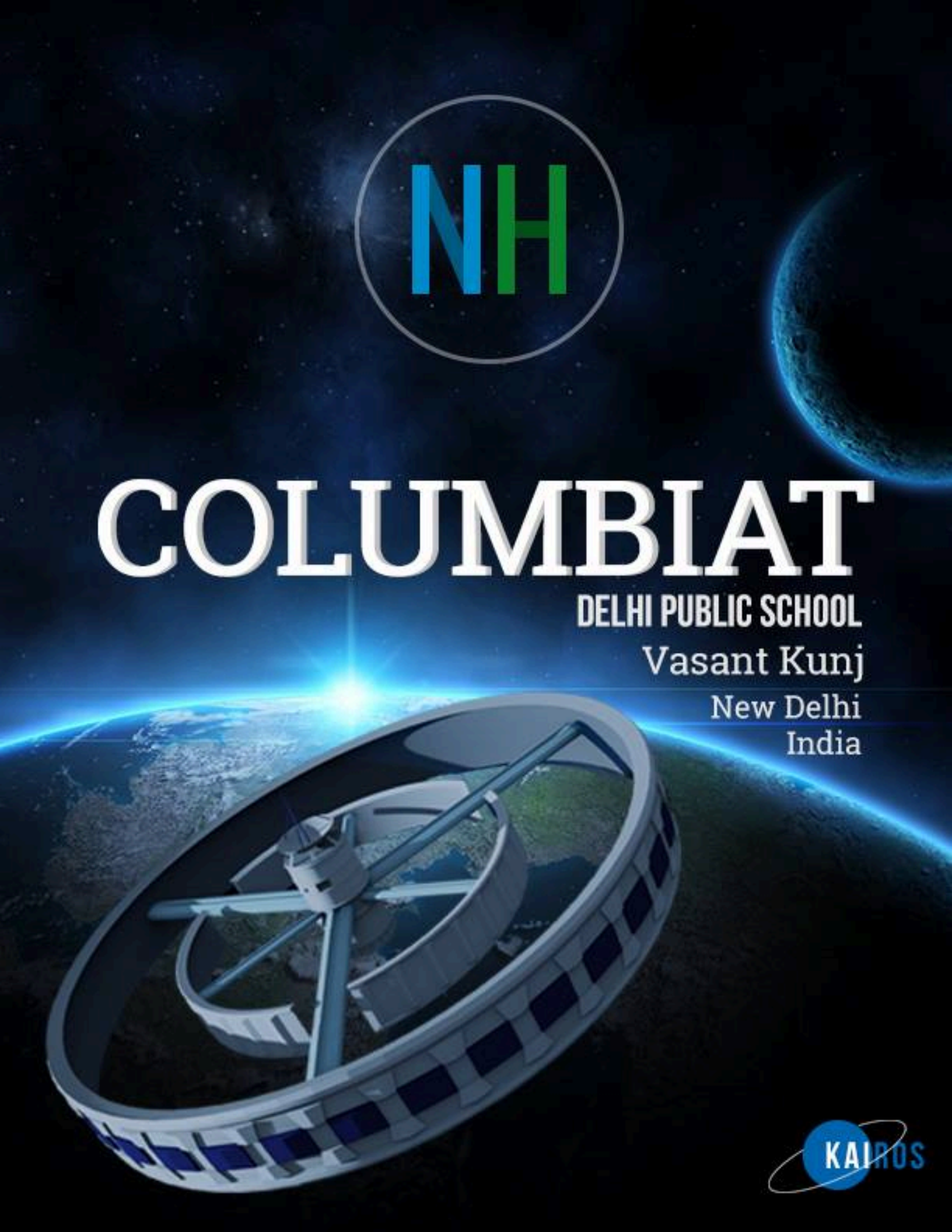
NH
COLUMBIAT
DELHI PUBLIC SCHOOL
Vasant Kunj
New Delhi
India
KAIROS

21st Annual International Space Settlement Design Competition
Proposing Team Data 2014

Name of responsible teacher/advisor: **BIRENDRA KUMAR PANDEY**
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e-mail address: k_singhal@hotmail.com

Names, [grade levels], and (ages) of 12 students currently expecting to attend the Finalist Comp
(we request that participants be at least 15 years old, and not older than 19)

KARTIK SINGHAL [12] (16)	AAHNA SINGH [12] (16)
VARUN PRAKASH [12] (16)	PUSHAN AGGARWAL [12] (16)
RUCHIT JAIN [12] (16)	AASHISH KUMAR [12] (16)
HARDIK ANEJA [12] (17)	
SAMARTH NEGI [12] (16)	[ ] ( )
VARUN MENON [12] (16)	[ ] ( )

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

I understand that if our Team qualifies for the International Space Settlement Design Finalist Competition July 25-28, we will be expected to finance our own travel to/from Titusville,

B.K Pandey 19-Apr-14

EXECTUTIVE SUMMARY

"There is a theory which states that if ever anyone discovers exactly what the Universe is for and why it is here, it will instantly disappear and be replaced by some-thing even more bizarre and inexplicable. There is another theory which states that this has already happened."

-Douglas Noel Adams-

As and when opportunity has struck man has made the seemingly tireless effort to reach beyond his capabilities to achieve and create that which in this universe of infinite possibilities, does not exist.

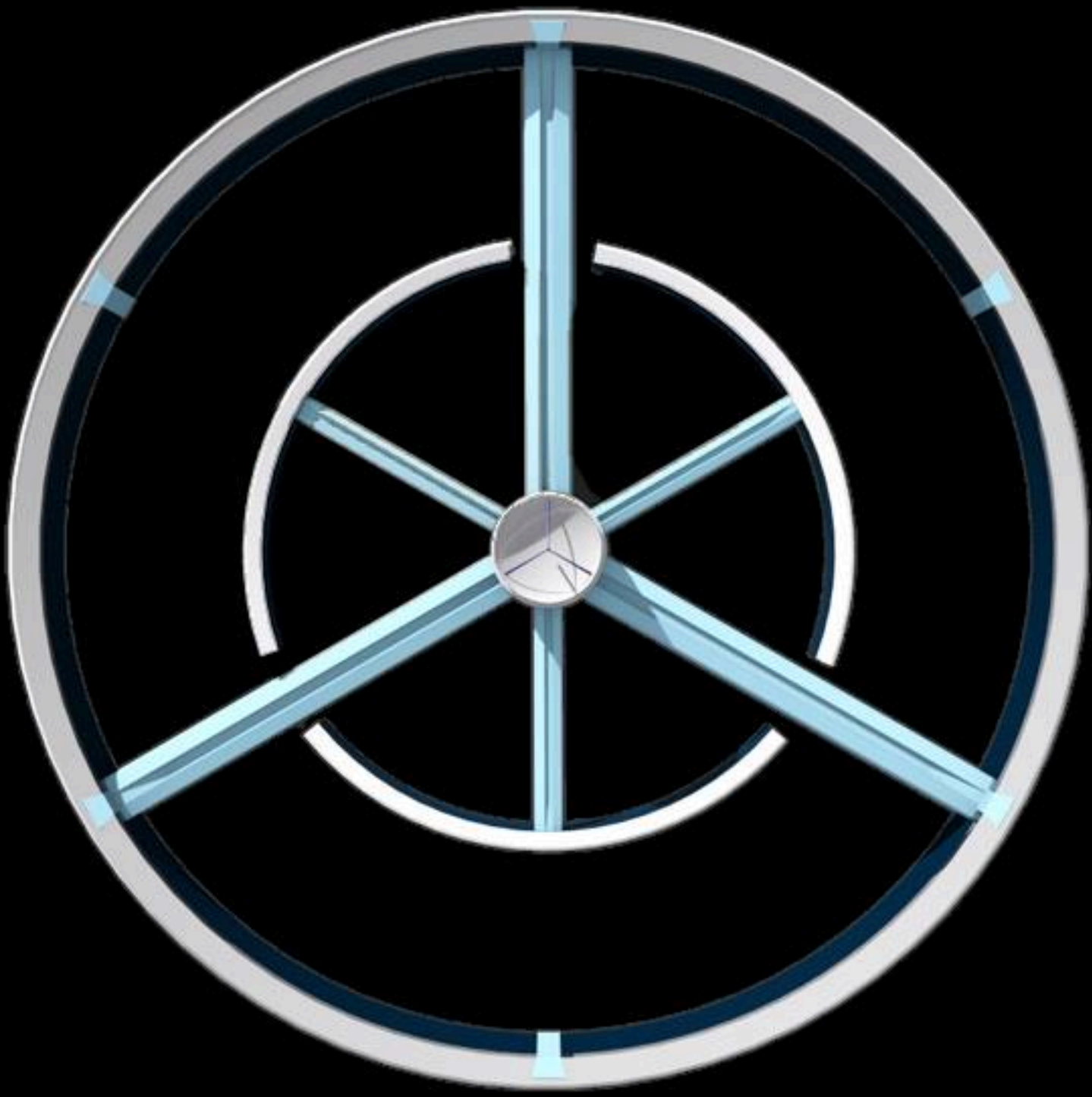
The columbiat is designed to host all visitors and inhabitants whilst maintaining the highest standards of hospitality and upkeep of prime service standards.

The external structure has been designed keeping in mind not only the requested guidelines but also the prime infrastructural standards. Though the structure is the much used torus, we at kairos have converted this marvel of architectural engineering into something that looks and feels the same, but on the inside we know that it is indeed something new and exquisite.

The automation by itself is a marvel of combined scientific efforts which has culminated into a grand spectacle. The columbiat will feature a system that has new and innovative robots built from the ground-up to service all labor intensive needs aboard the Columbiat. The situation indeed calls for the statement, ' There's a bot for that '. It will also showcase a one-of-its-kind, revolutionary 'Housekeep' which by itself is a controlled, stabilizing and self-monitoring AI system.

The operations and infrastructure of this exquisite presentation represent a hid-den, intermittent uniqueness. The Columbiat showcases a first-in-its-class com-munity infrastructure that provides all necessary day-to-day needs like food sup-ply systems, medical facilities, efficient housing and entertainment complexes (also including cinema complexes, stadiums and other recreational facilities).

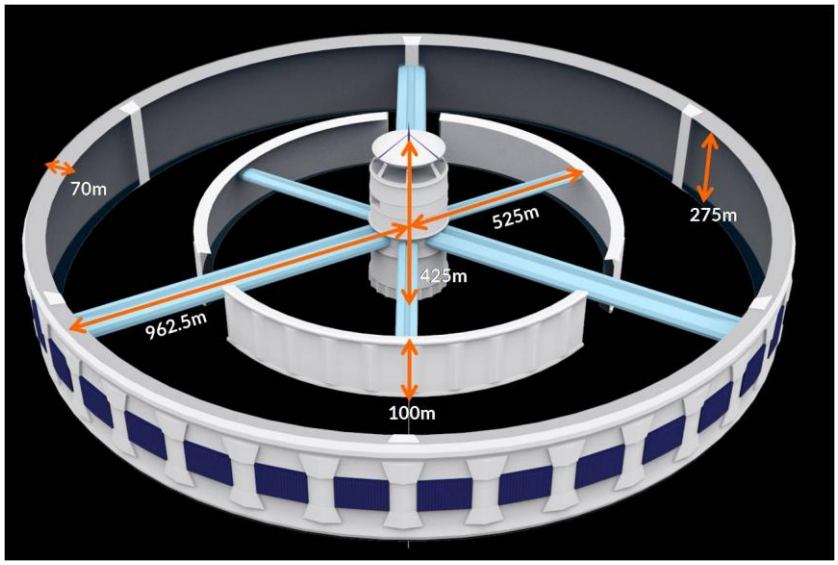
The community design has kept in mind all necessary required human factors, including attention focused on psychological, physiological and anatomical factors.



STRUCTURE

2.1 - STRUCTURAL OVERVIEW

The basic structure of Columbiat consists of one outer torus, three sections of a torus in a concentric fashion, and a central control tower, called the ADM.



The materials being used in Columbiat are as follows-

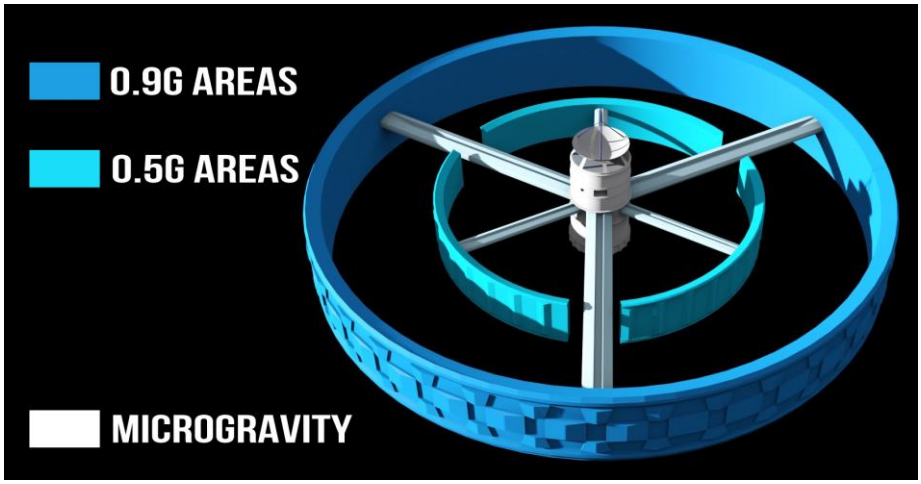
1. Outer curved surface of ADM and all tori - Silicon buckystructure panels interspersed with titanium rods as a framework, coated with a 1m layer of lunar regolith. The strong interlocking between titanium rods and silicon buckystructure panels not only allows for fast construction, but also provides excellent debris protection from micrometeoroids. The lunar regolith layer provides radiation protection.

2. Transparent surfaces - Two layers of aluminum oxynitride with a thin film of pressurized water in between, to ensure radiation protection. The film is 0.2m thick and the refraction produced is negligible. Also, the water is pressurized and pressure is constantly maintained, so that views from transparent surfaces are not disturbed.

The outer torus is provided with 0.9G gravity, the inner tori sections have 0.5G gravity and the ADM has microgravity. The ADM maintains a microgravity environment by means of a rotational interface in its middle section. It uses ball bearings to keep the tori rotating and the ADM still. The same rotational interface connects to all concentric torus sections and the outer torus, and rotates at the same RPM, which is 0.89. In the below shown diagram, the outer torus is in dark blue and the sub sections are in light blue.

The reason for selecting the gravitational magnitudes as they are, in the outer torus was that 0.9G is for all anatomical and biological reasons nearly the same as 1G, yet it provides extra comfort. This enables the human body to behave almost exactly as it would on Earth, and enables any subsequent children to have a healthy and proper growth. The difference from 1G is large enough to provide a more comfortable

environment, yet it is small enough to be negligible in terms of weakening of bones and muscles. Residents will face no difficulty adjusting to and from the 1G gravity of Earth. As for the concentric sections, they contain facilities such as industries and agricultural areas that do not necessarily need 0.9 or 1G gravity, and therefore since smaller sizes of those facilities reduce costs, they are provided with 0.5G.



With the obvious exception of the outer docking areas, the entire settlement is pressurized with an atmosphere at 1 atm.

In the above diagram, the outer torus is purely for residential and commercial use, whereas the inner sections are for industrial use, agriculture, repair facilities and storage. The central axle, called the ADM, is for administration and microG purposes. The ADM also houses the main communication dish and FSO connector at its topmost point and also contains an observatory.

2.2 - INTERIOR LAYOUT

Columbiat has an efficient interior layout, that maximizes the available space and minimizes the amount of infrastructure needed. Rather than build everything in one gigantic torus, Columbiat has one outer torus and three inner concentric torus sections, as shown in the diagrams.

The outer torus is for the residential and commercial areas in 0.9G. All commercial and residential infrastructure is in the outer torus, including houses, offices, shops, etc. The total area of the "down surfaces" there is 1.95 km^2, approximately.

The three inner concentric torus sections are called sections A, B and C. Each section contains 0.21 km^2 area in down surfaces, approximately, making the total down surface area as 0.6km^2 approximately.

The ADM only has about 100m of usable height, since it holds the docking module, communication array, rotation interface, space elevator interface and observatory. In this 100m high section, divided into four floors, the ADM has a total livable down surface area of 0.064km^2. Here, the ADM holds a Foundation Society office, zero-G recreational activities, etc. In the section just below the observatory, the ADM houses it's spare machinery and controlling computer systems.

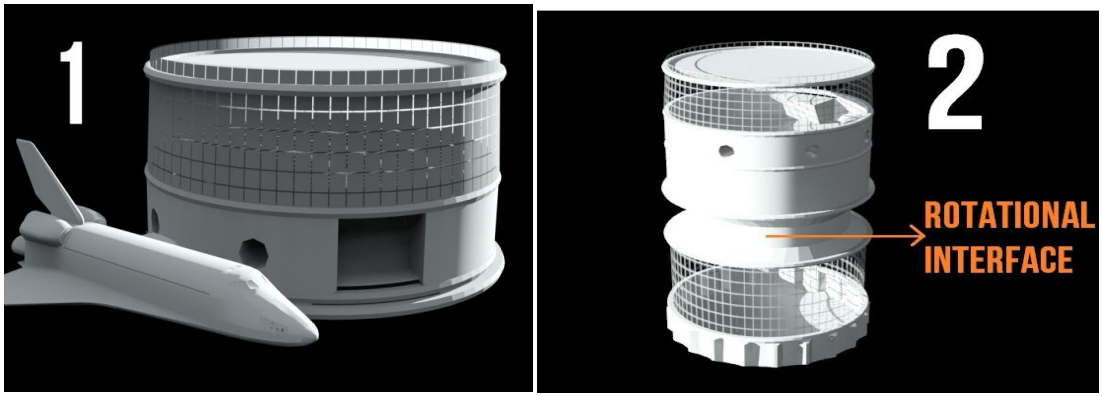
S.no	Structural Part	Radius	Height	Vertical Clearance	Surface Area
1	Outer Torus	962m	275m	75m	1.95 km^2
2	Inner torus sections	525m	70m	35m	0.2 * 3 = 0.6km^2
3	ADM	75m	400m	100m from inner surface	All sections counted = 0.05km2

S.no	Use	Area	Percentage out of total area
1.	Residential	1.8km^2	70%
2.	Agriculture and animal farms	0.25km^2	10%
3.	Industries and commercial area	0.01km^2	16%
4.	Facilities (Hospitals, PDS, etc.)	0.010km^2	0.04%
5.	Public Open Spaces	0.05km^2	2%
6.	Administration Areas	0.008km^2	0.3%

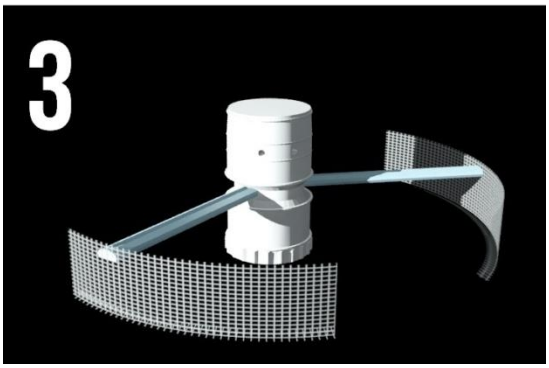
Please note that the above figures are rounded off so as to ensure clarity. For a more detailed area allocation and to see interior layout diagrams in detail, please refer to Human Factors, sub-torus community plans.

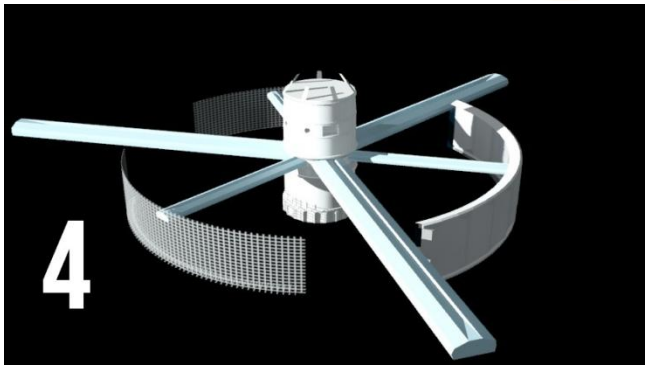
2.3 - CONSTRUCTION PROCESS

1. The construction and assembling process of the entire settlement takes place in LEO, lower Earth orbit, at a height of 576kms above the Earth, a relatively deserted orbit, to prevent risks from a disastrous outcome of the Kessler Syndrome.
2. The ADM tower is constructed first, floor by floor. When the first floor is constructed, it is used as a temporary workstation to build the next, and so on. The second thing that is built is the docking areas, to facilitate easy transfer of materials.

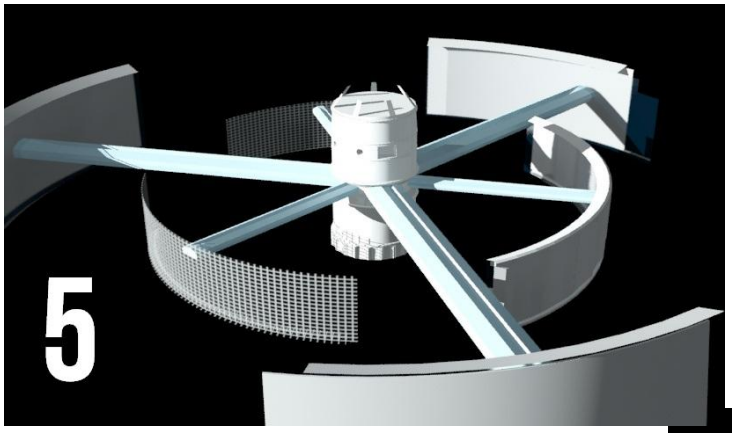


3. The rotational interface is installed next. The basic infrastructure for the transport rods is put into place. All of this is done by the ConstructionBots.
4. Both the torus and the inner concentric sections are fully modular in construction, and all the parts are sent up from Earth, requiring only assembly, docking and mating. In this way, using the ConstructionBots' robotic arms, first the sub-1G sections are assembled in orbit.

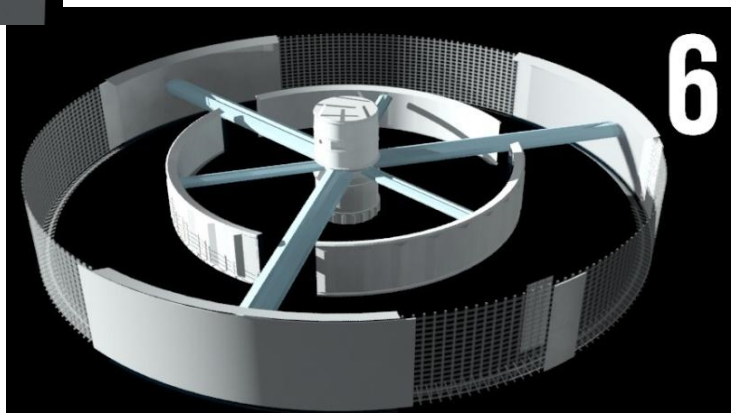




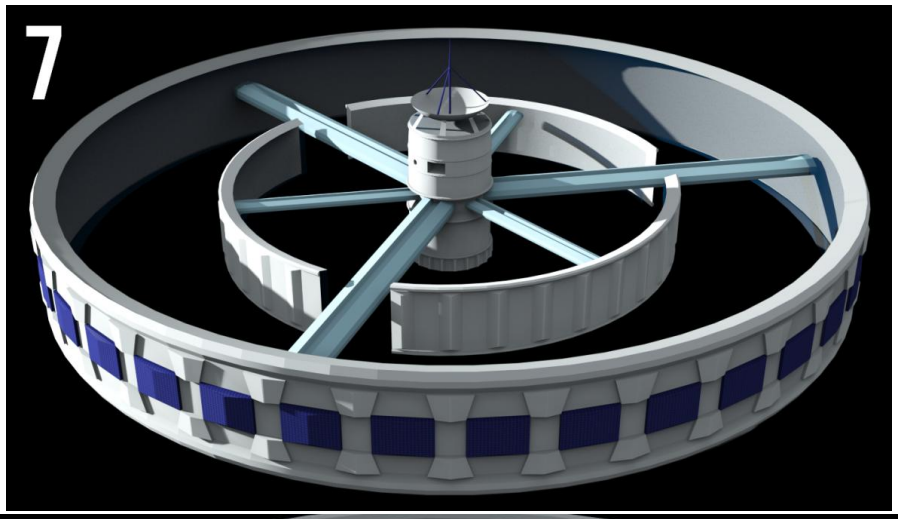
5. Next, the outer torus' construction begins from the ends of the three transport rods. It is during this time that human workers are sent up to correct any faults in the sub-1G sections. They are also sent up with atmospheric supplies so that they can use one of the sub-1G sections as a living and working base while assisting with the construction of the outer torus.
6. While the outer torus is constructed, the human workers, with automated assistance, pressurize the sub-1G sections with a 1 atm atmosphere. The entire aim is to do as many tasks simultaneously as possible to reduce construction time and therefore costs.

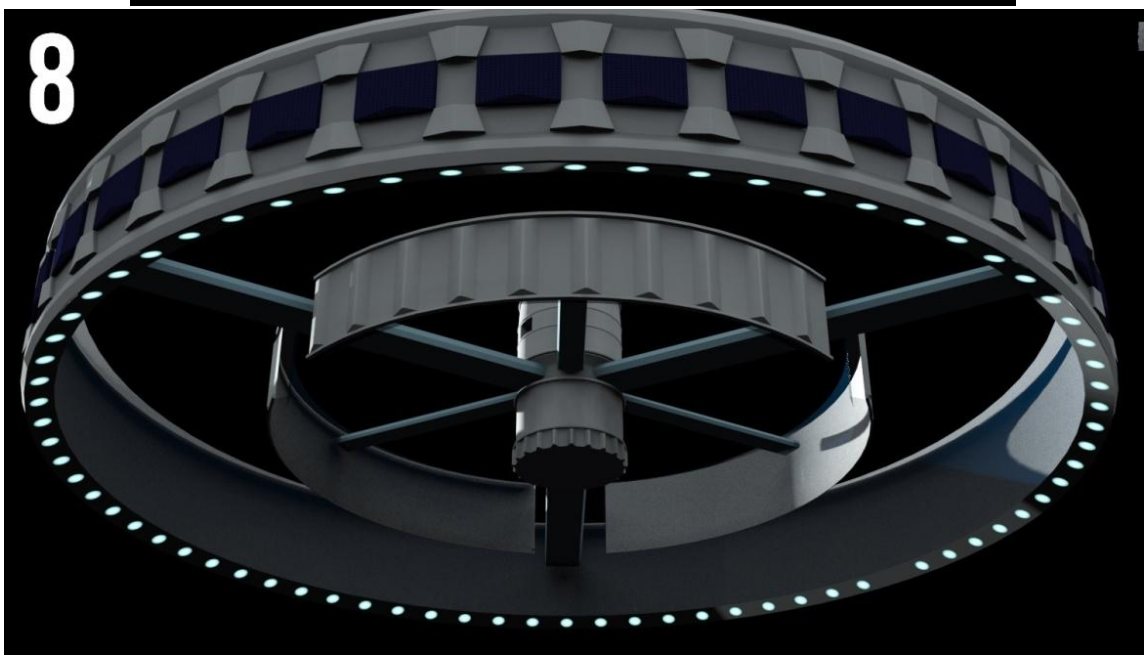


7. Once the settlement has been confirmed to be airtight and safe, the agricultural bots and workers and the flora and fauna are sent up, with adequate atmospheric supplies. They then work to start and sustain proper environmental cycles such as photosynthesis, oxygen cycle, etc.



8. When all of the cycles have been completed, the workers and internal construction robots are sent up to make the infrastructure of the settlement. All the infrastructure's materials are sent up in one series of launches. The internal automation systems are established at the same time.
9. Once all of the safety checklists have been cleared by the automation systems and all faults corrected, the settlement is now ready for transport. It is boosted from lower-Earth orbit into the L1 orbit using ionic propulsion. This process takes about 545 days.





10. During the transport to L1, the infrastructure of the settlement is constructed and assembled inside the settlement itself. This again helps to save time by completing tasks in parallel. And since the settlement is accelerating at 0.00008m/s^2, the gravity produced by the linear acceleration is negligible and therefore infrastructure can be constructed normally in the gravity provided by the settlement. The human workers rely on the already self-sustaining agriculture systems of Columbiat during this work period for sustenance.
    This again demonstrates Northdonning Heedwell's policy of simultaneous construction, making it faster and cheaper.
11. When the settlement is finally placed at L1 orbit, it is ready for the residents, and they are sent up on the last series of launches.

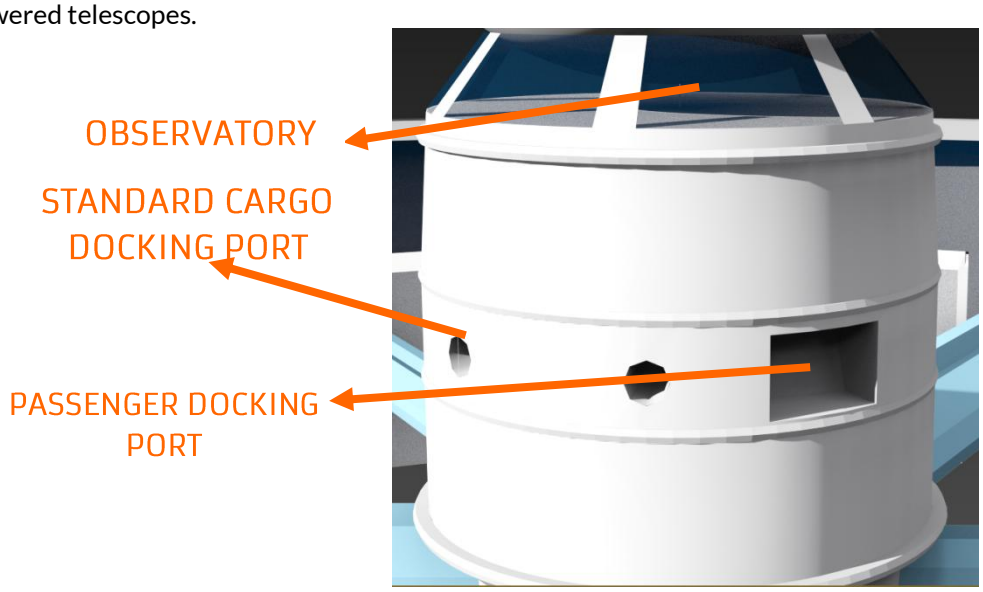
2.4 - Docking

Columbiat provides docking for five ships at once, including one airlock area for passenger ships. The cargo ships will load/unload their cargo by means of pressurized tubes connected to the ship or directly through the ship's airlock. After the cargo is transferred, it will immediately be checked by security bots and undergo decontamination processes if needed, all automated, only supervised by human operators, since security and safety of the residents are of the highest concern.

As for the passenger ships, they will use a larger airlock when they board the Columbiat. They will undergo a scanning process and decontamination if necessary. After that, they step out onto the pressurized dock and can enjoy the natural views before going down to the transport tubes.

It can also provide long-term emergency repair facilities for one ship, in the pressurized dock. This capability will be doubled when the adjacent docking chamber is extended to hold another pressurized dock for passenger and precious cargo transport in the future.

Visitors to Columbiat can, after entering, also visit the Observatory, located directly above the docking module. The Observatory allows natural views of the Earth and the moon, and is equipped with high-powered telescopes.



2.5 SPACE ELEVATOR

SPACE ELEVATOR RIBBON

The dimensions of the space elevator ribbon will be meter wide and 1 cm thick. Its length would be 60100 kilometers which would connect Columbiat with the Moon.

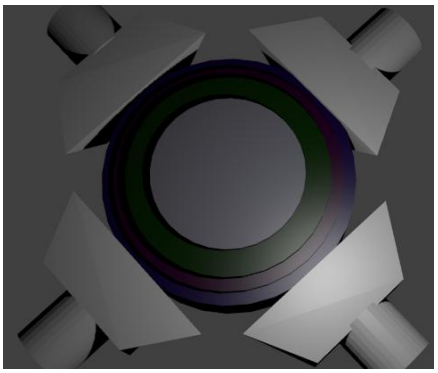
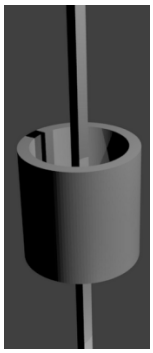
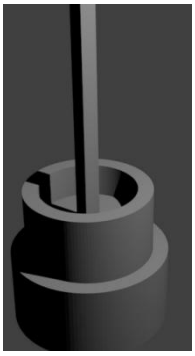
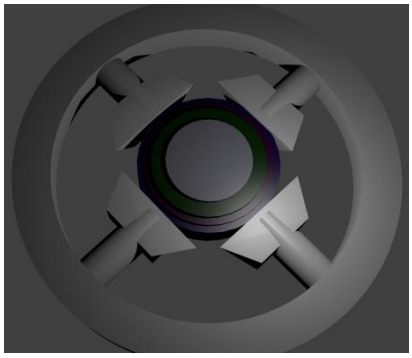
The Space elevator ribbon will be constructed by extruding viscous buckystructure feedstock through a catalyzing agent giving us a ribbon of silicon buckystructure and the required dimensions. This ribbon will be attached to the lower part of the ADM through strong structural supports and motors along with ball bearings in order to reduce friction and energy losses.

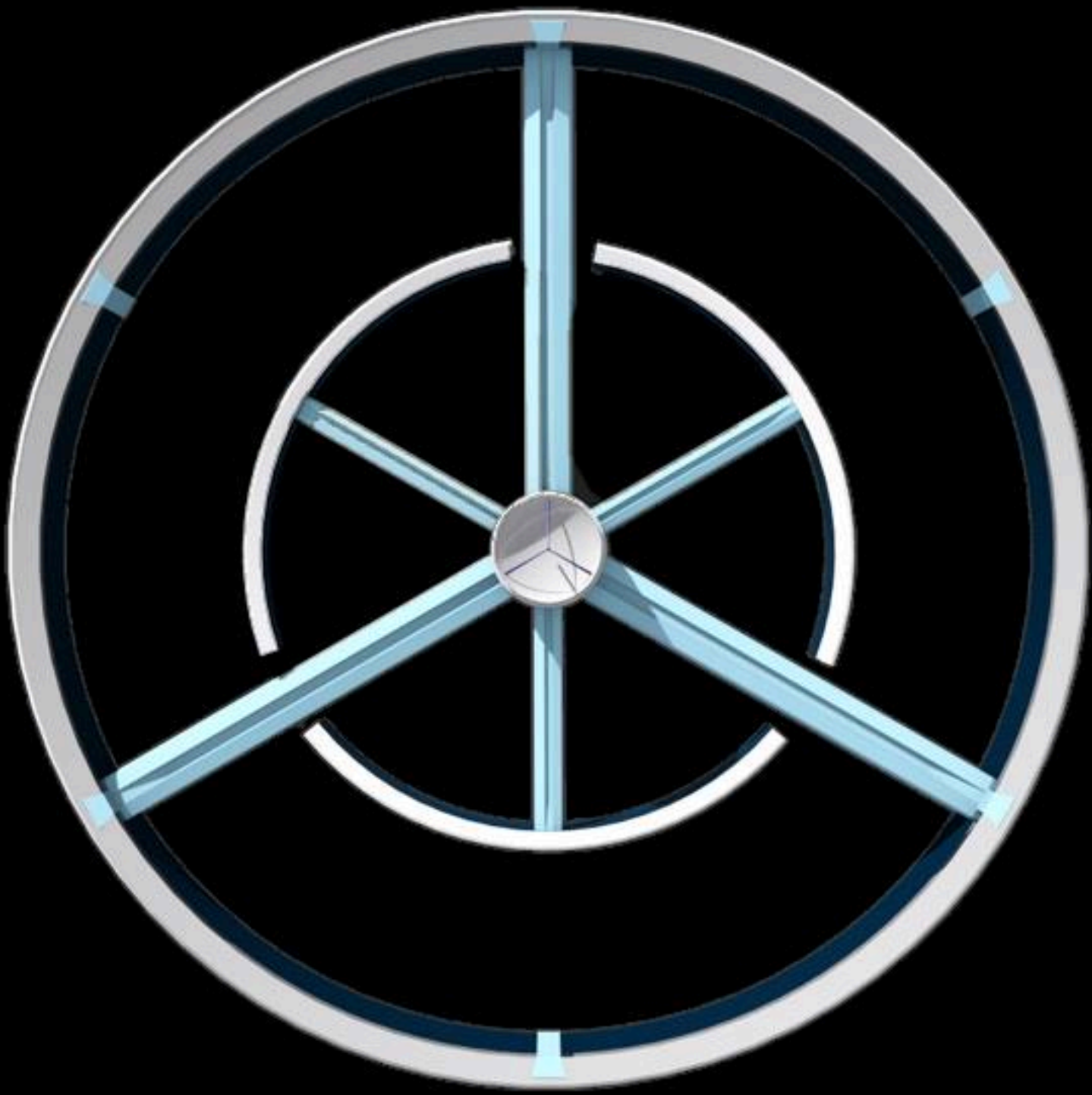
Moreover this attachment system would be attached to a slit in the ADM through which its movement in case of deflections would be possible.

The attachment to the moon surface would be through Drills that would get into the moon for a stronger grip. The drills will be fifteen meters deep and will be in an area with hard rock so as to ensure maximum grip and retention.

SPACE ELEVATOR STRUCTURE

The space elevator's structure would be a sort of a hollow cylinder, which would accommodate 100 passengers and two cargo containers. It's dimensions are a radius of 25m and a height of 60m. Following shown is the method by which the ribbon is attached to the elevator. For more information about the structure of the elevator, please refer to Human Factors.



OPERATIONS

3.1 - CONSTRUCTION MATERIALS

Materials	Sources	Properties	Purpose
Silicon	Lunar surface, sent from Earth	Has good electrical properties	**Industries**
Iron	Earth	General properties of metal	**Industries**
Steel	Earth		**Industries**
Aluminum	Earth	Light weight , high strength and mechanical stability	**Industries and Infrastructures**
Silver	Earth	Good conductor	**Industries**
HT Plastic	Earth	Strong , high temperature resistivity	**Infrastructure**
Astroquartz	Earth	Noncombustibility, high strength and durability , high temperature resistivity	**Industries**
Aluminum Oxynitride	Earth	Thermal insulation , extremely strong	**Transparent surfaces and infrastructure**
Silicon Buckystructure	Earth, Bellevistat	High flexibility , no degradation	**Outer shell**
Titanium	Earth	High tensile strength , crack resistance	**Frame work**
Silica	Lunar surface	Strong	**Glass fiber**
Lunar Regolith	Lunar surface	Radiation protection	**Radiation protection**
Nitrogen	Earth	Maintaining earth like sustainable environment	**Atmosphere**
Oxygen	Earth	For us to Breathe	**Atmosphere**
Carbon dioxide	Earth	Respiration of plants which in turns give us oxygen	**Atmosphere**
Water	Earth and Lunar surface	Coolant properties	**Industries and sustenance of human life**
Indium and Osmium	Earth	Protection from solar flares	**Radiation protection**
XR-5M15 Propulsion system	Earth		**Propulsion system**
Transparent Lunar Glass	Lunar surface	Protection from IR radiations	**Outer shell**

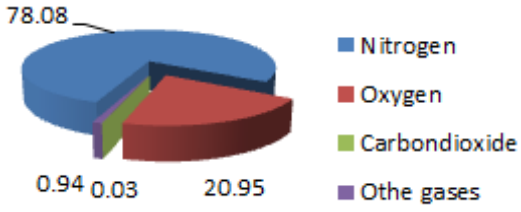
Storage between arrival and use - The main storage of cargo will be done in the warehouse which will be situated near the docking ports. The cargo will be segregated by the InfraArm and will be carried to specific warehouses in the city. The cargo will be transported to the settlement using transporting bots.

And as per the requirement the cargo will keep going to the main station with help of transportation bots.

3.2 - ELEMENTS OF BASIC INFRASTRUCTURE

3.2.1 - ATMOSPHERE CONTROL

Columbiat air composition would be approximately the same composition as Earth's.



The climate would be controlled by the projection of hot and cold air through industrial air conditioners. Temperatures would be determined by the seasons. Temperature would follow that of the global mean, and the temperatures would average ten degrees Celsius above and below the average on summer and winter. For comfort, spring and autumn climates would ease into winter and summer. The air pressure would be the average i.e. 1 atmospheric pressure. We can produce nitrogen with the help of nitrogen fixing bacteria to convert ammonia (obtained from plasma gasification) to nitrogen.

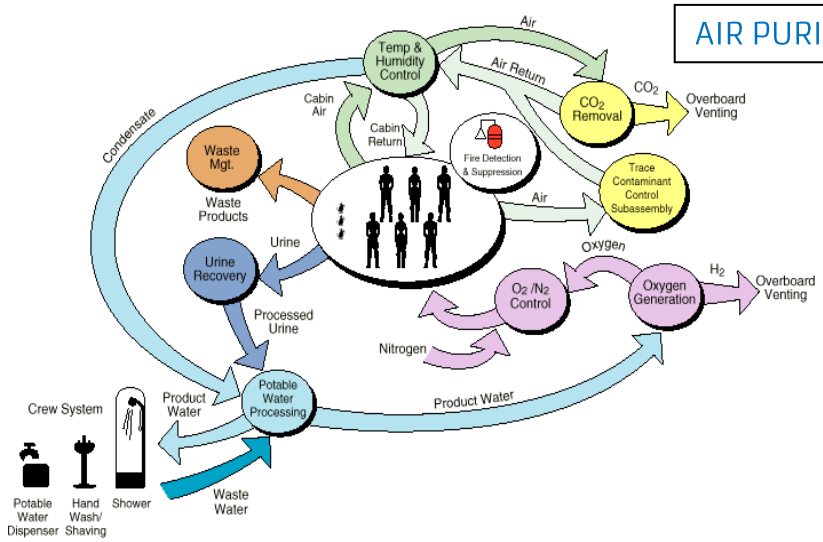
This would help in maintaining an Earth like sustainable environment.

Season	Mean Temp. (Celsius)
Spring	18-20
Summer	24-26
Autumn	20-22
Winter	15-18

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

We also have robots which will monitor the temperature and pressure in the settlement. If any undesired change is observed, it will be reported to the control room and quick measures will be taken.

AIR PURIFICATION CYCLE



control in colonies

Temperature inhabited

Filters and charcoal canisters: removes trace odours, dust and volatile chemicals from leaks , spills and out gassing

Using Airocides : Airocide is a successfully tested joint venture of NASA and FDA that clears the air of virtually all Volatile Organic Compounds (VOCs) - the harmful gasses emitted by daily use products. Each airocide unit comprises a diversified reaction chamber containing glass rings coated with titanium dioxide. With the help of a high intensity light, the TiO2 produces hydroxyls. When airborne organic molecules are drawn in and make contact with these hydroxyls, the carbon bonds in these molecules are broken.

Industrial Heat Management

Cabin Heat Exchanger in the decks cool the air, condenses the moisture and collects in the slurper. Water from the slurper is removed is moved with air to a fan separator, which uses centrifugal force to separate water from air. The air is recirculated and the water goes to a waste water tank.

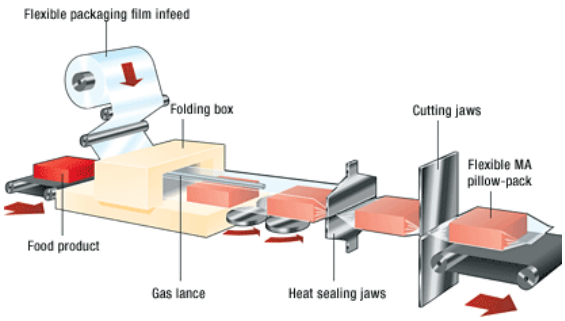
3.2.2 - FOOD PRODUCTION

METHODS OF FOOD PRODUCTION	
AQUAPONICS	It is a food production system that combines aquaculture, with hydroponics in a symbiotic environment. Using NFT (Nutrient Filter Technique) which uses water efficiently.
AQUACULTURE	It is farming of aquatic organism and aquatic plants. It involves cultivating fresh water and salt water Fishes: Salmon , Steelhead , Trout , Catfish , Tilapia and sea bass
AEROPONICS	It is the process of growing plants in mist environment without the use of soil.
VITRO PRODUCTION	Vitro production is production of engineered skeletal muscle tissue of animals i.e. raw meet
3D Food Printing (will be done in sub torus)	Micro plants will be present for converting raw food materials into processed syringe substrates that can be used in the tested and diversified 3D food printers that will be used to manufacture finished food products. The syringe-based machine works like an inkjet printer, depositing layers of viscous liquids to build up an object according to an uploaded design prior to production. Nutritional values in food can be altered by this technique, and also alternative and more efficient caloric sources like algae can be used. However, this is only a backup techinique as it isn't as economic as the ones above.

Food Packaging

Food packaging for sustenance of essential nutrients is quintessential and must be done indigenously. The Columbiat will make use of localized packaging plants equipped with modern thermoforming machines.

These are Form-Fill-Seal style machines that form the package from rolls of packaging film (webbing). Products are loaded into the thermoformed pockets the top web is laid and sealed under a vacuum, producing vacuum packaged products. Thermoforming can greatly increase packaging production speed. Thermoformed plastics can be customized for size, colour, clarity, and shape to fit products perfectly, creating a consistent appearance.



This process increases food substance lifetime by 6 times at an average when refrigerated and more when frozen. Vacuum sealed packing will prevent freezer burn by stopping exposure to cold, dry air. Facilities will be available for the purpose of sous-vide to make the process of cooking easier, less labour intensive and thus make low cost poaching effective.

Storage of Food - Food will be stored warehouses of area 0.0014 km^2 facility in .Temperature and humidity would be controlled in these storage facilities. The humidity would be 15% and access to such facilities will be highly restricted by the use of airlocks. Entry to these buildings would only be allowed after decontamination to prevent entry of microbes. An automated food retrieval system will be integrated into the infrastructure of the building so food can be easily retrieved and delivered. Vacuum

sealing would be done which will prevent freezer burn by stopping exposure to cold, dry air. Proper airlock systems would be installed.

Selling of Food - There will be markets in the settlement for selling fruits, vegetables, spices, grains and other commodities delivering of the processed food packages; The Public Distribution System (PDS) will also be largely automated. There will be vehicles just for transport of food, toiletries and other essential products to the PDS centres. All individuals will be required to present their Mobile Ids and collecting their required items of necessity.

3.2.2 - ELECTRICAL POWER GENERATION

Columbiat derives solar energy from solar panels. We have a single layer of solar panels, gallium graphene solar panels. The solar panels are situated on the outer torus' outer side.

Approximately 8150 Kwh per capita per year is required by the whole settlement, averaging industries, residential and commercial areas.

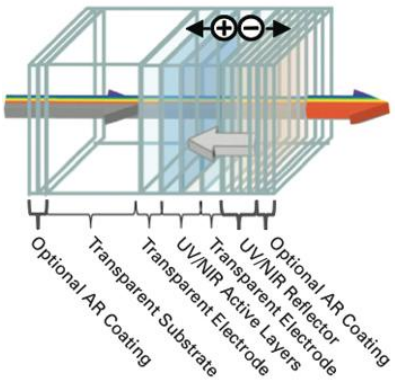
Area used for panelling the solar panels is **120,000 m^2.** Since the settlement rotates, only 60,000m2 of the solar panels will be in contact with sunlight at any given point of time.

	Gallium Graphene Solar Panels
Specific power	7.5372Kwh/m^2/day
Energy density	1000 W/m^2 accounting for rotation and other space objects blocking sunlight
Efficiency	60 - 65%

Therefore, the total power generated in the settlement is approximately 36 megawatts per hour, or 864 megawatts per day.

Storage of surplus power in the settlement

Energy Specification of Lithium Phosphate (LiFePO4) Battery	
Specific Energy	90–110 W/kg (320–400 J/g)
Energy Density	220 W/L (790 kJ/L)
Specific Power	300 W/kg
Time Durability	10 years
Cycle Durability	2,000 cycles
Nominal Cell Voltage	3.2V



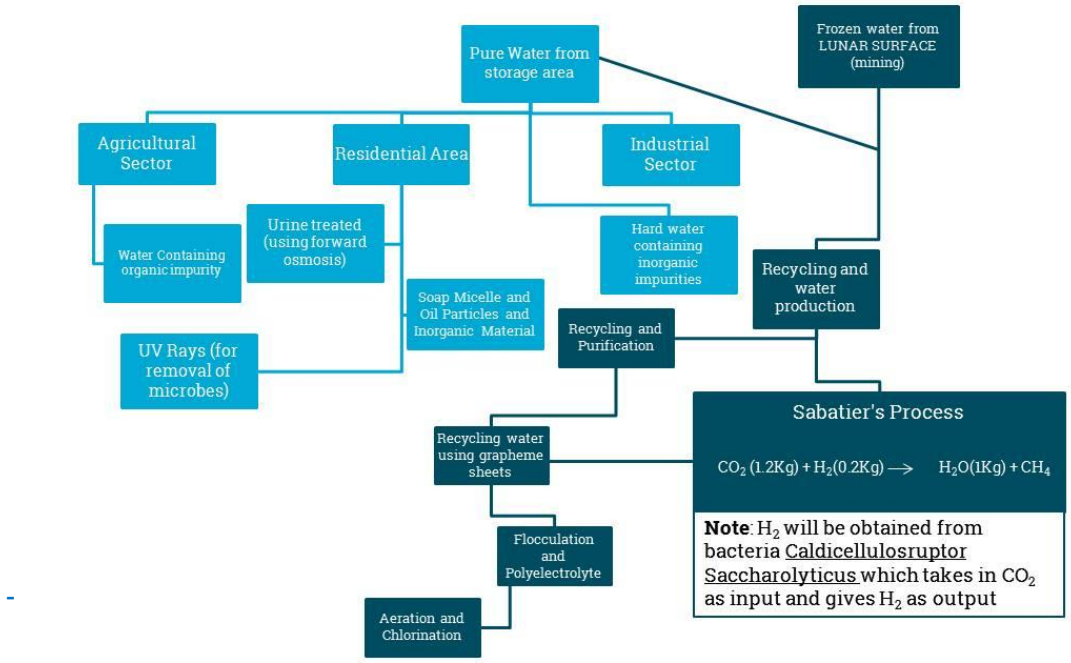
Power Generation for the space elevator -

The space elevator will also be powered by solar panels. The total area covered by the solar panels will be 1,570 m^2. It will generate approximately 1,318,800 watts per hour. Light reflecting off the lunar surface is ignored since it'll have negligible power gains.

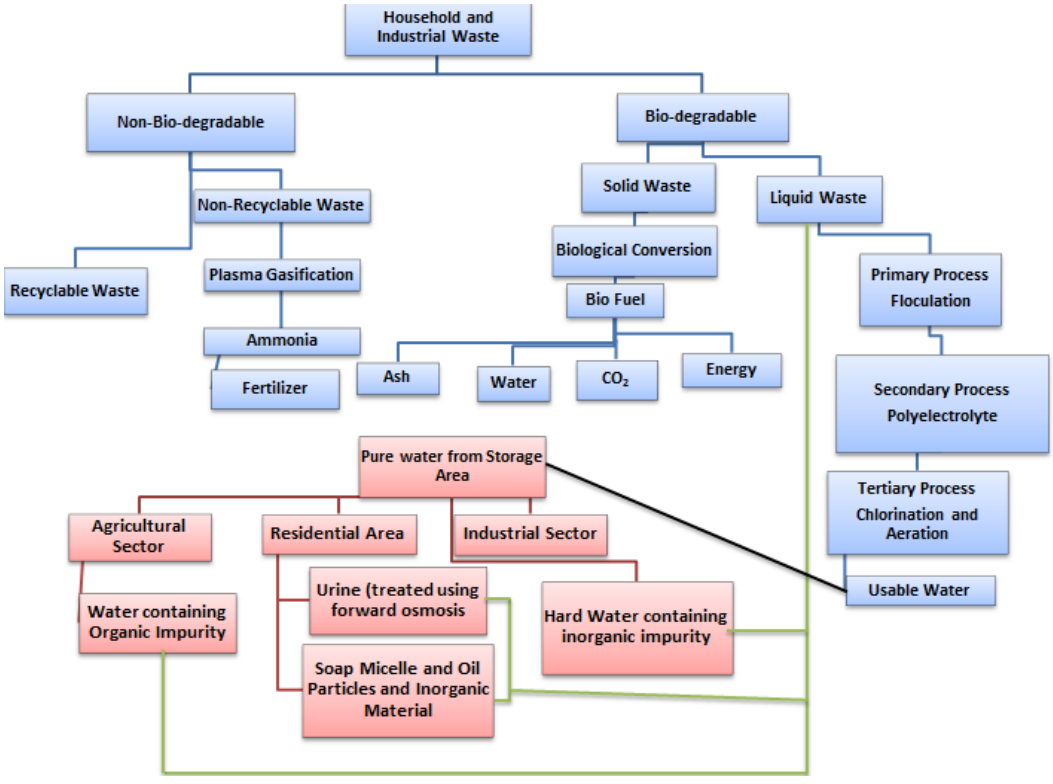
3.2.4 - WATER USAGE

Requirement per day per person	Efficiency of recycling	Daily requirement for the settlement
30 litres	90%	765000 litres

Water will be stored in the storage facilities in the sub-1G torus sections. It will be cleanly packaged and sent to the outer torus when needed by robotic assists.



3.2.5WASTE MANAGEMENT

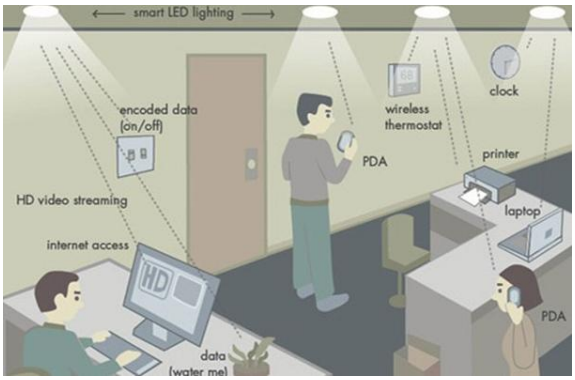


Using water efficiently

Vacuum Toilets will be used which has two chambers that separate the liquid and solid wastes. Using vacuum suction technology, such as those used in aircraft lavatories, flushing liquids would now take only 0.2 litres of water while flushing solids require just one litre. The existing conventional water closet uses about 4 to 6 litres of water per flush.

Single-stream recycling - refers to a system in which all paper fibres, plastics, metals, and other containers are mixed in a collection truck, instead of being sorted by the depositor into separate commodities (newspaper, paperboard, corrugated fibreboard, plastic, glass, etc.) and handled separately throughout the collection process. In single-stream, both the collection and processing systems are designed to handle this fully commingled mixture of recyclables, with materials being separated for reuse at a materials recovery facility (MRF).

Internal Communication



COLUMBIAT will make use of 5G based Li-Fi that will use Light Emitting Diodes (LEDs) as the delivery medium for networked, high speed communication in a diversified manner using optical and electrical multiplexing techniques, i.e., by simultaneously transmitting multiple data streams, and by using multiple transmitting and receiving antennas.

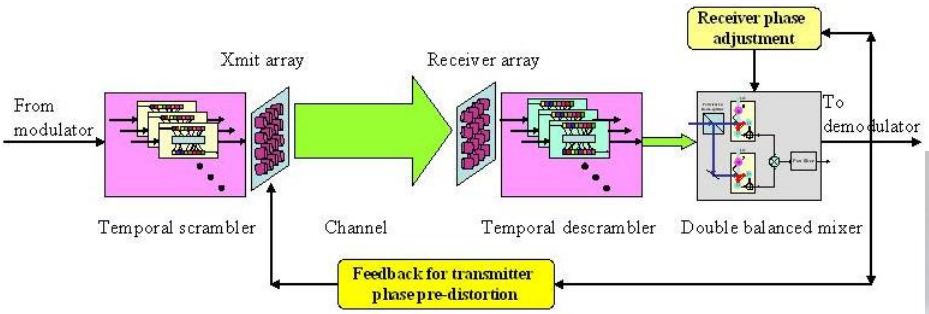
Fluorescent lamps will be used for signal transmission and specially designed photo diodes will be used for signal reception. Achieved speeds prove to be greater than 45 Gbp/s.

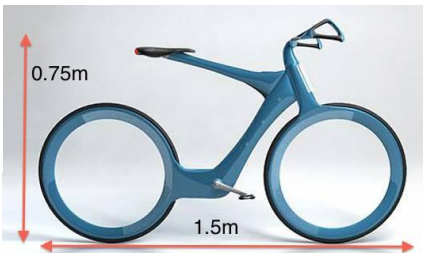
External Communication

External Communication systems will make use of FSO (Free Space Optical), a means of wireless communication that makes use of light propagation in free space for telecommunication and computer networking. Speeds of up to 10Gbps are achievable for simultaneous data, voice and video transmission, all at once.

FSO uses receivers and transmitters that feature full capacity bi-directional communication.

The system features higher bit rates, immunity to electromagnetic interference, protocol transparency and increased security in narrow beams.





Internal Transportation

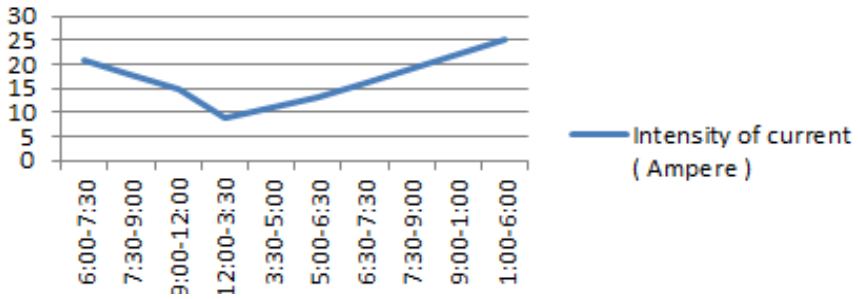
S. No.	Name	Description	Units
1	Polaris (Cycle)	Mechanical cycle that requires human effort and provides a good means of transport and also manual exercise	15,000
2	Icarus	Indigenous hover-board powered by parallel conductive electrodes that generate thrust by ionic wind	20,000
3	Walkalator	Parallel to surface of settlement for transport between buildings and in short open and closed spaces	2,200

These transport are only for the main torus, In sub torus we have no such transport because the sub torus has lesser area and has low gravity because of which people can easily walk around.

The sub-torii feature a micro gravity environment that requires assisted movement for enhanced stability and ease of purpose.
This need will be answered through the use of miniature hand-glove and boot thrusters, similar to the ones seen in the primary space suit.
These thrusters will provide sufficient thrust to propel people in micro gravity and even in zero gravity, if required.
These gloves and boots will be accessible to all entering and leaving the premises.

Day/Night provision cycle

The sky of Columbiat is made of aluminum oxynitride glass to have transparency. The underside of the sky, facing the down surface, is coated with transparent solar panels, which are arranged in a grid pattern and each corner of every panel holds a small light source, that is powered by the energy from the solar panel. So when Columbiat rotates and a particular section faces the sun, the panels charge, and when Columbiat doesn't face the sun, the light sources are activated from the power generated by the solar panels in that short amount of time. So when the sun shines naturally, the panels charge, and when the sun doesn't, the artificial lighting takes over. It is just enough power to activate the light source at near the Sun's intensity at Columbiat, and can be likened to the amount of light that would filter through on a relatively cloudy day on Earth. The transition from real to artificial sunlight is smooth and unnoticeable.

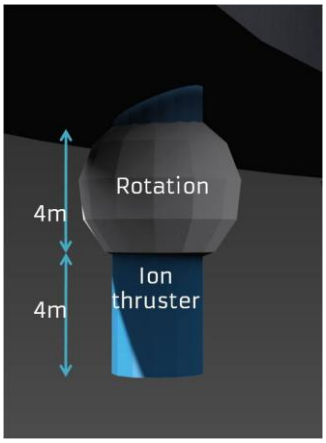


3.3 -CONSTRUCTION MACHINERY

The exterior of the settlement will be built almost entirely on the surface of the earth, once the construction is done, it will be folded and sent to the space in installments. Once it reaches the location where the settlement is to be set up, the ship carrying the settlement will open up (as shown in the picture) and will divide release many mechanical arm bots which are capable of assembling the settlement, called ConstruBots. Each of these bots will be equipped with sealant fluids, welding, molding the material using magnetic plates.

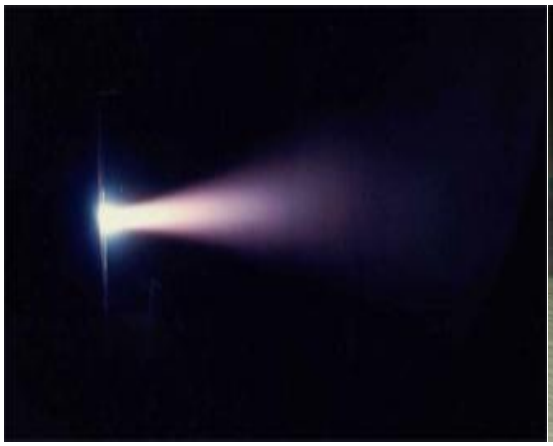
Once the whole exterior is constructed, it will be sealed and then the internal construction bots will be brought to the settlement. A temporary raw storage will be built inside the settlement where all the raw materials will be kept. Once the basic layout and interior design will be constructed, the taxi hub and proper storage spaces will be constructed inside the settlement .All the factories and industries will be set up and later all the houses will be built. For diagrams and details about the interior construction robots, please refer to Automations, Heavy Duty Construction Bots.

PROPULSION



For its propulsion systems, Columbiat will use ionic thrusters. Ionic thrusters are magnetoplasmadynamic thrusters, or MPDTs. Columbiat is equipped with 360 MPDTs, each with a thrust of 500N each, equipping Columbiat with 180,000N of thrust. MPDTs are better than other propulsion systems since Columbiat only needs propulsion systems for station keeping, minor thrust, RCS, and slow acceleration from LEO to L1 during construction. MPDTs have high specific impulses, very high efficiency, require very small amounts of propellant and take the majority of their energy from electricity, which Columbiat has a lot of due to solar power. Chemical rockets for the same purpose would require storage of excessive amounts of propellant, which is risky enough and would spread harmful exhaust chemicals.

The MPDT propellants will be stored in sections above the attachment interface. The attachment interface consists of servo motors allowing for the MPDTs to be positioned at any angle. Fuel is fed through a single pipeline going through the interface. The 360 thrusters are attached directly below Columbiat's outer torus, to ensure maximum structural stress management.



4.5)Space Elevator

The space elevator can accommodate 100 people within itself.

The journey will start from the ADM of COLUMBIAT. From the COLUMBIAT with an acceleration of 1 g the space elevator after covering about 600 meters will reach its max velocity of 250 miles an hour.

After the max velocity has been reached the propulsion systems will start rotation of the elevator in order to provide a 1g atmosphere and all services in the elevator will start.

The journey would take about 6 days and after the elevator is 700 meters from the surface of the moon the system would be decelerated with 9.8 meters per Second Square and would smoothly dock to the

docking station of the moon. Since the atmosphere on the moon is negligible, the space elevator will not require a heat shield.

The dimensions of the space elevator ribbon will be meter wide and 1 cm thick. Its length would be 60100 kilometres which would connect COLUMBIAT with the Moon.

The Space elevator ribbon will be constructed by extruding viscous Bucky structure feedstock through a catalysing agent giving us a ribbon of silicon Bucky structure and the required dimensions .

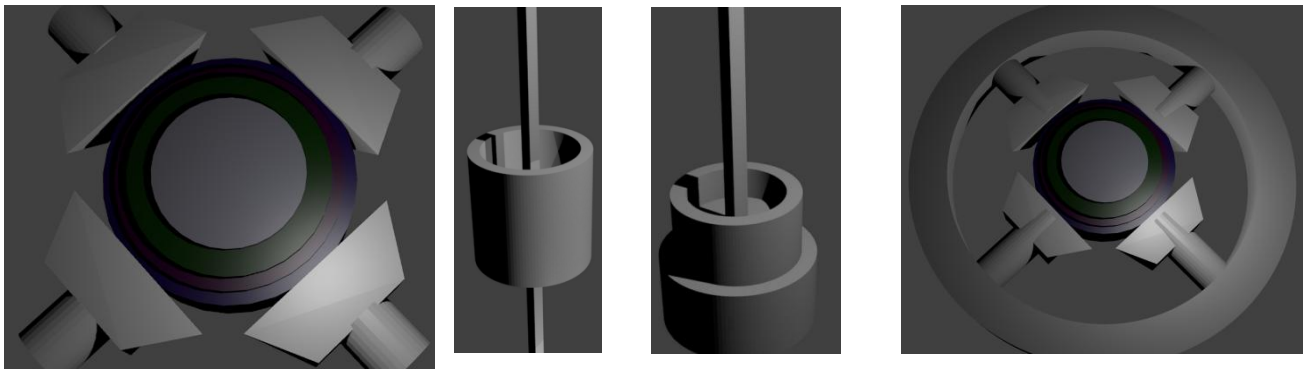
This ribbon will be attached to the lower part of the ADM through hydraulic pumps and motors along with ball bearings in order to reduce friction and energy losses.

Moreover this attachment system would be attached to a slit in the ADM through which its movement in case of deflections would be possible.

The attachment to the moon surface would be through Drills that would get into the moon for a stronger grip.

Attachment:

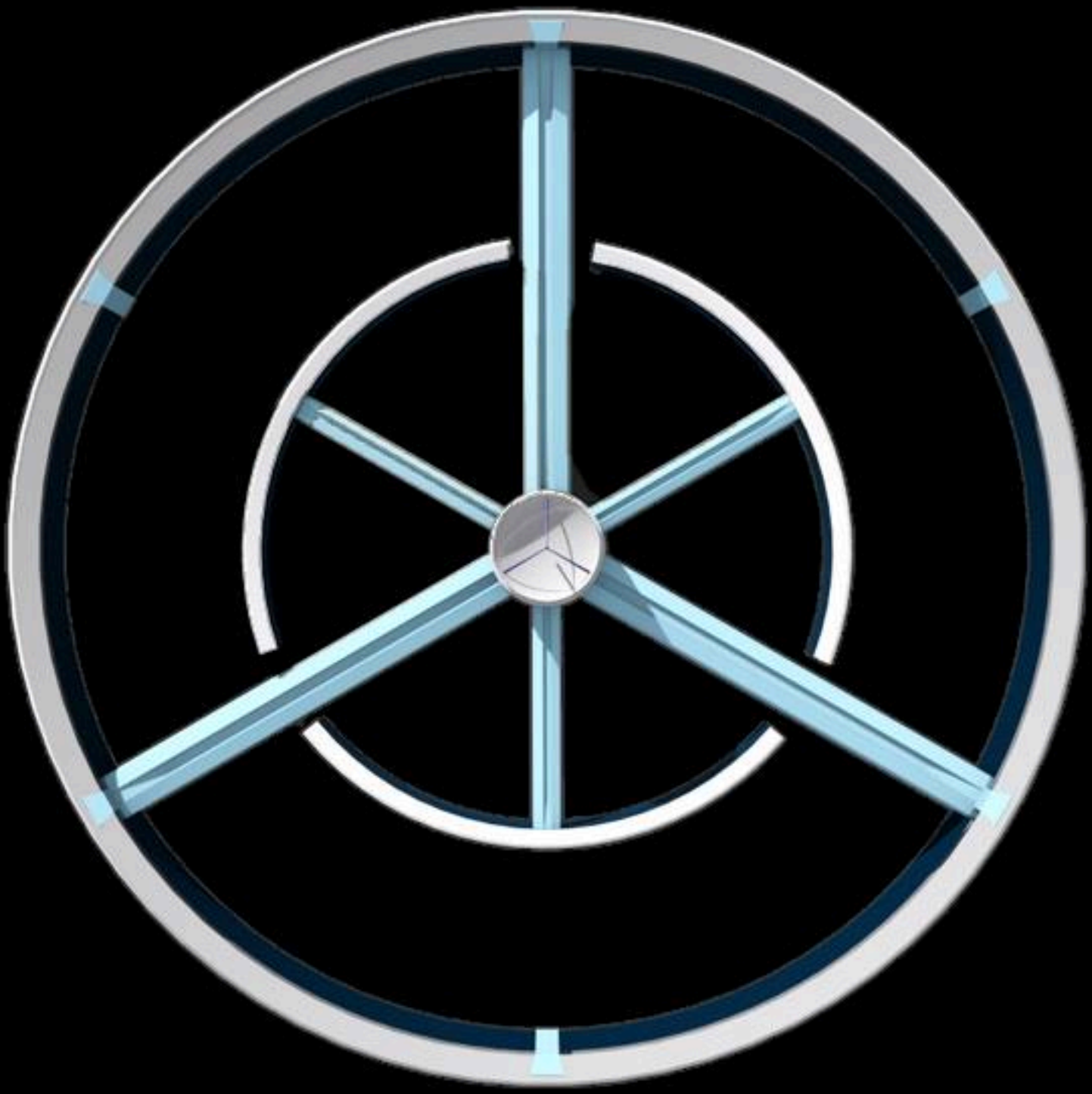
The attachment will constitute of a no of ball bearings to reduce friction. It will also constitute of a unibody construction mechanism, so that no loose part breaks away and it stays connected to the space elevator at all times. The attachment is reinforced by strong structural support from silicon buckystructure materials.



Dimension:

The spokes would be 20 meters in length and the radii of each spoke would be 2 meters so as to provide ample structural support.

The cylindrical region would be 25 meters wide. It would contain 2 shells of 45 meters and 15 meters in order to give sufficient volumes for cargo as well as passengers respectively.



HUMAN FACTORS

HUMAN FACTORS

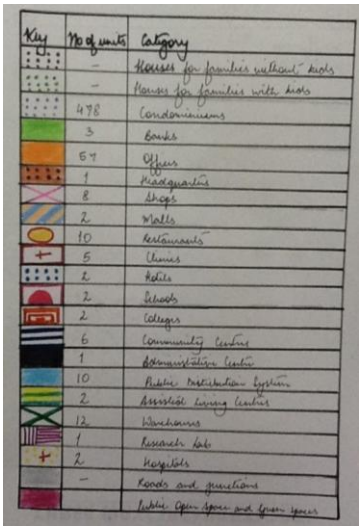
Introduction:

At a height of 223770 kilometers from the Earth, the ever-dynamic space settlement project- Columbiat aims at providing its constituent members with a spectrum of amenities. These attributes provided ensure that the members enjoy a good quality of life and well- being. Columbiat will provide services like housing, food, education, entertainment, medical, recreational activities, etc. Adding on, it would also provide its residents with natural sunlight and views of the Moon and the Earth, while at home. In short, it completely redefines the ideology of survival in space.

PROVISION OF SUNLIGHT

The sky of Columbiat is made of aluminum oxynitride glass to have transparency. The underside of the sky, facing the down surface, is coated with transparent solar panels, which are arranged in a grid pattern and each corner of every panel holds a small light source, that is powered by the energy from the solar panel. So when Columbiat rotates and a particular section faces the sun, the panels charge, and when Columbiat doesn't face the sun, the light sources are activated from the power generated by the solar panels in that short amount of time. So when the sun shines naturally, the panels charge, and when the sun doesn't, the artificial lighting takes over. It is just enough power to activate the light source at near the Sun's intensity at Columbiat, and can be likened to the amount of light that would filter through on a relatively cloudy day on Earth. The transition from real to artificial sunlight is smooth and unnoticeable.

4.1 - COMMUNITY DESIGN



The community design would serve as an ultimate Business Hub for businessmen, a Luxurious Stay for the rich and a Pure Source of Entertainment for people with recreational needs. It has been carefully designed keeping in mind, the various requirements of people irrespective of their backgrounds and age groups. The space city provides a comfortable environment for all its residents, so that they gain an experience like never before. The following goals are kept in mind while designing the community plans -

1. Provide excellent mass transit to reduce the dependence upon automobiles
2. Build good pedestrian and bicycle infrastructure including sidewalks and bike paths that are safely removed from automobile traffic.
3. Ensure affordable housing is available for people of all income groups.
4. Create community centres, microG sports and leisure gardens so that people can gather and mingle as part of their daily activities.
5. Offer access to green space and parks to provide children with fun and entertainment.
6. To design a community in a way that fulfills requirements of guests and residents, and provides ample business infrastructure in space.

4.1.1 - INDUSTRIAL AREA-

The industrial area of our settlement is located in the sub 1G section and comprises of various industries that are necessary for survival and cater to the basic needs of the citizens. Some of the industries are- Medical, Furniture, Mechanical, Metallurgical, Textile, Printing, Food Processing, Electrical, Gas Processing Plant, Water processing, Waste processing. A forested growth besets the industries so that the pollution and cocophany from the industries can be absorbed. This in turn leads to fresh air and atmosphere for the residents and the guests preventing form harsh sounds from the industries. The total industrial area measures 0.4km^2.

INDUSTRIAL WASTE MANAGEMENT- The industrial wastes include a large amount of toxic gases such as methane, carbon di oxide, carbon monoxide the gases are of of great use in Columbiat where methane and carbon di oxide will be used in water production and the gases will also be used to run propulsion systems. Toxic waste which are emancipated in small quantities and is of no use to our settlement would be treated to give useful products and wastes from the treatment plant will be collected for dumping into outer space.

4.1.2 - HOUSING

The housing is done in such a way that every resident has the required area for living, which matches their standard. The neighborhood in Columbiat has people from various backgrounds which enables them to mix with each other and gain exposure. In order to give service to residents, different housing bots and specially built mobile have been provided.

4.1.3 - ENTERTAINMENT AND RECREATIONAL

A) THE RECREATION CENTERS

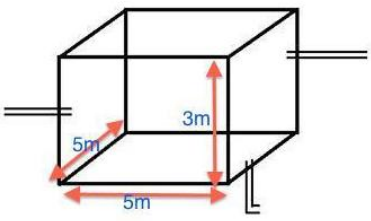
Libraries serve the readers with a completely different reading experience, both physical and digital. Malls are readily available for shopaholics. Foods of global cuisines are served in all restaurants to accommodate all residents. Other perks of living in the Columbiat space settlement include VR (Virtual Reality) Gaming, an Observatory built into the ADM, and 0-G games, and of course, trips to the lunar surface.

B) THE KAIROS COMMUNITY EDIFICE –

This is a three floored building and has casino, clubhouses and recreational games(includes small sports for people). This has been made for the people to enjoy at nights after their working hours and during holiday.

4.1.5 -THE MORGUE

It has been made in the 2 sub 1 G section. In order to deal with the Desolate deaths that will take place in the settlement, the dead bodies will be kept in a green atmosphere inside a green house where bacteria and insects will be present to decompose the bodies and emancipate large amounts of gases such as methane which will be extracted from the green house and used for purposes like manufacturing water and propulsion systems. If the deceased residents' next of kin so choose, the person may be sent back to Earth to be buried there.



4.1.5 - PARKS AND GARDENS

An array of parks and green areas are incorporated into the design of Columbiat space settlement providing an aesthetic and pleasant environment. All these parks offer a relaxing atmosphere for the inhabitants and are a great place for socialize. In addition, parks provide psychological relaxation as well, as they subconsciously remind new visitors and residents alike of Earth, enabling faster adaptation to

the prospect of living in space, if needed.

4.1.5) EDUCATION

In our settlement we have 2 schools and 2 colleges to cater to the education system. The Columbiat space settlement strives to build a well-developed integrated education system. The education system here provides a systematic 3 tier education system including vocational training centers. The education system shall consist of primary, elementary, secondary and high school institutions. The schools have modernized technology for studying purposes, including digital and computerized methods along with highly skilled and professional teachers. Apart from schools we have universities offering a variety of courses for the students to pursue their desired careers in space. Aspiring engineers can also collaborate with research labs onboard Columbiat to conduct experiments in the pursuit of discovery.

4.1.6 - BUSINESS HUB

In this belt we have the business requirements to fulfill the employment and the earning needs of the people of the settlement. A small part of this area will have stock markets, banks and offices for over 20 companies. This, in addition to sale and purchase of land, houses and property on Columbiat will add to the revenue. There will also be three banks in the outer residential torus to ensure healthy corporate competition. Columbiat also provides the highest luxury to visiting businessmen and an easily facilitated trip down to the lunar surface with it's space elevator, thereby opening a new channel for business with lunar resources.

4.1.7 - AGRICULTURE

Following are the foods that will be grown in agriculture areas -

Fruits and dry fruits **Mango, apple, grapes, cherry, lemon, orange, berry, plum, banana, raspberry, blueberry, melon, coconut, custard, guava, cranberry, watermelon, dates, almond, cashew, apricots, raisins, walnuts, pistachio, etc.**
Vegetables **Beans, onion, tomato, cauliflower, potato, lettuce, lentil, turnip, mustard, brocoli, corn, soya bean, peas, lotus stem, brinjal, Lady finger, pumpkin, mushrooms, etc.**
Others **Papyrus, cotton, jute, hemp, nettle, abaca, henequen, ramie, etc.**

4.1.8 - CONTROL CENTER

There is an administrative center in the city (outer torus) that monitors the settlement and maintains peace and security. Outside the settlement , The ADM has the following features which will monitor not only security but also has radioactive testing, bacteria testing ,micro-g research lab, micro-g sports, etc. The ADM is appropriate for a command center because the docking port is situated there.

4.1.9 - RESEARCH LABS

Since our settlement is located in space, there arises numerous possibilities in the field of research. It provides an apt system for conducting experiments. Testing of substances can also be done in these research labs. There will be two labs, one is located in the city, and it has an access hatch through which one can conduct experiments in space. The other lab is located in the sub 1G section which provides on-site microG environment. A smaller laboratory will be located in the Observatory, where it will use high-powered telescopes to scan the skies for astronomical purposes.

CLOTHING - (Source: Cotton and other synthetic fibre) Replenishment: 31,620 kg/year (Inc. Avg. of visitors) the old clothes are made to undergo several processes of cleaning. They are replenished in the Recycled Cloth Processing Mill where they are shredded and their fibre is then recovered using mechanical processes.

4.1.10 - CONSUMABLES

ANNUAL REPLENISHMENT- PAPER (Source: Bamboo and Cotton plants or Sugarcane waste) Replenishment: 168,810 kg/year (Inc. Avg. of visitors) Used papers will be replenished in Recycled Paper Processing Mills where they will undergo various processes like formation of slurry (fibre separation), removal of contaminations like ink, dust etc. The recycled fibre thus formed will be used to make new paper.

CLOTHING - (Source: Cotton and other synthetic fibre) Replenishment: 31,620 kg/year (Inc. Avg. of visitors) the old clothes are made to undergo several processes of cleaning. They are replenished in the Recycled Cloth Processing Mill where they are shredded and their fibre is then recovered using mechanical processes.

The following shows the details of consumables that will be used in the city.

Consumables	Amount (per capita per annum) in kg
Cosmetics	3.846
Garments	12.4
Stationeries	1.53
Washing Powder	9.924
Toiletries	12.888

Consumable	Amount (per capita per annum)
Oat	24.9295kg
Wheat	42.997 kg
Rice	34.9305 kg
Pigeon pea	10.7675 kg
Kidney bean	5.979875kg
Spinach	7.1175 kg
Cabbage	7.02625 kg
Fruits	3.58375 kg
Lettuce	1.800 kg
Carrot	4.47125 kg
Potato	6.19468 kg
Ginger	1.00375 kg
Onion	6.19468 kg
Garlic	1.00375 kg
Capsicum	5.475 kg
Lady finger	6.47875 kg
Butter	4.745 kg
Oil	7.75625 kg
Eggplant	6.47875kg
Chicken	75.555 kg
Fish	30.395 kg
Coffee or tea	1.2775 kg
Salt	.9125 kg
Meat	52.975 kg
Milk	73 liters
Sugar	10.49375 kg

4.1.11 - PSYCHOLOGICAL FACTORS OF LIVING

Psychological Factors	Causes	Common Remedies
Isolation	1)Lack of social interaction 2)Home sickness	• Earth like environment • Maintained Day/Night cycle • Use of bright colors and designs on walls, to lighten mood • Social and interactive environment • Views of the earth • Temperature and artificial weather control to experience various seasons of earth • Entertainment • Open areas • Adequate spacious
Stress	1)Increased Work Load 2)New and inhospitable surrounding	
Depression	1)Biochemical Environment 2)Psychological factors 3)Personal experiences	
Hallucination	1)Psychiatric disorders - schizophrenia and psychotic depression 2)Sensory Problem, such as blindness and deafness	
Confinement	1)Lack of adequate space	
Lipism Syndrome(person feels everything is a dream)	1)Psychiatric disorders 2)Past traumatic experience	

Asphyxiation(on entering low pressure areas)	1)Lack of oxygen 2)Choking	surroundings • Differentiated neighborhood • Proper balance diet • Earth like gravity • Proper medical facilities • Meditation and yoga
Solipsism Syndrome	1)Long period of isolation 2)Lack of social acceptance	
Claustrophobia	1)Fear of enclosed spaces which might trigger frequent panic attacks	
Insomnia	1)Anxiety 2)Excessive intake of caffeine 3)Underlying medical condition 4)Stress	

4.2 - RESIDENTIAL DESIGN

S. No.	CATEGORY	AREA PER unit (sq ft.)	NO. OF UNITS	TOTAL AREA sq. ft.	FLOORS (Ground+x)	Total area km2
1	Residential	Mentioned below	-		-	1.796
2	Banks	3000	3	9000	3	0.0008
3	Shops	1500	8	6000	-	0.001
4	Public Open Spaces	-	-	430556	-	0.06292
5	Restaurants	3500	10	35000	2	0.00325
6	Malls	7000	2	14000	3	0.0013
7	Hospitals	8000	2	16000	3	0.00150
8	Clinics	3000	5	15000	-	0.00139
9	Hotels	10000	2	20000	3	0.0018
10	Schools	3200	2	6400	2	0.00059
11	Colleges	4000	2	8000	2	0.00075
13	Community Centers	5000	6	30000	3	0.00278
14	Administration	3500	1	3500	2	0.0013
15	Roads & Transportation	-	-	-	-	0.01
	Animal farms					0.05
17	Research lab	8000	1	6000	3	0.00074
20	Offices (150 officials)	2000	4	8000	3	0.0007
21	Offices (100 persons)	1500	8	12000	3	0.001
22	Offices (30 persons)	900	15	13500	3	0.00125
23	Offices (5 persons)	500	30	15000	2	0.0014

24	Headquarters (300 persons)	4000	1	4000	3	0.00037
22	Ware houses	1000	12	12000	3	0.0011
23	PDS centers (Public Distribution System)	800	10	8000	2	0.0007
24	Automation repair center	2000	8	16000	3	0.00148
252	day care facility and assisted living	6000	2	6000	2	0.0056
27	Cycle stands	20	150	3000	-	0.00028
			TOTAL			1.95 km^2

S. NO.	CATEGORY	AREA PER UNIT sq. ft.	NO. OF UNITS	TOTAL AREA sq. ft.	FLOORS (GROUND+X)	TOTAL AREA sq. km.
1	clinics	2000	1	2000	2	0.000185
2	ADMINISTRATION	3500	1	3500	2	0.00032
3	WAREHOUSES	1000	1	1000	3	0.001
4	PDS CENTRES	800	1	800	2	0.006
6	AUTOMATION REPAIR CENTER	2000	1	2000	3	0.000185
7	Forest growth around industries	-	-	-	-	0.006435
9	Restaurant	3000	1	3000	2	0.000278
10	Agriculture					0.2
			Total			0.21 km^2

SECTION - B

S. NO.	CATEGORY	AREA PER UNIT sq. ft.	NO. OF UNITS	TOTAL AREA sq. ft.	FLOORS (GROUND+X)	TOTAL AREA sq. km.
1	Clinics	2000	1	2000	2	0.000185
2	ADMINISTRATION	3500	1	3500	2	0.00032
3	Recreational activities	1000	1	1000	3	0.05
4	PDS CENTRES	800	1	800	2	0.006
5	INDUSTRIES	8000	12	96000	3	0.2
6	AUTOMATION REPAIR CENTER	2000	1	2000	3	0.000185
7	Forest growth around industries	-	-	-	-	0.006435
9	Restaurant	3000	1	3000	2	0.000278
			Total			0.21 km^2

SECTION-C

S. NO.	CATEGORY	AREA PER UNIT sq. ft.	NO. OF UNITS	TOTAL AREA sq. ft.	FLOORS (GROUND+X)	TOTAL AREA sq. km.
1	Clinics	2000	1	2000	2	0.000185
2	ADMINISTRATION	3500	1	3500	2	0.00032
3	WAREHOUSES	1000	1	1000	3	0.001
4	PDS CENTRES	800	1	800	2	0.006
5	INDUSTRIES	8000	12	96000	3	0.2
6	AUTOMATION REPAIR CENTER	2000	1	2000	3	0.000185
7	Forest growth	-	-	-	-	0.006435

	around industries					
9	Restaurant	3000	1	3000	2	0.000278
10	Agriculture					0.2
		Total				0.21 km^2

Demographics of residents in the settlement-

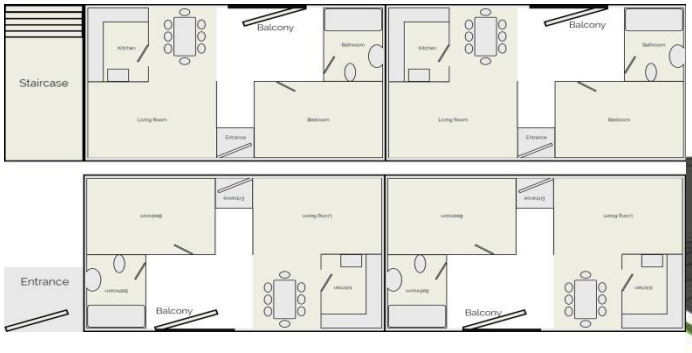
Type	Number
Married adults 70% (average age 40, median age 35)	16100
Single Men 15% (average age 33, median age 34)	3450
Single Women 10% (average age 40, median age 35)	2300
Children (under 18) 5% (average age 11, median age 9)	1150
Total	23000

Furniture	
Number of beds	13000
Number of chairs	45000
Number of tables	60000
Number of desks	60000

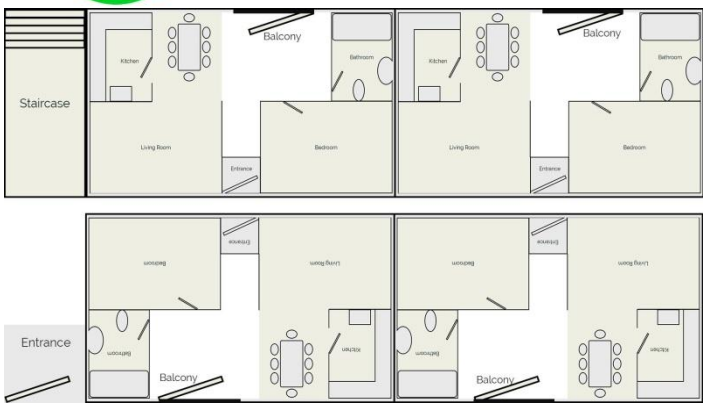
RESIDENTIAL AREA ALLOCATION-

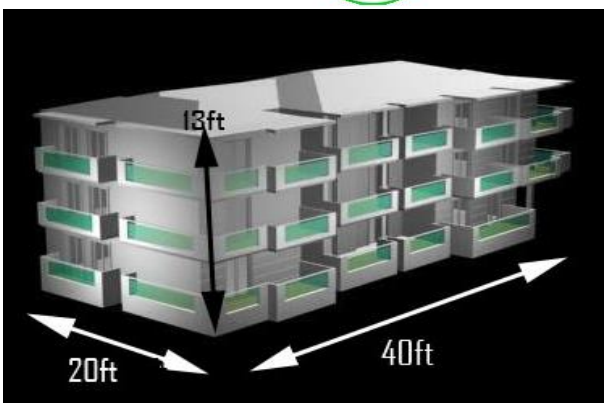
S.no	TYPE OF HOUSE	Area per house in sq. ft.	DEMOGAPHIC	No. of Buildings	TOTAL AREA TAKEN (km^2)	Area sq. ft.
1	Apartments type-1 Condominium	800	Single men	287	0.0213	229600
2	condominium	800	Single women	191	0.0114	152800
2	Residential type-1	1000	Families without children	1100	0.1	1100000
3	Residential type-2	1200	Families with children	15000	1.67	18000000
Total = 1.8027km^2						

Apartment type 1 - Specially designed for single men and women, these condomiums accommodate as many as 12 people at a time. We take special care as to how we allocate these apartments, there are bots to serve the people and nearby entertainment adds to its perks of living.



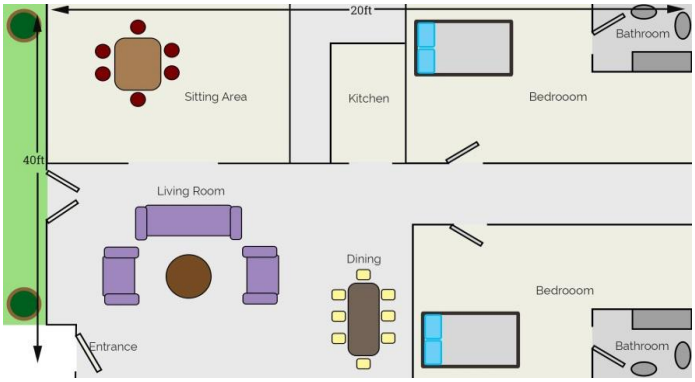
Apartment type 2 - These apartments also have 12 people residing in one building. It is provided with all the necessities and the allocation is such that they are adequately served by the bots during the working hours.





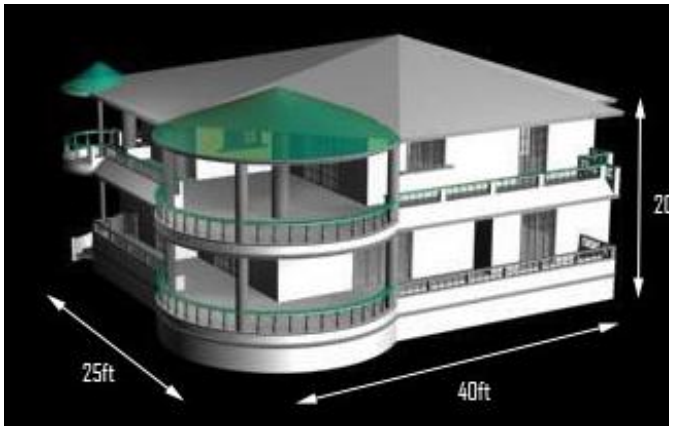
House type 1 -

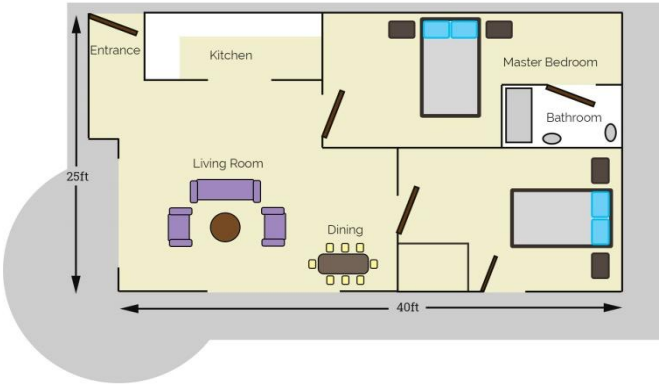
This house is specially made for people without children.

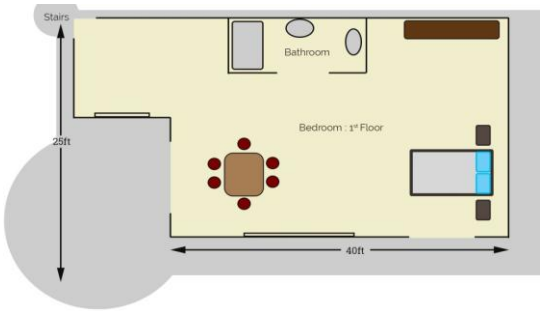


House type 2 -

These houses have been specially designed for families with children.







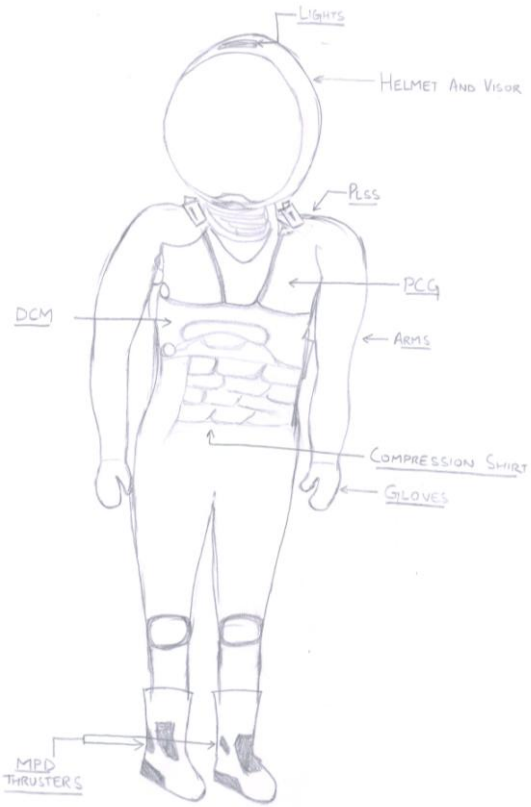
4.3 - SAFE ACCESS

4.3.1 - SPACE SUIT

Clear, impact-resistant polycarbonate plastic is used to make the helmet. It fits to the PCG by a quick-connect ring. The helmet is padded for providing comfort. Purge valve is present to remove carbon dioxide if the backup oxygen supply is required to be used. Inside of the helmet is treated with an anti-fog compound prior to use, for optimal visibility.

Extravehicular Visor Assembly (EVA) present over helmet has four headlamps, a wireless transmission camera, wireless communication DSCN communication system, anti-sunlight visor and cover to protect against thermal and mechanical impact

Primary Chest Garment (PCG)- HUT is replaced by a PCG made of polymerized stretchy plastic that provides 67% of required pressure. Remaining 33% of pressure is provided by Nickel-Titanium alloys, which act as active material and are present as tension lines on the suit. It is a tightly wrapped suit that provides increased mobility and is more natural and comfortable to wear.



Gloves- Gloves bear wrist bearings for easy movement. They fit into arms by quick-connect rings. Gloves have rubberized fingertips to help astronauts grip things. Fine fabric gloves under outer gloves are present for comfort. Outer gloves have loops to tether tools.

Arms- Arm units contain shoulder, upper arm and elbow joint bearings to allow movement in as many directions as possible. The arm units fit into the PCG by quick connect rings.

IDB- The In-Suit-Drink-Bag is a plastic pouch mounted inside the PCG that can hold water and is connected to a straw present near the astronaut's mouth.

PLSS- Primary Life Support System (PLSS) is an astronaut's backpack and contains oxygen tanks as well as cooling system i.e. LCVG (Liquid Cooling and Ventilation Garment). PLSS has a Primary and Secondary oxygen Pack, in cases of emergency.

Display and Control Module (DCM)- Chest mounted DCM contains necessary controls, switches and gauges. Wrist bound display module displays vital signs.

Compression Shirts- These are worn under the space suit and have an electronic scanner connected to a Nano processor. It helps in monitoring Heart Rate, ECG, G-Force, and body temperature, GSR etc. It also acts as an absorption garment that soaks up sweat and is connected to urine collection bag/garment.

H2O2 THRUSTERS - The suit has H2O2 thrusters that use very less fuel and provide ten hours of constant low thrust. The ejected exhaust materials is also not harmful, and these thrusters are very cheap to manufacture and maintain, and the fuel is inexpensive as well.

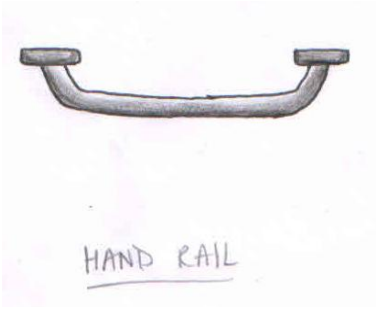
Materials used to make this specialized space suit are: Nylon tricot, Spandex, Urethane-coated Nylon, Dacron, Neoprene-coated Nylon, Mylar, Gortex, Kevlar and Nomex.

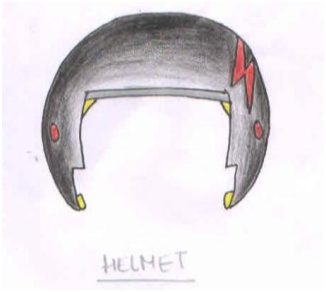
Donning/ Doffing Procedures

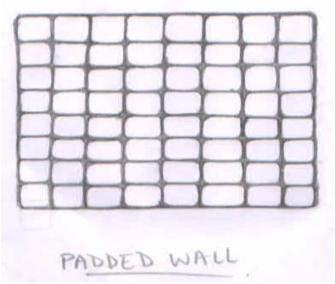
After entering the stowage room, the astronaut will stand in the magnetic shoes zones hoes will be firmly attached to the ground. Then the electric hand will automatically hold your waist, and the astronaut may then starts to done the pants, helmets, gloves, coat and the backpack on or off.

HUMAN FACTORS

SYSTEM/DEVICE	FUNCTION	LOCATION
PADDED WALLS	Polymerized, padded walls avoid bodily injuries and abrasion upon contact with surfaces in low g areas	Low G areas like Transport tubes
TETHERS	Spectra Fiber™ coated with Silicon Buckystructure to provide optimum strength and flexibility	Attached to suits and safety belts
HAND AND FOOT RAILS	Padded hand rails made of Titanium for providing support whilst standing, and also while floating in zero or micro-g	Transport tubes, outside surfaces and low gravity areas
GLOVES AND BOOTS	Polymerized rubber gloves for better grip and also protection from lunar dust	Associated with suits and additional safety gear
HELMET	Protection from sunlight, radiation and also mechanical injuries. Two light cum cameras for added protection through monitoring	Associated with suits and additional safety gear



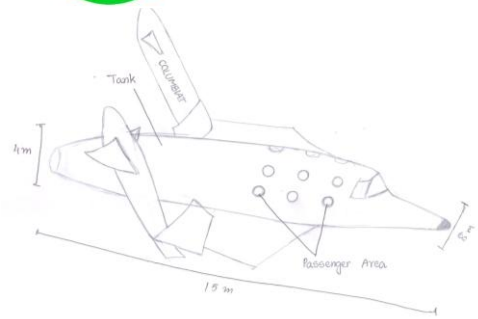


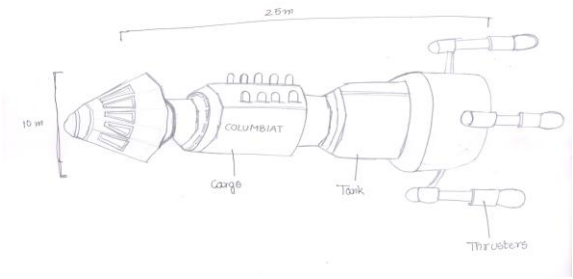


EXTERNAL VEHICLE

External transportation will take place through space capsules equipped with propulsion systems and food distribution systems.

S.No	Name of capsule	Description	No of Units
1	Pyro Matrix (For Tourism)	• Pyramidal in Shape • Can accommodate 100 passengers • Base area is 1000 meter square • Equipped with food distribution system.	25
2	Nabonidius (For Cargo)	• Cylindrical in shape with aerodynamical design. • Can accommodate 5 Cargo containers of standard size.	15





Airlocks System - To prevent air loss, a specialized computerized sequence within the doors will be used to maximize efficiency and safety.

Minimizing air loss takes the highest precedence, and computer sequencing will ensure maximum air retention. The air lock components are designed to work with maximum energy efficiency; helping to circulate power to other systems.

Control panels within every air lock room will prevent the doors being opened while the airlock is in use. Air lock pass code recognition ensures maximum security.

It has mountings for four high-pressure gas tanks, two containing oxygen and two containing nitrogen, which provides for atmospheric most specifically for the gas lost after a hatch opening during a spacewalk.

These tanks provide a replenish able source of gas to the Atmosphere Control and Supply System and 6.2 MPa oxygen for recharging the space suits.

Various computerised sensors would be present to keep a proper check. These computerised sensors will keep a record on air loss and keep storing the data, if any unusual change found in the data, quick measures will be taken.

MEDICAL FACILITIES

Basic medical facilities like civil amenities centres and medical supply outlets. 24 hour access to specialized hospitals with support from modular designs with access to basic drugs and medical scanning equipment. These medical bots will be trained to diagnose any illnesses and administer required medical procedures or drugs as and when necessary. The taxi hub will facilitate the hospitals in case of emergency. There are 8 clinics with two major hospitals that will cater to all the basic medical amenities

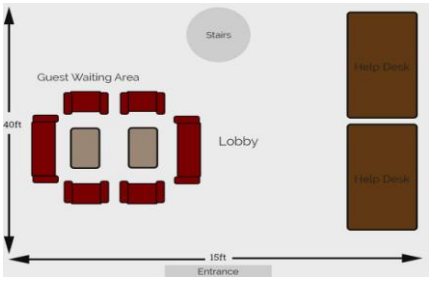
QUARANTINE

Every Torus/ sub torus is vacuum sealed and pressure stabilized against spread of any microbial diseases but giving due consideration to wide-ranging possibilities, there is provision for placing both the torus and sub torii in quarantine individually by means of an efficient, centrally-controlled isolation, lock-down mechanism. This mechanism can individually place the torus or any one portion of a torus/ sub torus under quarantine with provision for supply of basic requirements like food, water and medication through vacuum-stabilized, pressurized barriers.

For singular cases or cases with only a few people infected, there will be a separate Quarantine room, capable of housing fifty people at once. This chamber will be deadlocked and airtight and sealed, and the inmates will be totally isolated, sharing no contact, not even the breathing air, with the rest of the residents, until they are treated and all risk of contamination is eliminated. The entrance to the quarantine chamber is guarded by an airlock.

4.4) KAIROS OCEAN HOTELS AND RESORT

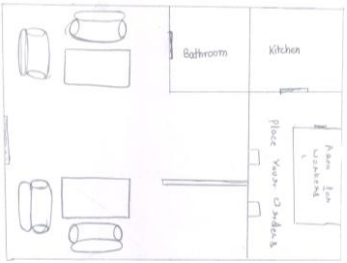
The specially built KAIROS OCEAN HOTELS AND RESORTS will serve the 2500+ transient population. The infrastructure of the hotel is marvelous with modern technology and entertainment facilities that will provide a once in a lifetime experience. To provide security to the residents and guests, a security unit will be employed and will be accompanied by bots. There will also be provisions to accommodate over 5000 guests during high traffic times such as when the Foundation Society begins other major projects in space and planetary settlements.



Hotel design

Restaurant interior layout

Lobby interior layout

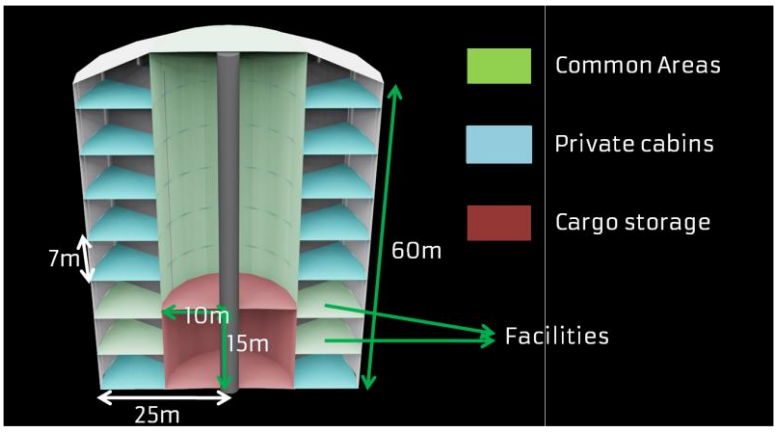


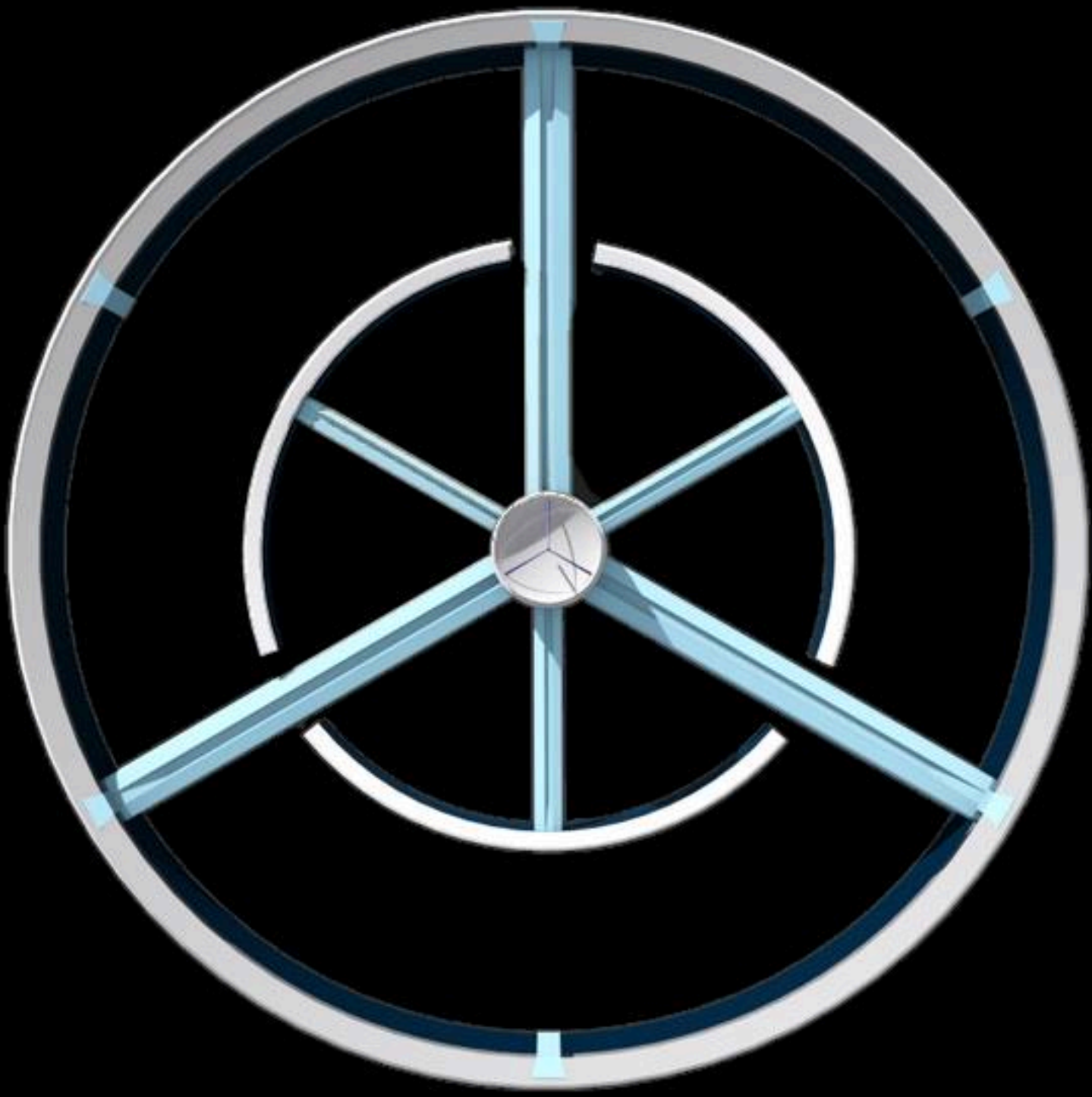
4.5 - SPACE ELEVATOR INTERNAL DESIGN

The space elevator internal design is so designed that provides privacy to all residents but also provides community areas. A journey to the Moon takes approximately six and a half days.

The space elevator cab has no provision of artificial gravity, since six and a half days in microG has little or no effect on the human body. The space elevator is a cylindrical structure, where the central part is for community activities, and the side sections are for private use. The side sections are equipped with computers, beds, desks, etc. to accommodate residents during the **6.5 day trip**. Each private cabin has an area of **205m^2** and vertical clearance of seven meters, which is more than sufficient for psychological problems for six days. The second and third last floors are for facilities such as toilets, PDS, etc. These facilities are free and available to all passengers. The space elevator cab can also accommodate cargo storage upto fifteen meters long in the community areas. Dimensions are given below in the diagram.

When the elevator cab is accelerated or slowed down, the passengers tie themselves to seats with seatbelts so as to ensure no accidents due to the G forces changes caused. In no event is the acceleration produced ever more than 1G, and there are only 2 acceleration events - launching from Columbiat and slowing down to land on the moon. In total, there are 5 private floors with eight cabins each, making a total of 40 cabins in the space elevator. The bottommost cabin is for luggage storage.





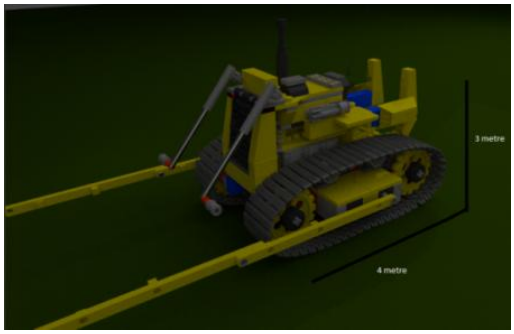
AUTOMATION

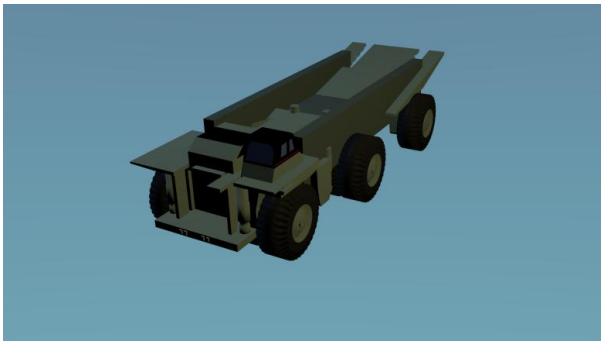
AUTOMATIONS

5.1 AUTOMATION OF CONSTRUCTION PROCESS

Heavy Duty Construction Bot	Multiple pre-programmed mechanical arms, Capacity upto 100 ton. Can be operated by a human also.	Assembly of infrastructures once the external construction of the settlement is complete.	7 bots employed
Precision bots	Inbuilt Carbon Nanotube 3D printer, Sharp carving tools attached to it and contains mouldable joints.	Prints interior objects , moulds them , fits them to the structures	50 bots employed (45 will be converted to modular bots later)
All-purpose bots	Bots with mechanical arms, thrusters and environmental Control sensors. They will also encompass a warm pressure steam-water spray paint jets after external construction is done.	Tests the work done by the other two bots using IR and laser pin-point sensors .Once construction will be done , according to the resident , the house will be painted by these bots	50 bots employed (All will be converted to modular bots once construction process is done)

Shown below the heavy duty construction bot and the transport utility at the settlement.





5.2 FACILITY AUTOMATION

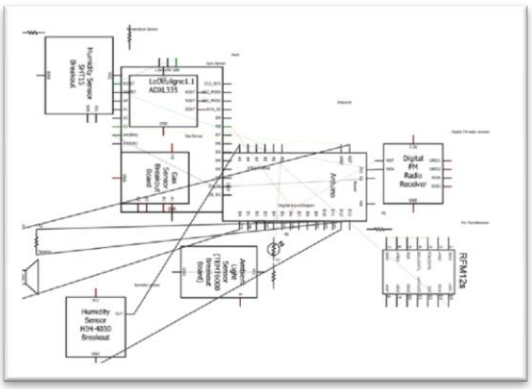
Field of work	Associated Problems	Automated systems Employed
Settlement maintenance and Repair	Any damage to the houses , Damages to roads , infrastructures , Damages to the external hull of the settlement	Bots used in construction(5.1)will be used
Safety functions(Backup and Contingency)	The settlement is to be provided with robots which will physically maintain the settlement, Planned routines during any calamity.	Splash system , Modular bots
Monitoring Systems	All the Environment conditions to be monitored	Housekeep , Surround Monitor, DetectBots

AUTOMATIONS

THE CONTROL CENTRE

All the administrative members will be provided special password protected mobiles which will have elevated privileges so they can monitor any system under their jurisdiction. All systems will be encrypted and can only be accessed by members of their department. Further people working in the ADM who monitor systems, will be given a new password every week. All the data transfers of the automation systems will be encrypted and will be monitored all the time. Special network frequencies will be used for high priority tasks.

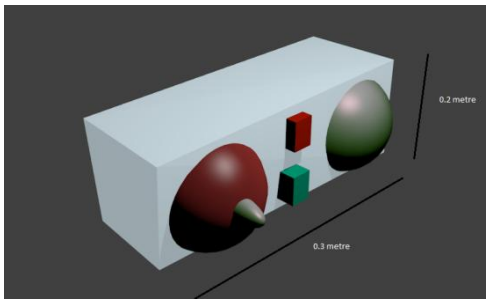
1. THE HOUSEKEEP



It is a system devised for monitoring and managing the conditions inside each Residential Complex. It encompasses a small box installed into all the factories, workstations and houses. It includes Temperature, Gyro, Gas concentration and even pressure sensors.
It collects data every 7 minutes and sends it to the ADM. The time of data stream of each module will be different depending on the type of infrastructure, meaning all warehouses will send their data at the same time, all houses will send their data at one time. Essentially each kind of infrastructure sends data at different time. This will ease up the tasks for the mainframe computer.
The temperature sensors monitor the temperature in every building detecting anomalies. In emergency or for a public message the Housekeep will also stream messages. If it detects any mishap, it breaks the seven minute routine and sends the data to the ADM immediately, whose computer processes it with the highest priority, since residents' safety is our highest concern.

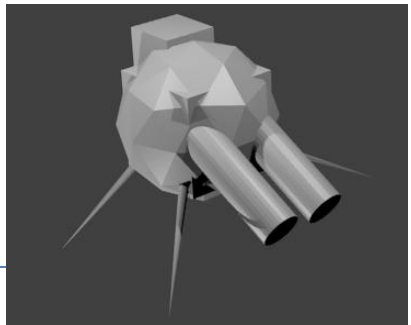
Gas sensors look for gas leaks or other harmful gasses. There will be an LCD screen which displays this data for the public.. A particular radio frequency will be reserved for the use of the housekeep. It also stores data for the past one month .Also , the data can be checked by any member of the settlement using a GUI based app on his phone.

2. SURROUND MONITOR



Above the entire settlement, there will be placed IR sensors, receivers and also thermal imaging sensors. Once the basic construction inside the settlement is done, these sensors will make a digital image of the entire settlement. These 2 different schemes of photos which will be generated will be used as reference images, one will be thermal and the other will be topographic. Once all roads and paths are built and houses and plots are allotted these reference maps will be digitally tagged. These will serve as the main reference image. It will then be marked with waypoints, road markers and important places like hospitals and PDS systems .Infra-red sensors located over the complete settlement will constantly create new maps after every 68 seconds. These will provide live traffic updates which can be viewed by a citizen. The automated transport system discussed further will also create their paths using these maps reducing traffic also coordinating with each other. These maps will be compared to the reference and if some critical difference arises, some pre-programmed steps will be taken (as explained in contingency).

Maps of the past one week will also be stored in a static storage system. These maps will be made in a minimalistic way so as to make their size small. [A photo of the prototype]
It will also form a crucial part of the emergency protocols.



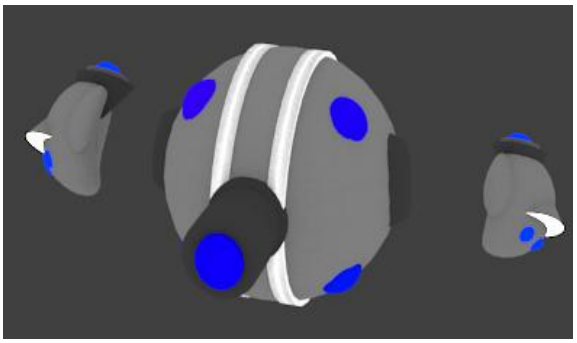
3. DETECTBOTS

>Special detection bots will be employed every 20 days at the surface of the Columbiat which will detect cracks and damages to the exterior hull. It will use ultrasonic detection to find these flaws accurately. Once these flaws are verified by the Scientists at the ADM. If these damages are minor and can be fixed by the mechanism in the DetectBots ,they will be fixed immediately but if they are severe and cannot be fixed by the Detectbots , the these bots will spray a temporary fix which fills the fracture by expanding till it is under sufficient strain . Later a team of astronauts physically go and fix this. Detectbots will use under-mounted ducted fans to achieve lift and fly around the torus, and will operate by internal batteries.

7 detectbots will always be placed to detect solar flares, these will be coated with polyethene XF1, its semiconductor chips will be encased with aluminium. They will encompass neutron monitors, GPS receivers and ionosondes hence they will inform about the effect of the solar flares 10 minutes in advance.

4. THE MODULAR DESIGN

This is one of the best innovations of Columbiat. Columbiat's robots are modular, i.e. they have replaceable parts. The same robots that were involved in the construction and assembly of Columbiat in Low-Earth-Orbit will be repurposed and reused by reusable universal arm brackets. Essentially, the robotic arms of the construction bots can be replaced by any other machine, such as water hoses for FireBots, weaponry for SecurityBots, etc.



The standard ModularBot is equipped with two robotic arms, a central computer, and a camera.

MECHANICAL SECURITY FORCE (SecurityBots): These will run either autonomously or by the administrators. They will be equipped with tasers, loudspeakers and 2 different colours of siren bulbs one blue and the other red. The blue bulb is activated only during calamities and disasters. They will also be equipped by a camera which will provide live feed. The security force will also be repurposed ModularBots. SecurityBots can also be repurposed into fire bots,

CONSTRUCTION - ConstructBots

They will also be equipped with a mechanical arm and will be automated. If required they will be able to work on commands by the Infrastructure Management department. These will have little storage space for raw materials and also access to the warehouses. They also work in unison, i.e. if a load is too heavy, Columbiat doesn't have larger bots to lift that load, it will employ multiple ModularBots to lift said load together. After the construction process is completed, they will be repurposed into modular bots. This ensures massive cost savings and demonstrates intelligent use of resources. These bots will use As for internal construction of infrastructure, there are seven HeavyDuty construction bots employed.

MEDICAL HELP

These ModularBots will be equipped with all the important medicines and utilities. Their modular parts will include a first aid dispenser, injection dispenser. Medical bots can also be repurposed into Repair mode, and using their precision arms and tools they can repair damages in Columbiat. If required, ConstructBots will help them lift heavy loads.

ADVANTAGES

- It will take approximately 3 minutes for a bot to be converted to another kind.
- The 200 modular bots which are commissioned do not have a particular division between these 3 types but are divided based on requirement. For instance during a calamity the construction bots will

convert to the Security and medical help bots. Or even to distribute a particular vaccine some security bots may get converted to medical bots

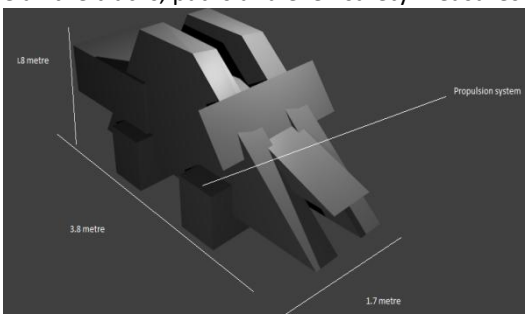
- The conversion process can also be overridden by the authorities according to the needs. This need based system is what makes modular robotics apt for our space settlement as it is efficient and extremely cost effective.

TAXI HUB

There will be an automatic taxi service in the colonies. The taxi's will run on electricity and will only be charged at their respective hubs. The residential colony will house 4 taxi hubs. These will coordinate and send taxis to the locations where taxis are needed.

Taxis can be summoned by the K1 Mobiles and will receive payment by them.
The taxi hub will also host another Heavy-Duty transport utility aimed at transporting industrial produce and raw materials from one location to another. This includes crop produce, cold storage materials, construction materials, finished products and other essential utilities.

The taxi hub will also employ a team of professionals who will monitor all the vehicles and even guide it. These vehicles unlike our conventional taxis will not require any human assistance to drive it around but will have the direct link with the monitoring system described above. It will have all the tracks, paths and even safety measures pre-programmed in it. However, in times of emergency, a citizen of Columbiat can choose to stop the taxi.



In case of any problem the operatives may guide or even remote control the vehicle.
As a safety measure a collision sensor will also be set up, it will basically perform two tasks, one being prevention and the other of helping after a collision. The taxis will scan for any vehicle or moving entity which is bigger than a particular size and has some particular characteristics and if it is another vehicle or a person the taxi will stop. These sensor will be lined throughout the taxi, and will be activated if another threat is detected at a distance of under 2 inches from the car. It will also function as a helping mechanism, along with the BAND, this will notify medical agencies on a collision i.e. the medical department will now receive 2 notifications, one from band and one from this sensor. This happens only when 2 cars collide or a person is hit. This 2 notification system is used by the medic department to be characterised as a symbol for an accident meaning, they will now send for help keeping in mind that this is a road accident.

Each vehicle will be tagged by a RFID to know about its whereabouts.

If any person owns a personal vehicle, it will also be tagged by the RFID and it will be synced to the owners K1 mobile .And the owner can check the location of his vehicle at any time.

CONTINGENCY PLANNING

When any calamity takes place, the HouseKeep will notify of change in any particular parameter in the settlement. Further, depending on the type of contingency, the vehicles will be made capable of getting pressurised and locked up until rescue. Each vehicle will hold a food reserve for 10 days and also some important medical supplies.The surrounding sensor will make thermal maps of the settlement and by protocol, it will coordinate with the housekeep; for e.g. if there is a fire at a building, or a building has collapsed, the housekeep will notify the ADM of a null value or a high temperature value, also the surround sensor will show change . This will notify the agencies of a problem also all paths made for the vehicles will be changed so as to leave the block in which calamity has been reported . During any contingencies the modular bots will convert to medical as well as security bots, they

will line up and create a track towards the escape pods. Also, backup servers and backup transmission lines will be set up for contingencies.

SPLASH-FREE SYSTEM

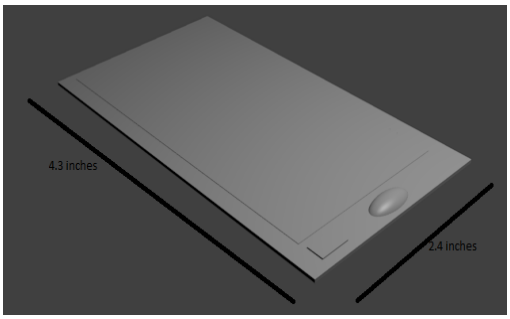
All infrastructures can be programmed to become air locked whenever necessary , if any fire is detected in any one of the infrastructures , The house is checked for presence of any human inside that infrastructure By checking if any band(refer 5.3) is located inside the infrastructure . If there is no band, the infrastructure gets locked down immediately and air is sucked out hence removing oxygen thereby stopping the fire. The outer fire will be stopped by modular bots.

5.3 HABITABILITY AND COMMUNITY AUTOMATION

LIST OF SERVERS IN THE COLUMBIAT

Name	Memory Cache	Processing Speed	Amount
MainFrame	800 TeraBytes	70PHz	1
Mainframe_2	800 TeraBytes	70 PHz	1
Mainframe backup	400 TeraBytes	50PHz	4
Operations	900 TeraBytes	45 PHz	10
Residential	200 TeraBytes	45 PHz	120
PDS	400 TeraBytes	45 PHz	61

THE ALL IN ONE MOBILE K1



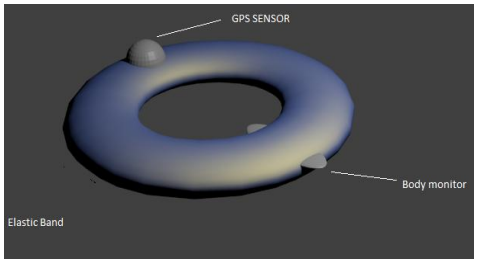
>A new state-of-art all in one mobile will be specially developed for the columbiat. Every person in the Columbiat will be allotted a digitally tagged mobile. It will also be used as an identity card. It will digitally contain information of the owner's family, his ration requirements, money in his account and other credentials.

>Even the temporary residents will also be allotted one and it will also include time of their stay.

> It will also function as a tracking system at times of emergency. Since it will be used very frequently by every person it will also be able to catch people who have overstayed their due time.

>Apart from being the conventional mobile it will also function as their wallet. There will be no currency in the Columbiat, There will only be credits which will be directly transferred to their Mobiles which they earn through their jobs or which are transferred through earth.

THE BAND



It is a simple band which is given to each member of the settlement on arrival, it monitors the heart pulse, blood pressure, and other important aspects, just like the housekeep this data is also sent to the mainframe to be processed and sorted for any anomaly it sends a modular medibot (described ahead) for help and if the problem is serious, an ambulance. It is also digitally tagged and synced with the K1Mobile Phones.

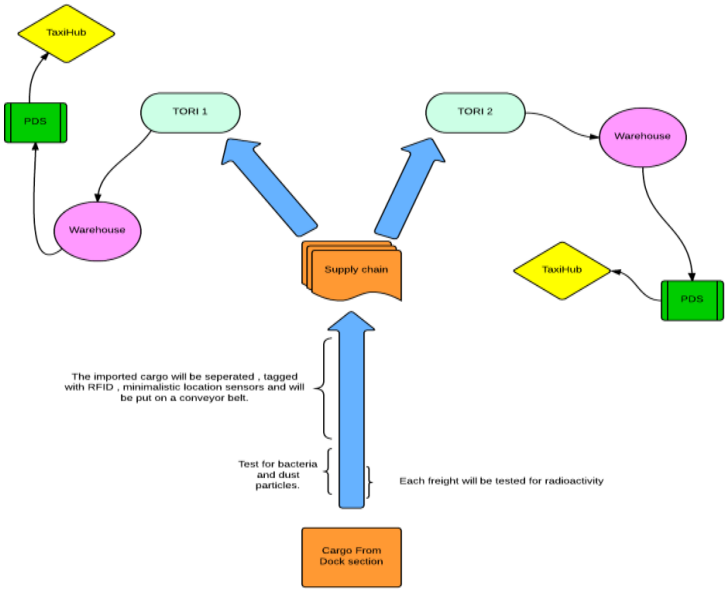
MOBOBOT

It is an advanced multitask robot to assist in household tasks like cleaning, vacuum, basically carrying out all sanitation tasks. It will be equipped with the basic tools which one would require at a home.

5.4 - MANAGEMENT AND INVENTORY

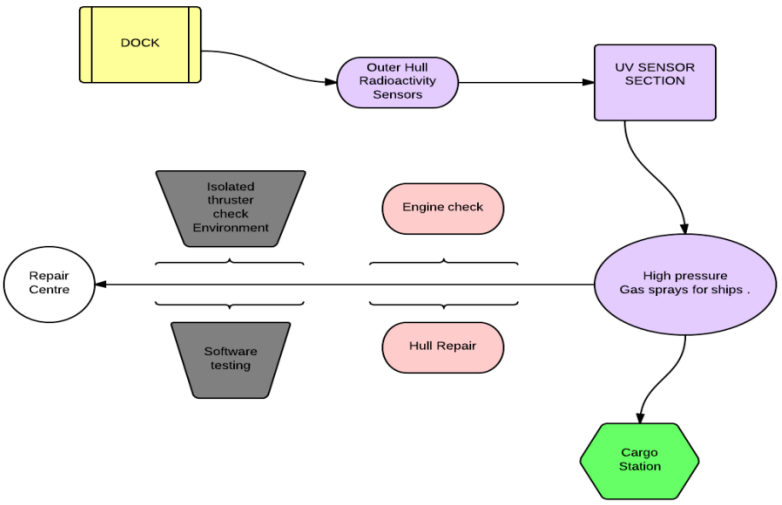
All the cargo which will enter the settlement will be tagged by a digital RFID sensor and also a barcode sensor, they will monitor the location of the cargo as well, location status and the details of the cargo. Once the cargo reached its location the tag on the cargo will be set as delivered. Any official employee can see the status of a cargo with the K1 mobile.

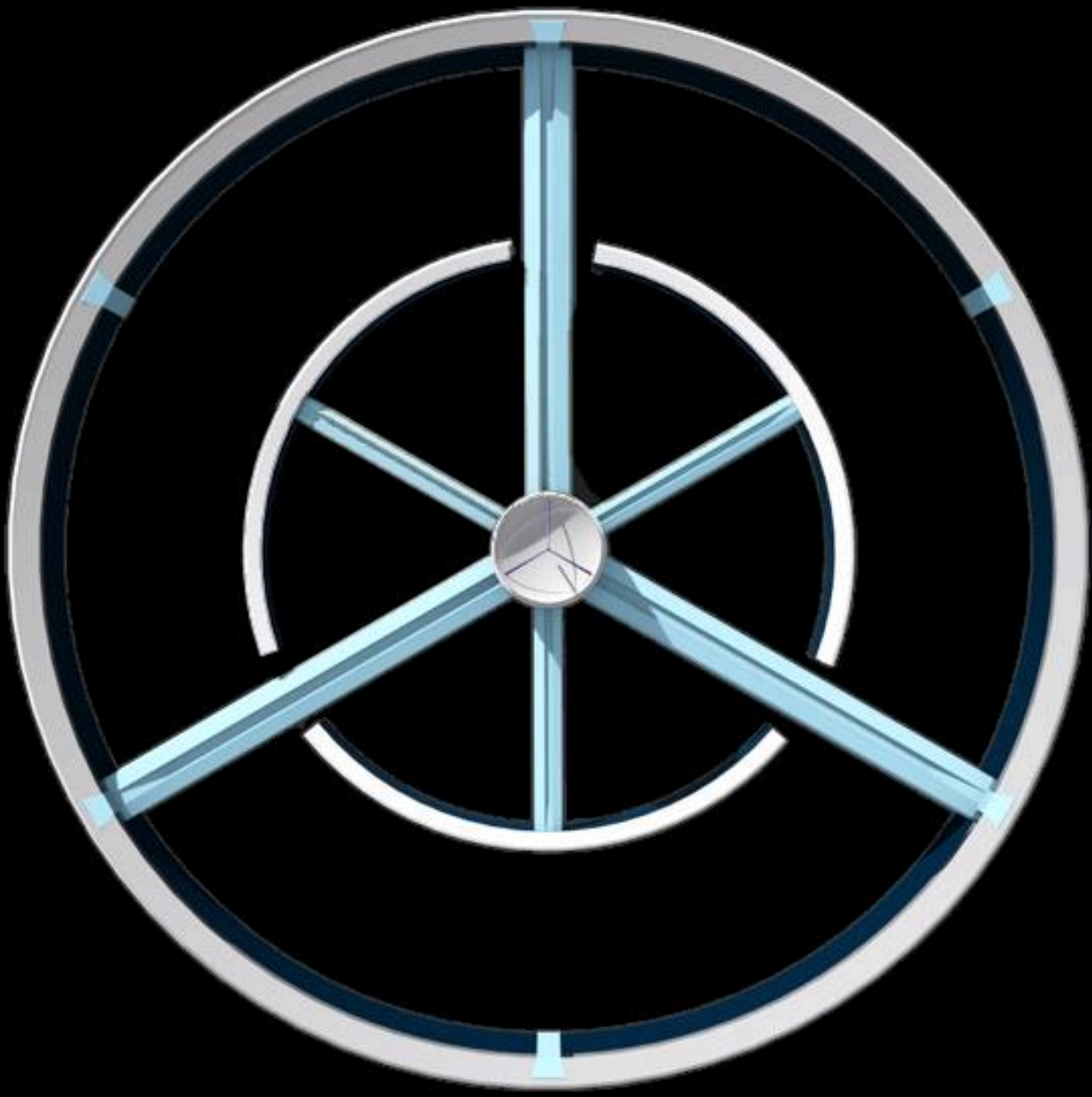
This is a render of our unloading tube. The cargo will travel in the cuboidal tube (golden). The black pistons will push down the cargo in the respective delivery tubes sending the cargo to a particular tube. (Blue is for the outer torus, purple is for the sub-1G sections.



5.5 DOCKING STATION

As shown in the diagram, each ship will have to go through a series of decontamination processes, once a ship reaches the repair centre, it can transfer its damaged robots to the Repair Centre and return to the dock.
> In the repair centre, there will be employed 25 trained engineers.
>The repair facility will first test all the robots and ship parts for possible dust contamination and radioactive contamination in a pressurised room using blue light IR detectors, UV scans and couple of other optical based scans.
>The repair facility will house a special room where the temperature and pressure conditions can be manipulated by the engineers and the robots and ship parts can be fixed under suitable conditions.
>It will also house several Compound based 3D printers and will be able to print out robot and ship parts in many different materials according to the robots needs.
>Once the robot structure is fixed, the robot software code will be tested and fixed, and the ship's software will be simulated on Columbiat's systems, checked and fixed if necessary.





SCHEDULE AND COSTING

SCHEDULE AND COSTING

PHASE 1 AND 2	
PROCEDURE	**COST**
Research and Development	$10,000,000,000
Designing and Outlining	$4,000,000,000
Analysis	$5,000,000,000
Total	$19,000,000,000

PHASE 3	
MATERIAL	**COST**
Transportation to LEO	$10 billion
Titanium and Aluminium	$3.5 billion
Silicon Bucky Structures	$4.5 billion
Aluminiumoxynitride Glass and Fused Silica Glass	$450 million
Carbon fibre	$900 million
Solar Panels	$210 million
Total	$19.56 billion

*Phase 3 includes construction steps 1, 2, 3, 4.

PHASE 4	
MATERIAL	**COST**
Titanium and aluminium	$3.5 billion
Construction Shack	$700 million
Silicon Bucky Structures	$15 billion
Aluminiumoxynitride Glass and Fused Silica Glass	$900 million
Other materials	$1.2 billion
Transportation to LEO	$13.1 billion
Transparent Solar Panels	$480 million

*Phase 4 includes construction steps 5, 6, 7, 8. The reason silicon bucky structure and transportation costs are low is because silicon buckystructures will not be sent up from the Earth but they will be imported directly from Bellevistat. Only the rest of the materials will be transported.

Phase 5-A: Housing Costs			
HOUSES	**NUMBER OF HOUSES**	**COST PER HOUSE**	**TOTAL COST**
Houses with children	15000	$2,400,000	$36,000,000,000
Houses without children	1100	$1,250,000	$1,375,000,000
Condominiums for single men	287	$2,200,000	$631,400,000
Condominiums for single women	191	$2,200,000	$420,200,000
Total			$38,426,600,000

PHASE 5-B:SUB SECTION COSTS			
CATEGORIES	**NO.OF UNITS**	**COST PER UNIT**	**TOTAL COST**
Clinics	3	$1,600,000	$4,800,000
Administration	3	$2,800,000	$8,400,000
Warehouses	3	$1,100,000	$3,300,000

PDS Centres	3	$640,000	$1,920,000
Industries	12	$8,800,000	$105,600,000
Automation Repair Centre	3	$2,200,000	$6,600,000
Recreational activities -		-	$12,000,000
Restaurant	3	$2,400,000	$7,200,000
microG Research Labs	1	$6,600,000	$6,600,000
Morgue	2	1,250,000	2,500,000
TOTAL			$165,920,000

Phase 5-C: Interior Construction Costs			
CATEGORIES	NO. OF UNITS	COST PER UNIT	TOTAL COST
Banks	**3**	$3,300,000	$9,900,000
Shops	**8**	$1,000,000	$8,000,000
Restaurants	**10**	$2,800,000	$28,000,000
Malls	**1**	$7,700,000	$7,700,000
Hospitals	**2**	$8,800,000	$17,600,000
Clinics	**5**	$1,500,000	$7,500,000
Hotels	**2**	$11,000,000	$22,000,000
Schools	**2**	$2,560,000	$5,120,000
Colleges	**2**	$3,200,000	$6,400,000
Community Centres- (casino, clubhouses, recreational games)	**6**	$5,500,000	$33,000,000
Administraton	**1**	$2,800,000	$2,800,000
Research lab	**1**	$6,600,000	$6,600,000
Offices (150 offcials)	**4**	$2,200,000	$8,800,000
Offices (100 persons)	**8**	$1,650,000	$13,200,000
Offices (30 persons)	**15**	$990,000	$14,850,000
Offices (5 persons)	**30**	$400,000	$12,000,000
Headquater (300 persons)	**1**	$4,400,000	$4,400,000
Ware houses	**12**	$1,100,000	$13,200,000
PDS centers (Public Distribution System)	**10**	$640,000	$6,400,000
Automation repair center	**8**	$2,200,000	$17,600,000
Day care facility and assisted living	**2**	$4,800,000	$9,600,000
Cycle stands	150	$10,000	$1,500,000
TOTAL	270		**$256,170,000**

PHASE 6 – SPACE ELEVATOR	
MATERIAL	**COST**
Silicon Bucky Structure (for ribbon)	$14 billion
Silicon Bucky Structure (for elevator)	$180 million
Titanium and Aluminium for Lunar surface operations	$780 million
Total	$14.96 billion

SYSTEMS OF COLUMBIAT	
Food Production (total)	$11 billion
Electrical Power Generation and Distribution (aside from cost of solar panels)	$2 billion
Internal and External Communication Systems	$3 billion
Internal and External Transportation (including propulsion systems of Columbiat)	$8.5 billion
Atmosphere Control (including transportation of atmospheric supplies)	$4 billion
Waste Management	$4 billion
Water Management	$4 billion
Day/Night Cycle	$200 million
Total	$32.7 billion

MAINTENANCE COSTS	
Maintenance of operational systems	$5 billion
Maintenance of Human Factor Buildings	$8 billion
Maintenance of robots	$2 billion
Maintenance of Communication servers	$13 billion
TOTAL	$28 billion

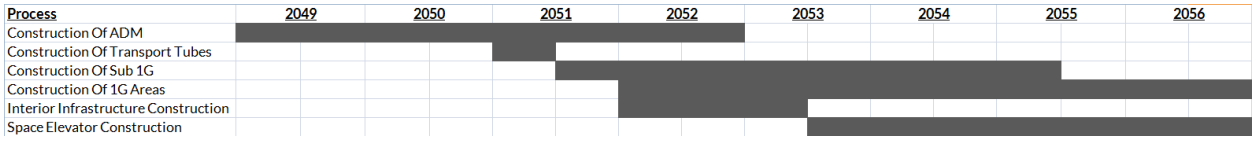
AUTOMATION			
NAME	COST per unit	QUANTITY	TOTAL
Heavy Interior Construction Bot	$100,000	40	$4,000,000
Precision bots	$40,000	50	$2,000,000
All purpose bots	$55,000	70	$3,850,000

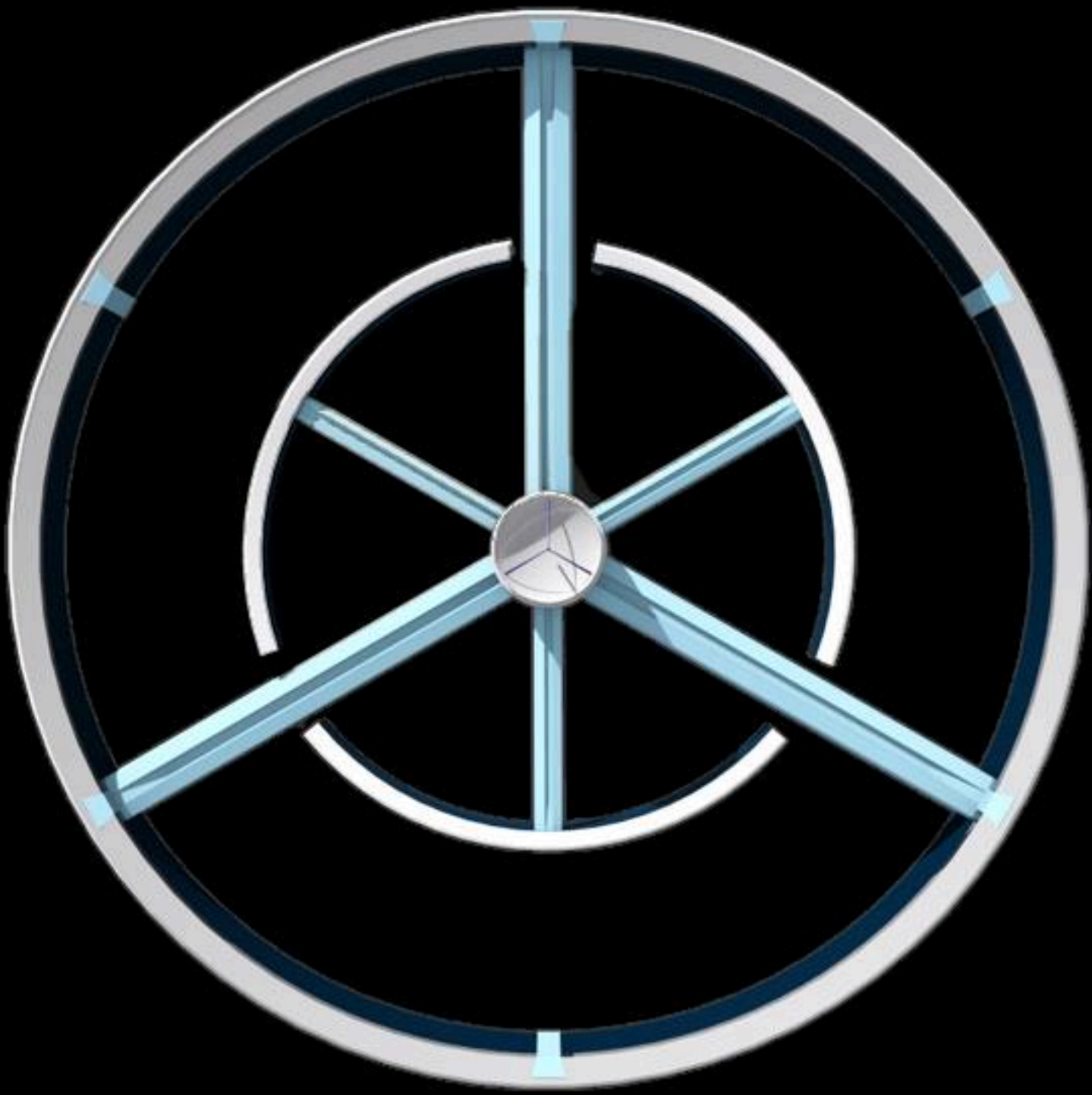
Moduar bots (first used for construction)	$70,000	1,000	$70,000,000
Housekeep	$10,000	20,000	$200,000,000
Surround Monitor	$15,000	40	$600,000
Taxi hub	$10,000	10	100,000
taxi	$90,000	200	18,000,000
K1 mobile	$1,000	26,000	$26,000,000
Band	$1,500	26,000	$39,000,000
MoboBot	$25,000	18,000	$450,000,000
DetectBots	$30,000	40	$1,200,000
Servers and Computers	$4,000,000	197	$788,000,000
Software for all systems in Columbiat	-	-	$4,500,000,000
Total			$6,102,570,000

FINAL COST	
Phase 1 and 2	$19 billion
Phase 3	$19.56 billion
Phase 4	$34.88 billion
Phase 5	$15.8 billion
Phase 6	$14.96 billion
Automation	$6.1 billion
Systems	$32.7 billion
Maintenance	$28 billion
GRAND TOTAL	**$171 billion**

Economic inflation has not been considered, and the precise total cost is $171,000,000,000.

SCHEDULING





BUSINESS DEVELOPMENT

7.1)TRANSPORT NODE AND PORT: - There will be a separate section for transportation in the ADM . The transport hub will be divided into three sections .The largest section will be the PRIME NODE - all the ships that land here either bring people or cargo to the settlement

While docking the ship will be assisted by the ADM n docking locations . Once the ship has been authorised for docking , it will be allocated a node . All civilian passengers will get off the ship here and visit the administrations section . Then the ship will go to the refueling and repair section if required . The second will be specially used for cargo transfer only . Ships bringing supplies and cargo will dock through this section . All the cargo from ships will be unloaded and put in the conveyor tube . This section is what will be primarily used for the heavy payloads and transport of materials for lunar development The third docking section will be reserved for emergency landings , for instance a ship is damaged and is incapable of landing , ships from this section will be deployed to haul these rescue the people and haul the ships in these sections . Along with these sections , there will alsobe set up locations on the ADM where ships can quickly refuel their propulsion oil.

An Administration section will be set up in the ADM , here the management of people going inside or outside the settlement will take place . Any person entering the settlement will go through a full background check . Once they have been verified , they will be given a BAND (refer automation 5.3), a K1 mobile(refer 5.3) and a new generated barcode will be digitally tagged to their BAND and K1s . This will serve as their digital Identity inside the settlement . People will also be able to transfer money to their accounts so that they can use them through their K1 phones. There will also be a customs check at this place . Any person leaving the settlement will also have to leave through the administrative section . Here they have to deposit their K1 mobiles and their bands . The people will be given an option to store digital data from their mobiles on an online server of a transfer drive so that they could access it once they leave the settlement . These people will also go through a customs check and they wll also be made to fill their dues and fines if any .

7.2.1)OFFICE FAILITIES: -We provide huge offices with luxurious amenities which will enable them to set up their headquarters. We give high speed internet, conference rooms, and research labs. Movable walls also help in making the area specific things better and this solves the problem of people, by using movable walls huge amount of people can be accommodated in one place during large conferences. We also provide computers and digital furniture which enables the officers to work with ease. The robots also add as an assisting luxury. The private robots handle the transport work or they just help the officer they have been assigned to. The security there would be of the highest class with CCTV's all over the place installed with night vision and multi zoom. Each employee would be given an ID Card which they will swipe at the gates and then only they would be allowed to enter. Moreover, a finger print scanner would also be installed for increased security. There will be robotic guards on the gate. There would be projectors installed in each room, each connected with director's room so that any important announcements can be made instantly. There would be the facility of intranet, which would provide various departments of a company to interact with each other. Each company would be given its own website to operate, which will make it possible for the customers to buy the products only from their homes only and provide support to the customers.

7.2.2) BANK FACILITIES - Columbiat will have three banks with further scope for expansion. The computers in the banks will connected by optical fiber, which will maximize the communicating speed.24x7 ATM service will be given by the banks to their customers and these ATM's will be located in every district. This will reduce the risk of carrying cash for the customers. Special helpline nos. will be provided to them by the settlement which they can use to solve the grievances of the customers. Moreover, loans, financial aid and financial advice will be provided by the employees of the bank to their customers. The rate of interest will depend on the usage of money from the loan and the time period. They will be various options available to the customer for the repayment of loan. The repayment can be done in terms of cash, kind or service which is beneficial to the bank. High security lockers would be made available to the customers with biocote anti-bacterial protection as standard which reduces the risk of cross contamination from services with high frequency. Digital Cash facility will be made available to the customers. Digital Cash is an electronic currency that exists only in cyberspace. The customer needs to pay the amount of cash he wants as digital cash to the bank and then the bank will send a special software through which customers can make online purchases resolving the security problems related to credit card.

7.2.3) FACILITIES FOR NEW FOUNDATION SOCIETY HQ

The New Foundation Society Headquarters will cater to 300 member staff with a scope for further expansion. The office will be luxurious and equipped with the latest technology, digitalized furniture, high speed internet, research labs and huge conference rooms. Special robots will be provided to the headquarters who will carry out the required work efficiently and effectively. The headquarters will be connected by fiber optics, which will provide for maximum transfer speed. There will be a food automator which will provide for any type of food required. The employees will be constantly trained by experts and professionals to improve their productivity.

7.2.4)COMPUTING CENTERS

Computing Centers will be provided to company to overlook the transaction and ensure its safety. Centers will enable secure networked internal communications for each company and will take care of the interconnectivity for transferring data.The data sent to the other companies would be encrypted with world class encryption There would be firewalls and IDS installed to protect any unidentified person to gain access

7.3) SPACE ELEVATOR OPERATION CENTRE

The space elevator of the space settlement will be operated through a special operation center built specifically for the purpose of providing power, monitoring faults and errors and guiding the space elevator capsule from the ring to the lunar surface. The solar power being used will be responsible for the rotational and translational motion of the elevator. The responsibility of operating this space elevator will be given to an external company which will monitor its functioning. Moreover the lunar surface will be made a tourist spot which will be supported by space elevator and the responsibility of maintaining this tourist attraction and providing facilities will be given to another external company thereby making the space elevator a business hub.

Sources of revenue -

1. **LAND AND PROPERTY -** The businessmen will buy land within Columbiat and set up their own commercial facilities to earn money. We will charge them for buying the land at the rate of just $1000/sq. ft. and help them in advertising their business. This way it will be profitable both for the Columbiat and the business since Columbiat will earn revenue and their business will expand and they'll get more no. of customers. Our experts will also help them setup and run their businesses and give them tips to expand it the very near future.
2. Buying & Selling of Private Land - The residents will either buy or rent the land available to them. The rates will be very less. The rate of houses will be 175% of the construction price to residents. The pricing ensures that the houses are affordable to all economic classes Columbiat is concerned with. The apartments would be given even at a lesser rate. If they rent a house, security deposit and an initial cost of around $100,000 will be taken from them which would be used in case they incur damage to the house. The rent would be decided on the basis of the size and location of the house. This way Columbiat can earn good amount of revenue and the residents will get a comfortable and luxurious place to live in.
3. Stock Markets - The stock markets will prove to be an important source of revenue for Columbiat. The residents and businessmen living in Columbiat can invest their money in the stock market. They would be charged a nominal commission of around 2% which would prove to be good revenue for Columbiat. This way, residents can get good returns on their investments and the companies will also get more capital to invest in their business operations. The companies will be charged a registration fees to get their stocks raised in the stock market depending upon the amount of capital they want to raise. The companies will also have to pay around 20% of their profits as taxes to the Columbiat. This would generate big amount of revenue for the Columbiat.
4. Lunar surface & Space elevator - Columbiat serves as a terminus to the lunar surface. Columbiat will charge visitors and passengers a small fee to use the lunar space elevator, which is safer than taking a direct trip in a spacecraft to the Moon.
5. Tourism - Columbiat will have many tourists every year who will stay at Kairos Hotels and Resorts and is one of the ultimate tourist destinations, being in space with the best view possible.

APPENDICES

Operational Scenario

- Space. The final frontier. It comes from the convergence of Chaos and Caligo. Going back to the very same place where we began. Not only where this odyssey began, not only where our adventures and misadventures began, but where life and science, as we know them, began. The only difference being, it's the third time over.
- These are the voyages of the human civilization. And the latest chapter in that story is the Columbiat. With the advent of new marvels of technology, even the seemingly clueless infant, who is aboard a vessel that as we speak, is en-route on its way to Columbiat, drop his jaws, much like the others in his company. It's a sight to behold, as they move around in outer space in Lower Earth Orbit they observe something unlike you've observed before. It's a marvel, it's Columbiat.
- The vessel enters its docking station, one with the intermittent glamour of Grand Central Station, yet it bustles like an Indian market, with life and liveliness.
- As we move on from the docking station, we arrive at the welcome center, the first formal greeting and welcome to the final frontier, at the brink of space, the ADM, the center of all operations, the place where it all begins and ends. It's homely and it's professional, airy, modern and impeccably clean and well-serviced.
- As the people wait, they are all provided with their access cards, currency and essential gadgetry for their life aboard this man-made marvel, and surprisingly enough this dispersal is through machines, efficient and effective.
- Because one of the ideals of this establishment is that man has strived and innovated for the past 20 centuries, it's his opportunity to kick back and enjoy his creations for the next 20.
- After the ADM comes the main Torus. One large piece of infrastructure made of the prime of materials at the zenith of mankind's scientific abilities. On the outside it appears as majestic as Kirk's USS Enterprise, the only difference... It's newer and it's better.
- On the first inside it is an integrated community. The layout, the first in its class, integrating the answer to all of man's logistic needs and also mastering the art of city planning, one block at a time.
- The community design brings to us the right balance of greenery and infrastructure, of metal and glass and of luster and brittle.
- Modular houses equipped with the sufficient resources, and robots and machinery that respond to every whim of the inhabitant are but one star in this wide, wide galaxy.
- Living here synonymous I the joy of living in on of trump's estates. Amenities are serviced, not manually but by bots and all new, revolutionary housekeep, it's Jarvis taken to a whole new level.
- Just because its space, it doesn't imply that we forget our own Earth. Hence , the columbiat brings to its visitors , greenery , libraries , advanced agriculture and even industries to give us what we need , at every step along the way , the way it is back home .
- Space no doubt is the final frontier, the brink of science and god, but man is only human. To address the concerns of entertainment and sports, we offer one sub torus that serves this very purpose.
- We move the next sub torus, one for agriculture, and 3D food printers, serving all nutritive needs, the way they should be – delicious that are nourishing.
- Undoubtedly the integrated systems of columbiat service all our needs. Taking a quiet moment to sit back and observe, we can observe supernovas , galaxies ,stars, moons and even meteors though the clear and united windows that guard us from the undiscovered space that lies ahead of us .

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http://img.clubic.com/01679942-photo-schema-d-un-reseau-smart-lighting.jpg

Human Factors:

http://members.tripod.com/the_uplinker/images/airlock1.jpg

Requirement	Where addressed	Page No.
The contractor will describe the design, development, construction and operations/maintenance planning for the Columbiat	1.0-executive summary	3
Providing a safe and pleasant living and working environment for 23,000 full-time residents, plus an addition-al transient population, between 2000 and 2500, of business and official visitors, guests of residents, and vacationers. Design is required enable residents to have natural views of Earth and the moon	2.1.1-Summary of structural design 2.1-exterior drawings	5
Identification of large enclosed volumes, their uses, and showing dimensions of major structural components and design fea-	2.1 drawings	5
Identify construction materials for major hull components.	2.1	5
Specify volumes where artificial gravity will be sup-plied, structural interface(s) between rotating and non-rotating sections, and rationale for selection of rotation rate and artificial gravity mag-	2.1	5
Identify volumes maintained in pressurized or unpressurized environments. Specify means for providing protection from radiation and debris penetration.	2.1	5
Percentage allocation and dimensions of interior “down surfaces”, with drawings Labeled to show residential , industrial, commercial, agricultural and other uses.	2.2	5
Describe the process required to construct the settlement, by showing the sequence in which major structural components will be assembled. Specify when artificial gravity will be applied.	2.3	6
Port facilities with simultaneous docking and unloading/loading of four cargo ships and one passenger ship, with long-term docking for one ship (For emergency repair. Provision for 100% expansion in future.	2.4	7
Construction of space elevator through extrusion of viscous buck structure feedstock through a catalyzing agent to form ribbons of the required dimensions. Formation of attachment interface as a thicker length of ribbon, upon achievement of required	2.5	7
Description of facilities and infrastructure necessary for building	3.0-summary of operations	10
Charts or tables for qualitative and quantitative assessment of materials and equipment required for the settlement construction	3.1	10

Requirement	Where addressed	Page no
Display of basic infrastructural elements for residential activities.	3.2	11
Layout diagrams displaying finished form con-versions entailing raw material ma-		
Graphic Representation of propulsion system(s), locations and interface(s) with the structure, propellant type(s), propellant storage, and description of thrust produced in each case.	3.4 3.3	19
Graphic Description of space elevator cab de-sign.	3.5	19
Illustrated community design a with description of amenities and services.	4.1	22
External drawings and interior floor plan of the least four residential floor layouts	4.2	27
Graphics showing visualizations of hand-rails,tether,cages and other systems enabling safe human exchange to any location or in low –g settlement areas	4.3	29
Floor layouts of arrival / departure areas and public areas of hotels, e.g., lobby, restaurant(s), and shops	4.4	31
Visualizations of seating areas and entertainment for space elevator passengers	4.5)	31
Numbers and types of computers, servers, soft-ware, network devices, and robots	5)summary	33
Robot designs, with their dimensions and illustrating how they perform their tasks.	5)Summary	33
Theoretically explanatory graphic visualizations of automated construction and assembly devices-- both for exterior and interior applications.		
Charts or tables listing anticipated automation requirements for operation of the settlement, and detailed identification of particular computers and robots to meet	5.1)	33
Graphic visualizations of robots and computers that people will encounter, and diagram(s) of network(s) and bandwidth requirements to enable computer connec-	5.3)	36
Illustrations, chart, or matrix showing inventory management system; and illustra-	5.4)	37
Graphics of robot repair facilities, including illustration(s) of measures implemented in order to prevent spread of dust contamination brought by visiting ships.	5.4)	37
Duration and completion dates of major de-sign, construction, and occupation tasks, de-	6.1)Timing	39
Chart(s) or Table(s) listing individual costs associated with different phases of con-	6.2)Costing	41
Business needs of columbiat	7.0) business development	