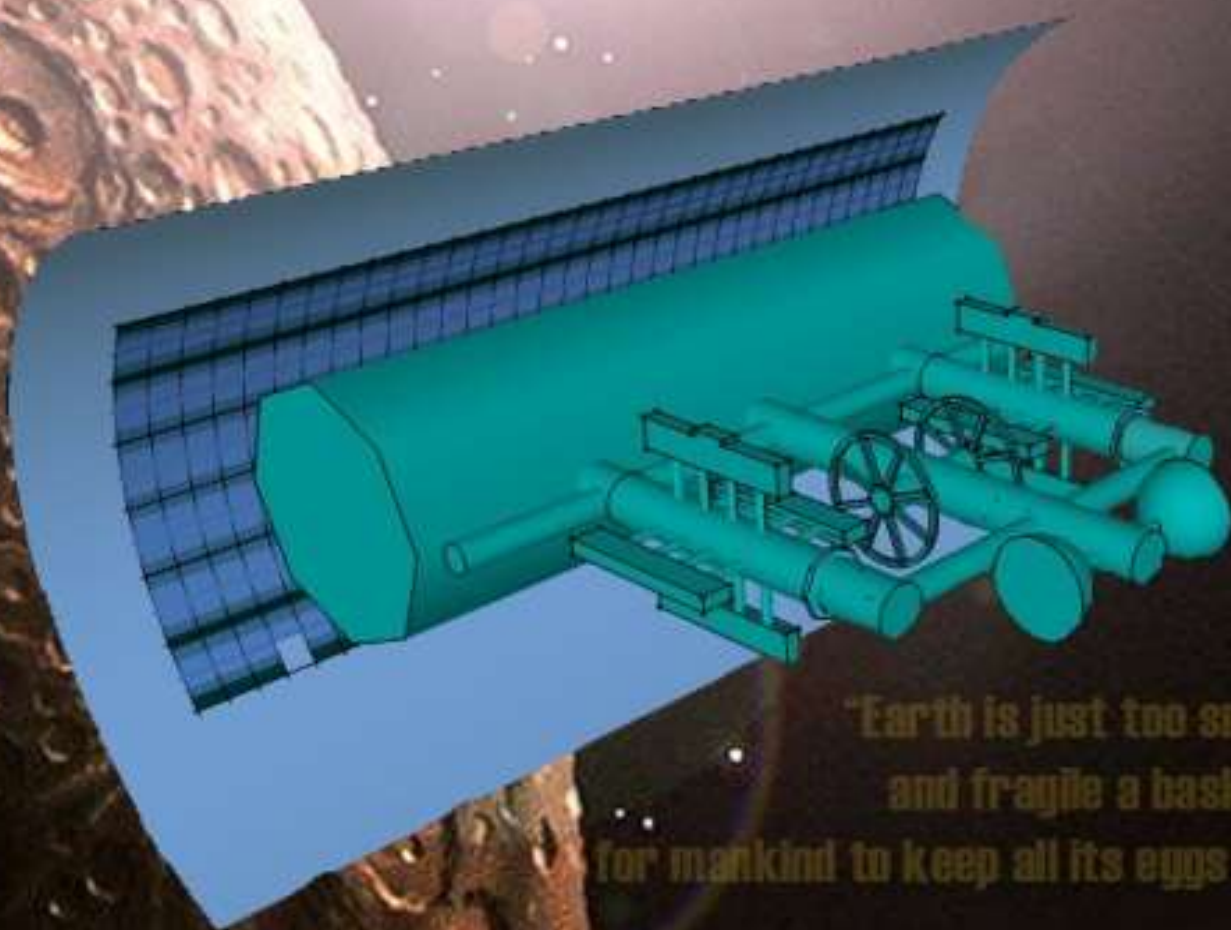




SPACE
SETTLEMENT

ARKAH

an ark to
carry us across



"Earth is just too small
and fragile a basket
for mankind to keep all its eggs in."

BIRLA HIGH SCHOOL, KOLKATA

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

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 (we request that participants be at least 15 years old, and not older than 19)

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

MEETA SHAILENDRA

RENU BUBNA

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,



Responsible Teacher/Advisor Signature

23-03-2012

Date

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1.0 Executive Summary

For a race that lives on elevation and progress, and that seeks to manipulate even the most dangerous entities to fit in accordance with its needs, the glorious sun that forms the greatest attraction. And so, in response to the request of the Foundation Society, Northdonning Heedwell presents the Arkah space settlement. A settlement that represents the advent of human race in the paradigm of space mining and harvesting of space resources. A settlement that battles the sun headlong, taming its forces into advancement of human civilization. A settlement that looks to take astronomical studies and researches to the next level and hopes that the Miracle metal 'reardonium' puts an end to the worries surrounding the shortage of minerals. Arkah's design is not all about a few shapes coming together; it has been made such to incorporate the needs whether it is the comfort of the Arkahns or business development. Safety, efficiency and aesthetics form the cornerstone of the settlement's design. Living in communities, Arkahns are provided with complete luxury and facilities which make Arkah a place for them to discover their full potential. Since, almost all labour would be undertaken by automation, humans are left with a sole purpose – to enjoy and socialize. Not only advanced technology and scientific factors, but what makes Arkah perfect is innovation. Welcome this blend of innovation and science, introduce it to the world as just another invention of science, but one which looks after the needs of all, from nature to human community.

Features:

- Arkah incorporates a structural plan that portrays the expansion plans of the residential and commercial areas requiring minimum change in the structure and thus not interfering in the normal working of the settlement.
- Among countless structural adaptations, the unique style of solar shield enables natural sunlight to enter the residential and commercial areas, but protects them from the harmful solar radiations. Also, windows have been provided in the residential and commercial areas, so that natural sunlight can pass through.
- A wave of innovative operational systems ranging from day and night systems, efficient network plan, fast transportation network to using advanced technologies for food production add to the efficiency of the settlement.
- The beautiful cum luxurious houses coupled with fascination recreational facilities seeks to fulfil those desires which were long awaited by the Arkahns
- Automation used all through the settlement would result in increased productivity and efficiency. Thus, Arkah would experience better facilities, and business operations. Automation services look to aid productivity on the settlement alongside forming the core of industrial operations.
- Arkah has taken in consideration financial and time constraints to design a business proposal. To have Arkah operational, it will take 21 years which reflects a remarkable speed with efficiently using the resources.



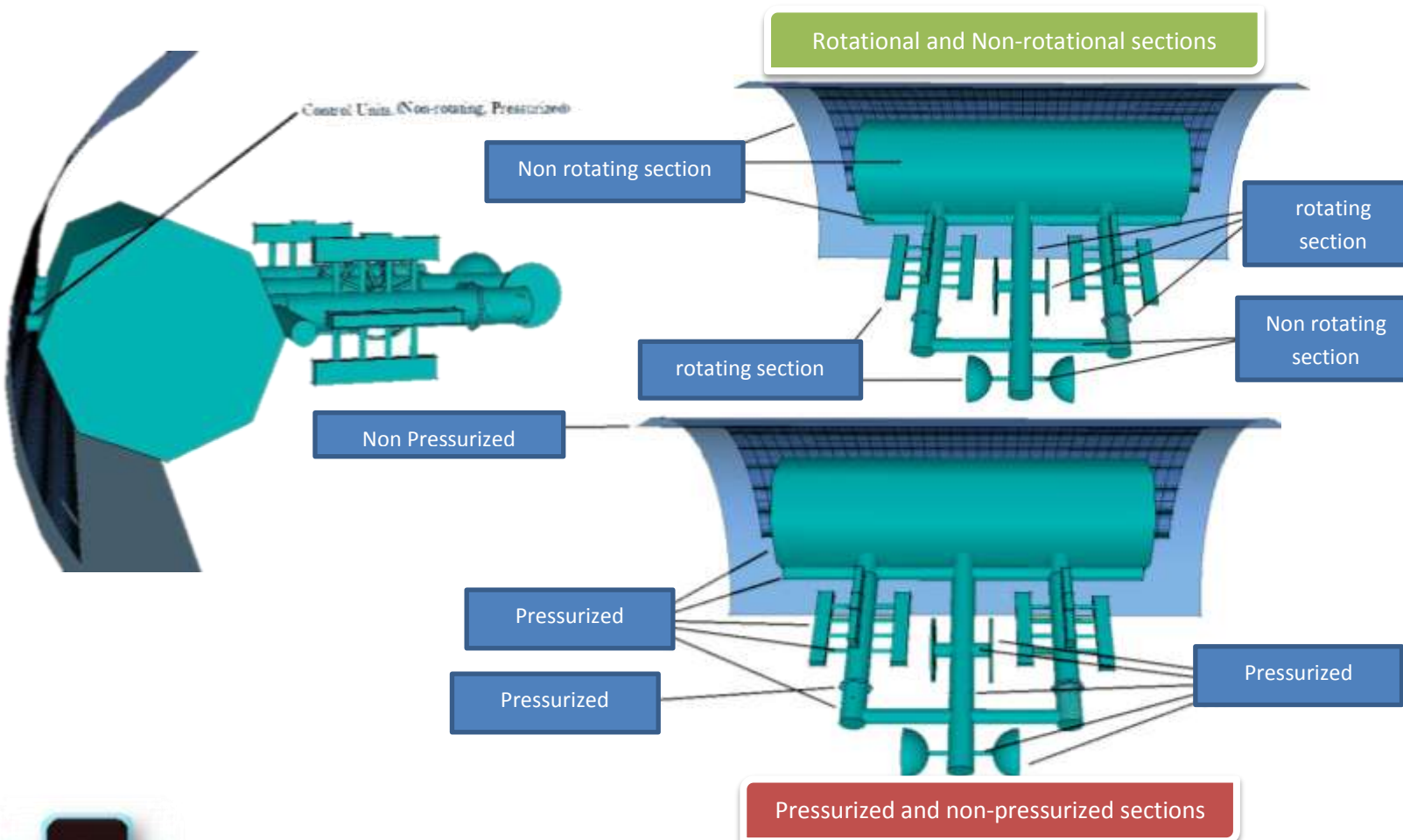
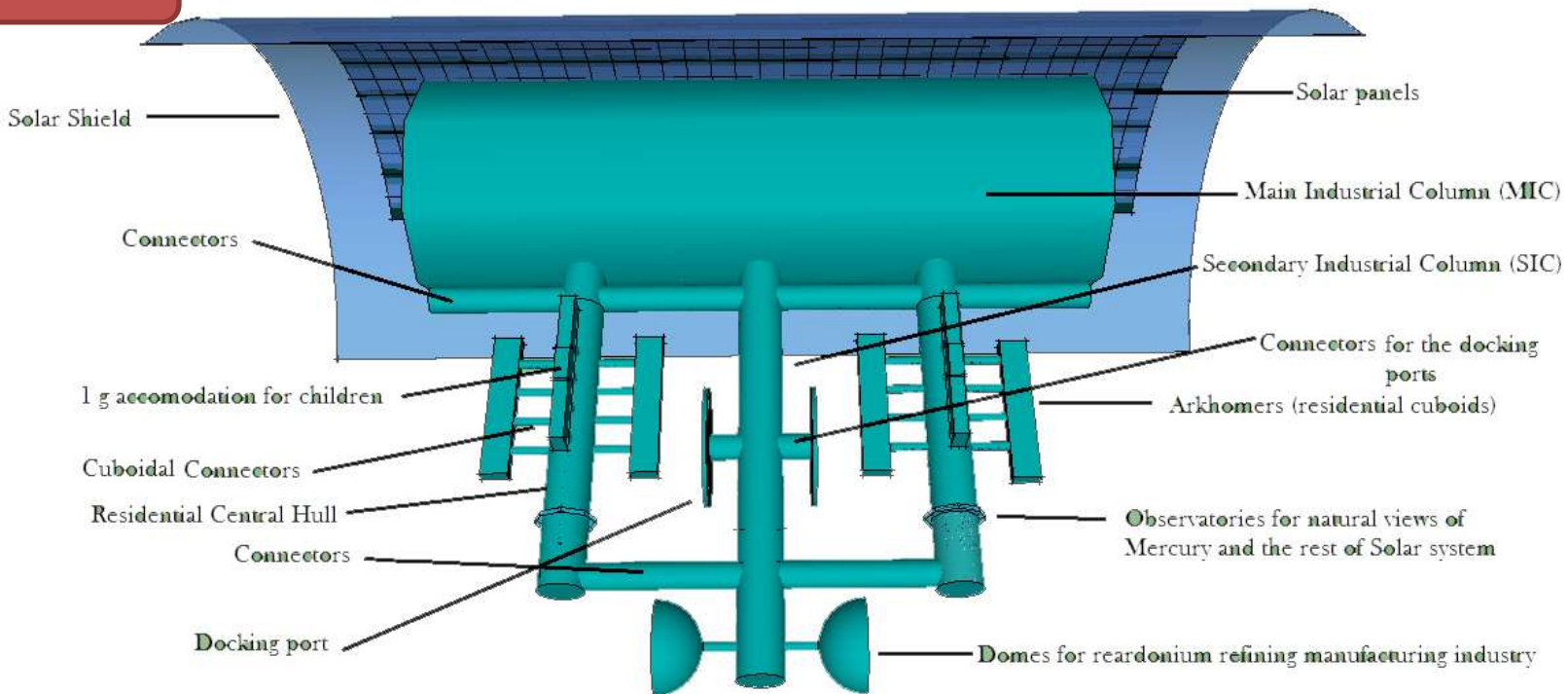
2.0

Structural Design



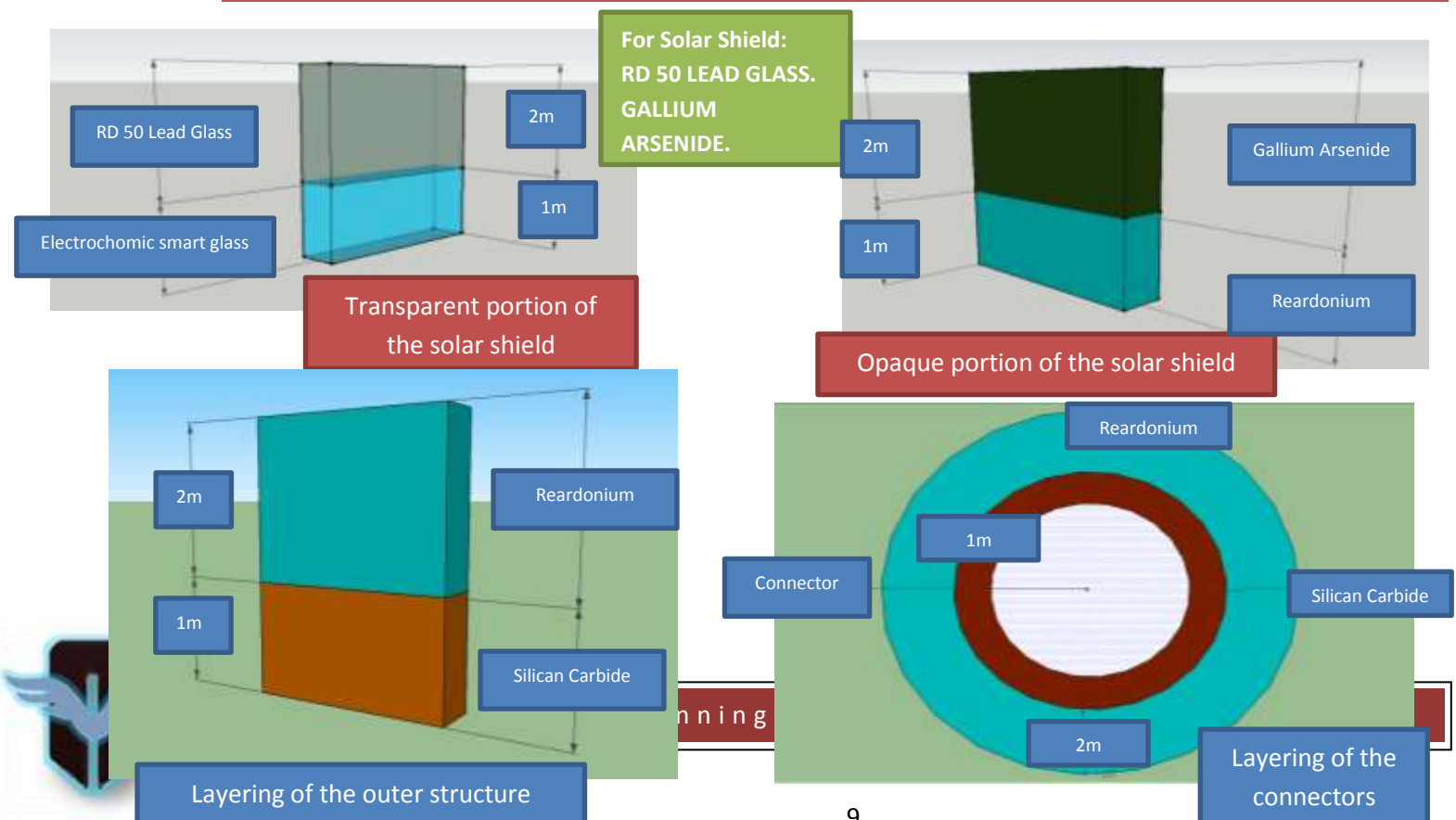
2.1

Exterior view



Attributes and uses of large enclosed volumes:-

S.No.	Location	Use
1	Solar Shield with solar panels	To prevent harmful radiations from entering the satellite and to allow natural sunlight to enter the settlement. These qualities are achieved by using special materials like RD50 Lead Glass, etc. which is transparent as well as repels radiation. The edges of our shield are transparent while the middle portion is opaque, built of Reardonium to prevent radiation. Solar panels are placed over this opaque portion of the shield.
2	Main Industrial Column (MIC)	This section of the settlement is an octagonal cylinder-like structure which will house 8 industries namely Processed food and drinks, Medical, Metal, Paints, Clothes and Spacesuit, Electronics, and Stationary. It will also house the Energy Storage unit, Robot Storage unit and Air Management Unit. Thus this is the primary industrial hub of our settlement. It is non-rotational and has no gravity.
3	Connectors	Their primary use is to increase the structural strength and stability of our settlement. They are also being used for transportation of people and goods throughout the settlement.
4	Residential Cuboids	Each residential cuboid (of a total of 8) has been divided into 4 levels in order to achieve the desired gravity at the respective levels. The lowermost level (towards the residential connector) comprises of the residential and commercial areas. The next level houses the agriculture sector. The next level below consists of the waste and water management units. The last level comprises of schools for children at 1g. But this level is present in only 2 cuboids (refer to overall design diagrams). They are rotational and they rotate about their own axis.
5	Secondary Industrial Column (SIC)	This cylinder has been divided into three sections, namely, Storage (It is to provide cargo warehousing for customs purposes and storage while waiting for transfer to other ships, Spacecraft Maintenance and Reardonium refining and manufacturing (0g) (in order when coming from the MIC towards the industrial domes). This cylinder consists of two rotational domes at the end.
6	Domes	There are 2 domes in our settlement. Each dome has been divided into 3 levels with a suitable RPM to get the desired variable gravity for the Reardonium refining manufacturing units. They are thus rotational.
7	Docking Ports	There are 2 ports in our settlement. One of them is for usage by humans and the other is for goods and freight. It has a capacity of handling 8 spacecraft at one instance. Thus, a total of 16 crafts can dock at a moment. It has no gravity.
8	Observatory	There are 2 observatories in our settlement. They provide the view of the surface of Mercury as and when desired



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S.No	Location	Shape	Dimensions	Total Surface Area (in m ²)	Volume (in m ³)
1	Residential Central Hull	Cylinder	Radius=250m Height=3000m	10214285.7	1178571428.57
2	Connector(from RCH to Residential Cuboid)	Cylinder	Radius=50 m Height=400m	4525713.92	100571428.57
3	Main Connector 1	Cylinder	Radius=150 m Height=7600m	7307142.85	537428528
4	Main Connector 2	Cylinder	Radius=150m Height=3600m	3535714.28	254571408
5	Connectors (between MIC and Solar Shield)	Cylinder	Radius=100m Height=200m	754285.70	25142856
6	Main Industrial Column	Octagonal Cylinder	Side=1000m Length=9000m	81656854.249	43423692300
7	Secondary Industrial Column	Cylinder	Radius=250m Height=4300m	7149999.99	84464285.1
8	Observatory	Octagonal Cylinder	Side=250m Height=50m	621708.616	10542715.44
9	Residential Cuboid	Cuboid	Height=350m Length=1670m Breadth=150m	12596571.44	606750000
10	Solar Shield	Curved rectangle	Length=12000m Breadth=8000m	96000000	288000000
11	Docking port	Ring	Inner radius=600m Outer Radius=650m Height=50m	Inner Surface Area=377142.857 Outer surface Area=408571.428	20428571
12	Domes	Hemi-Sphere	Radius=477m	3495789.527	454797966.846
13	Connector(from Docking Port to SIC)	Cylinder	Radius=150m Height=350m	942857.14	50199996
14	Connector(from Domes to SIC)	Cylinder	Radius=50m Height=226.71m	173931.98	3562584.41

Structural Interface between rotating and non-rotating structures:-

The structural interface used in our settlement will comprise of a system of tapered roller bearings that would separate the rotational section from the non-rotational section in every case it has been used, i.e. for the rotation of the residential areas and the industrial domes, and would help in the rotation of these sections. The tapered roller bearings consist of tapered rollers such that each one's axis converges at the primary axis of the bearing. They are capable of taking large radial and axial forces. They are made up of reardonium. This is because Reardonium has the property of self-lubrication, thus this would help us by providing a very low friction, reduce brinelling and by increasing its life.

Locations with their respective gravity and the Justification for its usage-

S.No.	Location	Magnitude used	Justification
1	Industries	0g	0g is better than most other gravity environments for manufacturing.
2	Heavy Manufacturing	0g	0g is better than most other gravity environments for manufacturing.
3	Connectors	0g	For easy transportation of people and to provide extra stability and connectivity to the settlement.
4	Storage	0g	For easy handling of cargo.
5	Reardonium Refining and Manufacturing	0g, 0.3g, 0.4g, 0.5g	Variable Gravity environments are required for Reardonium refining and Manufacturing to create a wider range of desirable material properties
6	Residential Areas	0.75g	Adults prefer staying between 0.7g to 0.8g
7	Commercial Areas	0.75g	Commercial Areas are present along with the residential areas.
8	Agriculture	0.85g	Conditions similar to earth are required for agriculture.

9	Waste Management	0.95g	To prevent unwanted scattering of wastes (which may happen in case of 0 g).
10	Schools for Children	1g	Children need to spend at least 3 hours per earth day at 1g for proper development.
11	Water Management	1g	Water management will be more efficient at 1g to prevent unnecessary floating of water.

Locations with their respective rotations per minute and the Justification for its usage-

S.No.	Location	Magnitude	Justification
1	Residential Area A and B	0.945433	The selected RPM facilitates in achieving required gravity for residential areas, commercial areas, waste management, agriculture, water and schools.
2	Dome A and B	0.75	The Selected RPM facilitates in achieving variable gravity conditions for Reardonium refining and Manufacturing.

Capability of Isolation in our settlement:-

Arkah has got a state-of-the-art system for isolation in case of depressurization of volumes. For details refer to section 4.3.3.

2.2

Interior down surfaces

Down Surface Areas Of the Settlement-

S.No.	Location	Down Surface Area(m ²)
1	Residential And Commercial Areas	2004000
2	Agriculture area	2004000
3	Waste and Water Management	2004000
4	Provision for 1g (schools)	111000
5	Observatory	210854.308
6	Connectors	0
7	Industrial Area	12094250.44
8	Docking Ports	785714.285
9	Storage	1964285.7
10	Spacecraft Repairing and Manufacturing	196428.57
	Total	21374533.303

Residential Areas-

The residential areas consist of residences as well as commercial areas sprinkled about widely in between the residences.

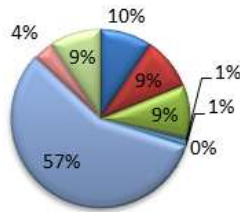
Industrial Area

S.No.	Type Of industry	Down Surface Area(m ²)
1	Processed foods & drinks	603106.8375
2	Energy storage	603106.8375
3	Air management unit	603106.8375
4	Medical	603106.8375
5	Metals	603106.8375
6	Storage (robot)	603106.8375
7	Finished	603106.8375
8	Paints	603106.8375
9	Clothes and spacesuits	603106.8375
10	Electronics	603106.8375
11	Stationary	603106.8375
12	Reardonium Refining And Manufacturing	5460075.227



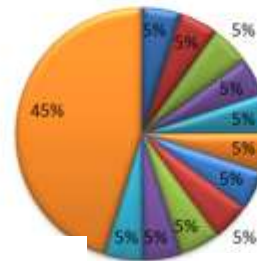
Down Surface Area

- Residential And Commercial Areas
- Agriculture area
- Waste and Water Management
- Provision for 1g (schools)
- Observatory
- Connectors
- Industrial Area
- Docking Ports
- Storage



The Industrial Area

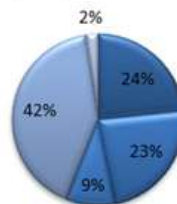
- Processed foods & drinks
- Air management unit
- Metals
- Finished
- Clothes and spacesuits
- Stationary
- Energy storage
- Medical
- Storage (robot)
- Paints
- Electronics
- Reardonium Refining And Manufacturing



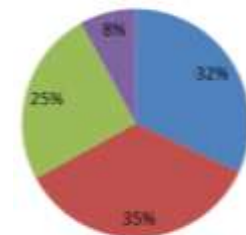
Secondary Industrial Columns

S.No.	Location	Down Surface Area
1	Storage	1964285.7
2	0g Reardonium Manufacturing And Refining	1964285.7
3	Docking Ports	785714.285
4	0.3g-0.5g Reardonium Refining And Manufacturing	3495789.527
5	Spacecraft Repairing And Manufacturing	196428.57

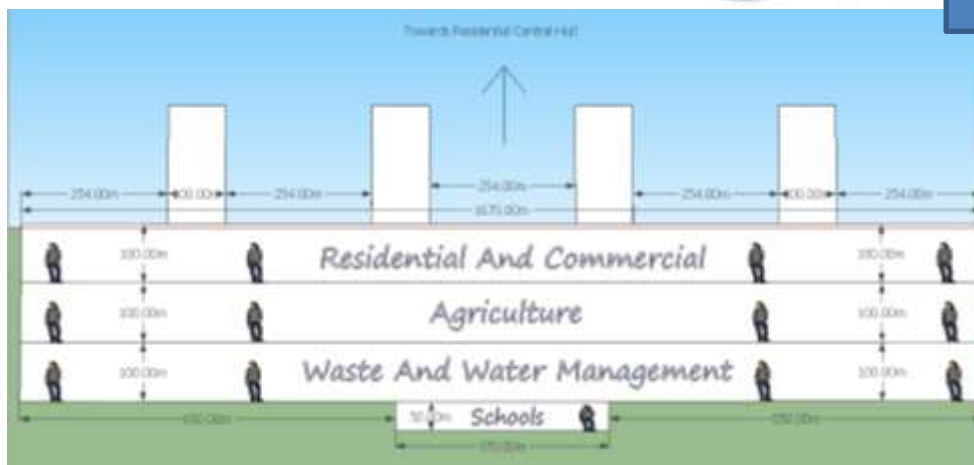
- Storage
- 0g Reardonium Manufacturing And Refining
- Docking Ports
- 0.3g-0.5g Reardonium Refining And Manufacturing
- Spacecraft Repairing And Manufacturing



Agriculture

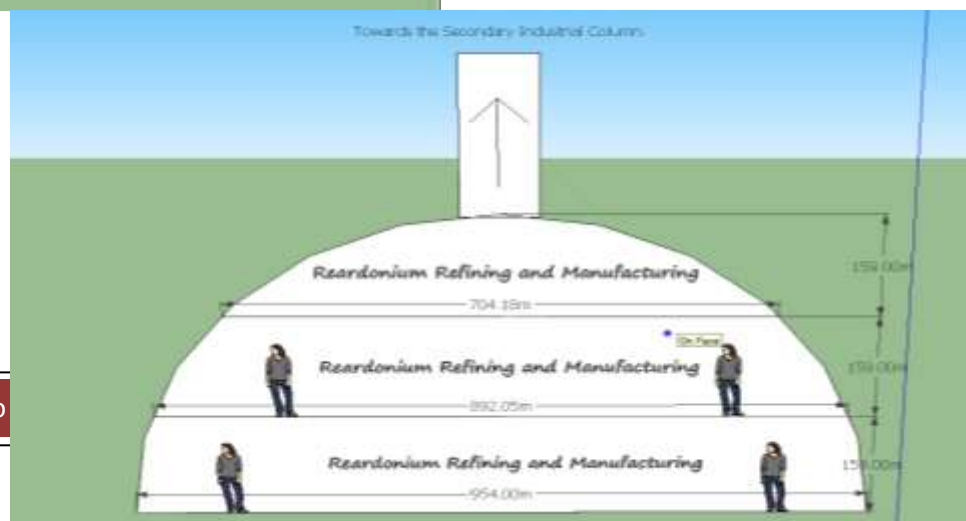


Vertical Clearance in gravity zones



Vertical Clearance of Residential Cuboids (the cuboid shown here has the 4th level, containing schools for children, but not all cuboids will have the same – Refer 2.1

Vertical Clearance of Domes

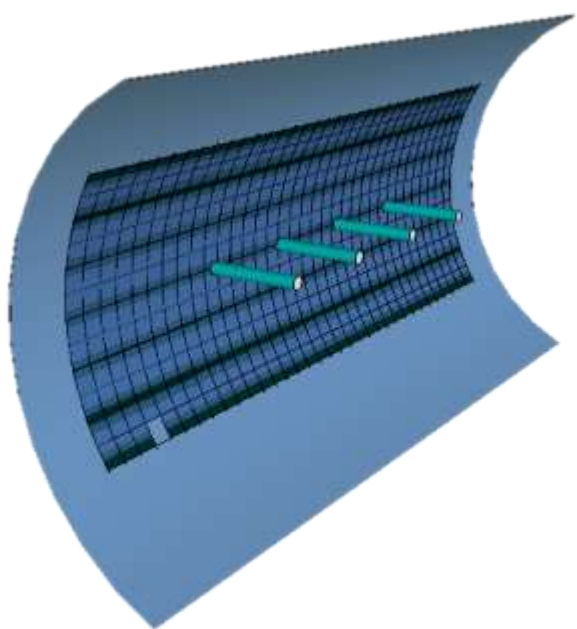


Vertical Clearance of Zero gravity zones-

S.No.	Location	Vertical Clearance
1	Main Industrial Column	1181.7m
2	Reardonium Refining and Manufacturing	190m
3	Docking Ports	50m
4	Storage	100m
5	Spacecraft Maintenance	600m

2.3

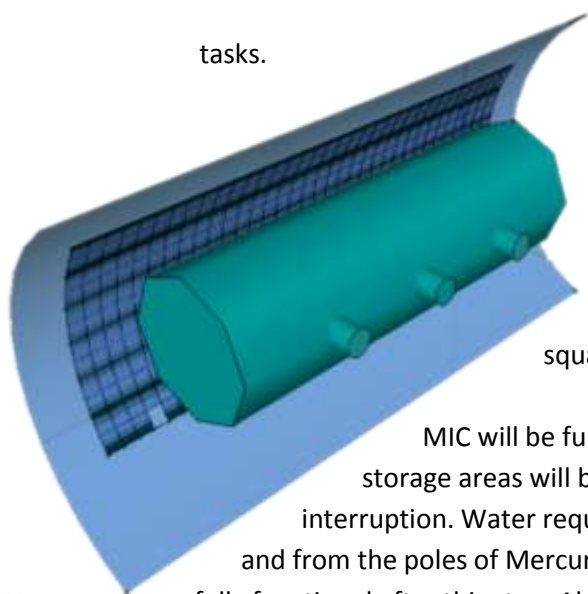
Construction sequence



tasks.

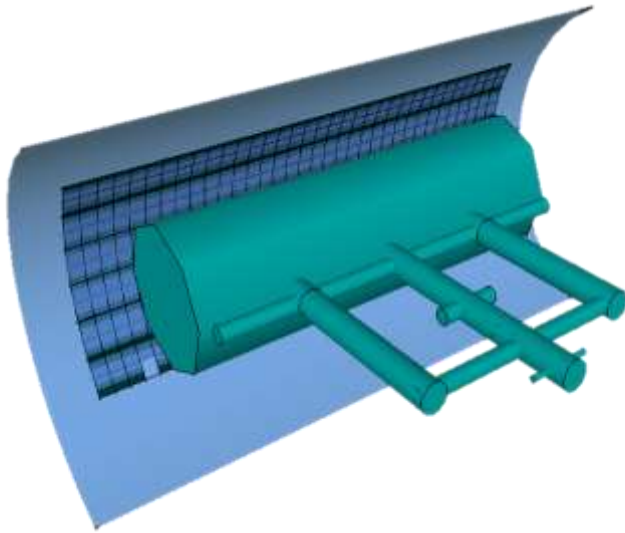
Phase 1 - Construction of Solar Shield and the control unit.

- i. The first step of this phase will be to construct the solar shield. Both the parts of the shield will be constructed (the opaque part and the translucent part). The solar shield is being constructed in the beginning, because our robots need protection from solar phenomena such as solar radiation and solar flares. But the robots building the solar shield will be protected (refer to section 5.1)
- ii. After the above step, the exterior of the control units will be constructed.
- iii. Now, the interior of the Control units will be furnished and pressurized. After this step, the control units will be capable of performing its routine

**Phase 2 - Construction of MIC.**

- i. In the first step of this phase, the exterior of the MIC will be constructed. This has been done to provide manufacturing areas of over 100,000 square feet, with over 60 foot ceiling.
- ii. In the next step of this phase, the interior of the MIC will be furnished and then pressurized. First of all, the energy storage areas will be installed, so that energy can be supplied without any interruption. Water requirements will be satisfied through imports from Earth and from the poles of Mercury (refer to 3.2.5). The Air management unit will also be fully functional after this step. Also the electronics industry will be set up, which will

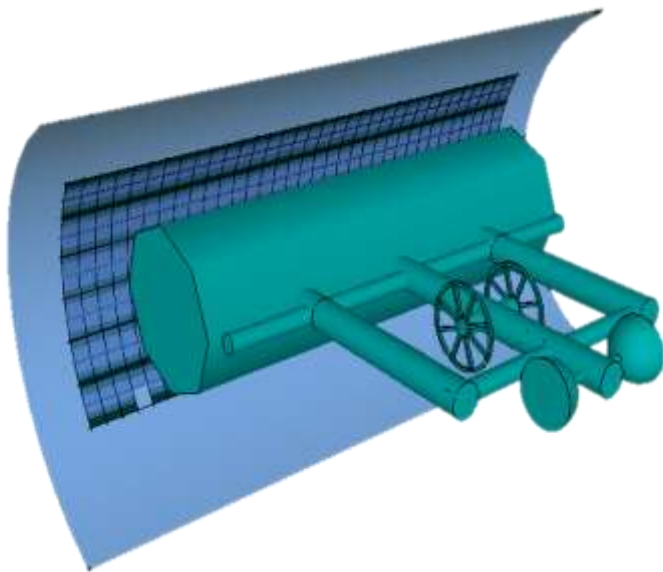
supply robots required for the construction process. But, the rest of the industries (listed in 2.1), will not be installed now. The MIC, at this moment, will support primarily the construction of the rest of Arkah. Once Arkah will be completed, the MIC will support other industries.



Phase 3 - Construction of all connectors and the SIC.

- i. Now, all the connectors of the entire satellite will be completed. This has been done to provide a preliminary skeleton of Arkah, which will facilitate in easy manufacturing. But they won't be pressurized.
- ii. After the connectors has been constructed, the exterior of the SIC will be constructed (excluding the domes). Since the domes won't be constructed, the SIC won't be pressurized.

Until this phase, we have seen that the Docking ports haven't been completed. Thus spacecrafts won't have a place to dock. But they can still supply goods or robots or personnel, through their airlocks.

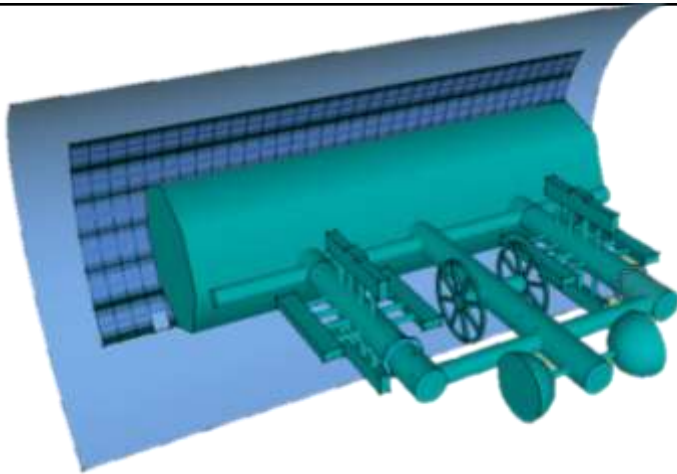


Phase 4 - Construction of the port and the domes.

- i. In the first step of this phase, the docking areas will be constructed, its interiors furnished, and it will be pressurized. This will open all the import and export lines. Thus personnel, goods, machinery, robots, etc can be supplied to Arkah, for further development.
- ii. Then, the domes will be constructed. And then the interiors of the SIC will be furnished. After this step, the SIC will be completely operational. Thus further manufacturing can take place at a faster rate.

Phase 5 - Construction of the Arkhomers.





i. In the first step of this phase, the exterior all the Arkhomers will be constructed. This also includes the 1 g accommodation for children.

ii. Then, the interiors of all the Arkhomers will be furnished and pressurized. And thus, the agricultural, waste

management, and the water management sectors will be functional after this phase.

Phase 6 - Construction of the observatories and initiation of artificial gravity

Construction technique in 3.3

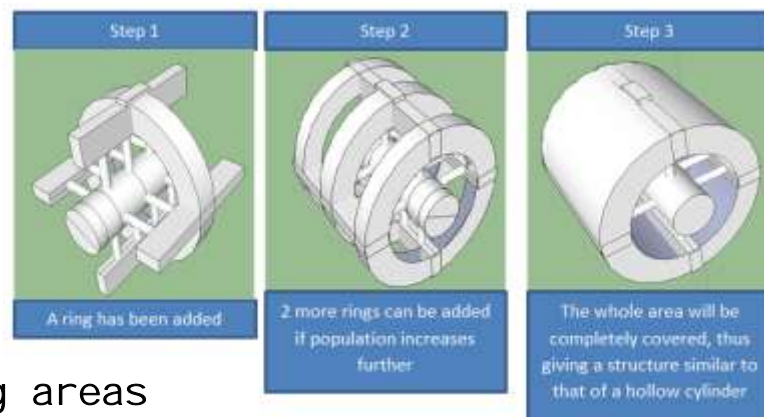
Method Of initiation Of Artificial Gravity-

In Arkah, *Magnetoplasmodynamic thrusters (MPD Thrusters)* are being used to initiate rotation and thus, initiate artificial gravity. Current is supplied to the thrusters by a 250-kJ capacitor bank that provides up to 30-MW to the thruster for 2 milliseconds. Though for a short period of time, the energy released is enough to start the rotation of the domes and the Arkhomers in our settlement. We would also be using, shock absorbing fluids near the tapered roller bearings since there is a chance that the settlement might undergo shocks when rotation is initiated in our settlement.

Future Expansion-

Population Expansion on Arkah is inevitable. For that, the residential areas can be expanded. We can also expand the agricultural or the water and waste management units, according to the needs.

The Arkhomers already have enough space to construct more homes. But, if even that is not sufficient, then we can follow the following steps.



2.4

Conditions for manufacturing areas

Arkah has all the facilities required for proper

manufacturing and refining of Reardonium. Thus, Reardonium refining and manufacturing would be performed in an environment which has got variable artificial gravity magnitudes ranging from 0g to 0.5g and a variable pressure range from vacuum to 20 psi.

The required gravity conditions are achieved due to the strategically positioned locations of Reardonium refining and manufacturing units in the settlement and by providing the required rotations per minute. For a 0g environment we have provided a special section in the Secondary Industrial Column (SIC). While for gravity magnitudes ranging from 0.3g to 0.5g, we have provided rotational domes with an rpm of 0.75 at the end of the SIC which have levels within them to provide various gravity environments.

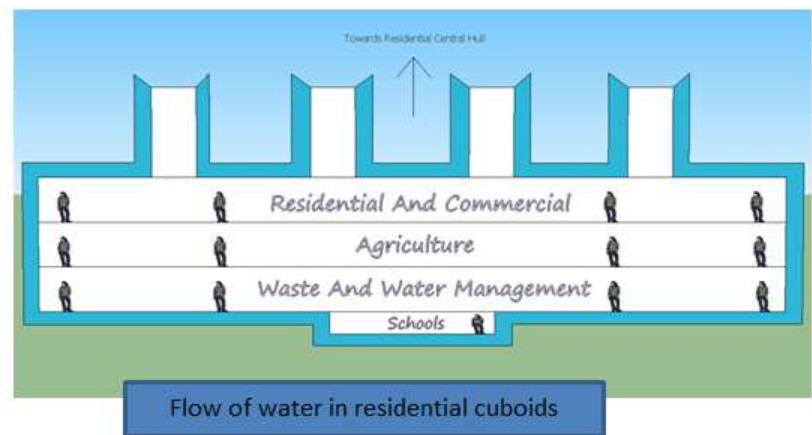


Variation in the atmospheric psi in the reardonium manufacturing units will be controlled by a vacuum pump. This vacuum pump will have its own air storage tank. It will have a regulator which will control the amount of air sucked into the tank and thus vary the pressure levels which will vary from vacuum to 20 psi, thereby controlling the pressure as required in the different processes of reardonium manufacture. And all this will be controlled by the Air Management Unit (present in the MIC).

2.5 Protection for human occupied areas

Protection by water: A 20 inch layer of water has been provided in the Arkhomers for the protection of Arkans Total volume of water used in all of the 8 arkhomers= 6557554291Litres

Protection by Solar Shields: Arkah's solar shield has been positioned in such a way that it protects the Arkahns from the harmful solar and cosmic radiations coming towards the settlement. It has an opaque and a transparent portion. The latter has been provided to allow natural sunlight to fall on the settlement. So wherever there is a window, Arkans will have access to natural sunlight. Materials like RD50 lead glass and Electro chromatic smart glass has been used for radiation shielding (refer to section 3.1).



Protection from Meteors: The same MPD thrusters which will be used for initiating rotation will be used for protection from meteors as the settlement will have the ability to pace up so to dodge the meteor attack.

3.0



OPERATIONS & INFRASTRUCTURE

3.1

Orbital Location and Materials

According to Newton's law of universal gravitation, every point mass in the universe attracts every other point mass with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Force of attraction between the Sun and the Space Station is given by-

$$F = G \times M_S \times M_{ST} / D^2 \quad \dots\dots\dots (1)$$

[MS = Mass of Sun; MST = Mass of Space Station; D2=Distance between them.]

If, the Force of attraction (F) between Mercury and the Space Station is also equal then,

$$d^2 = G \times M_m \times M_{ST} / F \quad \dots\dots\dots (2)$$

[M_m = Mass of Mercury; M_{ST} = Mass of Space Station; d2=Distance between them.]

On replacing the value of F from (1) we get,

$$d^2 = G \times M_m \times M_{ST} \times D^2 / G \times M_S \times M_{ST}$$

On replacing their values,

$$d^2 = 3.30200 \times 10^{23} \times (57910000)^2 / 1.98892 \times 10^{30} \text{ km}^2 =$$

$$(556758535.597208535285481567886) \text{ km}^2$$

d=23595.731 km Therefore , THE

distance between mercury and ARKAH IS **23595.731 KM**.

Formula =>

3.1.2 Orbital Location

Force of Attraction (F)	$G \times M \times m / d^2$ OR $d^2 = G \times M \times m / F$
Gravitational Constant (G)	$6.67300 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$
Mass of object 1 (Sun) (M _s)	1.98892×10^{30} kilograms
Mass of object 2 (Mercury) (M _m)	3.30200×10^{23} kilograms
Distance between the 2 objects (D)	57,910,000 km

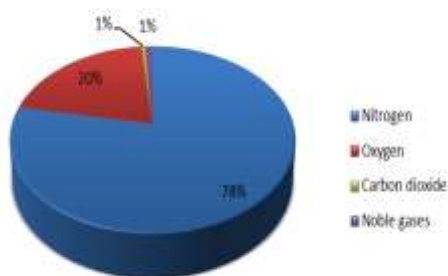
3.1.2 Materials

Material	Source	Use	Volume(m ³)	Density(kg/m ³)	Amount(Kg)
Silicon carbide	Mercury and earth.	Structural Base along with Reardonium.	11969753656	3260	39021396918560
Silica Aerogel	Silicates will be taken from Mercury.	Thermal insulation Radiation protection Absorbs infra-red radiation. Adhesive between layers.	150000	30	4500000
STF treated Kevlar 49	Earth.	Shielding.	93704	1440	134933760
Gallium arsenide	Gallium And Arsenic from Moon	Solar Panels (cells).	82008000	5910	484667280000
Nextel	Mercury Surface	Shielding.	93704	3900	365445600
Rd50 lead glass	Silicon will be taken from Mercury. Mercury will also provide Magnesium and aluminium.	Radiation Protection. Used as a transparent glass.	112195416	5050	566586850800
Reardonium	Mercury Mining Base	Structural Stability.	48126136273	7850	377790169743050
Carbon Nanorods	Carbon from 3200 Phaethon, Nickel from Mercury's core, Titanium from Mercury's surface.	Structural Support.	6596279	1400	9234790600
Electro chromic Smart Glass	Earth.	Used as a transparent glass. Also, In the making of solar shield.	56097708	2758	154717478664

3.2

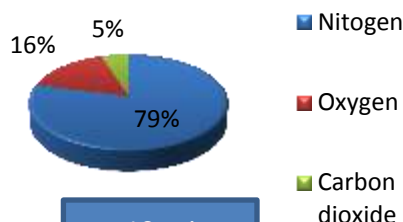
Basic Infrastructure

Air composition in residential sector



14.73 psi

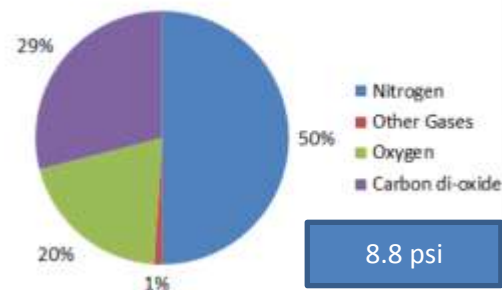
Air composition in industrial sector



10 psi

3.2.1 Atmosphere/climate

Air Composition in Agricultural Sector



8.8 psi

REPLENISHMENT OF GASES :

OXYGEN: Primary – Silicates obtained from Mercury (30% of Mercury's crust) will be used for oxygen production through electrolysis. This is a cheap and efficient mode of oxygen production.



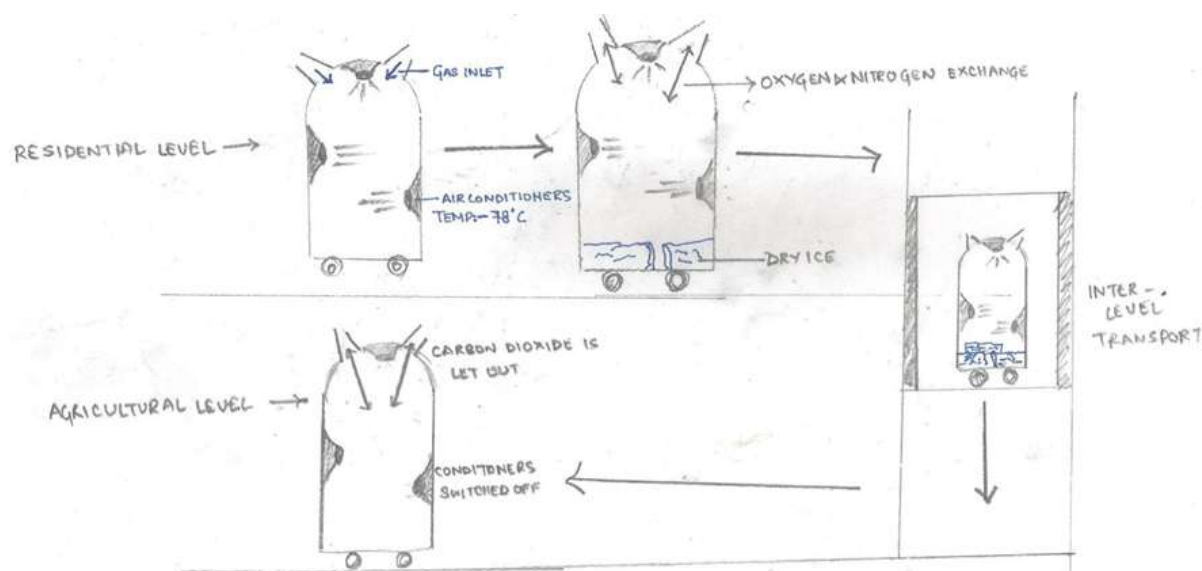
SECONDARY - oxygen will be provided to the agricultural sector and the residential sector initially from the earth. It will be transported in cylinders in the form of liquid oxygen. However when the life starts and goes on in Arkah then excess oxygen released due to photosynthesis from the agricultural sector will be extracted and then released into the atmosphere of the residential sector.

NITROGEN: Solely transported from the earth as Mercury has no supplies of nitrogen.

CARBON DI-OXIDE: Primary- electrolysis of carbonates which are abundantly available on mercury can provide us with carbon dioxide.

Secondary – carbon dioxide can also be obtained from the residential sector as well. Excess carbon dioxide can be absorbed from the residential sector and be transported to the atmosphere of the agricultural sector.

OTHER GASES- Other gases can be obtained from Mercury's atmosphere as well as imported from Earth.



Gas Fixation:

The imbalance created in the residential sector due to exhalation of CO₂ will be fixed by Pickabot which collects carbon as dry ice with low temperatures inside its container and then lets CO₂ to sublime when

come to Agricultural sector. As the Melting/Boiling temperatures of Nitrogen and Oxygen is -150 degree +, they will not be affected, and simply come in and go out.

Condition	Level	Method
Humidity	30% - 50%	Humidifiers
Temperature	Varies with season The temperature of the different seasons are :- Summer – 25 – 30°C Winter – 5 – 10°C Spring – 15 – 20°C	Air conditioners across the settlement will control the temperature of the residential as well as the commercial sector of the settlement. However the agricultural and the industrial sector will not be affected by this seasonal change. The agricultural will have a uniform temperature of 24 – 30°C. The industrial sector will have a uniform temperature of 20 – 30°C which will be ideal for manufacturing of reardonium.
Wind Speed	0-25 km/hr	It will be maintained by wind turbines fitted all over the settlement which will control the wind speeds according to the season prevalent in the settlement.

- Total amount of oxygen – 69618198768 cu.m
- Total amount of carbon dioxide – 21814053615 cu.m
 - Total amount of noble gases – 188611141.5 cu.m

- Total amount of air in the settlement – 435011006583 cu.m

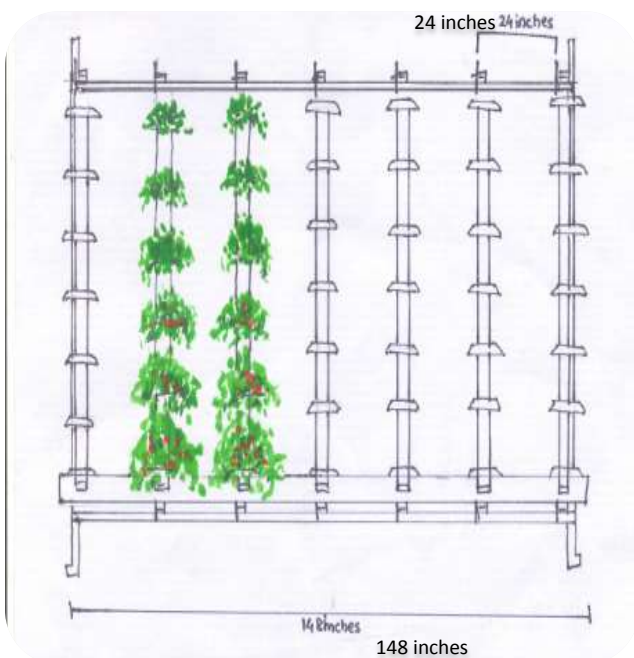
3.2.2 Food Production

FOOD in Arkah will be produced using the Vertical Aeroponic Growing System. This system uses an ultrasonic aeroponic fogger which creates fog using a drip system. The droplet size is between 5-50 microns. We will be using nutrient fog for thin root hairs and nutrient reservoir for tap roots. This combination creates an extremely efficient oxygen rich rooting environment.

MEAT PRODUCTION in Arkah will be done using specialized In Vitro meat production method/Meat printing. The process of developing *in vitro* meat involves taking muscle cells and applying a protein that helps the cells to grow into large portions of meat. Once the initial cells have been obtained, additional animals would not be needed. Moreover, one animal could provide more than a billion pounds of *in vitro* meat to feed Arkah's population with sufficient meat.

DAIRY PRODUCTS in Arkah will be Soya Milk based. It is a stable emulsion of oil, water, and protein, it is produced by soaking dry soybeans and grinding them with water. Soy milk contains about the same proportion of protein as cow's milk: around 3.5%; also 2% fat, 2.9% carbohydrate.

CROP	Tomato	Strawberries	Carrots	Wheat	Lettuce	Egg Plant	Total
REQUIREMENT/PERSON/YEAR	37.5	9.125	48.5	65.7	36.5	28.7	-
POPULATION	14200	14200	14200	14200	14200	14200	14200
TOTAL PRODUCTION	532500	129575	688700	932940	518300	407540	3209555



HARVESTING – Harvesting of food crops will be done by I-CUT from where the unpacked food products will be sent for packaging to the pack-bot using the conveyor belt.

PACKAGING – Packing of unpacked food products will be done Silicate Nano-particles, making bottles from nano-composites. A **packobot** will be used for this purpose.

STORAGE – Refer to section 3.2.9.

DELIVERY - Packaged food will be delivered to the warehouses via conveyor belts.

SALE - Selling of food will be done in retail markets. Home delivery will be done by **Deli-bot**.

Refer to 5.3 for automation services.

3.2.3 Electrical Power Generation

The main source of power production in for the settlement will be provided by solar panels which contain gallium arsenide. The type of photovoltaic cells used is Very Highly Efficient Solar Cells (VHESC). The area of the solar panels is approximately 14 square

miles which includes the 4 square miles required for reardonium manufacturing.

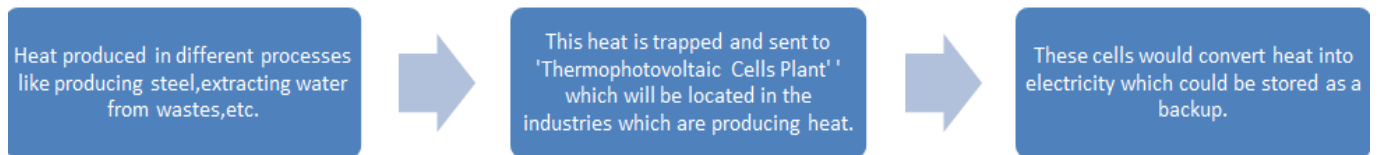
Backup:-

As a backup, the surplus energy produced by the solar cells will be stored in 'lithium iron phosphate (LiFePO4) Batteries'. These would be sufficient to meet the demand of the people for at least 10days. With this,

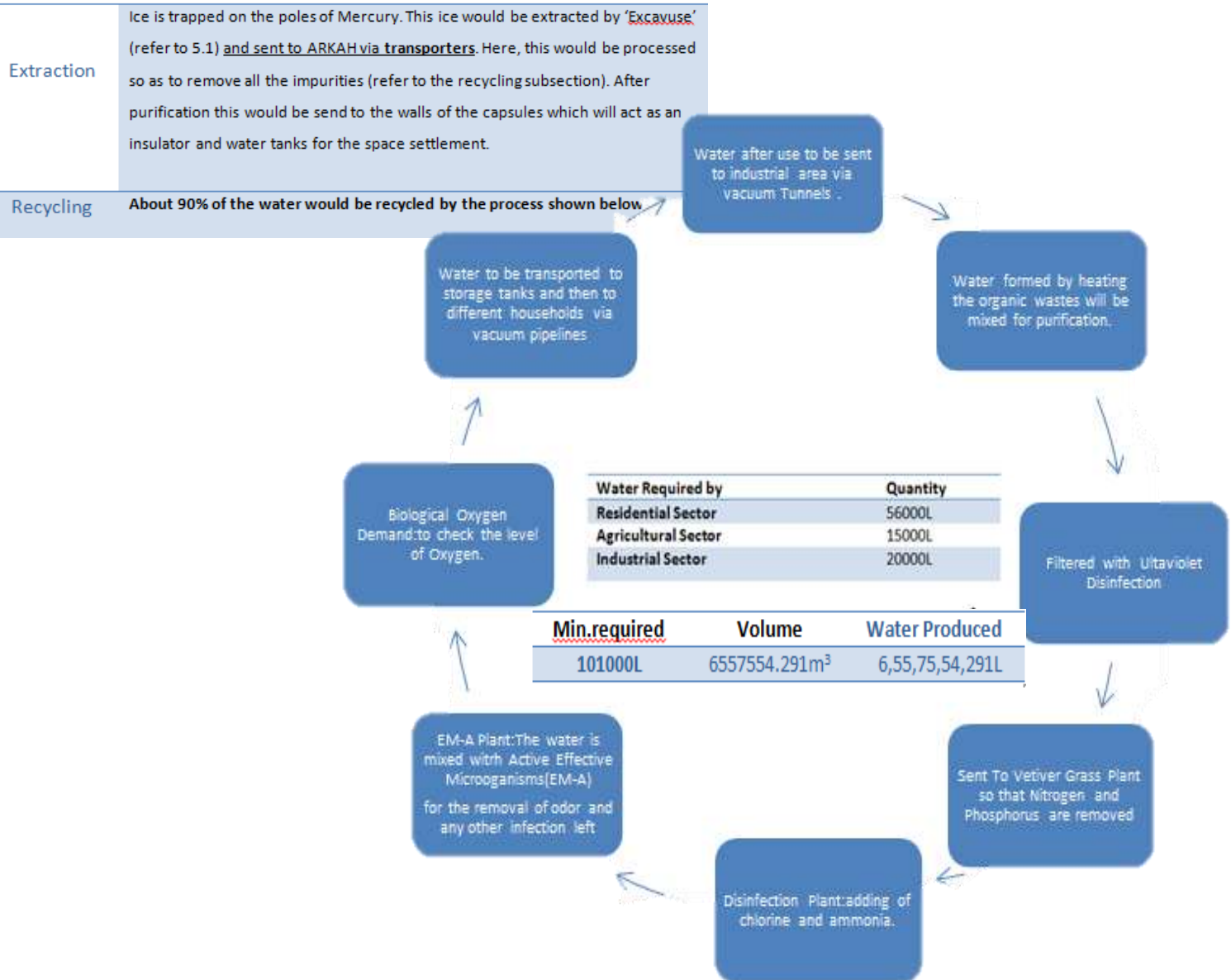
Amount of electricity	Electricity(in Kw hr/day)
residential sector	65242.8
agricultural sector	10785.528
day and night cycle	36500
water maintenance	45750
commercial sector	26783
Total electricity consumed in a day	185061.328
Total amount of electricity produced in a day	214945.54
Total amount of electricity produced in a year	78455122.1 Kw hr/year



energy will be produced by converting heat into electricity.



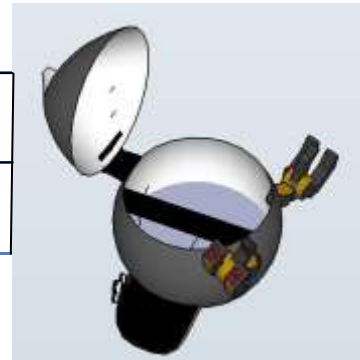
3.2.4 Water Management



3.2.5 Waste Management

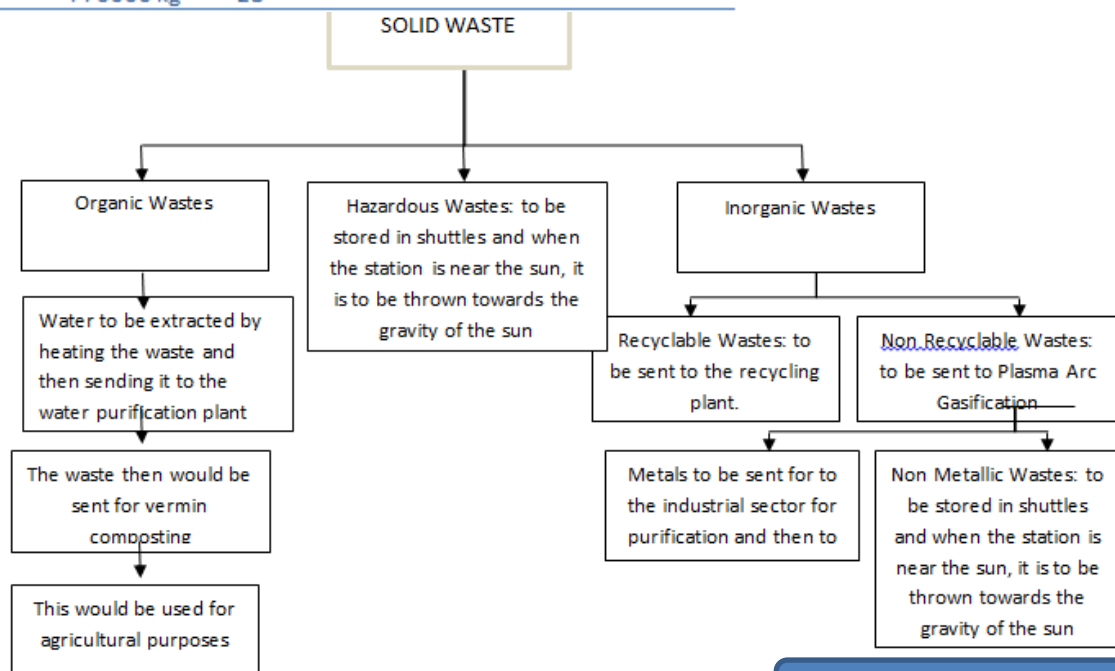
Collection Of Wastes

Residential Area and Agricultural Area	The waste will be collected by 'Dump-ty' (refer to 5.3) and it will dump the waste into the waste storage tanks in the commercial area. The tanks will be connected to the tunnels.
Industrial Area	The waste will be collected and then dumped to the tunnels via pipes where it will get mixed up with the wastes from residential area.



Sector	Quantity	Number of tanks	Dimensions	Volume of each tank
Domestic	420000 kg	8	3 x 4 x 4.38	52.5 m ³
Agricultural	150000 kg	8	3 x 4 x 1.56	18.75 m ³
Industrial	200000 kg	12	3 x 4 x 1.53	18.33 m ³
Total	770000 kg	28		

Waste produced by a person per day	30kg
Total domestic Wastes	420,000kg



3.2.6 Communication Systems

3.2.6.1 Internal Communication Refer 5.3 for network plan.

Fiber Optic Backbone(Wired LAN Technology) -

Efficient and fast , so no data loss

Central Modem communicates with residents through receiver ports

Any operation requiring extra bandwidth is provided an exclusive connection

Equipment Needed- Fiber Optic Cables are used .-

Speed-50 tbps

WiMAX((Worldwide microwave access)-

WLAN(Wireless Local Area Network) on Arkah: range up to 50 Km

Two Frequency ranges: 10 -60 GHz, 2 -11 GHz

High speed data transfers with efficient portability

Equipment needed-Cyber Systems: wireless "Hotspots", made by Routers via ceiling access points

Speed- 10 tbps.

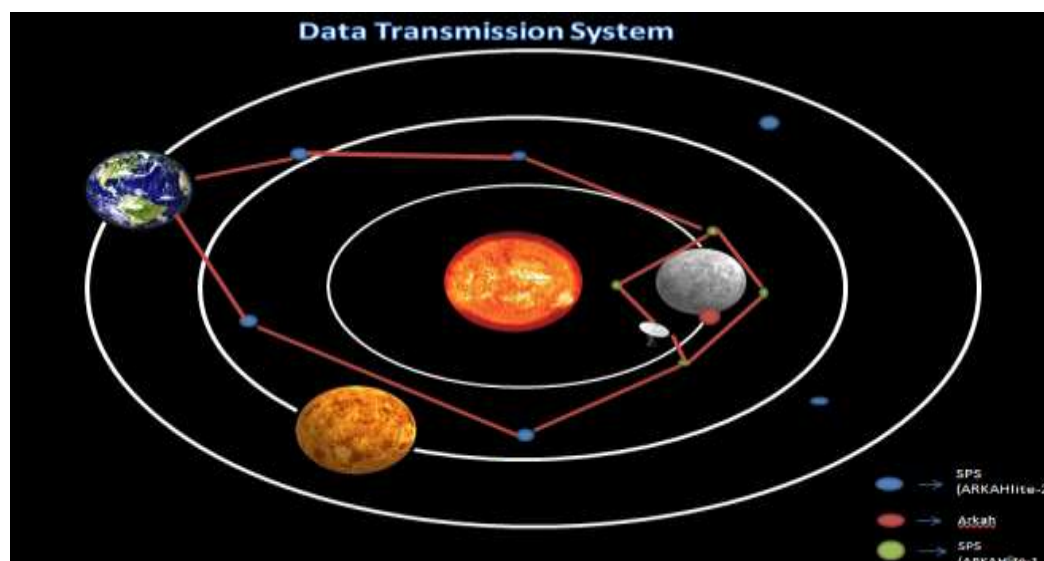
Speed-50 tbps



3.2.6.2 External Communication


Communication between Mercury and Arkah will be done using Ka Band Waves. (Arkahlite-2). The data will be transmitted from the communication antenna to the nearest SPS (Solar Powered Satellites) which will then trigger a data relay to transmit the data to the SPS closest to the curing base. Here, the data will be amplified and forwarded to the Curing-base.

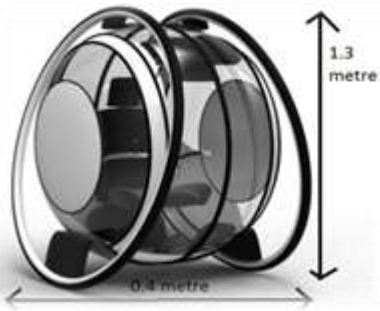
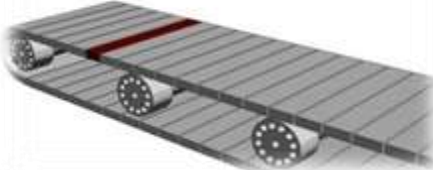

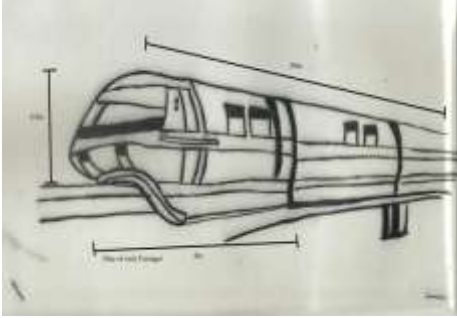
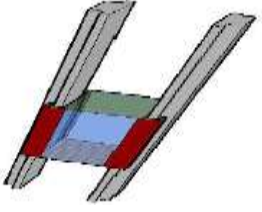
Communication between Arkah and Earth will be done using Laser Communication Technology (Arkahlite-1). The data will be transmitted first to SPS (Arkahlite-2) from where a data relay will be triggered forwarding the data to SPS in Arkahlite-1 from where it will be transmitted to the Earth.



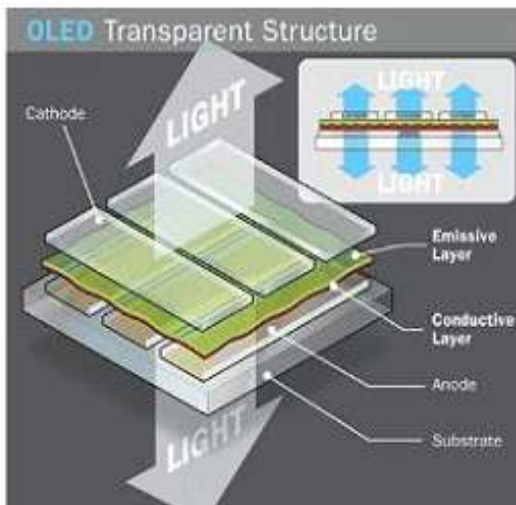
Name	Technology	Features	Satellites	Time, speed
ARKAHLite - 1	Laser Communication	<ul style="list-style-type: none"> Wavelength : 1500 nm Microwave radio frequency backup High bandwidth High data rates Discontinuous connection with Earth 	<ul style="list-style-type: none"> 6 Laser and radio equipped satellites. Solar powered satellites 	Data transfer speed – 6 tbps ^{mbps} Time – 16 -18 minutes, 2 way
ARKAHLite -2	Ka Band Waves	<ul style="list-style-type: none"> Frequency: 26.5-40 GHz Continuous connection with Earth 	<ul style="list-style-type: none"> 4 Laser and radio equipped satellites. Solar powered satellites 	Data transfer speed – 6 tbps ^{mbps} Time – 16-18 minutes, 2 way

3.2.7 Transportation Systems

Name	Design	Features	Quantity
Conventional-Cycling,Walking		<ul style="list-style-type: none"> Old mode of transport. Comfortable Also provides a method of exercise. 	5000 models for entire settlement.

Araba		<ul style="list-style-type: none"> Araba will be used by the Residents of Arkah for short-distance movement i.e supermarkets, seasonal parks etc. Provides a good and easy to use alternative to cycles so residents do not have to exert much energy. It is a two-seater transport and works on life PO4 batteries. Approximate Speed – 10m/s. 	2000 models for entire settlement.
Conveyor Belts		<ul style="list-style-type: none"> Used for transportation of Unpacked Food Products to the Pack-Bot from where Packed products are sent to the warehouses for storage. Cheap and efficient way of transporting food material. 	
Vacuum Transit	 Dimension = 300 x 15 x 15	<ul style="list-style-type: none"> Using higher pressure at stations and a low-friction, low-pressure chute, Gravity Vacuum Transit (GVT) compartments travel vertically at high speed, using pressure difference for acceleration and deceleration. Used for fast transportation in Industrial Sector. Works at 500km/hr. Efficient and cheap transport 	18 in total. 4 for MIC 3 FOR SIC 2 FOR DOMES 3 FOR CONNECTOR BETWEEN MIC AND SIC, RESIDENTIAL CONNECTORS 6 IN TOTAL FOR RESIDENTIAL CONNECTORS. (2 IN EACH)
Guchpam	 Dimension = 30 X 6 X 2.5	<ul style="list-style-type: none"> Monorail Transportation System for public transport in residential area. Each train will have 5 carriages carrying 200 people each. 	40 trains will be sufficient to meet daily transportation needs of the people of Arkah.
Maglift		<ul style="list-style-type: none"> It is totally controlled by electromagnets. It has high speeds It creates negligible friction. Thus it is capable of handling large loads. 	(16 in total. 2 in each cuboid.)

3.2.8 Day/Night Cycle



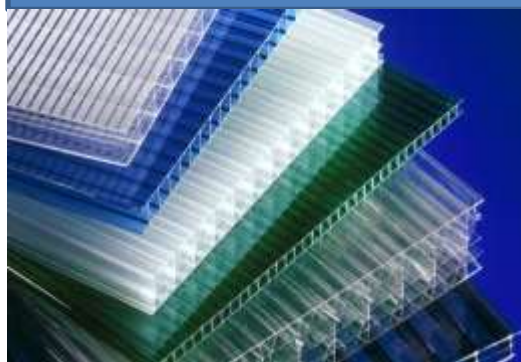
Transparent Organic LEDs

TOLEDs will be covering most of the area of the upper wall of the settlement, i.e., the floor below the water storage. Since they are transparent, they may allow natural sunlight and also emit their own light when required.

SOLEDs will be covering a minor area of the upper walls, at the two sides of the TOLEDs. These OLEDs are capable of emitting RGB colours. This property will be used for it to help provide red light during sunrise and sunsets and blue light during nights.



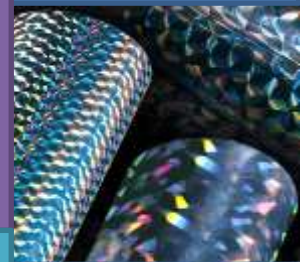
Stacked Organic LED



Polycarbon Lexan Sheets

These sheets will be complementing SOLEDs to diffuse the red and blue light, thus creating natural looking environments.

Our effort to accommodate residents and maintain psychological well-being is helped by Holographic films which create images of sun, clouds and the night sky.



Holographic Films



Fresnel Lamps

Plasma bulbs and Fresnel lamps will be used for artificial lighting purposes.



Plasma Bulbs

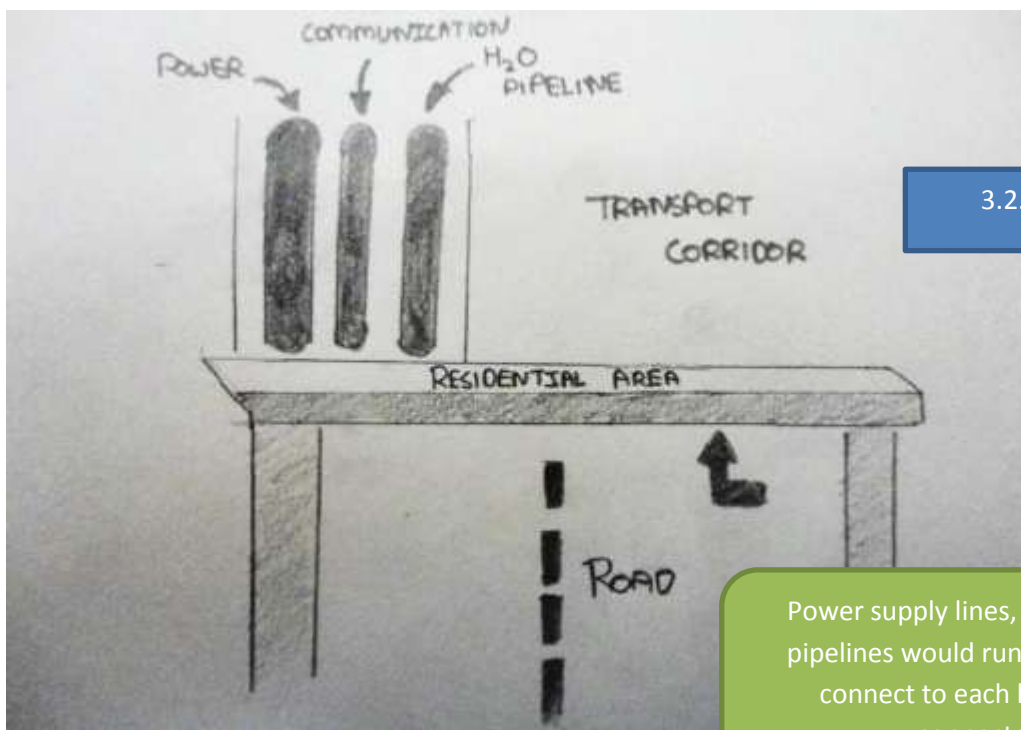
Time of Day	Duration	Light Intensity
Night	8 Hours	5 – 10%
Sunrise	4 Hours	10% - 50%
Mid-Day	4 Hours	50% - 100%
Afternoon	4 Hours	100% - 65%
Sunset and Evening	4 Hours	65% - 10%

3.2.9 Storage

FOOD	Packed food products will be transported to warehouses (20000m ²) via conveyor belts. These products will then be transported to the residential sector via <u>delibot</u> from where they will be sold.
WATER	Water will be first be transported to the 20inch layer surrounding the cuboids form where the water will be transferred to water tanks present in each level of the cuboids. The water used will be transported to the industrial area via tunnels. Refer to section 2.5.
WASTE	Waste will be stored in the tanks in the commercial area from where it will be transported to the industrial area via tunnels. The non-biodegradable inorganic wastes will be stored and then would be thrown towards the sun.

Power Storage in 3.4

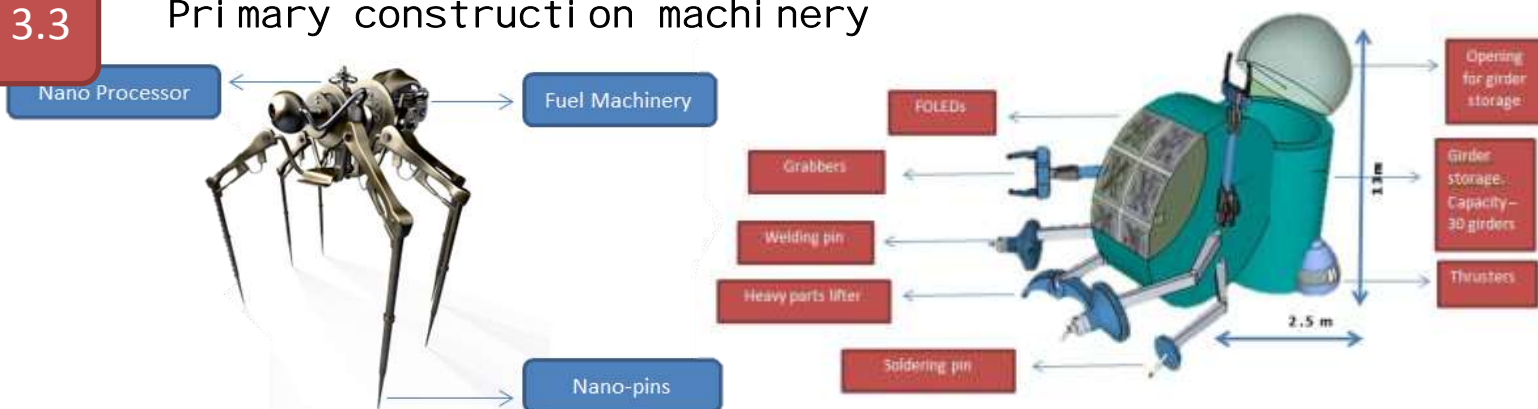
3.2.10 Routes



3.2.10.1 Transport Route

Power supply lines, Communication lines and Water pipelines would run alongside the road and as roads connect to each household, the lines would be connected to each household.

3.3 Primary construction machinery



Arkah will be constructed with the help of reardonium bars. They have been provided for structural strength. After the skeleton of the required component will be made from reardonium bars, nanobots will construct the rest exterior parts. Nanobots will be carrying molten reardonium with them (They may carry any other material according to the need). They will insert the reardonium molecule-by-molecule. This will prevent any kind of cracks while construction, making the structure even stronger. Since the solar shield will block the sun rays, the temperature on the side of the settlement will be cool enough to cool the molten reardonium. But, during phase 1, we cannot use nanobots, because the reardonium may not cool down due to direct exposure to the sun. Thus, after the placement of bars, we will place tiles to complete the solar shield. (for automation requirements in the construction process, refer to section 5.1)

During the phases 1 and 2 of the construction sequence, we cannot use construction components which are larger than 40 by 20 feet. Thus, the maximum height of the reardonium bars will be 40 feet. Also the reardonium tiles will be 40 by 20 feet.

3.4 Placement of solar panels

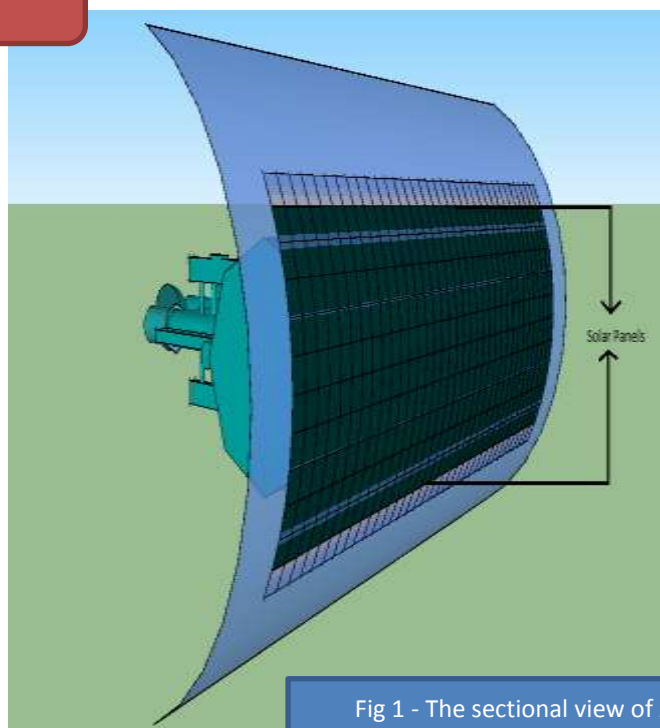


Fig 1 - The sectional view of Arkah showing the solar panels

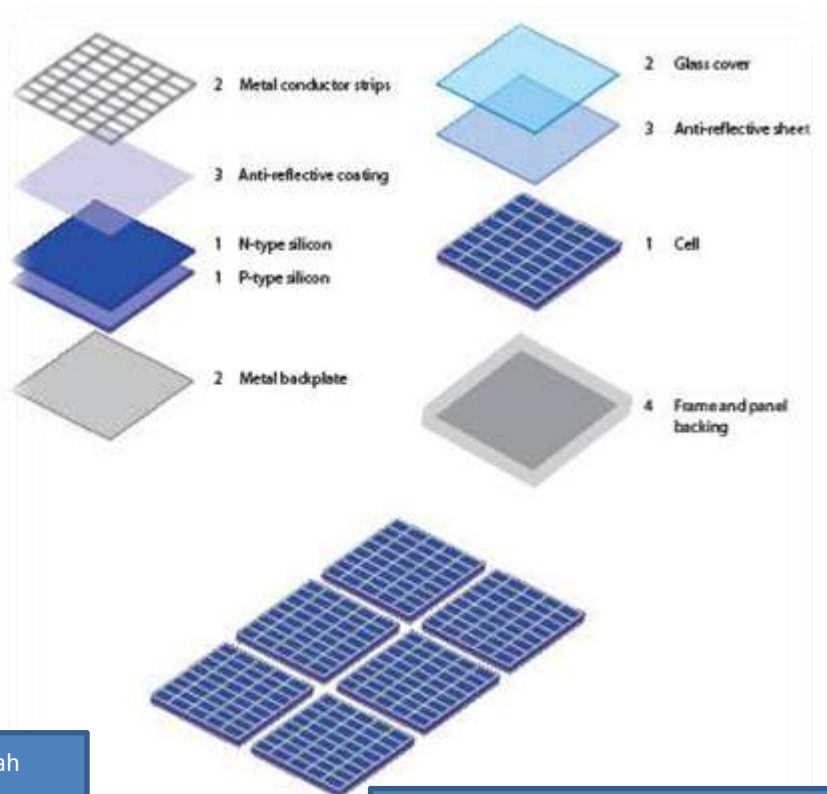


Fig 2 - Drawing depicting the different layers of the solar panels

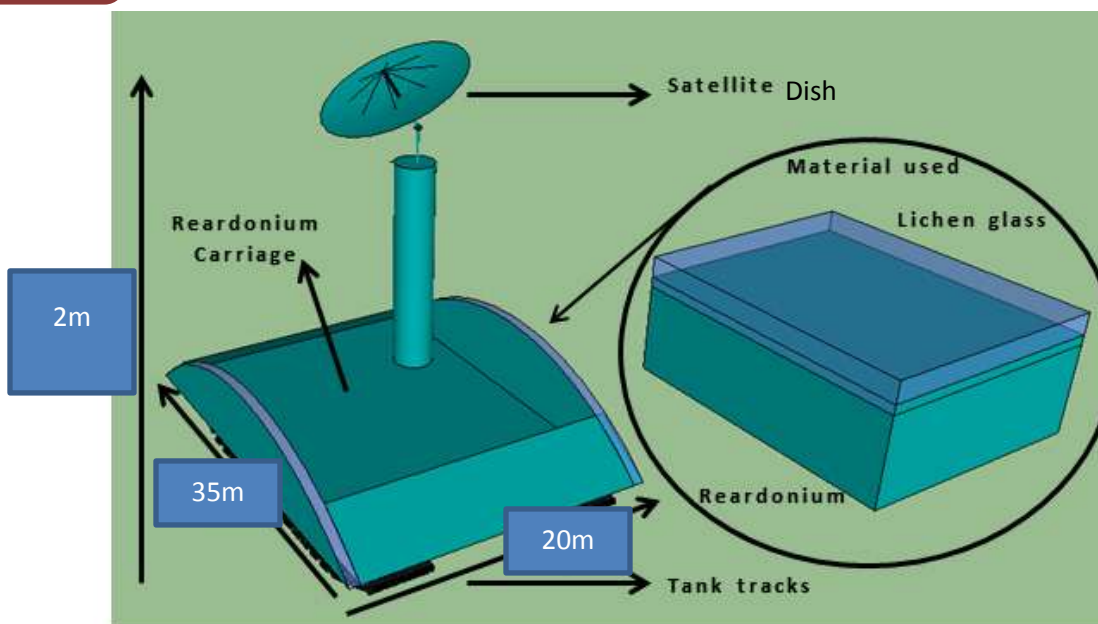
- Arkah has solar cells arranged in a rectangular form of dimensions 4 x 3.5 miles. The area of the solar panels is 14 square miles. These are arranged in a form which is optimum for electricity generation.
- The cells are arranged in a form on the solar shield to achieve optimum usage and maximum results.

POWER

The electricity which will be produced via the solar panels will be stored in Lithium iron phosphate (LiFePO₄) batteries. There will be 8000 batteries in total. They will be stored in the octagonal cylinder. Energy produced by Thermophotovoltaic Cells will be used in these batteries. The energy from these batteries can be used for a total of 10 days. The advantages of these batteries are :-

- They have high energy density of 220 Wh/L (790 KJ/L)
- They have iron as cathode which is readily available.
- They have high current and peak power rating.
- They provide full power until they are completely discharged, and recharge in just 2.5 hours.
- LiFePO₄ chemistry is also environmentally friendly — it's the least toxic of all the battery types.

3.5 Surface vehicle for moving reardonium parts



Reardon groove is the surface vehicle to move reardonium parts to get the desired material properties. It will be assisted by transporter for loading/unloading reardonium parts. (Refer 5.5.1)

4.0

HUMAN FACTORS

COMFORTING THE COSTUMERS



Fig 4.0.1 View of Mercury

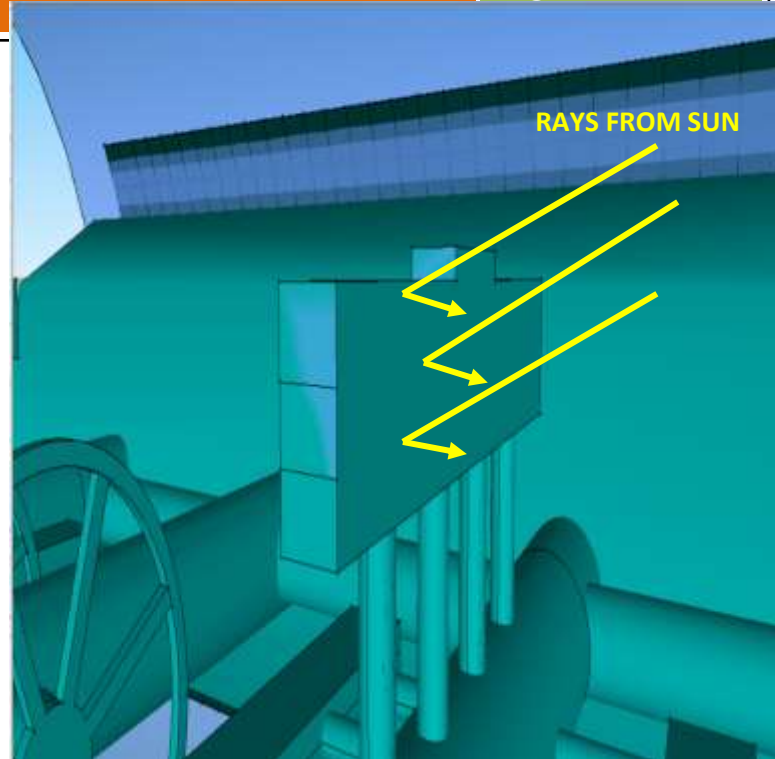


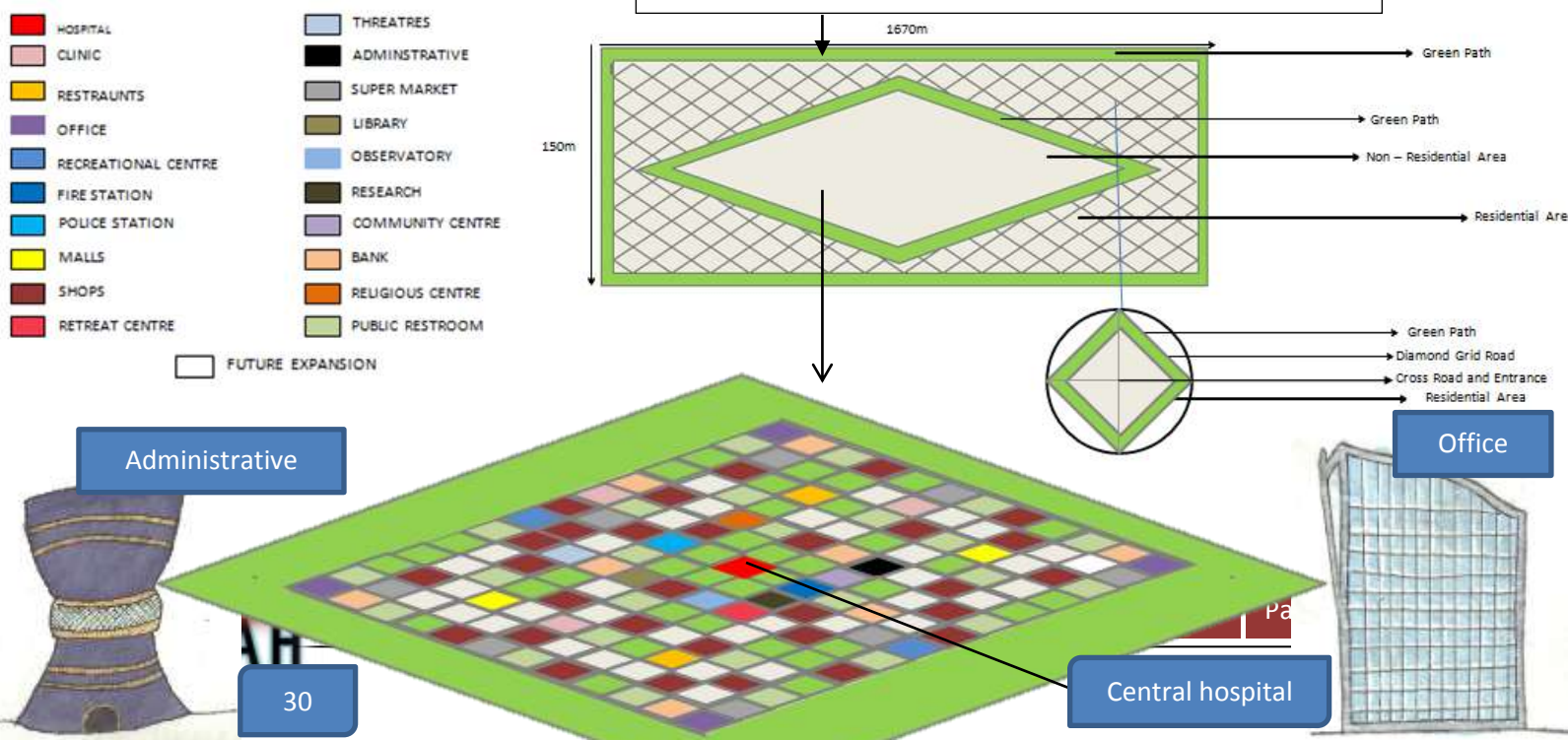
Fig 4.0.2 Natural Sunlight in settlement

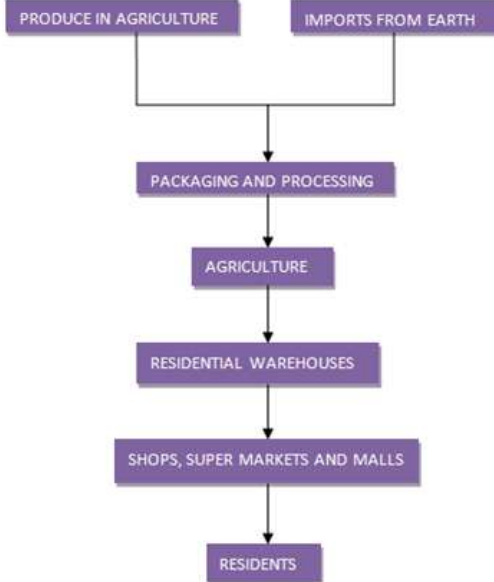
Requirement	Provisions
Sunlight	Sunlight is reflected into the residential; area via large reflectors placed outside the settlement
Views of surface of Mercury	Windows in residential establishments enable residents to enjoy views of mercury
Attributes of developed cities & countries	All types of amenities, entertainment and other services have been provided to the residents.
Minimum head turning	All roads are of diamond grid structure and there are no round corners in the residential and commercial sector.
Long lines of Sight	There are 8 residential sections which has breadth Of 150m and lengthOf 1670m which provides a very long line of sight and also reduces Claustrophobia.

4.1

Community Layout

Fig 4.1.1 Community Map/Layout with different sections and diamond grid paths and roads





PUBLIC DISTRIBUTION SYSTEM

CATEGORY	NUMBER
SHOPS	248
MALLS	16
POLICE STATIONS	4
FIRE STATIONS	8
SCHOOLS	8
COLLEGES	2
PUBLIC RESTROOM	210
HOSPITALS	4
HOTEL AND RESORTS	4
RESTAURANTS	16
OFFICES	32
CLINICS	26
RECREATIONAL FACILITIES	16
RETREAT CENTRES	8

Table 4.1.1 List of Services and Entertainment

CATEGORY	NUMBER
STUDIOS	4
THEATRES	10
ADMINISTRATIVE BUILDINGS	8
SUPER MARKET	64
LIBRARY	10
OBSERVATORY	10
RESEARCH CENTERS	10
COMMUNITY CENTERS	8
RELIGIOUS CENTERS	2
SPACE MUSEUM	2
BANKS	64



Table 4.1.2(A) & Table 4.1.2(B) CONSUMABLES AND CONSUMER GOODS

Consumables	Quantities
Toiletries and Cosmetics	3.5 kg
Medical Equipment	20 kg
Electrical Appliances	2.25 kg
Garments	13.5 kg
Stationary	10 kg
Miscellaneous	6.6 kg

Source Consumption per person per year

Meat:	
Fish	70kg
Beef	32kg
Chicken	73 kg
Soy Milk	180kg
Dry Products:	
1)Wheat	82.4kg
2)Rice	81.35kg
3)Sugar	38kg
4)Pulses	13.74kg
5)Almonds(import)	15.60 kg
6)Walnuts(import)	13.5kg
7)Corn	38kg
Vegetables And Fruits:	
Carrots	48.50kg
Lettuce	36.50kg
Peas	54.75kg
Potatoes	55.50kg
Tomatoes	65.50kg
Orange	36.50kg
Strawberries	9.125kg
Watermelon	32.12kg
Egg plant	28.67kg
Grapes	36.52kg
Tea & Coffee	2.80 kg

Table 4.1.3 (b) Variety of Consumables

FURNITURE DESIGNS

- 1)The function of THE BED (Refer Fig 4.1.4) is to modify the temperature of the room according to average body temperature of the person sleeping on it. Its one more unique feature is that it can also modify the hardness and softness according to the person's need.
- 2) The Chair (refer fig 4.1.5) senses the mood of the person sitting on it and is very flexible and modified very comfortably such that a person can easily reduce his or her stress and is very relaxing.

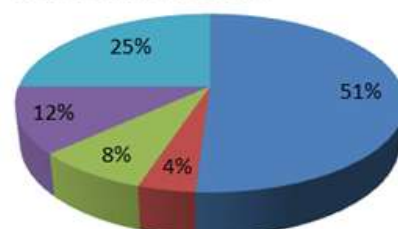
CATEGORY	NUMBER
VIP SINGLES	490 (280 MEN + 210 WOMEN)
VIP FAMILY(COUPLE+ SINGLE CHILD)	150 FAMILIES (450 PEOPLE)
VIP COUPLE	270 COUPLES (540 PEOPLE)
TOTAL	1480 PEOPLE (490 PEOPLE + 420 COUPLES)

CATEGORY	NUMBER
NON-VIP SINGLES	4410 (2520 MEN + 1890 WOMEN)
NON-VIP FAMILY(COUPLE+ SINGLE CHILD)	550 FAMILIES (1650 PEOPLE)
NON-VIP COUPLE	3230 COUPLES (6460 PEOPLE)
TOTAL	12520 PEOPLE (4410 PEOPLE + 3780 COUPLES)

Table 4.2.2 NON- VIP DEMOGRAPHIC BREAKDOWN

PERCENTAGE ALLOCATION OF AREAS

RESIDENTIAL	NON-RESIDENTIAL	GREEN PARKS
FUTURE EXPANSION	ROADS AND PATH	

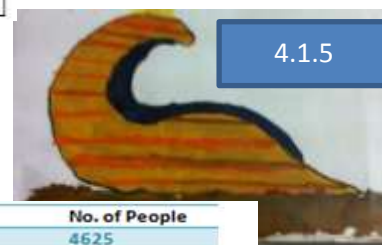


Occupation	No. of People
Engineer	4625
Medical	1075
Industrial(only for human monitoring)	100
Corporate	1450
Officials	2800
Public Servants	1650
Others	2300

Table 4.2.3 OCCUPATIONAL BREAKDOWN

CATEGORY	AREA	NUMBER
Design 1	1100 SQ. FT	490
Design 2	1000 SQ. FT	4410
Design 3	1400 SQ. FT	420
Design 4	1300 SQ. FT	3780
TOTAL		9100

Table 4.2.4. NO. OF HOUSE



Demographics

The people of Arkah are divided into VIP & NON-VIP on the basis of their pay scale, skills and occupation. About 10% to 20% of each category is VIPs

Population Breakdown

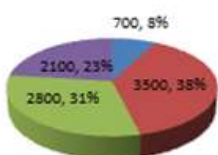
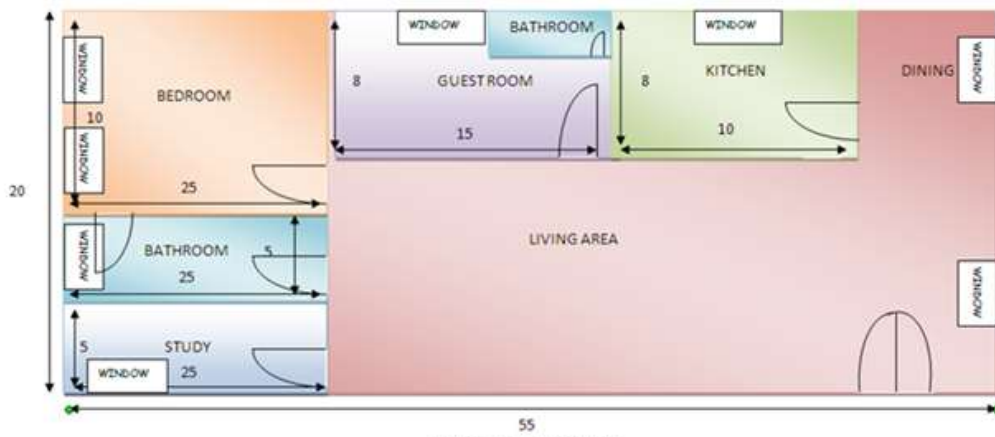


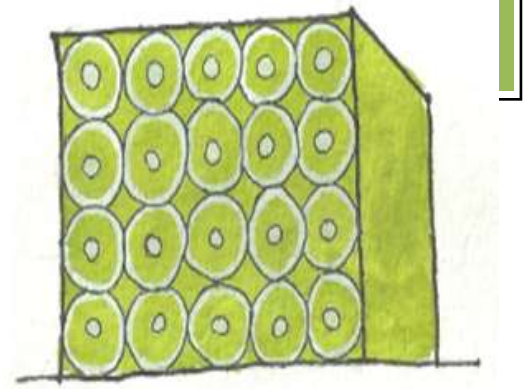
Fig. 4.2.1 Demographic Breakdown

- Families
- Couples
- Single Men
- Single Women

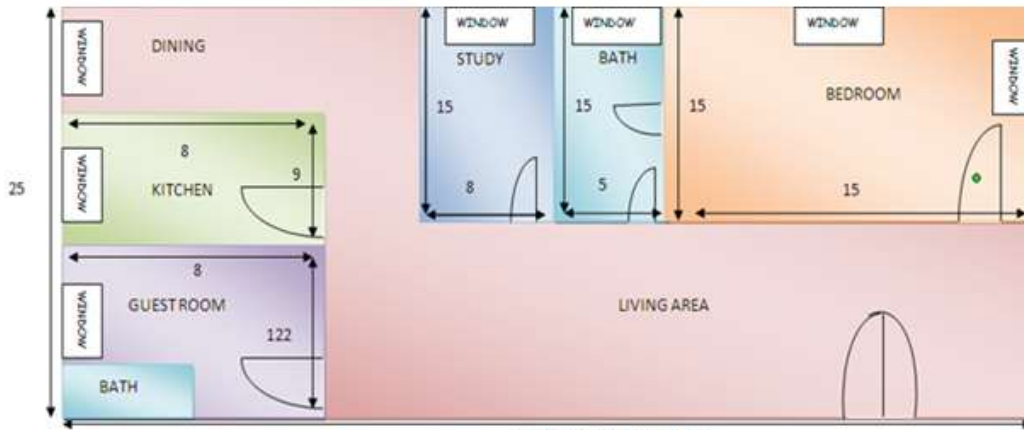




INTERIOR DESIGN 1



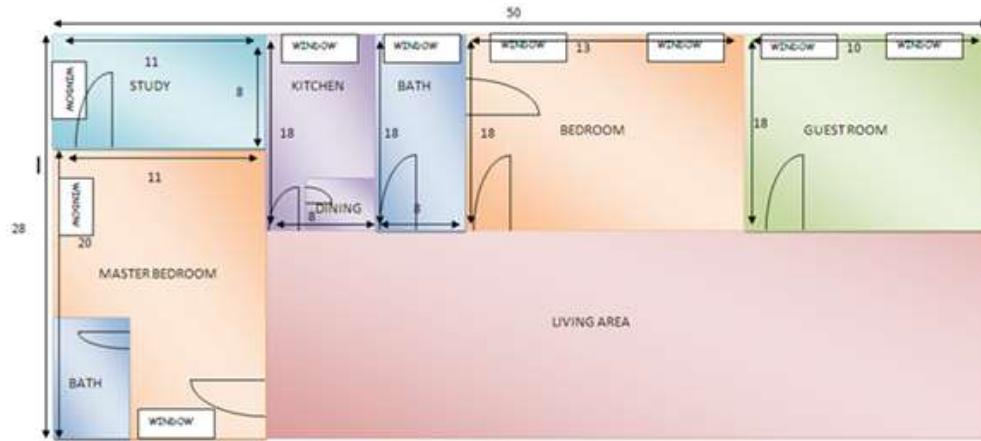
Exterior DESIGN 1



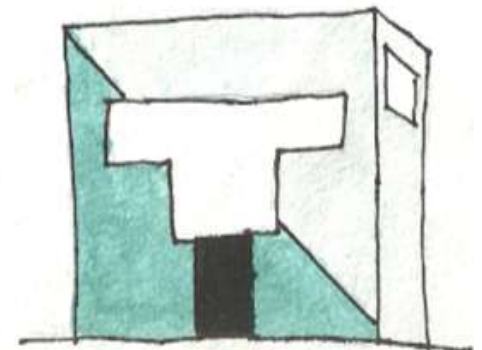
INTERIOR DESIGN 2



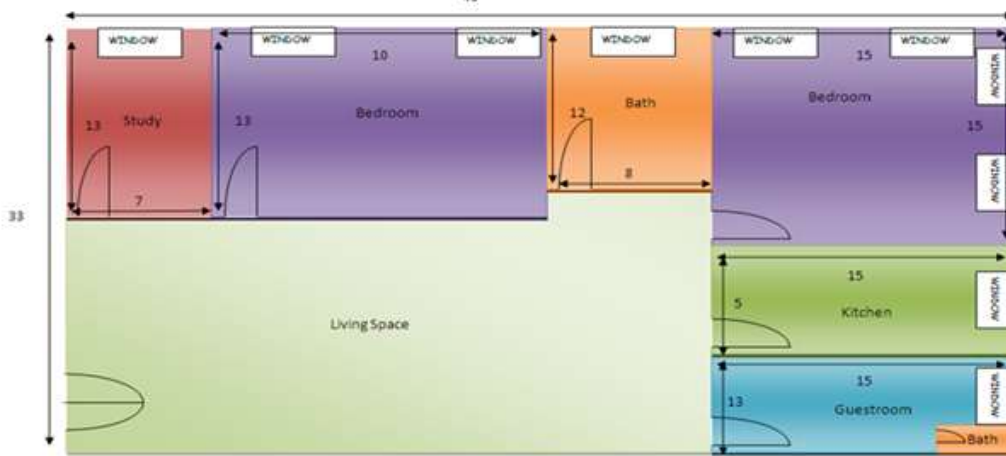
Exterior DESIGN 2



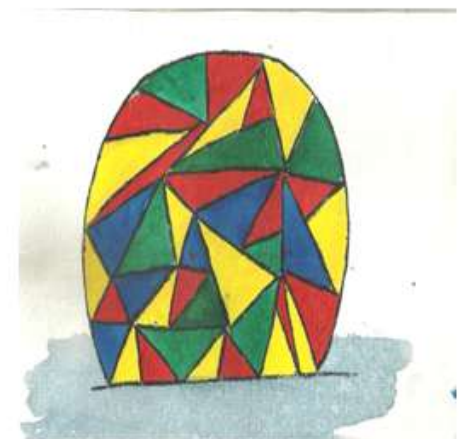
INTERIOR DESIGN 3



Exterior DESIGN 3



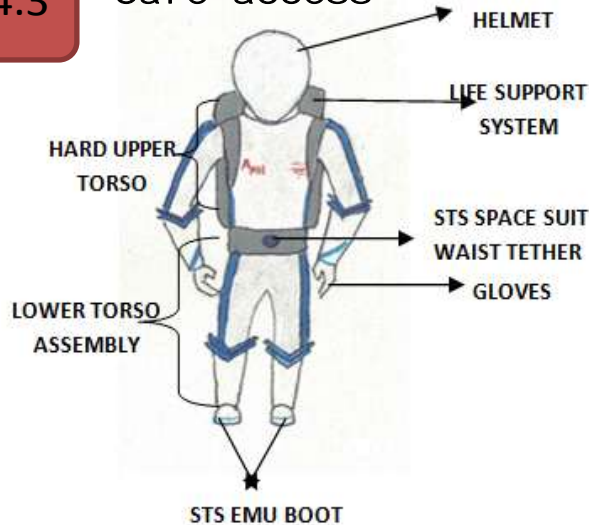
INTERIOR DESIGN 4



Exterior DESIGN 4

4.3

Safe access

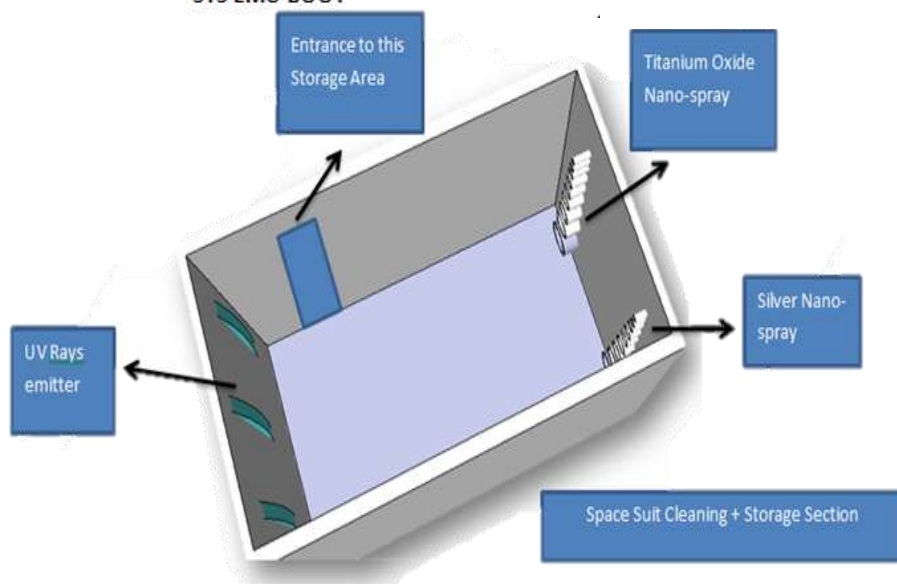


Arkah has a requirement of 1200 Hard Shell Spacesuits which are required when humans go out into space or on mercury for human monitoring of reardonium parts. THESE ARE MAINLY REQUIRED FOR EXTRA VEHICULAR ACTIVITY. It provides shielding against UV radiations and protection against micrometeoroids. It can also operate at higher pressures which would eliminate the need for an astronaut to pre-breathe oxygen to use a 4.9 psi space suit before an EVA from the 14.6 psi space shuttle as astronauts currently do.

Features of the Spacesuits-

1. The spacesuits are made of upper cortex of the lichens which will provide safety against the solar flares and radiations.
2. These suits are cleaned automatically once the astronaut opens it in the 2nd segment of the Airlock.

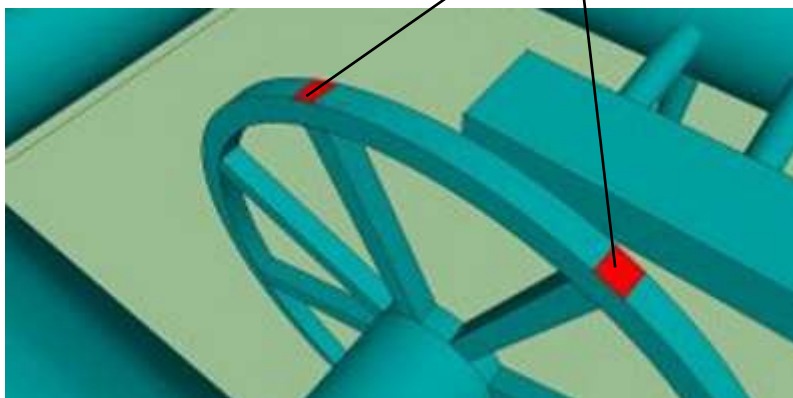
4.3.1.2 Spacesuit cleaning



Once the person opens his suit in segment 2 the suit automatically goes into the storage. Here the spacesuits are cleaned by Titanium Oxide and Silver Nano spray. Titanium Oxide and Silver particles are “photo-catalysts” that have the ability to turn UV rays into energy to break down the molecules of dust/dirt and thus remove it. Hence, the next time the person wears the space-suit, it is as white and clean as it can be.

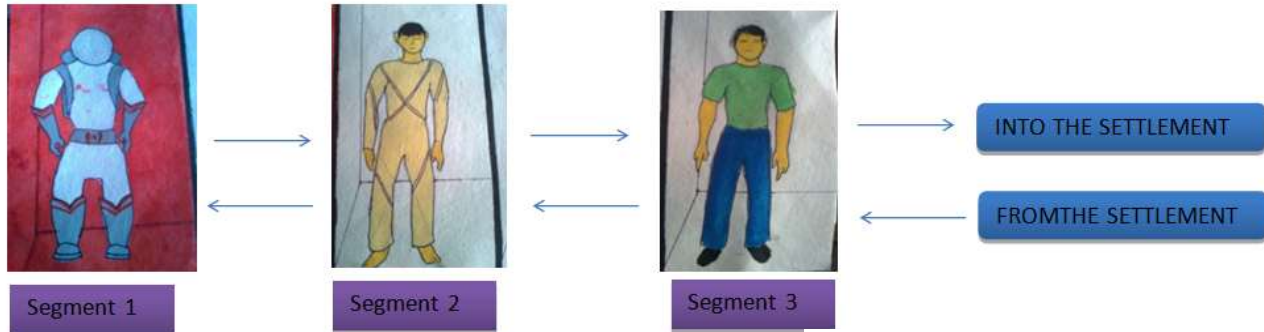
4.3.2 Airlocks

Illuminated Docking ports



- These are present at the Docking ports and the connectors which connect the industrial, residential hull and the central hull and the isolated section.
- To enhance visibility the exterior of the airlocks will be artificially illuminated.
- There are three sections of the airlock whose working has been shown below.

SEGMENT	WORKING
Segment 1	<ul style="list-style-type: none"> The Airlock is illuminated artificially. Once the Astronaut enters the Airlock and it gets sealed and then oxygen is flushed into the room. After oxygen is flushed into the room the white light turns on automatically, this is a signal for the Astronaut that he can take off his space suit.
Segment 2	<ul style="list-style-type: none"> Once the Astronaut moves from section 1 to section 2 there he gets air bath which helps him clean off the dirt. The Space Suits are stored in the second segment so that while going out from the settlement they can wear their spacesuits easily without any harm to their body.
Segment-3	<ul style="list-style-type: none"> In segment 3 the man wears his normal cloths and move into the settlement with no dust particles on his body.



Identification/Detection

- Presence of hazard detection systems in public and commercial areas.
- Presence of Robocop at crossroads

Warning System

- Audio visual warnings for humans on their wrist computers.
- The hazard detection system would alarm the robots to come to action.

Mitigation

- Relocation of robots. The humans are sent to the isolation chamber where all facilities have been provided till the hazard is solved.

Buffer Area

- Areas which will be under impact, in less than 20 minutes in off limits and all robot and human activities have been rescheduled.



FIG 4.3.2.2 WORKING OF THE DIFFERENT SECTIONS OF THE AIRLOCK

Step	Action
1	If the residential section gets depressurised the airlock opens with a audio visual alarm and the walls start to blink.
2	The people start moving towards the isolation chamber.
3	After people have moved into the isolation chamber the airlock gets sealed.
4	After the residential section gets re-pressurised the airlock opens, with walls turning normal.
5	People go back to their residential area.

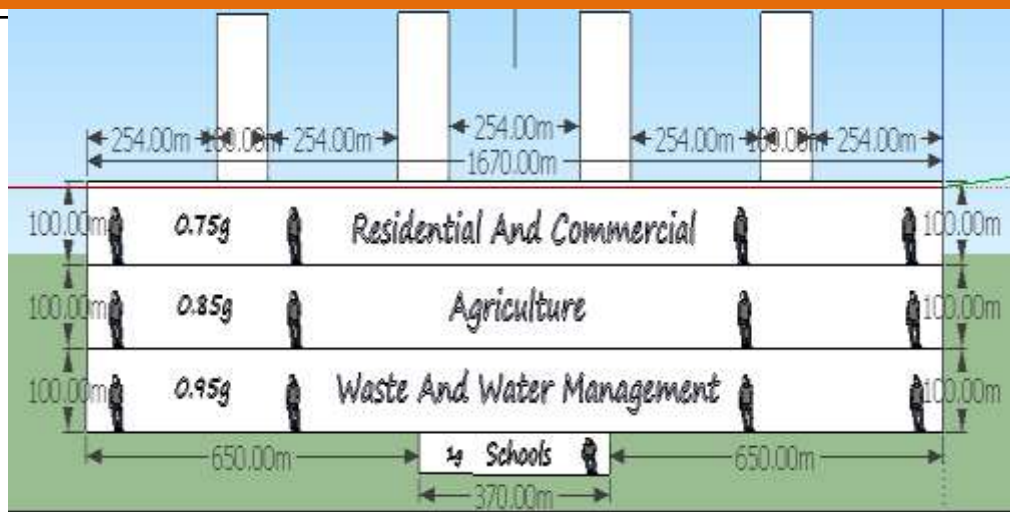
LOCATION	Gravity	RADIUS
Education Hub	1g	1000m
Residential Hub	.75g	750m
Agriculture Hub	.85g	850m
Waste Management Hub	.95g	950m

4.4

Provi si on of gravi ty

The varying acceleration due to gravity is possible as the rotation per minute (RPM) of the residential cuboids/domes is same, therefore with different levels with varying radius (from Residential cylinder) the value of gravity also changes.

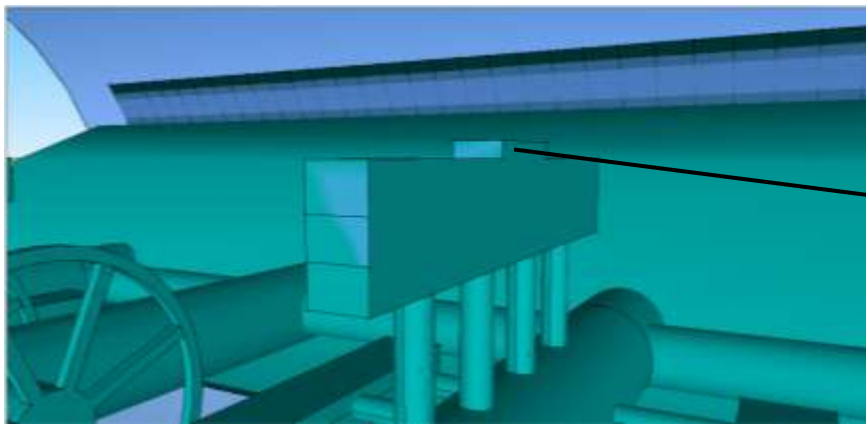




1g AREA FOR CHILDREN

The Arkah Primary School and College is located in the 1g area which is outside the residential area in the educational hub. This will facilitate the growth of children, where children will spend atleast 6 hrs a day. The normal school will work 5 days a week and the other days there will be extra activities in the school where children will spend 3 hrs a day. There are also other facilities like libraries, research centers, observatories and museums etc. where the children can spend time and enjoy.

1g Area for children (Educational Hub)

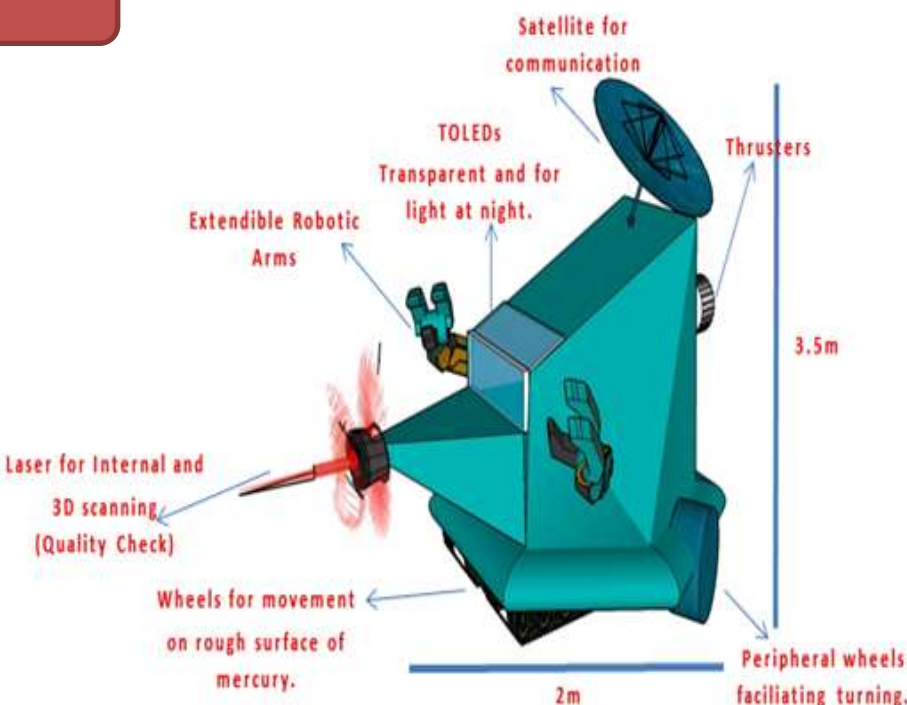


4.5

Surface vehicles for human inspection missions

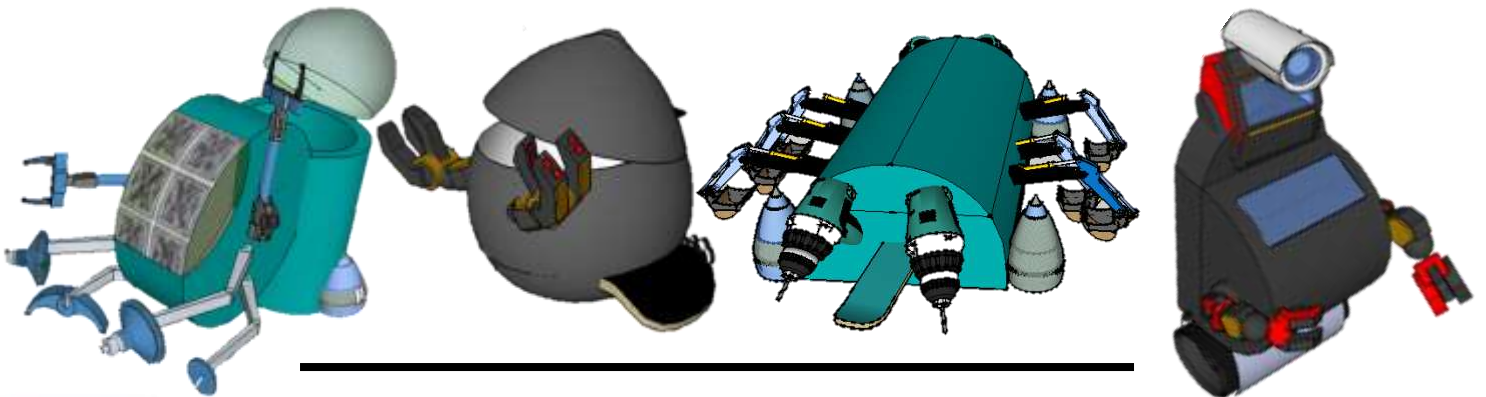
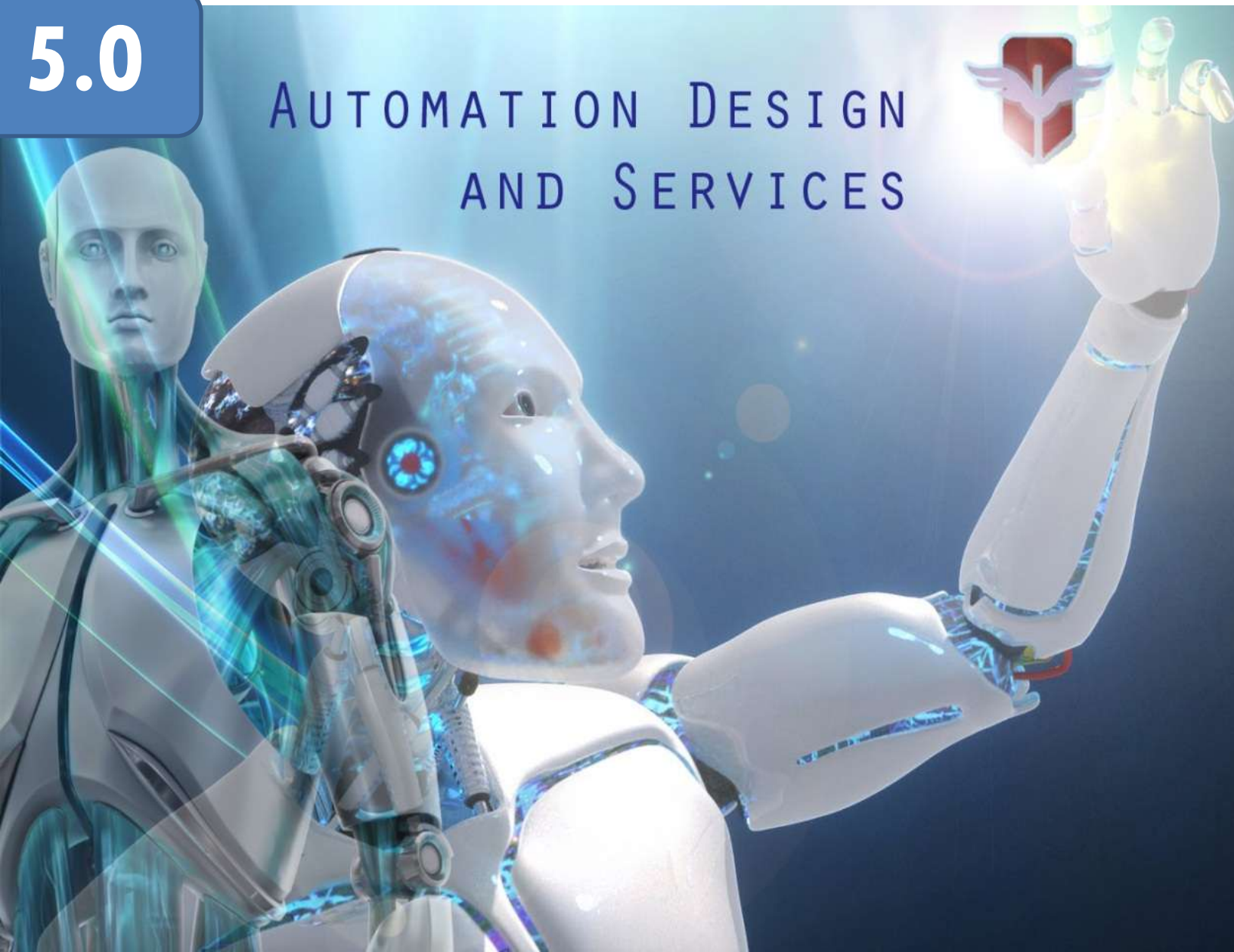
Features of the Surface vehicles (CROWER) –

1. Dust resistant surface
2. Infrared in the front portion for quality checking of reardonium
3. Works outside the 10 degrees terminator longitude.
4. Has a thruster which flies to get connected to the docking port for safe access of humans.
5. Specific storage area for food and water.
6. 360 degrees turn and view.



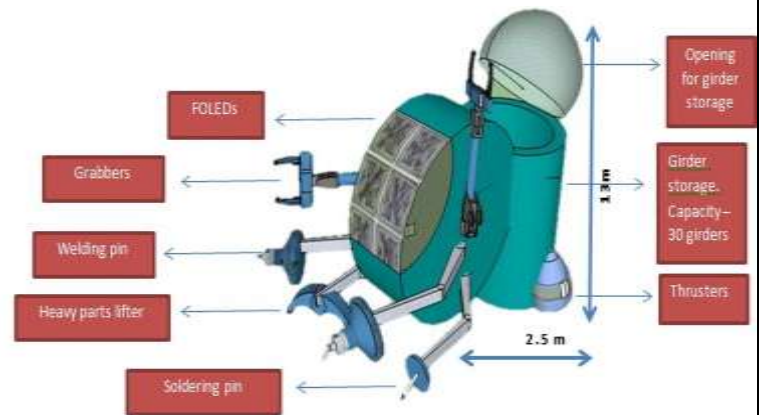
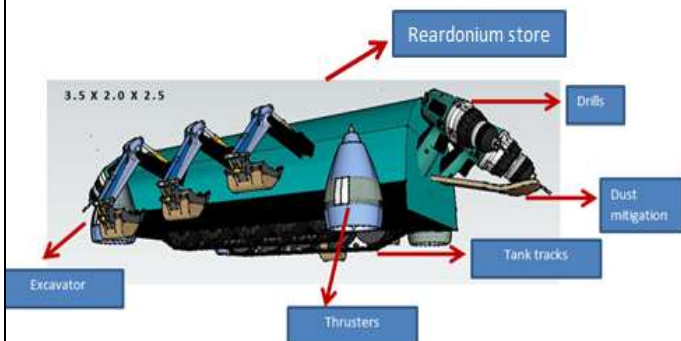
5.0

AUTOMATION DESIGN AND SERVICES



5.1 Automation for Construction

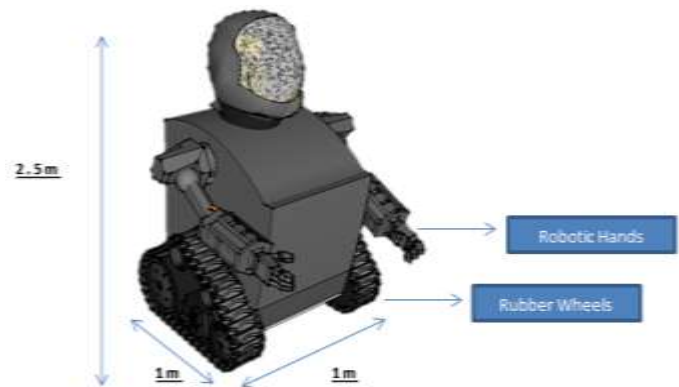
5.1.1 Excavuse: 1) Movement: Tank tracks for movement on the mercury surface and four rotatable thrusters for lifting itself up to the orbit. **2) Operation:** Six excavating hands on the 3.5m long side, four drills on the 2m long side helps it to mine and excavate. **3) Dust resistant:** A positively charged reardonium plate on the 2m long side helps mitigate the dust since all the dust (being ionic) get accumulated on this plate, and thus not interfering with the operations. Assisted by Transporter.



5.2.2 Constrow: It is equipped with eight hands, two grabbers, two welding pins, one heavy parts lifter and one soldering pin. All the eight are 1m long and 360 degree rotatable at all their joints. Its design helps it in carrying girders from the surface of the mercury to the construction base in the orbit and is equipped with thrusters to help in its moment. A part of its front is made up of Flexible Organic Light Emitting Diode over the reardonium metal to help construction when the natural sunlight is not available. This feature will be of use, once the peripheral systems need to be built behind solar shields.

5.2.3 Dwarf Constrow: It will be doing the construction job by "dipping" its **nano-pins** in the molten reardonium, transporting itself to the construction base in the orbit, and then

constituting molecules together, over the girders forming layers of reardonium. This process of construction will be advantageous because, there will be even a "nano-space" between two reardonium particles, thus giving a more solid structure with less chances of a hull breach. Its **nano processors** would help it to communicate work with other Nanobots, thus speeding the process and bringing in more efficiency. The fuel machinery will be carrying the fuel needed to run the robot. The robot will be powered by sperms, which would mean one of the most wasted materials put to use. Sperms would provide the perfect fuel for the nano bot as other fuels pose a difficulty to be broken down to the nano-level.



5.2.4 Interno: Its extendible robotic hands are able to lift heavy materials, and since they are rotatable at every joint, it makes them flexible to lay different things in an efficient way.

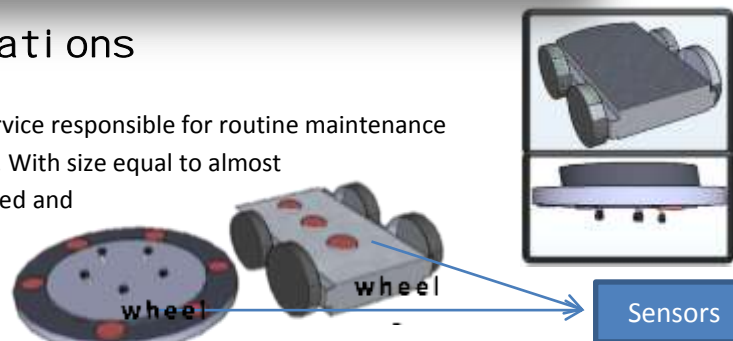
Name	Use	Number	Dimensions (m)
Excavuse	Excavating reardonium, transport it and also deliver it to construction base.	60	3.5 X 2.0 X 3.5
Constrow	Primary construction robot. For laying reardonium bars or support beams.	240	2 X 2.5 X 13
Dwarf Constrow	Main construction robot. For forming layers of reardonium over support beams molecule by molecule	850	Nano-sized
Interno	For internal finishing and construction like building buildings, painting and laying pipes	200	1.0 X 1.0 X 2.5

5.2 Types of robots and specifications

5.2.1 Tri-sensor bots and Penta-sensor bots – Automation service responsible for routine maintenance of the settlement running all along the internal walls of Arkah. With size equal to almost that of palm top, they are compact, take less space to get stored and provide fast movement.

Number – They will be 450 in number


Dimensions – 20cm X 10cm X 5cm



5.2.2 Automation Systems for Repairs

Internal Repairs	Any breach on the inside of the settlement will be communicated to the control unit by the sensors on the wall, which will in turn instruct the automation to come in action. The bots will be equipped with adhesives and other mechanical products and repair the breach. Time taken – 70 seconds.
External Repairs	Any breach on the exterior of the settlement will be repaired the same way as repaired on the internal side. The automation taking action will be equipped to combat extreme environments and solar flare activities. The external body of the automation will be coated with polyethylene foam bonded with reardonium metal with the help of adhesive films. Time taken – 3 minutes

5.2.3 Automation Systems for Safety

Automated Assistance	Though all the labour work would be done by Automation Systems in Arkah, minimal manual labour would be required in areas such as law enforcement and engineering. These would be provided with Automated assistance in order to nullify the possibility of flaws.
 Security	<p>Authorized and Private places would be provided with high level security for personal access. Such security measures may be cumbersome to use in Public Places, which will rather be provided with Exteroceptive Sensors. A common understanding to these systems would be Automated Security Guards. Exteroceptive Sensors will be used at entry and exit. The following are its features:</p> <ol style="list-style-type: none"> 1. Blue laser rangefinder senses up to 360 distance readings in a 180-degree slice; 2. 24 round golden ultrasonic sensors sample range readings in a 15-degree cone; 3. Ten touch panels along the bottom detect shoes and other low-lying objects. 4. Break beams between the lower and upper segments sense tables and other mid-level obstacles. 5. The screen at the top serves as a guide. <p>Also, at every crossroad, a Robocop (5.3) will be present ensuring discipline in the Arkah society and alarming the law enforcement officer about any breach.</p>
Hazard Detection	Hazard Detection Systems would be installed in all public places and in all communities. They are programmed to some level of tolerance to temperature, humidity, and vibration.

As the name suggests, these systems are equipped with detectors which may detect the changes when the provided factors exceeds their levels. These systems also have a small screen which is human-friendly and can be operated manually. Thus, it can be called to operate when required in emergency situations. Once they detect the problem or start operating, they send signals to the remote computer and also emit high-pitched sounds.

5.2.4 Backup and Contingency Plans

Fire	The Hazard Detection Systems would alarm the robots to come into action in case of fire and people would be informed on their mini-computing devices.
Cyber Breach	In case of cyber breach, Quantum Cryptography would help block the passage for unauthorized access and the culprit would be detected. In case of networking failure, network backup would help retrieve the information. Refer 3.2.6.1 for network plan.
Wall Breach	Sensed by the sensors fixed on the robots and repaired by the automation in 3-4 minutes.
Food Failure	In case the supplies from the earth are interrupted, the food storage would come in use which gets supplies from the agriculture section and vice versa.
Water Failure	In case of water failure, the Excavuse may be called for an immediate supply of ice to get water for Arkah
Docking Failure	Since there are two docking ports, if one fails the other may come to use. Thus, both ports backup each other.
Data Storage Failure	Switch to backup data storage which would retrieve information from the primary storage and restore back the information, once the primary systems start working
Power Failure	Batteries storing solar power will be used. Non-important activities would stop.
Failure in Automated Systems	Engineers to fix problems related to Automated systems.

5.2.5 Automation for Authorized Personnel Access

Security Measures	Specification
Iris Recognition	<ul style="list-style-type: none"> Analysis of the iris of the eye, which is the colored ring of tissue that surrounds the pupil of the eye. Widely regarded as the most safe, accurate biometrics technology and capable of performing 1-to-many matches at extraordinarily high speeds, without sacrificing accuracy.
Keystroke Dynamics	<ul style="list-style-type: none"> The rhythms with which one types at a keyboard are sufficiently distinctive to form the basis of the biometric technology known as keystroke dynamics Software-based and thus requiring no sensor. Less expensive.
Face Thermography	<ul style="list-style-type: none"> Thermo grams requires an infrared camera to detect the heat patterns of parts of the body that are unique to every human being (such as the face)
Hand Geometry Recognition	<ul style="list-style-type: none"> A camera captures an image of the hand, with the help of a mirror to get also the edge. The silhouette of the hand is extracted, and some geometrical characteristics stored. Hand recognition technology is currently one of the most deployed biometrics disciplines world wide

Ear Recognition	<ul style="list-style-type: none"> • Ear geometry recognition uses the shape of the ear to perform identification • An infrared image can be used to eliminate hair • Might be recognized at a distance
Skin Reflection	<ul style="list-style-type: none"> • In a range of wavelengths over 6mm patch, several LEDs send light into the skin, and photodiodes read the scattered light, which is analysed to perform the authentication.

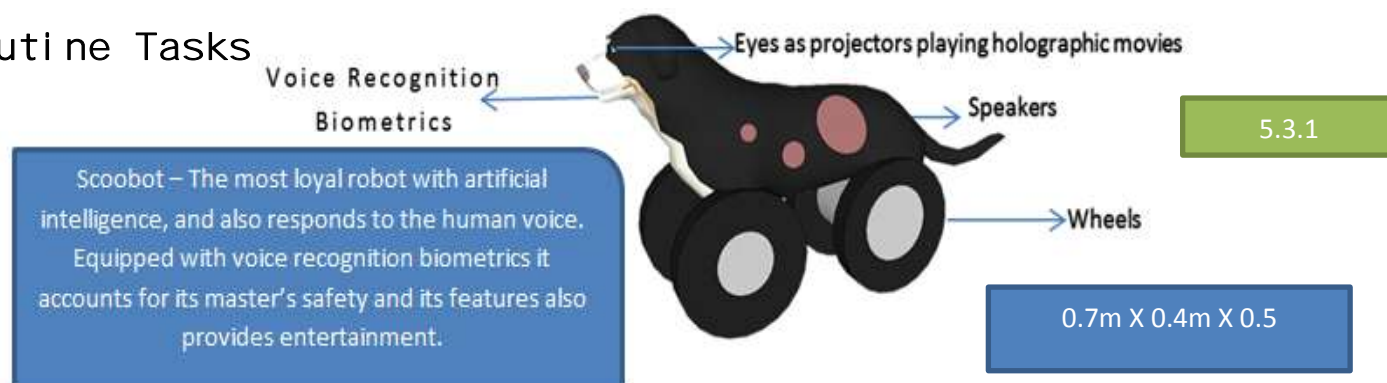
Arkah provides security measures to assure that only authorized personnel have access, and only for authorized purposes. We will be using **Biometrics** for such a purpose. This consists of methods for uniquely identify human beings. In common terms, **Biometrics is when a body acts as your password.**

For Arkah, authorized personnel shall be carrying **magnetic identity cards** which will carry the required information about the person. Once the person swipes the card, he may go through the following security measures, according to the levels of security required at different places, i.e. **low level security, medium level security, and high level security.** Where Iris recognition, Face Thermography, Skin Reflection and Ear Recognition are passive biometrics, Keystroke Dynamics and Hand Geometry Recognition require person's cooperation.

Type of Security	Security Measures	Locations of Use
Low Level Security	<ul style="list-style-type: none"> • Iris Recognition • Hand Geometry Recognition 	Residential homes, Arkah-availed commercial places like restaurants
Medium Level Security	<ul style="list-style-type: none"> • Skin Reflection • Keystroke Dynamics • Iris Recognition • Hand Geometry Recognition 	Agriculture, Water treatment plants, waste management unit,
High Level Security	<ul style="list-style-type: none"> • Iris recognition • Face thermography • Skin Reflection • Ear Recognition • Keystroke Dynamics 	Arkah Control Unit, Server Access

Cryptography is used to transform usable information into a form that renders it unusable by anyone other than an authorized user; this process is called **encryption**. This keeps the information away from unauthorized access or accidental disclosure and thus maintains cyber and information security. **Quantum cryptography** or **post-Quantum cryptography** is an efficient encryption process which will be used in Arkah. Thus, technologically also, Arkah will be providing high level of security.

5.3 Routine Tasks

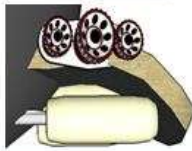
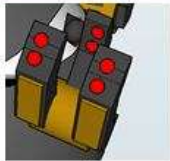


To separate bio-degradable and non-biodegradable waste, the hands have sensors which use technologies like metal detection, 3D scanning, weight measurement, tactile feedback, spectrometer analysis, and magnet affinity.

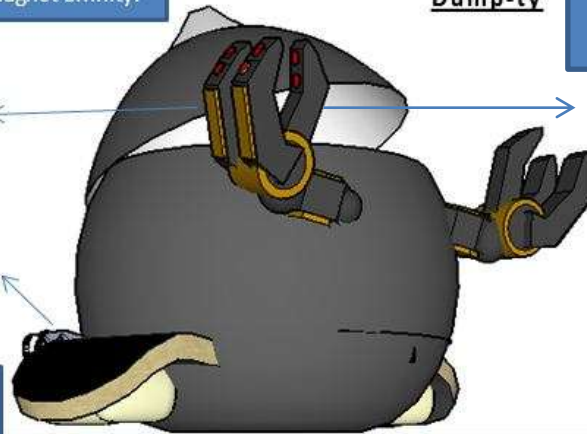
5.3.2

Dump-ty

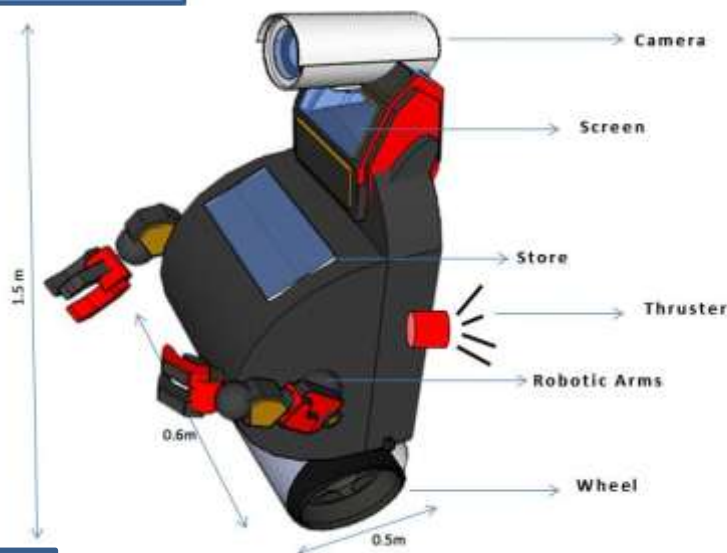
Dimensions – 1m X 0.6m X 1.3m
Number – 300 in number. Its fast movement helping in waste collection from 9100 houses



Six thrusters and four wheels help facilitate its movement.

**Extendible arms**

Robot for collecting waste and dumping it into the waste tunnel, and also separating the bio and non-bio degradable waste with two chambers provided. The robotic hands pick up/dispose the waste and also help in segregation.



5.3.3 Deli-bot: Automation for delivery of items to the residential homes from the commercial shops. The robot has been equipped to ensure fast and efficient movement. A screen shows the recipient's name and the camera helps the bot to navigate.

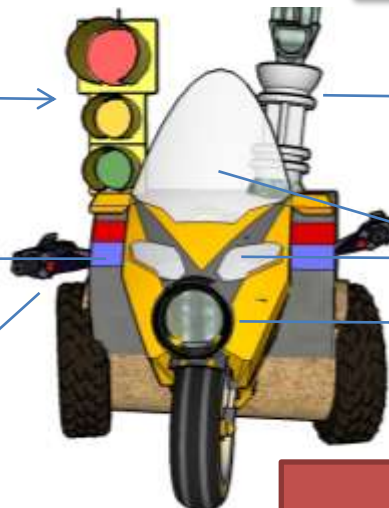
1m X 0.5m X 1m

5.3.4 Robo-cop

Traffic signal for traffic at every crossroad

SOLEDS for red and blue light which will be acting as horde in case of emergency

Anaesthesia guns which fires bullets of anaesthesia, and makes the culprit unconscious.



Extendible and Rotatable arm helping in regulating traffic.

TOLEDs

Camera

Rubber Wheels (3)

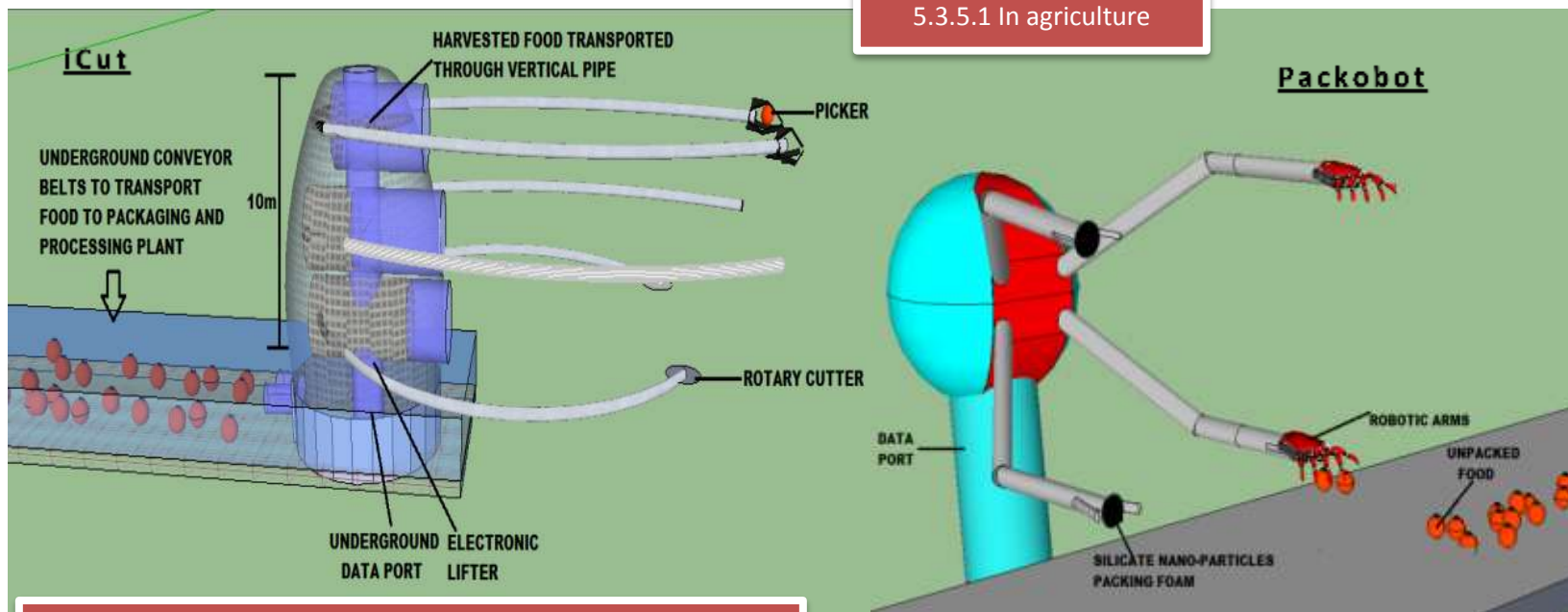
Other Features:

Thrusters: For fast movement in case of emergency.

Inbuilt Speakers: For producing high pitched sounds or siren sounds to alert the Arkahns.

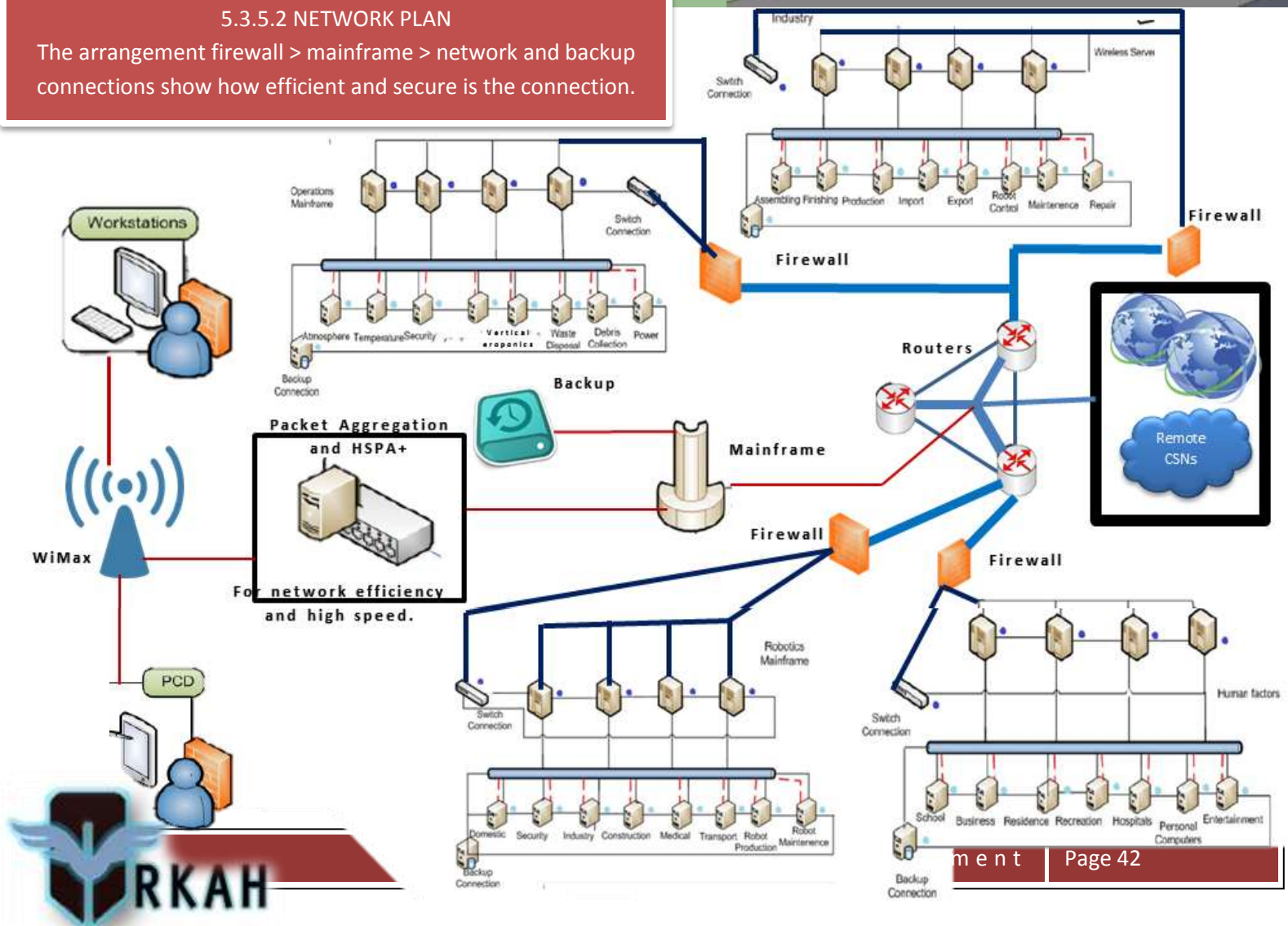
5.3.5 Automation for various

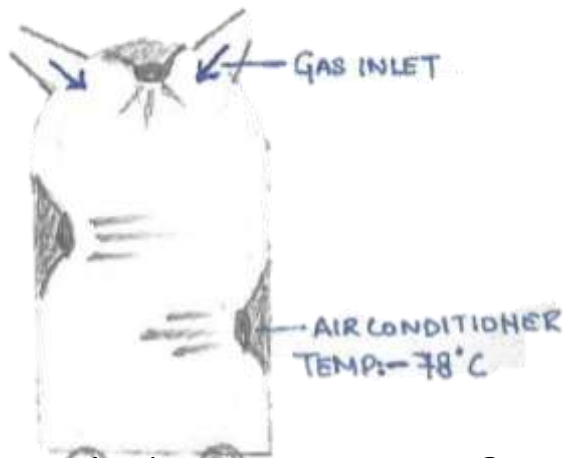
5.3.5.1 In agriculture



5.3.5.2 NETWORK PLAN

The arrangement firewall > mainframe > network and backup connections show how efficient and secure is the connection.

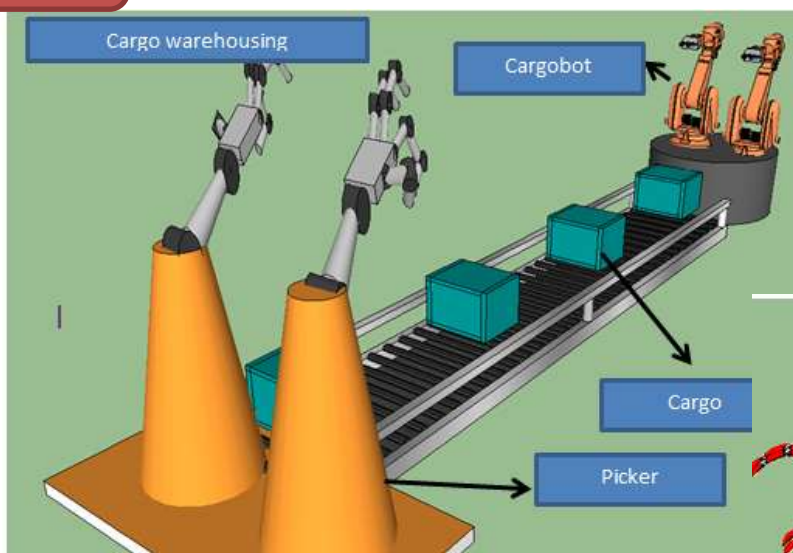




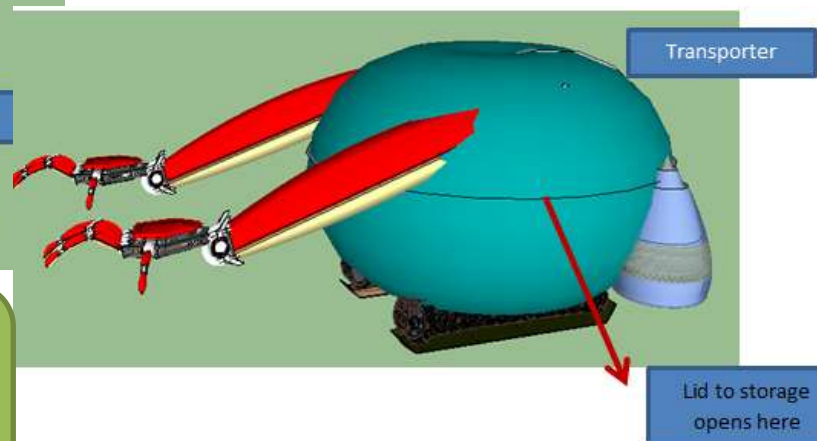
5.3.5.3 Picka-bot: For Carbon Dioxide Fixation between Residential and Agricultural level. The air conditioners inside the container helps collect dry ice which is let out as CO₂ in the agricultural sector

5.4

Reardonium parts manufacturing and refining

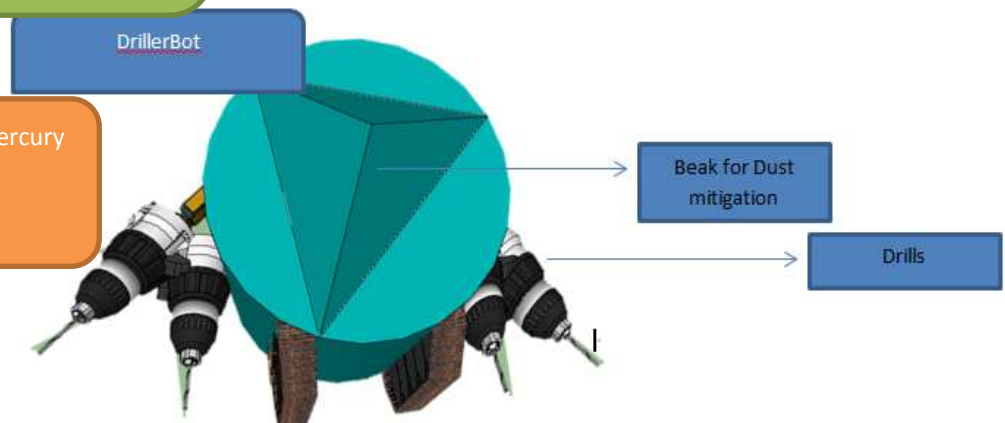


5.4.1 Cargobot and Picker: Automation responsible for efficiency in the cargo warehousing for reardonium manufacturing processes.



5.4.2 Transporter: Automation responsible for transporting reardonium to the construction base in the orbit, and also to assist the surface vehicles. The automation is covered by Alumina Aerogels over Reardonium protection it from solar flare activities.

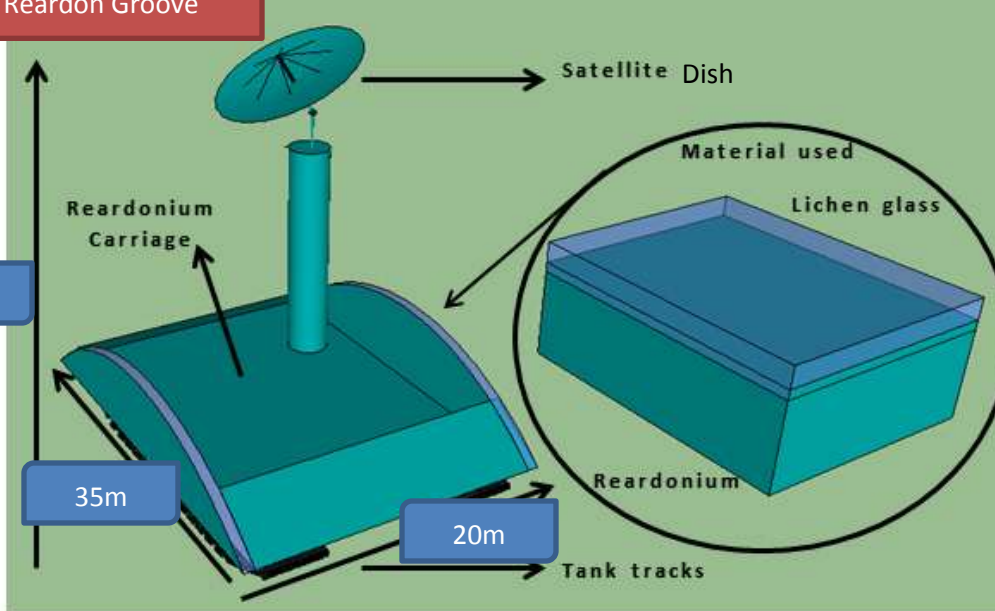
5.4.3 DrillerBot: Automation for drilling on the mercury surface thus stimulating the process of excavuse; helping it in extraction of reardonium.



5.5

Mercury surface robots

5.5.1 Reardon Groove

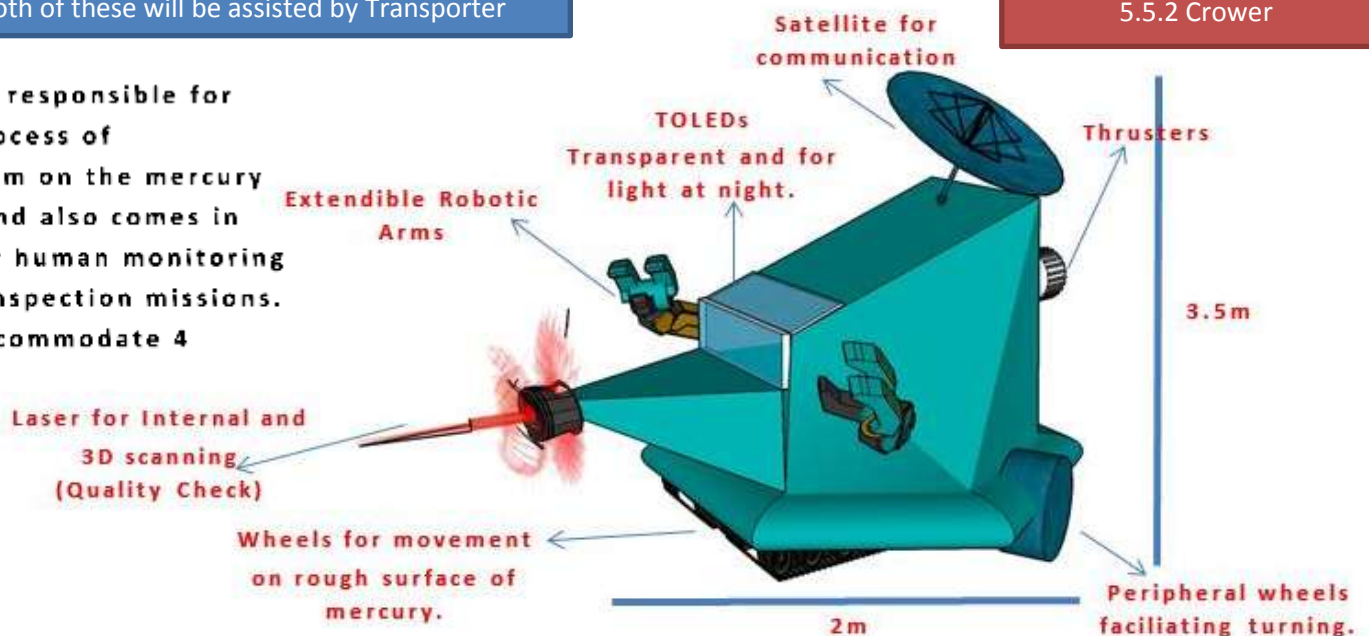


The automation taking part in Mercury surface operations to attain desired properties of reardonium parts. It will be moving parts to various locations on the planet surface, each part moved on average 2.5 times during its curing process.

Both of these will be assisted by Transporter

5.5.2 Crower

Crower is responsible for curing process of reardonium on the mercury surface and also comes in action for human monitoring and the inspection missions. It may accommodate 4 people.



“Safe” configuration: As shown in the diagram 5.5.1, the surface vehicles will be coated with a layer of lichen glass, protecting it from solar radiation. As noted by the Foundation Society metallurgists, metal properties changes when the metal is subjected to solar heat and solar radiation, when one factor is eliminated, properties will stay stable. This ensures “safe” configuration.

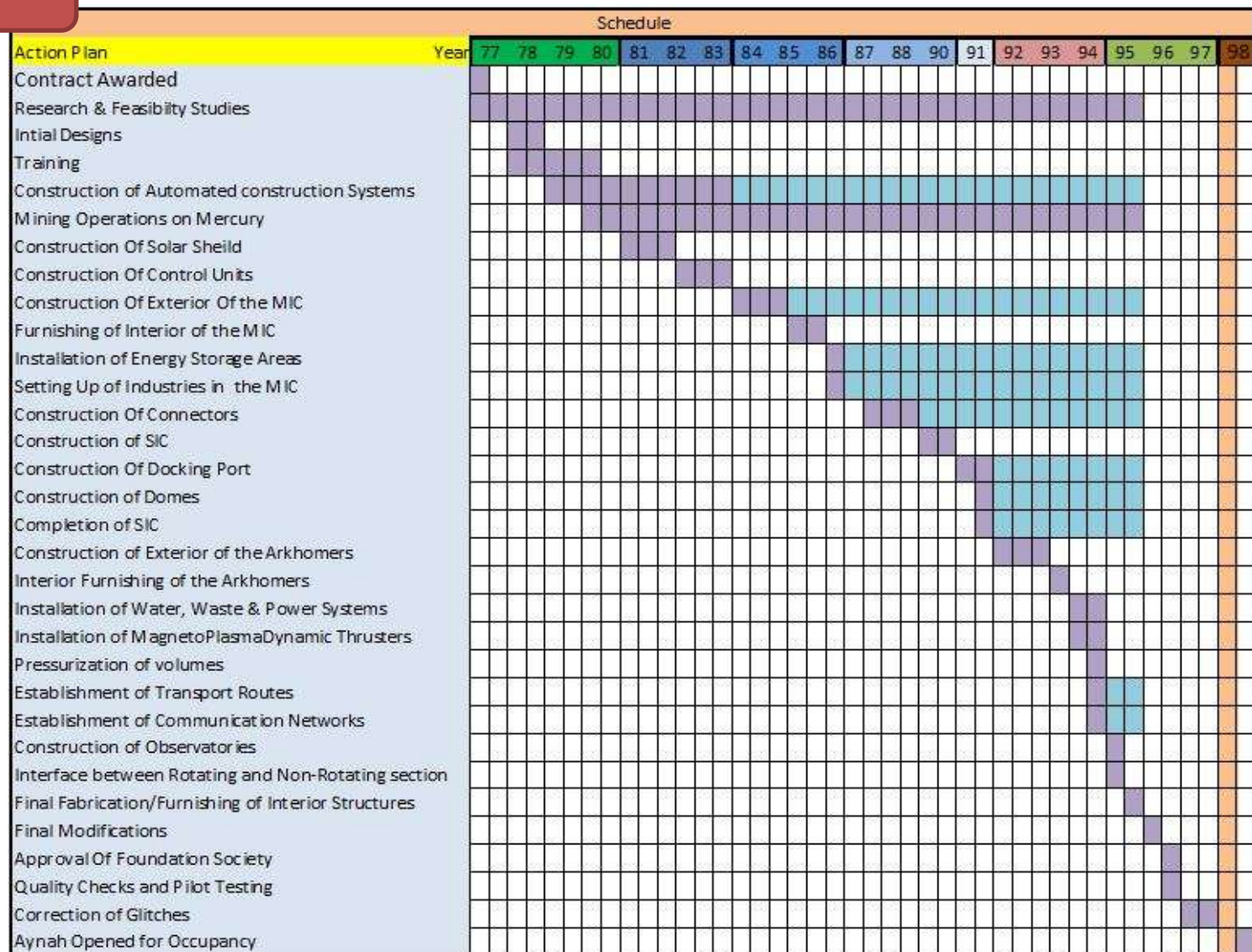
SCHEDULE COST &

-Steve Jobs



6.1

Schedule



Total time taken for Arkah to be operational – 21 years.

6.2

Cost

All cost in dollar\$

STRUCTURE			
UNIT	QUANTITY	COST PER UNIT	TOTAL COST
Silicon carbide	39021396918.56 Tonnes	2000	78042793838000
Silica Aerogel	4500 Tonnes	30000	135000000
STF treated Kevlar 49	3309125.53 foot ³	12	39709506.36
Gallium arsenide	484667280 Tonnes	1500	727000920000
Rd50 lead glass	566586850.8 Tonnes	5000	2832934254000
Carbon Nanorods	9234790.6 Tonnes	95000	877305107000
Electro chromic Smart Glass	1981071862 foot ³	10	19810718620
Nextel	365445.6 Tonnes	2000	730891200
Solar Panel	14 sq. miles	780000000	10920000000
Total			82511670438326

Phase 1
January 1st 2081 -
December 31st 2084

Phase 2
January 1st 2084 -
December 31st 2086

Phase 3
January 1st 2087 -
December 31st 2090

Phase 4
January 1st 2091 -
December 31st 2091

Phase 5
January 1st 2092 -
December 31st 2094

Phase 6
January 1st 2095 -
December 31st 2097

Hand Over to the Society
on 1st May 2098

OPERATIONS & INFRASTRUCTURE

UNIT	QUANTITY	COST PER UNIT	TOTAL COST
Weather Control System	1	N/A	20000000
Vertical Aeroponics System	99	200000/unit	19800000
Water Treatment Plant	1	N/A	10000000
Waste Treatment Plant	1	N/A	10000000
Microwave Transmission Tower	10	100000	1000000
Arkahlite	10	20000000	200000000
Cycles	5000	100	500000
Vaccum Transit	18	30000000	540000000
Araba	2000	10000	20000000
Guchpam	13.2km	16.96m/km	263472000
Conveyor Belts	13360	20\$/50m	5344
Day/Night Cycle Provisions	N/A	N/A	3500000
LiFe PO4 Batteries	8000	500	4000000
Maglev Lifts	16	27500000	440000000
Carbon Nanotubes	N/A	N/A	500000
Total			1532777344

HUMAN FACTORS

UNIT	QUANTITY	COST PER UNIT	TOTAL COST
SHOP	248	10000	2480000
MALLS	16	200000	3200000
POLICE STATIONS	4	200000	800000
FIRE STATIONS	8	200000	1600000
SCHOOLS	8	125000	1000000
COLLEGES	2	125000	250000
PUBLIC RESTROOM	210	10000	2000000
HOSPITALS	8	1200000	9600000
HOTELS AND RESORTS	4	130000	520000
RESTAURANTS	16	100000	1600000
GYMNASIUM	8	100000	800000
OFFICE	24	500000	12000000
CLINICS	26	600000	15600000
RECREATIONAL FACILITIES	16	140000	2240000
RETREAT CENTRE	8	200000	1600000
STUDIO	4	150000	600000
THEATRE	10	85000	850000
ADMINISTRATIVE BUILDINGS	8	75000	600000
SUPER MARKET	64	50000	3200000
LIBRARY	10	20000	200000
OBSERVATORY	10	80000	800000
RESEARCH CENTRE	10	300000	3000000
COMMUNITY CENTRE	8	120000	960000
RELIGIOUS CENTRE	2	50000	100000
SPACE MUSEUM	2	200000	400000
BANKS	64	10000	640000
DESIGN 1 APARTMENT	490	250000	122500000
DESIGN 2 APARTMENT	4410	200000	882000000
DESIGN 3 APARTMENT	420	350000	147000000
DESIGN 4 APARTMENT	3780	300000	1134000000
SPACE SUITS	1200	12000000	14400000000
AIR LOCKS	48	10000	480000
TOTAL			16752620000



AUTOMATION			
UNIT	QUANTITY	COST PER UNIT	TOTAL COST
EXCAVUSE	60	10000000	600000000
CONSTROW	240	7900000	1896000000
DWARF-CONSTROW	850	2500000	2125000000
INTERNO	200	5000000	1000000000
SENSORBOTS	450	30000	13500000
EXTEROCEPTIVE SENSORS	250	55000	13750000
BIOMETRIC SYSTEMS	250	50000	12500000
SCOOBOT	9100	25000	227500000
DUMP-TY	300	75000	22500000
DELI-BOT	300	75000	22500000
ROBO-COP	150	45000	6750000
PACKO-BOT	99	90000	8910000
i-CUT	99	1100000	108900000
AUTOMATION FOR INDUSTRIES	N/A	N/A	100000000
REARDON GROOVE	60	56000	3360000
CROWER	60	62000	3720000
TOTAL			6164890000
Grand Total			82536120725670

EMPLOYEE DIRECTORY

CATEGORY	SUB-CATEGORY	PERSONNEL	ANNUAL SALARY	ANNUAL EXPENDITURE
ENGINEERS	COMPUTER	800	175000	140000000
	CIVIL	800	160000	128000000
	MECHANICAL	500	175000	87500000
	ELECTRICAL	350	150000	52500000
	AERONAUTICAL	475	185000	87875000
	ROBOTIC	525	175000	91875000
	METALLURGICAL	1025	185000	189625000
	COMMUNICATION	150	140000	21000000
		4625		798375000
MEDICAL	GENERAL PHYSICIAN	275	160000	44000000
	SPECIALIST SURGEON	200	165000	33000000
	NURSING PERSONNEL	500	90000	45000000
	SHRINKS	100	120000	12000000
		1075		134000000
INDUSTRY	MANAGERS	75	160000	12000000
	TECHNICIANS	25	90000	2250000
		100		14250000
CORPORATE	BANKERS	300	175000	52500000
	BROKERS	150	120000	18000000
	ANALYSTS	350	120000	42000000
	ACCOUNTANTS	550	100000	55000000
	MANAGERS	100	250000	25000000
		1450		192500000
OTHERS	OFFICIALS	2800	100000	280000000
	LAW-ENFORCEMENT	300	125000	37500000
	CIVIL SERVANTS	800	125000	100000000
	LAWYERS	250	150000	37500000
	PROFESSORS	150	100000	15000000
	DIPLOMATS	150	200000	30000000
		4450		500000000
TOTAL		11700		1639125000

ANNUAL COSTS	
POWER	12000000
WATER	2500000
TRANSPORT	10000000
VERTICAL AEROPONICS SYSTEM	8000000
COMMUNICATION	7500000
DAY/NIGHT CYCLES	20000
WEATHER SYSTEMS	50000
MAINTENANCE -AUTOMATION	10000000
TOTAL	50070000

Total cost for
having Arkah
operational -
\$82536120725670

Annual Cost billed
to the Foundation
Society -
\$168919500

7.0

Business Development



Besides providing ambient living conditions, Arkah Hyperion space settlement would also have an economic base. Like any other human settlement (cities, countries, etc.) it will also follow trade practices. The business model of Arkah will revolve primarily around the manufacturing, sale and research of Reardonium. However, Arkah will host a variety of other business ventures.

Research:

Arkah provides an apt place to conduct research activities. It provides unique research opportunities on Mercury and Reardonium metallurgy. Most settlements earlier have either been lunar or Mars based. A space settlement on Mercury would open up new doors for research and further studies in astronomy.

Advantage of setting industries in zero gravity: On Earth, if a substance is subjected to various operations, then gravity has strong influence on the way the substance is modified. Thus, zero gravity conditions provide unique conditions for scientific, application-oriented and industrial research. Moreover, since the industries would be completely automated, the industries would be easy to handle.

Medical Nano-technology:

Nanorobots are essentially an adapted machine version of bacteria. They are designed to function on the same scale as both bacteria and common viruses in order to interact with and repel them from the human system. As we know, the main construction of Arkah would be done by Dwarf Constrow (3.3, 5.1) which are nanobots, these bots will then be used in Medics once Arkah is operational. Today, many critical illnesses do not have cures and thus are life threatening. This has resulted in loss of precious lives. Chemotherapy wreaks havoc on humans and nearly kills them in the quest to kill off their malignant cancer cells. Nanobots could be deployed in the body to **"turn off" cancer-causing cells in tumors** giving the same results as chemotherapy, but without the debilitating side effects. Large amounts of the bots are injected directly into the bloodstream, where they then float through the circulatory system in order to locate and fix problem areas of your body. The method used by the tiny bots is called RNA interference. The robots, which are smaller than most viruses, find the cells responsible for out-of-control growth and cut off their communication system, rendering them harmless and effectively turning off the cancer. This would provide further research in medical technology, and would have Arkahns so strong as to combat any disease.

Recreation, Tourism and Entertainment:

The community layout plan of Arkah provides space for future expansion, where it already has a series of commercial ventures like shops, restaurants, malls, theatres etc. These spaces will be leased out to interested companies. The established familiarity of these chains will instill a feeling of home in the residents, provide a variety and thereby increase sale. Holiday packages will also be developed for the residents and tourists on Aynah. These will include trips to the surface of Mercury, observation of Reardonium manufacturing processes, entertainment packages for the micro-g facility and virtual reality facilities.

Green Promoter:

Power on Arkah space settlement will be generated via solar cells. Waste will be recycled. No fuels have been used for internal transport and domestic households, thereby eliminating pollution. These facilities earn Arkah the title of green promoter.

7.1

Infrastructure for refining and manufacturing reardonium parts

Strategically Positioned Components of Arkah's structure: Humans will be out of harm's way due to strategically planned structure. A separate docking port for goods and freight ensures the safety of humans in the other docking port. Reardonium refining and manufacturing areas are located close to the docking port and the residential and the commercial sectors are located in a separate location which means dust would not be

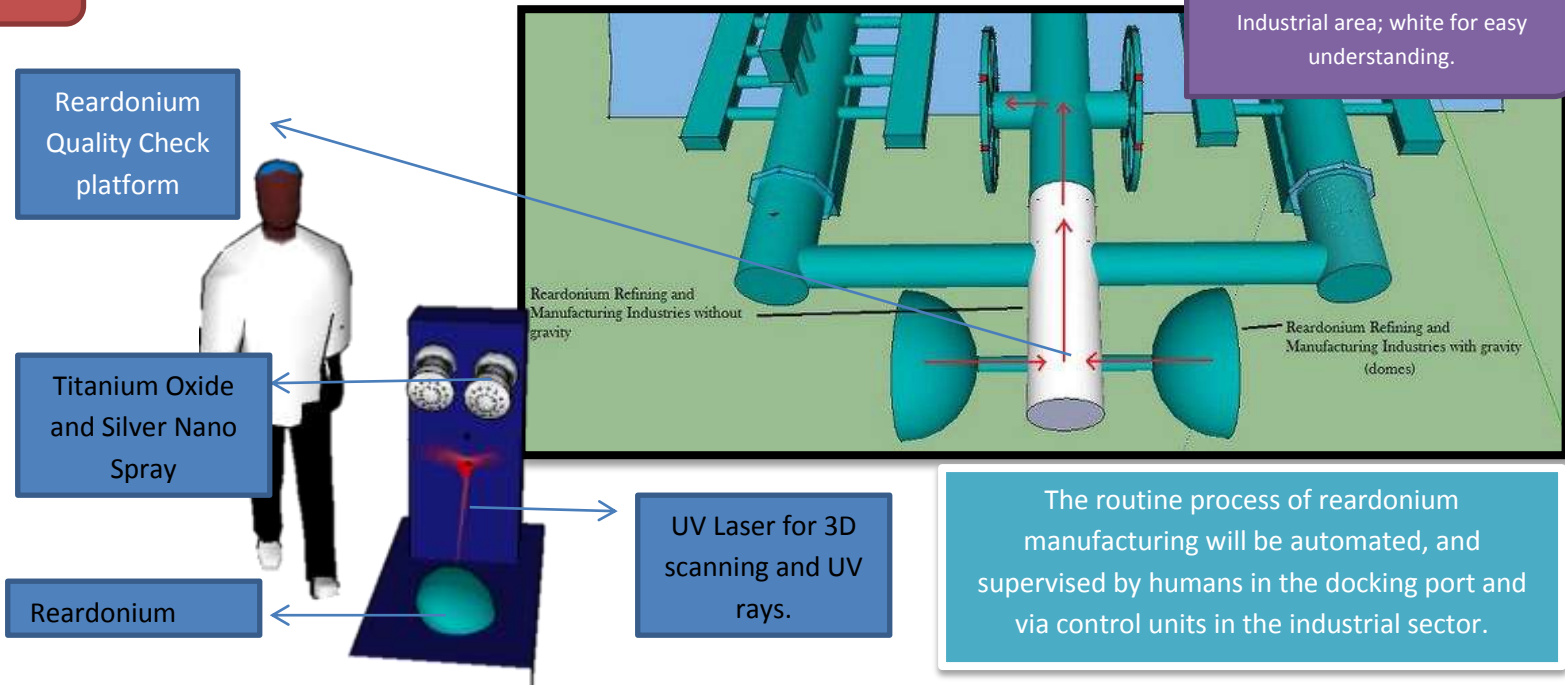


able to enter the habitable areas. Arkah is fully capable of handling and processing raw ore from the surface of Mercury. Arkah also provides manufacturing capability in various gravity and pressure environments. (Refer 2.4)

Faster Transport, Efficiency and Increased Productivity: Our efficient automation systems ensure secure and quality refining of raw ore and also the manufacturing of products. Also, we have vacuum transits and Maglev elevators for the transport of goods. The reardonium refining and manufacturing industry, the docking Ports and the storage areas of finished goods (Provide cargo warehousing for customs purposes and storage while waiting for transfer to other ships), are all located in the SIC. This proximity ensures faster transport of goods, resulting in increased productivity.

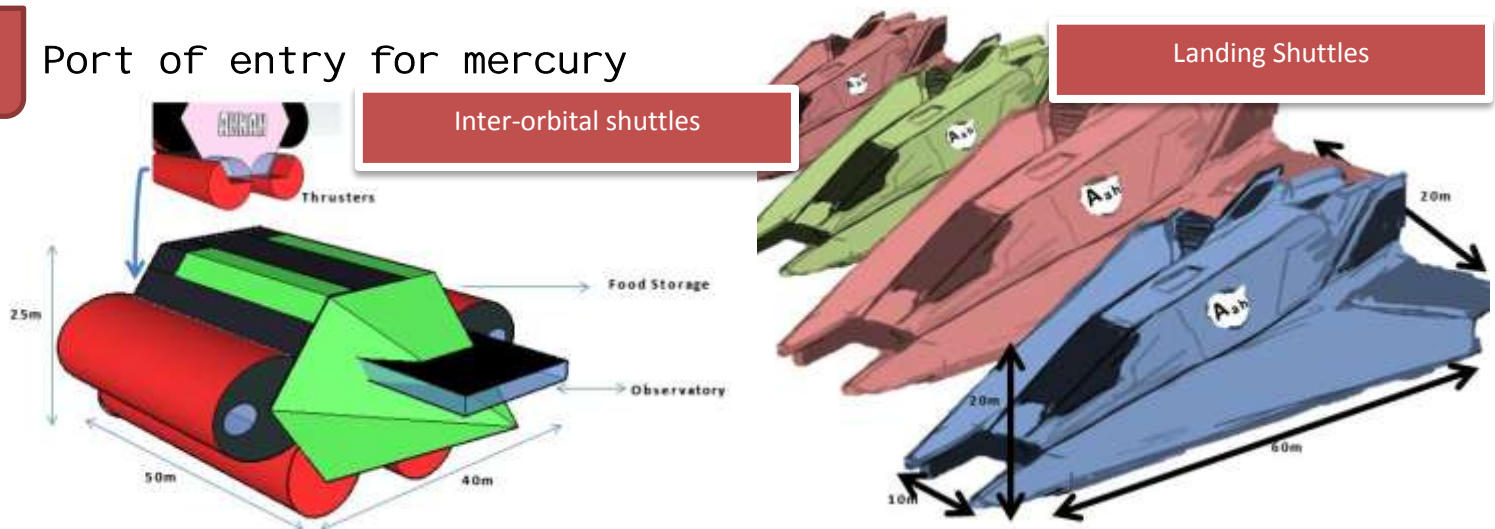
7.2

Receiving and shipping reardonium parts



7.3

Port of entry for mercury



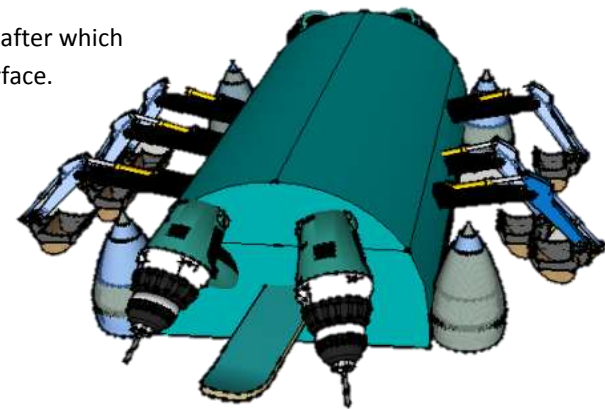
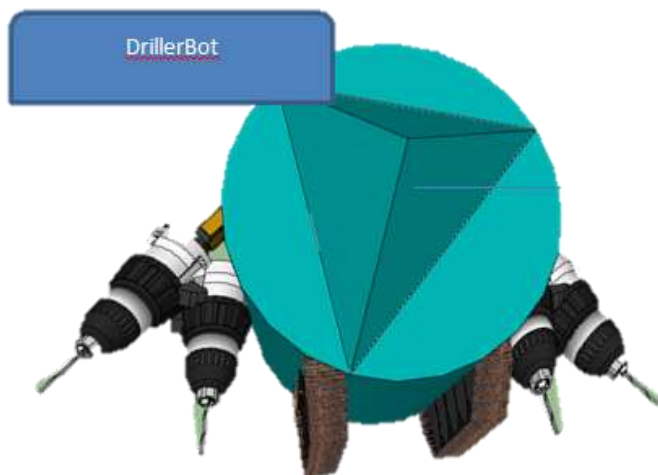
Carrobot and Pickerbot for cargo warehousing and Vacuum Transits for moving reardonium and reardonium parts along the industrial area and the docking ports provided. Refer 5.4.1 and 3.2.7

8.0 Appendices

8(A) Operational Scenario

MINING OF ORE

Drillerbots will drill through the mercury surface, for the extraction of ore after which **Excavuse** would excavate it, and thus mining the ore from the mercury surface.



Estimated Time: 1 and half hours.

Transport to docking port

The ores will be transported via **Excavuse** itself or via **Transporters** to the docking port of Arkah. The ores would then reach the industrial area via **Vacuum Transits**. This process of receiving the ores and then setting them for transport is supervised by humans.

Estimated Time: 1 hour

Manufacturing & Refining

Before reaching the industrial sector, the ore is sent to the RQC platform with the help of which dirt and grit would be removed. The ores will be refined so as to obtain reardonium. From here reardonium is sent to Manufacturing unit for obtain desired shapes and parts. Though, the process will be automated, it will be under human supervision from the control unit.

Estimated Time: 3 hour

Transport manufactured parts

From the industrial sector, reardonium is transported to docking ports via **Vacuum Transits**. The **landing shuttles** transport reardonium to the mercury surface for the curing process.

Estimated Time: ½ hour

Curing process

Reardonium will be loaded on **Reardon groove** with help from the **transporter** and moved on the mercury surface to get the desired properties. **Crower** would be doing quality checks on the mercury surface and would be an aid in the curing process. **Crower** would be the vehicle humans would be using when on **inspection missions** outside the terminator line.

Estimated Time: 1 Earth Year

Transport back to Arkah

The cured parts would be transported back to Arkah via **landing shuttles** for shipping and storage.

Estimated Time: ½ hour

Reardonium quality check

To remove dirt and grit from the cured reardonium part and for quality checking, reardonium parts would be sent to **RQC platform** under human supervision.

Estimated Time: 1 ½ hour

Transporting completed parts to customers

Interorbital shuttles will be used for transporting completed parts to customers on earth



8(B) Bibliography

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5.0 Automation

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8(C) Compliance matrix

Section	Requirements	Fulfillment	Page No.
Structural Design	A safe and pleasant environment for full time and transient residents and provisions of natural views of mercury.	Unique position of industries.	8
2.1 Exterior Design	Exterior view of settlement with major visible features	Refer to 2.1 Drawings Shown	8
	Showing rotating, non rotating and pressurized, non-pressurized sections	Refer to 2.1 Drawings Shown	8
	Indicating functions inside each volume	Charts Given Refer to 2.1	9
2.2 Interior Design	Layout of interior land areas and usage of these areas.	Charts depicting down surface areas given. Refer to 2.2	11-13
2.3 Construction Process	Construction Sequence of the settlement and method of initiating rotation for artificial gravity.	Sequence shown in 6 phases. Gravity through <u>MAGNETOPLASMA DYNAMIC THRUSTERS</u>	13-15
2.4 Manufacturing and refining of reardonium	Show how manufacturing areas will provide required conditions for reardonium manufacturing	Refer to 2.4	15-16

2.5 Protection of areas occupied by humans.	Configuration drawings and protection for areas occupied by humans.	Protection by water and solar shield provided. Protection from meteors ensured.	16
3.0 Operations and Infrastructure	Infrastructure necessary to build and operate the community	Infrastructure required for day-to-day working of Arkah given.	17-28
3.1 Location and Material Sources	The orbital altitude for Arkah and reasons for selections.	Distance between Arkah and MERCURY derived and shown.	18
	Materials and equipment to be used in construction and operations.	Quantity of materials specified	18
	Means of shipping the materials	Refer to section 7.3	51
3.2 Basic Facilities and Infrastructure	Basic Infrastructure for activities of settlement's residents	Food, Waste, Water Communication , Day and Night provisions given.	18-26
	Means of access throughout and between facilities.	Transport between 2 levels of cuboid provided by maglift and Vacuum Transit.	24
	Transportation vehicles and their designs	6 vehicles for internal transportation with dimensions given.	24
3.3 Machinery for Construction	Construction Machinery	CONSTROW & DWARFCONSTROW to be used.	27
3.4 Solar Panels	Solar Designs depicting Arkah design	Design of solar shield with dimensions given.	27-28
3.5 Surface	Vehicles for moving reardonium parts on the	Reardon Groove	28



Transportation.	surface of mercury.		
4.0 Human Factors	Natural sunlight and views of the Mercury surface for the residents.	Drawings showing natural view of Mercury from inside the settlement shown.	30
4.1 Community Design	Facilities for comfortable environments for the residents	Amenities & Entertainment provided to residents similar to that of Earth.	
	Variety and Quantity of consumables and other designs	Chart for food consumption and other consumables given.	30
	Public areas for physiological factors	Diamond grid pattern roads have been provided to reduce coriollis effect and long lines of sight to reduce Claustrophobia	30
	Overall community design	Map in 4.1	30
4.2 Residential Design	Designs of residential external and interior floor plan and the no. required for each designs.	4 interior floor plans and 4 exterior home designs have been provided.	32
	Demographic Breakdown	Divided into VIP's and Non-VIP's on the basis of pay scale and skills.	31
4.3 Safe Access	Locations and Markings of airlocks for entering the settlement	Illuminated airlocks for enhanced visibility shown.	34
	Spacesuits, its type and its uses.	Design and quantity of Hard-shell spacesuits shown.	33
	Warning system for assets in the path of the moving settlement	Hazard Detection systems Wrist type mini-computers.	34

4.4	Provision of 1g for the growth of children for at least 3 hrs. a day.	Educational Hub provided.	35
4.5	Surface Vehicles intended for the humans on mercury for the monitoring of reardonium and other purposes.	CROWER used and designs, functions shown.	35
5.0 Automation Design and Services	Specify numbers and types of computers and show robot designs	Refer to 5.0	36-44
5.1 Automation for Construction	Robotically accomplished construction	Excavuse Constrow DwarfControw Interno	37-38
5.2 Automation for operations	Automation application for operations Means to ensure authorized personnel access.	Biometrics CHART GIVEN. In 5.2	38-40
5.3 Automation to enhance livability	Describe computers and robots that people will encounter in everyday life and diagrams of network plan	ROBOCOP, SCOOBOT, DELIBOT, Network Plan, Packobot, I-CUT PICKABOT and DUMP-TY	40-41
5.4 Automation for mining and reardonium parts manipulation	Robot designs for handling and manufacturing of reardonium parts	CARGOBOT FICKABOT TRANSPOTER DRILLER	43

5.5	Surface Robots for manipulating reardonium parts on the surface and depicting safe configuration	Crower Reardon groove	44
6.0 Schedule and Cost	A Schedule for development and occupation of Arkah, and costs for design through construction phases of the schedule	Refer to 6.0	45-48
6.1 Schedule	Duration and completion dates of major designs	Arkah will be operation in 21 years(i.e.)2098	46
6.2 Costing	Costs related to the settlement	Annual cost and Total Cost for making Arkah billed.	47-48
7.0 Business Development			49-51
7.1 Reardonium Manufacturing and Refining	Infrastructure for refining and manufacturing Reardonium Parts	Provided in 7.1	50-51
7.2 Transportation of Reardonium	Receiving and shipping Reardonium parts	Provided in 7.2	51
7.3	Port of entry for Mercury	1)INTERORBITAL SHUTTLES 2)LANDING SHUTTLES 3)ROBOTS FOR CARGO WAREHOUSING 4)Vacuum Transit for moving REARDONIUM	51



ADDENDA - Nomenclature

According to Foundation Society's naming convention that requires the name to begin with "A" and with the suffix "ah", the name for this community has been put as Arkah. It has been named so because it draws parallel to Noah's ark which saved the world's animal and his family battling the great flood and similarly, this is a settlement which has come as a saviour for human society battling the strong forces of the sun.

