A Cooperative
Space Architectural Design Studio

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LUNAR OASIS - Architectural Visions for an Integrated Lunar Habitat

Youtube Channel - Module Emerging Fields in Architecture
https://www.youtube.com/c/EmergingFieldsinArchitecture

Online Publications - Space Architecture Design Studios
https://issuu.com/hochbau2
LUNAR OASIS
Architectural Visions for an Integrated Lunar Habitat

• Opportunities, limits and constraints
• Integrated life-support and greenhouse technologies
• Intercultural cross-disciplinary thinking and design process

11 mixed teams:
• 60 students, bachelor and master
• Mixed gender
• 24 countries
LUNAR OASIS

Architectural Visions for an Integrated Lunar Habitat

PROJECT:
LUNAR SHELL

A research station with a biological air and water filtering system

TEAM MEMBERS:
Flora Münzer
Sara El Masri
Iman Al Husseini
Rawan Al Solh
Manal Hamdan
Fardous Akrabi
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Location
Moon Southpole
Shackleton Crater
unlimited solar energy

Concept – Life Support System – Habitat Configuration

Environmental Control – Zero Waste Water-Air System

- Water recovery System I
- Water recovery System II
- Solar Energy
- Solar Mirror
- Sunrays
- Collecting tank
- Collecting with conicle stretched net
- Purified Water
- Extraction from Air
- Solar Still
- Humidity
- Plants
- Food/O2/CO2
- Crew
- Shower+tap
- Grey water
- Septic tank
- Recycling
- Toilet flush+laundry+gardening
- Waste water
- Bioreactor
- Water for washing
- Water for cooking and drinking
- Gardening

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**Module**
prefabricated, compact, multi-expansional

**Zoning**
private area – working zone – activities
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PROJECT: ATRIO
A research facility that explores the relationship between humans and plants

TEAM MEMBERS:
Alma Kugic
Valentina Radic
Aysha Alkaabi
Merna Ayman
Fatima Saed
Khairi Zrik
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ARCHITECTURAL CONCEPT & DESIGN

The location that was chosen is the Lunar South Pole, due to its potential presence of water in the eternal shadowed craters, almost always available sunlight that casts long shadows, mild temperature differences in comparison to the Moon’s equator, diverse terrain and Earth visibility that is necessary for communication.

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More precisely, the Shackleton crater ridge (lat. 89.46, lon 175.38) was chosen because it offers best sunlight to darkness ratio. Even during the worst lunar day the longest period of darkness is ~7 Earth days, with shortest periods of light between darkness of ~3 Earth days.

Water reservoirs are placed on the lunar surface: inflatable habitats, greenhouses for food production and solar panels for production of electrical energy. Water is extracted from the nearby Shackleton crater and oxygen out of regolith. Landing pad is located 1.5 km away and can be reached with pressurized lunar vehicle.
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01st FLOOR
The greenhouses are separated into two modules: one for food production and the other one for research purposes. The food production greenhouse is connected directly to the kitchen.

02nd FLOOR
The research greenhouse doesn’t have a direct access. It is controlled through the robotic arm and the space is connected directly to the science lab, allowing a direct examination of the samples.

SECTION

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LUNAI

An oasis on Earth is a testimony of how sheer will can force life into nothingness. It is the vibrant, lively green spot in the middle of a dry, dead sandy desert, or a small plant forcing itself through asphalt or concrete. Similarly, a habitat on the moon should be considered the same way, and should deliver the same feeling. The moon is dead, dry and silent. A habitat on its surface should act as a sanctuary, breathing life into this alien, distant environment. It should be a safe haven for those seeking shelter within it.

Much like a desert oasis, a lunar oasis should provide all the requirements for sustaining life on the moon. Additionally, since it is on a completely deserted and alien location, it should offer a sense of security and belongingness to those inhabiting it. A lunar oasis feeling like home is key to maintain the mental health of its people. Souvenirs, personal items and even natural elements from earth can aid in emphasizing that emotion, making people feel like they do actually belong to this place, or at least feel like they’re safe at home, even when they’re literally out of their world.
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PROJECT:
MOTHER FUNGUS
A self-generating research station on bio-technological strategies

TEAM MEMBERS:
Ludovica Breitfeld
Margaryta Kaliberda
Mahsa Abdi
Sara Laila
Fatemeh Mohammadi
Shada Salloum
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SITE PLAN

ATHLETE performs a maintenance for solar panels

ATHLETE's weekly check of the slope for any damages

rover in process of docking: research team returned from a three day mission

rover on its way up from the lava tube after delivering harvest from a motherbase's greenhouses

DIFFERENT CONDITIONS & GREENHOUSES

- greenhouse food
- greenhouse mycelia
- dust & temp: -15°C/-30°C
- fungal biomass production
- baking: high temperature

green: visual connection
yellow: vertical connection
green: horizontal connection

Connections

"LET'S GO FOR A WALK!"

SPORT STOP: CYCLING

SPORT STOP: TREADMILL

SPORT STOP: YOGA & AERIAL

COFFEE BREAK 🍈 & ☕️

SLOPE INTO THE LAVA TUBE

ROVER GARAGE

SOLAR PANELS

MOTHERBASE

FUTURE LUNAR SETTLEMENT

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WALL STRUCTURE

1. ATOMIC OXYGEN PROTECTION
   - Protect against atomic oxygen

2. MULTI LAYER INSULATION
   - Helps maintain thermal control of the module’s shell and interior atmosphere

3. DEPLOYMENT SYSTEM LAYER
   - Deploys restraint & bladder layers from hyper-velocity impact damage

4. MMOD PROTECTION LAYER
   - Protects restraint & bladder layers from hyper-velocity impact damage

5. RESTRAINT LAYER
   - Structural layer - carries loads & stress

OUTSIDE

INFLATABLE MODULE DEPLOYMENT

3. Release of pressurized CO₂ from containers, embedded within the pneumatic tubes to inflate an initial structure

4. Bladder layer
   - Gas (Ar) barrier
   - Durable flexible
   - Low permeability at high & low temp.

5. "H⁺ ION CAVITY"
   - Contains Hydrogen ions
   - Polymeric materials & felt cloth

6. Inner liner
   - Barrier for the crew
   - Flame-resistant
   - Easy to clean
   - Durably puncture-resistant

INSIDE

7. PROTON EXCHANGE MEMBRANE
   - Split H₂ into electrons & H⁺ ions

8. RETURN MEMBRANE
   - Extract O₂ & H

9. GROWTH CELLS
   - Contains growth mycelia structure
   - Ex. saprophytic fungi

10. SUPPLY MEMBRANE
    - Supplies N & CO₂ & H₂O

11. HEAT TRACE PNEUMATIC MEMBRANE
    - Supplies heat to growing cells, creates right conditions

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Thank you! Guest Lectures and Guest Critics: Olga Bannova, Sheryl Bishop, Daniel Inocente, Christophe Lasseur, Cesare Lobascio, Piero Messina, Gerhard Schwehm, Madhu Thangavelu, James Wise. The Austrian EXPO team: Helmut Döller, Erand Rica.