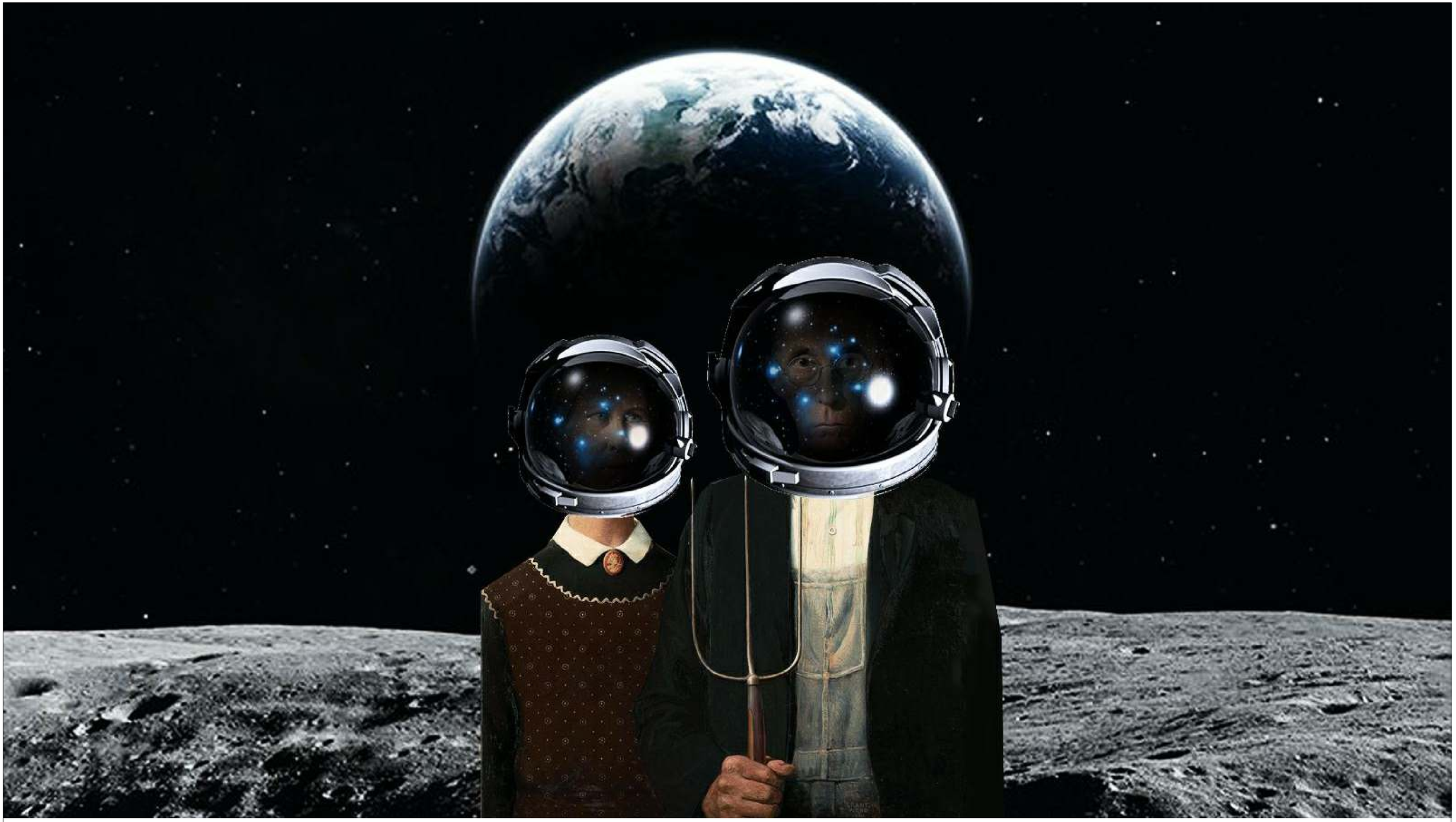


Institute for advanced architecture of Catalonia

LEAF space farm

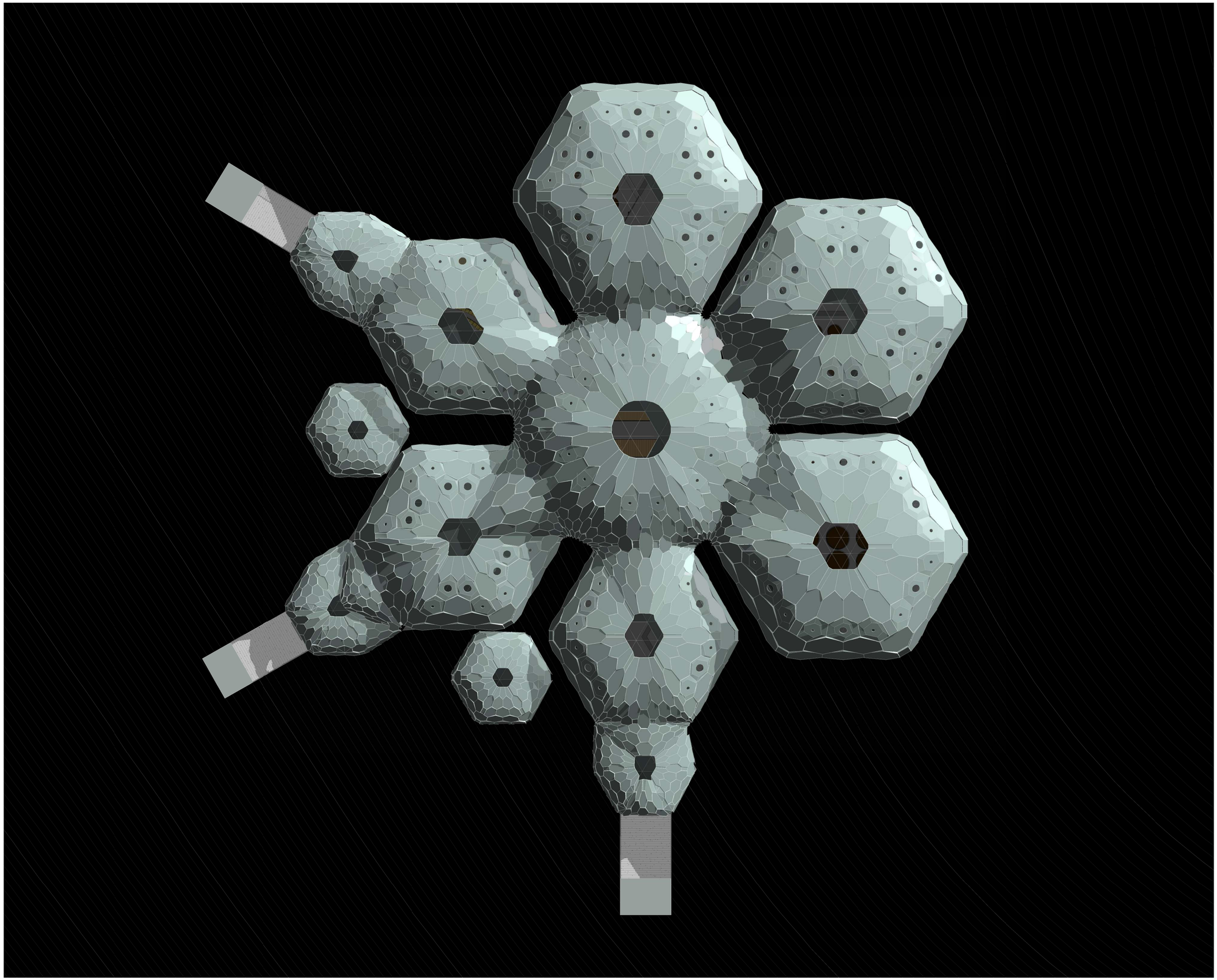
LUNA ENHANCEMENT AND AGRICULTURAL FARMING
Shackleton Crator, Moon
LEAF Crews: Alexander Tong, Dongyub Lee, Nawapan Suntorachai

IaaC - Institute for Advanced Architecture of Catalonia
MaCAD BIMSC 2020/2021
Studio Lead Faculty : David Leon & Faculty : Oana Taut
Integrative Modeling Lead Faculty: Ardeshir Talaei & Faculty : Sepehr Farzaneh



LUNA ENHANCEMENT AND AGRICULTURAL FARMING
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MASTER IN ADVANCE COMPUTATION FOR ARCHITECTURE AND DESIGN

// 02 - BIMSC + STUDIO SEMINAR

// GROUP NUMBER **07**



ALEXANDER TONG

DONGYUB LEE

NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

Project Proposal

Our design aims to contribute food production for 100 astronauts and possible to grow more on the Moon. The farm consists of 3 major groups of food including plants, insects, and animal meats products where smart farm system will be integrated to the monitoring that can be optimized by the algorithm.

The cultivation system is based on closed aspect of the system that the resources including air, nutrient, water, and energy will be regulated within the facility itself.

Therefore, our project needed to be developed as a modular system and that can be connected and disconnected, and also have some future growth area for expansion.

PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

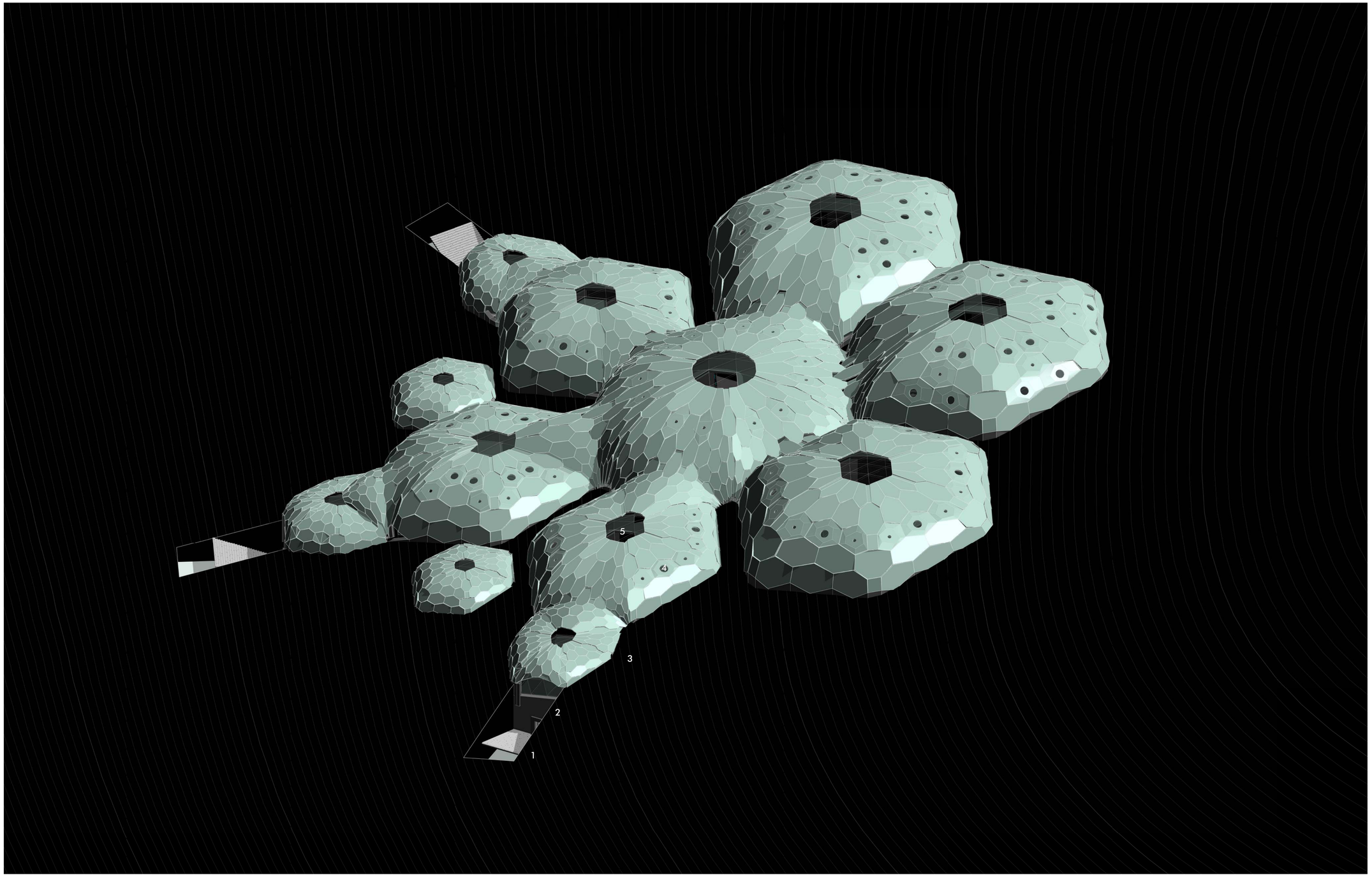
Site Plan

DRAWING NUMBER

A101

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21



OUTER SHELL DRAWING SCALE 1:200

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LEAF space farm

MASTER IN ADVANCE COMPUTATION FOR ARCHITECTURE AND DESIGN

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// GROUP NUMBER **07**

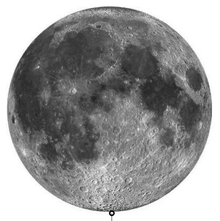


ALEXANDER TONG

DONGYUB LEE

NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

LEGENDS

1 RAMP FOR EMERGENCY ENTRANCE
2 EMERGENCY DOOR AIRLOCK
3 BASE WALL
4 3D PRINTED FABRICATED PANELS 300mm
5 SKYLIGHT OPENING

PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

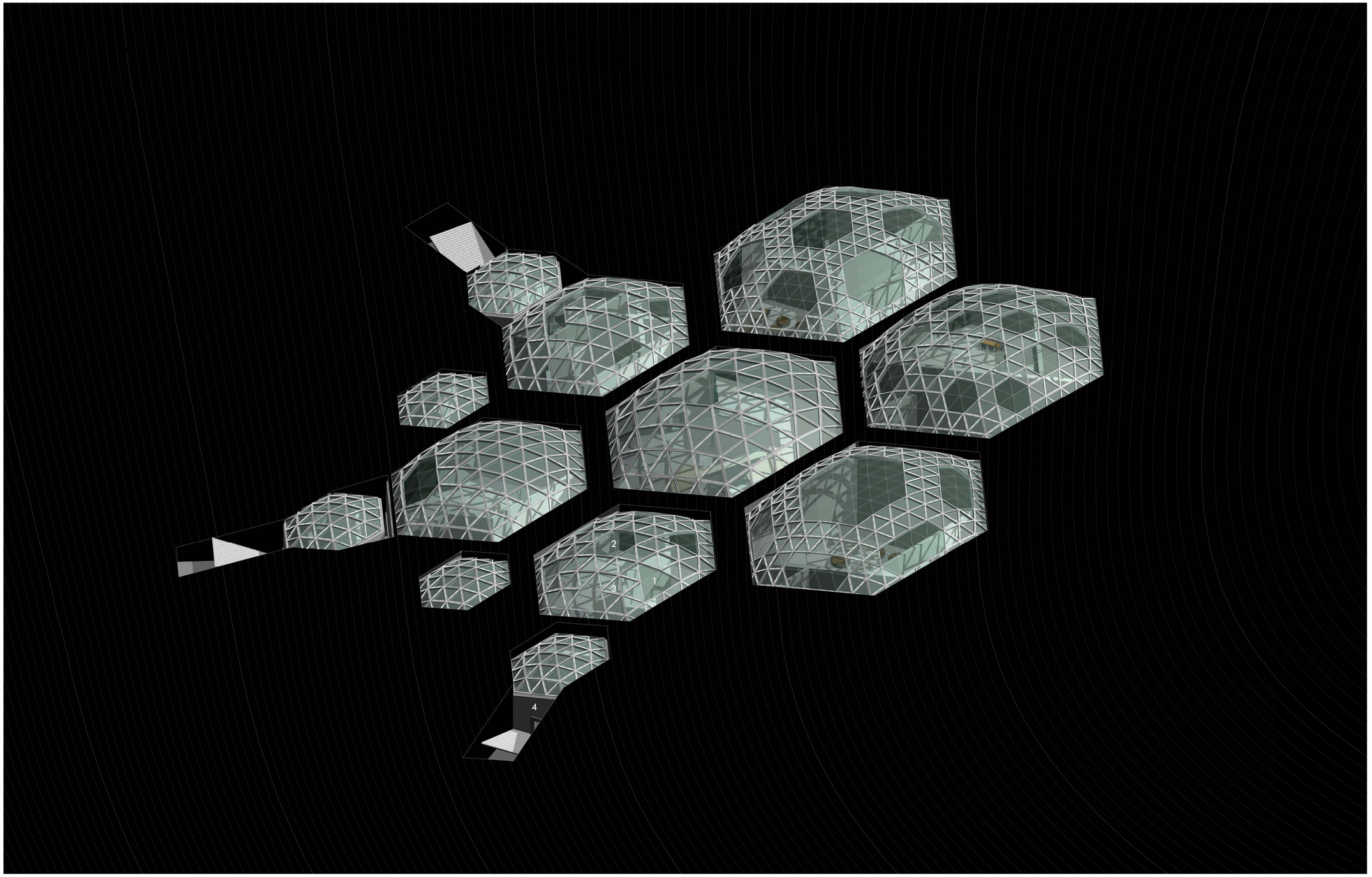
Outer Shell Axonometric

DRAWING NUMBER

A102

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21



INNER SHELL DRAWING SCALE 1:200

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LEAF space farm

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ALEXANDER TONG

DONGYUB LEE

NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

LEGENDS

1 INFLATABLE MEMBRANE ETFE TRIANGULATE MESH
2 GLASS LAYER SURFACES 40 MM
3 3D PRINTED REGOLITH STRUCTURAL FRAME
4 ANCHOR LOCATION WITH WALL

PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

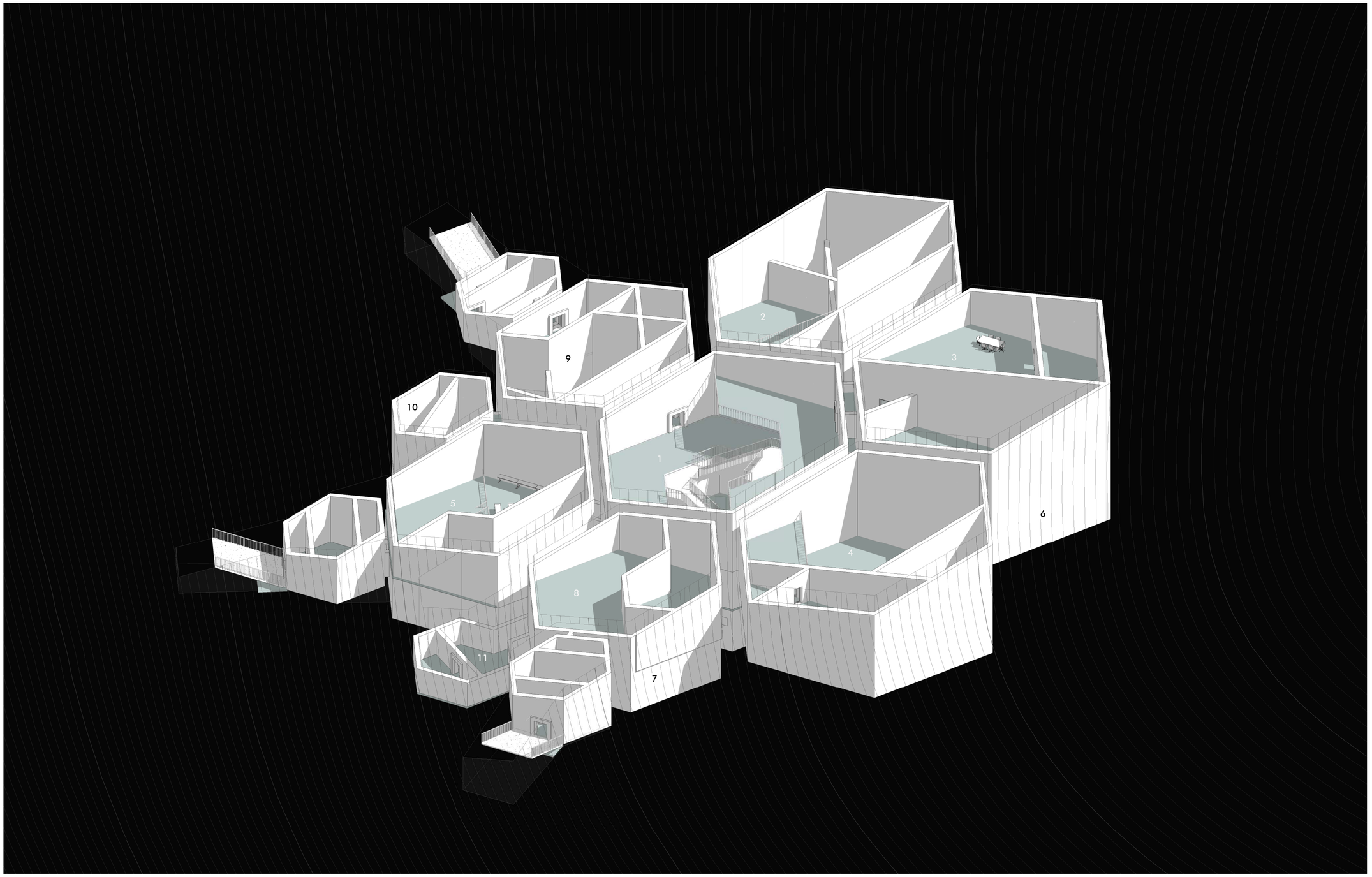
Inner Shell Axonometric

DRAWING NUMBER

A103

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	**Checker**	**03/10/21**



INTERIOR SPACE DRAWING SCALE 1:200

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LEAF space farm

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ALEXANDER TONG

DONGYUB LEE

NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

LEGENDS
1 STORAGE
2 VEGETABLE
3 INSECT
4 FISH
5 CELLULAR AGRICULTURE
6 FUNGI
7 WASTE MANAGEMENT
8 ADMIN
9 LIFE SUPPORT
10 UNDERGROUND CONNECTION
11 UNDERGROUND LABORATORY

PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

Interior Axonometric

DRAWING NUMBER

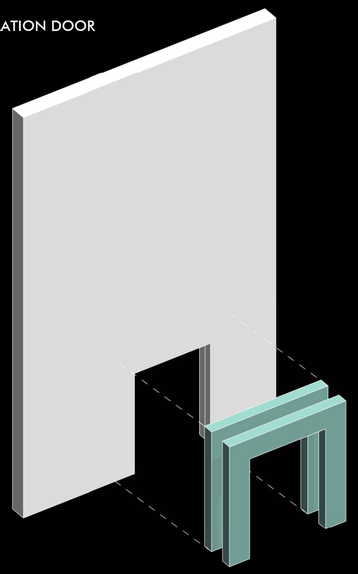
A104

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	**Checker**	**03/10/21**

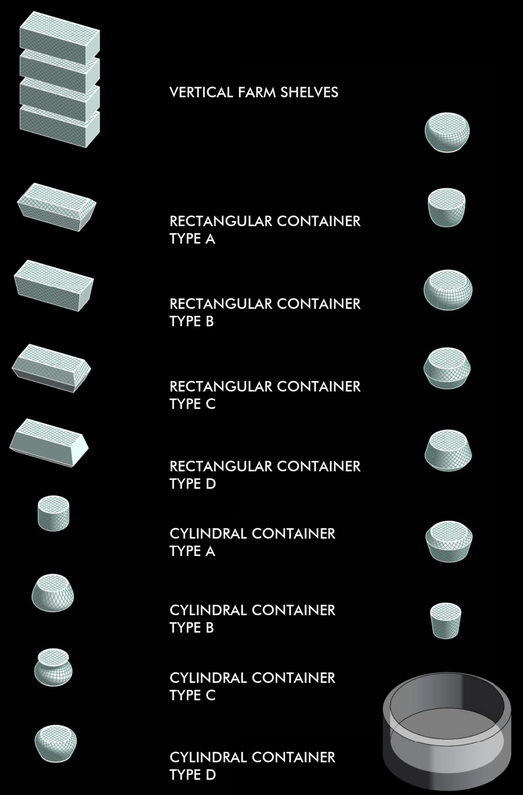
FARMING ELEMENTS AND AIRLOCK SYSTEM

1. AIRLOCK CIRCULATION DOOR



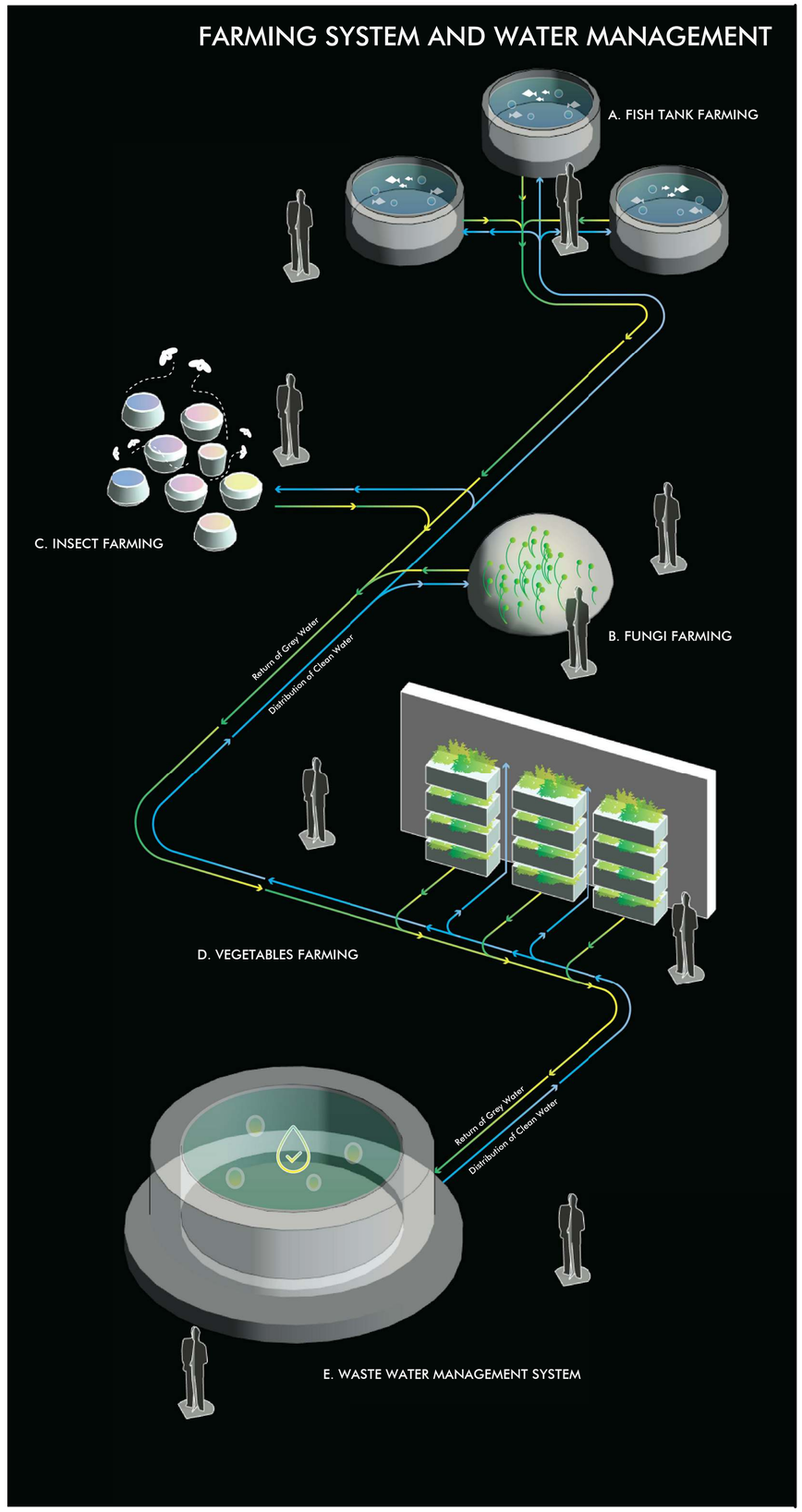
Double Layer of Airlock Doorframe

2. FARMING MODELS



SAMPLE ELEMENTS FOR SPACE FARMING SCALE 1:50

FARMING SYSTEM AND WATER MANAGEMENT



ACTIVITY FLOW AT SPACE FARMING SCALE 1:50

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THE MOON + SOUTH POLE + SHACKLETON CRATER
LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

PROJECT
LEAF

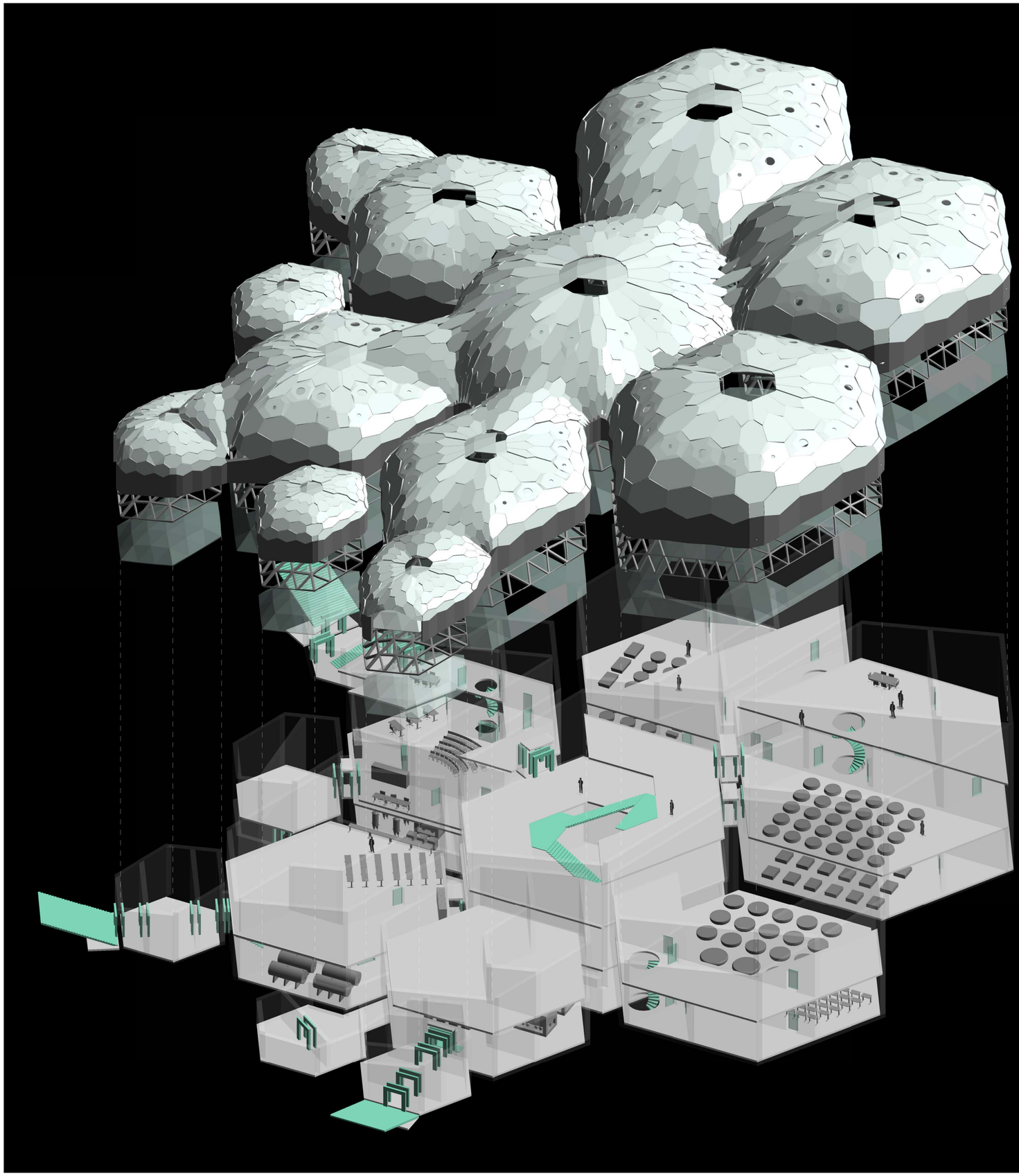
CLIENT
MaCAD BIMSC

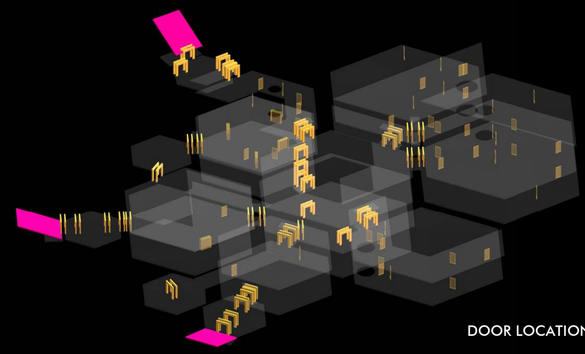
SHEET NAME
Interior elements

DRAWING NUMBER
A105

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21

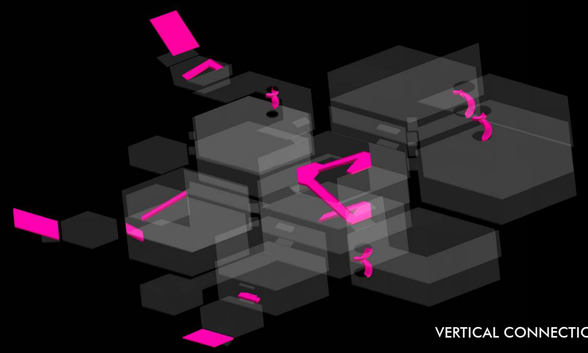




CIRCULATION ELEMENTS

DOOR LOCATION

The door locations are showing the emergency entrance of the 3 moduels in the front, while every connection need to be circulate through the central program, storage. All the door are airlock type in order to prevent risk of air loose.



VERTICAL CONNECTION

The stairs were shown in the pink colors where some modules have 2 floors according to the arrangement of space, which the underground will be the program that not requires so much light and mainly functioning for regeneration for waste management and ecosystem

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// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

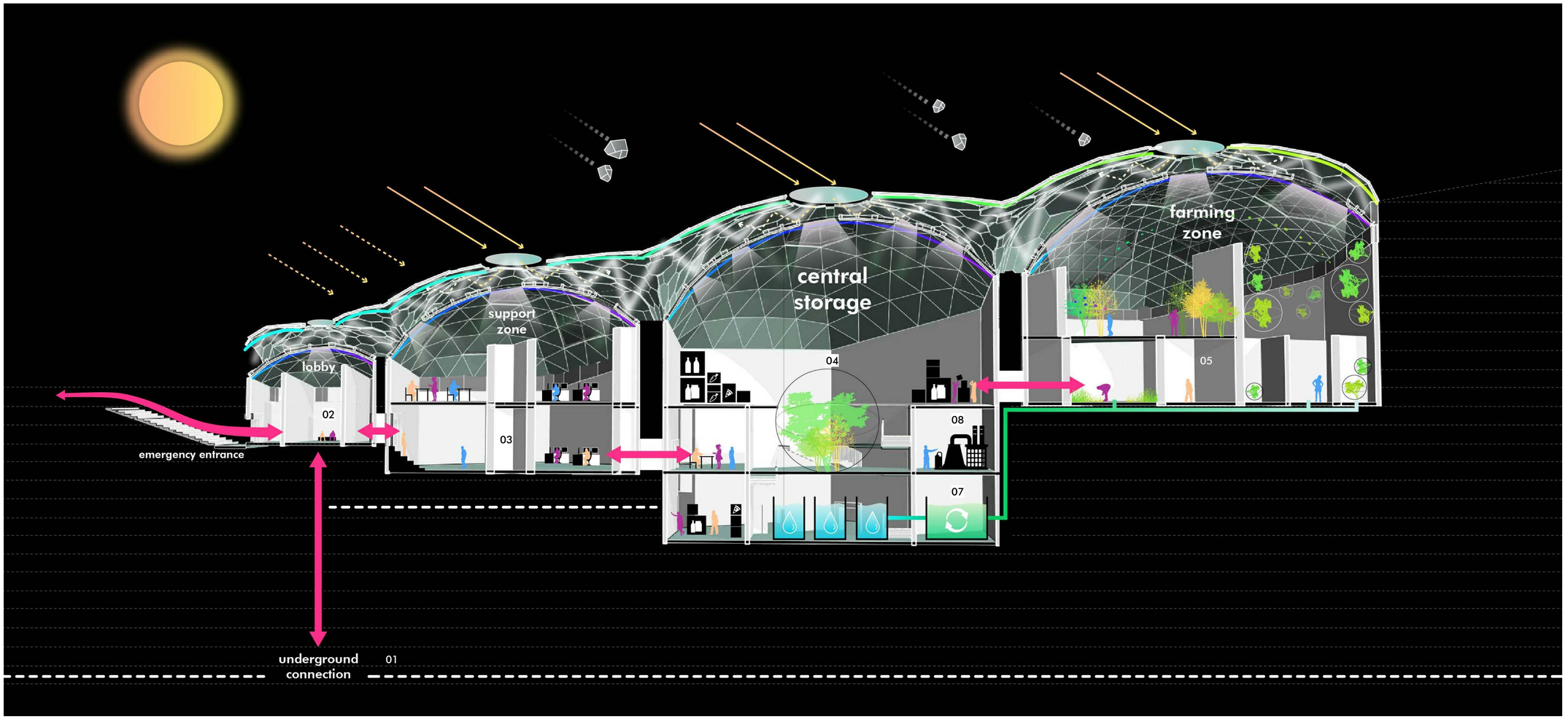
Circulation

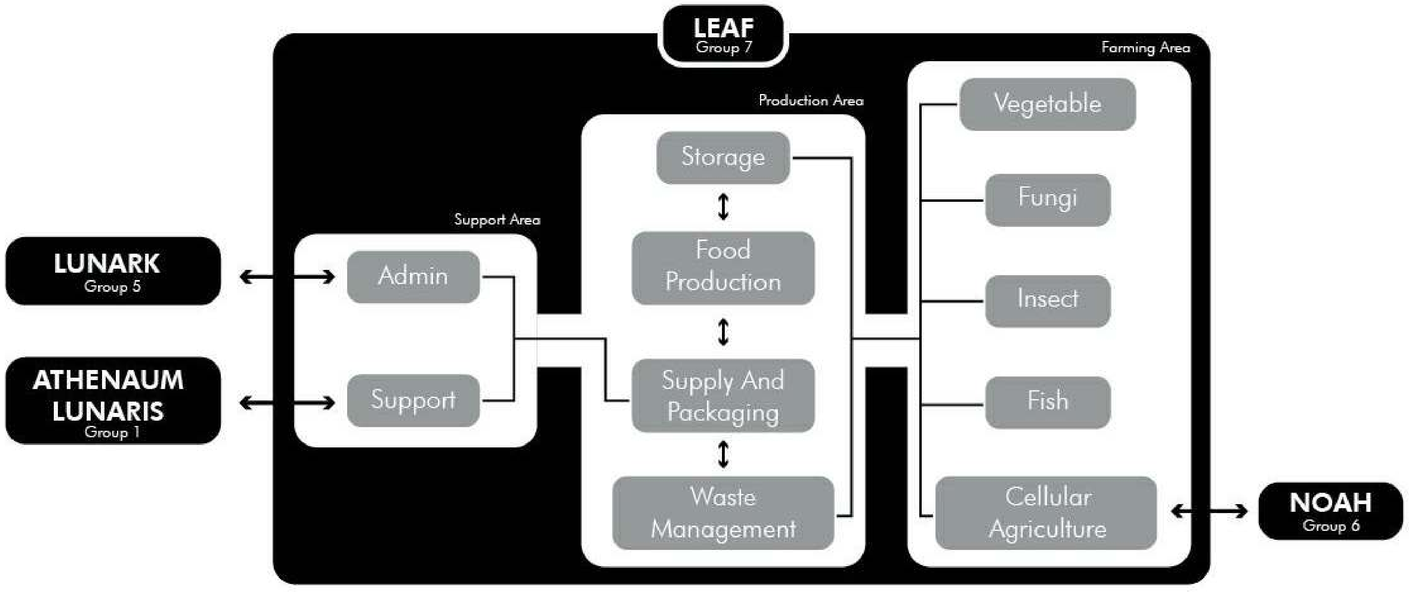
DRAWING NUMBER

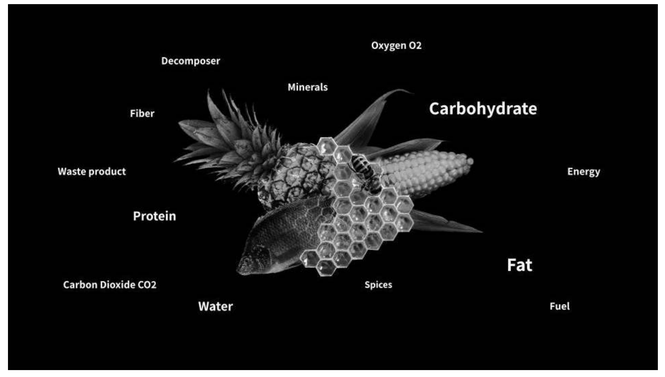
A106

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21







Space Farm

Space Farm is based on smart farming technology tested on Earth. Smart farming tackles the issue of farming in urban context with the aim to mimic ecosystem for transforming waste into food. We are facing a similar problem on the Moon. The technology is based the symbiosis relationships between four elements – Fish, Fungi, Insect and Vegetable. For example, water cycle is re-created here when grey water from space residence enters the space farm and it is filtrated by the vegetable sector and the resulting water can be fed to the fish or insect sector. Similar cycles are possible for carbon dioxide, ammonia and phosphates from human waste to turn into carbohydrates, fat and protein for the food consumption of the astronauts. Space farm relies on solar energy to power its cycles. In order to feed 100 astronauts, 5000 square meters will be required considering energy requirement of the astronauts and the inefficiency of lunar farming.

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MASTER IN ADVANCE COMPUTATION FOR ARCHITECTURE AND DESIGN

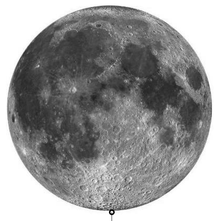
// 02 - BIMSC + STUDIO SEMINAR

// GROUP NUMBER **07**



ALEXANDER TONG | DONGYUB LEE | NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

Legend

01 UNDERGROUND CIRCULATION
02 LOBBY / ENTRANCE
03 SUPPORT AREA AND ADMIN
04 CENTRAL STORAGE
05 SPACE FARM ZONE
06 WASTE MANAGEMENT
07 RECYCLING WATER
08 FOOD PRODUCTION FACTORY

PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

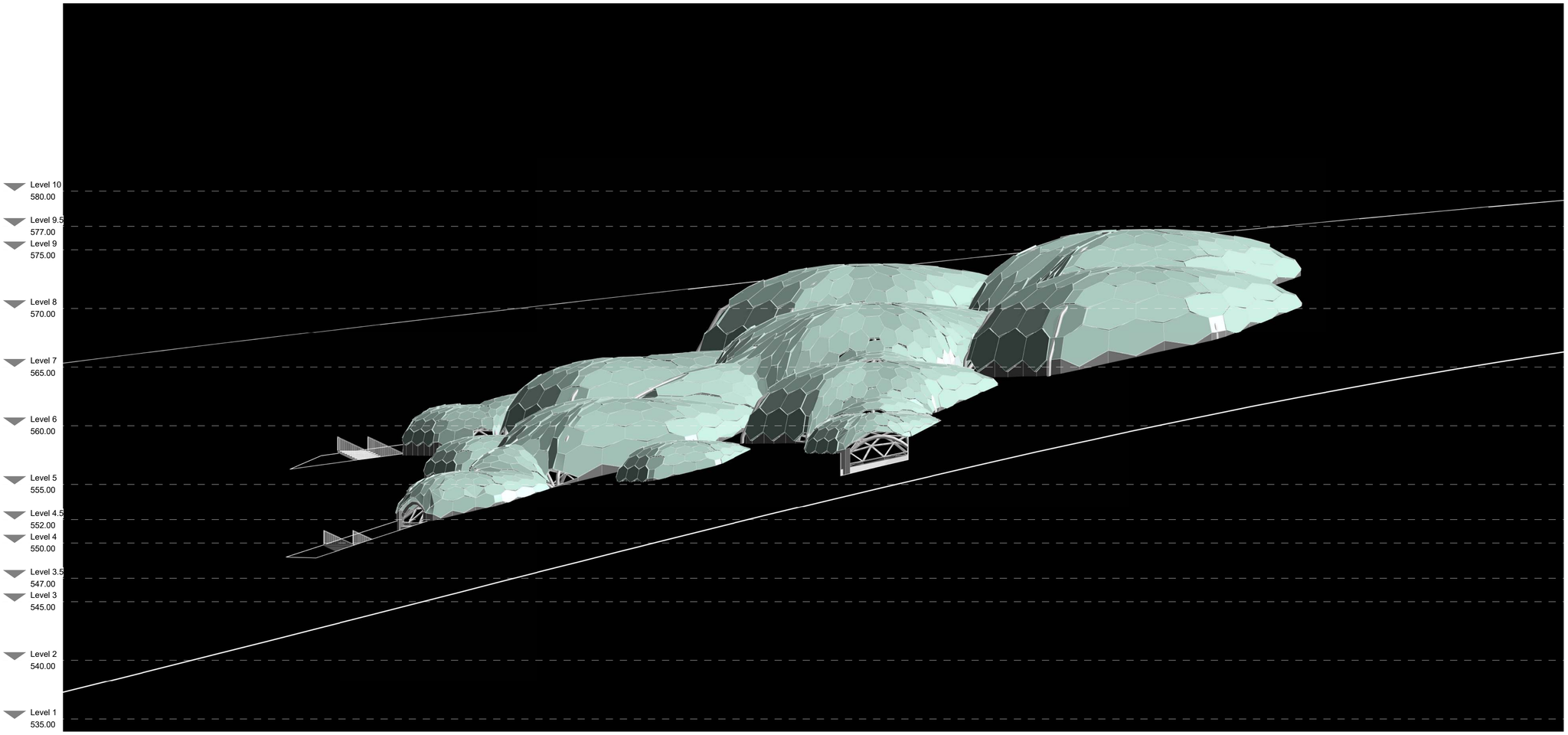
LEAF Ecosystem

DRAWING NUMBER

A107

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21



SOUTH ELEVATION_1 : 200

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// GROUP NUMBER **07**

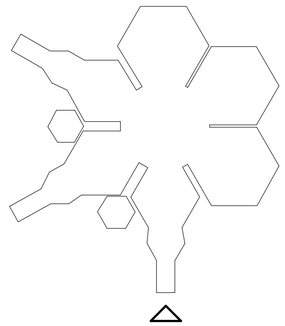


ALEXANDER TONG
DONGYUB LEE
NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER
LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM



PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

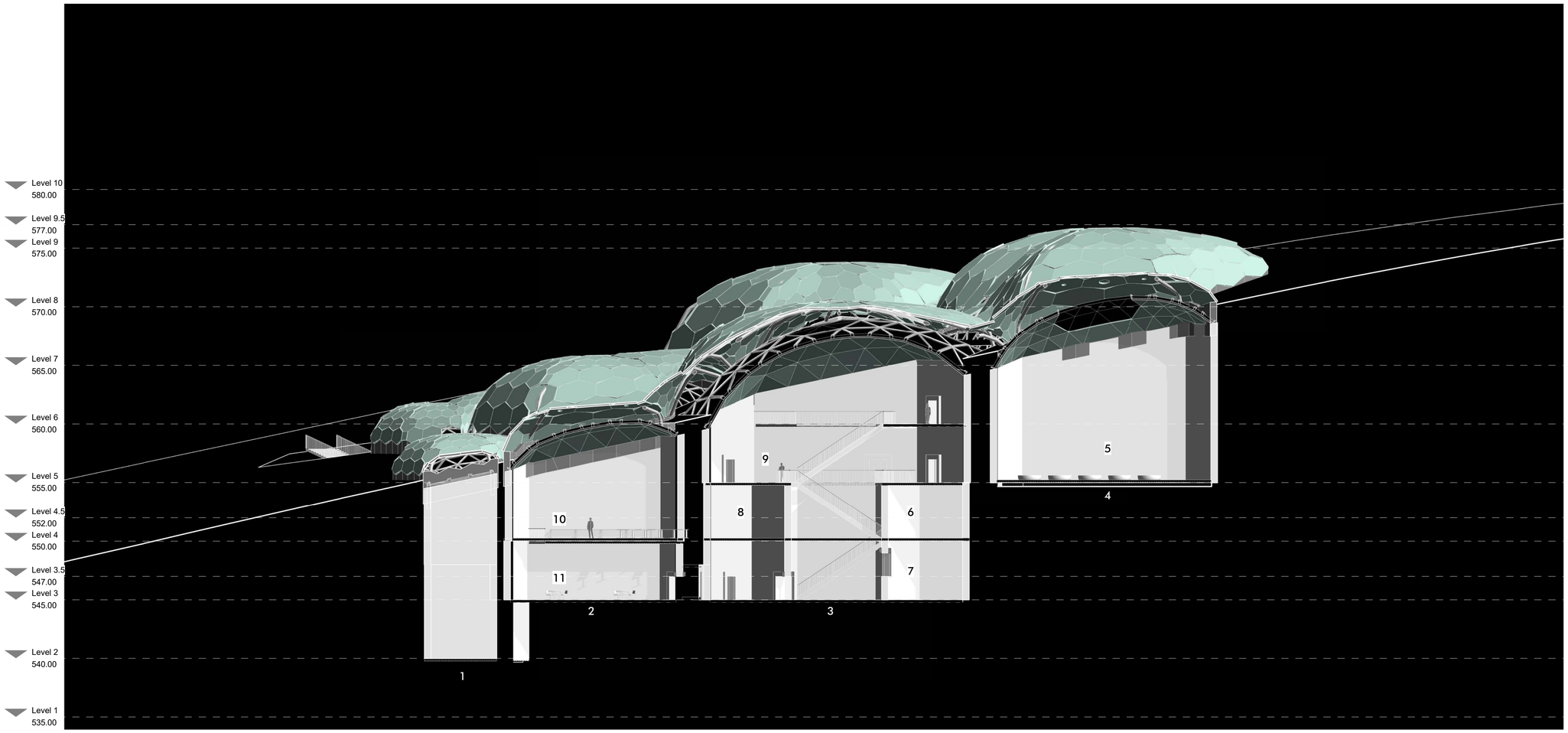
Elevation from South

DRAWING NUMBER

A108

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 200		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21



SOUTH CROSS SECTION_1 : 200

LEGENDS
1 UNDERGROUND CONNECTION
2 CELLULAR AGRICULTURE
3 STORAGE
4 WATER LIFE FARMING
5 FARMING AREA
6 FOOD PRODUCTION ROOM
7 WATER RECYCLE AND REGENERATION
8 STORAGE
9 STOCK - EXCHANGE AREA
10 SUPPORT AREA
11 ADMIN OFFICE

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MASTER IN ADVANCE COMPUTATION FOR ARCHITECTURE AND DESIGN

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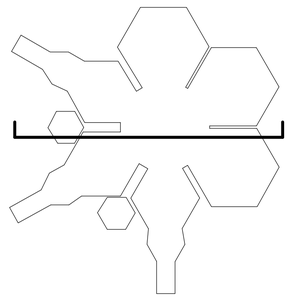


ALEXANDER TONG
DONGYUB LEE
NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER
LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM



PROJECT
LEAF

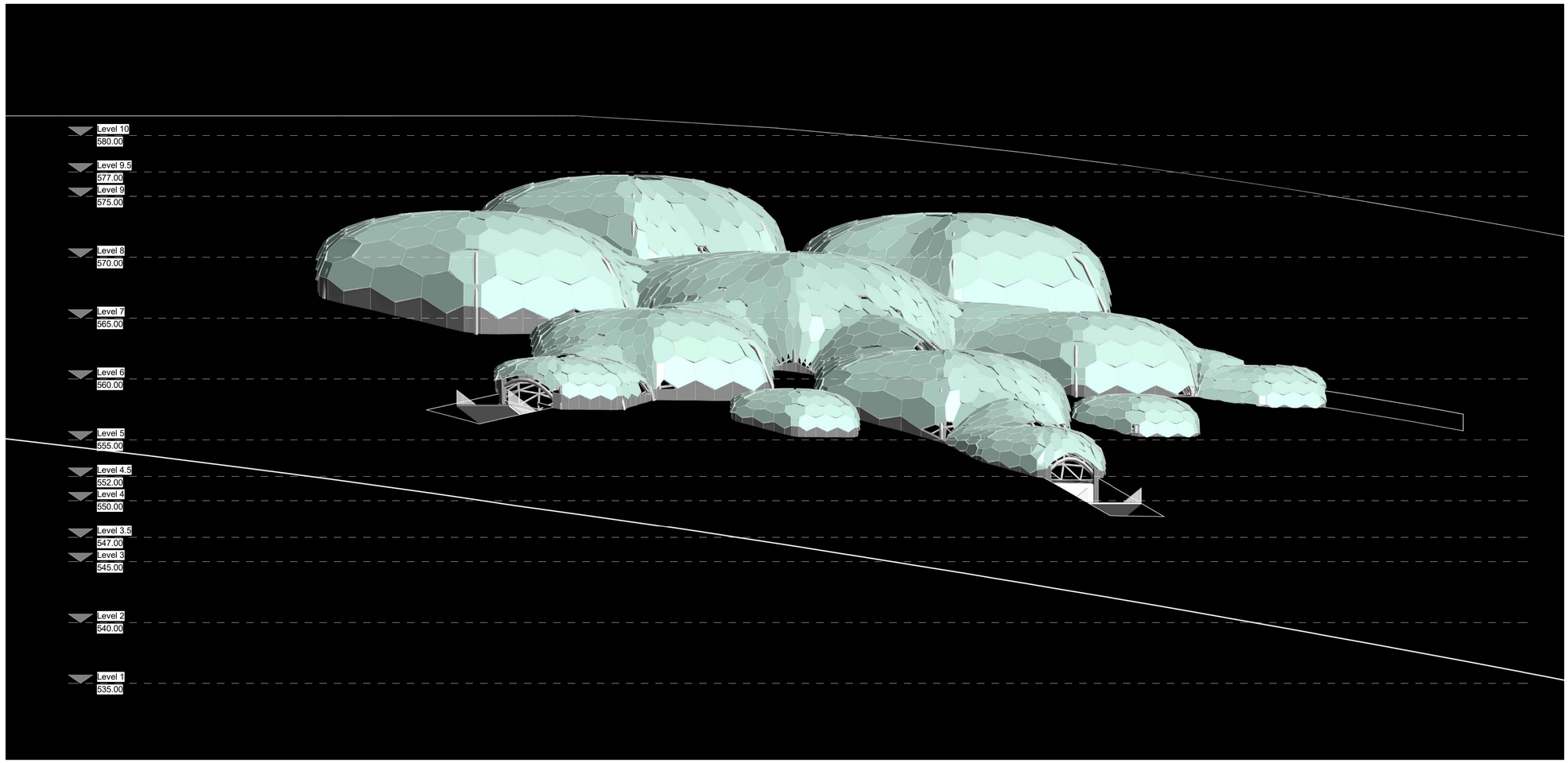
CLIENT
MaCAD BIMSC

SHEET NAME
Cross Section A

DRAWING NUMBER
A109

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 200		Project Number

DRAWN BY	CHECKED BY	DATE
Author	**Checker**	**03/10/21**



WEST ELEVATION_1 : 200

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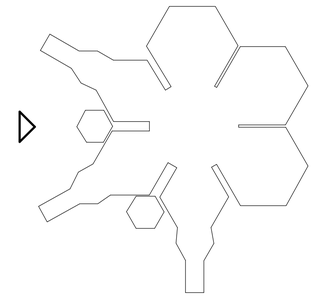
ALEXANDER TONG | DONGYUB LEE | NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM



PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

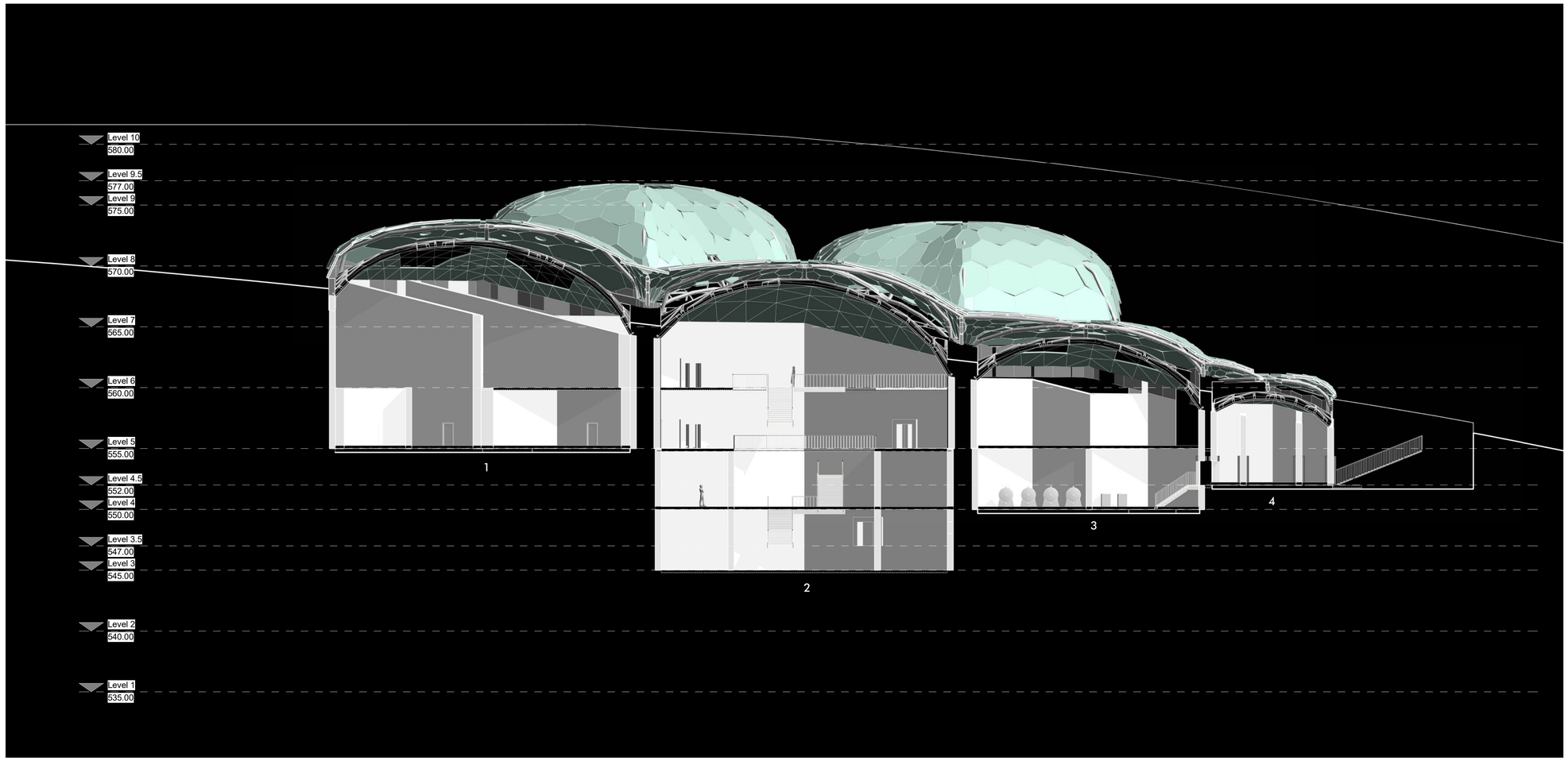
Elevation from West

DRAWING NUMBER

A110

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 200		Project Number

DRAWN BY	CHECKED BY	DATE
Author	**Checker**	**03/10/21**



WEST SECTION_1 : 200

LEGENDS
1 VEGETATION FARM
2 STORAGE
3 ADMIN AND WASTE MANAGEMENT
4 ENERGENCY SHELTER ENTRANCE

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LEAF space farm

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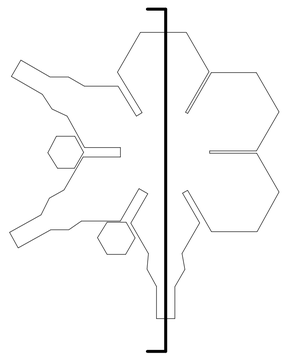


ALEXANDER TONG
DONGYUB LEE
NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER
LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM



PROJECT
LEAF

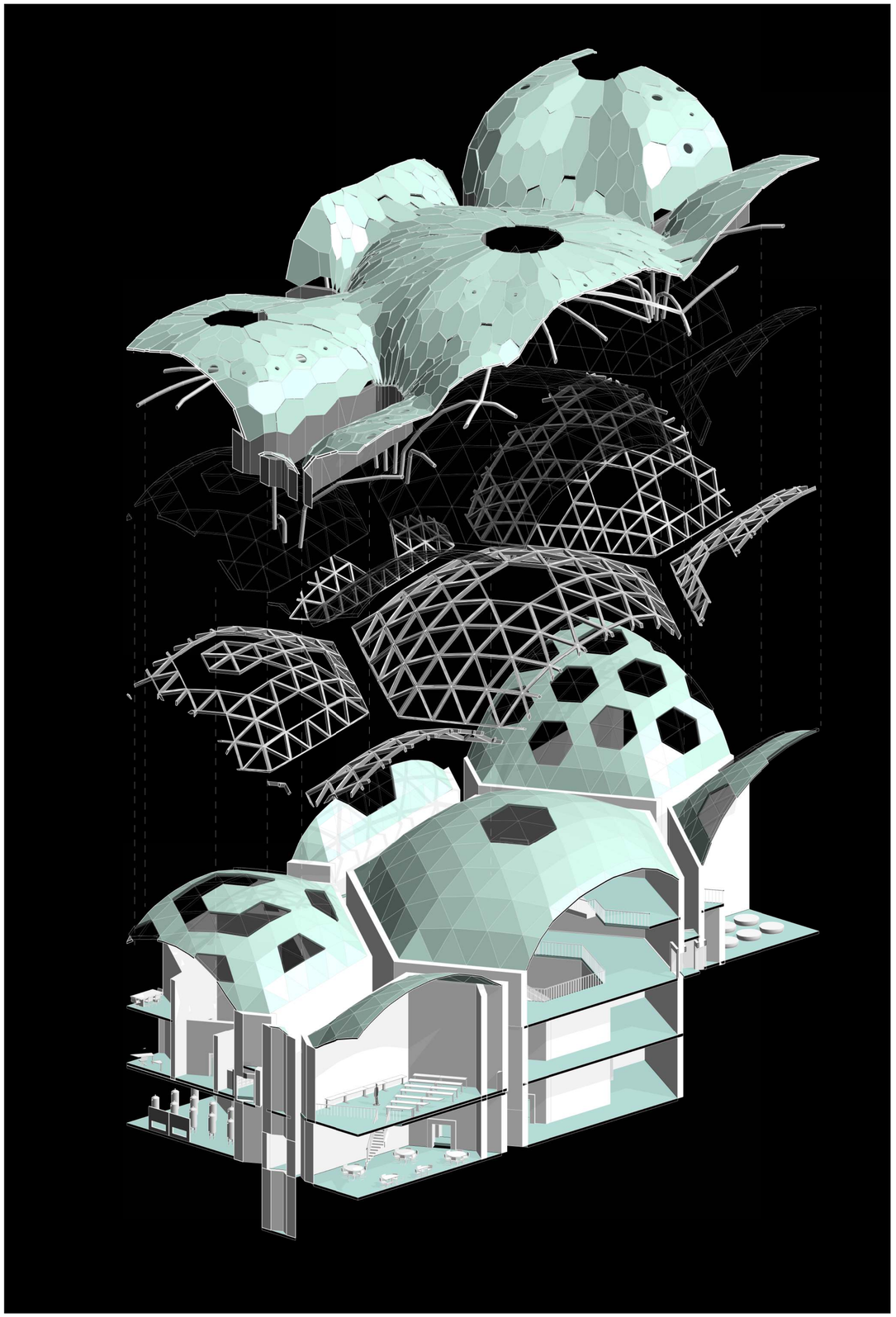
CLIENT
MaCAD BIMSC

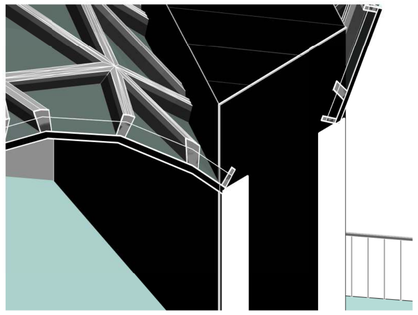
SHEET NAME
Cross Section B

DRAWING NUMBER
A111

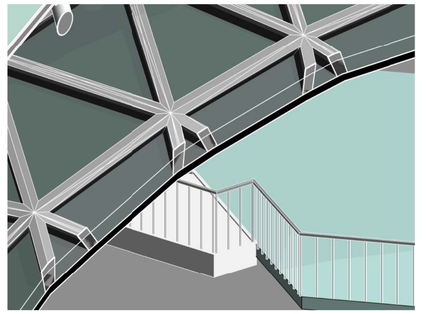
SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 200		Project Number

DRAWN BY	CHECKED BY	DATE
Author	**Checker**	**03/10/21**

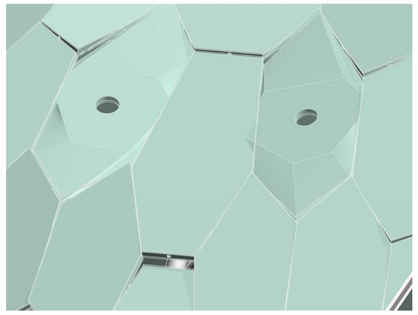




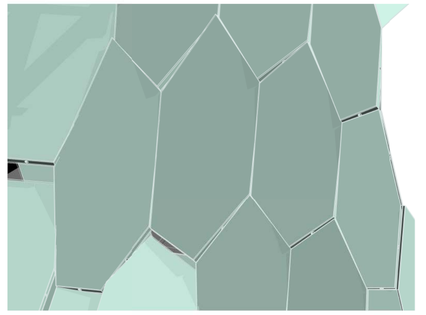
1. ANCHOR POINTS STRUCTURE
The Inner shell structurally connected to the 3d printed wall including the anchor point of the inflated membrane where initially functioning for pressurizing the internal atmosphere.



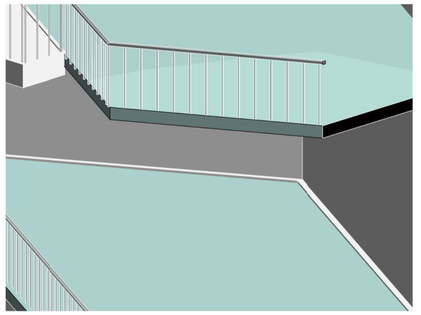
2. SHELL STRUCTURE
The Inner shell consists of 3 layers including inflated membrane, structural framing, and glass panel integrated with regolith 3d printed over the inflated membrane.



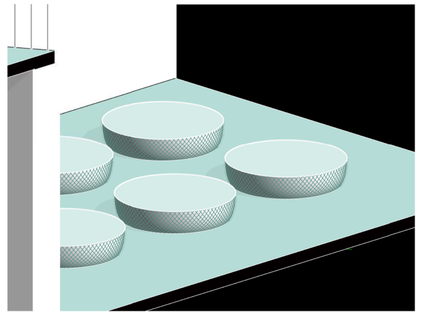
3. Outer Shell Paneling
The outershell paneling has been constructed the same way as Igloo construction where the panel connected at the edge and structurize as a dome.



4. Inner Shell Opening
Integrated with the Outer shell system, the opening areas are designed at the specific location according to the interior programs.



5. Interior 3d printed
All the interior structure were printed by moon regolith which the project used the soil and chemically extract into lunacrete for 3d printing.



6. 3d printed furnitures
As well as furnitures and tools for farming also were printed by the material extractions from the moon regolith.

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MASTER IN ADVANCE COMPUTATION FOR ARCHITECTURE AND DESIGN

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// GROUP NUMBER **07**



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// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER
LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

PROJECT
LEAF

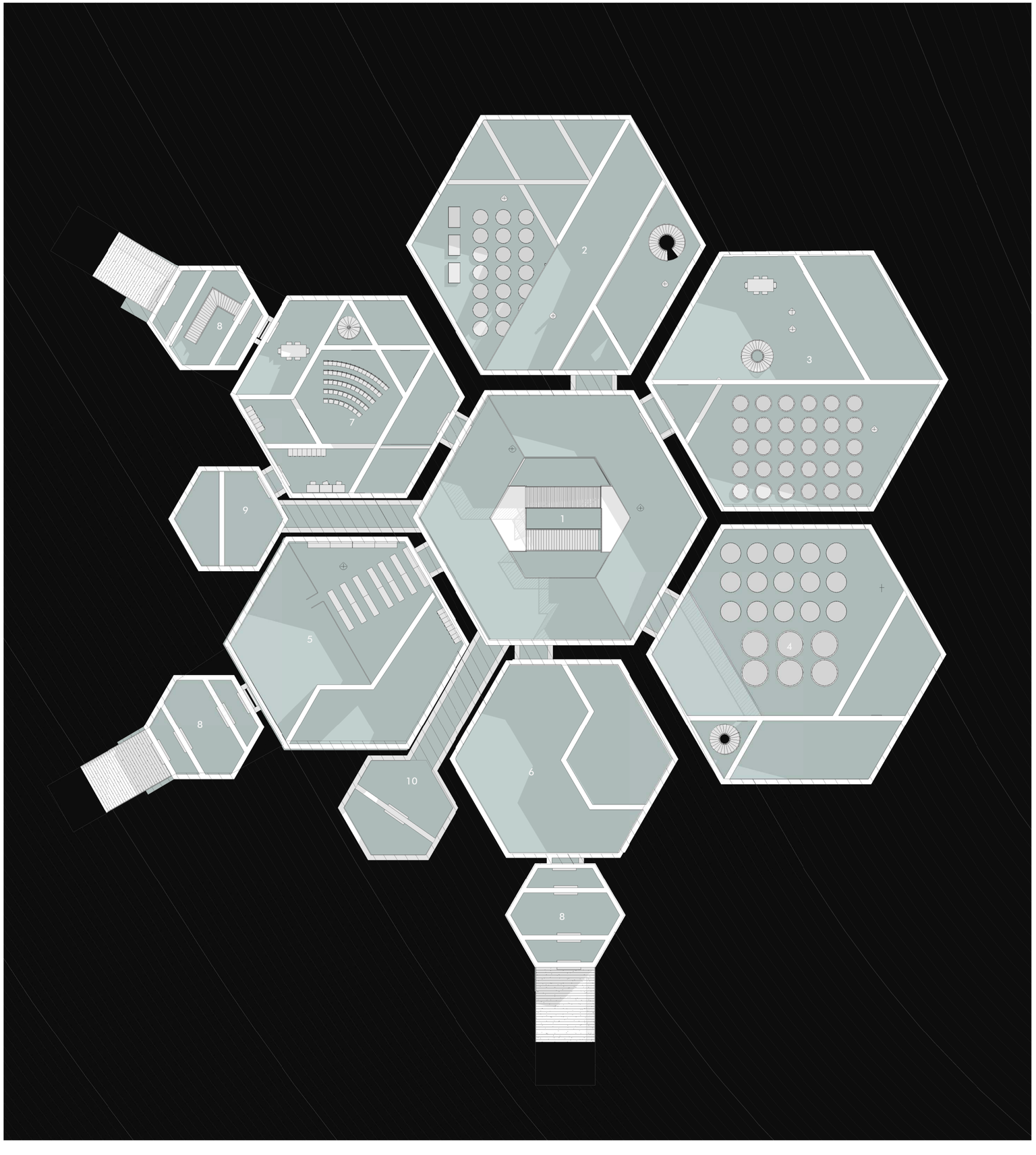
CLIENT
MaCAD BIMSC

SHEET NAME
Close Up Elements

DRAWING NUMBER
A112

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21



PROGRAM AREA ARRANGEMENT

Program Schedule		
Department	Name	Area
Admin		
Admin	Auditorium	73 m²
Admin	Main Lobby	53 m²
Admin	Office	36 m²
Admin	Germination Room	34 m²
Admin	Clean Storage	25 m²
Admin	Meeting Room	22 m²
Admin	Changing Room	21 m²
Admin	Toilet	9 m²
Cellular Agriculture		
Cellular Agriculture	Cellular Lab	117 m²
Cellular Agriculture	Bioreactor	108 m²
Cellular Agriculture	Lab and Storage	103 m²
Entrance		
Entrance	Front Entrance	38 m²
Entrance	Airlock	33 m²
Entrance	Front Entrance	33 m²
Entrance	Entrance	14 m²
Entrance	Front Entrance	12 m²
Entrance	Entrance	12 m²
Entrance	Airlock	12 m²
Entrance	Airlock	12 m²
Entrance	Entrance	9 m²
Fish		
Fish	Growth Rack	269 m²
Fish	Work Area	57 m²
Fish	Nutrient Storage Tank	56 m²
Fish	Packing Room	38 m²
Fish	Control Room	21 m²
Fish	Germination Room	17 m²
Fungi		
Fungi	Growth Rack	209 m²
Fungi	Working Area	60 m²
Fungi	Nurseries	38 m²
Fungi	Nutrient Storage	38 m²
Fungi	Packing Room	37 m²
Fungi	Control Room	20 m²
Fungi	NDS Room	20 m²
Fungi	Storage	17 m²
Fungi	Lab	17 m²
Fungi	Germination Room	16 m²
Insect		
Insect	Growth Rack	231 m²
Insect	Working Area	62 m²
Insect	Nurseries	43 m²
Insect	Control Room	43 m²
Insect	Packing Room	41 m²
Insect	Nutrient Storage Tank	22 m²
Insect	NDS Room	21 m²
Insect	Lab	20 m²
Life Support		
Life Support	Water Buffer Tank	90 m²
Life Support	Supply Room	89 m²
Life Support	CO2 Tank	89 m²
Storage		
Storage	Food Storage	197 m²
Storage	Food Production Area	149 m²
Storage	Storage Area	Not Placed
Storage	Supply Area	Not Placed
Vegetation		
Vegetation	Growth Rack	205 m²
Vegetation	Work Area	58 m²
Vegetation	Packing Room	37 m²
Vegetation	Storage	37 m²
Vegetation	Nutrient Storage Tank	37 m²
Vegetation	Germination Room	17 m²
Vegetation	Nurseries	17 m²
Vegetation	NDS Room	17 m²
Vegetation	Control Room	17 m²
Vegetation	Laboratory	17 m²
Waste Management		
Waste Management	Waste Treatement	202 m²
Waste Management	Waste Collection	96 m²

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LEAF space farm

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ALEXANDER TONG

DONGYUB LEE

NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

LEGENDS
1 STORAGE
2 VEGETABLE
3 INSECT
4 FISH
5 CELLULAR AGRICULTURE
6 LIFE SUPPORT
7 ADMIN
8 EMERGENCY ENTRANCE
9 UNDERGROUND CONNECTION
10 UNDERGROUND LABORATORY

PROJECT

LEAF

CLIENT

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SHEET NAME

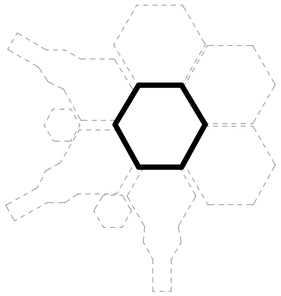
Top View Plan

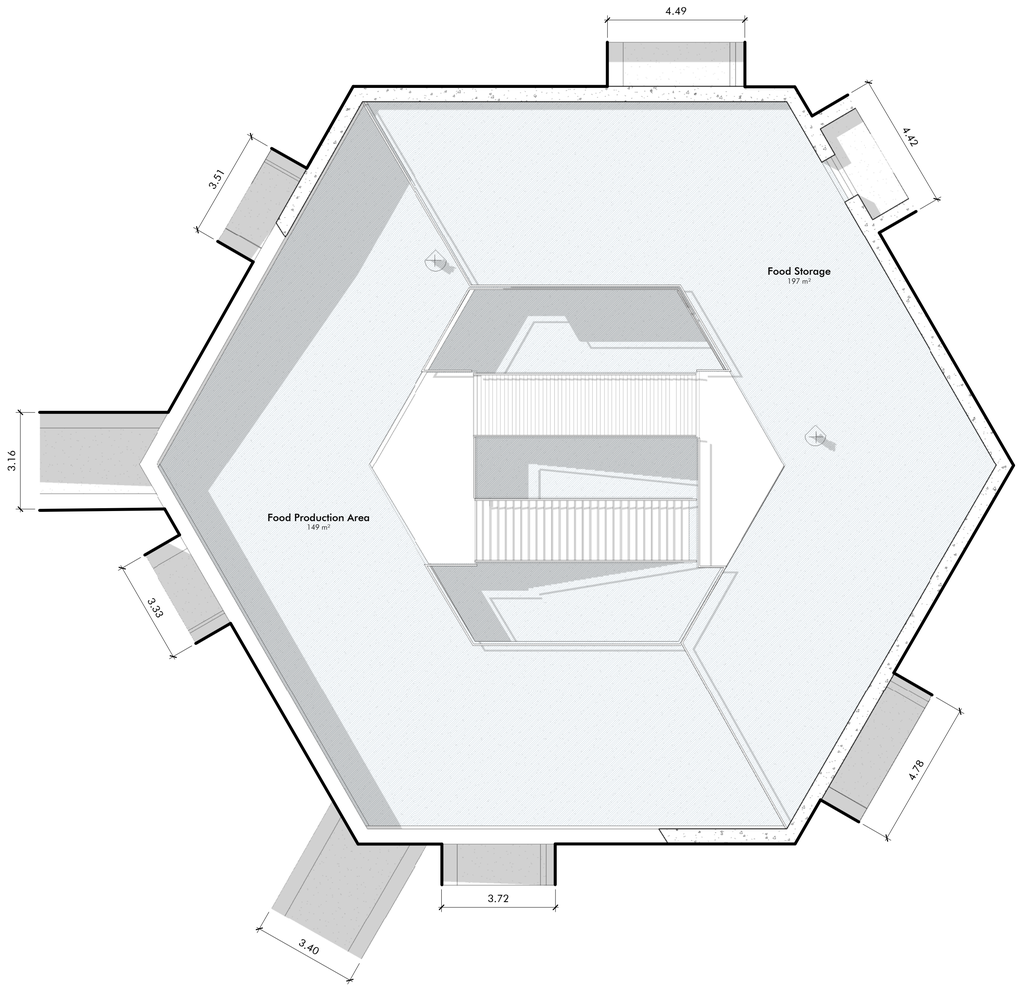
DRAWING NUMBER

A113

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

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Author	Checker	03/10/21





STORAGE

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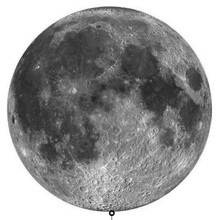
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DONGYUB LEE
NAWAPAN SUNTORACHAI

// PROJECT LOCATION



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PROJECT
LEAF

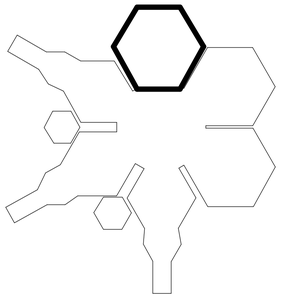
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MaCAD BIMSC

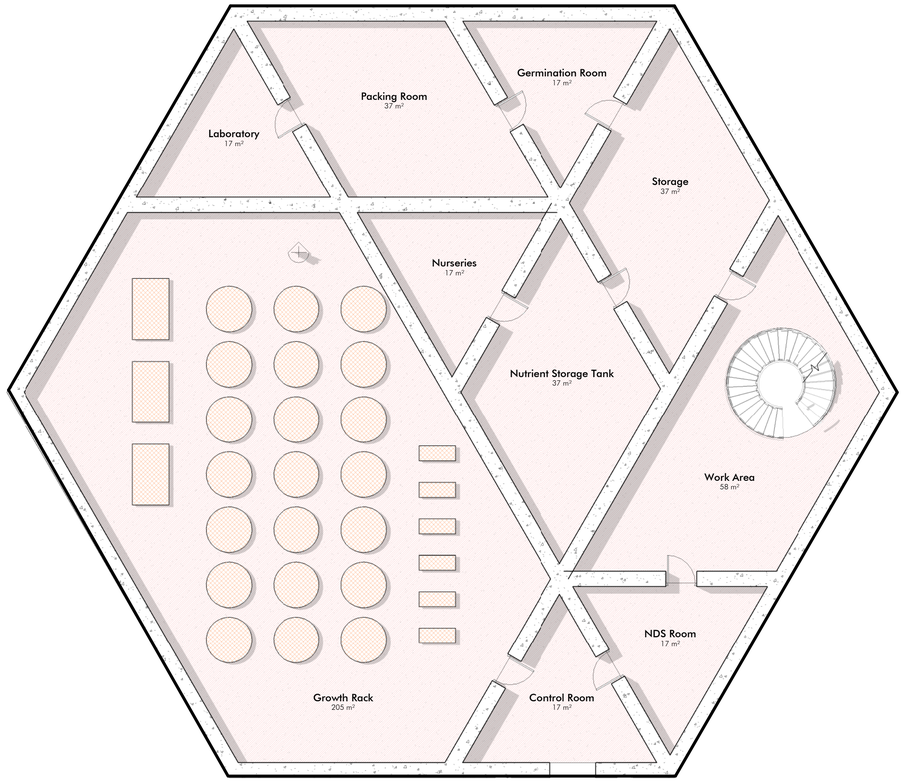
SHEET NAME
Storage

DRAWING NUMBER
A114

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21





VEGETABLE FARM

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PROJECT

LEAF

CLIENT

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SHEET NAME

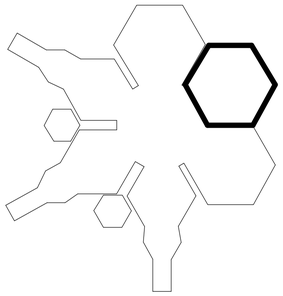
Vegetable

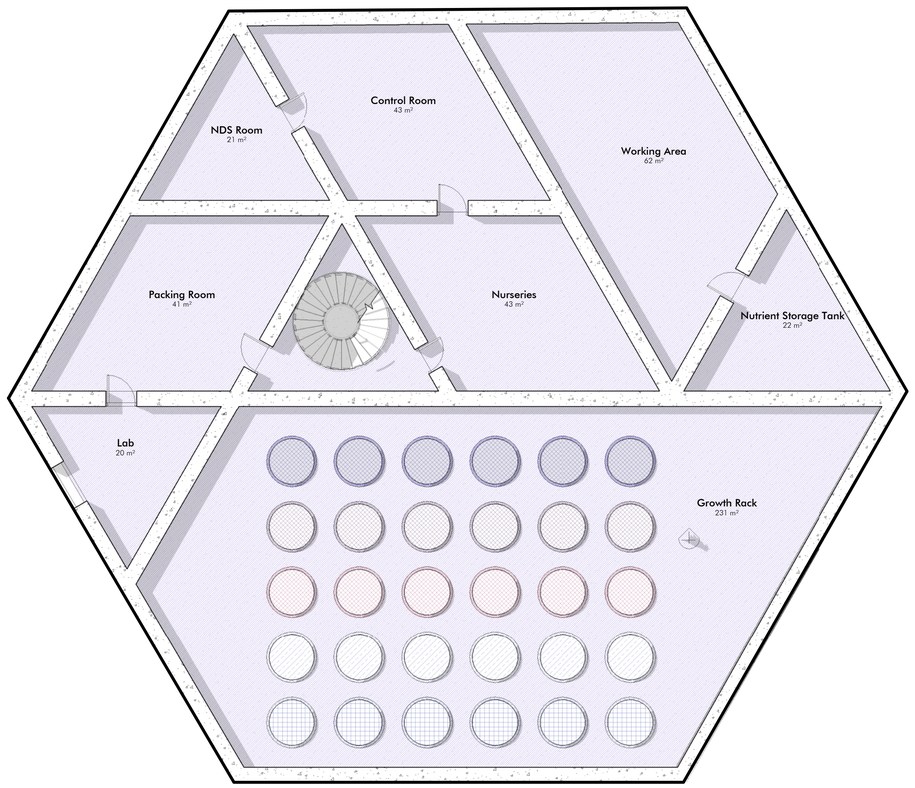
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SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

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Author	Checker	03/10/21





INSECT FARM

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PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

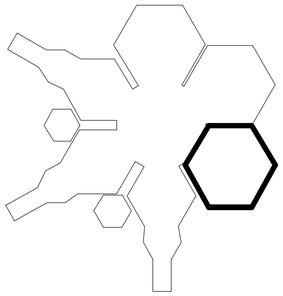
Insect

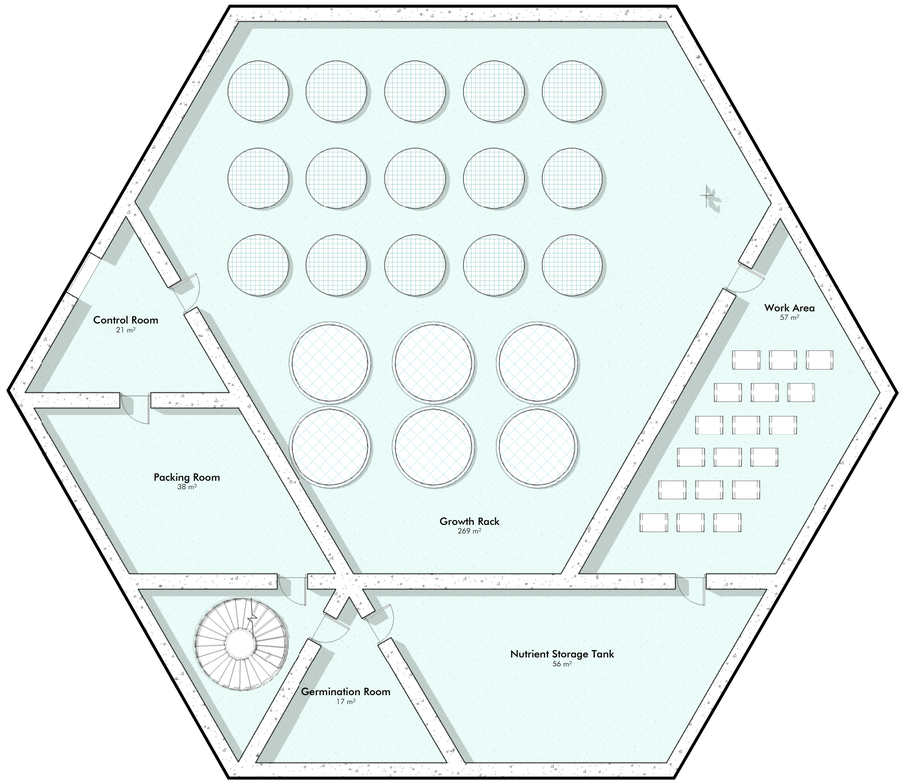
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A116

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

DRAWN BY	CHECKED BY	DATE
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FISH FARM

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THE MOON + SOUTH POLE + SHACKLETON CRATER

LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

PROJECT

LEAF

CLIENT

MaCAD BIMSC

SHEET NAME

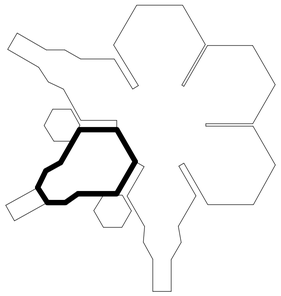
Fish

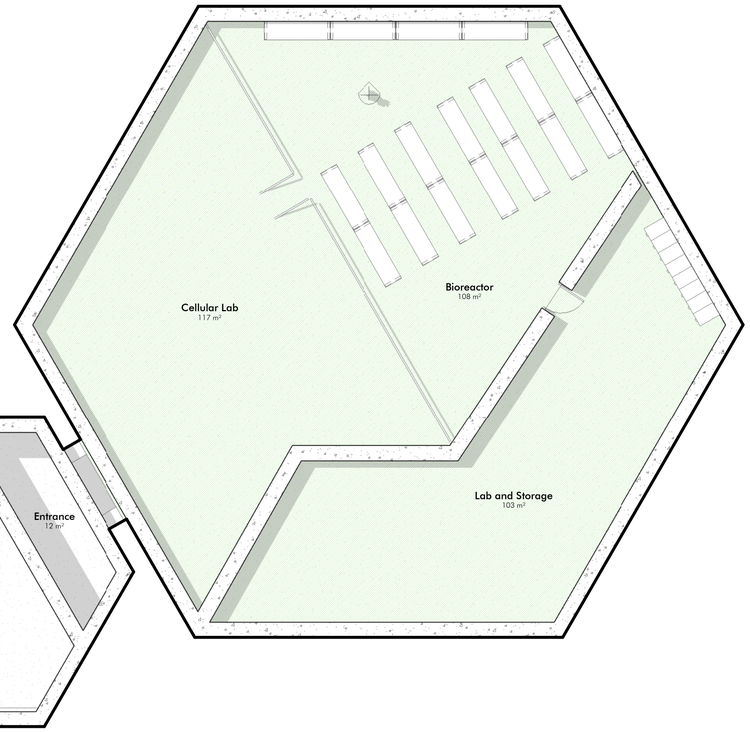
DRAWING NUMBER

A117

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

DRAWN BY	CHECKED BY	DATE
Author	**Checker**	**03/10/21**





CELLULAR AGRICULTURE FARM LAB

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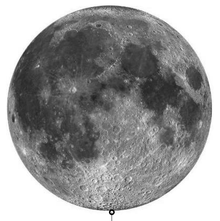


ALEXANDER TONG

DONGYUB LEE

NAWAPAN SUNTORACHAI

// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

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PROJECT

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CLIENT

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SHEET NAME

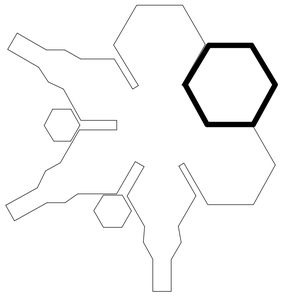
Cellular Agriculture

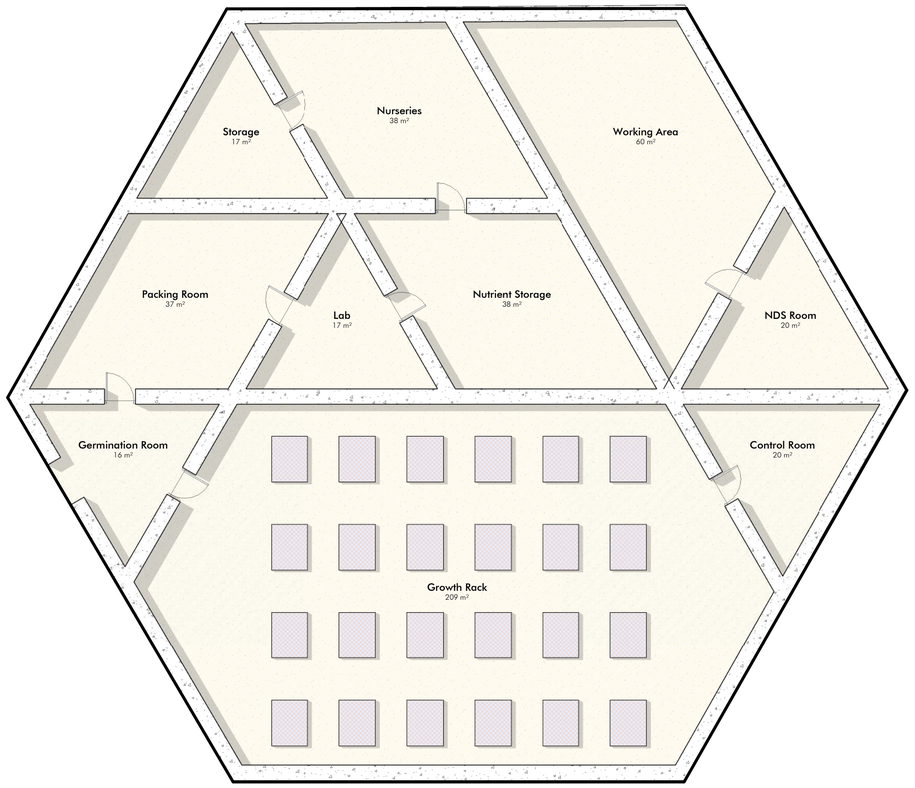
DRAWING NUMBER

A118

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

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Author	**Checker**	**03/10/21**





FUNGI LAB

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PROJECT

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SHEET NAME

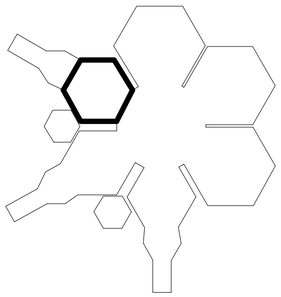
Fungi

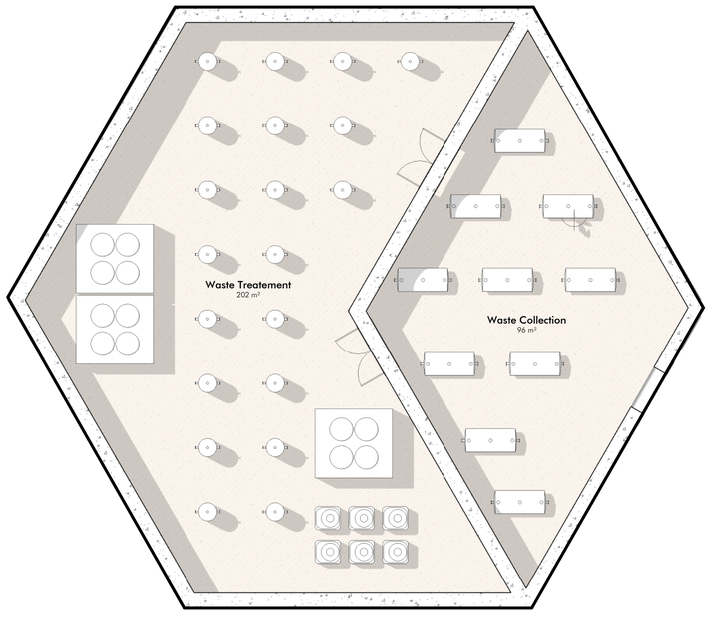
DRAWING NUMBER

A119

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21





WASTE MANAGEMENT AREA

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// PROJECT LOCATION



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LOCATION: 89.90°S + 0.00°E // SIZE: 19.2 KM

PROJECT
LEAF

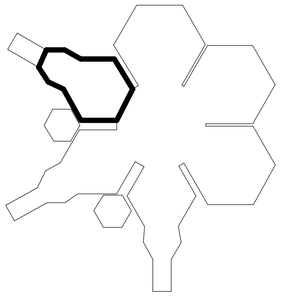
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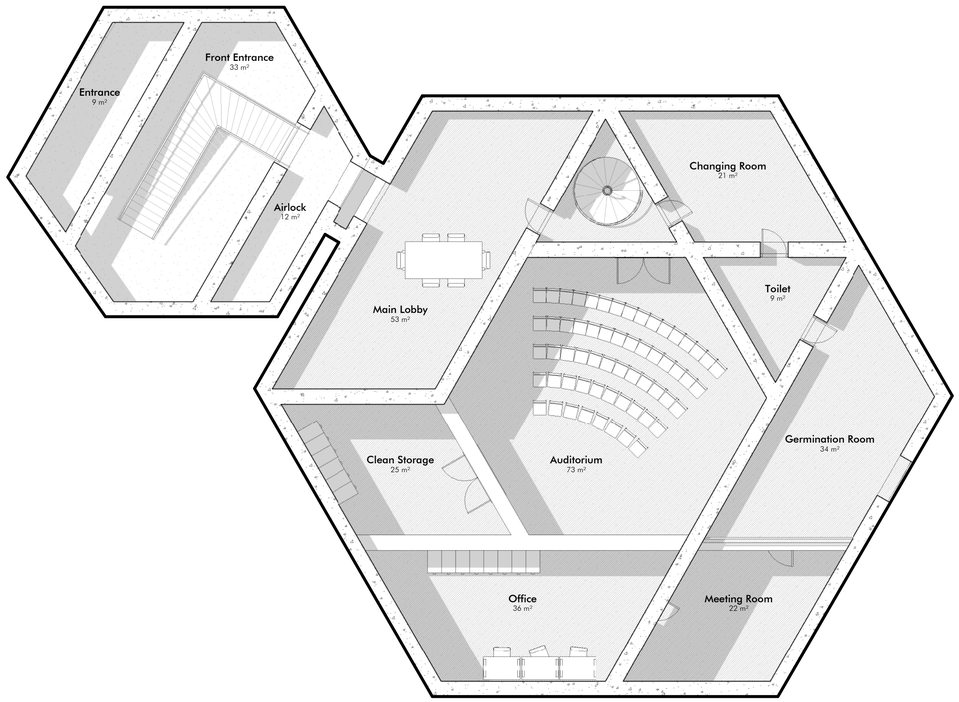
SHEET NAME
Waste Management

DRAWING NUMBER
A120

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21





ADMIN

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// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

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PROJECT

LEAF

CLIENT

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SHEET NAME

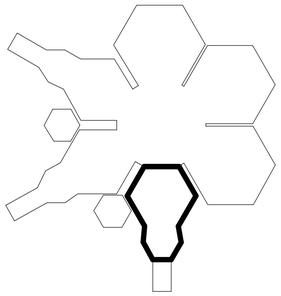
Admin

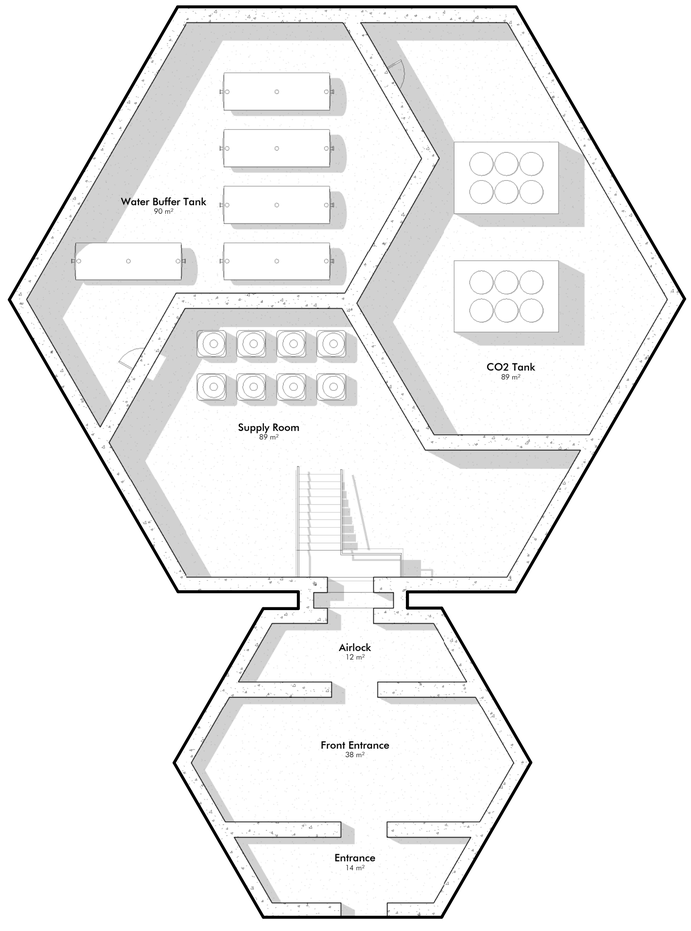
DRAWING NUMBER

A121

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21





LIFE SUPPORT CENTER

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// PROJECT LOCATION



THE MOON + SOUTH POLE + SHACKLETON CRATER

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PROJECT

LEAF

CLIENT

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SHEET NAME

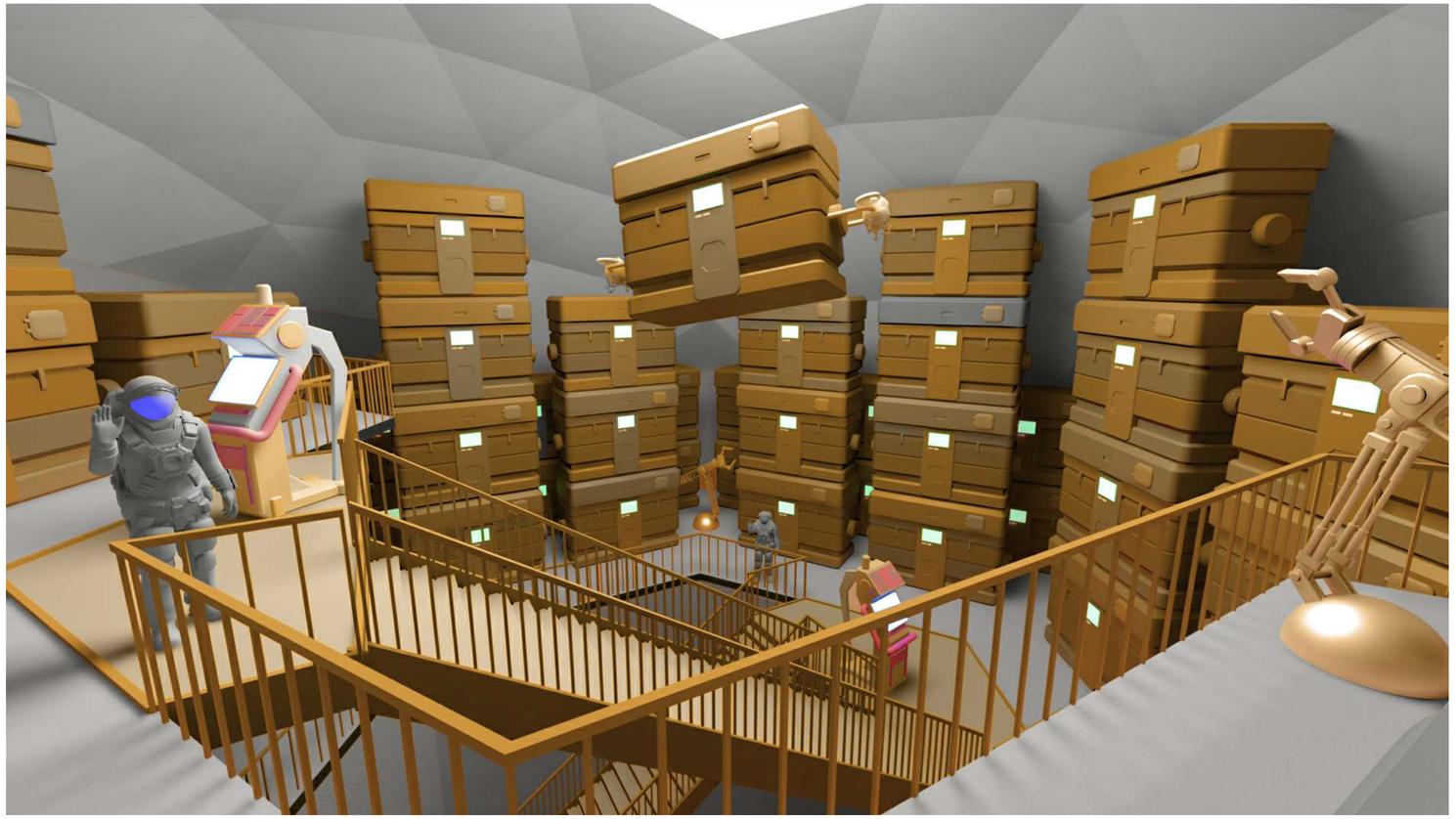
Life Support

DRAWING NUMBER

A122

SCALE (@ A1)	REVISION	PROJECT NUMBER
1 : 100		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/10/21



Storage
Starting from the center of building with storage where all the tools, building construction materials and food production are operated in this module.



Vegetable Farm
Vegetable Farm takes solar energy and carbon dioxide from the settlement to create carbohydrates for the astronauts. Grey water from the settlement is used to water the vegetables and human waste provides the necessary nutrients. The Farm has an area of 500m2 with an additional mezzanine level of 250m2 for future expansion.

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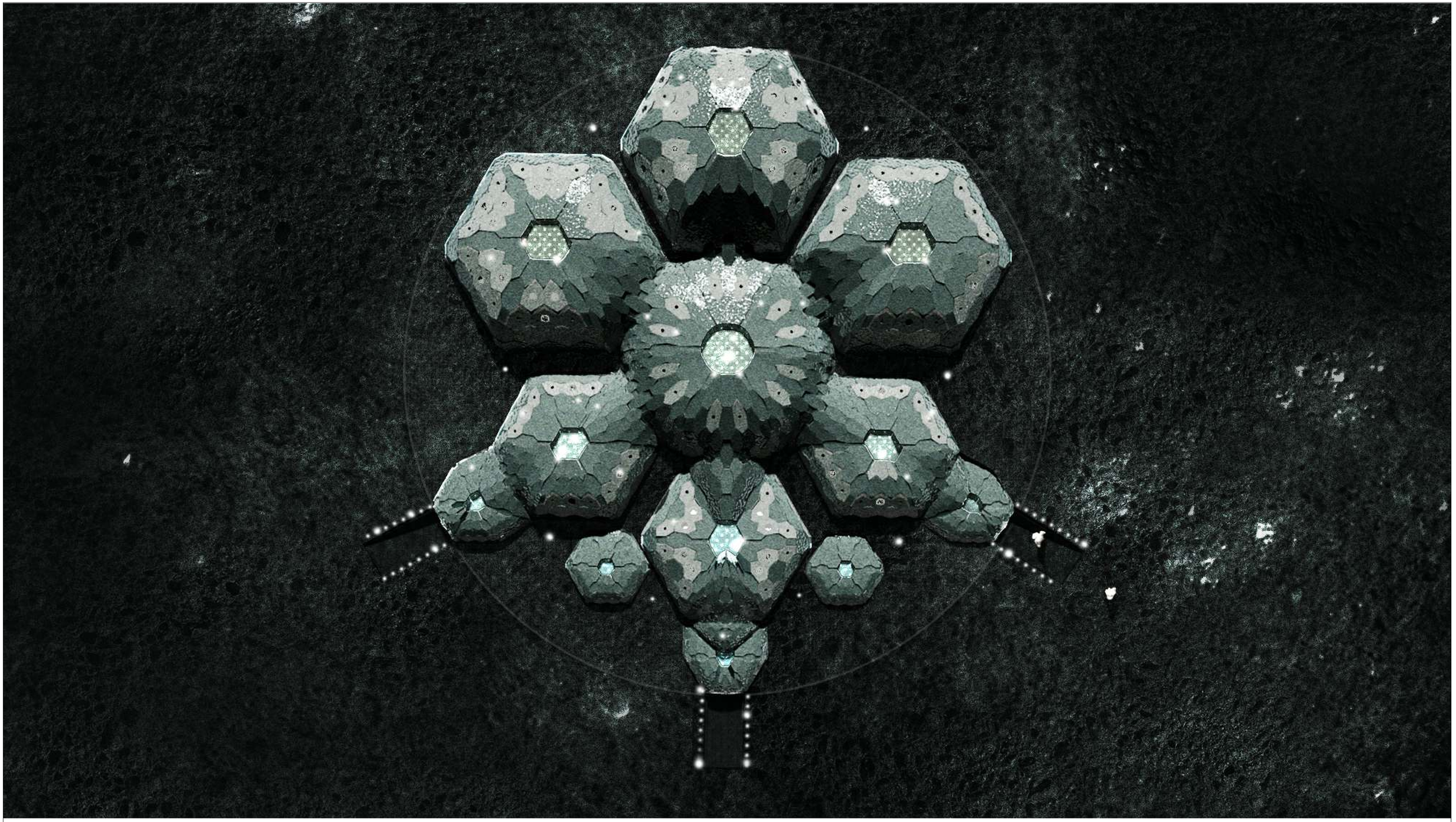
CLIENT
MaCAD BIMSC

SHEET NAME
Interior

DRAWING NUMBER
A123

SCALE (@ A1)	REVISION	PROJECT NUMBER
		Project Number

DRAWN BY	CHECKED BY	DATE
Author	Checker	03/24/21



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LEAF space farm

LUNA ENHANCEMENT AND AGRICULTURAL FARMING
Shackleton Crator, Moon
LEAF Crews: Alexander Tong, Dongyub Lee, Nawapan Suntorachai

IaaC - Institute for Advanced Architecture of Catalonia
MaCAD BIMSC 2020/2021
Studio Lead Faculty : David Leon & Faculty : Oana Taut
Integrative Modeling Lead Faculty: Ardeshir Talaei & Faculty : Sepehr Farzaneh



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LEAF space farm

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