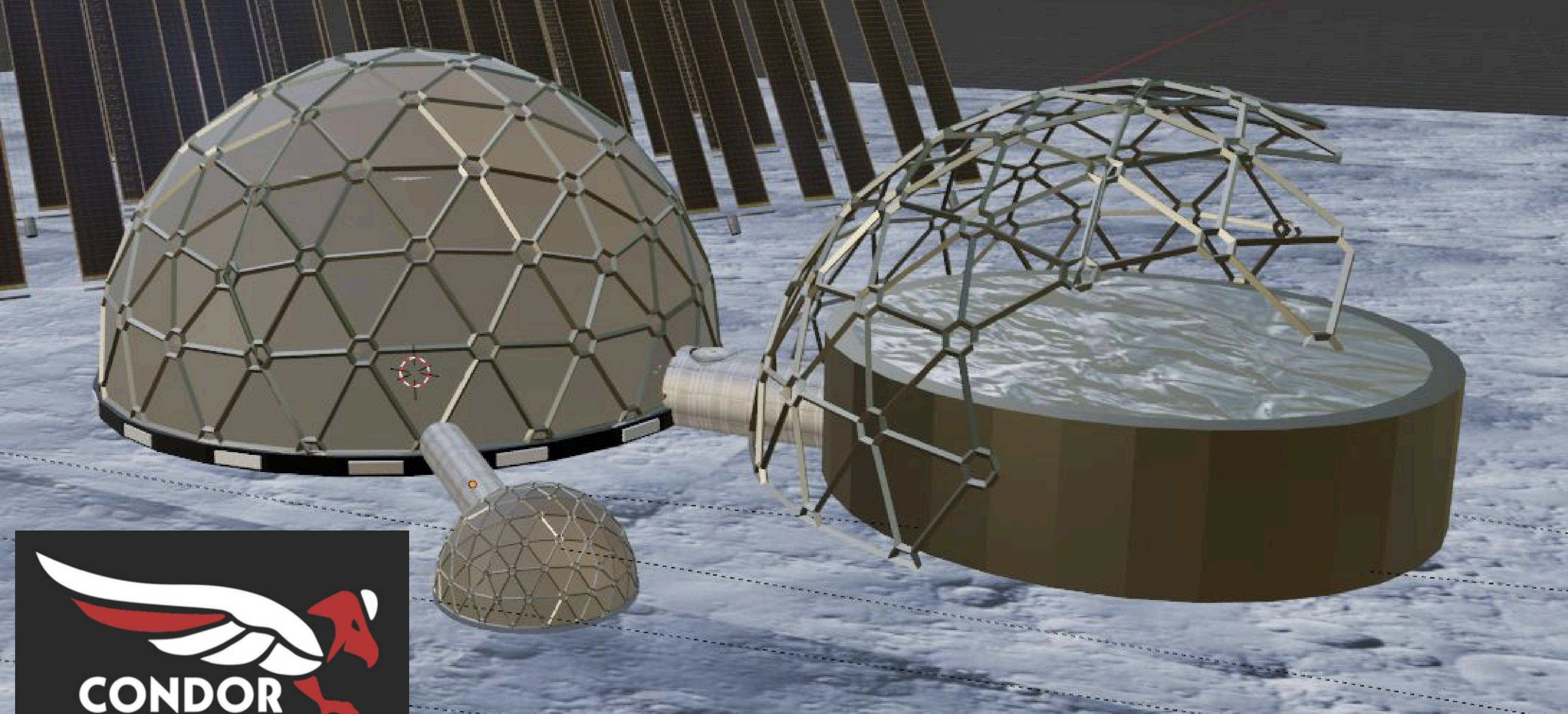
UKSDC

BALDEROL

PLANNED & DESIGNED BY CONDOR

Led by Kritin Kalani (President)

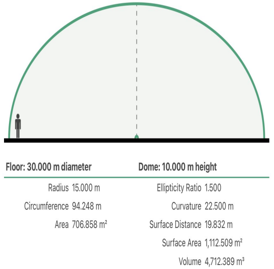


Birds Eye View Diagram and Scale - S1:

(to scale diagram)
1cm=10m

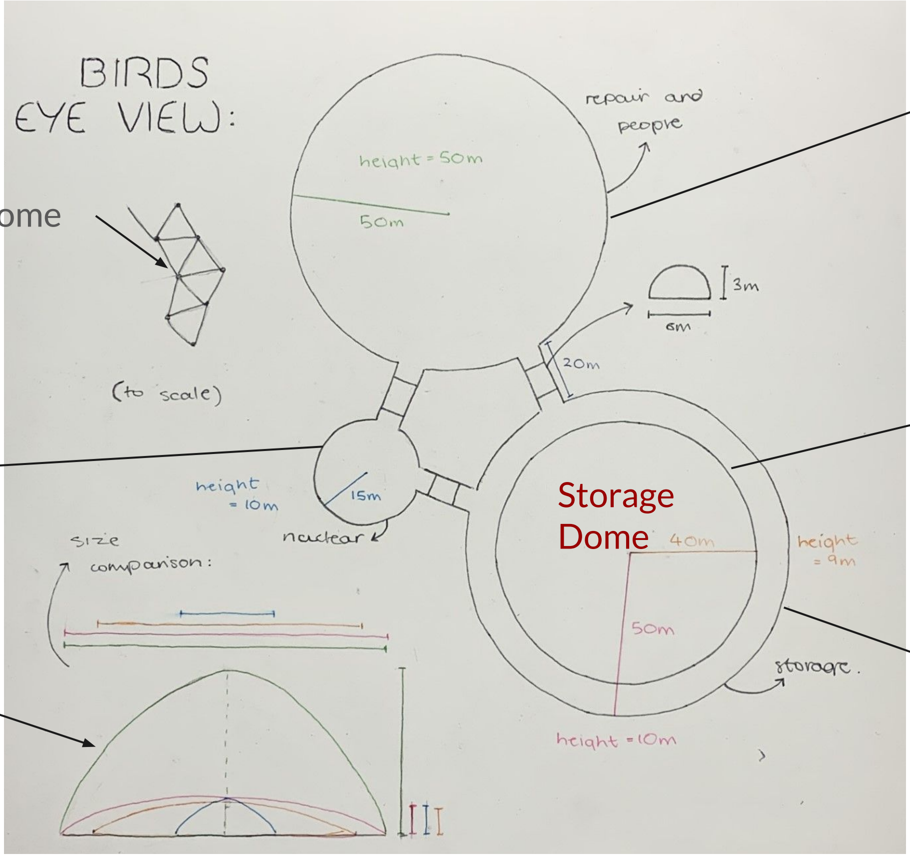
geodesic dome

Understanding the size comparison between the domes:



Nuclear Dome

A visual, cross- sectional diagram comparing all the domes:



Repair and People Dom

Inner Cylinder

Outer dome (built by 2050)

Sketch by Liza Newton

Structural **Engineering** - S1&S5

Main dome(hemisphere): radius=50m

- Human accommodation
- Harvester repair
- Hospital & infrastructures

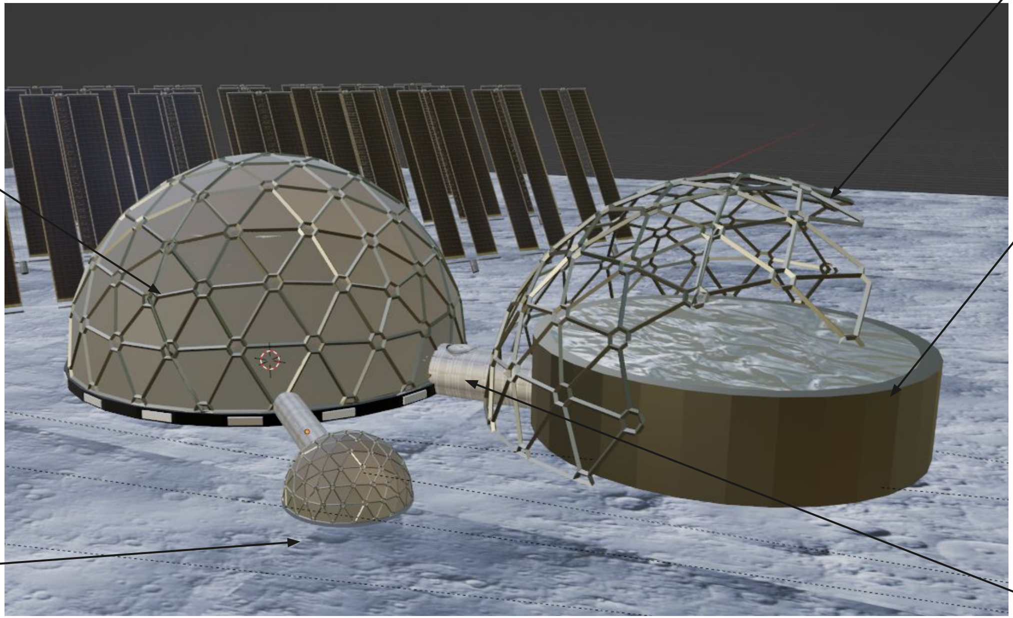
-Main farm beneath the surface

Nuclear dome(elliptical): Radius:15m, height:10m

-nuclear reactors kept seperate

-need maintenance

-hazardous



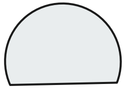
3D modelled by Nick James & Milton Mai

Extra repair domes to be built by 2050 to supply for repairment needs

Storage building: Radius= 50m, height=10m

- for storage of unprocessed waste- cylindrical shape inside
- broken Harvesters yet to be fixed
- decomposition station for replaced components

Connector paths: length= 20m, radius/height= 3m



-transportation route for easy access

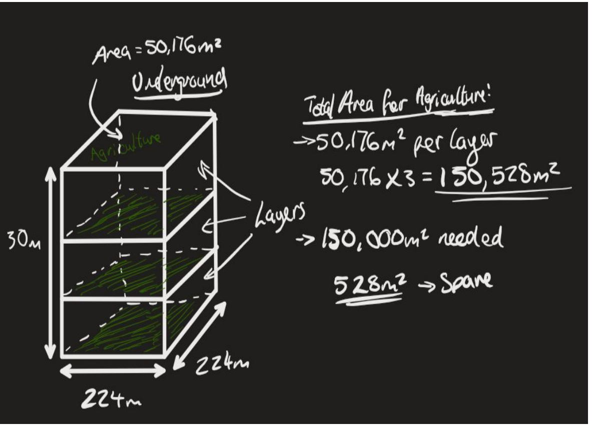
-connects all domes together

S2 - Operational & Mission systems

Repair and people dome- floors:

Area calculation diagram

50	Level 1 (10m	7853.975
40	Level 2 (8m)	5026.544
32	Level 3 (8m)	3216.98816
24	Level 4 (6m)	1809.55584
18	Level 5 (6m)	1017.87516
12	Level 6 (6m)	452.38896
6	Level 7 (6m)	113.09724



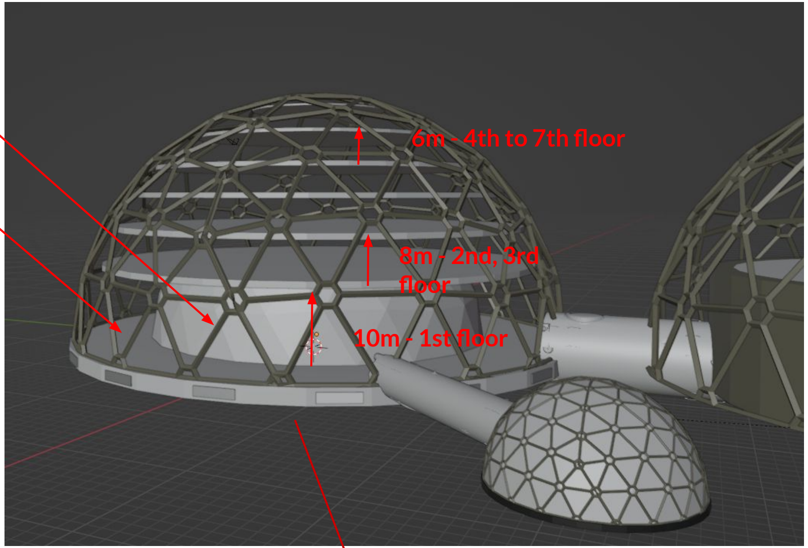
1st floor

Central - Repair compartment
- Radiation protection - lead shielding

Side wings
- Hospital for injured patients (doctors working)
- Transportations to other floors

2nd - 6th floor
- Human accommodations
- recreational areas

Top floor - control centre & oxygen room



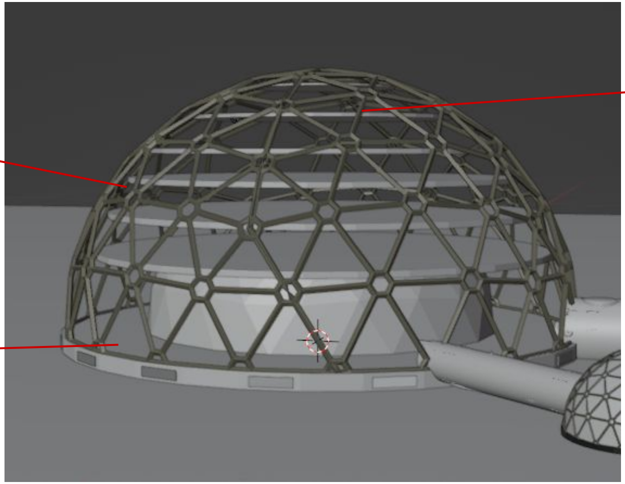
Underground modular hydroponic agriculture (4 layers)

Materials - S3

1.5m thick thermally insulated carbon fibre wall

10mm thick Polymer Flusshalt-X lining inside wall

Protects against radiation



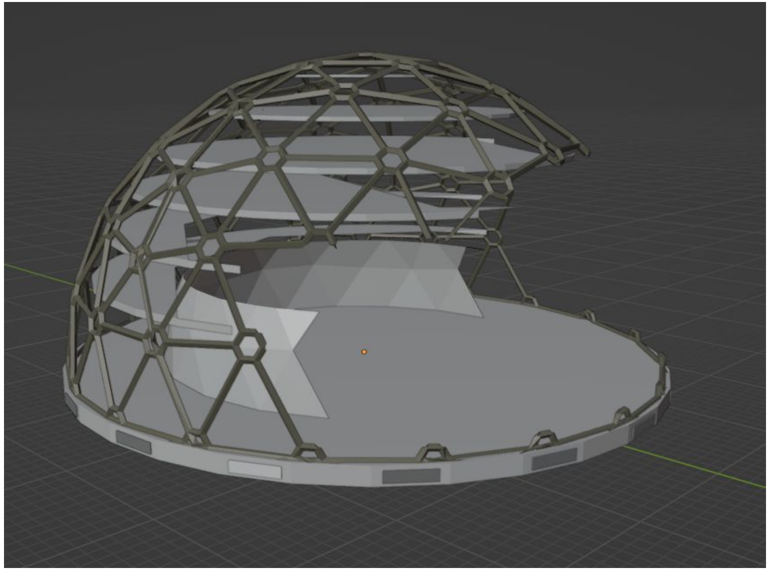
0.5mm thick Transparent coating from Sealant Advancement

Prevents gas leakage

Material	What it is used for.	Quantity	Cost	Key Points
Aerosols from AdMag	Goes between the layers of the exterior and protects from radiation.	188,484kg for human dome 13,344kg for nuclear dome 376,991kg for storage	£55.20 per kg £10,404,316.80 for human dome £736,588.80 for nuclear dome £26,389,378.29 for storage **Total: £37,530,283.89**	transparent
Coating from Sealant Advancements	Is painted on top of the structure to prevent gas leaks	Max 50m^3 7.85 m^3 for human dome 0.556 m^3 for nuclear dome	£43,370 per m^3 £340,606.30 for human dome £24,113.72 for nuclear dome £308,000 for storage **Total: £672,720.20**	Requires 30 days to dry. Only works for pressure differences of under 100 Pa
Thermally	Used as the main	16387500m^3 for	~£9 per kg	It is strong and
insulating carbon fibre	plating of the dome.	human dome 1668m^3 for nuclear dome 32201m^3 for storage	£147,487,500 for human dome £28,522,800 for nuclear dome £289,811.92 for storage **Total: £176,300,111.99**	thermally insulating.
Thermally insulating carbon fibre	Used for the bridge.	358.150 kg & 188.5m^3 for 1 bridge	£9 per kg **£9,670,050 total** for all 3 bridges.	

Total cost: £224,173,166.10

Structural Engineering - S4



Construction process:

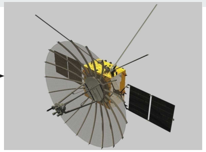
- Materials -> cargo ship -> moon
- Construction under moon in low gravitational field
  - **Cheap cost** with **high structural integrity**
- Constructed by **building bots** <- automation
  - Solar-powered

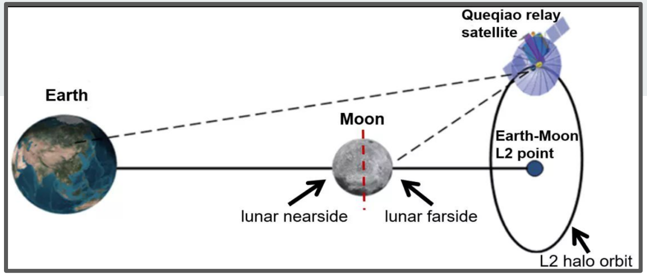
Steps:

1. Base constructed by bots - **3 months**
2. Layers & other building constructed **- 9 months**
   a. After base layer finished - some repairment compartments are available
3. Human sent to station - **constructed within a year**

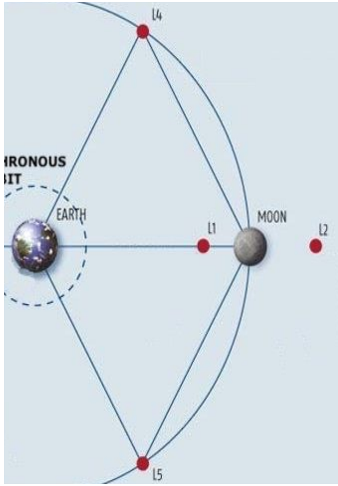
Mission Systems - M1

Cost- roughly $ 200 million





- Lunar Relay Satellites - act as **relays for communications** between Earth’s ground stations and Balderol.
- If Balderol is on far side of moon, satellites will orbit around an **equilibrium position(L2)** on far side of moon; if Balderol is on near side of moon then equilibrium position will be L4 or L5.
- Inspiration: Queqiao satellite (launched in 2018) used for same purpose.



Use of **infrared and radio waves** - infrared packs data into smaller space - **more data sent at once**

Kevlar, aluminium alloys to build satellite - **high strength** and **low weight**

Use of **Encryption** - Advanced Encryption Standard(AES) + VPNs

High Gain Antennas - sends narrower, precise beams of light; can travel over **longer distances.**

Dimensions - 4.2 m in height, 14 m in diameter

Mission Systems - M2

Network Security Levels	Personnel Levels	Threat Levels
Level 1 - Allowed to monitor, but not control various robots in the base.	The lowest level personnel access will be for maintenance staff.	1 - Yellow
Level 2 - Allowed to control the movement of robots in the living spaces of the staff.	The middle level personnel access will be for general engineers and medics/doctors.	2 - Orange
Level 3 - Allowed to control all motor functions of all robots as well as other automated operations in case of emergencies.	The highest level of personnel access will be given to the head engineer and base management.	3 - Red

Physical security for personnel:

Low:
4 digit number code

Middle:
Fingerprint and access card

High:
Fingerprint , facial recognition, as well as a 9 digit password

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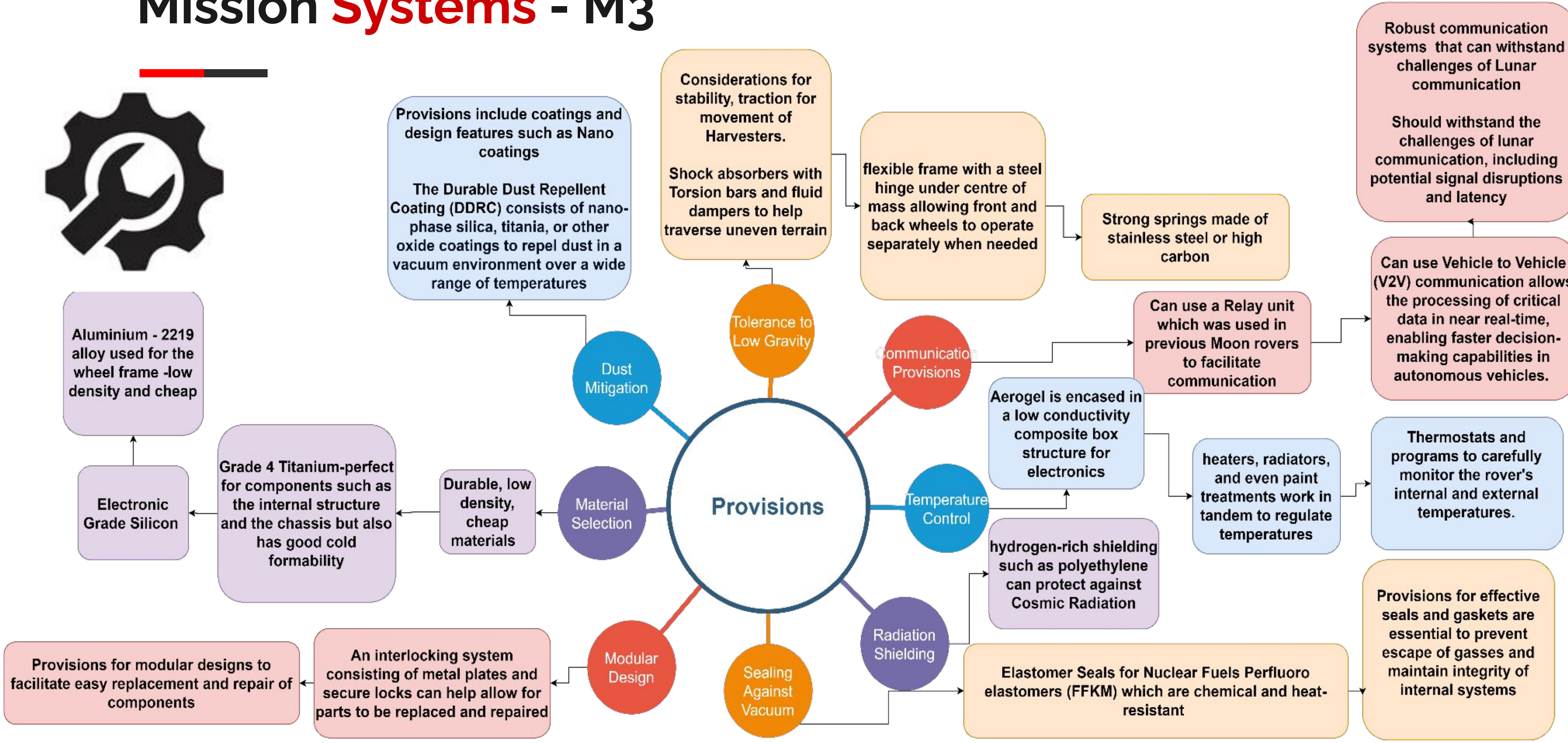
Mission Systems - M3



https://www.gavinrothery.com/they-never-went-to-the-moon/2011/8/21/designing-the-lunar-harvesters.html

Harvester maintenance facility - M4/5

Harvesters run a self assessment; can use **strain gauges**, **temperature sensors**, or **piezoelectric materials** to measure the changes in their mechanical or electrical properties caused by damage.

Controllers are available in a range of sizes to suit the harvesters.
Harvesters are transported inside the repair facility using an automated pulley system, with there being 4 main channels running parallel to each other, keeping the process continuous. Improving the structure of the harvester can be explained in these stages : finding structural limitations, analysing information and identifying improvements, such as wiring improvements (micron accuracy).

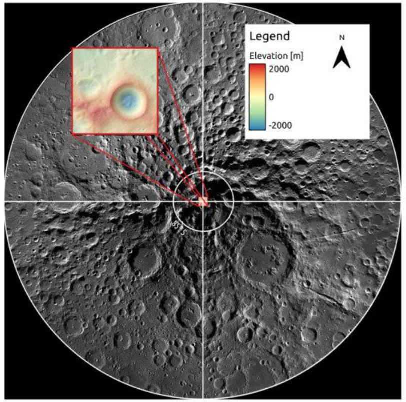
- When the harvesters are shut down, the **scanner is activated**, which will examine the whole system and detect any faults. If there happen to be any faults or malfunctions, this self damage is relayed to the central management district, where the system organises the harvesters in order of the damage occurred, with minor damages being prioritised first in order to reduce waiting time and keep the process efficient
- This allows a series of **mechanical and systems engineers** to work on any repairs.

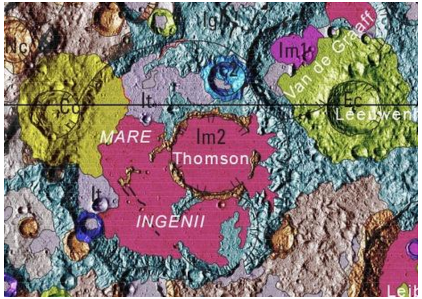
Human Factors - H1/H2

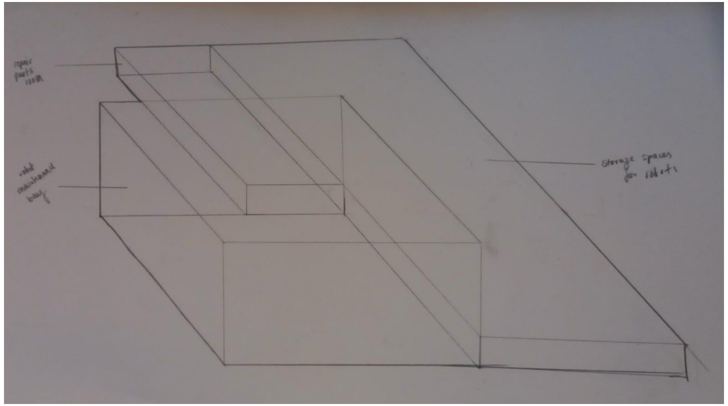
Thomson Crater

H1; Factors to consider include:

- Thermoregulation - the temperature must be controlled
- Radiation management - ensure shielding against harmful radiation
- Structural stability - possible materials to contribute to construction (strength & abundance)







Possible materials to consider for these structures include aluminium, regolith-based materials and advanced composites.

H2; The workspace would consist of:

- A robot maintenance bay (25 x 20 x 10m)
- 2 harvester storage spaces (20 x 40 x 10m)
- A repair parts room (10 x 20 x 3m)

Human Factors - H2/H3

Public Spaces;

Gym

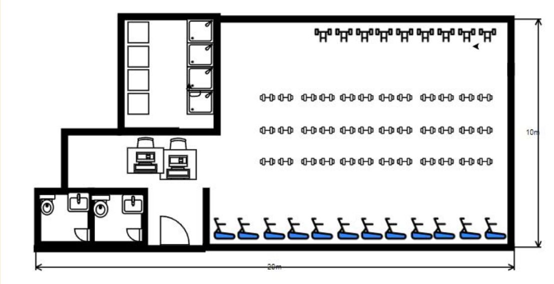
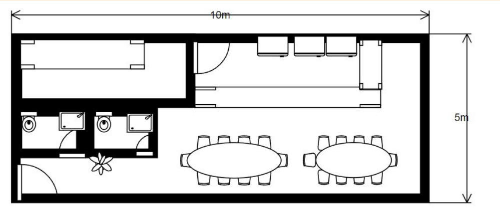
- Health Benefits
- Community Support

Pub

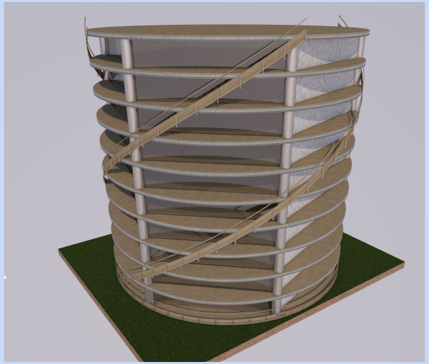
- Social Hub
- Relaxation and Leisure

Emergency Transportation

- Wide & Clear Pathways
- Emergency Elevator and Lifts
- Accessible Emergency Exits

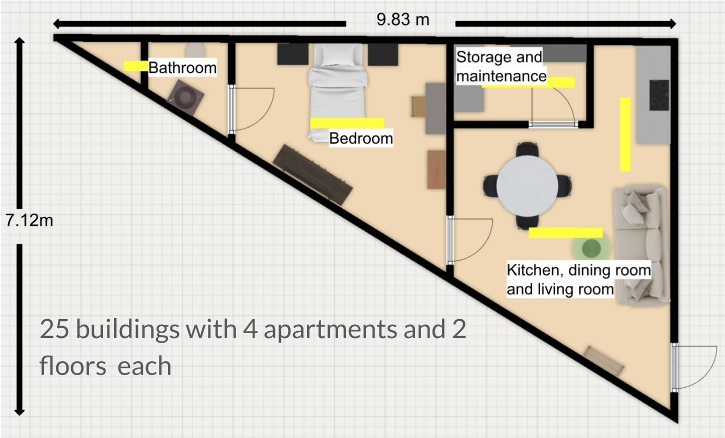
Modular residential buildings:

Designed and rendered by Nick James

Human **Factors** - H3

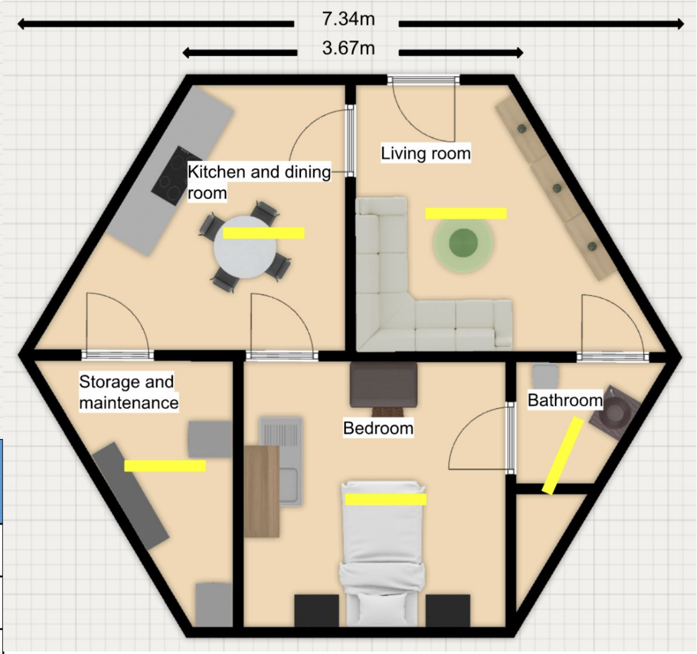
For rectangular buildings:



25 buildings with 4 apartments and 2 floors each

	Area/ in m^2 (for hexagon)	Area/ in m^2 (for triangle)
Apartment	35.00	35.00
Bathroom	3.17	2.05
Bedroom	9.94	9.70
Storage room and laundry room	4.74	3.57
Living room	8.61	19.68
Kitchen + Dining room	8.61	

For hexagonal buildings (50 buildings with 2 floors):



= efficient LED lights

Consumables:

Toiletries	Qty used (per month per person)
Shampoo	150ml
Shower gel	300ml
Toothpaste	110g
Razors	4
Tampons	21
First Aid	2
Mouthwash	500ml
Skincare products	3

- Food quantity mentioned in Operations slide 17

- The private sectors and the public areas are connected by a series of lifts scattered around the edge of the dome, which can be easily accessed by residents.

Human Factors - H4/5

Safety and Work Protocols

- **Elimination:** Physically remove the hazard(s)
- **Substitution:** Replace the hazard(s)
- **Engineering controls:** Isolate people from the hazard(s)
- **Administrative controls:** Change the way people work
- **Personal protective equipment (PPE):** Protect workers
- All of these techniques are used in conjunction with **Mission Systems Security** plan on Slide 8.

➔ **Effective disposal solutions**

➔ **Ventures by Sapien**

➔ **CRISPR Cod ,Modular Ecology to feed workers**

➔ **Park(Svalbard Seeds ,Synthetic Seeds for saplings)**

Manager/Admins X25 - Manages workload and other roles

Head Engineers X3 - Hydroponics,Nuclear and Maintenance

Security X20 - Patrols around base to ensure safety to all

Engineers X65 - Perform checkups and maintenance on nuclear reactors and robots

Medical X42 - Surgeons 15,Physiatrist 5,Other medical professions 22

Communication Officers X20 - Maintain constant communication within and out of base

Recreational and commercial X15

Specialised Cleaning Unit for harvester regolith X 10

Security + Fire Safety + Cleaning robots

➔ Safety precautions

➔ Physical dangers

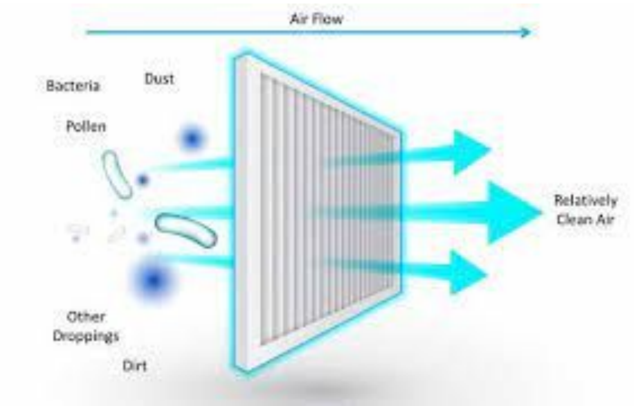
➔ Treatment facilities

➔ Accessibility

➔ Health robot

Operations & Infrastructure - O1

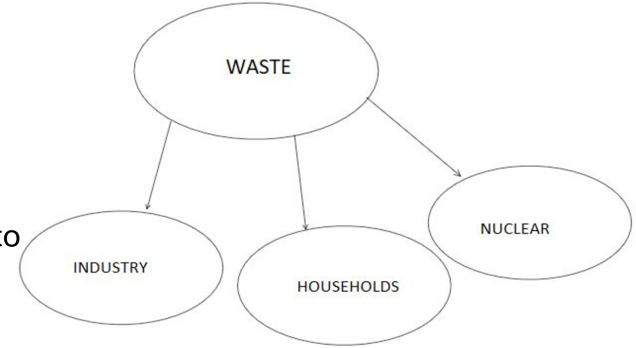
- **Air purity:**
    - Activated carbon filters to remove pungent odours
    - ULPA filters to filter 99.999% of airborne particles
    -
- **Atmospheric monitoring and regulation:**
    - Airlocks to seal atmosphere from Lossless Airlocks
    - Atmosphere makeup and pressure regulators from Vigilant System
    - Pneumatic air pressure regulators will be used to control >= 0.7
    -
- **Control of temperature:**
    - Heating: a hydronic system running throughout the settlement, heat pumps and a boiler and radiator system
    - Cooling: heat pumps and an ATCS to plump fluids through closed-loop pipes using a liquid-ammonia loop along the base's main truss to keep the station's solar panels cool



Operations and Infrastructure - O2

Waste Management

- Collection of sewage and solid waste:
  - Two separate plumbing systems using low pressure to deliver waste to collection point
  - Loaded onto capsules and sent through a double airlock to prevent any spillage



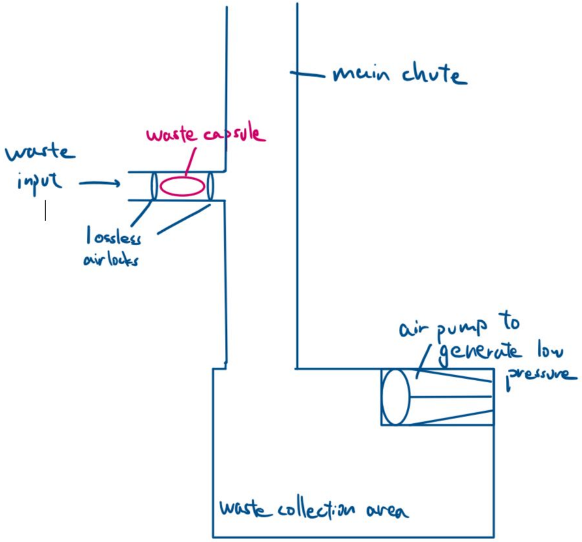
Water Management

Process for recycling of water from sewage systems:

- Water is recycled through Urine Processor Assembly.

Materials Used:

- Galvanised, wrapped with Soft-magnetic titanium alloy from Earhart Skunkworks
- Flexible rubber



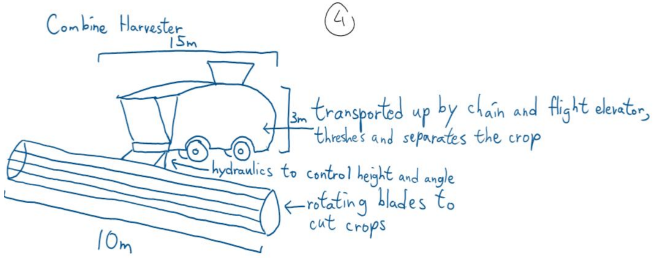
Operations and Infrastructure - 03/4

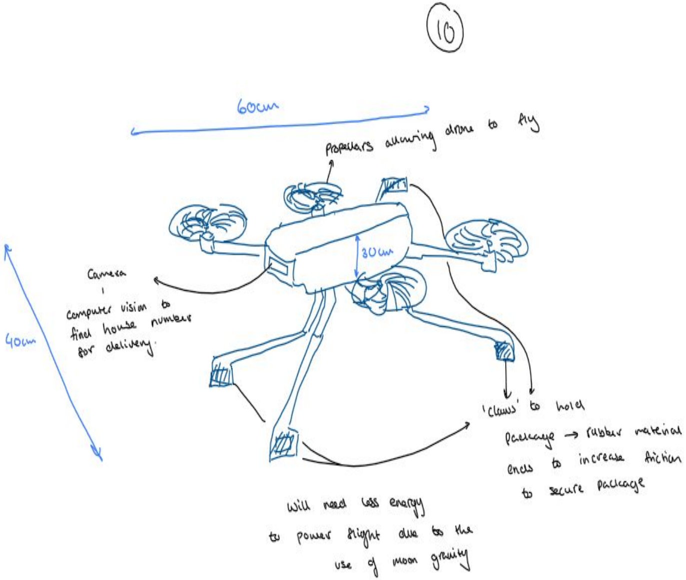
Hydroponic system for plant growth. GM plants with growth genes and vitamins; deep water culture will be used. Artificial light from solar energy. Air stones and diffusers oxygenate the solution

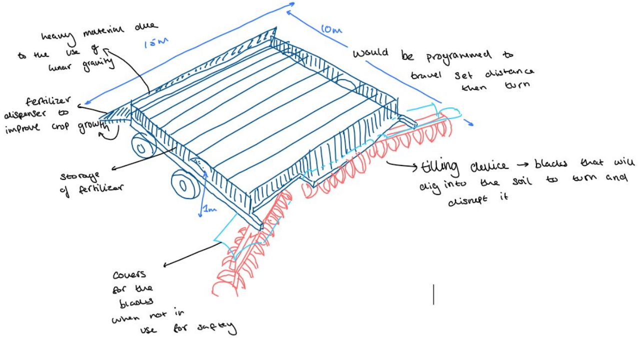
Watertight building. Canning. Temperature-controlled storage facilities. Freeze-drying. Robots can farm and distribute food to settlers.

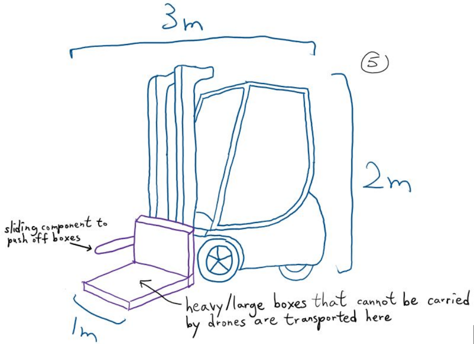
Energy supply: solar, with fission energy as backup. Atmosphere regulator, harvester maintenance and agricultural robots. A load following control the amount of energy produced per kilowatt/hour;limits energy at night, so enough electrical output remains to run 24/7. Extensive batteries to store sufficient power for the dark phase of the moon.

Food Item	Quantity
Sweet Potato	20,000m^2
Maize	10,000m^2
Wheat	28,000m^2
Leafy greens (spring greens, berries, tomatoes)	40,000m^2
Spices	2,000m^2







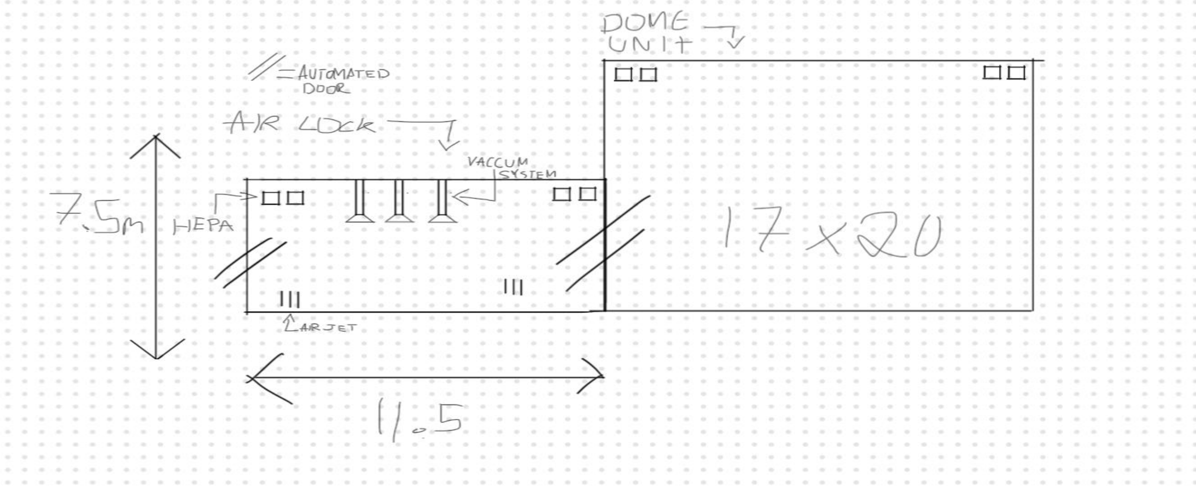


Operations and Infrastructure - 05

Moving equipment from lunar condition to pressurised volumes:

Airlock Types:

- Personal Airlock
- Harvesters' Repair Airlock
- Harvesters' Storage Airlock



HEPA Filters:

- Installed at entry points
- Capture regolith particulates

Ventilation System:

- Regulates airlocks
- Facilitates easy disposal of captured regolith

Specialized Cleaning Procedure:

- Maintenance workers equipped with air jets and vacuum systems
- Removes regolith effectively

Safety Equipment:

Workers provided with suits and filtration masks

Price:

£1,735,000

Business and Marketing - B1

Dome costing:

Exterior - £10,402,568.35; Aerosols - £37,530,283.89 (all domes); Coating - £672,720.20 (all domes); Thermally insulating carbon fibre is £185,970,162 for a final total of £234,575,734.40

Housing:

£17,520 - LEDs (housing); £1314 - LEDs (recreation and leisure); £8760 - LEDs (hospitals and clinics); total material costs for living arrangements is £12,375,000

Communication:

$200,000,000 - Lunar relay satellite including high gain antenna

Food:

Total costs are £35,270,000 for water, nitrogen, oxygen, disposal, modular ecology, trained workers and food

Business and Marketing - B2

Starting:- Early 2034

Stage 1: Life sustenance (building the exterior dome)- 2 years

Stage 2: Temporary living arrangements (food and accommodation) - 1 year

Stage 3: Permanent sustainability (planting food and full accommodation) - 1.5 years

Stage 4: Security and protection (building systems and making provisions) - 4 months

Stage 5: Comfort and adjustment (building working and recreational places) - 3 years

Stage 6: Transport (streamlining) - 2 months

Ends:- Late 2042

Business and Marketing - B3/B4

Core operational activities:
- Control Centre to initiate and adapt systems so that when more Harvesters are added to system, they are managed and tracked correctly
- When full fleet is achieved, extra dome will be constructed - same conditions as initial dome.
- Operational activities mostly the same. Initially would have surplus energy so that the only adaptation to increased fleet would be resource management for repairs of harvesters.

Lunar Base located at site Thomson (32.7 S, 166.2 E):
- Easy Landing/Takeoff for resource delivery/movement
- Due to past lava flows, the terrain would be flat an easy to build on.
- Mare ingenii - more flat ground around it for possible expansion
- Enough of a diameter to support the entire settlement
- Anything too far towards the south pole would be increasingly difficult to land and take off from - von karman and schrodinger ruled out

Thomson Crater