EUROPA ONE

Exploring Europa: The Quest for Extraterrestrial Life

2023 JACQUES ROUGERIE FOUNDATION AWARDS

Award's category : Architecture and Innovation for Space

Project's Name

Europa One

Description

Exploring Europa: The Quest for Extraterrestrial Life

FONDATION JACQUES ROUGERIE
GÉNÉRATION ESPACE MER
ACADÉMIE DES BEAUX-ARTS

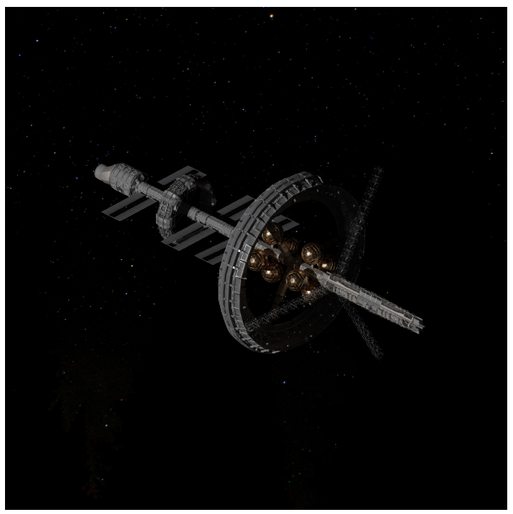
EUROPA ONE

Introduction

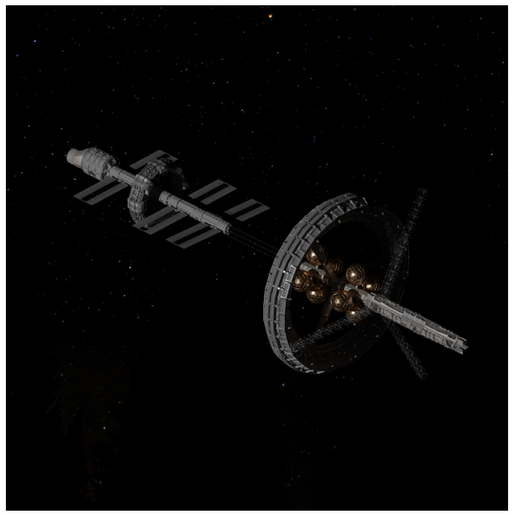
This project encapsulates a symbiotic convergence of function and design, offering a multifaceted haven catering to habitation, recreation, and exploration requisites. This elongated structure juxtaposes the icy core surface and the oceanic subsurface structures and bridges the gap between them by incorporating a hyperloop orchestrating fluid connectivity and transportation efficiency while fostering a comprehensive framework for lunar living and exploration.

Mission Goal and Implementation

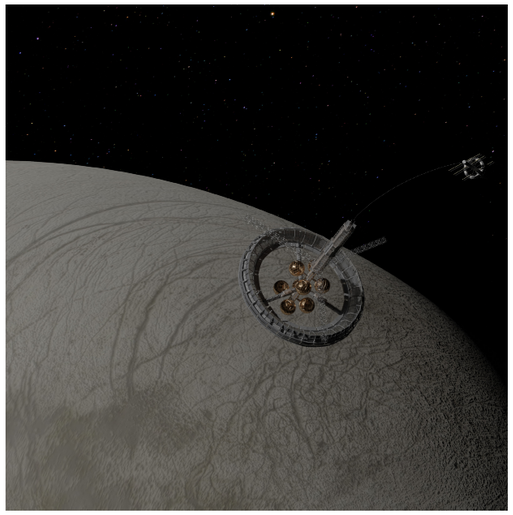
Our primary objective is to conceive a self-sustaining edifice, one that ingeniously engineers and dynamically accommodates Earth-sourced composites to the unique conditions of Europa, functioning autonomously. Through this ambitious endeavor, our purpose is to cultivate an environment conducive to sustaining life on Europa, while proactively envisioning forthcoming technological progressions. Our aspiration encompasses the establishment of a secure habitat that not only remains in strict alignment with the foundational principles of physics but also takes into profound consideration the intricacies of human psychology. Our core vision is the creation of a structure that artfully emulates organic forms, thereby nurturing an ecosystem that harmonizes with the very essence of vitality itself.



Stage 1- Launch spacecraft to Europa



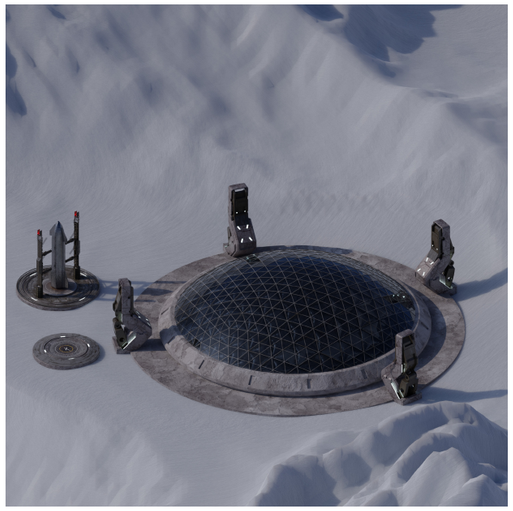
Stage 2- Europa Orbit insertion



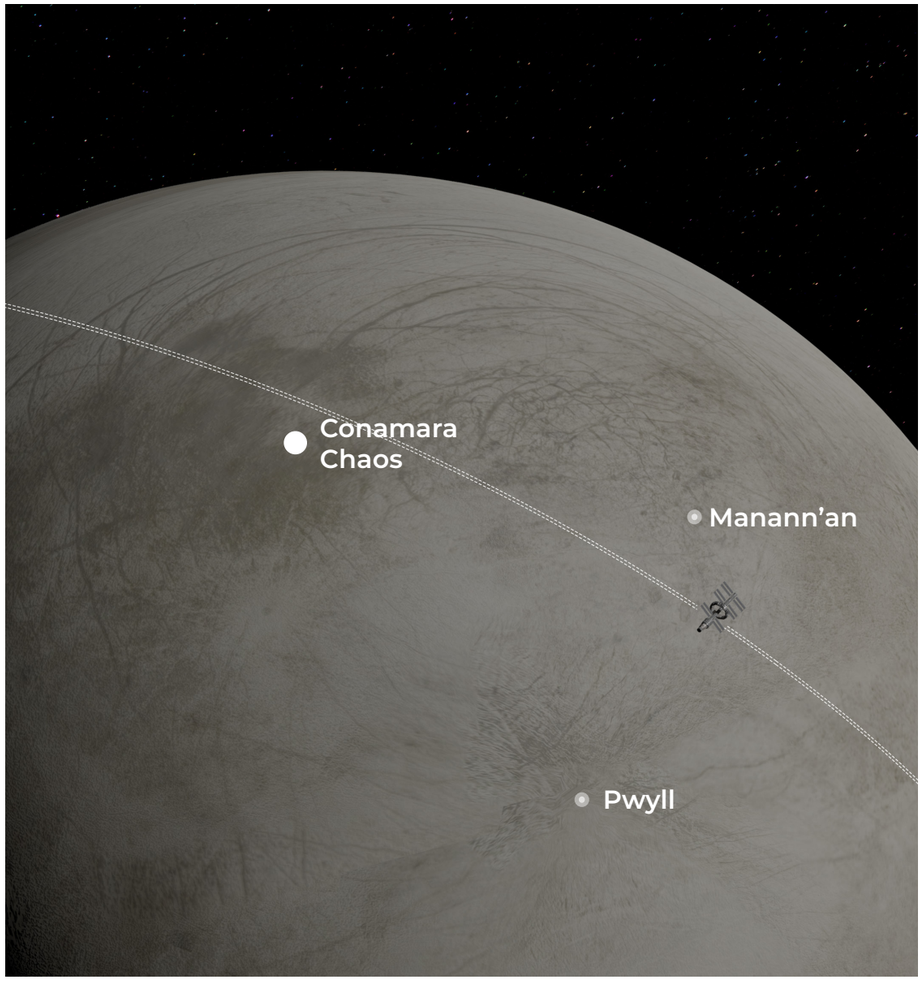
Stage 3- Soft landing on Europa

Stage 4- Assembling modules and manufacturing framework

Stage 5- Drilling hole for sub-surface's exploration



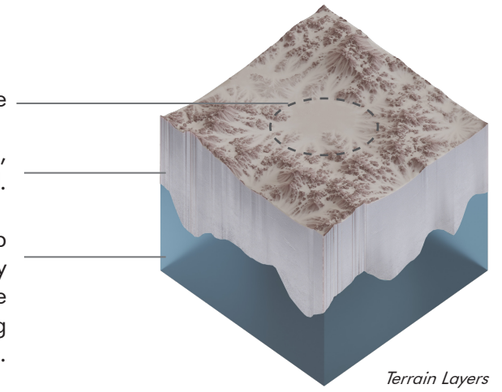
Stage 6- Activate research station, commence data collection



Europa potential landing sites

Conamara Chaos

The chosen site, Conamara Chaos, holds immense promise for a research station due to its fractured terrain granting potential access to Europa's sub-surface ocean, crucial for studying habitability and extraterrestrial life, and tidal forces maintaining liquid conditions. Tectonic activity additionally exposes materials, unveiling insights into the moon's composition and geological evolution.



Terrain Layers

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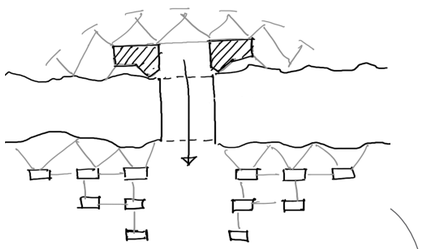
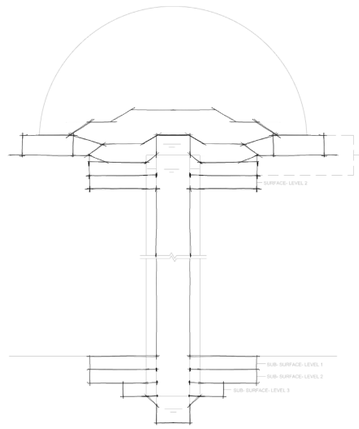
Design Concept

The concept originates from a necessity driven by the requirements and purpose of the space, coupled with the integration of nature's efficient resource utilization. Central to the idea is the notion of establishing a vertical linear passageway that enables systematic exploration of both surface and sub-surface domains. While prioritizing human necessities, the design offers a balance between structural adaptability and the provision of suitable environments for initiating life. The design iterates by extensively studying Europa's demanding climatic nuances and proactively resolving them via biomimicry integration within the architectural blueprint.

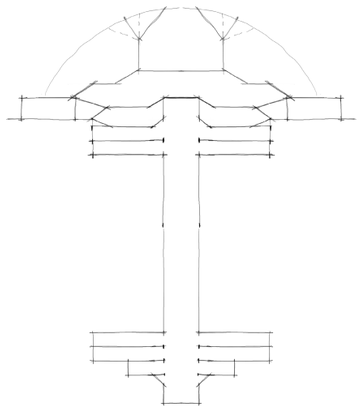
Form and Plan Development



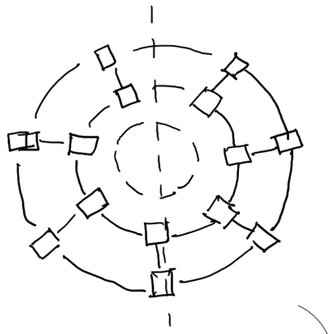
Step 1- Conceptualization



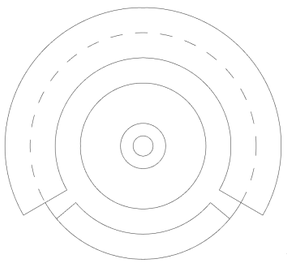
Step 2- Form Exploration



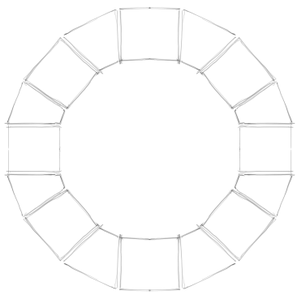
Step 3- Structural Optimization



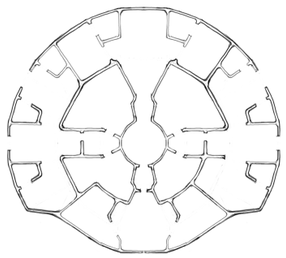
Step 1- Spatial Organization



Step 2- Interior Space Planning

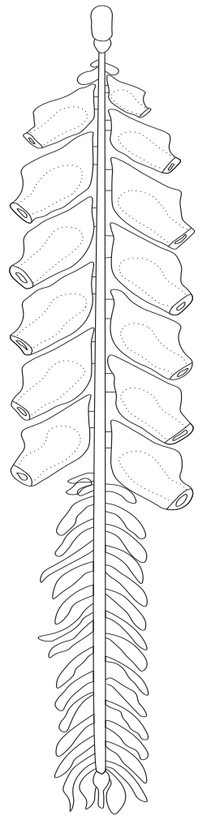


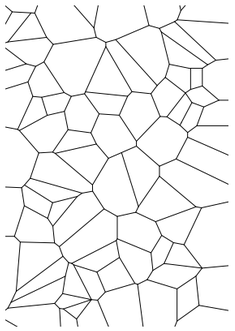
Step 3- Refinement



Step 4- Detailing

Biomimicry Inspiration and Integration

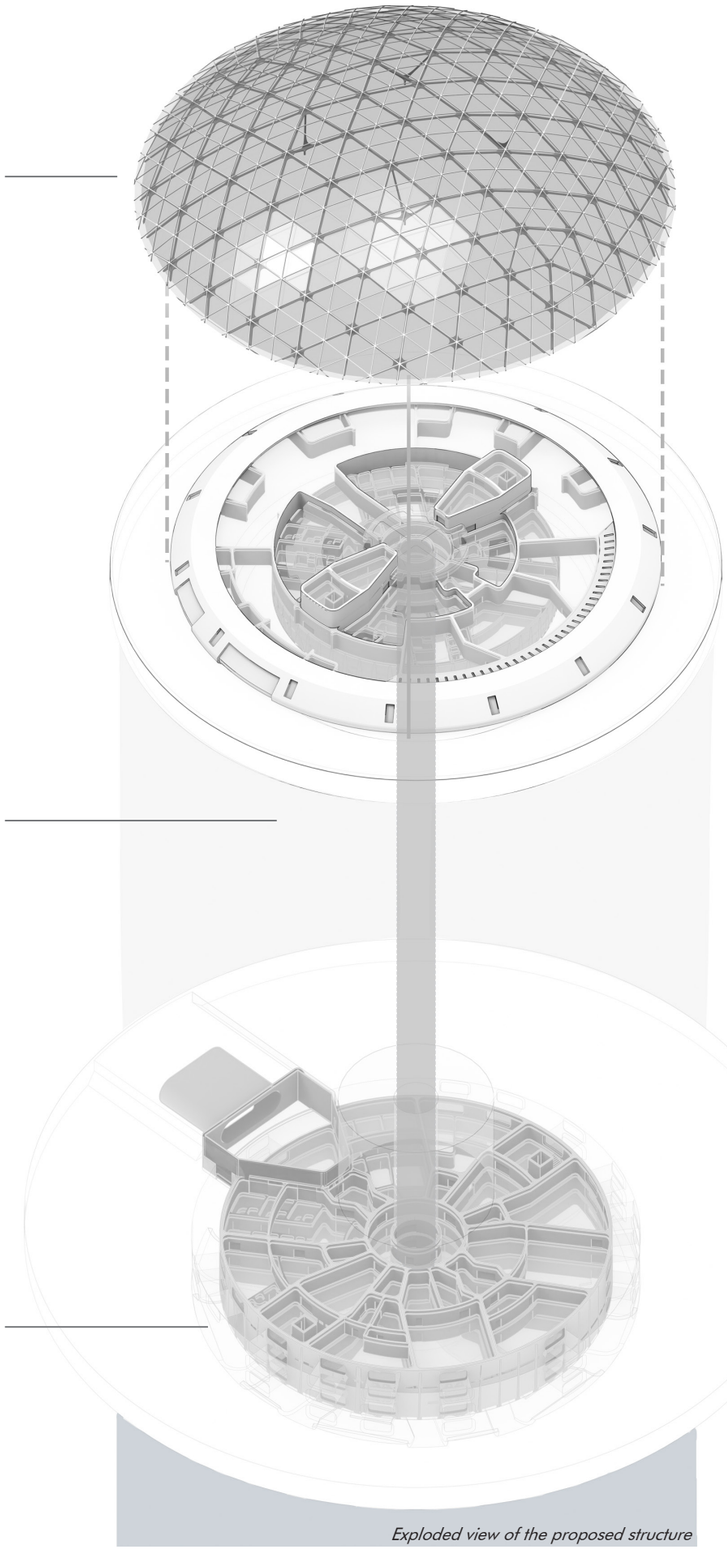




Framework: Bone structure, a highly evolved system, Dynamic Adaptation, Self healing, Composite Materials, Strength and flexibility.

Vertical Planning: Siphonophore, a colony composed of specialized individual zooids, working together as a single organism

Horixontal Planning: Voronoi cell pattern, a geometric arrangement of polygons where each polygon encompasses an area closest to a specific point



Exploded view of the proposed structure

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Surface Structure

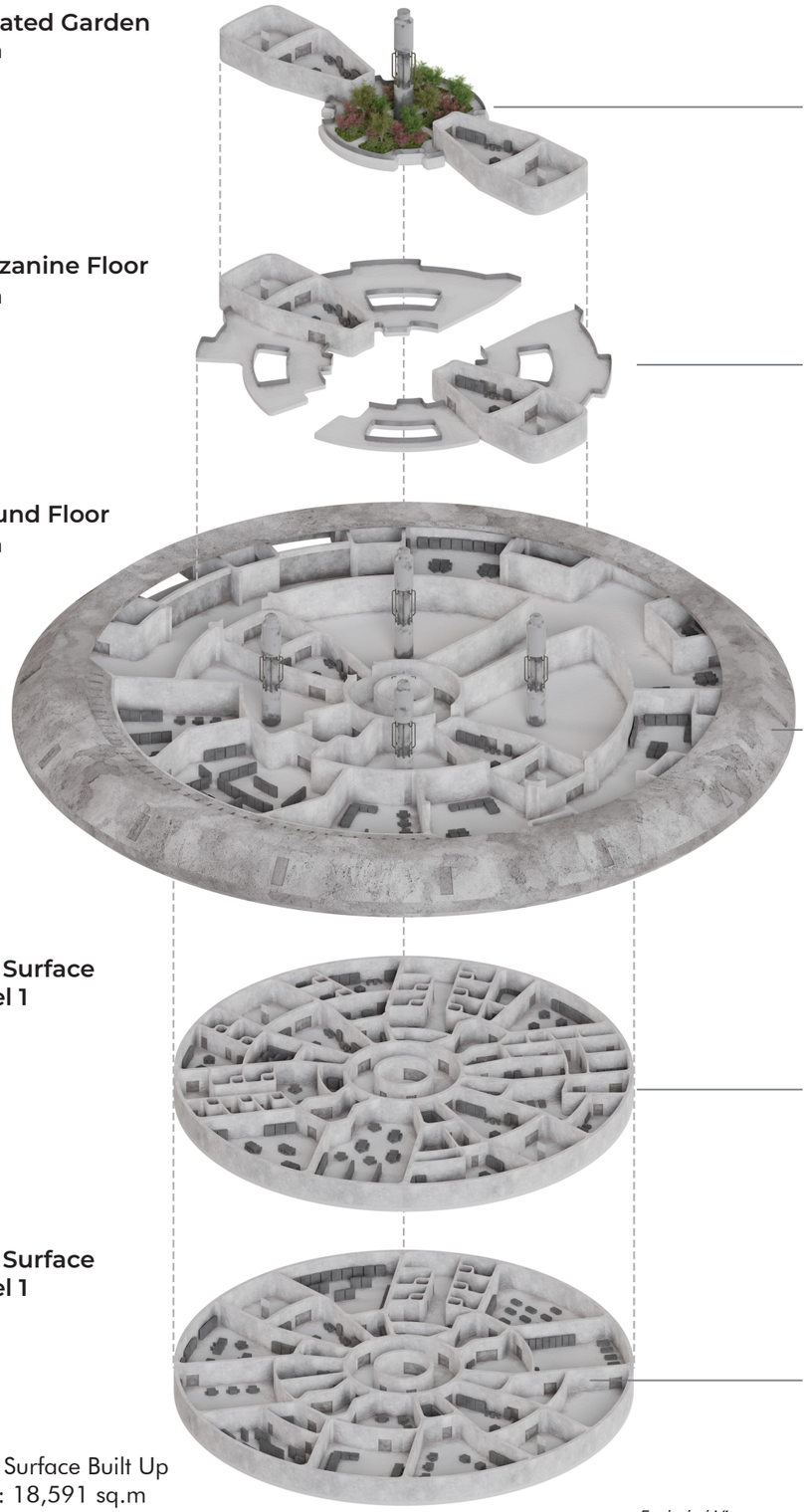
Elevated Garden
+8m

Mezzanine Floor
+4m

Ground Floor
±0m

Sub Surface Level 1
-4m

Sub Surface Level 1
-8m



Beneath the elevated gardens lies the crucial Life Support System

Hyperloop Terminal Floor

5000mm Exterior Regolith Shell provides thermal insulation and radiation shielding

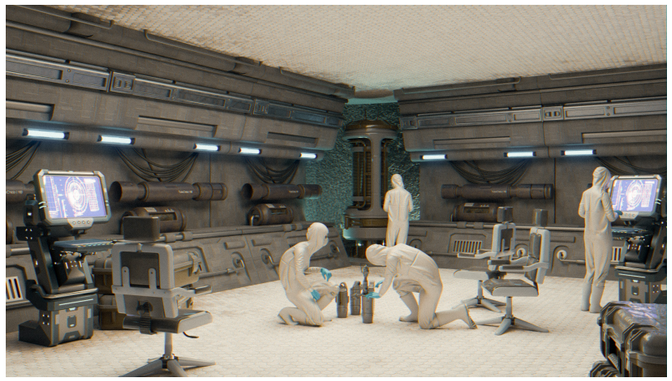
600mm Advanced Alloys + CFRP (Carbon Fibre Reinforced Polymer) External Walls with anti-icing coatings prevent ice buildup

300mm CFRP (Carbon Fibre Reinforced Polymer) Internal Walls with self-healing properties to repair minor damage

Total Surface Built Up Area: 18,591 sq.m

Exploded View

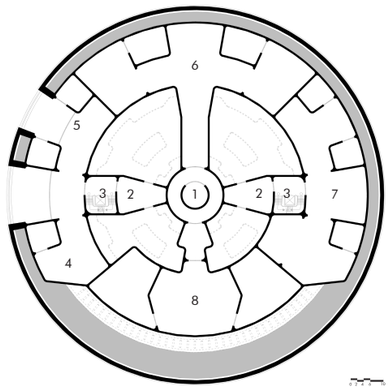
Hydroponic gardens ensuring fresh food production and a self sustaining structure.



The Ice Core Analysis Laboratory equipped with advanced tools for research purposes.

Elevated gardens providing a soothing touch of nature in the cosmos.

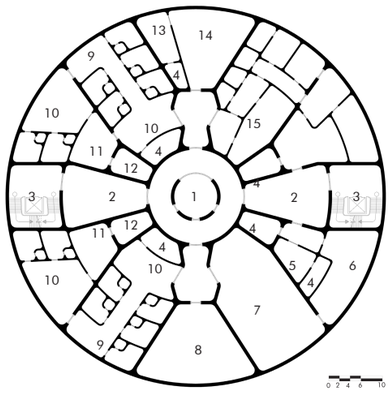
EVS (Extra-Vehicular Systems) to explore moon's icy surface safely.



Ground Floor Plan

Legend

1. Hyperloop
2. Arrival
3. Staircases
4. Extra Vehicular System
5. Docking
6. Fabrication Facility
7. Energy Generation
8. Hydroponic Gardens



Surface Level 1 Floor Plan

Legend

1. Hyperloop
2. Arrival
3. Staircases
4. Storage
5. Conference Room
6. Administration
7. Library
8. Art and Creativity Room
9. Crew Quarters
10. Common Lounge
11. Utility Room
12. Laundry
13. Kitchen
14. Cafe
15. Medical

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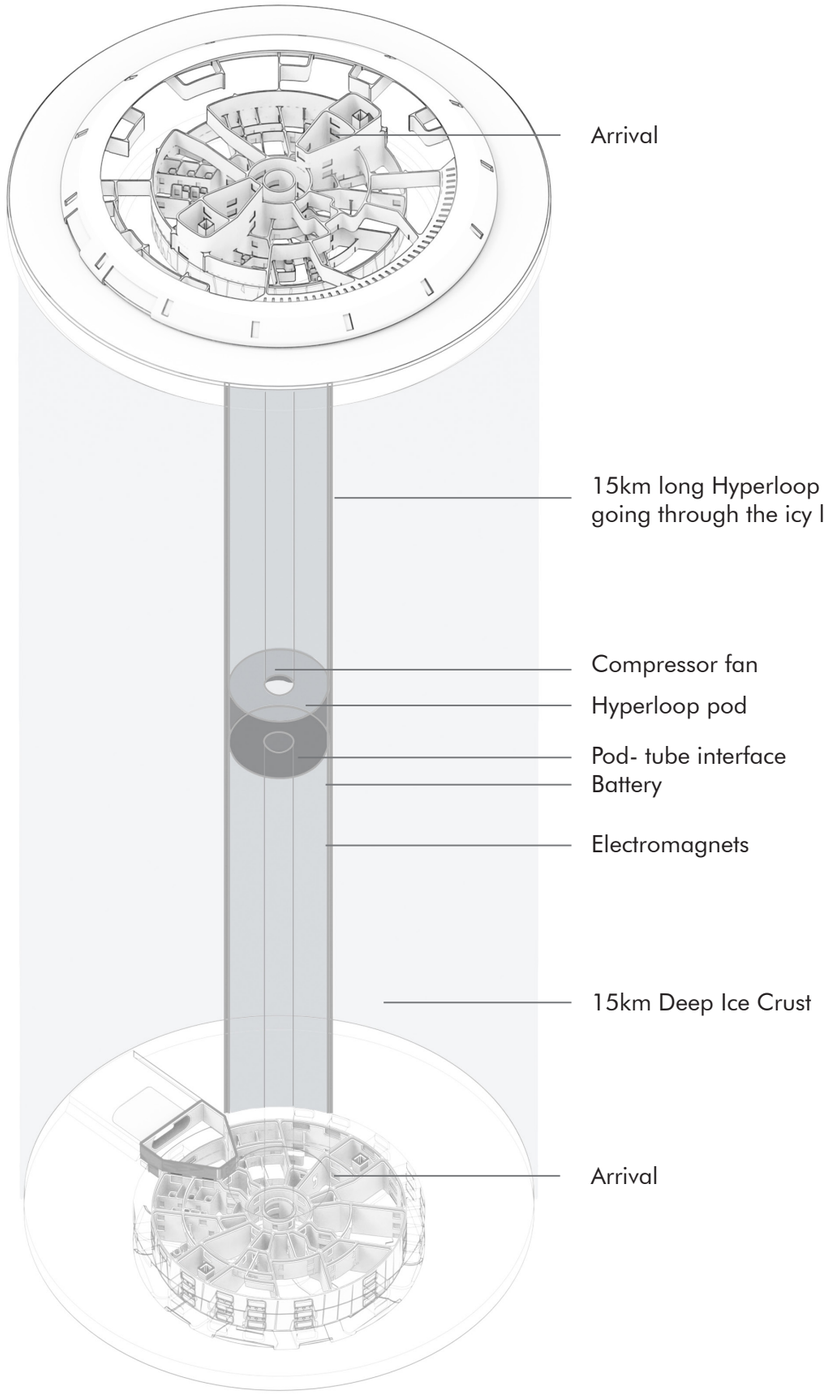
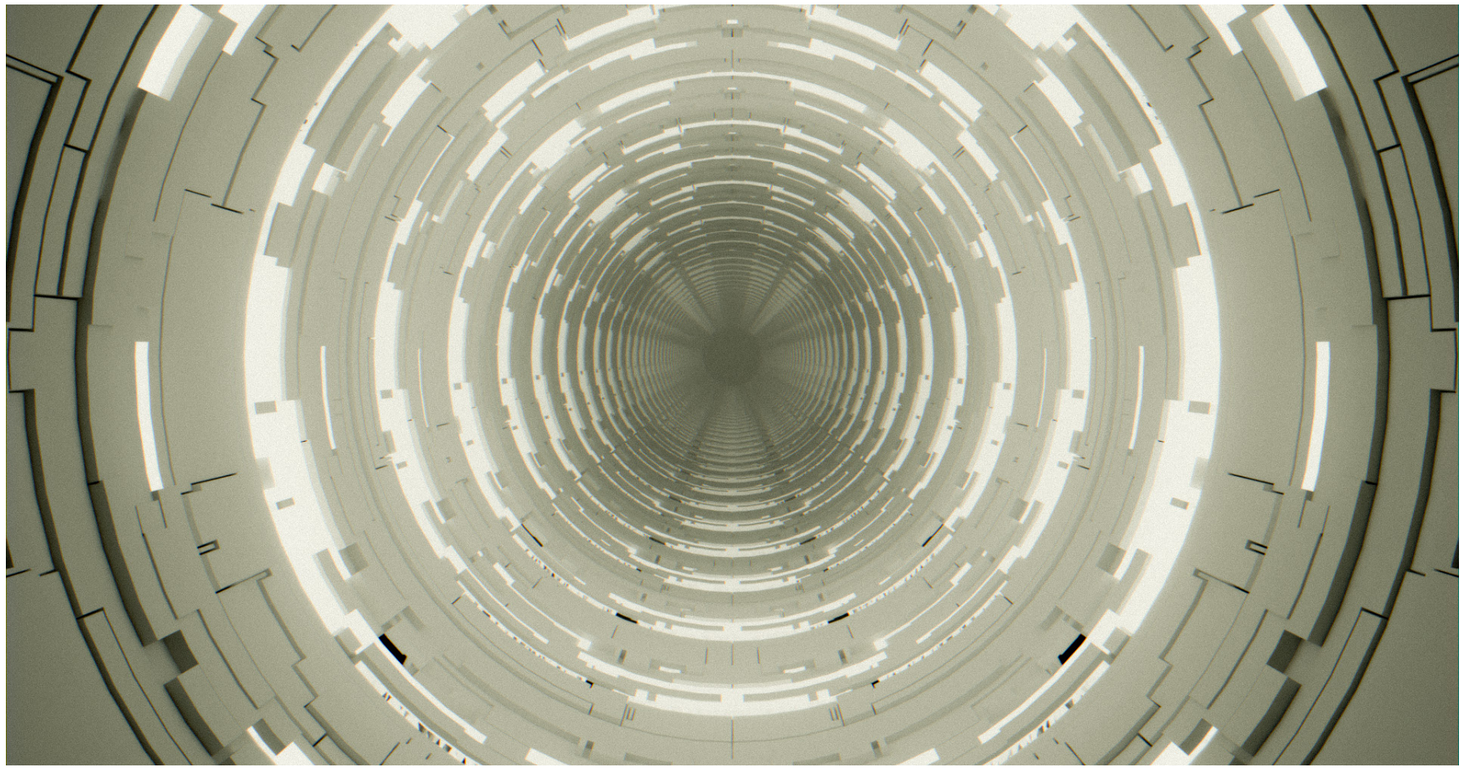
Hyperloop System

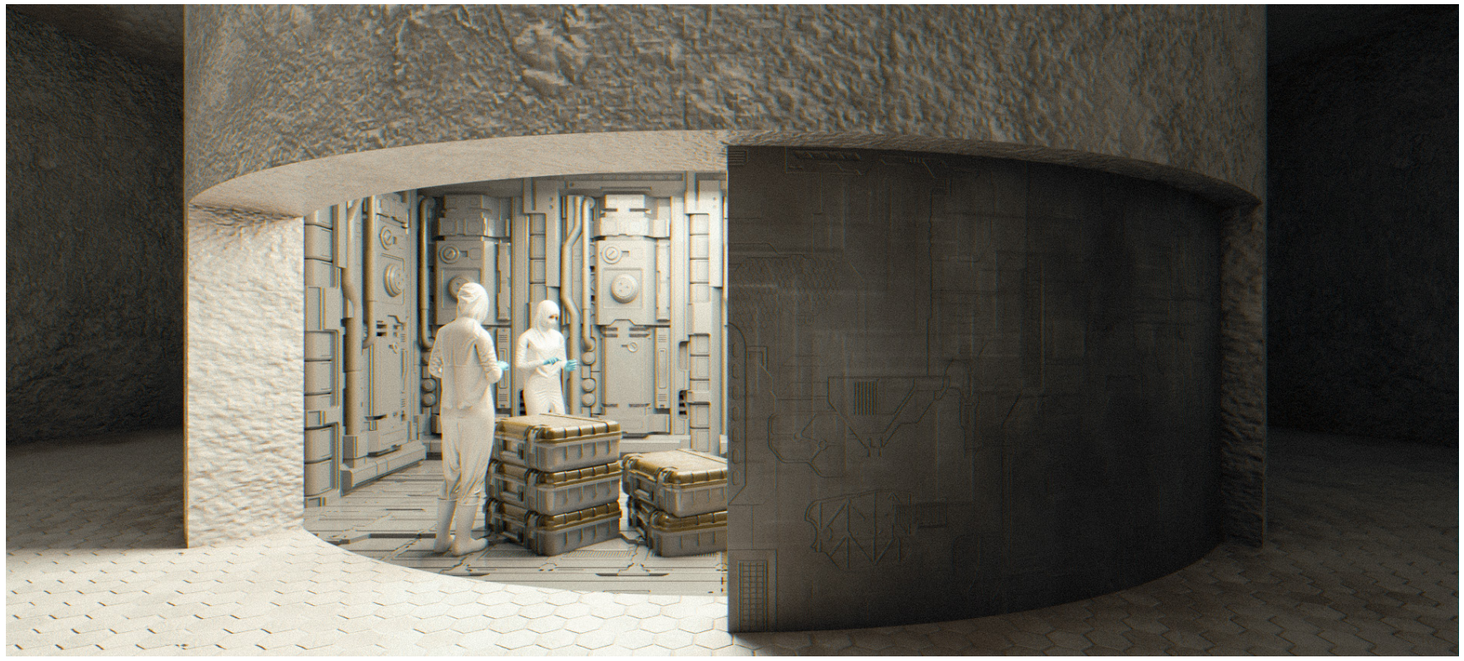


Exploded view

The Hyperloop, cutting-edge transportation concept, set to revolutionize interstellar exploration on Europa, Jupiter's moon. It offers rapid and efficient means to traverse moon's harsh surface, connecting the surface structure to the subsurface structure. Using near-vacuum tubes and magnetic levitation, Hyperloop pods can travel at incredible speeds, minimizing travel time and exposure to moon's extreme conditions.



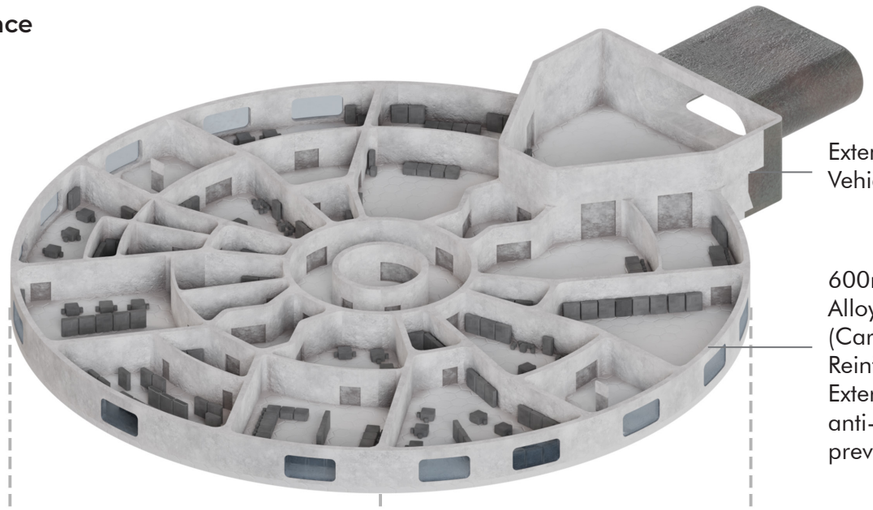
The inside view of the Hyperloop



The Hyperloop is bifurcated into two sections, catering to both services and transportation needs, as well as human movement and cirulation.

Sub - Surface Structure

Sub-Surface Level 1
-15032m



Extended EVS (Extra Vehicular Systems)

600mm Advanced Alloys + CFRP (Carbon Fibre Reinforced Polymer) External Walls with anti-icing coatings prevent ice buildup

Sub-Surface Level 2
-15036m

300mm CFRP (Carbon Fibre Reinforced Polymer) Internal Walls with self-healing properties to repair minor damage

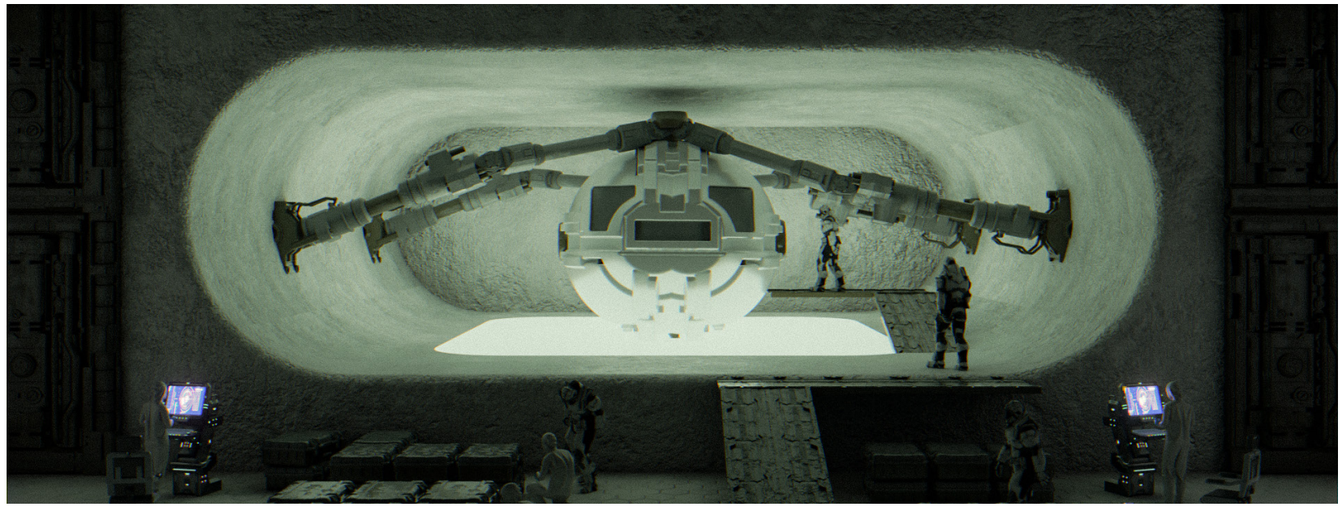
Sub-Surface Level 3
-15040m

Structure is bounded by a 5600mm Advanced Alloys + CFRP (Carbon Fibre Reinforced Polymer) Exterior shell with anti icing properties

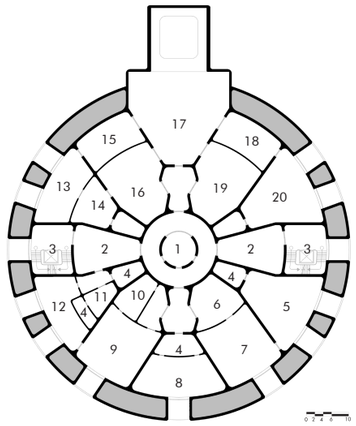
Total Sub-Surface Built Up Area:
11,877 sq.m

Exploded View

The underwater cafeteria is made to look welcoming and create a comfortable environment through biophilic design elements.

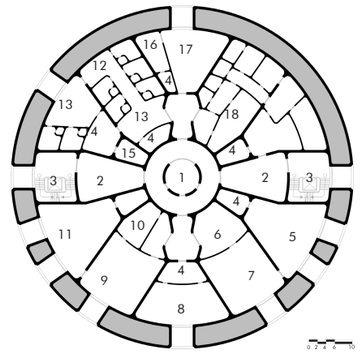


The Moonpool dock to send and retrieve underwater vehicles to study the moon's subsurface.



Sub-Surface Level 1 Floor Plan

Legend
1. Hyperloop
2. Arrival
3. Staircases
4. Storage
5. Biology Analysis Laboratory
6. Sample Prep Area
7. Biology Processing Laboratory
8. Cryogenic Storage
9. Environmental Monitoring Laboratory
10. Microscopy and Imaging
11. Conference Room
12. Administration
13. Data Delivery and Storage
14. Control Terminal
15. Material Delivery and Storage
16. Maintenance Hangar
17. Surface Dock
18. Radiation Screening
19. Automation Control and Storage
20. Space for Future Expansion



Sub-Surface Level 2 Floor Plan

Legend
1. Hyperloop
2. Arrival
3. Staircases
4. Storage
5. Biology Analysis Laboratory
6. Sample Prep Area
7. Biology Processing Laboratory
8. Cryogenic Storage
9. Environmental Monitoring Laboratory
10. Microscopy and Imaging
11. Maintenance/ Engineering
12. Crew Quarters
13. Common Lounge
14. Utility Room
15. Laundry
16. Kitchen
17. Cafe
18. Medical Area

A submersible embarking from the Moonpool dock for underwater exploration.

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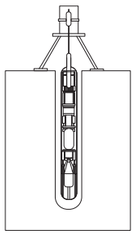
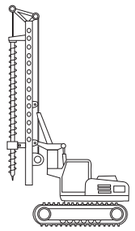
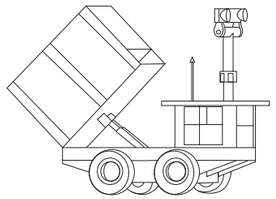
Construction and Technology



Cryobots: Employed to melt through Europa's icy crust



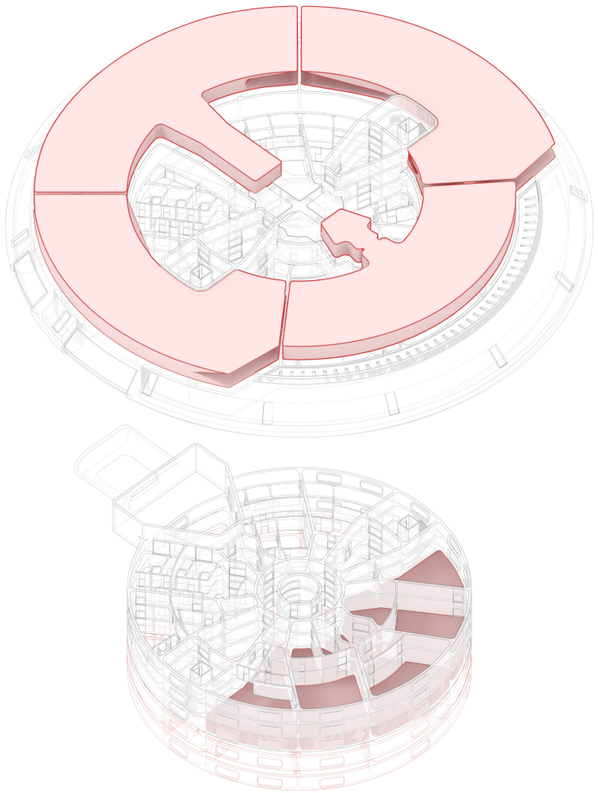
Drilling Rig: Utilized to bore through the icy shell of Europa



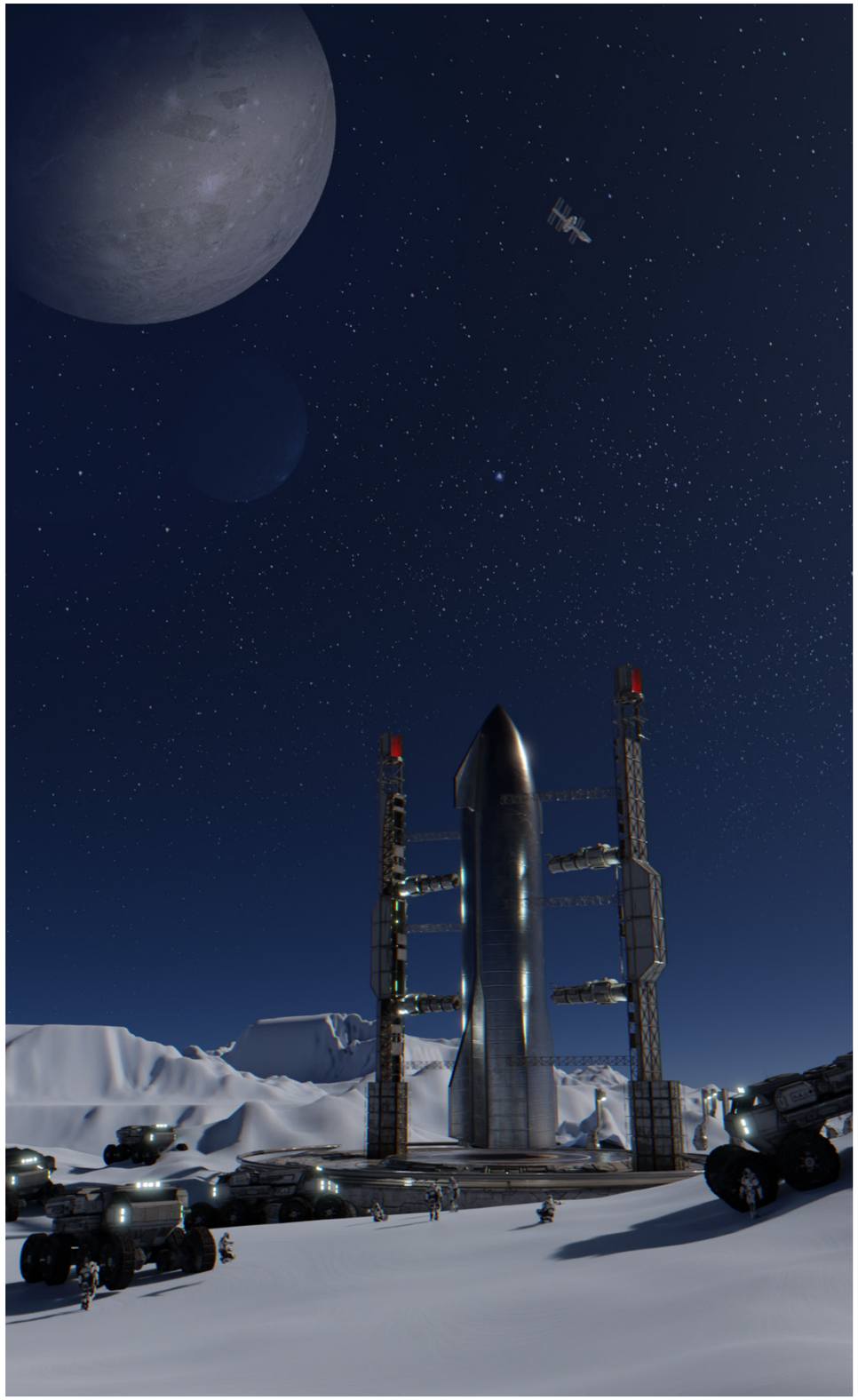
Regolith Process Vehicle: Adapted to collect and process surface materials for construction and resource utilization

Prospective Dimension

Our forward-looking vision extends to a multi-purpose Launchpad, fostering not only Europa research but also serving as a pivotal hub for intermediate transport, facilitating future space exploration endeavors. This dual-purpose facility exemplifies our commitment to advancing space exploration capabilities in an eco-conscious and collaborative manner.



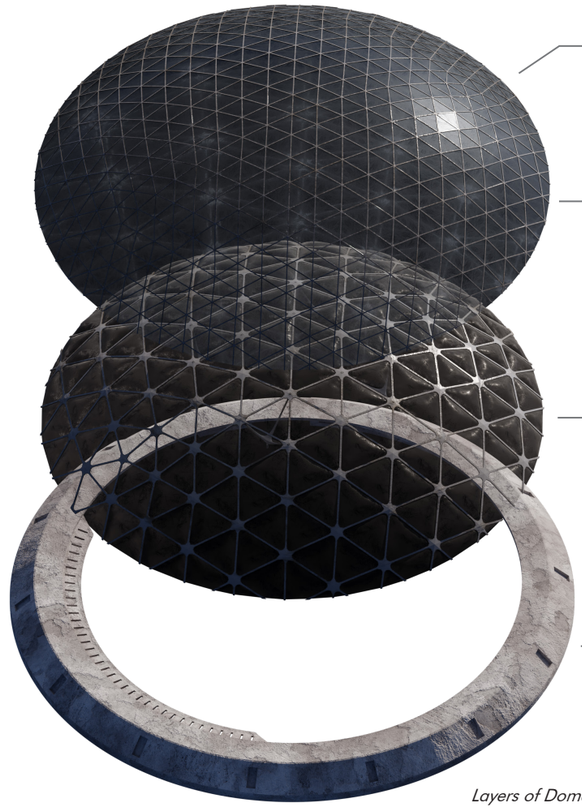
Expandable Spaces



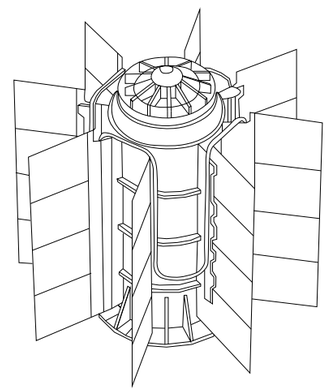
Research Station's Launchpad, acting as an intermediate base for outer solar system exploration in future.

Sustainability

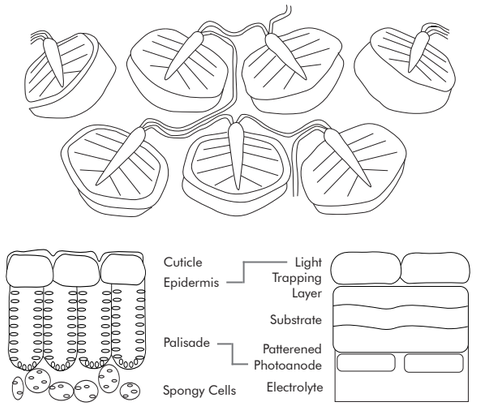
Embracing both nature's resilience and sustainable practices, our material selection strategy blends advanced composites from Earth with locally sourced regolith and ice on Europa. Inspired by transparent designs and adaptive strategies in nature, our research station stands as a symbol of innovative harmony with the planet. Our celestial endeavor echoes the elegance and functionality of Earth's enduring ecosystems, reflecting our commitment to harmonious exploration.



Layers of Dome



Radioisotope Thermoelectric Generators (RTGs) for Energy Generation



Transparent photovoltaic (PV) panels inspired by leaves

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