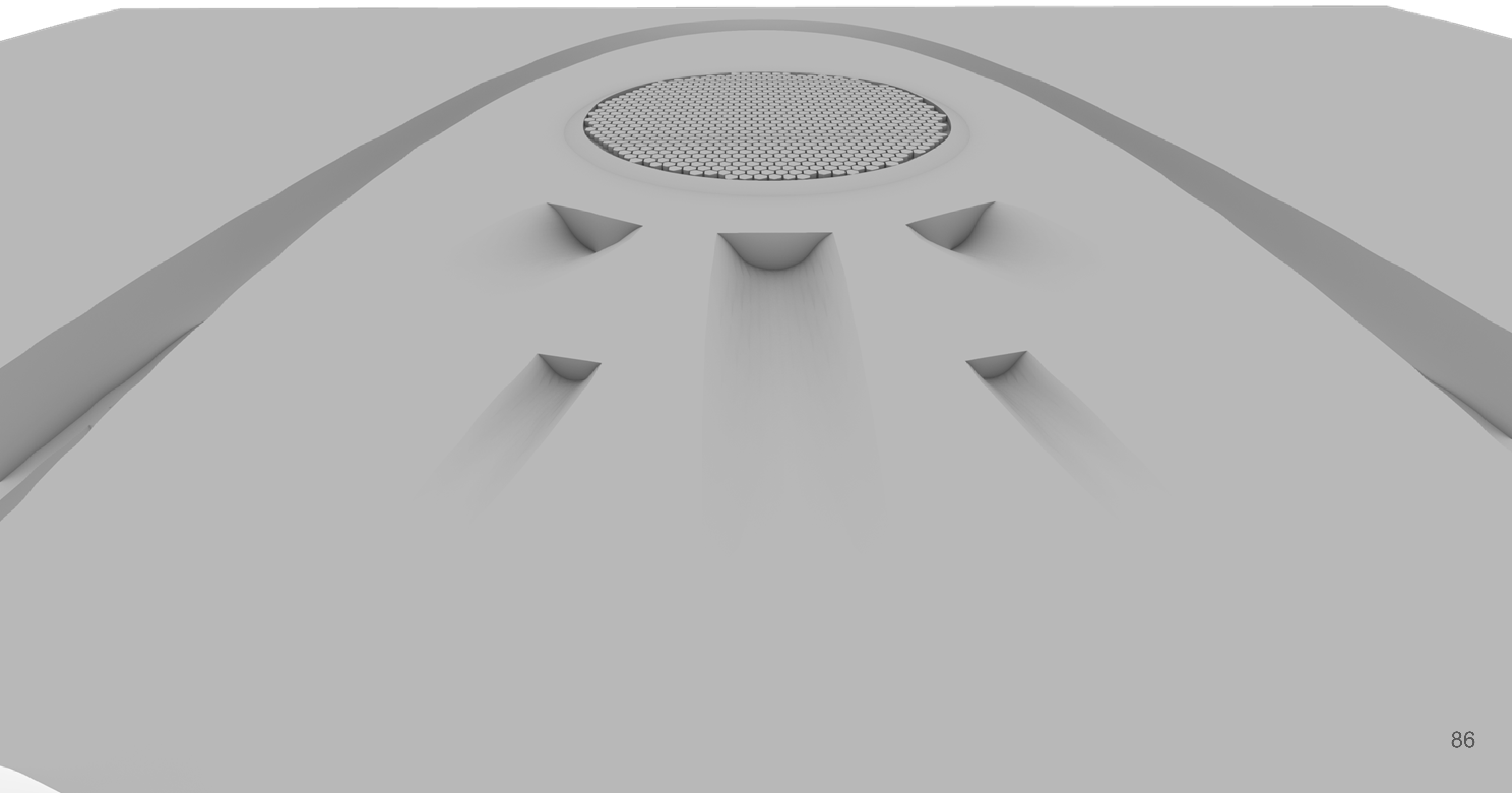


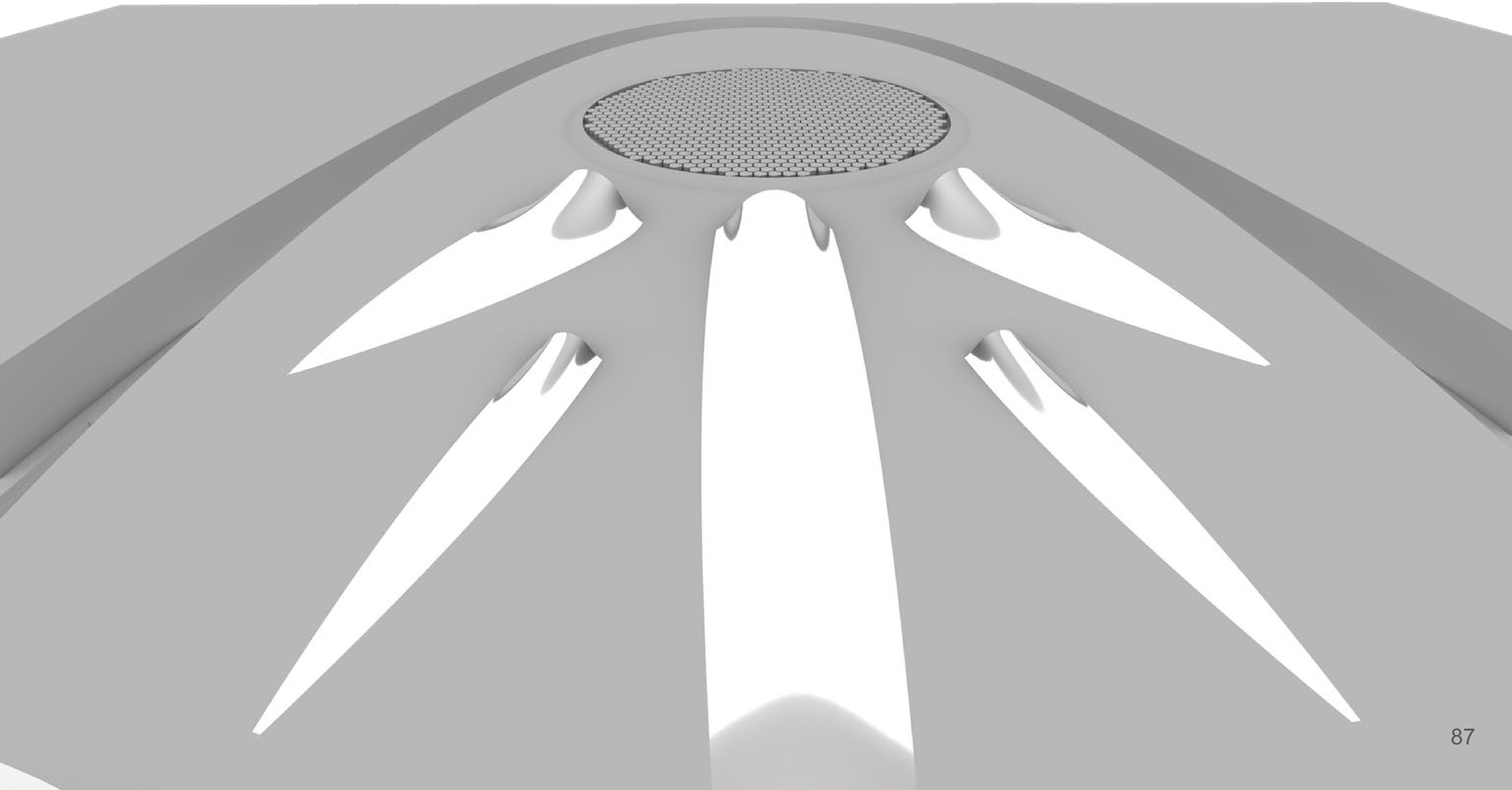


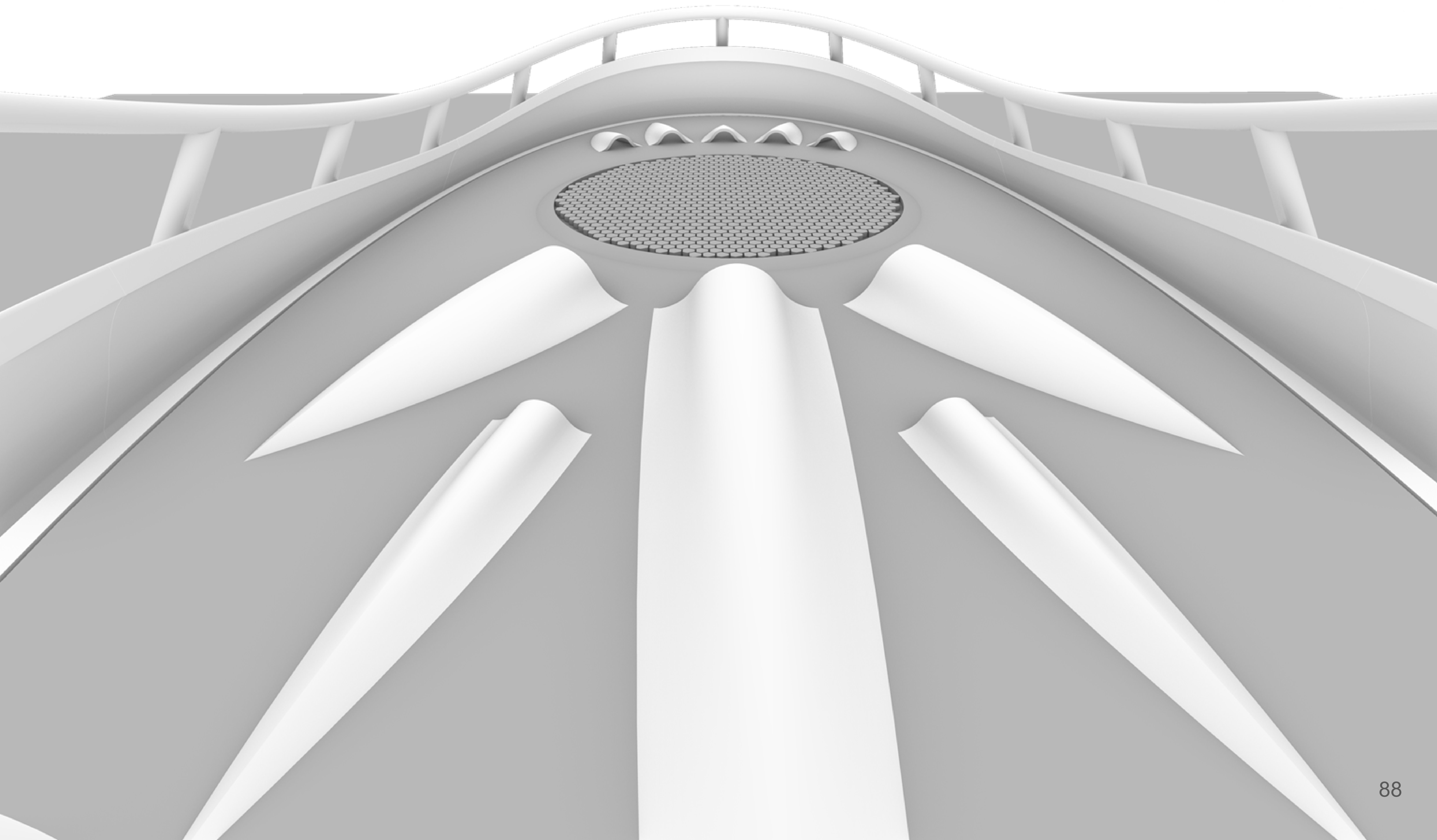
LANDING PAD: DEFLATED PLAN // SECTION

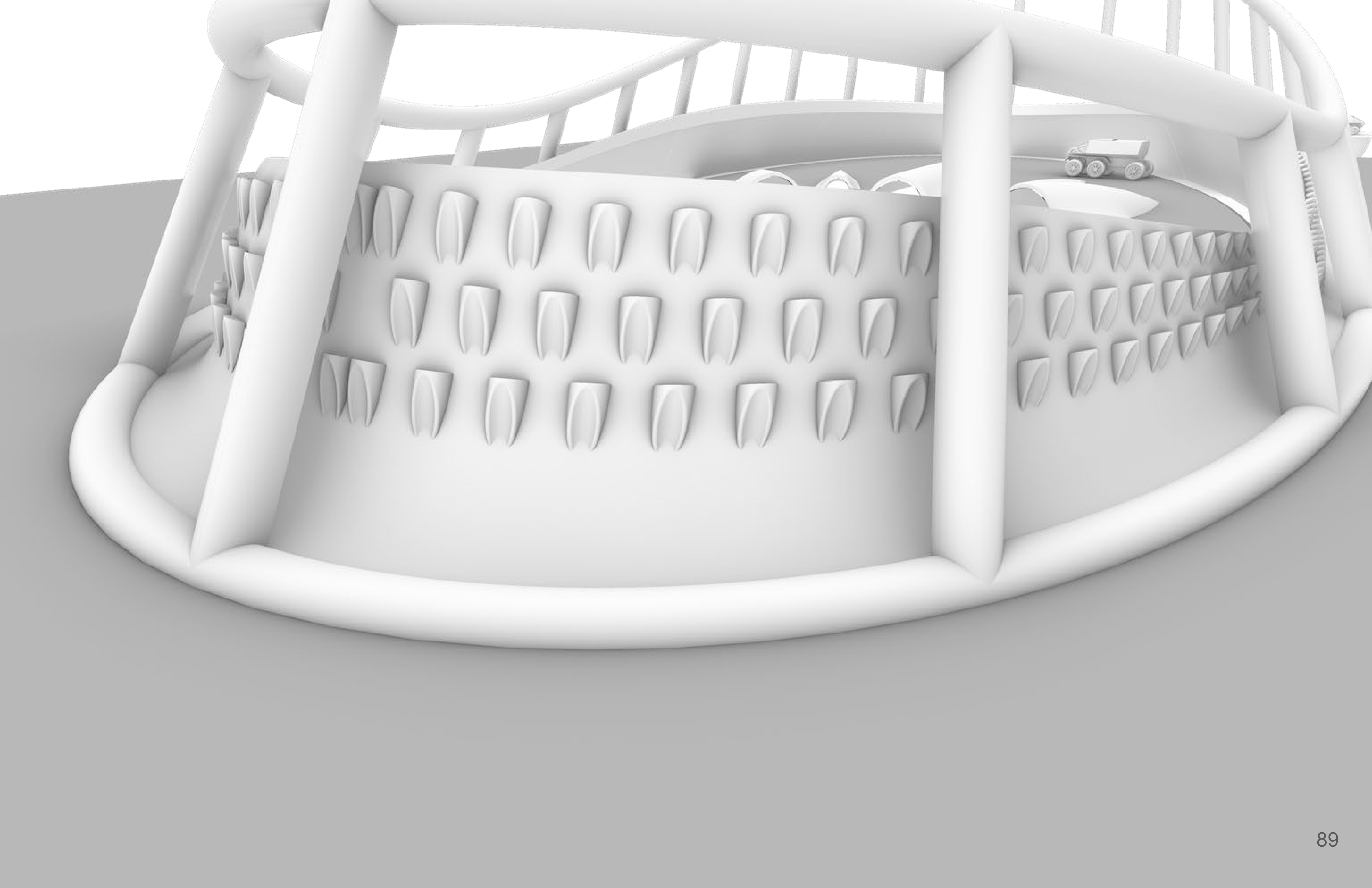


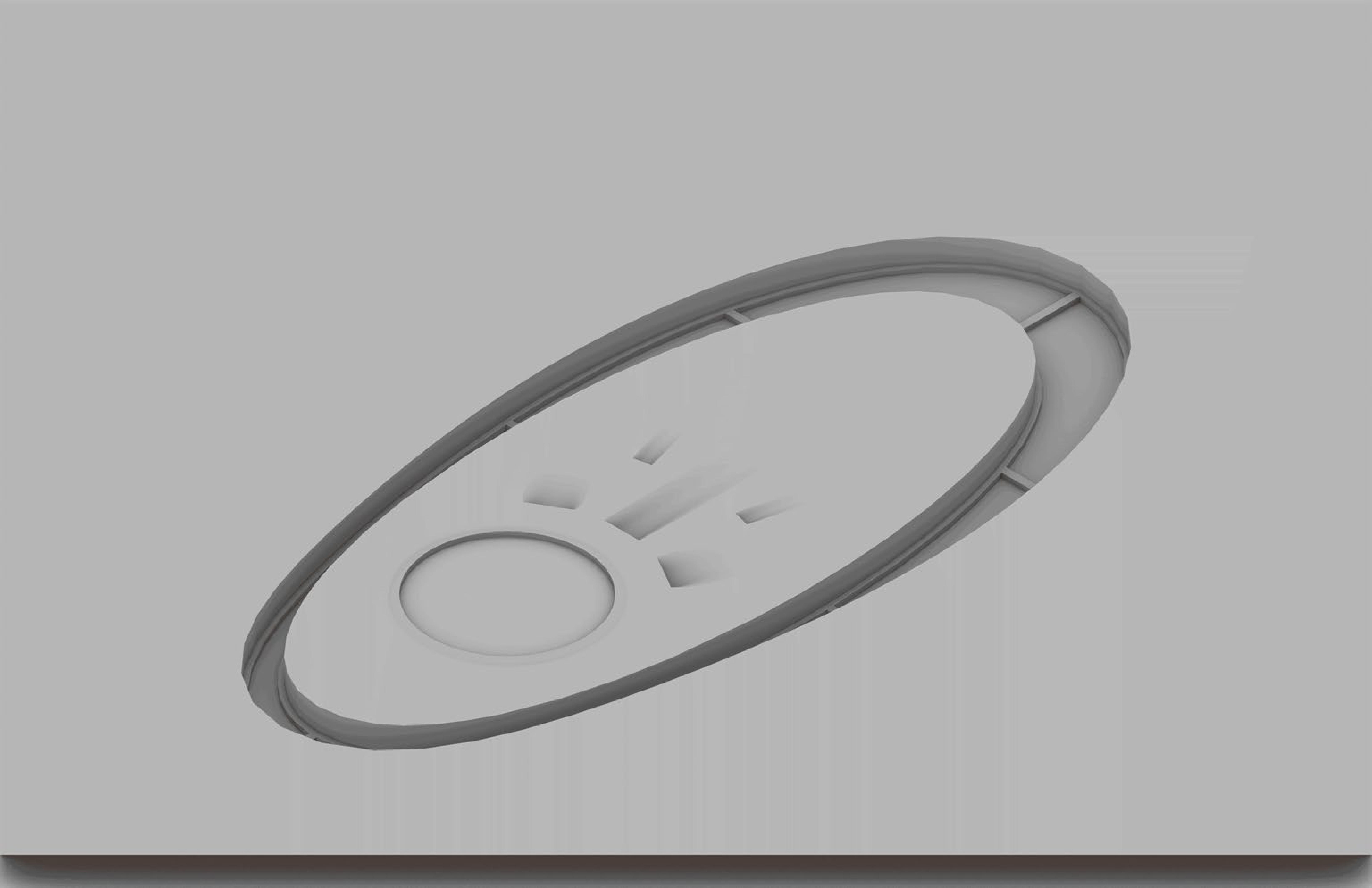


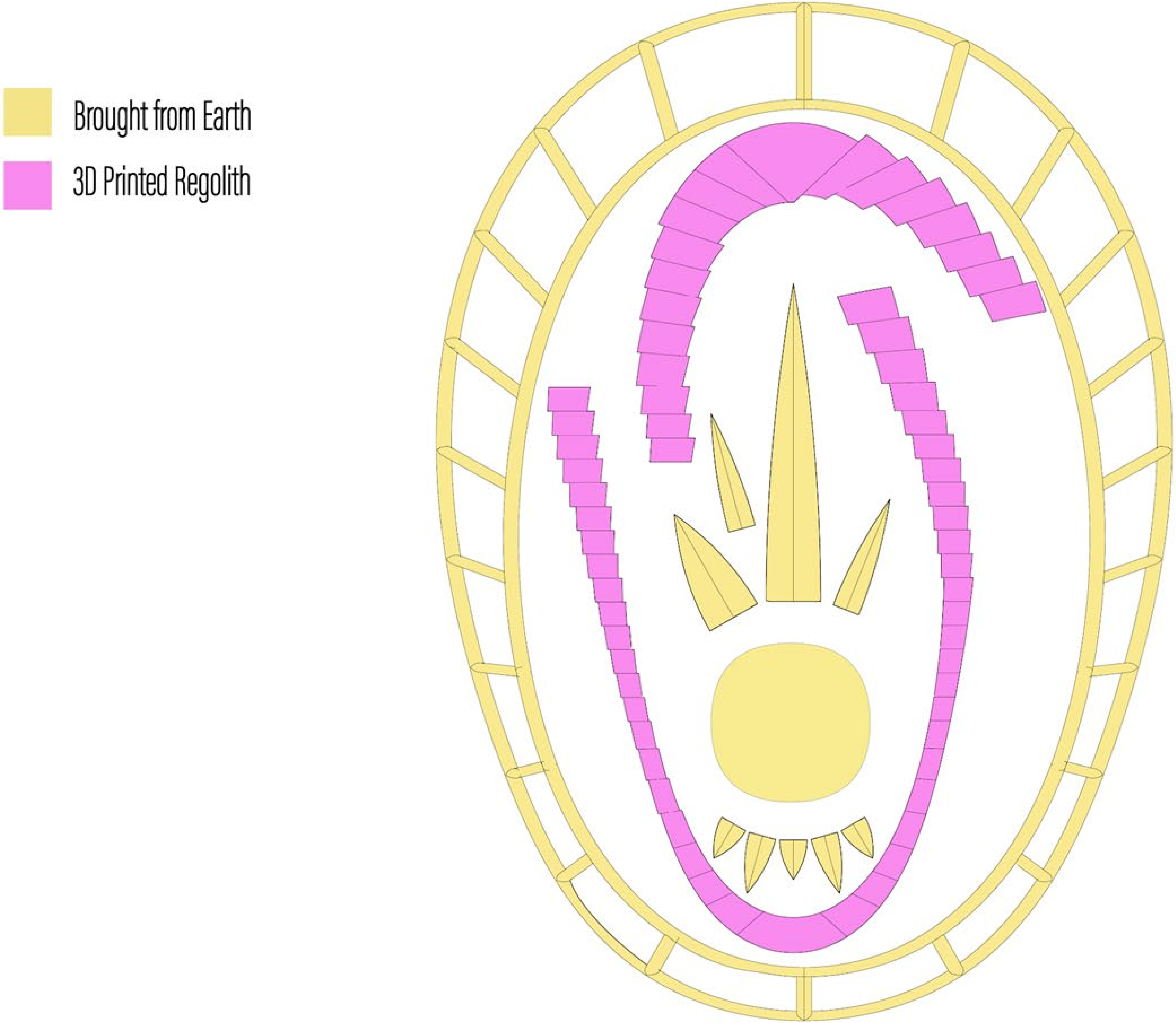



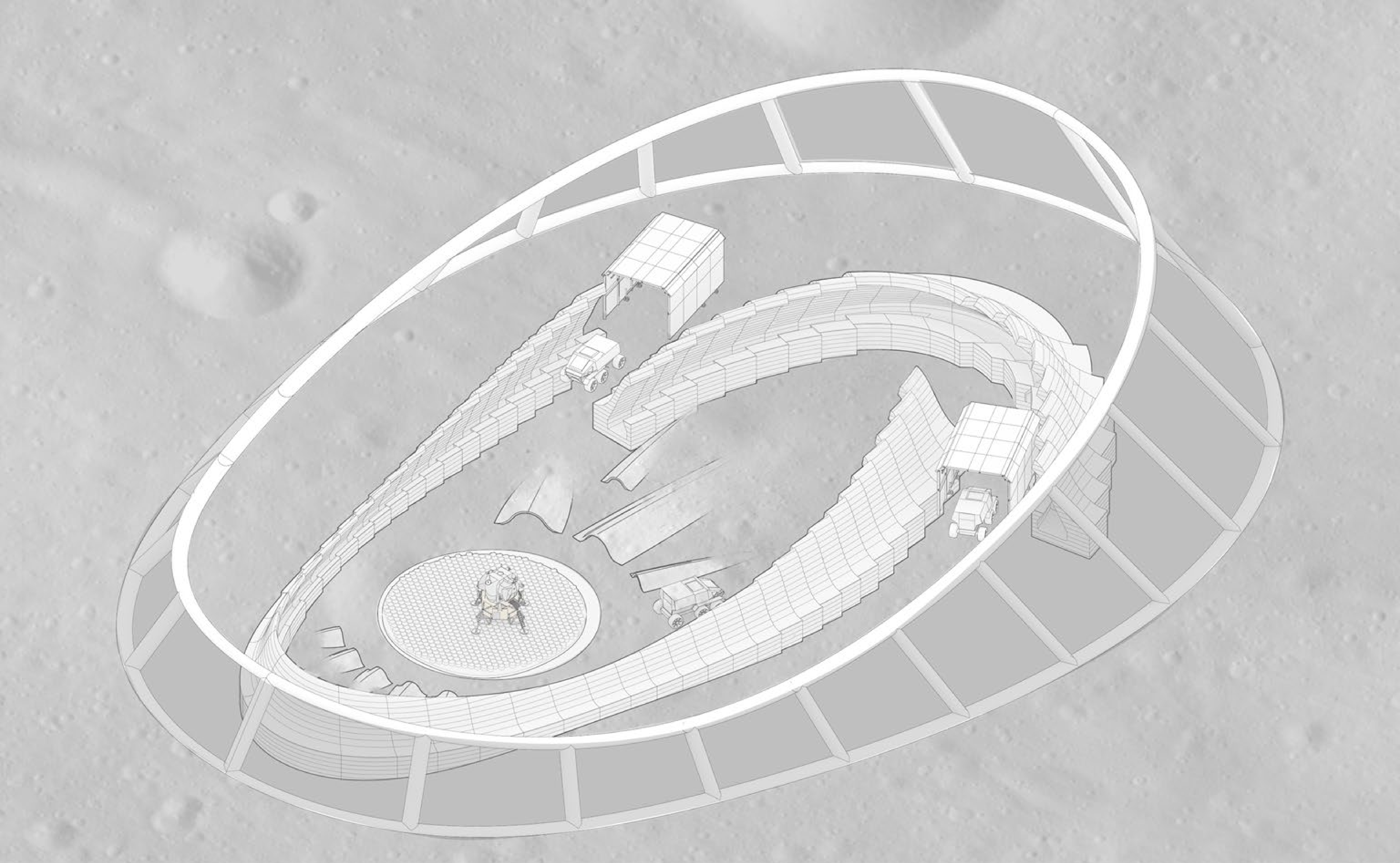









Brought from Earth
3D Printed Regolith



BUDGET & SCHEDULE

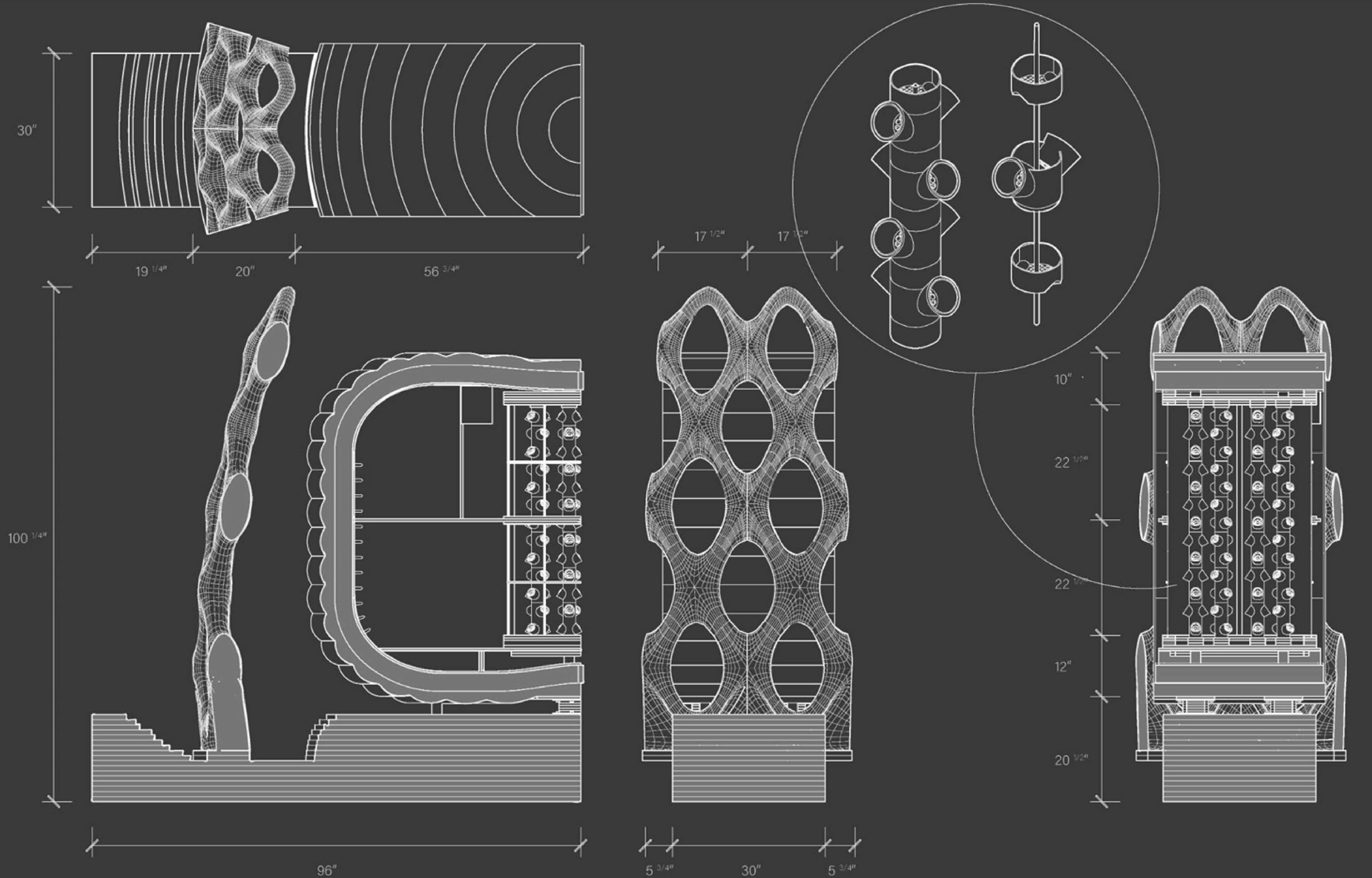
- PROJECT OVERVIEW
- PROJECT BUDGET OVERVIEW

	Start	End	2/25	3/1	3/4	3/8	3/11	3/15	3/18	3/22	3/25	3/29	4/1	4/5	4/8	4/12	4/15	4/19	4/22	4/26	4/29
Research/Development																					
Design Development	2/25	3/11																			
Material Selection	2/25	3/8																			
Protoyping	3/1	3/18																			
Material Sourcing	3/8	3/15																			
Sectional Detail Development	3/11	3/25																			
Physical Production Start																					
Construction	3/25	4/26																			
Construction: Frame	3/25	4/1																			
Construction: Interior	4/5	4/12																			
Construction: Details	4/15	4/26																			
Construction: Final Wrapup	4/22	4/26																			
Final Documentation																					
Physical Documentation	4/8	4/26																			
Drawing Development	4/8	4/26																			
Presentation Development	4/15	4/29																			
Review																					
Estimated Final Review Date		5/6																			

Name	Item	Description	Quantity	Receipt (Y/N)	Unit Cost	Total Cost	Tax	Delivery/Shipp	Total Cost of Transaction
EJ Maxwell	Ultimaker NFC PC - Black	0.75k 2.85m pc filiment	1	Y					
	Ultimaker NFC Tough PLA - White	0.75k 2.85m pla filiment	2	Y					
	Ultimaker NFC PLA - Yellow	0.75k 2.85m pla filiment	1	Y					
	Ultimaker NFC PLA - Blue	0.75k 2.85m pla filiment	1	Y					
	Birch Plywood Milling	Birch Plywood 1" X 4 X 8 VC	14	Y					
	Birch Plywood Milling	RIP Plywood 1" X 2'6" X 8		Y					
	Birch Plywood Milling	Birch Plywood 1/2 X 4 X 8 V(	6	Y					
	Aluminum Round Tubes	2" OD x 0.25" Wall x 1.5 ID A	2	Y					
	Aluminum Round Tubes	2" OD x 0.25" Wall x 1.5 ID A	2	Y					
Keshan Gober	Clay	205 Stoneware Clay 50lb	1	Y					
Mark Parsons	Vacuum Forming		4	Y					
	Epoxy		1	Y					
	S and J Supply			Y					
	S and J Supply			Y					
	S & F SUPPLIES			Y					
	CFD Flower Inc			Y					
	WEST SYSTEM 105B Epoxy Resin	(126.6 fl oz) Bundle with 205	4	Y					
	3D Printlife Yoga Flex	1.75mm White Biodegradabl	2	Y					
	OVERTURE PETG Filament 1.75mr	3D Build Surface 200 x 200 r	1	Y					
	WEST SYSTEM 105B Epoxy Resin	(126.6 fl oz) Bundle with 205	3	Y					
	MIT 3D Printing Assistence	Advising and Services	1	Y					
	Baomain Gereral Purpose Relay MY	8 pin terminal with DIN Rail F	1	Y					
	Beata Heuman: Every Room Should	Sing	1	Y					
	Etekcity Lasergrip 1080	Non-Contact Digital Laser Inf	1	Y					
	Adafruit ALS-PT19	Analog Light Sensor Breakou	1	Y					
	Organic Coffee Co.	OneCUP Breakfast Blend 36	1	Y					
	Linenspa Heavy Mattress Storage B	Double Adhesive Closure, Ki	1	Y					
	ELEGOO Electronic Fun Kit	Breadboard Cable Resistor, (	1	Y					
	uxcell ASH-25DA Solid State Relay	3-32VDC to 24-480VAC 25A	1	Y					
	UEETEK 3D Printer Heating Control	MKS MOSFET for Heatbed E	1	Y					
	DROK 180051US Numerical Control	DC 5-32V to 0-30V 5A Buck (	1	Y					
	Victory Pellets Extra Heavy (10 LBS)	Filling, Stuffing & Adding Wei	1	Y					
	SunFounder IIC I2C TWI 1602	1602 Serial LCD Module Dis|	1	Y					
	5lb Premium Virgin ABS Pellets for 3	Natural Color	2	Y					
	HiLetgo 1pc A4988 Stepstick Stepper		2	Y					
	12V Power Supply 10A 120W DC		1	Y					
	Ximimark A4988 DRV8825 3D Printer Stepper Motor Driver		1	Y					
	Etekcity Infrared Thermometer 1025D (Not for Human) Dual Laser		1	Y					
	Klein Tools TI250 Rechargeable Thermal Imager,		1	Y					
	Arduino Mega 2560 REV3		1	Y					
	HiLetgo RAMPS 1.4 Control Panel 3D Printer		1	Y					
	BIGTREETECH SKR Mini E3 V2.0 New Upgrade Control Board		1	Y					
	USA Material CR10 S4 Silicone Heater Pad 400 x 400mm		1	Y					
	SUNLU PLA 3D Printer Filament,		4	Y					
Maiti King	1248LMDF	12mm 4 X 8 Ultralite M.D.F	2	Y					
	148LMDF	25mm (1") 4 X 8 Ultralite M.D	24	Y					
	4410F	4X4 10' #2&BTR KD FIR	4	Y					
	FUEL	FUEL SURCHARGE	1	Y					
	148ACR	31/32 4x8AC Radiata ply	2	Y					
	2410F	2X4 10' #2&BTR DOUG KD I	30	Y					
	Clear Easy to Form PETG Sheet, 48"X96" 0.03 thick		2	Y					
	Styrene Black 48"x96"x0.04		5	Y					
	4lb 24"x48"x0.04"	Corafoam/Duraboard U40	8	Y					
	4lb 48"x96"x01"	Corafoam/Duraboard U40	1	Y					
	4lb 48"x96"x03"	Corafoam/Duraboard U40	3	Y					
Costa Perez	3 Pies and Drink	Dominos Pizza	4	Y					

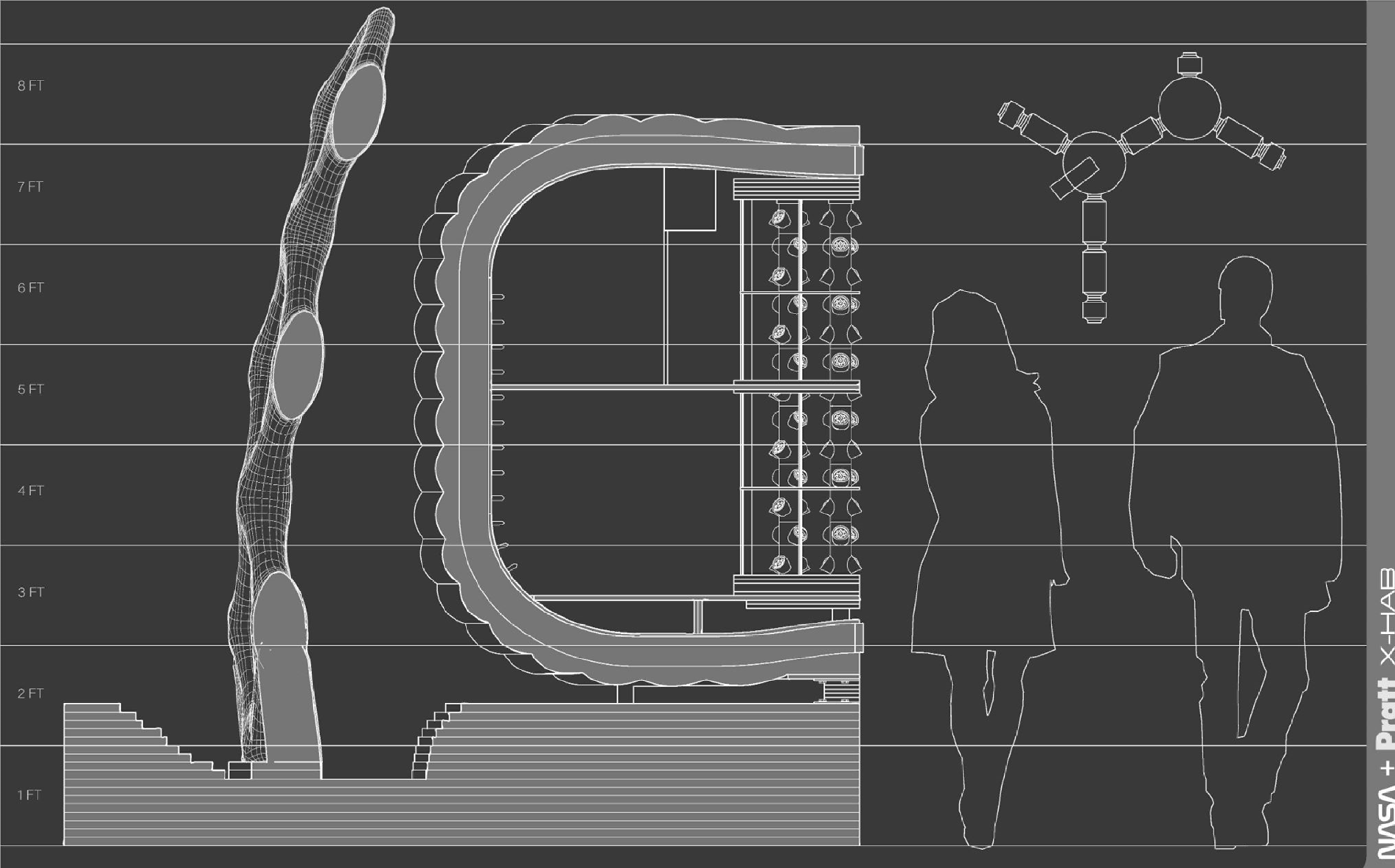
DISPLAY MODEL

- LUNAR BASE CHUNK
- CONSTRUCTION SEQUENCE

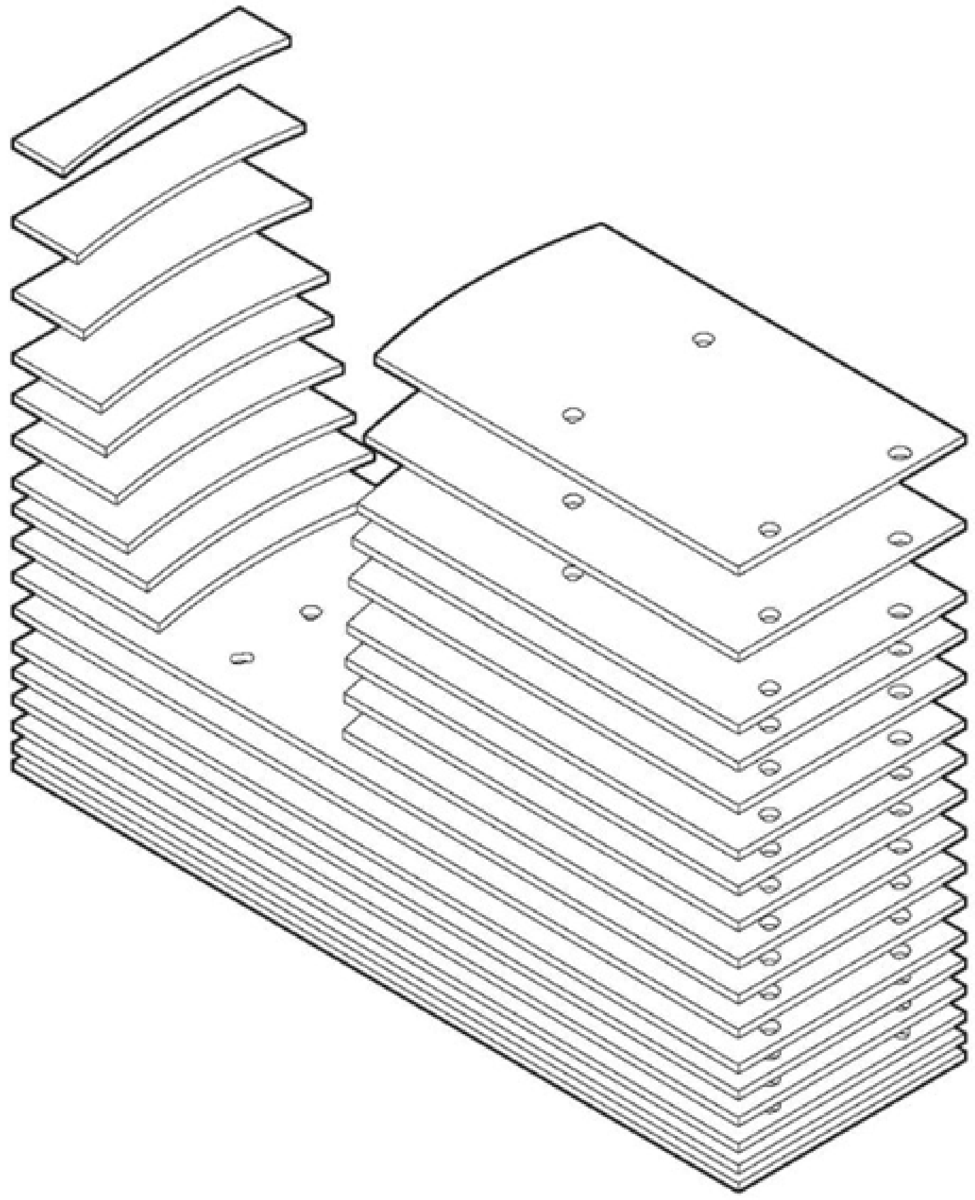


NASA + Pratt X-HAB

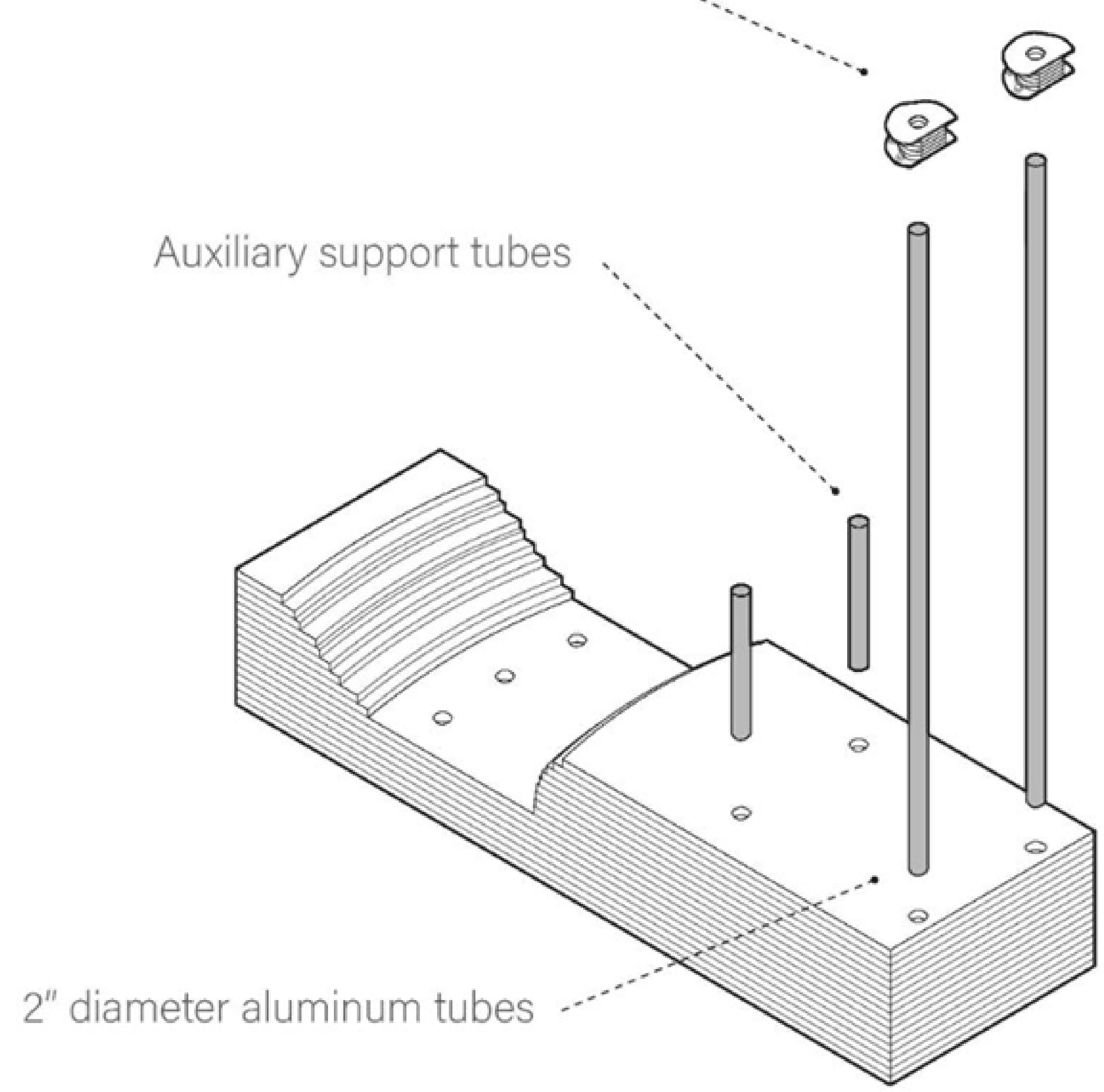
CHUNK MODEL 1/4 FT : 1 FT



DISPLAY SCALE 1/4 FT : 1 FT

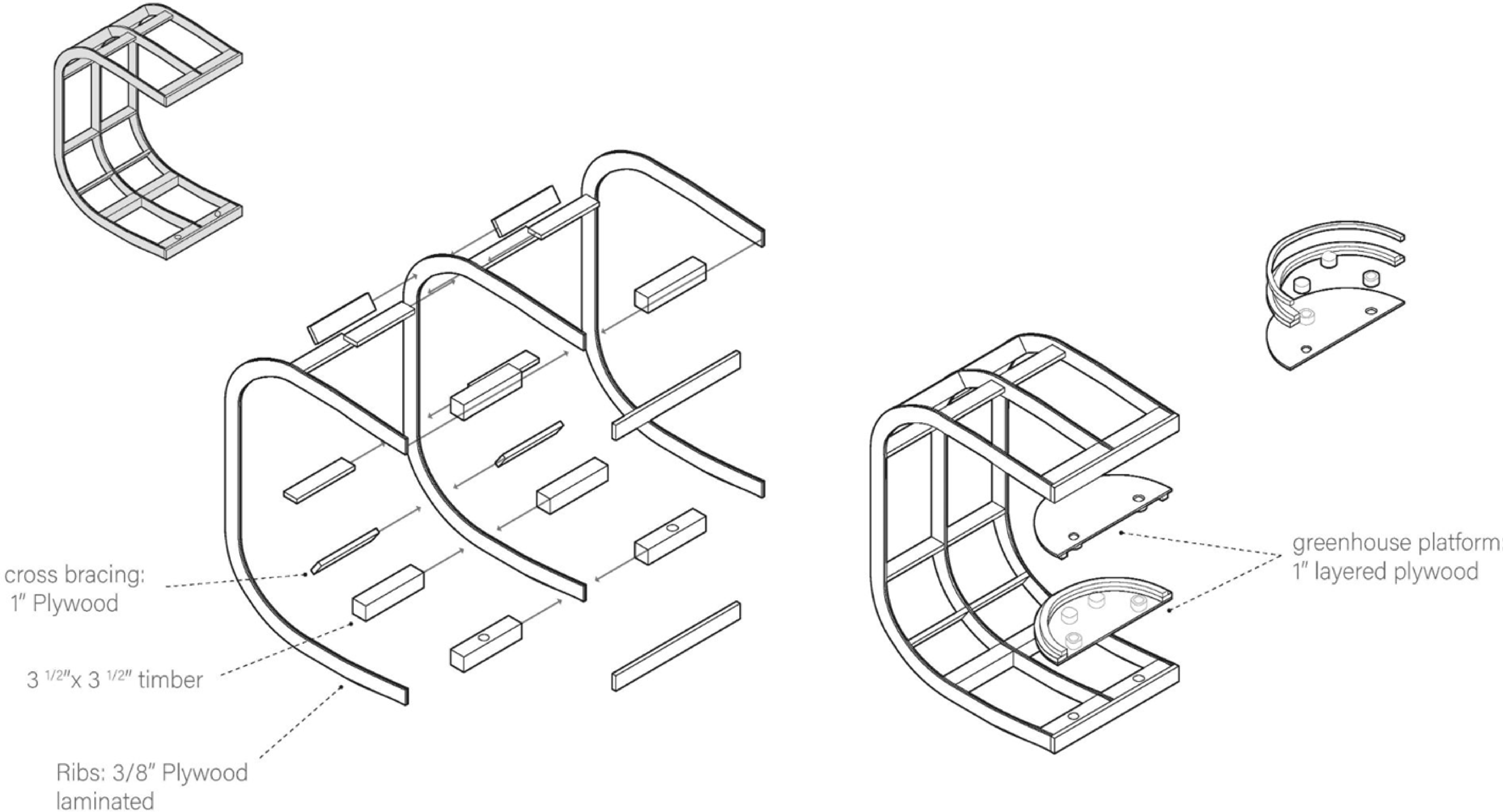


Base: 1" layered plywood

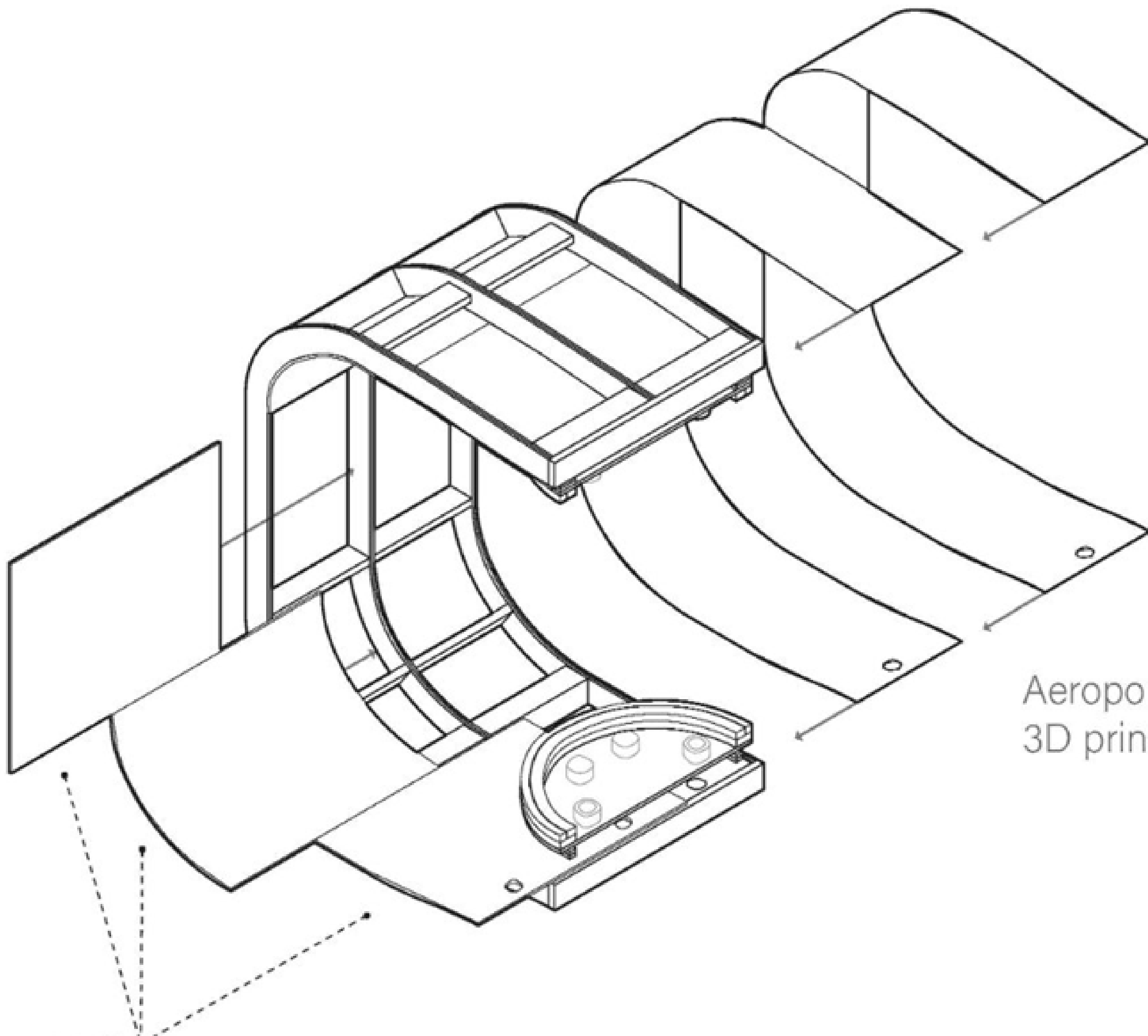


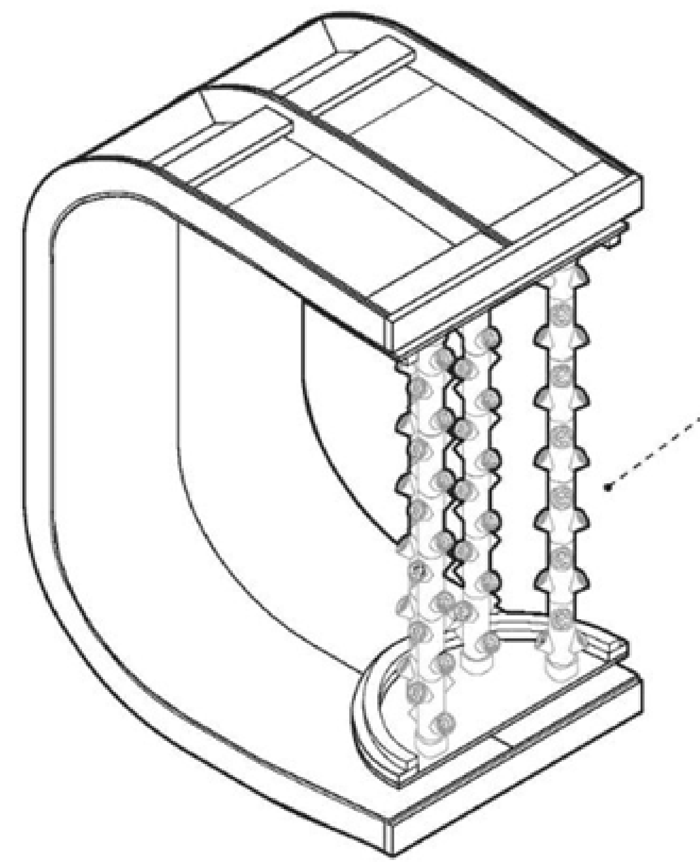
vertical supports

BASE ASSEMBLY

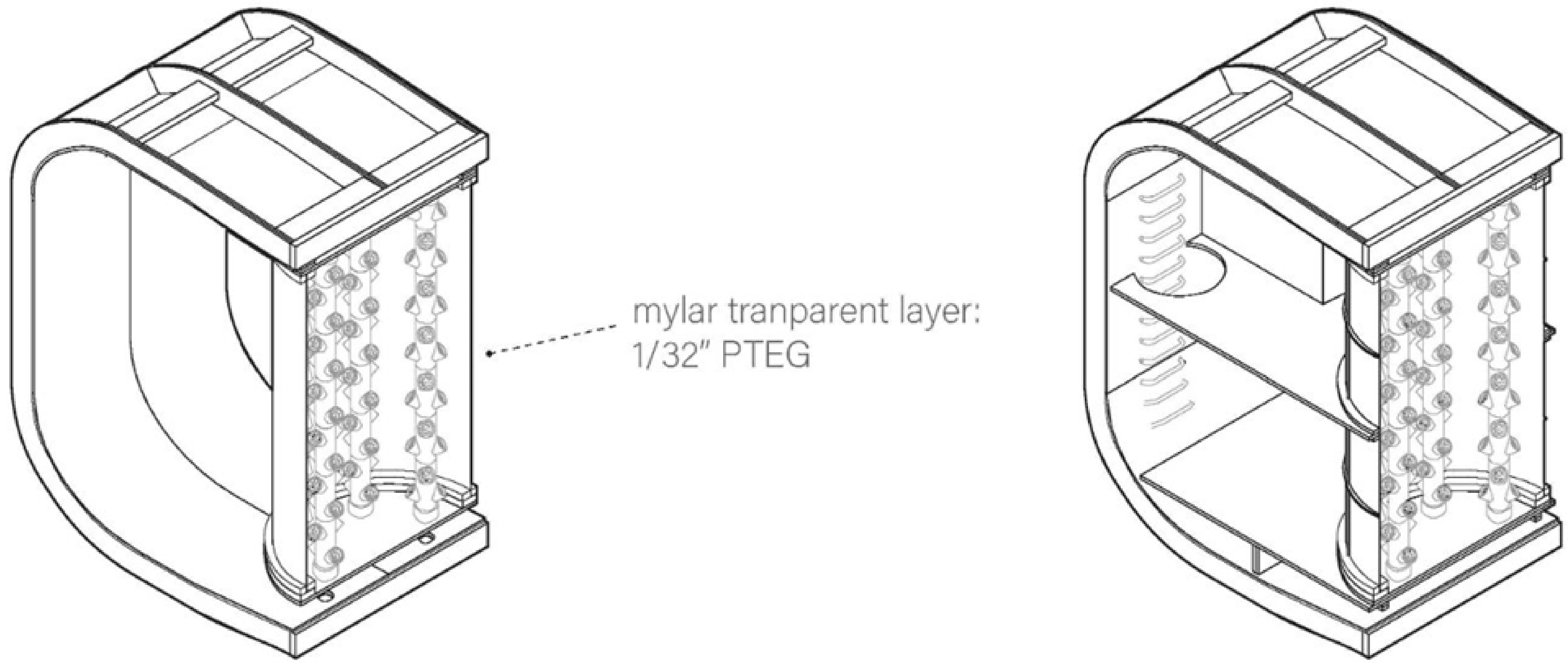


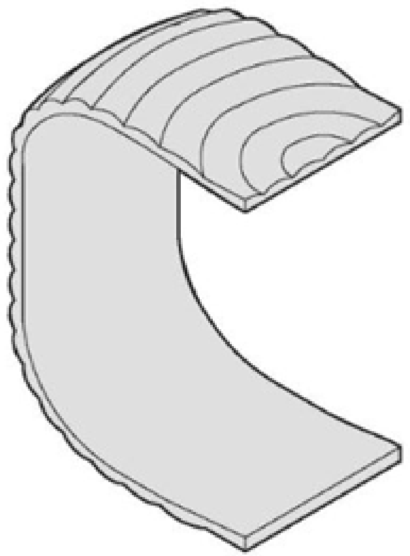
FRAME ASSEMBLY



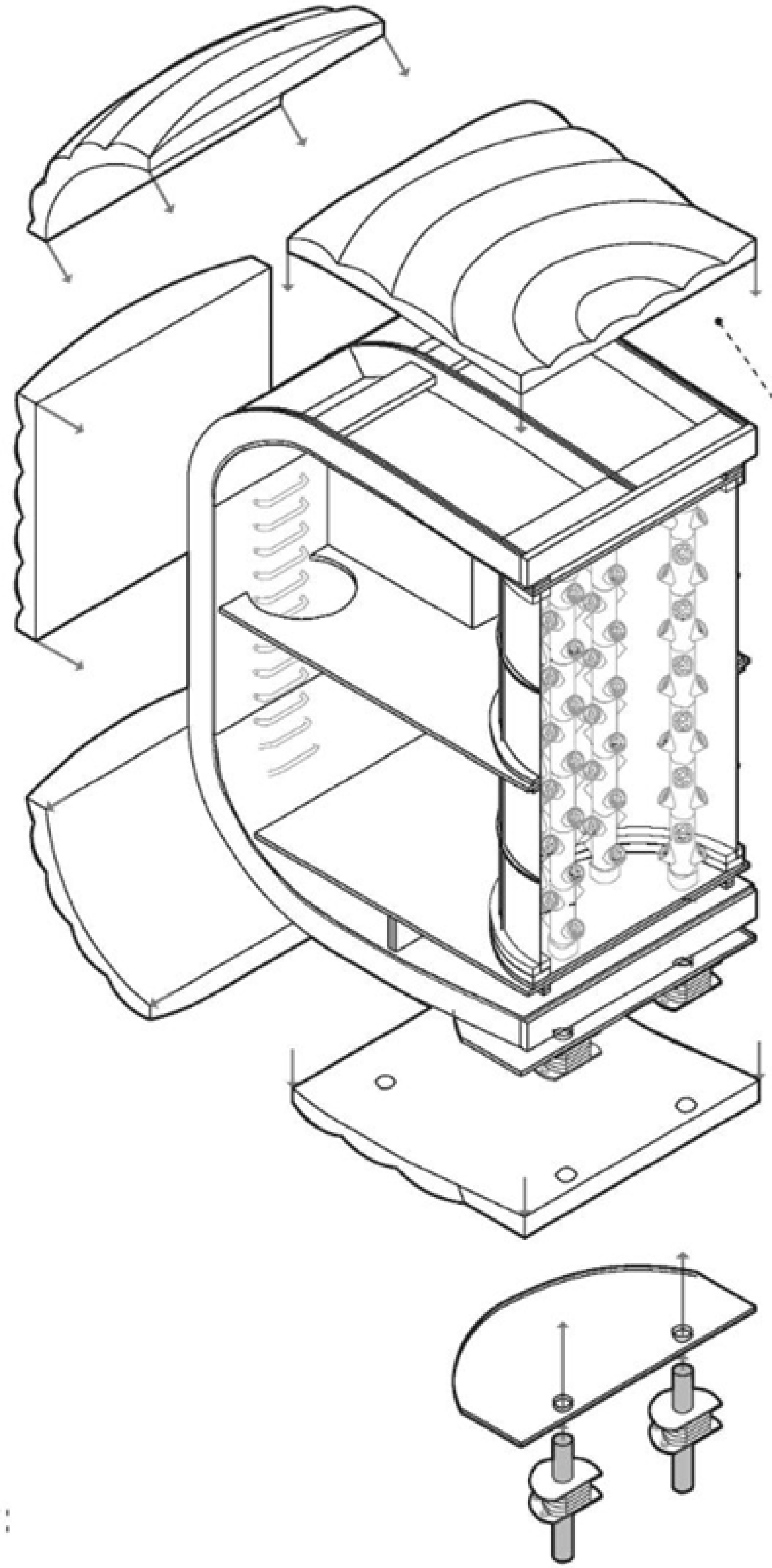


PANELING AND AEROPONICS

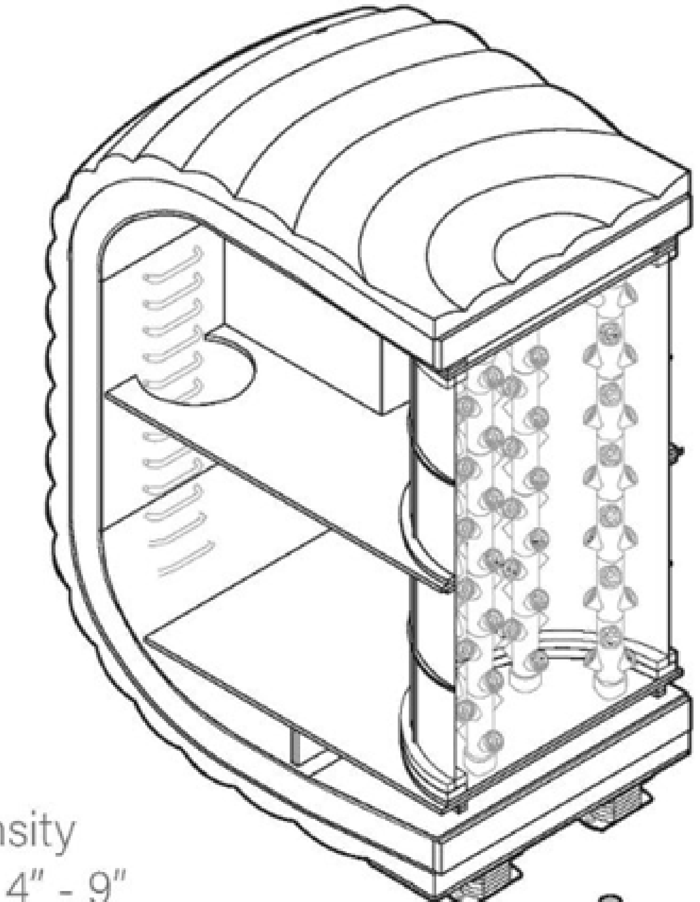

mylar tranparent layer:
1/32" PTEG

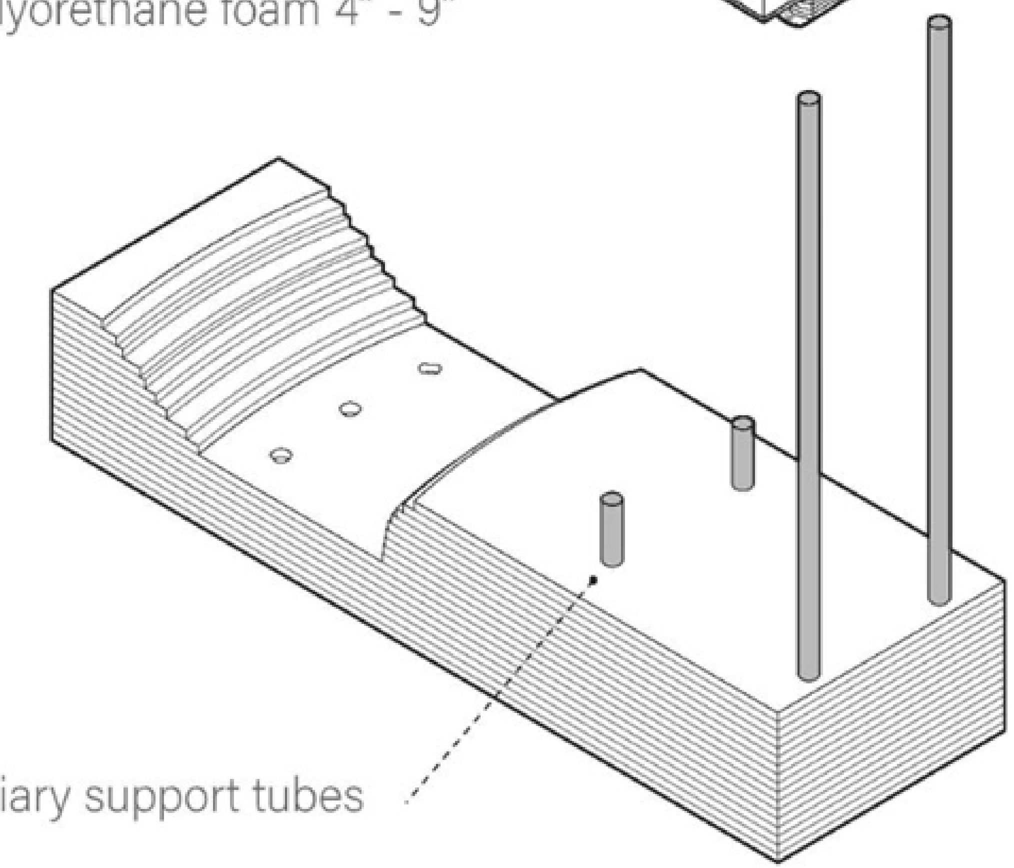


Inflatable section

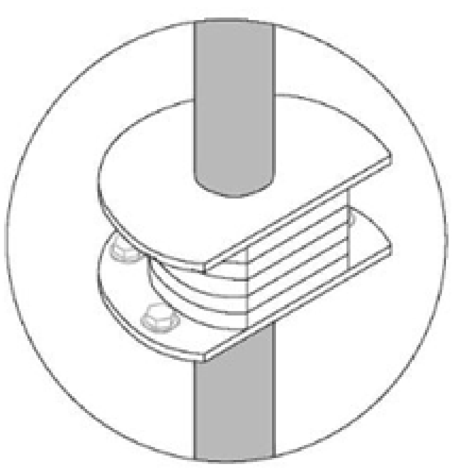


Inflatable: High density Polyorethane foam 4″ - 9″



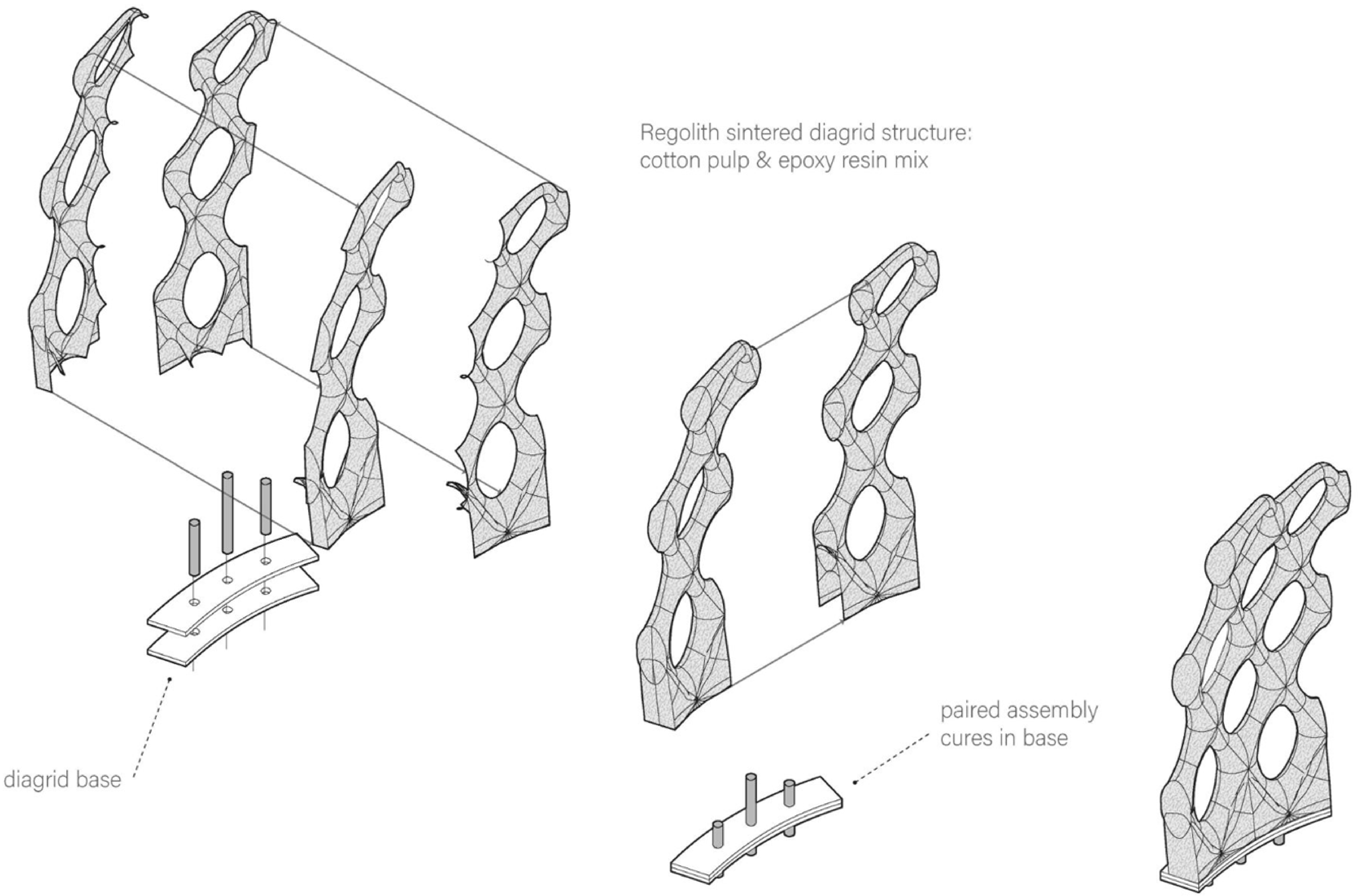


Auxiliary support tubes



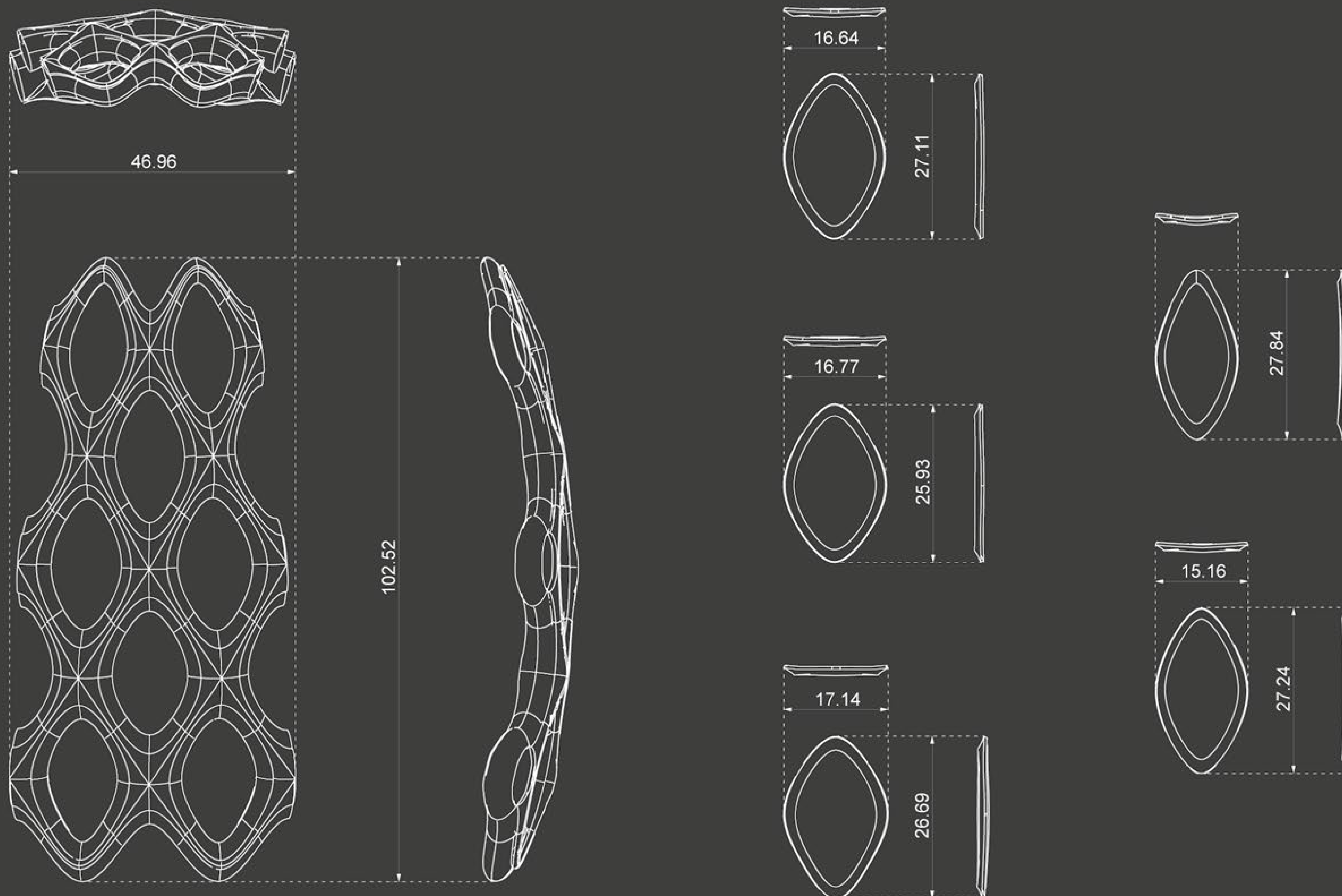
Base seismis isolator:
PLA 3D printed

INFLATABLE ASSEMBLY

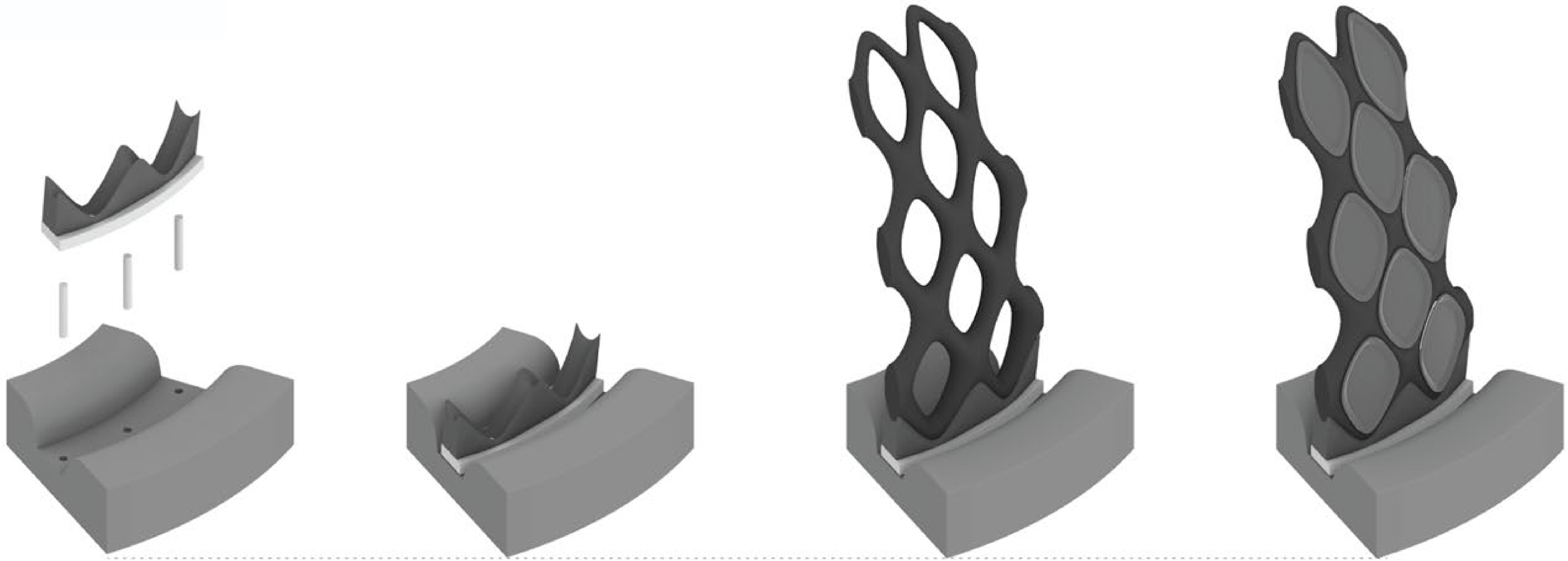


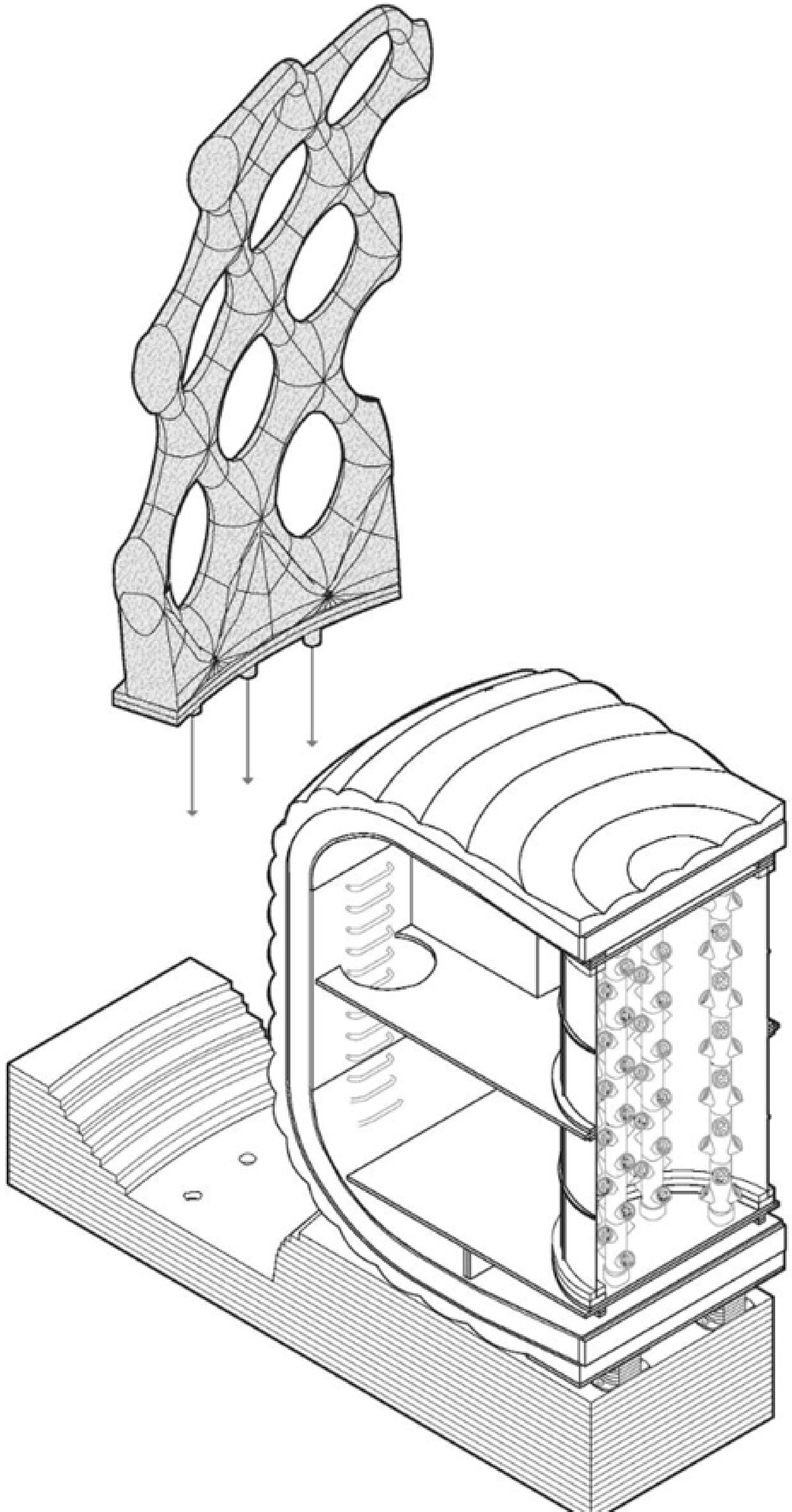
STRUCTURAL ASSEMBLY

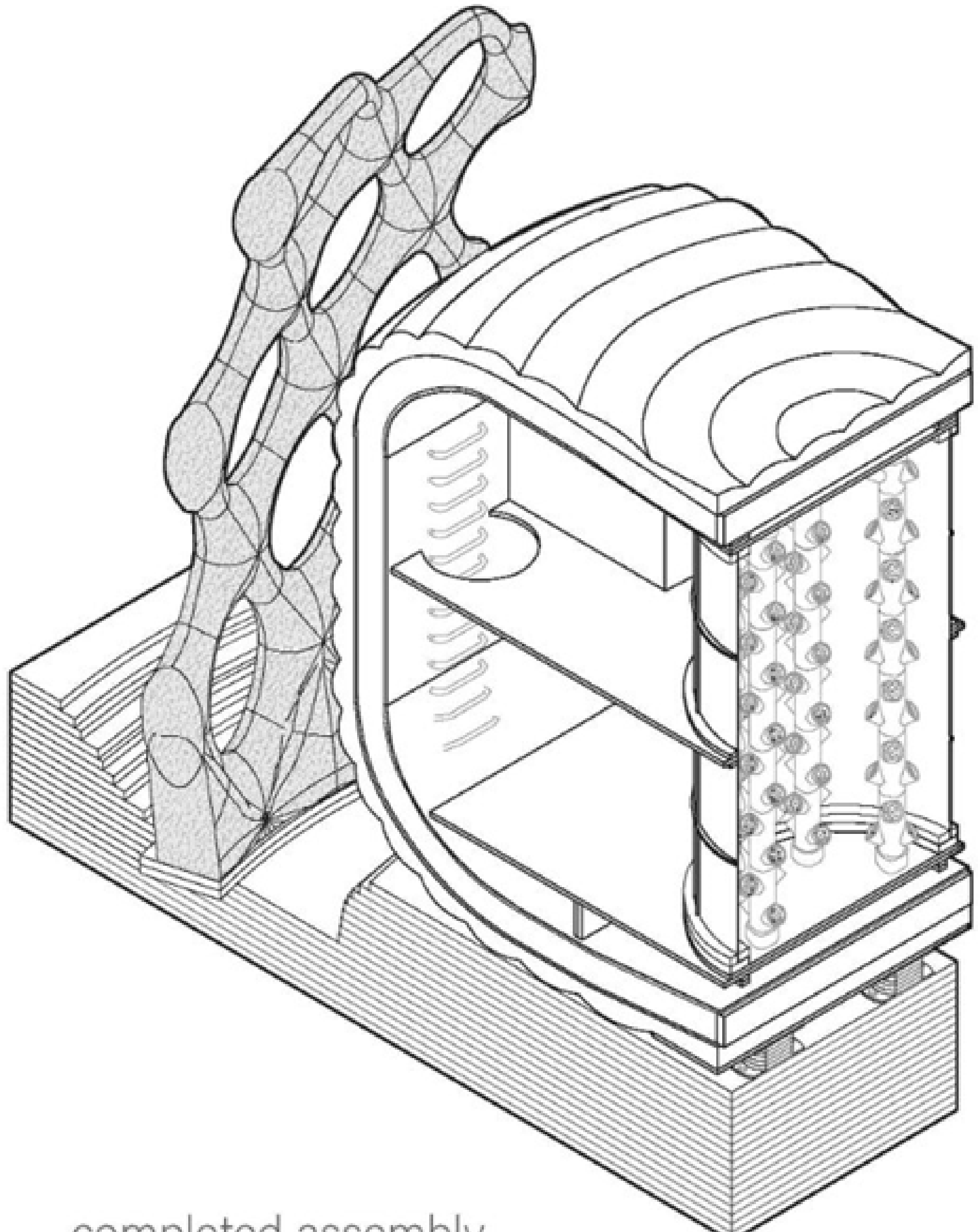
Structure Construction Document



Assembly Sequence



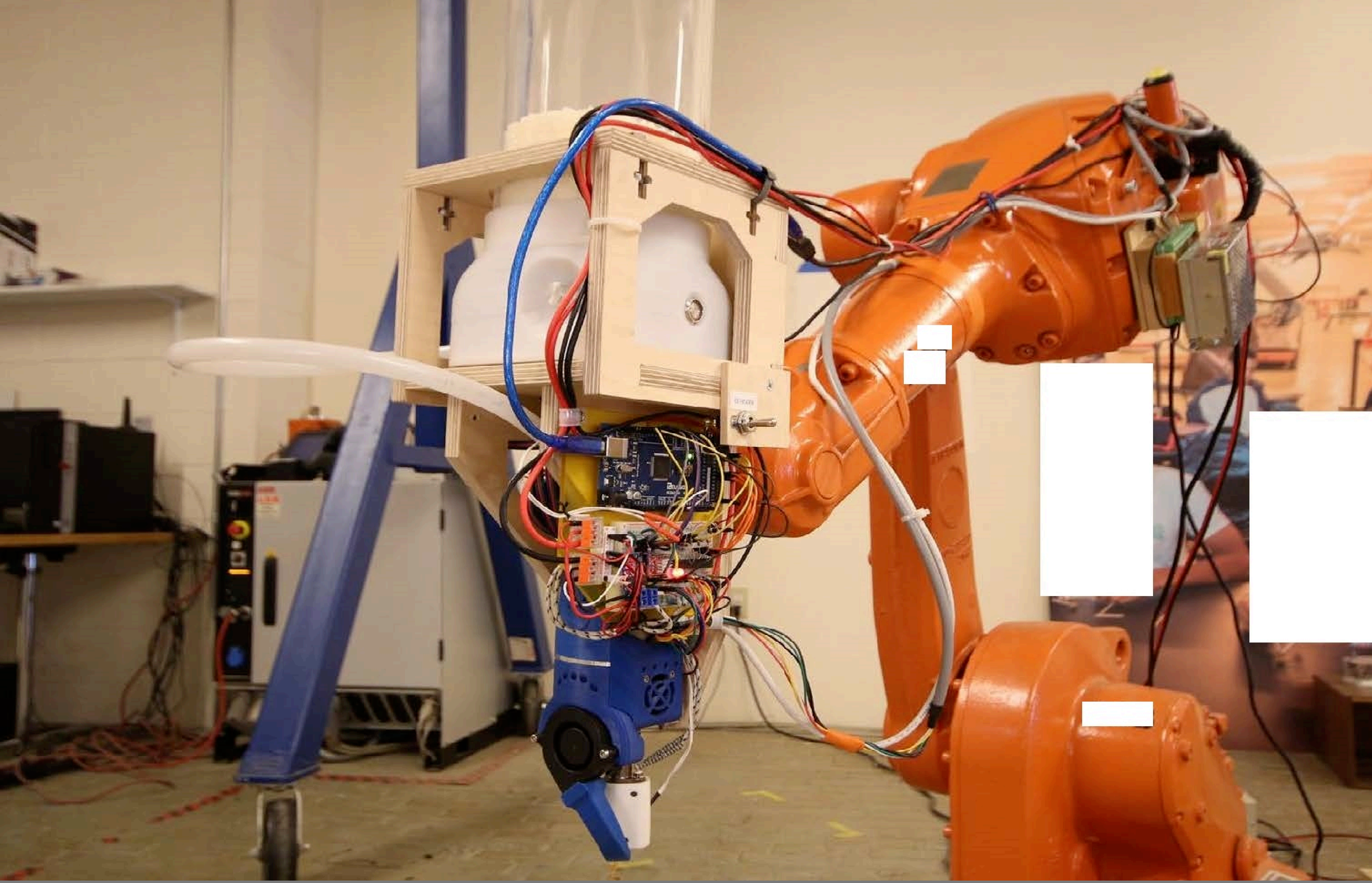


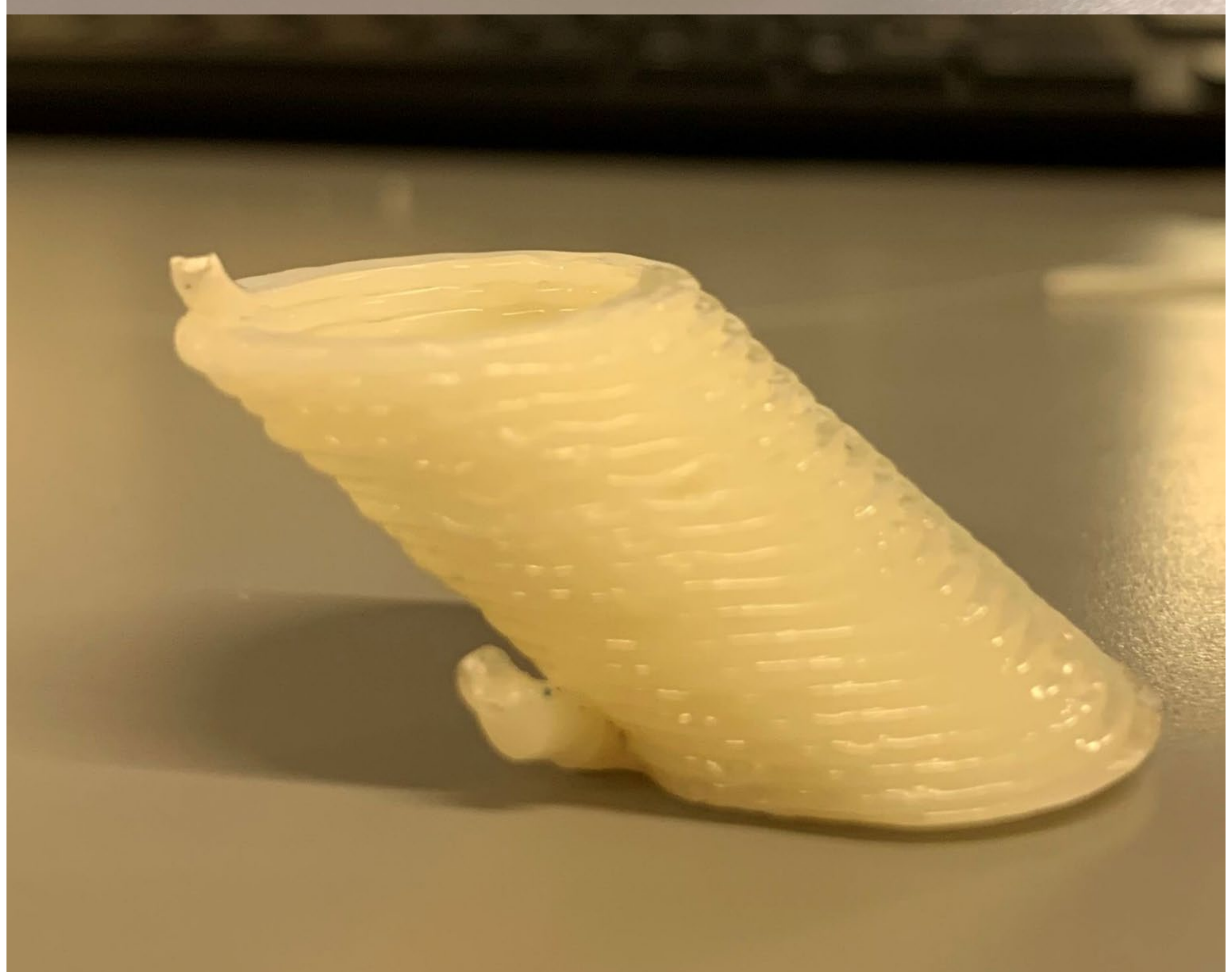
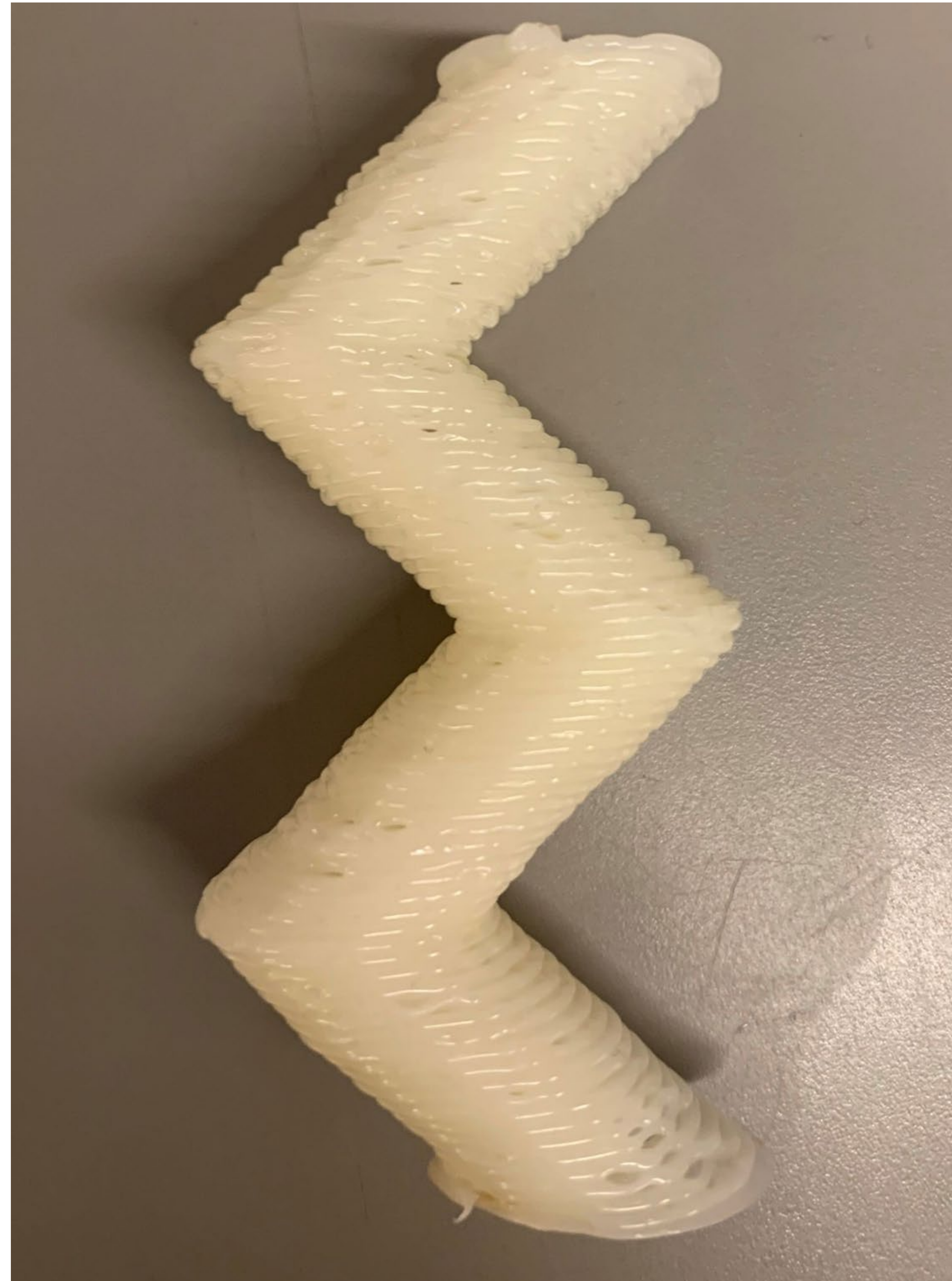


completed assembly

RESEARCH

- 3D PRINTING AND ROBOTICS









SECTION
PLANT SELECTION
Keep 6 feet apart
Thank you


EXIT


Keep
6 feet apart


EXIT

THANK YOU!

Mark Parsons & Michael Morris - Leading us through this amazing project.

Rodrigo Guajardo - Constantly helping us with any building problems we may have had and trusting us with all of his tools and machines.

Greg Sheward - Teaching us everything we need to know about subtractive manufacturing and using his own time to help us with the build.

Jason Lee and all other administrators - Putting up with all shenanigans that were a result from the build process of our model in the last few weeks.

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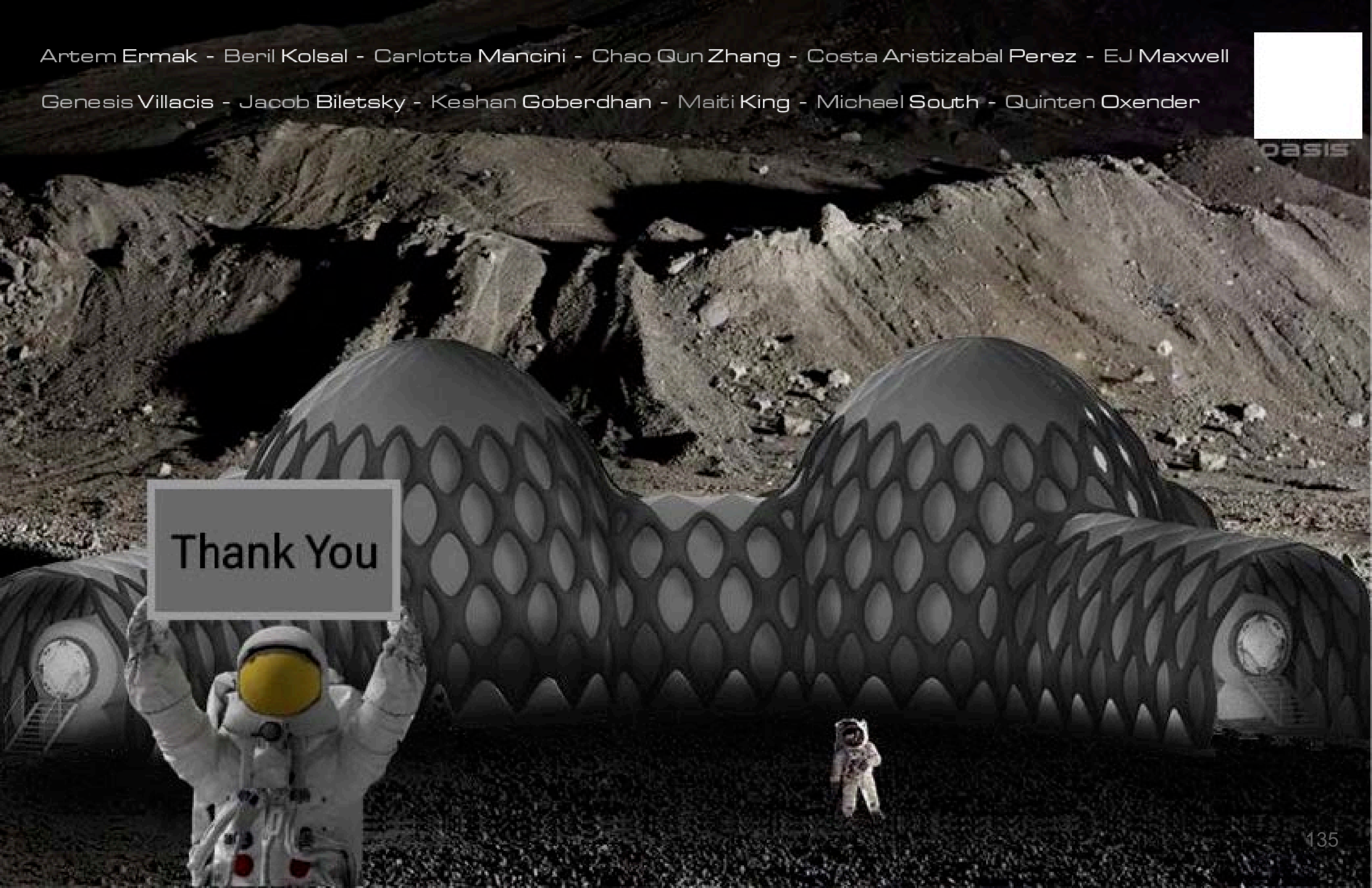
Dalma Foldesi and Jung In Seo - helping with material studies of the diagrid structure using their own ceramic printing research

Stiegelbauer - providing us with the facilities to vacuum form the large molds for our diagrid model

Big Rep - giving us our first larger scale 3d prints in our first semester

Chuma Osse, Kevin Harris, Abhishek Thakkar, Aaron Miranda, Ben Erickson and anyone else who help unload and transport hundreds of pounds of lumber.


Artem Ermak - Beril Kolsal - Carlotta Mancini - Chao Qun Zhang - Costa Aristizabal Perez - EJ Maxwell
Genesis Villacis - Jacob Biletsky - Keshan Goberdhan - Maiti King - Michael South - Quinten Oxender
oasis
Thank You