
UBIETY
A DPS AEROSPACE
CLUB PRODUCTION

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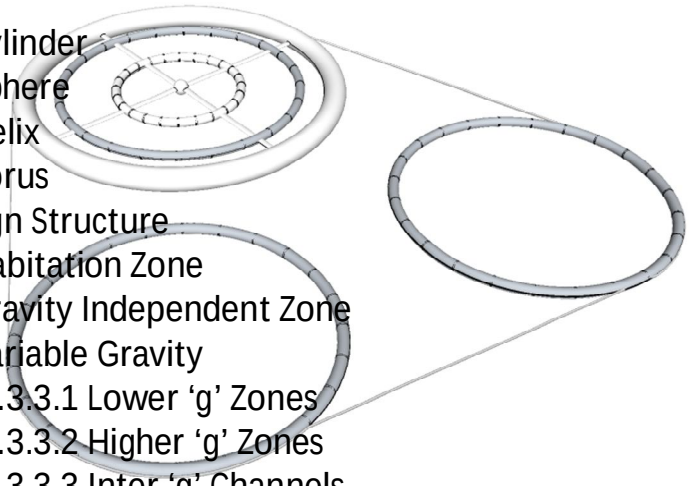

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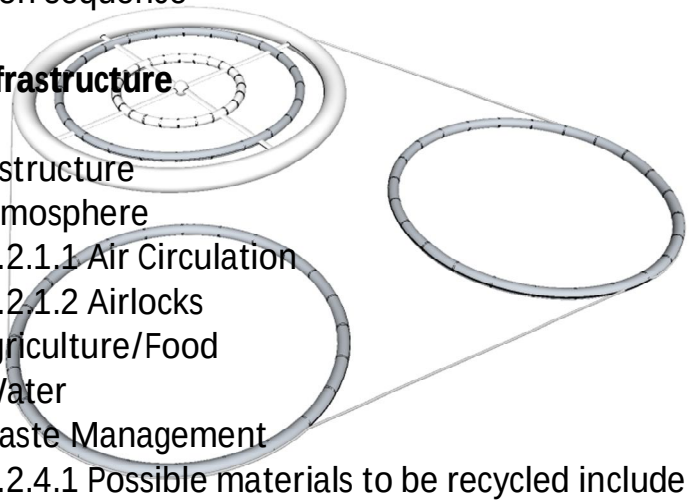

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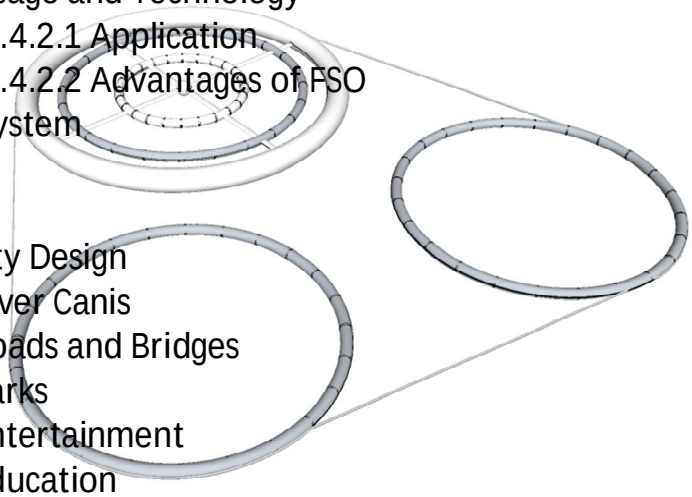

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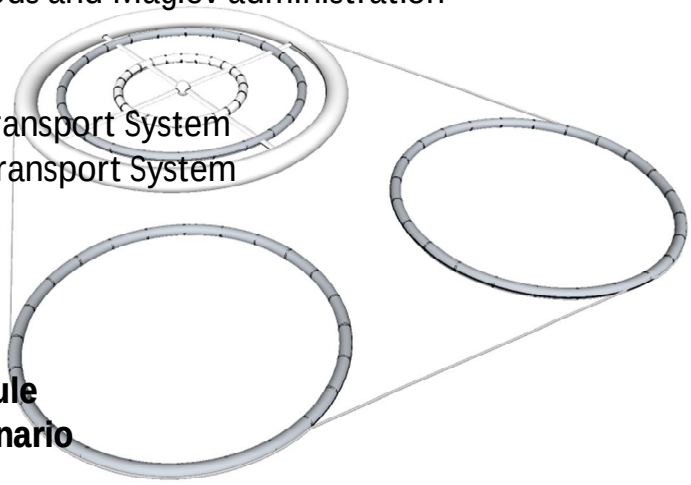

The Team

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Acknowledgement

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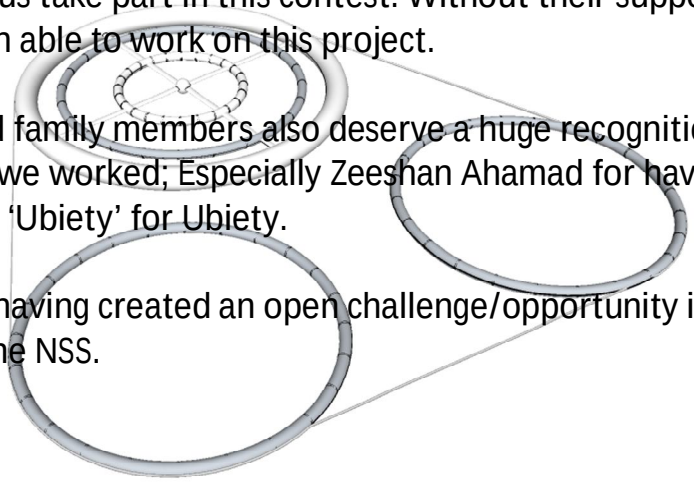
Secondly we would like to thank our school Delhi Public School Bangalore South for having let us take part in this contest. Without their support we would not have been able to work on this project.

Our dear friends and family members also deserve a huge recognition for having helped us as we worked; Especially Zeeshan Ahamad for having suggested the name 'Ubiety' for Ubiety.

We thank NASA for having created an open challenge/opportunity in collaboration with the NSS.



Overall Summary

The word “UBEITY” means – “The state of being localized in space”. (Farlex, 2011). This was chosen as the name of our Project as the main objective of Ubiety is to provide residential area for a population of human beings, to create a feeling of being home in space.

As the ever changing scenario on our planet Earth, including Global warming, Nuclear wafrare, Political unrest etc. The future of our Human race is in jeopardy – And there is only one way out – Up.

Main objectives of the Ubeity include –

- To provide the Infrastructure for exploration and development of our understanding of Outer Space.
- For research which would require conditions not available on earth but can be created on Ubiety. This could possibly include effects of no gravity on human beings over long durations, or also search for the nature of the elusive dark matter which constitutes as much as 80% of our universe (Wikipedia, 2011). We could also be able to research on how to manage environmental crises which exist on earth through study of the effects on the artificially engineered on the Ubeity. Research facilities leased to companies would also provide as a method of financing Ubiety.
- Allow the settlement of a large population to integrate as a society and function as any other State would on Earth. Since Human Beings are social creatures, isolation of people over long periods of time could potentially have drastic psychological effects. This provides an understanding into how people can survive in Space, not only biologically but also as psychologically and as a social being. This is something that will be a necessity in the near future, due to increase in population at alarming rates.

1.0 STRUCTURE

1.0 Structure

1.1 External Design and Features

1.1.1 Overall concept

Our approach to designing Ubiety was framed over a set of criteria that had to be satisfied. These include

a. Accommodating a population of about 30,000, with provision for expansion

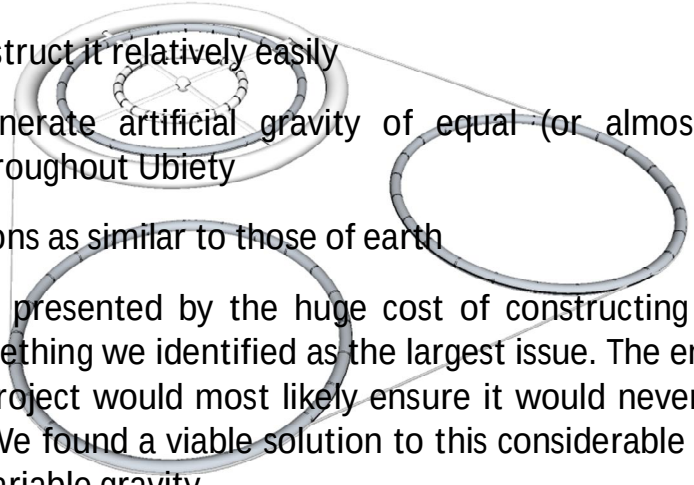
b. Uniformity in hull curvature to ensure even distribution of air pressure

c. Ensuring a low cost of construction and maintenance

d. Ability to construct it relatively easily

e. Ability to generate artificial gravity of equal (or almost equal) magnitude throughout Ubiety

f. Living conditions as similar to those of earth



The problem presented by the huge cost of constructing a space settlement was something we identified as the largest issue. The enormous cost of the entire project would most likely ensure it would never receive adequate funding. We found a viable solution to this considerable problem in the concept of variable gravity.

Keeping these in mind, we considered several shapes as well as combinations of shapes. In the end, we came up with an elegant solution to the most difficult criteria of all, the provision of variable gravity.

1.1.2 Population

The number as well as the type of people that would make Ubiety their home had to be considered. For this, the main purpose of Ubiety had to be decided upon. Given the possible time frame in which the project could commence, its main objective was predicted to be research as well as a sort of pilot project to explore the details of space habitation. Then we concluded that a population 25,000 people in addition to a transient population or emergency accommodation of 5,000 people should be planned for.

1.1.3 Factors Considered

Important factors such as cost, which could not be accurately predicted, were not considered to the extent to which materials were assessed. In the area of materials, we needed two major types. We needed those that would be used to construct the majority of the hull such as hull walls, and those that would be used to construct the more ergonomic areas of Ubiety such as windows. The properties we looked for in each material were similar, but with one key difference. The material used in windows would need to be transparent. The other properties we looked for were tensile strength, density (mass to volume ratio), resistance to corrosion, and most importantly, radiation stability and absorption capacity.

A very important condition in determining the structures involved in Ubiety was the fact that we had to minimize edges and corners. This was because they, in essence, present"weak points" in terms or air pressure. If the air trapped in Ubiety has a point or a set of points (edge) on which it can exert greater force due to its miniscule area, This becomes a weak point. This would result in an uneven distribution of air pressure. This is not desirable, as it could result in structural faults. Here, we ruled out shapes like cubes, cuboids, and polyhedrons.

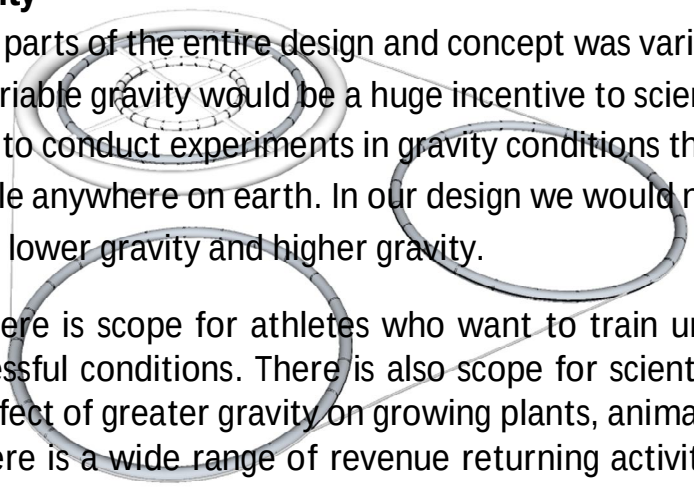
One of the most, if not the most important factor which determined the shape as well as the structure of the design, was the provision of artificial gravity. In space, we can only provide gravity through acceleration related to circular motion, better known as the centrifugal force which acts outward from the axis of rotation. This presented the necessity for all living areas which required stable gravity conditions to be equidistant from the

axis of rotation. Because of this, we instantly ruled out a number of shapes such as the dumbbell. At this point we also ruled out the sphere as a potential habitation area, due a unique problem. Though all points on a sphere are equidistant from the center, they were not equidistant from any axis of rotation, therefore resulting in a change in gravity with change in latitude on the sphere. The two structures that passed the gravity test were the torus and the helix, and possibly the cylinder.

Other criteria like ease of construction also played a role in narrowing out possibilities.

1.1.4 **Variable Gravity**

One of the essential parts of the entire design and concept was variable gravity. Providing variable gravity would be a huge incentive to scientists as it would allow them to conduct experiments in gravity conditions that would not be possible anywhere on earth. In our design we would need to incorporate areas of lower gravity and higher gravity.



In higher gravity, there is scope for athletes who want to train under the more physically stressful conditions. There is also scope for scientists who want to study the effect of greater gravity on growing plants, animals, etc. In lower gravity, there is a wide range of revenue returning activities such as lower gravity sports, healthcare and rehabilitation. Also scientists can study the effects of lower gravity on a multitude of things.

In what we call the variable gravity economy, Ubiety itself becomes source of revenue. Researchers, athletes, and even government organizations would pay to conduct activities in a different gravity environment, helping to mitigate the enormous cost of construction such a settlement. Thus we had to accommodate these environments in our design. Eventually, Ubiety will pay for itself, reducing the effect of the immense cost of a project of this magnitude.

1.2 Shapes

Following are the shapes we considered for Ubiety along with their respective advantages and disadvantages.

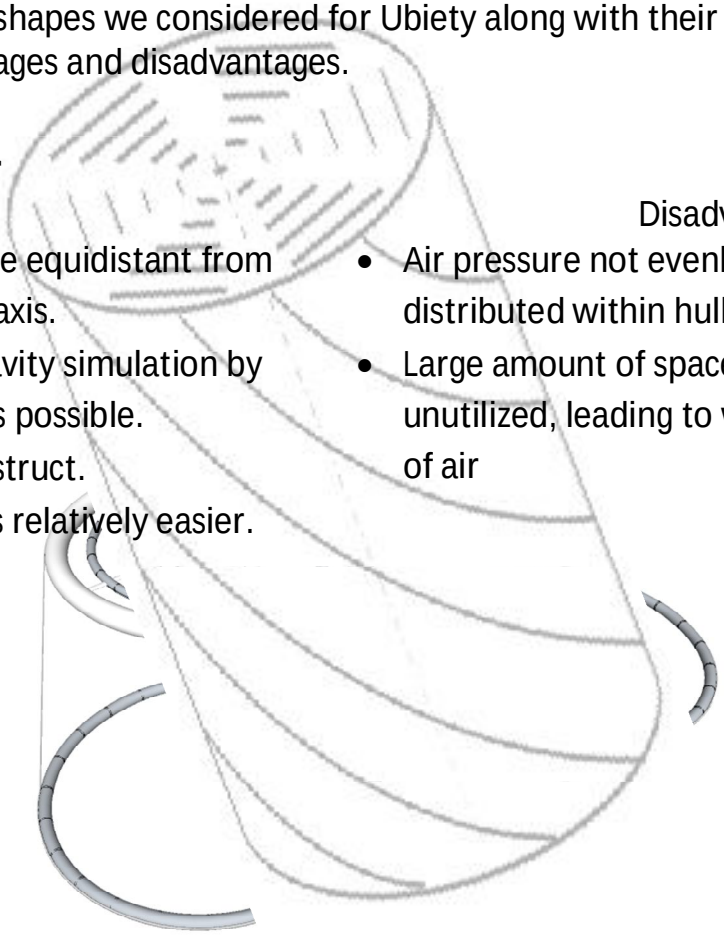
1.2.1 The Cylinder

Advantages

- All points are equidistant from the central axis.
- Artificial gravity simulation by revolution is possible.
- Easy to construct.
- Expansion is relatively easier.

Disadvantages

- Air pressure not evenly distributed within hull.
- Large amount of space unutilized, leading to wastage of air



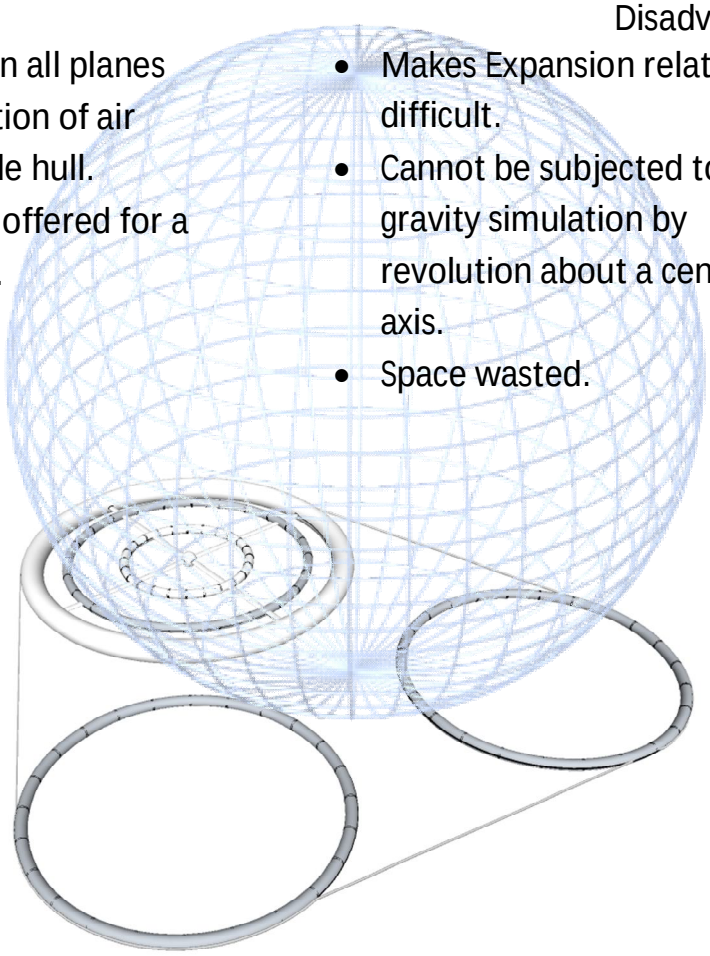
1.2.2 The Sphere

Advantages

- Symmetrical in all planes
- Even distribution of air pressure inside hull.
- Most volume offered for a given surface.

Disadvantages

- Makes Expansion relatively difficult.
- Cannot be subjected to gravity simulation by revolution about a central axis.
- Space wasted.



1.2.3 The Helix

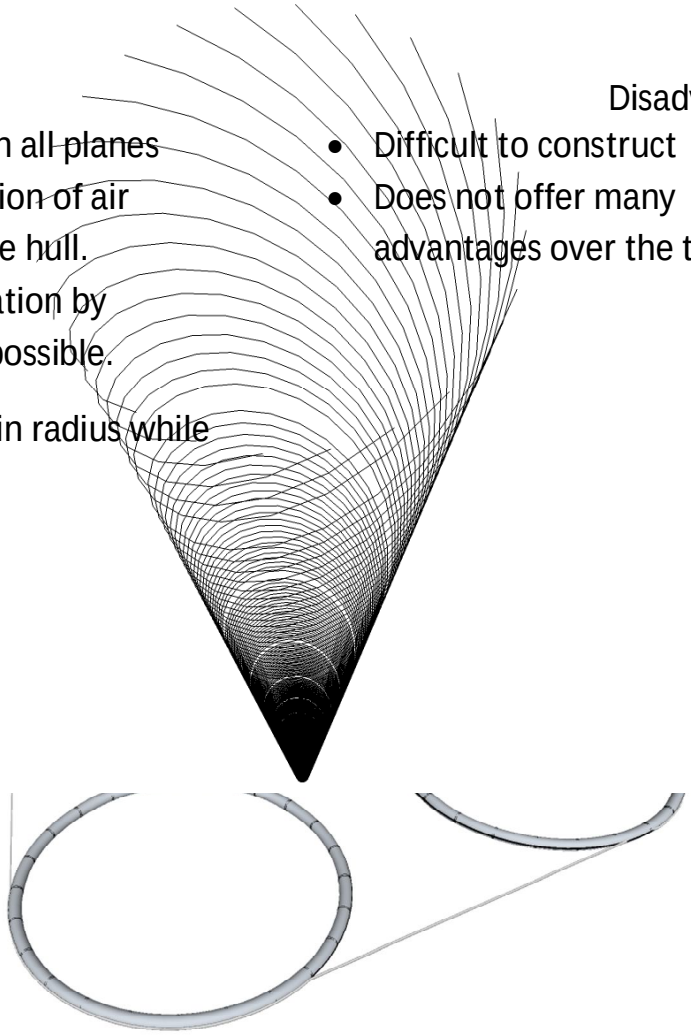
Advantages

- Symmetrical in all planes
- Even distribution of air pressure inside hull.
- Gravity simulation by revolution is possible.

Allows for variation in radius while sustaining hull

Disadvantages

- Difficult to construct
- Does not offer many advantages over the torus.



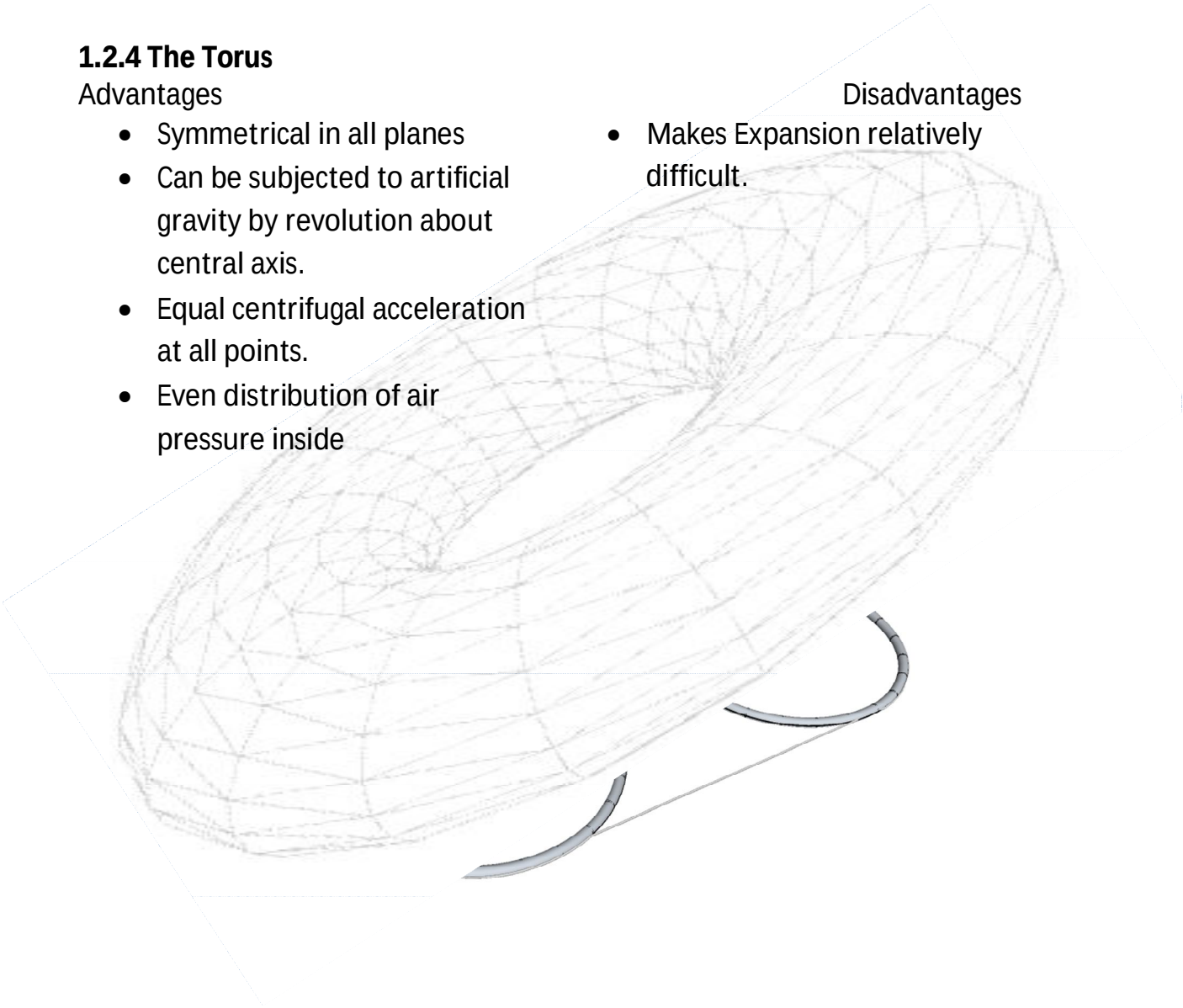
1.2.4 The Torus

Advantages

- Symmetrical in all planes
- Can be subjected to artificial gravity by revolution about central axis.
- Equal centrifugal acceleration at all points.
- Even distribution of air pressure inside

Disadvantages

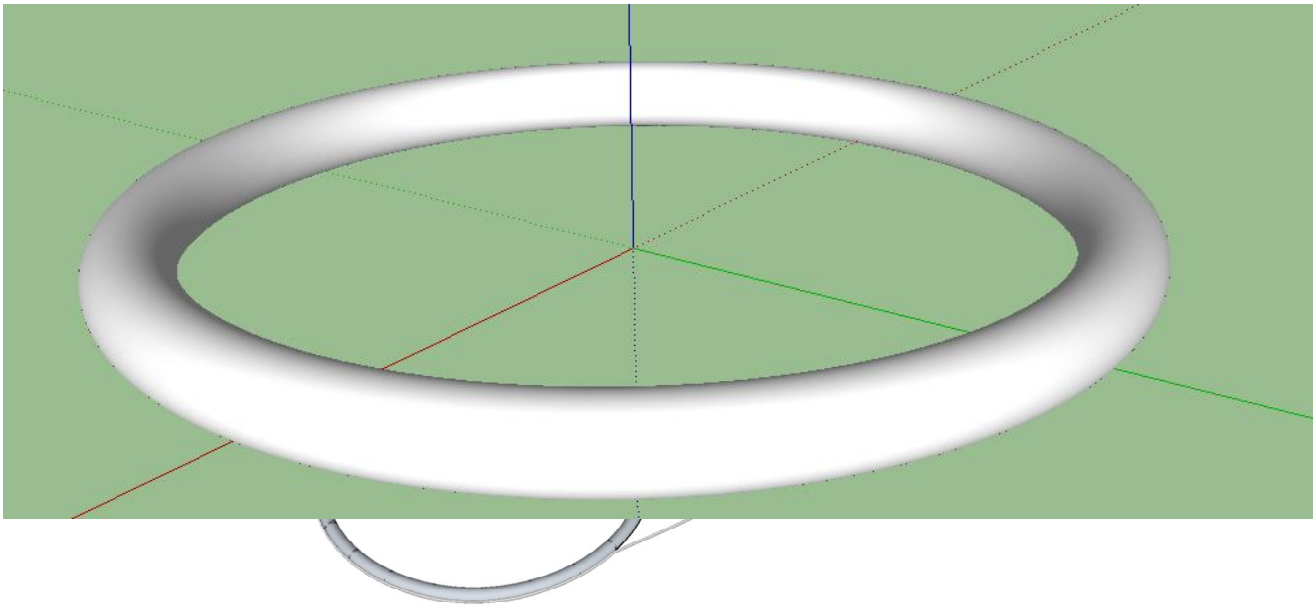
- Makes Expansion relatively difficult.



1.3. Final Design Structure

1.3.1 Habitation Zone

A torus was decided on as the shape to be used for all inhabited areas due to constant gravity on its interior, and its relative ease to build as compared to a helix. A large central torus is used in our design as the sight of 1g habitation, and will thus house all activities that require earth like gravity including housing the bulk of the population.



Img1: Habitation Zone

1.3.2 Gravity Independent Zone

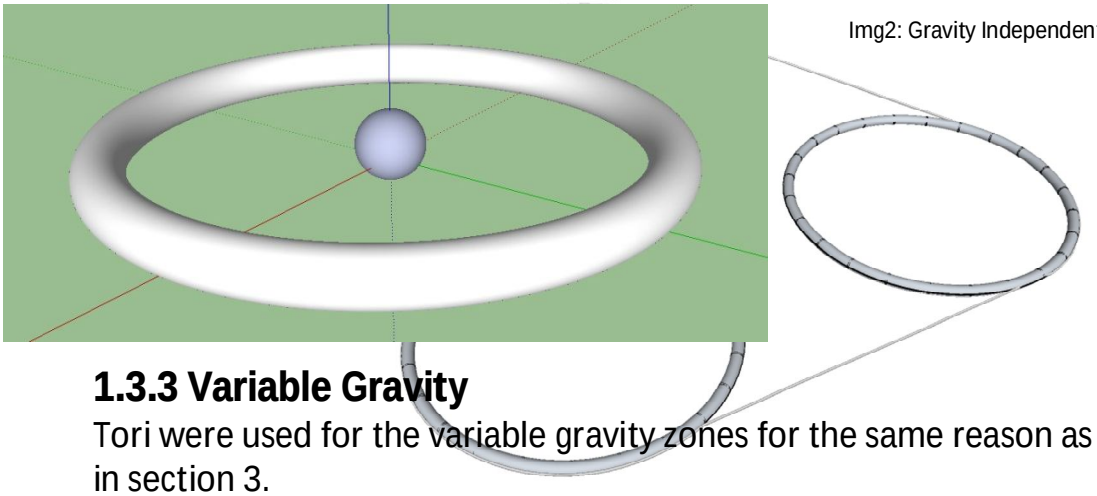
A large central sphere was placed at the center of the habitation torus. This component is not in rotation and doesn't generate gravity. It serves to provide area for non-gravity dependant activities such as:

i) Storage

ii) Power generation

iii) Communication and electronic component housing

A sphere was used as it provides the greatest volume to surface area ratio of all geometric shapes and results in less materials that must be transported to the location from earth.



Img2: Gravity Independent Zone

1.3.3 Variable Gravity

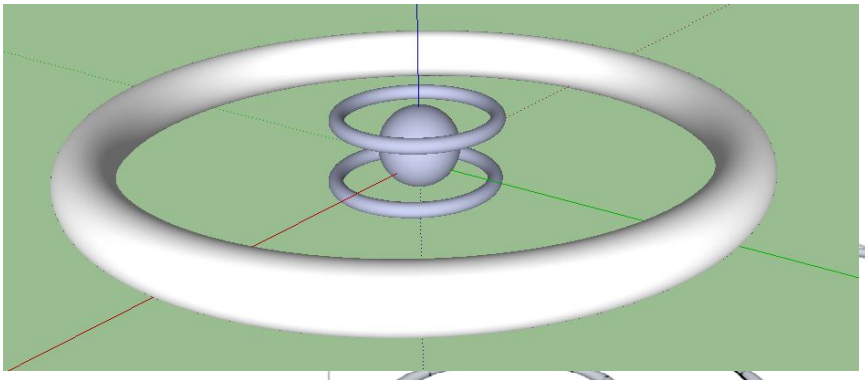
Tori were used for the variable gravity zones for the same reason as stated in section 3.

Radius (r)	Time	Velocity (v)	Gravity Produced v^2/r
x meters	1 second	$2x^2\pi m/s$	$4x^3\pi^2 m/s^2$
.5x meters	1 second	$1x^2\pi m/s$	$2\ x^3\pi^2 m/s^2$
2x meters	1 second	$4x^2\pi m/s$	$8x^3\pi^2 m/s^2$

Fig 1: dependence of gravity on radius

1.3.3.1 Lower ‘g’ Zones

As demonstrated in fig. 1, by changing only the radius and not the time period of rotation, the velocity of the torus will change enough to produce a significant change in gravity. This is due to centrifugal force (the pseudo force responsible for artificial gravity) being proportionate to the square of the velocity. Therefore, 2 tori of smaller radius were placed inside the large habitation torus, above and below the central sphere. These tori serve as low g zones.

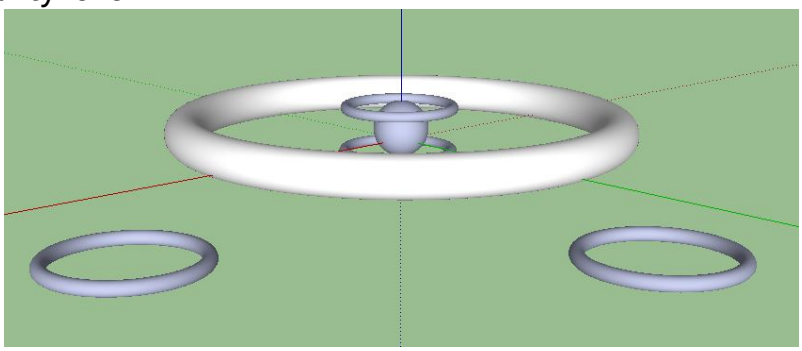


Img3: Low Gravity Zones

1.3.3.2 Higher ‘g’ Zones

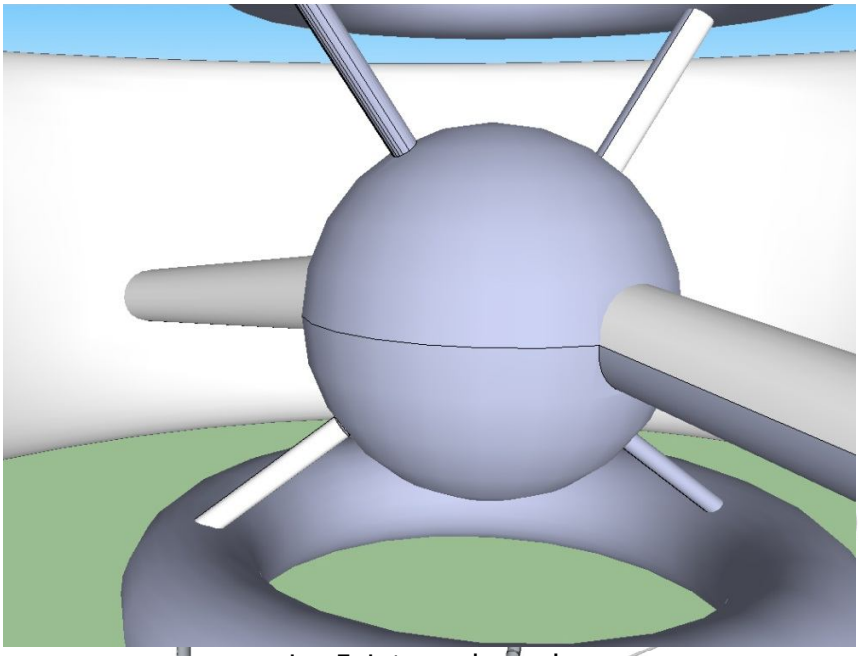
Although a torus of larger radius could be used as an area of high g, this would result in a torus of much greater volume as compared to the habitation torus. There isn’t enough demand for higher g to justify such a large structure, and it would therefore be a waste of resources. So small tori independent of the habitation torus were used and spun at appropriate velocities to attain the desired gravity level.

Img4: High Gravity Zones

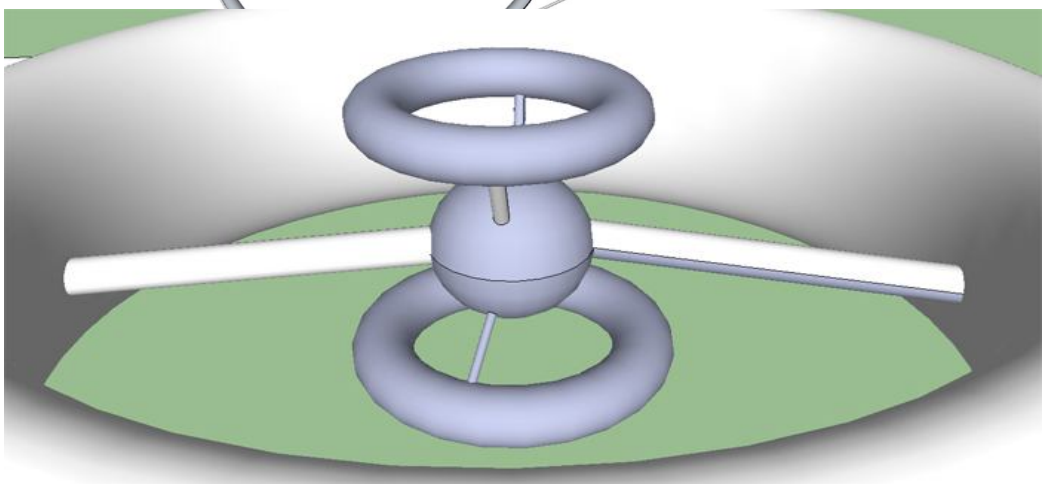


1.3.3.3 Inter-g Channels

A method of transport was needed between the two gravity levels, (that of the habitation zone and the lower g in the inner tori). As all three components are rotating at the same speed, no issue arises, and simple connection channels can be made.



Img5: Inter-g channels



Img6: Inter-g channels

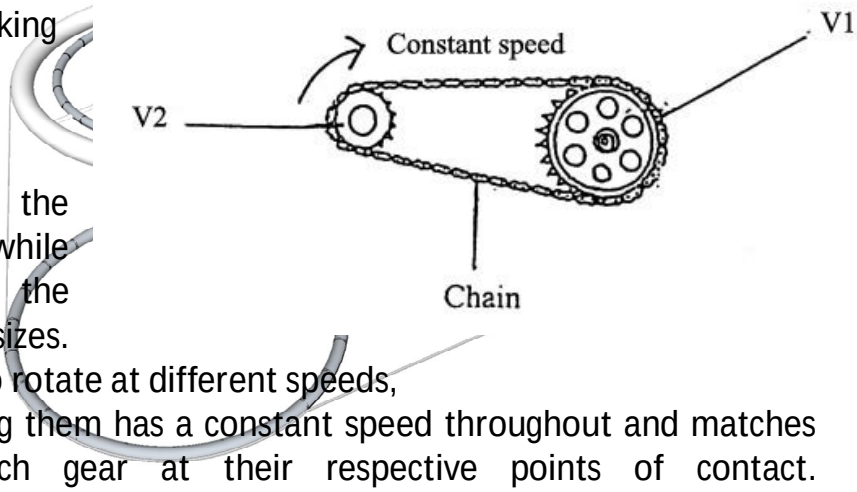
1.3.4 The Belt

Using independent tori at different velocities to attain high gravity posed the problem of transportation between areas of different speed. Since the habitation torus and higher g tori are at different velocities, they can't be connected by a simple channel like the channels between the lower g tori and main torus. The method of connection had to satisfy certain criteria:

i) it had to have the same speed as the main torus at their point of contact

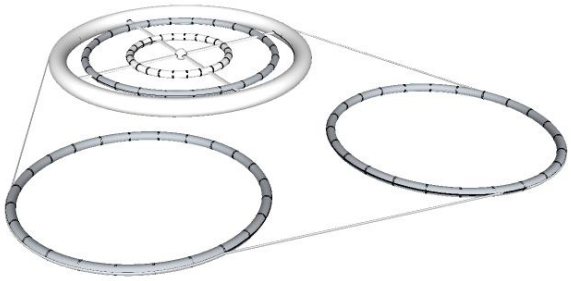
ii) it had to have the same speed as the higher g tori at their points of contact

Only if both these criteria were true, would transportation between the gravity levels become as simple as simply walking across. This was accomplished by the belt.

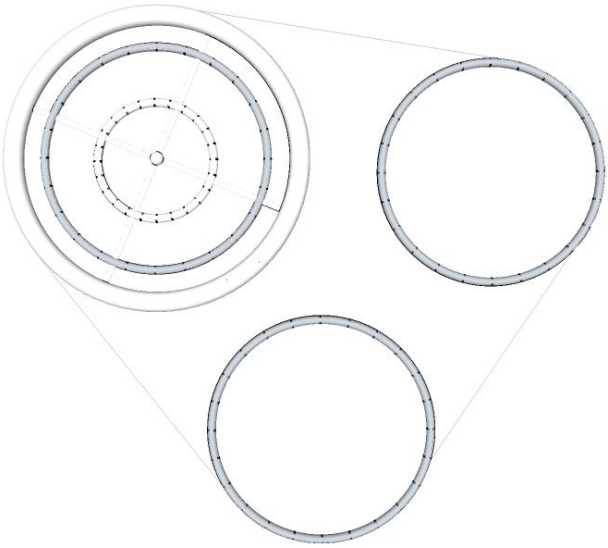


The belt resembles the chain on a bike, while the tori represent the gears of different sizes. The gears are free to rotate at different speeds, while the belt linking them has a constant speed throughout and matches the speed of each gear at their respective points of contact. Implementation of the belt meant that an individual could simple walk of a torus onto the belt, allow its rotation to carry him to the torus he wishes to go to, and simple step of when the belt comes into contact with the afore mentioned torus.

Therefore, we arrive at our final design.

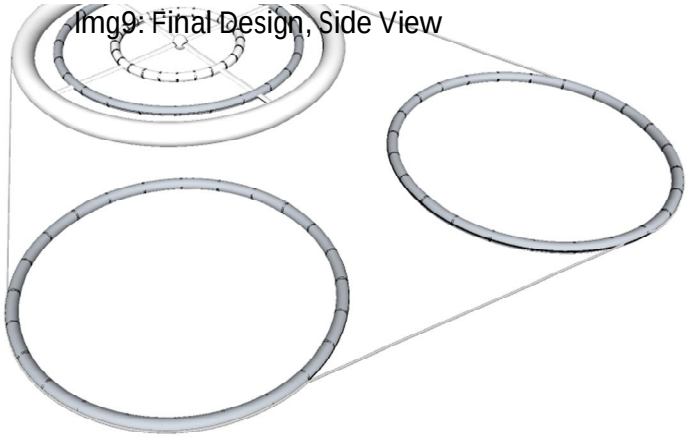


Img7: Final Design



Img8: Final Design, Top View

Img9: Final Design, Side View



1.4. Scaling

When deciding on the dimensions of Ubiety, it was important to keep in mind not only the number of people who would be living there, but the breakdown of the type of people that would constitute our population of 30,000. Different family structures, for example single people, couples, small families, etc would all have different requirements in terms of living space, working space etc. The activities for which space has been allotted are living, working, recreation, transport, and life sustenance related activities.

1.4.1 Population Breakup

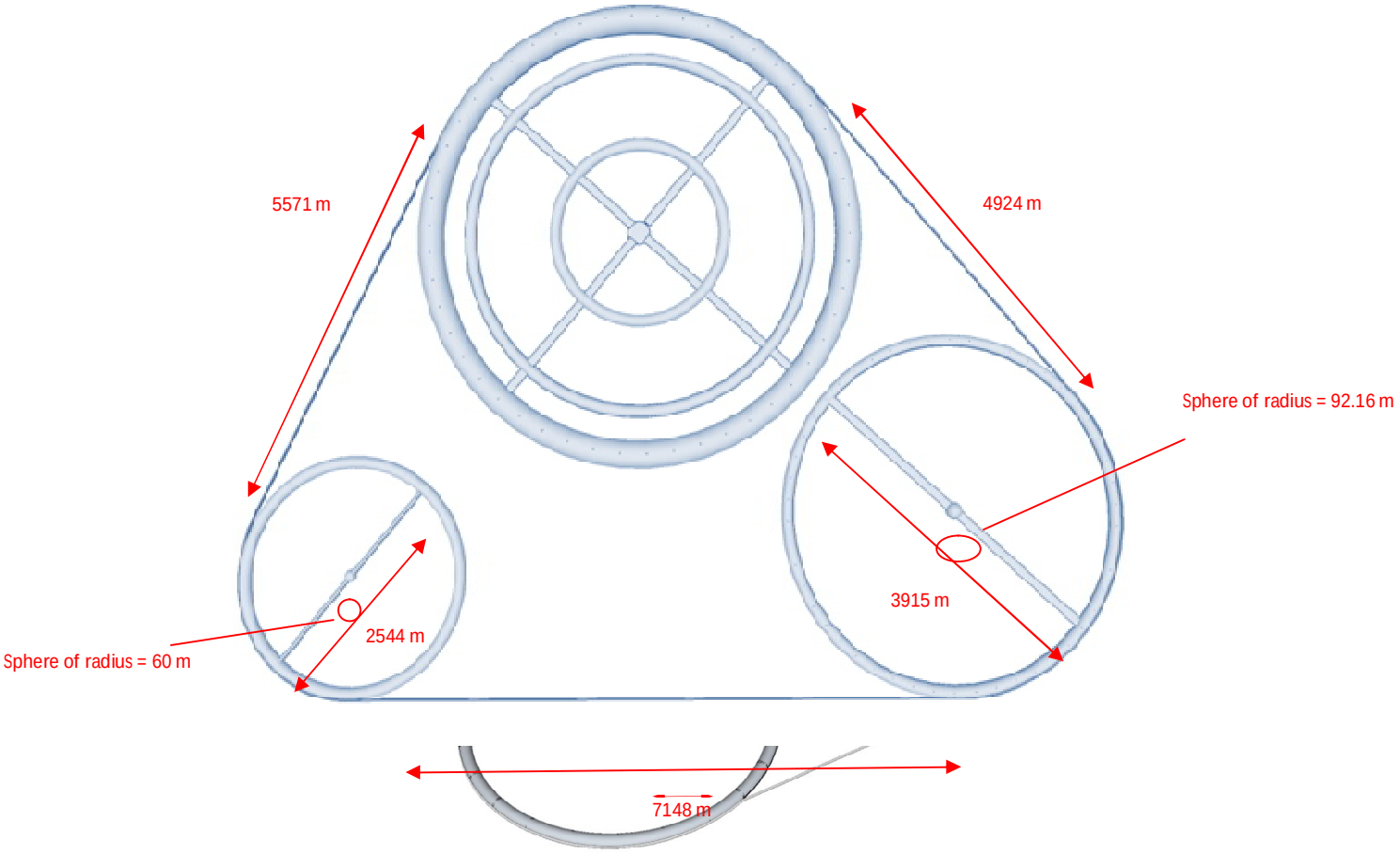
The population is divided into single inhabitants, couples, small families and extended families. Small families have 3-4 people while extended families have 5 or more people. Singles and couples are self explanatory.

Family Type	Percent of Population	Number of People (30,000 total)	Avg. Number or people per Unit	Number of Units (number of people/avg. number of people per unit)
Single	25%	7500	1	7500
Couple	20%	6000	2	3000
Small Family	45%	13500	3.5	3858
Extended Family	10%	3000	5	600

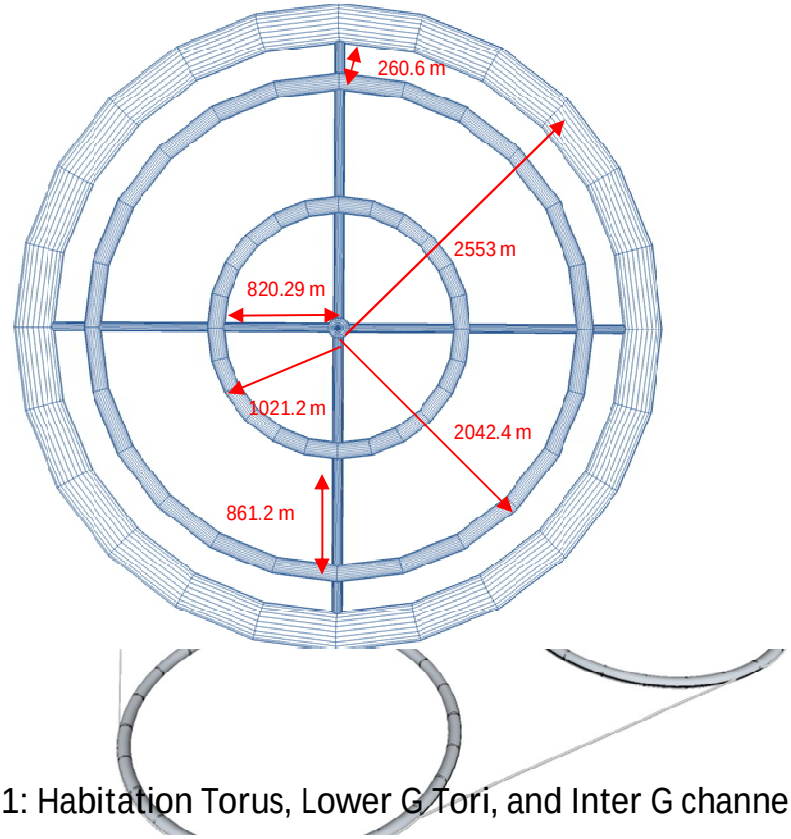
Fig2. Population Breakup

Following are several SCALED blueprints of the final settlement, along with an explanation of the “sleeve concept” as well as the different gravity levels we used.

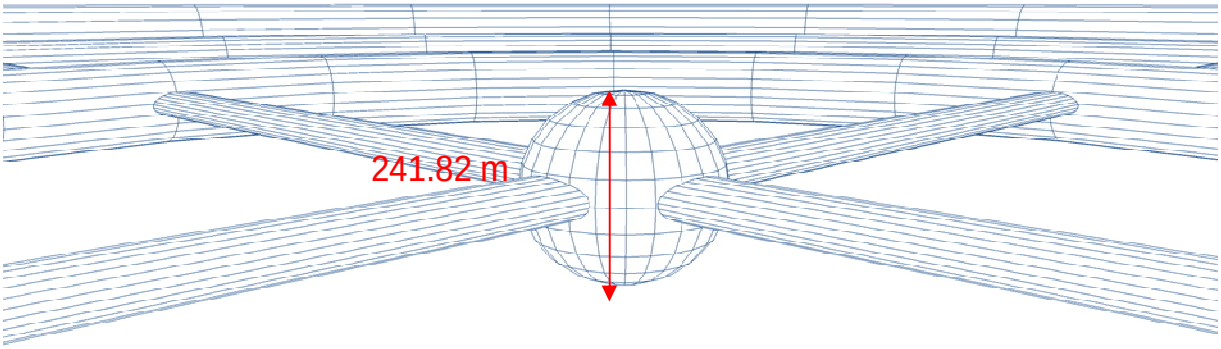
1.0 Structure



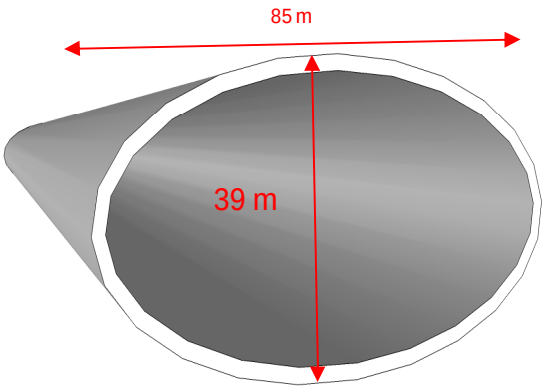
1.0 Structure



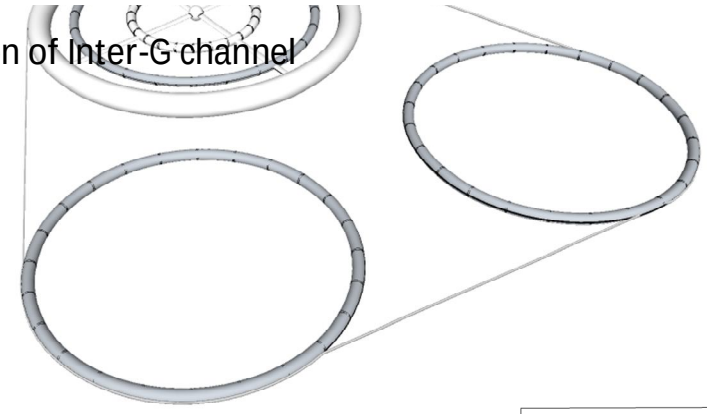
Img11: Habitation Torus, Lower G Tori, and Inter G channels

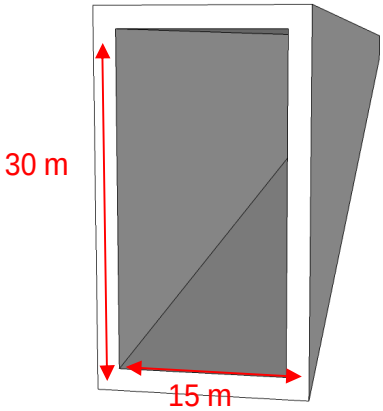


Img12: Central Sphere

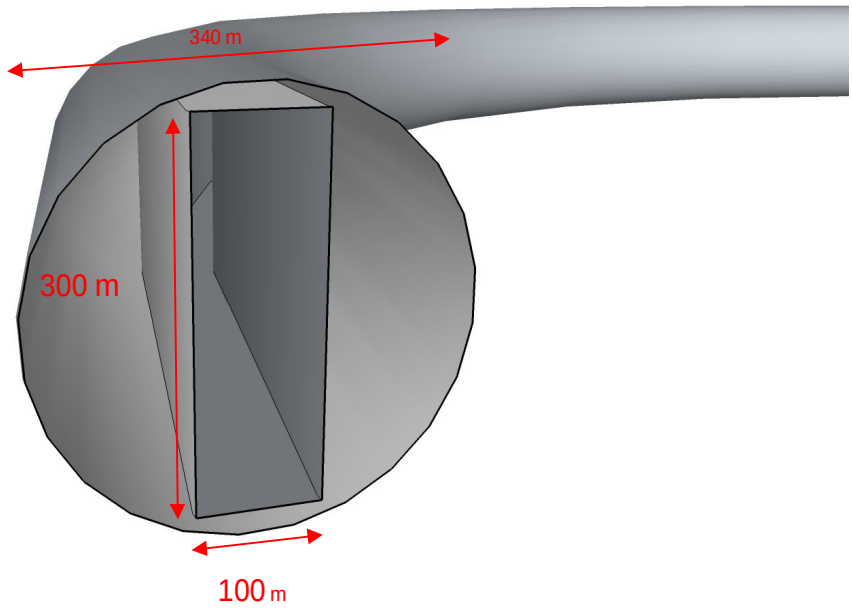


Img13: Cross-section of Inter-G channel

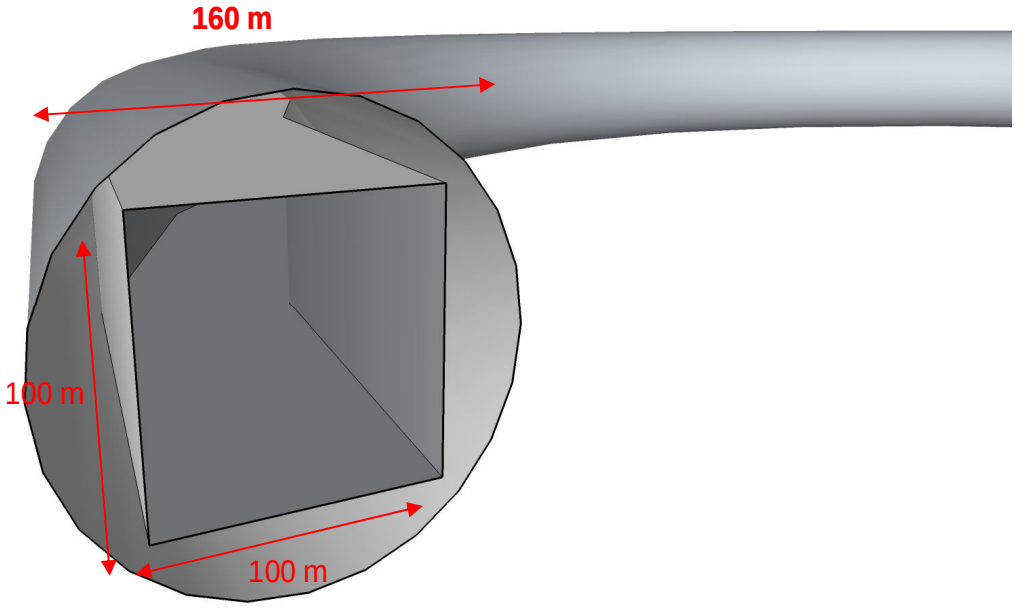




Img14: Cross Section of Belt



Img15: Cross section of Habitation Torus (utilizes “sleeve concept”)

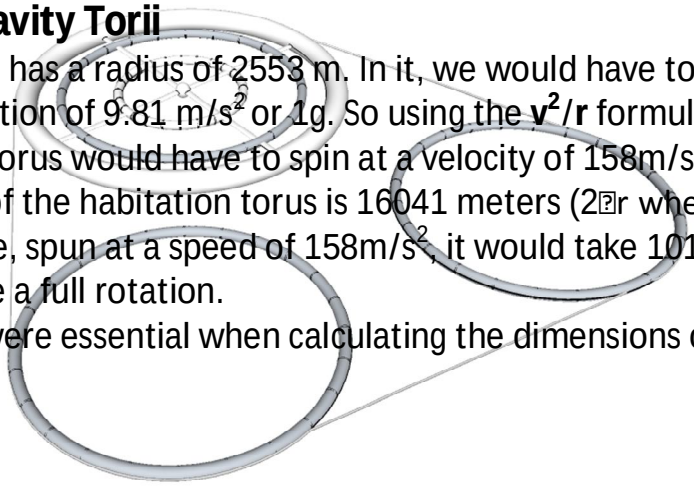


Img16: Cross Section of all Variable G Tori (utilizes “sleeve concept”)

1.4.2 Sleeve Concept

In the interior of every torus (habitation as well as variable gravity) there is a rectangle or square sleeve that runs the entire length. This rectangle/square forms the living region of each torus. For example, in the habitation torus, (see img15) the 300m long base of the rectangular sleeve would form the floor of Ubiety and the 100m long side of the rectangle would become the height of the ceiling. The rest of the torus, between the sleeve and the hull of the torus, is used for piping, wiring, transport of goods, hull support structure, etc. We call this area support region.

1.4.3 Variable Gravity Torii



The habitation torus has a radius of 2553 m. In it, we would have to produce an acceleration of 9.81 m/s^2 or 1g. So using the $\mathbf{v^2/r}$ formula, we calculated that the torus would have to spin at a velocity of 158m/s^2.
The circumference of the habitation torus is 16041 meters (2□r where r=2553m). Therefore, spun at a speed of 158m/s^2, it would take 101 seconds to complete a full rotation.
These calculations were essential when calculating the dimensions of the variable g tori.

1.4.3.1 Lower G Torii

There are two lower g tori of gravity .8 g and .4 g.

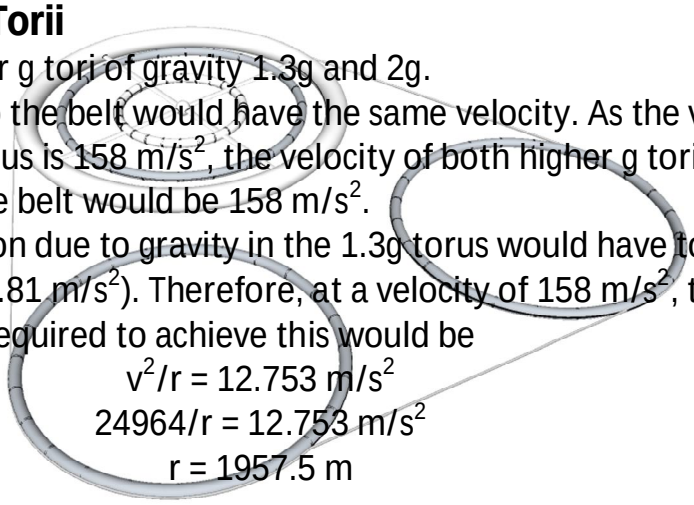
.4g: As the lower g tori are attached to the habitation tori, their time period of rotation will be the same, that is, 101 seconds. As depicted in fig.1, for a constant time, acceleration produced is directly proportionate to change in radius. Therefore, to produce .4g, we would simply need to create a torus with a radius .4 times that of the habitation torus.

$$0.4 * 2553 = 1021.2 \text{ meters}$$

.8g: Following the same logic, the .8g torus would need a radius of

$$.8 * 2553 = 2042.4 \text{ meters}$$

1.4.3.2 Higher G Torii



There are two higher g tori of gravity 1.3g and 2g.

All tori connected to the belt would have the same velocity. As the velocity of the habitation torus is 158 m/s^2, the velocity of both higher g tori which are connected to the belt would be 158 m/s^2.

1.3g: The acceleration due to gravity in the 1.3g torus would have to be 12.753 m/s^2 (1.3 * 9.81 m/s^2). Therefore, at a velocity of 158 m/s^2, the radius of the torus required to achieve this would be

$$v^2/r = 12.753 \text{ m/s}^2$$
$$24964/r = 12.753 \text{ m/s}^2$$
$$r = 1957.5 \text{ m}$$

2g: The acceleration due to gravity in the 1.3g torus would have to be 19.62 m/s^2.

Therefore at a velocity of 158 m/s^2, the radius of the torus required to achieve this would be

$$v^2/r = 19.62 \text{ m/s}^2$$
$$24964/r = 19.62 \text{ m/s}^2$$
$$r = 1272.4 \text{ m}$$

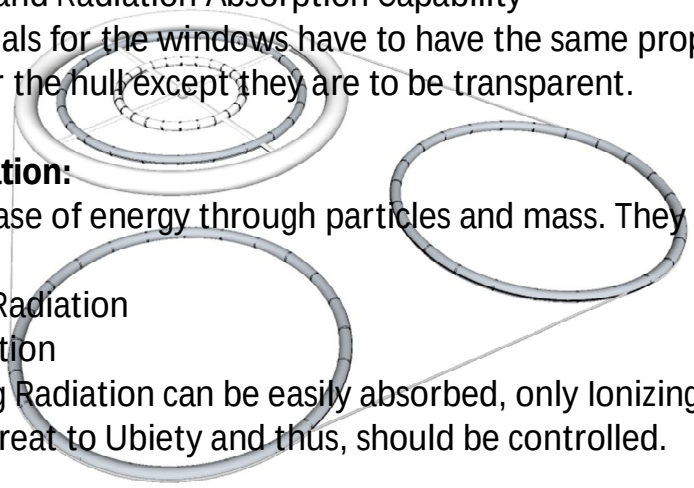
1.5 Materials

There are three types of materials used for our Ubiety. These two types are:

1. Materials used for the Hull
2. Materials used for the Windows
3. Materials used for structural strength

1.5.1 The Properties of the Materials:

Hull: The materials for the hull are to have:
Tensile Strength (1)
Strength to Weight Ratio (1)
Resistance to Corrosion and
Radiation Stability and Radiation Absorption Capability
Window: The materials for the windows have to have the same properties of materials used for the hull except they are to be transparent.



1.5.2 Types of Radiation:

Radiation is the release of energy through particles and mass. They are of two types:

1. Non-Ionizing Radiation
2. Ionizing Radiation

Though Non-Ionizing Radiation can be easily absorbed, only Ionizing Radiation poses a threat to Ubiety and thus, should be controlled.

1.5.2.1 Galactic Cosmic Radiation:

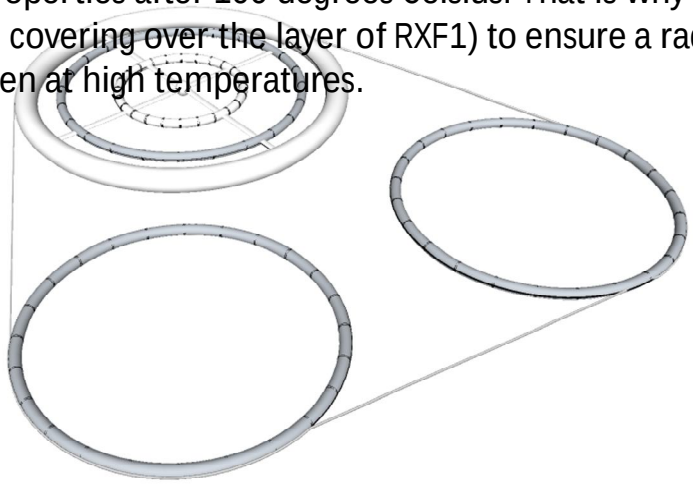
Their effects are not felt on earth as they are effectively dissipated by the earth's magnetic field. Their deflection in deep space however, could lead to a problem on Ubiety. Their effects on human health are most severe. They include neurological disorders, cataracts, and sometimes even cancer.

1.5.2.2 Solar Flares:

They occur due to sudden release in magnetic energy present in the corona of the Sun. They can some times create CMEs (mentioned below

1.5.2.3 Coronal Mass Ejection (CME):

They occur due to extensive Solar Flares, high speed solar winds and release of magnetic energy. We will block the above mentioned radiations by using certain materials like RXF1, and/or Aluminum as these have very good radiation deflection properties and are light weight and durable. The properties of these elements will be enumerated later. (Apart from that RXF1 looses these properties after 100 degrees Celsius. That is why there will be an Aluminum covering over the layer of RXF1) to ensure a radiation safe environment even at high temperatures.



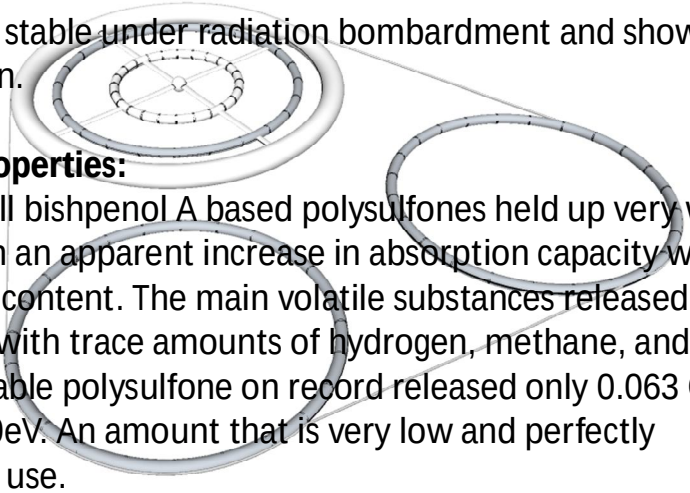
1.5.3 Materials used in Ubiety:

1.5.3.1 Window Materials:

The main material we plan on using for our windows are Bisphenol-Base (Bisphenol A.146) polysulfones {G (SO2) = .063} are radiation resistant. Tests have shown that they maintain their strength even after heavy radiation (this is probably due the very few cations and anions) and on average it has a 71.3% transparency. These properties make it very useful for the materials for windows.

Bisphenol A Based Polysulfones:

Bisphenol is an aromatic compound that is increasingly being used to manufacture polysulfones. Recent studies have shown that these compounds are very stable under radiation bombardment and show little radiation degradation.



1.5.3.2 Radiation Properties:

In irradiation tests, all bishpenol A based polysulfones held up very well under radiation, with an apparent increase in absorption capacity with increase in aromatic content. The main volatile substances released upon radiation were SO2, with trace amounts of hydrogen, methane, and carbon dioxide. The most stable polysulfone on record released only 0.063 G (SO2) on absorption of 100eV. An amount that is very low and perfectly acceptable for space use.

The Use of Bisphenol A in Ubiety:

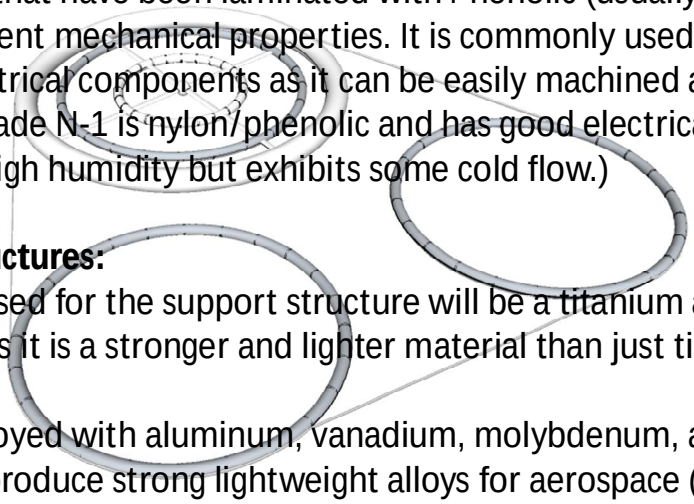
We plan on using Bisphenol A based polysulfone for our Window material, as it offers unsurpassed transparency for a radiation resistant material. On an average it has a 71.3% transparency. This shall be reinforced with support structures. The material we plan on using for our support structures will be an alloy which will be discussed later.

1.5.3.3 Hull Materials:

The hull will consist of 3 layers. 2 of these layers will have radiation deflection properties while the most inner layer will be used for insulation. The 2 radiation deflection materials will be RXF1 (a type of polyethylene) and Aluminum. These 2 materials are extremely light and strong, even though RXF1 is lighter and stronger than Aluminum, it still faces some problems against heat. So the outer layer will be of Aluminum, while the inner layer of RXF1, and the insulating (most inner) layer will be of either KAPTON or PHENOLICS.

Insulation:

PHENOLICS: Sheets that have been laminated with Phenolic (usually brown or black) have excellent mechanical properties. It is commonly used for the manufacture of electrical components as it can be easily machined and has great insulation. (Grade N-1 is nylon/phenolic and has good electrical properties even in high humidity but exhibits some cold flow.)



1.5.3.4 Support Structures:

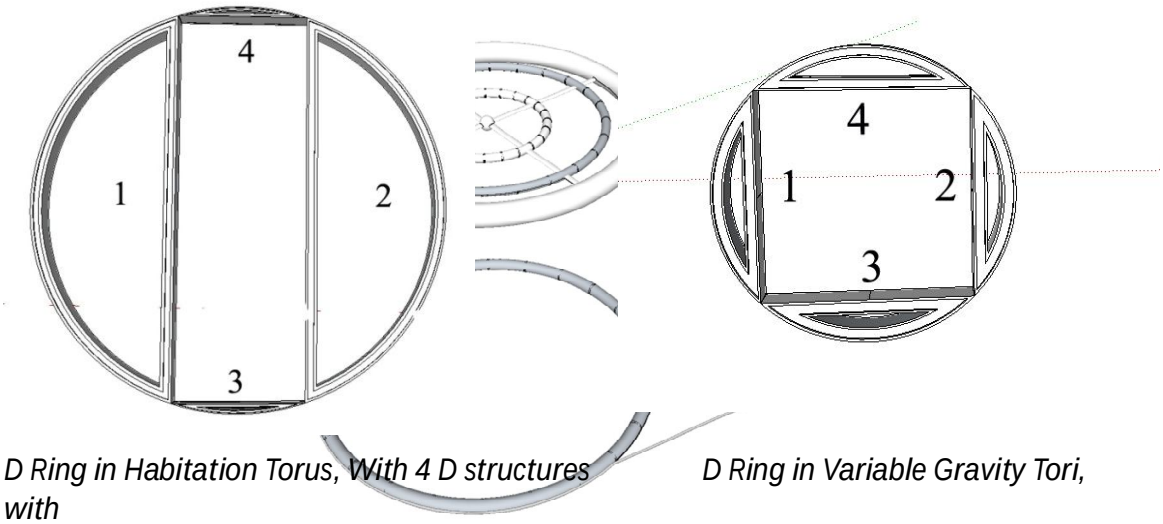
The main material used for the support structure will be a titanium alloy called Ti-5Al-2.5Sn as it is a stronger and lighter material than just titanium or aluminum.

Titanium is often alloyed with aluminum, vanadium, molybdenum, among other elements, to produce strong lightweight alloys for aerospace (jet engines, missiles, and spacecraft).

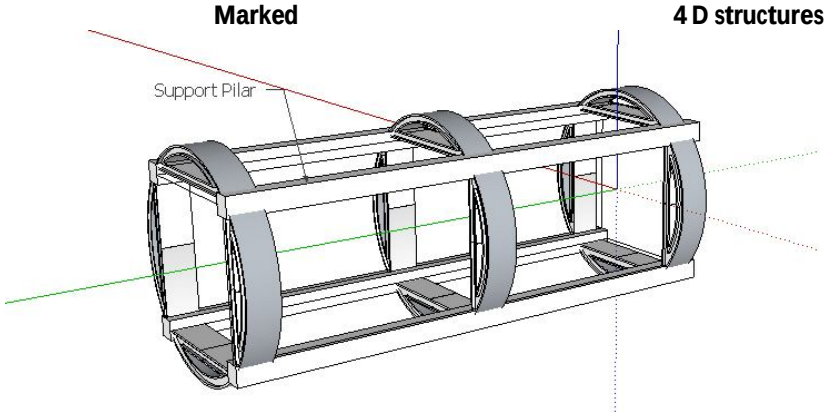
Our alloy consists of Aluminum and Titanium. The proportions in the alloy are 5% aluminum and 2.5% tin. This alloy is used in airframes and jet engines due to its good weld ability, stability and strength at elevated temperatures.

1.5.4 The Design for Support Structures:

The support structure that will be present in every torus, between the rectangular sleeve and the curved hull of the torus, will consist of four "D" shaped structures place perpendicular to each other. These four together will form a "D ring". D rings will be placed at regular intervals, with 15 degrees of separation between them, with a total of 24 D rings per torus. The D rings will be linked to each other with curved support pillars that run the length of the hull. Together the entire support structure creates a system that provides protection and ensures structural integrity on six different axes.

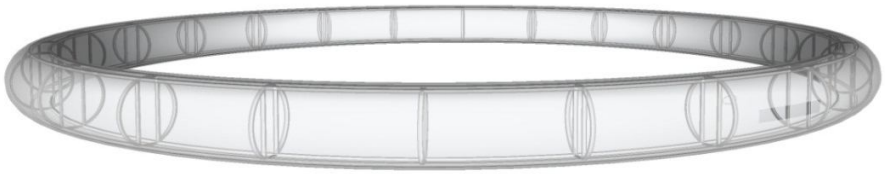


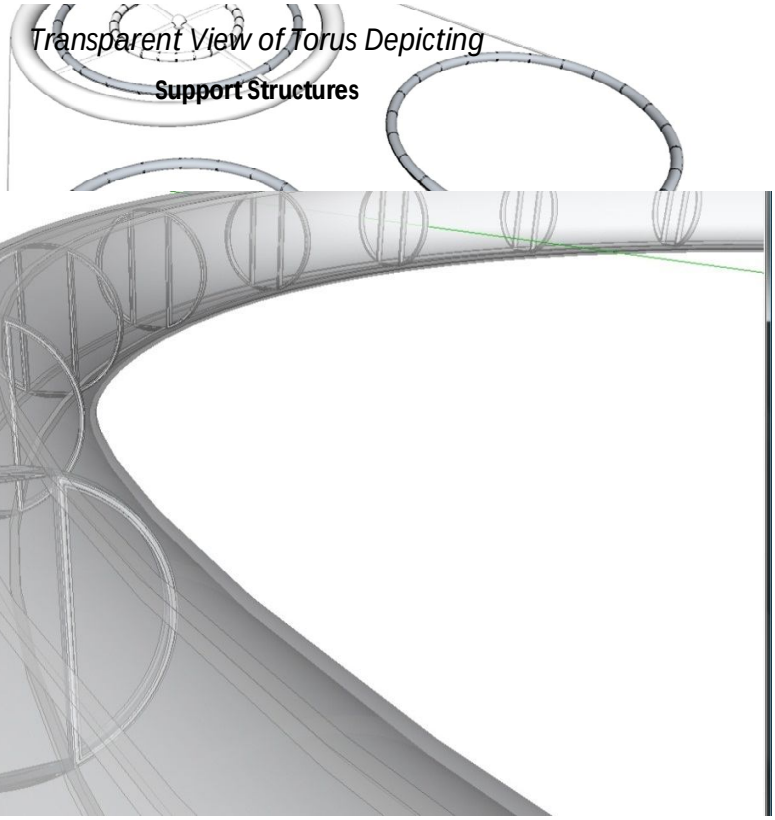
D Ring in Habitation Torus, With 4 D structures with **Marked** *D Ring in Variable Gravity Tori,* **4 D structures marked**



3 D rings linked by 4 support pillars

1.0 Structure





Transparent View of Torus Depicting **Support Structures**

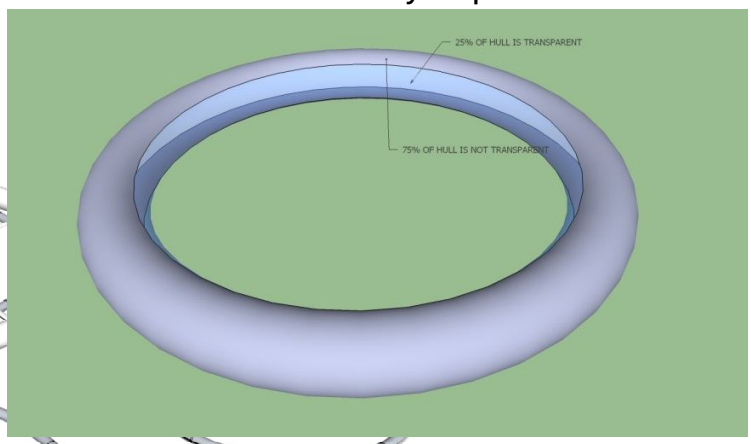
Close up view of support structures

1.5.5 Amount of Materials used for the Hull and the Windows:

The basic proportions of the amount for the windows to the hull are going to be 1:3. This implies that only one-fourth of the Tories' entire body will be made of Bisphenol A based polysulfone, while the rest shall be shall be of the 3 layers as mentioned above (Hull Materials).

The thicknesses of the layers in the hull of all tori are as follows:

1. Insulation shall be of 2 meters as thick insulation is definitely required especially in outer space.
2. RXF1 is the next layer. This is to be of 1 meter as it will block most of the harmful rays.
3. Aluminum is the final, strongest layer and will protect RXF1 from excessive heat. The layer shall be 50 centimeters thick.
4. Bisphenol A based polysulfone is the window material and it shall be 1 meter thick.



The materials in the inner sleeve are:

1. A layer of RXF1 .2 m thick

The materials in the inter-g channels are:

1. A layer of insulation 2m thick
2. A layer of RXF1 1m thick

The materials in the sphere are:

1. A layer of insulation .5m thick
2. A layer of RXF1 .5m thick

1.5.6 Volumes

HABITATION TORUS

Material	Insulation	RXF1 Polyethylene	Aluminium	Bisphenol A Based Polysulfone	Titanium Alloy (Ti-5Al-2.5Sn)
Volume (in m^3)	26,728,171.767	13,492,795.394	6,778,613.936	4,440,404.107	12,709,334.63

Variable Gravity Tori

.4 G torus

Material	Insulation	RXF1 Polyethylene	Aluminium	Bisphenol A based Polysulfone	Titanium Alloy (Ti-5Al-2.5Sn)
Volume (in m^3)	5,097,405.907	2,601,385.915	1293258.554	843723.859	5137225.07

.8 G torus

Material	Insulation	RXF1 Polyethylene	Aluminium	Bisphenol A based Polysulfone	Titanium Alloy (Ti-5Al-2.5Sn)
Volume (in m^3)	9,995,722.153	5,095,898.818	2,531,209.696	1,655,070.479	9,032,999.714

1.3 G torus

Material	Insulation	RXF1 Polyethylene	Aluminium	Bisphenol A based Polysulfone	Titanium Alloy (Ti-5Al-2.5Sn)
Volume (in m^3)	9,588,488.458	4,888,511.288	2,467,861.27	1,587,617.161	8,709,114.808

2.0 G torus

Material	Insulation	RXF1 Polyethylene	Aluminium	Bisphenol A based Polysulfone	Titanium Alloy (Ti-5Al-2.5Sn)
Volume (in m^3)	6,300,400.143	3,010,046.754	1,826,980.359	1,042,985.249	6,095,527.644

Inner Sleeve
(In habitation torus)

Material	RXF1 Polyethylene
Volume (in m^3)	2,569,122.089

(In .8 G Variable Gravity Torus)

Material	RXF1 Polyethylene
Volume (in m^3)	1,028,675.458

(In .4 G Variable Gravity Torus)

Material	RXF1 Polyethylene
Volume (in m^3)	514,337.729

(In 1.3 G Variable Gravity Torus)

Material	RXF1 Polyethylene
Volume (in m^3)	985,914.712

(In 2 G Variable Gravity Torus)

Material	RXF1 Polyethylene
Volume (in m^3)	640,655.69

Inter-G Channels

(Between central sphere and .4G torus)

Materials	Insulation	RXF1 Polyethylene
Volume (in m^3)	5,277,730.895	2,762,562.263

(Between .4G torus and .8G torus)

Materials	Insulation	RXF1 Polyethylene
Volume (in m^3)	5,540,945.084	2,900,338.458

(Between .8G torus and Habitation Torus)

Materials	Insulation	RXF1 Polyethylene
Volume (in m^3)	1,676,695.644	877,645.3776

(Connecting Opposite ends of 1.3g Torus)

Materials	Insulation	RXF1 Polyethylene
Volume (in m^3)	6,149,020.701	3,218,628.025

(Connecting Opposite ends of 2g Torus)

Materials	Insulation	RXF1 Polyethylene
Volume (in m^3)	3,995,502.672	2,091,395.93

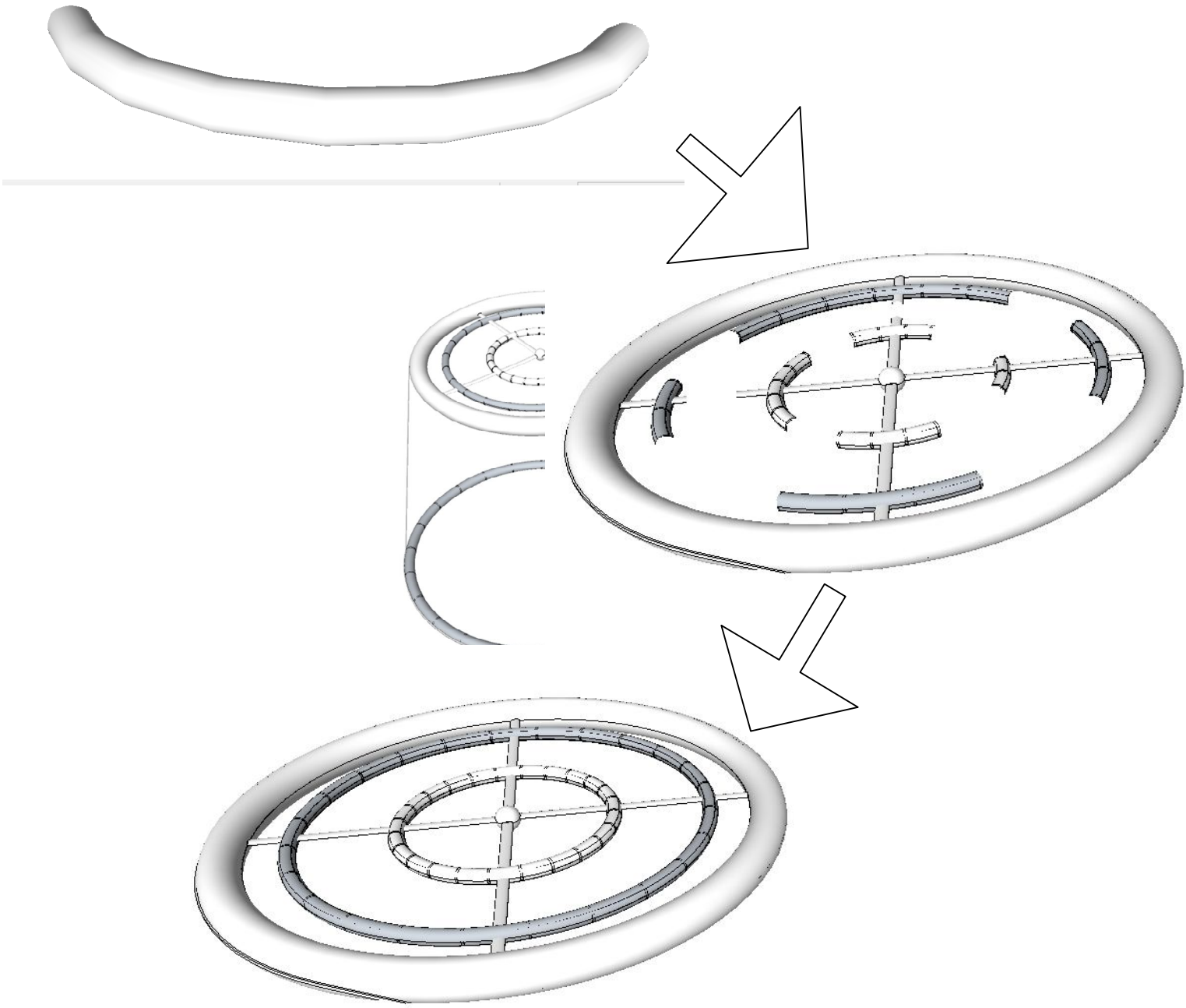
Spheres
(All three spheres are of equal size, volume given is sum of all three)

Materials	Insulation	RXF1 Polyethylene
Volume (in m^3)	276,707.079	278,995.603

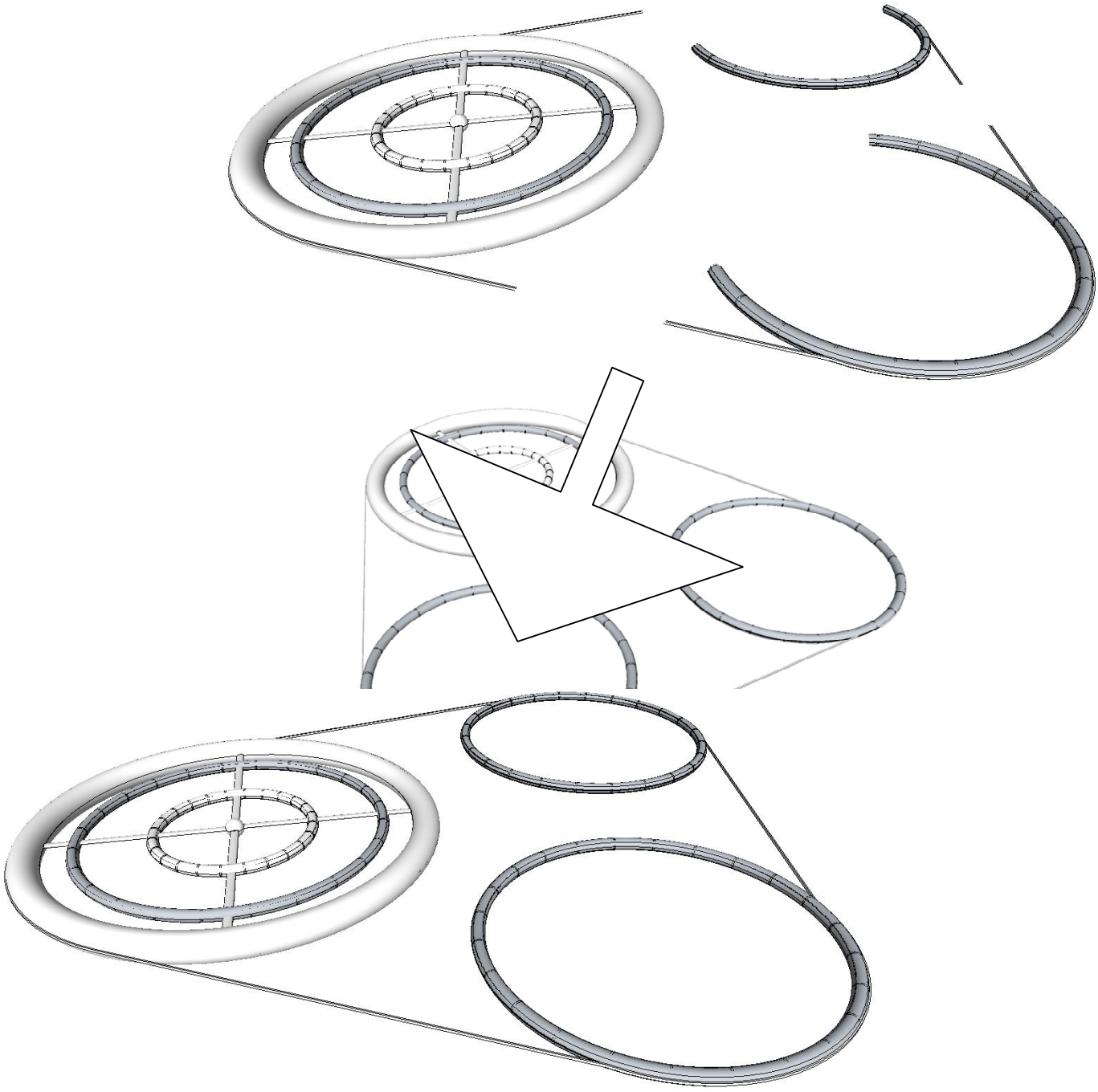
Using the above tables, we were able to calculate the total amount of each material that would be required to construct the entire settlement. They are given below"

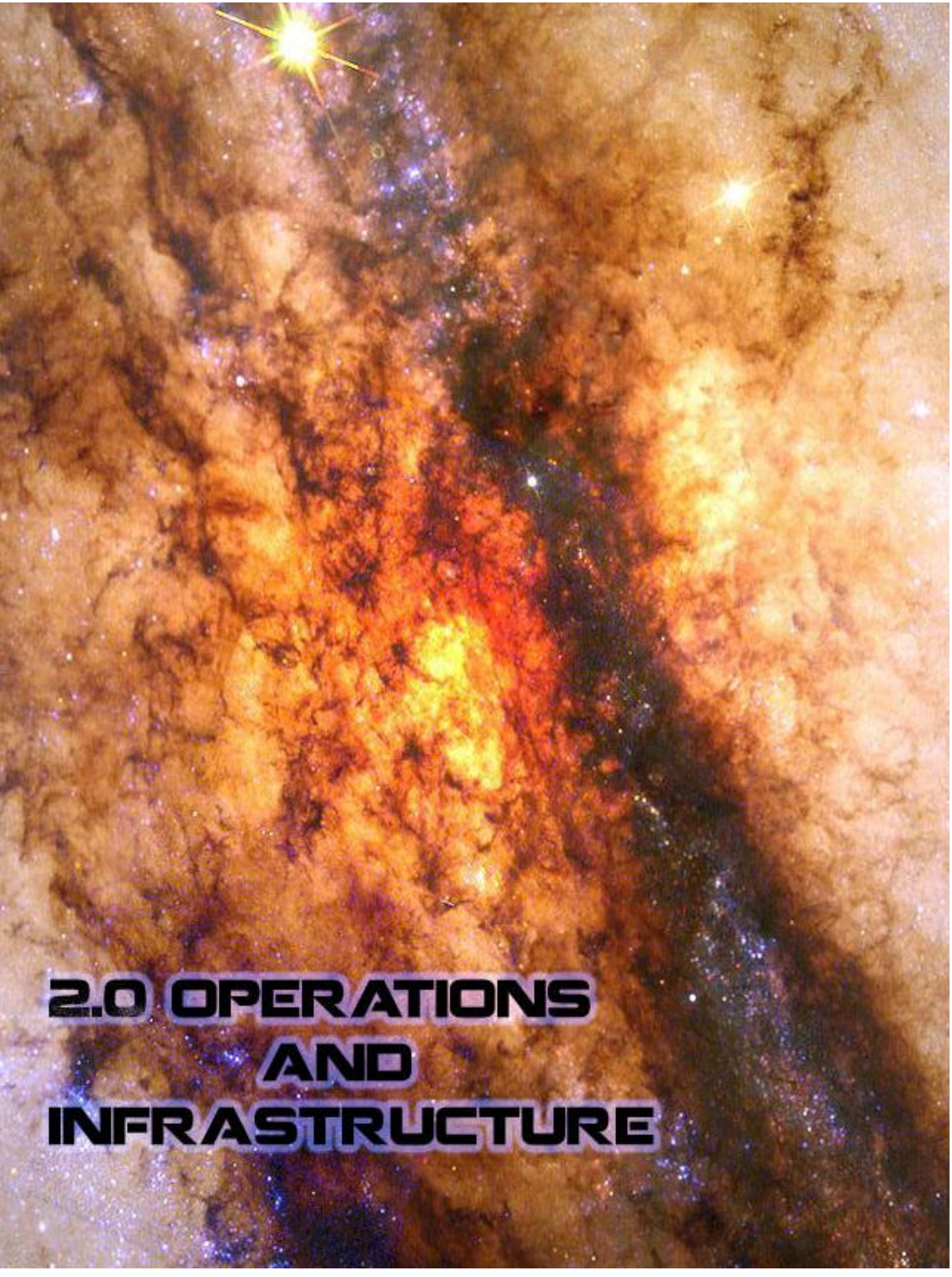
Materials	Insulation	RXF1 Polyethylene	Aluminium	Bisphenol A based Polysulfone	Titanium Alloy (Ti-5Al-2.5Sn)
Volume (in m^3)	80,626,790.5	46,956,909.5	14,897,923.815	9,569,800.855	41,684,201.87

1.6 Construction Sequence



1.0
Structure



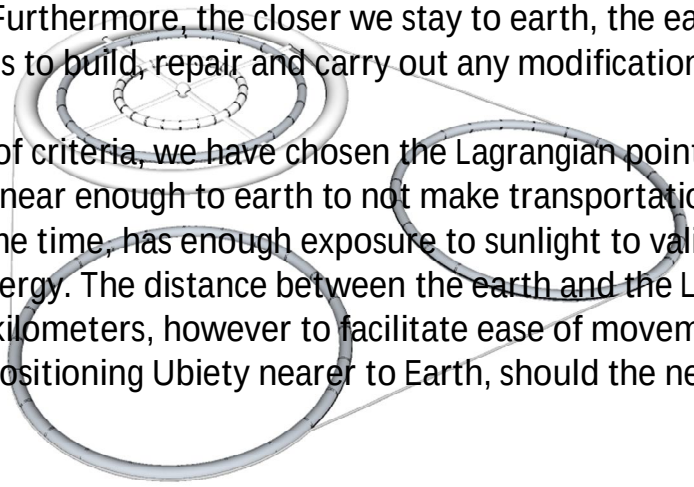

2.0 OPERATIONS
AND
INFRASTRUCTURE

2.0 Operations and Infrastructure

2.1 Location

Finding the perfect spot to position Ubiety can have drastic effects on other aspects of space-life. When positioning, various components have to be kept in mind, such as distance from Earth, relative position to the magnetic fields of the celestial bodies, and any other specific requirements exhibited by Ubiety.

With these in mind, we have looked at the vital necessities of Ubiety. For instance, for the transport of tourists and supplies between Ubiety and earth, we ideally need Ubiety to be close to the planet. Also, as solar energy is our secondary power system, it is essential that we remain in sunlight for as long as possible. Furthermore, the closer we stay to earth, the easier and more economical it is to build, repair and carry out any modifications to Ubiety.



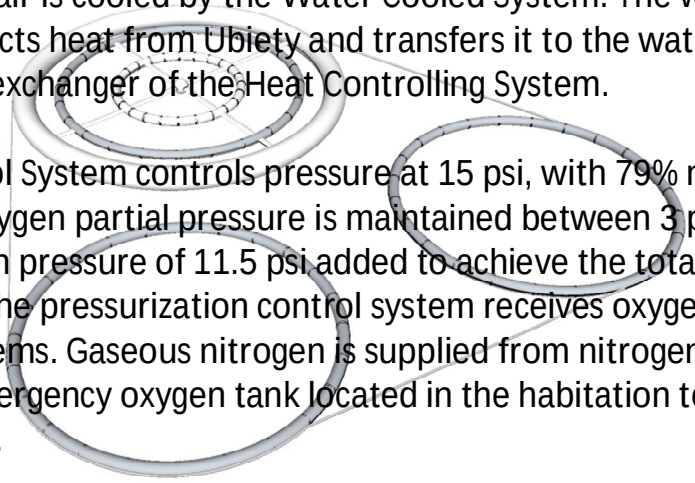
Considering our list of criteria, we have chosen the Lagrangian point L1 for Ubiety. This point is near enough to earth to not make transportation an issue, and at the same time, has enough exposure to sunlight to validate the using of solar energy. The distance between the earth and the L1 point is about 1.5 million kilometers, however to facilitate ease of movement, we have the option of positioning Ubiety nearer to Earth, should the need arise.

2.2 Basic Infrastructure

Life Support System

The Life Support System will be consisting of air recycling system, Heat Controlling System, water and waste management system and airlocks. All these equipments are located in the sphere of the habitation torus (Ubiety).

The Air Recycling System (ARS) maintains relative humidity between 30% and 75% maintains harmful and toxic gases at non-toxic levels and controls temperature in Ubiety. The ARS consist of water coolants and pressure control. Air used by the residents in Ubiety is radiated to the heat exchangers and the air is cooled by the Water Cooled System. The water coolant system collects heat from Ubiety and transfers it to the water coolant (loop) heat exchanger of the Heat Controlling System.



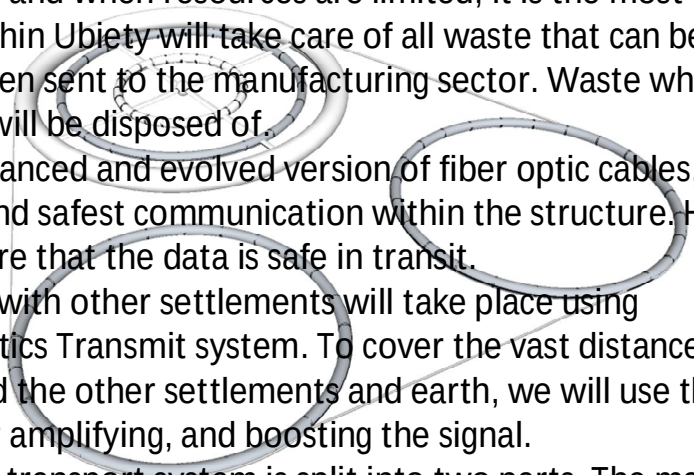
The Pressure Control System controls pressure at 15 psi, with 79% nitrogen and 21% oxygen. Oxygen partial pressure is maintained between 3 psi and 3.5 psi, with nitrogen pressure of 11.5 psi added to achieve the total pressure of 15 psi. The pressurization control system receives oxygen from oxygen storage systems. Gaseous nitrogen is supplied from nitrogen tanks for each system. Emergency oxygen tank located in the habitation torus will be used as a backup.

•The air composition and pressure will be identical to that on earth, ensuring no feeling of isolation or discomfort is felt by the residents. The day/night cycle will be artificially controlled, to ensure further comfort and natural working of our bodies.

• The food supply of Ubiety will be derived from agriculture using aeroponics.

•Water will be supplied to every house, office, lab, etc. in a measured, controlled fashion. While most of it will be recycled, it will run at one point. Spacecrafts passing from earth will carry water to Ubiety, and this will top up our water tanks.

• All forms of waste will be recycled as far as possible. It is the safest and cleanest option, and when resources are limited, it is the most feasible. A recycling plant within Ubiety will take care of all waste that can be recycled, which is then sent to the manufacturing sector. Waste which cannot be recycled will be disposed of.



•Using an advanced and evolved version of fiber optic cables, we can ensure the fastest and safest communication within the structure. High Bit encryption will ensure that the data is safe in transit.

Data transfer with other settlements will take place using the same Free Space Optics Transmit system. To cover the vast distances between Ubiety, and the other settlements and earth, we will use the optical telescope for amplifying, and boosting the signal.

• The internal transport system is split into two parts. The mass scale public transport system will constitute magnetic levitation trains, travelling along the circumference at very high speeds. The Stations will be evenly distributed across the entire settlement. For personal transportation, we will use segways to travel the short distances. To ensure that the system is entirely integrated the segways can be driven on and off the maglev trains. Refer to the section of automation for further detailing.

2.2.1 Atmosphere

Pressure and temperature are maintained inside the torus by a regulated supply of warm air within the torus which is carried in overhead pipes and released through vents in the ceiling of the torus (as seen by the humans inside). The composition of the air in the mixture is as follows:

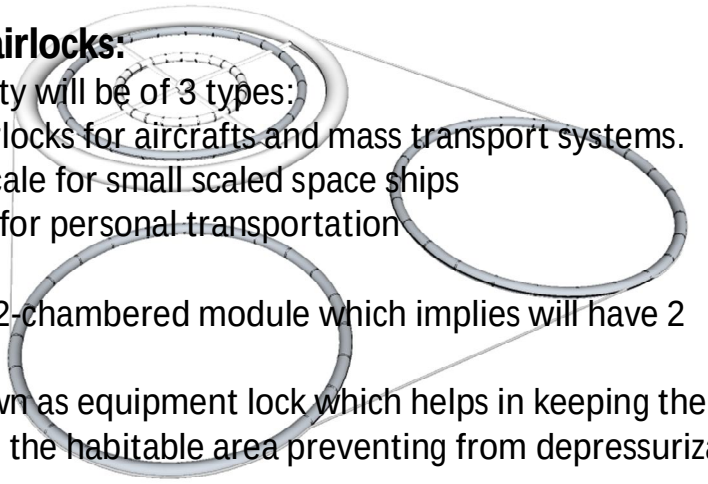
Gas	Percentage in air	Purpose
Oxygen	30	For ensuring normal metabolic activities in the body.
Nitrogen	68.5	Provides a chemically inert atmosphere. It also helps in the growth of some plants such as legumes which can serve as primary food crops.
Carbon Dioxide	1	Helps in the maintenance of temperature. It thereby lowers additional costs and power wastage on temperature regulation
Argon and Helium	0.5	Provides neutrality to the atmosphere.

2.2.1.2 Airlocks:

•"Permit passage of people through a pressure vessel preventing depressurization of the main habitable area." (eFn.wikipedia.org/wiki/Airlock)
•Consists of airtight doors.
•Also known as joint airlock module. Will be based as on the International Space station where it is used to initiate spacewalk for maintenance works on the ISS.
•Plays an important role for pressurization of the habitable area.
•Airlocks in Ubiety are the primary exit or entry points for the transportation of people, raw materials, etc.

Structure of the airlocks:

The airlocks on Ubiety will be of 3 types:
•First, large scale airlocks for aircrafts and mass transport systems.
•Second, medium scale for small scaled space ships
•Third, small scaled for personal transportation

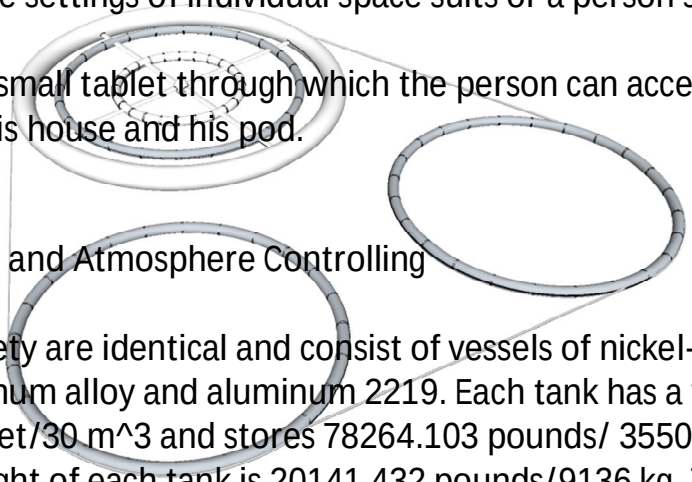


Basically it will be a 2-chambered module which implies will have 2 compartments.
•First chamber known as equipment lock which helps in keeping the pressure constant in the habitable area preventing from depressurization of the habitable area
•The first chamber stores space suits required for stabilizing the change in pressure.
•Second chamber is the final chamber and is separated from the first chamber by using an airtight door. Control systems will be fitted on to the system panel in the first chamber which will control the pressurization in the two chambers and openings of the airtight doors.
•It would be an exit chamber for the crew from where they can exit into the space.

Materials required for structure:

We will be using composite materials for the airlock.

•Firstly, aluminum will be used as it is strong and the durable. It will be used along with titanium.
•Second, carbon fiber for fireproof ability.
•Third, Kevlar, Mylar and polysulfone for amazing radiation absorbing capacity
•Since it has two chambers, a separate column has the control systems linked to the cabin pressurization.
•Each spacesuit will have a remote access to the control system and each person can adjust the settings of individual space suits or a person's own space suit
•System will be like small tablet through which the person can access the control systems of his house and his pod.



Habitational torus
Air Recycling System and Atmosphere Controlling
Oxygen
Oxygen tanks in Ubiety are identical and consist of vessels of nickel-chromium-molybdenum alloy and aluminum 2219. Each tank has a volume of 1059.439 cubic feet/30 m^3 and stores 78264.103 pounds/ 35500 kg of oxygen. The dry weight of each tank is 20141.432 pounds/9136 kg. The initial temperature of the stored oxygen is -285°F.

Hydrogen
The vessel is constructed of aluminum 2219. The volume of each tank is 2118.879 cubic feet/60 m^3, and each stores 9217.527 pounds/4181 kg of hydrogen. Each tank weighs 21644.984 pounds/9818 kg dry.
The initial storage temperature is -420°F. One tank of Hydrogen and one tank of Oxygen make 1 unit. An approximate of 250 units of tanks are needed for the Habitational Torus.

Nitrogen will have a similar storage procedure and will be released and controlled by the Air Recycling System.
Other gases will be present in very small amounts inside the torus, which will be maintained by the Air Recycling System.

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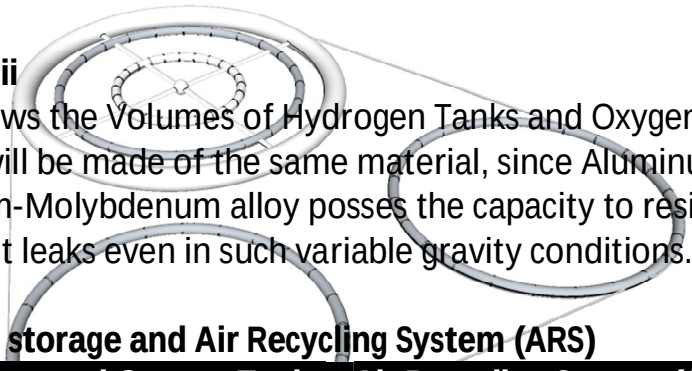


Variable Gravity Torii
The Table below shows the Volumes of Hydrogen Tanks and Oxygen Tanks. The storage vessel will be made of the same material, since Aluminum and the Nickel-Chromium-Molybdenum alloy posses the capacity to resist pressure and prevent leaks even in such variable gravity conditions.

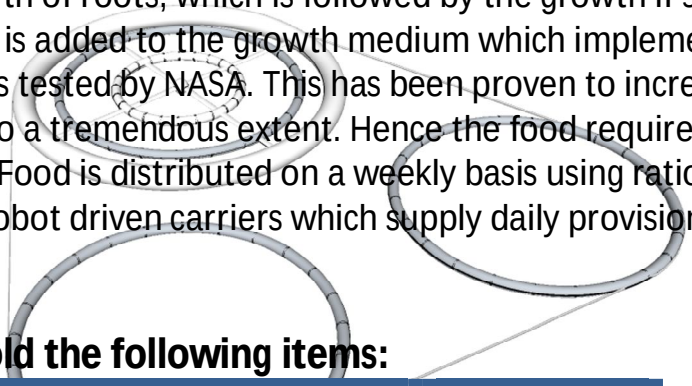
Hydrogen & Oxygen storage and Air Recycling System (ARS)

Torus Type	Hydrogen and Oxygen Tank	Air Recycling System (ARS)
	Storage Volume	storage Volume
0.4 G	208.52 m^3	4226.16 m^3
0.8 G	417.05 m^3	8452.32 m^3
1.3 G	799.43 m^3	16201.94 m^3
2.0 G	519.48 m^3	10528.15 m^3
TOTAL	1944.48 m^3	39408.57 m^3

2.2.2 Food and Agriculture

An initial supply of food is carried along with the residents when they are being transported to Ubiety. This supply can last for a period of three months. During this period, agriculture inside Ubiety is initiated. The agricultural practices will be enough to meet the average dietary requirements of all humans in Ubiety.

Agriculture inside Ubiety is implemented using the established practices of aeroponics. This is an efficient agricultural practice as it saves the cost and reduces the weight of having a growth medium like soil or gelatine as a tissue culture medium. In the absence of a growth medium, roots can absorb maximum amount of requisite gases. An artificial growth spray is used to initiate growth of roots, which is followed by the growth if shoots and braches. Zeolite is added to the growth medium which implements the concept of zeoponics tested by NASA. This has been proven to increase the yield of agriculture to a tremendous extent. Hence the food requirements of Ubietys are met. Food is distributed on a weekly basis using ration carriers. These are robot driven carriers which supply daily provisions to each household.



These carriers hold the following items:

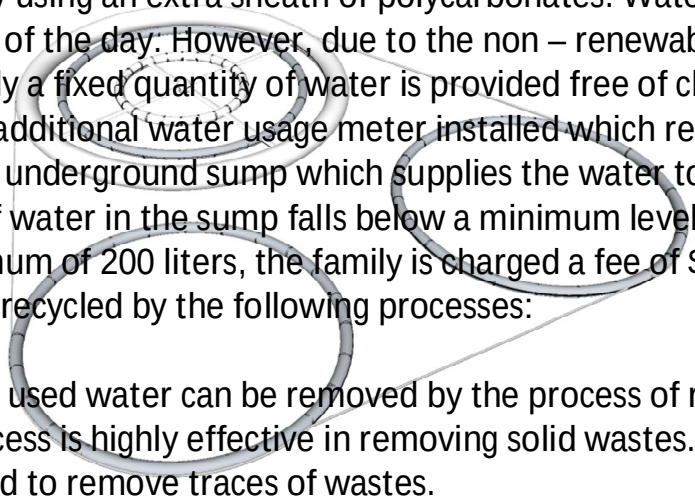
Commodity	Quantity
Breakfast Cereal	2 cartons
Pulses	2 kg.
Vegetables (six types of the family's choice)	12 kg.
Fruits (four types of the family's choice)	8 kg.
Drinking Water	60 liters

Basic food requirements will be met by these commodities. Additional purchases can be made by the family by shopping for food items at a nominal cost in times of extra need.

2.2.3 Water

Even though these are the available figures, we can never accurately figure out the amount of water the population may require within Ubiety. Because of this we need to consider 70Kg of water per capita per day as a more likely and conservative estimate.

This water would be stored in 4 open tanks of 10 x 5 x 5 m, which are considered to be sufficient for daily needs. Every house will have its own reserve tanks.
Water is supplied through underground (as seen by humans on Ubiety) pipes to all houses and workplaces. The supply pipes are made of fiber glass and strengthened by using an extra sheath of polycarbonates. Water is supplied at all times of the day. However, due to the non – renewability of water resources, only a fixed quantity of water is provided free of charge. Every house has an additional water usage meter installed which reads the level of water in the underground sump which supplies the water to the house. If the level of water in the sump falls below a minimum level of 100 liters out of a maximum of 200 liters, the family is charged a fee of $2 /liter. Waste water is best recycled by the following processes:



1. Solid wastes from used water can be removed by the process of reverse osmosis, as this process is highly effective in removing solid wastes. The water is then distilled to remove traces of wastes.

2. The water is then sent to a container which houses anaerobic bacteria. This decomposes the biodegradable solid wastes in anaerobic conditions and is then filtered using ultra filters.

3. U.V. purification systems are used for a final purification of the recycled water to kill all micro – organisms and thereby make it fit for drinking.

4. For purification of water, the process of chlorination is employed. Chlorination is carried out utilizing Chlorine dioxide.

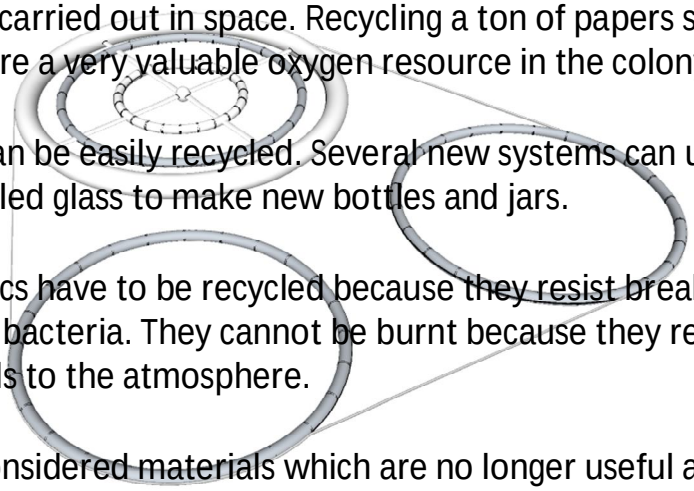
2.2.4 Waste Management

Waste cannot be totally recycled. The same methods that are applied on Earth cannot be used in Ubiety:

- Incineration because of the toxic fumes;
- Composting, because a big space is needed to leave the organic material to decompose
- Sanitary land fields, because they can change the soil composition deteriorating it, etc

2.2.4.1 Possible materials to be recycled include:

- Paper: Paper is certainly going to be recycled. The method is easy enough to be carried out in space. Recycling a ton of papers saves 17 trees, which are a very valuable oxygen resource in the colony.



- Glass: Glass can be easily recycled. Several new systems can use 100% of recycled glass to make new bottles and jars.

- Plastics: Plastics have to be recycled because they resist breakdowns by sunlight or bacteria. They cannot be burnt because they release toxic chemicals to the atmosphere.

- Wastes are considered materials which are no longer useful and can be disposed. Given the special nature of life in space and the need to recycle and re-use a maximum amount of materials, the solid and liquid wastes will be processed, along with human wastes.

- The recycling of gaseous wastes will be handled by the air recycling system.

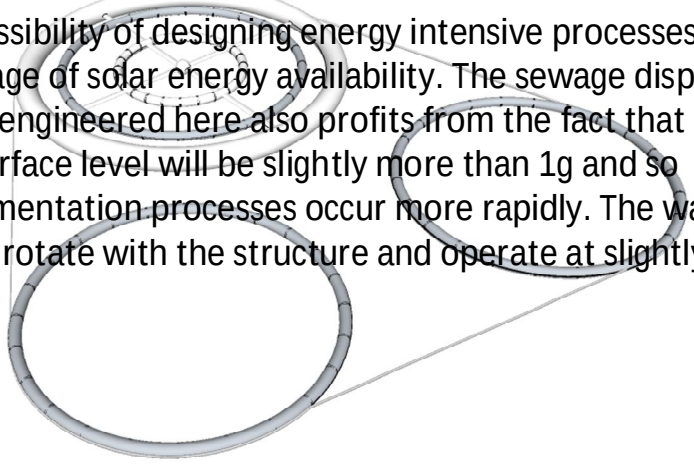
- The main objective of the waste management system is to process waste materials before they form toxic stuff and to convert them into different kinds of useful stuff.

- The metal waste thus received by us can be heated till its melting point, and then when it is molten by electrolysis we get the pure metal from the scrap and the rest is then use to evaporate water which can be used to run turbines and generate power for the lost energy that was used to liquefy the metal.

- Materials as plastic, aluminum and glass must be deposit in special places, collected and melted. One of the recycling methods combines non-incineration plastic disposal of technology.

2.2.4.2 Sewage treatment method

Ubiety offers the possibility of designing energy intensive processes that will take full advantage of solar energy availability. The sewage disposal method that will be engineered here also profits from the fact that artificial gravity below the surface level will be slightly more than 1g and so deposition and sedimentation processes occur more rapidly. The water treatment plant will rotate with the structure and operate at slightly more than 1 g.



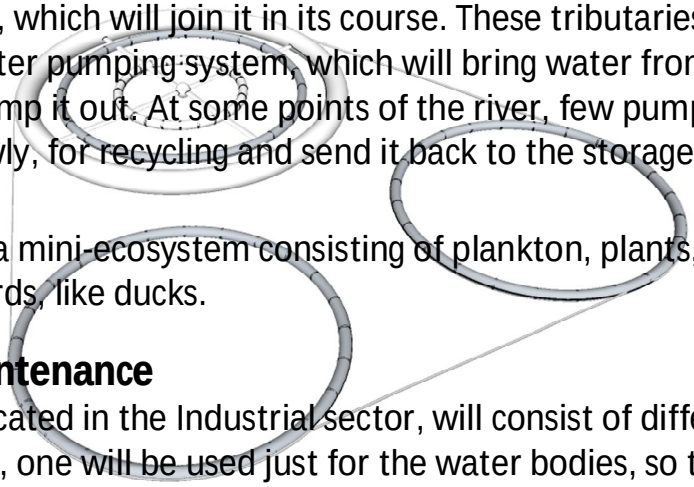
Water Bodies

2.2.6.1 Lakes

Ubiety will have large number of lakes, creating a natural life among the residents. These lakes will have plants, small fish and plankton, in them, to create a natural ecosystem in that area. Apart from this lakes too will be provided with abundant sunlight, which is really necessary for the growth of plants and fish.

2.2.6.2 Rivers

There will be one river running through the center of Ubiety to provide a fresh green environment and enrich the natural life in Ubiety. This river will have few tributaries, which will join it in its course. These tributaries will have an artificial water pumping system, which will bring water from the storage area and pump it out. At some points of the river, few pumps will drain out water slowly, for recycling and send it back to the storage area.



The rivers will have a mini-ecosystem consisting of plankton, plants, small fish and flightless birds, like ducks.

2.2.6.3 River Maintenance

The storage area, located in the Industrial sector, will consist of different section out of which, one will be used just for the water bodies, so that this water does not mix with the clinical (Distilled) or the drinking water.

The recycling plant will run with simple mechanical and physical means to remove dirt, since the main aim is to make the water look clean, since this won't be used for drinking. The plant will have one large filtration area, followed by the sedimentation, which will remove visible dirt. Slight chlorination and decantation will be done to remove other wastes like color due to staling or colloidal dirt.

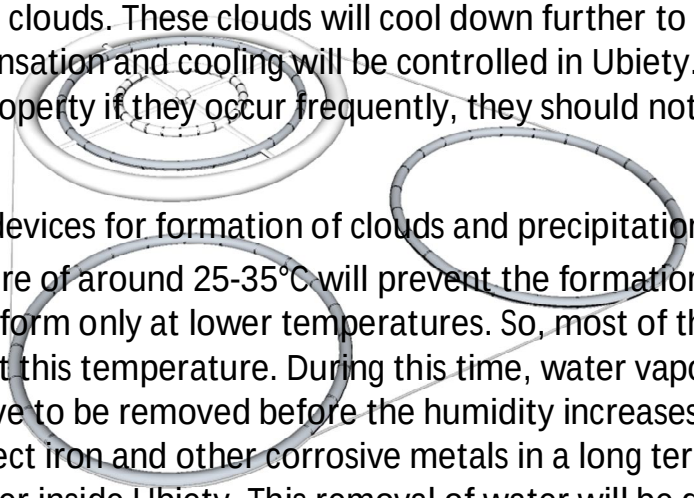
2.2.6.3 Water-proofing

The base of the terrace swimming pools will be generally concrete and steel, for support. This concrete will be topped with a PCE super plasticizer, which reduces pores. SBR Latex will be used for increasing adhesion and therefore adding to the waterproofing.

Bentonite water stops will protect the joints and wall from getting wet.

2.2.6.4 Water Cycle

Rain – one of the most important phenomenons, for living organisms, will not be non-phenomenal in Ubiety. Though rains will occur occasionally, they won't be absent here. Naturally, water vapor in the air will condense on rising up, to form clouds. These clouds will cool down further to give rains. But the condensation and cooling will be controlled in Ubiety. Since, rains can damage property if they occur frequently, they should not occur every day.



Working of cooling devices for formation of clouds and precipitation

A normal temperature of around 25-35°C will prevent the formation of clouds, since clouds form only at lower temperatures. So, most of the year will be maintained at this temperature. During this time, water vapor will increase and will have to be removed before the humidity increases, because this can affect iron and other corrosive metals in a long term, and can also cause swelter inside Ubiety. This removal of water will be done by special buildings, which are equipped with hydrophilic substances and will be able to remove water vapor, condense it down and reused for watering plants and replenishing water bodies. Around once in 6 months, temperature will be lowered to allow the residents to experience cold climate as well as help in creation of clouds. These clouds will take at least 2-3 days to form and will be cool enough to bring rain in around 3 more days. Thus, these seven days in the torus will be exceptionally cold at around 5-13°C, which can provide rain, replenishing water bodies, relaxing the residents, watering the plants and most importantly, provide a sense of naturalness to all the living organisms inside Ubiety.

2.2.7 Packaging and storage of materials

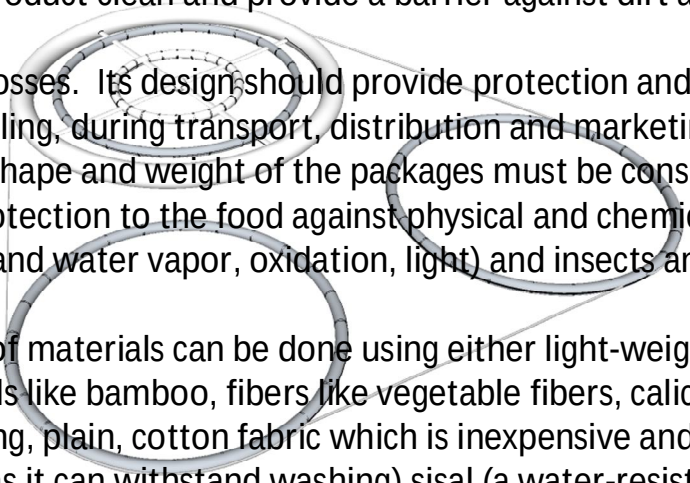
Storage and packaging of materials is quite easy. Packaging of materials is a very crucial and important procedure. All perishable items that can be packed can be either frozen to a very low temperature or subjected to vacuum or both to ensure the complete neutralization of the product or in other words, make it germ-free. This method is even used today on earth and is not at all expensive. The very low temperatures can be obtained by spraying liquid nitrogen on the product. This has no side effects on the consumer and this methods help retain the taste of food products for a long time.

Packaging must be done for the following reasons:

• It must keep the product clean and provide a barrier against dirt and other contaminants.

• It should prevent losses. Its design should provide protection and convenience in handling, during transport, distribution and marketing. In particular, the size, shape and weight of the packages must be considered.

• It must provide protection to the food against physical and chemical damage (e.g. water and water vapor, oxidation, light) and insects and rodents.



Also the packaging of materials can be done using either light-weight very slow rotting materials like bamboo, fibers like vegetable fibers, calico (closely woven, strong, plain, cotton fabric which is inexpensive and can be reused many times as it can withstand washing),sisal (a water-resistant fiber), jute, coconut/ banana leaves, metals, glass, etc. These are also recyclable and biodegradable and hence can be recycled into useful products again and again.

2.3 Energy Resources

2.3.1 Nuclear Fission

The technique of harnessing nuclear energy, involves the same technique as conventional thermal power plants – which are to utilize the heat energy liberated by burning fossil fuels, but in the case of nuclear power plants harnesses the heat released from nuclear fission.
The output of a reactor is controlled by controlling the number of neutrons available to continue the nuclear chain reaction.

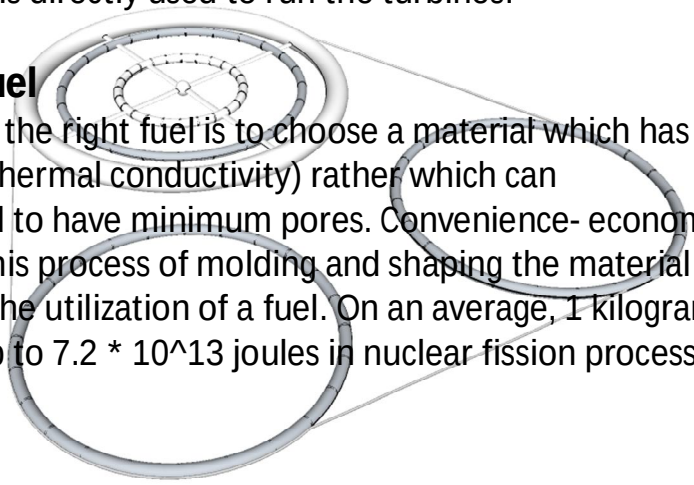
Reactor

There are several reactor technologies such as water reactors, metal reactors, breeder reactors and various other research reactors.

Pressurised water reactor		Boiling water reactor	
Pro's	Con's	Pro's	Con's
Coolant not in direct contact with nuclear vessel	Larger volume required, as steam generation chamber is separate from fission chamber	Lesser water pressure, hence more stability	Requires larger pressure vessel as fission and steam production chambers are combined
Allows for change in water volume, hence high precision fission control not necessary	Separate moderator and coolant required to control fission.	Rate of fission can be directly controlled by the water. Lesser volume required as steam is produced within fission chamber.	Since water is in direct contact with fission chamber, more complex calculations for precise output of fission.

The best reactor type for Ubiety would be the Boiling Water Reactor as it allows for more output per reactor volume, helping in the case of space constraints. It is also the most well-known reactor in the world. Most of the reactors are BWR's. Converting the reactor into a breeder reactor increases the usage of fuel by up to 60 times. In the Breeder reactor, radioactive waste including unused uranium and the newly produce plutonium is re-used in the reactor increasing the fuel economy drastically.

In this type of reactor, de-mineralized water acts as a coolant as well as a moderator. It absorbs heat from the reactor core and gets converted to steam. Being at a high pressure, the boiling point increases to about 250 Celsius+. The steam is directly used to run the turbines.



2.3.1.1 Nuclear fuel

The aim of choosing the right fuel is to choose a material which has least porosity (i.e.:- high thermal conductivity) rather which can compressed/molded to have minimum pores. Convenience- economically and technically- in this process of molding and shaping the material plays an important factor in the utilization of a fuel. On an average, 1 kilogram of uranium provides up to 7.2 * 10^13 joules in nuclear fission processes.

2.3.1.2 Energy consumption of settlement -

Purpose	Consumption
Residential= Number of houses (15000?)* 5units per day + public facility buildings @ 5000 units total per day	75000 + 5000 units = 80MW
Industry	150000 units = 150MW
Transport	50000units= 50MW
Life sustenance management systems (i.e. atmosphere composition control, waste disposal and waste management systems, water purification)	50000units= 50MW
Research labs	50000units=50MW
If anything to be added	
Total =	330 MW

There are 3 reactors in Ubiety each having a capacity of 150MW.
Total = 450MW

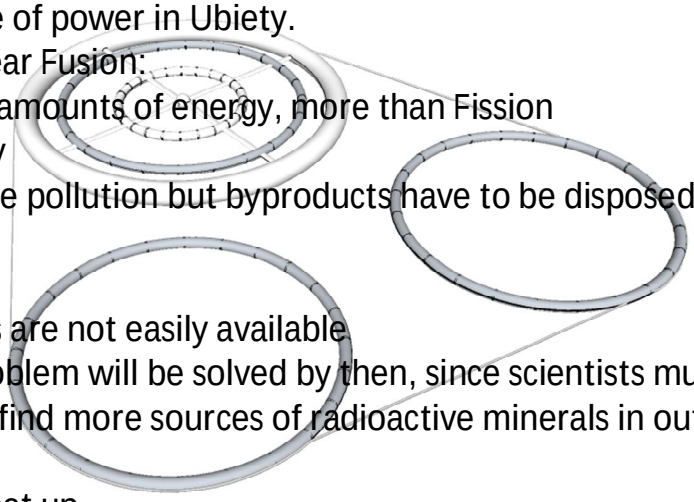
System	Volume
Reactor (3)	9112 m^3 (approx.) *3 = 27340m^3
Electricity Distribution and Management hub	2500m^3 (approx.)
Total =	30000m^3 (approx.)

2.3.2 Nuclear Fusion

Hypothetically and experimentally, Nuclear Fusion is one of the largest sources of energy in terms of energy released per molecule. It is basically the process of joining molecules to form a single nucleus. This process is accompanied with the release of huge amounts of energy. This energy can be harnessed to further create electricity for daily use.

"For now, an experimental fusion igniter has been set up, called the HIPER in Japan and a similar one in EU has started construction in 2010, called the HiPER." (Source: Discovery Channel and Wikipedia-HiPER)

Nuclear Fusion has a capability of creating large amounts of energy, enough to be a major source of power in Ubiety.



Advantages of Nuclear Fusion:

Creates large amounts of energy, more than Fission
Instant energy
Does not cause pollution but byproducts have to be disposed carefully.

Disadvantages:

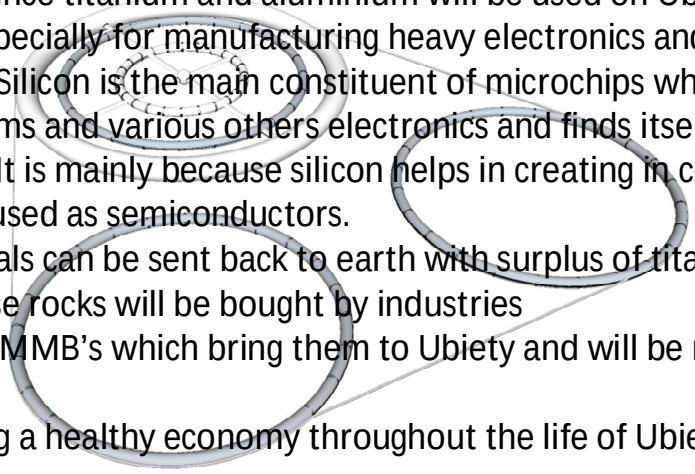
1. Raw materials are not easily available
   This problem will be solved by then, since scientists must be able to find more sources of radioactive minerals in outer space.
2. Expensive to set up
   Collaboration and sharing of wealth between countries might be able to overcome this disadvantage.
3. Waste Disposal
   Waste cannot be disposed by just throwing it into space. This is because the waste may come in the path of a spacecraft. So, to counter this problem, the waste will be enclosed in a cement capsule and ejected towards the sun.

In Ubiety, the fusion reactor will be located in the 0-G sphere. The process is started by providing energy from the fission reactor. This initiates the

collision among the Hydrogen atoms which then fuse to form helium atoms and creates large amounts of energy. This energy can be harnessed to meet most of Ubiety's energy requirements.

2.3.3 Moon Mining:

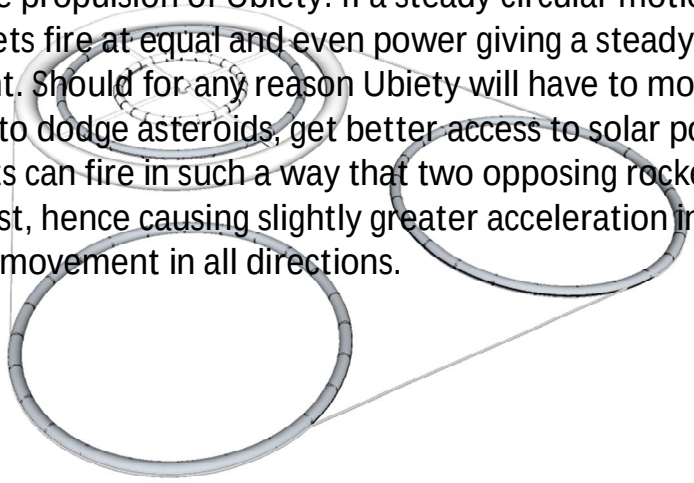
Moon is rich in minerals. Moon mining is considered valuable. 30-50 years down the line moon mining will be a separate industry itself.
The rocks mined from moon are basically valuable in millions of dollars. The minerals mined will be exported back the earth and will be sent to industries
Moon is rich in cobalt, nickel, titanium, aluminium, silicon and many other valuable minerals. Since titanium and aluminium will be used on Ubiety for various purposes especially for manufacturing heavy electronics and goods like the maglev etc. Silicon is the main constituent of microchips which will be used in the systems and various others electronics and finds itself in the electronic industry. It is mainly because silicon helps in creating in compact designs and can be used as semiconductors.
Other mined materials can be sent back to earth with surplus of titanium, aluminium, etc. these rocks will be bought by industries
These are mined by MMB's which bring them to Ubiety and will be refined for further use.
This helps in creating a healthy economy throughout the life of Ubiety.



2.4 Propulsion System

In order to maintain a constant gravity within Ubiety, the torii have to be rotated with a constant speed. To achieve this, we have used rocket based propulsion systems, powered by a cryogenic propulsion system. Such a system utilizes gases (primarily liquid hydrogen) as fuel, and liquid oxygen as an oxidizer. At temperatures below -253° C hydrogen liquidifies, and at temperatures below -183° C, Oxygen too is in its liquid form. We have decided to choose this system of propulsion over other fuel systems, as it is one of the most efficient methods of propulsion.

The Nozzles will be mounted at 4 diametrically opposite points on both the top and bottom of each torus. Hence there will be a total of 32 nozzles, controlling the entire propulsion of Ubiety. If a steady circular motion is desired, all the rockets fire at equal and even power giving a steady rotational movement. Should for any reason Ubiety will have to move out of its orbit (in order to dodge asteroids, get better access to solar power, etc.) then the rockets can fire in such a way that two opposing rockets fire stronger than the rest, hence causing slightly greater acceleration in one plane, allowing free movement in all directions.

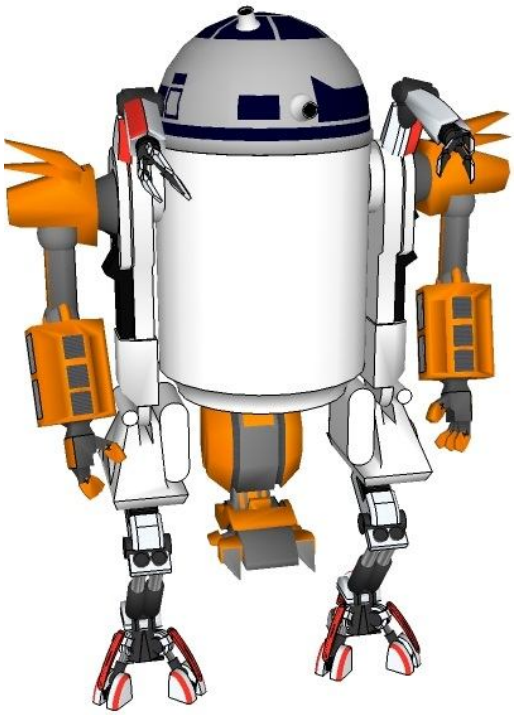



3.0
AUTOMATION

3.0 Automation:

3.1 Construction Robot:

The construction robot is given the task of constructing the entire structure so that it is suitable for habitation. To do this, they will work with the autoclaves and create the entire structure in the order mentioned before. The construction robot will be built to be able to carry large equipment and parts, and manoeuvrable enough to carry out precision tasks as well. It is a simple modification of the service robot. It will perform the construction both outside and inside.



3.2 Service Robot:

A service robot is a robot which operates semi- or fully- autonomously to perform services useful to the well-being of humans and equipment, excluding manufacturing operations. Our service robots have specialized robotic arms and manipulators primarily for the purposes of distribution and repair. They will be built with a safety shield similar to the main torus, but thicker, to protect them from radiations and solar flare when they are working outside the torus.

Along with the above, humanoid robots will also be introduced to cater to the requirements of security of the torus. In essence they will perform the task of security personnel.

Industrial robots consist of a jointed arm (multi-linked manipulator) and end effectors that are attached to a fixed surface. Along with the above, humanoid robots will also be introduced to cater to the requirements of security of the torus. In essence they will perform the task of security personnel.

FREE-SPACE OPTICAL COMMUNICATION

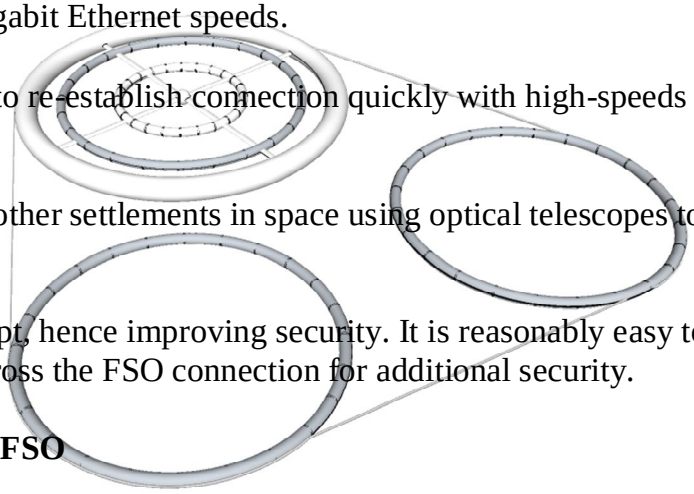
For telecommunications, an optical communication technology i.e. the Free Space Optics (FSO) will be used. This technology uses light that is propagating in free space to transmit data between two points.

USAGE AND TECHNOLOGIES

Free-space optical links will be implemented using infrared laser light. FSO is additionally used for communications between spacecrafts. We are using optical telescopes as beam expanders to bridge the distance from the other settlements already in action, to Our Settlement.

APPLICATIONS

- This technology provides LAN-to-LAN connections on campuses at Fast Ethernet or Gigabit Ethernet speeds.
- It can be used to re-establish connection quickly with high-speeds (disaster recovery).
- To connect to other settlements in space using optical telescopes to amplify signal.



FSO is hard to intercept, hence improving security. It is reasonably easy to encrypt any data travelling across the FSO connection for additional security.

ADVANTAGES OF FSO

- Ease of deployment
- License-free long-range operation (in contrast with radio communication)
- High bit rates
- Low bit error rates
- Not prone to electromagnetic interference
- Full duplex operation
- Protocol transparency

- Very secure due to the high directionality and narrowness of the beam(s)

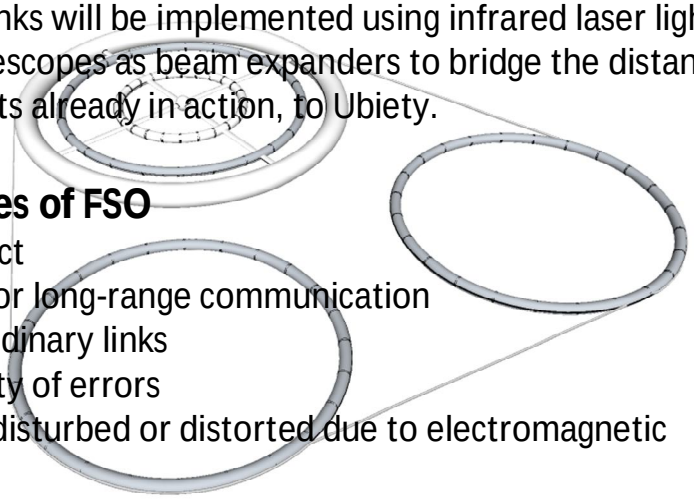
3.4 Community Automation

3.4.1 Free Space Optical Communication

Free Scale Optical communication technology will be used for sending important documents and secret talks as well as for general communication. This technology uses a feature of sending information in the form of light waves.

3.4.2 Usage and Technology

Free-space optical links will be implemented using infrared laser light. We are using optical telescopes as beam expanders to bridge the distance from the other settlements already in action, to Ubiety.



3.4.2.2 Advantages of FSO

1. Easy to connect
2. Can be used for long-range communication
3. Faster than ordinary links
4. Less probability of errors
5. Does not get disturbed or distorted due to electromagnetic inference.

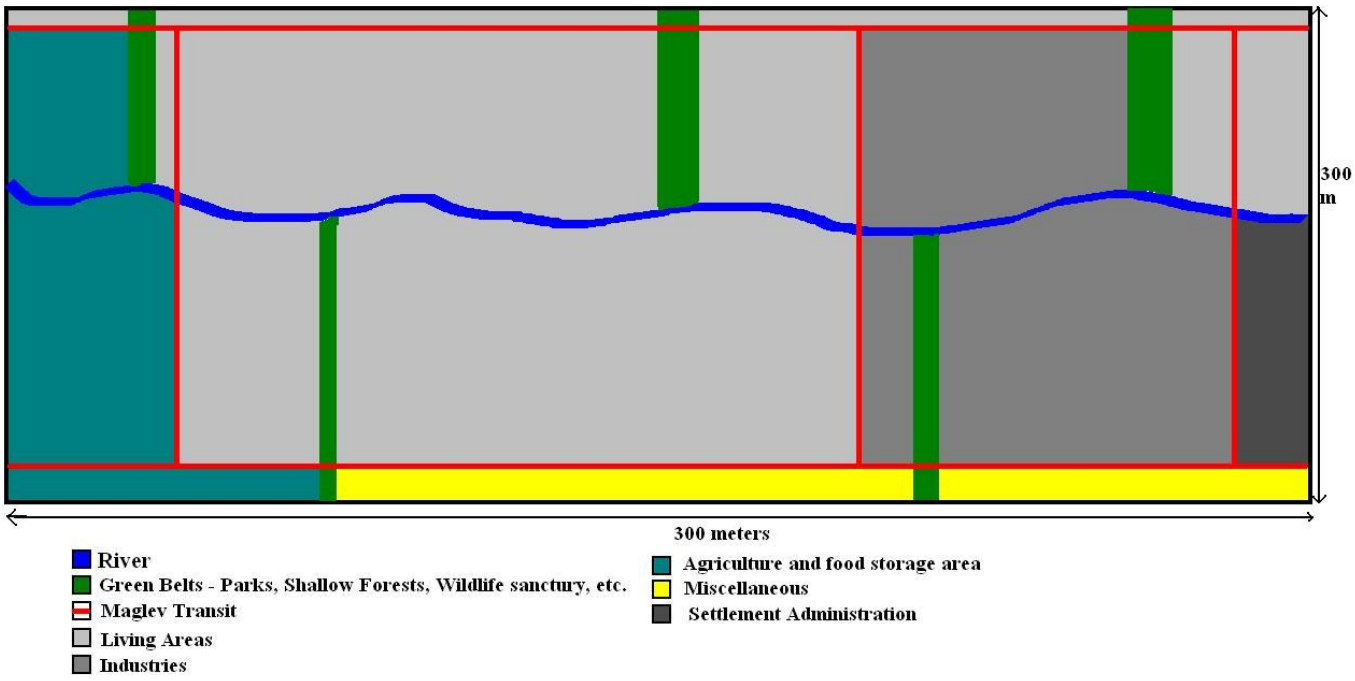
3.5 Security Systems:

Security of Ubiety is taken care of by the lasers from the asteroids and the thrusters which move Ubiety out of the collision course. Security inside the torus is maintained by humanoid robots which are programmed to not harm humans in any case but to tranquilize them in extreme conditions. Ubiety will have 200 of these. The laser system is similar to the one used by the Boeing YAL-1 aircraft.


4.0
HUMAN FACTORS

4.0 Human Factors

Ubiety's environment is designed keeping in mind the environment back on earth. The residents of this settlement are ensured state of the art facilities and a comfortable earth like atmosphere so that they don't feel "EARTH sick" while here on Ubiety. Residents don't have to adjust to Ubiety but Ubiety is designed keeping in mind their needs. The experience on board the Ubiety is like no other. The efficient and systematically designed layout of the residential torus keeps in mind the educational, social, religious and recreational needs of the residents.



4.1 Community Design

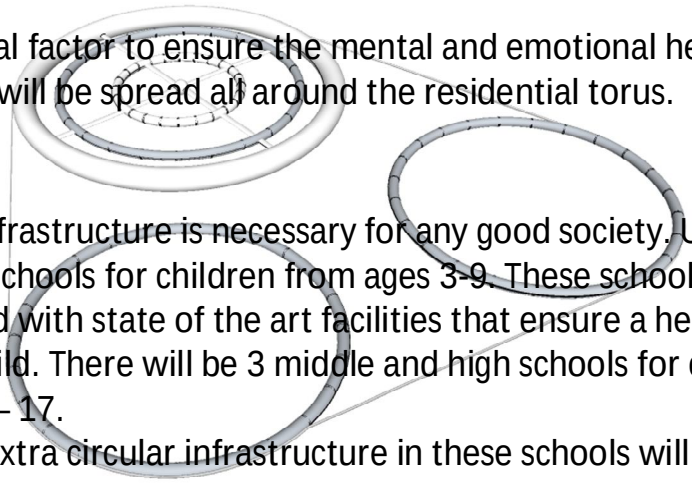
The community design on the residential torus of Ubiety is made keeping in mind the open lively and "free" feel and a structure similar to that of Düsseldorf, Germany. Düsseldorf ranks the 6th in the quality of living and infrastructure and is one of the most beautiful cities in the world thus making it our source of inspiration for the community design here on Ubiety the commercial. Agricultural and residential areas are separated by green belts yet the design of the city.

4.1.1 River Canis

River Canis runs through the centre of the entire Inhabitant torus. This river is the backbone of the ecosystem of the entire Inhabitant torus, and also serves as a source of food (fishes, lobsters etc.). Also infrastructure sports like white water rafting, canoeing, boating etc. can be set up in certain stretches of this river. Also the river can help irrigate the agricultural area with the help of canals.

4.1.3 Parks

Recreation is a crucial factor to ensure the mental and emotional health of the residents. Parks will be spread all around the residential torus.



4.1.5 Education

Good Educational infrastructure is necessary for any good society. Ubiety will have 5 primary schools for children from ages 3-9. These schools will be completely equipped with state of the art facilities that ensure a healthy upbringing of the child. There will be 3 middle and high schools for children in the age group 10 – 17.

The sports and the extra circular infrastructure in these schools will not be compromised upon. Music, art, dance, drama along with a variety of other sports will be encouraged here along with academics.

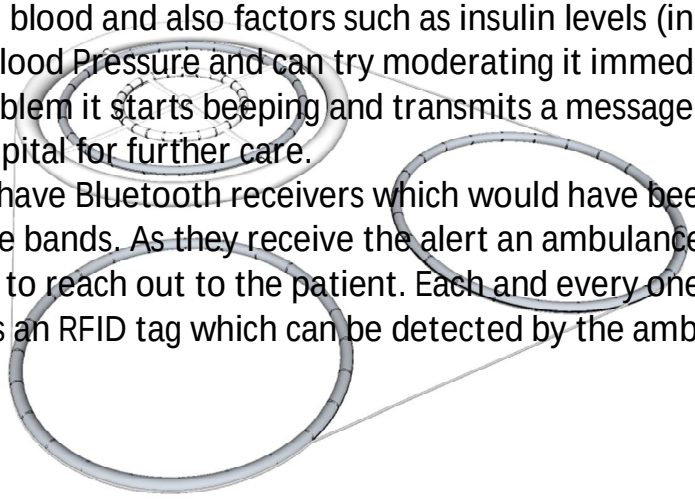
There will be 2 universities on Ubiety that offer major's in Earth Systems, Energy Resources Engineering ,Aeronautics and Astronautics, Architectural Design , Engineering Physics , Electrical Engineering and many more along with minors in various fields. The faculty in these universities will be amongst the best in the world

4.1.6 Medical Services

Ubiety has 2 general hospitals and various smaller health care clinics spread around Ubiety. Clinics are for minor ailments while the two general hospitals are for chronic illnesses and other potentially dangerous medical conditions. The general hospitals will be equipped with the best instruments and facilities and can handle virtually any illness on board Ubiety.

Every Resident has to take a yearly health check up at the one of the general hospitals to keep in check the health of the population.

Each person also wears an arm band, which measures the persons composition of their blood and also factors such as insulin levels (in case of Diabetic patients), Blood Pressure and can try moderating it immediately. In case any further problem it starts beeping and transmits a message to the nearest General Hospital for further care.



These hospitals will have Bluetooth receivers which would have been paired with these are bands. As they receive the alert an ambulance or such vehicle shall be sent to reach out to the patient. Each and every one of these bands also has an RFID tag which can be detected by the ambulance.

4.2 Residential Design:-

4.2.1 Housing:-

The housing facilities in UBIETY are similar to those on earth. We will be housing a population of about 30,000 people, out of which population is distributed as mentioned earlier.

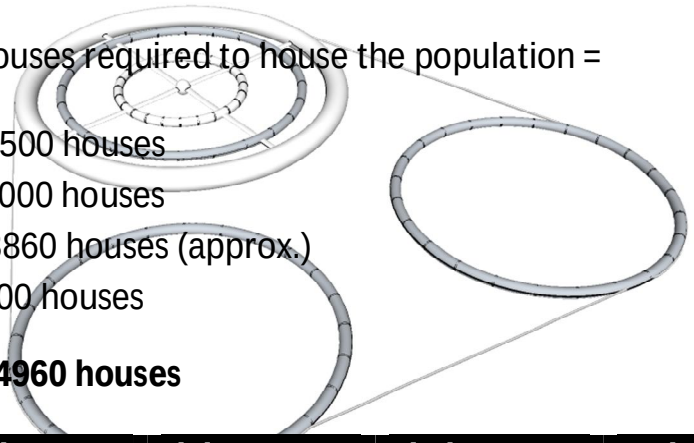
The house sizes are divided according to the number of people living in each house, i.e.:-

Singles: 1 person -1BHK

Couples: 2 people -1BHK

Small family: 3-4 people - 3BHK

Extended family: 5-6 people - 4BHK



So, therefore the no. of houses required to house the population =

Singles - 7500 houses

Couples - 3000 houses

Small family - 3860 houses (approx.)

Extended family - 600 houses

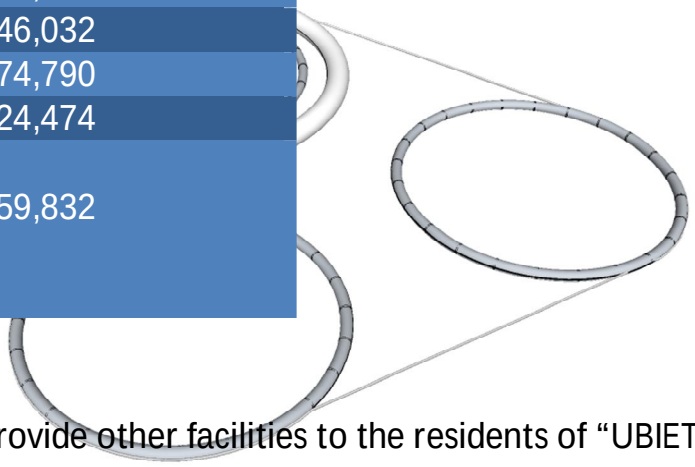
Total houses = 14960 houses

	Bedroom	Living Room	Kitchen	Bathroom
Single	1 (7500)	1 (7500)	1 (7500)	1 (7500)
Couple	1(3000)	1(3000)	1(3000)	1(3000)
Small Family	3(11580)	1(3860)	1(3860)	3(11580)
Extended Family	4(2400)	1(600)	1(600)	4(2400)
Total	**24,480**	**14960**	**14960**	**24,480**

The number of each individual living space is as follows:-

The total furniture in Ubiety is as follows:-

Commodity	Quantity
Couches	14,958
Sofa Chairs	29,916
Misc. Tables	63,906
Beds	24,480
Desk	24,474
Closets	48,948
Television	31,332
Dining Table	14,958
Dining Chairs	46,032
Cupboards	74,790
Bath Tubs	24,474
Dishwasher, Microwave, Washing Machine, Refrigerator	59,832



4.2.1.1 Parameters:-

Well to save space and provide other facilities to the residents of “UBIETY”, the houses are divided into:-

Apartments - 1BHK

Duplex Apartments - 3BHK & 4BHK

Area covered by apartments is as follows:-

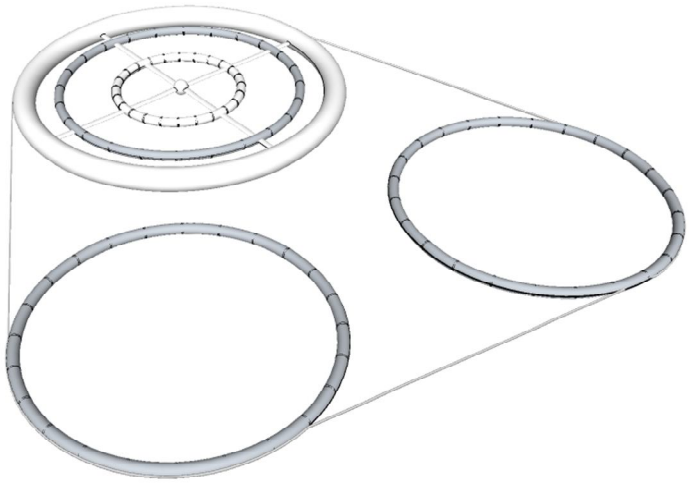
No. Of People	No. of Houses	Area
Single	7500 houses	750 sq ft. units
Couple	3000 houses	1200 sq ft. units
Small Family	3858 houses	1500 sq ft. units
Extended Family	600 houses	1750 sq ft. units

4.2.1.2Apartments:-

Ubiety has multiple apartment buildings for the residents. The design of the houses were done keeping in mind the modern day needs. The apartments in Ubiety provide luxurious and majestic living for the citizens.

Dimensions for each housing are:-

Type Of House	Dimensions	Total Area
Single	30ft. * 25ft.	750 sq ft. units
Couple	40ft. * 30ft.	1200 sq ft. units
Small Family	50ft. * 30ft.	1500 sq ft. units
Extended Family	50ft. * 35ft.	1750 sq ft. units



4.2.2 Housing Designs

4.2.2.1 Singles 1 BHK's

The house for singles will consist of 1 floor.

Fig 1.1
1 BHK External View

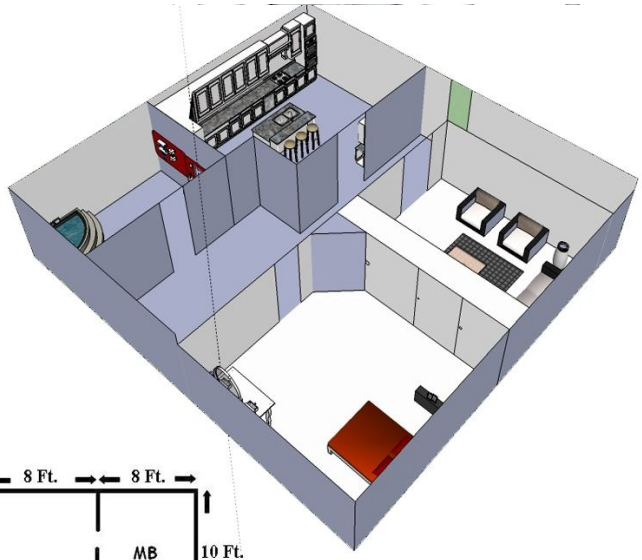
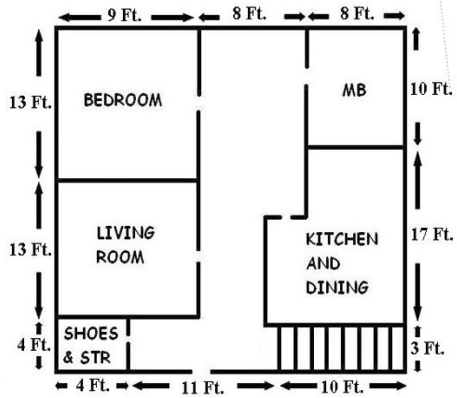


Fig 1.2 1BHK Interior Layouts



4.2.2.2 Couples 1 BHK's

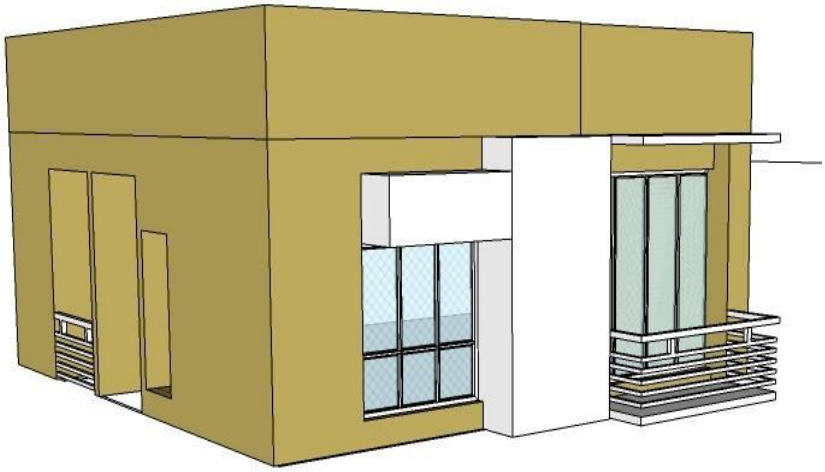


Fig 1.3
1 BHK External View

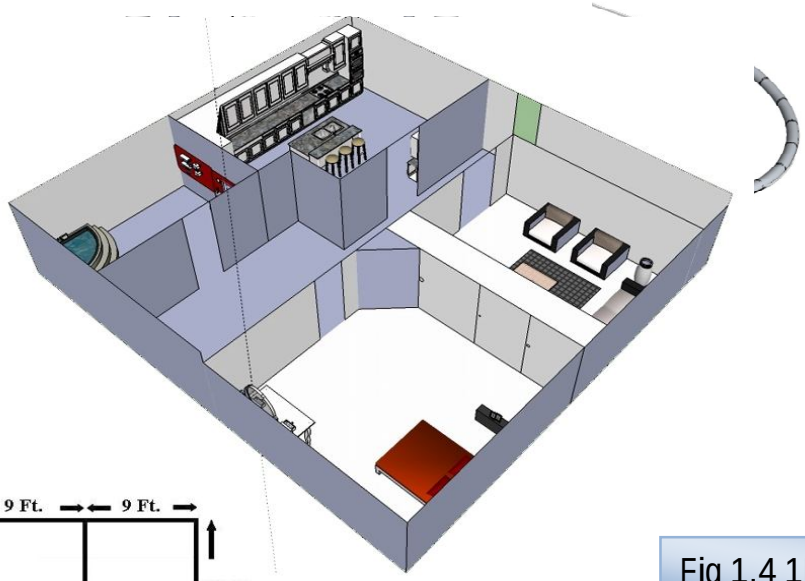
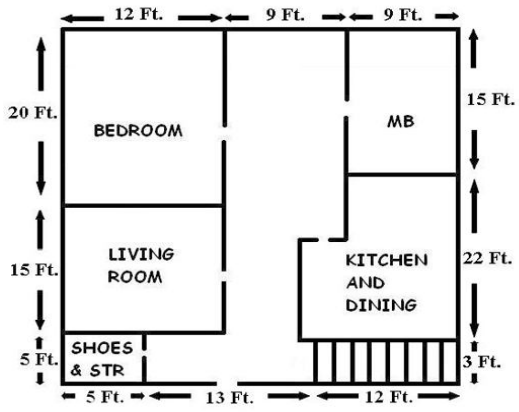


Fig 1.4 1BHK Interior



4.2.2.3 Small Family - 3 BHK's

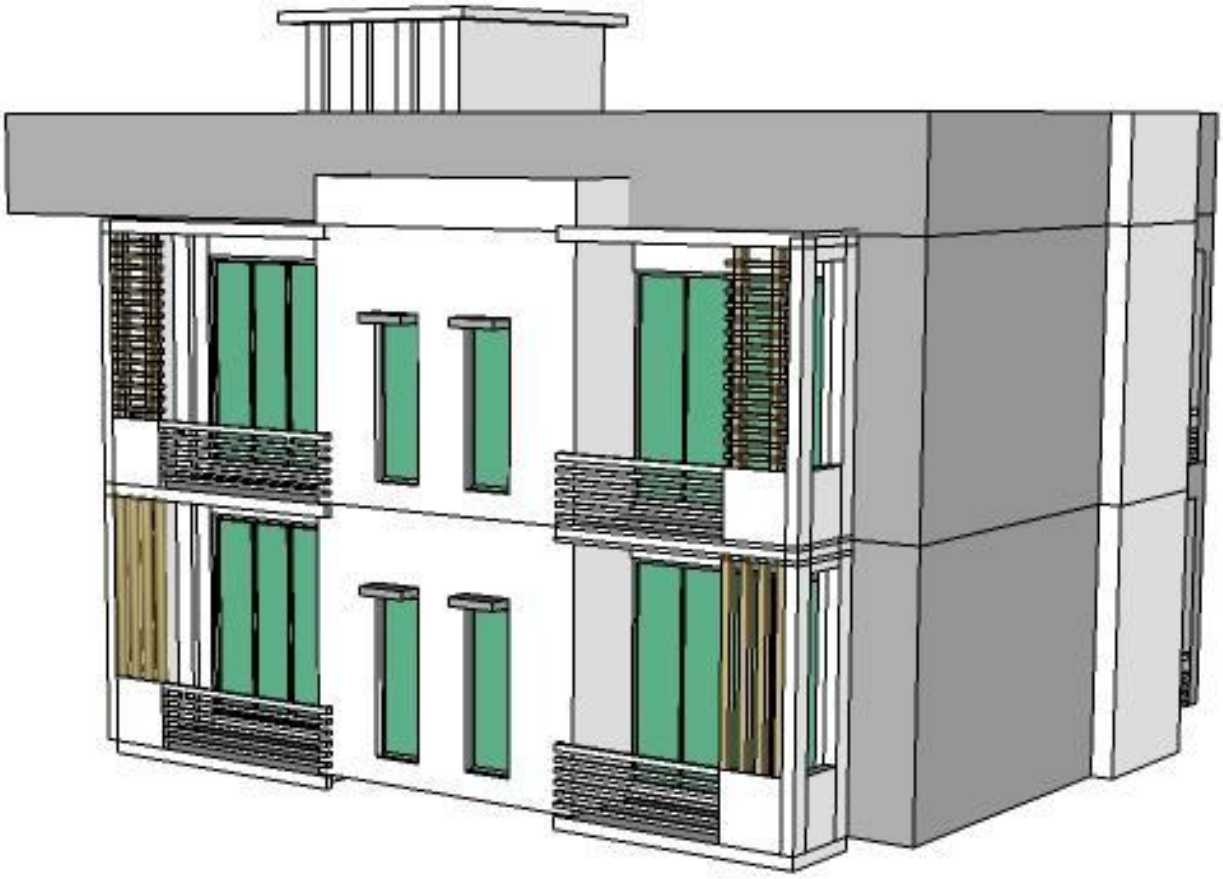


Fig 1.5
3 BHK External Views

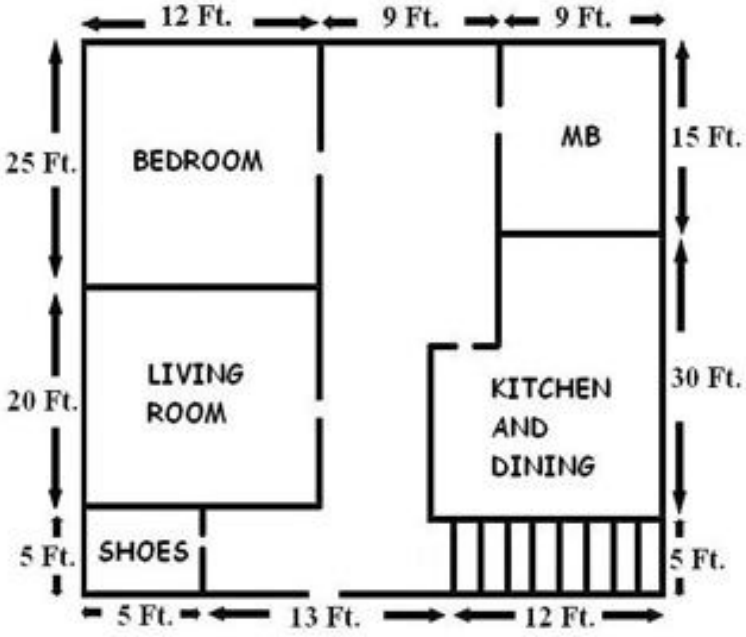
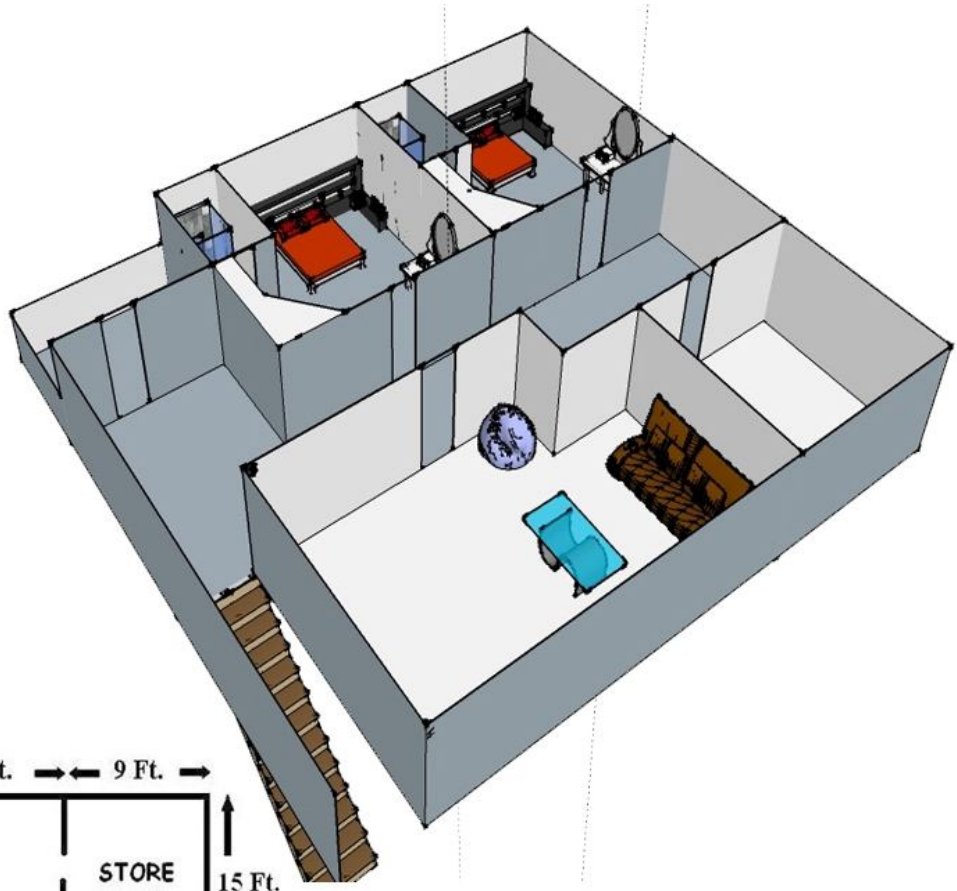


Fig 1.6
3 BHK Ground Floors



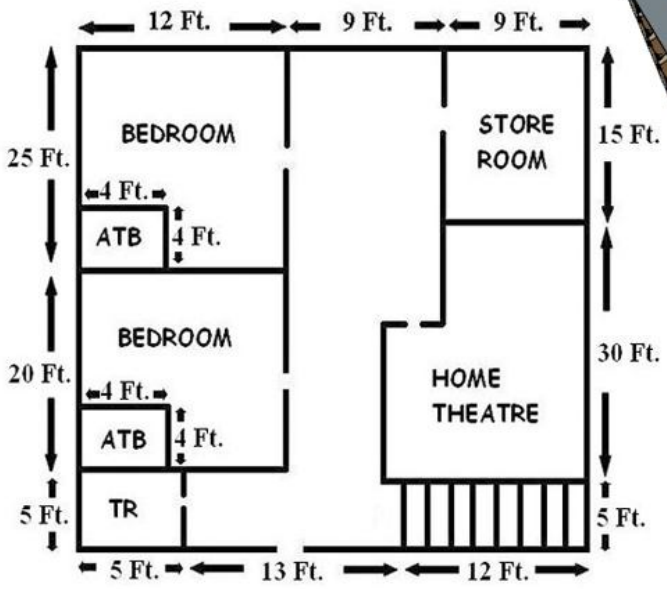


Fig 1.7
3 BHK First Floors

4.2.2.4 Extended Family - 4 BHK's

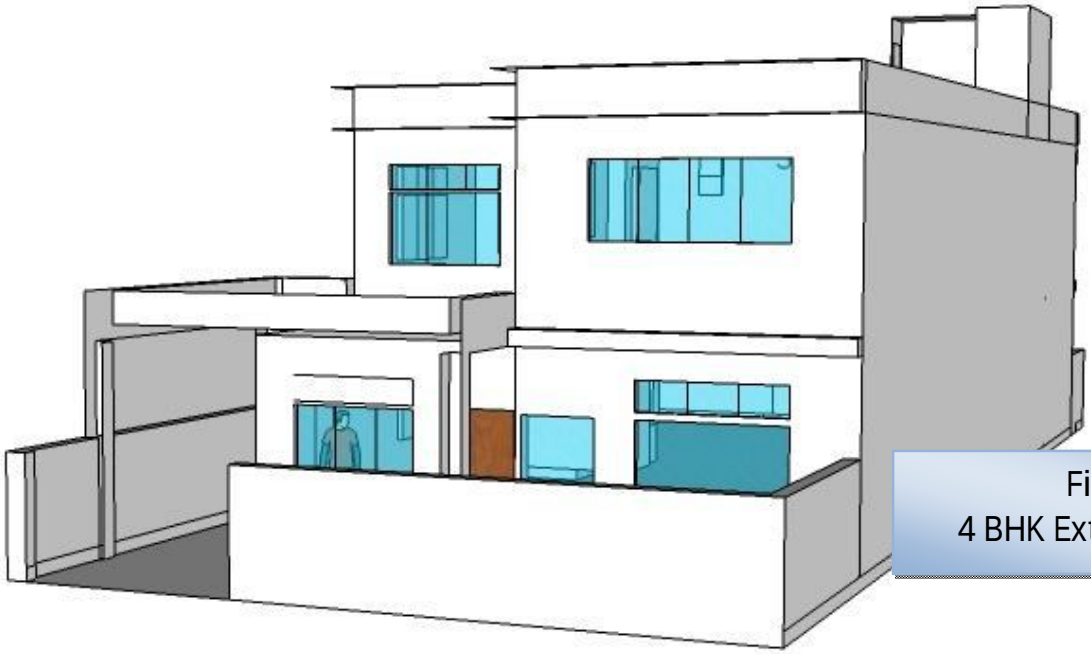
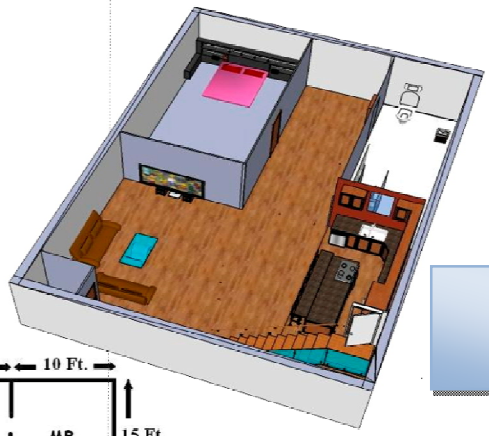


Fig 1.9
4 BHK External Views



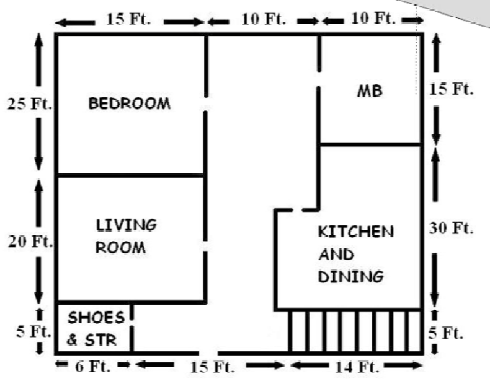
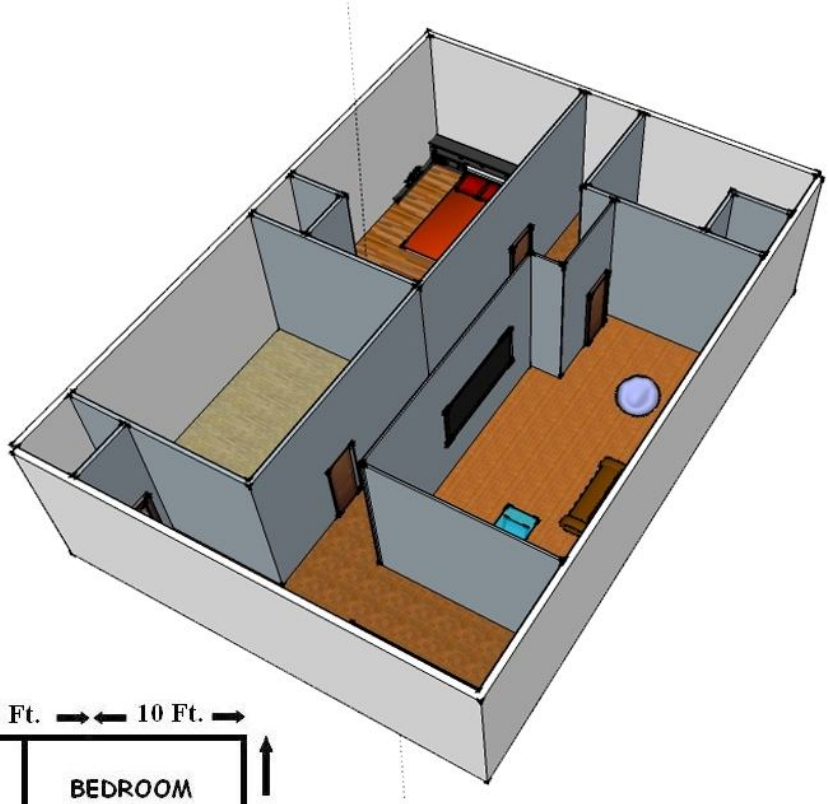


Fig 1.10
4 BHK Ground Floors



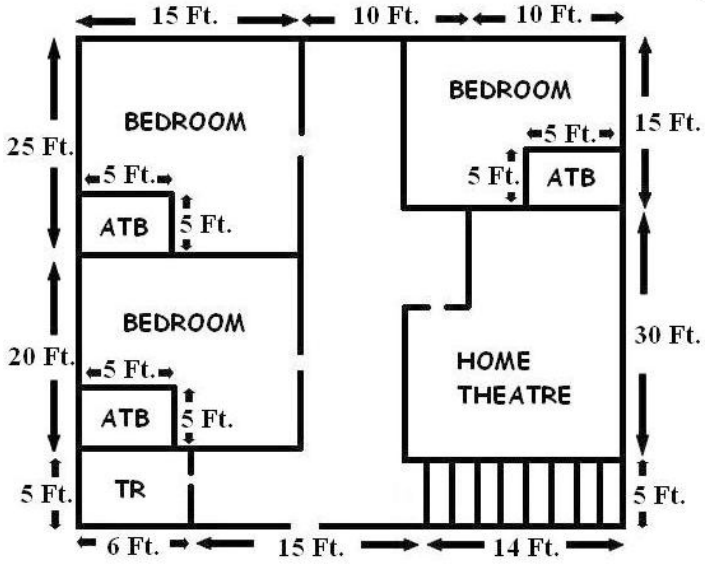


Fig 1.11
4 BHK 1st Floor

4.2.3 Offices:-

The offices in Ubiety are basically for the working population, who may not want to work from home.

Fig 1.11
Office Exterior

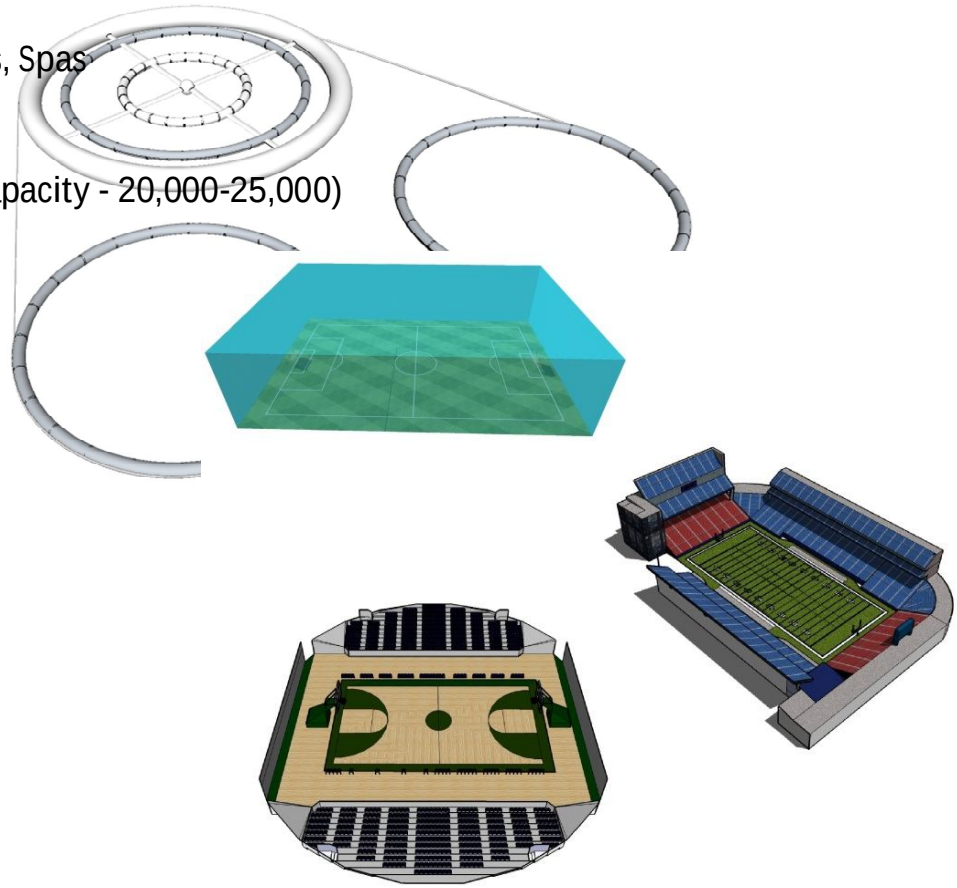
4.2.4 Recreational Facilities:-

4.2.4.1 Entertainment:-

- Theaters, Multiplexes
- Shopping Malls
- Casinos
- Restaurants, Bars, Cafes, Coffee Shops
- Party Halls, Clubs
- Tourist Spots
- Film Cities(For making Movies)
- Amusement parks
- Parks, Gardens
- Swimming Pools, Spas

4.2.4.2 Sports:-

Soccer Stadiums (Capacity - 20,000-25,000)
0 G Soccer
American Football
Basketball
Volleyball
Netball
Handball
Baseball
Cricket
Hockey
Tennis
Golf
Athletics Stadium



4.2.4.3 Others:-

- Parks, Gardens
- Amusement Parks
- Places of Worship according to the population.

4.3 Industrial Design

We will be having a separate place in Ubiety. This solves the problem of congestion and can accommodate all industries required for an economy in Ubiety.

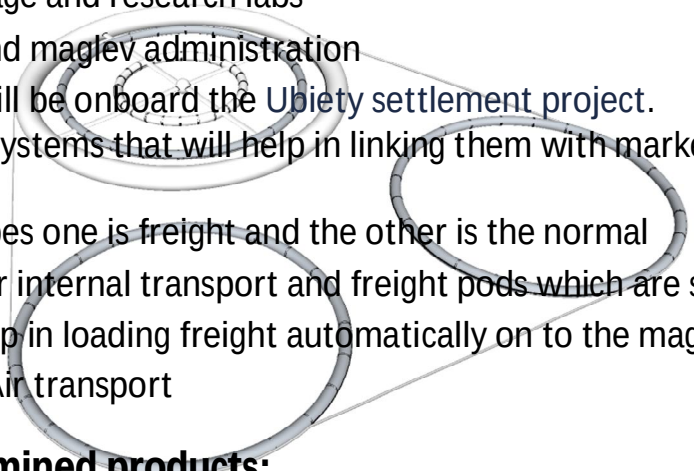
The types of industries we will be having will be:

- Processing mined products
- Automation factories
- Robot and other manufacturing industries
- Atmosphere creating hubs
- Water storage and management with waste management
- Chemical storage and research labs
- Finally pods and maglev administration

These institutions will be onboard the Ubiety settlement project.

The transportation systems that will help in linking them with markets will include:

1. Maglev : 2 types one is freight and the other is the normal
2. Pods: Used for internal transport and freight pods which are self-driven will help in loading freight automatically on to the maglev
3. Emergency : Air transport



4.3.1 Processing mined products:

- Mined products from the moon need to be refined for further use.
- Since in mining we will be using mining bots, so after the mined products are brought back to Ubiety, robots take their job and keep it for refining making the system fast and efficient
- The refined products will be later processed and be sent to the markets through freight maglev.

4.3.2 Automation factories:

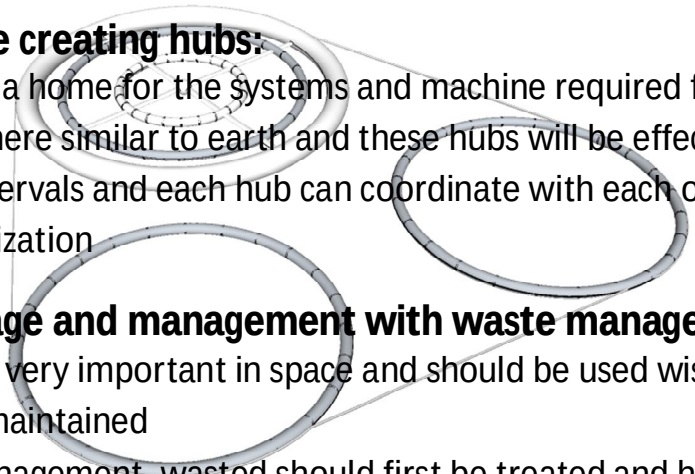
Automation factories will be manufacturing the automation products required for repair and maintenance of the torus as well as the systems for controlling the activities in the torus
The manufactured products are packed and sent to the required industries

4.3.3 Robot and other manufacturing industries:

This industry will be taking care of manufacturing the robots for the whole settlement and also manufacturing maglev trains and pods
Since the produce materials are bulky hence this needs a lot of place

4.3.4 Atmosphere creating hubs:

This industry will be a home for the systems and machine required for creating an atmosphere similar to earth and these hubs will be effectively placed at regular intervals and each hub can coordinate with each other for maintaining pressurization



4.3.5 Water storage and management with waste management:

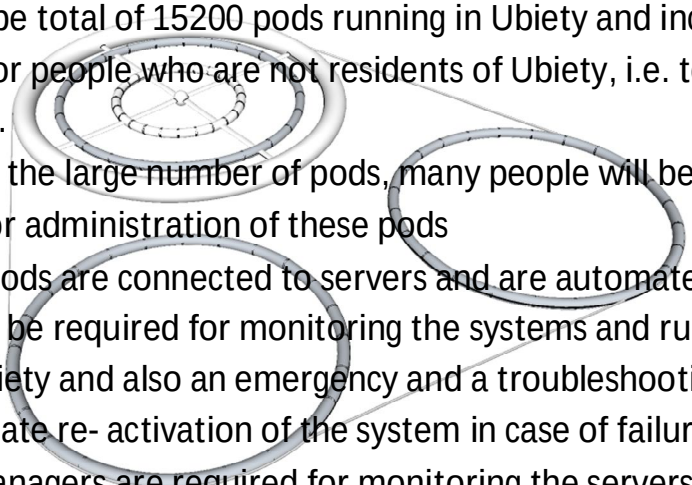
- Since water is very important in space and should be used wisely, a cycle will be maintained
- For waste management, wasted should first be treated and harmful effluents removed and the whole waste collected will be ejected out of Ubiety in a hyperbolic way which ensures that the waste doesn't' come back quickly.

4.3.6 Chemical storage and research labs:

- There will be research labs on board the **Ubiety**.
- This is mainly because we will have labs for further explorations which may help in more efficient way of functioning especially for generating power.
- The lower G tori will house the storage hubs for labs.

4.3.7 Pods and maglev administration:

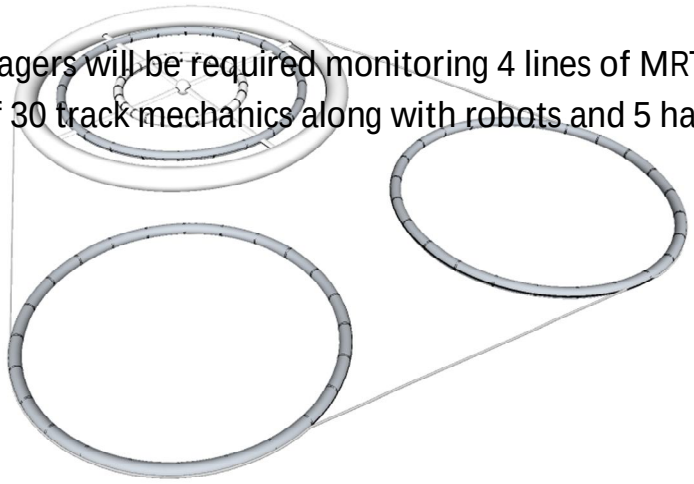
Pods



- There will be total of 15200 pods running in Ubiety and includes pod taxis for people who are not residents of Ubiety, i.e. tourists from earth.
- Because of the large number of pods, many people will be required for administration of these pods
- Since the pods are connected to servers and are automated , people will be required for monitoring the systems and running of pods in Ubiety and also an emergency and a troubleshooting team for immediate re- activation of the system in case of failure
- In all 10 managers are required for monitoring the servers and 9 engineers for immediate reactivation alongside the robots and a separate emergency team.

Maglev:

- There will be a total 40 -45 maglev trains for Mass Rapid Transit System [MRTS] on board the **Ubiety.**
- Each train will have 4 coaches, so there will be 152 coaches commissioned on to the service and this includes maglev required for freight
- In all there will 15 emergency drivers apart from the co-piloting robots which are different from the main robotic drivers. In case of a system failure in coordination of robots , the trains will be guided to the nearest station or a hangar like place
- 20 managers will be required monitoring 4 lines of MRTS and a team of 30 track mechanics along with robots and 5 hangers



5.0 TRANSPORT

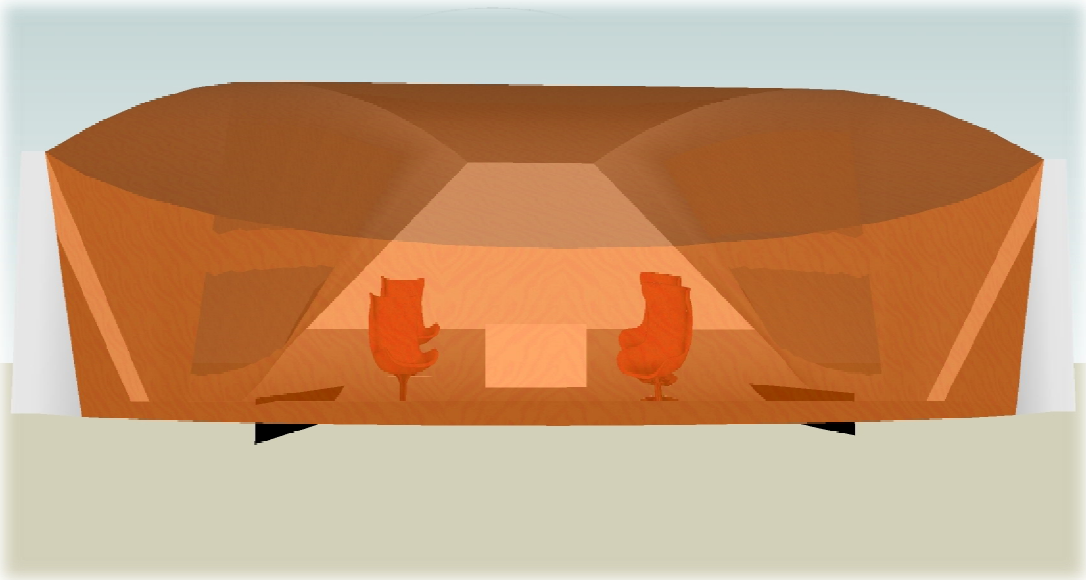
5.0 Transport

We classified transportation on 2 factors; one being internal transport i.e. transportation inside the torii's and second external transportation.

5.1 Internal Transport System (ITS)

We have mainly concentrated on 2 types of ITS in Ubiety: Personal pods and maglev trains.

5.1.1 Personal Pods



5.0 Transport

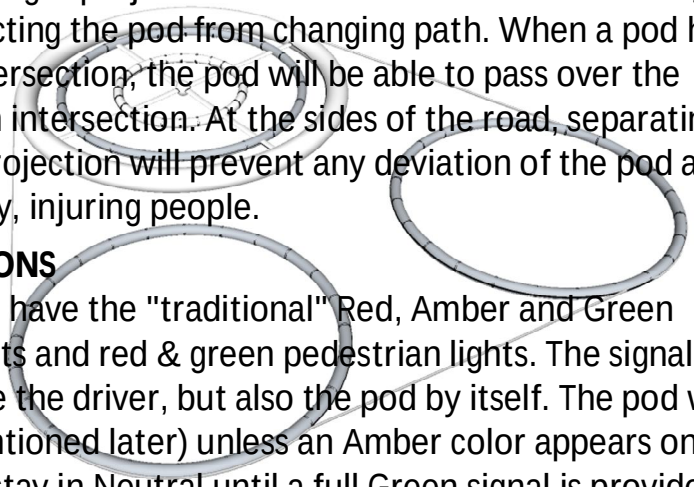
Replacing Cars on earth, Ubiety will contain more efficient pods. These pods have 2 great advantages over cars:

1. They don't run using fossil fuel and depend on the Renewable sources. So, consumption and emission is far lower than cars.
2. They can guide themselves and follow patterns, preventing traffic jams and accidents.

There will be streets, wide roads as well as Freeways for faster travel. These roads will be specially built, for greater interaction with the cars. These roads will have similar surveillance solutions, to that of present day London.

5.1.1.1 ROAD SPECIFICATIONS

Each road will have slight projections at the sides of each lane acting like a guide rail and protecting the pod from changing path. When a pod has to take a turn at an intersection, the pod will be able to pass over the projection before an intersection. At the sides of the road, separating the walkway, a 1-foot projection will prevent any deviation of the pod and damage the walkway, injuring people.



5.1.1.2 INTERSECTIONS

Any intersection will have the "traditional" Red, Amber and Green indicating Signal lights and red & green pedestrian lights. The signal lights will not only indicate the driver, but also the pod by itself. The pod will not start its engine (mentioned later) unless an Amber color appears on the signal light and will stay in Neutral until a full Green signal is provided.

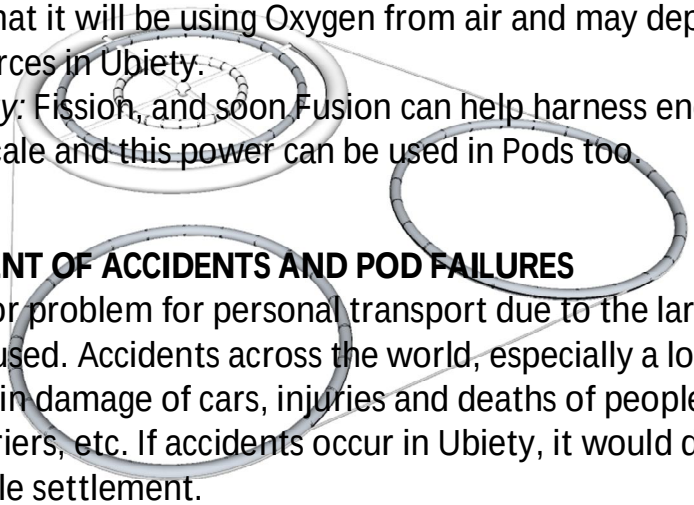
Apart from signals, at each intersection, similar to London's traffic congestion solving techniques, a sensor will be placed under the roads, which will measure traffic density and provide warnings and parallel routes to avoid traffic congestion.

Since pods will not be used for long route traveling, the roads won't specify long-route milestones or other such services.

5.1.1.3 ENERGY CONSUMPTION

Energy sources which can be perfect for pods:

- *Solar:* This energy is abundant in space and is widely captured by Ubiety. This energy is being used for the whole of torus's functions and can be also used here. Non-polluting, Inexhaustible, this energy is efficient for usage inside Ubiety.
- *Hydrogen Fuel:* H2 Fuel is, besides solar, the most ideal energy. The pods powered by this can take H2 either from air or fuel stations and use Oxygen from air to provide energy. Interestingly, the exhaust is edible. Water is its exhaust (Though it's distilled water) and can help in providing water for other sources (Maybe for Agriculture too). The main flaw is that it will be using Oxygen from air and may deplete Oxygen resources in Ubiety.
- *Nuclear Energy*: Fission, and soon Fusion can help harness energy on a very large scale and this power can be used in Pods too.



5.1.1.4 MANAGEMENT OF ACCIDENTS AND POD FAILURES

Accidents are a major problem for personal transport due to the large number of vehicles used. Accidents across the world, especially a lot in India, have resulted in damage of cars, injuries and deaths of people, damage of road barriers, etc. If accidents occur in Ubiety, it would damage and disturb the whole settlement.

The pods are built with ultrasonic sensors to measure distances between each other and will align themselves so that a limit of 3 feet is maintained. As mentioned earlier, the road edges will have a sensor to immediately inform the pod about its distance even if the pod fails to do that.

5.1.1.5 MATERIALS FOR THE POD

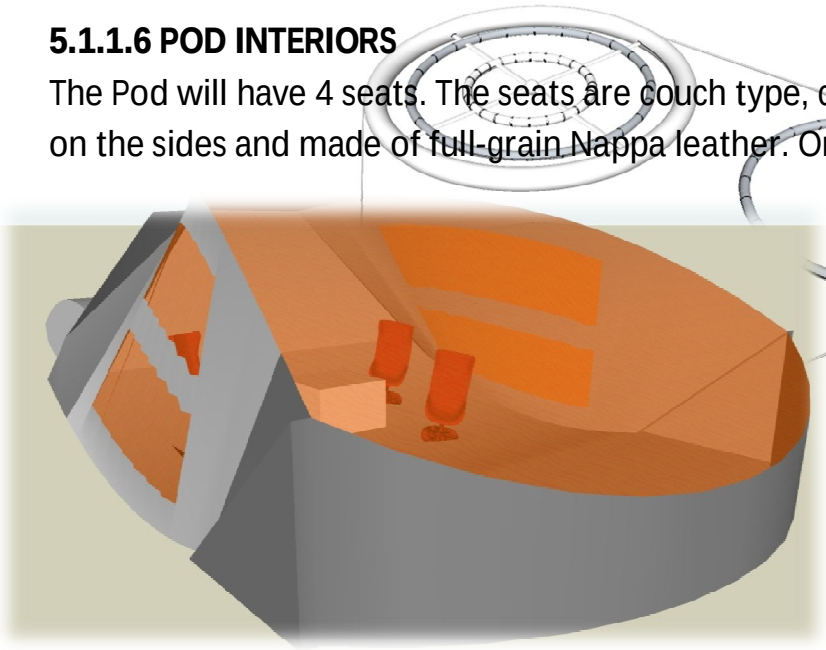
The pods will be made of aluminum alloy (6111). This is due to precipitation hardening caused by other metals, which can decrease life of the body.

The pods will be covered with Styrene-Butadiene Rubber to prevent damage of Pod body. The seats will be covered with Full-Grain Leather like the Nappa Leather used in high-end cars. This leather adds comfort and luxury to the passengers traveling by the pod.

The windshield will be made of laminated safety glass to provide protection against unidentified debris. The side windows (non-retractable) will be made of toughened glass.

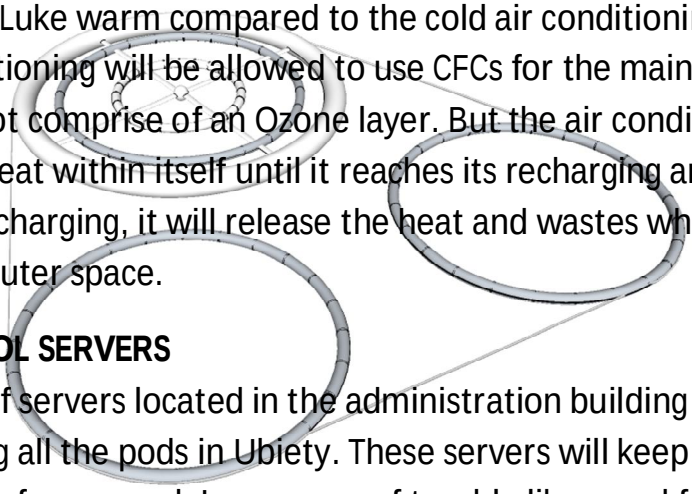
5.1.1.6 POD INTERIORS

The Pod will have 4 seats. The seats are couch type, containing handle bars on the sides and made of full-grain Nappa leather. One seat in the middle can be folded down to serve the purpose of a table, where the travellers can put their Laptops, Phones, Eatables, Bags, etc.



The Pods will be fitted with Wi-Fi, which will provide easy access to internet during travel.

They will run using an automatic drive train which will be connected to a map placed at the aisle side of the pod. Depending on where the person wants to go, (s) he will locate the point on the map and the pod will take him/her to that location. This map will have a system of roads and maglev tracks, and the person can choose where he wants to go. The Pod will take the fastest route as default, but the traveler can select his custom if he wants to pick someone else en-route. The Pod will have a small storage space where one can put their food items to keep them hot or cold or at normal temperature. The latter can be also used to store a bag or other items. The Pod will be carpeted so that even if one doesn't wear shoes, the temperature will be Luke warm compared to the cold air conditioning inside. The air conditioning will be allowed to use CFCs for the main reason that the torus will not comprise of an Ozone layer. But the air conditioner will be holding the heat within itself until it reaches its recharging area, where along with recharging, it will release the heat and wastes which will be disposed out to outer space.



5.1.1.7 POD CONTROL SERVERS

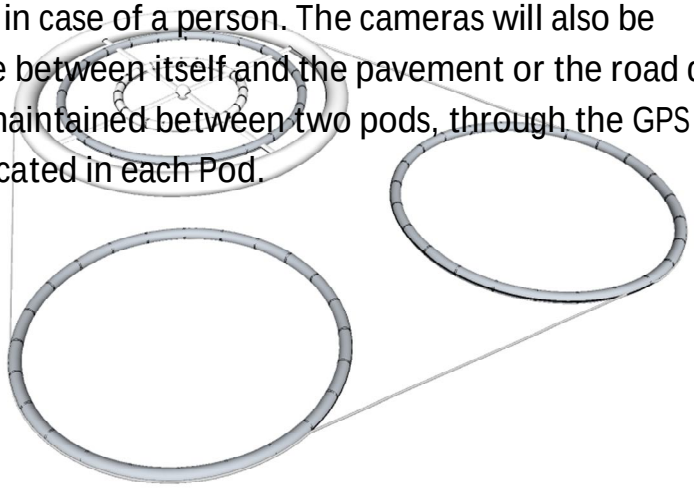
One large network of servers located in the administration building of the pods will be handling all the pods in Ubiety. These servers will keep a track of the whereabouts of every pod. In any case of trouble like a pod failure or a block, the other pods will be instructed to avoid these routes. They'll be given another short distance to go to the other side. The pods will keep updating the map everyday through these servers.

The servers here will be functioning like the rulers of the pods and will keep giving new configurations and rules to follow. For example, if a new system of head and tail light control has been introduced, the servers will send information to the pods to cut down their power supply to the lamps. With this, pods can maintain a close interdependence and integration.

As mentioned earlier, the traffic congestion problem by pod failures would be solved by the pod's head and tail lamps functioning as traffic lights. The Admin servers will be commanding the pods near the affected pod, to follow the traffic light rules when they reach the affected pod.

The next level of servers will be at the pod itself. A pod will have its own "Brain" which will work to maintain its own structure.

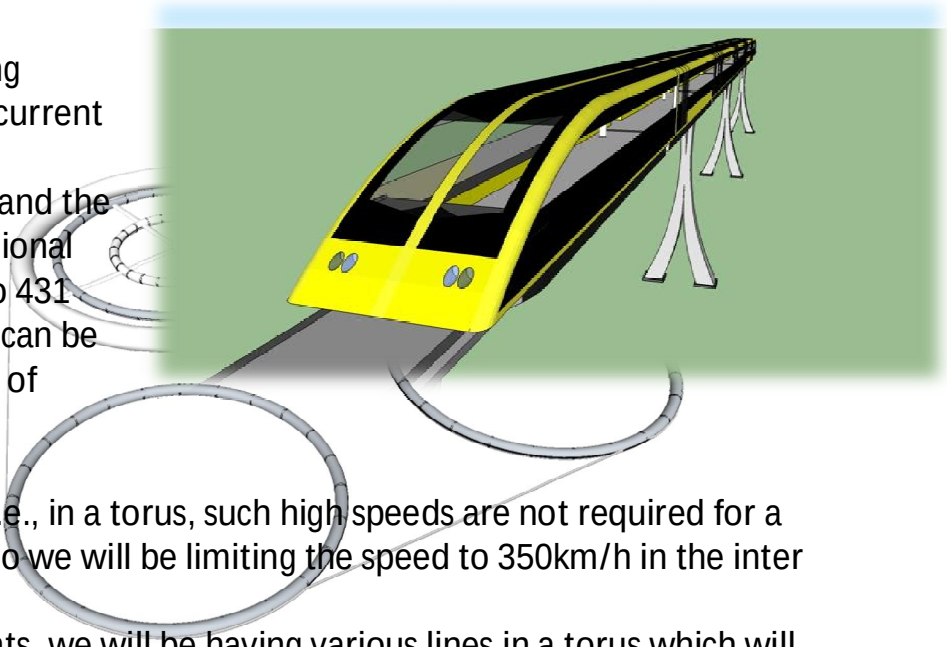
The pod will have a section of server which will be working for maintaining distance from objects. Cameras inserted in the pod will be programmed to differentiate between a moving person on the road and debris. It would slow down and stop in case of a person. The cameras will also be maintaining distance between itself and the pavement or the road divider. Distance has to be maintained between two pods, through the GPS systems with Locator Tags located in each Pod.



5.1.2 Maglevs

Maglev is a type of train which runs by magnetic levitation as the name indicates. In our project we will be basically using a sub group of maglev's running principles known as the EMS [electro magnetic suspension]. Electromagnetic suspension is the suspension of electromagnets which can provide magnetic levitation. This levitation can only be achieved by altering the strengths of the electromagnets.

This in turn can be achieved by supplying required amount of current to the magnets for achieving the speed and the levitation. A conventional maglev can run up to 431 km/h and the speed can be increased by the use of superconductors.



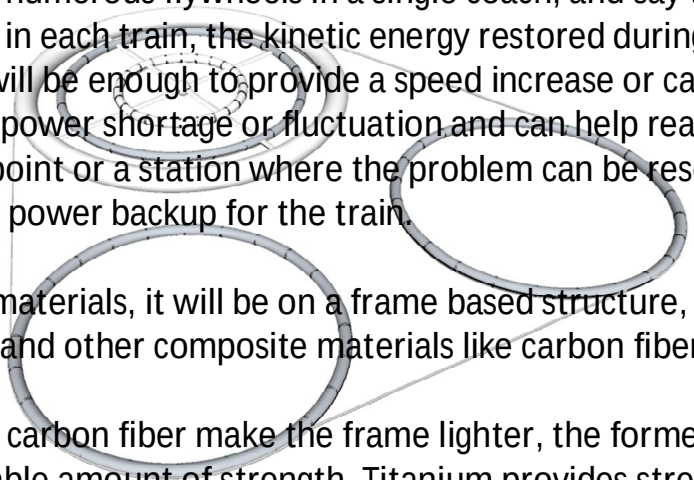
But on this project, i.e., in a torus, such high speeds are not required for a small distance line. So we will be limiting the speed to 350km/h in the inter torus line

As per the agreements, we will be having various lines in a torus which will link each and every sector from the torus, say it is the red line. There will be a placement of another set of lines running between these lines, say it is the blue line. A person from the center of the housing district or the so called downtown can connect to a intersection of the blue and red line by using either of these line , where there will be an interchange and a shift in lines can be done.

While coming to the stability of the system, we will be placing feedback loops which adjust the electromagnets continuously to correct the motion course or monitor the course of the maglev, which discards idea of instability.

In the torus the power supply is comparatively less than the power supply on earth. So, power must be efficiently used. So the increase and decrease in power supply to the electromagnet which controls the speed and breaking should be done in a gradual way to save power.

The unique part of the train is that it will have numerous flywheels at essential points which help in restoration of kinetic energy. This concept is basically based on the F1 cars as they have this system and has a single flywheel for kinetic energy restoration and provides an increase in speed or a boost upto15 seconds. This restoration is by braking or other means where kinetic energy is lost and is absorbed by the flywheel .But in our system there will be numerous flywheels in a single coach, and say there are about 5 coaches in each train, the kinetic energy restored during braking etc. Which will be enough to provide a speed increase or can help whenever there is a power shortage or fluctuation and can help reach a nearby mechanical point or a station where the problem can be resolved. This method is like a power backup for the train.

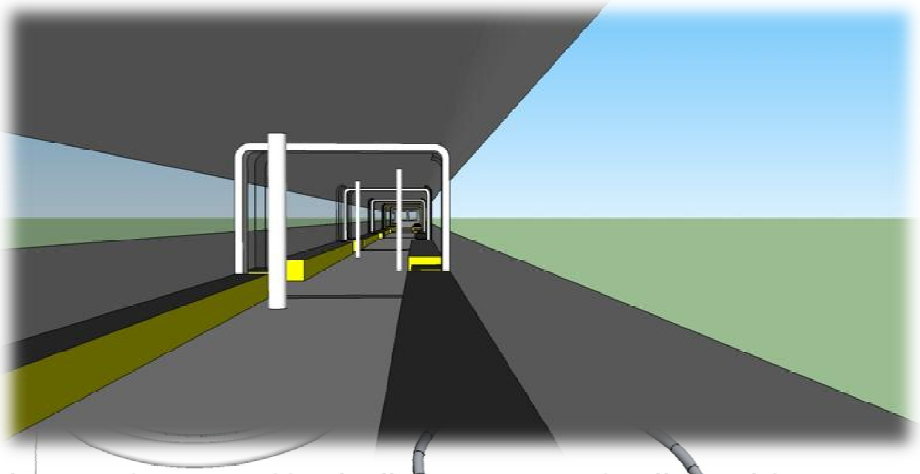


Now coming to the materials, it will be on a frame based structure, in which aluminum, titanium and other composite materials like carbon fiber will be used.
Since aluminum and carbon fiber make the frame lighter, the former also provides a considerable amount of strength. Titanium provides strength to the frame and is not heavy too.
The design will be based on aluminum and titanium frame. The frame will be having various elements like tension diagonals and tension absorptive struts. The major element of the frame would be a thick beam kind of structure in the front, sides and the back. There will be two sets of beams on each surface. The main purpose of these beams are to absorb the impact during a collision or a crash due to some system error and helps in reducing the damage to the whole train and will reduce causalities. These beams will be thick and will be made of aluminum and titanium. The carbon fiber and the other composite materials will be used to make the internal structure of the frame and also the exterior especially the top roof surface. The interiors are much similar to that of a train. It will basically have seats

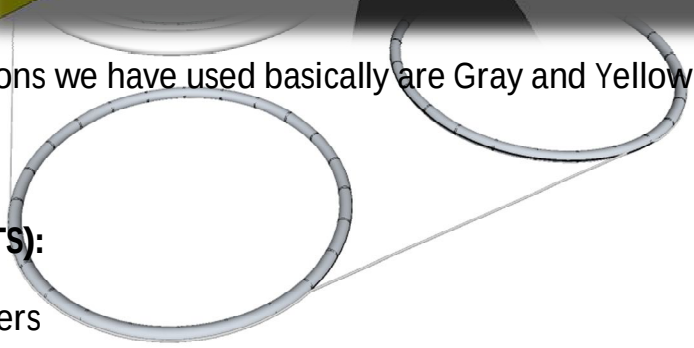
running along most of its way and a pair of doors in the middle. The seats will be basically much like the seats in a train, except with seatbelts since the train shall be moving fast.

Interiors

The interiors are much like normal trains having seats on the side of the trains inside. They will have poles in small intervals to hold on to for the passengers.



The color combinations we have used basically are Gray and Yellow with a little White.



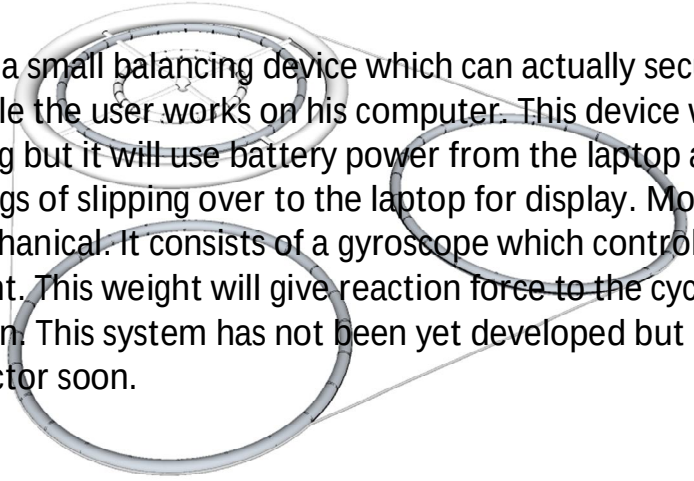
5.1.3 Dimensions (ITS):

Pod: Width - 2 meters
Length - 5 meters
Height – 2 meters
Tracks for pods: Width - 3 meters
Maglev: Coaches: Width – 4 meters
Length (cockpit) – 11 meters
Length (without cockpit, i.e., center coaches)) – 9 meters
Height – 3 meters
Tracks: Elevation – 5.5 meters

5.1.4 THE ALTERNATIVE PERSONAL TRANSPORT

The transport above is quick and without involving human work. But in space, not doing work can result in Bone and muscle problems. Along with gymnasiums, Ubiety will include cycles also for personal transport. Special cycle lanes beside freeways will enhance traveling by cycles. This provides exercise for the user as well as takes him to his destination.

The cycle build will be similar to those on earth except a few improvements on storage and balance. The cycle has a back carriage which can hold water, food and few folders. The front part of the cycle, will have a platform to place laptops, so that the cycle user can take a look at his work progress as he cycles.

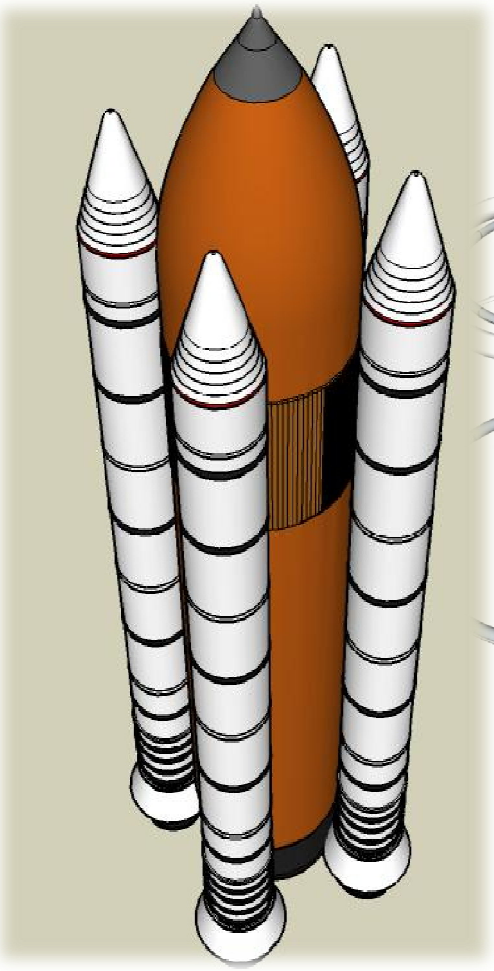


The cycle will house a small balancing device which can actually secure the cycle in position while the user works on his computer. This device will not be energy consuming but it will use battery power from the laptop and in turn give the warnings of slipping over to the laptop for display. Most part of this device is mechanical. It consists of a gyroscope which controls a heavy ball like weight. This weight will give reaction force to the cycle to drive back to position. This system has not been yet developed but might be a contributing factor soon.

5.2 External Transport System (ETS)

There are three sub categories in ETS, they are: Transportation between Earth and settlement/Large Space Transport Vehicle (LSTV), Moon Mining Bots (MMB), Emergency Escape Pods.

Transport between earth and settlement/Large Space Transport Vehicle:



5.2.1 Mechanism

The transport system to Ubiety from Earth will be of 3 categories:

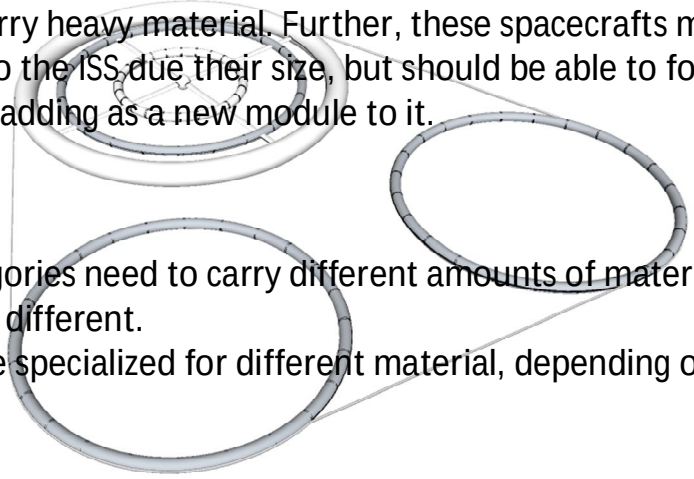
1. Small-scale transport – like few people (tourists) or documents
2. Medium-scale – like a large group of people (settlement residents, about 100 or so), house building materials, utensils, clothes, etc.
3. Large-scale transport – like Torus building materials, Food, Water, etc.

5.2.2 Propulsion

All engines will be similar to cryogenic engines running using liquid Hydrogen or similar gases, which would be developed in the near future. These engines would be then developed by different nations to meet the total demand of Ubiety.

Similar to the Saturn V rocket, these spacecraft's will be supplied with a 3-stage rocket.

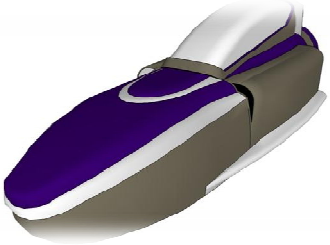
The Large Space Transport vehicles will be sent using 4 rockets (4-staged), such that they form a square in between for the spacecraft. This spacecraft should be able to carry heavy material. Further, these spacecrafts may not be able to dock on to the ISS due their size, but should be able to form an extension to the ISS adding as a new module to it.



5.2.3Carriage area

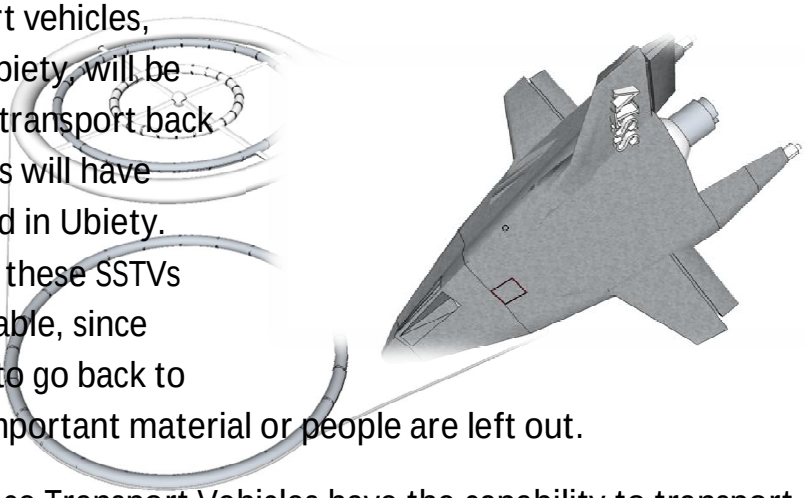
Since different categories need to carry different amounts of material, the carriage area will be different.
Also, Carriage will be specialized for different material, depending on the requirements.

Emergency Escape Pods



The Emergency Escape Pods are special pods located at multiple intervals and are needed in case of emergency. Under certain circumstances, like meteorite showers or damage of Ubiety, the people on Ubiety will enter the pods and the pods move over and temporarily settle on earth until later when Ubiety is fixed again.

SSTVs

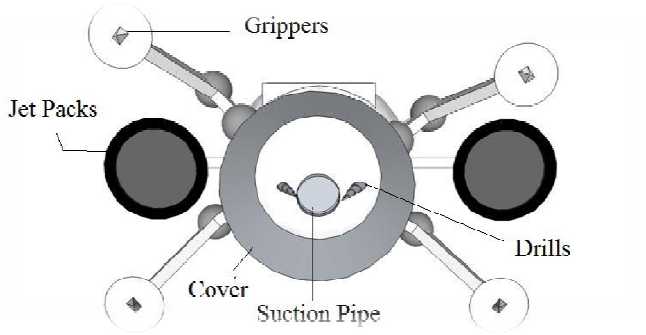


Small space transport vehicles, initially present at Ubiety, will be used for emergency transport back to Earth. These SSTVs will have horizontal launch pad in Ubiety. Like a Space Shuttle, these SSTVs will be partially reusable, since they should be able to go back to Ubiety in case any important material or people are left out.

MSTVs: Medium Space Transport Vehicles have the capability to transport around 100-150 people back to Earth. These MSTVs will be initially docked at Ubiety Space Ports. The MSTV will be the primary emergency transport.

5.0 Transport

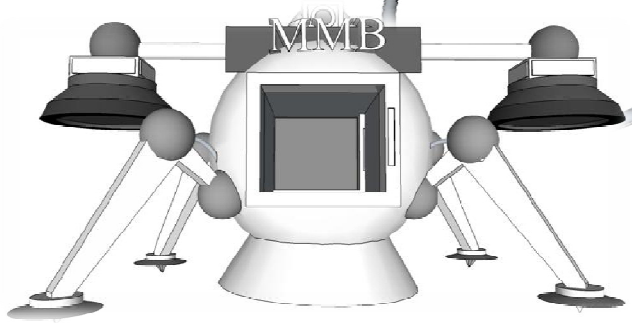
The MMB



The idea of Moon mining as mentioned above needs special bots to be able to perform functions such as landing on moon, digging out the minerals will need a slightly more sophisticated rather complex bot itself.

As a result of this we created a bot (The MMB) which consists of a camera in the front, 4 claws in the bottom, drills, suction pipe, Mineral Holder, cover (prevents drilled material to fly into open space). As the bot approaches the Moon, there are four claws which grip onto the Surface really hard. This enables us to dig into the Moon.

The bot's camera and chemical test will enable our researchers to figure out its composition and separate what is required for humans on Ubiety.



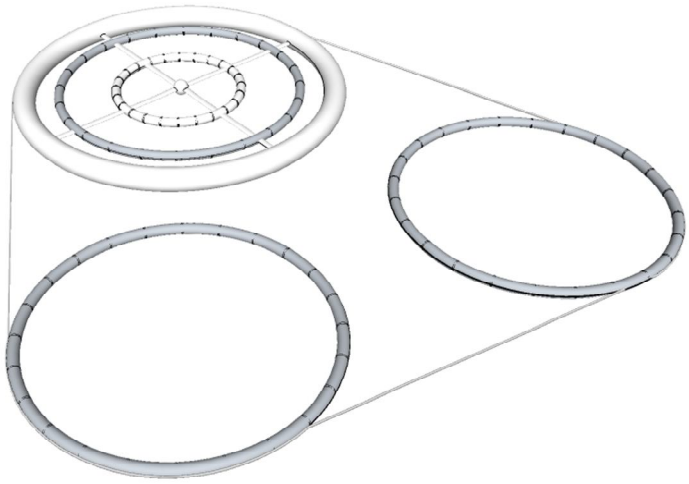
The mineral can be dug out by the drills and pulled into the Mineral Holder using suction pipe.

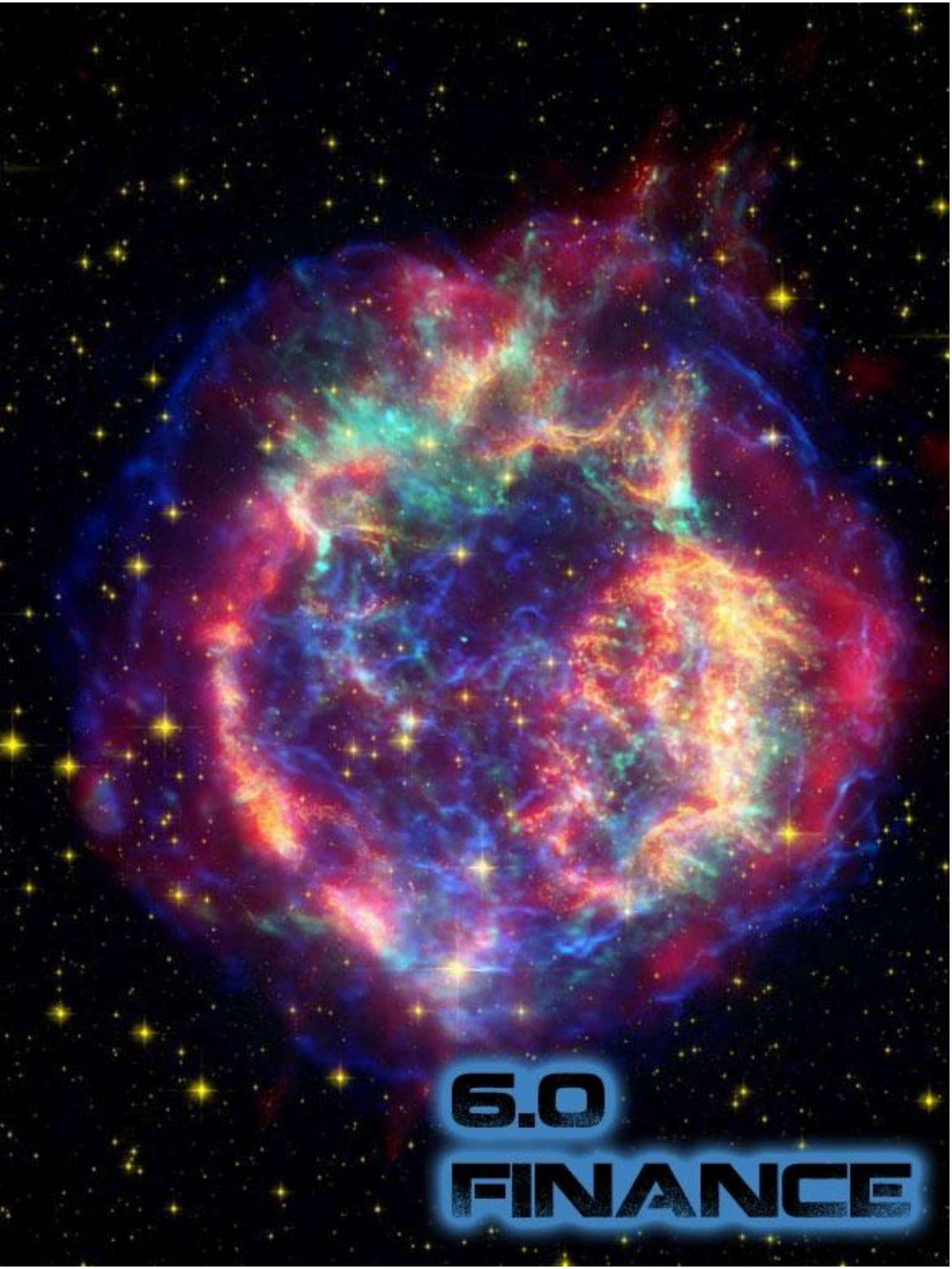
The MMB is designed in such a way that it retraces its path back to Ubiety after it is done mining. Since these MMB's don't destroy themselves we decided that Ubietys will have around 30 such bots which go out and return every second day to collect minerals.

Amount to Carry				
Food				
Veggies and fruits	LSTV	The craft will have a cold storage	Outer edge temp. = 4.5°C, 90-95% humidity core temp. = 0°C, 95-100% humidity	18000000 kg
		chamber to preserve the food		
Non-Veg	LSTV	Cold storage chamber equipped	Outer edge temp. = 4.5°C, 90-95% humidity core temp. = 0°C, 95-100% humidity	14325000 kg
Preserved food	MSTV	Temperature regulated around -10°C		6000000 kg
Seeds	MSTV	Temperature regulated around -5°C, gradually increasing to 5°C		28743750 kg
Water				
Distilled and drinking	LSTV	Water tight containers; 2 chambers	6772836.0942843L/day	
Industrial and Daily Chores	LSTV	Water tight containers; 2 chambers	6772836.0942843L/day	
Interior				
Maglev Trains	LSTV	4 coaches * {11 + (3 + 3) + 4 + 4 + 6	A total of 38 maglevs, i.e. 152 coaches - 157.529 km (total vol:118146.75 cubic m)	283552200 kg
		<for inter torii>} and extra materials		
		for expansion		
Pods	LSTV	15000 + 1000 (inner torii) + 10000	25600 pods * 500kg	13250000 kg
		(for Variable G torii)		
Soil	LSTV	4812291.627 sq m * 4 m (high) =		25023916.4604 kg
		19249166.508 cubic m		

5.0 Transport

Capacity Table Emergency Transport Mechanism	Capacity (people)	No. of Vehicles	Population
Emergency Escape Pods	50	100	5,000 people
Small Space Transport Vehicles	100	100	10,000 people
Medium Space Transport Vehicles	150	100	15,000 people
			30,000 people



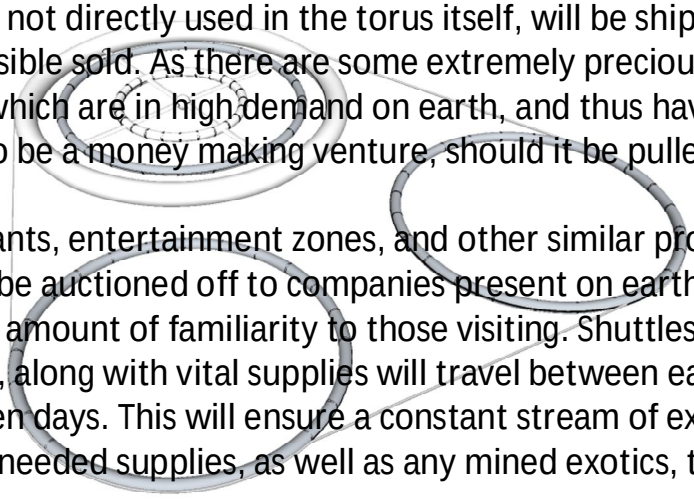

6.0
FINANCE

6.0 Finance

6.1 Business Plans

For any project to be financially viable and be able to sustain itself in space, a substantial and constant source of income is mandatory. To exploit the possible resources available in outer space, Ubiety will have capabilities of mining from the lunar surface. To further boost the incomes, space tourism facilities will be installed. Space hotels, space restaurants, activities in the variable-g torii, as well as small trips into space will be some of the activities of offer.

The space experience will be in high demand by the year 2070, and is sure to bring many wealthy tourists to Ubiety. Mined materials and precious elements, which are not directly used in the torus itself, will be shipped to earth whenever possible sold. As there are some extremely precious elements in space, which are in high demand on earth, and thus have a high price tag, it is sure to be a money making venture, should it be pulled of successfully.



The Hotels, Restaurants, entertainment zones, and other similar profit-making sources will be auctioned off to companies present on earth. This will ensure a certain amount of familiarity to those visiting. Shuttles, carrying the tourists, along with vital supplies will travel between earth and Ubiety every fourteen days. This will ensure a constant stream of exchange of personnel, much-needed supplies, as well as any mined exotics, that can be sold for profit.

To attain further funds to overcome the sizeable initial capital, we will be requesting all the involved parties (i.e. Organizations, Enterprises, wealthy individuals) to pull together their resources and support the construction of Ubiety financially. We can also request the Governments of interested countries to donate for the same. This, along with sponsorship, with help reduce the costs of running.

6.2 Cost

Item	Quantity (tonnes)	Cost per unit tonne (in $1000)	Total Cost(in $1000)
External Material			
Carbon	6500	80	520,000
Aluminium	12000	25	300,000
Steel	15000	12.5	187,500
Plastic	10000	10	100,000
Misc.	15000	15	225,000
Internal Material			
Plastic	5000	10	50,000
Aluminium	7500	25	187,500
Steel	3500	12.5	43,750
Wood	1000	15	15,000
Cement	5000	10	50,000
Transportation Materials			
Carbon	500	80	40,000
Aluminium	1000	25	25,000
Plastic	2500	10	25,000
Misc.	6000	15	90,000
Total:			1,858,750

Hence, total cost =$1.85875 billion dollars


7.0
PLANNING AND
STRUCTURE

7.0 Schedule:

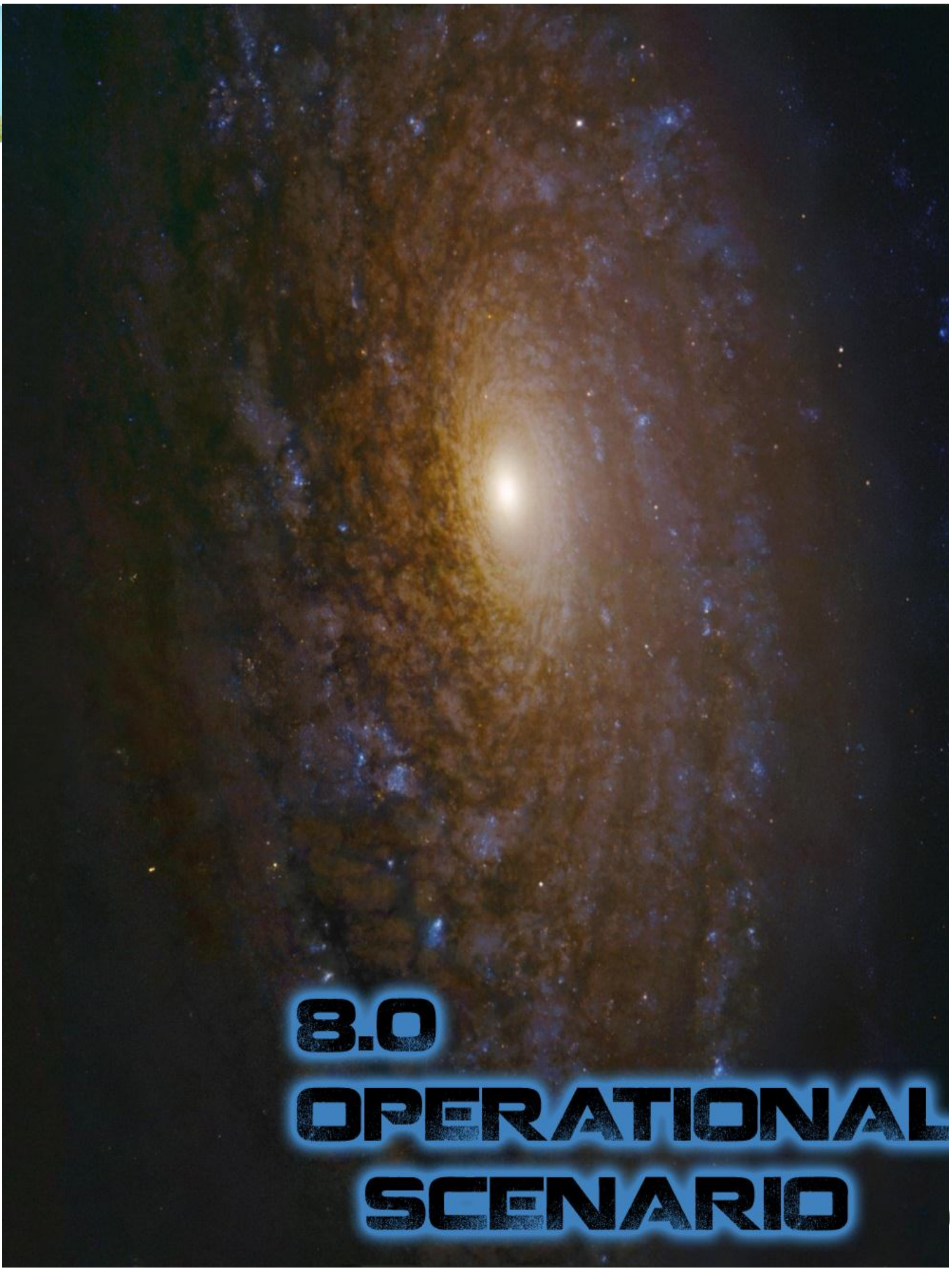
To ensure that we begin operations at the earliest, we will use multiple automated, self-sustained construction bots, which will work together to ensure extreme precision and accuracy of construction, this is vital for a settlement in outer space. These robots will have highly detailed navigation and mobility devices, capable of coordinating between each other to extreme accuracy, as well as planning and scheduling simple tasks. They will have solar cells on each, from where they generate their own energy. Since we are on the L 1 Lagrangian Point, sunlight is not a rare commodity, and solar power alone will suffice.

As there are multiple torii to construct, and then link up with the belt, we decided it would be optimal to divide the task into multiple stages, and go through the stages one at a time. The first stage will include the construction of the main habitational torus. Once this has been completed, the task force will then finish the inner torus and support structures, at the centre of the main torus. Upon finishing this, the robots split into three groups, two carry on to construct the two remaining torii, while the third begins construction of the belt.

According to our predictions, it will need 3 years to entirely complete the main torus, and a further year to complete the torii on the inside, after which, the robots will continue construction on the other torii. We expect this and the belt to be finished within a further 2 years, hence requiring a total of 6 years before the torus is fully operational.

During the first few months of living, food has to be carried to the torus, as the agriculture has to be set up and prepared, however after that Ubiety will be fully functional.

Element	Individual Time	Overall Time
Main Torus	3 years	3 years
Centre Torus, Support	1 year	4 years
Aux. Torii, Belt	2 years	6 years



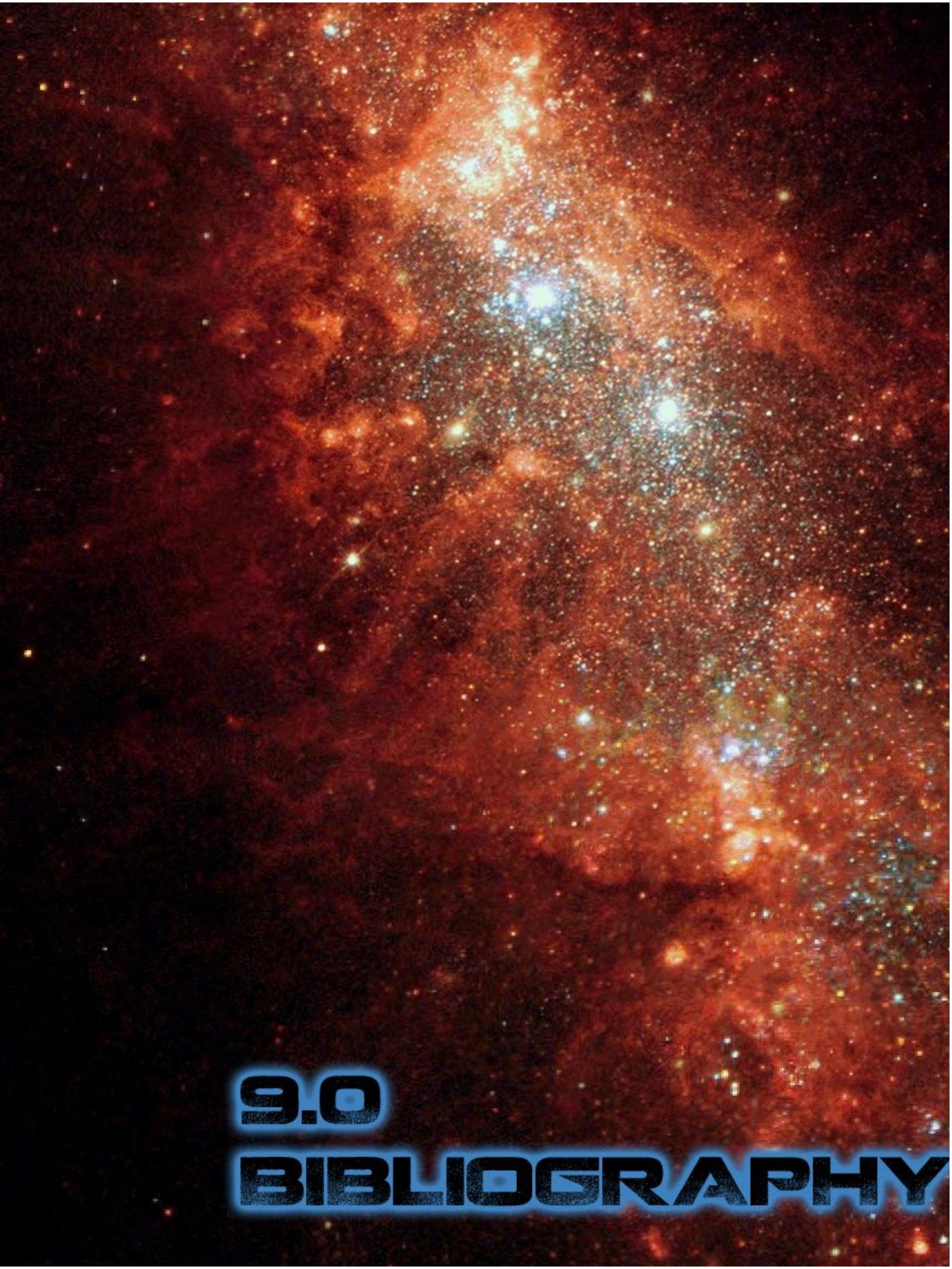
8.0 OPERATIONAL SCENARIO

8.0 Operational Scenario

Let us look at a realistic operational scenario; a busy day in Ubiety. Let us follow the Smiths family. They are a family of four, living in a 4 bedroom house. Mr. Smith is 38 years of age, and has been in Ubiety since the very beginning. He is a scientist and researcher. The majority of his time is spent in the labs and researching. He leaves for work at 8:30 in the morning, and takes the high speed Maglev from the station just outside his house. He reaches the labs in less than 2 minutes, and works there till 5 in the evening, when he again takes the Maglev back home. His wife, Mrs. Smith works at one of the restaurants in the tourist section, and is a receptionist. She leaves for work at 11 in the afternoon, and returns home by 10 in the night. She uses her own private vehicle to go to the restaurant, as she feels it is more convenient than taking the Maglev.

Their two children, Tim and Dave are 12 and 16 years old respectively. While Tim goes to school at 7 in the morning, returns home by 3, and spends his evening playing with his friends, and studying, his brother Dave goes to school at 8, and returns at 4. On weekends, Dave helps with keeping the community clean. He is part of a group which ensures that there is minimal littering. During his vacations, he also acts as a tour guide, helping tourists find out more about Ubiety.

One of Dave's friends, a 100m sprinter, has come to Ubiety to train for the upcoming Olympics, and spends much regulated time is the variable-g torus to build up his muscles stronger. He lives with his girlfriend in a 2 bedroom apartment, from where he travels to the variable g torus every alternative day with his personal trainer. His girlfriend works in a Casino, as a Poker Dealer. They often get together on weekends at restaurants, and visit amusement parks together. Life in Ubiety is as good as it gets.



9.0 BIBLIOGRAPHY

9.0 Bibliography

1. NASA ISS ECLSS
2. Formula 1 (inspiration taken)
3. City of Düsseldorf, Germany (inspiration taken)
4. Discovery Channel – Future Pods
5. www.zeoponix.com (NASA Zeoponics, Basic reference)
6. Wikipedia- Air locks, Automation, EMS(Eletro magnetic suspension - Maglev), Solar flares, RXF1, FSO(Free Space Optical Communication)
7. London's Congestion Charge Zone (CCZ)(National Geographic Channel, inspiration taken)