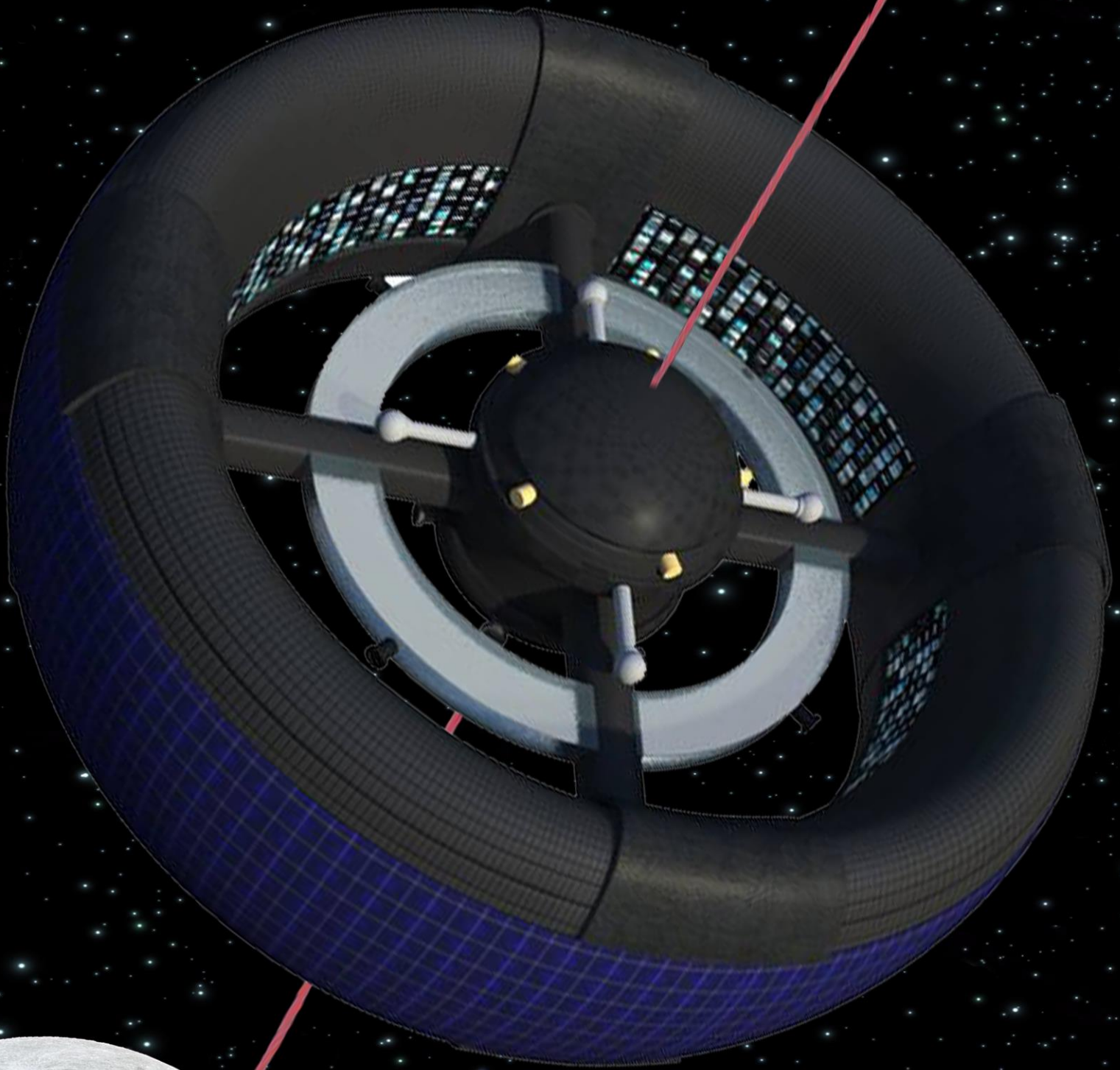
COLUMBIAT

Where Imagination Becomes Reality



PRINCESS MARGARET SECONDARY
SURREY, BC, CANADA

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

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

Aaaqil Hassan [12] (17)	Gaurav Modi [12] (17)
Hassaan Sheikh [11] (17)	Harshmeet Kang [12] (17)
Tarandip Gill [12] (17)	Khisrow Masood Hazhir[12] (17)
Ahnaf Aziz Anan [12] (18)	Kirnpreet Kaur[12] (17)
Aireen Aquino[12] (17)	[ ] ( )
Albert Ybanez [12] (17)	[ ] ( )

Names of two adult advisors currently expecting to attend the Finalist Competition:
Joe Sihota
Bhupinder Singh Rathore

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, Florida, USA.

Responsible Teacher/Advisor Signature

April 15th, 2014
Date

1.0-EXECUTIVE SUMMARY

1.0 - Executive Summary

The third space settlement to ever exist in the vast universe was engineered by our company in accordance with the contract awarded by the Foundation Society on May 15, 2049. This new design will act both as the primary business and banking center in space and home to tens of thousands of residents and visiting guests. Its innovative design will bring a new dimension of civilization – commerce – to space and serve as the foundation extra-terrestrial economy, hence living up to its name.

Our proposal has been categorized in the following departments which handle the various features of Columbiat: Structural Design, Operations & Infrastructure, Human Factors & Safety, Automation Design & Services, Schedule & Cost, Business Development, and Appendices.

Columbiat's innovative design is an extension of our structure team's ingenuity and creativity. The settlement will maintain an artificial gravitational magnitude similar to that of Earth's and rotates at a RPM of 1.0, which lowers the likelihood of the Coriolis Effect. These measures will ensure the satisfaction of residents and guests, our top priority.

Columbiat will also be the first settlement to possess a space elevator to the lunar surface, which will act as a mode of transportation between Columbiat and the moon, allowing personnel and goods to travel in comfort and safety. This advantageous asset will provide an alternative experience to visitors who navigate via the moon to the settlement and vice versa. It will also create lunar exploration opportunities, improving the chances of utilizing the abundant resources available on the moon.

A compatible operations and infrastructure will derive the most out of Columbiat's innovative structure. Our method of agriculture will ensure a constant supply of food. Utilizing techniques such as vertical farming, we will be able to drastically increase the amount of crops grown while simultaneously reducing the area needed for agricultural production, ensuring that all residents enjoy a healthy lifestyle in abundance. The implementation of such techniques is the essence of Columbiat, emphasizing on the use of technology to create a truly "human" experience.

Our automation team will incorporate automated systems and machinery throughout the settlement to assist residents in their daily lives. Efficiency, precision, and cost-reduction are considered the top priorities for such machines. The construction of Columbiat itself will be a prime example of such machinery in action, as the entire structure will be built using automated robots. Resident lives will also be improved through smart devices such as the Intelligent Chrono Graph (ICG), and ubiquitous services like Skeletal Computing and Cloud Storage.

Our schedule and cost is accurate and well budgeted. We believe it is possible to build a world-class settlement while remaining cost-effective. Columbiat will aid humanity's expansion into space and will yield superb return on investment. With our capabilities, Columbiat will be completed in 19 years and will cost just 161.25 billion dollars.

As the primary business and banking in space, business development opportunities are naturally abundant on the settlement. Its initial revenue streams consist of the Transportation Node and Port, Commerce and Financial Center, Space Elevator, as well as the ICG Monetization Ecosystem, all of which are "sufficiently flexible to add compatible business types with little configuration change."

Columbiat will revolutionize space travel, tourism, and economy. Our company believes that the proposal we have devised will satisfy every aspect and beyond of the minimum requirements laid down by the Foundation Society, and would very much so be privileged to again be a part of this historical event.

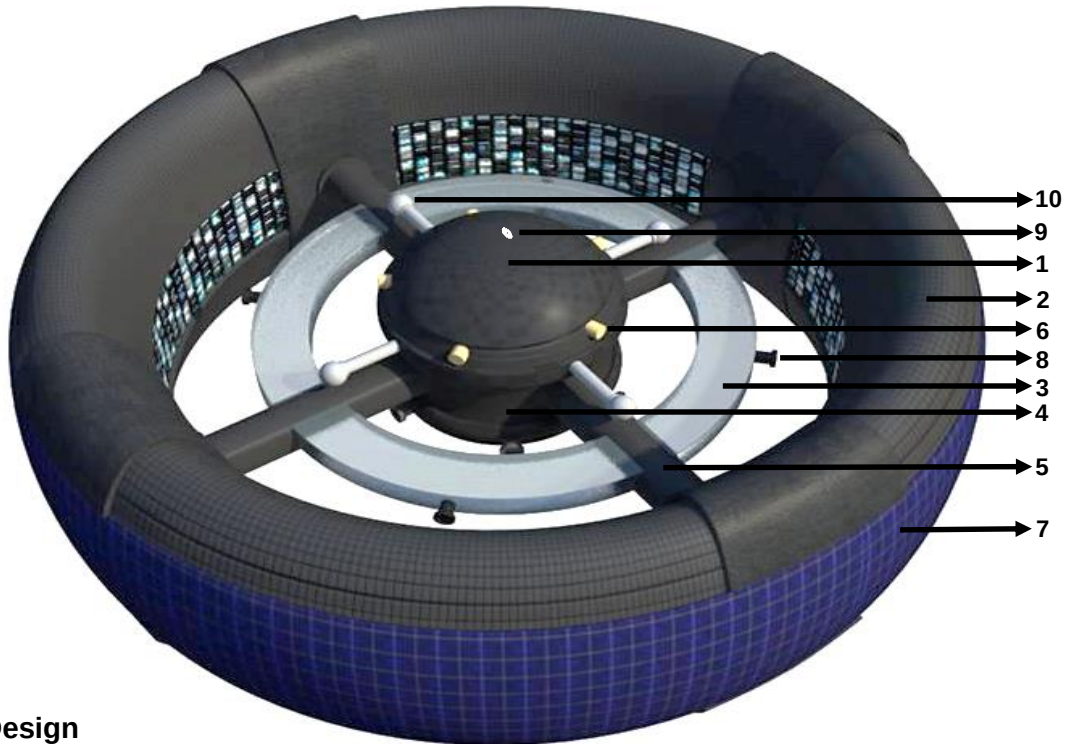

2.0-STRUCTURAL
DESIGN

2.0 Structural Design

Positioned as the primary business and banking center in space, Columbiat's structure is designed to ensure maximum efficiency while providing a safe and comfortable living environment for its 23,000 full-time residents and 2,500 visitors.

2.1 – Exterior Hull

Fig. 2.1.1 – Major Visible Features of Columbiat



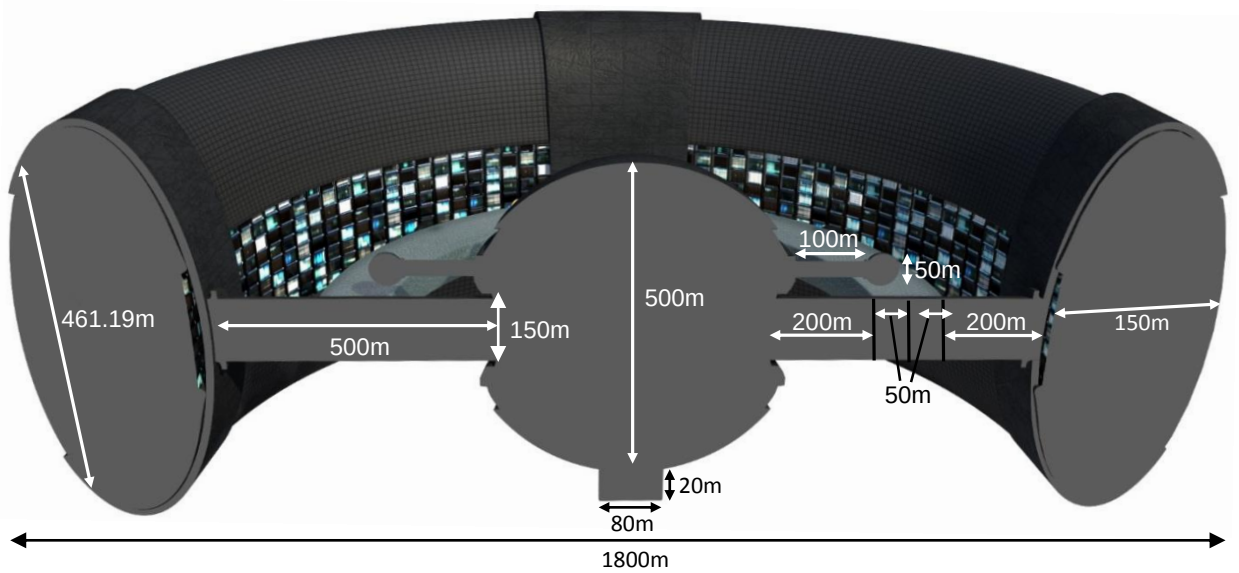
2.1.1 – Design

Its design consists of the following key structural components: the central sphere, the residential ovular torus, the agricultural/storage disks, the elevator cylinder bay, and the transportation and structural support spokes.

Table 2.1.1 – Major Component Key for Fig. 2.1.1

Key	Component	Rotating/ Non-Rotating	Pressurized/ Non-Pressurized	Utilization
1	Central Sphere	Non-Rotating	Pressurized	Hub of industrial sector
2	Residential Ovular Torus	Rotating	Pressurized	Housing for residents/transients
3	Agricultural Disk/Storage disk	Rotating	Pressurized	Agricultural production Cargo/excess supply storage
4	Elevator Docking Bay	Non-Rotating	Pressurized	Visitor/Transit Accommodations
5	Spokes	Rotating	Pressurized	Support, internal transportation
6	Docking Ports	Non-Rotating	Pressurized	Docking, loading/unloading of ships
7	Solar Panels	Rotating	Non-Pressurized	Means of capturing sunlight to produce electrical energy
8	Thrusters	Rotating	Non-Pressurized	Used to propel, maneuver and stabilize the settlement
9	Antennae	Non-Rotating	Non-Pressurized	External Communication
10	Micro-g sphere	Non-Rotating	Pressurized	Recreation/Entertainment

Fig. 2.1.2 – Dimensions of Columbiat



2.1.2 – Rotations per Minute Rate

The rationale for providing an RPM of 1.0 is founded on the principle of reducing the chances of our citizen's experiencing the Coriolis Effect. Furthermore, a lower RPM would aid in reducing maintenance costs of the rotating structural components due to less wear caused by space debris. Rotation will be maintained by thrusters placed on the outside of the Agricultural/Storage Disk. An outer band containing fuel is placed around the agricultural ring with a length of 10m to sustain the usage of these thrusters.

2.1.3 – Initiating Rotation

To initiate rotation of the settlement, thrusters placed on the outer circumference of the agricultural/storage disk will be fired at a linear velocity of 95 m/s over a span of 24 hours to achieve the desired RPM i.e. 1 rotation per minute.

2.1.4 – Artificial Gravitation Magnitudes

Artificial gravity will be produced in the following areas: the residential torus, the agricultural disk, and the storage disk. For the torus, a gravity of 0.985g was chosen as the most suitable environment for residents as it simulates a gravity similar to that of Earth. A magnitude of 0.615g was chosen for the agricultural ring as it proves exceptional for plant growth. A lower gravity enables plants to accommodate a greater size and height. The storage ring accommodates a gravity magnitude of 0.560g, as a lower gravity is ideal for the locomotion of heavy objects.

2.1.5 – Protection from Radiation and Debris

The entirety of Columbiat will be enveloped in multiple layers of radiation tolerant materials to drastically mitigate the amount of harmful emissions reaching inside the settlement. These radiation tolerant materials include: Super Adobe (1.5m), RXF-1 (0.5m) and Silicon Buckystructure (0.25m). Super Adobe, the first of the radiological protection line-up, will constitute the outermost layer of the settlement due to its shock absorbency, also allowing for protection from space debris and micrometeorites. An additional layer of Silicon Buckystructure glass with a width of 0.20m will be used because of its thermal insulation and radiation reduction properties.

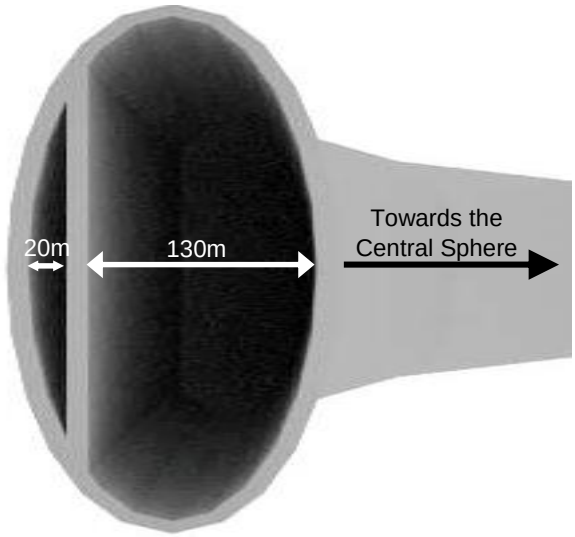
2.1.6 – Construction Materials

For full list of materials used in exterior hull construction of the settlement, refer to table 3.1.1 in Operations and Infrastructure.

2.2 – Internal Configuration

2.2.1 – DSA Allocation and Orientation

Fig. 2.2.1 – DSA Orientation of Residential Ovular Torus



Total DSA: 2,550,000 m²

Fig. 2.2.2 – DSA Allocation of Residential Ovular Torus

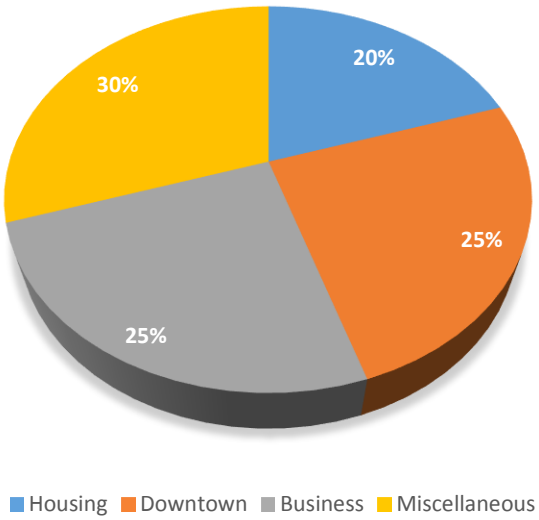
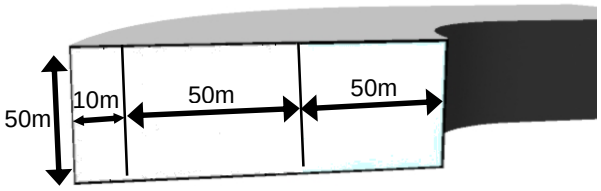


Fig. 2.2.3 – DSA Orientation of Agricultural Disk



Total DSA: 1,657,190.12 m²

Fig. 2.2.4 – DSA Allocation of Agricultural Disk

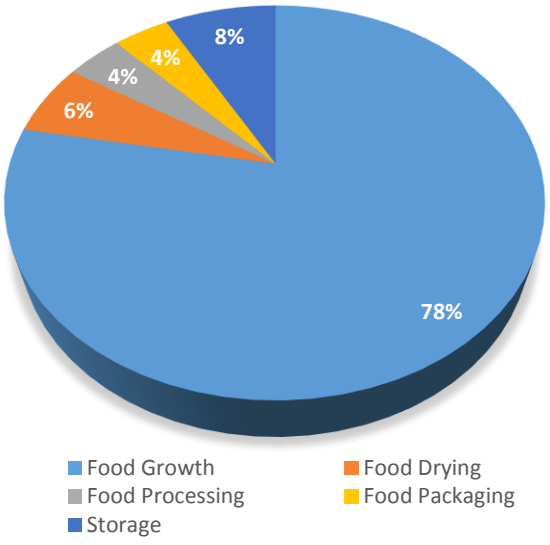


Fig. 2.2.5 – DSA Allocation of Central Sphere

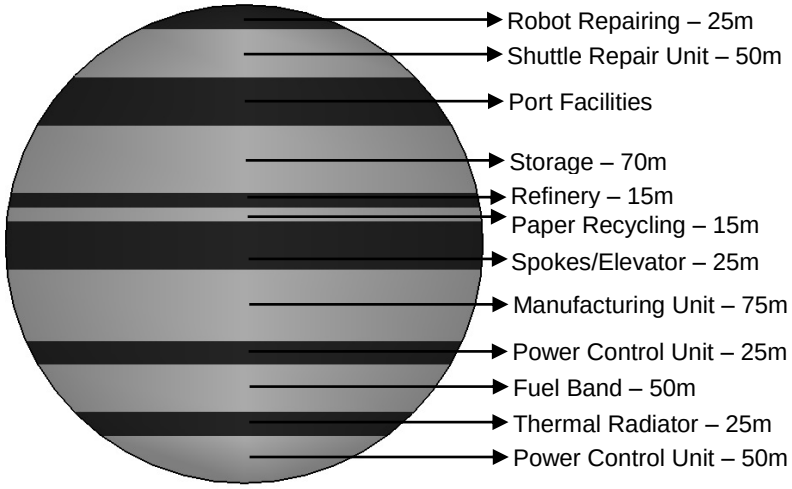
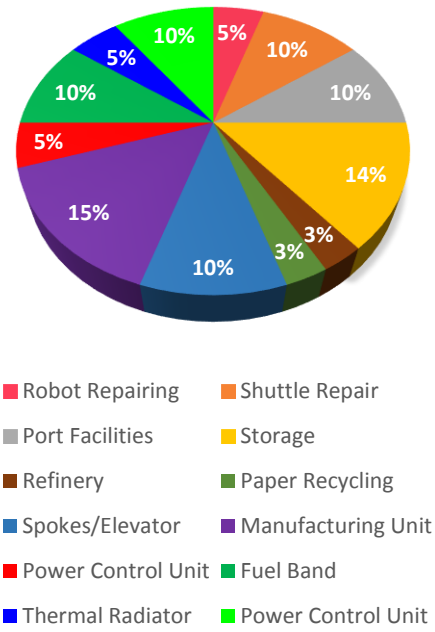
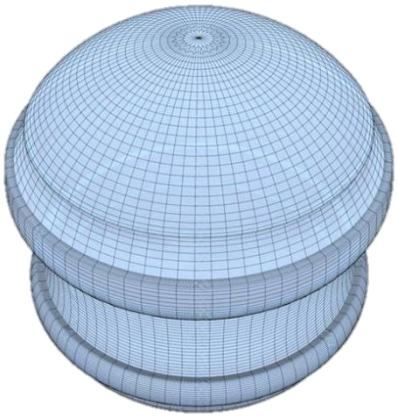


Fig. 2.2.6 – DSA Allocation of Central Sphere



2.3 – Construction Sequence

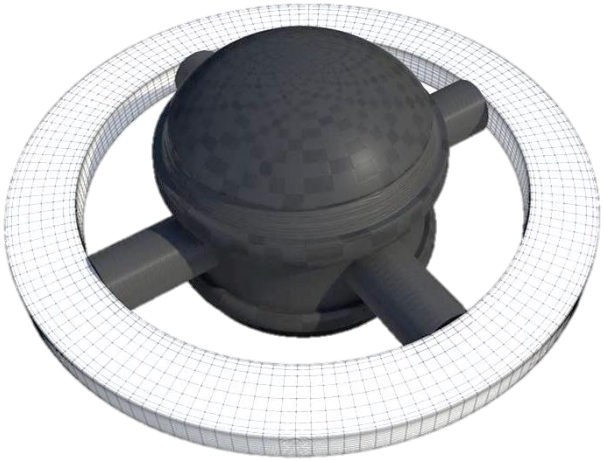
The following sequence of images shows the construction process of Columbiat:



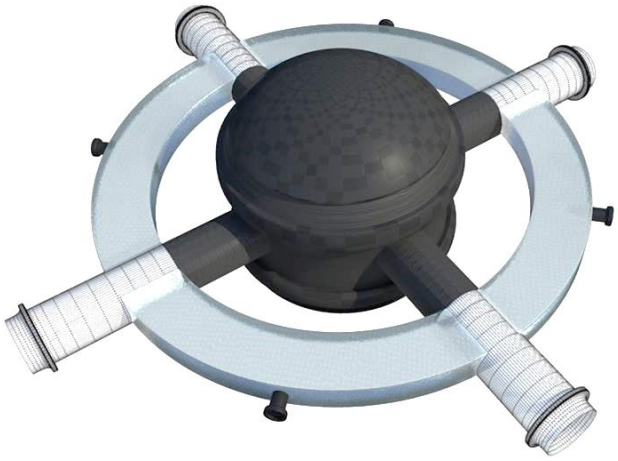
Phase 1: Framing and bodywork of the Central Sphere will commence once construction shack reaches site.

Phase 2: The 0g central sphere is complete. Work on the spoke framework up till the storage ring and the 0g elevator cylinder bay will now commence.

Phase 3: The spokes and the 0g cylinder are now complete. Interior construction of the Central Sphere will now begin. The settlement at this stage will connect with the space elevators' ribbons at both ends.



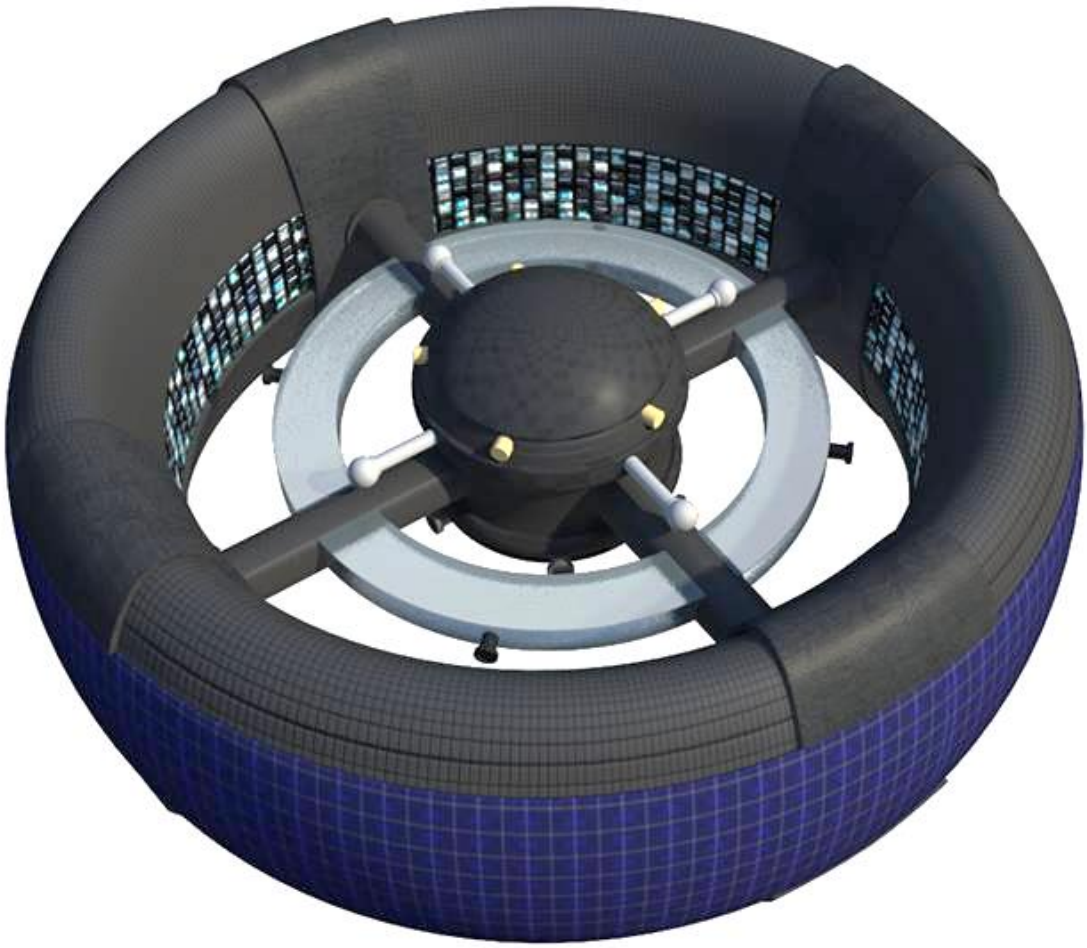
Phase 4: The frame and bodywork of the 0.56g storage disk, 0.62g agricultural disk and 0.63g fuel band will now begin.



Phase 5: The agricultural, storage, and fuel disks are now complete. The spokes will now undergo an extension past the disks to their final length. Thrusters will now be placed on the outside of the fuel layer.

Phase 6: The spokes are now complete. The 1g residential torus framework will now initiate from the spoke extension.

Phase 7: The 1g residential torus is complete. The construction of the micro-g spheres' framework, protruding from the central sphere, will now be carried out. Thrusters for station keeping will now be placed on the rotating band on the sphere. The disks and torus will now commence initial rotation at 1.0 RPM. Artificial Gravity will now be applied. Interior construction of the residential torus will now begin.



Phase 8: The micro-g spheres are complete. The antennae framework will now commence.

2.4 – Port Facilities

2.4.1 Docking Ports

The docking ports in the settlement will occupy a banded level on the central sphere. The height of this level will be approximately 75m above the rotating torus band, to provide sufficient space for transient ships.

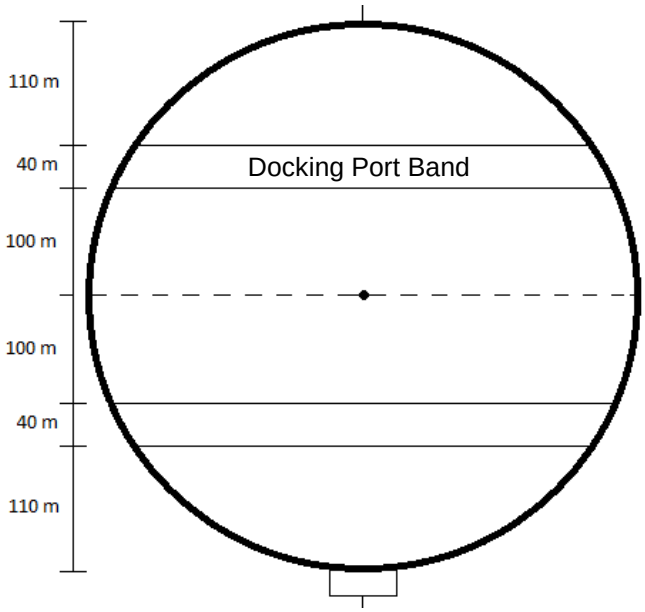


Fig. 2.4.1 Docking Port Band

This band will consist of six docking ports; four unloading/loading ports (Θ), passenger ship port (Φ), and a long-term docking port (Ϙ).

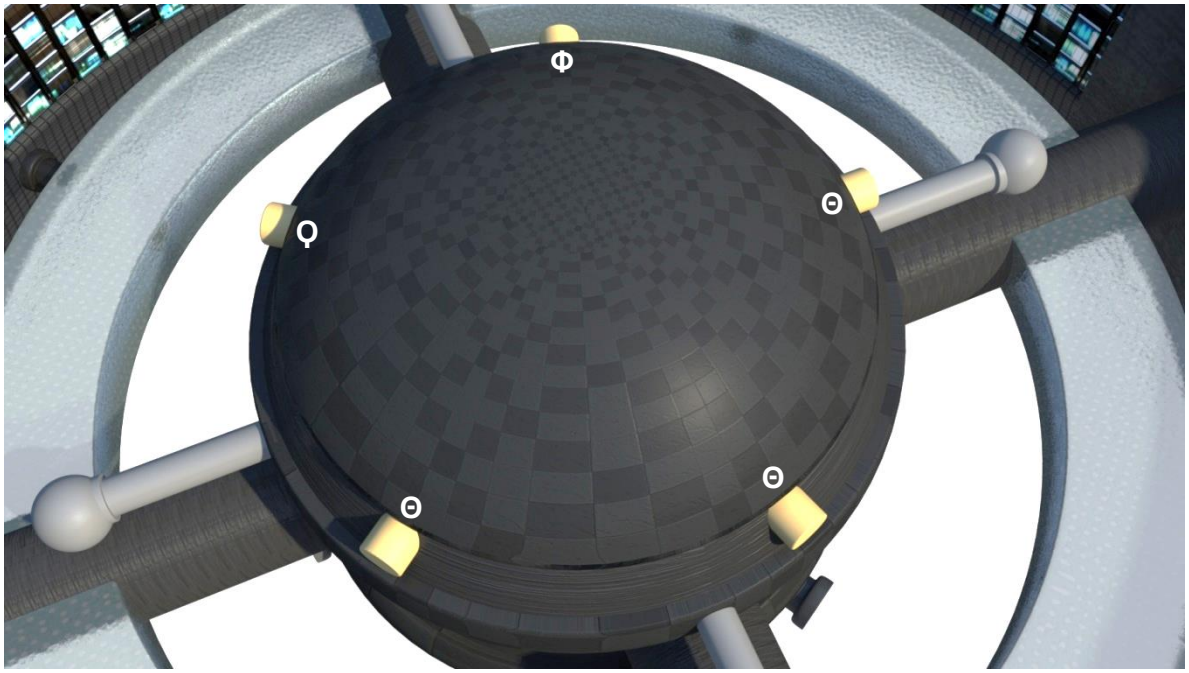
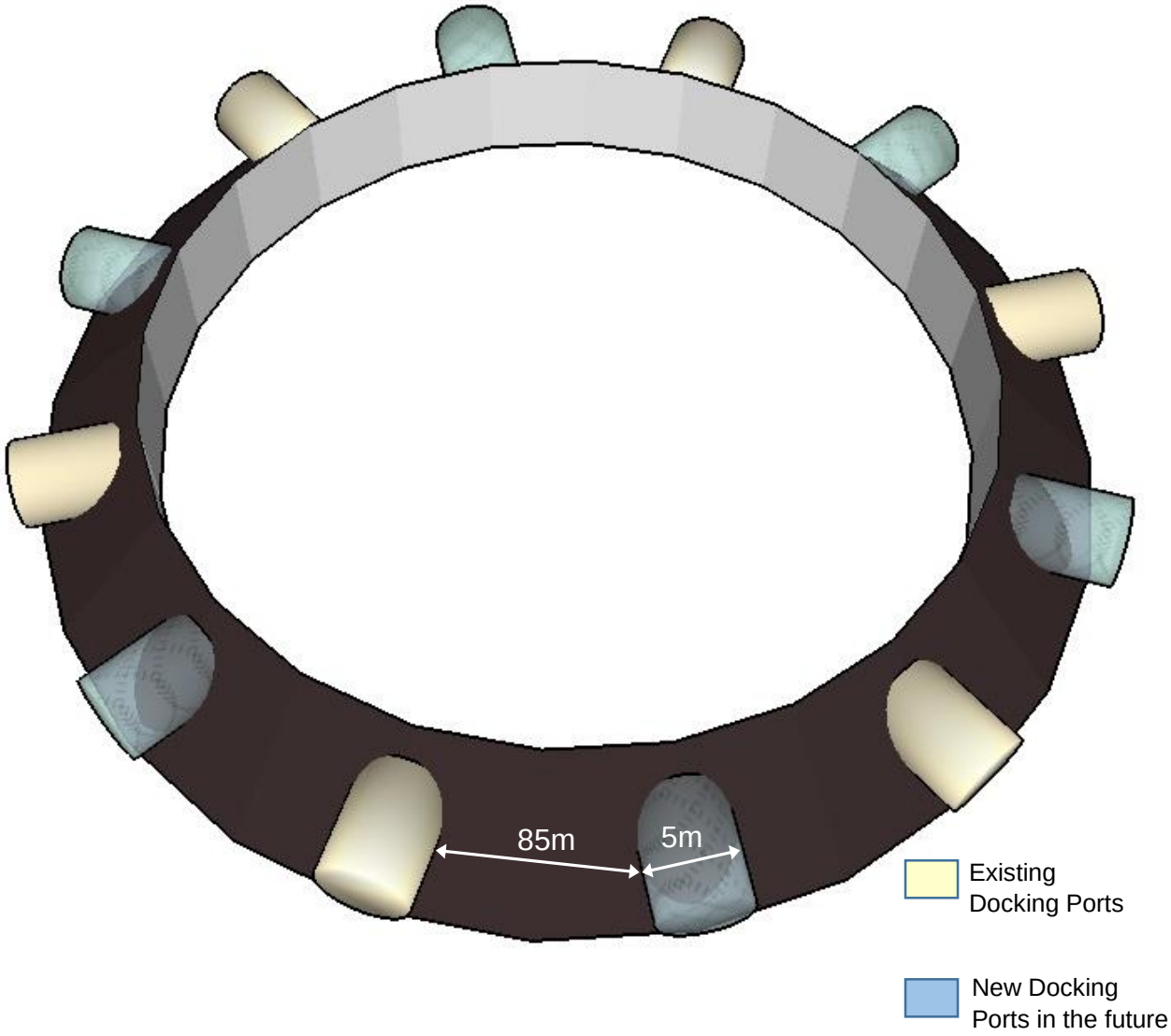


Fig. 2.4.2 Docking Ports

2.4.2 Future Expansion

It has the ability to expand to twelve docking ports in the near future. The location of these ports do not conflict for simultaneous docking due to the amount of clearance provided for each of them.

Fig. 2.4.3 Docking Ports Future Expansion



2.5 Space Elevator Attachment Interface

For Attachment Interface, refer to 4.5.


3.0-OPERATIONS &
INFRASTRUCTURE

3.1 Construction Parameters

Columbiat will obtain the majority of its construction materials from the Moon, due to its close proximity. Being placed on the Earth-Moon L1, transporting materials from Moon greatly reduces construction costs. In addition, these materials also provide protection against the harsh space environment, providing strength and stability to the design of the Settlement.

Table 3.1.1 - Types, amount and sources of construction materials

Materials	Width	Source	Application
Solid Materials			
Super Adobe	1.5m	Moon	Applied as a shock absorbent material along with protection from micrometeorites and radiation
RXF-1	0.5m	Moon	Solar radiation protection and structural support
Silicon Buckystructure	0.25m	Bellevistat/ Moon	Framework and structural support due to high tensile strength
RTV Adhesive	0.15m	Moon	Binding the layers together
Glass Materials			
Electro-Chromic Glass	0.1m	Moon	Block Sunlight to provide illusion of night
Transparent Alumina	0.1m	Moon	Structural support
Silicon Buckystructure	0.2m	Bellevistat/ Moon	Thermal Insulation and radiation protection

Table 3.1.2 – Equipment and their use

Equipment	Use
Framing Bot	Framework of Columbiat
Transporting Bot	Transporting rods and tiles
Tiling Bot	Adding tiles to the framework
Construction Shack	Construction equipment storage

3.2 Elements of Basic Infrastructure

3.2.1 External Communication

Lunar Lasercom Terminal System (LLTS) will be the primary means of communication between the Settlement and Earth. Its apparatus consists of a primary (concave) and a secondary (convex) mirror aligned to focus light on the detector and a 10 cm telescope which fires a 0.5 W laser. The infrastructure between the various components connected to the telescopes is created using optical fiber.

Table 3.2.1 – LLTS specification

Bandwidth	Uplink/Down Link Speed	Antenna Size	# of Antennas
0-193 THz	Uplink: 20 Mbps Downlink: 622 Mbps	Uplink: 15cm Downlink: 40cm	Uplink: 4 Downlink: 4

3.2.2 Internal Communication

Due to the abundance of silica on the lunar surface, Columbiat uses a silica core, single mode fiber optic cable for its internal communication. It transmits data at a maximum rate of 1.4 TB/s and operates at a bandwidth between 0-100 THz. Flex-grid technology is used to increase transmission rate of the fiber by increasing the number of operational channels.

3.2.3 Atmosphere

Table 3.2.2 – Atmospheric Composition

Gas	Percent	PPM	Partial Pressure	Kgf/m^2
Oxygen	70%	700,000	23.8 kPA	2426.92
Nitrogen	29%	290,000	9.86 kPA	1005.44
Water Vapor	1%	100,000	0.34 kPA	34.67
		Total	**34 kPA**	**3467.03**

In order to reduce structural engineering costs without compromising basic human survival requirement, Columbiat will have an atmospheric pressure level of 34 kPA, which is significantly lower than Earth's. To compensate for hypoxia related to such low pressure, the gas composition will be maintained at 70% oxygen and 29% nitrogen. A lower total Atmospheric pressure also eliminates hyperoxia and flammability issues associated with higher oxygen composition.

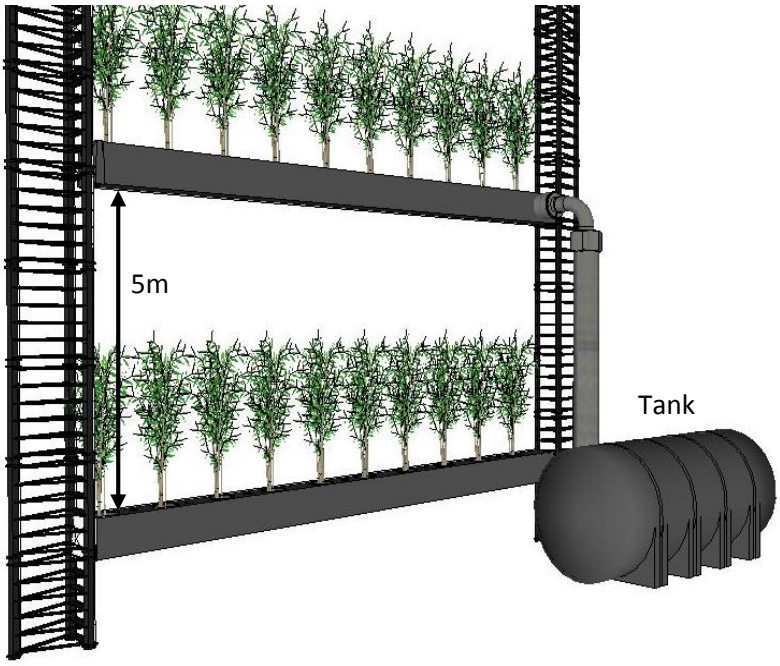
Table 3.2.3 – Weather Cycle

Season	Temperature	Humidity (%)	Breeze (km/h)	Period (Months)
Spring	4°C to 12°C	40	5	March – May
Summer	12°C to 23°C	45	4	June – August
Fall	23°C to 8°C	35	7	September – November
Winter	8°C to 0°C	30	9	December - February

At Columbiat, weather cycles will be maintained by an array of Condensed Heat Exchangers (CHE), while sky will be casted by projectors with intensity of 5,000 lumens. In addition, the amount of oxygen, nitrogen and water vapor in the air will be monitored by a mass spectrometer.

3.2.4 Food production

Fig. 3.2.1 – Vertical Farming



Until the Agricultural unit of Columbiat is ready and functional, food will be acquired from Bellevistat. Once ready, vertical farming with dynaponic pots will be employed in an area of 172,787 m^2. Each vertical farm will consist of ten floors, with each floor being 5 meters tall.

Growing:

Nutrient-rich solutions will be supplied to tanks, from where it will be misted to the roots of the crops. These 900 parts per million solutions will have a pH level between 5.5 and 5.8. Having an acidic, low pH environment will reduce funguses such as root rot. Furthermore, red and blue wavelength OLEDs will be used to attain maximum yield. Having vertical farms reduces the total DSA required while making the harvesting process more efficient, which reduces costs significantly.

Harvesting:

Columbiat will suspend nutrient supply three to seven days before harvest, at which point the solution will be changed daily for the amount needed to leech the unused salts. For harvesting, plants will be cut from the main stem above the roots and hung 'upside down' for drying. Once dried, the plants will be transported to the storage facility.

Storing:

An area of 172,787 m^2 in the agricultural unit will be reserved for food storage, making transfer of harvest both easy and cost-efficient. Food will then be preserved using Food Irradiation Technique (FIT), in which it is exposed to high levels of Gamma Rays beamed with Kinetic Energy ranging from 5 to 10 MeV. This disturbs the DNA of damaging microorganisms, which prevents microbial contamination and insect infestation, extends shelf life, and impedes ripening of fruits and vegetables, while reserving the original taste and nutrition values of the food.

Packaging:

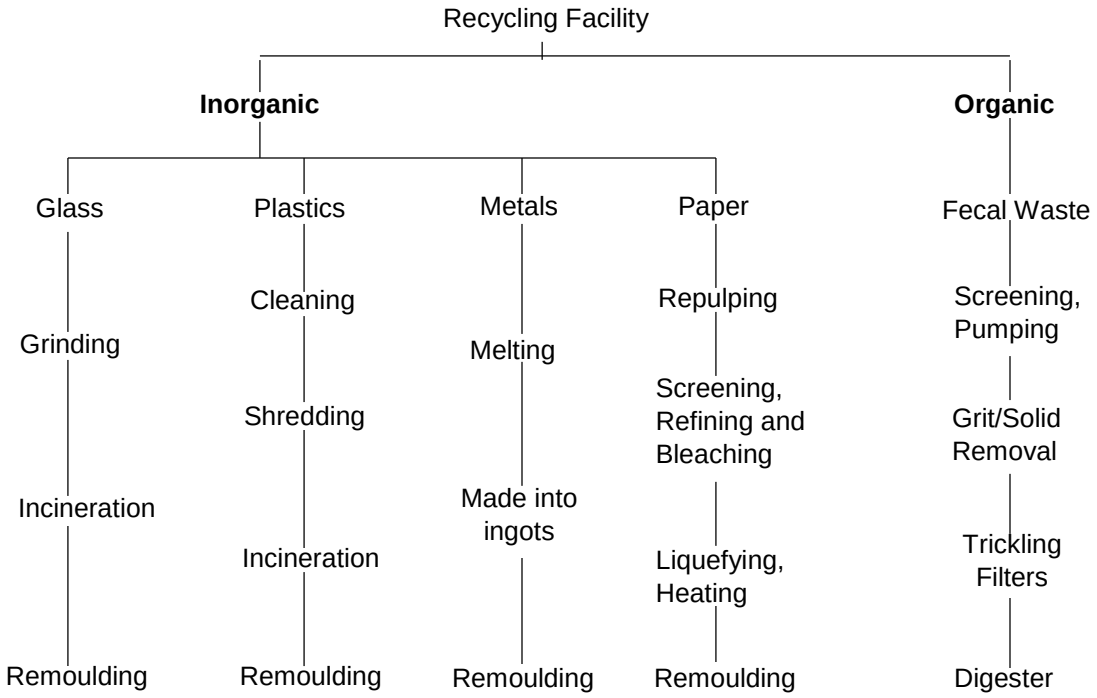
Post-FIT, food will first be stored in coolers. Once ready for packaging, Hypobaric Mylar bags, which lasts 80 years if frozen below -21 °C, will be used for packaging. This low-pressure state reduces oxygen concentration, which again prevents microorganism growth and increases shelf life.

Delivery and selling:

The agricultural processing unit will transform raw food materials into final goods ready for delivery, sales, and consumption. Delivery to residential torus will utilize elevators while retail outlets through underground pipelines.

3.2.5 Solid Waste Recycling

Fig. 3.2.2 Solid waste Recycling Flowchart



3.2.6 Water Management

Frozen water will be procured from the moon and treated at the Columbiat water treatment plant, where water will be liquified and processed to meet the daily requirement of 8925kL. Used water will then be recycled at 100% efficiency by the recycling unit.

Fig. 3.2.3 Solid waste Recycling Flowchart

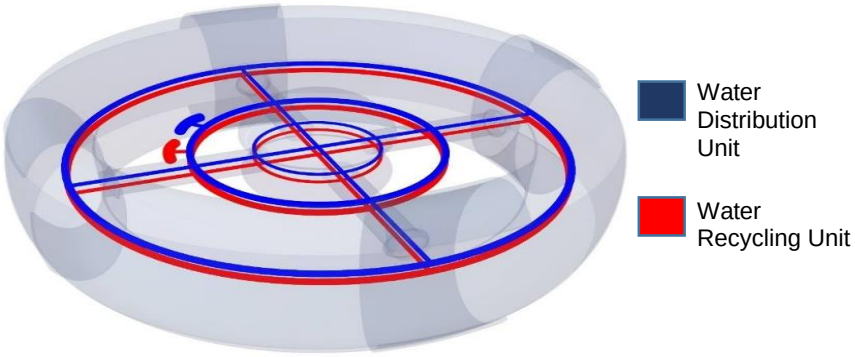
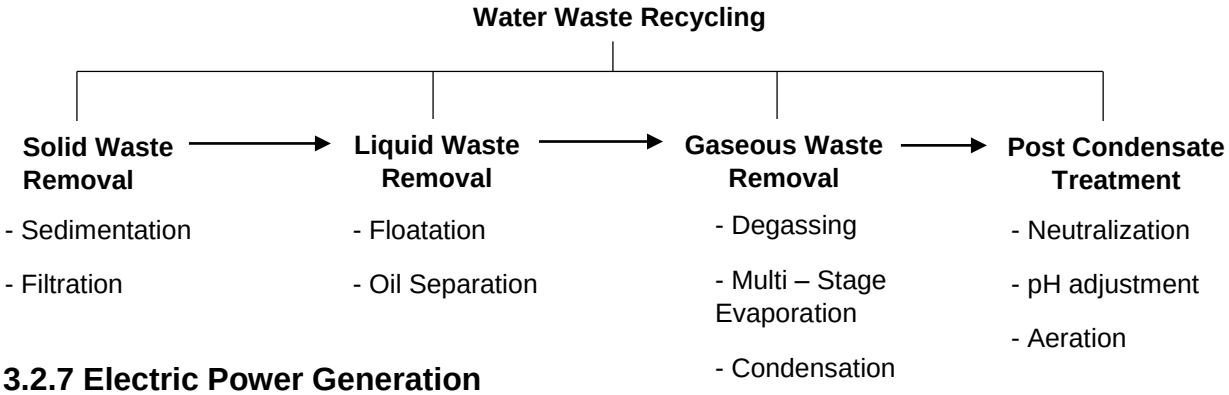


Fig. 3.2.4 Solid waste Recycling Flowchart



3.2.7 Electric Power Generation

Columbiat will utilize Perovskite Crystal solar cells with Aluminium Studs to maximize the efficiency of power generation. This particular type of cell was chosen over traditional silicon cells because of the increased efficiency - 50% as compared to 16-20%. The panels will be placed on the exterior of the Residential Torus, and will cover a total area of 1,000,000 m^2, producing 650,000kW of power at an efficiency of 650W/m^2. An excess of 63,300kW will remain after deducting the required amount of electricity and it will be stored in Lithium Ion batteries. Key materials required to construct these panels, such as Titanium, Oxygen, and Calcium, are conveniently abundant on the moon.

Table 3.2.4 Electric Power Allocation

Sector	Allocation (kW/person/day)	Total Allocation (kW)
Residential	3	76,500
Agricultural	6	153,000
Industrial	11	280,500
Station Keeping	3	76,500
Space Elevator	2	200
Total	**25**	**586,700**

3.2.8 Day and Night Cycle

A 24 hour day-night cycle will be used for Columbiat to ensure consistency with Earth and other settlements. The duration of day and night will alter seasonally. Reflectors placed on the Storage Disks will reflect natural sunlight towards the skyline of the Residential Torus. Electro-chromic smart glass will be utilized to change the opacity of the “sky” to allow for the appearance of different times of a day.

3.2.9 Transportation

A 0.9m sidewalk will be available to the residents to enjoy the pleasure of walking. In order to travel shorter distances, residents will be using bicycles, allowing for a healthy lifestyle. For destinations that are farther away, residents will be able to ride the Columbiat line – an underground train system that allows for convenient access to various locations on the city. The train system consists of 4 trains in total – 2 parallel ones that run clockwise, and 2 others that run counter-clockwise. It accelerates at a rate of 1.0m/s^2 reaching a maximum velocity of 10m/s – allowing it to travel from one end of the settlement to the other in just 10 minutes. There are 10 stops in total, with a distance of 275m between each, and a total track length of 2765m. Each train will consist of 4 cabs, each of which will be able to house 25 passengers.

Fig. 3.2.5 - Road

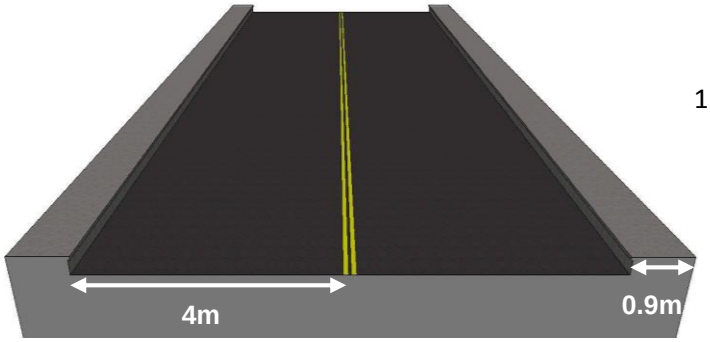


Fig. 3.2.6 - Bicycle

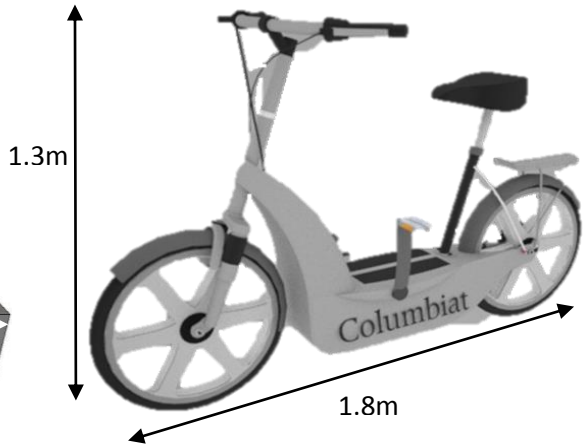
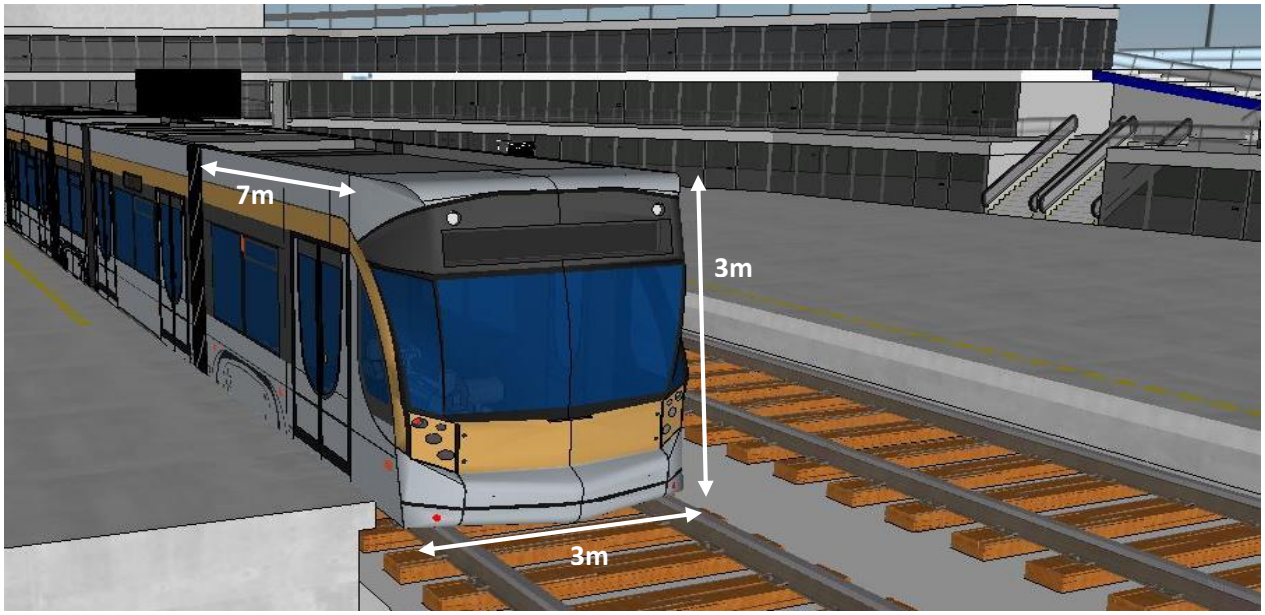


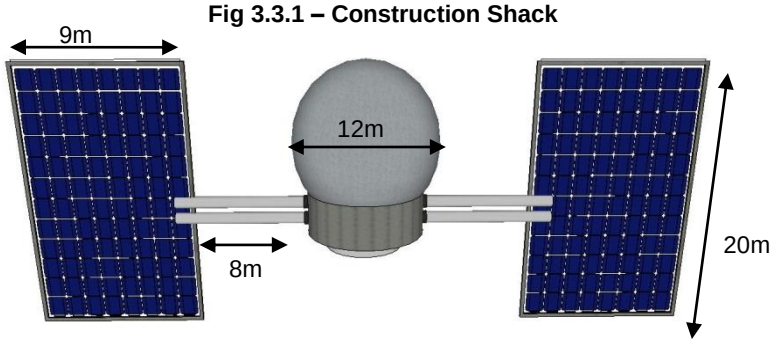
Fig. 3.2.7 – Columbiat Line



3.3 Exterior Construction

Construction Shack:

Fig 3.3.1 – Construction Shack



This will be deployed to carry out the construction of Columbiat directly at its orbital location. Components of the shack will be built on the moon, and then transported to L1 for assembly. It will serve as the main construction hub, consisting of the robots and supplies. Raw materials will be imported from the moon, and will undergo a refining process in which they will be converted into construction tiles and rods. After assembly, the shack will also house construction workers that will build and program the robots. All three types of robots will utilize thrusters to perform maneuvering.

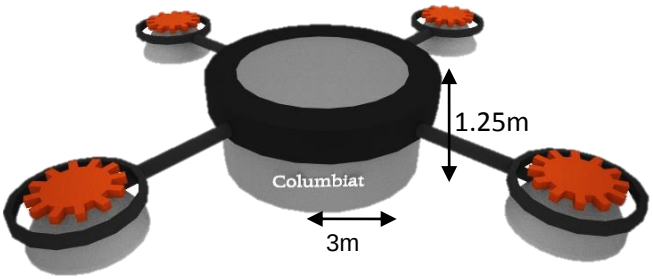


Fig 3.3.2 – Transportation Robot

Transportation Robot:

This is a supplemental robot that is able to carry 400 rods or 100 square tiles at peak capacity, from the shack to construction sites. Thrusters are symmetrically placed for each of the four quadrants of the robot in order to allow for maneuverability. The cylindrical structure of this robot will allow for optimum storage capacity.

Tile Framing Robot:

The process of framing involves the installation of an array of rods that form “frames” for tiles. It will be able to carry 32 tiles at a time. The robot has 2 arms, each branching out to 2 hands that are used to manipulate objects. The hands are also equipped with welding irons.

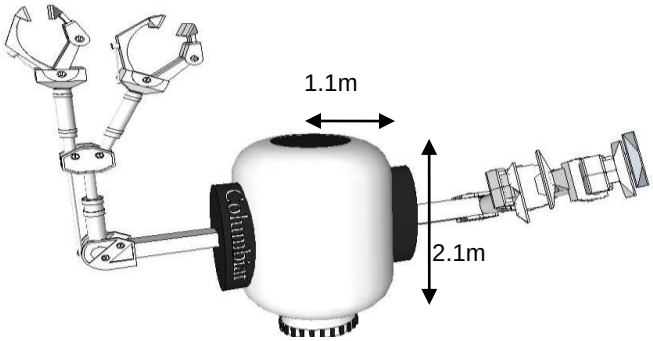


Fig 3.3.3 – Tile Framing Robot

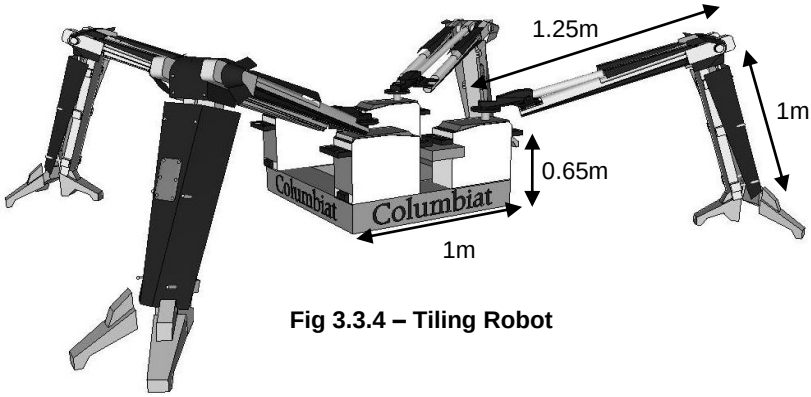


Fig 3.3.4 – Tiling Robot

Tiling Robot:

The final step in the construction process involves filling the areas framed by the aforementioned robot with tiles.

3.4 Propulsion Systems

Columbiat will have two distinct propulsion systems, the first one is a Magneto plasma dynamic (MPD) system for keeping the station at its orbit and the second system is an Electrostatic Ion Propulsion system (EIP) for the rotation of the settlement.

Table 3.4.1 Propulsion systems

Thruster Type	Magneto Plasma Dynamic (MPD)	Electrostatic Ion Propulsion (EIP)
Purpose	Station keeping	Rotation
Location	Central Sphere	Outer edge of storage disc
Fuel Type	Liquid Hydrogen	Xenon
Fuel Amount	60 tonnes	18 tonnes
Thrust	15,000 N	8400 N
Acceleration	0.0020 m/s^2	0.00109 m/s^2
Velocity of manoeuver	4.88 m/s	95 m/s (linear velocity)

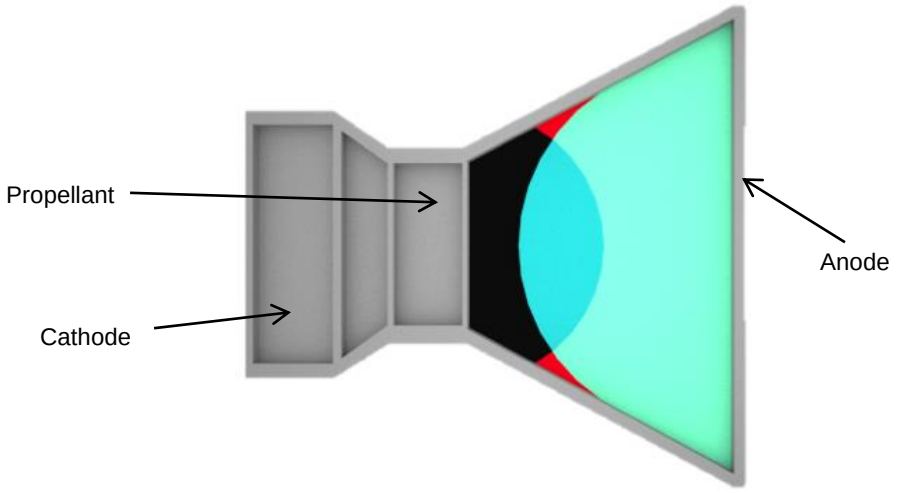


Fig. 3.4.1 Magneto Plasma Dynamic Propulsion

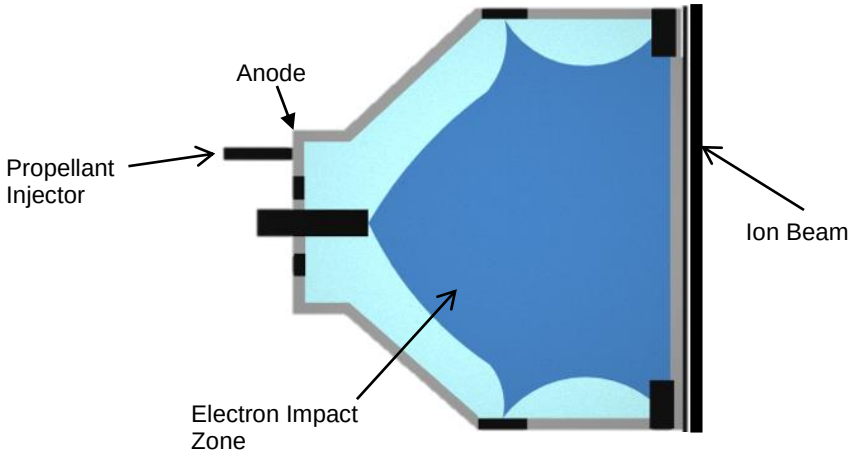
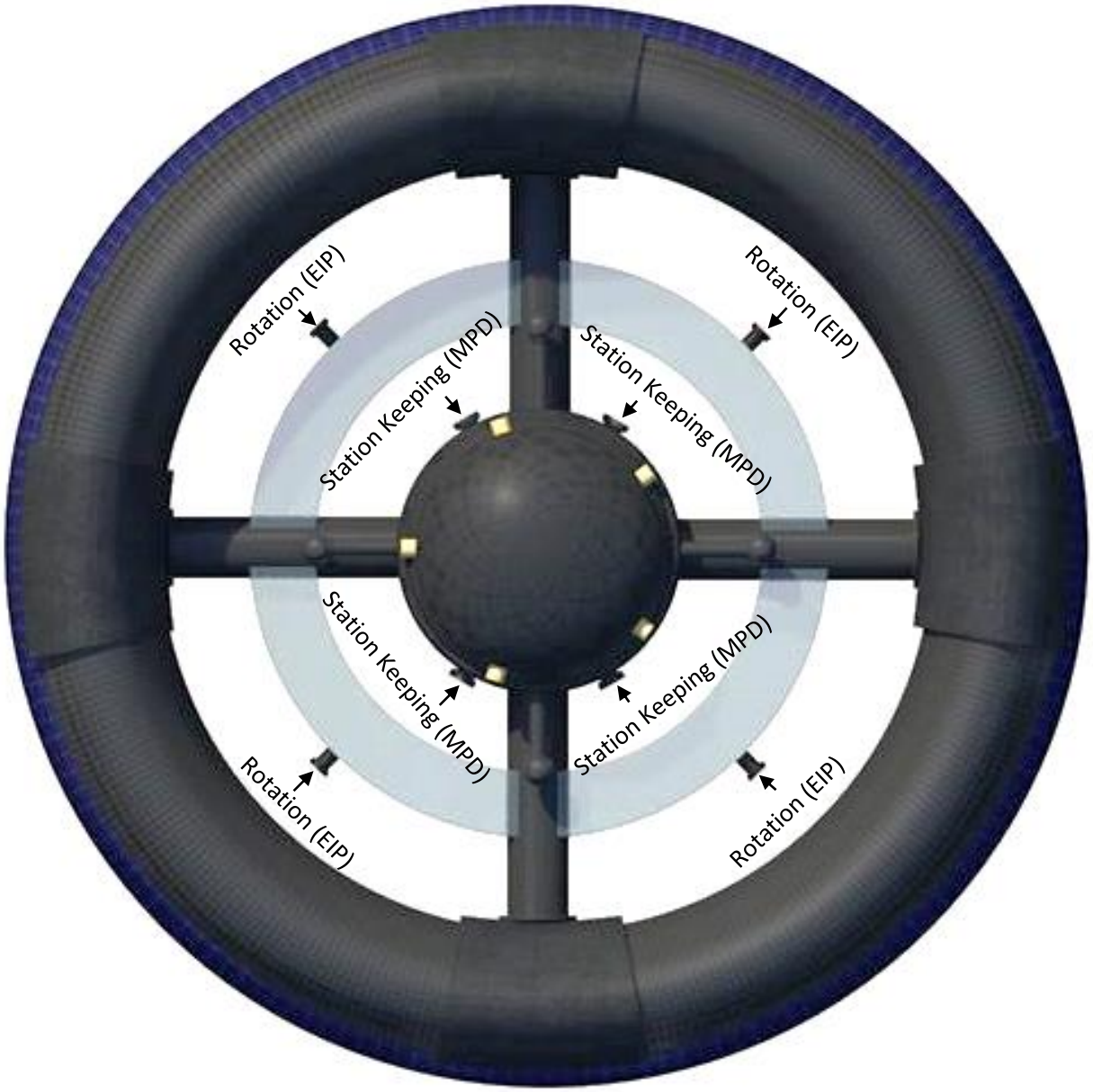


Fig. 3.4.2 Electrostatic Ion Propulsion

Fig. 3.4.3 Thruster Locations



3.5 Elevator Cab Design

For elevator cab design, refer to 4.5

4.0-HUMAN FACTORS & SAFETY

4.1 Community Attributes

Columbiat will provide a variety of consumables to its residents. These consumables will be produced at the manufacturing unit of the central sphere and will be delivered to the distribution center in the residential torus from where it will be distributed to stores via underground pipelines.

Table 4.1.1 List of Consumables

Consumable	Per Day (per person)	Per Year (per person)
Necessities		
Water	350 L	127750 L
Food	Men: 2,200-2,800 calories Women: 1,800-2,200 calories	Men: 803,000-1,022,000 calories Women: 657,000-803,000 calories
Oxygen	550 L	200,750 L
Clothes / Shoes	Men: 142 / 154	Men: 51,830/56,210
	Women: 262 / 315	Women: 95,630/114,975
Toiletries		
Mouthwash	40 ml	15 bottles
Floss	14 in.	4 spools
Toothpaste	3g	5 tubes
Hand Soap	9 ml	11 bottles
Body Soap	3 ml	4 bottles
Shaving Cream	2 ml	5 cans
Office Supplies		
Pen	1	36
Pencil	1	52
Eraser	1	26
Paper	28 sheets	10,220 sheets
Staples	8	2920
Printer Ink	1.12g	2 refills
Other		
Medicine	0.5g	180 kg

The 4 spokes divide the community of Columbiat into 4 sections: 2 residential, 1 business and 1 entertainment, each with dimensions of 461m x 1382m. The residential sections will contain all the houses and apartments along with facilities that are more eminent to the permanent residents of Columbiat. Keeping in mind that Columbiat will serve as the business and banking center in space, one section of the community is dedicated entirely for business. That area houses all the offices and bank facilities along with an illustrious headquarter for the Foundation Society. The entertainment section of the community will have various attractions for the visitors such as a stadium, mall, recreation center, casino, carnival, theatre, arcade, etc.

Fig. 4.1.1 Community Layout

Fig. 4.1.2 Layout of Commercial Section

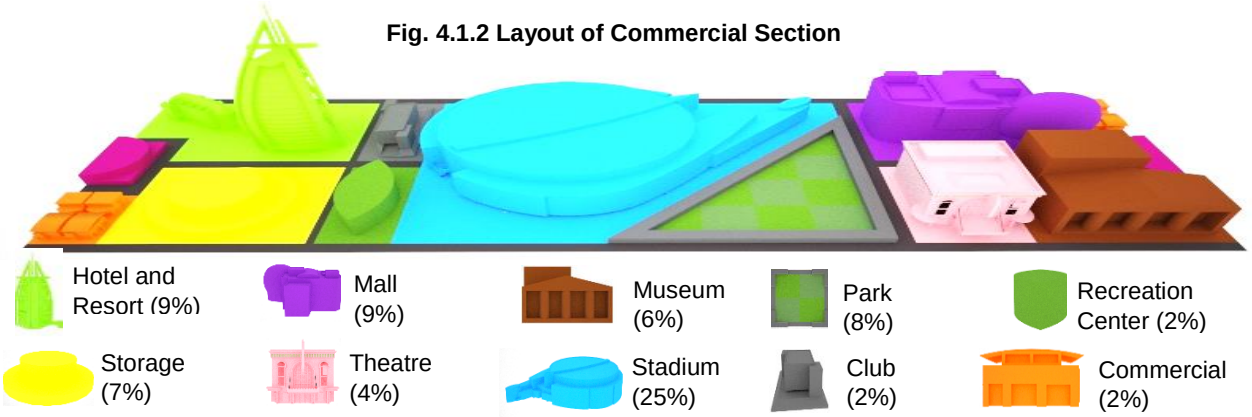


Fig. 4.1.3 Layout of 1st Residential Section

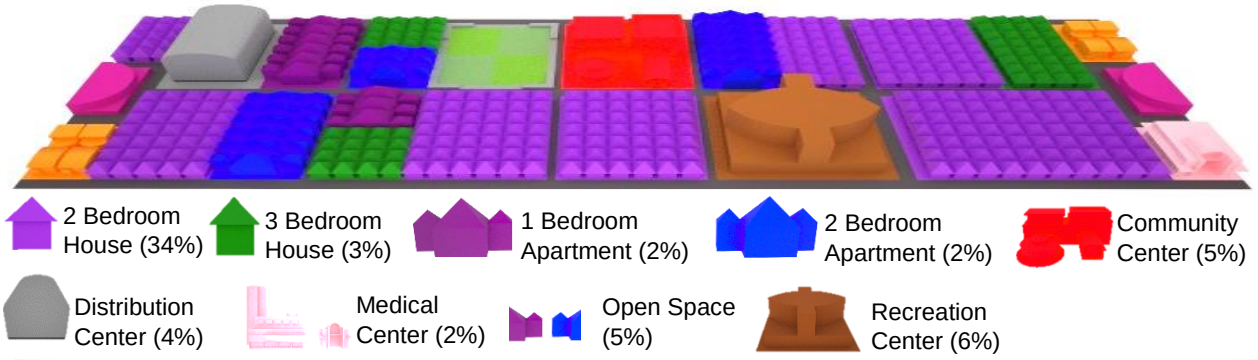


Fig. 4.1.4 Layout of Business Section

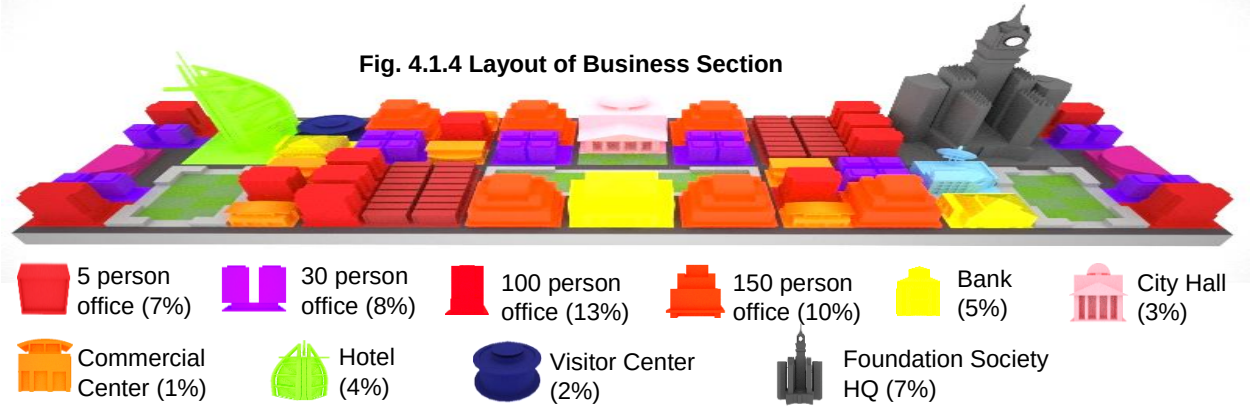
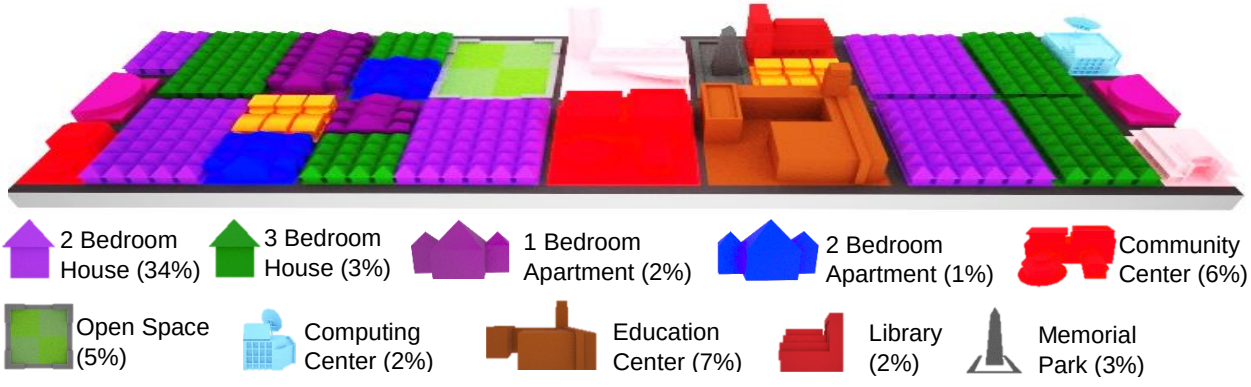


Fig. 4.1.5 Layout of 2nd Residential Section



4.2 Residential Homes

Columbiat will provide 4 styles of houses. Due to the diverse nature of Columbiat's population, residents will be offered different neighbourhoods depending on their preference.

Table 4.2.1 – Types of residences

Style	Floors	Dimensions (ft.) (LXW)	Area (ft^2)	No. of Houses
1 Bedroom Apartment	1	31 X 27	837	5750
2 Bedroom Apartment	1	31 X 31	961	4025
2 Bedroom House	1	37 X 31	1147	4025
3 Bedroom House	2	35 X 28	980	384

Fig. 4.2.1 Single Bedroom Apartment Floor Plan

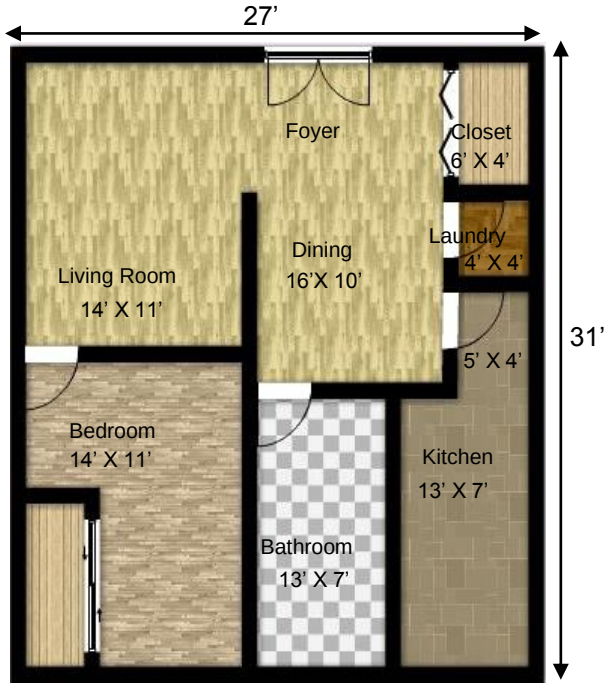


Fig. 4.2.2 Double Bedroom Apartment Floor Plan

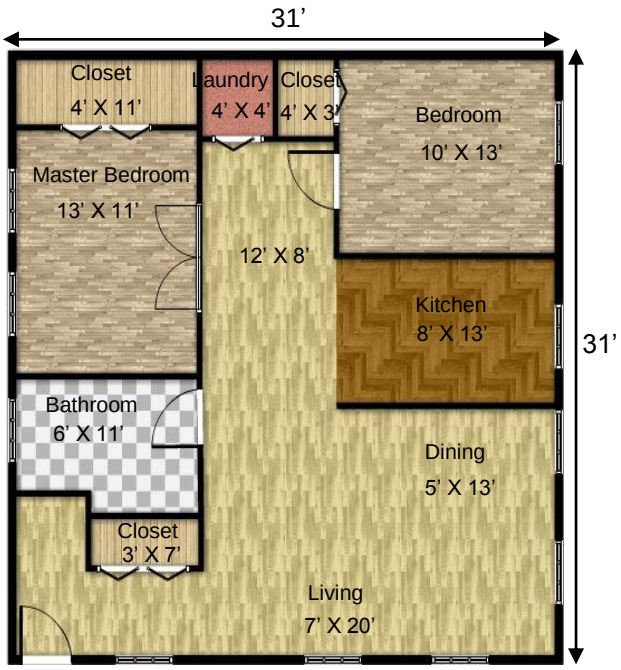


Fig. 4.2.3 Exterior of Single Bedroom Apartments

Fig. 4.2.4 Exterior of Single Bedroom Apartments

Fig. 4.2.5 Three Bedroom House Floor Plan (Bottom Floor)

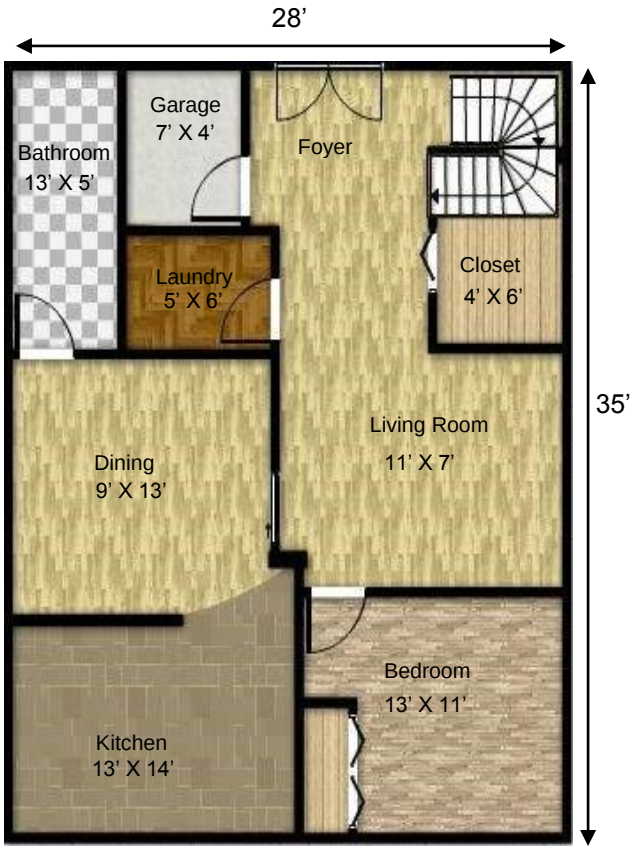


Fig. 4.2.6 Three Bedroom House Floor Plan (Top Floor)

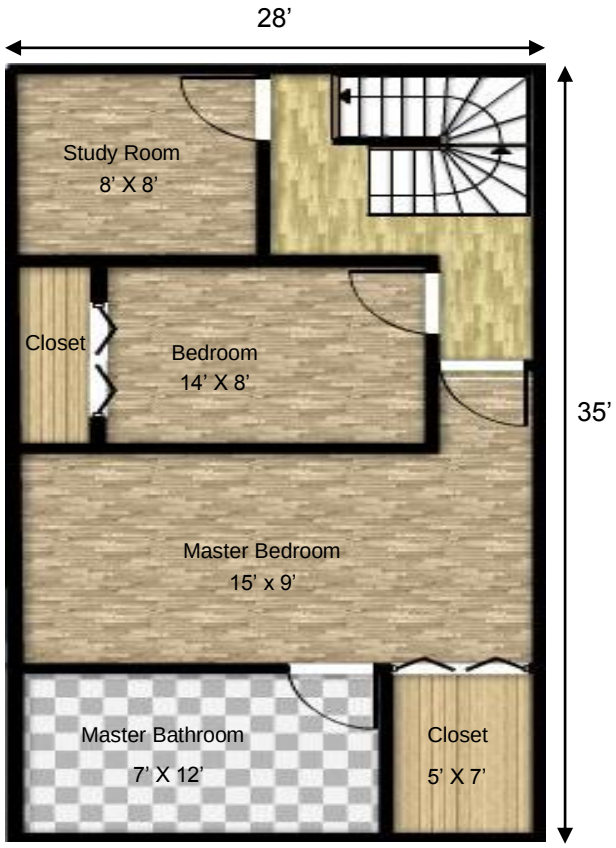


Fig. 4.2.7 Exterior of Three Bedroom House

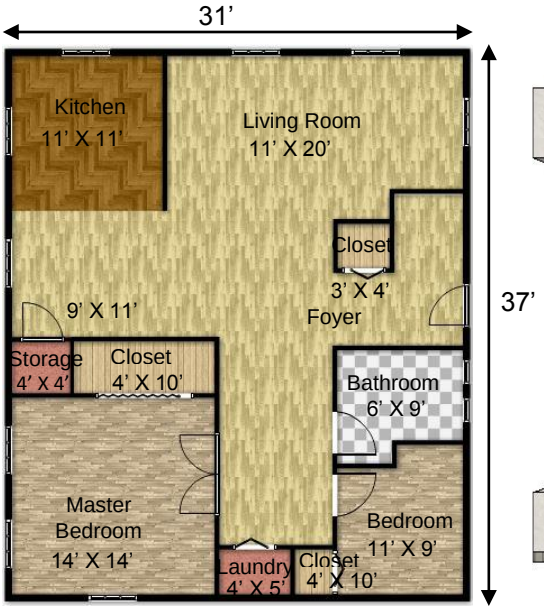


Fig 4.2.8 Double Bedroom House

Fig 4.2.9 Exterior of Double Bedroom House

4.2.3 Types of Furniture

The resources used to manufacture the furniture would be obtained from the moon. Ceramics will be used to construct the structure and framework of the furniture. It will be manufactured within the Settlement.

Table 4.2.2 Furniture per Household

Type of Furniture	No. per Household
Living Room	
• Sofa	2
• Armchair/Recliner	1
• Coffee Table	1
• Rug	1
• Table Lamp/ Floor Lamp	2
• Entertainment Center	1
Dining Room	
• Dining Table	1
• Chairs	4
Bedroom	
• Bed	3
• Nightstand	6
• Chest of Drawers	3
• Desk	1
• Chair	1
• Lamp/Floor Lamp	2
• Mirror	3

4.3 Donning and Doffing

Residents attempting to leave or enter the Settlement must undergo the process of donning or doffing. Spacesuits will be stored in a room preceding the pressurization chamber. The space suit will feature a bubble helmet allowing for a wide field of view and a backpack-like system to carry out all life-supporting

functions, hence enabling functionality outside of artificial gravity volumes. Donning and Doffing procedures will take place as follows:

Donning (Exiting Settlement):

1. Open hatch to suit
2. Climb inside the suit
3. Wait for suit to pressurize
4. Enter pressurization chamber
5. Wait for chamber to depressurize
6. Exit the airlock through the hatch
7. Open hatch to suit

Doffing (Entering Settlement):

1. Enter the airlock by opening the hatch
2. Engage the airlock cleaning system
3. Pressurize the chamber
4. Equalize suit pressure to chamber pressure
5. Open suit hatch
6. Exit suit through hatch
7. Enter the airlock by opening the hatch

The Airlock Cleaning System will ensure that all space suits returning to the settlement will undergo a purification process to completely remove debris, dust and any other contaminants. This will include:

- **Alternating Electrostatic Field**: AC voltage is applied to parallel wires stitched into the insulating fabric to create an electrostatic field barrier on the fabric surface.
- **Electrostatic Separation**: High voltage is applied between an aluminium coated Mylar sheet and the screen electrode of a cleaning device. Dust will be captured by the screen, and transported by a travelling wave into a collection bag.
- **Magnetic Separation**: A magnetic field will be used to separate the magnetic lunar dust from the suits.

Fig. 4.3.1 Airlock Design

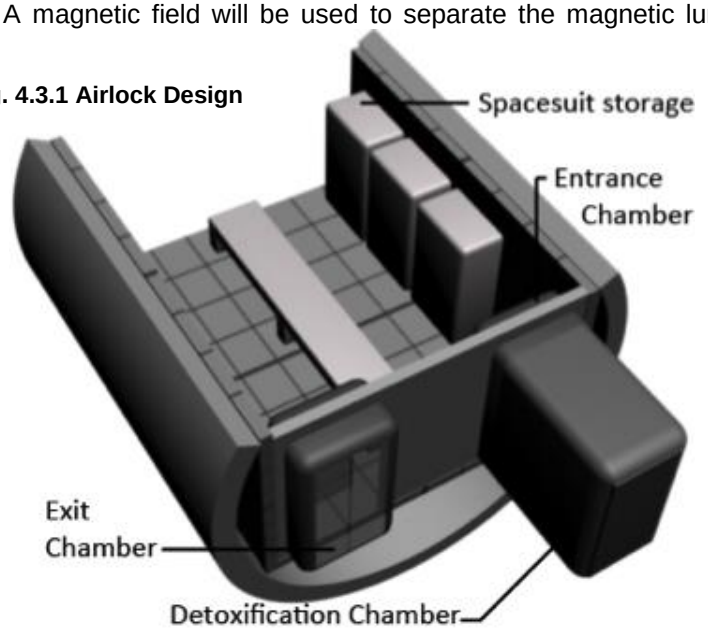
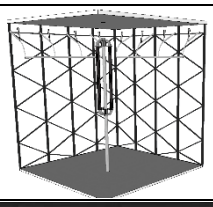
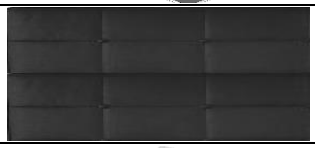


Table 4.3.1 – Devices to be used outside artificial gravity area

Device	Description
Tethers 	Tethers made out of silicon buckystructure will be used to prevent from floating away, also allowing increased movement in micro-g areas
Handrails 	It is easy to grasp on to and enables the person to propel themselves in a certain direction in low-g areas

Cages 	Horizontal elevators for moving around in groups
Cushioned Walls 	Placed throughout micro-g areas to prevent any injuries due to collisions
Small Jet Thrusters 	It will allow the person to move around in space. In case the person is untethered, these jet thrusters will help the person to come back to the settlement

4.4 – Arrival/Departure Facility

Columbiat will have the identical microgravity departure and arrival facility for both the space elevator and docking ports. Upon arrival, passengers will have the choice to rest in the lounge area equipped with comfortable and spacious couches, where they will be offered complimentary massages. A wide variety of micro-g cuisine will be provided as well. They will also be able to enjoy the views of the Settlement at the public observation area, where a live view of settlement will be projected to present a sneak peek of the settlement. Upon arrival, each visitor will be provided with an ICG (refer to 5.3.1) which not only will act as an identity card for them, but also act as their personal tourist guide. A medical center and a souvenir shop will also be available for the passengers.

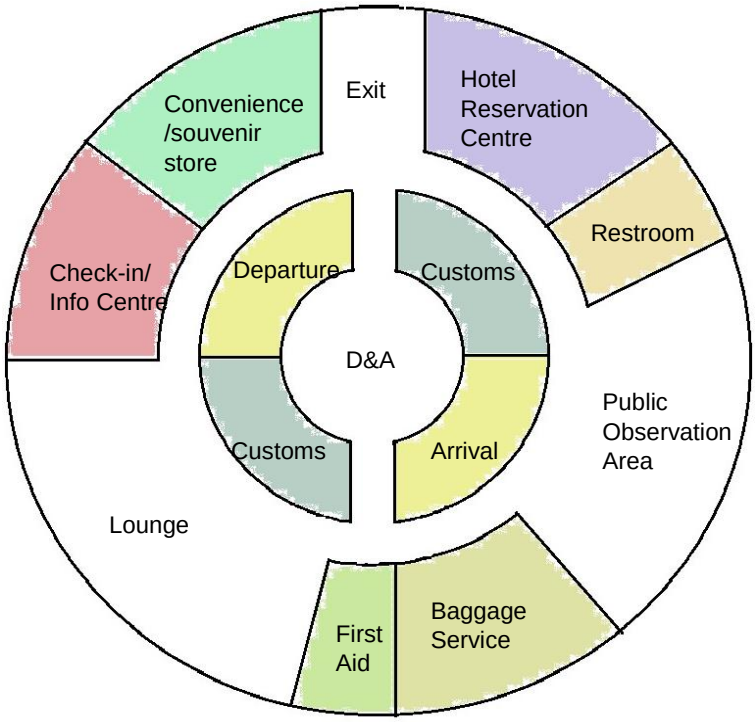


Fig. 4.4.1- Micro-g Arrival/Departure Facility

Security Measures

There will also be security measures to unobtrusively monitor visitors to assure that their activities do not interfere with the lives of permanent residents. ICG's of visitors will be specially programmed to give them only limited access to various secure areas within the settlement. A built-in GPS within the ICG will also assist in tracking down visitors in case of any emergency, ensuring them a safe and satisfying trip. For ICG functionality, refer to 5.3.1.

Attractions

Visitors will be provided with the option to reside in either the luxurious Celestial Inn or Xenia Hotel, located in the Residential Torus, or the exciting Floating Lodge, a hotel located in one of the micro-g spheres on the central sphere. The Floating Lodge will give an opportunity to the visitors to experience life in micro-g with and added touch of esteemed luxury. The remaining 3 micro-g spheres will feature a sports arena, a research lab, and a dance club. Columbiat will also host annual micro-g sport events in the sport arena, making it a pioneer in sports as well. In the micro-g research lab, a special area will be allocated for visitors to view and experience micro-g science experiments whereas the micro-g dance club will be the key attractions for visitors where they can literally "fly" around with their dance moves. Accommodation facilities in the Residential Torus are located adjacent to the arrival and departure gates allowing for convenient access to transients. Visitors will be presented with the option to visit a variety of unique, as well as traditional, attractions, including: World Mall; Holographic Movie Theatre; Foundation Society Museum; Parks & Recreational Centers; Arcade; Micro-g Dumbbell Facilities.

Fig. 4.4.2 Arrival/Departure Facility

4.5 – Space Elevator

The Lunar Space Elevator, a transportation medium between Columbiat and the Moon, will allow visitors and residents alike to experience space travel in unprecedented luxury. It may also be used to transport goods through use of the storage containers around which the passenger floors are built. In order to move between the two points of destination, the elevator will “climb” a 64000km silicon buckystructure ribbon using robotic traction lifters. At the other end of the settlement, an identical ribbon will be placed to acts as a counterweight.

4.5.1 – Cable Attachment

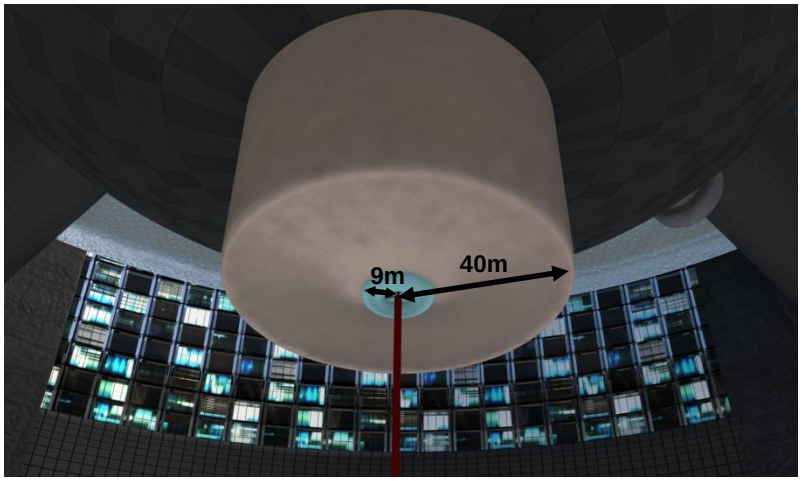


Fig. 4.5.1 Attachment Interface

The ribbon will be constructed using sections of hollow, cylindrical buckystructure ribbons 4m in length, 1cm thick, and with a radius of 0.5m. The hollow design allows for a greater weight to strength ratio. These sections will be manufactured by running viscous buckystructure feedstock through a catalyzing agent. After forming the length required of each piece, a thicker section of length 0.5m, 3cm thick, and a total radius of 0.48m, will be produced to acts as an attachment interface. The inner cylinder of the thicker portion will be lined with a 2cm thick layer of adhesive buckystructure material, allowing it to bind to other pieces. The attachment interface on the settlement will be created with the same dimensions as the elevator cab itself: 18m in diameter. A length of the ribbon will be placed inside the attachment tube, where it will then be firmly gripped and will remain clamped in that position using friction from micro-fibre arrays. Upon arrival, a walkway will be attached to the airlock, allowing for passage between Columbiat and the elevator.

4.5.2 – Cab Design

The 50m tall space elevator cab will consist of 3 layers: Residential, Storage, and Lift. The Residential section will contain 5 floors that include accommodation for transients, as well as an entertainment center. There are 2 smaller floors at the top and the bottom that hold a water reservoir, a septic tank, and a forward osmosis water recycling system. This section will be cylindrical and pressurized. The storage section consists of a pair of standard cargo containers. This section is enclosed, but not pressurized. At the center of the elevator cab, in between the cargo containers, is the Lift layer which consists of multiple robotic climbers that will allow it to move along the ribbon.

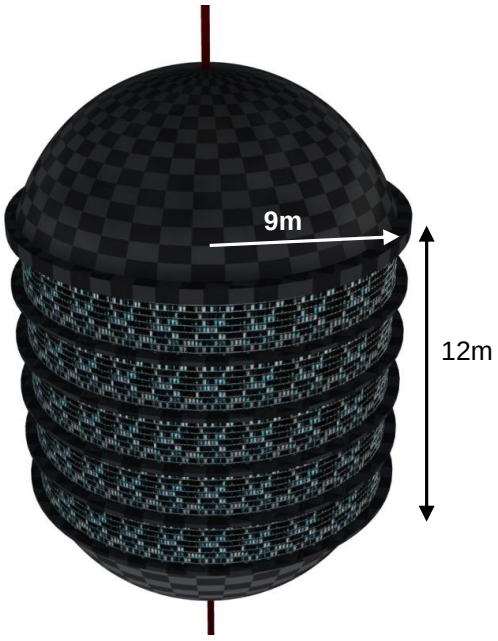


Fig. 4.5.2 Cab Design

4.5.3 – Accommodations

Each floor contains a band of rooms on the outside with 25 cabins, 10 of which are double rooms, and 15 are single rooms, allowing for 35 passengers per floor, and a total capacity of 140 passengers. Each room will be furnished with a 32” television, a single or double bed depending on the room, a desk, and a reclining massage chair. Gourmet room service, as well a fitness center, a spa and a nursery will be readily available on each floor for the passengers’ convenience.

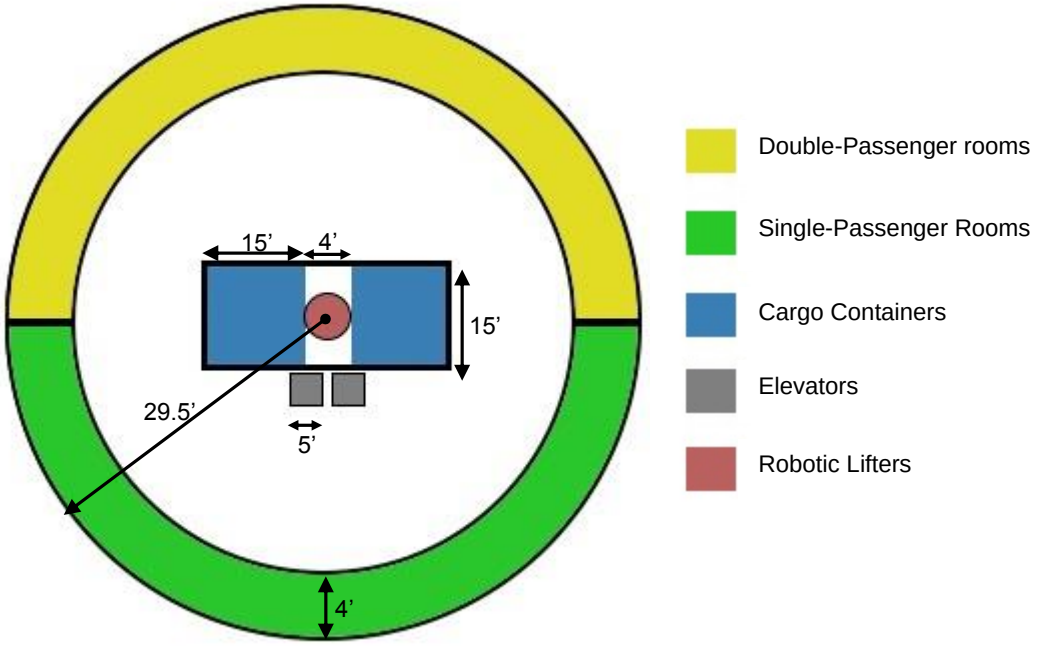


Fig. 4.5.3 Seating Area Floor Plan of Elevator Cab

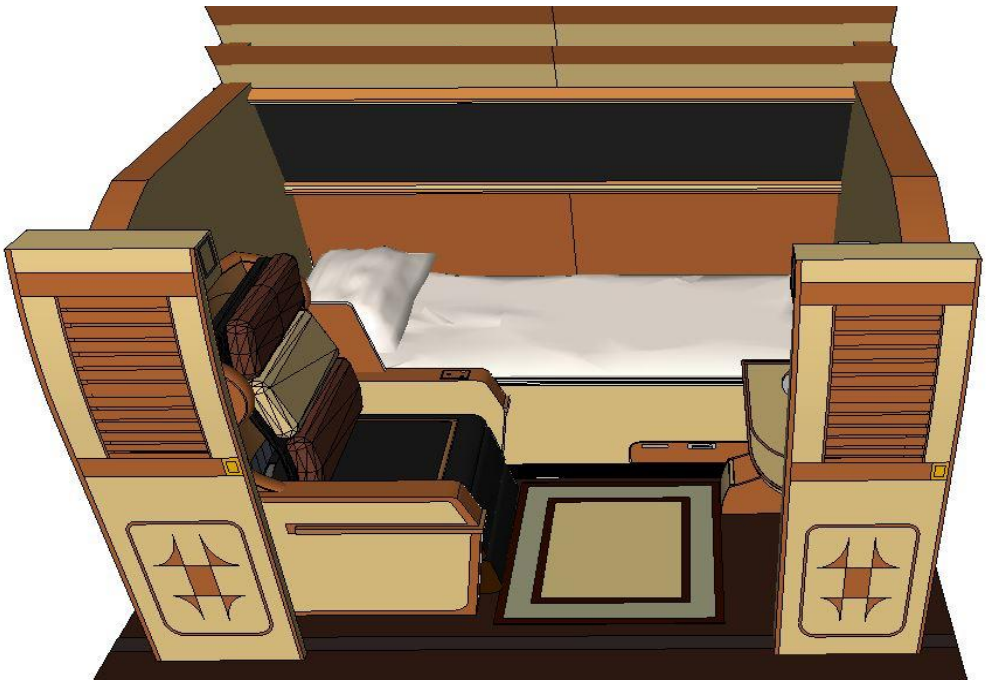


Fig. 4.5.4 Cabin Design for Space Elevator Cab

4.5.4 – Elevation Mechanism

The Space Elevator will utilize Robotic Lifters, consisting of electric motors that turn retractable traction tread rollers to pull itself along the ribbon. At both ends of the ribbon, the first 3km (Settlement end) and 100km (Moon end) will be covered with polymer microfiber arrays to increase the friction between the ribbon and the rollers. Through the first 3km in either case, the elevator will accelerate at a rate of $2m/s^2$, allowing for a maximum velocity of 111.76m/s, or 250miles/hours. When approaching its destination, the elevator will decelerate at $2m/s^2$ as well. The trip will last for just over 6 days.

4.5.5 –Entertainment and Amenities

With the breathtaking views plastered on the canvas of an everlasting night, the Space Elevator will be the epitome of luxurious tourism. An abundance of facilities and entertainment will keep passengers amused and engaged throughout the seven day long journey, while maintaining top notch service and accommodation. Dedicated attendants will be available on each floor to provide assistance as required. Four vast residential floors are reserved for the accommodation of the passengers, including sleeping quarters, a fitness gym, a spa and a nursery. The middle floor will be dedicated to entertainment, which consists of: a bar and lounge area, a concert stage, an arcade, and a lavish casino. Amenities will include a fitness center for each floor, a relaxing spa, and a children's nursery. Transportation between these floors is possible through 2 elevator shafts present towards the inner area of the first layer.

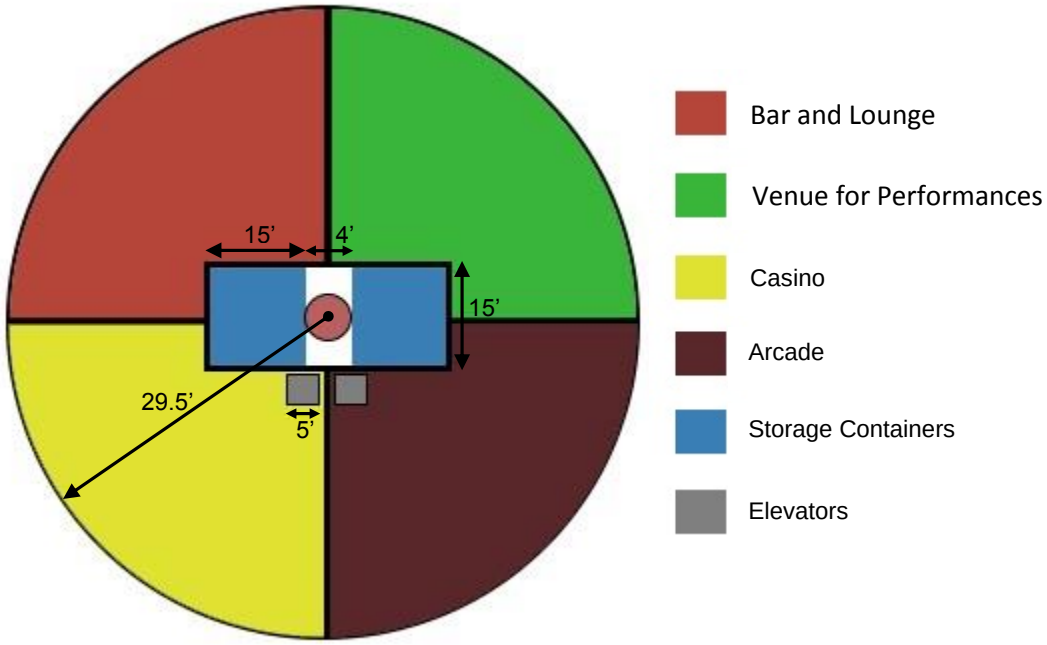


Fig. 4.5.5 Entertainment Area Floor Plan of Elevator Cab


5.0-AUTOMATION
DESIGN & SERVICES

5.1 – Automation for Construction

5.1.1 Construction Process

Transportation
-Materials and equipment will be transported/delivered by Exterior Construction Robots (ECR) pulling a trailer.

→

Assembly
-ECRs will assemble buildings using
-Internal Construction Robots (ICRs) will assemble smaller items that go inside the building

→

Interior Finishing
-ICU will be responsible for interior finishing

Table 5.1.1 Construction Robots

	Interior Construction Robot (ICR)	External Construction Robot (ECR)
Purpose	Interior finishing using pre-programmed furniture layouts and floor plans. Assembly of smaller objects that go inside the building	Assembly of larger objects and entire buildings. Transportation of materials to be used for construction
Description	The robot will possess two folded arms, which are used to manipulate objects, to which various utilities may be attached (e.g. nail gun, welding iron, chainsaw, paint roller). A number of ICUs can be programmed to work in "swarms" in order to perform tasks a single unit normally would not be able to. It will utilize treads which allow for efficient maneuvering indoors, and for climbing stairs. Its treads are magnetic allowing it to work in micro-g	This robot also possesses two folding arms which allow for grasping and manipulation of building sections and materials. It also has a hitch which can be used to attach flat beds and paving trailers, for transportation of goods and laying asphalt. Building construction plans, and pavement routes will be programmed directly into the unit for autonomous operation. Its wheels are equipped with electromagnets that allow it to stick to the floors in areas of micro-g

Fig. 5.1.1 Internal Construction Robot

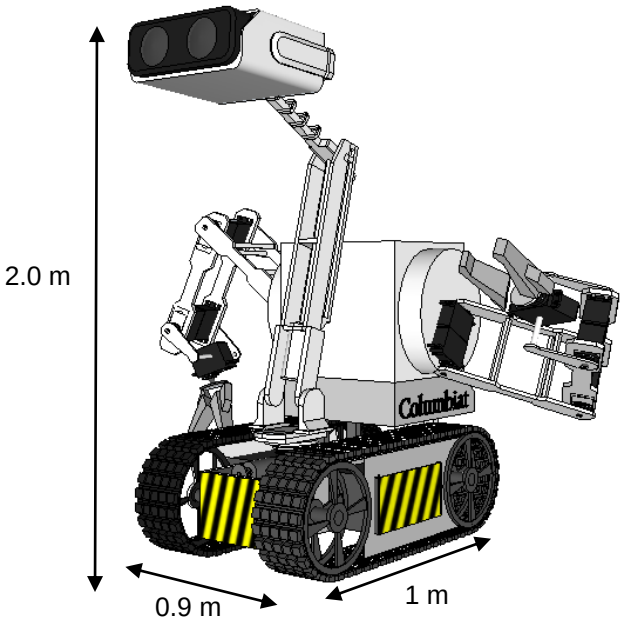
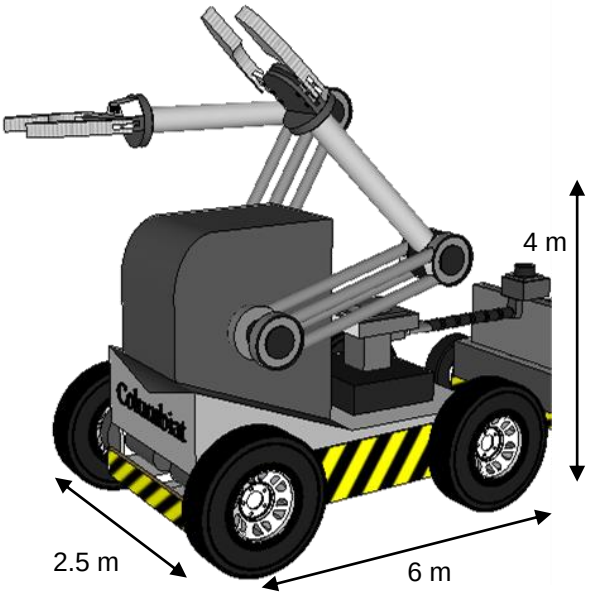


Fig. 5.1.2 External Construction Robot



5.2 Systems

Table 5.2.1 Automated Systems of Columbiat

System	Description
Internal Settlement Maintenance and Repair	For the maintenance of the internal systems of the settlement, ICRs will be repurposed as Internal Maintenance Units (IMUs). The IMUs will still use all the parts of the ICRs but will have smaller and more accurate graspers to handle delicate parts. For repairs, ECRs will be converted to Internal Repair Units (IRUs). IRUs will also have smaller graspers to handle repairs of smaller systems. In addition, it will have its wheels replaced with magnetic treads to be able to work in Micro-G
Critical Systems	Critical systems can only be accessed using computers located near the server room. Only residents with proper credentials will have access to critical data.
Security Measures	To secure areas of the settlement, doors will have locks that can only be opened by an ICG with the proper credentials (refer to 5.3.1)

Table 5.2.2 Contingency and Backup Systems

Problem	Detection	Short term solution	Long term solution
External Structural Damage	Pressure gauges and periodic scans	The multiple layers of structure provides aid in covering the damage	The Framing robot (refer to 3.3) will identify the dimensions of breach and repair/replace the panels accordingly
Network Failure	Firewall and immediate crash reports to central server	ICG provides its own personal hotspot for immediate activities	Repair of networking devices accordingly
Climate Control Failure	Vent Sensors	All internal buildings are equipped with heating systems	Heat from manufacturing unit will be delivered to the residential area until the climate control units are repaired
Fire	Heat detectors	Fire extinguishers along with spraying nozzles placed throughout the settlement	Evacuation of residents to agricultural disk and central sphere, depressurization of residential torus to control fire
Power outage	All electrical systems	Lithium ion batteries as mentioned in 3.2.5	Repair of solar panels and other electric components
Agricultural disc failure	Vertical farming failure	Extra food stored in the storage unit	Repair of agricultural units accordingly

Table 5.2.3 Devices

Device	RAM	Processor	Storage	Number of Devices
Tiling Robot	128 GB	64 GHz	1 TB	200
Tile Framing Robot	128 GB	64 GHz	1 TB	200
Transporting Robot	128 GB	64 GHz	1 TB	300
ICR	128 GB	64 GHz	20 TB	32
ECR	128 GB	64 GHz	15 TB	14
ICG	64 GB	32 GHz	Cloud	26000
EcoPrint System	2 GB	2 GHz	N/A	10000
HomeSystem	16 GB	10 GHz	Cloud	15000
OfficeSystem	32 GB	12 GHz	Cloud	15000
Sy-Pet	64 GB	48 GHz	20 TB	Manufactured on Demand

5.3 Convenience and Networking

5.3.1 Devices

The residents of Columbiat will be provided with various devices that will enhance their livability and lifestyle within their individual communities.

5.3.1.1 ICG

Every resident and visitor of Columbiat will be provided with an ICG, which acts both as a smart watch and personal assistant. It also serves as a health and fitness tracker using the built in heart-rate monitor. ICG keeps the residents up to date by displaying vital information throughout the day. The round design is meant to appeal to both genders while the premium built makes it feel both stylish and comfortable.

Fig. 5.3.1 - ICG

NFC:
The ICG will use NFC (Near Field Communications) technology in order to provide a convenient means of interacting with certain devices/facilities throughout the settlement.

Skeleton Computers: The majority of computers in the settlement will only contain basic, low power components, and will require activation using ICG through NFC tagging (tapping devices together). This will allow the user to access the specific amount of computing power, provided by a virtual machine running on a “cloud” server. As a virtue of this, if a person wants to upgrade their computing system, all they have to do is buy the desired processing power and use ICG to NFC tag any empty shell in Columbiat. The shell will automatically identify the resident and enable the appropriate processing power from the cloud.

Transaction: Residents will be able to use their watch as a means of transaction by simply tapping their watch on a payment processing module.

Clearance: Many facilities throughout the settlement will use an automated door system in coordination with ICG. A resident may simply tap their device onto a module adjacent to automated doorways in order to open them. This will also ensure that only those with specific credentials have access to restricted areas.

Security:
Due to the ICG’s diverse range of applications as a means of authentication and identification, security measures must be taken to ensure the wearer’s safety. The device must be authenticated every time it is worn by the user by performing a fingerprint scan using the clasp. In addition, all NFC features are deactivated when it cannot detect the wearer’s heart rate.


Fig. 5.3.2 - EBand

EBand:
An accessory to the ICG, the EBand is essentially an “earpiece” that pairs with the device using Bluetooth, converting ICG into a communication device. It uses bone-conduction technology to produce sound in a non-obtrusive manner, and as such, does not require an actual earpiece to be present in the ear canal. This is

done using a transducer module behind the ear lobe which vibrates the skull, which in turn transmits the vibrations to the cochlea. As a result, the user is able to hear his/her surroundings without intrusion. The Band also promotes privacy as all sounds produced can only be heard by the wearer. Microphones are present on the band in order to provide seamless integration with the voice assistant system.

5.3.1.2 Sy-Pet (Synthetic Pet)

The Sy-Pet will act as a replacement to real pets for the residents/visitors of Columbiat. It will come in different forms to fit the diversity of pets desired by the residents/visitors. It will act like the pet of choice using a sophisticated algorithm that can recognize commands and follow them. Sy-Pet will be equipped with wireless charging capabilities and will act like it is tired upon low battery. The pet will have a synthetic skin that feels like real skin and can be replaced at any time to change colour.

5.3.2 Access to Community Computing and Robot Resources

“Skeleton” computers will be placed throughout public areas for easy access. The same type of skeleton computers can be purchased for home use and will provide the same type of access to the user’s virtual machine. Workspaces will have their own version of skeleton computers that work on the same principle but use different virtual machines from home use. Users can access any of these skeleton computers as well as any robot resources using the NFC tag with the ICG as mentioned in 5.3.1.

5.3.3 Control of Systems

For control of systems, the ICG connects to the computer controlling home systems and can change settings over the network.

5.3.4 Privacy of Personal Data

To secure user data, it will be stored on “virtual hard drives” encrypted using 512-bit AES encryption. To secure connection, a 256-bit SSL encryption will be used. The private key for the hard drive is stored on the user’s ICG.

5.3.5 - Data and Networking

To store all the data on the settlement, servers will be built with a total of 1 Exabyte of usable storage. 500 Petabytes of this will be used to mirror the contents of the other 500. The data is stored on hard drives. Users are able to access this data using a wireless network that runs throughout the settlement. They are only able to access the contents of their virtual hard drive stored in the server. The wireless connections have a bandwidth of 450 Megabits/s. For faster access, fiber optic lines run to every skeleton computer allowing rapid access to a user’s virtual machine.

Table 5.3.1 List of Servers

Server	Location	Processor	Memory	Storage	Number
Main Server	Central Sphere	256 PFLOPS	4 PB	320 PB	1
Residential Server	Residential Torus	64 PFLOPS	2 PB	80 PB	1
Agricultural Server	Agricultural Disc	32 PFLOPS	2 PB	20 PB	1
Industrial Server	Central Sphere	64 PFLOPS	2 PB	30 PB	1
Communication Server	Central Sphere	4 PFLOPS	1 PB	10 PB	1
Space Elevator Server	Central Sphere	32 PFLOPS	2 PB	20 PB	1
Backup Server	Central Sphere	64 PFLOPS	2 PB	100 PB	1

5.4 - Inventory Management

Cargo arriving at the Columbiat docking port will be unloaded and sorted using robotic arms that are fitted with barcode scanners. Items will be identified using barcodes labels, and transported to a temporary warehouse in a capsule through a network of rails. The inventory is then taken from the temporary warehouse to their respective storage areas, where it is then utilized by facilities as required.

Fig. 5.4.1 – Inventory Management Matrix

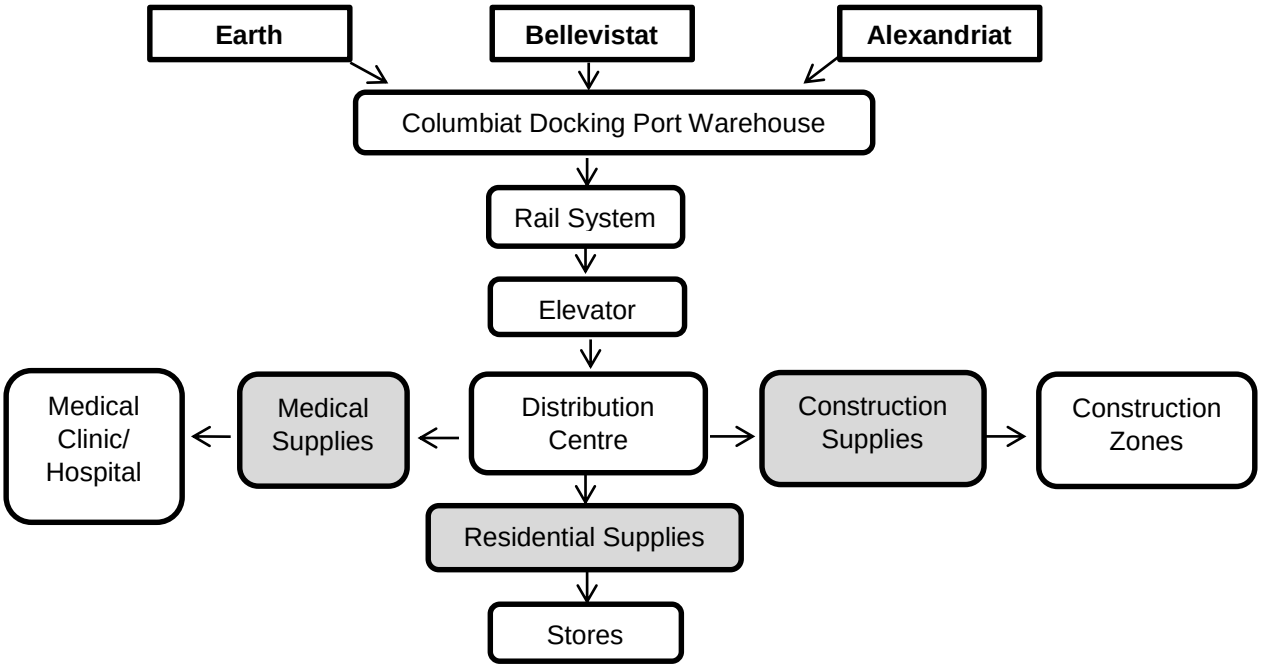
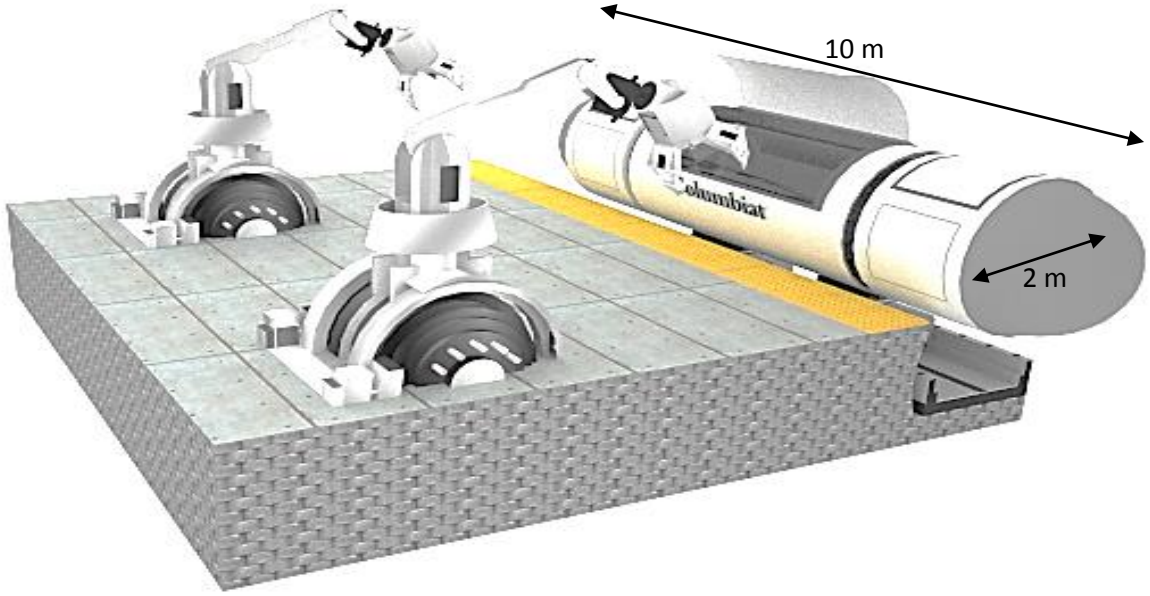


Fig. 5.4.2 – Cargo Handling Robotic Arms



5.5 - Repairs of Visiting Robots

Fig. 5.5.1 – Repair Process

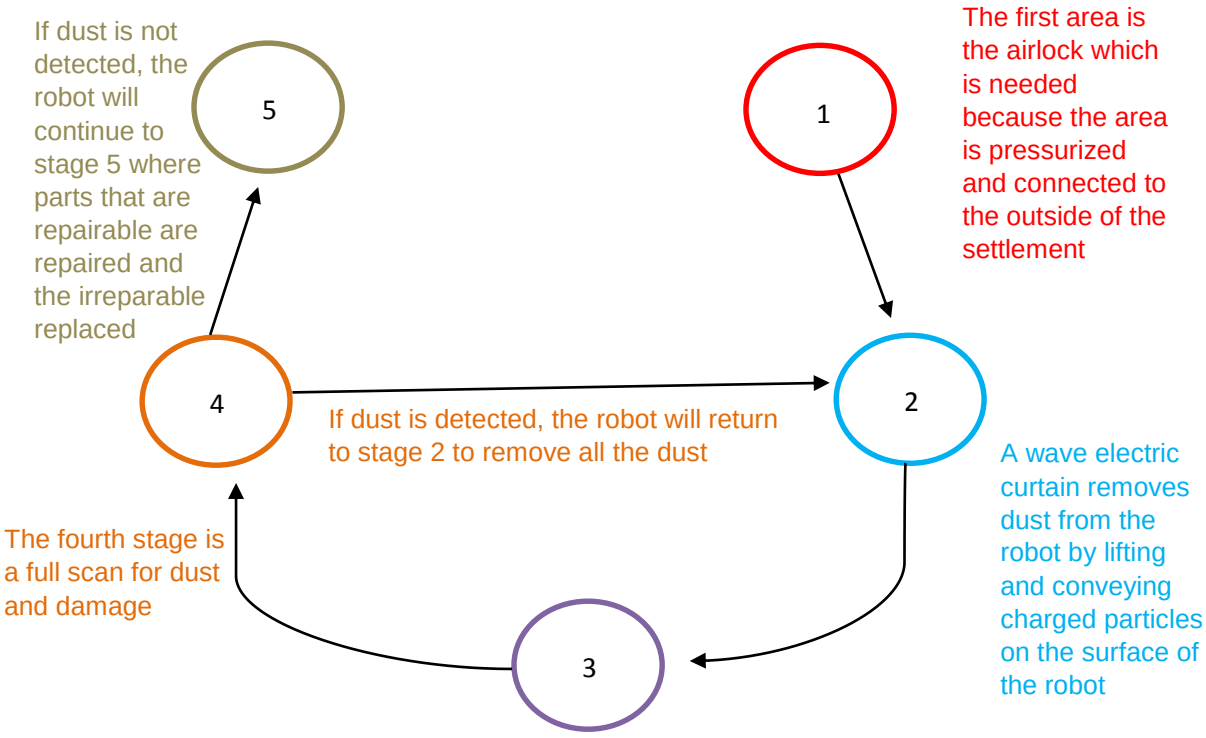
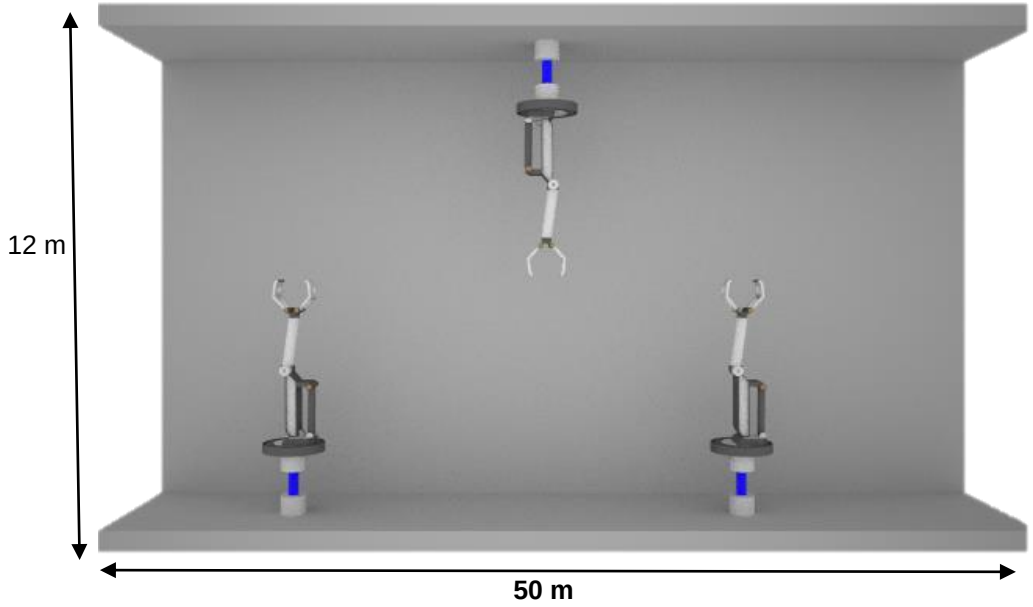


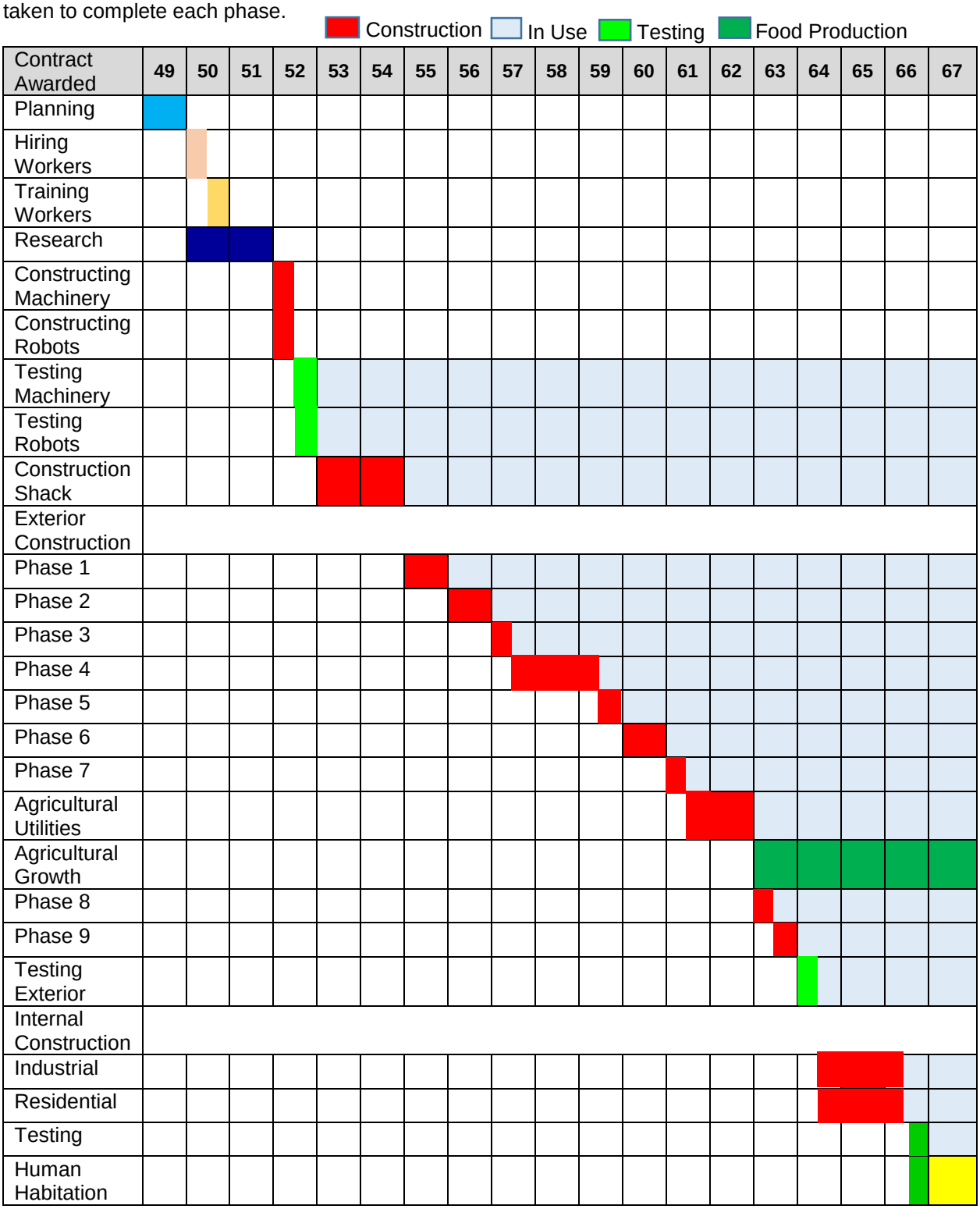
Fig. 5.5.2 – Repair Bay Layout



6.0-SCHEDULE & COST

6.1 Schedule

The planning regarding the construction of Columbiat will start on 16 May, 2049; one day after the contract is awarded (15 May, 2049). Through planning and series of steps, Columbiat will be ready for human habitation just within 19 years. The following chart shows different construction phases and time taken to complete each phase.



6.2 Cost

The contractor has accounted for all the costs required to complete the tasks. The Foundation Society will be billed with a total of just $161.25 billion which is significantly less. This cost accounts for all the construction work along with planning, research, hiring and training workers.

Table 6.2.1 – Construction Cost of Columbiat

Phase	Cost ($)	No. of Employees
Planning	3.5 M	80
Hiring Workers/Training Workers	252 M	1 500
Research	2 500 M	200
Construction Shack	6 500 M	300
Construction of Machinery/Robots	10 250 M	800
Exterior Construction		1 000
Phase 1	7 500 M	
Phase 2	3 000 M	
Phase 3	2 500 M	
Phase 4	6 000 M	
Phase 5	2 000 M	
Phase 6	4 000 M	
Phase 7	3 250 M	
Phase 8	2 000 M	
Phase 9	3 000 M	
Interior Construction		1 100
Residential Construction	19 000 M	
Agricultural Construction	16 000 M	
Industrial Construction	25 000 M	
Testing	45 M	80
Habitation	15 450 M	
Construction Materials	16 000 M	450
Acquiring Water	9 000 M	80
Agricultural Production	8 000 M	200
Total Cost	**161.25 Billion**	


7.0-BUSINESS
DEVELOPMENT

7.0 - Business Development

As the primary business and banking center in space, Columbiat features a business model that serves as the foundation to extraterrestrial economy. Future business development opportunities will be based on the following nine components:

Customer Segments

Columbiat has two main customer segments: Full-time residents and visiting guests. While there are certainly sub-groups within each segment, length of stay is nevertheless the key differentiator.

Value Propositions

To full-time residents, Columbiat will serve as a reliable and safe base to their life in outer space. To visiting guests, it will be the ultimate tourist destination as well as a "Singapore-in-orbit," a first-rated financial mega-hub that also acts as a key transportation center for space ventures and personnel.

Channels

Foundation Society will be responsible for the promotion of Columbiat. Whether it is to attract full-time residents or visiting guests, The Society will communicate its messages to the intended audiences via its departments on Earth and other Settlements.

Customer Relationships

There will be "Resident and Guest Service Centers" strategically placed across Columbiat to ensure maximum customer satisfaction. These centers will handle requests and solve problems that prevent residents and guests from enjoying their stay on the Settlement. Customers also have the option to do so via the web.

Revenue Streams

Columbiat will derive the majority of its revenues from the following sources:

1. Transportation Node and Port (Usage fees): docking, warehousing, cargo-handling, rest and recreation facilities.
2. Commerce and Financial Center (Rent and Service Usage Fees): offices, banks, headquarters, network connection.
3. Space Elevator (Transportation and Usage Fees): Raw material and personnel transportation, usage and consumption of in-elevator equipment and refreshments.
4. ICG Monetization Ecosystem (Usage and Service Fees): goods transaction, computer specification upgrades, Columbiat Line.

Key Resources

In order to generate the aforementioned revenue streams, Columbiat will require operational, maintenance, and management personnel, who bring along knowledge and experience from previous involvement with other Settlements.

Key Activities

In addition to cultivating satisfied customers, operating, maintaining, and managing the Transportation Node and Port, Commerce and Financial Center, Space Elevator, and the ICG monetization Ecosystem will ensure steady cash flow into Columbiat.

Key Partnerships

For Columbiat to succeed as the primary business and banking center in space, it will need support from Foundation Society, Countries which invested into the construction of the Settlement, as well as Corporate Investors (if any). It will also operate cooperatively along with other Settlements to achieve maximum productivity for all Foundation Society-run Settlements.

Cost Structure

Columbiat will incur the majority of its costs from the following sources:

1. Operation: salaries and wages, energy (if outsourced), etc.
2. Maintenance: Settlement repair and expansion, etc.
3. Marketing: Research, Promotion, etc.


APPENDIX A:
OPERATIONAL SCENARIO

A – Operational Scenario

Columbiat Script

* * * * *

[Presenter walks onto stage with authority]

NARRATOR: In the year 2049, the world has reached a turning point in an era of technological advancements. Mankind continues its endeavor for space colonization, ascending to the next level of interstellar travel and exploration. The world's leading space research company, the Foundation Society, has funded past contracts for relatively habitable regions within the reaches of our humble planet, Earth. These past projects include the settlements of Alexandriat and Bellevistat.

[Show past settlements]

NARRATOR: Today we present the Foundation Society's latest and greatest; Columbiat.

[Columbiat presented with fireworks/confetti]

NARRATOR: This attractive, self-sustaining civilization can be compared to the iconic Mesopotamia of the past as it will act as a pioneer of interstellar trade, tourism, and expansion. The incorporation of spherical, cylindrical, and disk-like structures allow for maximum Down Surface Area and volume, while maintaining consistent air pressure throughout the settlement.

[Spectating 1st person view through the settlement's docking ports, arrival/departure center, hotels]

NARRATOR: Columbiat will feature a multitude of attractions, both traditional and unique, including: the Lunar Space Elevator, the Floating Hotel, a Mall, a Casino, a holographic Theatre, and much more!

NARRATOR: The attractions will be divided up into various departments with respect to their specific functionality. For instance, the Grand Casino and night clubs, which focus on the adult demographic, will reside in their own district separate from the mall, theatre and arcade section, where children are more likely to visit.

[Spectating 1st person view through casino]

NARRATOR: The casino will feature standard games such as poker, blackjack, and slot machines, but will utilize a theme pertaining to space. For example, all playing cards will feature artwork centered on historical astronomers such as Galileo Galilei and Hypatia of Alexandria.

[Spectating 1st person view through nightclub]

NARRATOR: The nightclub will also feature futuristic traits such as lasers, electronic music (i.e. techno), holographic dancers, and astronomy themed decoration. The walls of the club will act as giant screens on which images and colours may be projected, resulting in a truly psychedelic experience.

[Spectating 1st person view through mall]

NARRATOR: Columbiat's mall will accentuate on having a diverse inventory for both tourists and residents alike. In addition, the food court will feature cuisines from around the world, but with a vegetarian twist. As with all tourism based cities, souvenirs unique to our settlement, such as moon dust and silicon bucky structure jewelleries will be available for purchase. Goods will be frequently imported from earth, and residents will have the option to order in certain products so as to avoid homesickness.

[Spectating 1st person view through theatre and arcade]

NARRATOR: As a replica of Shakespeare's iconic Globe Theatre, Columbiat's Holographic Globe Theatre will be playing the latest blockbuster movies, in addition to presenting traditional plays as well as original ones. Actors will be hired from among the residents interested. One example of an original work would be the company's rendition of the Shakespearean classic – *Macbeth in SPACE*. As with the previous attractions, the arcade will be centered on astronomy, featuring everything from classics such as Metroid and Space Invaders, to the latest augmented reality games such as Mass Effect 20: Rebirth of the Genesis and Dead Space: The Reckoning. All arcade machines will use skeletal computers which can be activated and played on using the ICG, allowing parents to conveniently pay for games as compared to the traditional coin system.

[Zoom out to settlement, then zoom into spectating 1st person view through micro-g Floating Hotel and Dance Club]

NARRATOR: Columbiat's museum, the Chronicles of Mankind, will embody a plethora of historical collections from the ancient civilizations of the Earth, to the first explorations of when man

began his indefinite search of the final frontier - space. From the Byzantine Empire to Queen Victoria I, from Neil Armstrong's successful landing on the moon to the Apollo Missions, and much more will all be showcased for all to observe. However, unlike the museums of the past, the Chronicles of Mankind will allow its visitors to experience the exhibits using an immersive augmented reality system.

[Spectating 1st person view through Chronicles of Mankind]

NARRATOR: On the central sphere of the settlement, four smaller micro-g spheres are present, each featuring a unique facility. For tourists, the most exciting of these are the Floating Hotel, and the Dance Club. Both of these facilities provide an unparalleled experience for visitors, as it allows them to feel the odd sensation of weightlessness while doing day to day activities. The Dance Club will be extremely similar to the one in the residential torus to maintain consistency using analogous design traits such as the screen-embedded wall.

[Spectating 1st person view through micro-g Research lab and GCU]

NARRATOR: The settlement will also be the first to host an interstellar institution known as the Galaxy Class University. With an education system in a league of its own, GCU will stand at the pinnacle of education, providing hands on experiences in numerous scientific fields with its proximity to the moon, and the micro-g research lab. Professors will be chosen based on educational merit, and display of interest in living at Columbiat. In collaboration with the labs and facilities unique to Columbiat, students also have the opportunity for future career prospects that are not far from home.

NARRATOR: Columbiat will offer all the pioneer experience of a lifetime – "To boldly go where no one has gone before!"

[Fade into Columbiat, panning out an angle as sunlight envelope the settlement in an aura of pure white]

* * * * *

END

Appendix B: Bibliography/ References

B - Bibliography/References

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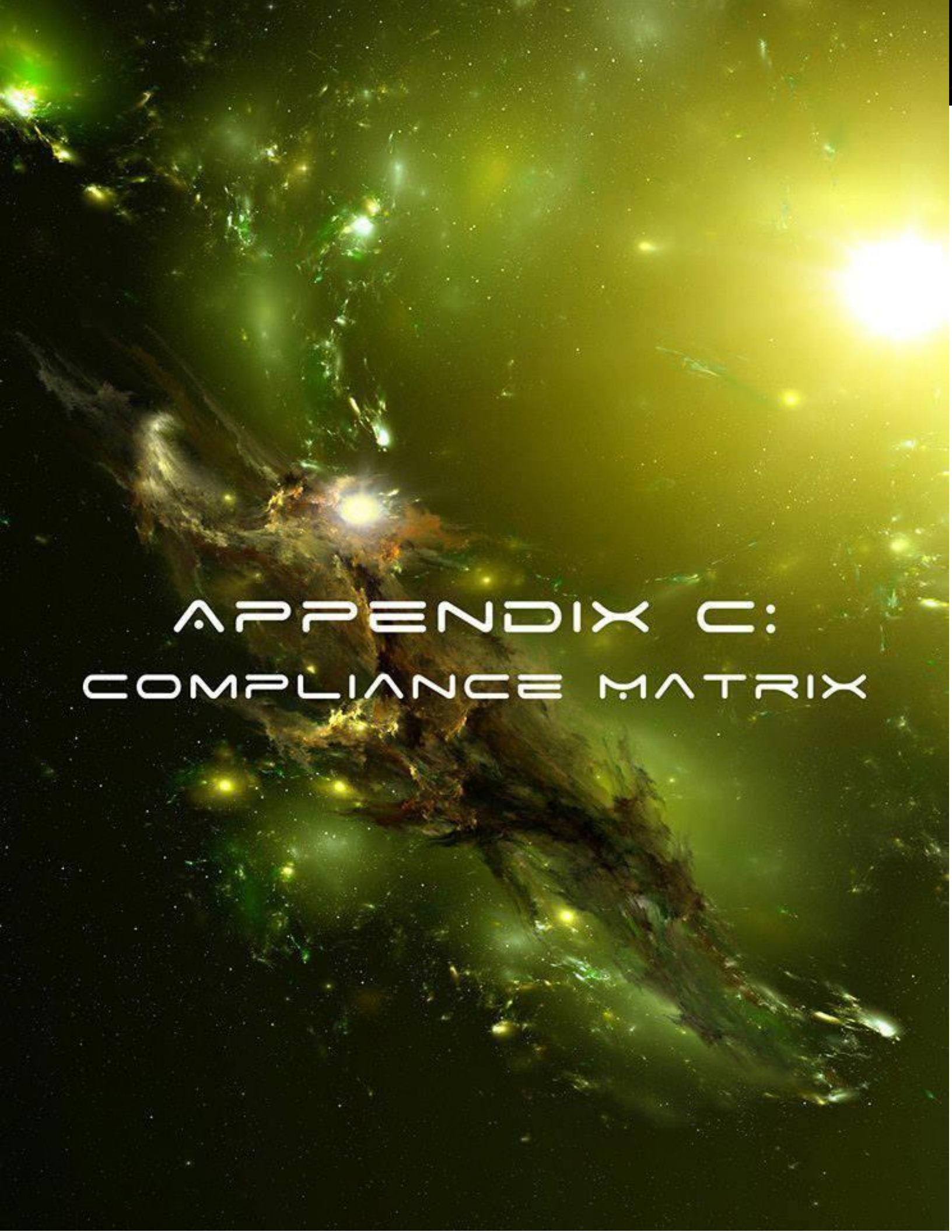

APPENDIX C:
COMPLIANCE MATRIX

C - Compliance Matrix

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