The future is in the Stratosphere

Interview w/ Clouds AO

Ana Lovrec Medved

Clouds AO is a New York-based architectural office operating across an exceptionally wide spectrum of practice. They are as dedicated to their constructed buildings – noted for their contextual relevance and contemporary forms – as they are to pioneering the future of living through speculative design. Their speculative work boldly explores the atmosphere as a new frontier for habitation, positioning it as the third and largest viable living space, scaled between the hydrosphere and the lithosphere. For this interview, I spoke with the firm's partners, Ostap Rudakevych and Masayuki Sono, to delve into their visionary work, using it as a lens to elaborate on the vast possibilities that space offers for the future of architecture and human existence.

ALM
The theme of this issue is the future of dwelling, and your office is, I believe, an epitome of that pursuit. Your work ventures into the seemingly unimaginable – space architecture – yet it is rigorously researched and on a path towards realization. What compelled you to begin such an extraordinary architectural exploration?

OR
The way we view the discipline of architecture is that a large part of it is about making fictions. We don't actually swing hammers; we make representations of something that could exist potentially. In a way, we're trained to create fictions and then get people to support them in hopes of realization. Often, they don't get built, and it's really magical when they do. Thinking about our training, and understanding that what we do is make visions – ideas and fictions that could exist – we asked: what if we push that to the limits? Instead of a conventional building for a site or a client, what if we extend the limits of fiction and imagination and use our training for something much larger than a simple building project on Earth? In trying to push that boundary, you start to realize we're only limited by our imagination. Really, almost anything you can imagine can become real at some point. So then, it becomes like a game. Your imagination is the only thing holding you back. The question is, what can I imagine?

MS
We do both: real built projects and self-motivated speculative work that we publish. With client-based projects, you can get very nearsighted, working on deadline after deadline and losing the longer vision of why we started the architecture. To balance and maintain that, we work on competitions or speculative projects. Having both creates a synergy that balances the reality of the building process with the longer vision – the reason we studied architecture in the first place. That's why we spend after-hours and weekends on projects that don't necessarily have clients or make money immediately. We try to merge them as much as possible. Winning the NASA competition for the Mars Ice House symbolizes that merger: the speculative becoming an actual project.

ALM
Your portfolio is remarkably diverse, ranging from early explorations of "floating" neighbourhoods for disaster victims, such as Cloud City, to skyscrapers that literally float from asteroid elements. You even design space stations and concepts for living on Mars. Beyond architecture, what other fields of knowledge are essential for this work?

OR
In a way, it's just an extension of conventional architectural practice. On a typical Earth-based project, we have general knowledge of things like lighting or structure, but we depend on experts – lighting designers, landscape architects – for the technical details. The space-based projects are similar. If it's on the surface of Mars, we might need a geophysicist or a planetary geologist to understand the site conditions. Maybe someone who knows robotics, plus all the typical structural engineering. It's about finding a team of consultants to support the vision. Once you have the general direction and concept, you find the people to help push it forward and give you pushback on reality. It's not very different than working on Earth with a team of people that share the vision.

MS
Each project on Earth is different, as well; the site, climate, and laws are different. It's all about research. We already work with different consultants on Earth projects with various programmes, so it's a methodology we can extend. The same goes for design strategy or values. For instance, that's how we won the NASA competition: we applied the same human-centred design methodology that we use on Earth to a project on Mars. Other people didn't get focused on that. Even if it's thirty years from now, people will be living there with the same needs and desires at the core. Valuing the human aspects at the centre made a difference.

ALM
The Mars Hydrosphere was a featured project at this year's Venice Architecture Biennale, so it's already familiar to many of our readers. Could you explain the concept behind it and how it expands our understanding of living, even here on Earth? Are there Earth-bound applications of this project, could the system inspire new models for sustainable, off-grid communities in remote areas of our planet?

OR
The Hydrosphere is fundamentally different from our previous Mars projects. The earlier ones were about science and exploration – classic NASA projects committed to exploring the universe. The mission for the Hydrosphere is different; it was proposed as a settlement, meaning that a lot of people would live there permanently. Starting from the point that it's a city, not a lab, we looked at what 10,000 people would need. The fundamental thing is water, and it's amazing how much water people use daily. The schemes we've seen for Martian settlements don't show this; they just show the habitat, the architecture, the bubble. They don't consider the infrastructure needed to support people.

We started with water. We knew water is a great shield for radiation and a thermal insulator. How can we use the properties of water as a design medium? Having an underwater settlement covers the requirements for consumption, radiation shielding, and insulation. When you create this air bubble under water, you can create an almost Earth-like atmosphere on Mars with very little structure. The atmosphere of Mars is a near vacuum but humans require high-pressure air. If you put the habitat on the surface, you need a strong container. In the Hydrosphere, the water pressure and air pressure are balanced so as to allow for a very thin, transparent structure. This is crucial when transporting materials from Earth, as weight and size are huge constraints. It's a synergy of all these design parameters that resulted in a kind of radical transparency, where the substance that supports life becomes the structure. You're surrounded by the water you're going to drink and the air you breathe. We saw it as a conceptual project illustrating our dependence on resources and our environment. If there's a slight imbalance, the whole thing collapses. It conceptually shows the fragility of life and our embeddedness in the environment.

MS
It took us a while to figure out the scale, from a residential to a community or city scale. We've been working on this concept on and off for almost ten years. A few years ago, we finally arrived at the current Hydrosphere diagram. Achieving radiation shielding at that scale was a challenge. The breakthrough was the idea that we don't just *have* radiation shielding; we *inhabit* the shielding, reversing the relationship.

As for your question about Earth applications, when you think about space exploration, it seems to go further away from Earth. But there are almost 2,000 *spin-offs*, patented technologies registered by NASA that have contributed to developments on Earth, changing our lives. People often criticize space exploration for the cost and risk, but the return is huge, benefiting Earth not only technologically but also in how we see things. The "Blue Marble" photo from Apollo totally changed our idea about Earth and its fragility, kick-starting the environmental movement. So not only technology, but our values have been transformed by space exploration.

Our idea has been to do both: explore space and re-import architectural ideas to Earth. Working with JAXA [Japan Aerospace Exploration Agency], we explored what we can do in space architecture that can lead to completely new structural systems or spatial experiences on Earth. The same is true for the Mars Hydrosphere: its principles could be implemented in underwater development on Earth, which is our planet's last frontier. It's a closed, self-sustaining system that could contribute to that field. We try to think both ways.

ALM
But is the project itself completely self-sustainable?

OR
I would say it's not completely self-sustaining; nothing is a truly closed system. Our understanding is that people like Elon Musk with SpaceX are proposing a robust transportation system to Mars, sending thousands of rockets. So there will be deliveries happening all the time. For the first people living on Mars, there won't be factories making everything you need, like band-aids or medicine. There will be a need for imports for probably several decades, until Mars can establish some independence. And I'm not even sure Mars has all the resources we would need. On Earth, we exploit every single part, and wars are fought over resources. It's not clear if Mars will ever get to the point of being fully independent. We just need to find out more about what's there.

ALM
You have somehow answered it already, but still: based on your pioneering role in these explorations, what do you believe is the tangible future of dwelling? Is it truly achievable for us to migrate through the stratosphere and inhabit the skies?

OR
We did a chart on the history of architecture. In prehistoric times, we lived under the surface of the Earth, in caves. Then we came out, and the first structures were nomadic tents. Then you have pyramids, stupas, cathedrals—compression structures made of stone, piling material higher and higher until the Eiffel Tower. Then you get steel-frame glass skyscrapers with increasing transparency. There's this exponential progression in the height of buildings and at the same time their lightness and transparency. While this is happening, we're starting to leave the surface of the Earth. We were always bound to the surface, bottom-dwellers bound by the horizon.

In the late 1700s, you have the first hot air balloon by Montgolfier brothers in Paris. We started to leave the surface for the first time. Powered flight occurred in the early 1900s, and the jet age and space age followed quickly. We're moving further and further away from the surface until present day, when people live in space permanently on the Space Station. There seems to be this trend of leaving the surface, getting further away from it. That's something we're interested in, and it plays out in our projects – the relationship of the building to the ground. To answer directly: yes, I think it's happening. We are migrating through the atmosphere and starting to inhabit the sky, and I think we're just going to continue that trend, expanding outward from the surface.

MS
Yeah, and once flying cars are actually implemented in society, that will totally change the city, making it completely three-dimensional. Right now, we're just crawling on the surface. Elevator is what's making it work, but still very limiting. It will be a complete shift. I think a big change is coming.

ALM
How do you combine your speculative research with your concrete, terrestrial projects? The space designs clearly involve physics and astrophysics, but what does the design process look like for both? Where do they connect? Do the advanced material sciences or structural models developed for space stations ever influence the engineering of Earth-based buildings, making them lighter, stronger, or more efficient? Do you use that directly in your projects?

MS
I see huge potential in membrane structures, which we've been promoting for use in space. The data shows that for space; architecture sent to other planets has to be very low mass and high performance. It has to be packaged very small but expand to the biggest possible size. We've also used 3D printing which we proposed for Mars here on Earth for dwellings and public displays, even working with the United Nations Industrial Development Organization to support Ukraine. That's one thing.

But membrane structure has a huge potential that hasn't been exploited yet. For the Avatar X project in Japan, we worked with a structural engineer who also works on Moon projects with JAXA. The structure we designed almost looks as if it were built on the Moon, but it's on Earth. The idea was to create a test field to simulate a Moon environment. The structure is a very lightweight, fully insulated membrane, which is suspended to monitor the inside a crater as well as around it. It was the most efficient solution. So that's an example of how innovative materials developed for space exploration can bring solutions to Earth projects. Using space-grade materials and design methodology on Earth creates something that wouldn't be as efficient or symbolic otherwise. That project indicated the big potential of membrane structures.

ALM
But until now, has this mostly been used in space exploration projects, or also in general architecture?

MS
In space, you have modules like Bigelow's expandable membrane modules proposed for the Moon or Mars – structures that are folded up and expanded. They're developed mainly to package architectural material as small as possible to fit in a rocket. In space, it's a pure necessity. On Earth, it's been mainly used for temporary structures, like expos or tennis courts. The application is very limited. There's a mental boundary where people think a membrane structure isn't "architecture" – it doesn't feel substantial enough. But I think that's a mental limit we put on ourselves subconsciously, and it can be totally overcome if applied correctly.

OR
A dry, technical example is ETFE, a common transparent membrane used in projects like the Beijing Water Cube or the Allianz Arena. But when we were working with NASA on the Mars Ice Home, their materials specialist said ETFE might not be the best for space due to degradation from atomic oxygen. She recommended other materials, like Tedlar, which is similar to Teflon but transparent. As part of that development, a swatch of the material was flown on the Space Station and exposed to space for about a year, then brought down to test its performance. So that's a specific case of material science, testing a membrane's properties in the harsh environment of low Earth orbit.

ALM
Returning to design, I believe a common thread running through your projects is an extreme sensitivity to human experience, from the 9/11 memorial on Staten Island and the competition proposal for the Lviv Cemetery to offices, restaurants, and the Analemma Tower. How does this humanistic focus influence your architectural philosophy?

OR
Architecture is for people. Without people, there would be no architecture. Giraffes don't need architecture. Neither do the robots on Mars: they're out in the open. So understanding that it's all about people is key. We realized this working with NASA. Having won that competition and starting to work with them, we saw their different approach. Architecture is a humanist, arts-based discipline; when I was a student, it was in the School of Art. NASA is full of engineers from hard sciences; their approach is functionalist. They see problems that need to be solved, but they don't focus as much on the cultural implications, philosophy, or aesthetics. A lot in architecture is about aesthetics, and that's important.

We realized the value architects can bring to something traditionally engineering-based. NASA's habitats look like machines. I think they also saw that value and recognized it. That exchange was rewarding—two different approaches coming together to make something that works better for people, which is our goal.

MS
The projects we work on vary in program and scale. The thing that ties them together is that we base the focus and the driver of the design on human experience. To us, that means the application of the strategy can run the gamut from small furniture to a Mars city. That's the backbone.

There's also our own design vocabulary. Our Earth-based buildings, like the memorial or the theatre, all share a desire to float, to free ourselves from gravity or conventional structural requirements. It's similar to the membrane idea: new technology allows more to happen. Structurally, things don't have to be an arch anymore. The Staten Island Memorial was an inverted arch, structurally challenging, but we did it. It's about freeing our imagination from being caged by convention.

Take the house made of ice on Mars. People first laughed at it; nobody took it seriously. But that's why it hadn't been explored. The idea may have passed on by others, but we took it seriously, and there was a hidden solution. It sounded crazy, but it actually made sense. It's about breaking out of the cage and playing around in your brain. That process also ties our projects together. It requires a kind of childish curiosity, but being serious about exploring it.

ALM
Among all your projects, do you have a favourite? And if so, why does it stand out?

OR
It's a difficult question, but for me, it's probably Cloud City – the balloons floating above Brooklyn. Looking back, I didn't realize it at the time, but it was the first one that broke away from the surface and opened the door to that thinking – the exploration of a building's relationship to the ground. We did research afterwards on architecture's progression towards lightness and verticality.

That project was also a little bit unexpected. They're just balloons, but the driver was the experience of New Orleans with Hurricane Katrina, which caused massive displacement. Half the city had to evacuate, many never returned, and communities were broken up. During the rebuilding, they weren't there to participate. That was traumatic for everyone watching. The competition prompt was for New York City: if a hurricane destroys a part of Brooklyn, how can we plan for the aftermath? The solution with Cloud City was to try to keep people in place, in their neighbourhood, to maintain the community and allow them to participate in the rebuilding. The idea of the balloon was that you could literally float above your home if it were destroyed. That one move of floating opened up a lot of the things we've been thinking about since. For me, it was a key that unlocked a certain door.

MS
It's a hard question, but I do like Avatar X. To me, it's very symbolic of the idea of space architecture and Earth architecture marrying, of re-importing ideas and developing on both fronts. It's too bad it's stopped for now. Hopefully, the idea will pick up in other forms in the future. For me, it simply symbolizes our motivation.

ALM
Let's end with a topic that feels particularly urgent to me, and one you tackled early on with projects like Cloud City and Aqualta: the imminent danger of natural disasters. Given that these events are becoming more frequent, how must our approach as architects shift from speculative solutions to integrating disaster resilience into everyday design?

OR
This reminds me of a lecture I saw at Columbia by Lebbeus Woods, a theoretical architect who did projects around violence and destruction, often related to war. He said something provocative that stuck with me: he hated the word "sustainability" because it's a negative word, implying a stasis, trying to keep things as they are. He thought we needed to be more active, proactive, and energetic about it.

I understand the anxiety of our time. I've been teaching for years, and students are very anxious about the climate. There's also this idea in schools that architects can save the world through our work, which I think is a little misguided. There's a limit to what we can do. In that context, adaptability is key. Understanding that things are always undergoing change—that's the one constant. Being able to absorb change or adapt to it... I think some of our projects address this, facing reality and adapting to it.

MS
I agree. Space architecture is all about adapting to the extreme environment and surviving. In a way, Earth is turning into Mars. We have to create filters to adapt to a more harsh, extreme environment.

We had a tsunami shelter proposal after the 2011 earthquake and tsunami in Japan. I'm from Kobe; we had a huge earthquake in 1995 that destroyed the downtown. My house was cracked, and my parents were trapped. What we learned is that we can never fight nature; it's not possible. It always goes beyond your expectation. Our tsunami shelter proposal was symbolic in that sense. The idea was not to fight the tsunami wave force. It's a simple thing: if you're swimming and a big wave comes, you don't stand there—you dive. You go underneath, and it passes by you. So the idea is to sway the force, to adapt to the magnitude of destruction, not to resist it. We're adapting the same principles from space architecture to Earth to save people.

The 3D-printed house we worked on was used after the Noto earthquake in Japan. The idea of an autonomous construction system helps in extreme environments, be it after a disaster or in a war zone, in a way that wasn't possible before. It's one little step. We just need to keep exploring and expanding the field for a changing environment. The situation in Japan is really bad, expecting a huge earthquake right beneath Tokyo and for Mount Fuji to erupt. It's definitely urgent.

OR
I think even traditional Japanese architecture is based on a changing environment, due to its geography and experience. The cultural approach to architecture is much more transient or temporary than European architecture. European architecture is heavy stone for permanence. In Japan, you don't see that permanence because of the constant change. It's a fundamental cultural difference in the approach to building.

MS
It's symbolic. At Ise Jingu, the shrine is rebuilt every 20 years. That's a great system for architecture to reach eternity—not by building in stone, but by creating a human system. It's like plants: they die and perish, but then they regenerate. That was the only way to extend the life of the architecture. That whole cultural thing, visible in literature and various fields, holds a key to dealing with new environmental shifts. Japan has built a culture and technique for surviving in a place more exposed to disasters.

Mars Ice Home

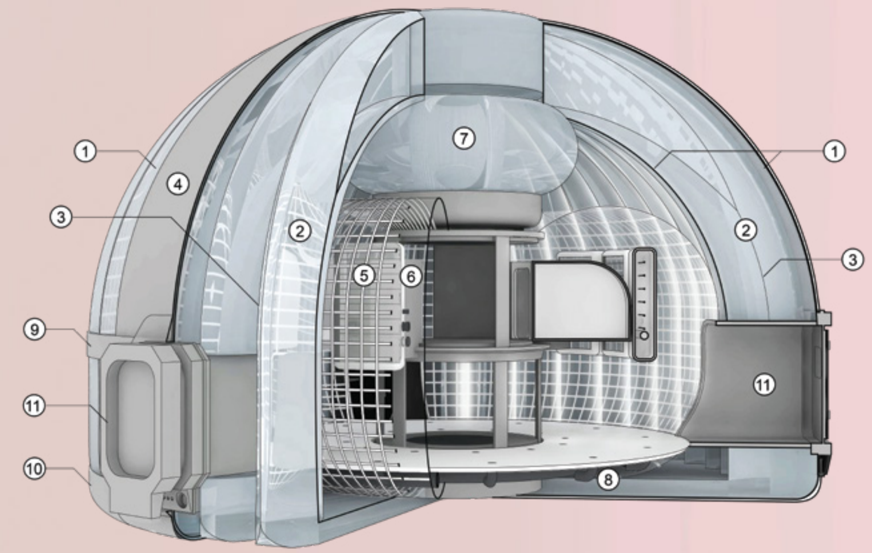
Type
Planetary habitat

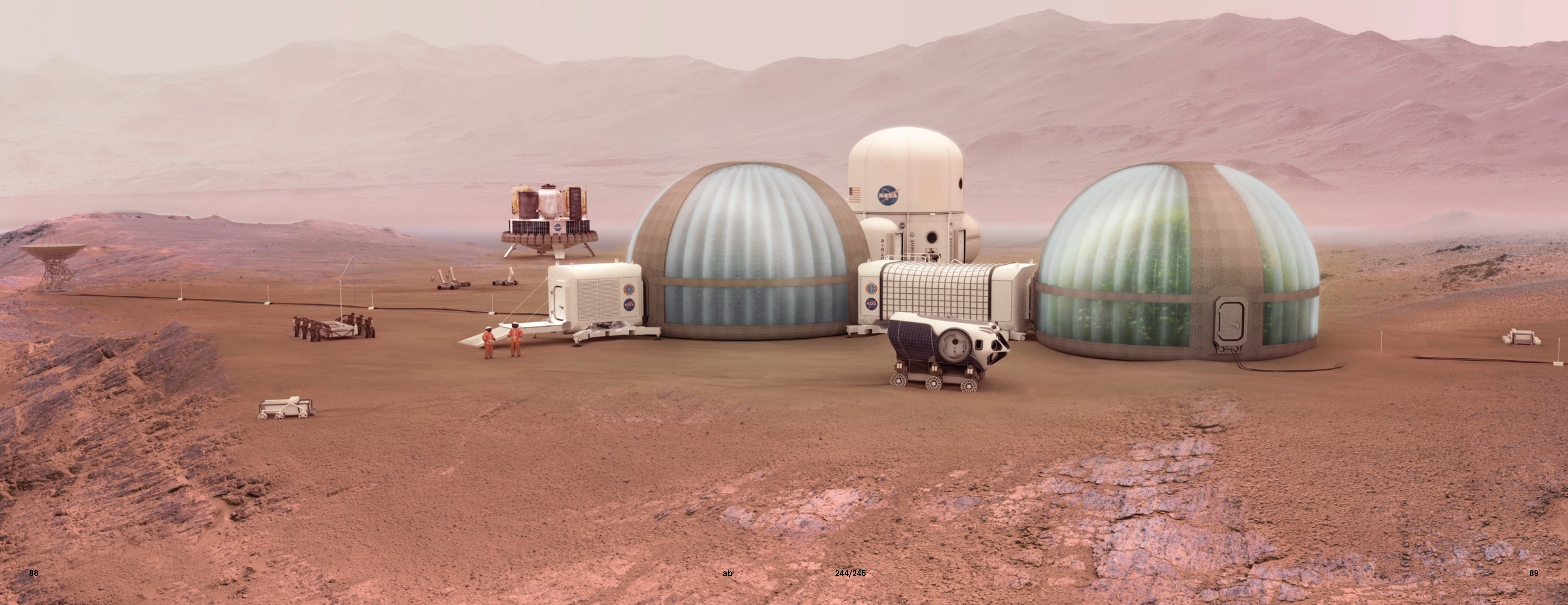
Location
Mars

Date
August 2016

Project Team
Clouds Architecture Office: Ostap Rudakevych, Masayuki Sono, Yuko Sono, Jeffrey Montes
NASA (Langley Research Center)
Space Exploration Architecture

1 CO_2 Insulation Layer
2 Ice Chamber
3 Vision Windows
4 Vertical Support
5 Restraint Layer
6 Bladder And Scuff Layer
7 Liquid Water Reservoir
8 Hvac Concealed In Floor
9 Structural Horizontal Seams
10 Base Reinforcement Layer
11 Hatch / Egress





Cloud City

Location
Brooklyn, NY

Date
February 2008

Project Team
Clouds AO w/ Studio Lindfors,
Ostap Rudakevych, Erik Jostock,
Gretchen Stump

LEGEND: CLOUD CITY TYPICAL UNIT

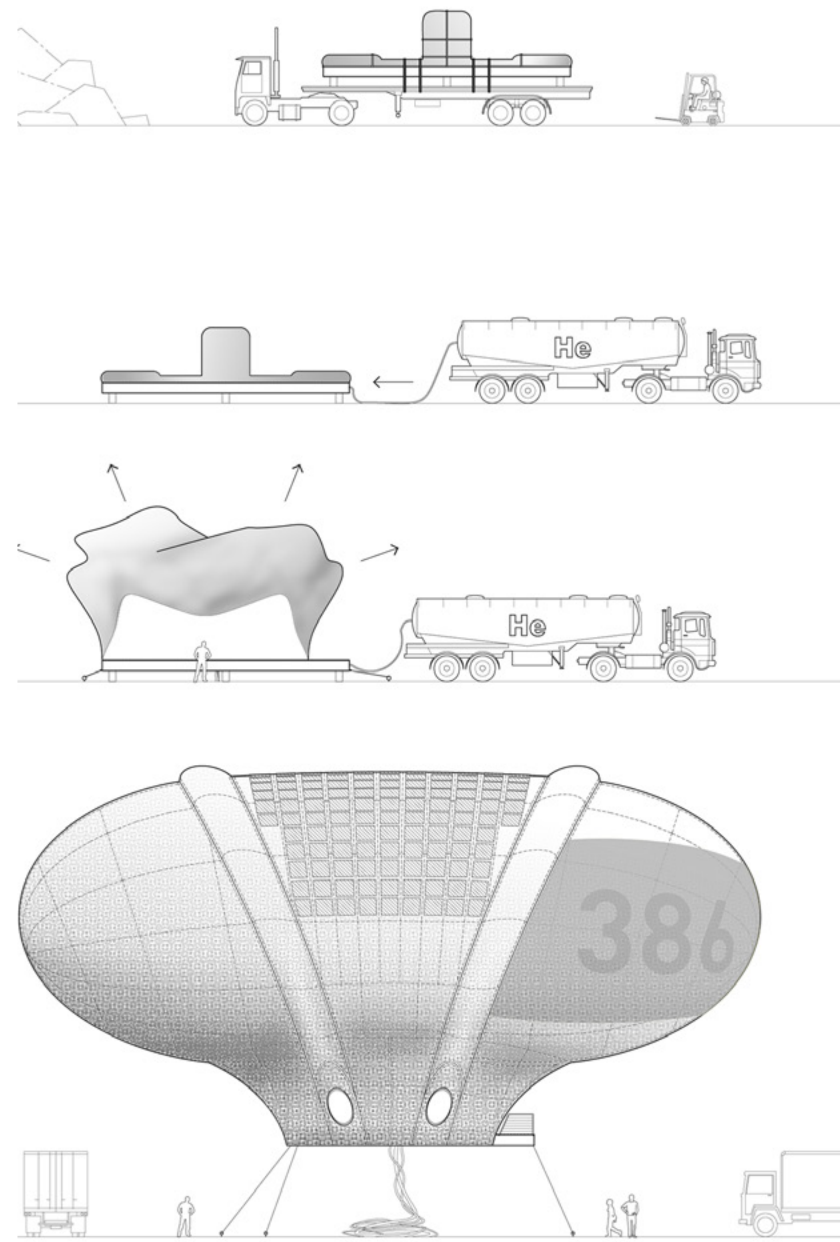
A:
A pre-fabricated inflatable home is delivered on a flatbed semi trailer. Forklifts remove the lightweight home to a staging area.

B:
The home is unwrapped and connected to a helium tanker for inflation.

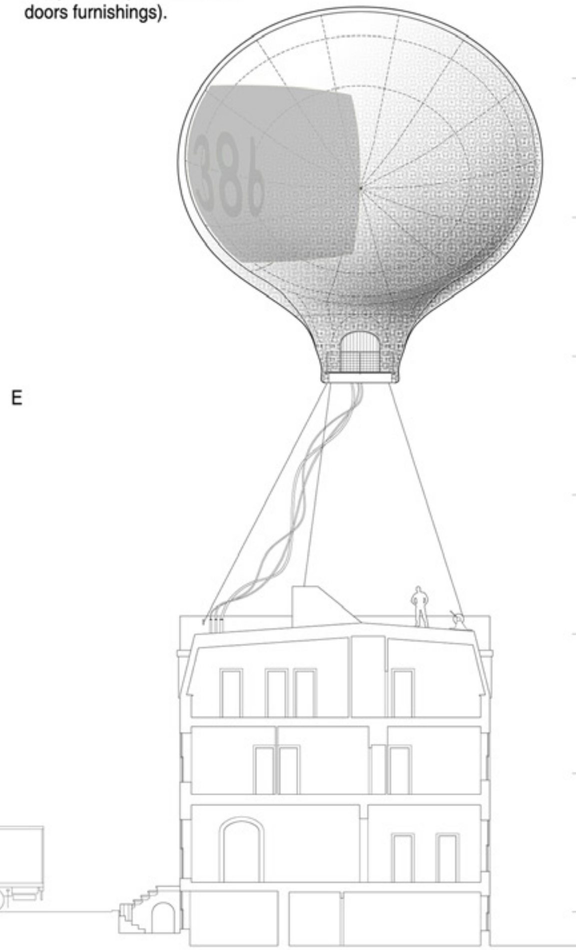
C:
As the home inflates, workers fluff-out flexible components and install and connect rigid components (i.e., windows, doors furnishings).

D:
As the home achieves buoyancy, workers are able to maneuver the home to its desired position. Utility services are connected via flexible hoses, and the home is fixed in place with steel guide wires.

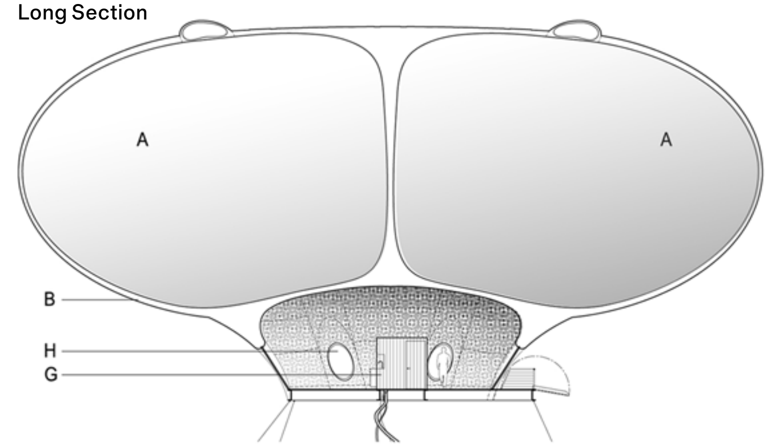
E:
An inflated floating home deployed over an existing structure. Utilities are connected to existing lines at rooftop.



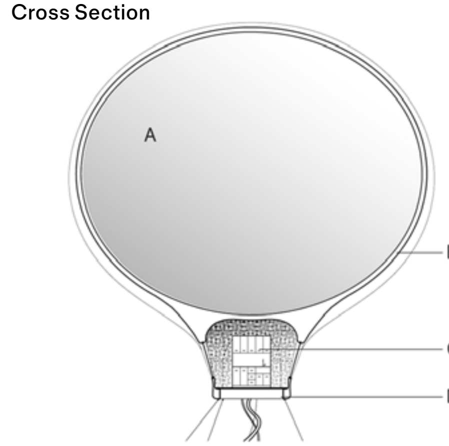
E



Long Section



Cross Section



Staten Island 9/11 Memorial

Location
Staten Island, NY

Completion
September 2004

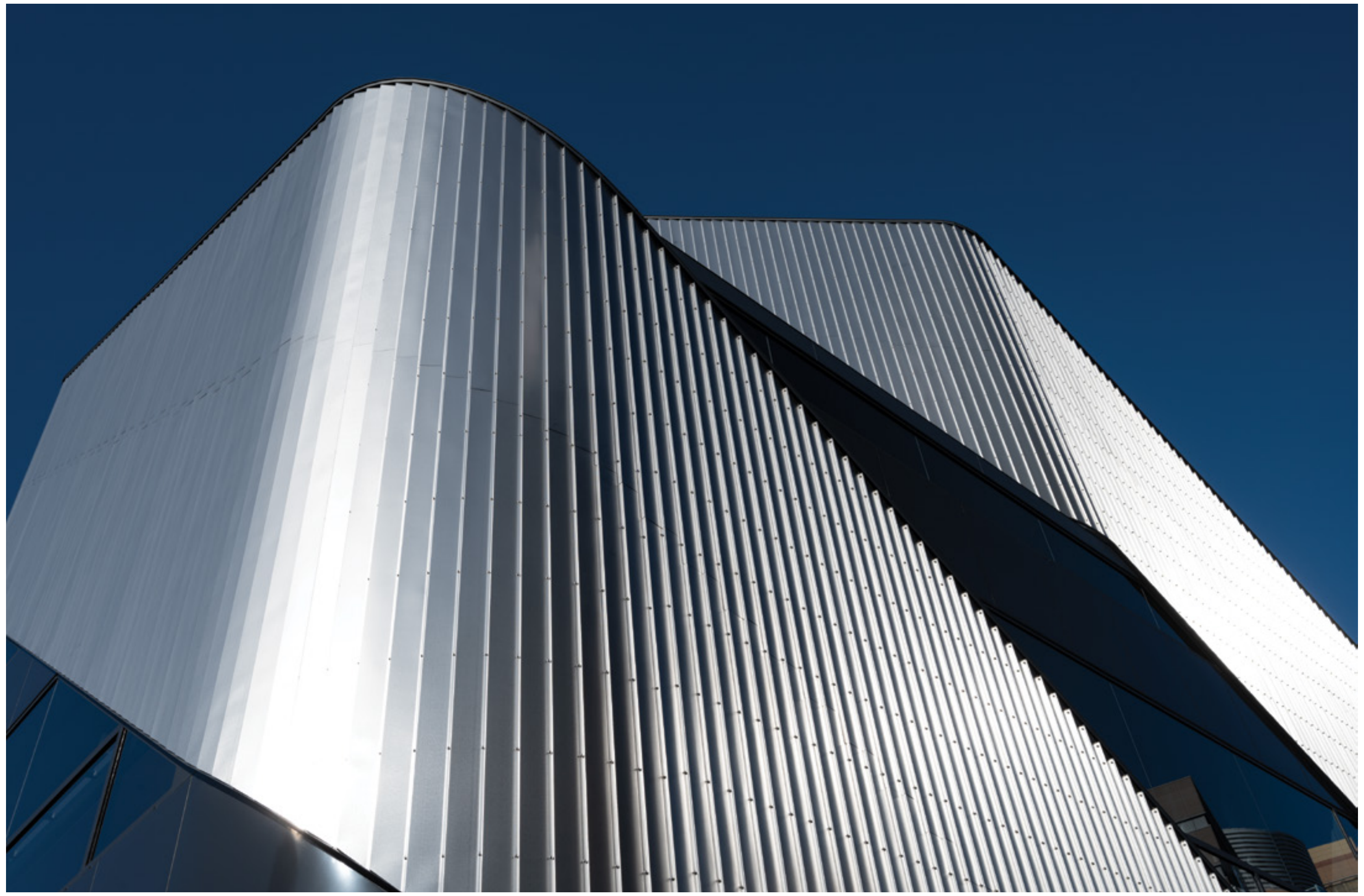
Project Team
Masayuki Sono, Lapshan Fong
Structural and Civil engineer Weidlinger Associates Inc.
Landscape design Mathews Neilsen Landscape Architecture
Lighting design Fisher Marantz Stone
Graphics and Signage That's Nice
Photography Suisho Moriguchi, Brian Mosbacher

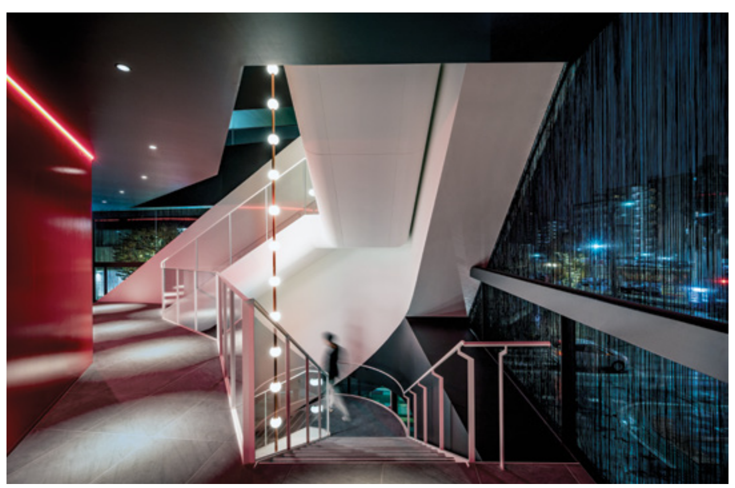
010 Building

Location
Hakata Ward,
Fukuoka, Japan

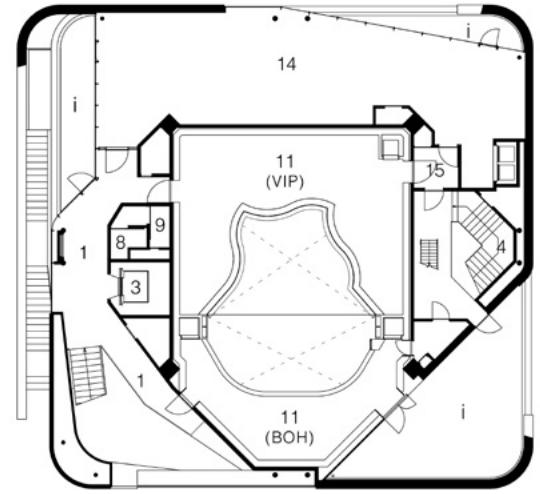
Completion
December 2022

Project Team
Design Architect Clouds Architecture Office
Executive Architect and Theater Design NKS2 Architects + Takumi Nakahara Architecture
Restaurant Design Nobuo Araki/The Archetype
Bar Design Mundi Space Design Labo
Structural Engineering Ohno Japan
Construction Saeki Kensetsu Co Ltd
Lighting ModuleX Inc
Landscape Eiji Asada/Ordinary+Space
Photography GION

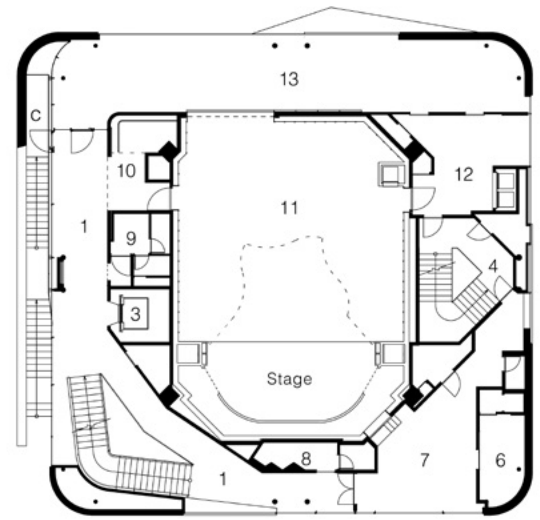




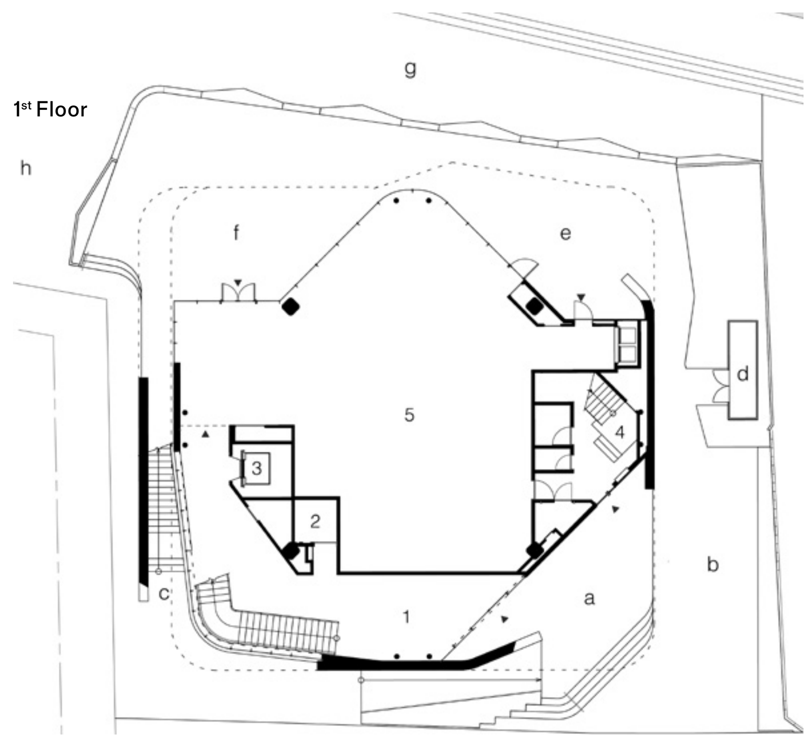
3rd Floor



2nd Floor



1st Floor



a Main entrance
b Porch
c Entry to upper level
d Dumpster
e Outdoor kitchen
f Terrace Seating
g Riverside Park
h Event space
i Balcony

1 Lobby
2 Bathroom (ADA)
3 Elevator
4 Service stair
5 Restaurant
6 Dressing room
7 Green room
8 Bathroom (W)
9 Bathroom (M)
10 Reception / Cloaks
11 Theater
12 Kitchen
13 Bar
14 Restaurant
15 Antichamber

S=1:350

Mars Ice House

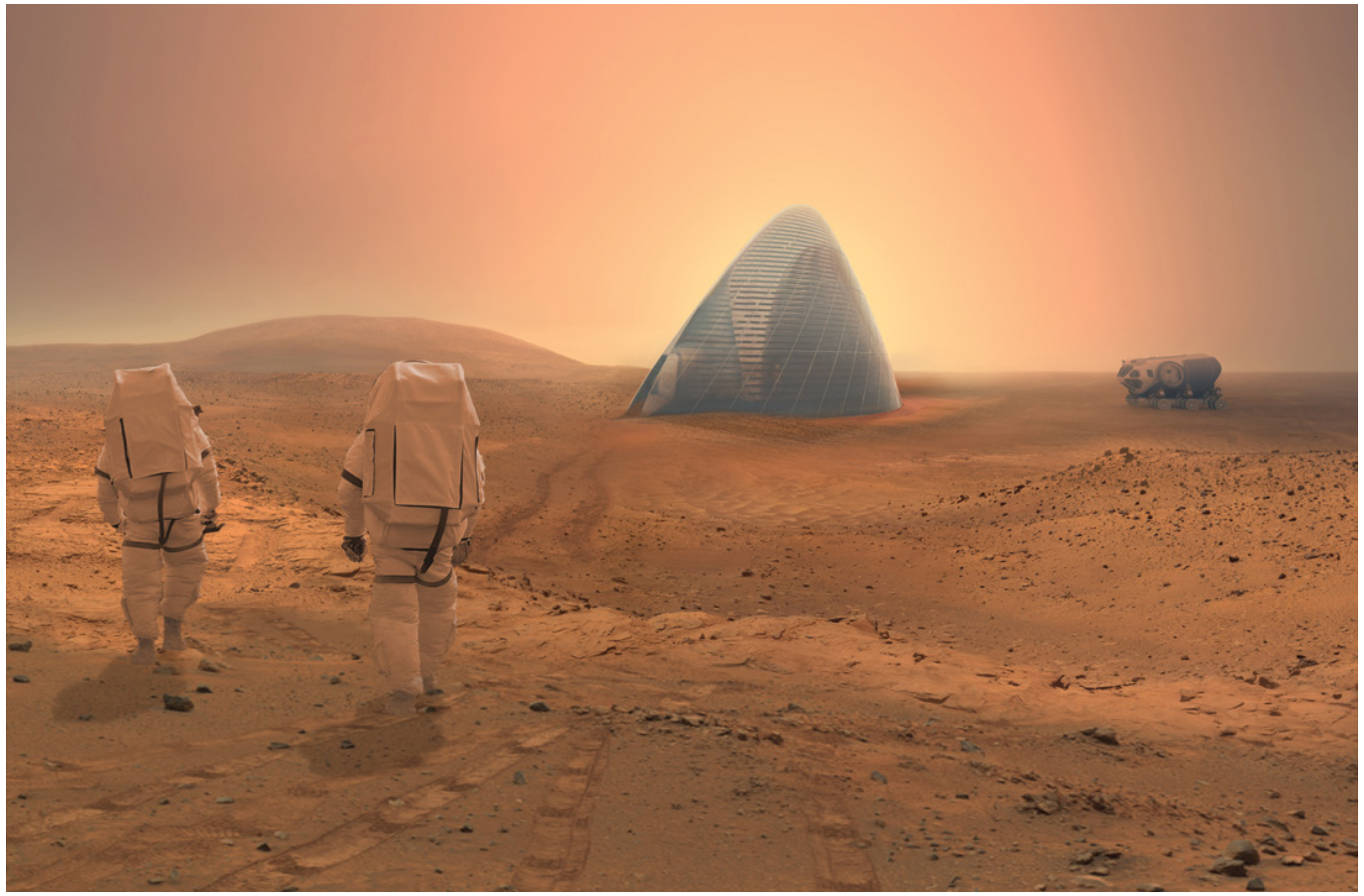
Type
Extra-planetary habitat

Location
Northern Slopes,
Alba Mons, Mars

Date
September 2015

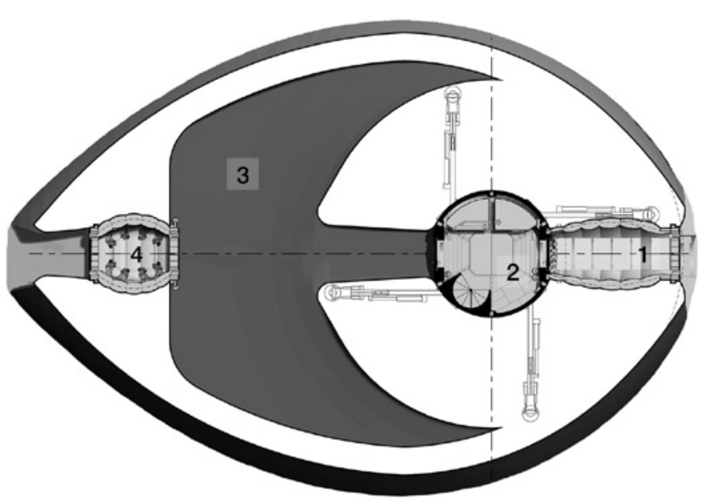
Project Team
Clouds Architecture Office
Ostap Rudakevych,
Masayuki Sono, Yuko Sono

Space exploration Architecture
Christina Ciardullo,
Kelsey Lents, Jeffrey Montes,
Michael Morris, Melodie Yashar



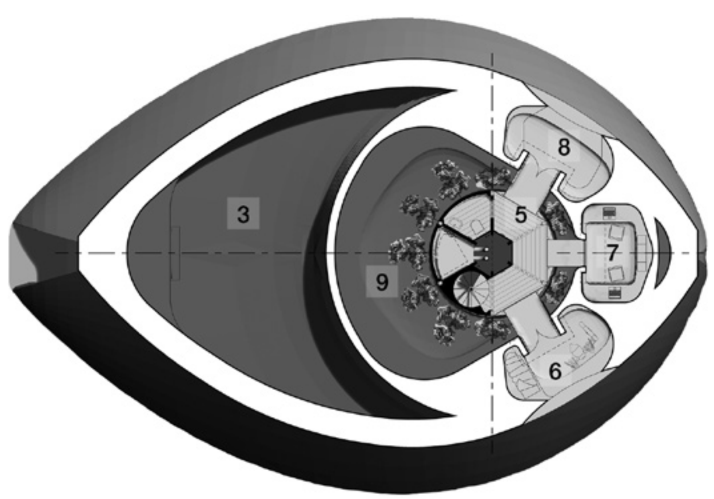
Level 1

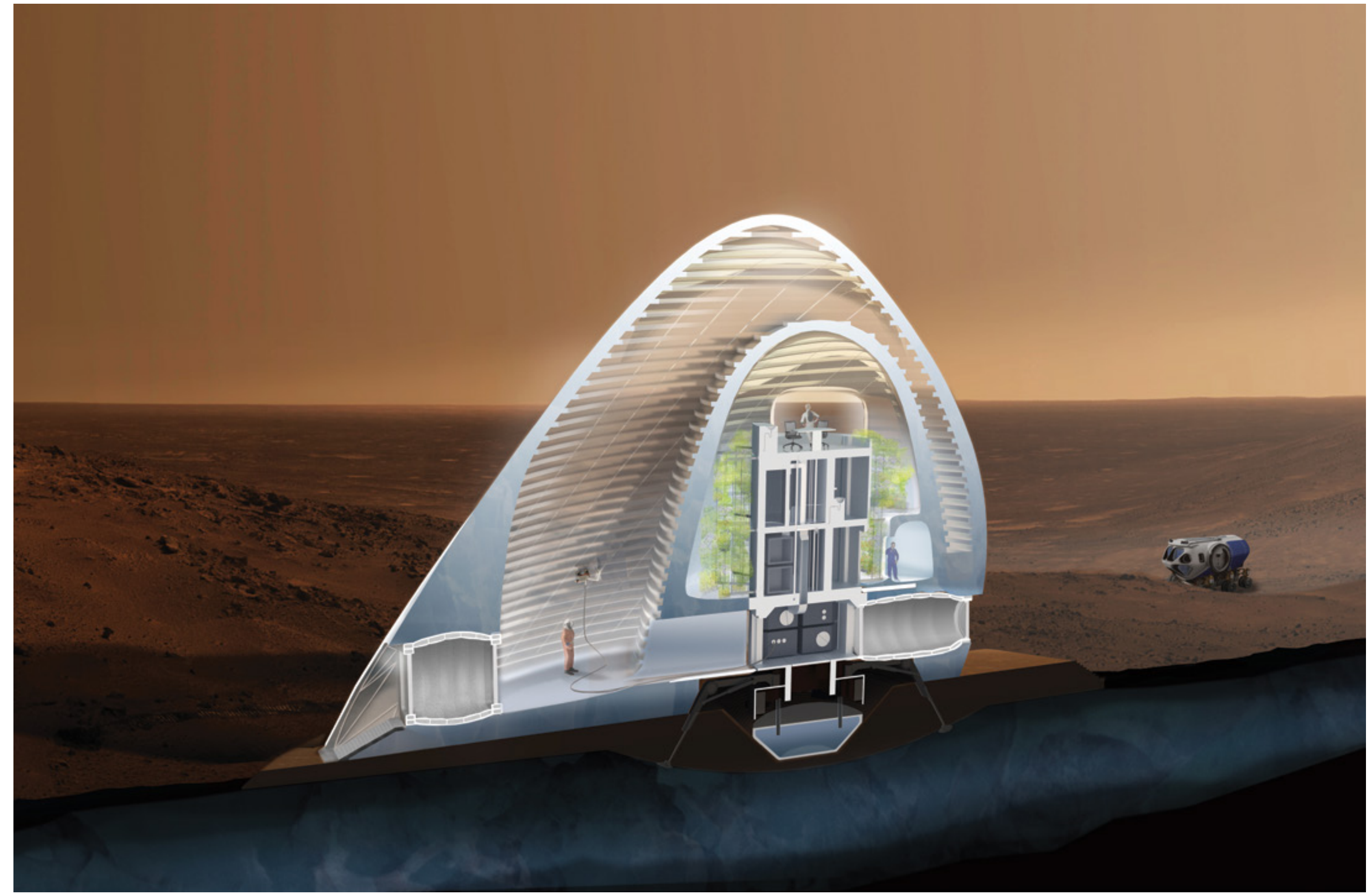
4 Egress Airlock
3 Yard (Intermediate Containment Zone)
2 Entry Level / ECLSS Units
1 Rover Dock Airlock



Level 2

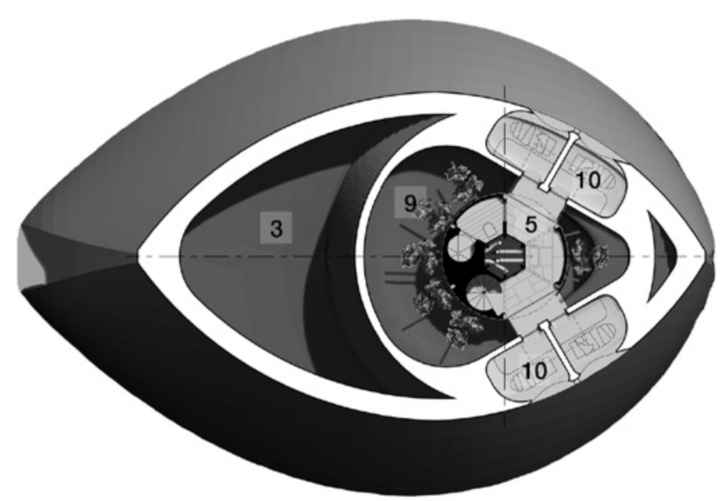
9 Vertical Greenhouse
8 Library / Small Room
7 Laboratory
6 Exercise / Medical Support
5 Hygiene Area
3 Yard (Intermediate Containment Zone)





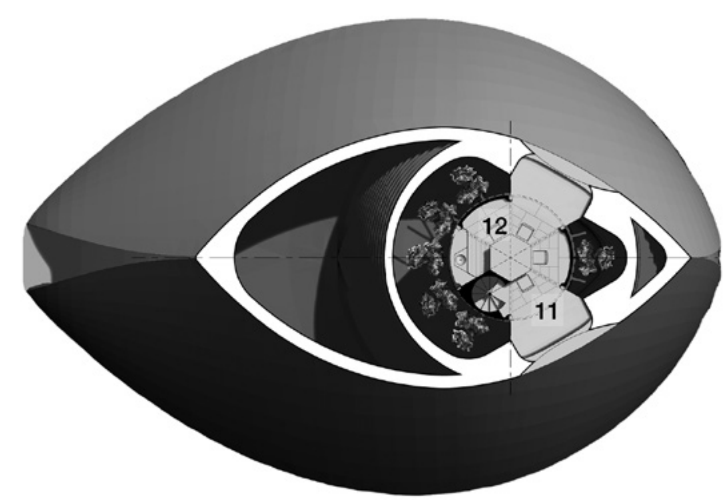
Level 3

10 Crew Quarters
9 Vertical Greenhouse
5 Hygiene Area
3 Yard (Intermediate Containment Zone)



Level 4

11 Wardroom / Gallery
12 Food prep

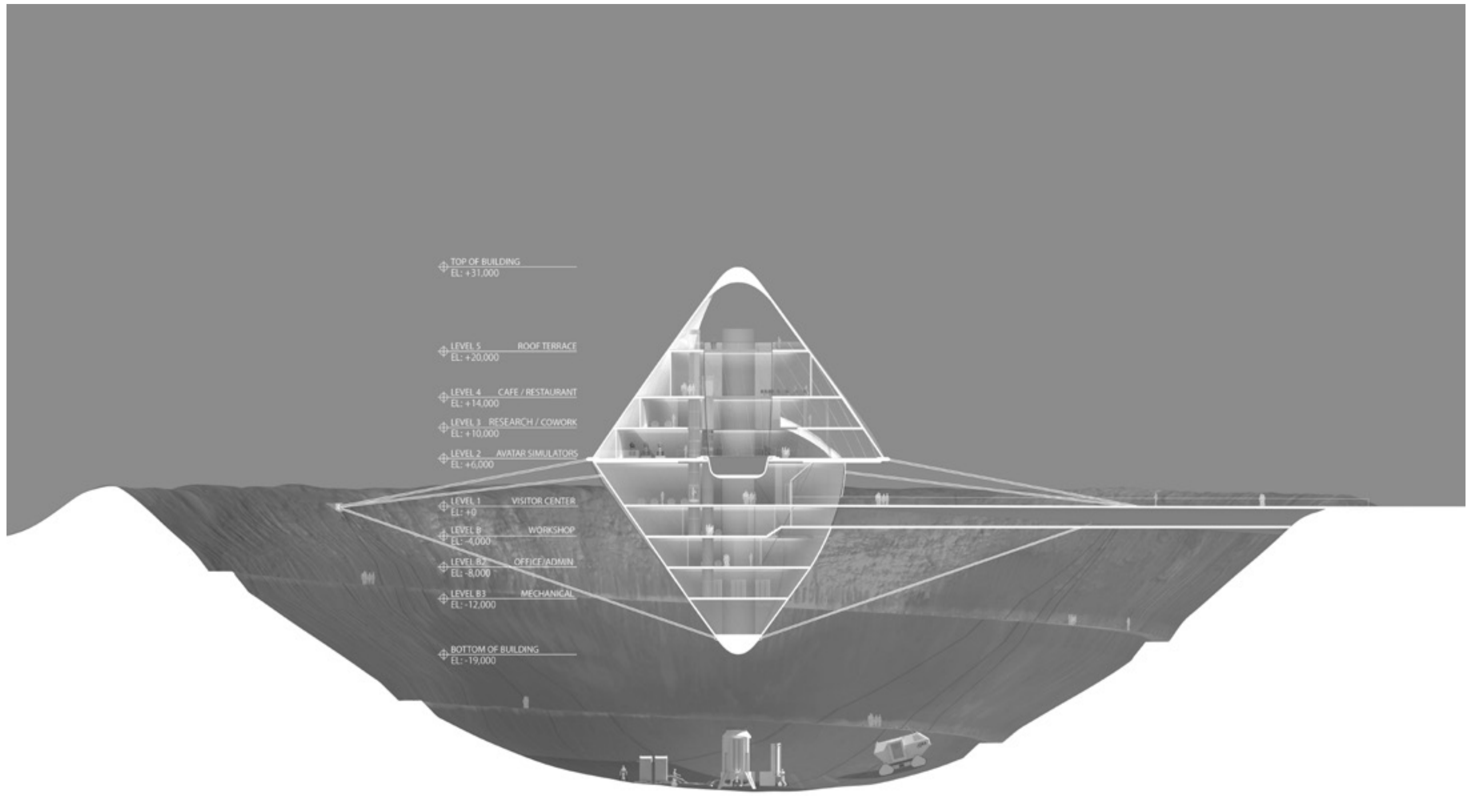


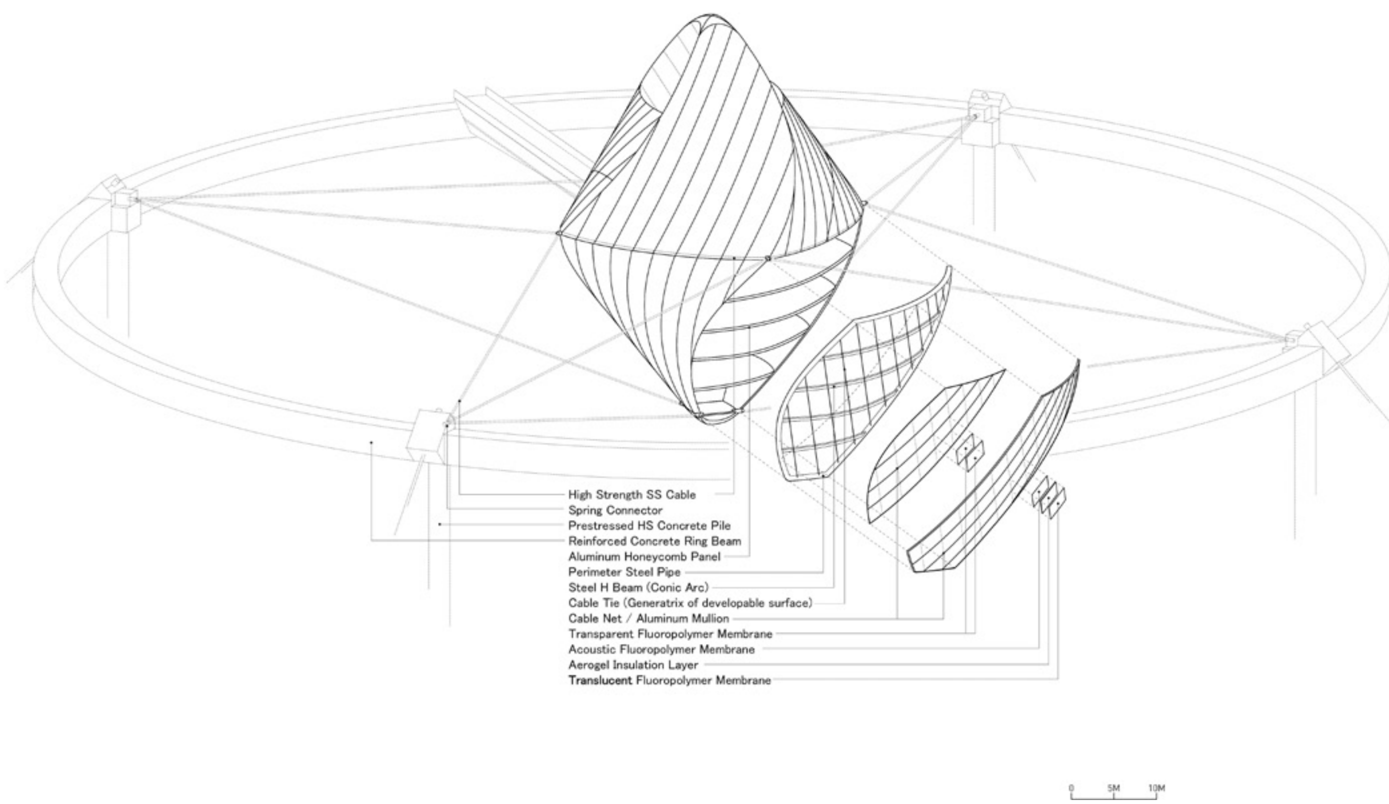
Avatar X Lab

Location
Oita, Kyushu, Japan

Date
Ongoing

Project Team
Design Architect Clouds Architecture Office
Masayuki Sono, Ostap Rudakevych,
Yuko Sono, Kevin Huang
Structural Design Jun Sato /University of Tokyo
+ Jun Sato Structural Engineers Co Ltd
Model Photography GION



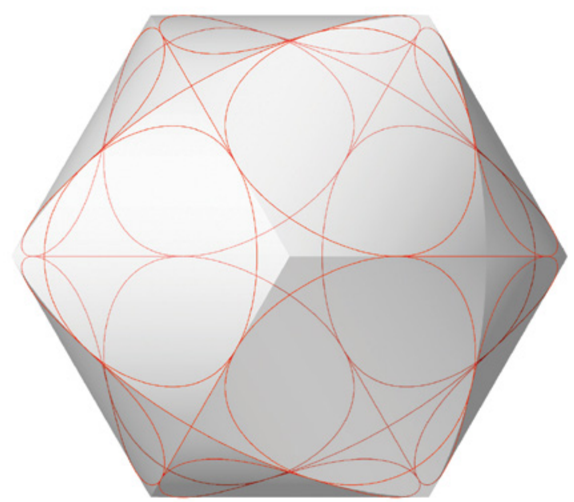


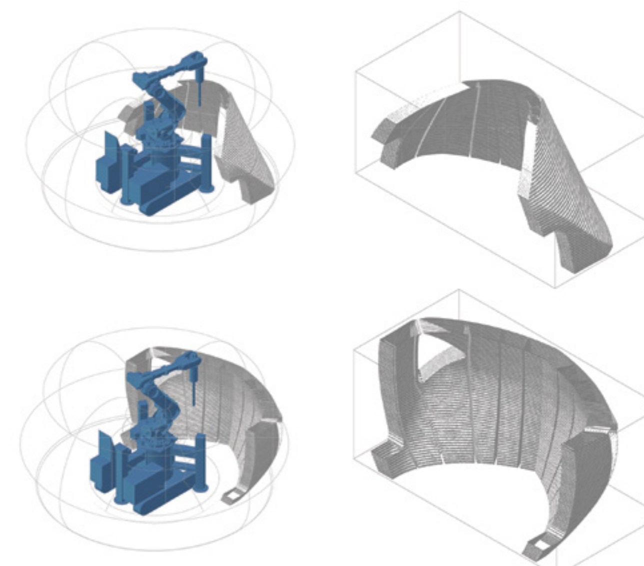
Serendix Sphere

Location
Worldwide
(based in Komaki,
Aichi, Japan)

Completion
March 2022

Project Team
Design Clouds Architecture Office
Structural Consultant Chihiro Katoh
Assembly and Constrution Hyakunen Jutaku Co Ltd,
Kaede Koumuten, Nabejyu Co Ltd





Mars Hydrosphere

Type
Planetary habitat

Location
Lowell Crater, Mars

Date
May 2025

Project Team
Design Architect Clouds Architecture Office
Project Designers Ostap Rudakevych, Masayuki Sono, Maria Clara Machado
Structural Engineer Jun Sato /University of Tokyo + Jun Sato Structural Engineers Co Ltd