ARESAM
NORTHDONNING HEEDWELL
LITTLE FLOWER HIGH SCHOOL
HYDERABAD,
ANDHRA PRADESH, INDIA

1.0 Executive Summary

Whenever one speaks of life outside Earth, the common man and Astronauts would first think of Mars. The thought of other living and intelligent beings was a topic of consideration for many fictional books. The first space probe to orbit around Mars was the Mariner 9 launched in 1971. After that there have been many missions sent to Mars to find out more about it.

In response to the request sent by the Foundation Society, we at Northdonning Heedwell present the proposal for '**ARESAM'** which shall satisfy them by fulfilling all their requirements. In view with the foundation society, we agree that Aresam is going to be the most ambitious project that will be taken up by the Foundation Society.

Mars is the next heavenly body known to have similar conditions to that of Earth. It has a vast collection of minerals equal to that of earth. Its moons Phobos and Deimos also have a vast collection of minerals. Recognizing the complicity of the project, we have decided the Apoapsis and Periapsis of our settlement around Mars. Aresam will act as a Gateway to Mars, as many exploration missions will be sent to the surface of Mars from Aresam.

The structure of our settlement is stable consisting of a Central Cylinder, two Torii and a new special feature called the Moibius Tube. This tube will be helpful for the internal transport free of fuel with the use of the Centrifugal Force generated as the structure rotates. The docking stations allow us to dock more ships so that the supplies which we receive will not be interrupted. There will also be a communication hemisphere to enhance better communication in Aresam. The construction is going to be done in 6 phases. We will launch the first part of our settlement from the moon so that the cost of propulsion systems would be less.

The internal community designs give the residents full comfort and the Earth like conditions help them in adjusting to our settlement. Our training centre in Aresam will train people to adjust to Mars like conditions so that they get used to it when they go on Mars. All the solutions and answers developed by us at Northdonning Heedwell are purely based on Reality and Fact and not mere Fiction.

The advantages and new additions of our proposal are:

- Faster and easier internal transport
- We will be providing Natural Sunlight for the Day and Night Cycles so that we can save electricity and also provide natural views of the space and Mars
- Proper Water facilities and Waste management in the communities
- Water flowing through the pipes in the Moibius tube acts as major a source of Hydro electric power.
- The waterfalls provided in the communities will provide a natural view, entertainment for the residents, partly purify water by Aeration and acts as a minor source of Hydro electric power
- 'A-Green' systems help in maintaining cleanliness in the Hospitals
- During our revolution period at the Perihelion of Mars' orbit, we will be going into the darkness for about an hour. During this period we will be using excess energy produced by Solar panels. Sodium Halide lamps to provide Artificial Sunlight. Lead Cooled Fission Reactors are used in the case of energy crisis
- We will be using a special material called K-Tect to build houses which can be reused without wastage
- In the Networking of Aresam we have invented a new type of Network called 'Aronet' which is a mix of Hybrid Tree, Butterfly, Honeycomb and Bus Networkings

Shorthand Notations

NH	Northdonning Heedwell
Km	Kilometres
m	Metres
cm	Centimetres
atm	Atmospheres
Kg	Kilograms
gm	Grams
KW	Kilo Watts
l*b*h	Length*Breadth*Height
%	Percentage

P2MR	Perpetual Motion Mono Rail
N	Newton
TSA	Total Surface Area
RPM	Rotations Per Minute
VTOL	Vertical Takeoff and Landing
$	US Dollars
ξ	Argentia
Sft	Square feet

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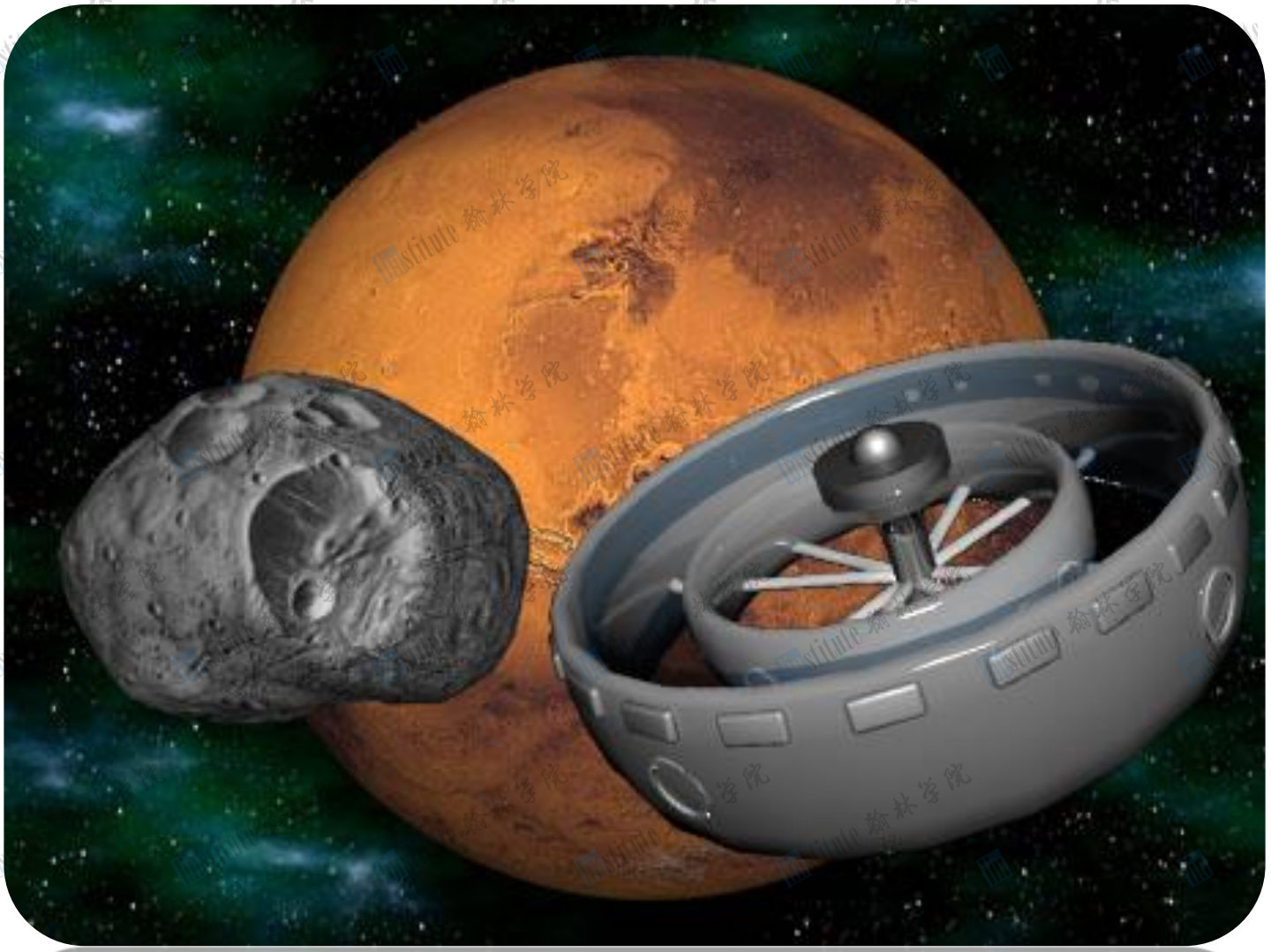
LITTLEFLOWER HIGH SCHOOL

STRUCTURAL ENGINEERING



BUILD TO EXCEL!

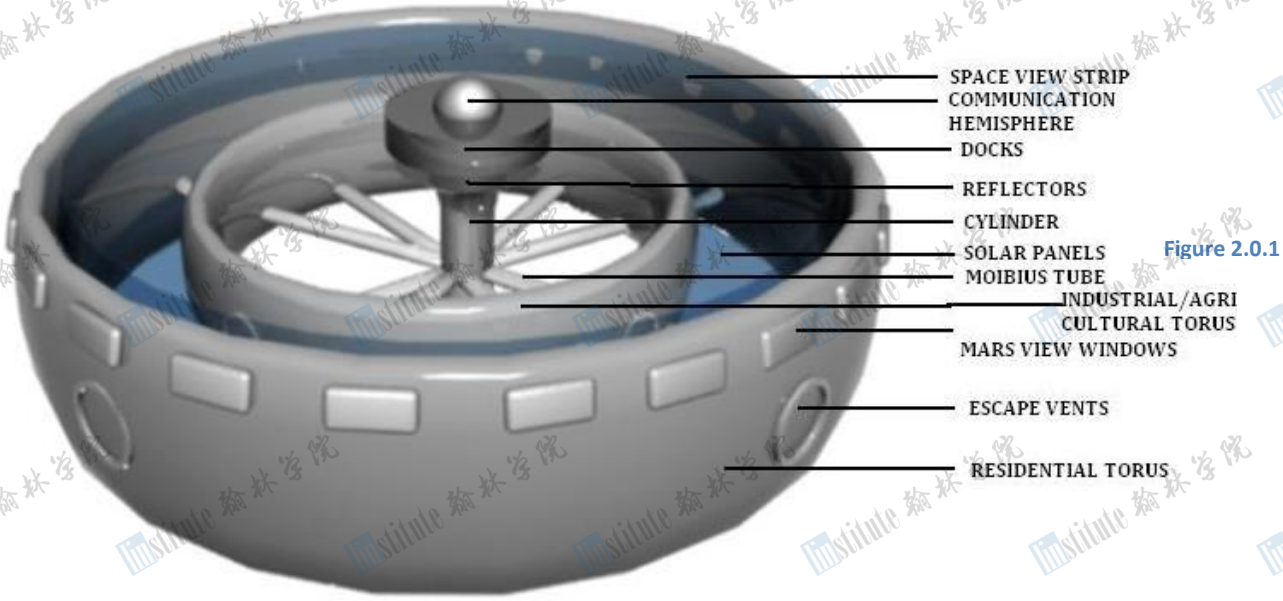


Figure 2.0.1

2.0. Introduction

We at NH in response to the Foundation Society's request for proposal have designed Aresam, the perfect balance for luxurious life and economic prosperity. The settlement will be a safe and pleasant place that will host 20,000 full time residents and 500 transit residents. It will be fully proficient in order to enable the residents to have natural views of Mars and the space outside. We are providing conditions as close as possible to that of earth, in order for the people to be able to perform activities in normal conditions. Unlike other settlements, Aresam is also enhanced with a design that optimizes its business operations, maximizing not only the production of goods and resources but also integrates the production capabilities into the everyday life of the colony.

We at NH have decided to build Aresam as a two torii structure keeping in mind the requirements given by the Foundation Society. The outer rotating ellipsoid torus will serve to accommodate residential requirements. The inner ellipsoid torus will serve to accommodate the industrial and agricultural purposes.

2.1 External Configuration

2.1.1Description of the volumes used and areas allocated

Table 2.1.1.1 **Dimensions**

Description	Primary torus	Secondary torus	Cylinder	Docks
Major radius/ radius (m)	514	200	150	200
Minor radius(m)	300	150	NA	NA
Height (m)	NA	NA	1500	80
RPM	0.94	0.94	0.94	0 (non rotating)
Gravity(N^2)	9.8	3.5	0 to 1.4	0
TSA m^2	9,069,261.45	3,422,322.51	1555714.29	352000.001

Table 2.1.1.2	Description
Name of the hub	Description
Central cylinder	The central cylinder is mainly used for transportation, long term docking and storage of the materials required for the secondary torus. As the central cylinder is also rotating, the gravity in the cylinder varies from the centre to its edge. Micro gravity is observed throughout the cylinder. We use air lock systems for transportation within the cylinder. We will also be including a horticultural section in the cylinder because fruits and vegetables grow faster and bigger in micro gravity areas.
Residential torus	This torus is mainly used for the residential purposes. This torus has gravity similar to that of earth's gravity (9.8N).This Torus also consists of water purifiers, waste processors, and water storage tanks.
Industrial/agricultural torus	This torus has got three floors with 100m vertical clearance. This torus is used for agricultural and industrial purposes. Here we have a gravity of 3.5N which is useful for both Industrial and Agricultural purposes. We have also provided a community for the transit population in this torus so that they get used to the Martian gravity
Docks	The docks are in the shape of a cylinder. The docks will be pressurized and non-rotating.
Moibius Tube	The Moibius tube helps us with easier transport with the help of centrifugal forces and with the minimal usage of energy. We are using the Moibius tube to the highest extent in our settlement, so high that even the entertainment is provided to the residents using the Moibius tube.

2.1.2 MATERIALS USED IN THE SETTLEMENT

MATERIAL	Purpose	Part of construction	Thickness
Titanium	Used to add on to the most structural components, hardest and most durable metals.	External	2m
Aluminium	Used in the various internal systems of Aresam and is easily moldable.	Internal	1.5m
RXF-1	Used as protection against cosmic rays, solar flare activity.	External	2m
Super adobe	Reduces radiation exposure, provides thermal insulation & protection from meteorites.	External	4m
Carbon Nano tubes	Used for providing strength. They will be produced from tubular technology.	Internal	1m
Copper conductive tube	Used as a radiator and also for giving strength	External	0.9m
Martian regolith	Used for radiation shielding and also for interior finishing.	External and Internal	2m
Poly carbonate-thermo plastic	Used as a good shield against debris and also used as a window.	External	5m
Polymer disperse-liquid crystal device	Covering of windows.	External	2m
Super black	Used for radiation shielding.	External	0.4m
MMOD Shield	Used as a good radiation shield and is also impact resistant.	External	2m
Demron	Easily synthesized also used as a radiation shield. Provides strength to the structure.	External	1m
Ceramic	Used for internal construction	Internal	NA
Dicyclopentadiene	Used for debris shielding.	External	1m

Kevlar-49	Against debris and meteorite.	External	1.5m
Optic fibers	Used for providing sunlight	Internal	NA
Stainless steel	Used for internal construction	Internal	NA
Neoport	Used for internal construction	Internal	NA
Total thickness			26.2m

2.1.3 Artificial gravity: A gravity of 9.8N, similar to that available on the earth is achieved through rotation in the residential torus. This magnitude has been chosen because it would be the most comfortable for the residents.

The gravity of the inner torus must be equal to that of the Martian surface. We are providing a community in this torus for those who will be going to the Martian surface so that they can get used to that gravity.
This would have several advantages, some of them being:

- Ultimate mass production processes for commercial products on Mars can be initially tried and stabilized in this torus.
- Scientists, engineers, and also the tourists who will be visiting the Martian surface will be accommodated in this torus.
- If at all any life is found on Mars its study would be convenient if the test labs were located in the same gravity where it was found.

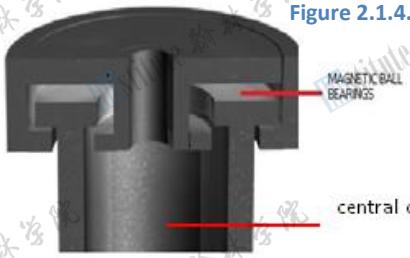
Table 2.1.3.1 artificial gravity	
Rate of rotation	0.94 RPM
Radius of Residential Torus from the centre of the cylinder	1010.56m
Gravity in Residential Torus	9.8N
Radius of Inner Torus from the centre of the cylinder	366.1m
Gravity in Inner Torus	
Third floor(agriculture)	1.5N
Second floor(industries)	2.5N
First floor(industries, transit community)	3.5N (Martian gravity)
Radius of Cylinder	150m
Gravity in the Cylinder	0-1.4N

As mentioned earlier, artificial gravity is produced by rotating the torii. Immediately after the construction is complete four propellers are attached to the torus at an equal distance between them. These would thrust the torii into the necessary rate of rotation. As there is no opposing force in space, the rotation would ideally continue forever.

2.1.4 Structural interface between rotating and non rotating sections

We the engineers of NH have decided not to rotate the docking station since there will be difficulty in landing the spaceships. For this purpose we have decided to use an innovative idea of using ball bearings between the cylinder and the docking station. These ball bearings prevent the docking station from rotating even though it is in contact with the cylinder. This is to facilitate easy landing of space ships and extra settlement vehicles. The cylinder also provides stability for the docking station.

Figure 2.1.4.1

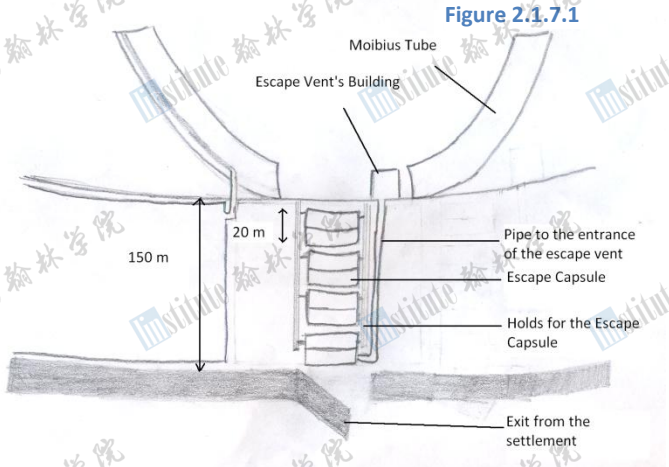


2.1.5 Shielding: Radiation is one of the main hazards of space. Safety of our settlement's residents is the main priority at NH. The materials that are used for shielding the settlement from radiation as well as debris are mentioned in the table 2.1.2.1, with such extensive shielding NH is confident that major hazards of space habitation would be kept well under control.

2.1.6 Pressurized and non pressurized sections: We will be providing a pressure of 1 atm throughout the settlement so that all the areas are accessible by the people.

2.1.7 Escape vents: In case of an emergency, people from the communities can reach the rail station using the internal mono rail and proceed to the docks using the mono rail in the Moibius tube. In a major emergency, four vents are provided at equal intervals to evacuate

Figure 2.1.7.1

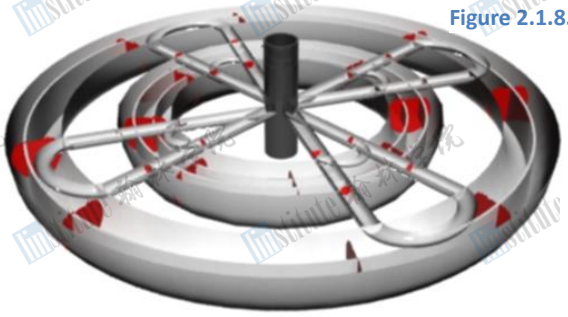


1600 people each at a time. These vents are conveniently placed beside the rail station.

2.1.8 Isolation of volumes:

In case of emergencies different parts of the settlement can be isolated automatically with the digitally controlled shutters provided at various points without affecting access to escape vents. There are 56 shutters in the figure 2.1.8.1 marked in red. Using this different part of the residential area, industrial area, and agricultural area can be isolated. The cylinder, the agricultural and industrial and residential torii can also be isolated

Figure 2.1.8.1



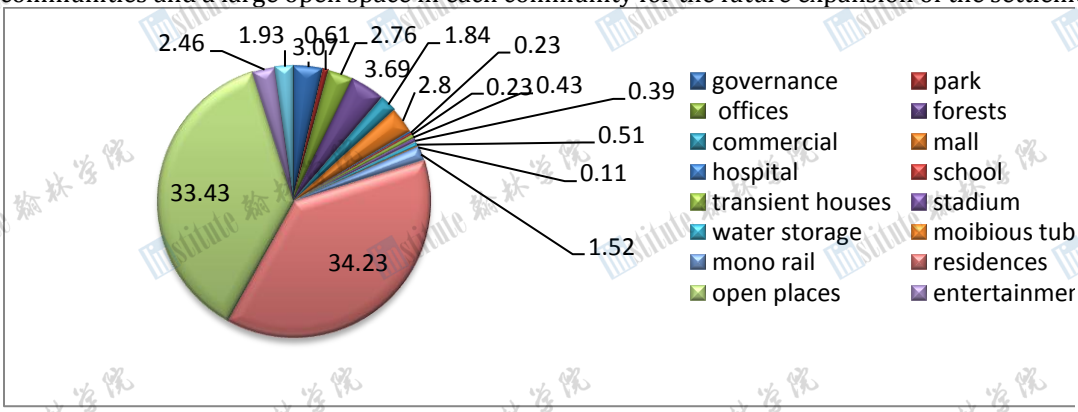
2.2 Internal Arrangement:

The key to efficient operations of any city is its planning. At NH we have a unique style of community planning.

2.2.1 Area allocation of Residential Torus

The dimension of the residential torus has been decided taking several factors into consideration. The habitable land i.e. the down surfaces for construction would be on a flat strip, placed in the centre of the primary torus. The total down surface is divided into 4 equal communities. The area of the total residential area is 3.5 km^2. This area has been divided into 4 equal communities and a large open space in each community for the future expansion of the settlement.

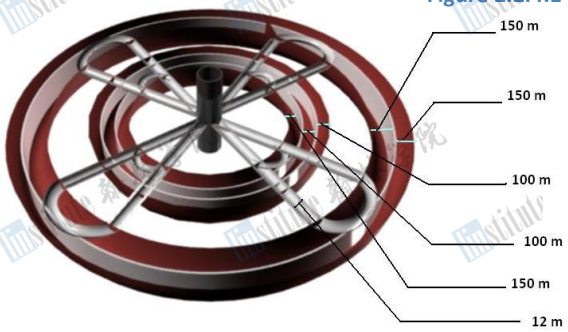
Figure 2.2.3.1



2.2.2 Area allocation of Industrial/Agricultural Torus:

The inner torus is mainly used for agricultural and industrial purposes. The total area required for industries is 1.44km^2 and the total area required for agriculture is 1.41km^2. In this total area of 2.85 km^2, we have provided a few houses so that the people going from Aresam to Argonom can be accommodated there.

Figure 2.2.4.1



2.2.3: (Refer after 2.5.4)

2.2.4 Vertical Clearance:

The vertical clearance in our settlement at various places is shown in the figure 2.2.4.1.

2.3 Construction Sequence:

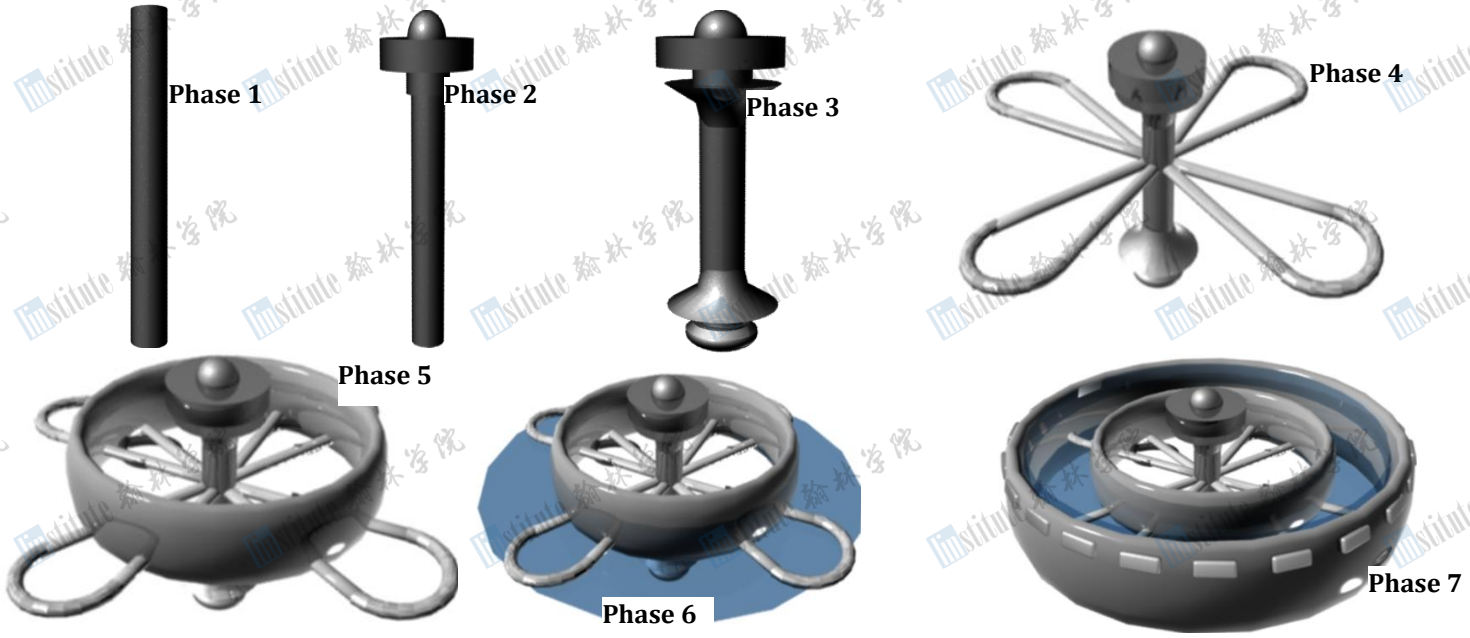
Stage 1: In this stage of construction, the cylinder is constructed partially on the lunar base and then it is launched into the orbit. The propellers are attached to the bottom of the first phase. This helps the cylinder in the linear motion. It stores the material for future construction.

Stage 2: The docking ports are constructed in order to facilitate transportation to Aresam especially for materials and machinery. The communication hemisphere is also constructed in this stage to facilitate the communication between earth and the other settlements.

Stage 3: The reflectors are constructed in this stage so that while constructing the other parts of the settlement it reflects the light. The nuclear reactor is also constructed in this stage. This will be the primary source for energy until the solar panels are built. After the solar panels are built the reactor acts as a backup energy source.

Stage 4: The two Moibius Tube are constructed in order for transportation and for supporting the torii. The MOIBIUS TUBE is built first as it helps in transportation of materials and also supports the two torii that will be constructed. It also helps in building the solar panels and other structures.

Stage 5: The industrial torus is built after the solar panels are built. This is the main manufacturing unit for our settlement. It is built for the convenient refining of the materials used for the construction of the residential torus. We will use detachable Ion and Magnetic Beam thrusters for rotating the settlement. The artificial gravity generated will be helpful for the Industrial and Agricultural sectors.
Stage 6: The solar panels will be placed in this stage to facilitate the production of electricity. This will be helpful as it will be used for supplying the entire settlement with power.
Stage 7: In this phase the residential torus is built with the windows. The thrusters are placed on this torus. With the completion of this stage the settlement will be complete and will be ready to be inhabited by people.



2.4 Future expansion:

Aresam's existing features can easily handle existing transportation demands but as Mars becomes a commercially profitable centre, the movement of goods and passengers would increase in the future. As the population increases the expansion of the settlement has to be done .This expansion demands improved facilities at Aresam in two major categories:- 1) increase in the number of docking ports
2) Expansion of some area to accommodate the people.
Some areas have specifically been left for increased residential requirements in the future. The population of Aresam increases by 3000 for every 40 years. The open spaces that have been left occupy a 33.43 % of the area of the residential torus. This open place will be used in the form of gardens till the expansion starts. For further information refer human factors.
The settlement is also going to be a very crucial part for the construction of Astoria in the asteroid belt.

2.5 Pre-Fabricated Base:

The pre-fabricated base will be constructed at Aresam and it will be kept in a container of dimensions 9m in length, 4 m in breadth and height. We at NH have decided that the structure of the pre-fabricated base will be in the form of a capsule. This capsule is simply a cylinder with two hemispheres at both ends. We at NH have selected this structure as there is more space since there will be no acute angles.

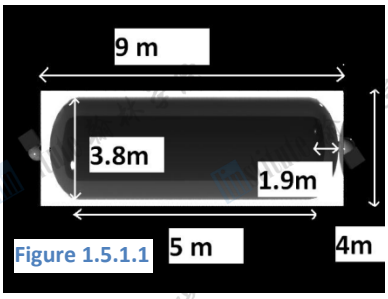


Figure 1.5.1.1

2.5.1 Stacking Procedures:

The capsule in the container will store machinery and other materials which are required for mining, research work and it will also carry some Arement walls so that they can be placed in the capsule to form rooms. These walls will be folded and placed inside the capsule. The cushioning material which is filled between the capsule and the container

would be used to make extra space with the help of the robot named ARE-KV. The solar panels and the communication dish will be stacked in a compact form.

2.5.2 Deployment Process:

- The pre-fabricated base is so simple that it can be deployed in 7 hours.
- The container would open itself with the help of automated systems.
- Then the cushioning material will fall down.
- The supporting beams for the capsule will come out, pushing the capsule up.
- Then the interior construction robot would come out and transform the cushioning material into a tube.
- The tube will be filled with air making it into a hemisphere. This will be furnished with titanium mesh, that will keep the hemisphere from exploding as the pressure outside is very less.
- In the mean time the solar panels and the communication dish will be setup by the space suited persons with the help of the robots.
- The Arement walls will be placed in order to form rooms in the capsule.
- Then the pre-fabricated base is ready to use.

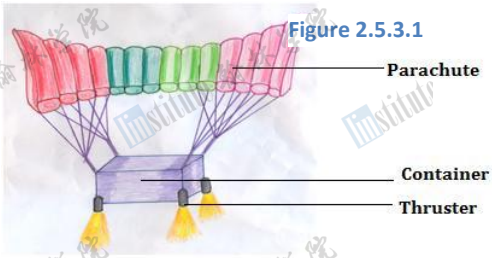


Figure 2.5.3.1

2.5.3 Interim Process:

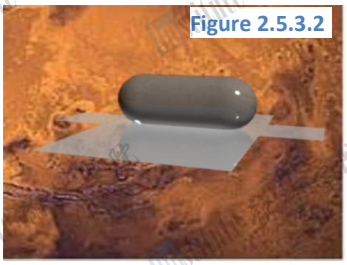


Figure 2.5.3.2

Stage 1: It is in the un-deployed form. The capsule is in the container. It is launched onto the Martian surface. It is equipped with two Magnetic beam thrusters. It will also be equipped with a parachute.

Stage 2: The magnetic beam thrusters are used to land the Pre-fabricated base safely. After landing the container opens and the cushioning material falls down leaving the prefabricated base open.


Figure 2.5.3.4

Stage 3: The door of the capsule opens. The interior of the door contains steps. As the door opens the steps come out. The ARE-KV comes out and makes the cushioning material into tubes so that they can be inflated.

Stage 4: The two space suited persons come out and they start deploying the communication dish, satellites and the tubes are inflate to form the hemisphere. The walls will be arranged in the capsule. The pre-fabricated base is ready to use.

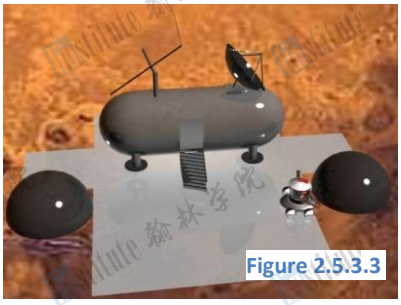


Figure 2.5.3.3

2.5.4 Un-deployment Process:

The process of Un-deployment is fast, and may take 4 to 5 hours.

- First the air from the hemispheres would be taken out; the solar panels and communication dish would be made into compact form and they would be stored in the storage area.
- The hemisphere would be then made into the cushioning material with the help of a robot.
- The Arement walls would be made into compacted form and then stored in the storage area.
- Then the poles supporting the capsule would come inside making the capsule touching the box container.
- Then the robot would go inside and the steps are taken inside and the door would close, after this the rest of the processes are automated.

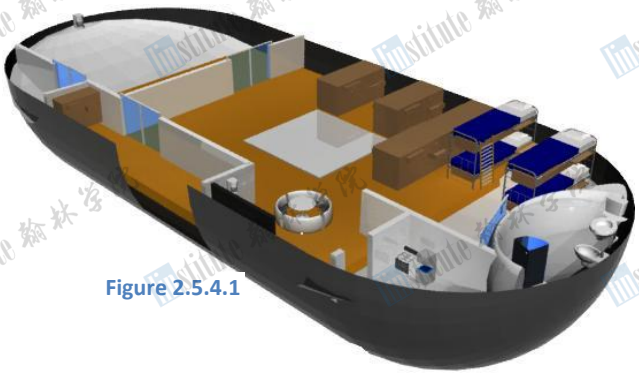
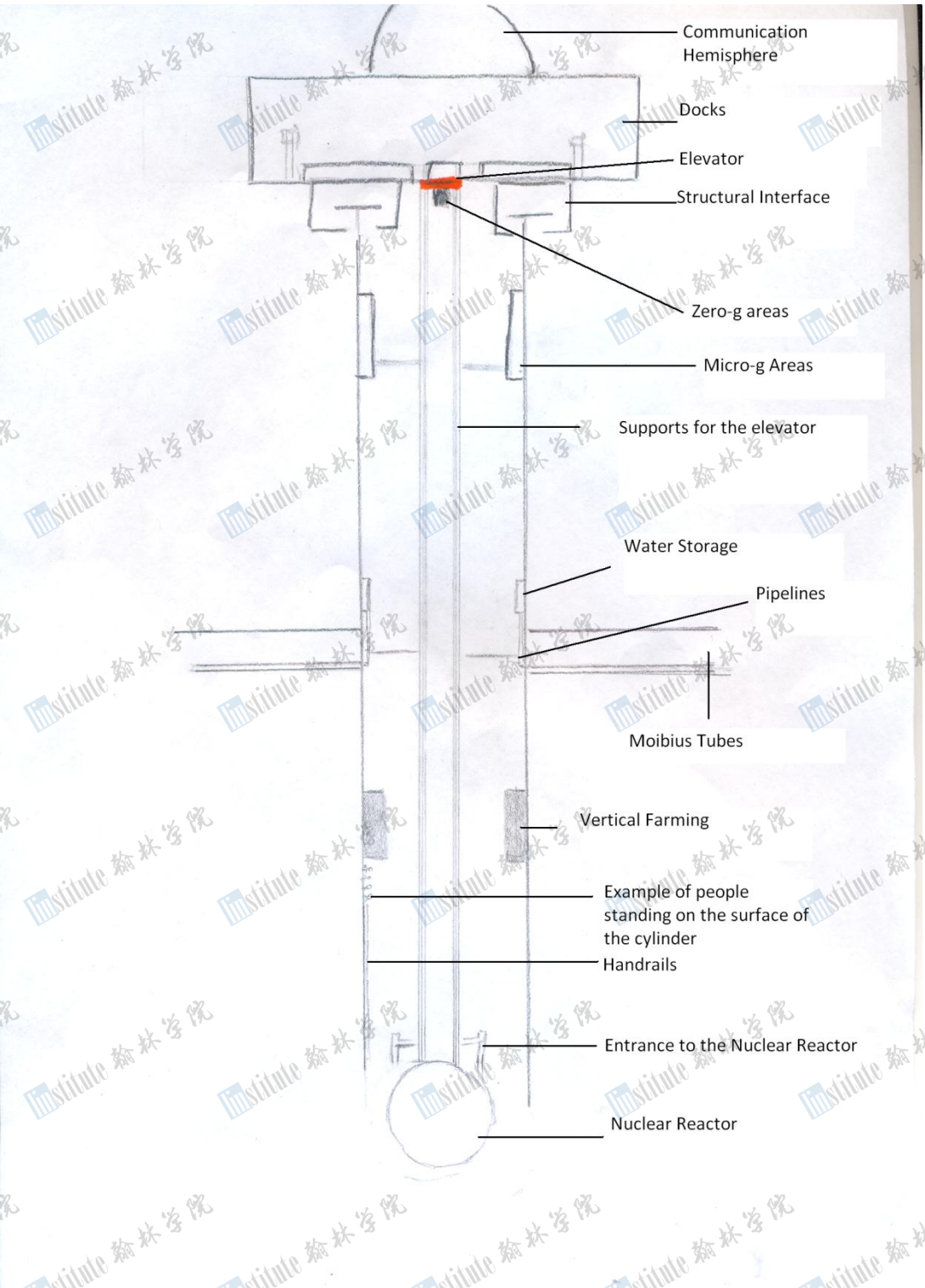


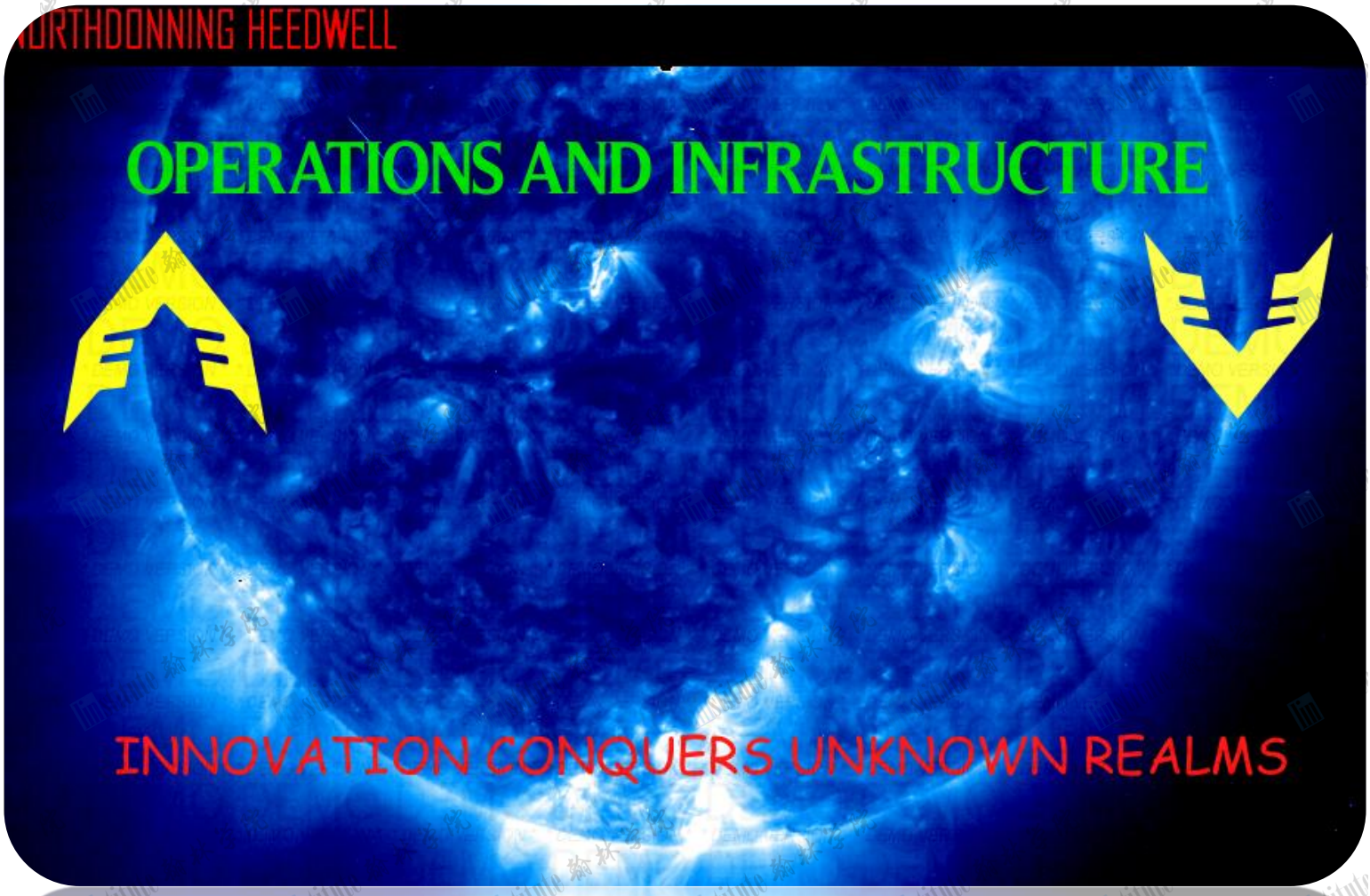
Figure 2.5.4.1

- The container would slowly close and the pre-fabricated base would be in its compressed form.
- This container would then take off to Aresam. As it will land there safely it doesn't need to do much cushioning material. But there will be cushioning material in between the container and the capsule in the case of an emergency.

2.2.3 Area allocation of Central Cylinder:

The central cylinder is mainly used for connecting the different parts of the settlement to the central cylinder with the help of the MOIBIUS TUBE. The cylinder is used for long term docking, transportation of residents and mainly the 0g activities. Firstly, a gravity of 9.8N i.e. equal to the earth's gravity has to be provided while simultaneously keeping the rate of rotation less than 1 RPM.




NORTHDONNING HEEDWELL
OPERATIONS AND INFRASTRUCTURE
INNOVATION CONQUERS UNKNOWN REALMS

3.1 We at NH will be deciding Apoapsis and Periapsis and the average distance of Aresam from the surface of Mars. The reasons and advantages of this location are:

- This location will be approximately equidistant from Phobos and Deimos. This will be helpful as we can extract minerals more easily from the moons of Mars.
- The orbit will be bent at an angle of 75 degrees to the surface of Mars so that Aresam will receive continuous sunlight during its revolution at the Aphelion of Mars.

Table 3.1.1 Orbital Location	
Apoapsis	16,489.4 km
Periapsis	16,347.8 km
Inclination of orbit	75 degrees
Average distance	16,418.5 km
Inclination of the settlement	19.8 degrees
Length of the Orbit	103,202.629km
Time period of one Revolution	5.5 hours

3.1.2 Materials and Equipment Required:

Table 3.1.2.1

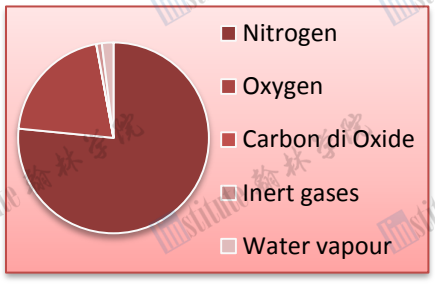
Material Required	Use of the material	Source	Amount
Titanium	Construction	Moon, Phobos, Deimos	1785 tonnes
Aluminium	Construction	Moon, Phobos, Deimos	307.45 tonnes
Optic Fibres	Sunlight Provision	Earth	NA
Kevlar-49	Radiation shielding	Earth, Moon	.15 tonnes
Super Adobe	Debris Shielding	Phobos	.265 tonnes
Super Black	Radiation Shielding	Earth	.1088 tonnes
Gold (Foil)	Radiation Shielding and Plating	Mars	.500 tonnes
Iron	Production of Steel	Mars, Phobos	NA
Arement	Construction of Houses	Made in Aresam	4800 tonnes
Polycarbonate Thermoplastic	Protection of Windows	Manufactured on Phobos Mining base	.456 tonnes
Martian Regolith	Debris shielding	Martian surface	.2305 tonnes
Silicon	Computer chips, Glasses	Phobos, Mars	1.5 tonnes
RXF 1	Radiation Shielding	Cosmic Rays	10.61 tonnes
Demron	Strength and Shielding	Mars, Earth	1.344 tonnes
Dicyclopentadiene	Debris Shielding	Earth	.2834 tonnes
Carbon Nano Tubes	Strengthening of settlement	Earth	.385 tonnes
PDLC Glasses	Natural Sunlight	Made on Earth	115 tonnes
Artificial Leather	Furniture	Earth	12.3 tonnes
Sulphur	Making Plastic	Phobos	1 tonne
Iridium and Osmium	Protection from solar flares	Earth	1.5 tonnes

Table 3.1.2.2

Equipment Required	Source
Construction Equipment and Heavy Manufacturing	Bellevistat
Mining Equipment	Alaskol

The equipment required and the materials from earth will be brought in space vehicles or through Benevectoras. The materials mined in the mining station will be transported by Sejaks. (Refer Human Factors)

3.2 The elements of basic infrastructure required by the residents of Aresam are:



Chart

3.2.1 Atmosphere:

The atmosphere in Aresam provided by Northdonning Heedwell will be the same as that of Earth's atmosphere. The pressure during construction will be maintained at 0.2 atm and when it is inhabited by people it will be 1 atm. The density of air will be 1.293kg/kl.

Table 3.2.1.1	
Gas	Percent
Nitrogen	78.08%
Oxygen	20.95%
Carbon-di-Oxide	0.036%
Water Vapour (Variable)	0-2%
Inert Gases	0.934%

The gases required will be brought from the following places or by the following processes:

Table 3.2.1.3	
Gas required	**Source**
Nitrogen	Earth , Mars, Earth's Moon
Oxygen	Electrolysis of Water, Lunar surface
Carbon-di-oxide	Mars' Atmosphere
Inert gases	Earth's and Mars' Atmospheres

Table 3.2.1.4	
Gas Required	**Method Used**
Oxygen	Electrolysis of Water
Hydrogen	Electrolysis of Water

The gases required will be stored and transported in their liquid forms. The water exhaled and lost by humans will be collected in the form of condensed water and will be sent for water purification.
There will be 2 main seasons, summer and winter. The average temperature throughout the year will be 18 degrees centigrade.

Figure

3.2.2 Food:

Seeds can be grown without soil by having favorable conditions such as Artificial Sunlight, Moisture and Atmosphere.

We will be using the method of Vertical Aeroponics to grow plants. The advantages of this method are:

- Uses very less water
- Uses less area
- Crops grow in about 30 days

The vegetables and fruits will be in the zero gravity area as they grow faster and better there. Vegetables like potatoes, cabagge, cucumber, beans etc. can be grown by using Hydroponics. Artificial sunlight will be provided using High Intensity Discharge Lamps (HID). Sprinklers will be placed on top of the rows to water the plants.
Meat will be produced using stem cells. The stem cells will be allowed to grow till the meat is formed. Then the process and the conditions required will be stopped and the meat can be consumed.

Table 3.2.2.3	
Usage	**Area in km^2**
Agriculture in Normal Gravity	0.82
Growth of vegetable and fruits in 0g areas	0.21
Growth of meat in Normal Gravity	0.38
Packaging in Normal Gravity	0.21
Total Area required	1.62

Vegetables and fruits will be salted and then will be vacuum packed. Meat will be dried and then smoked with the help of water vapour. Then the meat will be vacuum packed. The packaged food will be sent to the people as per their requirements.

3.2.3 Electricity:

Electricity in Aresam will be generated using solar power and nuclear power as backup. We will use Rotatable Organic Solar Panels. For production of Nuclear Power, we will use Lead Cooled Fission Reactors. There will be a Power Grid and a Power Generating station in the cylinder through which electricity is generated and supplied in the settlement. Minor amount electricity will be generated through Hydro Electricity. The water falls from a height of 100 m into the storage lake. Turbines will be placed here and thus electricity is generated.

Table 3.2.3.1	
Amount of Power required	20,038,000KW
Area of Solar Panels	1.2km^2
Electricity Per House	5000KW
Amount of electricity produced by 1 gram of Uranium 235	202,800KW
Amount of Uranium to be taken per year	856 grams

Electricity produced will be stored in Solar batteries. Electricity will be supplied to the Residential, Agricultural and Industrial areas from the Main source as per their requirements. The batteries will be able to store up to a capacity of 25,000KWs of Energy.

3.2.4 Water Management:

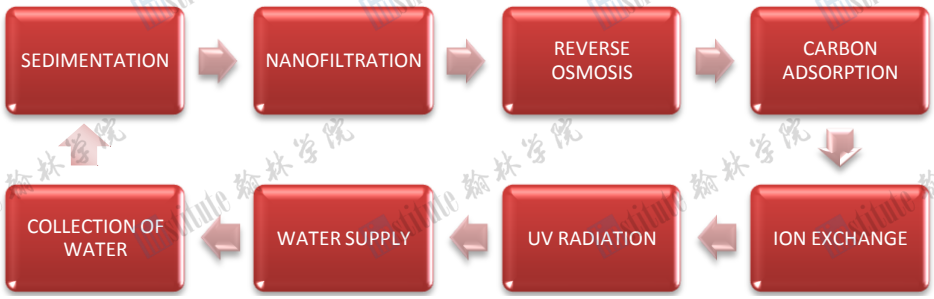
Water is required by every person in the settlement and for maintenance purposes.

Table 3.2.4.1 Water	
Source of water	Earth, Mars, Moon, Phobos, Deimos
Consumption per person per Day	56 litres
Drinking Water	4 litres
Bath	35 litres
Toiletry	17 litres
water required settlement for 6 months in Aresam	10000 kilolitres

Steam and water will be used for bathing to save water.

Water Purification:

Chart 3.2.4.2



After the water from the Moibius tube falls into the storage lake which is at a height of 20m, the water will be sent for purification process. After purifying the water will be stored at a height of 15m. This height is sufficient to distribute the water to any residence without use of pumps. Each house will have a separate tank which can store up to 65 litres of water. A small amount of water will get converted to water vapour for maintaining atmospheric balance.

3.2.5 Waste Management:

We will obtain wastes in the form of Liquids and solids in Organic and Inorganic types.

Table 3.2.5.1	
Material	**Method**
Industrial and Household Solid Inorganic waste	The solid wastes obtained from the industries will be disintegrated by the **Centrifugal Density Separator** using which we will obtain all the materials separately. Materials like K Tect can be reused directly and glass can be made molten and reused. Plastic will be refined by using the method of **Carbonization** after which the plastic becomes a biodegradable substance. A Geobacter species called as **Sulfurreducens** will also be used to degrade plastic. The residues formed will be buried on the surface of Mars and Deimos.
Solid Organic Waste	Organic solid waste will be degraded with the help of **Geobacter**. The residue will be compressed and incinerated. The remaining wastes formed will be buried on the surface of Mars and Deimos. It is estimated that per day one person can excrete upto an amount of 800 grams.
Liquid waste	The liquid waste obtained undergoes the Aeration method. The chemicals present in the polluted liquid will be neutralized. After this the water is purified and reused.
Nuclear Waste	Nuclear emissions emitted by the nuclear reactor will be absorbed by the lead around it. If the emissions escape from the reactor, the Geobacter of the species **Uraniireducens** will absorb it.

3.2.6 Communication:

Communication inside Aresam will be done through the use of 7G technology. The advantage of this technology is

- High transfer speed of multimedia files
- Transfer speed from 15Gbps-22Gbps

We will be placing 5 communication towers inside the settlement to ensure proper communication.

Table 3.2.6.1 Internal Communication	
Device Used	Glone
Dimensions (l*b*thickness)	12*6*1 cm
Number of Communication Sets	23,000 for 2 years

Figure 3.2.6.2

(Source: www.texually.org)

External Communication:

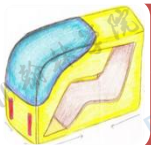
The method of communication to be used in Aresam is called Stradalite. Radio waves of the frequency 26.5 GHz to 40 GHz will be used as a medium for long distance communication. We shall be using free space optics as a backup. We will place 2 satellites, one around Earth and one around the Moon.

Table 3.2.6.3 External Communication

Technology Used	Stradalite
Number of Satellites	2
Speed	10-15 Gbps

3.2.7 Internal Transport:

Chart 3.2.7.1



CASSETTE

Capacity - 2 People (Personal Transport)

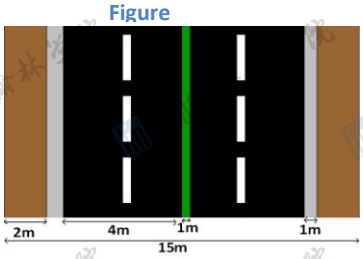
Dimensions (l*b*h) - 3*1.2*1.5m

ARECLE

Capacity - 2 People (Manual Personal Transport)

Dimensions(l*b*h) - 2*0.25* 1.3

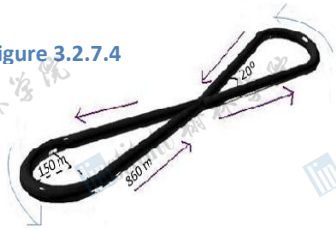
Figure



We will be providing the following for the transport internally in Aresam. Cassette cars can be fitted into the Monorail trains which can transport cassettes through communities. There will be 2 types of roads; Narrow roads and Broad roads with the widths of 7.5m and 15m respectively.

- **MONORAIL:** We will use Monorails which move perpetually under the influence of the centrifugal force and very minimal use of energy which is in fact generated while the monorail moves with no additional cost.
- Loading and unloading is done by moving two Monorails A, B with the same speed on the adjacent tracks. When the mono rail from the Moibius tube i.e. the perpetual motion mono rail(P2MR) and the Monorails A and B reach the same velocity and are on adjacent tracks the loading and unloading takes place simultaneously .
- Pipes are provided below the tracks so that goods can be transported from the cylinder to the industrial and the residential torii using the centrifugal force.

Figure 3.2.7.4



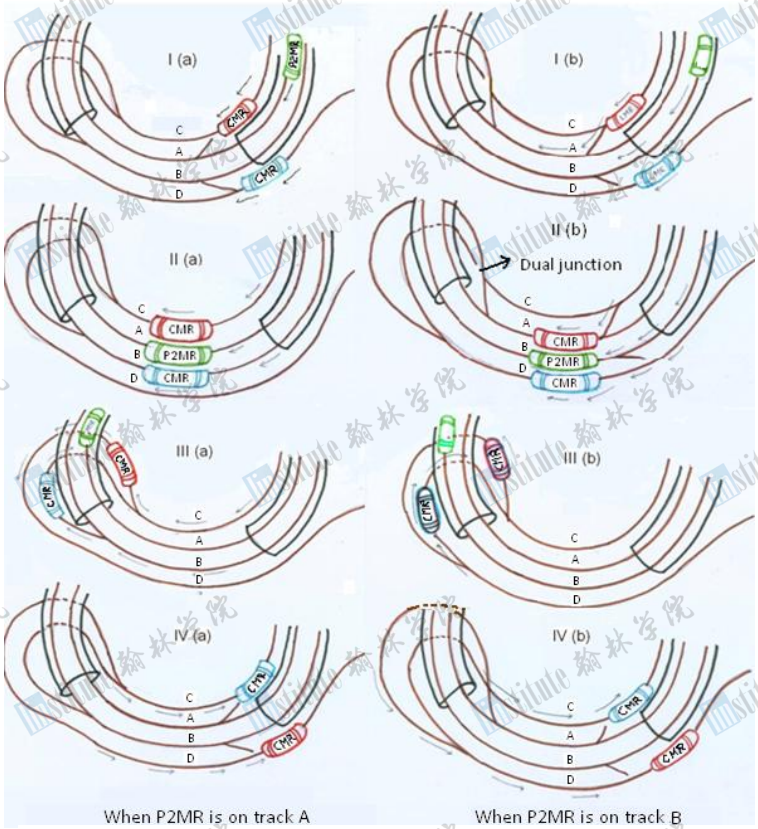


Figure 3.2.7.3: Steps showing Loading and Unloading on to and from P2MR

Direction of rotation of settlement

Direction of movement of the monorail

P2MR(Perpetual motion monorail)

CMR(Circuit monorail)

CMR(Circuit monorail)

Monorail tracks

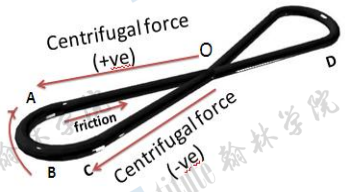
Moibius tube

Perpetual motion of P2MR:

(O to A) The Mono rail in the Moibius tube travels from the cylinder to the industrial and the residential torii using centrifugal force. The frictional force acting is negligible. The horizontal component of reaction to the revolution also helps in the increase of velocity. As it approaches **A** the velocity is very high and generator is put on to partially reduce the velocity and to produce electricity which may be required while it moves from **C**

upward. At a distance of nearly 500 m from **O** the velocity crosses 100m/sec and gradually electricity can be produced using dynamos which act as breaks. Thereafter the velocity is maintained between 100 to 150 m/sec all the while producing electricity which will be used during the movement from **C** to **O.**

Figure 3.2.7.5



Forces acting on the monorail

(A to B) At this point the velocity is of the Monorail is maximum and at **B** the residential Monorails come alongside the main mono rail **(P2MR)** with the same velocity.

(B to C) The momentum that is attained till **B** helps to move against the reaction to revolution

(C to O) The momentum attained earlier is enough to counter the centrifugal force which gradually reduces. The reaction to the horizontal component of the reaction to the revolution helps the forward movement because of the angle of the tube.

(O to D) The inertia helps it move across **O** towards **D**. From **O** to **D** the movement is similar to **O** to **A**.

3.2.8 Day And Night Cycle:

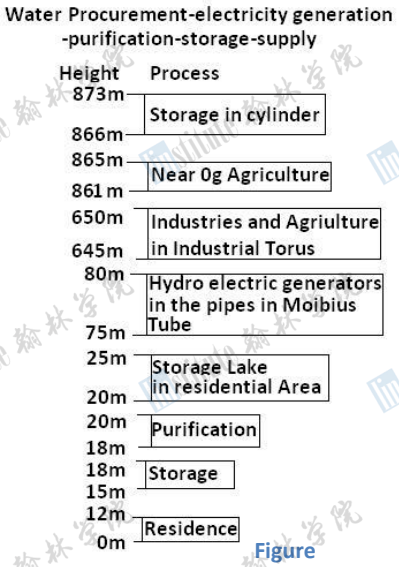
Northdonning Heedwell seeks to provide 12.5 hours of natural sunlight to the residents of Aresam. We will use PDLC (Polymer Dispersed Liquid Crystal) devices. We will place polycarbonate thermoplastic glasses above the PDLCs to protect the windows from collisions. To distribute the natural sunlight uniformly, we will be placing optic fibres across the ceiling. There will be a difference of 4 hours between each part of the settlement.

Table 3.2.8.1 Day And Night	
Number of Hours Per Day	12 ½ hours
Number of Hours Per Night	11 ½ hours
Total number of Hours	24 hours
Difference of time between each sector	4 hours

3.2.9 Propulsion Systems for Artificial Gravity:

We will be using VASIMR (VAriable Specific Impulse Magnetoplasma Rocket) propulsion system for placing the first phase in orbit. After the construction of the settlement, we will be using Ion Thrusters and Magnetic Propellers to rotate it.

3.2.10 Storage Facilities:



Figure

Table 3.2.10.1	
Places Of Storage	Cylinder, Under the Floorings
Period of Time till the commodities last	12 Months

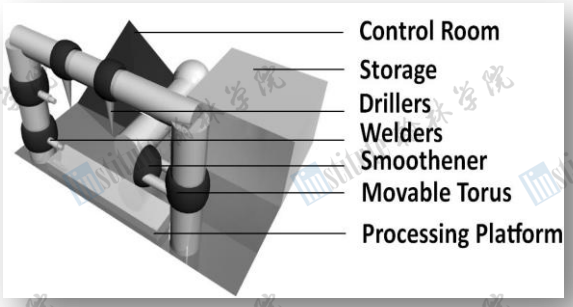
We will be producing more food than required in Aresam. This food will be stored in the cylinder and under the floor where there will be enough space.

3.2.11 Supply of Water and Electricity with routings of Waste

We will provide Pipelines underground to transport Water and Electricity and to route back wastes. We will provide Water Purifiers and Waste Purifiers in the Outer Torus.

3.3 Primary Construction Machinery

We will employ Primary Construction Machinery beside the Mining Base on Phobos. The material which is obtained after refining will be sent to these machines called Are-Cons. We will employ **2 Are-Cons**.



Figure

Features of Are-Con:

- Dimensions - 50*35*20m
- Uses: The main use of the Are-Cons is that they will convert the refined material into its final form

Please refer Automations Designs and Services for Construction and Assembling robots on Page

3.4 Mining Station:

We at Northdonning Heedwell plan to build a Mining Station on the First and the biggest moon of Mars, Phobos. Once Aresam starts getting profits, we shall establish a mining station even on Mars. The Mining Station on Mars will also act as a research station so that we will know more about the surface of Mars.

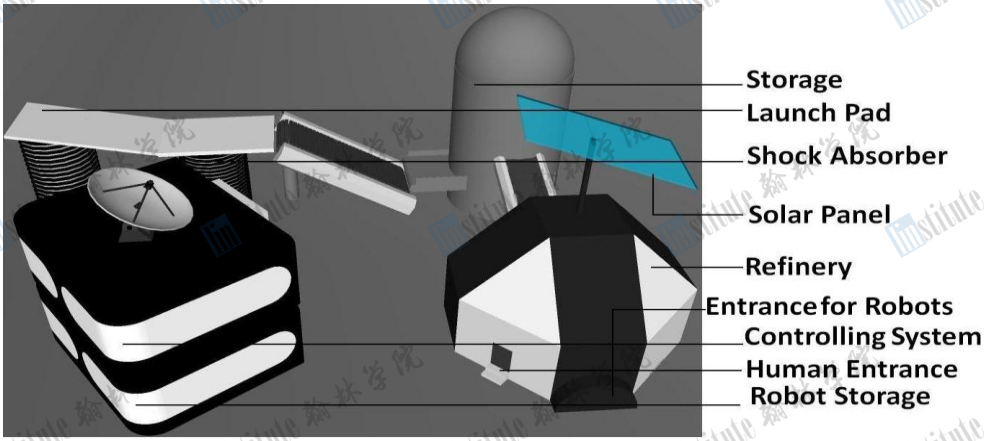


Figure 3.4.1

The above image shows an illustration of the mining station at Phobos. This mining station is equipped with refineries for ores available on Phobos.

Table 3.4.2

Part of the Mining Station	Dimensions (in metres)
Refinery (side*height)	8*5
Storage Tank (radius*height)	5*15
Robot storage and controlling systems (l*b*h)	8*5*5
Launch pad	30*26*5
Solar Panels (l*b)	9*7
Shock Absorber (radius*height)	8*10

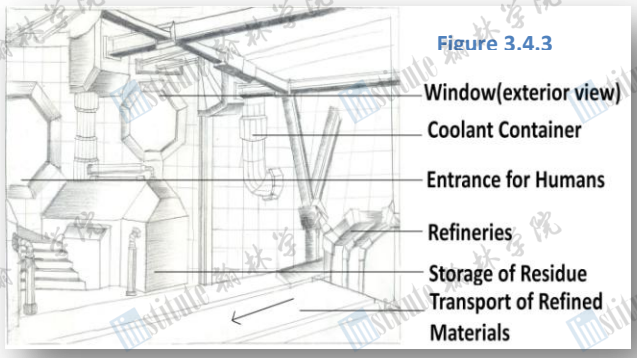


Figure 3.4.3

The following image shows the interior of the refinery in the Mining station of Phobos. The floor of the refinery is in the shape of an Octogan whose sides are equal. We will employ various methods to refine each material that has been mined out. The following charts show the methods of refining of few available materials

ALUMINIUM REFINING:

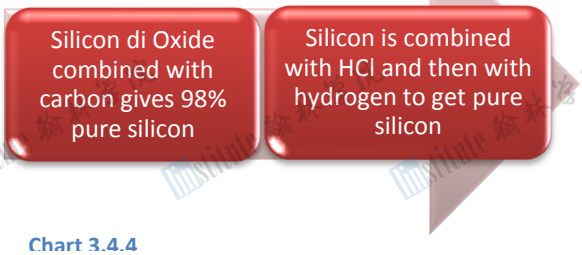


Chart 3.4.4

SILICONREFINING:

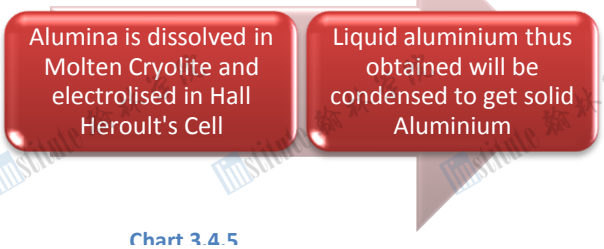
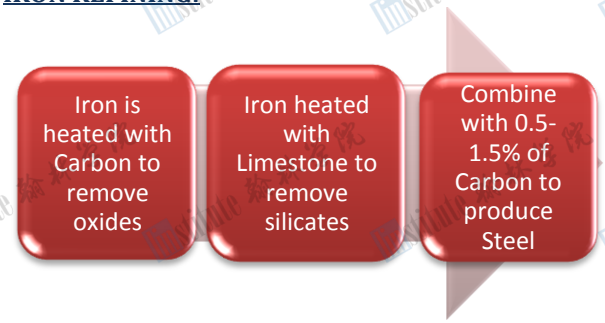
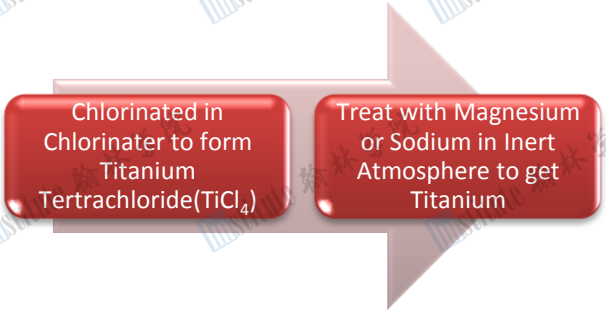


Chart 3.4.5

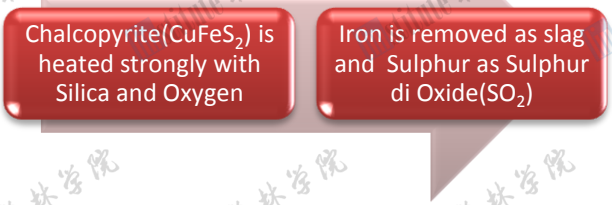
IRON REFINING: Chart 3.4.6



TITANIUM REFINING: Chart



COPPER REFINING: Chart 3.4.8



SULPHUR REFINING:

Chart 3.4.9

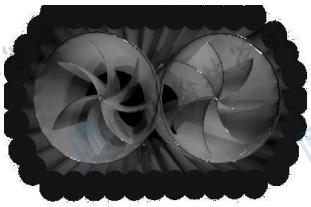
The refined material will be supplied to the Are-Cons which will be placed by the side of the mining station. The Are-Cons will shape the material into the required shape.

Transport Vehicle [TEJARIO]:

Figure 3.4.10

We will also be employing Tejario a Transporter cum Mining machine. Tejario will transport robots and mined out materials to and fro from the mining station. It is equipped with 2 cameras with a covering of polycarbonate thermoplastic which will give its controller a complete vision of the surroundings. Its Pressure Treads allow it to carry heavy loads without breaking and they have the ability to travel on most rough surfaces. The drilling arms of Tejario help it to break away obstructions or to help the robots in digging. It runs on an electric battery which can be recharged by using solar panels.

Figure 3.4.11



PRESSURE TREADS

3.5 Prefabricated Bases:

The shape in which our prefabricated base will exist is a capsule. The Facilities and Infrastructure required to operate a prefabricated base are:

3.5.1 Air:

The volume of the prefabricated base is 85.39m^3. The density of the atmosphere will be 1.293kg/m^3.

Table 3.5.1.1

Gas	Percent	Quantity in Kilolitres
Nitrogen	78.08%	66.672512
Oxygen	20.95%	17.889205
Carbon-di-Oxide	0.036%	0.0307404
Water Vapour (Variable)	1%	0.8539
Inert Gases	0.934%	0.7975426

Figure 3.5.1.2

There will also be an atmosphere controlling system which will control the amount of air according to the percentages. It will also have a backup so that it can make the atmosphere stable when it becomes uneven. We will also provide oxygen cylinders for the people who go on exploration walks on Mars.

3.5.2 Food:

The people inside the prefabricated base will be provided with food for 20 days and the food for the remaining 10 days will be grown by using the Aeroponics method. The food requirements for each person according to our maximum estimates are:

Table 3.5.2.1

Type OF Food	Amount of food required per day per person
Cereals and pulses	540 gm
Vegetables and fruits	220 gm
Meat and Fish	55 gm
Milk	155 gm
Sugar and Jaggery	50 gm
Eggs	2
Fats and Oils	35 gm
Roots and Tubers	60 gm

Plants will be grown in the hemispheres placed outside the prefabricated base.

3.5.3 Power:

The main source of Power provided in the prefabricated base will be from the Sun. We will be sending Solar Powered Batteries along with the base so that they can be recharged and used from the power generated by the Solar Panels. The requirements of the prefabricated base for power are:

Table 3.5.3.1 Power	
Power required per person per day	2 MW
Energy require for the Prefabricated base per day	16 MW
Capacity of Each Battery	8 MW
Dimensions of Solar Panel	3*1m

We will be sending 3 Solar batteries along with the Prefabricated Base. These will help in providing power for the base.

3.5.4 Water:

The source of water will be Aresam. Water will be purified in Aresam and brought to the prefabricated base. The amount of water required in the prefabricated base is shown in the following table.

Table 3.5.4.1

Usage of water per person	Amount required
Drinking	4 litres
Bathing	10 litres
Other purposes	6 litres
Total amount of water	20 litres
Mode of transport	Brought with the Base
Mode of Replenishing	By Sejaks
Total amount of water required per month	1.5 kilolitres

The prefabricated base shall consist of a storage tank with a capacity of 5 kilolitres. Water purifying systems will also be provided in the prefabricated base so that the water required will be minimized.

3.5.5 Waste systems:

Waste produced in the Prefabricated Base will be decomposed and degraded in a slightly similar manner to that of Aresam. Organic and Human waste will be decomposed by using Geobacter. Other inorganic and non-degradable material will be buried using a drill kit present inside the base. The following table shows the data for the waste management:

Table 3.5.5.1

Type of Waste	Amount
Human Feaces	Not exceeding 800 grams
Human Urine	250 ml (approximate)
Solid and Inorganic waste	400 grams


HUMAN FACTORS
NORTHDONNING HEEDWELL
YOUR COMFORT IS OUR JOY
we make u
love where u live
YOUR TEAR IS OUR FEAR

4.0 Human Factors

4.0.1 Natural Views of Space and Mars Below:

Natural view of space and mars is provided using a transparent strip and windows on either sides of the residential torus. The transparent strip is provided with prisms to provide outer views at the same time reflect the light from the sun to adjacent prisms internally to keep the whole torus lit throughout. To view mars below a reflector is provided above the mars view window

4.0.2 Features of Community Design:

The moibius tube which comes into the torus touches the community in a form of a semi-circle, above which is the Aresam Eye, a large ferry wheel which is a replica of the London Eye.
The place below the moibius tube is the area allocated for water storage.
The water from the pipeline is sent to the water storage area directly with the help of gravity and when it enters in the storage area it creates a waterfall.
The hospital is placed in the heart of the community.
There are five roads connecting the hospital.
The community contains a large area of open places (33.43%) which includes gardens also. This area is used for building new houses, buildings etc. which is a result of rapid demographic shifts.
The moibius tube's mono rail and the community's mono rail run side by side so that they can exchange cassettes and capsules. The monorails run at the same speed side by side.
The vertical farming is provided beside the monorails. They are up to three storey buildings high.

4.0.3 Features in Residences:

All the residences (including the smallest houses i.e., even 930 sft.) have bathtubs.
The luxury house has a swimming pool which is filled by the water which comes from the mini-treatment plant that is placed below the house. This water is free of chlorine; instead it is treated by UV rays.
The luxury houses contain a porch.

4.0.4 Steps taken to prevent Coriolis Effect:

We the engineers of NH have taken all the steps to prevent the Coriolis Effect in the settlement.
In the settlement as we are proving the natural views of space, there could be Coriolis Effect acting on the people living in our settlement. This is taken care by reducing the speed of rotation of our settlement to 0.94 rpm.
When the internal transportation is taking place in the moibius tube ,as the moibius tube is closed and no external view is available there cannot be any Coriolis effect.

4.1 Community Design:

4.1.1 Area Allocation:

There are two types of roads: 1) Broad Road-15m 2) Narrow Road-7.5m. The total area allocated to the roads and paths is 785,194m^2 in each Community

Table no 4.1.1.1

Area Allocated To:	Area (m^2)	Percentage	**Area Allocated To:**	Area (m^2)	Percentage
Governance	25000	3.07%	**Sound-Proof Stadium**	3750	0.39%
Park	5000	0.61%	**Water Storage**	4200	0.51%
Offices	22500	2.76%	**Moibius Tube's Mono-Rail**	960	0.11%
Forests	30000	3.69%	**Community's Mono-Rail**	12420	1.52%
Commercial	5000	1.84%	**Residences**	278365	34.32%
Malls	23000	2.83%	**Open Place (includes gardens)**	269773	33.43%
Hospital	1900	0.23%	**Entertainment**	20,000	2.46%
School	1900	0.23%	**Vertical Farming**	15700	1.93%
Transient Houses	3500	0.43%	**Roads and Paths**	785194	9.73%

4.1.2 Map of Community Design:

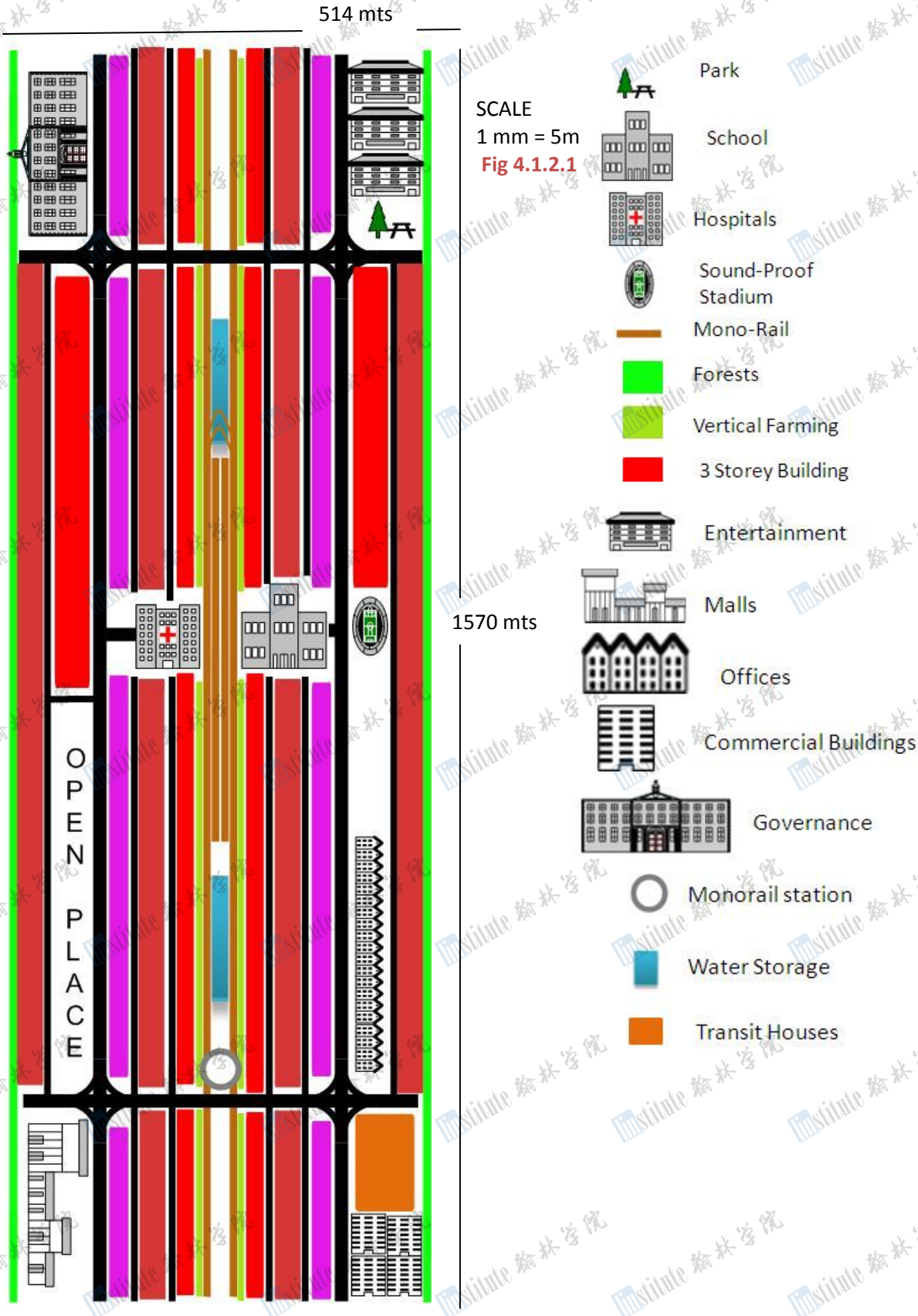
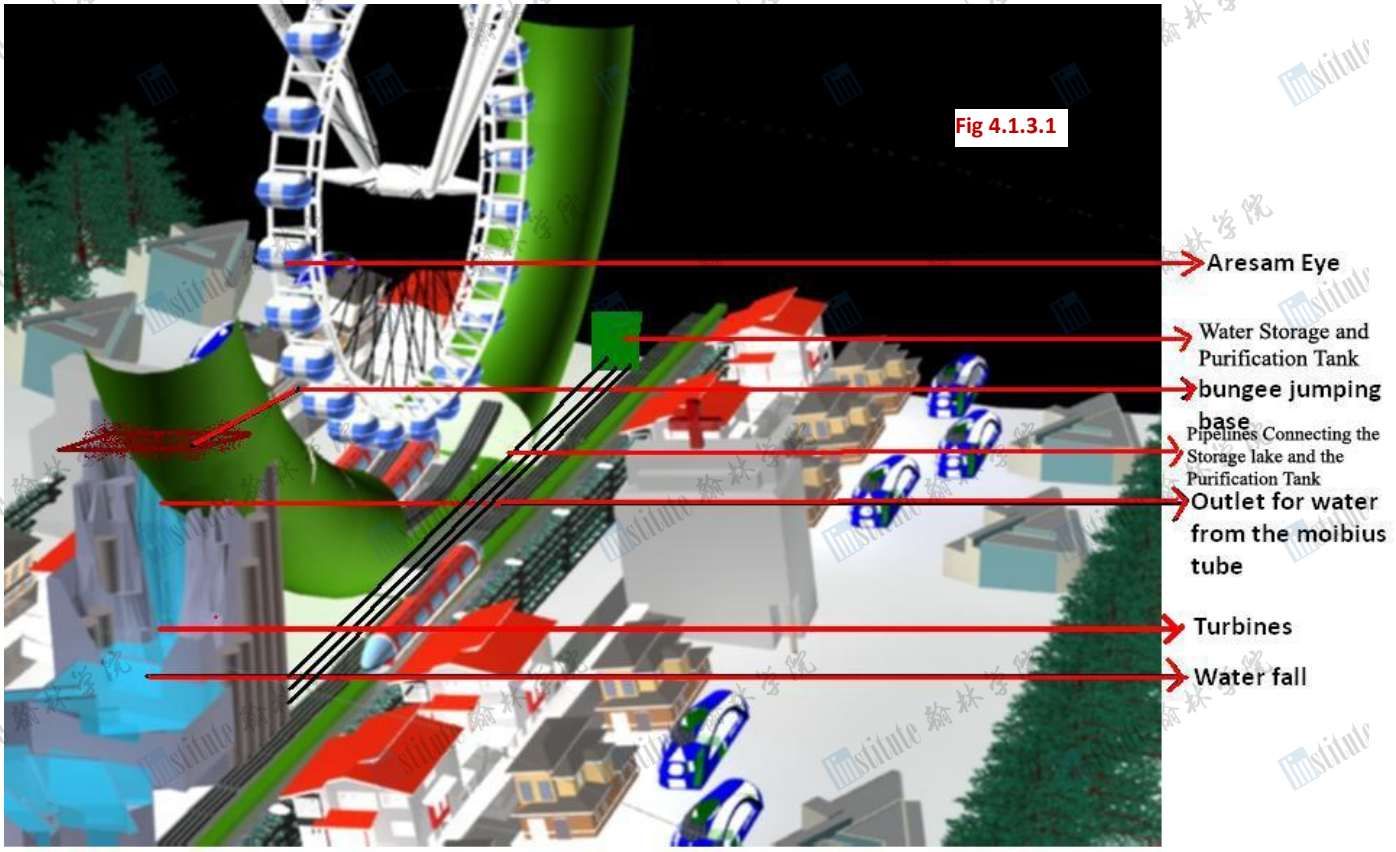


Fig 4.1.2.1

4.1.3 Entertainment:

Most of the entertainment provided in our community takes place near the moibius tube.
The part of the moibius tube that enters into the community is covered with rocks so that it provides a hillock view to the residents in the community.
An aesthetic visual effect is provided for the residents in the community by creating a waterfall, while the water is transferred to the storage tank through pipes in the moibius tube to the residential area. This also helps in partly purifying the water through aeration process.
In the community hall there will be separate rooms for yoga and meditation.



4.1.4 Variety and Quantity of Consumables

Table no 4.1.4.1 Balanced Diet Per Person Per Day

Foods	Adults (gm)	Children (gm)
Cereals	480	400
Pulses	47	45
Leafy Vegetables	70	50
Other Vegetables	55	50
Fruits	65	85
Milk	155	250
Sugar And Jaggery	35	45
Meat And Fish	45	40
Eggs	60	60
Fats And Oils	35	38
Roots And Tubers	55	30

Table no 4.1.4.3

Foods	Protein Gm	Fats gm	Carbohydrates Gm	Energy Kcal
Nuts And Oils				
Almond	22	51	20	580
Cashew nut	18.22	43.8	30.19	550
Coconut	3.3	33.5	15.2	350
Walnut	15.2	65.2	13.71	660
Meat				
Pork	18.7	4.4	0	114
Fish	88.4	1.1	0	364
Goat	21.4	3.6	0	118

4.1.5 Parks and Recreation

Aresam has given a lot of importance to parks and recreation. There is one park in each community sprawling over 5000m². There are four such parks in the whole settlement. These parks contain a small river which is simulated and the ends of parks are virtually simulated to make it look never ending!

4.1.6 Distribution

The food from the agricultural sector is brought to the residential sector by the monorail that runs in the Moibius tube. The transfer of goods takes place as mentioned in the 3.2.7 in page no. . At the station they will be transferred into the distribution vehicle which takes them to the grocery store present in the community. From here the residents can buy the goods by coming to the stores or using special debit card swipes from their houses. By just typing the desired commodity and swiping the card, money transaction will take place and the commodities will be sent to the houses with the help of service bots. No. of vans in the settlement is 40. In the van the atmosphere of the refrigeration space is controlled by cooling the interior space to a preselected temperature by spraying liquid nitrogen within the space. After discontinuing the spraying, liquid nitrogen is conducted through a heat exchanger which extends across a portal communicating the space with ambient air. A ventilator forces air through the portal and the heat exchanger and into the space, whereby the ambient air is cooled and displaces gaseous nitrogen from the space. This creates a cold breathable atmosphere within the space to enable food to be loaded or unloaded. The air is sent in containers by the P2MR.

Table no 4.1.4.2 Variety and Quantity of Consumables

Foods	Protein	Fats	Carbohydrates	Energy
Cereals And Pulses				
Wheat	23.15	9.72	51.8	360
Maize	3.2	1.2	14	122
Peas	5.4	0.4	14.5	80
Spices And Condiments				
Cardamom	10.2	2.2	42.1	229
Chilies	15.9	6.2	31.7	246
Ginger	1.82	0.75	17.7	20
Vegetables And Fruits				
Cabbage	1.28	0.1	5.8	20
Cauliflower	2	0	5	20
Apple	0	0	10.4	56
Banana	1.09	0.33	22.8	90
Lemon	1	0.9	11.1	57
Carrot	1	0.2	9	40
Potato	2	0.1	19	80
Onion	1.1	0.1	9.4	40
Diary Produce				
Milk	3.2	4.1	4.4	67
Egg	3.1	2.8	0.2	39
Butter	1	81	0	720

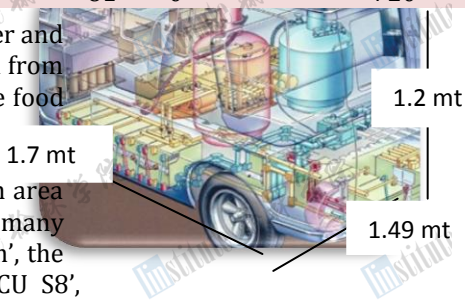


Fig 4.1.6.1

4.1.7 Medical Facilities:

There are four hospitals in the residential torus. Each hospital is spread over an area of 500m². These hospitals can also enable quarantine. These hospitals use many technologies such as the 'AGreen system', the 'Are- Toric Solution', 'Are- Doppler HCU S8', 'Are-WS'. The AGreen system is a wireless system which is fixed in the hospitals which tracks the staff members, checking whether they clean their hands properly; and tag them if they don't. 'Are-Toric Solution' is a combined solution to provide a fast and reliable toric lens surgery to patients with increased safety through an integrated workflow. 'Are-Doppler HCU S8' is a portable system which is a perfect combination of 4D and echo-cardiology which is used in the cardiology wing and other technologies which can be used in other branches of medicine. The high configuration of system enables to meet the strictest requirements from the cardiologist. Are-WS is a wireless video technology to meet the video transmission challenges in the operating room.

Fig 4.1.7.1

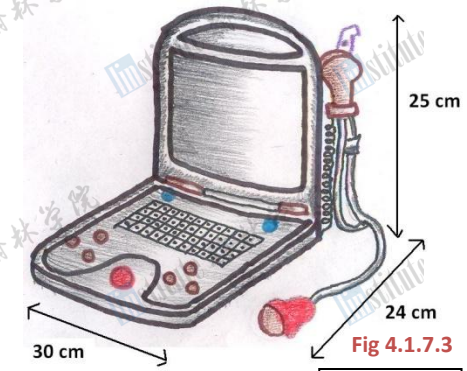


Fig 4.1.7.3

Are-Doppler HCU S8

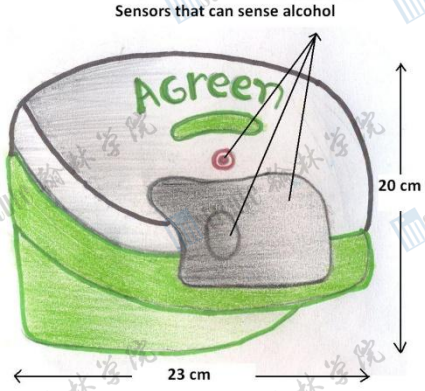


Fig 4.1.7.2

Fig 4.1.8.1

4.1.8 Education

In Aresam there will be one school. With latest developments of a particular subject or topic at their disposal, students can definitely enhance their knowledge and skills not only for examination but for careers as well with the help of the digipads. The students will be able to access the videos, web pages, text documents or notes installed by the teachers. The digipads comes with a touch sensitive display that permits the use of a stylus to write papers, solve math equations, highlight text and make notes, creating a digital classroom environment for students.

4.1.9 Long Lines Of Sight

The community is designed in such a way that it apparently appears to be big. The line of sight would be similar to that of Earth i.e, 1120m.

4.2 Housing:

The population has been divided into three categories *viz.* High Income (20%), Medium Income (50%) and Low Income (30%). According to these categories they have been allocated houses.

4.2.1 Interior Floor plans

Fig 4.2.1.1

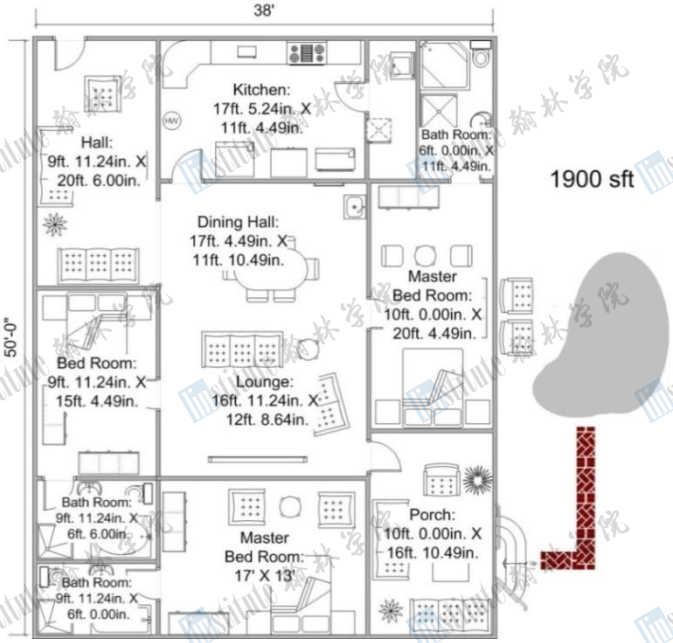


Fig 4.2.1.2

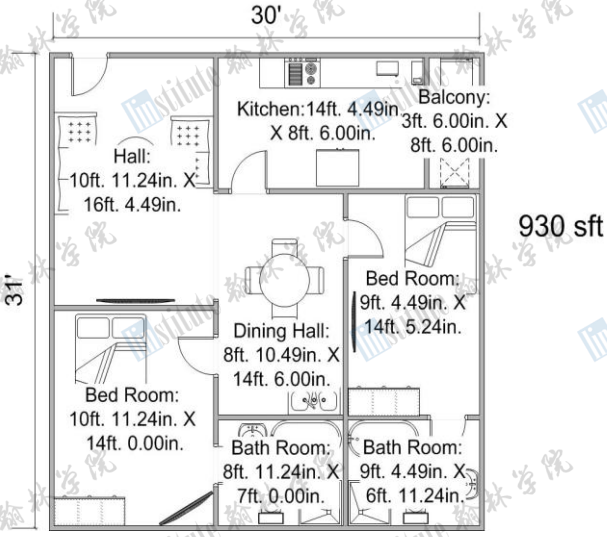


Fig 4.2.1.3

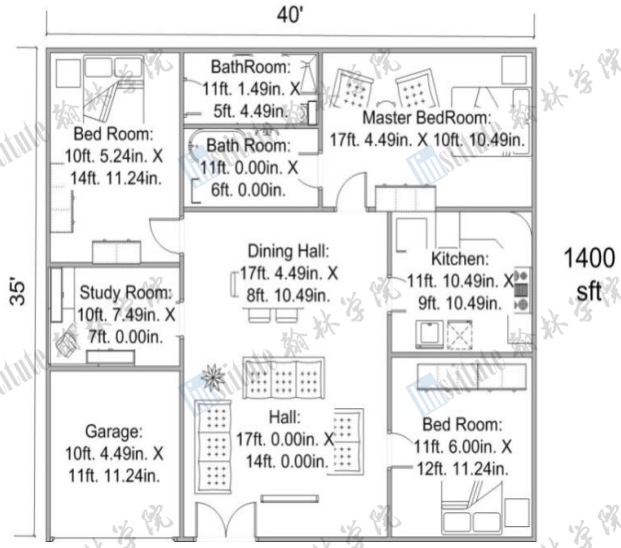
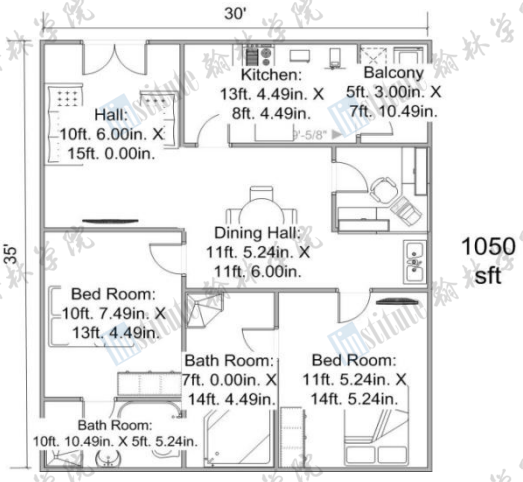
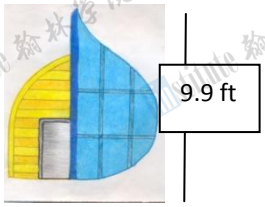


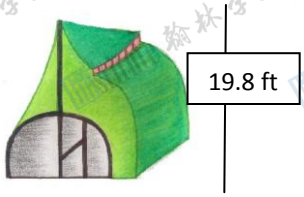
Fig 4.2.1.4



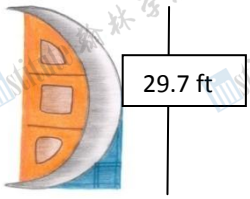
4.2.2 External Drawing



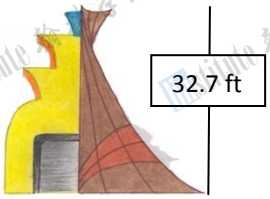
Eco-Pagoda
Fig 4.2.2.1



Egyptian Greens
Fig 4.2.2.2



Lunar Melon
Fig 4.2.2.3



Flower Steep
Fig 4.2.2.4

All the four designs are eco-friendly with flowering, aromatic, fruit bearing plants lining the walls of the houses giving them soothing effect and natural colors. The plants aid balancing of atmospheric gases and prevent unhealthy radiations from the walls. This also becomes a viable option for reducing the cost of food and aesthetics. We would also use seasonal flowers and change the external colors periodically.

Table no 4.2.2.5

Design Name	Area occup-ied (sft)	No of Bedr-ooms	Allocated to	No. required for each design	No of floors	No of houses per floor	No. of buildings	Area per floor (sft)	Total Area (sft)
Figure 1 (Design 1)	1900	3	High Income Married Adults	800	1	1	800	2400	1920000
Figure 2 (Design2)	930	2	Low Income Singles	580	2	2	145	2015	292175
Figure 3 (Design 3)	1400	3	Medium Income married adults and high income singles	2520	3	2	420	2975	1249500
Figure 4 (Design4)	1050	2	Low Income married adults and medium income singles	2650	3	2 3rd floor is penthouse	530	2275	1205750

4.2.3 Furniture Table no 4.2.3.1

Design	Description	Total no of the furniture	Material	Dimensions
 Fig 4.2.3.1 Energy POD	This pod is sound proof. It will energize the person and it also plays music.	7350+1055(in offices)	Aluminium, leather	1.8 mts X 0.5 mts X 0.4 mts
 Fig 4.2.3.2 Multipurpose Bed	This bed would be provided in the hall which gives the facility of watching television and storing books. It is convertible.	6550 (one in each house)	Titanium, Glass , Cotton	

 Fig 4.2.3.3 Egged Table	This furniture is easily convertible and when closed it requires comparatively little space to store when not in use. It is used in offices to work. It can accommodate four adults	2110	Cotton, aluminium, iron	Radius = 1.3 mts, height = 0.8 mts	

4.2.4: Source and Manufacture of Furniture items and Appliances:

Materials such as aluminium, titanium and iron are brought from Phobos and materials such as glass cotton are made/grown in Aresam

The manufacture of furniture items and appliances will be made with help of Are-KV.

4.3 Safety Systems and Devices and Vehicles

4.3.1 External Transportation **Table no 4.3.1.1**

Design	Name	Utility	Capacity	Distinct Features	Dimen-sions	No. per each design	Payload (lbs)
 Fig 4.3.1.1	Sejaks	To transport various robots from Aresam to mining base on Phobos and mars and vice versa and wastes to Deimos.	50 robots	Its structure helps to transport the robots, goods and machinery easily.	20m x 20m x 10m	3	710,231
 Fig 4.3.1.2	Auror a	To transport passengers between Earth and Aresam	1165	Unique different design is useful in the dock and easy to land	22m x 15m x 6.6m	5	46,600
 Fig 4.3.1.3	Viper	To transport passengers between Mars and Aresam	960	Its sleek design makes it the fastest means of transport between Earth and Aresam.	25m x 14.86m x 8m	3	14,124.8
 Fig 4.3.1.4	Pugna	To transport people and cargo from Aresam and other settlements	650	Luxury and gaming facilities inside the ship.	15.5m x 7.6m x 4.9m	10	24,206

4.3.2 Airlock Systems

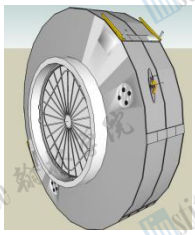


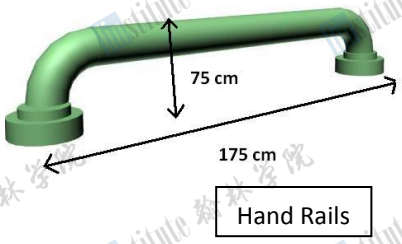
Fig 4.3.2.1

Dimensions: - Radius r = 47.72 mts height = 5 mts Capacity -600 people No. of Floors-2. It contains two floors with a capacity of 300 each. Each floor has a height of 2.5 mts

Another airlock is provided on top of the major dock which will give access from the top of the dock to the chamber where the docking is done. This dock will be used mainly to transport space ships

The radius of this dock = 100 mts. The height of the dock=80 mts

Fig 4.3.4.1



4.3.3 Safety systems to be used in zero-g or micro-g areas:

Human access in micro-g will be basically low but there will be more robots working in this area.

There will be cameras and motion sensors to monitor the humans in the zero-g and micro-g areas.

These cameras will report danger if there is any harm caused to the humans.

4.3.4 Safety Devices to be used:

Handrails: These handrails will be kept on the walls so that the humans can walk safely in the zero-g areas. These are provided at a height which is suitable for humans. The handrails that are attached to the walls are 9 cms in height.

Foothold: The foothold to be used in these areas is designed in such a way that it provides utmost comfort to the humans. There is a support for the Achilles' tendon so that it doesn't go back. There are also magnets provided below the heel of the foot so that the foot remains in place. Cushion is also provided below the hold for the front part of the foot so that there is no harm caused to the foot. This is a common problem experienced by humans in zero-g areas.

Tethers: The tether will be attached to the spacesuit near the stomach which can be attached to the handrail also. This can enable fast movement in the zero-g or micro-g areas. The tether is provided with a spring so that they can move about for some distance freely. The spring in the tether is attached around the stomach so that it doesn't hang down.

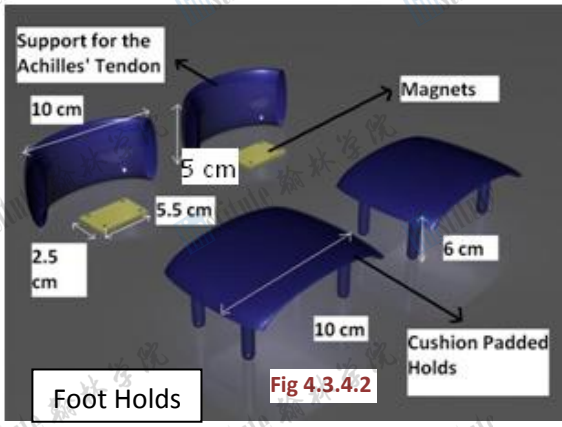


Fig 4.3.4.2

4.3.5 Space Suits

We are providing two different kinds of space suits. One is for operations in unpressurized volumes within the settlement and the other is for external operations and Mars operations. Radiation shielding is provided to the space suits used for external and mars operations and the ones used inside the settlement are not provided with radiation shielding.

Fig 4.3.4.3

4.3.5.1 Donning and Doffing Procedures:

While donning the space suit the person first wears the flexible bio suit and does not wear anything else for the next half an hour, so that he gets used to the bio-suit. Then he wears the gloves and the gecko boots. And then finally wears the pressurized helmet. While doffing the suit, first the helmet is to be removed then the gloves and the boots and finally the bio suit.

4.3.5.2 Materials used in making space suit:

Nylon tricot; Spandex; Urethane-coated Nylon; Dacron

4.3.5.3 Special features of the space suit:

It is skin tight and is very comfortable.

It provides easy mobility.

Using the specially designed tethers the space suited persons can attach themselves to the hand rails and other devices provided in the micro gravity regions.

It is so comfortable that people using that can even take a nap in it.

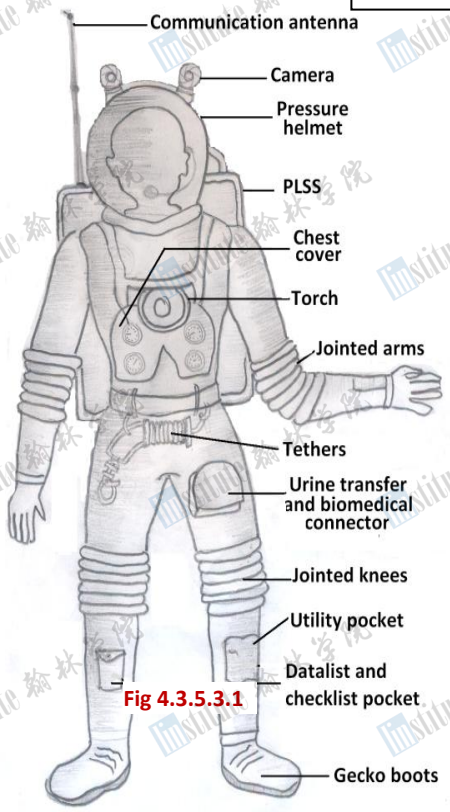


Fig 4.3.5.3.1

4.4 Demographic Shifts:

Since Aresam will get a lot of residents and transient population, the settlement is designed in such a way that it can accommodate up to 22000 people including the transient population. Hence flexible community design and residences are provided.

4.4.1 Demographic Changes in the Transit Population:

There is a constant increase in the transient population i.e., 50 per year up to 30 years. After 30 years the transit population will become 2000.

4.4.2 Flexible Housing and Community Design:

We at Northdonning Heedwell are providing a free space of 273273m^2 in the community. This will be used for future expansion. Initially this will act as green cover for the community and when the expansion starts this space will be used for the construction of houses. The walls in the houses are made up of Arement sustainable which can be used as interior walls, exterior walls, floors and roofs. These can be easily installed and easily removed and taken to a different place or can be built as offices or new houses. These are very useful for the transient population. The transit population is temporary and every time a new person comes to the settlement he must be provided with a new house. So these walls can actually

be removed and they can form a new house according to the person's choice. The number of floors can be increased and also partitions can be made to make new rooms.

4.4.3 Demographic Trends:

The population of Aresam will gradually increase over time. The increase in population is given in the following two charts. There will be a gradual increase in all sections of people and it increases more in the case of singles as children grow up to be singles.

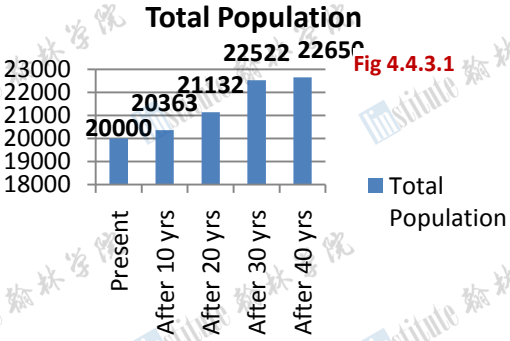


Fig 4.4.3.1

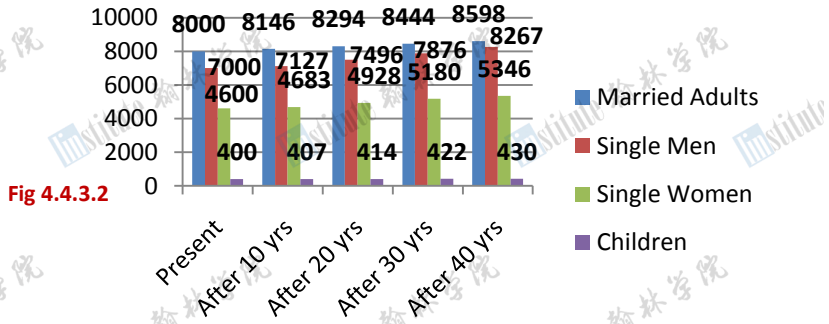


Fig 4.4.3.2

4.5 Prefabricated Bases:

We at NH realized the importance of research work on Mars. The floor plan of the pre-fabricated base is given in the adjacent figure. The dimensions of various

4.5.1: Features of the Prefabricated Base:

There are two double bunk beds with the racks below the mattress. The columns of the bunk bed can be reduced in height so that they will take fewer places when stored. This is convertible to a sofa.

There is an opening provided for the storage area below the floor. This will be closed once the pre-fabricated base is in its un-deployed form.

The water will be stored in the cushioning material surrounding the capsule with a capacity of 5.97 kl.

The table provided in the capsule is named as 'egged table' (please refer 4.2.3). During storage the ARE-KV will be stored safely under the table and in between the material.

There is area allocated to information storage which acts as a 'black box' to the pre-fabricated base.

An airlock system is provided near the entrance of the capsule to control the pressure. Place for donning and doffing of the spacesuit is provided.

One of the hemispheres outside the capsule will be used for aeroponics and the other one will be used for storage.

The acute angles created in the bathroom and near the bunk bed are perfectly used up by the shower, bidet and the table.

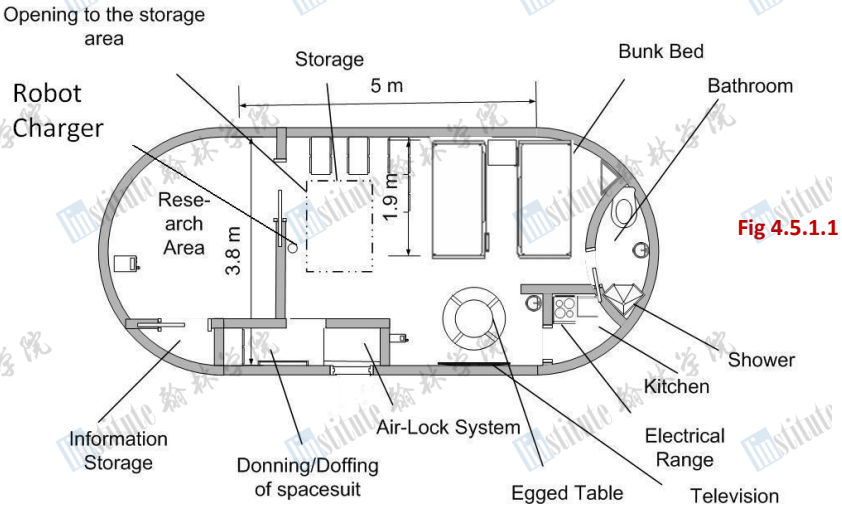


Fig 4.5.1.1

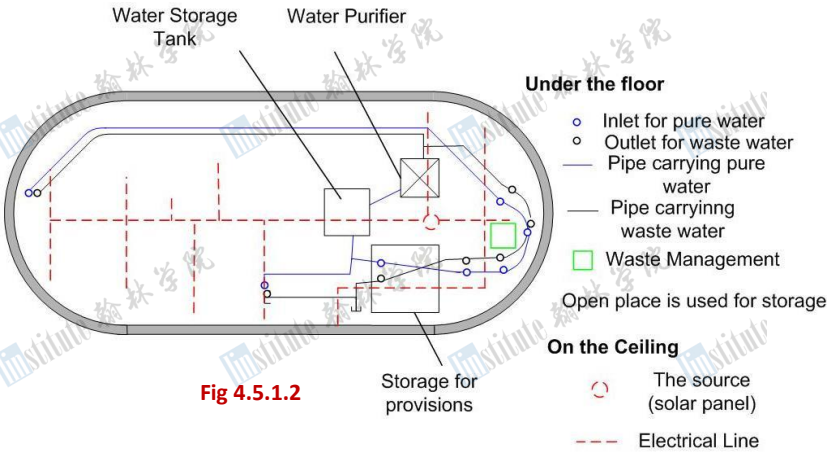


Fig 4.5.1.2

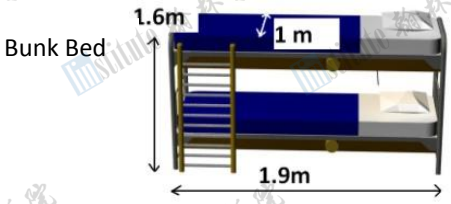
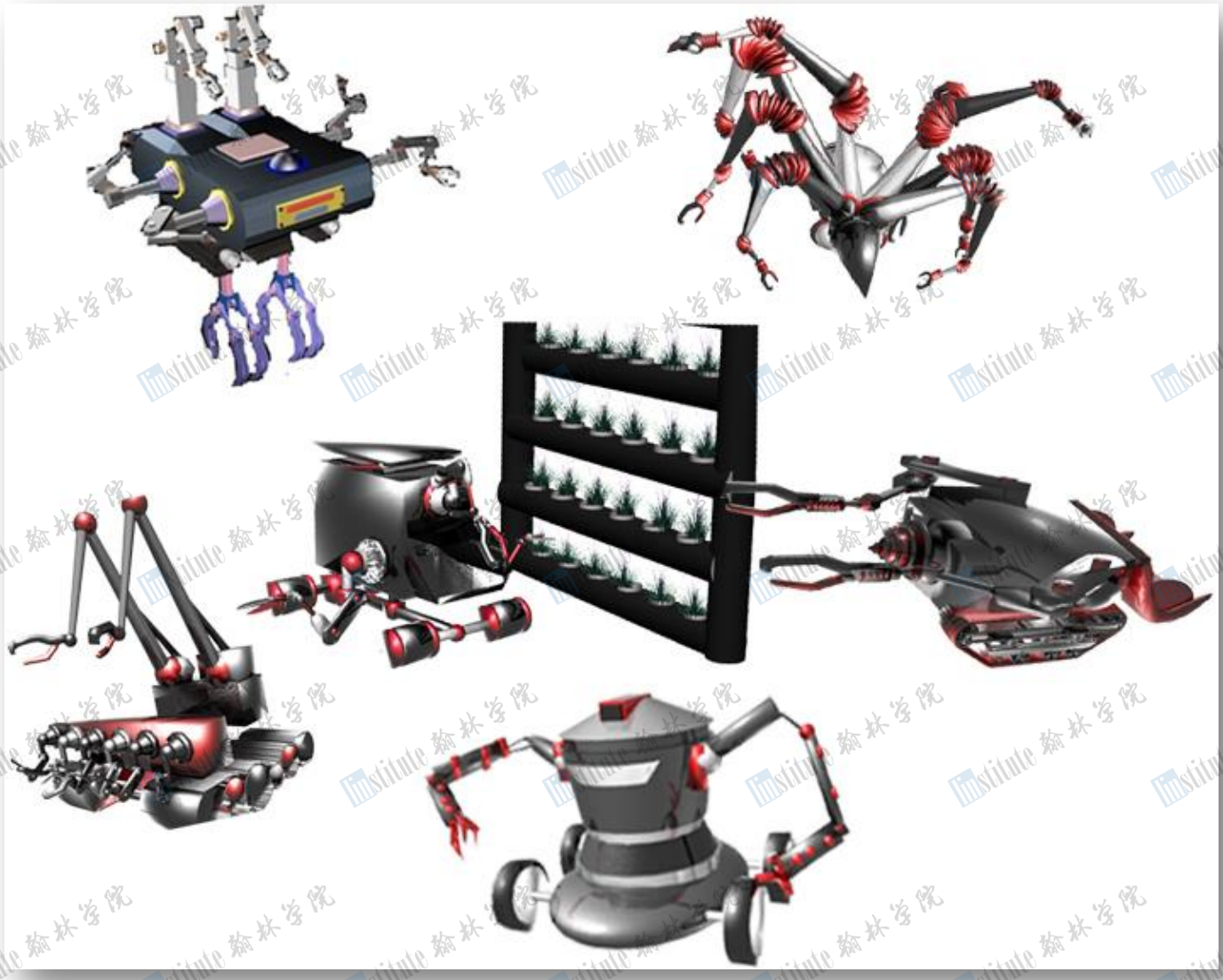


Fig 4.5.1.3

NORTHDONNING HEEDWELL

AUTOMATION DESIGNS AND SERVICES

LITTLE FLOWER HIGH SCHOOL



5.0 AUTOMATION DESIGNS AND SERVICES:

The Automation Engineers have worked untiringly to provide the best facilities to enhance the livingability of the people of ARESAM. The robots we provide have been designed and developed by ourslves. The robots mentioned are cost-effective and reliable. We are not only keeping in view the maitenance of the community but also the maintenance of the robots. Keeping in view the RFP we put forward our department.

Table 5.0.1 showing the different Devices used and their configurations:

DEVICE	HARD DISK CAPACITY	RAM	TRANFER SPEED (MAX.)	PURPOSE
Personal device	1024 GB	17.9 GB	2.6 GB/s	For gaming, music, programming and designing. It is also equipped with a projector, which projects a virtual screen on any opaque surface and uses hand signals as input signals.
Home PC	5252 GB	92.2 GB	14 GB/s	This serves for the purposes of gaming, music, and programming, designing, and scheduling personal activities. They also allow the humans to give commands and control the robot's functions. The PC's main function is to provide entertainment and storage facility to the humans in the settlement.
Industrial computers	15360 GB	269.688 GB	81 GB/s	Used for all industrial purposes: Such as, controlling, planning, designing and programming the robots. It has high storage capacity. All the, reports, fatal errors, chemical leakages , if any and minor/major damages etc, will be recorded in these PCs. All the above will also be reported to the nearest sub-server.
Hospitals	840 TB	14.6 GB	11 GB/s	Used for storing health information of the residents. The information is recorded till the person leaves the settlement. If the person migrates to any other settlement these records are sent to that settlement.
Schools	6144 GB	107.875 GB	21 GB/s	The school computers are used for educational purposes. These are loaded with softwares that are necessary for the lessons, chapters, educational material, syllabi, periodical examination papers, results, reports etc. These records are very important as the student will be given a copy of his records when he completes his schooling.

Table 5.0.2 showing the details of the Servers and their Configurations:

TYPE OF SERVER	HARD DISK CAPACITY	RAM	TRANSFER RATE(MAX.)	NUMBER OF SERVERS PRESENT
Main Server of the Settlement	1,026,460 GB	18022.4 GB	121 GB/s	1
Residential and Entertainment Sub-Server	547,143 GB	8396.8 GB	64 GB/s	2
Industrial and Agricultural Sub-Server	763,659 GB	12902.4 GB	78 GB/s	2
Back-Up Server	4,581,954 GB	15974.4 GB	182 GB/s	4

5.1 Automation for construction and interior finishing and assembly:

5.1.1Automation for External construction: We the Automation Engineers of NH have decided to employ RCX 1(Figures 5.1.3 and 5.1.4) to serve this purpose. This robot has two clamps through which it attaches itself to any supportive structure. It also consists of four thrusters fixed at different places to facilitate the movement. The arms possess the capacity to hold, place and weld the material in place. In addition to the above, it also has storage area, a built in computer and a camera.

5.1.2 Automation for Internal construction: The ARE-MSR Robot (Figures 5.1.5 and 5.1.6) is used for the interior construction of the settlement. This robot has three specific parts i.e., storage area, welding arms and placing arms.

5.1.3 Automation for Interior Furnishing: The ARE-KV Robots(Figure) are employed for the furnishing and finishing of the interiors of the settlement. After completion of this stage the same robots are used to facilitate the needs of the residents in their homes.

Table 5.1.4 showing the robots used for construction and assembly of the settlement:

ROBOT	SPECIFICATIONS	DIMENSIONS (L X B X H) M^3	USES
ARE-JS	Spider-like arms, two laser arms.	[5 X 3.7 X 6.3] $\mathbf{10^{-27}}$	Used to repair minor damages and report it to the main server using radio signals.
ARE-MSR ROBOT	Conveyer belt, Storage area, Variety of arms to serve various purposes.	2.5 X 2.0 X 4.0	Used for Internal construction; transporting, placing and welding materials in place.
RCX 1	Clamps, Lasers, Pincer arms, storage capacity.	1.5 x 2.0 X 2.5	Used for exterior construction. Once the settlement is built, these robots will serve during the times of emergency for external repairs.

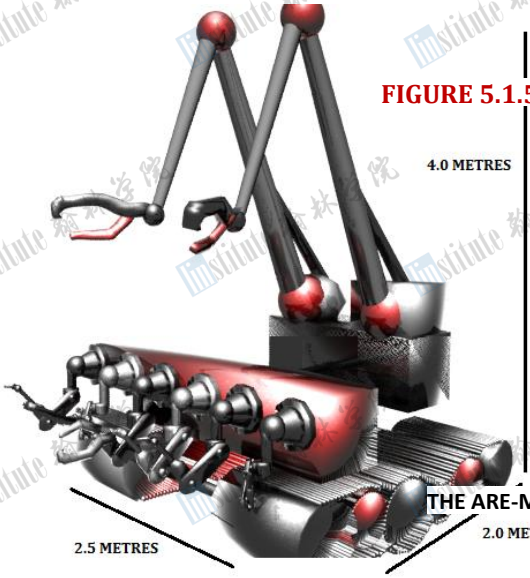
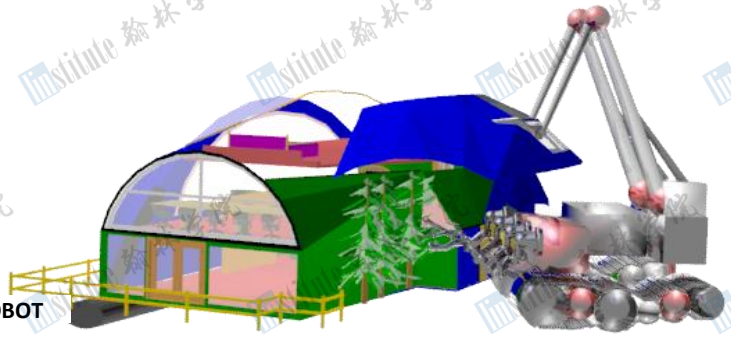


FIGURE 5.1.5

FIGURE 5.1.6



THE ARE-MSR ROOBOT

FIGURE 5.1.7

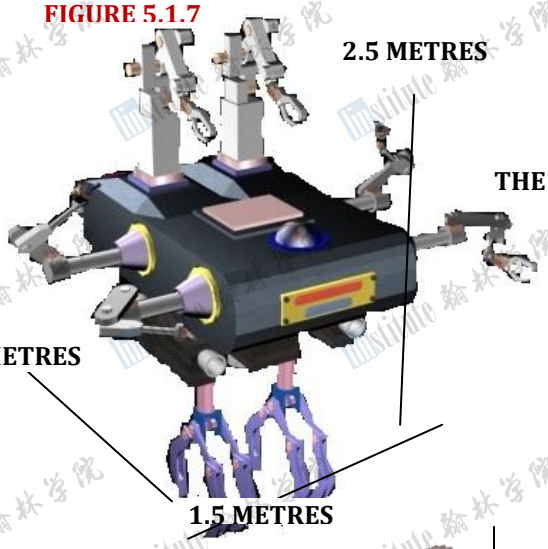
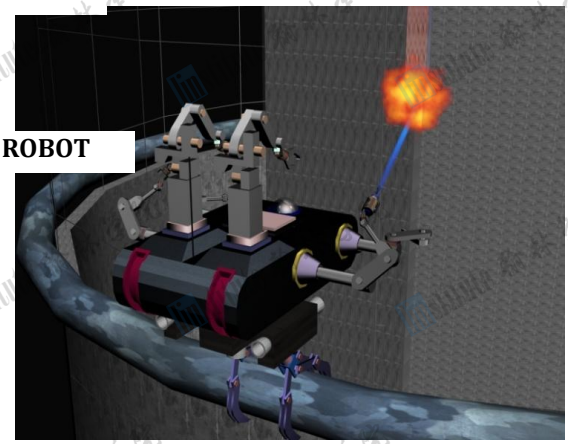
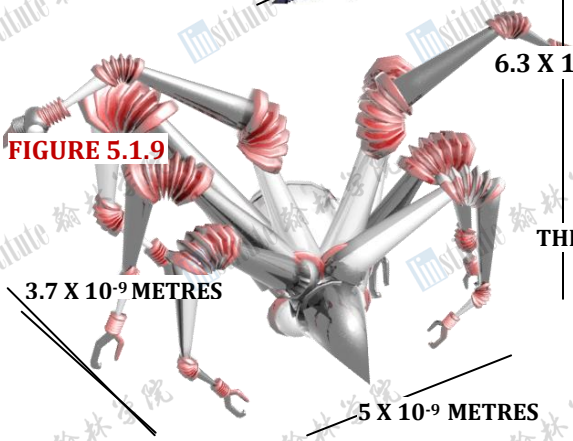


FIGURE 5.1.8



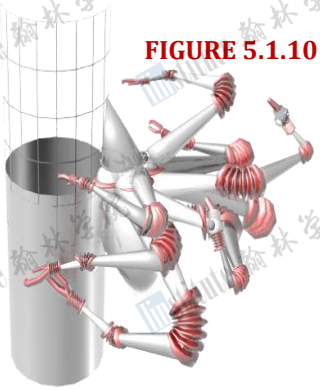
THE RCX 1 ROBOT

FIGURE 5.1.9



THE ARE-JS ROBOT

FIGURE 5.1.10



5.1.11 Automation for transportation: We at NH have not allotted specific robots for transport of materials from the source to the construction site. Instead we have provided storage area in each of our construction robots. Transport of goods and cargo is done through special conveyer belts. Robotic arms are provided at the junction of two conveyer belts to sort out the cargo.

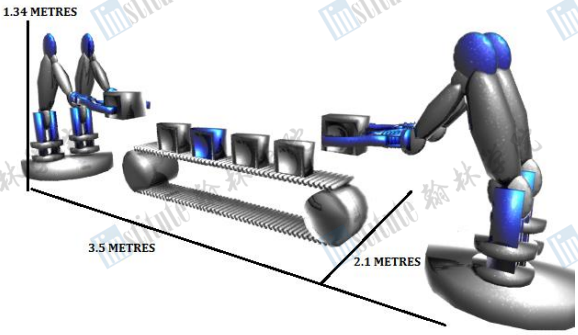


FIGURE 5.1.13

5.1.12 Automation for the Assembly of settlement: The settlement's central cylinder is initially built near Alaskol, the moon base, and then uses propulsion systems to place it in orbit. Then the RCX 1 robots start their construction process. Once the basic skeleton of the structure is built, the ARE-MSR Robot starts its internal construction and then the ARE-KV robots are employed to finish the furnishing of the settlement.

5.2 Automation systems for settlement maintenance, repair, and safety functions, including contingency plans.

Table 5.2.1 showing the Contingency plans for the settlements safety:

DAMAGE CAUSED	INDICATIONS	RESPONSE WITHIN	REMEDIAL ACTION
Damage to the Shielding	Alarms ring in that particular region.	15 seconds	People from that specific area are evacuated to the next community. Robots are deployed to repair the damage as fast as possible.
Fire Break-Out	The temperature recorders blow an alarm.	5 seconds	The water spouts fixed to the roof begin to shower at that specific region. In industrial areas, the industries cease functioning until the problem is solved.
Damage to the settlement by an asteroid or any other body.	All the alarms ring. All the functions going on in the settlement cease	Immediately	People are evacuated through the escape ports and transported to the nearest settlement. The robots first evacuate the people and then themselves get into the escape ports.
Change in the amount of gases in the atmosphere	The atmosphere controlling system reports it immediately to the nearest sub-server.	5 seconds	The people living in that specific area of the settlement are evacuated until the atmospheric gas %'s are brought back to normal. Robots will then patrol through that area to see if there was any corrosion caused to the structure due to the changes in the atmosphere.
Failure in the functioning of the Solar Panels	Naturally we will observe power fluctuations in the settlement. The corresponding system also sends an malfunctioning report to the nearest sub-server.	70 seconds	Power production is shifted to nuclear power as fast as possible. The defective solar panels are replaced by the new ones by the robots. The defective ones, if repairable are mended and stored for further usage. Later, power production is again shifted back to solar power
Uncontrolled production of nuclear energy	The system employed to control this energy will send an error report.	15 minutes	The nuclear reactor chamber is detached as soon as possible. Any other damages caused to the settlement, are repaired. Robots patrol through the nearby areas to make sure that there are no traces of wastage of nuclear energy in the settlement.
Failure in water processing systems.	Over storage of water leads to the bulging of the water pipelines. Supply of impure water occurs when the purifying systems fail. The systems monitoring this function forward an error report to the nearest sub-server.	3 minutes	Until the repairs are made, the water supply and storage in that area is stopped. Robot patrolling in that area also takes place after the repairs.
Failure of PDLC devices.	Complete brightness or darkness is	45 seconds	Robots are deployed immediately to repair the damaged PDLC devices. Failure in doing so, may

	observed in that affected areas.		cause many adverse affects on the humans and the settlement itself.
Failure of Propulsive Systems	The settlement's propulsion is halted or the movement of the settlement will be disturbed a little.	20 seconds	The damaged propulsion systems are detached and new ones from the storage are fitted.
Failure in the Electronic clothes	Small electric shock impulses will be felt by the person wearing them.	20 minutes	The batteries of these electronic clothes will be immediate disposed through robots. The person will be transported to the hospital for a check-up. Any health hazards/side effects caused due to the electric impulses will be treated.
Damage to the Monorail Systems	The monorails fail to function properly. There may be some major/minor damages detected.	15 minutes	The systems controlling the monorails will detect any major/minor - damages/problems and report to the nearest sub-sever. This damaged monorail will be repaired through another service monorail. The time required to repair may vary according to the type of problem caused. Later, the monorail will have to go through a few primary tests.
Damages in Airlocks	There may be varying differences in the level of air inside the airlocks. People inside will feel suffocated and breathless.	10 seconds	This problem in the airlocks is immediately detected by the system controlling it. People inside are immediately evacuated and repairs are undertaken. Several tests are done before the airlock is used again.
Solar flare	The robots working on the exterior of the settlement will get damaged due to the solar flare.	Within 1 min	A coat of Iridium- Osmium alloy, Martian regolith and silver coated cenospheres will be immediately painted over the robots and then the nanobots are employed to detect any minor reapirs.
Unauthorized Access	ID's, Servers and computers can be subjected to hacking.	10 sec	Locate the infringement and trace theIP of the hacker. The AHTS(Advanced Hacker Tracking System) will be activated immediately.

5.2.2 Robots for maintenance: Maintenance of the seetlement is one important aspect. We are therefore, emphasizing on the topic that more robots are employed to do this work. We are configuring this task of maintenance in as many robots as possible so that the costs can be maintained and the number of robots on the settlement is reduced. Lesser the robots more the people feel earth-like.

5.2.3 Robots for repair: For minor repairs, the ARE-JS are used. They fill the gaps and seal the settlement. For major damages, the construction robots are employed. These robots these are made of titanium and coated with Iridium- Osmium alloy, Martian regolith and silver coated cenospheres and hence are resistant to solar flare activity.

5.2.4 Authorized access to Critical Data: Care is taken not to allow the personal and private data into the settlement. The provision of personal devices to every resident of the settlement is actually one of the methods to ensure it. Confidential data of the settlement is maintained in highly protected computers and different methods like scanning of retina, DNA, finger prints and providing passwords to ensure that the data is not lost to an unauthorized person.

Portable data sticks: We the engineers of NH have decided to use a new breed of portable data-sticks, which use light pulses to transfer data. These devices have a storage capacity, which starts from 8 TB. These devices store data in a way, similar to the SSDs, but show a distinction in the method of data transfer.

They convert the data into light impulses, which fall on the single photon detectors installed in all the computers and personal devices on ARESAM.

Table 5.2.5 showing the number and names of various robots:

Name of the Robot	No. on board in ARESAM
ARE-KV	6,990
ARE-MSR	87,653
ARE-TAR	170,000
ARE-SAN	130
ARE-JS	35,000
RCX 1	143,547
ARE-KV (Compact Form)	660
ARE-RP	50

Table 5.2.6 listing anticipated automation requirements for operation of the settlement:

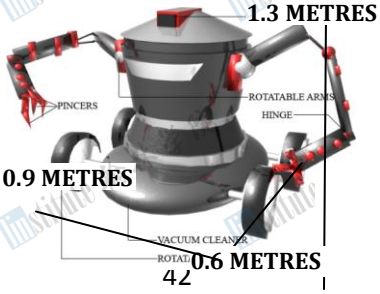
PURPOSE	SYSTEM	FUNCTIONS COVERED
Structural Maintenance	ARE-SM	Security, cleanliness, other simple operations of the settlement.
Atmospheric Control	ARE-AC	Supervision over the temperature, pressure, humidity etc. Can be over-taken by humans at any time.
Nanobot systems	ARE-NS	Commands over the ARE-JS Robots in the settlement used in various field viz, Biology and repair of the settlement etc.
Enhancing robotic work	ARE-RW	Updates the robots with the latest information periodically and improves their work efficiency
Environmental Adaptability	ARE-EnA	Sense the climatic entities and reports them to all the robots for them to adapt.
Domestic Maintenance	ARE-DoMain	Supervises over the maintenance of the communities, sectors and the settlement
Electricity distribution and Generation	ARE-Elec	Supervises over the electricity necessities, production and consumption. It also supervises the solar-panels' functioning and usage. .(Refer Operations And Infrastructure pg.)
Networking	ARE-NW	Supervises the networking in ARESAM. Any problems and fatal errors found will be reported through them.(Refer pg.)
Help services	Sub-Servers	It facilitates the residents with help services like fire emergencies, health emergencies etc.,
Food Management	ARE-FM	Supervises over the production, consumption, usage, harvesting and culturing of crops in the settlement. Also supervises over the Vertical Farming Method of production.(Refer Operations And Infrastructure pg.)
Health Monitoring	ARE-HM	Supervises and records the health of the residents. Also controls and commands the electronic clothes.(Refer Human Engineering pg.)
Docking Control	ARE-DC	Supervises stores and displays the schedule of ships docking into the settlement. Also monitors their repairs and launching functions. Loading and unloading of cargo is also taken care of by this system.
Day/Night Cycles	ARE-DNS	Supervises over the day and night cycles and controls the PDLC glasses.(Refer Human Engineering pg.)

5.3 Automation for Enhancing livability in ARESAM:

5.3.1 Personal delivery of services: For Internal and external Communications Services, Entertainment, Information and Computing, the computers and personal devices are used. ARE- KV Robots are provided to each house in the settlement. Other robotic assistance is provided as and when necessary.

5.3.2 Maintenance robots: Maintenance of a community is an important factor that will attract people to reside in ARESAM. We are providing space-class facilities to the residents to make their lives simpler, faster and better. The ARE-KV Robots, Are-JS Robots are mainly employed for these purposes. The ARE-KV Robots, apart from the houses'

FIGURE 5.3.3



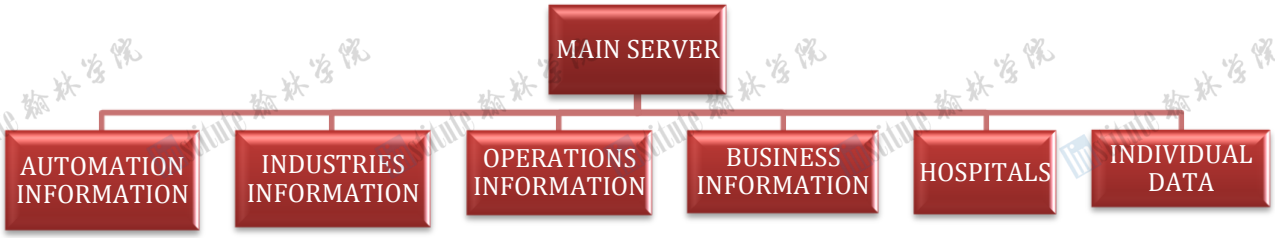
maintenance, will also involve themselves in the maintenance of the community they belong to, whereas the ARE-JS Robots will indulge in minor repairs of ARESAM.
The ARE-TAR also is used to harvest the crops grown in and around the residential communities. The ARE-TAR, apart from harvesting, also helps in cleaning-up and maintaining the hygiene in the settlement.

5.3.4 Automation for Agriculture: The ARE-TAR agricultural Robot is equipped with various parts like the scissor-arms, storage compartment and pincer-arms. It also has an elevator fixed on its top-side that helps it take samples from bigger heights.

FIGURE 5.3.5

FIGURE 5.3.6

5.3.7 Information stored in the main server that will be accessible only by authorized personnel:



AUTOMATION INFORMATION:
- Number of robots used in the settlement.
- Remedies for new diseases.
- Computers involved in different purposes.
- Robots involved in the hospitals.
- Computers used for dictating the information to the robots.

INDUSTRIES INFORMATION:
- Information of production of new goods.
- Research information.
- Mining stations.
- Details of new materials found on Mars.

BUSINESS INFORMATION:
- Cost of various things.
- Accounts showing profit and loss in the settlement.

INDIVIDUAL DATA:
- Education Records
- Certificates
- Identity Proofs
- Criminal Records
- Health Status
- Other Personal Data

HOSPITALS:
- Health records of all the people in the settlement.
- Types of robots and their daily routine.
- Types of medicines to be used for different diseases.
- Security systems.

OPERATIONS INFORMATION:
- Research for pre-fabricated base.
- Water processing system.
- Day and night controlling system.
- Schedule of space ships.
- Internal and external communication.
- Waste processing.
- Propulsion systems.

5.3.8 Networking in Aresam:-We at Northdonning Heedwell are providing butterfly network for external and honey comb network for internal networking. For this networking, we are providing a main server in the

center and an extra server shall be provided which will act like a backup server. This server will be connected to the main server. The main server will further continue on both sides into two sub servers. There will be Industrial Server and Agriculture Server on both sides of the Main Server connected to the first Sub-Server.

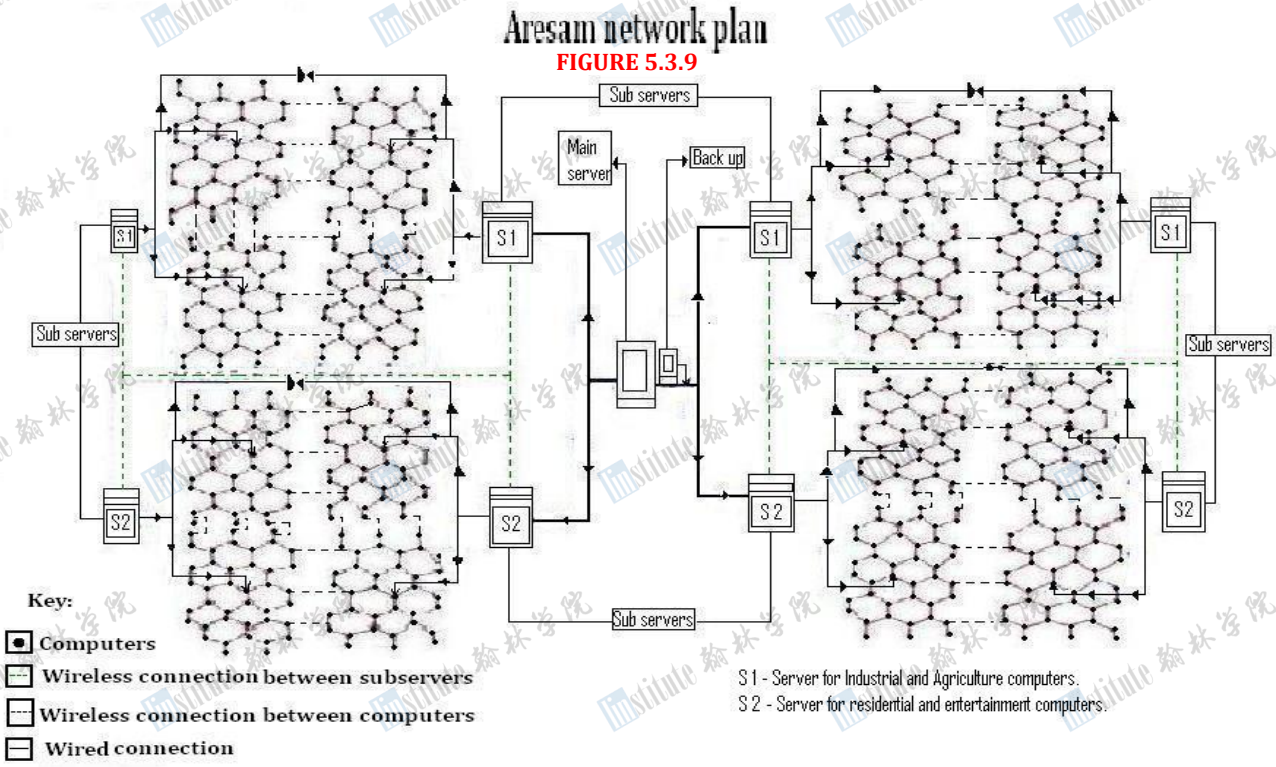


FIGURE 5.3.9

To the second Sub-Server, Residential and Entertainment sector Server will be connected. The computers will be connected in the form of honeycomb mesh network. As there are two types of computers connected to each Sub-Server the honey comb arrangement will be divided into the form of bus network. This shall further continue in a wireless connection to another set of computers which are arranged in the form of honeycomb in the serial of bus and are attached to another sub server. Likewise for the other Sub-Server the computers will be connected in two groups. These are the Residential and the Entertainment sector. These computers are further continued in the form of another set of wireless computers. All the Sub-Servers in the settlement are connected to each other with wireless means of communication. If any person from the Industrial sector wants to access his computer from the Residential sector then he will have to pass through certain formalities like retina scan, finger print, passwords etc. from the Sub-Server the connection to the computers will be provided with the help of a node present exactly in the center of the honey comb. Therefore there shall be total eight Sub-Servers provided in ARESAM and one main server, the other acting like a backup server.

The following measures are taken to avoid hacking, and misusing of personal and very critical data. The critical data of the settlement will be loaded onto the Main Server of the settlement. The personnel having access to the Main Server has to pass through many securities and only then will he be able to operate it. The checks would not take much time as two to three checks will be done at one time. If unsuccessful then an alarm rings immediately with high intensity that will make that person unconscious (the sound resembles the ultra-sonics.) If successful then the person will be able to operate the Main Server without any difficulty.

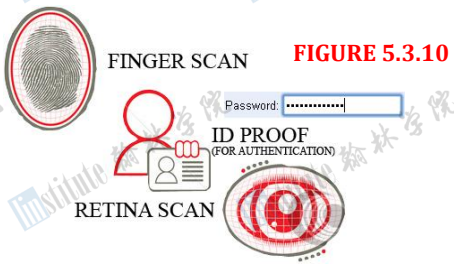


FIGURE 5.3.10

5.4 Communication between Earth and Mars and dealing with communication delays:

The minimum distance between Earth and Mars is estimated to be 54, 510, 620km and the time delay will be 181.702 seconds (3.028minutes).The maximum distance between these two planets is estimated to be 401,355,980kms. At this distance, the minimum time delay will be 1337.85seconds (22.29minutes). But the average communication delay is calculated to be around 759.72 seconds. (12.662minutes).We have decided to transmit and receive data to and from earth continuously.

Moreover, all the data from the earth will be taken to the settlement at the time of transport of computers and other devices. In this way, the data will be available at all the time to the residents of Earth. Any update which has taken place on Earth will be transmitted to settlement immediately. Any new website created on Earth will be detected and the data will be transmitted to the settlement. If any resident tries to use this data, his computer is redirected to the server on the settlement. This gives an appearance of instant access. The Internet speed will be 18 Gb/s with the average frequency ranging between 52.8 – 80 Giga Hertz.

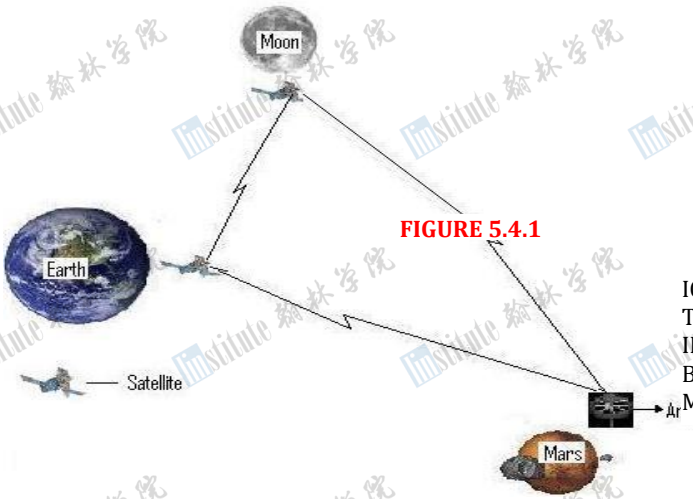


FIGURE 5.4.1

FIGURE 5.4.2

ICON INDICATING THAT THERE WILL BE A DELAY IN THE COMMUNICATION BETWEEN EARTH AND MARS.

FIGURE 5.4.3

ICON INDICATING INSTANT ACCESS TO COMMUNICATION BETWEEN EARTH AND

5.5 Automation for Deployment of pre-fabricated base:

We have decided to send the ARE-KV to help the researchers in the deployment of the pre-fabricated base. This robot will be sent in its compact form to save space in the pre-fabricated base. It will be placed in the storage area in the pre-fabricated base and later moved outside by the humans. This robot has three pincer arms and other equipments, which help it in deploying the pre-fabricated base. Its arms are rotatable and help it to move things around it in any desirable place. It also has a camera and storage area for storing materials if necessary.

FIGURE 5.5.2

THE ARE-KV COMPACTED FORM

0.7 METRES

FIGURE 5.5.1

0.7 METRES

0.4 METRES

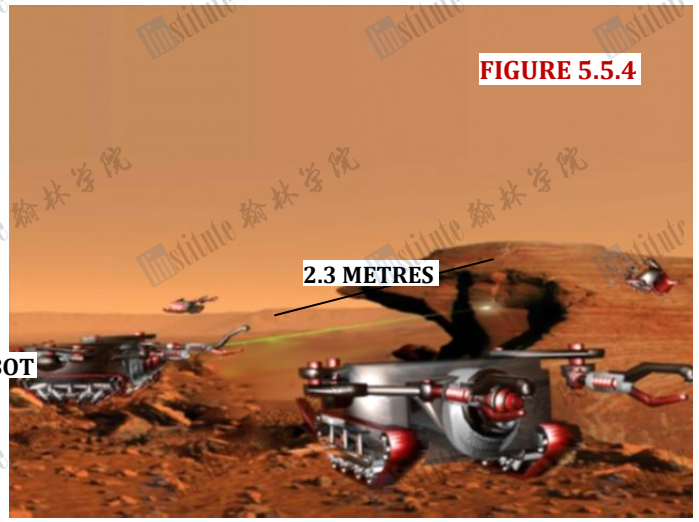
The ARE-RP will be used to explore and research theMartian atmosphere, rocks and soil. It has a special drill bit, a four pincer rotatable arm, testing area, a rotatable camera, temperature sensors, gas detector, information transmitters and other devices which make it a robot perfect for its job. It is compact, light weight and very effective at its work.

5.5.3 Automation for Mining on Phobos/Deimos: As mentioned above in Operations and Infrastructure pg.no. we are mining on Phobos/Deimos. Therefore the Automation engineers have developed a unique design for the ARE-SAN mining robot. This robot has a mining arm at its centre to allow free drilling in any direction. It is also equipped with two other pincer-like arms which help it in handling the mined material. At the apex of these Pincer-like arms are placed lazors which hlelp it in mining. It has a storage shaft/area on its dorsal side. At its end it is equipped with a bulldozer-like arm which helps it to digging the soils of Phobos/Deimos.

FIGURE 5.5.3

THE ARE-SAN ROBOT

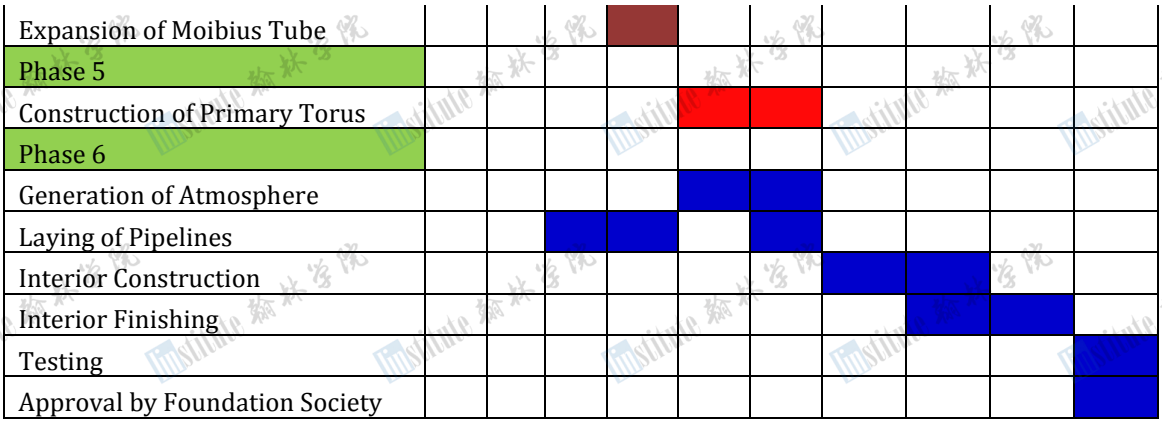
FIGURE 5.5.4



6.1 Schedule of Aresam:

Aresam will be scheduled to be completed in nine years. The Schedule for Aresam is shown in the below table

20++	55	56	57	58	59	60	61	62	63	64
Pre-Construction Phase										
Contract Awarded										
Manufacture of Robots										
Research Work										
Mining of Materials										
Phase 1										
Construction of Cylinder										
Phase 2										
Construction of Docks										
Communication Hemisphere										
Reflectors										
Nuclear Reactor										
Phase 3										
Construction of Moibius Tube										
Construction of Solar Panels										
Phase 4										
Construction of Secondary Torus										



6.1.1: Schedule Dates:

Major Design	Date of Completion
Cylinder	3-Aug-56
Docks	7-Sep-57
Communication Hemisphere	3-Dec-56
Reflectors	3-Feb-57
Nuclear Reactor	8-Dec-56
Moibius tube	3-Jan-58
Solar Panels	3-Jun-57
Secondary Torus	7-Oct-59
Primary Torus	20-Dec-60
Foundation Society Members can enter into the settlement on	17-Oct-2064

6.1.2: The original population will be established on 17-Oct-2065.

6.1.3: No of Employees in each phase:

Name of the Phase	No of the Employees
Pre-Construction Phase	Researchers: 120; Engineers:30
Phase 1	Engineers: 70; Researchers: 25
Phase 2	Engineers: 90;Researchers: 15
Phase 3	Engineers: 140; Researchers:20;
Phase 4	Engineers: 125;Researchers: 10; Technicians: 20
Phase 5	Engineers:150; Technicians:30
Phase 6	Technicians: 75; Engineers: 90

6.2 COST:

6.2.1 Cost billed per year of Aresam's Design through construction:

6.2.2 Costs billed in every phase of construction of Aresam:

Year	Costs
2055	43b $
2056	14b $
2057	16b $
2058	50b $
2059	60b $
2060	20b $
2061	8b $
2062	15b $
2063	10b $
2064	5b $

PHASE 1 Material	Cost of the material
Aluminium	28,300,000$
Super adobe	742,000$
Carbon nano tubes	230,000$
Interior Costs	7,500,000,000$
TOTAL	**7,529,272,000$**

PHASE 2 Material used	Cost of the material
Docks	12,600,000,000
Super adobe	420,000$
Space Ships	6,670,000,000$
Stainless steel	350,000$
Titanium	245,000$
Reflectors	740,000$
Nuclear rector	302,300,000$
TOTAL	**19,574,055,000$**

PRE-CONSTRUCTION PHASE	Cost
Mining Base	8,560,350,000$
Research	920,600,000$
Robots and technologies used in Aresam	54,400,000,000$
TOTAL	**63,880,950,000$**

PHASE 3 Material used	Cost of the material
Titanium	650,000$
Aluminium	34,000$
Super adobe	250,000$
Mono-rails	1,616,086,390$
Pipelines	256,400,000$
Rails	6,716,840$
Solar panels	1,260,000,000$
TOTAL	**3,140,137,230$**

PHASE 4	
Industries	95,600,000,000$
Titanium	245,000$
Community with 3.5g	1,600,000,000$
Pipelines	15,600,000$
Agricultural Sector	8,490,000,000$
Aluminium	245,300$
Super black	785,000$
Kevlar	317,900$
Rxf1	923,000$
Di cholo pentadiene	3,400,000$
Martian regolith	2,310,000$
Gold	321,980$
Magnetic super condensing lens	930,000$
Demron	32,100$
Mmod shield	498,000$
Optic fibres	241,000$
TOTAL	**105,715,849,280$**

PHASE 5	
Commodity used	**Cost**
Residential Community (excluding houses)	33,500,000,000$
Escape Ports (Minor docks)	50,600,000$
Rails	3,893,600$
Pipelines	45,000,000$
Titanium	23,000$
Aluminium	4,930,000$
Super black	6,700,000$
Kevlar	289,000$
Rxf1	4,765,000$
Demron	245,000$
TOTAL	**33,676,745,600$**

PHASE 6	
Process	**Cost involved**
Generation of atmosphere	5,000,000,000$
Laying of pipelines	300,000,000$
Interior construction (houses)	1,834,178,800$
Interior finishing	1,270,000,000$
TOTAL	**8,404,178,800$**

TOTAL COST OF ARESAM=**241,921,187,910$ = 4,384,223,758.2ξ (currency of Aresam)**

6.2.3: Revenue Generated per year:

Revenue generated from	Revenue
Docks	11 b$
Houses	7 b$
Food	96m $
Entertainment	8b $
Taxes	1.58 b$
Advertisement Rights	2.5b $
Marketing to passengers	11m $
School fees	18m $
Total Revenue Generated	**30.205 billion $**

The revenue generated every year is 30.205 billion US $ and the payback period is **8 yrs.**

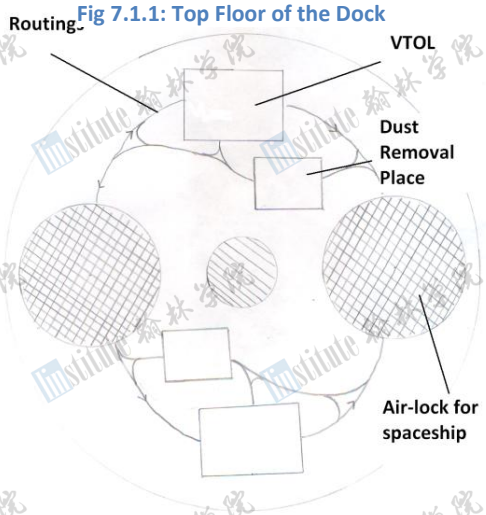
7.0 BUSINESS DEVELOPMENT:

7.1 Sufficient Flexible Design to add Compatible Business Types:

The industries of Aresam would first support the construction of residences and then they can help in research work or in the construction of Argonom.

7.2 Docking: The spaceships will use Vertical Take Off and Landing (VTOL). As the dust should not enter Aresam the dust removal procedure will take place above the dock soon after landing from where it will go to the airlocks.From the airlock the spaceship is taken to the docks. The spaceship will then go to the terminals. The arrival and departure terminals can handle 4 ships each. The dock control which is placed near the airlocks handles this. Jet-Bridges are provided for the people to get down from the spaceships. From the terminal the people will go to the elevator which will take them into the cylinder. The airlocks are large so that they can take two ships to the top of the docks in an emergency. Private ships will be charged for taking off and landing.

Fig 7.1.1: Top Floor of the Dock



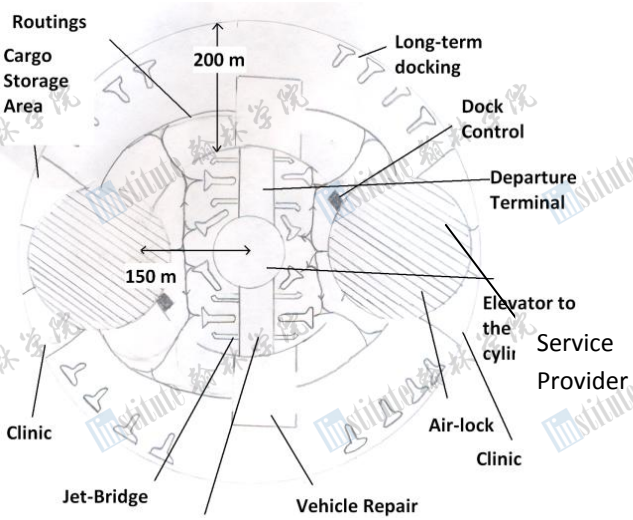


Fig 7.1.2: Dock Chamber

7.3 Long Term Docking: The dock can provide a long term docking for upto 16 ships. It can be extended upto 25 ships.

7.4 Cargo-Handling Capacity: The permanent cargo storage area is located adjacent to the airlock. There are two floors in the terminals. The ground floor is used for cargo. The cargo is sent down from the first floor to the ground floor. It is sent to the spaceship with the help of conveyer belts in the jet-bridge.

7.5 Terminal Facilities to the Passengers: There are two terminals in the dock, arrivals and departures. The facilities provided to the passengers in the terminals during the wait are a café, music, virtual gaming, spas and saloons. The intra planetary money exchange services will be provided so that the passengers can exchange their currencies with the Aresam's currency i.e., Argentia. Facilities such as pick up and drop to the dock which is provided to each and every passenger with the help of mono-rails and elevators.

7.6 Warehousing: Warehouse in the settlement will be automated warehousing which will run with the help of conveyer belts and robots. The warehouse will be placed in the docks.

7.7 Refueling: The fuels required by the spaceships will be stored in the fuel station which is present near the dock so that the ships can be refueled fast. The density of the fuel will be less so that they avoid explosions.

7.8 Provisioning Services for Spaceships: There will be varied services offered to the ships and crew members. The services for the ships will be provided in the area allocated to the Vehicle Repair System. The services for the crew members will be provided near the airlock and they will include boarding, lodging, medical and entertainment services.

7.9 Base and Repair of Spaceships: There is a base where the space ships would be repaired. This base would be located in the docks. At NH we feel that the most common problems relating to spaceships is about the thermal insulating tiles, engine combustion and propellers, there is a special area allocated in the industrial sector for the manufacture of these tiles. Then the tiles would be sent to the docks where they will be stored in the storage area. Here when the space ship comes into the repair base the robots would replace the tiles. They will also take care of the interior problems of the space ship. There is a storage rack in front of the robot which will carry the parts of the spaceship. There is a ramp for the robots to reach to the maximum height of the spaceship.

7.10 Dust Removal Procedures: The spaceship entering the dock would first undergo the dust removal process. This process would take place in the following steps:

- The electric impulses would convert the dust particles into positive particles.
- Then there would be another positive charge which would come from the interior of the spaceship.
- These particles which come from the interior of the spaceship push the dust particles out form the spaceship.
- The robot which is used for repair would also be used for the cleaning of the spaceship.

7.11 Source of materials for vehicle, robot and pre-fabricated base construction: please refer table no. 3.1.2.1

7.12 Medical and Quarantine Services: There are totally four hospitals which are placed in the center of the respective community for fast access. If an epidemic breaks out in the settlement then these hospitals which are also quarantine hospitals will isolate the patients. There are two clinics in the dock and several clinics in the residential torus to take care of other medical activities.

7.13 Vehicle and Robots Transportation System: The vehicles and robots will be transported with the help of spaceships. They will land on the mining base with the help of VTOL , where surface operations take place.

7.14 Transportation of Food and other commodities: The food will be first vacuum packed and then sent to the docks from where the spaceships will take them to the surface of Mars. The goods which include commodities will be packed according to the material.

7.15 Research Center and Production of Goods: NH provides a research center for the assay and development of commercial products of the materials collected on Mars. They are fully equipped for the exploration of these materials. This research center for assay of materials and for carrying out experiments with these materials is located in the industrial torus.

The materials which are collected from Mars are sent to this research center. It is placed in the industrial sector so that if the materials are proved to have commercial potential then the production will be started immediately.

7.16 Cost Criteria: Here is a table of the costs of products on earth. The transportation costs from Mars to Earth would be 500$ per kilogram. Therefore it would take 500,000$ per ton to transport from Mars to Earth.

Element	Cost on Earth per ton	Commercial Viability
Iron[1]	4450 $	It is costlier to take the element from Mars to Earth than purchasing it there.
Nickel	750,000$	It is one of the best commercially viable products on Mars. It can be taken from Mars to Earth.
Sulfur	2000$	It is costlier to take the element from Mars to Earth.
Uranium	687,842.3$	If found in large quantities on Mars it is commercially viable.
Potassium	88,184.92$	Not commercially viable on Earth
Thorium	5,291,700$	Thorium is the most commercially viable product.

The best products that are commercially viable on Earth are Nickel, Uranium and Thorium.

7.17 Lab Configuration to Enable Quarantine: To enable quarantine following configurations are there in the labs:

- The materials will be analyzed in the glovebox vacuum chamber.
- The materials collected from Mars will be directly sent to this lab.
- The spaceships will undergo quarantine on the docks.
- Investigation will take place in the labs with the help of university and hospitals.
- The materials will be brought in an isolation van from the dock to the lab.
- If they are not harmful then they can be stored or redistributed.

7.18 Flag of Aresam: Aresam will have its own symbol in the form of a flag. The Flag of Aresam depicts the friendly relationship between Earth and Mars. All the products produced or manufactured in Aresam will bear the symbol of Aresam. Even the spaceships of Aresam will be painted in the colors of Aresam. The dots present on the flag resemble an arrow depicting man's reach from Earth to Mars.

Fig 7.1.3: Flag of Aresam

7.19 Currency: Aresam will have its own currency. The Aresam's currency will be called as Argentia (argent=money in French, ia =in Aresam) meaning money in Aresam. The symbol for Argentia is **ξ. Exchange rate: 1ξ=50$**

7.20 Culture: Apart from celebrating their own religious festivals, the people of Aresam will also be celebrating Aresam Day on October 17th every year. Aresam Day is celebrated on this day because that is the day when Aresam starts functioning. On this day the flag of Aresam will be hoisted at the government headquarters provided in every community.

7.21 Manufacturing Processes: Processes such as extraction of metals will take place in the non-pressurized volumes. Few agricultural processes will be held in non-rotating volumes. All the other manufacturing processes will be held in rotating volumes. Spacesuits, robots and other products manufacture will be held in the pressurized volumes of the settlement.

7.22 Representative Scene in the Production Line:

A scene in the grinding processes to be held in the settlement.


Fig 7.1.4: Grinding process in the production line

APPENDIX 'A':

Formulae used	
TSA of cylinder	$2\pi r(h+ r)$; h= height of the cylinder, r= radius
Volume of cylinder	$\pi r^2 h$; r= radius, h= height
TSA of ellipsoid torus	$\pi(r_1+r_2)$ *2π*R; r_1=minor radius, r_2=major radius, R= radius of the ellipse
Volume of ellipsoidal torus	π $\{(r_1+r_2)/2\}^2$ *2π*R; r_1=minor radius of ellipse, r_2=major radius of ellipse(cross section), R= radius of the torus
Artificial gravity	$(2\pi\omega/60)^2 * R = g$; ω= Rotations per minute, R= radius
Centrifugal force	$mv^2/2$; m= mass, v= velocity
Centrifugal acceleration	v^2/r; v= velocity r= radius
Initial, final velocity	$v^2-u^2=2gs$; v= final velocity, u= initial velocity, g= acceleration due to gravity, s= distance
Volume of hemi- sphere	$4/3\ \pi r^3$; r= radius

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