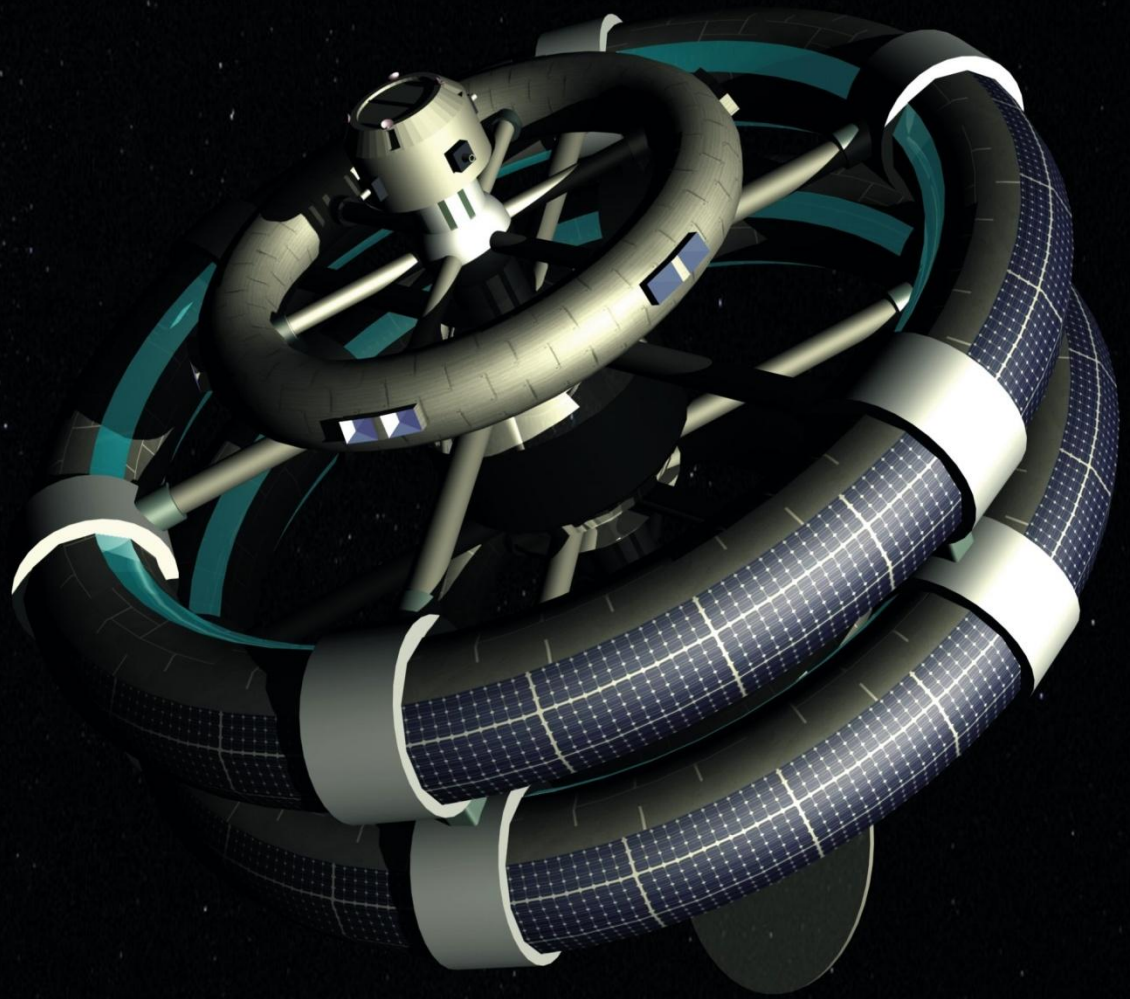
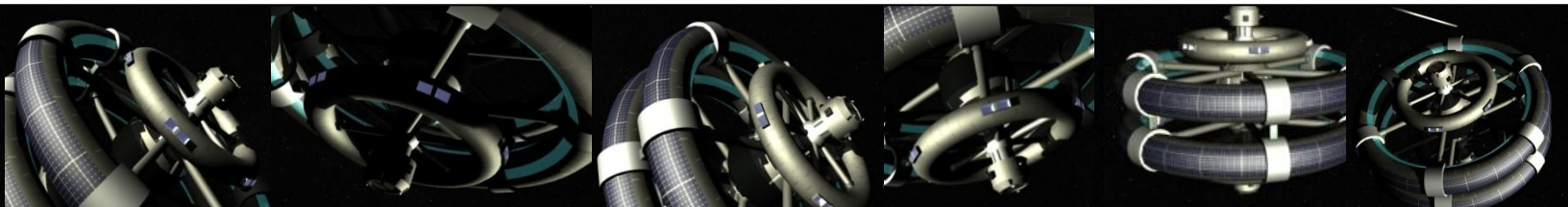
HYPERION

SPACE SETTLEMENT



THE FUTURE AWAITS . . .



15/03/2011

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ACKNOWLEDGEMENT

At the outset, we would like to express our ceaseless gratitude to the Almighty for the love and blessings he has bestowed upon us because of which we were able to put all our efforts together and present this paperwork.

Secondly, we would like to thank our parents for their immense support and affection which proved to be a backbone for us while doing this tough job. We would all like to thank our friends who not only helped us all the way through but also proved to be an enormous moral support.

But most significantly, we would like to express thanks to **NSS/NASA** for this amazing platform that they have created which brings out the best in every individual. It has really helped us chase our dream and bring something we had only imagined to a global stage where it will be judged by the best. We feel elated to be a part of this lifetime experience and that is why we are really grateful to **NSS/NASA** from the very bottom of our hearts.

A word of extensive appreciation goes to Lakshit Sharma, Shefali Sharma, and Suraksha Kumar for being a helping hand. An honorable mention goes to 'Ishaan Offset Printers' for printing our proposal.

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EXECUTIVE SUMMARY

"If my mind can conceive it, heart can believe it, I know, I can achieve it."

From ages and ages, humans have traversed through cities, states, countries and continents in search of a ***better life*** *and sometimes for* ***"survival"****. Now it's time to move to a new world: Space.* ***Hyperion Space Settlement*** *enlightens our visions with a brighter and better future in a new home, the darkest place ever encountered by humanity.*

Hyperion is built for expanding human influence, expanding life across lifeless and expanding our limitations. The settlement holds on to stability in a definite manner right from its very structural arrangement to the technical build up of the settlement to the placement location.

Vision behind Hyperion:

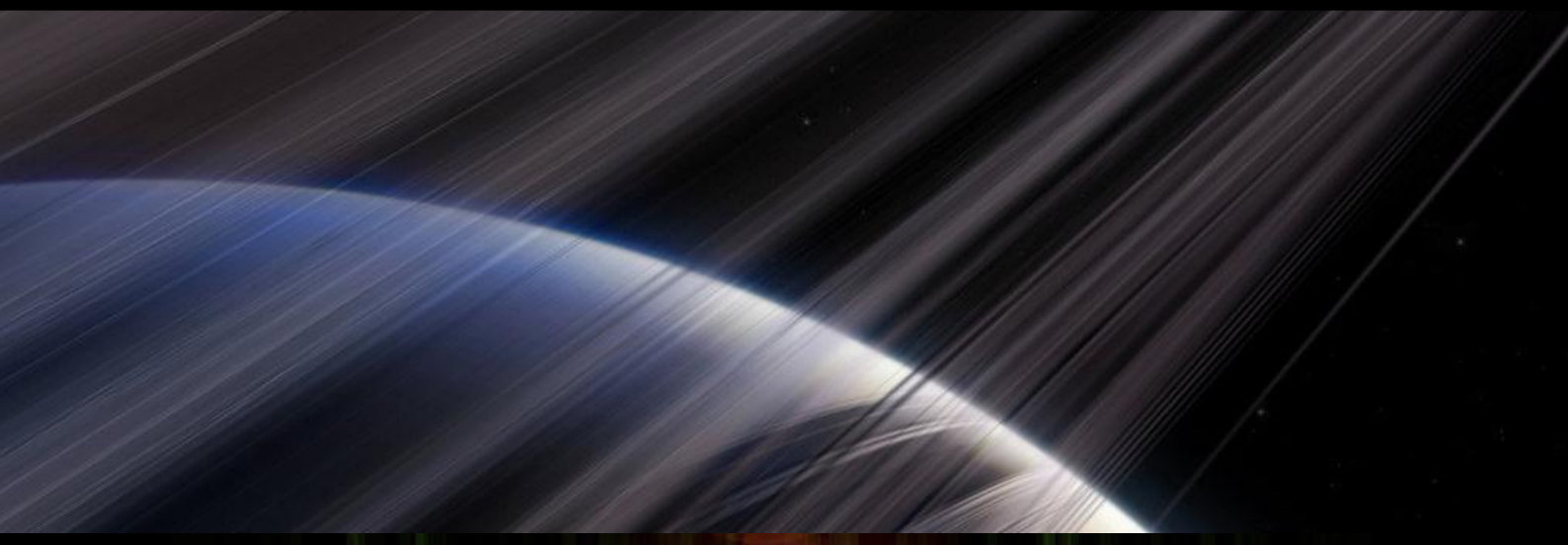
- Using the advantage of living in space in best possible way and attain best structural support and stability.
- Providing large surface area for living so as to occupy large number of people in a single settlement.
- Building a thriving economy by Leading Trade Hub with earth and supporting our ambitions to go and search outer space especially Mars and whole Solar System.

Features of Hyperion:

- Hyperion's structure is the best model showing strength, stability and large surface area for living. The structure has some splendid features such as a non-rotating torus which provides the thrill and excitement of full space-life experience to the residents and tourist.
- Ultimate arrays of technologies and robots have been added to give life a new height. An astounding docking section has been built which provides a bi-transit system having different docks for import - export and residents - transient population.
- A New well designed Community Layout has been provided giving a chance to choose between a variety of housing plans and lifestyle. Personal Rapid Transport, called POD, is installed in both the residential tori for easy and fast movement of the residents.

1.0

INTRODUCTION



1.1 WHY HYPERION?

Light, as we know, is the ultimate source of energy. It forms the basis for all life forms on earth; everything in nature sprouts towards light. Just as light creates conditions on Earth for us to dwell, in a similar manner our settlement will provide an environment for human beings to nourish and thrive in space, thereby exploring new spheres of life. In Greek mythology, Hyperion (*Hyperiôn*) was the Titan of Light (Sun). Hyperion is also referred to in Greek mythology as "God of Watchfulness and Wisdom" and was responsible for providing light to the Earth.

In a similar manner, this space settlement guided for its function, through energy from the sun, shall come up to evolution from this very perennial source of life and provide conditions apt for creatures to thrive in an environment similar to Earth yet miles away from it.

1.2 THE HYPERION SPACE SETTLEMENT

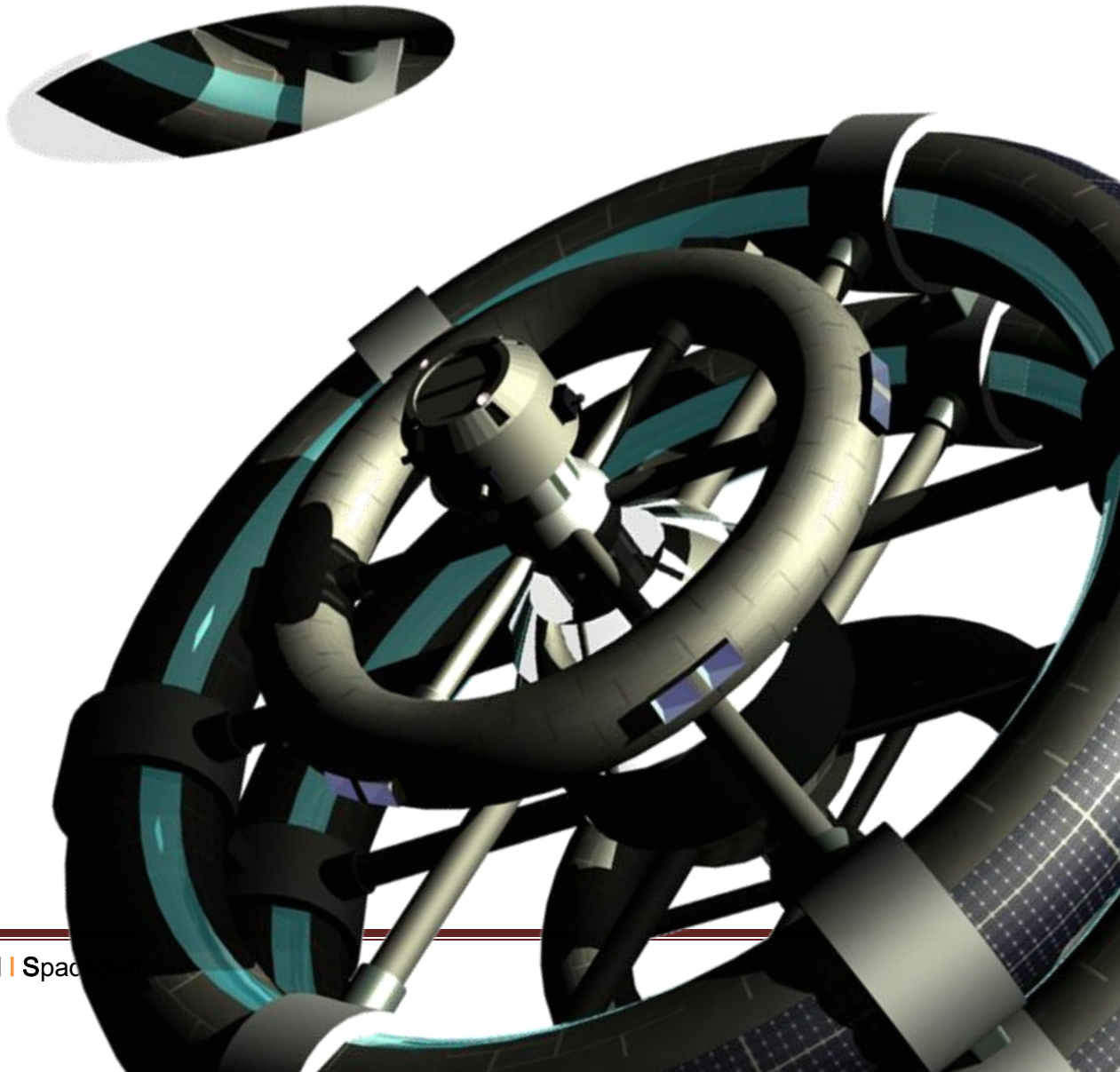
The infinity of the Universe can be fit into the finite sized Brain - Wisdom is Infinite

Beginning with a scientific outlook, everything around us, from the very gigantic mountains to the ever so small grains of sand is composed of the atoms - the basic unit of matter which further comprises the very being that is us on this **Earth**. The infinite universe sounds everlasting and almost beyond visions as we mouth it at the first instance but, can all be concentrated to a size of the grain, after all it all has emerged out of that much sized arena. The atom is further comprised of electrons that are in continuous rotation along their respective orbits around a central nucleus that forms the life of an atom and contains other vital components as the protons and the neutrons. We then come across the concept of quarks which further make up these units of matter. The remaining substrate is what we call **Space** or **Nothingness, 'The Ultimate Shoonya (zero)'**. Our universe exists in a congruent manner; our galaxy is geometrically more of like an atom, heliocentred as the nucleus for the atom made up of a myriad gases each having a vital significance on its presence and similar to it we have the protons and the neutrons. Everything in the universe originates first at the vibrational plane and then goes on to convert into energy and finally has a form that we call matter. And on the path to achieve the final form what we call matter, it always runs through to lunge towards stability; symmetrical the arrangement, higher is the stability and the better it is.

The **Hyperion Space Settlement** is a true representation of this very figure where we have established a relationship between our space settlement and the mighty nature in a similar way. It holds on to stability in a firm manner right from its very structural arrangement to the technical build up of the settlement.

(Refer to section 1.3)

- The stability of any structure is defined on the basis of top-bottom and left-right **symmetries**. The structure is a mirror image of its counter-side if cut from the centre; leading to stability and also proving that the centre of mass lies along the line joining the plane dividing the hemi-structures into equal parts.
- The universe as we have already discussed, is same at the micro-level due to which the stability is not much altered even at the macro-level. Due to the tendency of the whole structure to be divided into equal parts both from top-bottom and left-right, the centre of mass lies exactly at the centre and thus, stability is achieved. Hence, the **Hyperion Space Settlement** provides a languid description of stability in all possible terms taking the dream much nearer to possibility.



1.3 Symmetry

The Hyperion Space Settlement is symmetrical throughout so as to make it stable. The red line divides the settlement into two equal halves showing the left-right and the top-bottom symmetries. The following figures show that centre of mass lies exactly at the centre.

Side view :

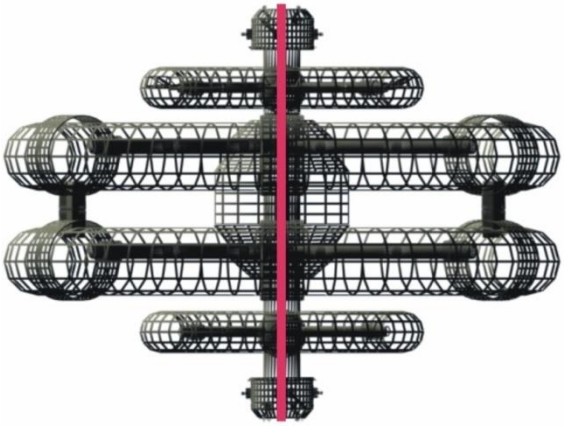


Fig. 1.3.1 Left-right Symmetry

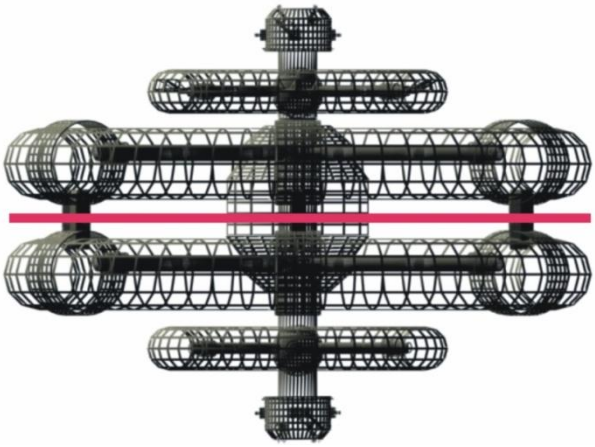


Fig. 1.3.2 Top-bottom Symmetry

Top View :

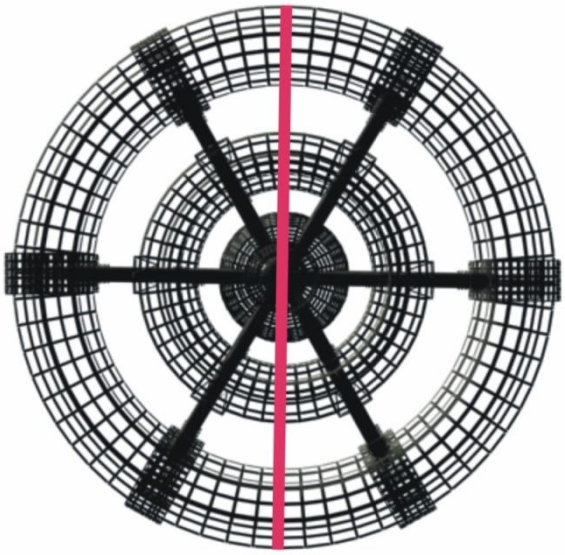


Fig. 1.3.3 Left-right Symmetry

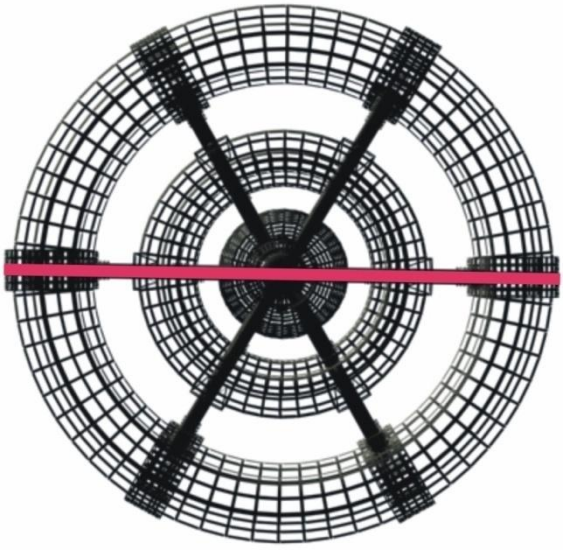
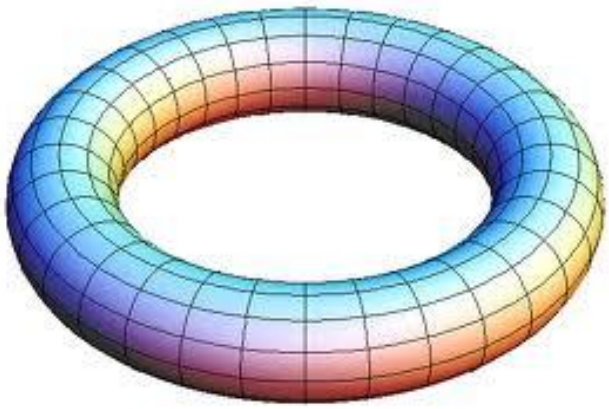


Fig. 1.3.4 Top-bottom Symmetry

Table 1.1 Justification for the shape of the settlement		
Shape	**Advantages**	**Disadvantages**
Torus	• The whole outside of the torus rim is about the same distance from the axis of rotation so there's lots of 1g living area • it requires much less air volume as compared to cylinder and sphere • natural sunlight can be provided in the settlement with the use of mirror • the inhabitants cannot view the other side of the space settlement, so it does not pose any psychological effect	• Due to increasing structural stress with increase in the size of tori, making large tori for large populations is difficult
		

2.0

STRUCTURAL ENGINEERING

“Every Innovation needs a Design, Every Design needs an Idea, and Every Idea needs an Imagination.

But to be Made, Everything needs Engineering.”

2.0 STRUCTURAL ENGINEERING

*The exoskeleton of the **Hyperion Space Settlement** is well laid, providing the best structural strength possible. The settlement is symmetrical throughout so as to achieve stability (section 1.3). The structure of the settlement would provide it potency and vitality to endure all adverse conditions in space. Just like nature, the settlement is constructed with all diverse features; to provide its residents with an extraordinary life so that they can explore and work with each aspect of nature and enjoy the ambience just above them!*

2.1 Basic Structure

The **Hyperion Space Settlement** shall provide a safe and pleasant living and working environment for **18,000** full time residents and an additional population not to exceed **2,000**, of business and official visitors, guests of residents and vacationers. The Settlement shall enable the residents to have a complete natural view of the Space and the Earth below. Also the settlement shall be a new beginning towards the exploration of the outer Space.

2.1.1 Hull Components

The unique design of the settlement shall consist of the most advanced technology which comprises of the hull components which are one of its kinds. The settlement shall consist of the following major hull components:-

1. Residential Torus A
2. Residential Torus B
3. Central hub
    a. Central Cylinder
    b. Sub-cylinder
    c. Upper Thrusting section
    d. Upper Docking section
    e. Disc 1 and Disc 2 (attached through the spokes of Residential Torus A)
    f. Disc 3 and Disc 4 (attached through the spokes of Residential Torus B)
    g. Lower Thrusting section

h. Lower Docking section

4. Torus C (stationary) and Torus D (1/2g)
5. Mirror 1 and Mirror 2

2.1.2 Salient Features of the Settlement

- The **Hyperion** Space Settlement shall be a four-torus system:
  a. **Residential Torus A and Residential Torus B (1g)** - the main residential area in the settlement providing earth like environment.
  b. **Torus C (μ g)** - the torus shall be made non-rotating with the help of **ball bearing system**. (Refer to 2.4)
  c. **Torus D (1/2g)** - for management of Life support systems and 1/2g accommodation of the people; to be used for biological labs; for industrial purposes.
- There will be two spheres at the interface of connecting spokes of **Torus C** and **Torus D** to provide maximum surface area for the region as these regions need maximum surface area for uninterrupted regular transportation. Refer to **Construction sequence Table 2.8.**
- The settlement is provided with Two Docking sections located at top and bottom of the central hub. Each section shall consist of **four docking ports**, placed at sufficient distance from each other to prevent any damage to the spaceships. The docking sections have been made non-rotating with the help of ball bearings arrangement. (Refer to section 2.4.1)
- Two mirrors placed at an angle of **45º** to the plane of **tori**, placed **400 m** above and below the Central hub help in providing sunlight to it at all times.
- Windows on the **Residential torus A**, **Residential torus B** and **Torus C** (stationary) lets the residents view the space outside.
- Two pairs of **Discs (disc 1, disc 2 and disc 3, disc 4)** placed as shown in fig. 2.1 and fig. 2.4, will reflect sunlight from **Mirrors (1 and 2)** to the windows of residential tori. These discs shall be inclined at an angle of **45º**.
- **Torus C** shall be fully devoted to the **Space Life**. This torus shall be a centre for astronomical researches and space exploration.

- **Torus D** shall be used for recreation and sports purposes.
- The **Central cylinder** shall be used for bio-labs and researches related to medicine; large scale industries shall be located here including warehouse for storage of heavy goods.

2.1.3 Settlement Views

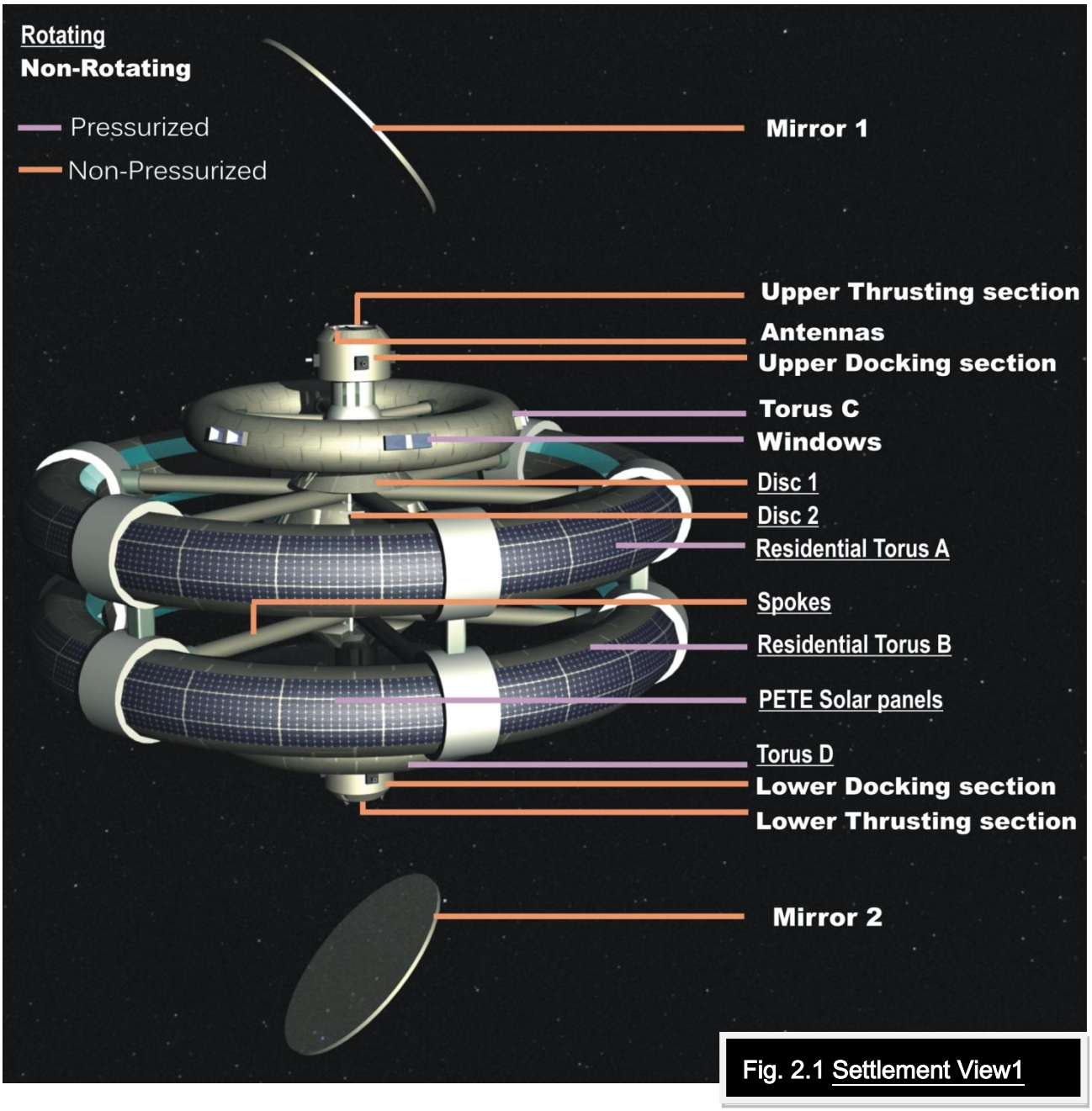


Fig. 2.1 Settlement View1

2.1.4 Dimensions of Major Hull Components :-

Table 2.1 Dimensions of Major Hull Components

Structural Component	Dimensions			Surface area (m^2)	Down surface area (m^2)	Volume (m^3)
	Major radii	Minor radii	Height			
Residential Torus A	932m	130m	-	4778356.5	1521769.6	310593175.36
Residential Torus B	932m	130m	-	4778356.5	1521769.6	310593175.36
Torus C	463m	80m	-	1460798.3	465222.4	58431993.44
Torus D	463m	80m	-	1460798.3	465222.4	58431993.44
Mirror 1 and Mirror 2	260m	-	-	212264	-	-
Central hub						
Central cylinder	80m	-	1420m	713408	-	28536320
Sub-cylinder	260m	-	260m	424528	-	55188640
Disc 1	200m	140m	70m	98477.78	-	-
Disc 2	260m	200m	70m	133234.64	-	-
Disc 3	200m	140m	70m	98477.78	-	-
Disc 4	260m	200m	70m	133234.64	-	-
Upper Docking section	140m	-	110m	96712	-	6769840
Lower Docking section	140m	-	110m	96712	-	6769840
Upper Thrusting section	100m	-	50m	31400	-	1570000

Lower Thrusting Section	100m	-	50m	31400	-	1570000
Spokes						
For Residential Torus A (6)	30m	-	810m	152604	-	2289060
For Residential Torus B (6)	30m	-	810m	152604	-	2289060
For Torus C (6)	20m	-	390m	48984	-	489840
For Torus D (6)	20m	-	390m	48984	-	489840

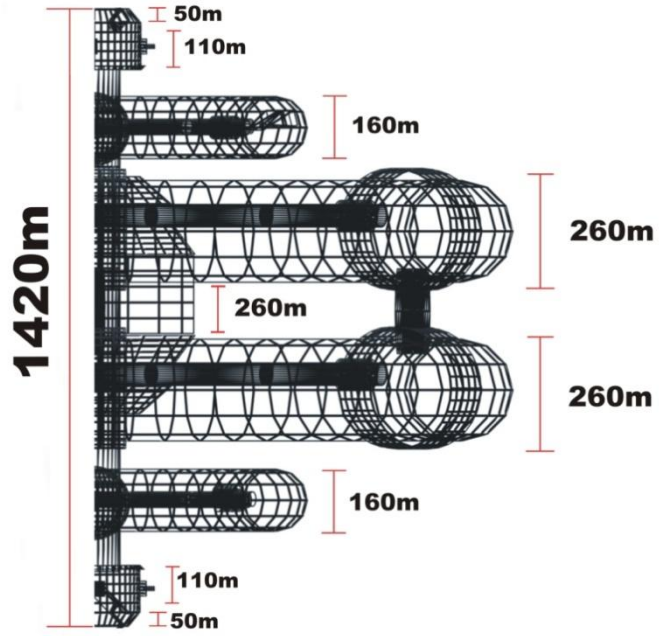


Fig. 2.2 Side View

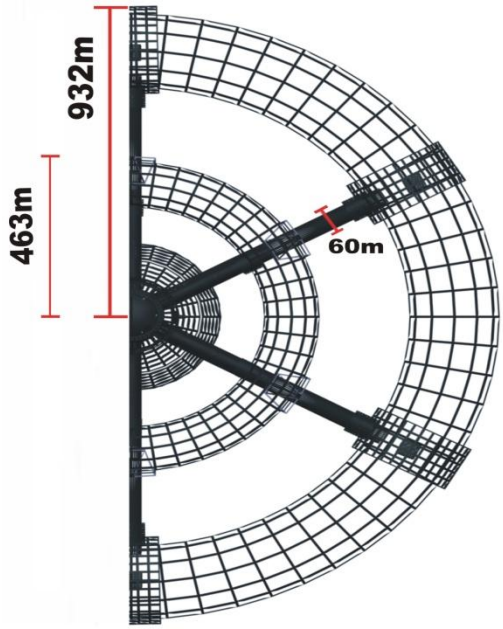


Fig. 2.3 Top View

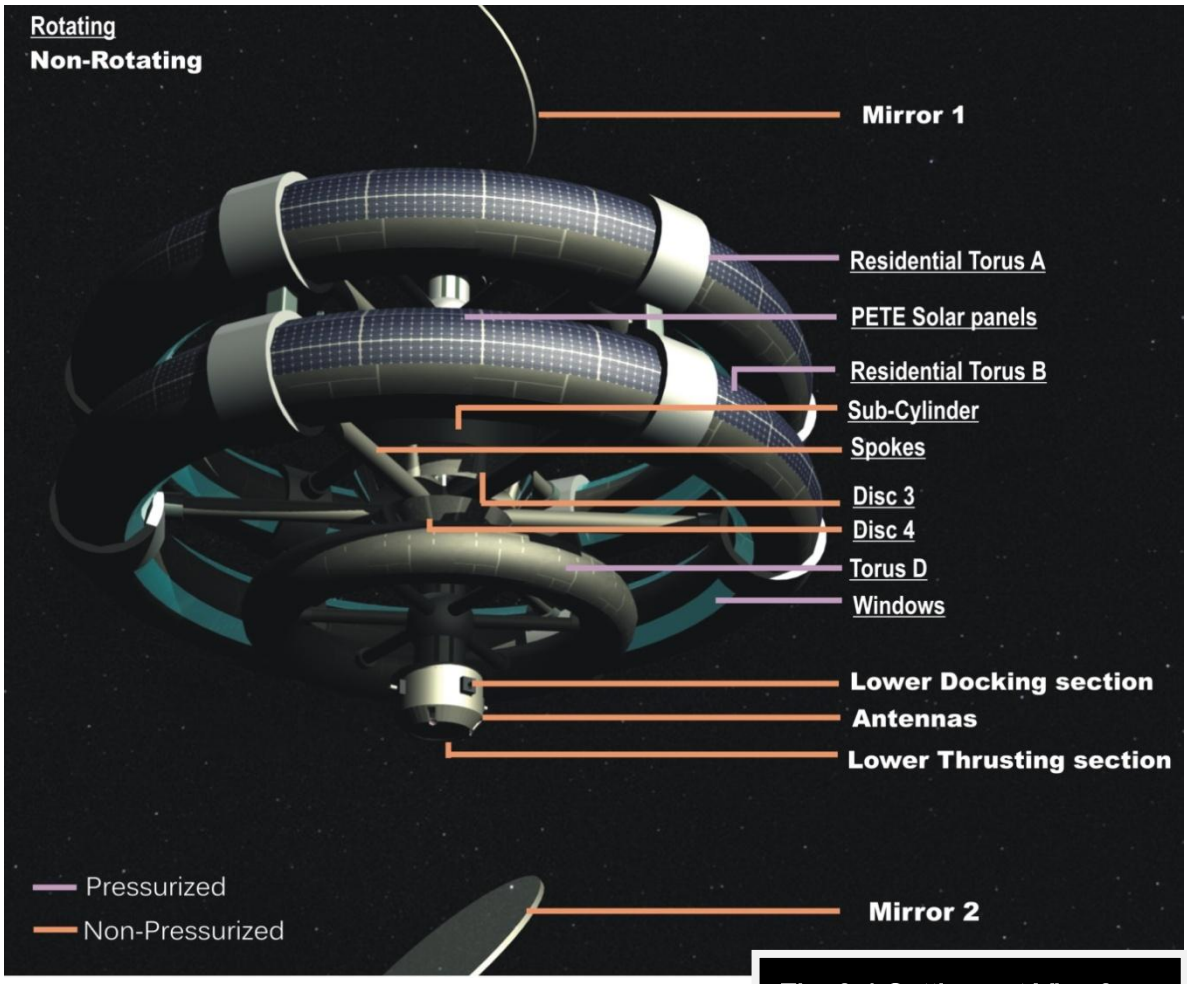


Fig. 2.4 Settlement View2

2.1.5 Construction Materials

The entire settlement shall be based on a symmetrical arrangement of multilayered triangles meshed as in truss while the outer casing shall be a network of criss-cross blocks so as to provide strength, durability and shock resistance along with self repairable properties. All the layers would be kept intact using a layer of durable adhesives, available in close proximity. Hence the structure shall be modular.

Table 2.2 Construction materials

Material	Properties	Tensile strength
Carbon Nanotubes	• Very high tensile strength • Resist high temperatures	63GPa

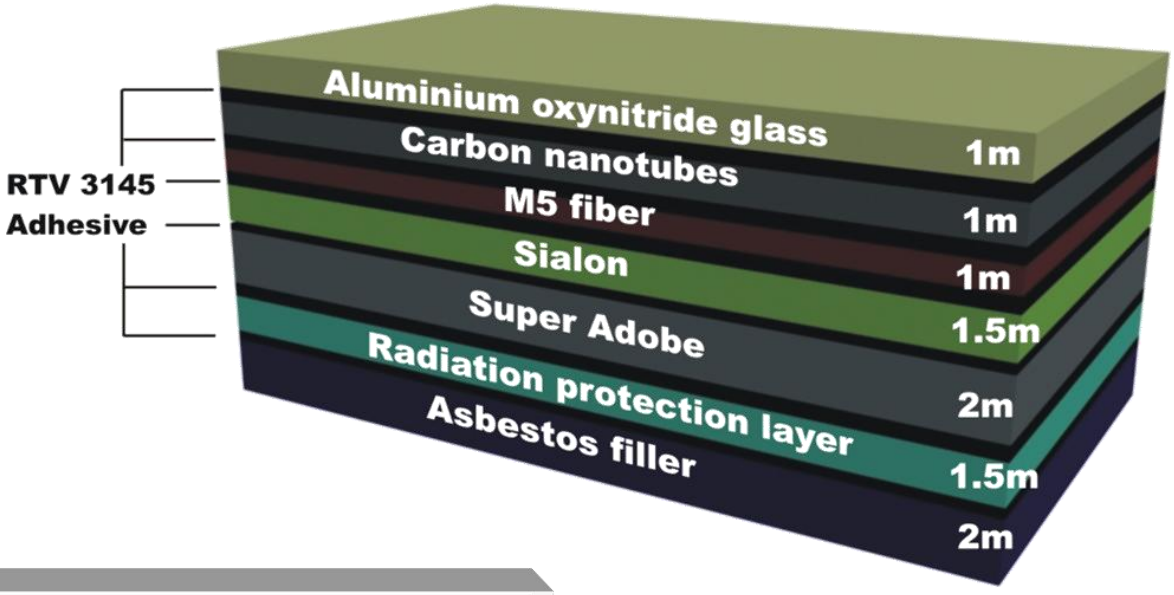
Aluminum oxynitride glass	• High tensile strength • Very high melting point • Good shock absorber	1700MPa
M5 fiber	• High density • High performance fiber • High tensile strength	3690MPa
Super adobe	• High tensile strength • High resistance to solar radiation • Very low thermal conductivity • Very high service temperature	1400MPa
Radiation protection layer	Refer to table 2.3	Refer to table 2.3
Asbestos filler	• Heat resistant • Used as an insulator • High tensile strength	4.4GPa
Aluminum titanate mesh	• High tensile strength • Good thermal shock resistant • High service temperature	4.6GPa
Sialon	• High tensile strength • Excellent thermal shock resistance • Low thermal expansion • Good oxidation resistance	4.72GPa

Table 2.3 Radiation and Debris protection materials

Material	Properties	Tensile strength	Use
Twaron	High tensile strength, Fatigue resistance, Dimensional stability	2760 MPa	Thermally stable, Highly impact and Chemical resistant
Polyethylene Foam	Low density, wide working temperature, flame resistant	2.10 MPa	Used for absorbing and dispersing radiation
RTV-3145 Adhesive	Good adhesive properties, UV resistant, ozone resistant, thermal resistant and excellent curing properties	6.48 MPa	Radiation protection and used as seal for layers

Silicone rubber	Resist extreme temperature (1350 °C)	2.6 MPa	Heat insulator
Nitinol	Shape memory alloy, regains shape after deformity, high tensile strength	960 MPa	Excellent shape recovering properties
Sealant Gel	Restricts formation of air bubbles and cracks on silicone gel, Combustion resistant properties	50 MPa	For filling up impact affected areas

Fig. 2.5 Layer Concept



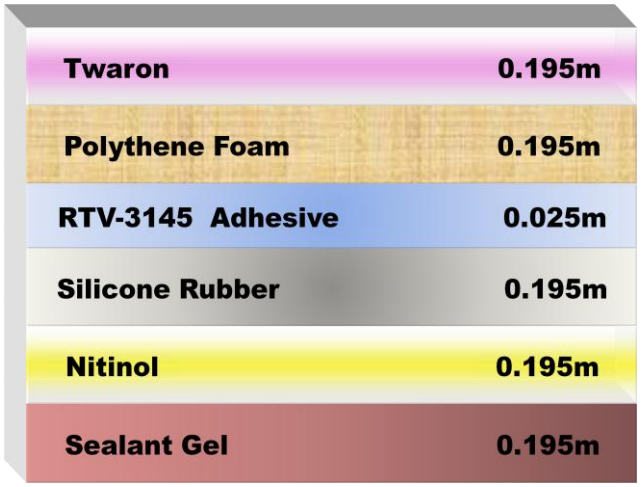


Fig. 2.6 Radiation Protection

2.2 Internal Layout

2.2.1 Internal Design: The Hyperion space settlement has been constructed perfectly and divided into different halves providing diverse features to make it a dream destination for vacationers. The two Residential Tori shall provide a **secure, peaceful and pleasant** environment for living and working to its residents. Apart from living area the tori shall accommodate **commercial area, medical facilities, educational institutions, religious places, recreational facilities and agricultural facilities.** There shall be a main '**Hyperion Shopping Mall'** located at the centre of the living area. Besides the shopping mall, each neighbourhood shall have small shops and markets providing access to all kinds of daily products and other necessary requirements. Two riverines shall flow throughout **Residential Tori A and B** respectively to give its residents a scenic view, and shall be used for recreational purposes and water storage.

The distribution of industries are **textile industry** (18%), **sugar industry** (15%), **fibre industry** (17%), **food processing industry** (16%), **robotic industry**(14%), **paper manufacturing industry**(8%), **metal processing industry** (18%), **power generation**(20%) and **others** (3%) of the total industries. The agriculture area shall be the grain house of the settlement. It shall also provide **cash crops** (3%), **beverage crops** (6%), **energy crops** (11%), **food crops** (10%), **fruits and vegetables** (10%) and **others** (3%).The automation control centre shall manage the climate and pressure.

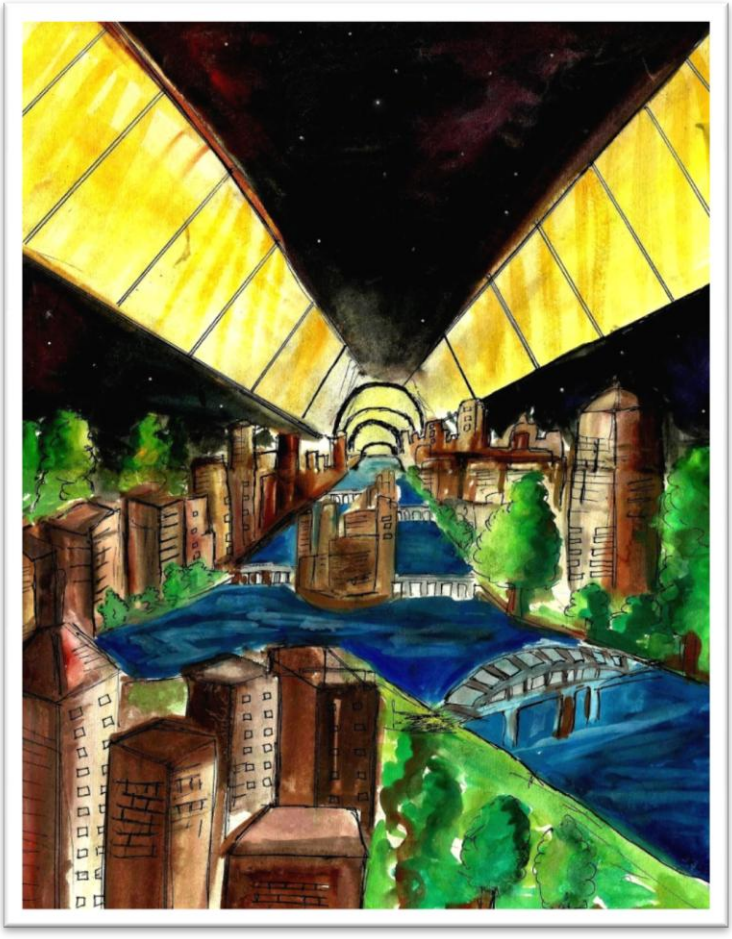


Fig. 2.7 Cross section of the Residential Torus

2.2.2 Distribution and Allocation of Areas

Table 2.4 Distribution of areas in Residential Tori (A and B)			
Criteria	Surface Area Required (m^2/person)	Total area	Percentage area of torus (%)
Residential area	49	441000	28.98
Shops	2.3	20700	1.36
Offices	1	9000	0.60
Schools/Colleges	1	9000	0.59
Hospitals	0.3	2700	0.17
Assembly (church / halls)	1.5	13500	0.88
Recreation and entertainment	1	9000	0.59
Public open spaces	10	90000	5.91
Service industry	4	36000	2.36
Storage	5	45000	2.95
Transportation	12	108000	7.09
Misc. infrastructure	7.1	63900	4.19
Plant growing areas	44	369000	24.24
Animal areas	5	45000	2.95
Food processing, storage etc.	4	36000	2.36
Agriculture drying area	8	72000	4.73
Private property and area for future development	13.88551	124969.6	8.21
Total area	169.08551	1521769.6	100

Table 2.5 Distribution of areas in Torus D		
Criteria	Area (m^2)	Percentage area of torus (%)
Industries	158175.61	34
Half ‘g’ accommodation	102348.92	22
Bio-labs	55826.69	12
Recreation Activities	69783.36	15
Temporary Storage	46522.24	10
Miscellaneous	18608.88	4
Upgrade	13956.66	3
Total area	465222.4	100

2.2.3 Artificial gravity

Artificial gravity shall be induced by the **rotation of the settlement** about its central axis from **west to east** with rotation in **elliptical plane** similar to the earth so that the direction of apparent movement **of stars and heavenly** bodies during night remains same as that of **earth**. The settlement being in a **non-inertial frame of reference system**, an observer situated at the periphery shall experience a **centrifugal force** which can be **equivalent** to the **gravity** produced at earth.

Studies have shown that human body does not cope with rotational frequency greater than **2 rpm**. Various psychological factors arise up in case the rotation rate is more than 2 rpm. Moreover, the effect of the **Coriolis force** is experienced only if the rpm is above 2. Therefore, keeping the fact in mind, we provide the settlement a rotation rate of **0.97rpm**, which is best, suited for human wellness and this rotation rate provides **earth** like gravity levels along with the desired weight of a person; thus prevents any side effects.

The value of acceleration has been calculated in the following way:-

We know,

$$F = ma \qquad (1)$$

And,

$$F = mv^2 / r \qquad (2)$$

Where, **m** = mass of an object lying on the periphery of the torus

r = major radius of the torus

v = velocity of the object **($v = 2\pi r / t$)**

t = time period of rotation = **61 s**

Therefore, **equating (1) and (2)**

⇨ $mv^2 / r = ma$

⇨ $a = v^2 / r$

⇨ $a = (2\pi r / t)^2 \div r$

⇨ $a = 4\pi^2 r / t^2$

For **Residential torus A and Residential torus B**,

⇨ $a = 4 \times 3.14^2 \times 932 / 61^2$

⇨ $a = 9.86\ m/s^2 = 1g$

For **Torus D**,

r = 463 m

⇨ $a = 4 \times 3.14^2 \times 463 / 60^2$

⇨ $a = 4.90\ m/s^2 = 1/2g$

The magnitude of gravity in various hull components and justification has been listed in Table 2.6.

Table 2.6 Gravity and Magnitude

Hull Component	Magnitude	Justification
Residential Tori (A and B)	9.86 m/s^2	Best suited for human dwelling, Psychologically viable, increases human efficiency, creates earth like environment
Torus-C	Micro(μ) g	Zero 'g' recreation, space life
Torus-D	4.9 m/s^2	Low 'g' accommodation, use of low 'g' for bio labs and research, saves energy and fuel, low 'g' recreation
Central Hub	Micro(μ) g	Easy storage in warehouses, communication and docking systems work best in zero 'g'

2.2.4 Pressurized and unpressurized volumes

- **Pressurized volumes -** Various hull components of the settlement shall be pressurized at different rates according to their need. Refer to table 2.7.

Table 2.7 Pressurized facilities

Hull Component	Pressure	Rationale
Residential Tori (A and B)	1 atm	Best suited for humans, creates earth like atmosphere, prevents breathlessness, energy output does not decrease
Torus-C	1 atm	Best suited for humans, creates earth like atmosphere, prevents breathlessness, energy output does not decrease, improves performance in sports
Torus-D	1 atm	Best suited for humans (visitors from earth), energy output does not decrease

- **Unpressurized volumes -** The central cylinder, docks and spokes shall be included in the unpressurized volumes; instead pressurized transportation would be used to travel in these volumes i.e. in **spokes** and from **docking section** to **Torus D**.

  In order to prevent harm to the stored goods in the warehouses, it is always advised to keep the storage modules unpressurized. Since these areas are highly automated,

humans do not need to enter these areas so frequently. If they do, they shall wear their spacesuits (refer to 4.6).

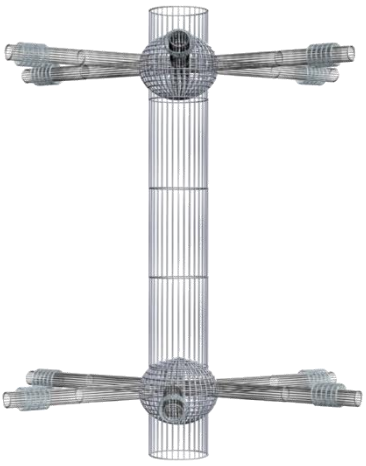
2.3 Construction Sequence

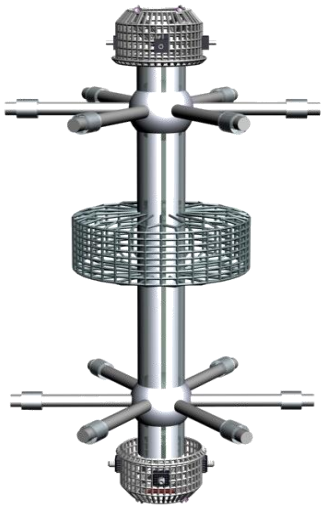
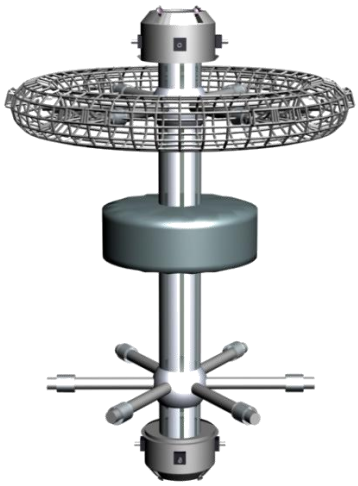
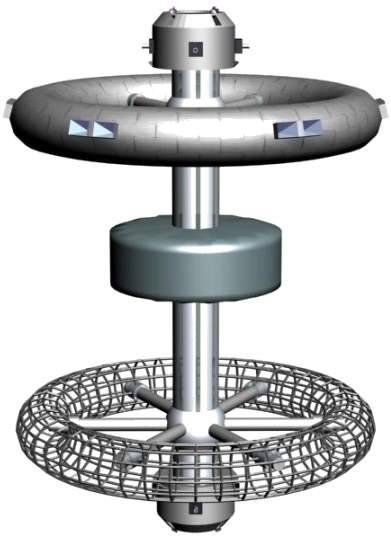
A construction base shall be established before the construction of the settlement starts. The base shall consist of highly automated systems i.e. robots and communication systems. The construction of the **Hyperion space settlement** shall be completed at the **Earth – Moon L4** liberation point. The construction of the settlement shall start with the construction of the basic framework of the major hull components-The mesh.

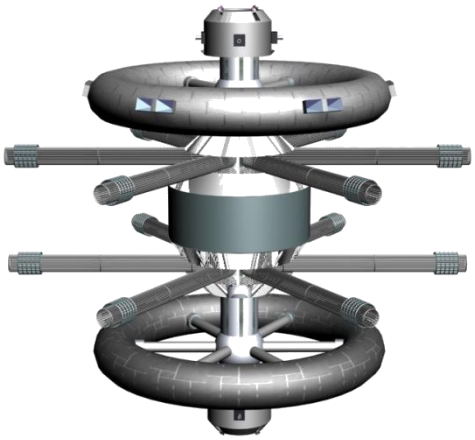
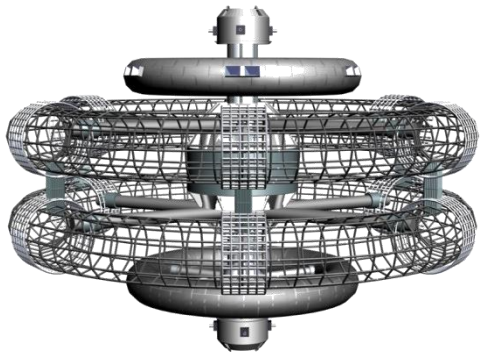
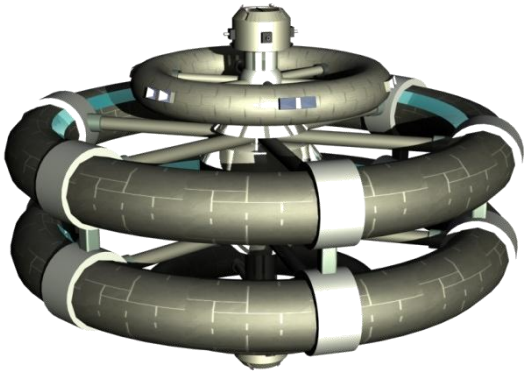
A thick **mesh composed of steel rings** having a radius of **8 metres** shall be made and assembled one over the other and then **sandwiched together**. Then the structure would be **welded** to obtain the desired structure. After the construction of each of the hull component, its exterior tiling shall be started. After the tiling of the major hull components, the interior construction shall be initiated. All these processes shall take different durations which have been mentioned below.

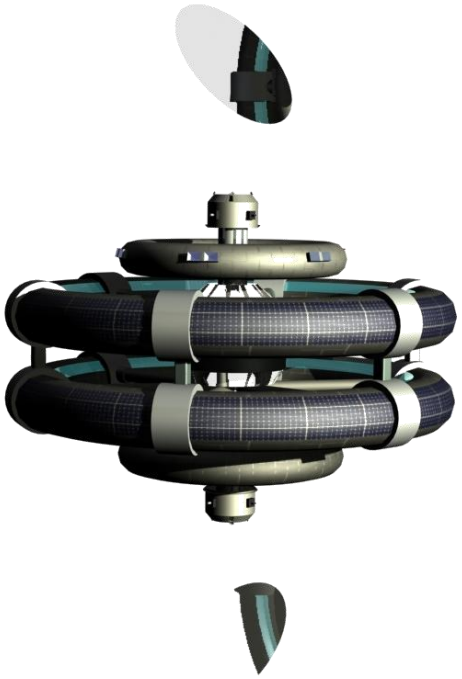
The construction shall be completed in following steps:-

Table 2.8 Construction Sequence

Step	Construction Sequence	Time required	Image
Step 1	The construction of the settlement shall start with the construction of the central cylinder. The mesh construction shall start from its middle to its ends. This step shall also include the construction of connecting spokes for **Torus C** and **Torus D** along with a **sphere** at the interface of connecting spokes and central cylinder.	2.5 years	

Step 2	This step shall start after complete welding of joints in step 1. This step shall include the mesh construction of the sub-cylinder and the upper and the lower docking and thrusting sections along with the exterior tiling of central cylinder and connecting spokes of the Tori C and D.	2 years	
Step 3	This step shall be initiated after the completion of step 2. In this step, the mesh of the Torus C shall be constructed. This step shall also include the exterior tiling of sub-cylinder, upper and lower docking and thrusting sections.	1.5 years	
Step 4	This step shall start immediately after the welding of mesh in step 3 has been done. The exterior tiling of Torus C shall be completed in this step and the mesh construction of Torus D would start thereafter.	1.5 years	

Step 5	After step 4 has been completed, the mesh construction of the spokes for Residential Tori A and B would start. Along with this, the construction and tiling of Discs 1, 2, 3 and 4 shall be done. The tiling of Torus D shall also be done in this step.	2.5 years	
Step 6	This step shall start with the mesh construction of Residential Torus A first and then of Residential Torus B. A double layered mesh shall be used for the residential torui framework in order to provide extra strength. The tiling of the spokes for these tori shall be done alongside.	3 years	
Step 7	This step shall start after complete welding of meshes in step 6. In this step the exterior tiling of Residential Tori A and B shall be done. The interior down surfaces of central cylinder, Tori C and D shall be completed alongside.	3 years	

Step 8	The final step shall include the installation of industries in Torus D and central cylinder, solar panels, Life support systems, Mirrors A and B, pressurization of volumes. The interior construction of the residential tori A and B shall be done in this step. With the sealing of hull components of the settlement, it would make the settlement ready for the residents to move in and start a new life.	4 years	

Total time to construct the settlement = 20 years

2.4 Rotating and non-rotating sections

The Hyperion Space Settlement has been divided into various sections according to work to be done in the section. Various hull components have been made non-rotating to execute the work to be done in these sections efficiently in order to run the settlement smoothly without creating any hindrance in work of other hull components.

2.4.1 Rotating and non-rotating interface

Torus C, the docking sections and the thrusting sections have been made non-rotating with the help of **frictionless ball bearings** in the areas of their interface with rotating hull components of the settlement. Each ball in the setup shall have a **diameter** of **14m**. Lubricants with **high thermal properties** and **surface tension** shall contribute in effective lubrication of the balls. The lubricant shall be allocated with the provision of two porous layers impregnated with lubricant. The **Hyperion Executive** shall regulate the amount of lubricant to be allocated via automated systems.

- **Upper non-rotating section:** The upper non-rotating section consists of
    1. **Torus C**
    2. **Upper Docking section**
    3. **Upper Thrusting section**

The section will be made non-rotating at the interface of **Torus C** with **Central Cylinder**. A **sphere** will be constructed at their interface to provide large surface area for smooth movement and traffic-free transportation.

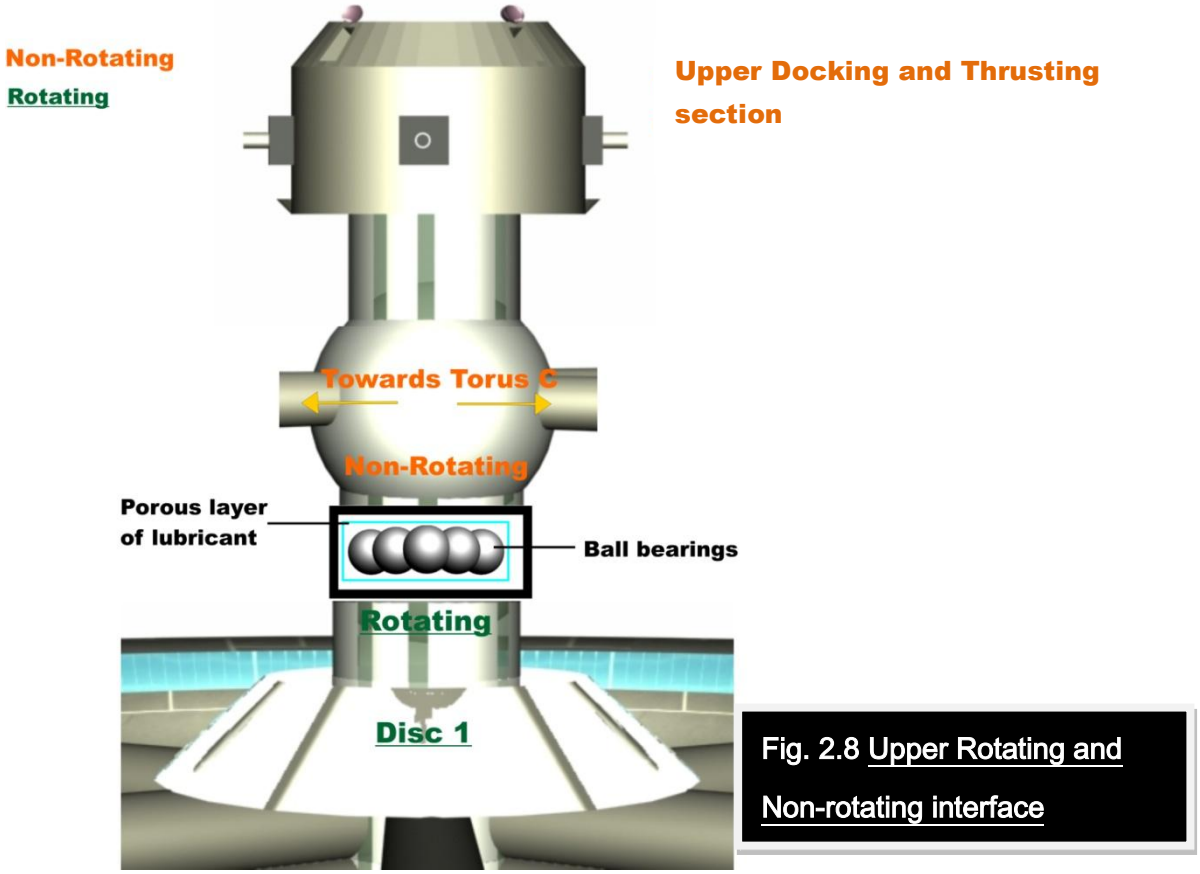


Fig. 2.8 Upper Rotating and Non-rotating interface

- **Lower non-rotating section:** The lower non-rotating section consists of
    1. **Lower Docking section**
    2. **Lower Thrusting section**

The section will be made non-rotating at the interface of **Torus C** with **Lower Docking and Thrusting section**. A **sphere** will be constructed at their interface to provide large surface area for smooth movement and traffic-free transportation.

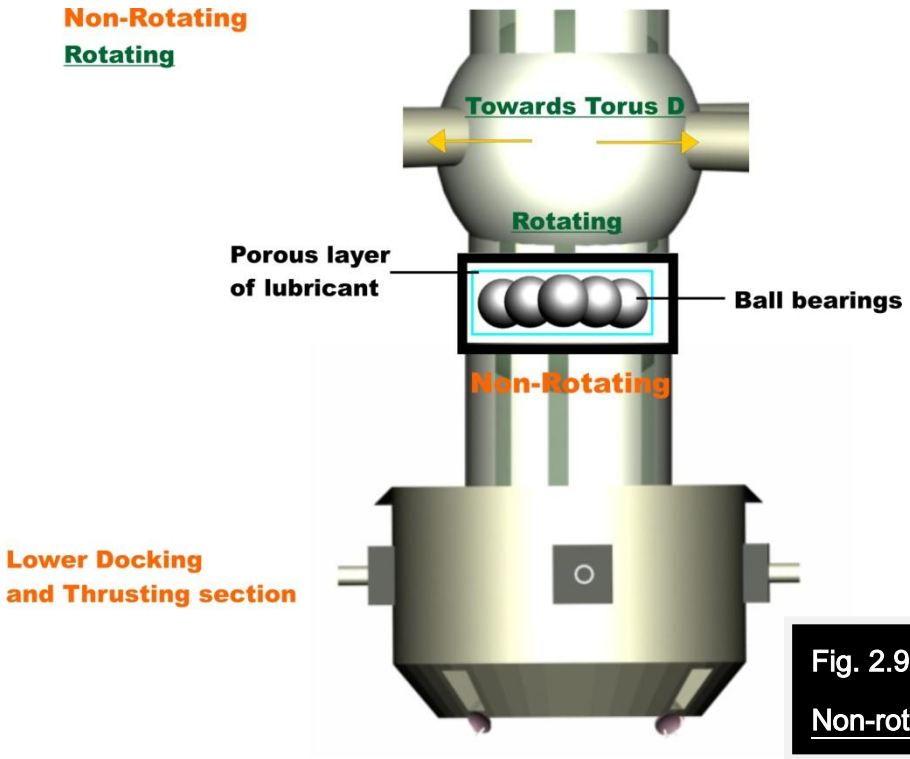


Fig. 2.9 Lower Rotating and Non-rotating interface

2.4.2 Lubricants

Ammonium based **ionic lubricants** have been used in the ball bearings. This type of lubricant has been used due to its **thermal properties**. Moreover, it is **environment friendly** and **economically viable**. The lubricant is **non-volatile** even at high temperatures. The quantities of lubricants to be used shall be regulated by the **Hyperion Executive.**

Table 2.10 Properties of Ionic Lubricants

Lubricant	Properties
Ammonium Ionic liquids	• Thermal stability • Low vapour pressure • Electric conductivity • Better solvent properties • High heat capacity • Non flammability • Liquid crystalline structures • Biphasic systems possible

2.5 Docking and Thrusting Sections

2.5.1 Docking Sections

The Hyperion space settlement will provide a dynamic docking facility. The settlement shall be equipped with highly efficient, safe and fast docking system. There will be **two docking sections (upper and lower)** in the settlement:

- **Lower Docking section**: The Lower docking section would be used for transient population and cargo ships due to proximity from **Torus D (1/2 g)**; as transient population will first be exposed to **1/2 'g'** environment and then to **1 'g'**. Also, the goods imported from earth would be stored in **Torus D** as industries are located here.

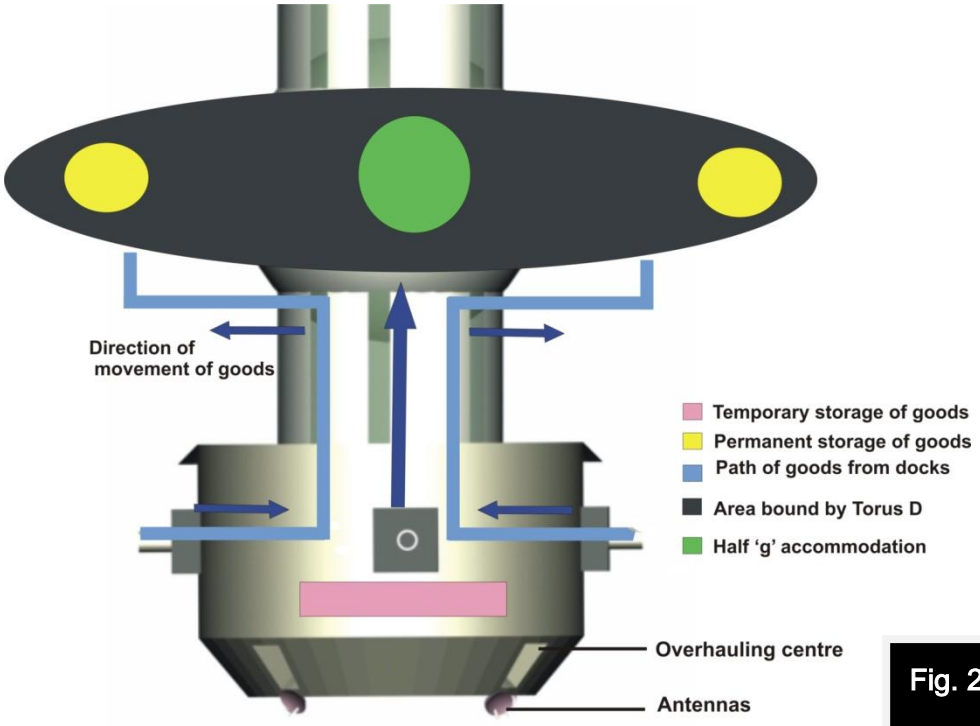


Fig. 2.10 Side view of lower docking section

- **Upper Docking section:** The Upper docking section would be used by permanent residents of the settlement: who wish to visit earth, for business purposes (exporting goods to earth), space research, etc.

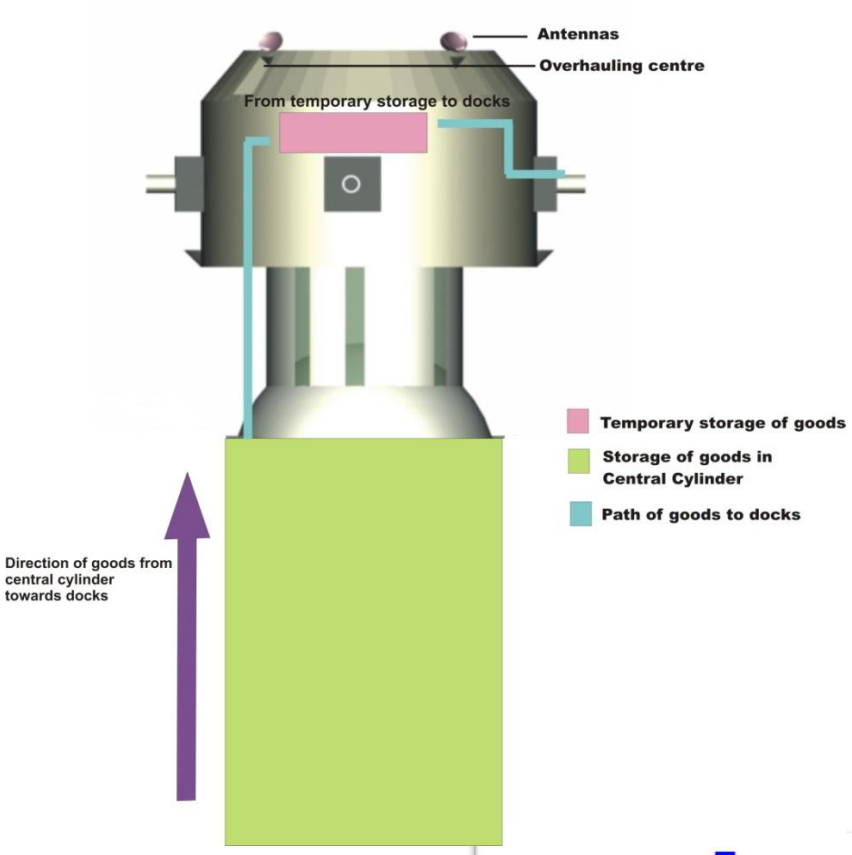


Fig. 2.11 Side view of upper docking section

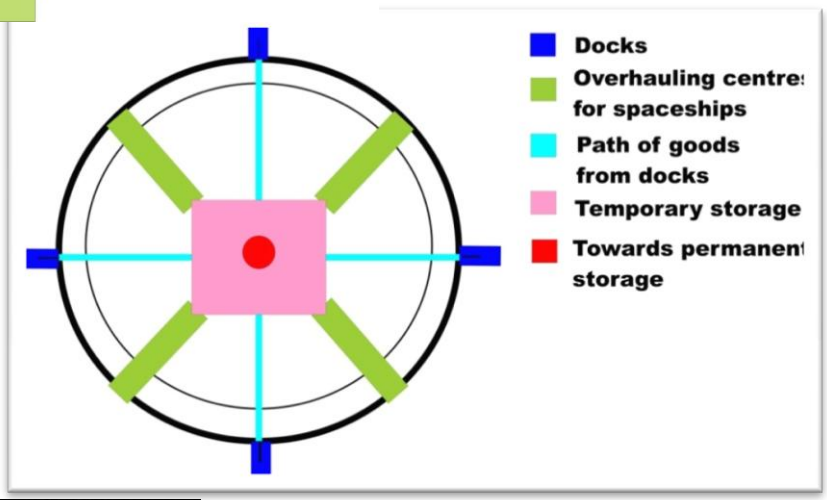


Fig. 2.12 Top view of docking section

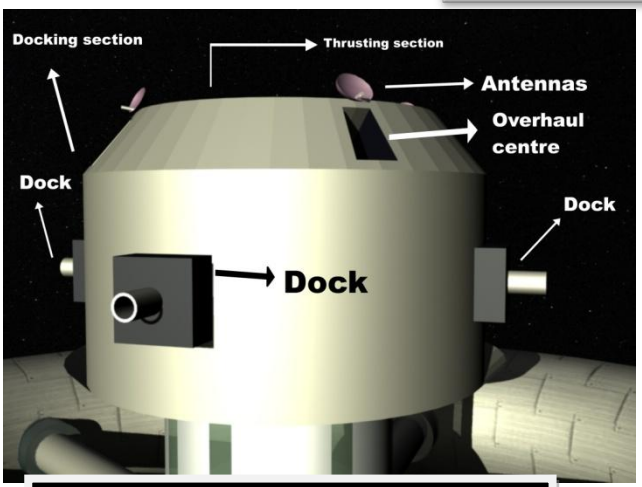


Fig. 2.13 Docks and overhaul centre

For safety purposes, the docking sections have been placed at the upper end and lower end respectively which are **non-pressurized** and **non-rotating** areas. Each section would be provided with **four docks ports** placed on the opposite faces of the docking section so

that they do not pose any hindrance for each other. **Four overhauling centres** would also be provided. Fully automated overhauling centres controlled by the **Hyperion command centre** will repair the spaceship in no time in case it has been damaged due to collision with space debris.

2.5.2 Thrusting sections

2.5.2.1 Thrusters

Provision of **Helicon Double Layer Thrusters (HDLT)** at the upper end and the lower end of the central hub enables the movement of settlement from its original position in case asteroid or other space debris obstructs its trajectory.

2.5.2.2 Mechanism of Helicon Double Layer Thrusters (HDLT):

Injecting gas into the tubular region, causes antenna (wrapped around the chamber) to emit **electromagnetic wave** due to which the gas breaks down and results in plasma formation. Plasma gets heated when the antenna excites a Helicon wave in the plasma. There is a constant **magnetic field** in the source tube (supplied by solenoids), while going away from the source region whose magnitude decreases. The source region has high density plasma whereas the exhaust region has low density plasma. Between both these regions there exists a sharp boundary which is associated with acute change in electric potential. Higher electric potential exists within the source region as compared to the exhaust region. This difference leads to rapid change in plasma properties which is defined as **current free electric double layer.** The difference also contributes in keeping electrons within the limit source and acceleration of the ions away from this area. Overall neutrality of plasma in the exhaust region is ensured through escape of enough electrons.

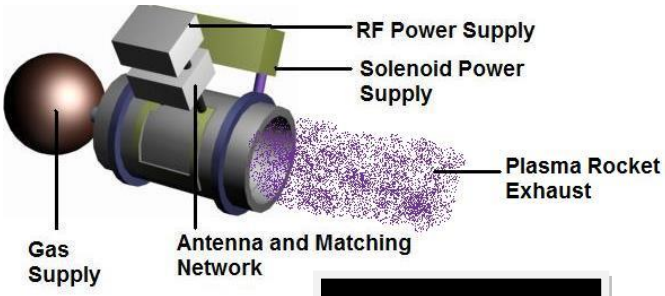


Fig. 2.14 HDLT

Comparison

As compared to other ion thrusters it has two main advantages:

- Without any use of untrusted components like high voltage grids, an acceleration electric field can be created in **HDLT.**
- Emission of equal number of electrons and positive ions cancels the need for a **neutralizer.**
- The HDLT has no electrodes hence preventing electrode erosion over time. The radiofrequency power is transferred to the electrons of the plasma using an external double saddle field antenna placed around the source tube.

2.5.2.3 Thrusting Sections

The settlement is provided with three thrusting sections; **two** for its translation and **one** for its **rotation.** The thrusting sections for the translation of the settlement shall be located at the upper and the lower ends of the central hub respectively. These thrusters shall be covered when not in use and would be taken out only when required. The settlement shall be rotated by two thrusters located diametrically opposite to each other. These thrusters shall thrust the settlement only once to gain an angular velocity of **0.97rpm**. In case of any delay in rotation due to unforeseen reason, these thrusters shall be fired again at a required rate to gain the same velocity.

1. **Upper Thrusting Section:** The upper thrusting section shall be located at the upper end of the central hub. It will be provided with **three HDL Thrusters**; the **Middle Thruster** shall have a radius of **10m** and the other two thrusters shall have radius of **7m** respectively. These thrusters shall be used for thrusting the settlement in downward direction.
2. **Lower Thrusting Section:** The lower thrusting section shall be located at the lower end of the central hub. It will be provided with **three HDL Thrusters**; the **Middle Thruster** shall have a radius of **10m** and the other two thrusters shall have radius of **7m** respectively. These thrusters shall be used for thrusting the settlement in upward direction.

OFF-Position ON-Position

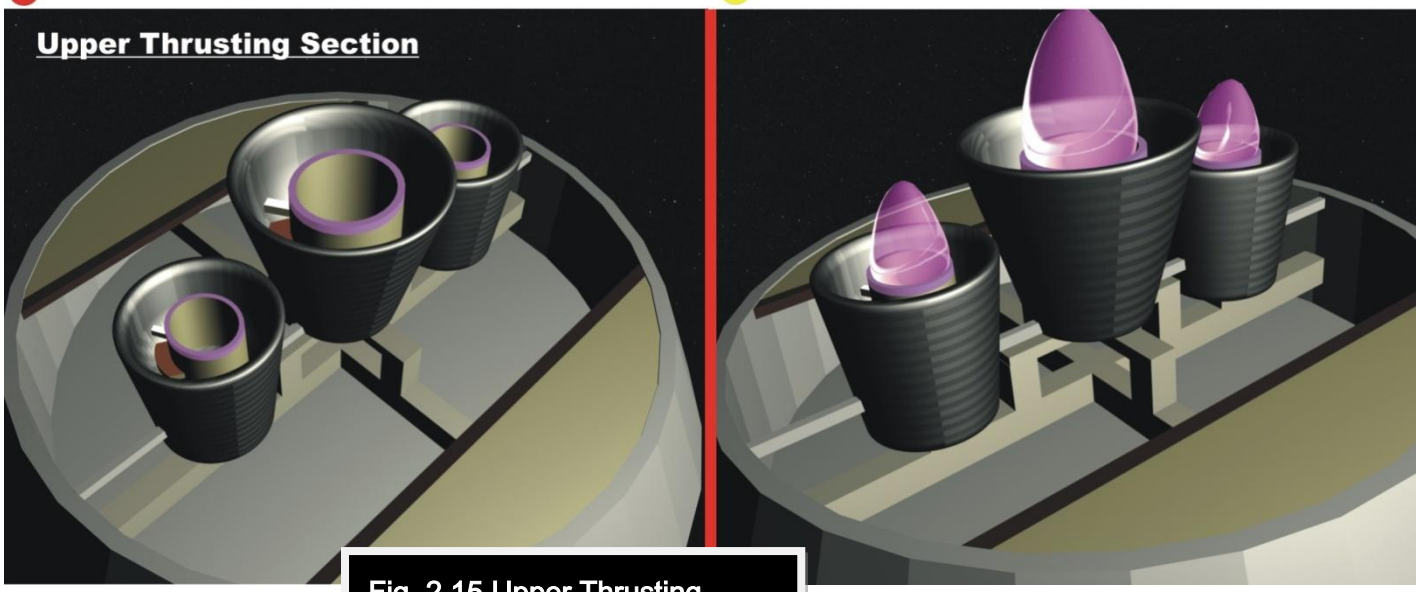


Fig. 2.15 Upper Thrusting

OFF-Position ON-Position

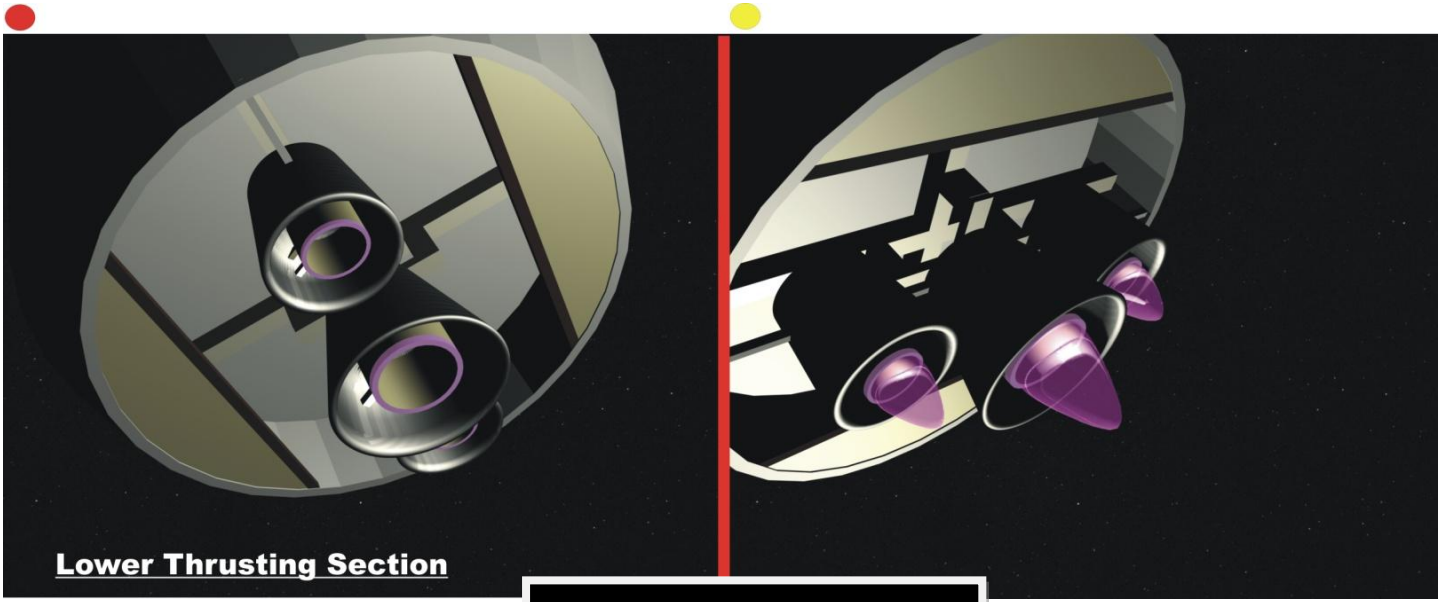
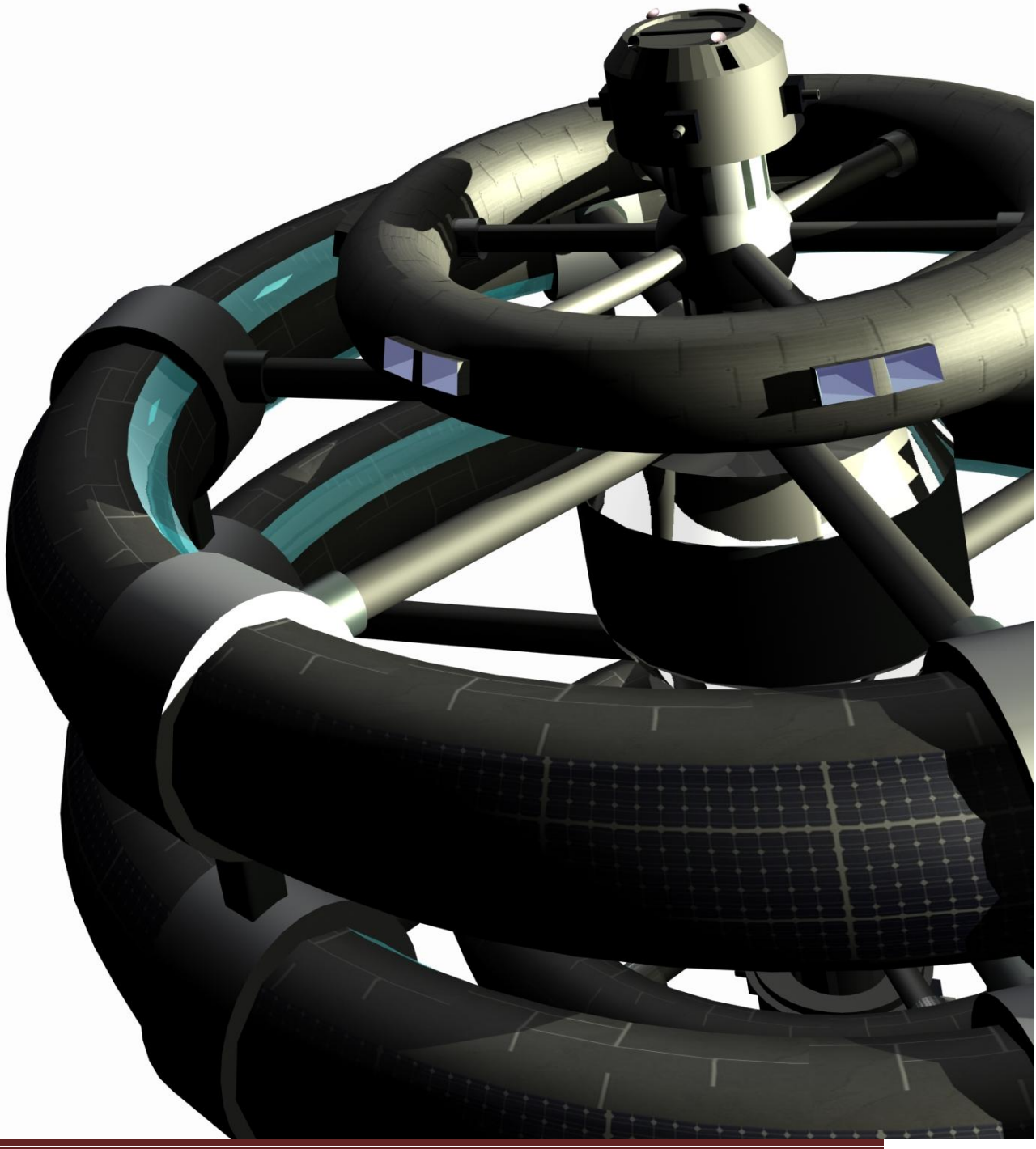


Fig. 2.16 Upper Thrusting

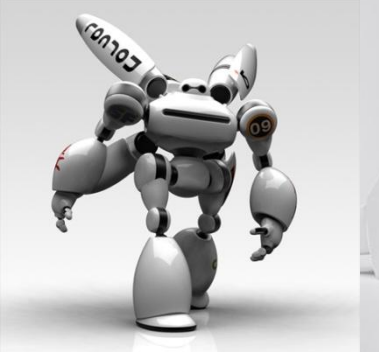
2.6 Half-'g' Accommodation

The visitors will arrive on space ships operating at **micro-g levels** (i.e. docks). So to enable adaptation of visitors, **accommodations** at half 'g' levels of the **primary settlement volumes** shall be provided in the **Torus D** which has gravity equal to **1/2 'g' or 4.9 m/s².** The visitors shall be taken to **Torus D (1/2g)** for about **30 hours** before they are sent to **1g** levels i.e. **Residential tori** to prevent any damage to muscles and tissues. The accommodation area shall be isolated from the **industrial area** in the torus to **ensure safety** of the visitors. This area shall have pressure of **1 atm** which shall be same as in the **residential area**.



3.0

OPERATIONS AND AUTOMATIONS

3.0 OPERATIONS AND AUTOMATED SYSTEMS

3.1 Operations and Infrastructure

After the space settlement is constructed, the subsequent key task would be to operate it flawlessly for which a soaring numbers of automated systems will be mandatory. Therefore, an absolute co-operation of the operations and automated systems shall help accomplish this goal. The settlement will be equipped with all kinds of automated systems counting robots, communication, etc. to ensure safety to its residents; consequently, providing them an enhanced life.

3.1.1 Orbital location

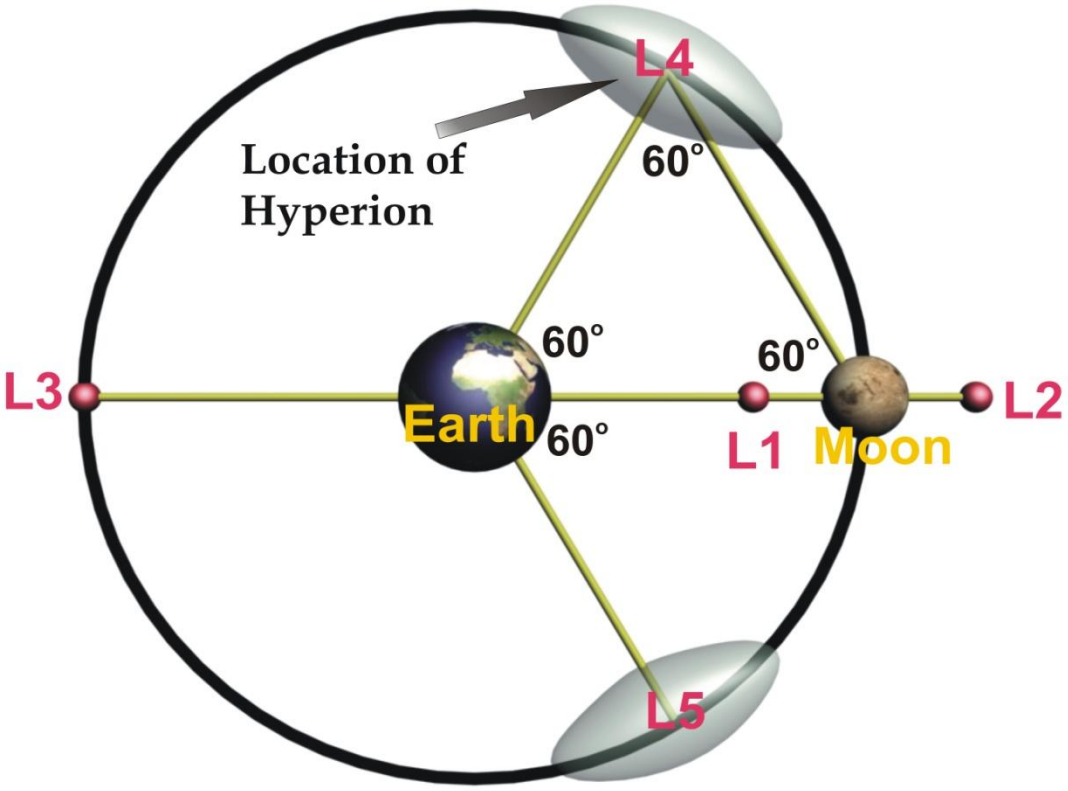
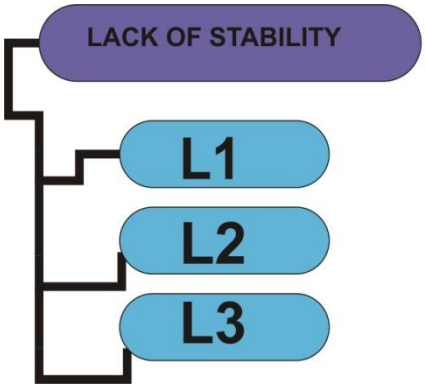


Fig. 3.1 Orbital Location

3.1.2 Justification of selected locations:-

Why not L1, L2, L3?



Justification for Rejection of L5:-

Despite the fact that **L5** provides stability yet it is rejected because it contains interplanetary dust. Also, it does not provide some conditions that L4 does.

Table 3.1 Justification for selected location	
Stability	The Lagrange point **L4** constitutes stable equilibrium points, so that an object placed there would be in a stable orbit with respect to the Earth and Moon. With small departures from L4, there would be an effective restoring force to bring the settlement back to a stable point
Close proximity from the sources of raw materials	The construction base **L4** is **384400 km** away from the moon, makes transfer of the raw materials easy and less time consuming, owing to the distance between the locations
Possibility of eclipse	The possibility of eclipse will be same as that on the moon
Other assets	a) Building solar power satellites b) Research on Mars and its orbit c) Research on Mars-Jupiter asteroid belts d) Research for extra terrestrial organisms

Other advantages of placing the settlement on L4 include:-

- Additional **1/6th** of the far side of the moon will be visible (earlier inaccessible from earth) **Fig 3.2**
- Equal distance from the moon and earth
- Capable of direct communication
- Can behave as a relay point in communication between earth and the far side of the moon

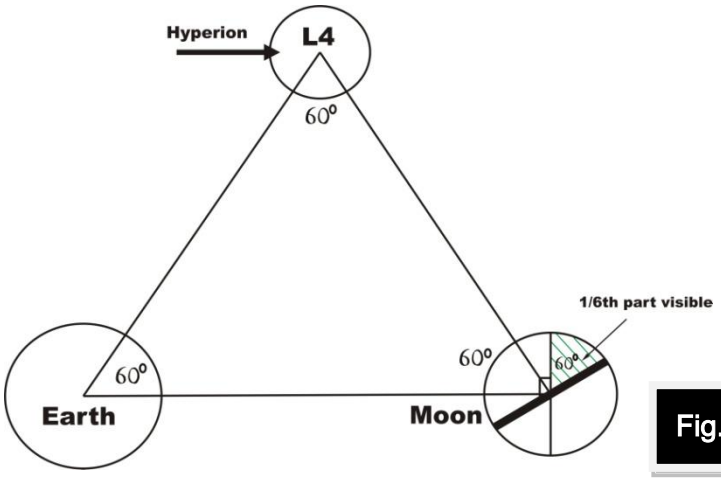


Fig. 3.2 Far Side of Moon

Table 3.2 Orbital Information				
Semi major axis	Perigee	Apogee	Revolution period	Rotation period
384 399 km	363 104 km	406 696 km	27.3 Days	61 seconds

3.1.3 Construction Material sources

Construction of **Hyperion Space Settlement** shall take place on **Earth-Moon L4.** The materials shall be mined on earth and moon. The mined materials on moon shall be stored in storage modules which will be constructed on moon, prior to the beginning of construction of **Hyperion**.

Table 3.3 Construction material sources	
Name	Source
Aluminum oxynitride glass	Moon: aluminum, oxygen abundant on moon
M5 fiber	Earth : artificial fiber to be manufactured on earth
Asbestos filter	Moon : manufactured of silicates which are abundant on moon
Super adobe	Raw materials procured from earth and moon and then manufactured on lunar base

Aluminum titanate	Moon : aluminum abundant on moon Earth : titanate extracted from earth
Sialon	Moon and Earth: mixture of different compounds
Carbon nanotubes	Earth : carbon nano tubes will be manufactured on earth
Radiation protection material	
Twaron	Earth : artificial fiber manufactured on earth
Polyethylene foam	Moon : a hydrocarbon available on moon
RTV-3145 adhesive	Moon : as it contains silioxanes, silicones and hydroxyl terminated
Silicone rubber	Moon : silicones of required material is abundantly available on moon
Nitinol	Earth : nickel and titanium available on moon
Sealant gel	Earth : artificial gel (manufactured on earth)

3.2 Contingency plans for failures

Keeping in mind all kinds of problems, our settlement provides contingency plans for failures in any of the automated systems or machinery. These plans have been mentioned in table 3.4.

Table 3.4 Contingency Plans

Contingency	Vulnerable areas	Detection	Problem fixation	Time taken to fix the problem
Fire	Houses, industries, Public areas etc.	Smoke detectors will be installed in the walls of settlement	In case of fire people will be evacuated from the affected area and mono ammonium phosphate will be automatically sprinkled by the smoke detectors	< 70 seconds
Hull breach	Walls of settlement	Any damage to any hull component will be detected by the sensors on the walls of settlement and reported to	Sealant gel used in the walls of settlement will create a layer on the damaged part and will temporarily seal it. Specialized robots will repair the damaged parts	< 60.5 seconds

		command center	with RTV-3145 adhesive	
Power failure	Whole settlement	-	Switch to backup power source – **XANTERX XW** series huge storage batteries with super nanowire capacitors. The problem will be analyzed and swill be repaired via automated systems	< 2-4.5 hours
Solar flare	Various hull componen ts	-	Polyethylene foam has excellent resistant properties against solar flare and will thus shield all the external walls and devices. Any damage if caused will be analyzed and repaired.	< 2 minutes
Biological infection	Areas near industries, labs, sewage plants etc.	Nano detectors	Infected areas and infected people will be quarantined. Evacuation plans will be executed if needed. Source of contamination will be fixed by automated systems	< 9 minutes
Docking accident	Docks	Hyperion traffic controller will detect the problem	Traffic will be directed to docks on the other side. Automated systems will repair the damages	< 14 minutes

Cyber security breach	Cyber network of the settlement	Highly developed cyber security systems will detect the problem	• Quantum cryptography will be used that keeps out the intruder by changing the encryption key. • Original files will be restored. The intruder will be located and appropriate action will be taken against him	<10 milliseconds
Data storage failure	-	-	Backup storage devices will be started.	< 3 minutes
			Primary data storage will be replaced with new ones	Variable
Food failure	-	-	Residents will be provided nutrient pills. As soon as possible the food will be arranged	variable
Water failures	-	-	Residents will be provided water from backup water storage. Water will be arranged as soon as possible	variable
Robots failure	-	-	They will be repaired by specialized engineers as soon as possible	variable

3.2.1 Advanced Contingencies

In case an asteroid or any large space debris approaches the path of the settlement, a complete contingency plan would be followed to prevent the settlement from any kind of damage.

a) **For minor sized asteroids:** In case any asteroid with a diameter of about **150 km** comes into path of the settlement, contingency plans will be followed immediately and would be controlled by the **Hyperion Executive**. The settlement will be provided with several sets of **parabolic reflectors** with a large **aperture**. These mirrors will be placed in an order so that they focus the sunrays to a point on the asteroid. Due to very high temperature at a point, the asteroid will melt at that point, thus forming an **air-pocket**. Due to this air-pocket, there are fair chances of the asteroid to change its path.

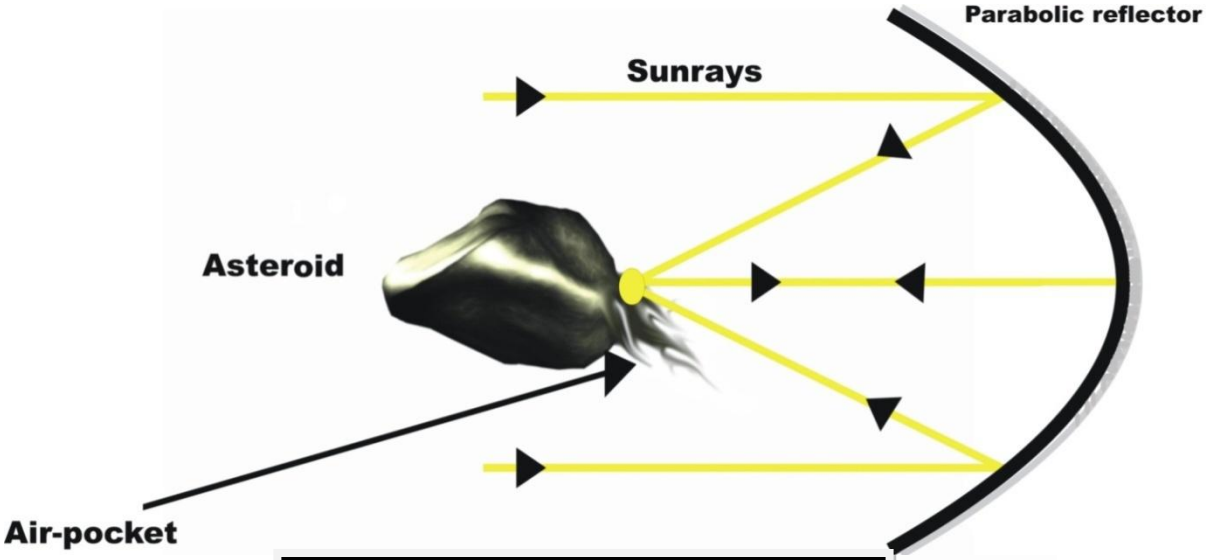


Fig. 3.3 Working of Parabolic reflectors

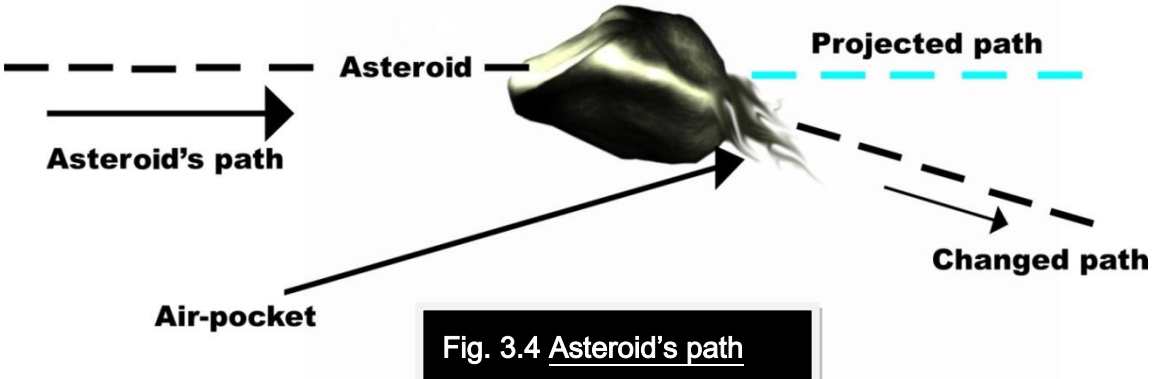


Fig. 3.4 Asteroid's path

b) **For major sized asteroids:** In case any asteroid with diameter of about **250km** comes into the path of the settlement, the settlement would be translated from its position using thrusters. During translation of settlement, there is not much of a difference in the net force experienced by a person and hence he will not feel much of a difference in his weight while the settlement is being accelerated for translation. The settlement will be accelerated for 45 minutes and will attain a constant velocity with which it will cover the rest of the difference.

3.3 Automated systems and features

The settlement will be provided with the most advanced automated systems which include robots; these will be available all the time to its residents for all kinds of help required.

Types of robots and their functions have been listed in table 3.5.

Table 3.5 Types of Robots and specifications

#	Purpose	Specifications
1.	Contingency plans	
a)	Fire	• Robots would be equipped with **Smoke detectors** to detect smoke and will contribute in immediate evacuation of population • Robots would also sprinkle **Mono ammonium phosphate** to extinguish fire
b)	Air contamination	• Robots employed for safe evacuation of people will evacuate the population and seal the area • Robots will clean the air and make it fit for residents
2.	External Construction	Robots will carry out different tasks at same time; same type of robots with similar mechanisms would be working at construction sites Robots will be equipped with following: • Mesh builder • Adhesive explosion system • Machine for soldering • laser welder • Large space for storing construction materials • large containers for storing waste materials

		• Small recycling units would be installed to recycle selective waste materials
3.	**Extraction of lunar materials**	• Robots participating in extraction activities would be equipped with excavator, scoop, shockers for movement and storage tanks
4.	**Other features**	
a)	**Domestic help**	Robots used for domestic purposes will have following features : • Human like structure for carrying out household activities • Robots will be provided with long arms, storage spaces, advanced vacuum cleaners and programmed for carrying out chores like cooking, child care, cleaning • Robots used in homes will also take care of local networking and local security purposes • Robots will be programmed in a way that they show immediate response in case of any mishap such as fire, minor hull breach
b)	**Agriculture**	• Robots programmed for taking care of agricultural practices will surely eliminate the requirement of human labour force checking the SOLEDs and maintaining them. Also they would sow, monitor and harvest the crops and plants. Robots will also carry out the processing and packaging work along with its transportation to retail markets
c)	**Recreation Activities**	• Different types of Robots would be programmed for controlling the recreation activities in 0 'g' and ½ 'g' areas by taking care of stadium • Robots during sports activities will care of the players by providing them water, energy drinks. Also they will hold practice sessions for players before actual game
5.	**Interior Finishing**	Robots will have following equipments for internal finishing : • Extra long arms for wiring and taping and roller for leveling. • Advanced vacuum lifter for lifting pre-constructed walls/house • Machines for floor tiling • Cargo tanks to store pipes • Robotic arms for laying pipes • Roller brush for applying paint and wallpapers

3.3.1 Networking Methods

For internal communication, the settlement shall have both wired and wireless networks. For wired networks, **Optic fibre cables** shall be used; whereas **Wi-MAX** wireless networks shall be used for wireless networking.

For specifications and details refer to **Life Support Systems 5.6.1**.

Table 3.6 Networking Devices	
Device	**specification**
Wired networks	
Ethernet Switch	Ethernet switch with 512-1024 Ethernet ports
Optic Fibre Cables	36 TBps (Bandwidth)
Optic Fibre Routers	2 TBps (Transfer speed)
Wireless Networks	
Wi-MAX Towers	2.64 Ghz frequency providing connectivity at a speed of 64 GBps in a radius of 70m
Wi-MAX routers	16 GBps (transfer speed)

3.3.2 Advanced Security measures to prevent unauthorized access

Our settlement provides the most advanced security measures to prevent any unauthorized access to critical and important data. The data shall be available to only authorized personnel and only for authorized purposes. **Biometric identities** shall be used as security measures.

Table 3.7 Security Measures	
Security Measure	**Specification**
Keystroke Dynamics	• Examines person's keystrokes and dynamics such as rate of typing and pressure, total time consumed for typing a particular message and time interval between hitting certain keys on keyboard • Dynamics of different individuals would be saved
Facial Thermography	Infrared cameras would detect the pattern of facial heat due to blood flow
Ear Pattern Recognition	An Otophone would be employed to verify ear pattern and shape

	of outer ear, lobes, bone structure and size which are unique to each person
Fingernail Bed recognition	• A system would scan the dermal structure under the finger nail • The human nail bed is a longitudinal structure comprising of parallel vascular rich skin rows with parallel dermal structures in b/w narrow channels unique to each individual
Iris Scan	Closed Circuit camera and near infrared sensor would analyze and scan the eye
Laser Security	Special lasers encompassing high security areas when broken by an intruder would produce alarming sounds

Table 3.8 Locations of Security Measures

Location	Security Measures	Reason
Houses	• Iris Scan • keystroke dynamics	Only owners can enter the house
Public Places	• Iris Scan • Ear Pattern Recognition • Facial Thermography	Easy and extremely secure
Administrative Desktop Use	• Iris Scan • Facial Thermography • Ear Pattern Recognition • Fingernail Bed Recognition	Medium level security required in offices
Server Access	• Iris Scan • Keystroke dynamics • Ear Pattern Recognition • Laser Security • Fingernail Bed Recognition • Ear Pattern Recognition • Facial Thermography	Demands High Levels of security. Laser security would protect precious data

3.3.3 Physical Locations of Automated Systems

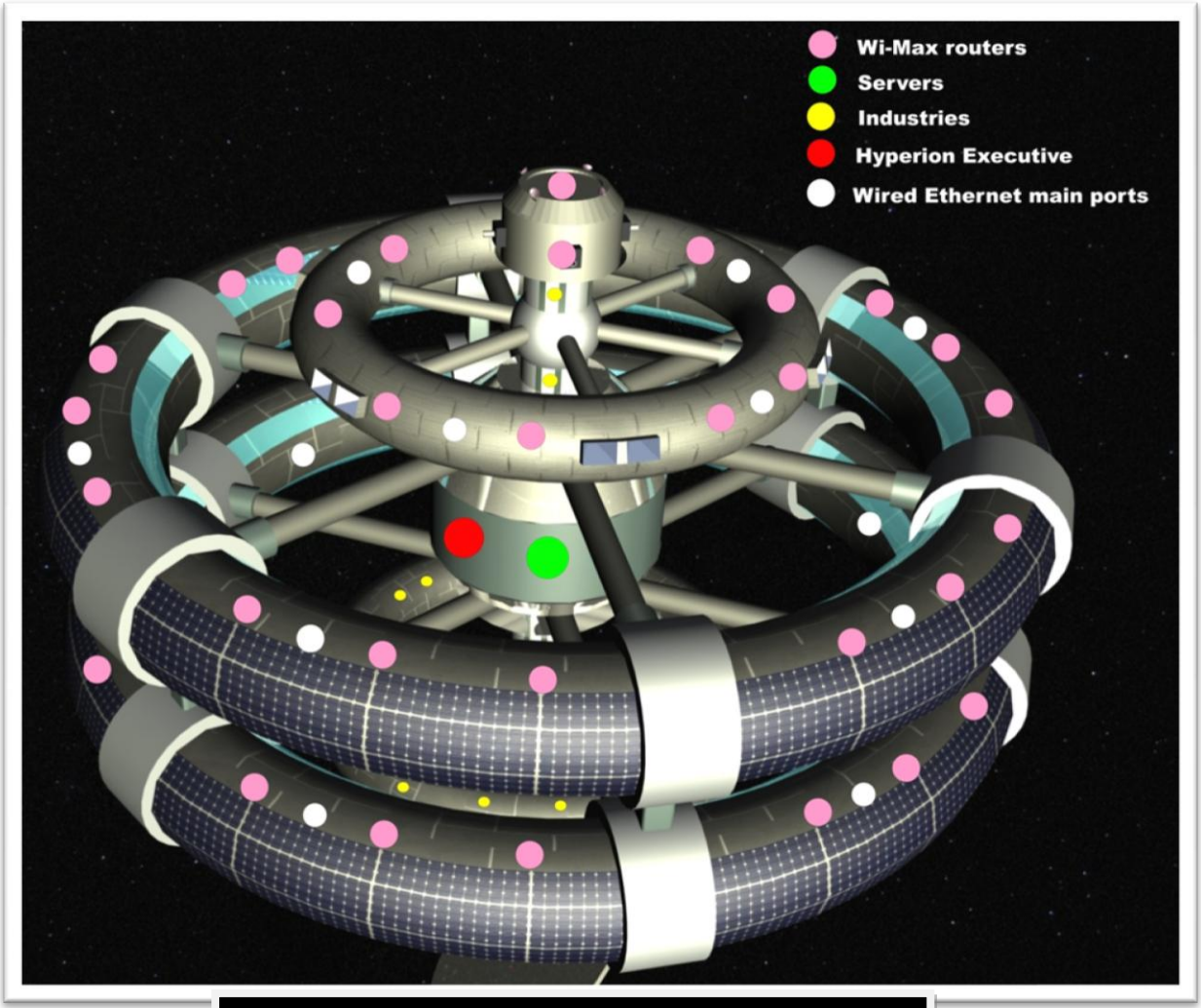


Fig. 3.5 Physical Locations of Automated Systems

3.4 The Hyperion Executive

The Hyperion Executive or **the command centre** shall be the most important area in the settlement; it will receive inputs from all over the settlement i.e. docking section, Tori, Thrusting section, etc. It shall command the settlement through inputs from sensors placed all over the settlement. The Hyperion Executive shall be located in the sub-cylinder at the centre of the settlement. This area shall be kept non-pressurized as there will be no interference of humans in the area. If required, the humans will control the command centre using remote control sensing while staying

at home. This dynamic technique enables them to control the settlement within no-time.

Various systems shall be required by the settlement to work and for its residents to live a luxurious life. The number of systems required and their function has been mentioned below.

Table 3.9 Computer systems

Type	Function	Number
Servers		
Executive server	• Manages and controls data from all other servers	2
Industrial server	• Monitor the amounts of raw materials to be used in various industries, minimizing the wastage of materials • Analyze the output of industries and moreover control the **Waste Management System**	4
Agro-based server	• Monitor the **amount, colour and intensity of light** required by plants in different levels of their growth and amount of nutrients to be added in the liquid used in **hydroponics** • Check the growth pattern of different crops	4
Settlement movement servers	• Maintain the settlement's rotation at **0.97rpm** • Calculate the thrust required to rotate the settlement in case of **change in rotation state**	4
Community Server	• Being a common server to all nodes it manages and stores information about residents and their families	4
Security Server	• Maintain security devices and prevent their malfunctioning and hacking • Intruder would be caught in no time in case of **cyber breach**	2
Docking port Server	• Monitor **incoming and outgoing ships** • Manage repair work and refueling work in the spaceship	2

Communication Server		2
Sports/Recreation Server	• Monitor the **Micro 'g' recreational activities** and any other sports tournament talking place in **Hyperion City Stadium(fig. 4.)**	2
Back-up Server	• Back up all important data present in other servers so that it can be put into use in case of data loss	4
Nodes		
Personal NCDs (nano computing devices)	For personal use by the residents of Hyperion	18000+
Administrative desktops	Workstations to be used in offices and authorized personnel only	2000+

3.4.1 Nano Computing Devices

Every resident shall be provided with smart portable computing devices. These devices shall be made up of nano particles. Nano particles are resilient that is they can easily change their shape and size. Hence people can change the dimensions of the computing device as per their convenience.

Fig. 3.6 Nano computing devices

3.5 Transportation

Hyperion Space Settlement provides a **Personal Rapid Transport** system called **PODS** for the easy movement of residents throughout the settlement. This is centrally controlled by the automated systems and every pod is wirelessly connected through the main router and other pods. There will be three pod stations in each torus. These pods have a **smart-interaction** system which will play the user's choice of songs or news or any live game going on to make the journey comfortable and giving a break from the boring working schedule.

Magnetic Pod Tracks are located along the sides of the roads. By clicking the Pod button present on the person's **personal wristband**, It gives an instant message to the router which decides which pod to send in the least time. The pod will reach the person within no-time and person will select desired location on the **touch screen 3D map**. The pod using **Hyperion Location Router System (HLRS)** will decide the shortest way to the destination. After leaving the people to their destinations, the pod automatically goes to the nearest station or to the next person if someone requires.

For overcoming the traffic and parking problem, the pods will have a durable roof with **magnetic track strip** placed on them from the front till the back. If at any time, two pods in the opposite direction or a faster pod happen to arrive on the same track then one pod will move above the other pod on the **magnetic strip tracks** and will land on the other side of track, thus continuing its journey.

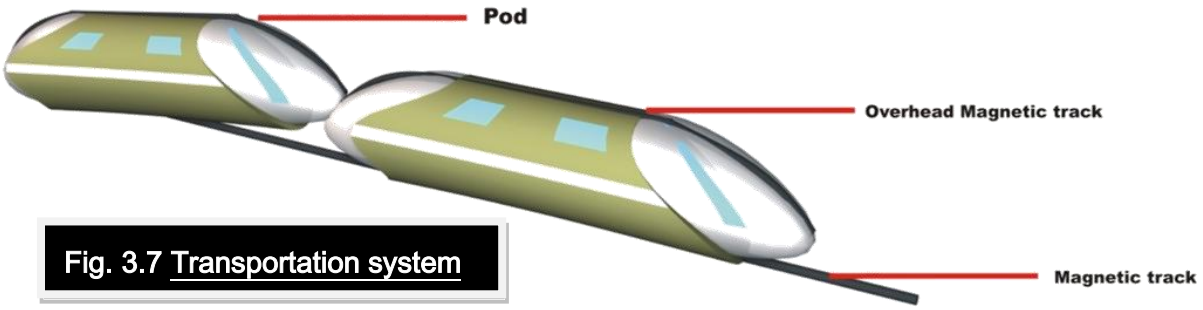


Fig. 3.7 Transportation system

Also there will be Emergency Pods owned by police, hospitals, fire departments and federal agencies. These pods will have the power to re-route the routes of other pods according to their need. All these pods will have special robots according to specification required.

3.5.1 Transportation between Spokes

Spokes are non-pressured areas of the settlement; therefore a pressured vehicle for mass transport is needed for movement between spokes. A **pressurized vacuum POD** system having a glass tube and spherical pods is built for transportation. These pods move using **magnetic and gravitational force fields** between the **steel pod** and the **glass tube** resulting in steady placement of passengers. These pods can carry **12 people** at a time to avoid the sense of overcrowding in the pods.

4.0

HUMAN LIFE DESIGNING

4.0 HUMAN LIFE DESIGNING

Hyperion Space Settlement will be a destination which will exhibit the zenith of human imagination. A place - self sustainable, technically advanced, pollution free, safe environment, perfectly controlled but still so natural to live. Humans would come here, live here, work here, play here and feel like a home.

While living in space, we need to think on many aspects of human life to make it as living on Earth and better:

- Consumables
- Sunlight
- Community Design
- Residential Design
- Safety
- Recreation

4.1 Consumables

4.1.1 Food

Food is the basic need of all living beings to gain energy. **Hyperion** will provide the best quality food to its residents. Since no single food group can nourish the body with all the vital ingredients it requires; it is important that we consume a variety of healthy foods to derive the nutrition our body needs. So the residents will be provided with a variety of cuisines that will have high nutritional value. The production of all food will take place in the agriculture sector.

Table 4.1 Balanced Diet Chart of Hyperion's Citizens (Nutrition and Quantity)

Food Stuff	Energy (kcal)	Proportion (in Balanced Diet)	Quantity - Per Person Per Year (in kg)
Cereals			
Wheat	360	440	6242.177
Rice	370		

Maize	122		
Pulses			
Peas	80	46	652.591
Vegetables and Fruits			
Cabbage	20	60	851.206
Cauliflower	20		
Lettuce	21		
Carrot	40	52.5	744.805
Potato	80		
Onion	40		
Apple	56	250	3546.691
Banana	90		
Lemon	57		
Nuts and Oil Seeds			
Almond	580	450	6384.045
Cashew Nuts	550		
Coconut	350		
Walnut	660		
Spices and Condiments			
Cardamom	229	20	283.735
Chillies	246		
Ginger	20		
Flesh Foods			
Pork	114	100	1418.677
Fish Meals	364		
Goat Meat	118		
Produce			
Cow Milk	67	40	567.471
Butter	720		
Egg	39	60	851.206
Beverages	12	10	141.868

4.1.2 Other Consumables

Apart from food, all other consumables shall be produced from raw materials in the different parts of settlement and transported to the two Residential tori in bulk. For ease of availability of the goods, all the consumables will be delivered to the distribution centres present near the residential areas.

Table 4.2 Production and Quantity of Other Consumables

Consumable	Raw Material	Production per Year	Products	Production and Distribution
Cloth	Cotton Bamboo	456000 m	Clothing, Footwear, Linen, Accessories	Agriculture sector to Local Markets
Medicines	Chemicals	24000 kg	For headache, surgeries, First Aid	Earth and Operations Core to Dispensaries
Electrical Appliances	Metals, Wires, Plastic etc	684000 units	Washing Machine, Light Bulbs, Microwave etc	Earth to Houses (Pre-installed)
Toiletries	Different items	182400 kg	All Cosmetic, Soaps, Personal Hygiene	Operations Core to Local Markets
Paper	Bagasse – waste product of Sugarcane	According to monthly basis. Approx. 38000 kg	Writing sheets, Tissues, Official notes etc	Agriculture Sector to Operation Core to Stationeries

4.2 Sunlight

Due to location of **Hyperion Space Settlement** i.e. Earth-Moon L4 Lagrange Point, sunlight shall be available to the settlement at all times. Also, Eclipses due to the earth are not much frequent.

Mechanism

Two discs are constructed at the interface of spokes from (both Residential Tori) with the central cylinder. The sunlight reflects from the mirrors placed above the settlement and falls on these discs, which further reflect the sunlight to the windows of Residential Tori. Same mechanism follows for Residential Torus B. There are four discs, two for each Residential tori.

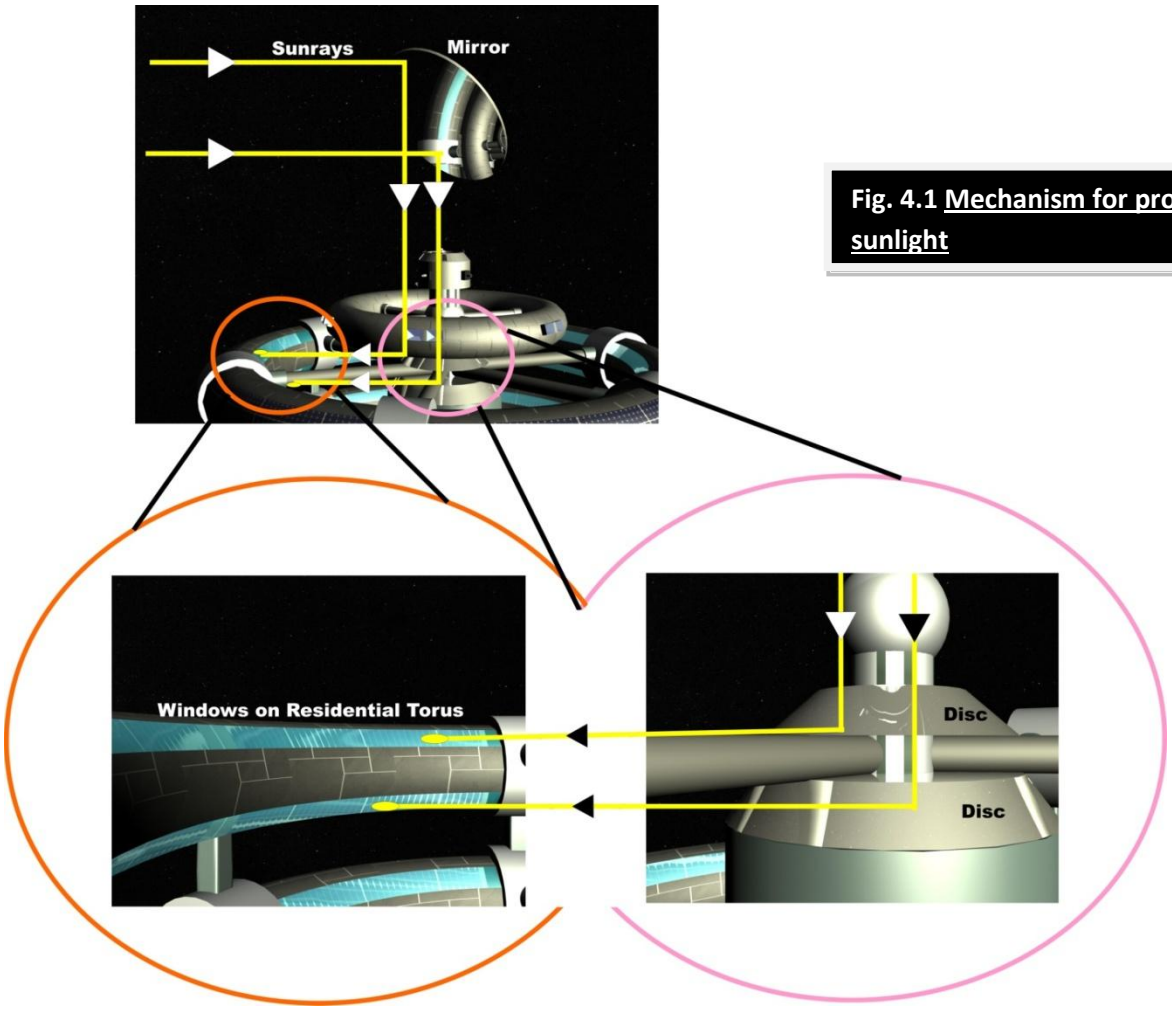


Fig. 4.1 Mechanism for providing sunlight

4.3 Community design

Hyperion Space Settlement has two Residential tori which will provide the best living space for 18000 residents of the settlement. The two tori include residential, commercial and green areas providing an organic ambience. The residents will have access to gardens, parks and the **ion Rivers** flowing thorough the tori would make a calm and peaceful environment.

Every person has different needs and preferences in his or her living style. While one man may wish to live in a tranquil environment, others may prefer to live in the hustle bustle of a city. **The Hyperion Space Settlement** provides two main blocks of living space. The **Residential Torus A** provides living space for those who prefer a living environment similar to that of any metropolitan city of the current times. Placed right below it, the **Residential Torus B** will be preferred by those who would rather like a quiet living space, in the vicinity of green hills, beaches and lakes but with the same facilities as the residential torus A.

4.3.1 Neighbourhoods

Residential Torus A: The residents will have access to all kinds of luxuries that a modern infrastructure can support. There will be supermarkets supporting every commodity, businesses of all levels, a powerful economic centre and government offices. High rise buildings, less open spaces, bright LED lights and elevated roads will be the characteristics of this torus.

Residential Torus B: It will be a heaven for adventure lovers and peace seekers alike. Artificially constructed hills and lakes will provide places of recreation for the residents. Greenery will be abound in all directions and places of residence in well forested areas will provide a healthy atmosphere for the next generation to grow in. This torus will have all the modern facilities as the Residential Torus A has, but will give the residents a tranquil environment like earth.

4.3.2 Routes

All the places in the settlement will be well connected through roads, bridges, elevated roads, underground routes, and paths along the Ion Rivers. These paths and roadways will provide residents chance to walk, exercise and bike promoting physical exercise and low-cost and eco friendly alternative over motorised transports. The automated magnetic tracks for the **Pods** along the metalled roads will also connect each corner of the settlement.

4.3.3 Health

One main hospital and three small health care centres shall be present in both the residential tori. All the hospitals will have an access to emergency **Pod** system as soon as a case is

reported. The nearest Pod will be activated and will reach the destination, take the patient and one person with him and will go the nearest health centre. After the diagnostic in the Pod by the automatic **RPD (Robotic Pod Doctor)**, the Pod will decide which first aid is to be given and where to take the patient. Other than this, when residents arrive in the space settlement, a tablet containing several micro-sensors will be given to them. The micro-sensors will scan the body and give a full report of the residents' health. Fast and all time health services of the Hyperion settlement will ensure the welfare of the citizens.

4.3.4 Education

Quality of education forms the foundation of any society. Hyperion's education system shall be central and integrated. While it is under the government, there shall be private schools providing a choice to citizens. One primary school in both the tori will be present present for children aged 4-14 years. One High school will be present for children aged 14-16 in both the tori. For admission in higher studies, an online exam will be conducted for students of both the tori (30 seats are reserved for earth's students) and the selected students will study in the '**Artraues University'** present in a peaceful environment in residential torus B. **The Artraues University** offers studies in business, history, languages, arts, sciences, mining, engineering and medicine. Apart from human teachers, virtual teachers, smart classrooms and mind and mood sensors will be used to increase the level and quality of education.

4.3.5 Parks and gardens

Many parks, gardens, lawns are build to enhance the beauty of Hyperion. As discussed earlier, Residential Torus B has more open spaces, so number of gardens in this torus will be more than in Residential Torus A. This torus will also provide open spaces in front of houses giving people an option to incorporate lawns, organic farms or gardens. All these parks and gardens offer a relaxing place to the people in the evenings and create a pleasant environment.

4.3.6 Hotels and rest houses

Hyperion Space Settlement will be a haven for tourists. Tourists shall be provided environment

with full view of Outer Space and even enjoy the cut edge topography of earth. In Residential Torus A, hotels shall be present near big malls and business hotspots. Night Life here will consist of Discos and Bars which will be open 24x7. In Residential Torus B, there shall be many hotels. Hotel business here will not be limited to providing a room to stay, the hotels will manage tourist's tours and letting them enjoy each and every attraction of the Hyperion - Hills, **Ion River**, Beaches, forests, tranquil environment and the ultimate space view.

4.4 Residential design

Hyperion Space Settlement provides residents a wide variety of houses to choose from. But all houses share common air theme, automations and construction material.

4.4.1 Housing details

4.4.1.1 Construction: The houses will be constructed using bricks made by totally eco-friendly, inexpensive and fast process that is **Microbial-Induced Calcite Precipitation** using **Sporosarcina pasteure** (which can be found on earth, moon, martin soil) and **Sunlight** (which is abundant in space). These bricks are very hard and strong proving great structural support. Other than this, bamboo will also be used. Landforms in the settlement shall be made using martin soil.

4.4.1.2 Technology: All the houses will have high tech and cut-edge automation technology. The houses will have smart electronics and appliances which will communicate with each other, maintain a profile of each person's usage, wastage and taste and using this information optimise its performance in future and lessens work of the residents.

4.4.1.3 Eco-friendly: The best part of the houses in Hyperion Settlement is that all of them shall have a unique vertical garden or green roof which will not only help creating pleasant surroundings but also will help in cleaning the pollutants from air, production of oxygen, purifying water and even organic farming.

4.4.2 Residential Torus A

- **Modern Loft** - Workaholic people and the ones who want making home something to look forward to, those live in a modern loft. These types of houses will be present near work places and shall be present in wide range of prices. They will have two bedrooms usually an individual or a couple shall live in it.

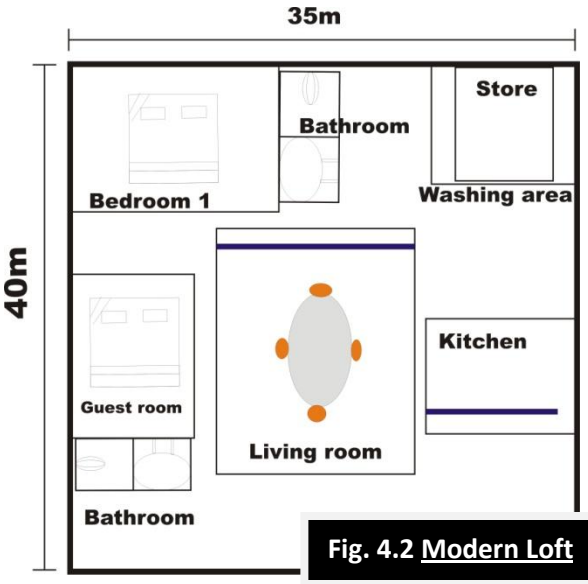


Fig. 4.2 Modern Loft

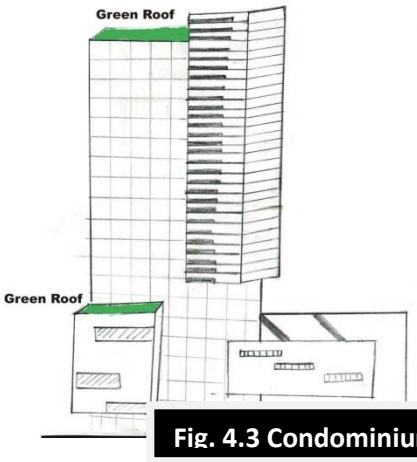


Fig. 4.3 Condominium

- **Condominium** - A group of housing units where each home-owner will share an individual unit. A condominium will have 4-6 floors, having living area for 20-25 people. Large Windows and modern infrastructure gives an open look to these apartments. Families and couples choose this for living in because of low cost, open look and location.

- **Bungalow** - Typically will be 1 or 2 stories tall. These will contain broad overhanging eaves and big porches. Perfectly suited for large families. Bungalows shall be present in the residential areas of the upper town.

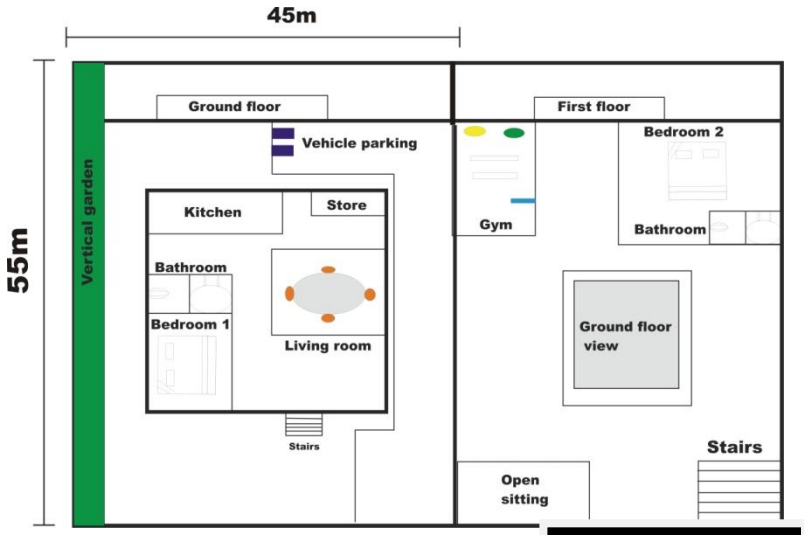


Fig. 4.4 Bungalow

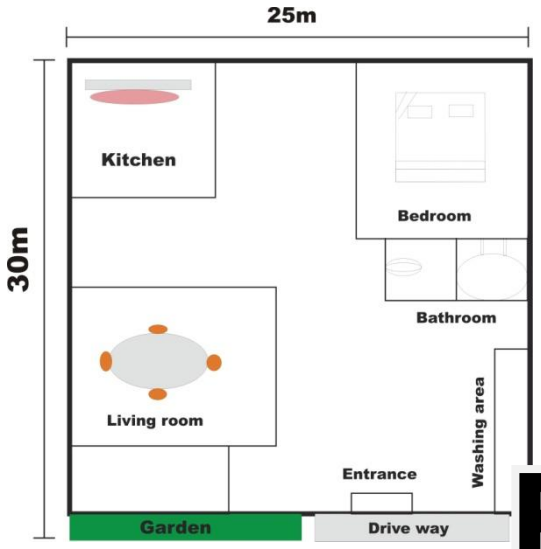


Fig. 4.5 Small town houses

- **Small Townhouse** - Small and compact, a series of multi-level houses shall be connected by common sidewalls. These homes will be for individuals and couples. Based on the modern architectural design, these would give a comfortable look.

4.4.3 Residential Torus B

- **Colonial House** - Colonial house plans will have 2 or 3 floors with gable roofs, pillars, multi-pane windows and symmetrical and open-space design. Generally for adults with children. These houses shall have a lawn or an open green space for relaxing, giving people calm and restful environment. Other features of this design shall be entry-hall, fireplace and classical details.

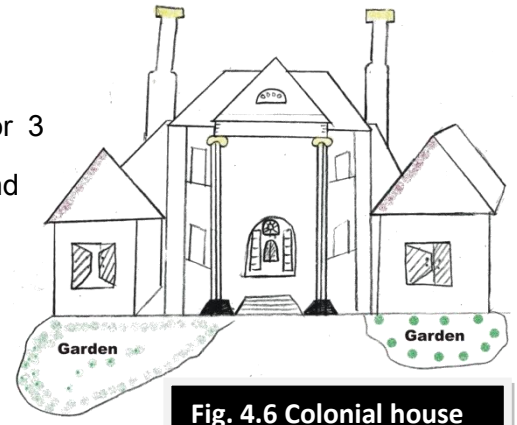


Fig. 4.6 Colonial house

- **Cotswold Cottage** - A childhood dream house of every person reminding of bed time stories. These houses shall be present near lakes, the ion river and on the hills. Asymmetrical design, steep gables and arched doors are some features of these houses. Preferred by individuals and couples.

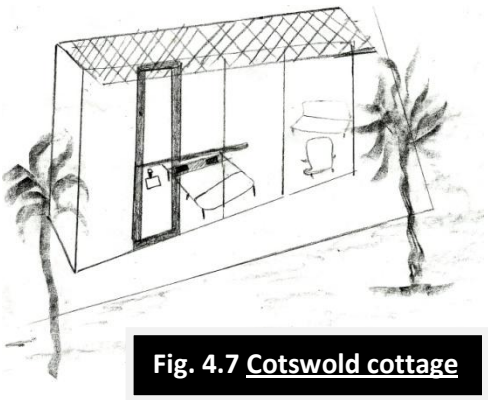


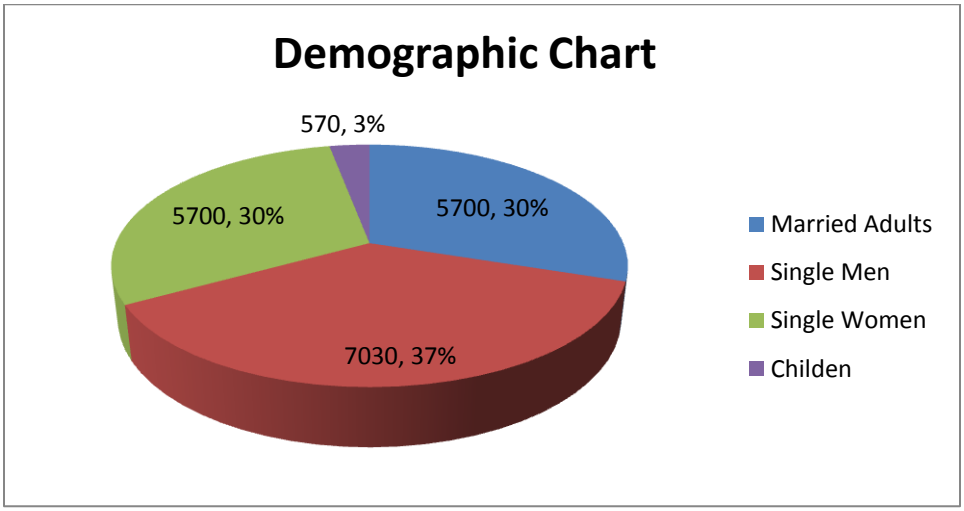
Fig. 4.7 Cotswold cottage

- **Cape Cod Houses** - These shall be small and economical houses present near shops of daily needs and business. **1 or 1/2 stories** houses will be for small families and couples. Large and open spaces for space, light and ventilation shall be present with symmetrical design of the buildings.

Fig. 4.8 Cape Cod house

4.4.2 Demographics

Total Population-18000; Transient Population-2000



4.4.3 Demographic shifts

Eventually as time passes, demographic shifts are bound to occur in the Hyperion Space Settlement. Taking this into account, many provisions have been taken to support this change such as modular house designs, open space in front of houses where a more room can be added according to need and time. Also community living as a measure to reduce the effect of demographic shifts will be added, where citizens would live in different apartments in the same building.

4.5 Safety in micro 'g' environment

Safety is important in all environments. Hence for this purpose, padded walls shall be provided in exterior as well as interior hull surfaces (inside central hub) with the series of tethers and handrails. People shall move around by holding tethers attached to the ceilings and handrails which shall be on the sides. Also people will wear special **Velcro boots and gloves** for better grip.

1) **Tethers and clips:** The latch of the space suits would attach to the handrails for easy movements of the residents.
2) **Padded walls:** There will be padded walls in the micro 'g' areas so that residents don't get hurt when they hit the hard surface.
3) **Velcro boots and gloves:** People will wear Velcro boots and gloves when inside central hub, for a firm grip and avoid any inconvenience. The floor and handrails will be covered with **Velcro loops** whereas the gloves and soles of boots will be covered with **Velcro hooks**. On moving, the Velcro hooks would stick to the Velcro loops and hence provide a firm grip.

4.6 Access to Unpressurized volumes

4.6.1 Spacesuit design

On moving from pressurized to unpressurized region many risks are involved. So a system is required to protect the person from any damage. **Bio suit** has been designed precisely to overcome the dangers involved during switching between environments.

4.6.1.1 Bio suit

Biosuit is a space suit devised in order to ensure a light weight travel and flexibility throughout. It provides **life support** by using mechanical counter pressure applied to the entire body by a tight fitting suit (except helmet).

4.6.1.2 Components of Bio suit

- A skin tight body suit
- Pressurized helmet
- Velcro like gecko boots
- Hard torso shell
- **Portable life support system (PLSS)** which includes oxygen tanks, cooling water system and carbon dioxide filters.
- Gloves
- Helmet
- Other sensors
- Antennas
- Urine collector

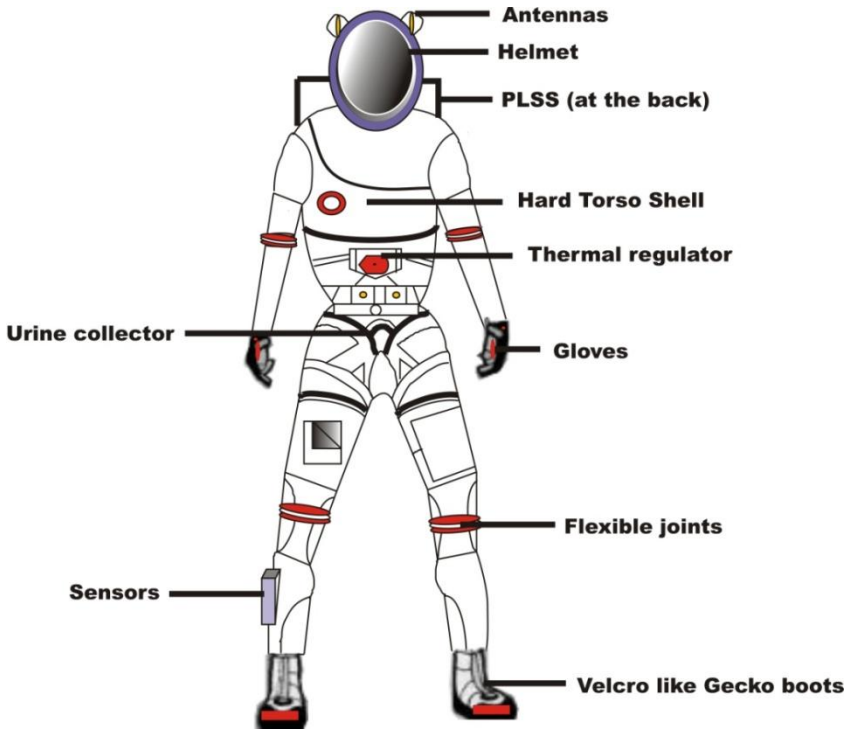


Fig. 4.9 Space suit View 1

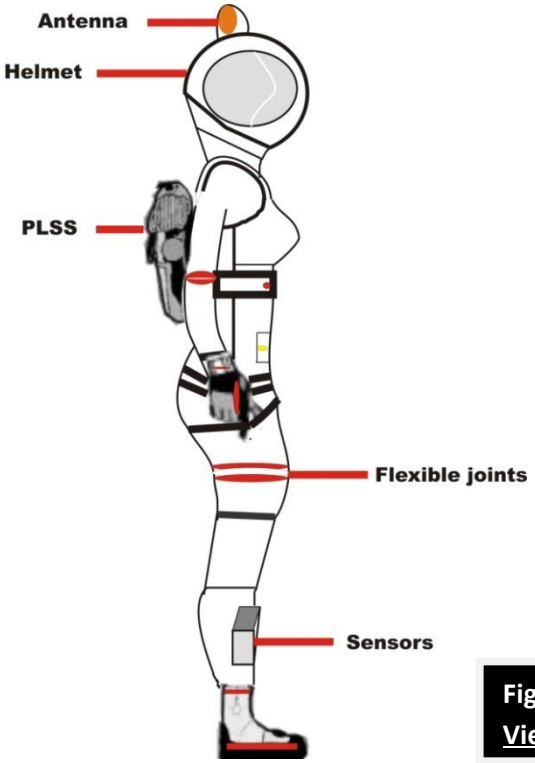


Fig. 4.10 Space suit View 2

4.6.1.3 Composition of biosuit

1) Smart polymers (biosuit layer)
2) Nickel-titanium (biosuit layer)
3) d3o (biosuit layer)
4) Kevlar Fiber (biosuit layer)
5) Carbon fiber (Rigid Torso Shell)
6) Aluminum titanate (Exoskeleton)
7) Chromel-R Neoprine (Exoskeleton)

Piezoelectric materials embedded on the bio-suit shall be used as a power source for it. The **SMARTsuit** technology shall repair any hole in the bio suit by automatically releasing a liquid to the site of hole, during a puncture in the suit.

4.6.1.4 Donning and Doffing of space suit

1) Donning

Steps for Donning

- First the residents shall wear the bio suit layer
- Then hard torso shell is donned next
- Couplings worn at the hips with **PLSS** shall seal the hard torso shell
- Urine collector shall be put on next
- Then the helmet, gloves and boots are donned. The gas pressure shall flow freely into the helmet and down the tube on bio suit layer and the gloves and boots as well.

Before donning the space suit the residents shall be made to breathe pure oxygen for ten to fifteen minutes so as to accommodate them to pure oxygen atmosphere of the space suit.

2) Doffing

PLSS shall be shut down and boots and helmets shall be removed while doffing. The elastic bio suit would be removed at the end after the removal of hard torso shell.

4.6.2 Airlocks

The airlocks shall be situated at the interface of the **pressurized** and **non-pressurized** volumes for decreasing the air loss in the settlement. They shall be located at the interface of spokes and torus; and spokes and central cylinder (central hub). The air lock system shall facilitate the movement of people from pressurized to unpressurized volumes due to its efficient working.

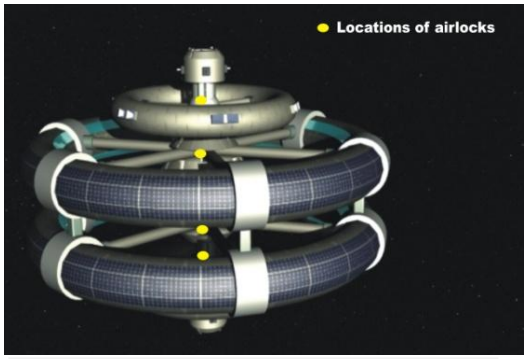


Fig. 4.11 Location of Airlocks

4.6.2.1 Working of Airlocks

The airlock shall have a chamber consisting of airtight doors. When a **transporting pod** will move from the spokes to the central cylinder the chamber shall be filled with compressed air to match the chamber's pressure to that of spokes. Then the doors shall open allowing the vehicle to move and shall be closed afterwards. The suction pumps would start to create vacuum in the chamber by sending the air back to the spokes. Then the door to the central cylinder shall open allowing the pod to enter the cylinder.

In case a person wants to enter the spokes from central cylinder he shall be first accommodated in the same chamber where the pumping of compressed air shall equalize the pressure. Then the doors towards the spokes shall unlock allowing him to move. The working of suction pumps shall send the chamber back to the spokes.

4.6.3 Volume of Air Loss

The working of Airlocks and use of POD for transportation shall contribute towards negligible loss of air when moving from pressurized to unpressurized region and vice-versa. But this negligible loss could turn into considerable loss of air after a month or so. Oxygen generators with high competence shall reimburse with this amount.

4.7 Recreation

Hyperion Space Settlement offers a rich array of recreational activities to make it a wonderful place to live in. We will conduct space concerts, dances, social gatherings and athletic activities throughout the year. All these activities would take place in different **'g'** levels. This shall be a complete thrilling experience for its residents and visitors from earth. The recreation environment shall be provided with retractable roofs which shall be implanted with **Transparent-OLEDs (TOLED)** that shall flash the ongoing events, animations, movies, etc. The whole environment shall be equipped with binaural audio systems for a complete 3D sound surround.

4.7.1 Sports activities

The Hyperion City Stadium lies inside Residential Torus B. This is a multi-sport stadium with many other facilities like gymnasiums, etc.; Sports events like boat racing, American football, cricket, hockey, etc. shall be held here.

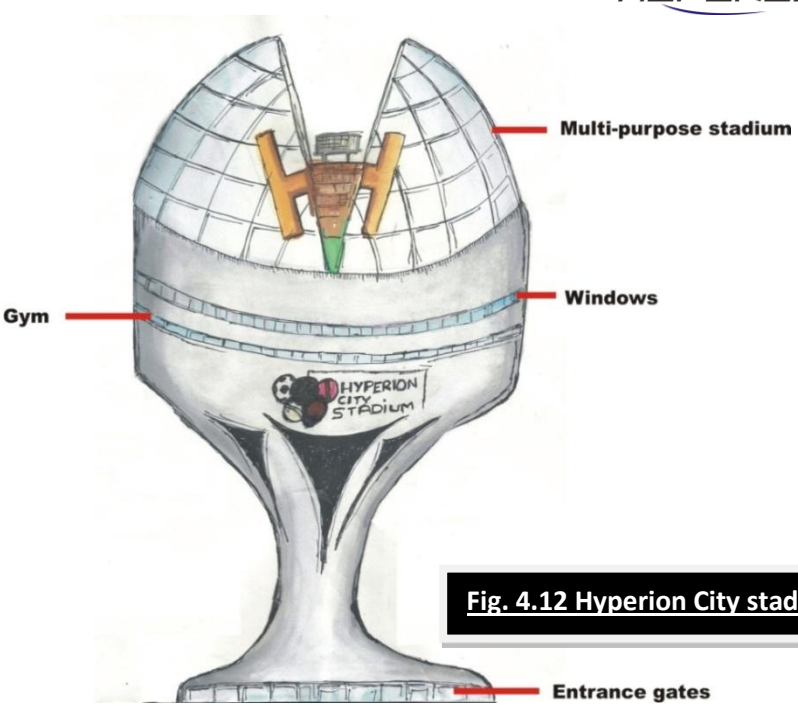


Fig. 4.12 Hyperion City stadium

4.7.2 Hype-Relax and Rehabilitation Centre

With a view to various vagaries of lifestyle, our settlement shall also provide its residents with a **Hype-Relax and Rehabilitation Centre** to provide them health in a safe and effective manner along with an enjoying and blissful experience.

The Hype-Relax and rehabilitation centre would be a **pyramidal** building surrounded by a pool that shall serve the purpose of a deluxe spa for relaxation containing **sulphur water** which is effective in digestive disorders and skin ailments. The lowermost part of the pyramid shall provide a multi-purpose gym for all age groups that would accommodate 160 people at a time. The first floor shall comprise an aerobics hall on one side and sauna bath on the other, housing another 90 people at a time. The second floor shall serve the purpose of a technical room where the music system, cameras, frequency modulator etc. shall work. The third and the uppermost floor shall be kept for meditation and massage purposes for another 75 people.

The whole building shall be equipped with sound-proof walls and with music put at a favourable frequency with the help of the frequency modulator at which the brain functions in total relaxation. The frequency shall act like a current that would magnetize the soul to attract positive energy from all around and concentrate it within oneself.

The hype-relax and rehabilitation centre shall be positioned and designed in a way that the peak of the pyramid receives maximum amount of cosmic energy. Thus, apart from providing earth like environment to reside, we also aim to fulfill the physical and psychological needs of the residents.

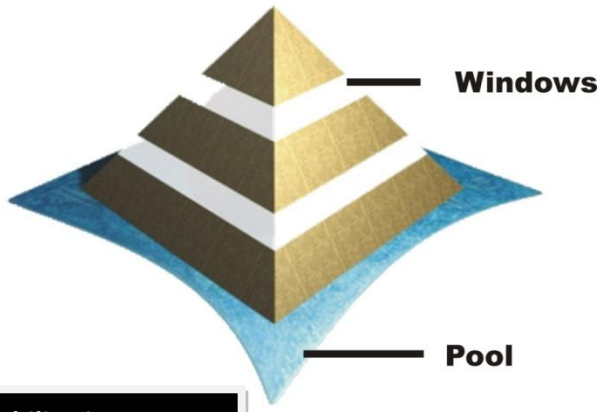


Fig. 4.13 Hype-Relax and rehabilitation centre

4.8 Life in Torus C (Stationary torus)

Hyperion Space Settlement is built to provide its residents Earth like life, yet better than earth. So there must be a place which gives them a real thrill and fun experience; or a full space-life experience to them. **Hyperion Space Settlement** has a **stationary Torus C**, just above the Residential Torus, A to provide a never before felt experience of **micro 'g'** and taking people to ecstasy; beyond one's imagination!

4.8.1 Basic engineering

1) **Non-Rotating** - This torus uses ball bearing system (refer to **Structural Engineering section 2.4**) to make it stationary.
2) **Lighting** - Artificial Lighting is provided in this torus as natural lighting system causes half of the torus to be permanently in light and other half to be in complete darkness. To avoid this, there will be no windows and all the lightening is provided by LED lights.

4.8.2 Features

- **Astronomy -** One of most important advantages of a stationary torus in space will be astronomy. As the torus is non-rotating, the position and angle of telescopes need not be changed each second. This helps in a constant observation of stellar objects. The observation will be done by the **Observatory windows** present on the outer walls of

Torus C. **Hyperion's micro gravity observatory** is well equipped with latest telescopes, computers and **Velcro surfaces** to provide a firm grip and better observation.

- **Amusement Parks- 'X-Alane Amusement Park'** will be present on this torus which will have rides running a real-thrill experience in people. This park will have rides which will enthrall the people with adventure and excitement in the micro-'g' environment. Rides which go through water, air and space at the same time will be the major attractions for tourists.
- **Discos and Restaurants-** There shall be two micro-gravity discos and three restaurants in Torus C providing the people Dance and Food while flying, an enthralling experience by itself. This gives the people a full space like experience.
- **Sports- 'Hawks Field Stadium'** shall be present in Torus C which will host the inauguration and some events of the **Space Olympics** held every 3 years. This will also be used as a sports complex for its residents providing a wide range of sports like soccer, galactic football, air-baseball, etc. Other than micro gravity, the stadium has many more attractions like 3D score boards, 3D sound system, Hologram video screen at the top of the stadium to view replays, personal message taker tabs on the seats and goggles with **10x zoom** of the game which provide an array of features. Other than the stadium there shall be adventure micro-g sports too in Torus C.

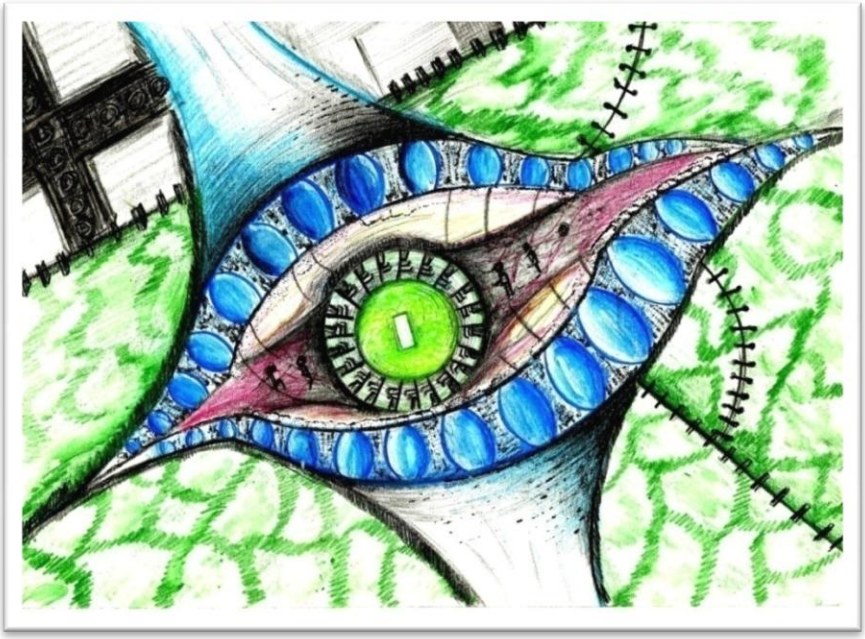


Fig. 4.14 Hawk Field stadium

HYPERION LIFE SUPPORT SYSTEMS

5.0

Hyperion Space Settlement is perfectly designed to provide luxurious living conditions along with all necessary equipments to protract life. The thinking unit of the settlement, ***Hyperion Executive*** *is positioned in the sub cylinder and controls all the automated systems. The* ***mesh*** *of the settlement shall provide durability, potency, and flexibility. There shall be an effective and fast system for provision of food, water and other basic commodities to residents of the settlement. The two types of networks that are* ***wired and wireless networks*** *shall provide high speed communication facilities and data exchange with minimal loss. Different mechanisms shall work in the settlement for* ***amputation and replacement*** *of various substances. Also the artificial day and night provisions shall contribute to provide earth like conditions on the settlement.*

This segment describes all the systems that enable **Hyperion** to support life.

5.1 Energy Requirements

Sunlight being abundantly available in space shall be used to produce electricity to meet the energy requirements of the settlement and to end the energy crisis on earth by trading surplus electricity (section 6.2.1). **Photon Enhanced Thermionic Emission (PETE)** solar panels are mounted on both the residential tori, covering **1/6th** of curved surface area of both tori that is **1592785.5 m^2**.

The efficiency of **PETE solar panels** is **double** than the traditional solar panels. Hence the solar panels shall produce **2 kW per sq. metre per day.**

Table 5.1 Energy requirements for various sections of settlement (kW/day)

Sections of the settlement	Energy required
Residential	80000
Industries	40000
Automated systems	5000
Agriculture	3000
Docks	4000
Thrusting section	150000
Total	**282000**

Table 5.2 Power resources and justification		
Technique	**Reasons for selection**	**Power produced /day**
Photon enhanced thermionic emission (PETE) Solar Panels	• Solar energy is the cleanest and cheapest source of energy • Solar energy is abundantly available in space and moreover is a renewable source of energy	**1592785.5 kW**
	Advantages of PETE solar panels	
	• **PETE** solar panels are quite efficient and can generate electricity both from solar sunlight and heat of the sun • Traditional solar panels often stop working on hitting **100C°**, whereas the PETE solar panels can even work at **250C°**; this is mainly due to the coating which enables it to work even at higher temperatures • Ordinary solar panels can only use light of specific wavelengths and the unused frequencies just generate heat proving a hindrance to their working. But this is not the case in PETE panels as they convert the waste heat into electricity.	

Power produced by settlement /day = 1592785.5

Power required by settlement/day = 282000

Surplus Power/day = 1592785.5 – 282000 = 1310785.5 kW

XANTERX XW huge storage batteries **nano wire ultra capacitors** shall be used to store surplus power.

5.2 Food Production and Management Unit

The citizens of the settlement shall be provided with best food and would be given a balanced diet to ensure a good mental and physical health.

5.2.1 Methods for food production and their advantages

Table 5.3 Methods of food Production

Hydroponics	Aeroponics
• Contributes towards the elimination of soil borne diseases and unwanted weeds • Requirement for pesticides is low • As only water is required for growth so this eliminates the requirement of crop rotation and fallow lands • There is no release of nutrition pollution because of controlled system. • The water in the system can be reused thus lowering water cost	• It is proven successful in case of hard root plants • Efficient utilization of space vertical placement of plants • It reduces the need of labour as correct nutrient requirements can result in extremely fast harvests. • Nutrient requirement by the plants is quite less, this is due to reduced volume nutrient throughput

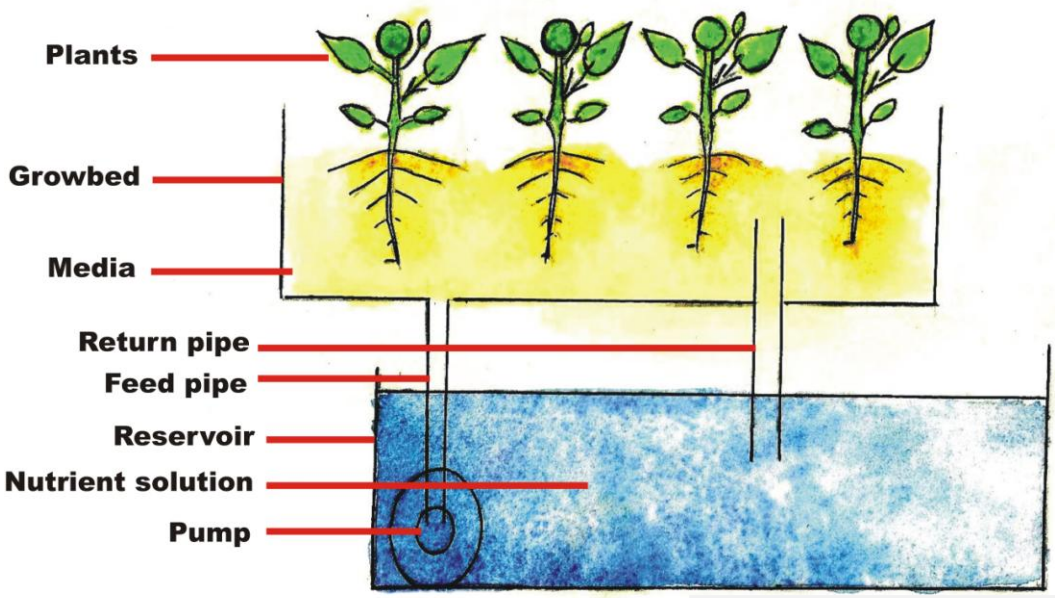


Fig. 5.1 Hydroponic system

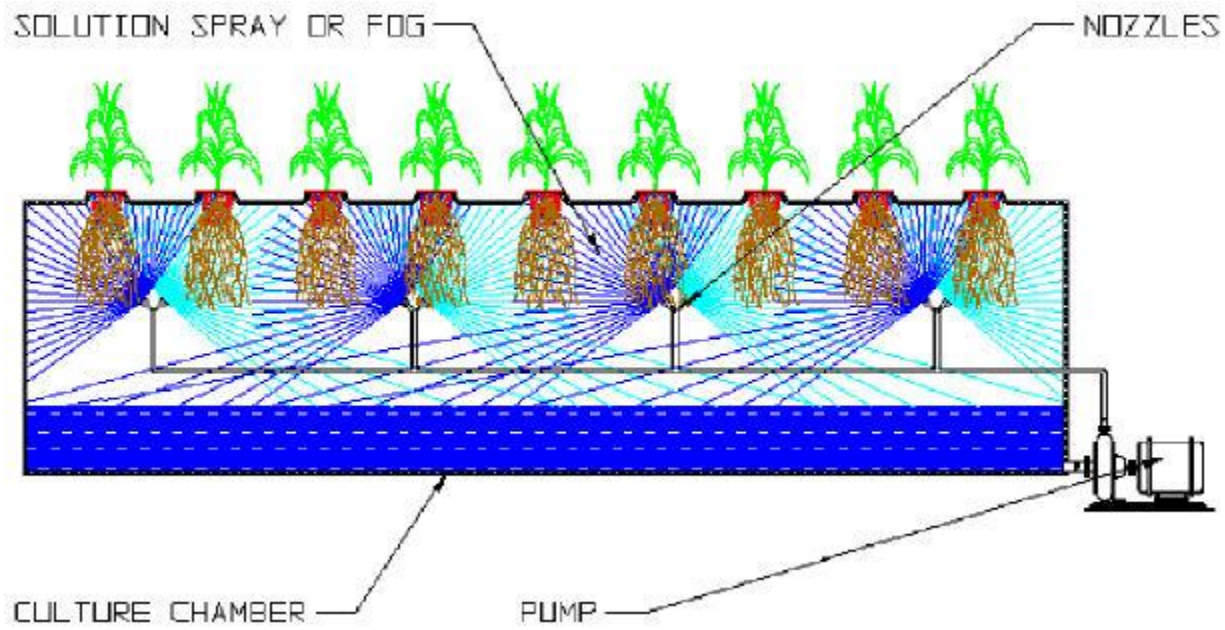


Fig. 5.2 Aeroponic system-
http://www.hhydro.com/faq.php?q_id=7

Table 5.4 Food Production and Management	
Growing	The crops and plants shall be grown using **aeroponics** and **hydroponics**. The much needed blue and red light rays which act as an energy resource of plants shall be provided through **SOLED** as plants only use red and blue light. Incandescent lamps shall also be required to furnish the light rays.
Harvesting	The programmed **robots** shall sow, monitor and harvest plants and crops and send them for processing and packaging
Storage	The food grains like wheat, maize shall be stored in dry, clean and isolated area under low temperature to avoid bacterial growth and pest attack. The perishable fruits and vegetables shall be stored in refrigerators under required conditions
Processing and Packaging	Vegetables and fruits shall be processed and packed using reusable vacuum poly nylon pouches and shall be sent to marketplace for consumption
Transporting	**Refrigerated trucks** shall be used to deliver the food products to local and main markets. A system shall also be maintained to ensure regular delivery of food items to the residents in the settlement through small **refrigerated vehicles**
Selling	Food products shall be available to every citizen of the settlement through main and local markets

Table 5.5 Food and Area requirements			
Crops			
Name	**Requirement (g) /person/day**	**Yield (g/m²/day)**	**Total area (in %)**
Cucumber	15	29.153	6.23
Peas	18	139.76	2.12
Cabbage	28	17.81	7.52
Cauliflower	22	31.02	3.26
Sugarcane	32	3.89	3.11
Wheat	130	12.96	26.33

Maize	100	10.58	10.36
Barley	100	9.98	12.12
Rice	110	16.95	9.25
Pulses	47	5.45	10.34
Lettuce	16	36.625	8.23
Potatoes	51	151.71	1.13
Animals			
Name	**Requirements(g) /person/day**	**Area(in m^2/animal)**	**Total Area(in %)**
Meat	60	3.17	48.54
Fish	65	3.07	51.64

5.3 Day/Night Cycle Provisions

Same monotonous environment with no variation in light shall fill the citizens of the settlement with boredom. Hence best efforts for the provision of artificial Day/Night shall be made by the means of **TOLED (Transparent Organic light Emitting Diodes)** capable of 70% to 85% transparency. TOLED use transparent contact on both sides and due to its bi-directional emission, light is emitted from both the surfaces. TOLEDs shall be installed on the roofs of Residential tori. Also they provide full transparency when switched off, hence shall not obstruct the view of space. **LED (light emitting diodes)** shall be used in the residential tori for the provision of artificial lightening. In the agricultural sector the requirement for blue and red light necessary for growth shall be fulfilled by the use of **SOLED (Stacked Organic Light Emitting Diodes)**. Two mirrors shall also be placed near the respective ends of the settlement for natural light

5.4 Water Management Unit

Water is one of the basic and most essential requirements for any human settlement. A human can live without water for maximum 3 days. Since a space settlement can carry a finite amount of water hence it becomes necessary to replenish and produce it.

Table 5.6 Water requirements	
Water required/person/day	1000L
Water required by **Residential Tori A and B/day**	18000kL
Water required by **Tori C and D/day**	200kL

5.4.1 Production of Water

Various chemical reactions and processes involving catalysts shall be used to produce water. Example: $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$. Some processes are listed below:

Sabatier process

The Sabatier process involves the reaction of hydrogen with carbon dioxide at elevated temperatures at elevated temperatures and pressures in the presence of an alumina catalyst to produce methane and water.

$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$

For production of 1 kg of water, we need to react 0.222 kg of hydrogen with 1.222 kg of Carbon dioxide. The by-product of this reaction METHANE can be used for a number of purposes such as propellants of aircrafts and for other industrial uses.

By Using Iridium

Most compounds react with either hydrogen or oxygen, but this catalyst (iridium) reacts with both. It reacts with hydrogen to form a hydride, and then reacts with oxygen to make water; and it does this in a homogeneous, non-aqueous solvent

Element	Sources
Hydrogen	Hydrogen tanks
Iridium	Moon
Alumina	moon

Process

In a typical fuel cell, the diatomic hydrogen gas enters one side of the cell; diatomic oxygen gas enters the other side. The hydrogen molecules lose their electrons and become positively charged through a process called oxidation, while the oxygen molecules gain four electrons and become negatively charged.

5.4.2 Replenishment and purification of water

Water shall be recycled in each and every possible way. A series of processes shall be used for the purification and replenishment of water. The following processes shall be used in order to make water potable -

- **Pre –chlorination :** for algae control and arresting any biological growth
- **Aeration :** for removal of dissolved iron and manganese
- **Coagulation :** for flocculation

- **Coagulation aids also known as polyelectrolyte :** to improve coagulation and for thicker floc formation
- **Sedimentation :** for removal of suspended solids trapped in the floc
- **Filtration :** for removal of carried over floc
- **Disinfection :** for killing bacteria
- **Reverse osmosis :** for removal of molecules larger than water
- **UV rays :** to inactivate microbes
- **Solar distillation :** this process uses sun rays for evaporation of water

5.4.3 Water Management

All these activities of purification and replenishment of water shall take place in **Hyperion water and waste management base** located in each Residential torus respectively and production of water shall take place in **Water production house.**

Hyperion Water and Waste Management Base (HWWMB)

All the activities to make water potable shall take place in **Hyperion water and waste management base.** Impure water and sewage shall be collected and sent to **HWWMB** via underground sewage pipes. The purified water shall be transported via underground pipes to various places in the torus and some amount shall be stored in emergency storage and riverine.

5.5 Waste management Unit

A settlement also needs proper waste management systems in order to be hygienic and a pleasant place to live in.

Both solid and liquid waste shall be collected from the houses through pipelines to a storage tank in the residential torus. This waste shall then be transferred through the pipeline system to **HWWMB**. In the unit the waste shall be separated as biodegradable and non-biodegradable.

1. **Biodegradable:** Biodegradable materials shall be collected and processed to produce manure and bio-fertilizers which shall be used as manure for kitchen gardens and home gardens.

2. **Non-biodegradable:** All the non-biodegradable products shall be collected and recycled via a technique called **Thermal depolymerization.** In this technique complex organic molecules are converted into simpler ones by applying intense pressure and heat and produces useful crude oil and glass.

5.6 Internal and External Communication

Communication

Communication in the settlement shall be of two types:

1) Internal Communication

2) External Communication

5.6.1 Internal Communication

The internal communication inside **Hyperion Space Settlement** shall be separated into two categories:-

a) Wired Networks

b) Wireless Networks

- **Wired Networks (wired LAN):** Wired Local Area Network (LAN) shall be wired using optic fibers due to its following advantages
  - High data transfer speed of 64 Gbps
  - Also the data transmission takes with minimum signal loss over long distances and virtually no data loss over short distances.

It shall be used to provide internet facilities to residents, and networking and data swap between industries and **Hyperion Executive.**

- **Wireless Communication (Wi-Max):** Internal wireless communication shall be carried by **Worldwide Interoperability for Microwave Access (Wi-Max)** due to its following advantages :
  - High working frequency that is **2.6 GHz** and connectivity speed of atleast 2 Gbps which reaches up to 10 Gbps
  - It has a large coverage area up to 70m radius.

It shall be used for wireless conduction of data. For talking hold of Wi-Max signals modems shall be placed at every local area.

5.6.2 External Communication

To facilitate external communication with space ships through radio waves, antennas have been installed on the upper end of the stationary cylinder of the settlement. These antennas shall also transmit electricity through micro wave signals to earth. The antennas shall work with a frequency of **23.12-28.41 GHz.**

5.7 City Atmosphere and Weather control

Table 5.7 Composition of atmosphere and quantity of different gases requisite

Substance	Percentage	Amount required (m^3)	Source
Nitrogen	78.08%	$2.2x10^6$	Earth
Oxygen	20.94%	$10.16x10^5$	Moon
Carbon dioxide	0.0314%	$11.12x10^2$	Earth and agricultural section
Argon	0.094%	$2.2x10^4$	Earth
Hydrogen	0.00005%	2.44	Moon
Others	0.0026%	63.17	Earth

5.7.1 Atmospheric Composition: A clean, pollution and dust free and oxygen rich atmosphere shall be provided for maintaining hygienic and healthy living. Automated air purification systems shall be installed in the walls of the hull components that are to be pressurized working constantly to purify air. Domestic robots shall also be equipped with small air purification systems for small scale purification.

Table 5.8 Amputation and Replacement of Substances	
Substances	**Replenishment**
Oxygen Replenishment	Electrochemical oxygen generator Oxygen candle furnace Oxygen from plants
Amputation of Dust Particles	High Energy Particulate air filter (HEPA)
Amputation of Carbon dioxide (CO_2)	CO_2 scrubber (it in return produce oxygen) and phytoplankton in the riverine
Amputation Of Carbon monoxide (CO)	LiOH absorbers CO-H_2 Burner Carbon monoxide scrubber
Air purification	Electrostatic air filters

5.7.2 Weather and Climate control: The settlement shall be endowed with artificial climate in order to provide earth like conditions. The climate shall be controlled by automated systems; for every **1kg of air**, at **0℃, 1.97-3.0 grams of vapour** content is present and at **30℃ 12.0-27.95 grams of vapour** is present like that of earth. The provision of rain shall be made using artificial Dye machines which will produce chronograms of rain and light. These machines shall be installed at the roof of both the residential tori.

5.8 Ersatz-Gravity (Pseudo gravity)

Pseudo gravity shall be generated in the settlement by rotating the settlement at **0.97rpm** about its axis. Different hull components of the settlement shall have different 'g' levels. For more details refer to **Structural Engineering 2.2.3.**

6.0

HYPERION – A BUISNESS HUB

6.0 HYPERION- A BUSINESS HUB

6.1 Trade and Commerce

Besides providing ambient living conditions, **Hyperion space settlement** would also have an economic base. Like any other human settlement (cities, countries, etc.) it will also follow trade practices. The settlement would support multilateral trade.

The settlement shall trade with Earth as it will have a leading advantage of being in space. In turn, we shall buy goods for its needs from Earth, if required.

Advantage of setting industries in micro gravity: Weightlessness provides unique conditions for scientific, application-oriented and industrial research. On Earth, if a substance is heated, melted, solidified, crystallized, mixed, sprayed or burnt, then gravity has a strong influence over what will happen. Moreover, the industries would be easy to handle due to weightlessness in micro 'g'.

6.2 Types of Trades

There shall be four main industries in Hyperion involved in trade which are:

1. **Electricity industry**
2. **Pharmaceutical industry**
3. **Glass industry**
4. **Ceramic industry**

These four industries shall play an important role in Hyperion's economy. The industries would be fully automated and shall be equipped with hi-tech machines. All industries would be controlled and maintained by the **Hyperion Executive**.

6.2.1 Electricity industry

Hyperion space settlement shall employ **Photon enhanced thermionic emission (PETE)** solar panels (refer to table 5.2).

As Earth is suffering from energy crisis, Hyperion space settlement shall act as an environment friendly energy provider by trading surplus electricity with the earth.

Mechanism of transfer of Electricity

The surplus electricity in the settlement shall be converted into **microwaves** which shall be transmitted to earth through a channel of satellites. For the purpose of transfer of electricity to satellites, **solar power satellite (SPS)** (working as receiver) shall be placed in an orbit whose mean distance from earth is 192201 km. It will further direct the microwaves to **SPS** placed in geostationary orbit facing the respective halves of the earth. Two ground stations shall be established on earth in the line-of-sight of the two respective satellites in order to receive electricity in form of microwaves. Here, it shall be converted back into usable electricity.

Surplus electricity produced per day by the settlement; after fulfilling its needs shall be used for trade i.e. **1310785.5 kW**.

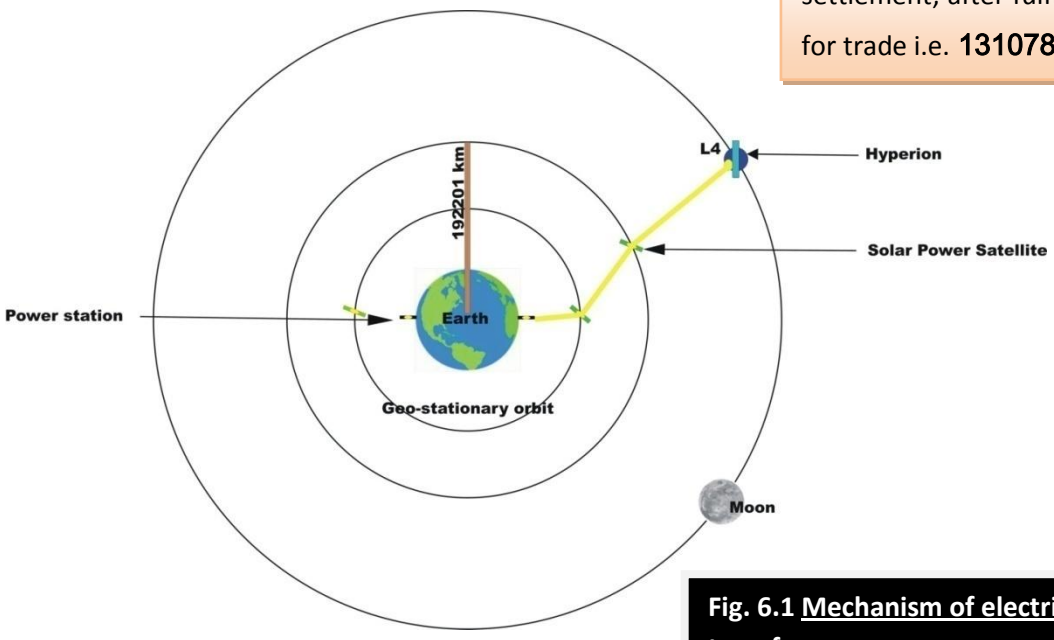


Fig. 6.1 Mechanism of electricity transfer

6.2.2 Pharmaceutical Industry

Today, many critical illnesses do not have cures and thus are life threatening. This has resulted in loss of precious lives. The studies have shown that medicines manufactured in space have special properties and can cure such diseases which were earlier incurable. Our settlement will manufacture these medicines abundantly and sell these to earth for treatment of such diseases.

6.2.2.1 Medicinal significance of micro-gravity

- Primitively incurable diseases like **AIDS** and **Cancer** can now be treated with the aid of **micro gravity crystal growth** since Proteins grow bigger and more efficient in the absence of gravity. These crystals provide a basic understanding of the mammal life at the molecular level. By using methods like **X-ray diffraction** and **atomic force**, the crystals can be grown better, hence the technique of **crystallography** shall provide an aid to better understanding of these diseases; more effective medicines can be produced. These crystals shall be grown in the central cylinder.
- The other focus of biotechnology in microgravity shall be on **cell and tissue culturing** experiments; to grow cells on a tissue in near-weightlessness, that otherwise is unachievable on Earth. The medical benefit of microgravity tissue and culture engineering would lead to new research models in cellular and molecular biology. These studies would aid in developing new tissues for potential transplant operations.
- The other uses of micro gravity would include specialized researches as weightlessness provides conditions apt for these experiments. On Earth these experiments are not possible as gravity has a great impact on expected results. Thus, micro gravity allows uncovering the fundamental effects at work.

6.2.3 Glass industry

The Glass industry will be one of the major industries in the settlement. Reasons for having glass industries:

- Glass produced in space in space is of superior quality. During the production of glass on earth, moisture enters the glass and as a result the glass produced is of low quality and is not so strong. Since there is no involvement of moisture in space and it provides appropriate conditions for manufacturing; therefore the glass produced is unbreakable.

Also the raw materials required in glass production are easily available.

Raw material	Source
Silica	Moon
Aluminium	Moon

- The industry shall be located in **Central cylinder** for easy transportation of raw materials and finished goods. It shall produce glasses for space shuttle, industrial use, domestic use, designer glasses etc.

6.2.4 Ceramic industries

Ceramics are inorganic as well as non-metallic materials which have been processed or used at high temperatures. The settlement shall have ceramic industries. It has excellent thermal properties. Ceramic is used for variety of purposes like floor tiling, walls of spacecrafts etc. The main raw material of ceramic is silicon that is abundantly available on moon. The industry shall not only produce raw ceramic but also designer ceramic tiles, tiles for space shuttles etc.

SCHEDULE AND COST

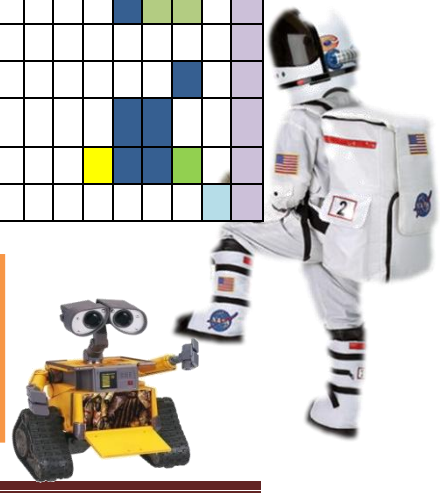
7.0

7.1 Construction Schedule

Action plan	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preliminary construction studies																					
Construction of Automated construction Systems																					
Central cylinder																					
Concentrated solar panels																					
Spokes for Tori C and D																					
Sub Cylinder																					
Docking sectons																					
Thrusting sections																					
Antennas																					
Torus C																					
Torus D																					
Discs																					
Spokes for Residential Tori A and B																					
Residential Torus A																					
Residential Torus B																					
Interface between Rotating and Non-Rotating section																					
Installation of Life Support System																					
PETE solar panels																					
Installation of Industries																					
Pressurization of volumes																					
Installation of mirrors																					
Interior finishing																					
Testing of the settlement																					

	Usage
	Research
	Testing
	Preliminary construction
	Construction and transportation
	Time for delays

The construction of Hyperion shall take 20 years which shall be made possible through use of heavy duty simultaneous multitasking by Automated Systems.



7.2 Cost of Hyperion

Table 6.1 Cost of settlement			
Name	Quantity	Cost ($) / quantity	Total cost ($)
Central hub			
Biological labs	1	2000m/unit	2000m
Sub cylinder	1	4000m/unit	4000m
Docking section	2	3200m/unit	6400m
Thrusting section	2	1000m/unit	2000m
Antennas	8	4m/unit	32m
Concentrated solar panels	-	-	4m
Torus C			
Astronomical center	1	2000m/unit	2000m
Stadium	2	450m/unit	900m
Hotels and discos	30	25m/unit	750m
Aluminium oxynitride glass	6008212.22 kg	30/kg	180,246,366.6
Carbon nanotubes	3293021.33 kg	50/kg	164,651,066.5
M5 fibre	193282.122 kg	100/kg	19,328,212.2
Super Adobe	8217623.21 kg	-	1,021,762,321
Radiation protection layer	10283843.1 kg	-	3,019,283,919
Asbestos layer	365098377 kg	35/kg	12,778,443,195
LSS systems	-	-	3100m
Atmosphere	-	-	19000m
Residential Tori A and B			
Aluminium oxynitride glass	12016424.44 kg	30/kg	360,492,733.2
Carbon nanotubes	6586042.66 kg	50/kg	329,392,133
M5 fibre	386564.244 kg	100/kg	38,656,424.4

Super Adobe	16435246.42 kg	-	2,043,524,642
Radiation protection layer	20567686.2 kg	-	6,038,567,838
Asbestos layer	730196754 kg	35/kg	25,556,886,390
Solar panels	1592785.5 m^2	25$/$m^2$	39,819,637.5
Houses	-	-	8000m
LSS system	-	-	9000m
Hotels	31	25m/unit	775m
Agriculture	-	-	710m
Riverine	-	-	500m
Atmosphere	-	-	50000m
Malls	10	10m/unit	100m
Transportation	-	-	15500m
Others	-	-	5000m
Torus D			
Aluminium oxynitride glass	6008212.22 kg	30/kg	180,246,366.6
Carbon nanotubes	3293021.33 kg	50/kg	164,651,066.5
M5 fibre	193282.122 kg	100/kg	19,328,212.2
Super Adobe	8217623.21 kg	-	1,021,762,321
Radiation protection layer	10283843.1 kg	-	3,019,283,919
Asbestos layer	365098377 kg	35/kg	12,778,443,195
LSS systems	-	-	3100m
Biological labs	1	2000m/unit	2000m
Industries	-	-	2500m
Spokes			
For Residential Tori A and B	12	250m/unit	3000m
For Tori C and D	12	100m/unit	1200m

Salaries			
Engineering technicians	10000	125,000/year	10000m
Financial advisors	1500	135,000/year	2044m
Construction workers	25000	50,000/year	10000m
Other workers	-	-	1000m
Total Cost			231,227,034,011

Total Cost of Hyperion: $ 231,227,034,011

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Epilogue

Our idea – though it is not a new one – is to use engineering to make a new, fresh beginning; to take our understanding to the next level. This "next level," to us, is space. Space colonization is inevitable. As Michael D. Griffin says "a single planet species will not survive" – and, as is evidenced by our waste of resources, he has been proved right. Earth will not be able to sustain human civilization much longer. Although governments and organizations have started working to sustain phenomena like global warming, the harm done so far will be very difficult to neutralize. On these Space Settlements, incorporating structures, will allow for a sustainable and Earth-like environment to be replicated. Rotating the settlement at a suitable rotation rate can be used to produce Earth-like gravity – this cannot be created on the Moon or Mars because of low 'g' values.

Some problems which pose a major challenge will be-

Psychological factors and remedies	
Problem	**Common remedies to all problems**
Isolation	• Earth like environment • Meditation and yoga • Maintained day/night cycle • Proper medication • Proper mapping of interiors • Open Spaces • Systematic desensitization (consecutively exposing of phobic things) • Recreational activities • Entertainment • Suitable jobs • Cognitive behaviour therapy • Proper balanced diet
Boredom	
Depression	
Aviophobia (fear of height)	
Keno phobia (fear of large open spaces)	
Solipsism Syndrome	
Loss of sense of taste	
Asphyxiation (on entering low pressure areas)	
Insomnia	
Stress	
Confinement	
Hallucination	
Lipism syndrome (person feels everything is dream)	
Physiological problems and remedies	
Reduction of bone mass (during space flight and space tours)	• Earth like gravity **(9.8 m/s^2)** • Radiation shielding • Regular exercises • Regular medical checkups • Regular work outs • Proper medication • Space suit for EVA • Safety measures in low g areas • Proper Balanced diets
Cardiovascular deconditioning	
Weightlessness	
Osteoporosis	
Asthenia Syndrome (fatigue)	
Growth of kidney stones	
Neurophysiologic	
Atherosclerosis	
Muscle atrophy	
Slow recovery from injuries	

The Hyperion Space Settlement is an ambience in itself. We have thrown light on all aspects and provided a new life system. Our settlement is a perfect system, to change dreams into one big reality, reality of thriving in mysterious Space, being calm and composed. - **HYPERION**