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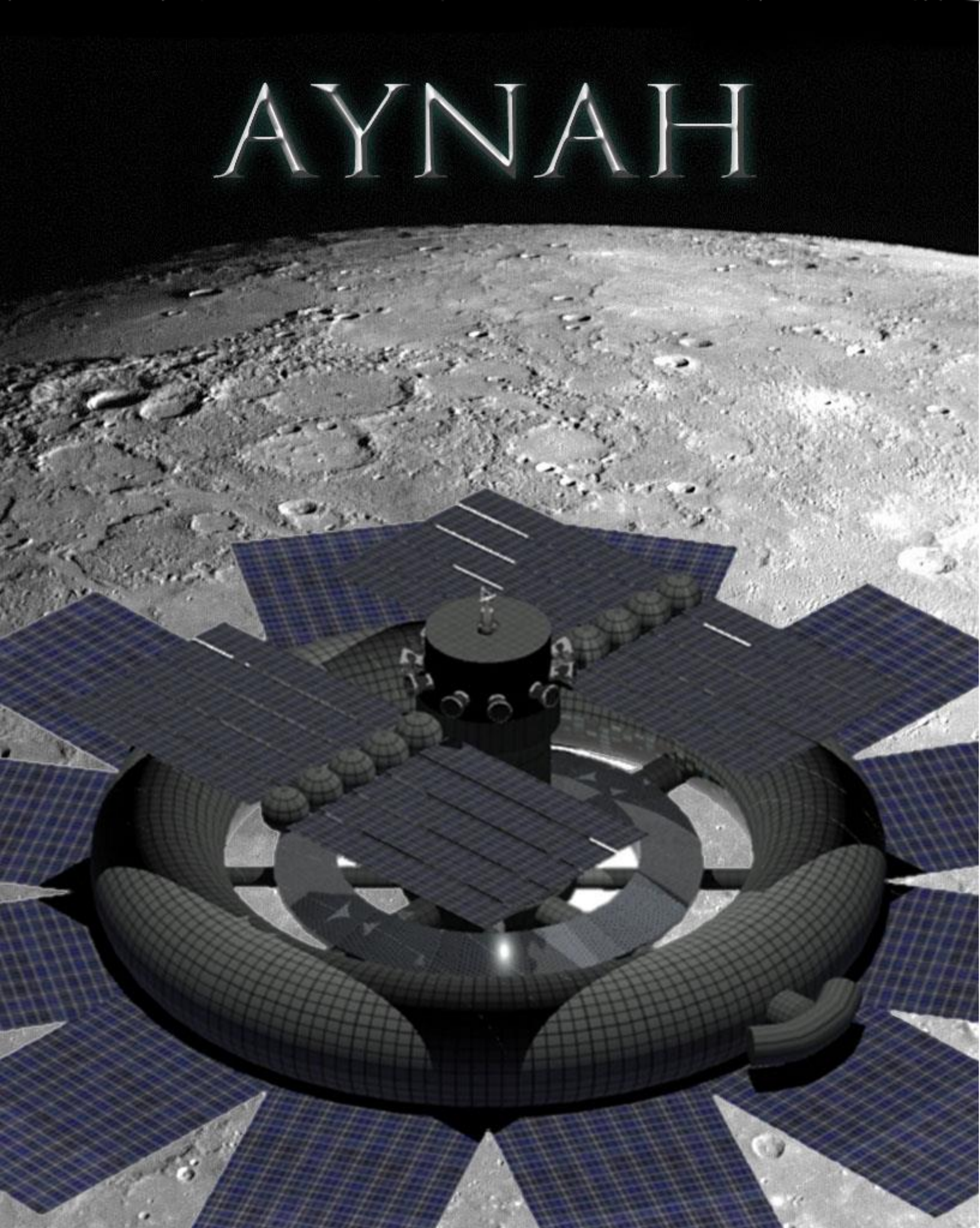
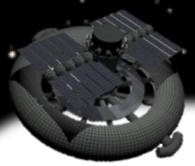


PRINCESS MARGARET SECONDARY SURREY, BC, CANADA



AYNAH

19th Annual International Space Settlement Design Competition
Proposing Team Data 2012

Name of responsible teacher/advisor:	Neder Dhillon
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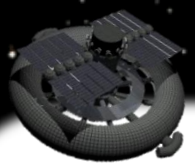
Names, [grade levels], and (ages) of 12 students currently expecting to attend the Finalist Competition:
(we request that participants be at least 15 years old, and not older than 19)

Alice Ho [11] (17)	Mohammed Zoubhair Moosuddee [11] (17)
Hassaan Sheikh [9] (15)	Vincent Tang [12] (17)
Ishmeet Singh [11] (17)	Sindi Sharma [12] (17)
Haroon Chaudhary [11] (16)	Khush Lamba [12] (18)
Gurvansh Sharma [11] (17)	[ ] ( )
Harinderpal Singh Khakh [11] (16)	[ ] ( )



Names of two adult advisors currently expecting to attend the Finalist Competition:

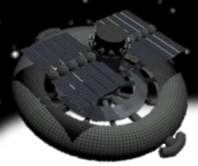
Bhupinder Singh Rathore | Neder Dhillon

I understand that if our Team qualifies for the International Space Settlement Design Finalist Competition July 27 - 30, we will be expected to finance our own travel to/from Nassau Bay, Texas, USA.

Neder Dhillon | 03.28.12

Responsible Teacher/Advisor Signature | Date

1.0 EXECUTIVE SUMMARY



1.0 - Executive Summary

Our company has successfully designed a space settlement in response to the Foundation Society's contract which is awarded 8 May, 2077. Our company's main goal is to extract Reardonium from Mercury and to refine and manufacture it in Aynah. This will provide opportunities for Aynah to do businesses with Earth and other settlements. Our company has placed Aynah specifically 383.79 km away from Mercury into its polar orbit and in order to maintain its position, Aynah has been designed with thrusters.

Our proposal is organized according to the following sections which deal with the different aspects of Aynah; Structural Design, Operations and Infrastructure, Human Factors, Automation Design & Services, Schedule & Cost, and Business Development.

Our Structural Design deals with the complicity of high radiation and production of gravity. Artificial gravity will be generated by rotation of components of Aynah as a result of the centrifugal force. Our company has also decided that comfort of the residents of Aynah should be prioritized. As our customers, we hope to give them an awesome experience in space. Our residents will not only have a natural view of Mercury but they will also get a chance experience zero g.

Operations and Infrastructure of Aynah is carefully designed to bring Aynah to its highest potential. Construction materials are precisely chosen for the sake of protecting Aynah from solar radiations. In addition, with Aynah being in the sun-facing orbit of Mercury, our company has taken advantage of the high solar constant of 9 Kw/m^2 and has chosen Gallium Arsenide solar panels as our main source of energy.

Our community design and services have been designed to bring maximum comfort to our residents. Our company has designed a 1g bean for the betterment of children development. High levels of entertainment and services provided in the beans will also attract the older residents to spend time there. Despite all the fun, Aynah also supports the importance of learning and has provided highly advanced schooling equipment for students.

Automation Designs and Services of Aynah will provide the best and most advanced technologies. We have designed special robots/machineries which will provide assistance in manufacturing and management of Aynah. In addition, our high speed networks will be highly efficient and provide top safety for personal data.

Our schedule and cost is detailed and well budgeted. We have kept in mind from the start that it is important to provide top quality of living while maintaining the level of cost. We are proud to be able to find the balance which allows us to complete Aynah within 18 years and with a cost 117.352 billion dollars.

Business Development handles all of the commercial parts of Aynah. With our ability to mine Reardonium, a rare metal, we are able to increase our economy by doing businesses with other settlements and Earth.

Our company feels privileged and would like to conclude by thanking 'THE FOUNDATION SOCIETY' for allowing us to take part in their remarkable project. We believe that our proposal has satisfied every aspect of what was requested and we would be honoured if given a chance to take part in such a historical event.

2.0 STRUCTURAL DESIGN

2.0 External Configuration

Aynah's structure design will place a serene and safeguarded environment for its residents at the summit of its priorities. The careful positioning of Aynah will give its resident a pristine panorama of Mercury's surface. Minute calculations will been refined to accommodate 14,000 permanent residents and 200 visitors, as requested, while still being able to function efficiently as a prominent economic investment.

2.1 – Exterior Hull

2.1.1 Design

The settlement will consist of 5 major components: the residential torus, the beaded cylinder, the agricultural discs, the transportation spokes, and the central cylinder. Aynah will have a relatively low RPM of 0.88. This will reduce much of the Coriolis Effect bringing comfort to the residents. The cost of construction and maintenance is reduced quite a bit as a low RPM is more manageable to monitor and correct.

Table 2.1.1 – Attributes of Aynah

Component	Volume (m^3)	Gravity (g)	RPM	Functions
Torus	1.42×10^{10}	0.8	0.88	-Residence -Commodities
Central Cylinder	8.48×10^{7}	0	--	-Industry -Repair
Beaded Cylinder	8.04×10^{5}	0.1-0.5	0.88	-Manufacturing & refining Reardonium Parts
Discs	5.3×10^{7}	0.42-0.48	0.88	-Agriculture
Spokes	4.14×10^{3}	N/A	0.88	-Transportation

Fig. 2.1.1 – Major Visible Features of Aynah

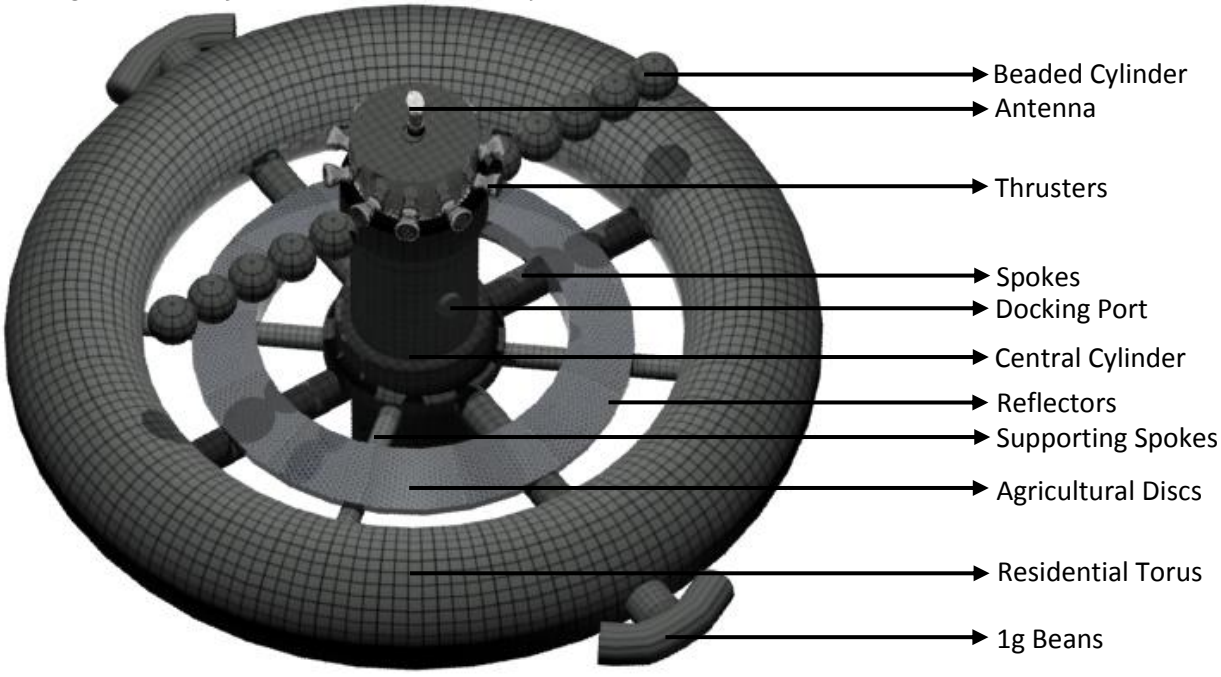
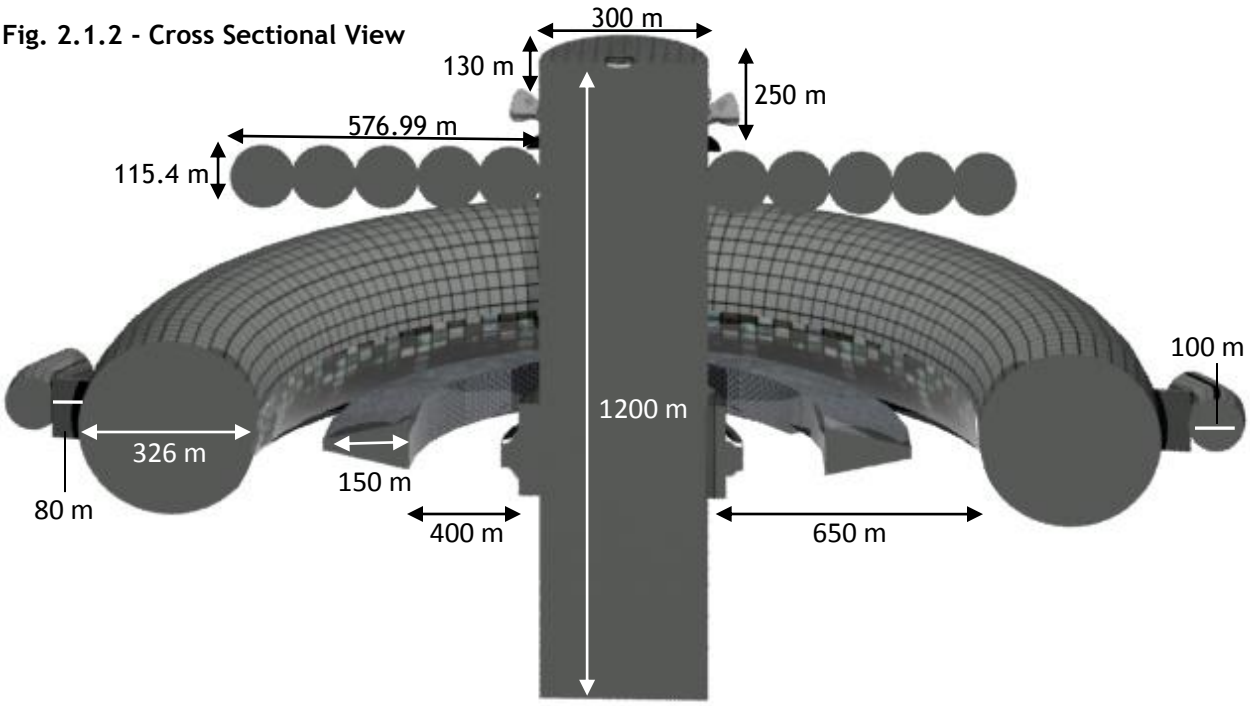


Fig. 2.1.2 - Cross Sectional View



2.1.2 - Specifications

Aynah will be outfitted with solar panels that will radiate from the outer edge of the residential torus. Some solar panels will also be situated on either sides of the beaded cylinder (refer 3.4). 12 thrusters will be located on the central cylinder to help keep Aynah in orbit. Other major features will include communication antennae and docking ports. A five docking port system will be established on Aynah. 3 of them will be located at the bottom of the central cylinder for entering/exiting the settlement. The other 2 ports will be stationed on the exterior of the refinery of the central cylinder for import of mining material and export of completed parts.

Table 2.1.2 - Pressurizing and Rotation

Component	Rotating/ non rotating	Pressurized/ non pressurized
Torus	Rotating	Pressurized
Central Cylinder	Non-Rotating	Partially Pressurized
Beaded Cylinder	Rotating	Pressurized
Discs	Rotating	Partially Pressurized
Spokes	Rotating	Pressurized

2.1.3 - Escape Route

In cases of emergencies or depressurization, Aynah will have the ability to gather all residents into the four agricultural discs within 30 minutes and isolate them from the rest of the settlement. Each spoke will incorporate a four elevator system, with a capacity of ~ 100 people each, going at the speed of 13 km/h.

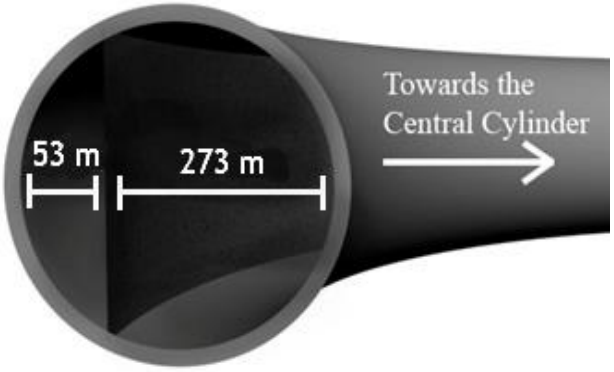
2.1.4 – Pseudo-Gravity

Artificial gravity will be generated on different areas of the settlement from the centrifugal force created when the structure is rotated. The magnitude of g will differ across the 4, carefully positioned, main sections of the settlement that gravity will be generated on. First, the 0.8 g in the residential torus was decided as it is the most favourable for optimal human development. In the agricultural discs, g will range from 0.42 – 0.48 to account for discrepancies in crop preferences. The relatively lower range of g will ensure maximal crop growth speed and yield. Next, the centrally located industrial cylinder will be non-rotating and will not generate gravity. Finally, the beaded cylinders specialized for reardonium manufacturing and refining will incorporate the 0.1 – 0.5 g range.

2.2 – Internal Configuration

The internal configuration of the settlement greatly influences lifestyles the inhabitants will have on Mercury's orbit. Given the amount of space, Aynah will have the ability to hold 14, 000 residence and 200 visitors. Plus, the design of Aynah will make it more efficient for visitors and residents to enter and exit the settlement. The various sections composed in the settlement will have certain down surfaces to ensure stability of the structure while keeping in mind the needs of the citizens. Aynah will consist of three subdivisions; residential, agricultural and industrial.

Fig. 2.2.1 - DSA Orientation of Residential Torus



The width of the DSA is 240.57 m and its area is 1.62×10^6 m^2

Fig. 2.2.2 - DSA Allocation of Residential Torus

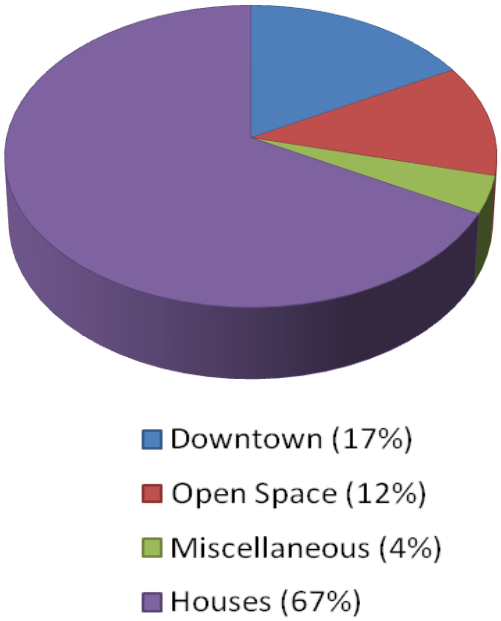


Fig. 2.2.3 - DSA Orientation of Discs

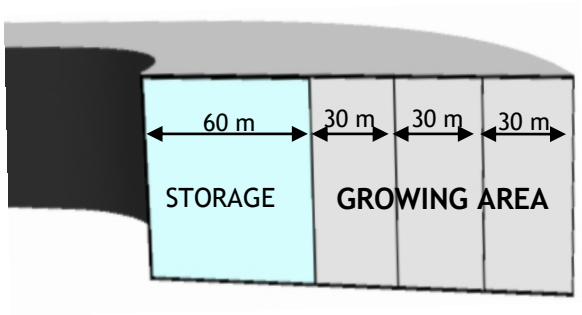
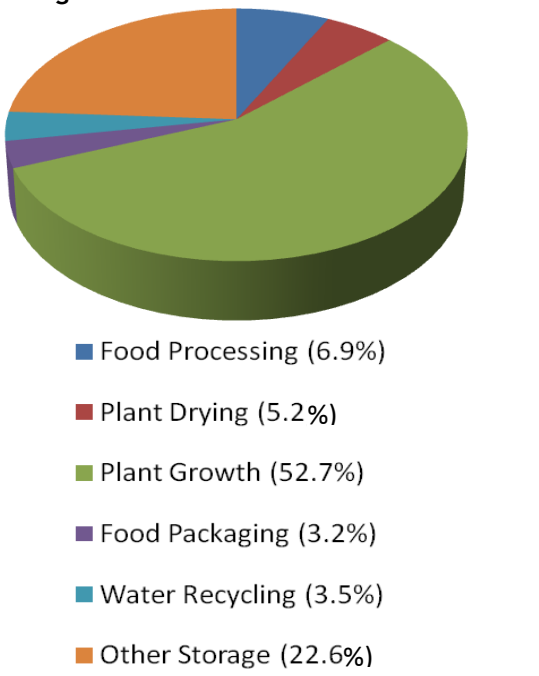


Fig. 2.2.4 -DSA Allocation of Discs

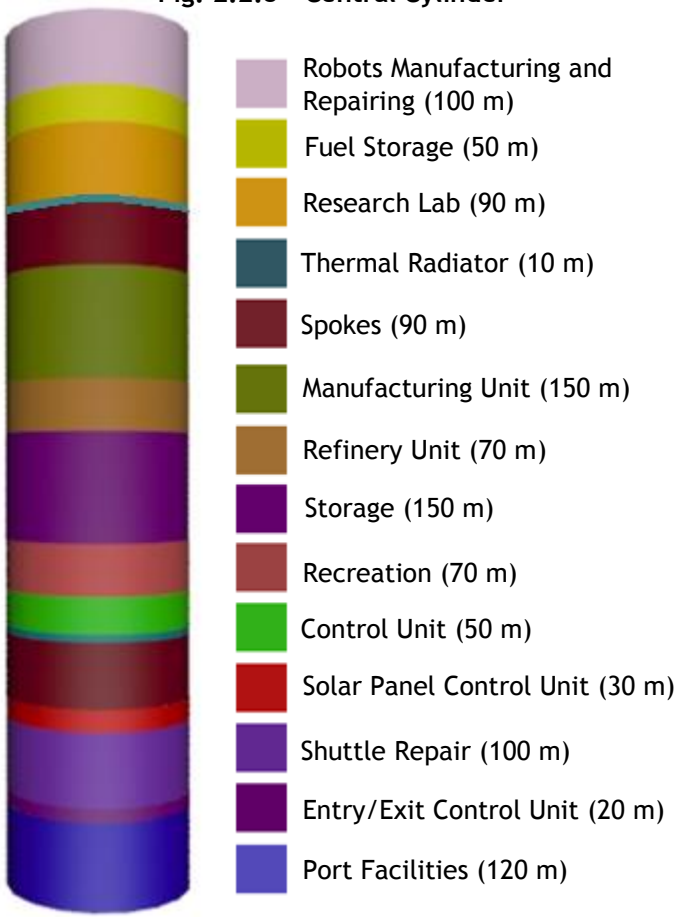


The width of each DSA is 90 m. The disc is divided into 2 main areas: storage area and food growing area. The growing is divided into 3 parts with each part having a different DSA. The DSA 1 is 2.77 x 10^5 m^2. The DSA 2 is 2.94 x 10^5 m^2. The DSA 3 is 3.11 x 10^5 m^2.

Central Cylinder

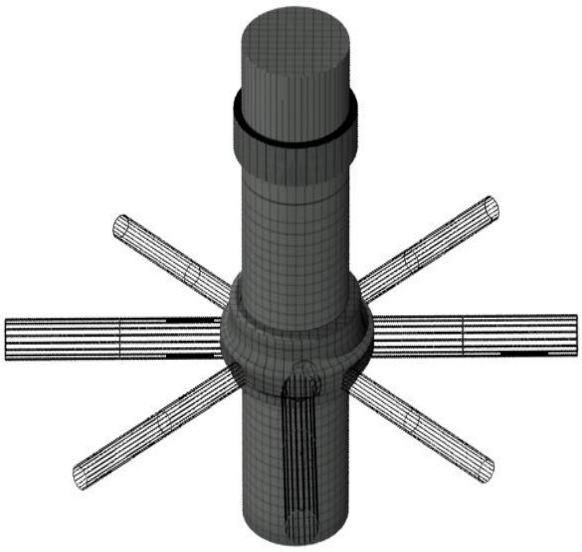
The central cylinder of Aynah will be the only non-rotating component of the settlement. This will make it an ideal location for facilities which require zero gravity such as zero g recreation, industries, refinery, and research labs. The Central Cylinder will also have a Manufacturing Industry to meet the needs of the residents. Reardonium manufacturing will take place in the beaded cylinder but its zero g refining will take place in the Refinery Unit of the Central Cylinder. The Entry/Exit control unit will monitor all the shuttle activities along with the port facilities. To facilitate external communication, a 70 m antenna will be placed at the top of the Central Cylinder.

Fig. 2.2.5 - Central Cylinder

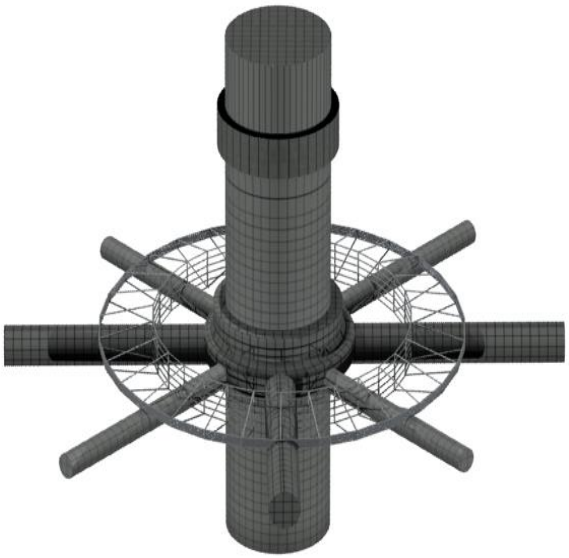


2.3 -Construction Sequence

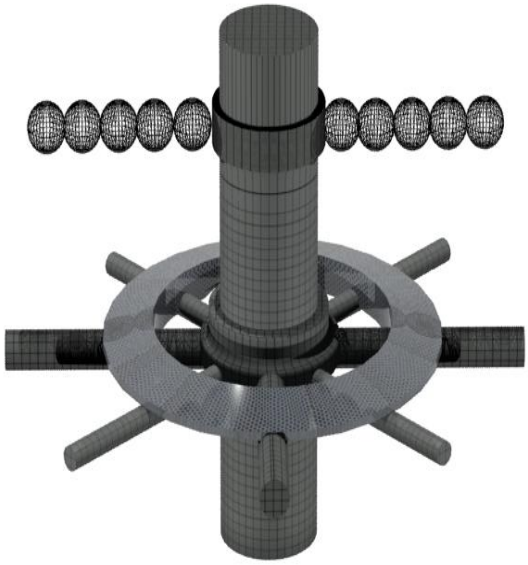
Phase 1: Framework of the central cylinder begins.



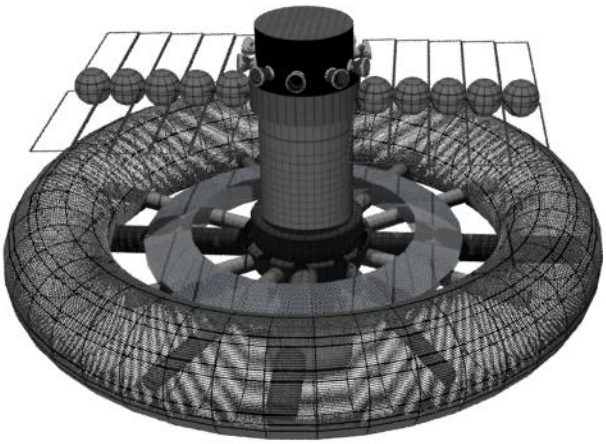
Phase 2: Central cylinder is completed. Framework of spokes begins.



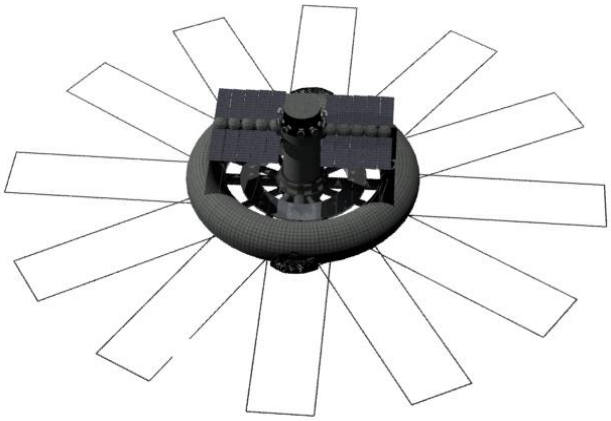
Phase 3: Spokes are completed. Framework of Agricultural Disc begins.



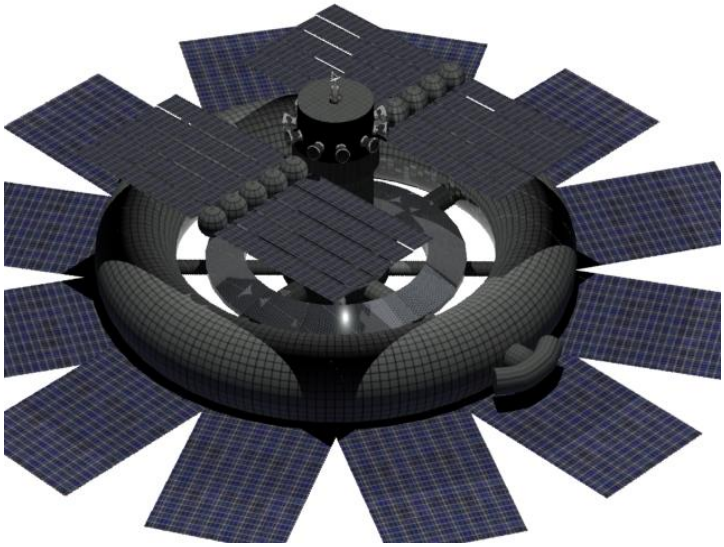
Phase 4: Agricultural disc is completed. Framework of the beaded cylinder begins.



Phase 5: Framework of Residential Torus begins. Installation of Solar Panels on Beads begins.



Phase 6: Residential Torus is completed. Installation of Solar Panels on Residential Torus begins.

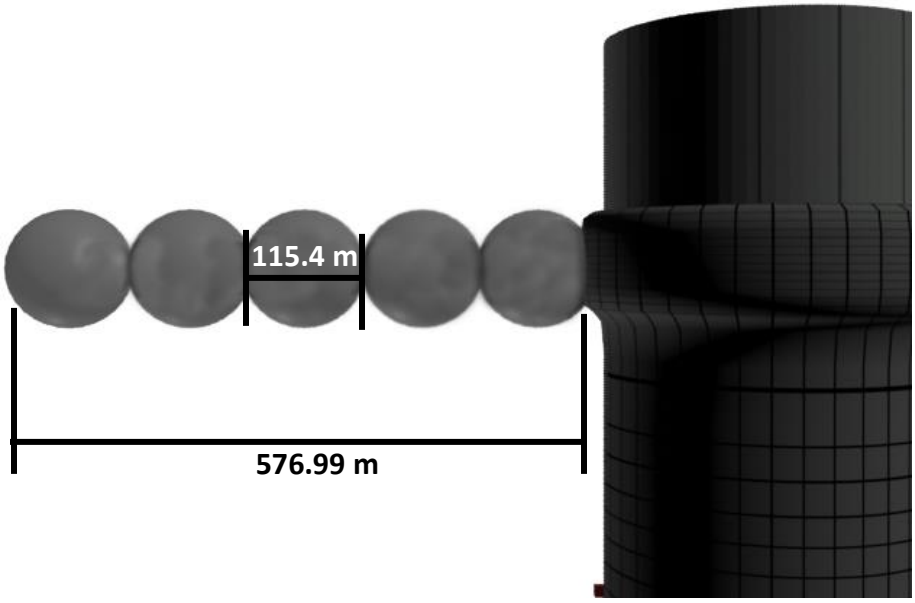


Phase 7: Installation of Solar Panels is completed. Antennas are installed and Aynah is completed.

The rotation of Agricultural discs starts at Phase 4 so that by the time the entire settlement is completed, food production set up is ready for the residents. Solar Panels are applied as early as Phase 5 to start producing energy. The rotation of Beads also starts in Phase 5. To rotate the settlement, thrusters are used periodically at 45^{o} at the Agricultural and Bead's spokes respectively. To get rid of the heat produced by friction due to rotation, a Thermal Radiator layer is applied which releases the heat in free space.

2.4 – Reardonium Refining and Manufacturing

Fig. 2.4.1 – Beaded Cylinder

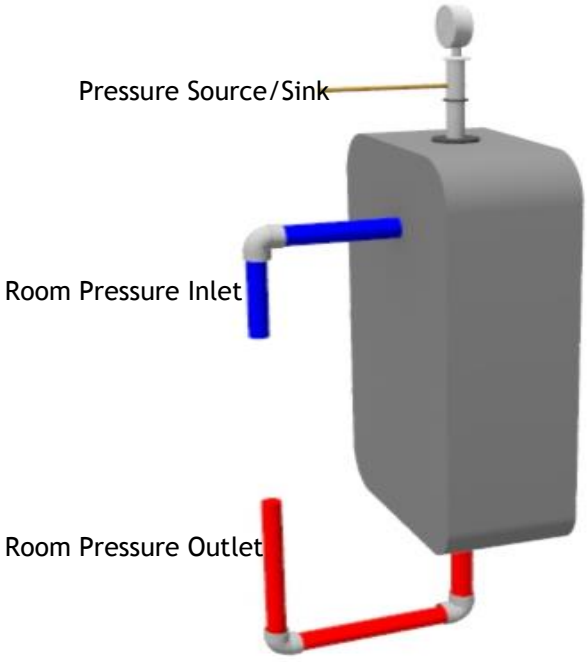


Reardonium refining and manufacturing will take place in 10 specialized beads which extend from the central cylinder. Going out from the center cylinder, each bead will increase by 0.1g and 4 psi. This will allow gravity to range from 0.1 - 0.5 g and for the pressure to range between 0 – 20 psi. For zero g, manufacturing unit of the central cylinder will be used.

Table 2.4.1 – Attributes of Beads

	Bead 1	Bead 2	Bead 3	Bead 4	Bead 5
RPM	0.88	0.88	0.88	0.88	0.88
Gravity	0.1g	0.2g	0.3g	0.4g	0.5g
Pressure	4 psi	8 psi	12 psi	16 psi	20 psi

Fig. 2.4.2 – Pressure Control Valve



Pressure Control

The pressure in each bead of the cylinder will be varied. It will be controlled with a Suction-Recirculation method. Each bead will have a Pressure Control Valve installed in it. Air inside the beads will be sucked in by the room pressure outlet of the Valve and intensified or diluted, depending on situation, by the pressure source/sink attached to the system. Then, it will come back through the room pressure inlet. Using this Pressure Control Valve, a pressure difference of 0 - 20 psi will be created between beads.

2.5 – Protection from Radiation

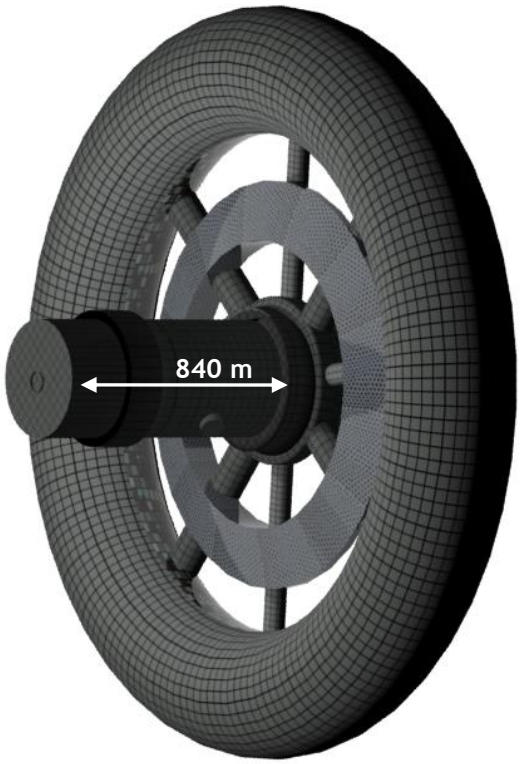
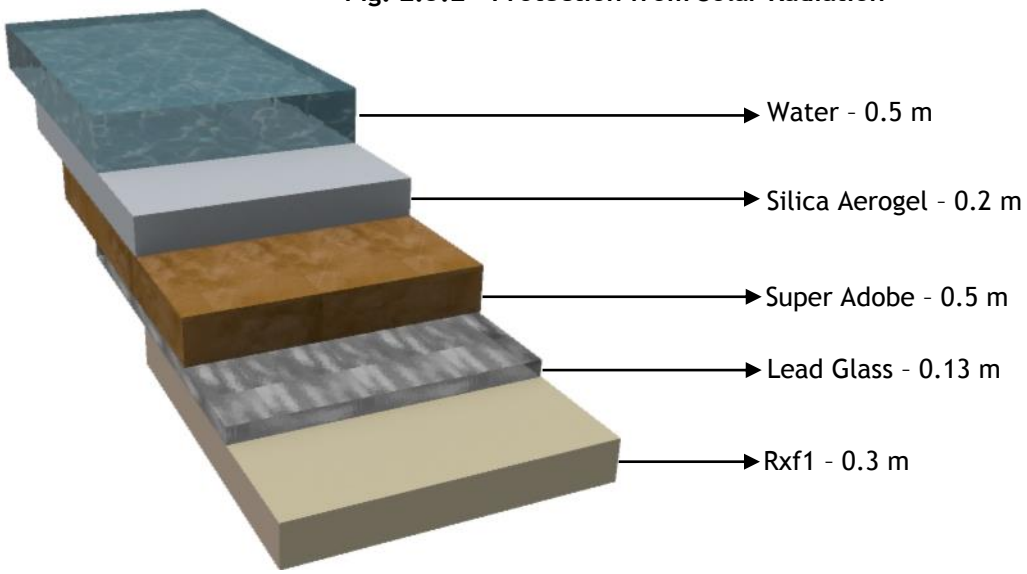


Fig. 2.5.1 – Residential and Commercial Areas

The residential area will be the main area occupied by humans. It will be placed on the opposite side of the settlement to increase the away distance from the sun. Aynah will be placed in a sun-facing orbit with the top of the central cylinder facing the sun. The Residential Area will be kept at a total distance of 840 m from the top of the central cylinder. This will prevent harmful radiations from the sun from directly affecting the residential area. Other than distance, the Beaded Cylinder and its solar panels will shadow the Residential Area, blocking even more radiations. A 0.5 m water layer will be placed in between the outer layers of the residential torus to trap radiations from sun and to provide insulation against heat. In addition, Aynah will have Lead glass, Super Adobe and RxF1 to further protect the settlement from intense radiation (refer to 3.1). Si-Aerogel will be used as an insulator against excess solar heat as it will only allow sun light to pass but will block most of the heat. Thermal Radiator ring on the Central Cylinder will also remove any excess heat from the Sun.

Fig. 2.5.2 – Protection from Solar Radiation



3.0 OPERATIONS AND INFRASTRUCTURE

3.1 Construction Parameters

3.1.1 – Orbital Location

Aynah is placed in sun-facing Mercury polar orbit at an altitude of 383.79 km. In order to keep Aynah in the polar orbit of Mercury, thrusters will be used.

Fig. 3.1.1 – Orbital Location

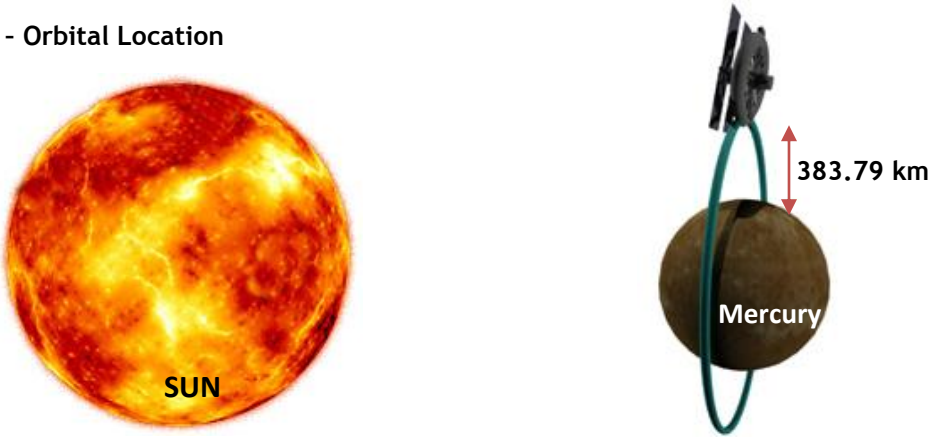


Table 3.1.1 – Reason for Selection of Orbital Location

Global coverage of Mercury, which makes it easy to find mining locations
High data resolution due to close proximity
More cost effectiveness due to less travel time to and from Mercury
Constant sunlight ratio

3.1.2 – Construction Materials

Besides reardonium, the following construction materials will be used in Aynah:

Table 3.1.2 – Construction Materials

Types	Width	Source	Reason for selection
Electrochromic Smart Glass	0.12 m	Alaskol	Modulates heat and light transmission
Super Adobe	0.50 m	Mercury	Used in mid layers as a shock absorber
Lead Glass	0.13 m	Mercury	Protects people from radiation
RTV Adhesive		Mercury	Binds materials together
Titanium	0.25 m	Alaskol	Framework
Silica Aerogel	0.20 m	Mercury	Allows light to enter but blocks heat
Rxf1	0.30 m	Alaskol	Blocks radiation
Water	0.50 m	Mercury	Absorbs radiation

3.1.3 – Equipment

Table 3.1.3 – List of Equipment and Uses

Name	Uses Before Completion	Uses for After Completion
AAH 101	Welding pipes	Repairing and Maintenance
AAH 102	Dispatching pipes	Repairing and Maintenance
AAH 103	Apply tiles to framework	Repairing and Maintenance
Construction shack	Control hub of construction	Mercury Mining Base
Fuelling Station (LOX and LH_2)	Provide fuel for thrusters	Mercury Mining Base
Super Adobe Packing Equipment	Packages Mercury regolith into fiber sheets to form Super Adobe	Mercury Mining Base
Mining Equipment	Mines materials from Mercury	Mercury Mining Base

3.2 – Elements of Basic Infrastructure

3.2.1 – Air Revitalization System (ARS)

Atmosphere, climate and weather will be controlled by ARS, which will consist of the following components:

Temperature and Humidity Control (THC)

The Temperature Control Unit maintains the temperature according to the seasons. Multi-layer insulators made of Mylar and Dacron trap heat rays from Sun to produce heat. The excess heat is used as Thermal Energy in Central Cylinder. Desired amount of humidity is achieved by pumping and filtering water vapour into the air as needed. Excess humidity will be sent to the WRRS.

Table 3.2.1 - Temperature and Period Chart

Season	Temperature (°C)	Period (Months)
Summer	18/29	3
Spring	12/21	5
Autumn	8/16	2
Winter	-2/+8	2

Water Recovery and Recycle System (WRRS)

Liquid waste is recycled back into pure water. Excess humidity filtered from THC is also converted into pure water. Electrolysis of water produces Oxygen and Carbon dioxide which are sent to GES.

Gas Exchange System (GES)

Traces of CO_2 are removed from the Residential Torus and are sent to the Agricultural Discs and vice versa for O_2. Any missing amounts of O_2 or CO_2 are covered from the supplies from WRRS. Airborne chemicals, oils and odours are filtered using activated carbon beds.

Table 3.2.2 – Air Composition

Oxygen	21%
Nitrogen	78%
Water Vapour	1%
Atmospheric Pressure (14 lbs. / in^2)	

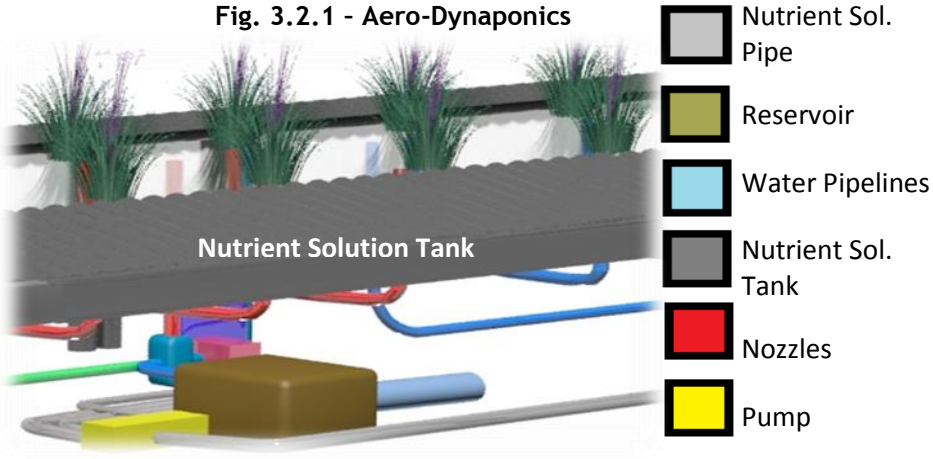
3.2.2 – Food Production

Food will be produced using Aero-Dynaponics, in the agricultural disk in a total area of 882,158.6171 m^2. This will include an average area of 62.123 m^2 per person. This area will be sufficient to provide the residents with food for an extra six months in case food production fails.

Aero-Dynaponics

This will consist of a nutrient solution tank, connected by a pipe to a reservoir equipped with a motor to pump water back to the tank. Nutrient solution will flow between the tank and the reservoir continuously. This constant flow of the solution will prevent the growth of algae and will eliminate the need to supply oxygen to the solution at regular intervals. Above the nutrient solution tank, will be chamber from which the roots of plants will be suspended. The nutrient solution tank will consist of nozzles which will spray the roots with a mist of nutrient solution from time to time.

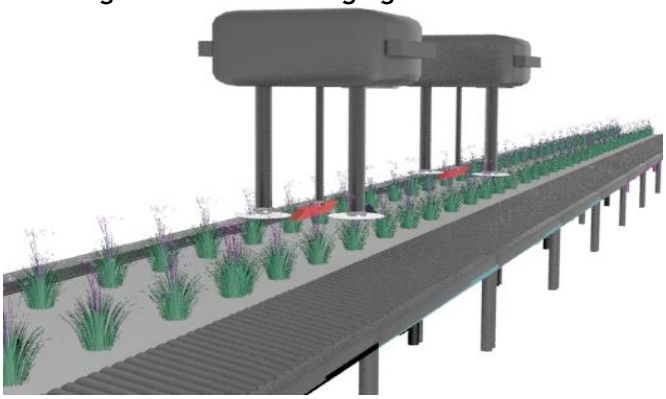
Fig. 3.2.1 - Aero-Dynaponics



Harvesting

Prior to harvest, nutrient supply will be stopped for 3-7 days. Then agricultural robots, which are attached onto the ceiling, will cut the main stem above the roots, and hang it 'upside down' for drying. Once dried, the plants will be transported to the storing facility.

Fig. 3.2.2 - Harvesting Agricultural Robot



Storage

When sent to the storing facility located in the storage area of the agricultural disc, Pulsed Electric Field will be used to sterilize the food products. Products will be placed between two electrodes and a voltage pulse of 20-80kV will be applied for a couple of micro-seconds.

Packaging

When packaging food, oxygen present in the food packages will be displaced by gaseous nitrogen. This will create a nitrogen-rich atmosphere which will extend the shelf life and prevent growths of bacteria. In addition, it will also affect freshness in a positive way by preserving original properties of the food item.

Delivery

After food is packed, it will be transported to the food storage facility in the residential area through the spokes.

Selling

Residences in Aynah will be equipped with smart containers to store food. Smart containers will consist of weight sensors which will be used to keep track of the amount of food in each container. The smart containers will keep a record of the resident's average consumption of a food item, and when necessary, will place an order with a store which will deliver food to the resident's place. However, if a resident wants to monitor his food quantity himself, these smart containers will have an over-ride function to allow him to do so.

3.2.3 Electric Power Allocation

Table 3.2.3 - Electrical Power Allocation

Area	Per person (kW)	Total allocation (kW)	Area Required (m^2)
Residential	1.7	24,140	301,750
Agricultural	1.5	21,300	266,250
Industrial	4.0	56,800	710,000

For electric power generation, refer to 3.4

3.2.4 - Water Management

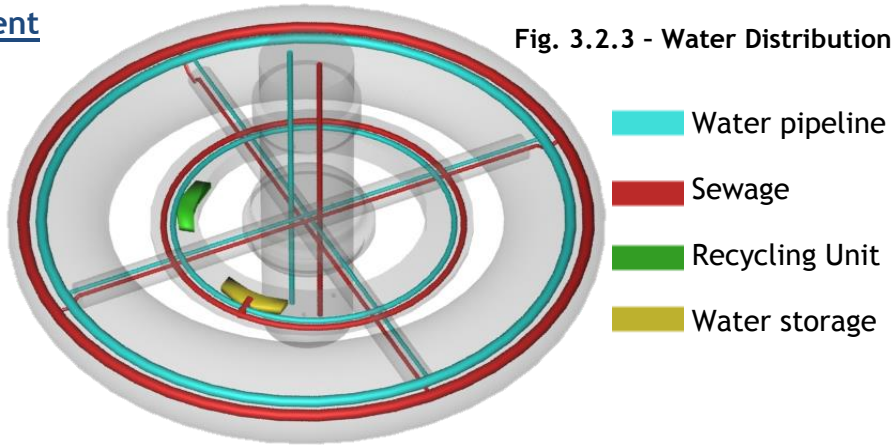
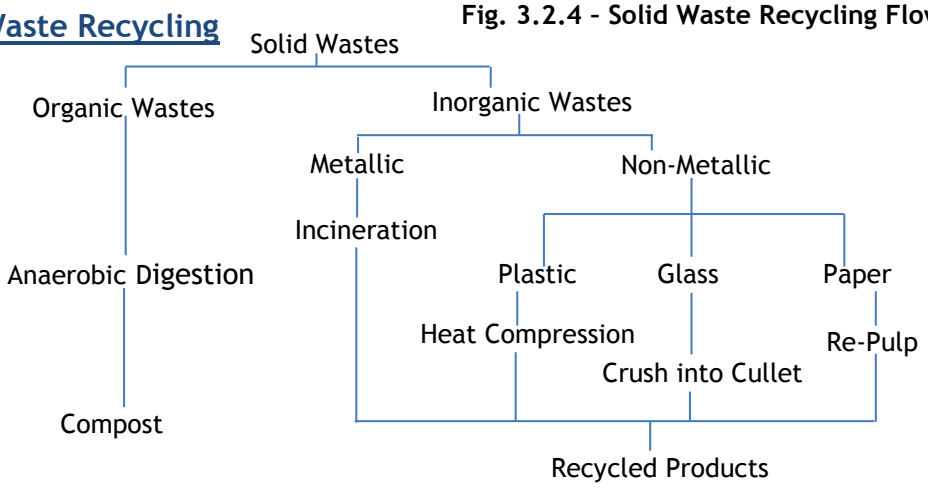


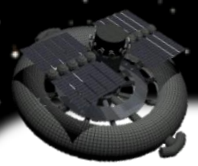
Fig. 3.2.3 - Water Distribution

Aynah will procure 594,270 m^3 of water from the north pole of Mercury prior to the completion of the settlement, which will be stored in the water storage area in the agricultural disc. After the initial procurance, water will be recycled. In total, Aynah will need 1,320.6 m^3 of water each month. This means that Aynah will have up to one month of extra water supply in case of recycling failure.

3.2.5 - Solid Waste Recycling

Fig. 3.2.4 - Solid Waste Recycling Flowchart





3.2.6 – Communications

External Communication

Interplanetary Internet Network (IPN) will be used for external communication. A space network of disconnected internet will be created using UDP and DSN.

User Datagram Protocol (UDP)

UDP will be used to capture and transfer data from nearby settlements and air-crafts. It will provide port numbers to help distinguish different user requests and a checksum capability to verify that the data arrives intact. Exchange of small data units will save the processing time of the network applications.

Deep Space Networking (DSN)

The Central Cylinder Communication Hub will have a 70 ft. antenna which will send and receive signals to and from a 230 ft. antenna located on Earth. S, X and Ka band frequencies will be used for transmission of data whose signals will be intensified using the antennas on other settlements for higher quality.

Table 3.2.4 – DSN Signal Frequency

	Transmit	**Receive**
S	2290 - 2300 MHz	2110 - 2120 MHz
X	8400 - 8450 MHz	7145 - 7190 MHz
Ka	34200 - 34700 MHz	31800 - 32300 MHz

Transmission Control Protocol (TCP) will also be used to establish a full duplex connection between two endpoints; each endpoint will be defined by an IP address and a UDP port number. Other than sending signals, DSN will also have the ability to track space flights.

Internal Communication

Fiber-optic communication will allow Aynah to transport 1 Tb/sec from one place to another by sending light pulses through a Zinc Selenide optical fiber. The light will form electromagnetic wave that will be modulated to carry information. To reduce noise, Aynah will have two Antennas, each covering a distance of 3.5 km. This will not only increase the transmission rate but allow Aynah to have a backup satellite as well.

3.2.7 – Day and Night Cycle Provisions

Aynah's day will consist of 16 hours of daylight and 10 hours of night. Reflectors at the central cylinder will be continuously adjusted at different angles to provide the illusion from dawn to dusk. Electrochromic smart glass, placed on the residential torus, will be activated through automated timers to provide night. Any lack in intensity will be covered using artificial OLEDs.

3.2.8 – Internal Transportation

Internal transportation in Aynah will provide many different varieties of transportation for all of its residents. This internal transportation will consist of Spaceway, cars, and bicycles.

Spaceway

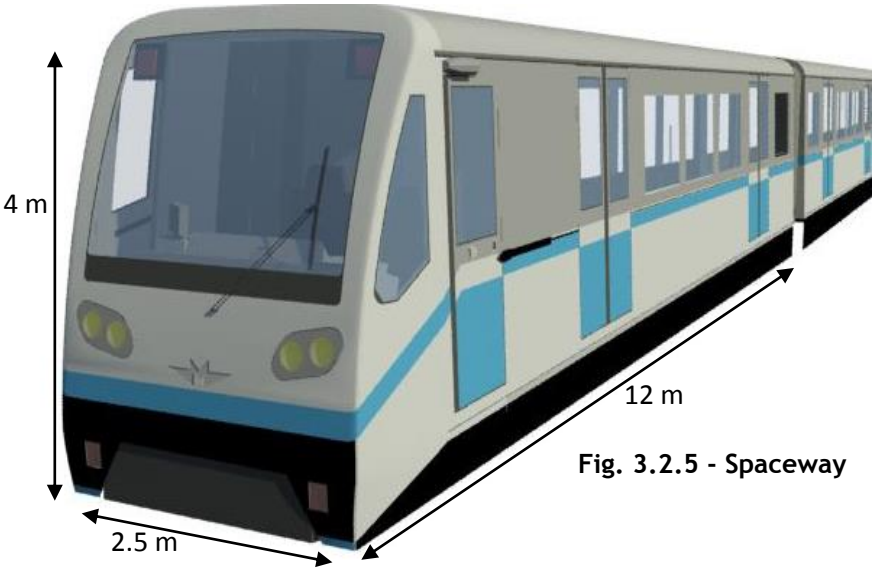
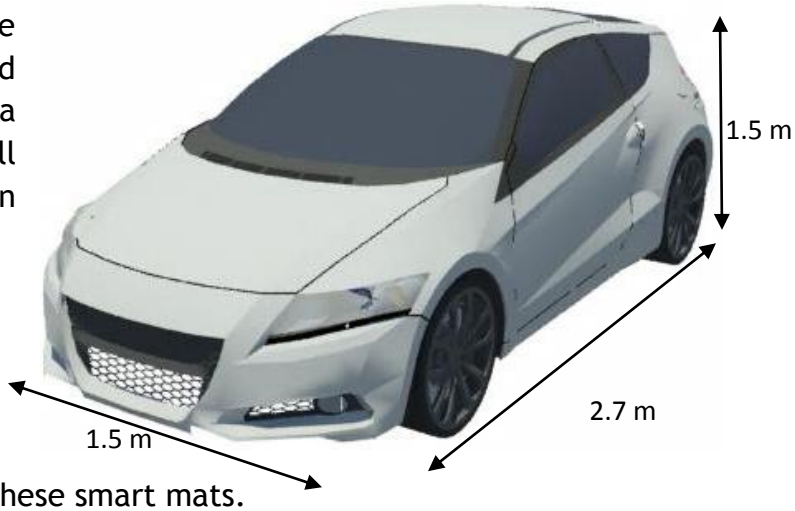


Fig. 3.2.5 - Spaceway

A specialized Spaceway will operate in an underground dome. There will be two parallel tracks each covering a distance of 6741.858 m. Spaceway will travel in opposite directions along these tracks at an average speed of 5.5 m/s. There will be 4 Spaceways, two on each track. The two Spaceways travelling in the same direction will be about 11.55 mins. apart at any time. There will be 8 stops, the distance between adjacent stops being 842.73 m. Spaceway will wait for 20 seconds at each stop and take about 2.55 mins. to travel between two adjacent stops. This will allow residents to get anywhere in the residence area within 11.55 mins. Each Spaceway will have 4 compartments, with the capacity of each compartment being 25 persons. It will take a Spaceway about 23 minutes to complete a full circle.

Cars

Fig. 3.2.6 – Car



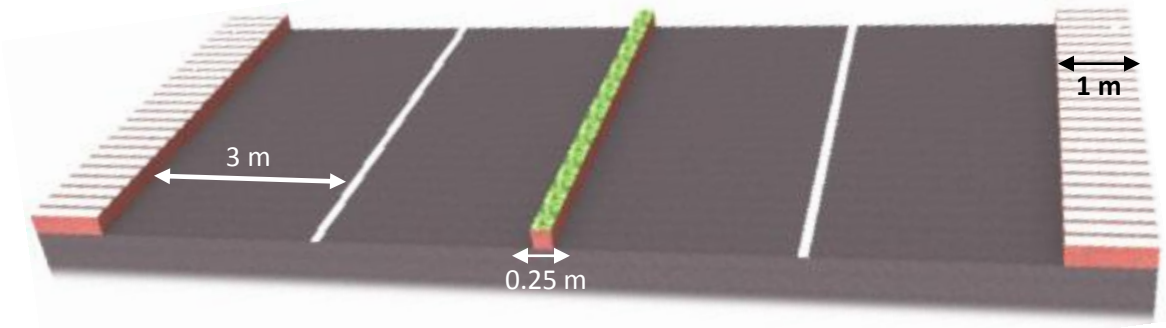
Aynah will have fully electric cars available. These cars will be able to run at a maximum speed of 50km/hr, and will have a lithium imide battery which will be able to last about 350 km on a full charge.
Each garage floor will be equipped with a smart mat, which will automatically charge a car parked on it. Parking spaces throughout the residential torus will also have these smart mats.

Bicycles

Bicycles, in addition to being another means of internal transportation in Aynah, will also provide residents a means of exercise to keep fit and will also allow them to enjoy outdoor beauty.

Fig. 3.2.7 - Bicycle

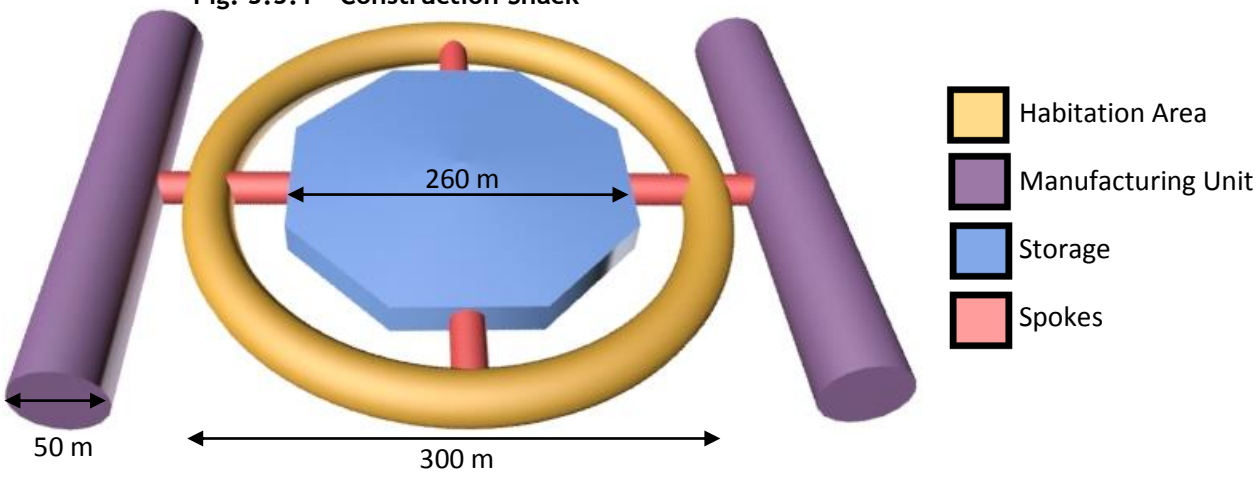
Fig. 3.2.8 - Road Design



3.3 - Construction Machinery

Construction of Aynah will be done directly at its orbital location. The construction shack will be the control hub of Aynah's construction. It will be temporarily occupied by workers during the construction process. These workers will create and program the construction robots, and will later operate and monitor them as they construct the settlement. Aynah's construction will be done in a two-step process. The first step will be the assembly and welding of the framework, which AAH 101 will carry out. The second step of construction will be the tiling. AAH 103 will undertake this job.

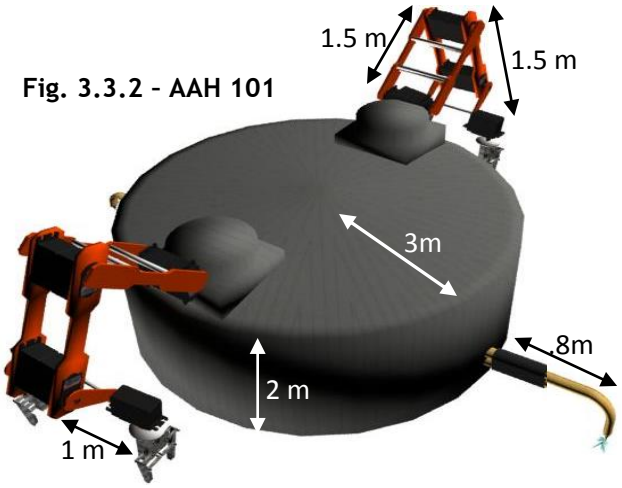
Fig. 3.3.1 - Construction Shack



AAH 101

AAH 101 will be responsible for the construction of the framework of the settlement. It will receive rods from AAH 102. It will have two pairs of arms; each pair will be used to pickup one rod at a time and place it in its respective position. Having two pairs of arms makes the framework process faster and also provides stability. Its welding gun will be situated on a revolving belt, positioned on the lateral surface of the robot. This welding gun will be used to weld the rods together. This robot will have thrusters to allow it to manoeuver around the structure. The lightweight property of the robot will enhance mobility.

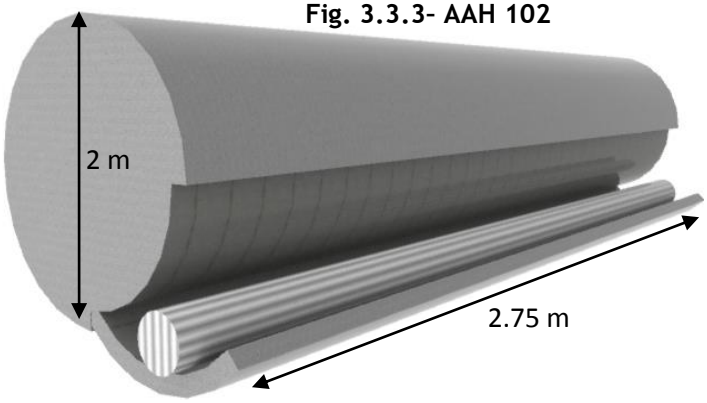
Fig. 3.3.2 – AAH 101



AAH 102

AAH 102 will transfer rods from the construction shack to the construction site. It will dispatch one rod at a time to AAH 101. It will store 36 rods in its internal storage compartment for each trip to the construction site. It will have thrusters to allow it to move between the construction shack and construction site. When required, the side flap will open, allowing one rod to come out, to be picked up by AAH 101. Its cylindrical shape allows maximum volume so that many rods can be stored at once. Also, the flap mechanism will allow faster transmission of rods.

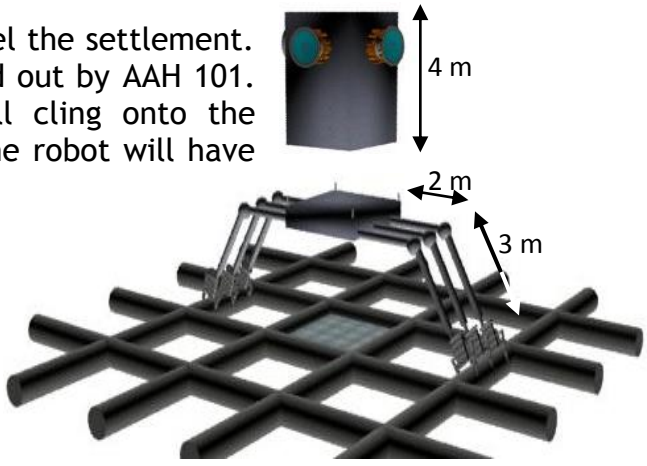
Fig. 3.3.3- AAH 102



AAH 103

The function of AAH 103 will be to panel the settlement. It will place tiles on the framework laid out by AAH 101. This robot will have claws which will cling onto the framework while it is applying tiles. The robot will have the capability of applying 9 tiles in a 3X3 grid while standing in one position. The refilling chamber of AAH 103 will detach itself when more tiles are needed and retrieve them from the construction shack and continue until the project is complete. The refilling chamber will have thrusters for it to be able to retrieve tiles from the construction shack for AAH 103.

Fig. 3.3.4 – AAH 103



3.4 - Solar Panels

Aynah will have an area of 10,704,000 m^2 (4.133 mi^2) of solar panels. This will generate enough power for its operations and the production of Reardonuim.

Fig. 3.4.1 - Beaded Cylinder Solar Panels

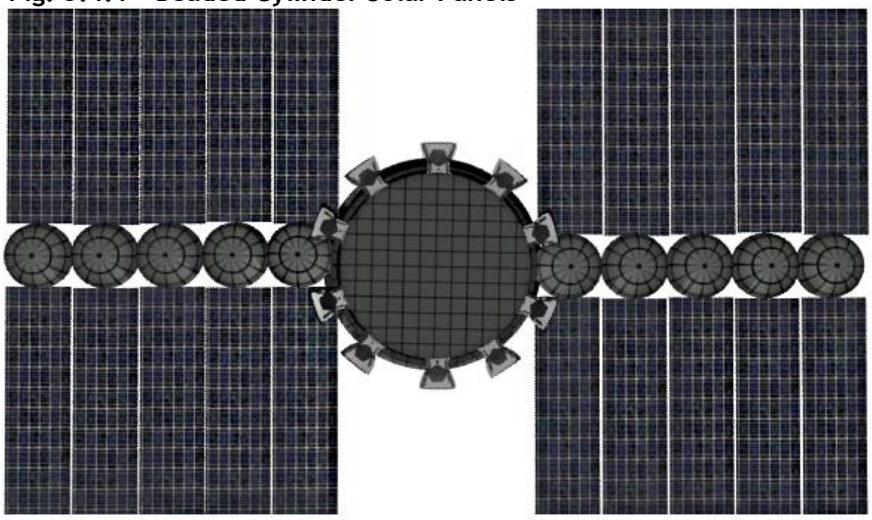


Table 3.4.1 - Solar Panels

Location	Length (m)	Width (m)	Spacing (m)	Amount
Residential Torus	1630	530	1	12
Beaded Cylinder	650	110	10.4	20

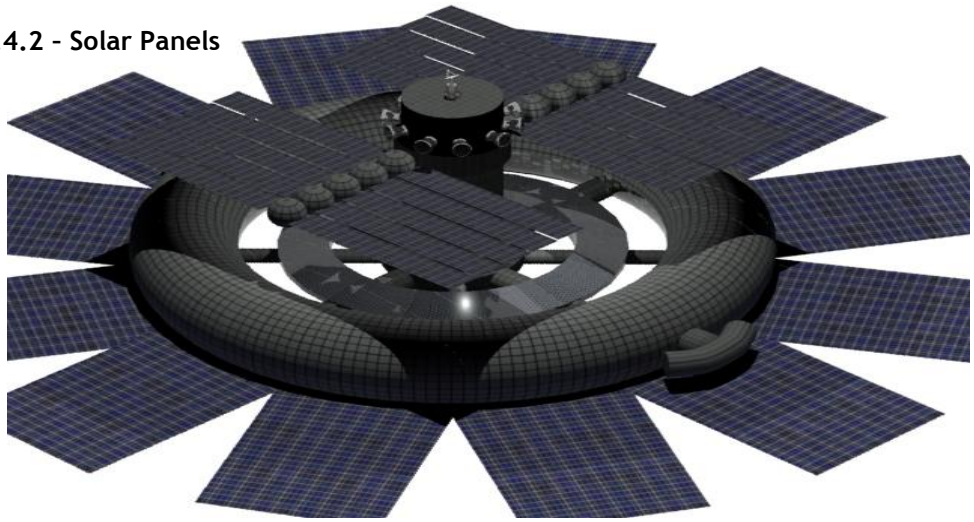
3.4.2- Solar Cell: Gallium Arsenide

Each solar panel is an area of multi-junction solar cells composed of Gallium Arsenide.

Table 3.4.2 - Reasons for Gallium Arsenide

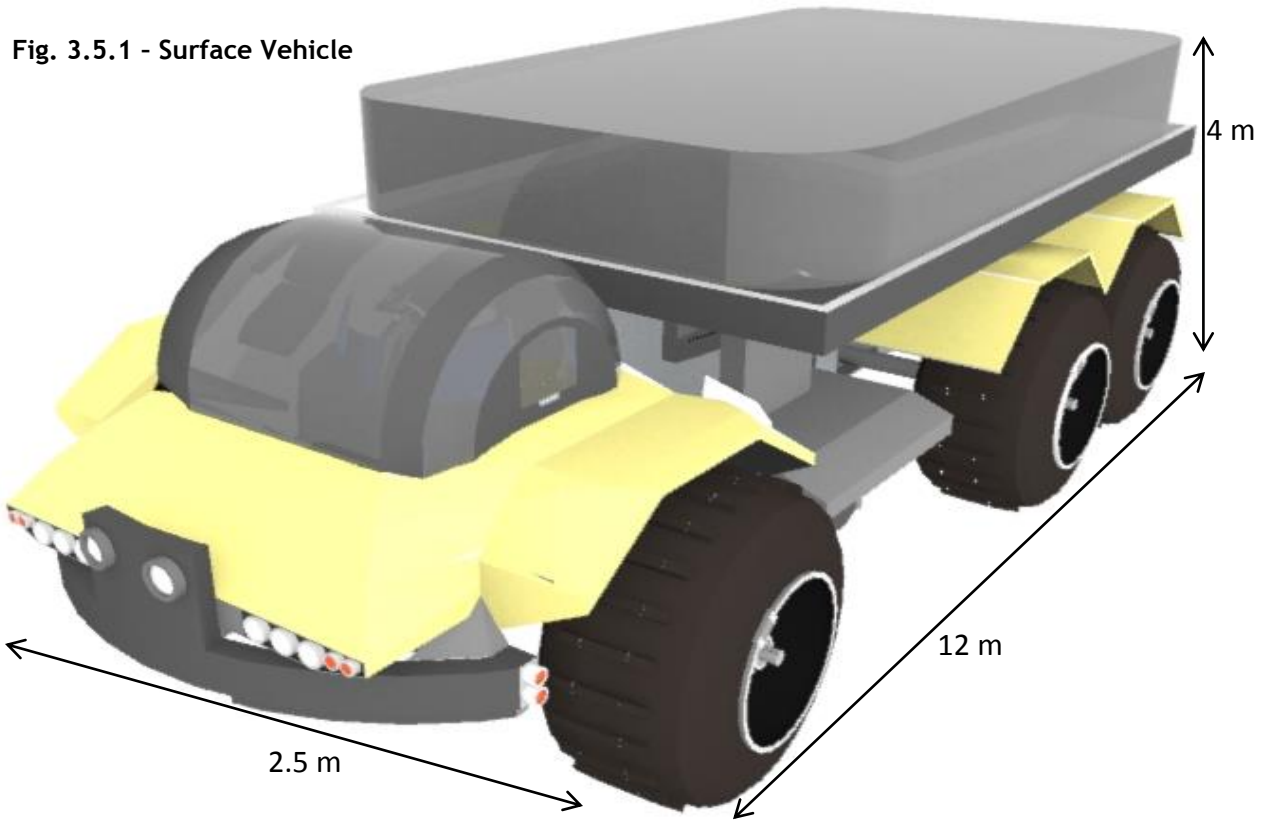
High efficiency of 42%
High absorptivity
Low sensitivity to heat
High resistance to radiation damage
Requires a cell only a few microns thick to absorb sunlight

Fig. 3.4.2 - Solar Panels



3.5 – Surface Vehicle for Moving Reardonium Parts

Fig. 3.5.1 – Surface Vehicle



The surface vehicle, used to move Reardonium parts, will run on the energy generated by its solar panels. These solar panels will be located at the top of the trailer. Extra energy will be stored in lithium imide batteries for movement during the night. This vehicle will have an elegant design for easy mobility. Having a back door and a ramp will increase the efficiency of unloading and loading Reardonium parts. The vehicle will incorporate suspensions to assist it in travelling. The suspension will consist of two wishbone shaped arms with upper and lower torsion bars to bear the weight of the vehicle. To minimize turbulence while moving, it will also have a restraining device between the framework and the upper wishbone arm. The wheels on the vehicle will be specially designed for its purpose on the surface of mercury. The wheels will use a zinc-cobalt coating to create and strengthen the bond between steel and rubber on the wheels as well as to prevent rusting. Also, it will increase traction for easy movement. This vehicle will move, on average, 2.5 times an earth-year and remain stationary during the rest. While it is stationary, the vehicle goes through dust removal process and undergoes any repair if needed. To prevent any damages, the vehicle will be stored in Mercury mining base.

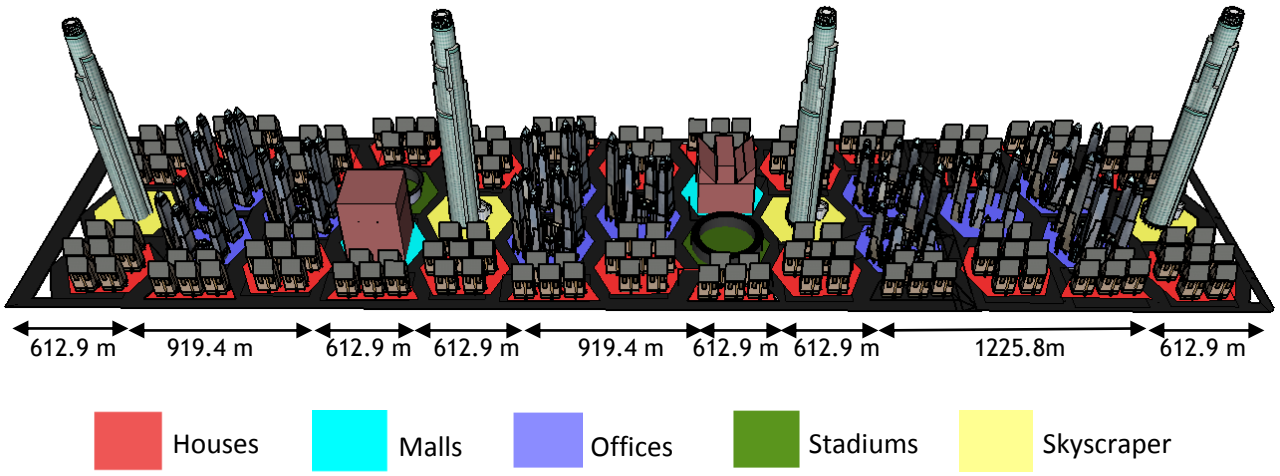
4.0 HUMAN FACTORS

4.0 - Community

Aynah's urban services will provide comfort and convenience along with high standards of living for its residents. It will provide unparalleled natural views of outer space, especially Mercury.

4.1 - Community Design

Fig. 4.1.1 - Community Design



4.1.1 - Attributes

Hospital/Safety Station: This section of Aynah will provide medical and emergency-response services required for the sustained functionality of the settlement. Besides a hospital, this compound will consist of a fire department and a police station.

Sports Complex: A group of sports facilities will be present in Aynah to provide its residents with an opportunity to compete in as well they may spectate numerous sporting events. Some of the facilities provided include a soccer ground, a shooting racing, a race track, an athletic track and a multipurpose indoor stadium.

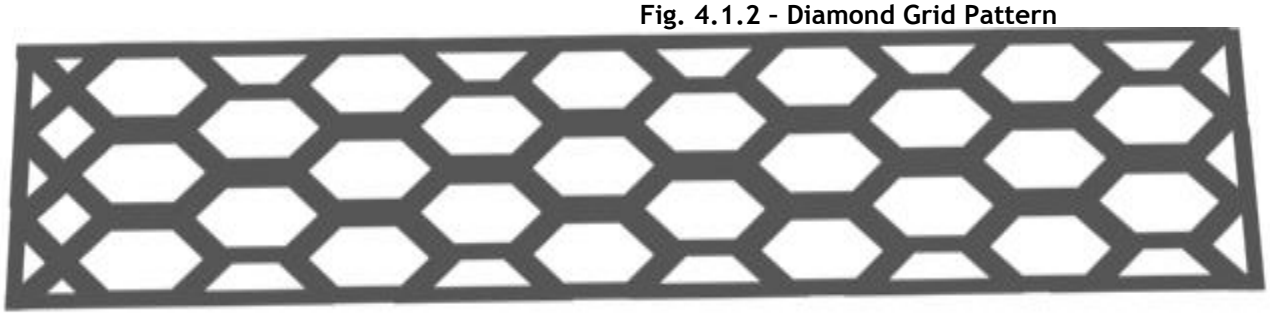
Mall: A mall located in the downtown area of the settlement will serve as a major hub for urban culture. It will house a wide variety of shops and services ranging from grocery stores to clothing retailers to a gaming arcade. It will also contain a food court located centrally for easy access from all parts of the mall.

Open Space: There will be greenery and small parks spread throughout the settlement to allow the settlers to connect with nature and take pleasure in its beauty, or simply go for a walk. These parks will have natural components such as trees, flowers and fields of grass as well as architectural structures such as water fountains and sculptures.

Diamond Grid Road Pattern

Aynah's roads will consist of adjoining hextagons, forming a consistent honeycomb pattern laid throughout the Residential Down Surface area. A honeycomb pattern will minimize the amount of head-turning while rounding corners. The placement of buildings in adjacent pentagons will allow for least need of rounding acute angles.

Fig. 4.1.2 – Diamond Grid Pattern



4.1.2 – Services

The settlement will contain many special services which will be designed to make the lives of the residents more comfortable; just as they would expect from a modern community.

Table 4.1.1 – Special Services of Aynah

Health Care
Police Service
Fire Service
Banking
Social Service
Water Service
Waste management
Public Transportation
REC Centers
Public Centers (Libraries etc.)
Daycare
School / University
Prisons

4.1.3 – Consumables

Aynah will provide a wide variety of consumables for its residents. The consumables will be manufactured in the manufacturing unit of central cylinder and will follow the same route for delivery as food (Refer Delivery in 3.2.2). Consumables will be distributed by workers who will manage the goods in warehouses and stores. Citizens will be able to purchase the items from the stores by using the standardized point system.

Table 4.1.2 – Consumable Requirements of Aynah

Consumables	Quantity Required per Month	Storage
Food	952543.977 Kg	Storage Disk
Water	1320600L	Storage Disk
Medicines	12 Kg	Central Cylinder
Clothing	213000 Items	Central Cylinder
Oxygen	258,837,600 L	Storage Disk
Personal Hygiene Items	284000 Items	Central Cylinder
Household	355000 Kg	Central Cylinder
office supplies	426000 Items	Central Cylinder

4.2 – Townhouses

Aynah provides 4 styles of houses. Each of these houses are designed to meet the various needs of the residents. All furniture will be made out of **Polystyrene, as it** can form a hard impact-resistant plastic. Source of this material will be Mercury.

Table 4.2.1 – Types of Residences

Style	Capacity	# of Floors	Dimensions (ft)	Area (ft^2)	# of Houses	Allocation (ft^2)
Single Room	1	1	25′ x 40′	1000	5000	5×10^6
Double Room	2	1	30′ x 40′	1200	3600	4.32×10^6
Three Room	4	2	30′ x 40′	2400	700	1.68×10^7

Fig. 4.2.1 - Floor Plan for Single Room Houses #1

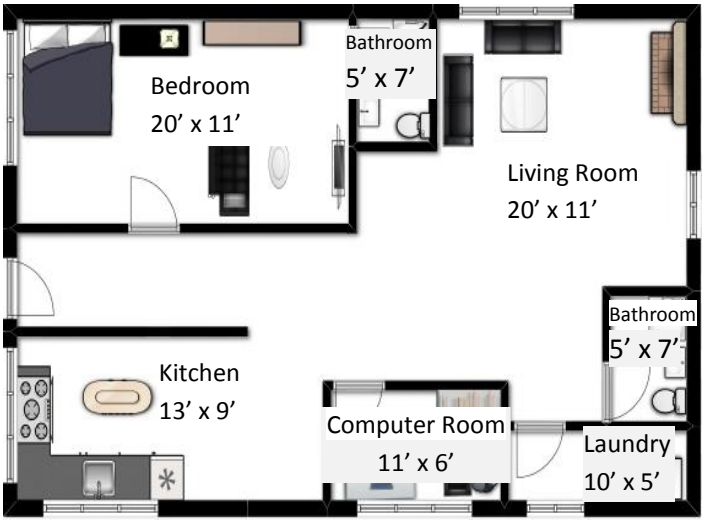


Fig. 4.2.2 -Single Room House #1

Fig. 4.2.3 – Floor Plan for Single Room Houses #2

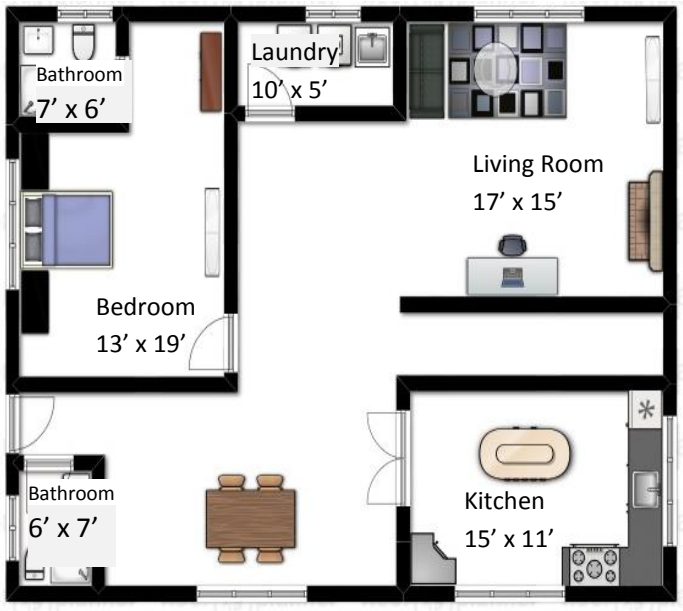


Fig. 4.2.4 -Single Room House #2

Fig. 4.2.5 - Floor Plan for Double Room Houses

Fig. 4.2.6 -Double Room House

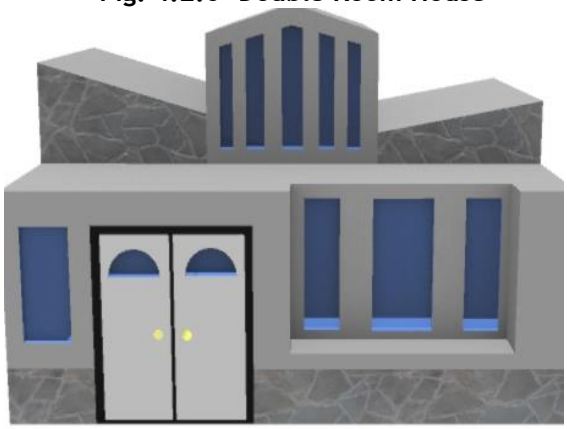


Fig. 4.2.7 - Triple Room House

Fig. 4.2.8 - 1st floor of Triple Room Houses

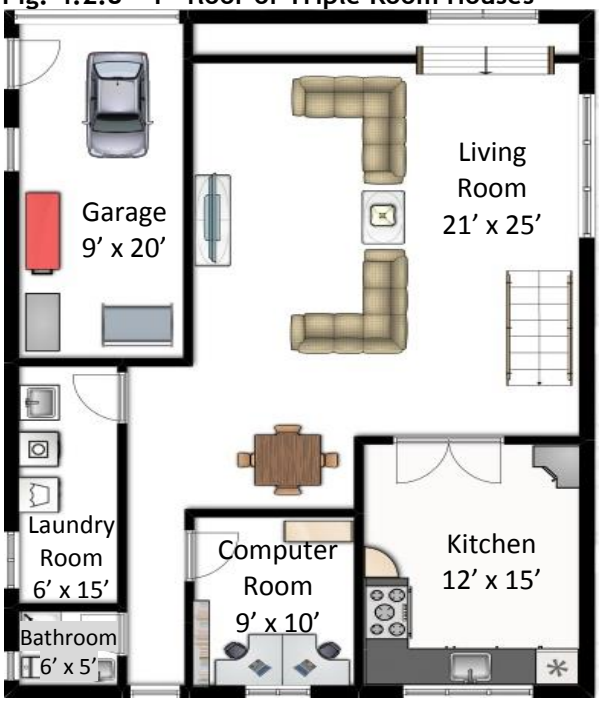
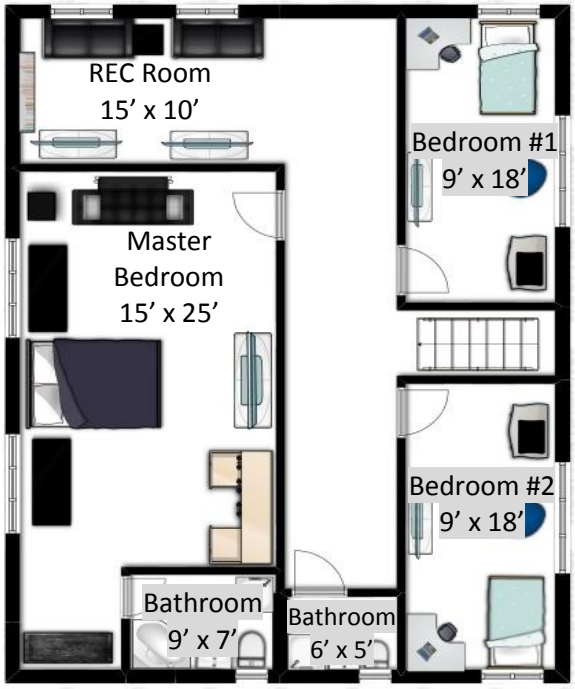


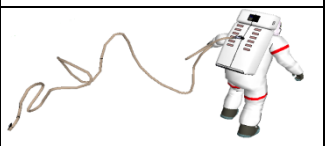
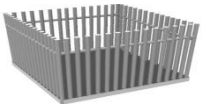
Fig. 4.2.9 - 2nd floor of Triple Room Houses



4.3 - Designs

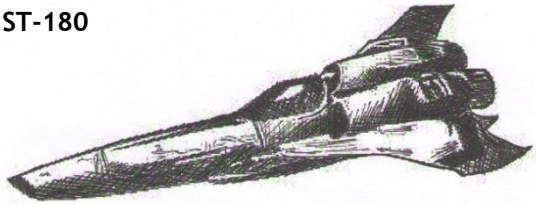
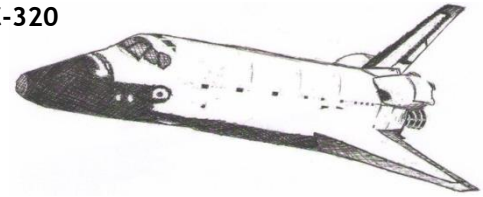
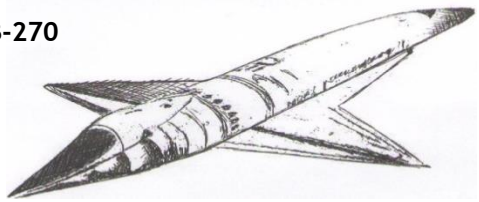
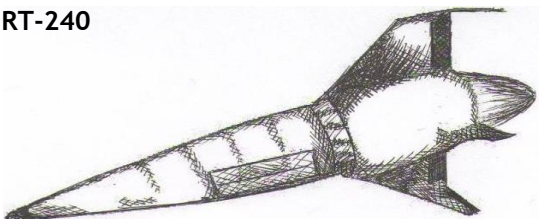
4.3.1 - Systems and Devices

Table 4.3.1 - Devices

Name	Description	Image
Handrails	It will be used by residents for stability and support while moving through the zero-g areas of the settlement. Individuals will be able to grasp the handrails to direct themselves in a certain direction.	
Tethers	It will be used in micro-g so that the person will be able to stay where they are supposed to be and not be carried away. This is crucial to have when leaving the settlement.	
Force Resistant Walls	The walls in the micro-g recreational area will be covered by this soft cushion layer to avoid injuries by decreasing the impact when an individual collides with the wall.	
Space Cage	The space cage will enhance a person's ability to move in micro-g. It will have a volume of 7.65 m^3 and will be constructed with aluminum and stainless steel.	

4.3.2 - Space Vehicles

Table 4.3.2 - Space Vehicles

Vehicles	Dimensions (m)	Payload	Purpose
ST-180 	26 x 15 x 13	18 tons	For short distance space travelling.
TC-320 	37 x 24 x 17	32 tons	Initially to transport cargo and residences then it is used to transport visitors.
MB-270 	35 x 15 x 13	27 tons	Transport materials from Aynah to other settlements and vice versa.
RT-240 	28 x 16 x 12	24 tons	Transports Reardonium parts from Mercury to Aynah.

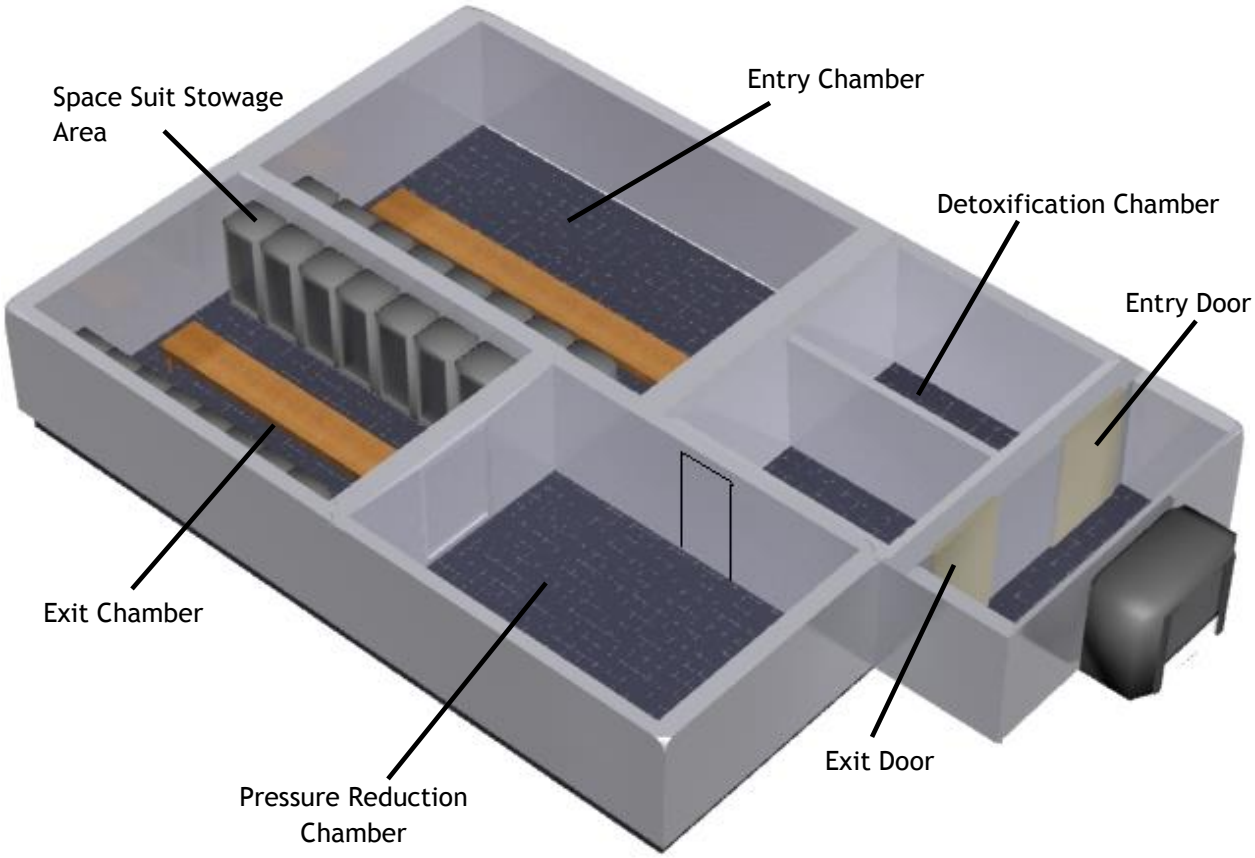
4.3.3 – Airlocks

The airlocks of Aynah will be 20 m by 15 m. The airlocks will have 2 chambers: one for entry to space and the other exit from space. The spacesuit stowage area will be located inside both these chambers.

Donning:
The person will enter the airlock and don the spacesuit, helmet and the life support backup. After that, a leak check will be conducted on the spacesuits. Once the check is complete, the person will enter pressure reduction chamber in which vacuum will be created. After the pressure chamber, the person will exit the airlocks.

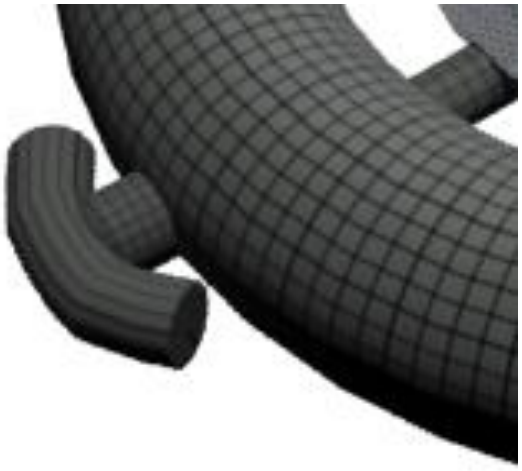
Doffing:
Before the person enters the airlocks, they go through the detoxification chamber in which any dust particles will be removed from the spacesuits. All the dust particles will be sucked out of the desalination chamber. As they enter the airlocks, the pressure will be increased to normal. Once it becomes normal, people will be able to doff their spacesuits and place them inside the spacesuit stowage.

Fig. 4.3.1 – Airlock Design



4.4 – 1 g Experience

Fig. 4.4.1 – External View of Bean



To have a gravity of 1 g which is required for the development of children throughout their growing years; Aynah will have 2 beans that will be attached to the outer side of the residential torus. In one of the beans, Aynah will have a school for children and a child care centre for the infants, so that they can spend more most of their day there. This will enhance the bone development during their growth stages. On weekends, when the school will be closed, children can spend their time in recreation centre and other facilities present in the bean. To balance the centre of mass, Aynah will have another bean located on the other side of the residential torus. In this bean, a jail will be placed.

Fig. 4.4.2 – Dimensions of Children Development Bean

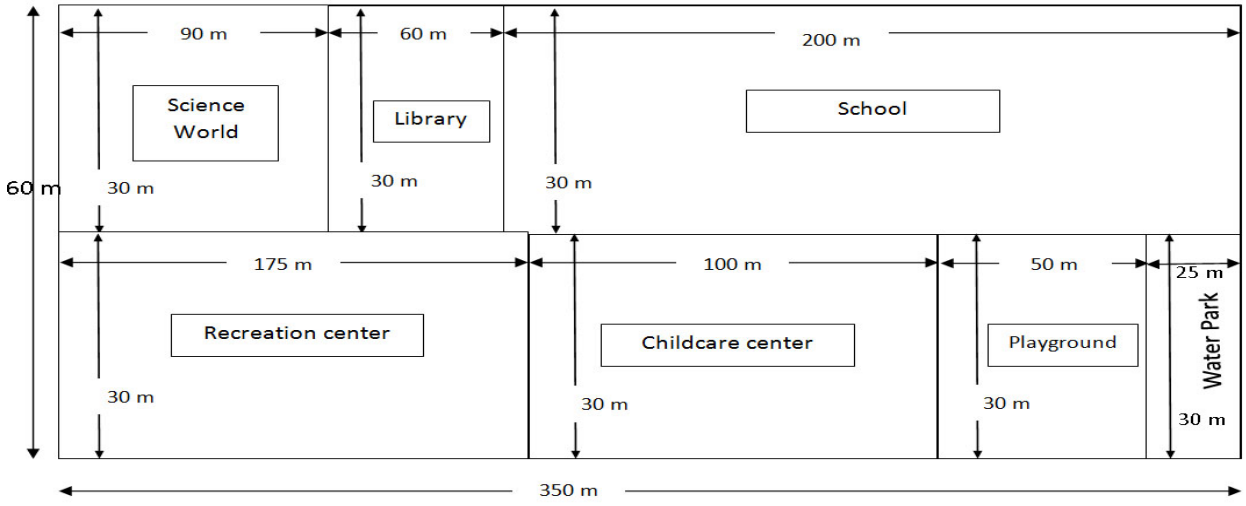


Fig. 4.4.3 – External View of Children Development Bean

4.5 – Surface Vehicles

Since space suits are only useful within 10^{o} of longitude from the terminator, surface vehicles will be provided for human inspection of the reardonium during the curing process. These vehicles will allow humans to examine the curing process during Mercury night and Mercury day.

Table 4.5.1 - Features of Surface Vehicles

Features of Surface Vehicles
Composed of lead and titanium to protect from solar flares
Consist of an ARS system giving the person the right amounts of oxygen to inhale
Contains emergency oxygen masks
Air Bags for safety
A camera (located outside of the vehicle) will provide a complete view of surrounding
Will contain power to charge any electronics
Heating and Cooling systems

Fig. 4.5.1 - Surface Vehicle # 1

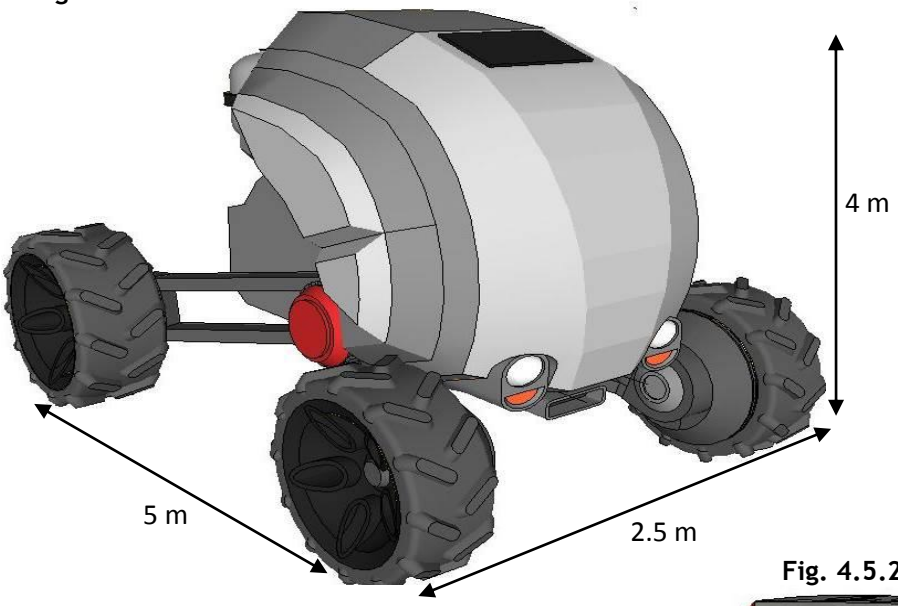
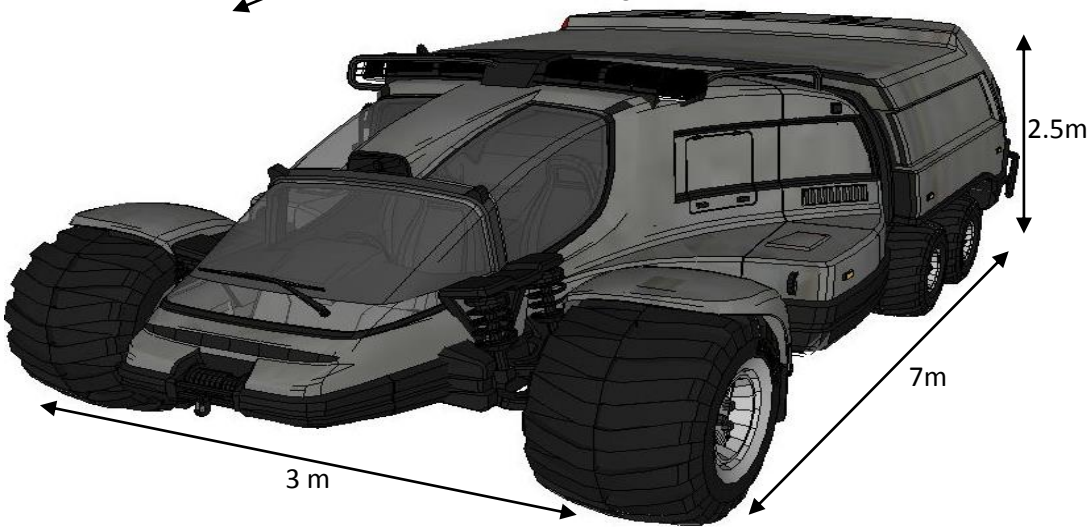
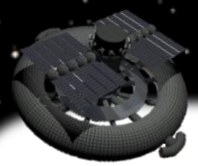


Fig. 4.5.2 - Surface Vehicle # 2



5.0 AUTOMATION DESIGN AND SERVICES



5.0 AUTOMATION DESIGN AND SERVICES

Aynah's automation system will allow it to sustain a large population efficiently. For higher efficiency and to avoid human errors, most of the activities will be automated and coordinated by super computers.

Table 5.0.1 - Devices

Device	Processor	Memory	Storage	Number
Phone	32 GHz	32 Gb	512 Gb	13,300
OneAllpen	2.4 GHz	2 Gb	64 Gb	11,000
HTP 9000	128 GHz	516 Gb	128 Tb	9,000
Assistobot	256 GHz	1 Tb	256 Tb	5,600
Chef-O	32 GHz	32 Gb	512 Gb	9,300
OLED TV	--	--	1 Tb	8,672

Table 5.0.2 – List of Servers

Server	Location	Processor	Memory	Storage	Number
Main Server	Central Cylinder	256 PFLOPS	4 Pb	200 Pb	1
Residential Server	Residential Torus	64 PFLOPS	2 Pb	60 Pb	1
Agricultural Server	Agricultural Torus	32 PFLOPS	2 Pb	20 Pb	1
Industrial Server	Central Cylinder	64 PFLOPS	2 Pb	40 Pb	1
Mining Server	Mining Base	32 PFLOPS	1 Pb	20 Pb	1
Backup Server	Central Cylinder	64 PFLOPS	2 Pb	100 Pb	1

Table 5.0.3 – Network Devices

Device	Location	Purpose
UDP	Central Cylinder	Communication between Aynah and Space Vehicles
DSN Antenna	Outer surface of central cylinder	External Communication of Aynah
Antenna	2 in Residential Torus	Communication within Aynah

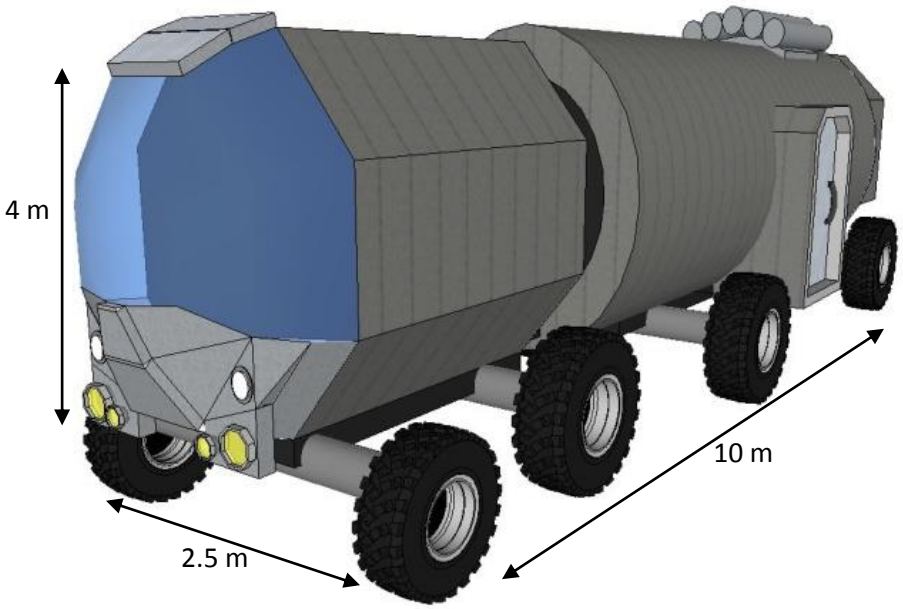
Data Storage

For data storage Ferroelectric data storage technology will be used. It will have a data density of 4 trillion bits per every square inch. It will use electrical memory storage which is far more efficient than magnetic and flash memory devices. Residents will have access to portable memory storage devices ranging from 2 Tb to 256 Tb.

5.1 – Automation for Construction

The material utilized for construction of housing will be synthesized in the manufacturing unit of the Central cylinder. The material will be shaped into components for the construction of the exterior structure of buildings such as walls and roofs.

Fig. 5.1.1- Delivery Truck



The products will be transported from the manufacturing unit to the residential torus via spokes. From that, the delivery truck will transport the materials to the construction site. The builder robot will assemble every building at the construction site. Presence of two arms and the ability to adjust its height will make assembly very efficient. All the construction will be done in the central cylinder. Only assembly of parts will take place at the residential torus. By doing this, the total cost of construction will decrease dramatically.

The exterior of the settlement will be constructed by AAH 101; AAH 102 and AAH 103 (refer to 3.3).

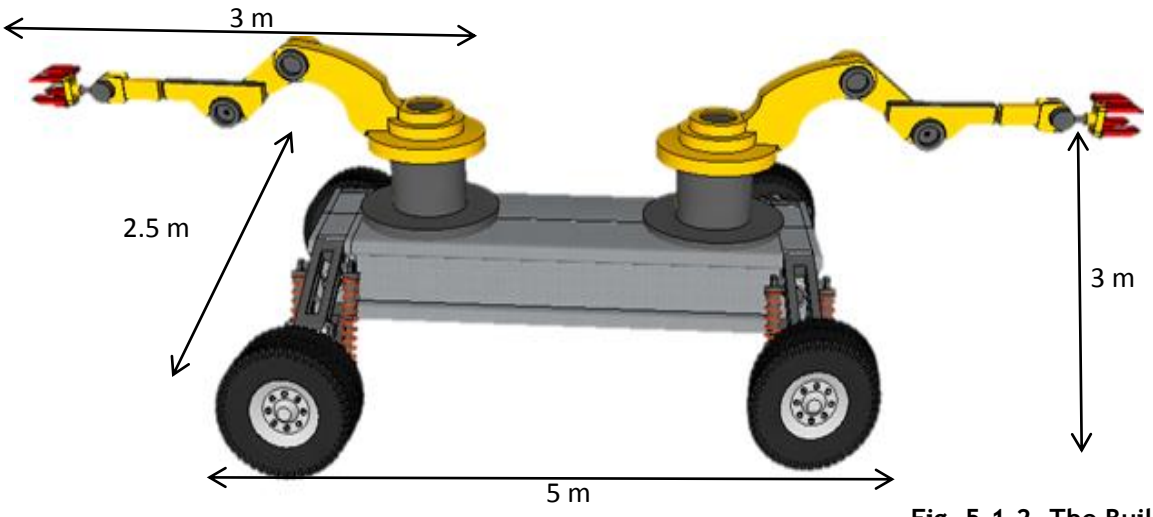


Fig. 5.1.2- The Builder

5.2 – Systems

5.2.1 –Maintenance

The control unit will be responsible for ensuring that the four components of the settlement are rotating at a constant RPM. The RPM of Discs, Residential Torus, Spokes and Beaded Cylinder will be maintained through the use of thrusters.

5.2.2-Repair

Any cracks or other complications requiring repair will be detected using Fault Detection System (FDS). It will perform laser scanning which will mark any faults on the settlement's exterior. AAH 101 (Refer to 3.3) will be responsible for the external repairing of the settlement once the construction is completed. It will go to the site of the threshold and repair the fault as needed. Its functions and capabilities will allow it to perform tasks such as welding parts together as well as holding materials in place. Presence of titanium coating on the outer surface of AAH 101 will protect it during solar flares.

5.2.3-Contingency Plan

If any potentially hazardous malfunctions are detected in the residential area, then all residents will be instructed to make their way towards the agricultural discs which will be isolated from the rest of the settlement. Presence of storage compartment within the agricultural discs will provide them with basic amenities such as food, water, oxygen supply for at least one month. During the events of Solar Flares, all the mining equipment will be stored in the mining base of Mercury.

5.2.4-Network Security

All of Aynah's residents will be using an internal network (Refer to 3.2.6). This network will give them the privacy and capability of accessing their critical data. Aynah will use a biometric identification method to protect all of the residents' personal data. For access to the critical data, a password will be required prior to the sequences of tests. In case of security breach, the IP address will be tracked and the person responsible will be put through a legal trial.

Table 5.2.1 – Bioidentification Tests

Test	Technique
Fingerprint	Scanning of ridges on fingers through infrared beam
Palm Vein	Scanning of hand veins through infrared beam
Retina Scan	Low intensified light analyze blood capillaries
Face Recognition	Facial characteristics scanning

5.3 – Convenience and Networking

5.3.1 – Helping Robots

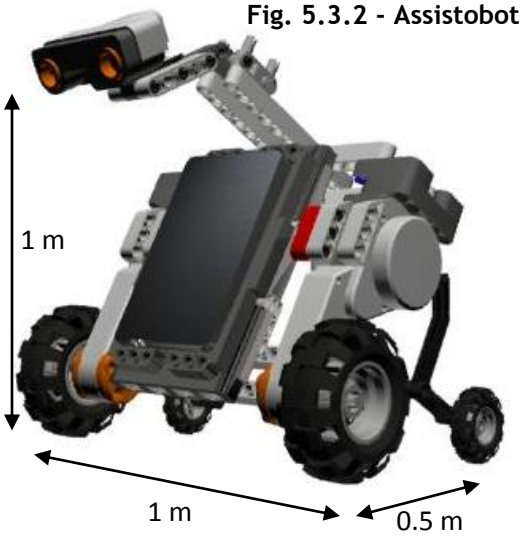
Fig. 5.3.1- Chef-o

Chef-o

It will have an inbuilt processor with which it will cook thousands of recipes. The touch screen command interphase will be used to communicate with the machine. The resident will be able to choose the desired food item and Chef-o will cook it itself, thus completely eliminating any manual work. It will also be configured with a voice command system. It will be able to perform diverse ways of cooking different foods to satisfy resident's appetite.

Assistobot

Fig. 5.3.2 - Assistobot



It will be used in offices to complete various tasks such as printing paper, doing complex calculations and also fax or scan documents. The camera equipped eyes of Assitobot will scan any document placed on a table and display it onto the screen attached to it in the front. It will also act as a personal assistant in the offices reminding the residents their important appointments and will also have the ability to make charts and presentations for them.

OneAllpen

Fig. 5.3.3 – OneAllPen

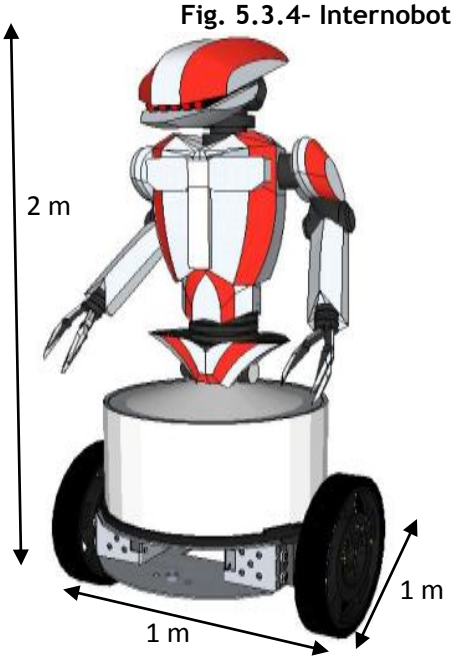
It will be equipped with a voice recognition chip allowing it to take notes on its own, thus eliminating the need for the residents to physically write. Not only it will write down the notes, it will have an ability to also record them into its 32 GB storage. Camera sensor located at the tip of OneAllpen will allow it to capture pictorial data. It will also be able to locate errors in the textual data written with certain fonts-recognized by the OneAllpen internal computer.

5.3.2- Automation for Maintenance

Internobot

A robot, called Internobot, will perform maintenance of Aynah. Internobot will be equipped with laser sensors and GPS technology to enable it to travel within the Residential Torus. It will also be equipped with proximity sensors that will allow it to detect objects around it. It will perform a regular quality check of the internal infrastructure and perform maintenance as required. Its energy source will include a rechargeable lithium Imide battery that will allow it to function for long periods of time.

Fig. 5.3.4- Internobot



5.3.3- Personal Devices

Phone

The residents of Aynah will electronically communicate with each other with phones that utilize Fiber Optics network of Aynah(Refer to 3.2.6). A slide-able tablet attached to the side of the phone will allow residents to connect to the internet. Aynah will be able to interact with all the other settlements and Earth through the means of Interplanetary Internet (Refer to 3.2.6).

Fig. 5.3.5- Phone

Entertainment

Aynah's residents will have an ultra-resolution OLED television set. The OLED TVs will be configured with 3Dimaging display. The 3D imaging will be configured with a dual view TV screen. The TV will also be equipped with proximity sensors which will scan audience movement and adjust the position of its 3D display accordingly. Residents will have the choice of subscribing to an optional movie service, which will provide further entertainment. The televisions will be available in a variety of sizes varying from 32 inches to 75 inches.

Fig. 5.3.6 -OLED TV

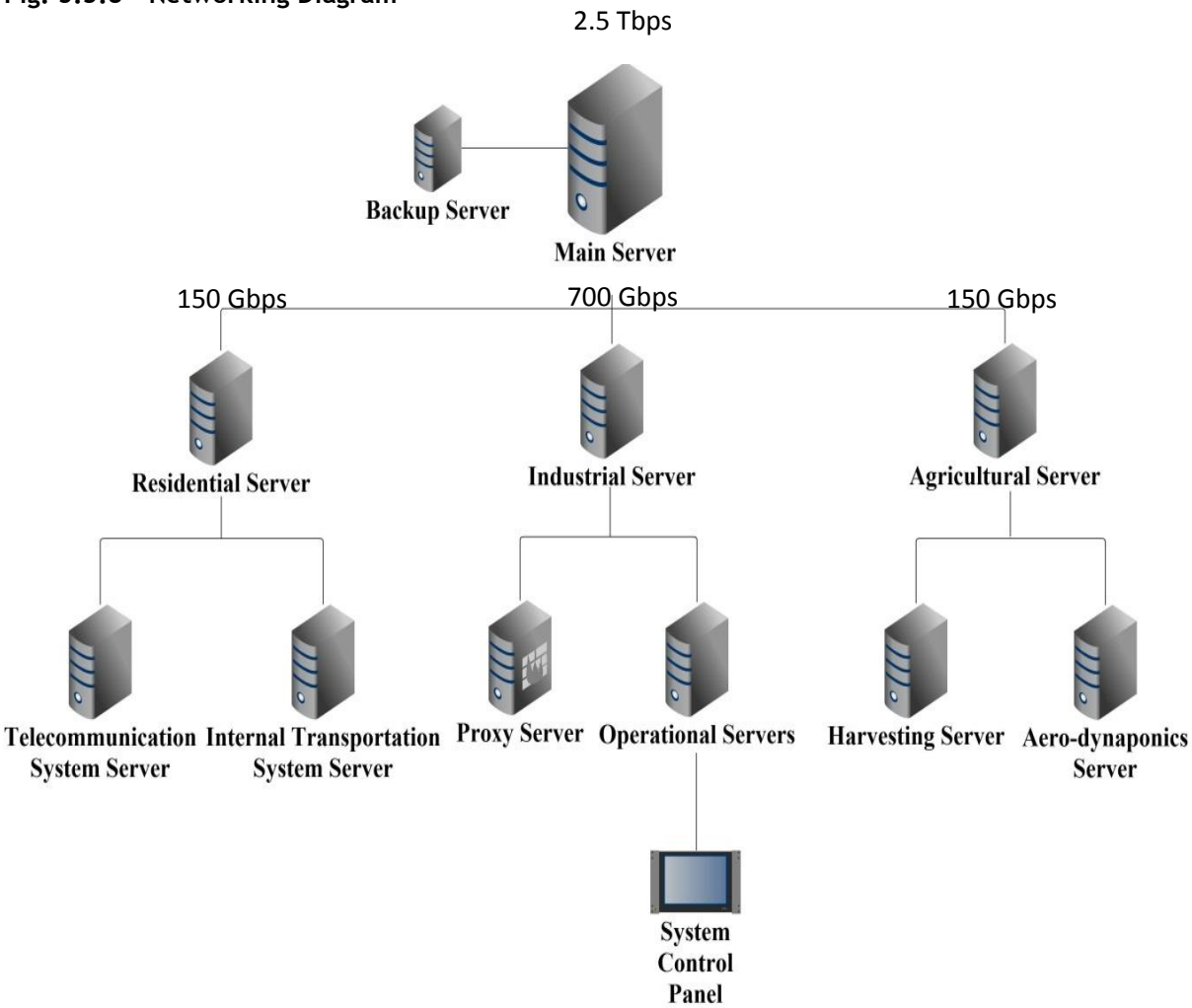
Computing

Fig. 5.3.7 – HTP 9000

Every resident will be provided with HTP 9000, whose flawless graphics will make it perfect for gaming or any other personal use. HTP 9000 will come with a physical keyboard as well as with a virtual keyboard lite which will shine down onto the table and will have the ability to work as a normal keyboard. HTP 9000 will always have to most up-to-date software and Aynah will continuously develop new features which can be easily accessed by residents.

5.3.5 – Networking

Fig. 5.3.8 – Networking Diagram



5.4 - Reardonium Handling Machinery

5.4.1 – Unloading

The ore will be unloaded into the central cylinder via the Handlers. The main function of the Handlers is Reardonium parts handling. Then the ore is transported using tubes with built-in suction pumps. These are used so that, in case a piece of the ore breaks off, it can still be transported without difficulty. Having tubes will also ensure that the ore is kept in place in the microgravity environment.

5.4.2 – Testing

The ore will travel to the testing chamber via the tubes. Then it will pass through various tests to ensure quality. The Handlers on the other side of the testing chamber will pick up the ore which fails any of the tests and send it back into the spaceship bound for Mercury. The ore that pass all the tests will be transferred to the refinery.

Table 5.4.1 – Testing of Reardonium Parts

Property	Testing method
Tensile Strength	Tensile Test
Hardness	Indentation Hardness Test
Surface and Inside Defects	X ray inspection
Yield Strength	Yield Strength Test
Elongation	Elongation Test
Chemical Components	Chemical analysis, quality control testing, troubleshooting, advanced research, trace and ultra-trace level chemical analysis
Compact Property	Charpy impact test

5.4.3 Handling

The Reardonium parts handling will be done by the Handlers. They will play a prominent role in the transportation of Reardonium ore/parts throughout Aynah. They are attached to the walls of the structure and are situated in many locations throughout the process. First they will unload the ore arriving from mercury, as mentioned above. Then, they will collect the ore that passes the tests and transfer them to refinery in the central cylinder. The ore that requires refinery at 0.1 g to 0.5 g beaded cylinder will be placed into the elevators by them.

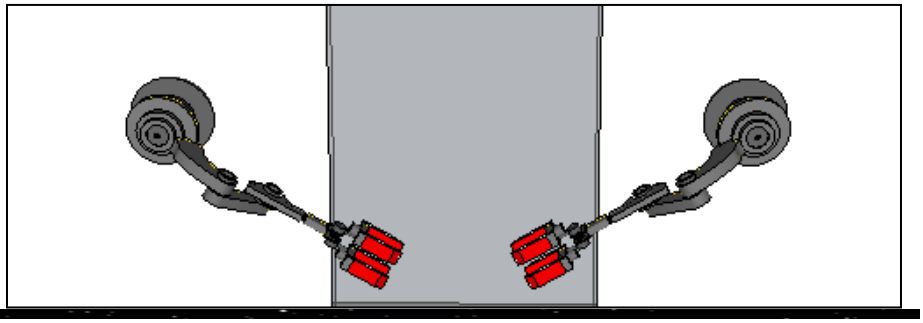
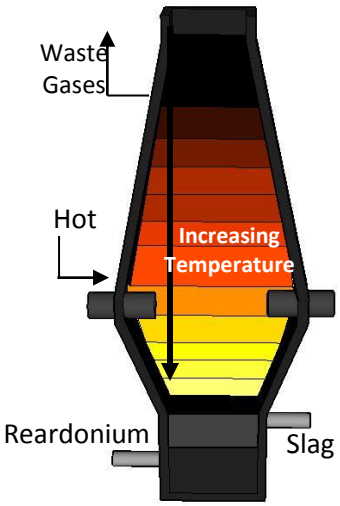


Fig. 5.4.1 - Handlers

5.4.4 - Refining

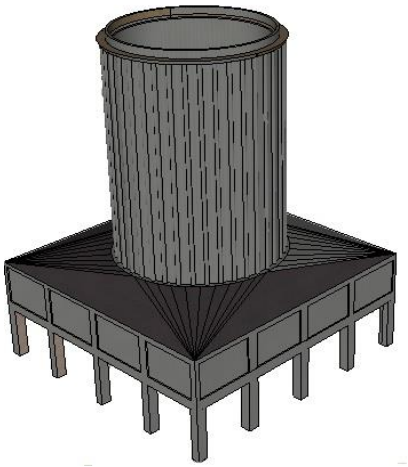
Fig. 5.4.2 - Blast Furnace



The zero-g refining will take place in the central cylinder. The ore requiring refinery at 0.1-0.5 g will be sent to the beaded cylinder via elevators. During refining, the Reardonium will be extracted from its oxides in a blast furnace surrounded by heat-resistant bricks. Blast furnace will be loaded with Reardonium ore, coke (made by heating coal) and limestone (calcium carbonate). The refining process will be as follows: A blast of hot air will be sent in near the bottom of the furnace through holes which will make the ore glow, as the coke burns in the preheated air. The limestone will begin to decompose and the carbon dioxide gas produced will react with more hot coke higher up in the furnace, producing carbon monoxide in an endothermic reaction. Carbon monoxide is a reducing agent; it will rise up the furnace and reduce the Reardonium ore. The molten Reardonium produced will trickle to the bottom of the furnace. The calcium oxide formed from the limestone will reacts with acidic impurities in the Reardonium ore to form a liquid slag. This slag will also trickle to the bottom of the furnace, but because due to less density, it will float on the top of the molten Reardonium. The molten ore will be then transported to the manufacturing unit.

5.4.5 - Manufacturing

Fig. 5.4.3 - Molder



The ore requiring to be manufactured in zero-g will be sent up to the manufacturing unit of the central cylinder. For manufacturing in 0.1 to 0.5 g, the ore will be transferred to the beads. Reardonium received at the manufacturing will be poured into the cast of the Molder. Molders of various sizes will be functioned to make casts of desired shapes. After the cast molds into the required shape and size, it will be set to cool into a solid mass. Once the Reardonium has been completely cooled, the Molder will open its cast and the part made of pure Reardonium will be ready for transport. The Handlers will also come into use when the Reardonium parts are to be placed in and out of the elevators.

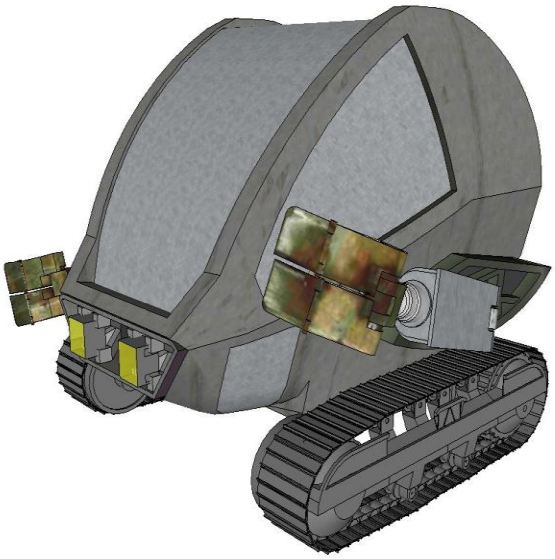
5.4.6 Loading

Once the Reardonium parts enter from the elevators, Handler will place them in a tube headed for the docking port. At the docking port, the Handler will load the parts onto the ships for curing on Mercury's surface.

5.5 - Mercury Surface Machinery

There will be three robots for operation on mercury's surface. All three of them will be made of lead/titanium that will protect them against solar flares. They will also be equipped with super bright LEDs to facilitate movement during night time. Loader will be used for the loading/ unloading of Reardonium parts to and from the Carrier (refer to 3.5).The trailer of the vehicle will have a conveyer belt laid out. From the edge of the trailer, the Loader will pick up the Reardonium with its arms and place them in a storage area. The loading process will be reversed during unloading.

Fig. 5.5.1 – Loader



The next two robots will be the same ones used in the construction of Aynah (refer 3.3) with some slight modifications.
AAH 102 will be altered so it can handle Reardonium parts and transfer them between the curing plant and the storage area. It will have arms to lift the Reardonium parts and place them inside its storage compartment. It will also be fitted with tires so it can move from the storage area to curing plant. Presence of tires will eliminate the need of thrusters which will be removed from its surface.

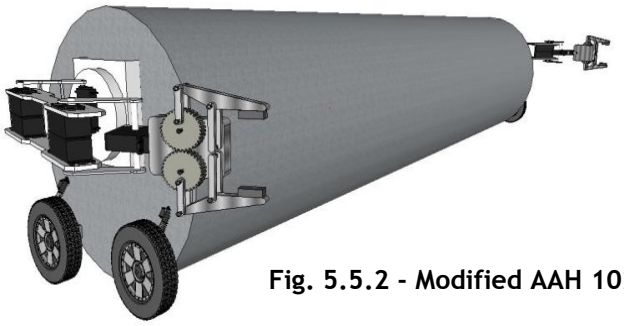


Fig. 5.5.2 - Modified AAH 102

A modified version of AAH 103 will be used for turning Reardonium parts over for curing. Its claws will be enlarged for it to be able to hold Reardonium. It will be fixed to one spot throughout the curing process. The curing process involves the Reardonium undergoing induction heating in which an open flame is directly applied to the Reardonium and the heat is induced within the part itself by circulating electric currents.

Fig. 5.5.3 - Modified AAH 103

6.0 SCHEDULE AND COST

6.0 - Schedule and Cost

6.1 - Schedule

The planning of Aynah will start on May 9, 2077 which is the very next day of award of contract. Through various methods involved, Aynah will be ready for human habitation within seventeen years (May 6th, 2094). The process of establishing full population will take 364 days (May 5th, 2095). The following chart demonstrates the different phases of construction process and time taken to complete each phase.

Table 6.1.1 – Construction Schedule

Phase	Days/Date starting from 20-										Completion Date
	77	79	81	83	85	87	89	91	93	95	
Hiring Workers											August 15th
Training Workers											April 15th
Making of robots											July 9th
Functioning of robots											September 3rd
Construction Sequence:											
Phase 1											May 9th
Phase 2											August 9th
Phase 3											February 16th
Phase 4											November 17th
Phase 5											December 2nd
Phase 6											August 3rd
Phase 7											August 3rd
Internal Construction:											
Residential											January 12th
Agriculture											January 3rd
Industrial											January 9th
Testing :											
Exterior											May 3th
Interior											May 6th
Habitation											May 4th

6.2 - Cost

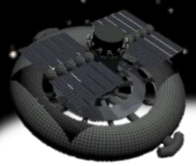
Table 6.2.1 - Cost

Phase (No. of Employees)	Description	Cost
Hiring Workers (150)	Done at Auroria	2 Million
Training Workers (1200)	Done at Columbiat	300 Million
Making of robots (500)	Done at Bellevistat	15 000 Million
Functioning of robots (1200)	Build the settlement	10 000 Million
Construction Sequence (900):		
	Phase 1	2 500 Million
	Phase 2	3 000 Million
	Phase 3	2 000 Million
	Phase 4	3 500 Million
	Phase 5	11 500 Million
	Phase 6	7 000 Million
	Phase 7	4 000 Million
Internal Construction (1200):		
	Residential	35 000 Million
	Agriculture	20 000 Million
	Industrial	47 000 Million
Testing (120):		
Exterior	Exterior	200 Million
Interior	Interior	350 Million
Habitation	Transfer of Population	16 000 Million
Total Cost :		**$117.352 Billion**

Table 6.2.2 - Cost per year to the Foundation Society

Year	Task	Cost
2077	Hiring Workers, Training Workers, Making of robots	901 Million
2078	Making of Robots, Functioning of Robots	8 167 Million
2079	Functioning of Robots, Phase 1	1 460 Million
2080	Functioning of Robots, Phase 1	1 460 Million
2081	Functioning of Robots, Phase 1, Phase 2	2460 Million
2082	Functioning of Robots, Phase 2	1 625 Million
2083	Functioning of Robots, Phase 2, Phase 3	2 625 Million
2084	Functioning of Robots, Phase 3, Phase 4, Phase 5	7 425 Million
2085	Functioning of Robots, Phase 5	2 925 Million
2086	Functioning of Robots, Phase 5	2 925 Million
2087	Functioning of Robots, Phase 5	2 925 Million
2088	Functioning of Robots, Phase 5, Phase 6	6 425 Million
2089	Functioning of Robots, Phase 6, Phase 7, Internal Construction	25 125 Million
2090	Functioning of Robots, Internal Construction	17 625 Million
2091	Functioning of Robots, Internal Construction	17 625 Million
2092	Functioning of Robots, Internal Construction	17 625 Million
2093	Functioning of Robots, Internal Construction	17 625 Million
2094	Functioning of Robots, Internal Construction, Testing	18 175 Million
2095	Habitation	16 000 Million

7.0
BUSINESS DEVELOPMENT



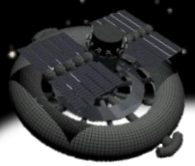
7.0 Business Development

Infrastructure for Refining and Manufacturing Reardonium Parts

When RT-240 will enter the docking port, Handlers (refer to 5.4.3) will transfer the ore through its route in Aynah. After being tested, the Reardonium ore will be transported to the refining area where it will be placed in the blast furnace (refer to 5.4.4). The dust and grit formed during the various processes that Reardonium undergoes will be removed using suction pumps planted at various locations inside the refining and manufacturing unit. The suction pumps will transfer dust and grit to the solid waste management plant located inside the central cylinder. These wastes will be incinerated (refer 3.2.5). Aynah will have a 1154 m beaded cylinder, with each bead increasing by 0.1g and 4psi, which will allow the manufacturing of Reardonium to occur in various gravity and pressure environments. The minimal distance of 350 m between the manufacturing areas and human occupied areas will ensure that the two are well-separated. The central cylinder of Aynah will be designed so that there is a docking port on the refining area of the cylinder. This will allow parts to be transferred easily and quickly within Aynah. In addition, all the processes concerning Reardonium will be placed adjacent to each other which will make the process faster and cheaper by minimizing transportation.

Receiving and Shipping Reardonium Parts

Curing of Reardonium materials will be situated on the surface of Mercury. Once the materials are free of raw ores they will be required to go through a Fluorescent Inspection Process before entering Aynah. This process will require the use of fluorescent light (UV light) to distinguish the threshold of the material, current damages and assures that no raw materials will enter habitable areas. Once the materials are properly inspected, they will be sent to the storage area of Aynah located in the central cylinder. When needed, Aynah will also deliver completed parts to customers throughout the solar system. Parts to be delivered will be placed into pallets which will then be packed and placed into MB-270 (refer to 4.3.2. This will keep the parts clean and free of damage. This whole process will be automated. The Handlers will be responsible for removing the cured parts from the docking port and placing them onto elevators. From there, another pair of Handlers will place them in the aforementioned storage area where it will be stored until it is ready to be delivered. The Handlers will then put them in the elevators which take them to the manufacturing area to be packed. The Handlers will carry out the task of packing the Reardonium parts and will also be responsible to transfer them to the docking port and loading them onto the awaiting MB-270.



Port of Entry for Mercury

There will be five docking ports connected to the structure of Aynah; three located at the bottom of the central cylinder and two on the refining area. The docking ports will be separated from each other due to their use. Since materials will be needed in the refinery area, it will be crucially important that the materials from Mercury be shipped directly to that area for maximum efficiency. Hence, the space shuttles will land on the docking ports closest to the refining area. This will also ensure that dust and raw materials do not enter habitable areas. In addition, all personnel and cargo will land on the docking ports that are at the bottom of the central cylinder. This will ensure that the shuttle will not come in contact with the thrusters and gives people room to store their bags within the 120m docking utility area. Handlers will also be located at the docking ports located below the residential torus. They will be responsible for moving cargo containers between the arriving TC-320 (refer to 4.3.2) and the warehouses located inside the docking port facility.

8.0
APPENDICES

8.0 – Appendices

A – Operational Scenario

First, Reardonium ore will be extracted from Mercury using equipment from the mercury mining base. Once extracted, it will be transported to the storage area using the AAH 102 (refer to 5.5). From the storage area, Loader (refer to 5.5) will load the Reardonium ore onto the Carrier (refer to 3.5). Carrier will transport the Reardonium ore to the launch pad. Loader will unload the ore from the vehicle and load it onto the awaiting RT-240 (refer to 4.3.2), which will transport it to Aynah. The RT-240 will enter Aynah through the docking ports situated outside of the refinery compartment. Once the ore enters the docking port, it will be unloaded into the central cylinder via Handlers (refer to 5.4). The ore will be then transferred to the testing chambers where it will undergo tests on its various properties to ensure good quality. The larger ore will require all the tests due to its size but the smaller ore will only undergo an x-ray scan to ensure proper internal composition. If the quality of any ore is not good, then it will be sent back to the docking port; from there, the ore is loaded onto RT-240 and sent back to Mercury for curing. In the refining unit both the parts will go into the blast furnace (refer to 5.4.4) to remove impurities, and then will be cooled and transported to the manufacturing unit by the Handlers. The high-quality ore will be sent to the beaded cylinder for 0.1 - 0.5 g refining and manufacturing. The parts will be then go through the blast furnace and will be molded by the Molder (refer to 5.4.5). The smaller part will be molded into tire rims by a small size molder and the larger part will be molded into panel for construction of future ventures by a large size molder. Then, they will go back down through the elevators and will be placed in a tube going towards the docking port. RT-240 will carry the Reardonium parts from the docking port to Mercury's surface for curing. Loader will unload the Reardonium parts from the RT-240 and place them in the storage area. AAH 102 will then take the Reardonium from the storage area to the curing plant. At the curing plant, AAH 103 (refer to 5.5) will assist in the curing process by flipping the Reardonium to get a better material cure. The curing process of the smaller part will take shorter amount of time than that of the larger part. The humans will inspect the Reardonium curing process on board the Surface Vehicles (refer to 4.5). This is where Reardonium will encounter human interaction for the first time. After successful inspection, the Reardonium will be taken to the storage area by AAH 102. Loader then will collect the Reardonium from the storage area to the launch pads and will load them onto the RT-240 bound for Aynah. Once it will reach Aynah, the RT-240 will enter the docking port from where the Handlers unload the cured Reardonium parts. The Reardonium parts will then be placed onto elevators and stored in the storage unit of the central cylinder, ready for sale. The larger part will take more time than the smaller part because it will have to undergo more tests in the testing chamber. More time will be taken in molding a bigger piece than a smaller. Cooling will also take more time. Also, curing of larger part will be longer. Therefore, the time taken for the bigger part to go through all these processes is approximately 5 months whereas the smaller part will take approximately 3 months to undergo all the processes.

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